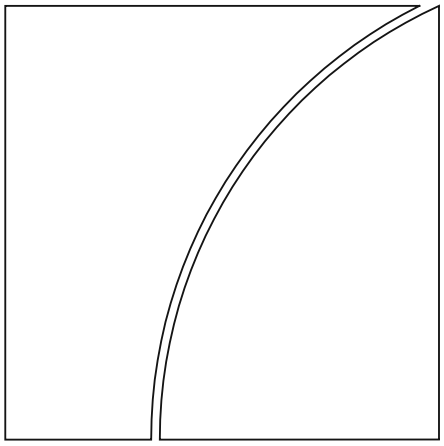
Irving Fisher Committee on Central Bank Statistics



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External statistics in a fragmented and uncertain world

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The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the European Central Bank, the Bank of Spain, the IFC and its members and the other institutions represented at the meeting.

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Proceedings of the second edition of the External Statistics conference organised by the Irving Fisher Committee with the European Central Bank, in collaboration with the Bank of Spain, Madrid, Spain, 12-13 February 2024.

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External statistics in a fragmented and uncertain world: addressing novel analytical challenges

Jorge Diz Dias, Mónica Covadonga Gómez Ramos, Esther Martín de Andrés, Fausto Pastoris, Martin Schmitz, Olivier Sirello, Bruno Tissot[1]

Executive summary

In an increasingly politically fragmented yet economically and environmentally interconnected world, **external statistics are paramount to address new developments in international economic relations arising from global challenges**. They are the lenses through which to observe the main drivers of the global economy, ranging from globalisation, digitalisation and climate change to the new trends in international trade and financial flows shaped by the fault lines of geopolitics.

Yet in an uncertain world changing with unprecedented speed, external statistics need to quickly adapt to evolving user needs, especially for policymaking. This calls for regularly revisiting statistical concepts, experimenting with new indicators and harvesting the deluge of data arising from the advance of technology. Considerable work has been undertaken over recent decades to fill data gaps and, perhaps more significantly, update the methodological framework and ensure consistency within and across macroeconomic accounts. But much more work lies ahead despite strained resources.

First, in terms of analytical and measurement needs, a focal point for external statistics is to better **capture the impacts of globalisation, digitalisation and climate change**. This entails a certain number of actions, such as improving the coverage of large multinational enterprises (MNEs) and special purpose entities (SPEs), designing approaches beyond residency-based concepts to map financial flows, innovating measurement techniques for digital and intangible assets, and integrating climate change factors into external statistics.

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The views expressed here are those of the authors and do not necessarily reflect those of the BoS, the ECB, the BIS, the IFC or any of those institutions represented at the conference.

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In addition, the statistical community aims at **improving the consistency, comparability and relevance of external statistics**, both in terms of methodology and data. The joint revision of the System of National Accounts (SNA) and the Balance of Payments Manual (BPM) in 2025 is a major milestone in this regard. Yet more can be done, especially to achieve consistent implementation, namely in the recording of cross-border flows or transactions between residents and non-residents, to ensure integration of data sources and to streamline coordination within the statistical system, particularly among central banks and national statistical offices.

More broadly, **external statistics need to be "fit for multiple needs" to stay relevant** in response to the rising demand for multidimensional statistical information. In practice, this means that they have to serve and swiftly adapt to the new demands across the wide range of users. A telling case is the key role played by external statistics to navigate the complexities of geopolitics in the wake of recent tensions and document the resilience of global value chains amidst increased fragmentation and reshoring patterns.

A related lesson is the need to **foster experimental external statistics** to face growing, pressing and timely data needs. This includes experimenting with new approaches tailored to analytical requirements, designing innovative methods and testing unexplored data sources. The trade-off is to balance such experimental indicators with reliable, accurate, high-quality and trustworthy statistics.

Harnessing alternative and big data sources for producing official statistics on the external sector is also important. This may not only aid in overcoming sudden stops in the provision of traditional indicators, such as those experienced during the Covid-19 crisis in 2020–22. It can also help enhance and complement conventional sources. Examples such as geospatial data, mobile phone records, credit card transactions, securities, credit and business registers illustrate ways to improve the estimation of balance of payments (BOP) statistics.

Further, **innovation is not an option, rather a necessity**. Keeping abreast of changes, including advancements in artificial intelligence (AI), may yield significant advantages, particularly by enabling producers to tap into the abundance of new data types, enhance data integration and facilitate the communication of external statistics. New techniques to collect data, such as web scraping, also play a growing role in reducing the data reporting burden while improving timeliness overall. Yet, a certain number of challenges and risks cannot be ignored: concerns on "black box" issues, misuse of data, increased costs and ethical and privacy risks may be particularly challenging when it comes to adopting these novel technologies.

Lastly, the growing demand and supply of statistics undoubtedly require **stronger international statistical cooperation to foster data stewardship, sharing and a better centralisation of statistical collections**. Efforts to improve data interoperability, usability and reusability are key ingredients for sound external statistics, particularly because statistical offices and central banks may have shared or strongly connected responsibilities in the compilation process. Regional and global business registers, with the help of global identifiers and harmonised collections, should also be regarded as a priority for identifying or "profiling" MNEs' attributes.

Taken all together, these recommendations call for a **clear and comprehensive roadmap for enhancing information on the external sector in the years ahead**, based on a shared vision to leverage innovation, promote international cooperation and maintain trust in official statistics.

1. Introduction: charting a new course for external statistics in a complex and multifaceted global landscape

External statistics continue to grapple with the long-standing challenges posed by globalisation. The growing complexity of international financial intermediation chains, including through SPEs, and the proliferation of hidden assets are just a few examples calling for the reassessment of residency-based metrics as well as for the use of more detailed, granular databases. In addition, **the evolving landscape of the global economy in recent years has resulted in tectonic shifts for external statistics**. The restructuring of global value chains, amidst renewed geopolitical tensions and trade barriers, has seen onshoring activities gain prominence, adding complexity to tracking cross-border investments. Moreover, the rapid expansion of digitalisation, reinforced by the evolution of working modes, has further underscored the importance of accurately measuring cross-border digital services. Last but not least, swings in financial conditions have triggered volatility in global financial flows, revealing heterogeneous patterns among investors and countries. This emphasises the need for better and more granular data to identify the causes driving the shifts in global flows, in turn supporting policymakers to make informed decisions.

Taking these developments together, a new course has emerged for external statistics in the post-pandemic "new normal" revolving around four patterns.

First, **mounting uncertainty coupled with remarkable economic shocks have underscored the critical importance of enhancing statistical agility** to support policymaking and analysis during unforeseen and rapidly changing situations. The use of experimental statistics and access to alternative data, such as private and administrative sources, have proven helpful during peaks of high uncertainty and sudden stops in data flows such as during the Covid-19 crisis, not least because traditional data collection exercises faced significant challenges, making it harder to gather timely and accurate information.

Second, **the urgency to address climate change has reached unprecedented levels**, necessitating innovative approaches to compile and measure environment-related concepts within the BOP framework. The imperative to mitigate climate risks, which have by nature a global perspective and may not be adequately tackled by country-based statistical apparatus, has become more pronounced than ever before. This has compelled policymakers to recalibrate existing metrics and methodologies to accurately reflect the environmental impact of economic activities and assess emerging risks to the financial system. This effort is also a key deliverable of the **update to the SNA and BPM**.

Third, **the rapid proliferation of AI has unlocked new frontiers in data analysis and compilation**, not only by offering novel insights into complex economic phenomena but also by enabling more nuanced decision-making processes. The rise of AI has in addition prompted a critical examination of the evolving role of official statistics.

Fourth, **digital services have expanded sharply across the world, reflecting an intensified embrace of technology-driven solutions** and a fundamental shift towards digitalisation in various sectors of the economy. These developments have been accompanied by significant information gaps in official statistics, exacerbating global asymmetries that demand urgent action. Further, the measurement of

digitalisation requires leveraging alternative data sources such as payment records, mobile phone usage data and satellite imagery.

It is against this setting of **major transformations in the post-Covid-19 new normal** that the Irving Fisher Committee on Central Bank Statistics (IFC) of the Bank for International Settlements (BIS) and the European Central Bank (ECB), in collaboration with the Bank of Spain, convened the **second edition of the External Statistics Conference** on "External statistics after the pandemic: addressing novel analytical challenges" in February 2024. This edition followed the inaugural conference held in Lisbon, Portugal, in 2020, shortly before the pandemic's onset.

Drawing together users and compilers of external statistics across all continents, representing central banks, national statistical offices, international organisations, academia and the private sector, the conference fostered the exchange of ideas and insights not only on the main challenges but also on opportunities in the field of external statistics. The contributions presented are referenced in this overview of the *IFC Bulletin* and grouped into four themes: the multiple roles and facets of external statistics to meet novel analytical needs (Section 2); the methodological updates and measurement challenges (Section 3); the need for a forward-looking perspective to leverage innovation, the ongoing avalanche of data and international cooperation (Section 4); and the proposal for establishing a comprehensive roadmap for external statistics (Section 5).

2. The multiple roles and facets of external statistics to meet novel analytical needs

Fast-changing macroeconomic conditions, exacerbated by major economic shocks and geopolitical fragmentation in an economically interconnected environment, **generate new demands for external statistics**. They also call for making them fit for multiple needs, in particular to provide useful insights across the broad policy spectrum.

Being fit for multiple needs: the roles of external statistics in a growingly uncertain world

The past few years have been characterised by a rapid accumulation of macro-financial vulnerabilities driven by major shifts in the global economy. The first one is the quick and unforeseen swings in global financial conditions, including evolving monetary conditions and changes in global economic linkages. Second, extraordinary shocks have significantly disrupted global value chains. Questions have arisen about the future of globalisation amidst growing geoeconomic fragmentation, as trade and financial openness could create excessive external dependencies. Third, the global expansion of financial intermediation, with the rising share of non-bank actors, has made financial interlinkages more complex, contributing to heightened uncertainty and macro-financial risks.

Against this background, it appears clear that **external statistics need to be fit for multiple needs** and provide insights into the several policy analytical requirements to stay relevant, as noted by the Governor of Bank of Spain, Pablo Hernández de Cos, in his opening remarks.

First, external statistics are crucial to providing insights into the realm of **financial stability**, particularly when it comes to monitoring international macro-financial risks. With the growing interconnectedness among countries, mapping external risks and dependencies in the trade of goods and services and financial flows is key for policymakers to track and limit **external vulnerabilities**, particularly in the context of severe shocks. External statistics also help in grasping the rising role of **cross-border non-bank financial intermediaries** and taking appropriate regulatory actions.

A second area is **climate change**, which is intrinsically linked with external statistics. To say the least, these statistics are essential to **mapping climate-related risks across countries,** leveraging the framework of the BOP and international investment position (IIP). They can in particular help policymakers take appropriate measures to mitigate climate change and its effects on the economy.[2] All in all, they can also provide insights into the **environmental impact of various cross-border activities**, such as carbon emissions linked to trade, tourism and foreign direct investment (FDI).

Third, statistics on the BOP and IIP are fundamental to assess the **international transmission of monetary conditions**. While such analysis is not new (Lane (2020), Bergant et al (2020)), the increasing **complexity of cross-border financial intermediation chains** requires more granular, detailed and sectoral external statistics, as stressed by Philip Lane in his keynote speech. This is notably the case for the euro area where non-bank financial intermediaries, and particularly investment funds, have been amplifying financial flows considerably during periods of shifting risk sentiment (Beck et al (2024)). Further, research conducted by the Geneva Graduate Institute highlights that detailed external statistics can play a key role in documenting the drivers of investment flows and heterogeneities across sectors, particularly in the wake of monetary shocks.

Fourth, **external statistics are critical to understanding the fault lines of geopolitics** in an increasingly uncertain landscape. The recent large shocks have unveiled the fragility of global value chains and the related supply bottlenecks, prompting decision-makers to design policies to foster **supply chain resilience**, triggering to some extent new **re-shoring or near-shoring** patterns. In this context, it has become essential to develop new methods to measure which countries own or control the supply chain, by augmenting statistics on international trade with detailed data on ownership, for example from business registers as suggested by Statistics Netherlands. Additionally, the surge in **geopolitical tensions** has revealed changing patterns in global linkages driven by the adoption of **financial sanctions** and **trade barriers**. BOP data can play a useful role in assessing how those tensions are mirrored in trade and investment flows and, more importantly, how these are rerouted through third or "connector" countries (Gopinath et al (2024)).

[2] See Box A: "Climate change and official statistics: an interview with Galina Hale", p 10.

Going beyond borders: the geographies of financial flows serving different analytical perspectives

In the quest to make external statistics fit for multiple needs, a diverse array of approaches may be employed to grasp the different **geographies of financial flows** depending on the analytical perspective followed.

One key discussion revolves around the extent to which a **residence-based or nationality-based perspective should be preferred to analyse the geography of financial flows**. The selection of one approach over another typically depends on the pursued analytical goal (McGuire et al (2024a)). Traditionally, the residence view offers an analytical framework to measure where funds are sourced and used, while also being consistent with key macroeconomic indicators and concepts, such as gross domestic product (GDP), BOP, IIP and other macroeconomic statistics. However, it fails to capture the cross-border activity of multinational lenders and borrowers which is based on economic *ownership* or *control*, rather than *residency* (Sanchez Pacheco (2023)). Here, the nationality view, which consolidates firms' balance sheets to the country where they are headquartered or *controlled*, may be better suited for monitoring **financial stability risks**, especially to quantify countries' credit risk exposure and funding dependencies. As an example, a paper from FGV São Paulo School of Economics indicates that, from the consolidated-by-nationality perspective, international financial integration can be larger relative to those estimates based on conventional, residence-based data. The nationality-based approach also helps to better assess international linkages, for example related to **monetary policy** spillovers.

While the residence-to-nationality remapping is not a new issue in external statistics (Tissot (2016)), the growing international exposure of firms unavoidably calls for additional approaches. One option is the **revenue-based approach,** which gives insights in terms of investors' portfolio allocation. In practice, one will use firm-level geographic revenue records to measure investors' exposure to international firms outside of their country of nationality or residence. As highlighted in a paper from the Board of Governors of the Federal Reserve System and University of California, this approach suggests that US exposure to emerging markets is currently underestimated and that portfolio investments of US residents are much more diversified abroad than revealed by traditional statistics. Moreover, developing **currency-based metrics** can also be a useful approach. In fact, key currencies shape the patterns of global financial flows and offer crucial insights into major international finance dynamics, such as countries' external debt and financial institutions' foreign currency needs (Bénétrix et al (2020), McGuire et al (2024b)). Reflecting this, the BIS has set up a unique global liquidity indicators (GLIs) data set that sheds light on foreign currency credit denominated in three major reserve currencies.[3]

Finally, the **analysis of onshore-offshore financial centres** can be particularly valuable to grasp the complex geography of financial flows (Pogliani et al (2022)). Offshore financial centres act as hubs for cross-border investment flows and centres of securities issuance by foreign firms, for instance because of their favourable fiscal and regulatory regimes. It is thus important being able to "look through" international groups to correctly analyse global financial integration. For instance, the euro area appears to be less integrated with the rest of the world compared with what is shown

[3] Data can be accessed through the BIS Data Portal at data.bis.org/topics/GLI.

by traditional residency-based statistics (Beck et al (2024)). A second relevant example is to look-through third-party holdings of securities to measure "**missing assets**" in global portfolio assets and liabilities. Data on third-party holdings are instrumental to shedding light on the ultimate owner of the securities, which are not well captured by traditional data sources such as the Coordinated Portfolio Investment Survey (CPIS). Milesi-Ferretti (2024) argues that, in practice, this data gap causes a mismatch between global portfolio assets and liabilities, with global assets being typically lower than liabilities. And, indeed, by using granular data on third-party holdings, the ECB has been able to estimate the missing assets due to unreported foreign custody securities and redraw the geographical allocation of portfolio positions compared with official sources.[4]

Capturing the complex and heterogeneous cross-border operations of multinationals

An important challenge for external statistics is to better capture the **heterogeneous activities of MNEs**. This is critical particularly to reduce distortions in macroeconomic aggregates such as in small open economies, as seen with the 2015 "Irish case" (OECD (2016)). First, the impact of global firms in the area of investment and trade data for intellectual property products (IPPs) is very visible. Joint research from the Central Bank of Ireland and the ECB shows that MNE activities can blur the real-time assessment and forecasting of key economic indicators in the euro area, such as the business cycle, the current account and capital stock. This is notably explained by the fact that MNEs can operate large and sudden transfers of intangible assets and IPPs. Second, complex MNE activities may also generate distortions in data related to FDI. For instance, developments in euro area FDI over the past decade have been very much driven by financial centres which have a strong MNE presence. As global firms tend to involve numerous legal entities, including SPEs, it is increasingly hard for statisticians to correctly estimate the real impact of FDI on the economy (Pastoris (2024)).

To cope with these challenges, compilers may consider several solutions. First, **new breakdowns** can undoubtedly play an important role. A major step, already implemented for instance by the ECB since April 2024, is to include additional data on **SPEs** in regular statistical releases.[5] Such data complement other enhancements, particularly on new **sectoral and geographical** breakdowns which allow for better coverage of international financial flows (Emter et al (2023)). Looking forward, more internationally harmonised data and centralised registers on MNE activities, including new statistics on **foreign-controlled corporations** in BOP, would mark another step towards improving the understanding of the dynamics of MNE operations and their impact.

A second, related solution is to refine techniques to better estimate the real impact of FDI by identifying the **ultimate host economy**. This is particularly relevant to assess where the economic benefits and the risks of the investments really are. In this context, collecting and integrating **additional information**, especially more

[4] Other data sources, including direct collections from foreign custodians and mirror data, may also be particularly helpful to estimate missing assets.

[5] See ECB Guideline (EU) 2022/747 of 5 May 2022 amending Guideline ECB/211/23 on the statistical reporting requirements of the ECB in the field of external statistics (Guideline ECB/2022/23).

granular data obtained from business registers, could help. For example, the Banco de Portugal employs the EuroGroups Register and Outward Foreign Affiliates Statistics to analyse Portuguese FDI. The approach also uses three different methods for measuring outward FDI statistics by the ultimate host economy, revealing a significantly different geographic distribution of FDI compared with official data. For example, it shows lower importance attributed to Luxembourg and the Netherlands and increased roles for Brazil and Colombia. The US Bureau of Economic Analysis conducts similar analyses, using six different ways to reallocate FDI equity positions from the immediate to the ultimate host economy. Applied to the US case, this analysis shows that the two countries with the largest decrease in importance as FDI destinations are the Netherlands and Luxembourg. Other approaches may also involve more complex estimation techniques. For example, the Bank of Italy suggests a new method to estimate FDI distribution by ultimate host economies by joining multiple data sources, including the Coordinated Direct Investment Survey (CDIS) database, and techniques, such as betweenness centrality and a Markov chain (Accoto et al (2023)).

Measuring climate change through the lens of external statistics

Another increasingly important topic in external statistics is **climate change**. To meet rising policy questions, the demand for statistics in this domain has unavoidably become an urgent priority for compilers (NGFS (2022)).

For central banks, measuring climate change is crucial for at least two purposes. One important dimension is **measuring climate-related risks** to ensure monetary and financial stability (IFC (2022)). In this regard, climate change may have effects on both the supply and demand side, which may ultimately impact central bank mandates (Bolton et al (2020)). More importantly, the materialisation of events related to climate change can create physical and transition risks that have to be properly measured (BCBS (2021a)). Another dimension is to **assess the move to a greener financial system** and its impact. Here, green finance can play a key role by supporting "activities that sustain or improve the condition of the environment" (AEG (2022)). Yet, while good quality data on climate finance are instrumental to support the shift towards a lower-carbon economy, they are still largely missing. Several national and international initiatives have been attempting to fill these gaps in recent years. A noteworthy one is Recommendation 4 on green finance within the context of the third phase of the **Data Gaps Initiative** (DGI) endorsed by the G20. The aim is to gather statistics on sustainable, sustainability-linked and green debt securities, and green listed shares, by issuer and holder, based on comparable indicators and self-commitments by economies (IMF et al (2023a)). The Climate Change Indicators Dashboard of the International Monetary Fund (IMF) is also an important initiative that features statistics on climate finance.

External statistics are instrumental for addressing these issues, not least because of climate change's impact on cross-border transactions globally. First, from the dimension of risk, mapping climate-related exposures across countries, such as in terms of instruments and sectors, can be facilitated by the framework provided by the BOP and the IIP. In this regard, the Guidance Note B.6 by the Balance of Payments Task Team suggests **integrating measures of climate change risk into external statistics**, including by adding a supplementary "of which" category for green bonds in the BOP and IIP (BOPCOM (2022)). This proposal has been endorsed in the context

of the joint revision of the SNA and BPM[6] and ensures strong complementarity with the DGI (Barahona et al (2024)). Other useful indicators to capture climate-related risks from the BOP perspective could be the location of borrowers or lenders exposed to physical or transitional risks. Information on financial derivatives can in particular provide valuable insights into how investors manage risks related to climate change and sustainable investments (BCBS (2021b)). Second, and perhaps more importantly, **external statistics are pivotal to assessing cross-border aspects of climate change**. For instance, they may help to track international investment flows to mitigate its impact. Further, BOP data can feed experimental indicators for measuring global carbon emissions balances across countries, for example to show whether countries are net exporters or importers of carbon dioxide (CO_2) emissions (Yamano and Guilhoto (2020)). Another case is the use of specialised and granular data, which can be useful to measure the FDI carbon footprint (Genre et al (2024)) or cross-border trade in CO_2 emission allowances through the derivatives market, as shown by the Narodowy Bank Polski.

Yet **most climate change-related statistics present several challenges**. First, the lack of common definitions prevents achieving full **consistency in terms of data and methodology**. For example, while considerable work has been undertaken to set up homogeneous taxonomies to define green financial instruments, most of them are still voluntary, enforceable only within some jurisdictions, or can be complemented with heterogeneous private standards.[7] Ensuring consistency also calls for harmonising existing statistical concepts across the main methodological frameworks. In practice, this means ensuring alignment across manuals, notably the SNA, the BPM and the System of Environmental Economic Accounting (UNECE (2021)), but also across international classifications, eg the statistical classification of economic activities in the European Community (NACE) and the International Standard Industrial Classification of All Economic Activities (ISIC) (CMFB (2023)). A second challenge is the lack of **comparability** across indicators and countries, which is largely explained by the poor degree of harmonisation and **the notable disparities in aggregated and granular data collections** (Aurouet et al (2023)). This challenge is often seen as a major obstacle for banks and regulators to use climate scenario analysis and assess resilience to environmental risks (BCBS (2024)). Key recommendations are to use proxy indicators while also making extensive use of metadata to provide a full account of the information sources used, including their caveats.

Another important strand of limitations relates to the **gap between the policy urgency and the relatively slower pace of producing new official statistics on climate change**, which typically have longer horizons. In fact, most of these statistics are released annually, often with a delay of one year or more, which may not fit policymakers' needs (UNECE (2020b)). One way to tackle this issue is to release sets of experimental indicators to serve users' immediate needs, while perhaps not completely fitting statistical standards. The climate change-related statistical indicators disseminated by the ECB are a telling example. Notwithstanding continuous progress to ensure highest statistical standards, this exercise clearly acknowledges the caveats and limitations of these statistics and their status as

[6] See Joint Forty-Third Meeting of the IMF BOPCOM and Twenty-Fifth Meeting of the Advisory Expert Group on National Accounts (20 February 2024).

[7] For a review on the adoption of taxonomies among G20 DGI economies, see IMF et al (2023b).

experimental (Statistics Committee Expert Group on Climate Change and Statistics and Working Group on Securities Statistics (2024), Kanutin (2024)).

More fundamentally, **the BOP framework might not be sufficient to incorporate climate change in external statistics**. A typical case is the approach to follow regarding the measurement of international CO_2 emissions. **Residence-based metrics**, aligned with the BOP and IIP, allocate carbon emissions to the country where the economic operator, such as a firm, is resident. Yet, one might also want to allocate them to the country where they take place (territory principle), beyond the residency of the economic operator, or where the firm is headquartered or controlled. This approach, based on **ownership**, can be particularly useful to shed light on carbon emissions by MNEs, monitor whether these circumvent domestic emissions standards or, more broadly, track if FDI can foster the transfer of low-carbon technology across borders (Borga et al (2023)). Finally, another perspective is to measure the carbon footprint of **final domestic demand**. From a policy perspective, this metric might be critical to estimate carbon emissions balances and assess countries' dependencies on foreign carbon-intensive goods (Yamano et al (2023)). Yet, such approaches still face considerable data and methodological gaps, calling for further international cooperation. A pivotal effort in this regard is the DGI, particularly its Recommendation 3 targeting the development of a methodological framework and compilation guidance for estimating FDI carbon footprints.

Box A

Climate change and official statistics: an interview with Galina Hale



Galina Hale is Professor of Economics at the University of California, Santa Cruz. Previously she served as Research Adviser at the Federal Reserve Bank of San Francisco and as Assistant Professor of Economics at Yale University. Her current research interests focus on attracting mainstream finance to climate solutions, the sustainability of the global food system and international financial stability, especially with respect to climate risks. She participated in the panel discussion "Addressing post-pandemic challenges and looking forward, the analysts' perspective" at the second edition of the External Statistics Conference (2024).

1. Your work has been instrumental in highlighting the importance of incorporating climate change considerations into economic statistics. Could you share your motivations and the pivotal moments that led you to pursue this line of research?

I believe one of the biggest financial risks related to climate change stems from the lack of information about financial firms' exposure to them. Given that financial firms' vulnerability to climate risks results from the vulnerabilities of their customers, non-financial firms and households, it is crucial to have reporting of climate change-related variables, including greenhouse gas emissions, plans for transition to zero emissions, as well as exposure to physical risks resulting from climate change and plans for adaptation measures in response to such risks. Without this information, it is very difficult to assess the materiality of climate risks to the financial system and therefore to take measures to mitigate any systemic risks.

2. While the relationship between economic activity and its environmental impact has long been recognised, it is only recently that statistical frameworks, such as balance of payments,

have begun to explicitly account for climate change factors. From your perspective, what were the primary catalysts that prompted this shift, and what challenges did you face in advocating for the inclusion of climate change statistics in official economic statistics?

I think the demand for such statistics comes from government policies, including the Emissions Trading System of the European Union (EU) and climate stress testing that many bank regulators now conduct. In addition, there is an increasing demand from investors which leads to transition from voluntary disclosures, such as the Task Force on Climate-related Financial Disclosures framework, to more reliable, audited, government-required disclosure, such as new rules from the US Securities and Exchange Commission. Aside from politics, I believe the pushback comes from companies that have not chosen to disclose climate variables voluntarily. The main reason for the lack of climate reports is the cost of measuring relevant variables. Additionally, there is a risk of adverse selection, where firms that choose not to publish climate data may do so because they anticipate that investors will not react positively to the information that would be disclosed.

3. One of the key recommendations from the recent External Statistics Conference was the introduction of new categories to identify environmental, social and governance (ESG) investments, green bonds and climate change-related financial flows within balance of payments statistics. Could you elaborate on the significance of these measures and how they can facilitate a better understanding of sustainable finance and its impact on the global economy? And would there be additional climate change-related indicators on your "wish list" in the field of external statistics?

I believe this is a great idea. It will allow us not only to account for the share of green assets in global markets, but also to identify deficits and surpluses in investments in climate solutions. Current climate solution spending is 10 times smaller than needed to achieve the Paris goals, and very little of what is spent comes from institutional investors. Given that national investment needs for climate solutions may not be distributed across countries in proportion with financial flows, understanding global patterns of green investment flows will help official funding sources direct their spending to countries that do not receive enough private flows (relative to their needs for green transition and climate adaptation). My wish list will of course include green loans, green FDI, portfolio investments into firms offering climate solutions, as well as government climate-related transfers and loans. I have a strong opinion that ESG investments should not all be lumped into one category. There are "E" investments (climate- and biodiversity-related) and "S" investments (anything related to other sustainable development goals). I am not sure if "G" even belongs in the group.

4. As we strive to enhance the granularity and accuracy of climate change statistics, what are the key challenges you foresee in terms of data availability, methodological limitations and international coordination? Additionally, how can we foster greater collaboration between official statisticians, policymakers, academia and the private sector to overcome these hurdles and ensure that climate change statistics remain relevant and responsive to evolving policy needs?

I believe international harmonisation of the approaches to climate change statistics methodologies is key. The Task Force on Climate-related Financial Disclosures seems to have set best practices that can be used as a benchmark for required reporting. The EU taxonomy could be refined and adopted by international standards setters. We absolutely need to avoid any opportunities for climate disclosure-related regulatory arbitrage. I believe most challenges are political or technical, not least because statistical standards may not be harmonised across countries. From a technical point of view, given the global nature of the problem, this is an opportunity for extensive collaboration and a unified global methodology and reporting standards. An additional obstacle stems from the fact that climate risks are fundamentally uncertain. Thus, a unified approach to

scenario analysis, based on shared socioeconomic pathways, for example, is also crucial. A further challenge is the complexity of climate metrics, which requires a flexible approach that can be refined over time, making global coordination even more challenging. I believe regular meetings that involve official statisticians, academics, the private sector and policymakers are key to achieving these goals. Statisticians provide the framework, academics can advise on best measurements, the private sector can give feedback on the potential impact on their businesses and use cases, policymakers can contribute to discussions on institutional constraints and the feasibility of various reporting requirements. All these parts are necessary and likely to change over time. I recommend an annual meeting to allow us to adapt to the changing physical, regulatory and political climate.

3. Adapting to change: methodological updates and measurement challenges in external statistics

Reviewing external statistics' standards is essential for keeping pace with new developments, fostering consistency in macroeconomic accounts and reducing international asymmetries. Despite notable progress, significant challenges remain, fuelling the development of experimental indicators, methods and techniques.

Revisiting external statistics' standards to foster consistency and reduce global asymmetries

An important milestone in external statistics is the joint revision of the SNA (SNA 2025) **and the BOP and IIP Manual** (seventh edition, "BPM7"). Adjustments to the conceptual framework have become a pressing need in recent years to properly respond to the tectonic shifts observed in the global economy, especially since the Great Financial Crisis of 2007–09 and, more recently, the Covid-19 pandemic. In practice, and according to the IMF, updating macroeconomic statistical standards means revising the concepts (ie changing what is measured), the presentation (ie changing how the statistics are presented) and, ultimately, the methodology (ie changing how activities are measured). As regards the new BPM7, the methodological revisions can be grouped into four key thematic areas: globalisation, digitalisation and financial innovation, external sector sustainability, and sustainable finance. Major changes revolve around the proper definition and measurement of fintech and non-bank financial institutions' activity, the identification and recording of cryptoassets, the introduction of a standard definition for net international reserves, the clarification of unlisted equities' valuation and the identification of green investments.

A critical priority in the update process has been to ensure full coordination between the revision of external and national accounts, with the underlying goal of **improving consistency of macroeconomic statistics**. In fact, for the first time, the update of the BPM has been conducted in close coordination with that of the SNA. Moreover, cooperation has been ensured across other domains, notably Government Finance Statistics, Monetary and Financial Statistics and the System of Environmental Economic Accounting, as well as other key initiatives such as classification updates (ISIC, Central Product Classification), FDI and trade statistics, and the DGI (Barahona et al (2024)). Coordination is also critical to **reduce international asymmetries**, which may arise for instance from heterogeneous

sources, recording practices or methodological interpretations. At the EU level, important steps have been initiated by the Committee on Monetary, Financial and Balance of Payments Statistics (CMFB) to further enhance statistical collaboration between the European System of Central Banks and the European Statistical System (ESS). The aim is to develop a common vision for measuring globalisation as well as to improve the consistency and completeness of economic statistics (CMFB (2024)). These actions draw on burgeoning work done over the past few years, particularly to establish coordination activities on MNEs and reduce asymmetries in a certain number of areas, such as FDI, international trade in goods and services statistics and, more broadly, BOP. At the international level, the Task Team on Global Asymmetries in External Sector Statistics, set up by the IMF Committee on Balance of Payments (BOPCOM), aims at identifying the main reasons behind global asymmetries, how they may hamper data quality and propose best practices to address bilateral asymmetries. Ultimately, supporting countries in adopting the new methodological framework will also be critical to achieving these goals.[8]

Notwithstanding recent progress, several challenges lie ahead in the compilation of external statistics

Undoubtedly, there have been significant enhancements in data availability for external statistics over the past few decades. A noteworthy trend is the growing number of countries releasing comprehensive data on IIP. Further, various data sources on cross-border bilateral financial positions are available through international data collections such as the BIS's international banking statistics and the IMF's CPIS and CDIS data sets. These collections not only serve as valuable resources for analysts but also provide supplementary data for compilers to augment national statistics with further breakdowns and enhance the consistency and comparability of the estimates across jurisdictions. For instance, they can be very effective to leverage **mirror data** when compiling external statistics (Pradhan and Silva (2019)). As an example, the Central Bank of Malaysia uses various complementary sources for compiling the BOP. Specifically, bilateral outward CDIS data from counterparty economies are matched with reported inward FDI, while BIS data on deposits in the rest of the world, particularly for non-bank entities, are matched with reported data on deposits abroad.

Yet a certain number of measurement challenges and data gaps persist in several key areas. First, statistics on **portfolio investment** still suffer from incomplete data collections both in terms of geographical and sectoral coverage. A typical consequence is the inaccurate recording of transactions in FDI or portfolio investment. Further, research from the Brookings Institution shows that limited country participation in the CPIS may partly explain why data on global cross-border portfolio securities liabilities are substantially larger than estimates of the corresponding assets. Additionally, traditional data sources fail to capture portfolio assets of resident investors kept in custody abroad, also called third-party holdings. In short, when resident investors hold foreign securities via foreign custody accounts, these foreign assets may be missed by compilers. This is explained by the fact that non-resident custodian entities typically do not report directly to national authorities. To overcome this **blind spot** in portfolio investment statistics, the ECB suggests

[8] In this regard, the IMF has jointly organised with other regional and international organisations the "BPM7 Outreach Events", notably to raise awareness and explain the envisaged changes in BPM7.

enhancing data collection, dissemination and global sharing of third-party holdings data as well as to integrate them into the existing official data sources, such as the CPIS.

The measurement of **migration and cross-border mobility** is another key area where compilers of external statistics continue to struggle. Several reasons can be advanced, not least the complex data integration involving disparate information sources, ranging from administrative registers to social media (UNECE (2022)). More specifically, measuring personal transfers, which are increasingly relevant due to growing migration movements, is particularly hard. The main reason is that they often relate to small, individual transfers below the reporting thresholds of the BOP compilation framework. Additionally, transfers may be routed through informal and unregulated channels which are difficult to capture by statisticians. Joint research from the Deutsche Bundesbank and Bank of Spain relies on multiple alternative sources to estimate personal transfers from Germany, including direct reporting from money transfer operators, household surveys and administrative data.

A further area is **tourism and travel estimates** in the BOP. This item has been particularly complex to grasp in recent years, not least because traditional ways may be inadequate to accurately estimate travel receipts during extraordinary shocks. For example, some methods typically assume that tourism revenue is generated in the same month as when tourists arrive (arrival basis). As shown by the Bank of Thailand, this assumption does not account for travellers with longer stays, for instance in case of unexpected restrictions, as happened during the Covid-19 pandemic. One alternative option is to follow a stock basis approach which records tourists' expenditures throughout the whole period of their stay.

Additionally, the **digital transformation of the economy** continues to challenge compilers. A key reason is that cross-border trade in digital services is difficult to capture in practice despite continuous improvements in the methodological framework.[9] Here also, a possible solution is to rely on alternative data. For example, the Reserve Bank of India developed a new approach to measure cross-border digital services trade integrating data based on payment card information to include e-commerce transactions in the BOP. Similarly, Bank Indonesia harvests alternative data from e-commerce platforms in order to identify entities involved in cross-border digital trade.

More broadly, digital transformation is also propelling a **shift from tangible to intangible activities**, adding even more complexity to the production of official statistics (Haskel and Westlake (2018)). On top of software and databases, intangible assets include research and development and other IPPs. Research conducted by the Central Bank of Ireland and the ECB shows that MNE activities are strongly interlinked with intangible assets, not least because they play a role in tax-optimisation and profit-shifting strategies. Although their measurement has improved, their volatile patterns, combined with intra-group relocations of IPPs that are hard to grasp, may have sizeable impacts on macroeconomic indicators such as GDP and the current account balance, blurring the overall business cycle analysis (Tissot and Truong (2019)). This is particularly the case for countries such as Ireland that have a sizeable MNE presence.

[9] Key methodological advances also include the second edition of the *Handbook on Measuring Digital Trade* (2023), which provides additional clarifications of the concepts related to digital trade.

The path towards experimental statistics for the external sector

More fundamentally, the challenges above, coupled with new users' needs and the availability of novel data sources, have been driving the production of **experimental statistics.**

Experimental indicators are indeed gaining relevance in official statistics, especially in response to the recent pandemic (IFC (2023b)). Experimental data typically use novel sources and offer advantages over traditional statistics in terms of timeliness.[10] In the field of external statistics, one example is the work developed by the Organisation for Economic Co-operation and Development (OECD) to measure global trade using geospatial data on ports and vessels. Although the primary purpose of these data is to ensure the safe navigation of vessels, they can also be used to build experimental indicators for monitoring international sea-borne merchandise trade. Moreover, given the significant share of maritime transport in global trade, this method has also helped to generate experimental real-time indicators to monitor global supply chains. A related case is PortWatch, a collaborative effort between the IMF and the University of Oxford, designed as an open platform for monitoring maritime trade flows using satellite-based vessel data. The project aims at supporting authorities, policymakers and the general public in assessing the impact of realised and potential trade shocks, such as natural disasters or other climate-related events. The platform offers advanced analytical tools to run simulations based on predefined stress-test scenarios, for example to estimate country-level spillovers following a disruption in a specific port. It also provides a tool to identify vulnerabilities within the global transport network in case of climate-related adverse events. Another example, for financial information, is from the Bank of France, which developed experimental indicators to value unlisted equity in FDI based on market capitalisation ratios instead of relying only on own funds at book value, as is conventionally done.

Compilers of external statistics have also been experimenting with new tools, for example to increase the availability, frequency and timeliness of data. Techniques such as **web scraping**, which involves collecting data from various web pages, are increasingly used in official statistics including by central banks (Belchev and Lamboray (2021), IFC (2021a)). More specifically, in the field of external statistics, Bank Indonesia leverages web scraping to capture digital trade from various online sources, notably e-commerce websites. Another area includes using advanced analytical tools borrowed from data science and econometrics. For example, Bangko Sentral ng Pilipinas uses **machine learning (ML)** techniques to better capture the determinants of FDI in emerging Asian economies, unveiling for instance that environmental variables such as total natural resource rents and carbon intensity are significant FDI determinants. Similarly, work by Banco de Portugal shows the usefulness of **network analysis** to better understand foreign investments (Silva et al (2023)). More broadly, research by the Bank of Spain and Deutsche Bundesbank shows the usefulness of advanced **econometric approaches** to improve the accuracy and timeliness of estimates of FDI income. Lastly, a further area of experimental techniques covers **pilot surveys**. For example, the Central Bank of Egypt shows that the Egyptian Customs Authority, in collaboration with other public authorities, is

[10] Although there is no unique definition of experimental statistics, they are usually understood as statistics compiled with new data sources and methods which are sufficiently reliable to be published but whose quality is lower than that of official statistics. For example, see ECB and Eurostat.

contemplating a pilot survey for assessing digital trade. Through sampling methods, it aims to determine the proportion of e-commerce postal parcels to include data on cross-border transactions of digital goods and services by resident households and businesses.

4. Coupling innovation with growing data availability and stronger international statistical cooperation

Frontier technologies such as AI bring several benefits but also challenges for data compilers

In a fast-changing and increasingly competitive data landscape, **innovation is not an option, rather a necessity**. Official statistics in particular have faced heightened pressure to leverage innovation in recent years, not least to increase their timeliness and accuracy.

Embracing frontier technologies, such as ML and generative AI, **presents several opportunities for the compilation of official statistics**. First, these technologies enable **tapping into new information sources**, such as social media texts, speeches and other unstructured data. For instance, large language models (LLMs) are able to achieve human-like proficiency in a wide number of tasks, including analysis, editing, summarisation and, more importantly, generation of texts (Araujo et al (2023)). Second, new data science techniques allow the **harnessing of the wealth of granular data** increasingly available (IFC (2021b)). For example, they can help streamline data editing, especially with large data sets, and improve overall timeliness (UNECE (2024b)). They also **enhance data integration and linkages**, for example by connecting together multiple and disparate data sources. This has become a key challenge in the growingly competitive data ecosystem (UNSD (2024)), particularly in the area of geospatial data (Habchi (2024)). A third opportunity is to **facilitate the communication and understanding of statistics**. In this regard, a key goal of the joint revision of the SNA and BPM is to foster the understanding of macroeconomics accounts, by targeting a broader audience, including non-experts. Here, AI can help, as it already exhibits great promise to communicate more effectively and improve statistical literacy among the public (IFC (2024a)). Practical use cases include using search engines and customised chatbots tailored to users' needs as well as enhancing data access in the context of the SDMX standard (SDMX (2024)).

Yet there are several challenges posed by this innovation wave. First, these new technologies may leverage algorithms which can be hard to understand, raising concerns in terms of transparency, explainability and "black box" issues. These points are particularly challenging when it comes to implementing production pipelines, for example because statistical offices may not be ready to give a full account of the rationale behind the selection of parameters required by the underlying models (UNECE (2024b)). This, in turn, entails **safety**, **ethical** and **governance considerations** regarding the use of AI in statistical organisations, notably to counter possible negative impacts due to the misuse of data, propagation and self-reinforcement of biases, as well as harmful consequences for society (UN-ABAI (2023), OECD (2024)). Third, most big data- / AI-based IT infrastructures rely on cloud service providers, which also raises a certain number of issues, such as **data privacy** and **security**, **third-party dependency** and **increased costs in IT services** (UNECE (2023a)). It also

highlights the need for further collaboration, co-investments and mutualisation of costs, such as the EU "one-stop shop" initiative on AI for official statistics by Eurostat.

Harnessing the growing availability of granular and alternative data to enhance external statistics

Along with the spread of innovative technologies, the **compilation of external statistics** can greatly **benefit from the proliferation of new data sources**.

These include granular and large data sets originated from public authorities, including administrative records. These types of data typically enable the compilation of more detailed breakdowns or occasionally offset the inadequacy of conventional data collection methods (UNECE (2023b)). One notable example is the use of granular data from the Immigration Bureau by the Bank of Thailand for better estimating cross-border travel income and expenses, especially during the Covid-19 period. Similarly, the Bank of Italy combines customs data on trade in goods with granular surveys on trade in services to measure the complementarity of goods and services trade. Further, research from the Central Bank of Chile and Bank of Spain shows that firm-level data obtained from fiscal and customs authorities have been instrumental in capturing how Chilean firms adjusted their international trade activities during and after the pandemic shock. Another notable example is the use of instrument-by-instrument databases to compile external statistics, such as security-by-security holdings and issuance data for compiling portfolio investment (Dilip and Tissot (2024)). Similarly, the Central Bank of the Republic of Austria uses granular and big data on financial derivatives reported under the European Market Infrastructure Regulation to improve the compilation of the BOP. Yet this work has also underlined the complexity of using granular data, as they are often not directly intended for statistical purposes and may require greater effort than traditional sources, most notably in terms of processing, integration and quality management (IFC (2024b)).

Additionally, external statistics can leverage alternative information sources and new data formats. These typically include unstructured data, such as text. For instance, innovative techniques such as LLMs allow central banks to explore new possibilities in data production, such as extracting information from articles, generating textual descriptions of tables and series, and improving statistical classifications or taxonomies (Araujo et al (2024)). One possible use case in external statistics could be to refine the analysis of corporate events, such as mergers and acquisitions, to better record FDI. Another notable example is the work undertaken by Bank Indonesia to identify cross-border digital trade actors through the collection of qualitative information, such as **textual data**, from online websites. **Geospatial and positioning data** have also been gaining traction, not least for climate change-related statistics, although their integration with official statistics raises several challenges (UNECE (2024d)). Moreover, **mobile phone records** have proven useful in providing better estimates, particularly for tourism-related activities.[11] For example, a joint study from the Bank of Spain and the Spanish national statistical institute (INE) uses these data, along with **card transactions**, as a complement to traditional surveys to improve the geographical breakdown of tourism expenditure. Finally, another strand of unstructured data is **satellite imagery**, whose development in official

[11] For methodological guidance, see UN Global Working Group on Big Data for Official Statistics (2019).

statistics has been catalysed by the work of the Task Team on Earth Observation Data under the Committee of Experts on Big Data and Data Science for Official Statistics of the United Nations (UN) (UNSD (2015)). And, indeed, satellite data appear to be particularly useful for proxying trade disruptions and economic activity (d'Aspremont et al (2024)).

While alternative data present several opportunities, their use also raises several challenges. These typically feature imperfect quality (IFC (2023b)), concerns about the protection of privacy (Nichols et al (2023)), limited historical depth (Woloszko (2023)) or inadequate methodological requirements, calling for further preprocessing. For example, a key issue in the use of credit card transactions for BOP compilation is that they are at times recorded on a *net* basis, while *gross* transaction values are required. To address this challenge, the Reserve Bank of India took advantage of its regulatory power to instruct card networks to report the data on a gross basis. More broadly, a key issue raised by the IMF BOPCOM is the limited availability of alternative data – particularly due to scarce online data collection systems, administrative sources and surveys – that may exacerbate current account asymmetries (BOPCOM (2023)).

The need for stronger international cooperation…

The growing demand for and supply of data necessitate robust international data governance. The ongoing deluge of information, combined with recent advances in technologies such as AI and computational power, emphasises the need for strong data stewardship (UN-CEB (2023)).[12] In fact, despite the existence of vast data pools, mostly accumulated through electronic devices and networks, their access remains limited by strong market competition, privacy regulations and associated expenses. This may prevent compilers, especially in low-income countries, from harnessing alternative sources for the compilation of external statistics. Facilitating data access through sound governance is therefore crucial (Krizman and Tissot (2021)). A prominent example is the UN Global Platform,[13] a cloud-based, open and inclusive data ecosystem which supports international collaboration, particularly in the area of new data sources and innovative methods. This initiative supports several projects, including the IMF PortWatch to monitor trade disruptions from space.

A second aspect is to make data findable, accessible, interoperable and reusable, including through the promotion of common standards.[14] These are particularly important to facilitate the integration, interoperability and linking of multiple information sources (Gregory (2024)). For example, in the domain of macroeconomic statistics, the Statistical Data and Metadata eXchange (SDMX) standard is widely used by central banks, both as providers and users of aggregated

[12] Data stewardship can be defined as "ensuring the ethical and responsible creation, collection, management, use and reuse of data so that they are used for public good and benefit the full community of data users" (UNECE (2024a)).

[13] The UN Global Platform has been established under the aegis of the UN Committee of Experts on Big Data and Data Science for Official Statistics.

[14] The FAIR principles outline a set of guiding principles to foster the discovery and reuse of data by multiple stakeholders (Wilkinson et al (2016)). More specifically, they require data to be findable (eg with rich, clear and searchable (meta)data), accessible (eg open and standardised), interoperable (eg with common vocabularies) and reusable (eg with accessible data usage licences, detailed provenance and relevant attributes).

statistics. It provides an informational model and brings three major advantages. To start with, it allows **data and metadata to be harmonised *within* and *across* statistical domains**. For instance, macro statistics on the BOP and IIP are typically modelled through the "BOP" Data Structure Definition (DSD).[15] This BOP DSD includes not only concepts specific to the BOP area (eg "international account item") but also those belonging to other statistical domains, such as national accounts (eg "valuation"). In addition, SDMX ensures **proper governance of statistical concepts**. A notable example is the fact that any changes, for example those triggered by conceptual updates, are properly introduced after extensive consultations with subject matter experts and upon the agreement of the owners of the related concepts (SDMX (2014)). Finally, **standards such as SDMX enable and foster interoperability** (UNECE (2024c)). This entails several benefits across statistical processes, from collection – with lower reporting burden – to dissemination – through the implementation of open data platforms (Laaboudi et al (2024)).

…especially to promote data-sharing

A key aspect to meet the growing need for granular and alternative data for external statistics is data-sharing, both *within* and *outside* the official statistical community in each jurisdiction as well as across countries.

Sharing data resources *within* the national statistics ecosystem is a first, crucial priority, as national statistical offices and national central banks typically have shared responsibilities in the compilation of external statistics (UNECE (2020a)). For example, most national central banks in the EU are responsible for the compilation of BOP/IIP.[16] They jointly cooperate and share data with Eurostat and national statistical offices, particularly to reconcile BOP and national accounts (ESS-ESCB (2024)). Moreover, from an organisational perspective, the setup of so-called "Large Cases Units" (LCUs) can be useful to exchange information on MNE activities among all the stakeholders involved.

Sharing of data should also occur *outside* the official statistical community, particularly with academia and the private sector. On the one hand, sharing data with academic institutions has become an established practice in several countries over the past few years. The creation of **research data centres** enables researchers to access confidential data from central banks while also safeguarding anonymisation, secure access and confidentiality (IFC (2023a)). Another noteworthy example includes the **International Network of Exchanging Experience on Statistical Handling of Granular Data** (INEXDA), which promotes knowledge-sharing on micro data issues across academia, central banks and international organisations (IFC (2018)). In the area of external statistics, the cooperation between central banks and researchers has been instrumental in advancing the understanding of several topics, including hidden securities (ECB, University of Osnabrück and World Bank), assessing euro area financial integration (Columbia Business School, ECB and Stanford University) and analysing the dynamics of international financial integration and households (Central

[15] The DSD belongs to the SDMX Information Model and comprises a set of concepts to describe and identify data (SDMX (2016)). The DSDs for the BOP (SDMX-BOP) and FDI (SDMX-FDI) are available at sdmx.org.

[16] For examples see the Memorandum of Understanding signed by Eurostat and the ECB on the quality assurance of statistics underlying the Macroeconomic Imbalance Procedure.

Bank of Ireland and Trinity College Dublin). On the other hand, **data sharing between private and public statistical agencies** has also become more relevant in official statistics, not least to supplement traditional statistical methods as well as to address timely policy needs (Jahangir-Abdoelrahman and Tissot (2023)). For example, the Bank of Italy and Bank of Thailand relied on mobile phone data, originated from wireless carriers, to refine their estimates of tourism flows during the Covid-19 pandemic (Carboni et al (2023)). Additionally, efforts are under way to establish digital platforms for data-sharing and knowledge dissemination, exemplified by initiatives like data catalogues, such as the Ministry of Statistics and Programme Implementation National Data Archive in India, or data spaces, such as the Common European Data Spaces (OECD (2022), European Commission (2024)). But, despite these advancements, the landscape of **data-sharing with the private sector lacks standardised taxonomies** to facilitate agreements and ensure a level playing field.

Hence, the above initiatives are being complemented by renewed efforts to streamline **data-sharing frameworks and practices at the global level**, especially under the third phase of the DGI. In particular, its Recommendation 13 has produced a new taxonomy for accessing private data, delineating the types of data to be shared, the roles of various stakeholders (such as data users, producers or holders) and the channels through which data are exchanged. Turning to Recommendation 14, it aims at establishing the definition of a set of principles for data-sharing, including for micro data. In addition, there has been limited but important progress in the actual sharing of statistical information at the international level, especially in specific regions such as the EU or in the context of BIS global statistical activities (Tissot (2017)).

Innovation can also play a decisive role in promoting data-sharing to support the compilation of external statistics, thereby alleviating the reporting burden while also facilitating a more comprehensive profiling of MNEs. First, **centralised collections** can help bridge the gaps between business and trade registers (UNSD (2024)). Lane (2024) advocates for centralised data collections on an international scale to consolidate data concerning the top 500 MNEs within the European Union, akin to the existing framework for supervising banks. A priori, this approach may mitigate information disparities and improve consistency in recording MNE activities. More broadly, work is also ongoing in the community of official statisticians to identify best practices for collecting data related to globalisation and digitalisation, such as e-commerce.[17] Second, the **adoption of unified reporting and common identifiers** is also crucial in this regard. Typical examples are the global Legal Entity Identifier (LEI) covering legal entities across markets and jurisdictions taking part in financial transactions with information on their ownership structure, or the Permanent Identifiers (PermID) made available by the London Stock Exchange Group (UNECE (2024e)). The streamlining of data reporting and linkages can also be facilitated by the national and regional initiatives, including the Register of Institutions and Affiliates Database (RIAD)[18] within the European System of Central Banks and the EuroGroups Register (EGR) serving as a coordination platform within the ESS for survey frames pertaining to global business activities. Third, **multi-source and multi-mode data collections** can be developed to pool together data from different sources, such as online questionnaires, monitoring offices, private providers and

[17] For instance, see the workplan of the task team on globalisation and digitalisation of the Committee of Experts on Business and Trade Statistics (E/CN.3/2024/18).

[18] See Perrella and Catz (2020).

traditional surveys. Key examples are the Smart Data for Multinational Enterprises project (Papailias et al (2021)) and the OECD-UNSD Multinational Enterprise Information Platform, which sources national, regional and private business registers to gather information on the world's 500 largest MNEs and includes a monitoring tool for large corporate events, such as mergers and acquisitions (Pilgrim and Ang (2024)).

5. Developing a roadmap for external statistics

Six building blocks…

Given the unprecedented speed at which the world is changing, anticipating emerging trends in external statistics is critical in at least two ways. First, from the user perspective, **anticipatory thinking** plays a critical role in meeting emerging analytical needs and addressing the measurement challenges posed by globalisation, digitalisation and climate change. Second, from the producer perspective, the growing availability of data and new techniques requires **proactively adapting statistical processes** to increase the quality, timeliness and relevance of, and trust in, external statistics. This calls, in turn, for sound strategies to use frontier technologies in a responsible, accountable and ethical way. Ultimately, the two perspectives combined call for setting up a **comprehensive roadmap to develop external statistics** in the years ahead, articulated in six blocks:

i. Capturing the impact of globalisation in an increasingly borderless world. Globalisation will continue to put pressure on residency-based concepts, challenged by transnational activities which permeate geographical borders. Presenting data based on economic *ownership* or *control* will be critical to better capture economic linkages and exposures. Accurately measuring the intricate activities of MNEs and global financial intermediaries will also be key. In practice, several proposals can be suggested:

- Producing additional breakdowns on SPEs, for example to better track the advantages offered by the host country such as a lower tax burden.
- Compiling supplementary data on foreign-controlled corporations to analyse the extent of domestic *versus* foreign control in globalised economies.
- Enhancing data on global value chains to track the complex cross-border production networks that characterise modern trade.
- Identifying the economic ownership of securities' holdings through indirect data collections (eg custodian data) and international data sharing (eg third-party holdings in the CPIS).
- Compiling data on the currency composition of trade in goods and services and investment flows to better inform on currency exposures and risk management.

ii. Adapting external statistics to a digital and intangible reality. The fast digital transformation of today's society, shaped by the ubiquity of technology, the tokenisation of finance and vast cross-border flows of data, will keep challenging users and producers of external statistics. Key actions may include:

- Refining guidance and measurement techniques on digital trade, e-commerce transactions and intangible assets, such as software and data.
- Developing a framework for classifying and measuring innovative financial products, such as cryptoassets.
- Further refining the statistical treatment of financial derivatives in view of market practices, reflecting the increasing complexity and importance of these instruments.[19]

iii. Incorporating environmental aspects into external statistics. In particular, the threat of climate change unavoidably prompts adapting and embedding environmental-related metrics in external statistics. Key steps may include:

- Producing indicators on climate change and introducing new categories to identify environmental, social and governance (ESG) investments and green equity, loans and debt securities within the BOP and IIP.
- Combining data on the location and economic activity of direct investment enterprises with information on physical and transition risks from climate change.
- Going beyond residency-based metrics to measure international carbon emissions, for instance considering alternative approaches based on territory, ownership or final consumption and production.

iv. Achieving consistency, reducing asymmetries and improving reconciliation. Attaining consistency in recording practices, improving stock-flow reconciliation and ensuring comparability and completeness of external statistics will remain primary concerns for compilers. They call for various initiatives, including:

- Improving the coordination and the exchange of information among and within the international and national statistical systems, particularly between central banks and national statistical offices.
- Enabling a close dialogue with all the stakeholders involved in the chain supporting the production of external statistics, not least to make a better use of business registers and improve the linking of data across multiple sources.
- Enhancing MNE data collections, to make them more effective for both reporters and compilers.

v. Harnessing alternative data sources and types. Alternative data have become essential for supplementing or addressing the limitations of traditional sources mobilised for external statistics, especially to enhance accuracy and relevance. Proposals include:

- Tapping into new information sources and data types, such as geospatial and positioning, mobile phone and credit card data, to further improved monitoring of cross-border activities, such as tourism.

[19] In line with the ongoing steps taken by the BIS to refine the provision of comprehensive measures for the size and structure of global derivatives markets.

- Leveraging payment statistics to gain additional insights into cross-border flows.
- Making better use of regulatory data to compile external statistics, for instance in the context of the European Market Infrastructure Regulation for financial derivatives.

vi. Promoting the agility and timeliness of external statistics in a fast-changing global landscape. To cope with growing uncertainty, regularly revisiting methodological and statistical processes, including through more timely releases, will play a pivotal role to better inform policymakers and the broader public. Several concrete actions that will be crucial in this regard include:

- Promoting access to micro data to perform ad hoc aggregations tailored to users' needs, especially to support evidence-based policymaking.
- Enhancing the production of experimental statistics as well as the compilation of supplementary items or breakdowns (based on their relevance, priorities and urgency).
- Investigating the feasibility of compiling higher-frequency BOP data.

…putting a premium on innovation, cooperation and securing public trust

To be successful, the implementation of the above roadmap requires a clear and shared vision of the future of external statistics. **Leveraging innovation, promoting international cooperation and maintaining trust in official statistics will be essential** in bringing such a vision to fruition.

First, there is no doubt that **innovation will continue to be high on the agenda** of external and official statistics as the facilitator for improved data acquisition, integration, management and analytics. It will empower statisticians with the required tools and techniques to complement traditional sources and fill gaps with alternative data, including in close collaboration with the private sector. In parallel, reaping the benefits of innovation and addressing its challenges will continue to require adequately trained staff, investment in IT as well as prioritisation of costs.

Second, in the light of the intricate interdependence of economies and the threat of climate change, **international cooperation is a fundamental requirement to preserve and promote further**. It can play a pivotal role in fostering global data governance and, more practically, in accessing, exchanging and sharing information. It will also help broaden the corpus of available information for producers and users to better understand pressing global issues.

Finally, and more fundamentally, **securing trust in external statistics will be essential to serving the public good**. In an increasingly competitive information ecosystem, the imperative to maintain accurate, credible and relevant external statistics cannot be overstated. More efforts will be needed to employ tailored communication to better engage with users as well as foster data-informed policymaking. Enhancing the accessibility and interpretability of data through enriched and transparent metadata will also be essential. Ultimately, central banks and statistical offices will need to promote sound stewardship to preserve the relevance of, and trust in, external statistics.

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IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Introductory remarks[1]

Pablo Hernández de Cos,
Governor, Bank of Spain

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

BANCO DE ESPAÑA
Eurosistema

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Fit-for-purpose external statistics in a changing global landscape

Opening Remarks at the Conference "External statistics after the pandemic: addressing novel analytical challenges"/ Irving Fisher Committee on Central Bank Statistics of the Bank for International Settlements, European Central Bank and Banco de España

Madrid

Pablo Hernández de Cos
Governor

Good morning,

It is a great pleasure for me to welcome you to the second Conference on External Statistics, organised by the Irving Fisher Committee on Central Bank Statistics of the Bank for International Settlements, the European Central Bank and the Banco de España. This conference aims to promote the interaction between compilers and users of these crucial statistics.

Let me first thank you all for showing such a great interest in the conference. A large number of contributions have been received from statisticians, analysts and researchers, which I believe will provide an excellent basis for discussing and exchanging ideas over the next two days.

I would also like to give special thanks to Philip Lane, who is sure to contribute some very inspiring ideas about the challenges of maximising the usefulness of external statistics for accurate analysis and sound policy making.

And I am also grateful to our colleagues from the Bank for International Settlements and the European Central Bank for choosing our institution to co-organise this second edition of the conference.

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Before turning to the subject of the conference, I would like to say I am particularly fond of the external sector and its statistics, as they remind me of a time when, as a young researcher, I immersed myself in them to better understand the external challenges facing the Spanish economy. External statistics are currently bringing very good news about the Spanish economy, but this has not always been the case.

In the past, with its integration into the European Union and the adoption of the euro, greater external openness allowed Spain to boost its economic growth and converge towards the most advanced economies in Europe, thanks to more active participation in global markets, the adoption of foreign innovations, the availability of external financing and increased competition in its economy.

However, the external sector also represented a significant macro-financial vulnerability for Spain when persistent external imbalances built up. This was the case during the expansionary phase experienced by the Spanish economy from the late 1990s until the Great Financial Crisis, a period marked by significant competitiveness losses vis-à-vis Spain's main trading partners. The accumulation of these imbalances was fuelled by a context in which growth expectations – based on domestic demand – turned out to be very optimistic and by the availability of abundant financing from abroad on very favourable terms.

During this phase current account deficits rose very significantly, to 9.4% of GDP in 2007, contributing to a substantial increase in Spain's negative net international investment position (IIP) (to 97.6% of GDP in 2009). At the time Spain had one of the largest external imbalances among the advanced economies.

Indeed, the high dependence on external financing dramatically increased the impact on our economy of the Global Financial Crisis and the tensions in the euro area. In an initial phase, the financial crisis led to high capital outflows, following an abrupt correction of Spain's growth prospects. As in other highly-indebted peripheral euro area economies, Spain's large external debt proved to be a major source of macroeconomic vulnerability, particularly during periods of financial turbulence or changes in investor sentiment.

But the picture has changed radically over the last decade. Following the Great Financial Crisis, the external sector has made a huge contribution to the recovery of the Spanish economy. This has been achieved through a very significant adjustment underpinned by a series of structural reforms that led to an internal devaluation process, reversing the competitiveness losses accumulated in the past. In terms of relative unit labour costs (ULCs), these losses amounted to almost 20% from the introduction of the monetary union until 2008, but were virtually corrected by 2015 thanks to the competitive adjustment process undergone by the Spanish economy. These sustained gains over time were made possible by the relative wage moderation, while the improvement in relative labour productivity occurred mainly during the large-scale job destruction experienced during the recession.

The improved competitiveness of the Spanish economy boosted export growth, leading to gains in global real market shares, which, during the recovery from the economic crisis, performed better than in our main euro area trading partners. Thus, Spain's market share grew by around 2% between 2010 and 2019, in contrast to the declines seen in France and Italy and the stability in Germany.

This has allowed us to maintain sustained current account surpluses for the first time in our recent economic history. And they have even survived the COVID-19 pandemic, the energy crisis caused by the Russian invasion of Ukraine and the tightening of interest rates. In 2023, there was a current account surplus – of around 2.5% of GDP, a higher percentage than in 2019 (the year before the health crisis) – for the twelfth consecutive year.

The resilience of the current account to the shocks of recent years has been underpinned by the recovery of tourist flows as the COVID-19 pandemic subsided and by the strong dynamism of non-tourist service exports. These developments prompted a significant correction of Spain's negative net IIP, which fell by 40 percentage points (pp) of GDP from 2009, to stand at 53.6% of GDP in the third quarter of 2023.

The adjustment was concentrated in the private sector, whose negative net IIP fell by 70.7 pp of GDP between 2009 and 2023, to 5.8%, mainly as a result of the correction of the private financial sector's debtor position.

This sector had accumulated a high level of external indebtedness in the form of debt securities during the expansionary stage prior to the financial crisis. Conversely, the debtor external balance of general government is now higher than in 2009 (up by 12.5 pp of GDP to 38.2%), in line with public debt developments.

Despite this adjustment, Spain's negative net IIP remains comparatively high, so external surpluses will continue to be needed to reduce this potential source of vulnerability. This objective requires, in particular, the consolidation of a path of structural correction of public finances, with a view to reducing the high level of public debt accumulated in recent years,

since, as I have already mentioned, the process of external deleveraging of the Spanish economy has been concentrated in the private sector, while the public sector's debtor position has increased. At the same time, export growth in the medium term could be jeopardised if the deterioration in ULCs relative to our main euro area partners observed since the pandemic continues over time. Sustained external surpluses ultimately depend on real productivity gains that allow for wage growth without undermining firms' competitiveness. To mitigate these risks, we need to adopt a set of structural policies aimed at boosting productivity by improving productive capital, labour force skills and market efficiency, removing obstacles to business growth.

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In a more general context, it is clear that openness has enabled the global economy to experience sustained and widespread growth over the past few decades, but this has also led to the accumulation of certain vulnerabilities.

Recent extraordinary shocks, the COVID pandemic and the war in Ukraine have significantly disrupted global value chains and commodity markets and have created an environment of heightened uncertainty and geopolitical tensions.

These new developments have emerged in the last few years, but before that we had already seen trade tensions between the United States and China. And, unfortunately, in recent weeks we have added to the list the war in the Middle East and the still unknown consequences of the Red Sea crisis.

These shocks have clearly raised new questions about the future of globalisation and the growing importance of geopolitical factors in economic relationships.

In this sense, although globalisation of the good trade was already slowing before the pandemic, concerns about the resilience of global value chains and the security of the supply of strategic products are now becoming more apparent.

This is particularly relevant for countries as open as the European Union, which is probably the most open region in the world. In 2019 the share of foreign trade in the EU's GDP reached 54% after increasing significantly, a percentage that is double the figure for the United States (26%). Let me give you another figure: the share of global value chain participation in trade is around 20 pp higher in the European Union than in the United States.

The same conclusion can be reached if you look at financial figures, such as the stock of gross external assets and liabilities relative to GDP, which is again higher for the European Union than for the United States.

We are more open and, therefore, more dependent, so we have to be particularly concerned about the potential risks that could arise from changing patterns in globalisation if these changes do not take place in an orderly manner.

In the global context, beyond the European Union, these concerns are driving decisions made by firms and governments alike. Governments are increasingly concerned that, in this new scenario, trade and financial openness could create excessive dependencies on third countries. Accordingly, they are trying to respond to this new environment and have moved

geopolitical considerations higher up in their agendas with policies seeking, precisely, to limit external vulnerabilities.

In this new globalisation context, governments and firms could be moving towards a scenario where they favour diversification over dependence, security over efficiency, or regionalisation over globalisation.

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Against this background, external statistics, which have traditionally been crucial to monitor the health of open economies, are again becoming increasingly important, as they are key to supporting more informed decisions by policymakers to pursue the most efficient strategies.

I am afraid that the statistical community is once again under strong pressure to keep statistics fit for purpose. You will need to make a tremendous effort to keep up with these developments and find solutions to the growing demand for information.

This brings me back to the objective of the conference: discussing how to deal with new analytical challenges in order to keep external statistics fit for multiple needs. With this aim in mind, key conceptual and practical issues relating to international accounts will be explored over the next two days.

Two coordinated global initiatives illustrate the relevance of the issues on the agenda: the revision of the International Monetary Fund's Balance of Payments and International Investment Position Manual (coordinated with that of the UN System of National Accounts) and the G-20 Data Gaps Initiative 3.

The issues addressed by these two initiatives are manifold. The fragmentation of multinational enterprises' (MNEs) production processes across the globe and its impact on the exchange of intellectual property products, the expansion of digital trade and the greater complexity of financial flows are just a few of the challenges that complicate the work of statistical authorities around the world.

It is becoming increasingly difficult to disentangle who the ultimate investors are, as they are lost in a long string of transactions around the globe. This can have serious implications for analysing financial stability in our economies. We might be more vulnerable and more exposed to certain economies and to certain instruments than we might at first think.

Providing more insight into non-bank financial intermediation, climate change or the informal economy are also novel challenges for external statistics producers, but the list goes on.

There are a number of interrelated issues involved, all of which require analysts to manage and receive more information from external statistics compilers, as well as more complex quality assurance processes.

It seems that prioritisation will be a central issue in the practical implementation of the new editions of the statistical standards. And for this prioritisation, I believe meetings between users and compilers, such as this conference, are essential.

But prioritisation is not enough. In order to provide more timely and granular information to analysts and policy-makers while keeping the burden on compilers and reporters reasonable, further modernisation and efficiency gains are essential.

To gain efficiency, better use must be made of existing information. Access to private sector and administrative data and data sharing mechanisms between statistical agencies, both at national and international, level are key.

In this regard, tax records, social security data, credit card data or mobile phone data have proved to be very useful in complementing surveys and other traditional data sources during the COVID pandemic.

These tools bring to the discussion new partnerships for the production of statistics (private-public or public-public) and call for strengthened collaboration between national statistical offices and central banks.

Confidentiality barriers should be knocked down by revising related regulations and making use of the best technological solutions. Promoting the extensive use of the Legal Entity Identifier (LEI) is also an important objective that would facilitate the identification of counterparties and thus data-sharing at the international level.

Efficiency and data-sharing leads me to the important measures that we must forge ahead with to make granular information available to researchers through data laboratories and thus multiply the usefulness of the enormous amount of information that we handle.

In this regard, national central banks and other authorities need to coordinate to make microdata from complementary sources available to researchers. Let me provide an example. I consider it of the utmost importance that the analysis of trade flows in goods and services – based on data that are largely in the hands of statistical institutes and tax authorities – be combined with that of the financial variables closely monitored by central banks and, particularly, with data on foreign direct investment. These are complementary areas whose analytical potential would be multiplied enormously if trade and finance data could be made available at the microdata level.

Another aspect of data-sharing relates to the idea of collecting the information only once and consistently. We are trying to move in this direction as regards reporting by credit institutions with the Integrated Reporting Framework (the so-called IReF), which will harmonise, standardise and integrate existing ESCB requirements for collecting statistical information from banks across statistical domains and countries.

Likewise, one might ask whether a similar approach could be used for multinational enterprises. Indeed, MNEs need to report a large amount of information in different regions, in compliance with different reporting regulations. Any effort to standardise such reporting would surely imply a lower burden on these enterprises and result in more consistent and better quality information for the authorities and, ultimately, sounder assessment and policy analysis.

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All in all, high-quality and timely external statistics that also minimise the burden on reporting institutions are essential. I hope you will be able to rise to the many challenges that lie ahead and ensure that these data are fit for the high purposes for which they are needed. I wish you a pleasant stay in Madrid and a very fruitful conference.

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Euro area international financial flows: analytical insights and measurement challenges[1]

Philip R Lane,
Member of the Executive Board of the European Central Bank

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

SPEECH

Euro area international financial flows: analytical insights and measurement challenges

Keynote speech by Philip R. Lane, Member of the Executive Board of the ECB, at the joint Banco de España, Irving Fisher Committee on Central Bank Statistics and European Central Bank conference "External statistics after the pandemic: addressing novel analytical challenges" in Madrid

Madrid, 12 February 2024

Introduction

It is my great pleasure to speak at this second edition of the conference on external statistics, jointly organised by the Banco de España, the Irving Fisher Committee and the European Central Bank, after having contributed already to the first edition of this conference in Lisbon in February 2020, just before the onset of the pandemic.[1] As a long-standing user of external statistics, both in academia and as a central banker, I am very pleased to see that since the last conference the richness and availability of external statistics – in particular for the euro area – has been further enhanced. This is of particularly high value for the analysis we do regularly at the ECB, as I will show today. At the same time, there are still significant measurement shortfalls in external statistics and many analytical hurdles to overcome, including specific challenges for the euro area.

Today I will focus on the analysis of euro area financial flows, in the current context of the monetary policy tightening cycle and elevated geopolitical tensions. In addition, I will outline some areas where I see potential for further enhancing the statistical information available for such analysis and for improving the underlying statistical infrastructure.

The euro area is highly financially integrated, both internally and externally: an accurate measurement of financial linkages is key for our understanding of euro area exposures to external shocks and the international transmission of the ECB's policies. The analysis of euro area cross-border financial linkages has become increasingly complex in recent years, in particular owing to the expansion of international financial intermediation chains, which often involve non-bank entities located in international financial centres, including in some euro area countries.[2] At the same time, the ECB – together with the euro area national central banks – has developed new breakdowns of the euro area balance of payments and international investment position (b.o.p./i.i.p.) statistics that facilitate an enhanced, albeit still imperfect, analysis of risk exposures and interconnectedness.[3]

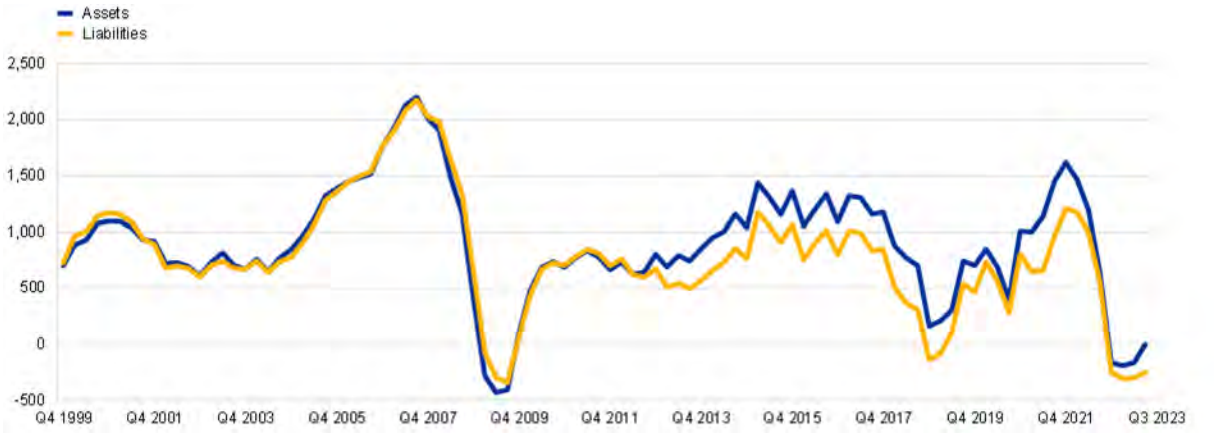
Euro area financial flows at the current juncture

Euro area international financial flows sharply reversed in 2022 – from a multi-year peak observed in 2021 – into the largest retrenchment since the global financial crisis (Chart 1).[4] The retrenchment affected both foreign assets and foreign liabilities, in line with their strong co-movement observed over the past decades. More recently, in 2023, euro area financial flows started to pick up again.

Chart 1

Euro area financial account

(four-quarter moving sums, EUR billions)



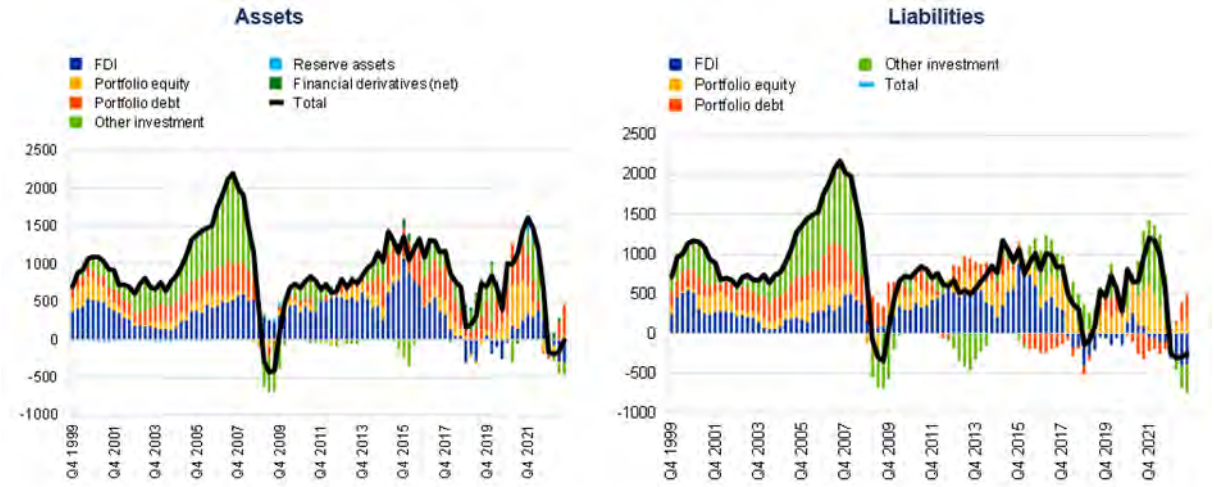
Source: ECB.
Notes: A positive (negative) number indicates cross-border net purchases (sales). Net financial derivatives are reported under assets. The latest observation is for the third quarter of 2023.

The swings in euro area international financial flows over the past few years were to a great extent driven by foreign portfolio investment and foreign direct investment (Chart 2).[5] Accordingly, I will focus my remarks on these two components of the financial account that – due to the intricacies of euro area financial intermediation – require a particularly careful analysis. To this end, I will use the available detailed official statistics, but also draw on insights from research studies.

Chart 2

Euro area financial account

(four-quarter moving sums, EUR billions)



Source: ECB.
Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. For liabilities, a positive (negative) number indicates net purchases (sales) of euro area instruments by non-euro area investors. The latest observation is for the third quarter of 2023.

Euro area portfolio investment flows – the sectoral dimension

I start by examining detailed information at the euro area (resident) sectoral level to better understand the factors driving aggregate foreign portfolio investment flows. Focusing on the non-bank financial intermediaries sector provides valuable insights.

At a structural level, the sectoral breakdown reveals the predominance of the investment funds sector (including money market funds) as holders of portfolio investment securities issued by non-euro area residents. It accounts for 64% of total equity and debt holdings in the third quarter of 2023. It follows that an analysis of the cross-border investment patterns by investment funds is crucial, not only for assessing the exposures of the investment fund sector, but also for understanding those of the underlying investors. Insurance companies, pension funds and households are significant holders of euro area investment fund shares, while foreign investors residing outside the euro area are also major investors in euro area funds.[6] Recent research shows that euro area investment funds are a source of portfolio diversification for the underlying euro area investors, in particular towards extra-euro area assets.[7] For foreign investors, euro area investment funds not only provide exposure to euro area assets but also constitute intermediation vehicles for global portfolio investment.

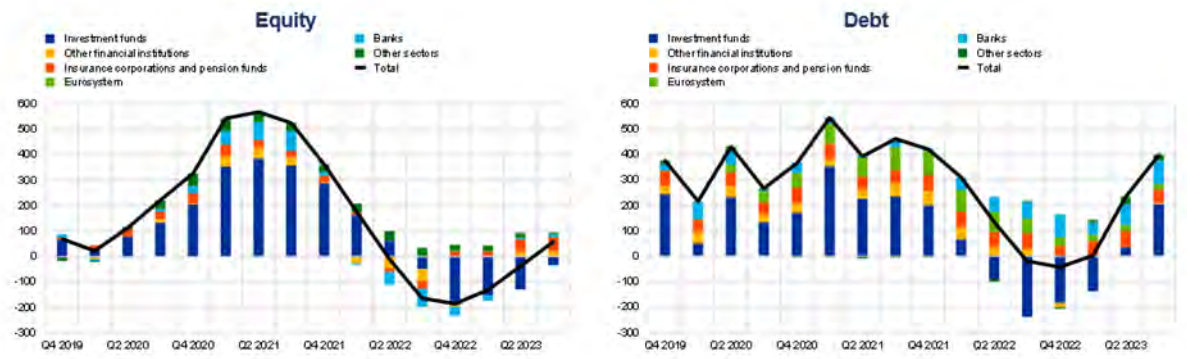
Investment funds account for a significant proportion of the fluctuations in international portfolio investment flows (Chart 3). This is consistent with a procyclical demand for investment fund shares, with the underlying investors strongly affected by shifts in global sentiment. This helps to explain the 2022 retrenchment, given the low risk appetite prevailing in global financial markets following the

Russian invasion of Ukraine. The data also confirm that insurance corporations and pension funds tend to be more stable investors, at least in relation to their direct holdings.[8]

Chart 3

Euro area portfolio investment assets by resident sector

(transactions; four-quarter moving sums, EUR billions)



Source: ECB.

Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. Investment funds include money market funds. Other sectors include governments, non-financial corporations, and households and non-profit institutions serving households. The latest observation is for the third quarter of 2023.

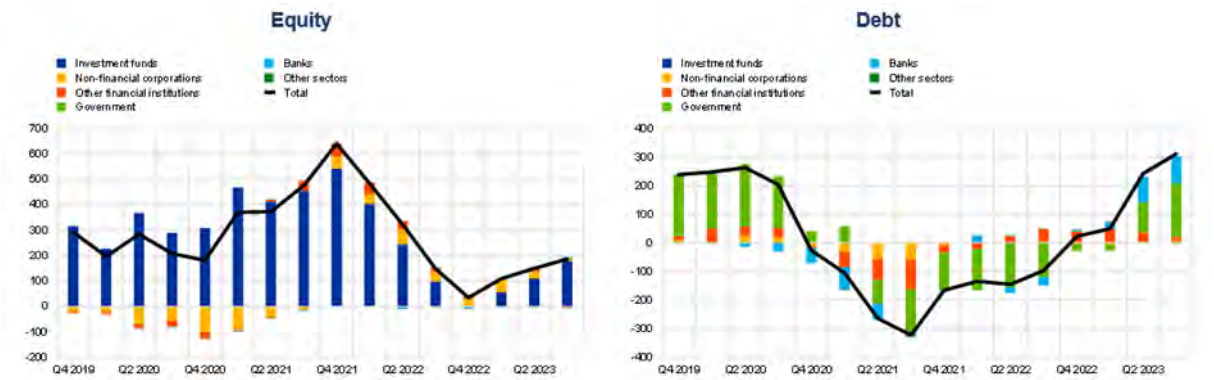
While a structural analysis of the drivers of euro area portfolio flows is beyond the scope of today's remarks, I would like to highlight that – apart from the geopolitical factors weighing on investor sentiment – the monetary policy tightening of the ECB may also have contributed to the retrenchment in portfolio flows. In fact, the shifts in investment patterns observed in 2022 marked an end to a protracted phase of large-scale portfolio rebalancing towards extra-euro area securities, which had started in 2014 when the ECB introduced negative interest rates and launched its asset purchase programmes.[9] More recently, the net purchases of foreign securities by euro area investors rebounded amid the global shift in the interest rate environment, with higher interest rates especially prompting a step-up in international bond purchases.

On the liability side of euro area portfolio investment, investment funds played a similarly large role in the drying-up of foreign net purchases of euro area equities in 2022. The combination of the sizeable euro area investment fund industry and the strong extra-euro area investor base – especially for those funds based in Ireland and Luxembourg – amplifies euro area financial flows, particularly during times of sharp shifts in risk sentiment (Chart 4). At the same time, since the amplification in part reflects the pass-through holdings of external investors in external assets, the impact on euro area financial dynamics is overstated by focusing on un-adjusted measures.[10]

Chart 4

Euro area portfolio investment liabilities by resident sector

(transactions; four-quarter moving sums, EUR billions)



Source: ECB.

Notes: For liabilities, a positive (negative) number indicates net purchases (sales) of euro area instruments by non-euro area investors. Investment funds include money market funds. Other sectors include the Eurosystem, households and non-profit institutions serving households, insurance corporations and pension funds. The latest observation is for the third quarter of 2023.

Higher euro area interest rates and the ending of net asset purchases by the Eurosystem have visibly boosted the appetite of foreign investors for euro area debt securities since 2022 (Chart 4). This is a reversal of the pattern during the years 2014-2019 when foreign investors were large net sellers of euro area debt securities, especially sovereign bonds. That is, monetary policy clearly plays a significant role in determining net foreign debt inflows, via both the level of interest rates and balance sheet policies. In an environment of rising interest rates, foreign investors have turned into net buyers of euro area debt securities, especially sovereign bonds and bank bonds.

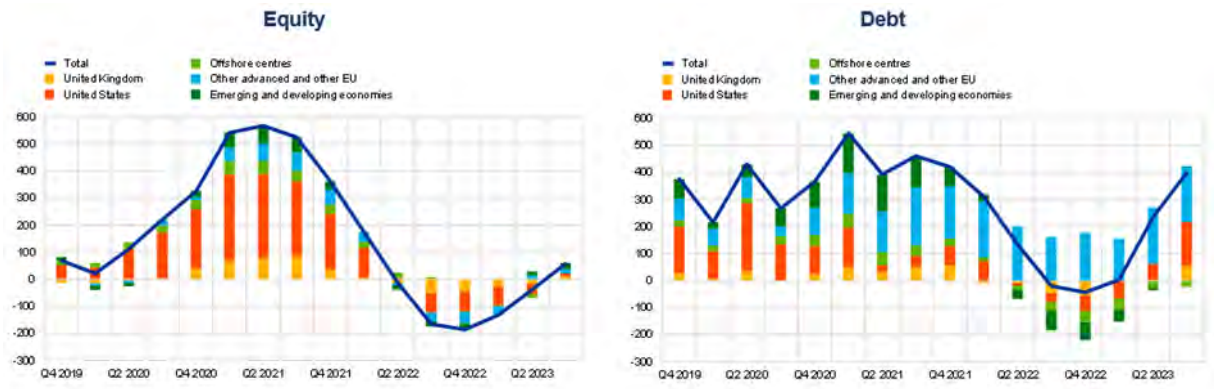
Euro area portfolio investment flows – the geographic dimension

The new counterpart breakdowns available in the euro area b.o.p./i.i.p. allow for a better coverage of the geography of international financial flows, vis-à-vis both advanced economies and emerging market economies.[11] These data reveal that in 2022 euro area investors reduced their exposures to equity securities in a broad-based fashion across geographic counterparts (Chart 5).[12] The retrenchment was particularly pronounced vis-à-vis the United States and the United Kingdom.

Chart 5

Euro area portfolio investment assets by counterpart location

(transactions; four-quarter moving sums, EUR billions)



Source: ECB.

Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. “Other advanced and other EU” include Australia, Canada, Japan, Norway, South Korea and Switzerland as well as the non-euro area EU Member States and those EU institutions and bodies that are considered for statistical purposes as being outside the euro area, such as the European Commission and the European Investment Bank. “Emerging and developing economies” include all countries and country groups not shown in the chart, as well as unallocated transactions. The latest observation is for the third quarter of 2023.

For debt securities, the picture is more nuanced: during the retrenchment in 2022, euro area investors on balance sold a significant amount of securities issued by US and UK residents, while net purchases continued vis-à-vis other advanced economies and the non-euro area EU (Chart 5). The strong net sales of debt issued by emerging market economies and offshore financial centres were particularly striking, especially given their relatively small weight in the euro area portfolio. Among emerging market economies, these net sales were driven by disinvestments of securities issued in China, Mexico and Russia.[13] While euro area net purchases of debt securities recovered strongly vis-à-vis most regions in 2023, the sentiment towards emerging economies and offshore financial centres remained muted.

While at first sight emerging economies and offshore financial centres may appear as rather unrelated investment destinations, these are in fact closely linked, since the debt securities issued in offshore financial centres are to a significant extent issued by subsidiaries of corporations based in emerging markets, particularly in China. Recent research, as presented in the first session today, finds that euro area and US investment in emerging market corporate bonds is substantially larger when investment in issuance by offshore subsidiaries of emerging market corporations is taken into account.[14] For the euro area, estimates show that the “nationality-based” holdings of corporate debt securities of the BRICS countries are around six times higher.[15] This example highlights the difficulty in tracing ultimate exposures across the financial intermediation chains. At the same time, it shows how ambitious research involving the careful merging of various datasets may provide complementary information to the public, which could lay the ground for future enhancements to official statistics.

While information on the geography of euro area portfolio investment assets has become increasingly rich, it is notoriously difficult to obtain a full grasp of the foreign holders of euro area securities.[16] This relates to the phenomenon of globally missing assets, as the portfolio investment liabilities that are reported globally consistently exceed reported assets.[17] This gap, in turn, can be linked to a significant degree to equity securities issued in the United States, Ireland and Luxembourg.[18] There is a range of conjectures on the origins of the globally missing assets. A primary explanation relates to the non-reporting of assets held in custody abroad (so-called third party holdings), in particular by investors with no statistical reporting obligation such as households or non-financial corporations.[19] Within the euro area, such third-party holdings are already reported by custodians as part of the securities holdings statistics, which increases the coverage of intra-euro area portfolio investment holdings. However, security holdings that are held in custody outside the euro area can at best be estimated.[20] In closing this significant data gap, I see room for international initiatives to promote a comprehensive and granular reporting of third-party holdings (for instance in the context of the IMF's Coordinated Portfolio Investment Survey) by those countries with a strong custody industry.[21]

Euro area foreign direct investment flows

Taking a longer-term perspective, euro area foreign direct investment (FDI) flows were remarkably stable for decades, even during crisis times, before entering a phase of exceptionally large, positive flows from about 2015 (as shown in Chart 2). This was followed by a period of high volatility and – more recently – a strong retrenchment phase.[22]

As I have noted on previous occasions, the developments in FDI over the past decade have been very much driven by euro area financial centres due to the presence of multinational enterprises (MNEs) in these economies.[23] MNEs tend to have complex organisational structures which frequently involve numerous legal entities, including special-purpose entities (SPEs), across various countries.[24]

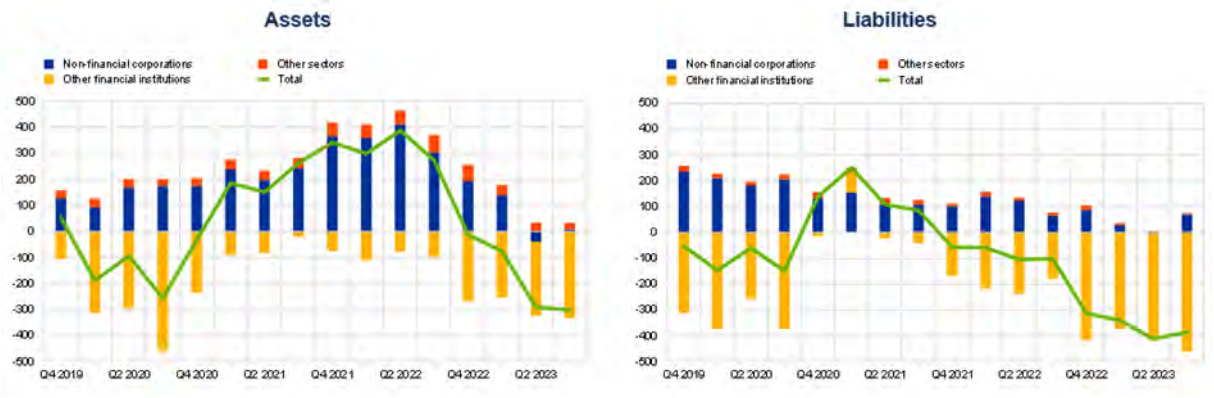
While the interpretation of euro area headline FDI figures has not become easier over the years, more detailed sectoral and geographic breakdowns facilitate the analysis of FDI. Moreover, our understanding of euro area FDI is set to improve further in the near future, with the publication of a separate breakdown for SPEs in euro area b.o.p./i.i.p. statistics.

Taking a sectoral view of the retrenchment observed in euro area FDI since 2022 reveals the important role of the other financial institutions (OFI) category, which also includes SPEs and holding companies (Chart 6).[25] The strong positive correlation between gross FDI asset and liability transactions related to OFIs suggests that these "financialised" flows often "pass through" the euro area without being absorbed in the domestic economy. Preliminary data suggest that SPEs represent around 30 per cent of euro area FDI asset and liability positions and 55 per cent of FDI assets and liability positions in the OFI sector. More insights on the role of SPEs in euro area cross-border statistics will become available with the publication of the b.o.p./i.i.p. dataset for SPEs this spring.

Chart 6

Euro area foreign direct investment by resident sector

(transactions; four-quarter moving sums, EUR billions)



Source: ECB.

Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. For liabilities, a positive (negative) number indicates net purchases (sales) of euro area instruments by non-euro area investors. “Other sectors” include all institutional sectors not shown in the chart. The latest observation is for the third quarter of 2023.

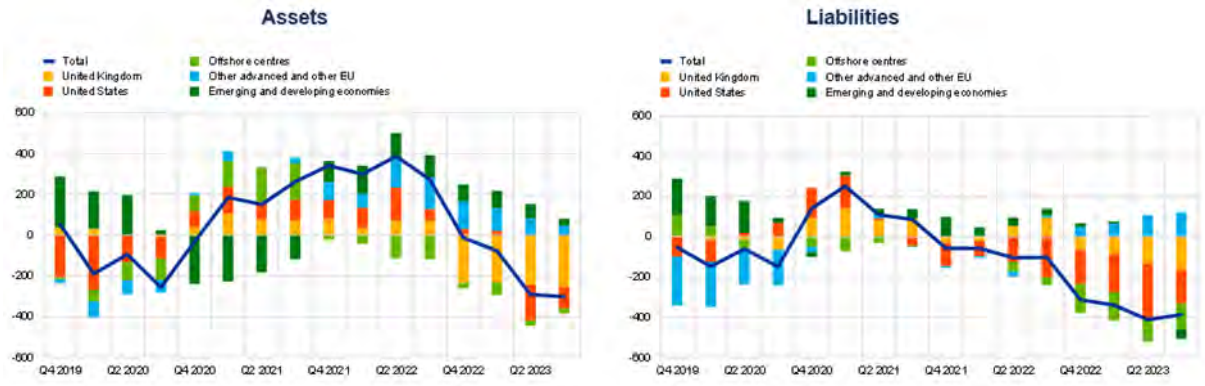
In contrast to OFI-related FDI flows, the FDI flows of the non-financial corporate sector are mainly driven by the euro area countries outside the group of financial centres and hence tend to be more closely related to developments in the real economy. Accordingly, while there was no large-scale retrenchment, the recent slowdown in this sector’s FDI transactions appears to be consistent with lower global and euro area growth momentum and might also provide tentative signs of companies pulling back from overseas direct investment amid heightened geopolitical risks.[26]

The geographic breakdown of FDI flows brings additional insights (Chart 7). The recent retrenchment occurred vis-à-vis counterparts in the United States, United Kingdom and in offshore financial centres, which suggests a close relation to MNE operations, particularly in combination with the sectoral evidence presented before. Having said this, euro area FDI asset flows to other destinations have proven to be more resilient in recent years, albeit on a much smaller scale.

Chart 7

Euro area foreign direct investment by counterpart location

(transactions; four-quarter moving sums, EUR billions)



Source: ECB.

Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. For liabilities, a positive (negative) number indicates net purchases (sales) of euro area instruments by non-euro area investors. “Other advanced and other EU” include Australia, Canada, Japan, Norway, South Korea and Switzerland as well as the non-euro area EU Member States and those EU institutions and bodies that are considered for statistical purposes as being outside the euro area, such as the European Commission and the European Investment Bank. “Emerging and developing economies” include all countries and country groups not shown in the chart, as well as unallocated transactions. The latest observation is for the third quarter of 2023.

Similarly to portfolio investment, even these more detailed FDI data remain insufficient to fully look through the often complex cross-border chains to identify the ultimate investor countries and ultimate host economies involved in FDI relationships. This is a notoriously difficult task, not only due to the complex ownership structures of MNEs, but also because it requires very comprehensive information. Sharing data among national statisticians across borders could be helpful – something I will return to later in my remarks. Nonetheless, some research-based advancements in identifying the ultimate countries involved in an FDI relationship (also to be presented at this conference) provide useful insights.[27] Data on inward FDI on an ultimate basis reveal, for example, a much larger role of the United States as an investor in the EU compared to the official (immediate counterparty basis) data.[28]

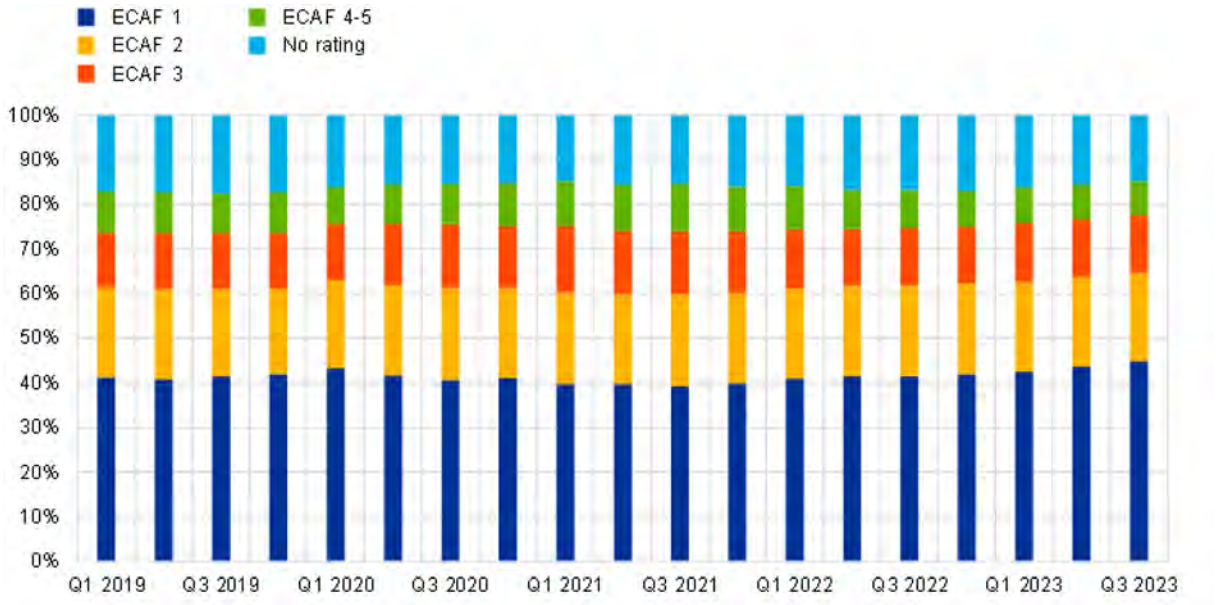
Potential enhancements to data and statistical infrastructure

Combining b.o.p./i.i.p. statistics with security-level data such as the European System of Central Banks’ (ESCB) Securities Holdings Statistics allows for a granular analysis along various dimensions, such as currency, issuing entity and security characteristics, including the rating.[29] For the latter, experimental ECB data on euro area portfolio investment assets show an increase in the share of high-rated debt securities since 2021, in line with a preference for safer assets during times of elevated risk aversion (Chart 8).[30]

Chart 8

Euro area portfolio investment debt asset position by rating category

(percentage shares of outstanding amounts)



Source: ECB.

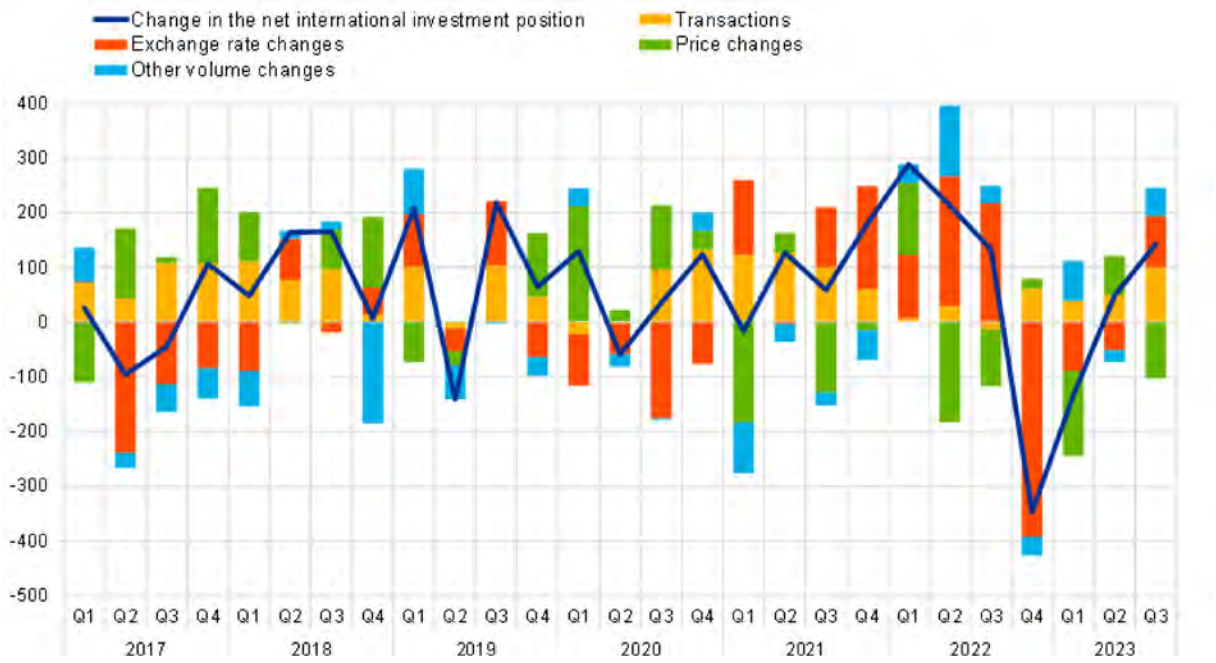
Notes: Experimental data following Rodríguez Caloca, A., Radke, T. and Schmitz, M. (2021). The ratings categories are drawn from the Eurosystem Credit Assessment Framework (ECAF). The ECAF provides a harmonised rating scale of five credit quality steps. The first step includes securities rated from AAA to AA-, the second from A+ to A-, the third from BBB+ to BBB-. In addition, the fourth category includes all rated securities with a rating below credit quality step three and the fifth category reflects those securities without a rating. The latest observation is for the third quarter of 2023.

In addition, and this also stressed in the ongoing update of the balance of payment manual, it is very useful to have a fully integrated view of the international investment position, showing how the transmission of financial shocks propagates through the valuation channel arising from exchange rates and other asset price movements to an economy's external balance sheet.[31] Unlike when I started doing research on this topic, nowadays such data are readily available in the official statistics of many economies, including for the euro area, with a considerable degree of detail, and show, for example, the importance of exchange rate-induced valuation effects (Chart 9).

Chart 9

Changes in the net international investment position of the euro area

(outstanding amounts; EUR billions)



Source: ECB.

Note: The latest observation is for the third quarter of 2023.

To enhance the analysis of globalisation-related phenomena, and in particular to isolate the impact of MNEs, I support the plans of the ESCB to establish new data on foreign-controlled non-financial corporations in the balance of payments and the financial sector accounts. It would also be essential for such data to be available for the non-financial accounts, in order to observe the impact of MNEs on production and capital formation patterns. In this context, I would like to stress once more that it is analytically very useful to have fully consistent data on external accounts and domestic sectoral accounts, as is the case for the euro area datasets on b.o.p. and quarterly sector accounts. This supports the analysis of interconnectedness and helps to identify domestic sector imbalances that ultimately drive external imbalances.[32]

More generally, in terms of statistical infrastructure, I would like to highlight again that further efforts are needed to improve the analytical value of macroeconomics statistics. In my view, to keep official statistics fit for policy analysis, these need to enable a fast response to crises and keep pace with the rapidly evolving global activities of MNEs and financial intermediaries. For example, I am very much in favour of the development and use of experimental statistics to boost statistical agility. In this context, the pandemic has shown the usefulness of “non-standard” higher-frequency data sources, for instance to enhance our understanding of labour market dynamics.

Another improvement that is worth considering is facilitating the safe exchange of confidential statistical information for well-justified statistical purposes across borders, especially within the

ESCB/European Statistical System (ESS). This can be achieved by a sound and supportive legal basis, coupled with robust and safe information technology systems supporting the exchange of data. This would minimise the risks of unlawful disclosures, while maximising the benefits of synergies through collaboration between statistical authorities.[33]

As I have advocated before, there is a strong case for exploring avenues to collect data on internationally active, large MNEs in a centralised way, at the EU rather than national level. This could eliminate information gaps and overlaps across countries and ensure a more timely, complete and consistent cross-country recording of the activities of MNEs. A coordinated approach across the EU could be a win-win situation, as it would reduce the statistical reporting burden of MNEs by removing the need to complete questionnaires from 27 Member States in more than 20 languages. This streamlined process would not only benefit the MNEs themselves but also the statistical authorities responsible for collecting and analysing the data. It would improve timeliness, enhance the accuracy of reporting and ultimately contribute to a more efficient and effective system of data management. This is already being pursued by the ESCB in relation to the banking industry through standardising area-wide data reporting by banks.[34]

Conclusion

In my remarks today I have focused on euro area financial flows in the current context of the monetary policy tightening cycle and geopolitical tensions. I have stressed the usefulness of available data for the regular analysis we do at the ECB, but I have also highlighted the areas where measurement issues still hamper our full understanding of portfolio investment and foreign direct investment exposures.

I would like to highlight once more that further efforts are needed to improve the analytical value of external statistics and this can be achieved by enhancing the underlying statistical infrastructure.

As a long-standing user of external statistics, I very much look forward to the discussions at this conference and will closely follow future enhancements to the data on cross-border statistics.

1.

See Lane, P.R. (2020), "The analytical contribution of external statistics: addressing the challenges", keynote speech at the Joint European Central Bank, Irving Fisher Committee and Banco de Portugal conference on "Bridging measurement challenges and analytical needs of external statistics: evolution or revolution?", 17 February.

2.

See Lane, P.R. and Milesi-Ferretti, G.M. (2018), "The External Wealth of Nations Revisited: International Financial Integration in the Aftermath of the Global Financial Crisis," *IMF Economic Review*, Vol. 66, No 1, International Monetary Fund, pp. 189-222.

3.

The new data reported in accordance with the amended ECB External Statistics Guideline ECB/2018/19 include additional breakdowns by resident sector, counterpart country and foreign direct investment debt instruments. The new series is currently available for the euro area aggregates as of the first quarter of 2019 and data for earlier periods will be made available in the course of 2024. Additional information on the euro area balance of payments and international investment position statistics can be found on the ECB's website.

4.

See Emter, L., Schiavone, M. and Schmitz, M. (2023), "The great retrenchment in euro area external financial flows in 2022 – insights from more granular balance of payments statistics", *Economic Bulletin*, Issue 4, ECB.

5.

Transactions in the category "other investment" also reversed from high positive values in 2022 – in particular on the liability side – mainly owing to a decline in the deposits of non-euro area residents held with the Eurosystem.

6.

See Carvalho, D. (2022), "The portfolio holdings of euro area investors: Looking through investment funds," *Journal of International Money and Finance*, Vol. 120, pp. 102-519 and Beck, R., Coppola, A., Lewis, A., Maggiori, M., Schmitz, M. and Schreger, J. (2023), "The Geography of Capital Allocation in the Euro Area", *working paper* available at SSRN.

7.

See Carvalho, D. and Schmitz, M. (2023), "Shifts in the portfolio holdings of euro area investors in the midst of COVID-19: looking through investment funds", *Review of International Economics*. Vol. 31, Issue 5, pp. 1641-1687 and Beck, R., Coppola, A., Lewis, A., Maggiori, M., Schmitz, M. and Schreger, J. (2023), op. cit.

8.

See Timmer, Y. (2018), "Cyclical investment behaviour across financial institutions", *Journal of Financial Economics*, Vol. 129, No 2, pp. 268-286.

9.

The ECB's asset purchase programme was initiated in mid-2014, while its pandemic emergency purchase programme was launched in March 2020. Net asset purchases under both programmes were discontinued in 2022. See Cœuré, B. (2017), "The international dimension of the ECB's asset purchase programme", speech given at the Foreign Exchange Contact Group meeting, 11 July; Lane, P.R. (2019), "The international transmission of monetary policy", keynote speech at the CEPR International Macroeconomics and Finance Programme Meeting, 14 November; and Bergant, K.,

Fidora, M. and Schmitz, M. (2020), "International capital flows at the security level: evidence from the ECB's Asset Purchase Programme", *Working Paper Series*, No 2388, ECB, Frankfurt am Main.

10.

See Beck, R., Coppola, A., Lewis, A., Maggiori, M., Schmitz, M. and Schreger, J. (2023), op. cit.

11.

The list of counterpart countries now includes for instance all G-20 and EU countries outside the euro area. In particular, information became available for a number of additional advanced economies (Australia, Norway and South Korea) and emerging market economies (Argentina, Indonesia, Mexico, Saudi Arabia, South Africa and Türkiye).

12.

On the determinants of the geography of the equity holdings of euro area investors, see Lane, P.R. and Milesi-Ferretti, G.M. (2007), "The International Equity Holdings of Euro Area Investors," in *The External Dimension of the The Euro Area* (Di Mauro, F. and Anderton, R. eds), Cambridge University Press.

13.

For details on how euro area investment in Russia evolved following Russia's invasion of Ukraine, see Emter, L., Fidora, M., Pastoris, F. and Schmitz, M. (2022), "Euro area linkages with Russia: latest insights from the balance of payments", *Economic Bulletin*, Issue 7, ECB.

14.

See Bertaut, C. C., Bressler, B. and Curcuru, S. (2019), "Globalization and the Geography of Capital Flows," *FEDS Notes*, Washington: Board of Governors of the Federal Reserve System, Coppola, A., Maggiori, M., Neiman, B. and Schreger, J. (2021), "Redrawing the Map of Global Capital Flows: The Role of Cross-Border Financing and Tax Havens", *The Quarterly Journal of Economics*, Vol. 136(3), pp.1499-1556 and Beck, R., Coppola, A., Lewis, A., Maggiori, M., Schmitz, M. and Schreger, J. (2023), op. cit.

15.

The BRICS countries are Brazil, Russia, India, China and South Africa.

16.

The ECB provides estimates for euro area portfolio investment liability positions by counterparty. However, these are subject to uncertainty as securities are regularly traded in secondary markets and held via custodians and other financial intermediaries.

17.

See Milesi-Ferretti, G.M. (2023), "Many Creditors, One Large Debtor: Understanding The Buildup of Global Stock Imbalances after the Global Financial Crisis," *IMF Economic Review*.

18.

See Milesi-Ferretti, G.M. (2024), “Missing assets: Exploring the source of data gaps in global cross-border holdings of portfolio equity”, *mimeo*, Hutchins Center on Fiscal and Monetary Policy, The Brookings Institution, and Beck, R., Coppola, A., Lewis, A., Maggiori, M., Schmitz, M. and Schreger, J. (2023), op. cit.

19.

See Zucman, G. (2013), “The missing wealth of nations: Are Europe and the US net debtors or net creditors?”, *The Quarterly Journal of Economics*, 128(3), 1321-1364.

20.

See Bui Quang, P. and Gervais, E. (2019), “How to identify “hidden securities assets” in the Balance of Payments: methods of Bank of France”, *BIS IFC Bulletin,* No 49.

21.

See Diz Dias, J. et al. (2024), “Where are the hidden securities in external statistics?”, *mimeo*, ECB.

22.

Foreign direct investment-related flows were traditionally considered to be the least volatile category of international capital flows. See, for example, Eichengreen, B., Gupta, P. and Masetti, O. (2018), “Are Capital Flows Fickle? Increasingly? And Does the Answer Still Depend on Type?”, *Asian Economic Papers*, Vol. 17(1), pp. 22-41. However, in recent years the strong role of multinational enterprises has been accompanied by increased volatility, especially for small open economies. See, for example, Di Nino, V., Habib, M. and Schmitz, M. (2020), “Multinational enterprises, financial centres and their implications for external imbalances: a euro area perspective”, *Economic Bulletin*, Issue 2, ECB.

23.

Euro area financial centres commonly include Belgium, Cyprus, Ireland, Luxembourg, Malta and the Netherlands.

24.

SPEs located in euro area financial centres typically hold equities, manage debt issuance and allocate funding across parent and subsidiaries.

25.

See Emter, L., Schiavone, M. and Schmitz, M. (2023), op. cit.

26.

See Attinasi, M.G., Ioannou, D., Lebastard, L. and Morris, R. (2023), “Global production and supply chain risks: insights from a survey of leading companies”, *Economic Bulletin*, Issue 7, ECB.

27.

See Brew, K. et al. (2023), "Experimental Ultimate Host Economy Statistics for U.S. Direct Investment Abroad", *BEA Working Paper Series,* WP 2023-9; Figueira, C. (2023), "Where is the real impact of Foreign Direct Investment? – The case of the Portuguese outward foreign direct investment", *mimeo*, Banco de Portugal; and Gómez-Llabrés, C., Pastoris, F. and Schmitz, M. (2023), "Who stands behind European FDI investors? A novel characterisation of pass-through within the EU", *BIS IFC Bulletin,* No 58.

28.

See Eurostat (2023), *US remains top EU foreign ultimate investment partner*, 13 May.

29.

See Rodríguez Caloca, A., Radke, T. and Schmitz, M. (2021), "The more the merrier: enhancing traditional cross-border portfolio investment statistics using security-by-security information", *BIS IFC Bulletin,* No 55.

30.

Further developments of approaches combining micro and macro data, for example to measure euro area portfolio investment holdings of sustainable debt securities, will be very much welcome (see "Experimental indicators on sustainable finance" on the ECB's website). More broadly, the data needs in macroeconomic statistics to cover climate change and sustainable finance have become very apparent in recent years. These include, for instance, the recommendations of the third data gaps initiative regarding climate change and FDI statistics presenting the associated carbon footprints as well as physical and transition risks. Official statistics in this field are needed to assess the social and economic impact of climate change and monitor the financial vulnerabilities stemming from physical and transitional risks.

31.

See Lane, P.R. and Milesi-Ferretti, G.M. (2007), "A Global Perspective on External Positions", in Clarida, R. H. (ed.), *G7 Current Account Imbalances: Sustainability and Adjustment*, National Bureau of Economic Research, pp. 67-102.

32.

See Allen, C. (2019), "Revisiting External Imbalances: Insights from Sectoral Accounts", *Journal of International Money and Finance*, Vol. 96, pp. 67-101.

33.

See Committee on Monetary, Financial and Balance of Payments Statistics (2023), *Opinion on the Exchange of Confidential Statistical Information (ECI) on European Statistics for statistical purposes between the ESS and the ESCB*, 12 June.

34.

See “Making banks’ data reporting more efficient” on the ECB’s website.

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EUROPEAN CENTRAL BANK

EUROSYSTEM

Euro area cross-border financial flows: analytical insights and measurement challenges

Madrid, External Statistics conference



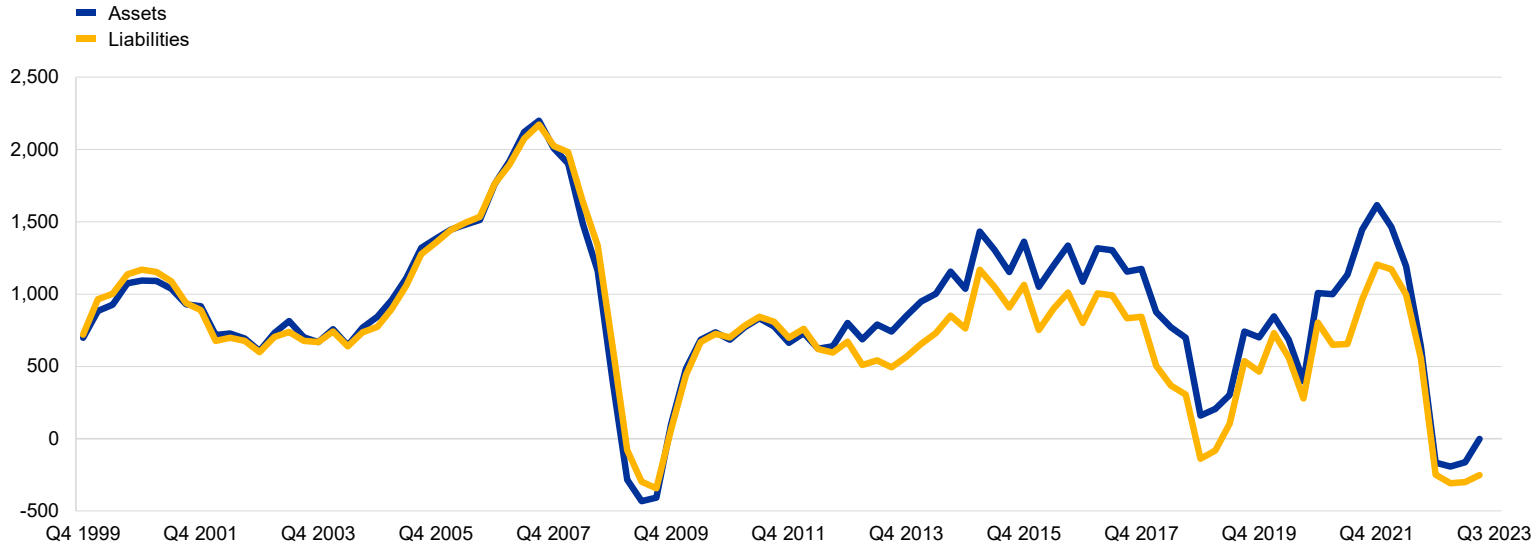
12 February 2024

Philip R. Lane
Member of the Executive Board

Sharp retrenchment in euro area financial flows, following multi-year peak

Euro area financial account

(four-quarter moving sums, EUR billions)



Source: ECB.
Notes: A positive (negative) number indicates cross-border net purchases (sales). Net financial derivatives are reported under assets. The latest observation is for the third quarter of 2023.

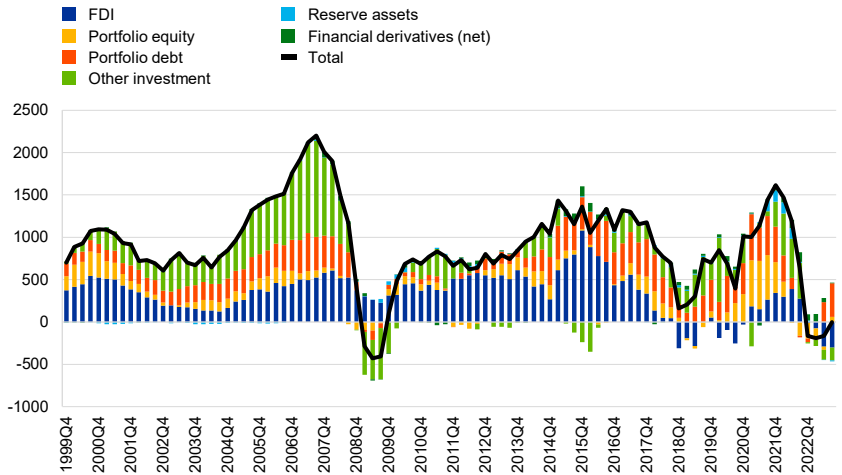
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Pronounced retrenchment in portfolio investment and FDI

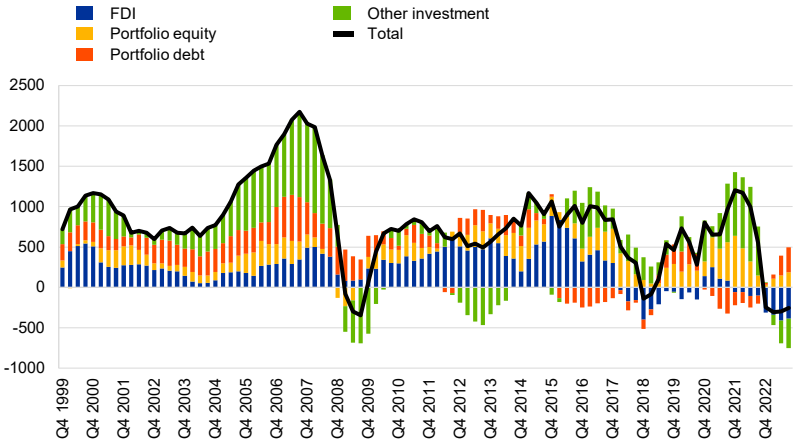
Euro area financial account

(four-quarter moving sums, EUR billions)

Assets



Liabilities



Source: ECB.

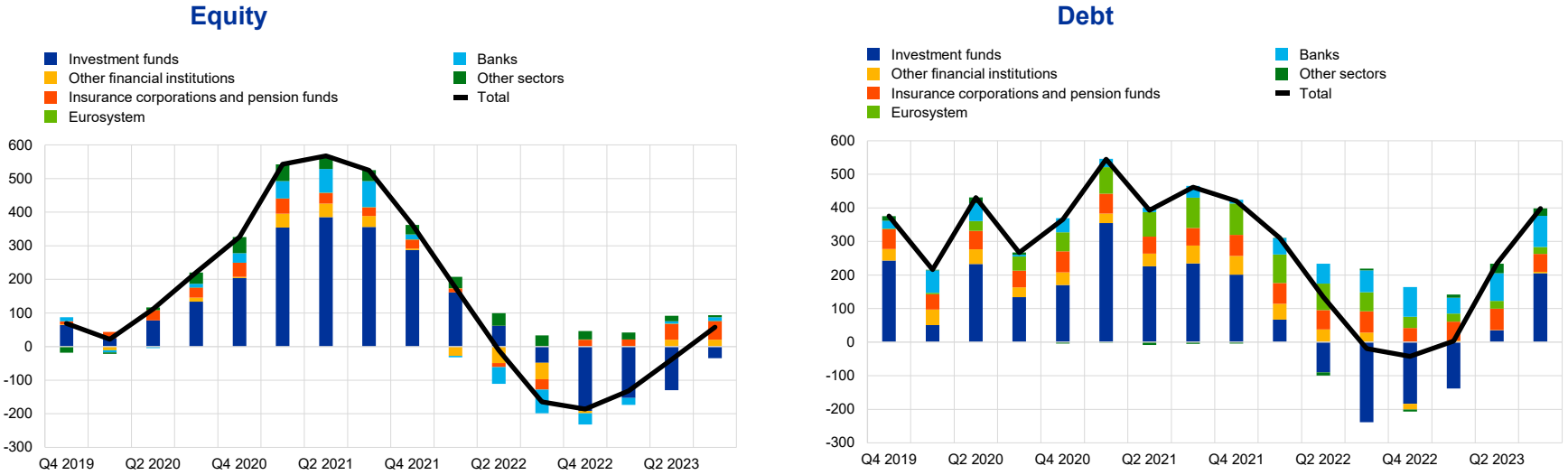
Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. For liabilities, a positive (negative) number indicates net purchases (sales) of euro area instruments by non-euro area investors. The latest observation is for the third quarter of 2023.

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Important role of investment funds in driving euro area portfolio flows

Euro area portfolio investment assets by resident sector

(transactions; four-quarter moving sums, EUR billions)



Source: ECB.

Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. Investment funds include money market funds. Other sectors include governments, non-financial corporations and households and non-profit institutions serving households. The latest observation is for the third quarter of 2023.

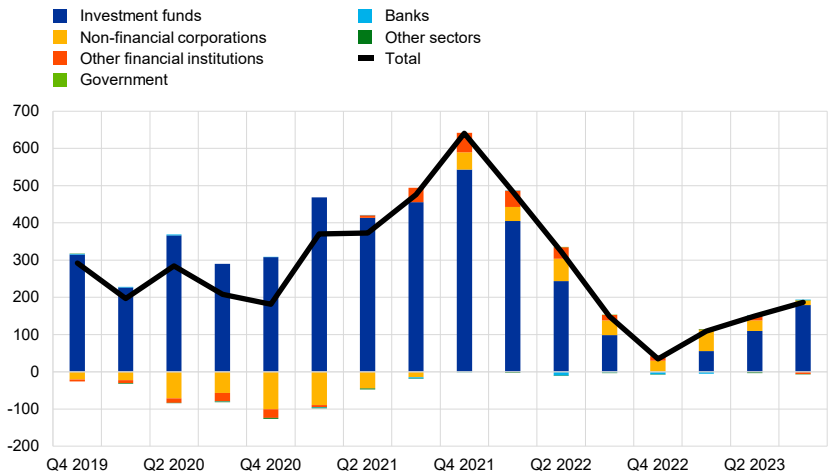
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Foreign investors' appetite in euro area securities picked-up recently

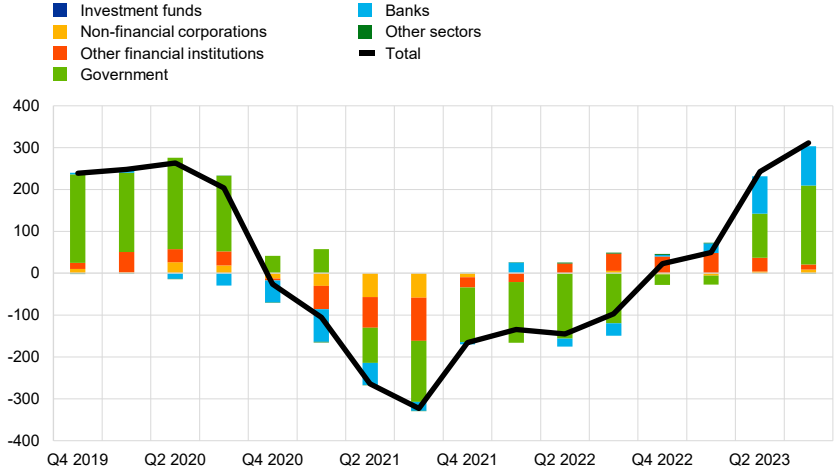
Euro area portfolio investment liabilities by resident sector

(transactions; four-quarter moving sums, EUR billions)

Equity



Debt



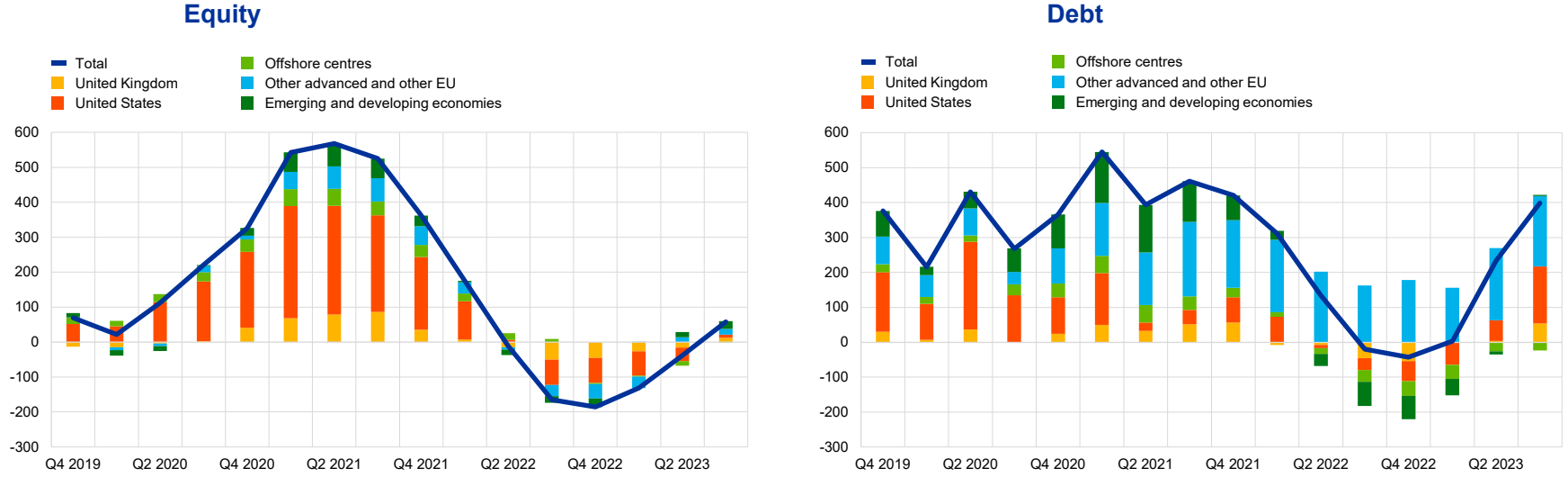
Source: ECB.
Notes: For liabilities, a positive (negative) number indicates net purchases (sales) of euro area instruments by non-euro area investors. Investment funds include money market funds. Other sectors include the Eurosystem, households and households and non-profit institutions serving households, insurance corporations and pension funds. The latest observation is for the third quarter of 2023.

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Portfolio flows retrenched broadly, particularly in EME and offshore debt

Euro area portfolio investment assets by counterpart location

(transactions; four-quarter moving sums, EUR billions)



Source: ECB.

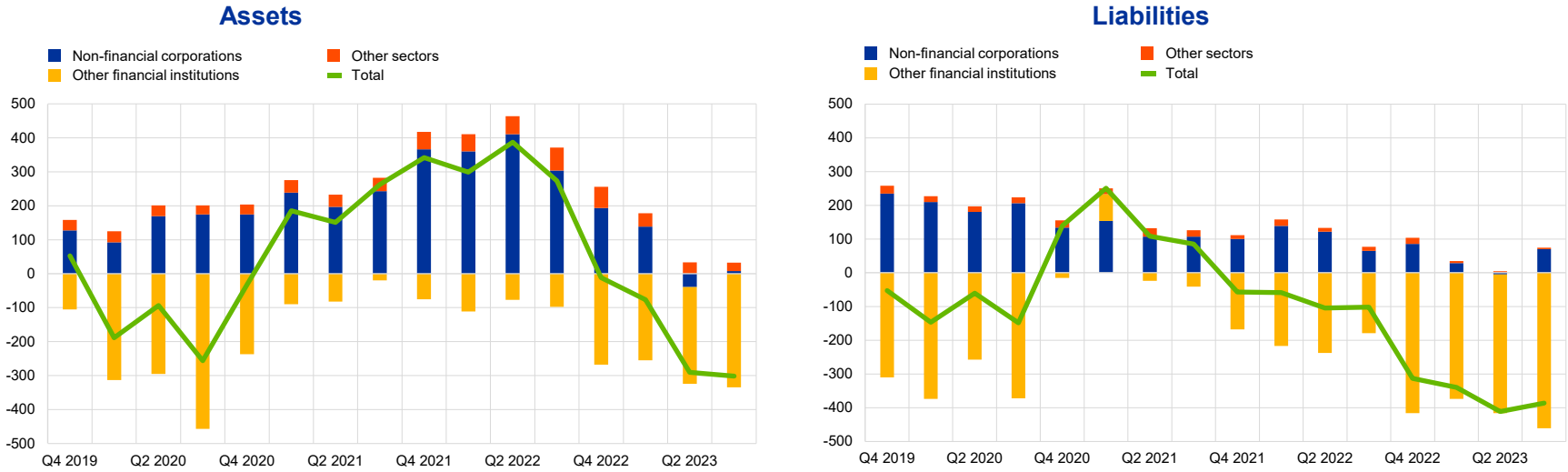
Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. “Other advanced and other EU” include Australia, Canada, Japan, Norway, South Korea and Switzerland as well as the non-euro area EU Member States and those EU institutions and bodies that are considered for statistical purposes as being outside the euro area, such as the European Commission and the European Investment Bank. “Emerging and developing economies” include all countries and country groups not shown in the chart, as well as unallocated transactions. The latest observation is for the third quarter of 2023.

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Strong retrenchment in “financialised” FDI, slowdown in non-financial FDI

Euro area foreign direct investment by resident sector

(transactions; four-quarter moving sums, EUR billions)



Source: ECB.

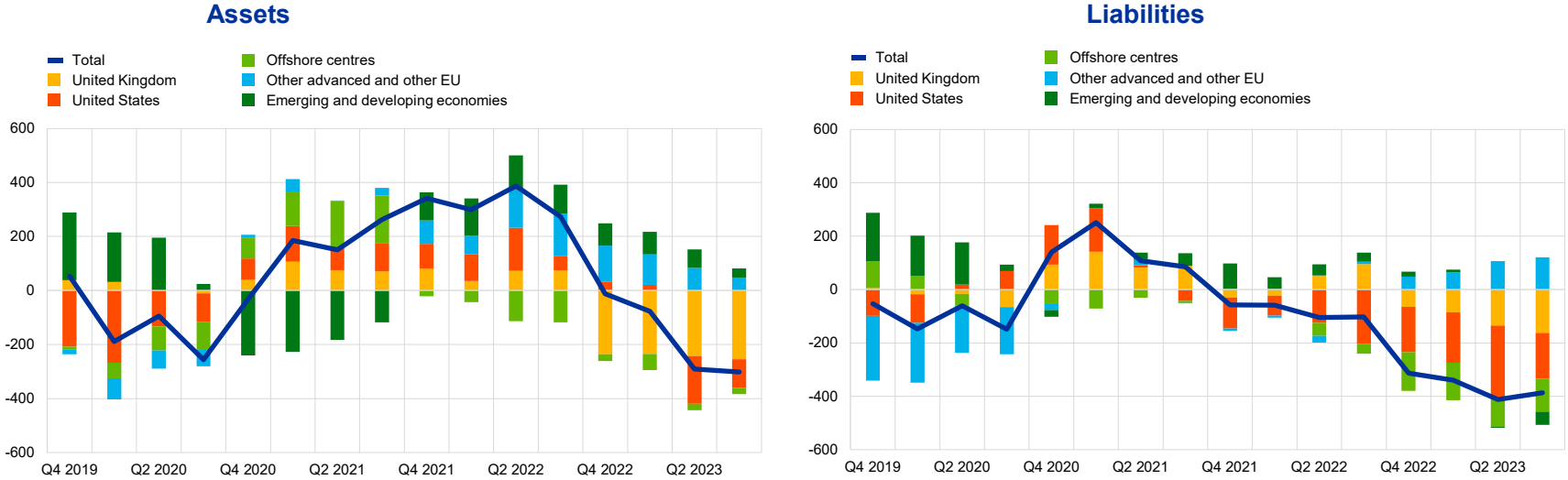
Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. For liabilities, a positive (negative) number indicates net purchases (sales) of euro area instruments by non-euro area investors. “Other sectors” include all institutional sectors not shown in the chart. The latest observation is for the third quarter of 2023.

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Geographically concentrated FDI retrenchment

Euro area foreign direct investment by counterpart location

(transactions; four-quarter moving sums, EUR billions)



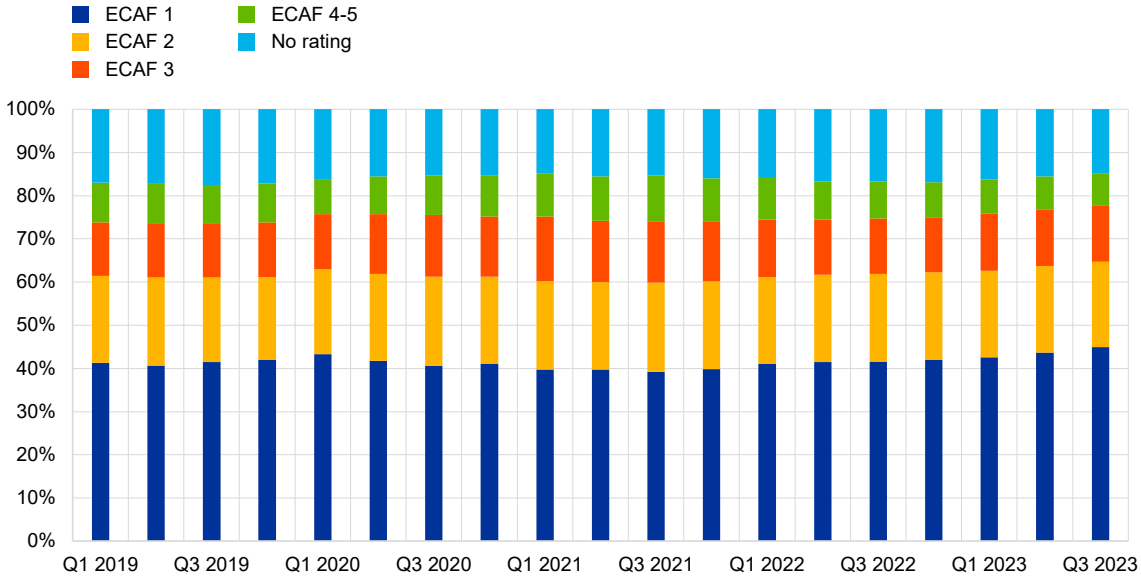
Source: ECB.

Notes: For assets, a positive (negative) number indicates net purchases (sales) of non-euro area instruments by euro area investors. For liabilities, a positive (negative) number indicates net purchases (sales) of euro area instruments by non-euro area investors. “Other advanced and other EU” include Australia, Canada, Japan, Norway, South Korea and Switzerland as well as the non-euro area EU Member States and those EU institutions and bodies that are considered for statistical purposes as being outside the euro area, such as the European Commission and the European Investment Bank. “Emerging and developing economies” include all countries and country groups not shown in the chart, as well as unallocated transactions. The latest observation is for the third quarter of 2023.

Decline in euro area cross-border holdings of low-rated debt securities

Euro area portfolio investment debt asset position by rating category

(percentage shares of outstanding amounts)



Source: ECB.

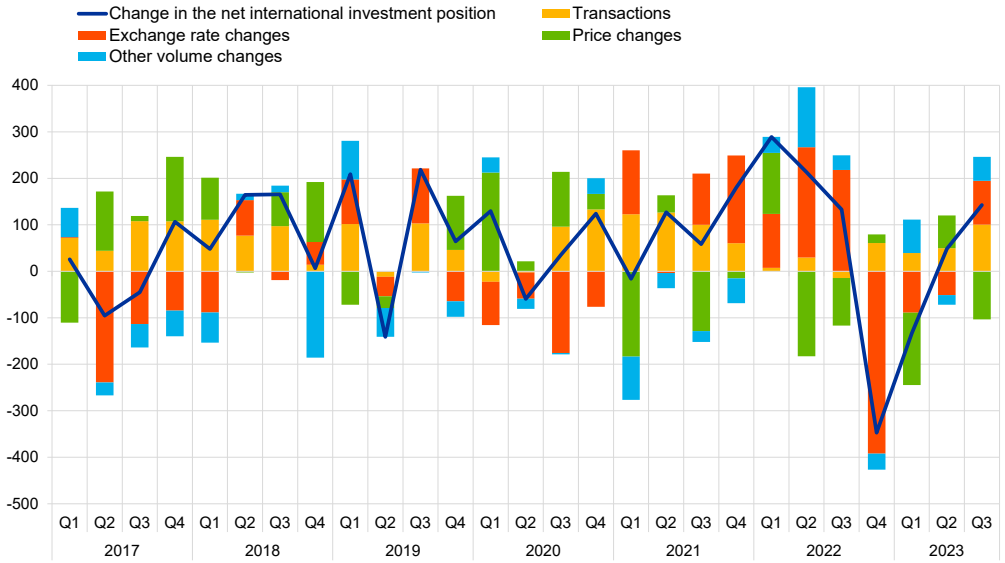
Notes: Experimental data following Rodríguez Caloca, A., Radke, T. and Schmitz, M. (2021). The ratings categories are drawn from the Eurosystem Credit Assessment Framework (ECAF). The ECAF provides a harmonised rating scale of five credit quality steps. The first step includes securities rated from AAA to AA-, the second from A+ to A-, the third from BBB+ to BBB-. In addition, the fourth category includes all rated securities with a rating below credit quality step three and the fifth category reflects those securities without a rating. The latest observation is for the third quarter of 2023.

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Usefulness of fully integrated view on the international investment position

Changes in the net international investment position of the euro area

(EUR billions)



Source: ECB.
Note: The latest observation is for the third quarter of 2023.

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Globalization and the reach of multinationals implications for portfolio exposures, capital flows and home bias[1]

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[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Globalization and the Reach of Multinationals
Implications for Portfolio Exposures, Capital Flows, and Home Bias

Carol Bertaut, Beau Bressler, and Stephanie Curcuru[1]

This version: August 10, 2021

Abstract

The growing use of low-tax jurisdictions as locations for firm headquarters, proliferation of offshore financing vehicles, and growing size, number, and geographic diversity of multinational firms have clouded the view of capital flows and investor exposures from standard sources such as the IMF Balance of Payments and the Coordinated Portfolio Investment Survey. We use detailed, security-level information on U.S. cross-border portfolio investment to uncover the extent of distortions in the official U.S. statistics. We find that roughly $3 trillion – nearly a third of U.S. cross border portfolio investment – is allocated to a country different from its primary economic exposure by standard reporting conventions. Expanding to consider global implications, we estimate that the geographic exposure of roughly $10 trillion – about one-fourth – of the stock of global cross-border portfolio investment is similarly distorted, and that exposures to emerging markets are likely understated by about a third. Estimates of the international exposures of U.S. investors are even larger when we distribute the exposure from holdings of domestic and foreign firms according to the geographic distributions of firm-level sales. Our results have implications for conclusions we draw about the factors influencing capital flows, in particular those to emerging markets.

Keywords: Balance of payments, capital flows, financial globalization, foreign assets, international financial data, home bias

JEL classification: F30, F32, G15

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[1]Bertaut and Curcuru are in the Division of International Finance at the Board of Governors of the Federal Reserve System, Bressler is at University of California, Davis. We thank seminar participants at the International Monetary Fund, the Bank for International Settlements, the Federal Reserve Bank of San Francisco, the European Financial Management Association 2021 Meetings, and the Federal Reserve Board for helpful comments. The views expressed are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System. An earlier version of this paper including data files is available at https://www.federalreserve.gov/econres/notes/feds-notes/globalization-and-the-geography-of-capital-flows-20190906.htm

I. Introduction

The residence-based framework of measuring international exposure is increasingly less informative, as a growing number of firms locate in low-tax jurisdictions and issue securities through offshore subsidiaries. This has clouded the view of capital flows and investor exposures from standard sources such as the IMF Balance of Payments and the Coordinated Portfolio Investment Survey. Recent work has taken steps to address this issue: Bertaut, Bressler, and Curcuru (2019) map security-level data on U.S. investors' cross-border holdings from a residence-basis (where the issuing subsidiary is incorporated, or "resident") to a nationality-basis (reflecting the country of the parent firm) and find that 30% of the market value of long-term foreign portfolio securities held by U.S. investors in 2017 reflected exposures to countries other than as reported in the official U.S. statistics. Coppola et al. (2020) map the universe of traded securities to their parent companies and subsidiaries and provide adjustment factors for converting residence-based statistics to a nationality basis. These studies underscore the limitations of the residence-based statistical framework used in official datasets of cross-border positions and capital flows.

However, in a globalized economy even these nationality-based statistics cannot fully capture the true economic exposures of investors. Securities issued by firms with operations around the world will provide exposure to countries other than the country of nationality or residence, as discussed in Cai and Warnock (2012). Indeed, stock prices of internationally-exposed U.S. firms certainly respond to foreign shocks and developments such as dollar appreciation or announcements about potential changes to trade policy such as tariff increases (see, for example, Amiti, Kong, and Weinstein 2020). In this note we combine security-level data on U.S. holdings

of common stock with firm-level geographic revenue data to get a fuller picture of the economic exposure of U.S. investors. We then briefly examine some of the implications of this remapping for our understanding of home bias, which is one important driver of cross-border investment.

II. Data and Methodology

Our estimates of the geographic exposure of U.S. equity investors consider the full equity portfolio of U.S. investors, including equity of U.S. companies. We start with the annual surveys collected as part of the Treasury International Capital (TIC) system. These data are collected on a legal residence basis for construction of the U.S. International Investment Position. The data on U.S. holdings of stock issued abroad comes directly from the "U.S. Residents Portfolio Holdings of Foreign Securities" survey. U.S. investor holdings of stock issued domestically is inferred from the difference between the total stock market capitalization for each firm (from Worldscope) and the total the amount held by foreign investors as reported in the "Foreign Residents' Portfolio Holdings of U.S. Securities" survey. We then reassign each firm from country of residence to country of nationality using the remapping algorithm of Bertaut, Bressler, and Curcuru (2019).[2]

We then take this remapping of equity holdings from the country of residence to nationality one step further and remap equity holdings based on the geography of firm revenue. Our data on firms' geographic revenue distribution comes from Worldscope.[3] This is a challenging exercise,

[2] For this exercise focusing on the U.S. investor equity portfolio, our residence-to-nationality remapping only affects equity of foreign firms, as all of the common stock equity identified as "U.S." in the TIC system is also identified as "U.S." by standard benchmarks such as the MSCI. The mapping would be less straightforward if we were to extend our analysis to the U.S. bond portfolio, because debt issued by U.S.-resident financing subsidiaries with foreign parents are included as "U.S." bonds by TIC.

[3] Worldscope defines their geographic sales variable as "represents the total revenues from the geographic region updated in the respective description."

because geographic segment descriptions reported to Worldscope are non-standardized and often refer to regions rather than individual countries. When revenue is allocated to a region, we allocate revenue to the component countries of each region based on each country's GDP weights in each region.[4] Overall, Worldscope coverage for firms in the U.S. equity portfolio (especially for U.S.-listed firms) is quite good, and improves over time. We are able to classify market capitalization and U.S. portfolio holdings for December 2003 through 2018. By 2018, we have data on nearly 9,200 firms with market capitalization at end-2018 of $68 trillion.[5]

III. Revenue-based Estimates of U.S. Equity Exposure

Figures 1a, 1b, and 1c compare total U.S. portfolio holdings on a residence, nationality, and revenue basis. On a residence basis, holdings of domestic equities amount to about $21 trillion in December 2018 (Figure 1a), roughly 80 percent of the total equity holdings of U.S. investors of about $27 trillion. Domestic holdings are slightly higher on a nationality basis, increasing to $21.8 trillion (Figure 1b), reflecting our reclassification of $800 billion in holdings of equity of U.S. multinationals incorporated in offshore centers. Holdings of emerging market equity are also slightly larger, in large part reflecting the reclassification of financial center equity to China (see Bertaut et al 2019).

Our remapping using the geography of firm revenue presents a much different picture of U.S. investor exposure. On a revenue basis, domestic equity holdings remain the largest portion of the

[4] This methodology for allocating geographic revenue is similar in spirit to Amenc et al. (2015) and also to Morningstar's "Revenue Exposure by Region." See Appendix for more details on methodology. For firms not reported in Worldscope or with incomplete information, we use data from Bloomberg and from company annual reports where possible to determine market capitalization and sales revenue allocations.

[5] By comparison, the World Bank's World Development indicators lists global equity market capitalization for 2018 at $68.6 trillion. In terms of foreign-issued equity held by U.S. investors, we are able to match more than 80% of the market value of foreign common stock held in the early 2000s, increasing to more than 90% by 2009.

total portfolio but fall to $18 trillion (figure 1c). This smaller U.S. exposure reflects the fact that large-cap U.S. firms have substantial revenue from global sources and thus holding their shares provides U.S. investors with considerable exposure to other countries. Of course, the reduced exposure to the United States and increased exposure to the rest of the world is partially offset by a reallocation of some of the holdings of foreign equity: Foreign multinationals often generate significant revenue from U.S. sales, and thus U.S. investors acquire some U.S. exposure through their holdings of foreign stocks. The differences in geographic allocations between the revenue-based statistics and the residence- and nationality-based statistics are shown in figures 2a and 2b, respectively. In the early part of our sample, most of the reallocation from domestic to foreign exposure was to other developed countries. In more recent years, however, most of the remapping has been to emerging market economies.

Two particularly striking facts stand out from the revenue-based holding estimates. First, we find that U.S. investors may have as much indirect foreign exposure from their holdings of equity of U.S. multinationals as from direct holdings of foreign equity. The sources of the domestic and foreign exposures of U.S. investors are shown in Figure 3. In December 2018, U.S. investors had $4.6 trillion of foreign exposure from their holdings of U.S. equity, almost as much as their $4.8 trillion of foreign exposure from their direct foreign equity holdings.

Second, we find that U.S. investors have about as much exposure to emerging markets as they do to advanced foreign economies, as multinational firms generally have significant exposures to emerging markets. In 2018, U.S. investors had $4.6 trillion in emerging market exposure, including $2.5 trillion through U.S. holdings of domestic multinationals, versus $4.9 trillion of advanced economy exposure.

IV. Implications for Home Bias

Our results have implications for a wide range of topics of interest to global policy makers and academics. These include conclusions we draw about the factors influencing capital flows, in particular those to emerging markets, and the drivers of international investment allocations more generally. For instance, one long-standing puzzle in the international finance literature is investor "home bias"; in other words, the lack of diversification of international investors relative to the optimal holdings implied by the International Capital Asset Pricing model (ICAPM). The ICAPM predicts that in a world with frictionless markets the optimal asset allocation is the world portfolio; in other words, investors should spread their wealth among global equities according to each asset's share of global market capitalization. For example, since U.S. equities currently make up about 40 percent of global market capitalization, about 40 percent of U.S. investors' equity holdings should be in U.S. stocks.

The usual estimate for the degree of home bias in investor portfolios compares portfolio allocations in foreign (to the investor) equity to shares in global market capitalization:

$$Home\ Bias = 1 - \frac{\frac{(holdings\ of\ foreign\ equity)}{(total\ equity\ portfolio)}}{\frac{(foreign\ equity\ market\ cap)}{(world\ equity\ market\ cap)}} \quad (1)$$

Note that if portfolio shares are close to or equal market capitalization shares, the ratio in the second term of equation (1) will be close to one. Thus, the ratio is typically subtracted from 1 to measure “home bias”, so that the larger this resulting calculation, the greater the extent of home bias. A home bias of 0.5 means that investors hold half as much foreign stock (or twice as much domestic stock) as implied by the ICAPM.

In practice, investors in the U.S. hold larger shares of their wealth in domestic securities than predicted by the ICAPM, and this is true for investors around the globe. There is a large literature on the potential causes of home bias, which include hedging motives arising from exchange rate and other risks, and frictions such as transactions costs as well as easier access to and better information about domestic markets. Coeurdacier and Rey (2013) provide a comprehensive survey of this literature. This literature focuses on factors that affect investor demand for exposure, and the associated characteristics of investment in different countries. But how these portfolio shares – and market capitalization shares – are constructed can lead to markedly different measures of home bias, which in turn can confound our interpretation of what drives portfolio preferences.

Figure 4 shows our home bias estimates for U.S. investors. When holdings are measured by residence, home bias in common stock is quite high. That said, it has trended down slightly from about 0.75 in the early 2000s to about 0.65 after the global financial crisis, and it has remained around that level for the past several years. When instead holdings measured on a nationality basis, home bias is even higher, largely due to holdings of firms in financial centers that we remap to the United States. Home bias estimates are notably lower when holdings are revenue-based, generally below 0.5. This lower level of home bias largely reflects the additional exposure to foreign countries that U.S. investors achieve through their holdings of equity of U.S. multinationals.

The marked differences in home bias magnitudes and trends across measures suggests caution is needed when constructing home bias estimates using aggregate data such as the IMF's Coordinated Portfolio Investment Survey (CPIS). The CPIS is collected on a residency basis, and

as our analysis shows, holding shares of multinational firms can considerably increase the measured global exposure of a country's investors. Our investigation of the U.S. portfolio indicates that U.S. home bias clearly still exists, but estimates of the magnitude of the bias are notably lower when calculated on a revenue-exposure basis.

We can further illustrate the portfolio diversification effects of investment in multinational firms using the relative portfolio weight measure introduced in Ahearne et al (2004):

$$Relative\ Portfolio\ Weight_i = \frac{\frac{(holdings\ of\ country\ i\ equity)}{(total\ equity\ portfolio)}}{\frac{(country\ i\ equity\ market\ cap)}{(world\ equity\ market\ cap)}}. \qquad (2)$$

Table 1 presents descriptive statistics for the relative portfolio weights of the U.S. investor foreign portfolio with country holdings estimated alternatively by residence, nationality, and revenue-exposure. Averaged across foreign countries, country weights are about 0.25 on both a residence and nationality basis, but there is considerable heterogeneity: For both measures, estimates range from close to zero, indicating almost full "country bias", to more than 1, indicating that U.S. investors actually hold *more* than the market capitalization share in a few countries. Consistent with our finding of lower overall home bias on a revenue-exposure basis, revenue-based portfolio weights are generally larger than are either the residence- or nationality-based weights, though these too show considerable heterogeneity. The residence- and nationality-based weights are highly correlated with each other, as would be expected given that the nationality reassignments primarily affect the handful of financial center countries. Their correlations with the revenue-exposure based weights are notably lower.

These ICAPM-based measures of home bias omit factors widely acknowledged to also influence portfolio preferences. To capture some of these other factors we estimate a gravity model which includes many of the factors shown by the literature to drive portfolio allocations (see Portes and Rey 2005 and Fidora, Fratzscher and Thimann 2007) in the form:

$$Relative\ Portfolio\ Weight_{i,t} = \alpha_i + \beta \boldsymbol{X}_{i,t} + \varepsilon_{i,t} \quad (3)$$

where $\boldsymbol{X_{i,t}}$ represents a vector of country-level controls. The regressions are estimated over our entire sample period of 2004-2017. Control variable definitions are in Appendix B.

Alternative constructions of relative portfolio weights generate different conclusions about factors that influence portfolio preferences. Column 1 of Table 2 shows the coefficients from the estimation of equation (3) when the portfolio weights are constructed on the standard residence basis as in the CPIS. As is typical in the literature, variables proxying for frictions such as country familiarity and financial development are generally significant and with the expected signs: U.S. investors have higher portfolio weights in countries where English is the official language and where broad-band internet access is higher, and lower weights in countries that are more geographically distant.[6] U.S. investors also have somewhat higher weights in countries with a larger share of equity market capitalization owing to firms in consumer or industrial sectors (the financial sector is the omitted dummy). The "financial center" dummy variable adds a nontrivial 0.4 to the estimated portfolio weight, an effect larger in size than the combined effects of having internet access one standard deviation higher than average, geographic location

[6] Similar results (not shown) hold for alternative measures of financial development or if the share of U.S. trade in country *i* is substituted for distance. Variables capturing aspects of portfolio returns (such as the correlation of country equity market returns with U.S. market returns, or GDP growth with U.S. growth) are generally insignificant in these regressions.

one standard deviation closer, and using English as an official language. The size and significance of this dummy variable highlights that country-level characteristics of financial centers likely have more to do with the choice of firm incorporation than they do to explaining investor preferences.

Column 2 repeats the exercise using portfolio weights constructed on a nationality basis. Results are largely similar to the residence-based results, although the financial center dummy is a bit smaller, and the consumer sector share of market capitalization is no longer significant.

Our understanding of the drivers of portfolio allocation changes when we measure holdings on a revenue-exposure basis. Relatively few of the country-level explanatory variables remain meaningful in explaining portfolio weights (column 3), although distance remains significant at roughly the same magnitude. The consumer sector share also remains significant. However, the overall explanatory power of the regression variables as measured by the R^2 drops noticeably.

What does matter is the presence of U.S. multinationals, as suggested in Table 3. Activities of multinationals can provide an additional channel for information about a country, and investor familiarity with "home country" firms specifically provides a further informational advantage. A variable that captures the share of sales revenue generated in a country that owes specifically to U.S. firms has a highly significant and materially important effect in explaining U.S. investor portfolio allocations (column 1). This measure, which is only applicable to the revenue-exposure basis, contributes on average about half of the estimated revenue-exposure portfolio weight, and the size of this effect is about 50 percent higher if the U.S. sales revenue share is one standard deviation higher. The significance of this variable holds in a panel regression with country fixed effects (column 2) and in a panel regression when both country and time effects are included

(column 3). These results at the country level are consistent with our findings in Figure 3, which showed that U.S. investors gained considerable *indirect* overall foreign exposure through their holdings of U.S. multinationals.

These results suggest that country-level characteristics that matter for investor portfolio allocations may additionally enter indirectly, through the choices multinational firms make about which markets to enter and where to concentrate their activities, and the informational advantages that investors gain through activities of multinational firms, especially those of firms from the same home country. They also suggest that country-level aggregate measures of portfolio returns and correlations may be insufficient to explain investor portfolio allocations across countries. Richer analysis that takes into account firm-level characteristics, returns, and correlations are likely to be more informative.

V. Conclusion

In this paper we demonstrated the weaknesses of standard measures of cross-border portfolio investment as a proxy for geographic exposure. Our findings have important implications for any work in international finance which relies on these data and should be of interest to academics, policy makers, and global investors. Our improved exposure measures could possibly change our understanding of the drivers of capital flows, exchange rate movements, and global asset returns more generally. In future work we will use our improved exposure measures to explore these and other important topics.

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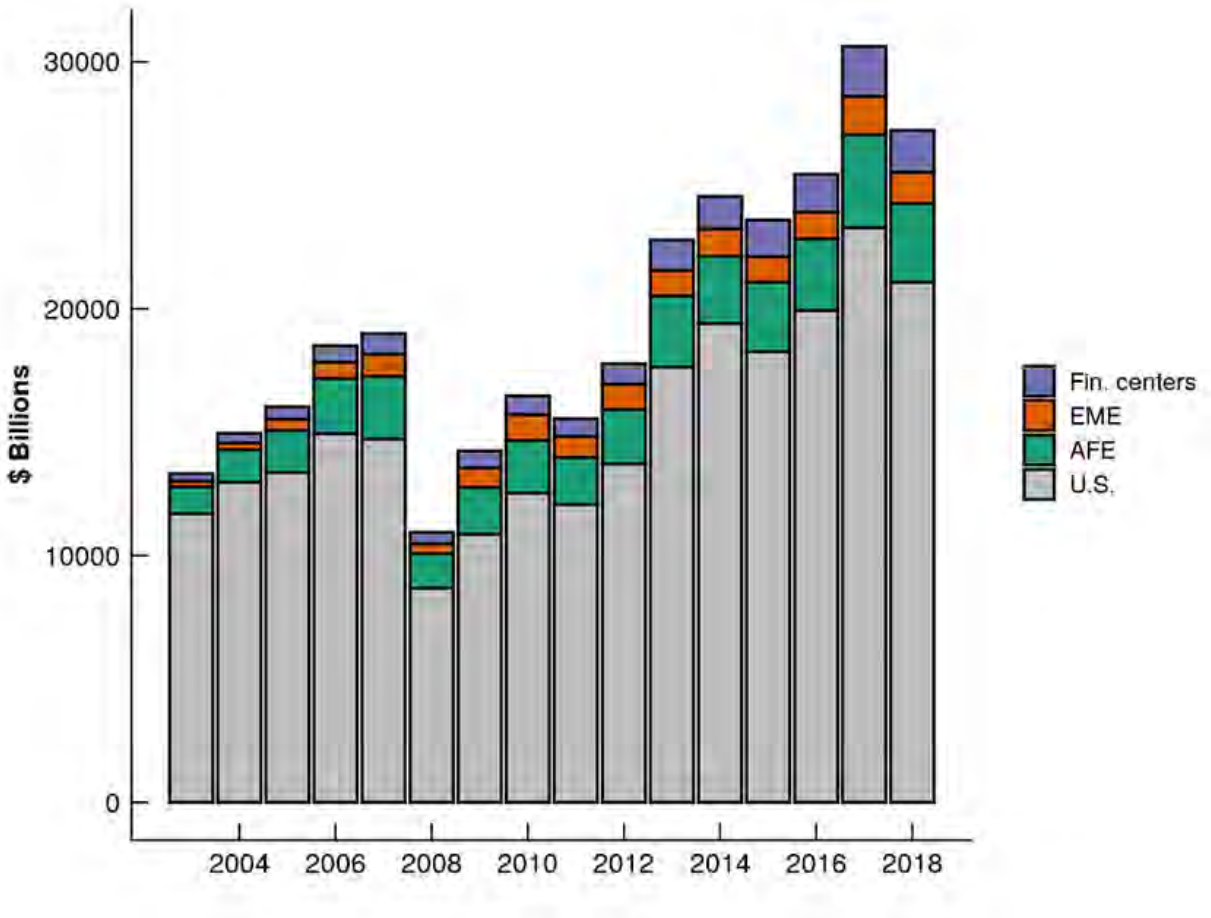
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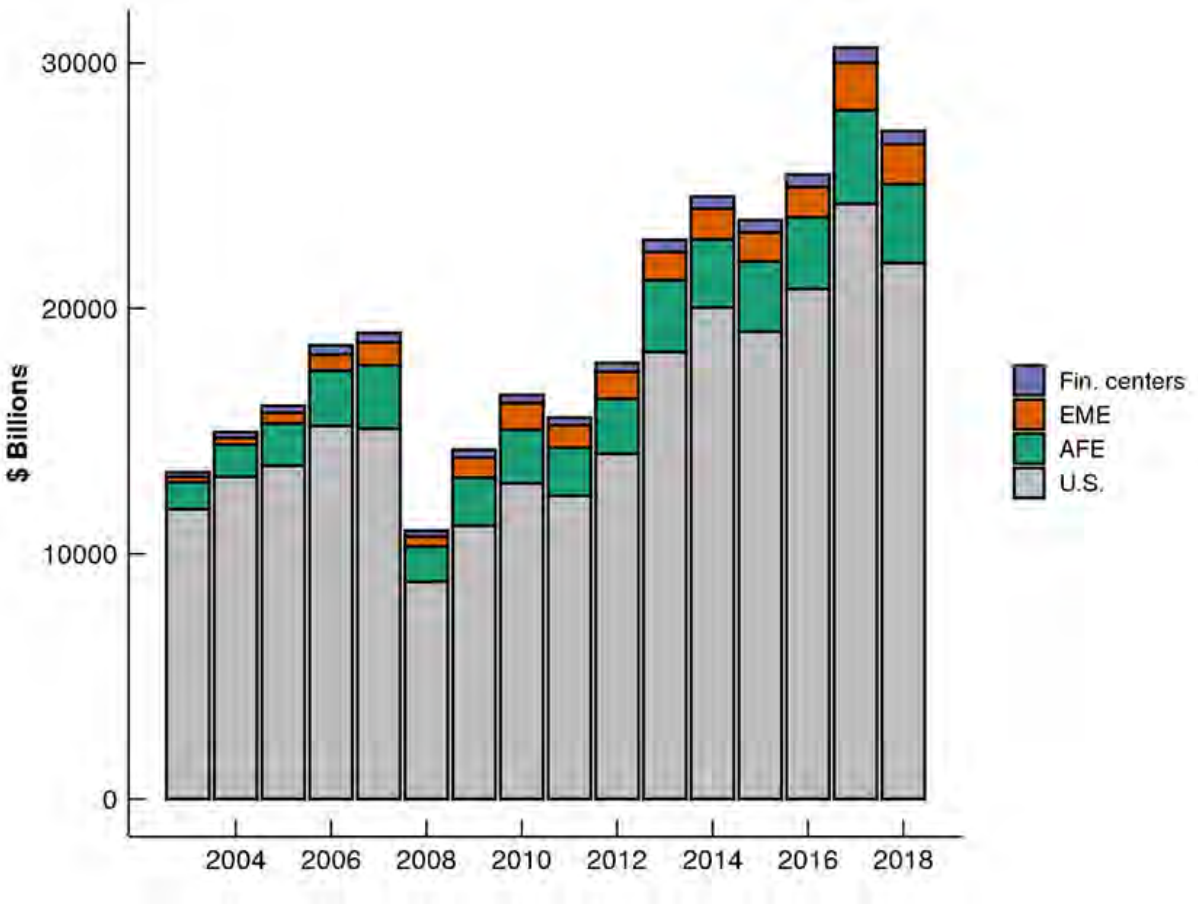
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Figure 1a. U.S. holdings of common stock, Residence basis



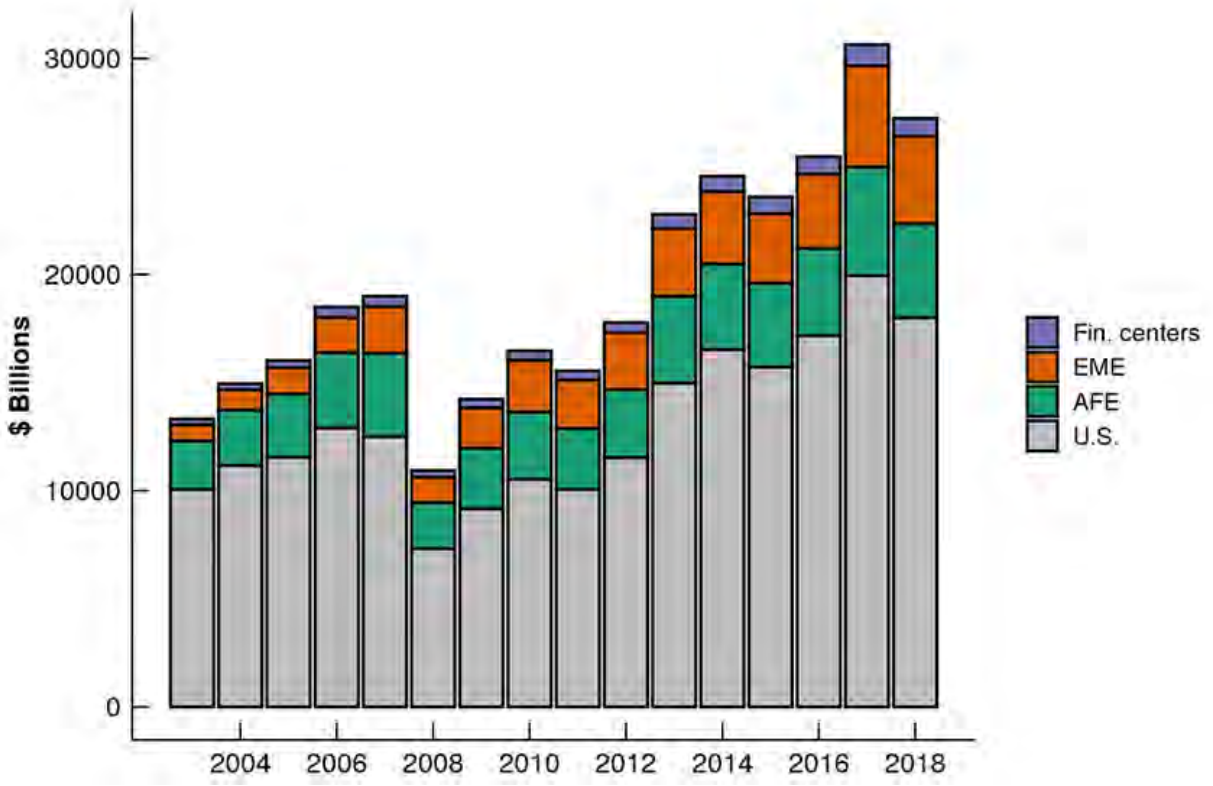
Source: Treasury International Capital System; Bloomberg; Refinitiv Worldscope Fundamentals; Authors' calculations.

Figure 1b. U.S. holdings of common stock, Nationality basis



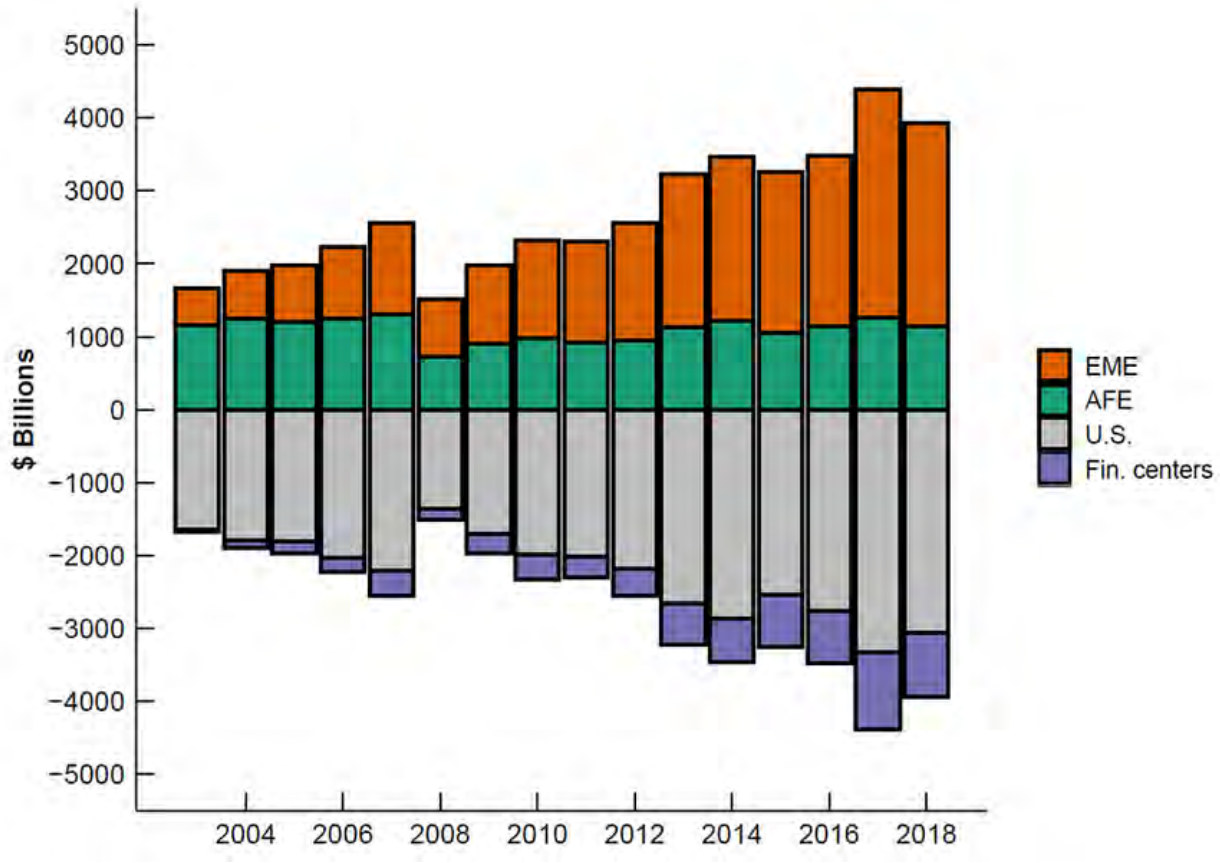
Source: Treasury International Capital System; Bloomberg; Refinitiv Worldscope Fundamentals; Authors' calculations.

Figure 1c. U.S. holdings of common stock, Revenue-exposure basis



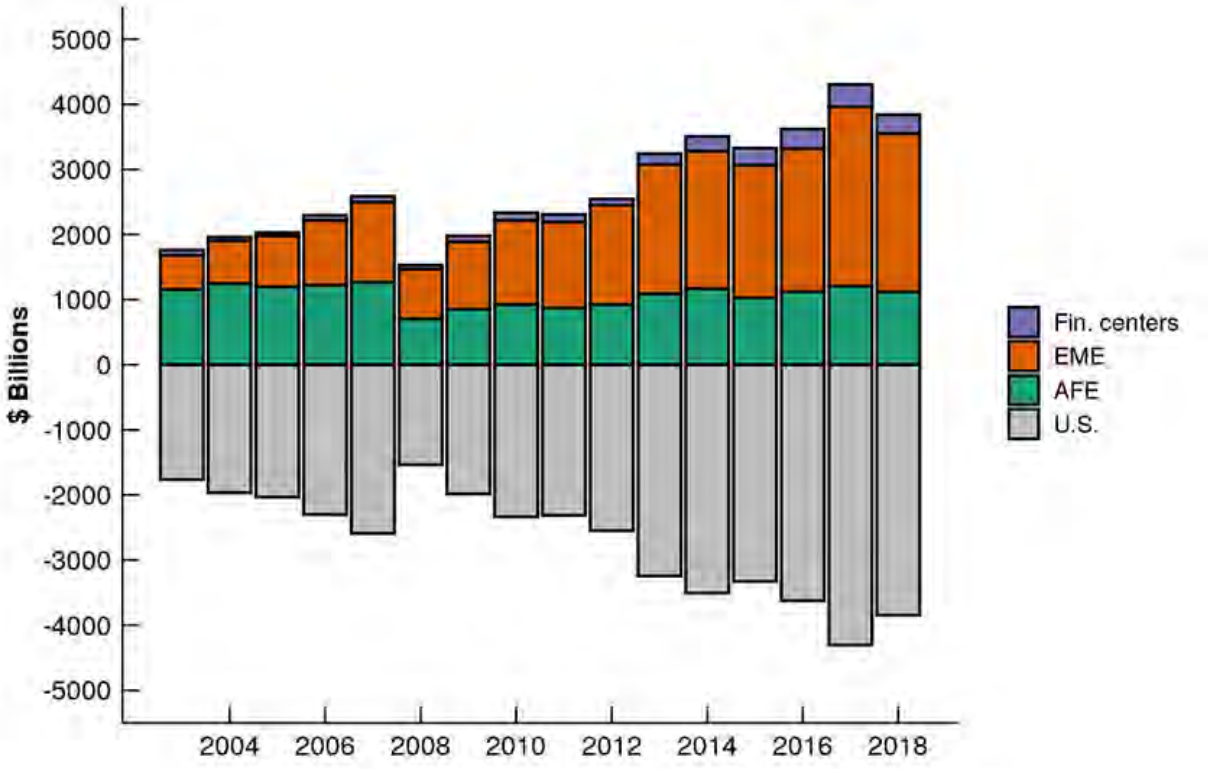
Source: Treasury International Capital System; Bloomberg; Refinitiv Worldscope Fundamentals; Authors' calculations.

Figure 2a. U.S. holdings of common stock, Difference between revenue-exposure and residence basis



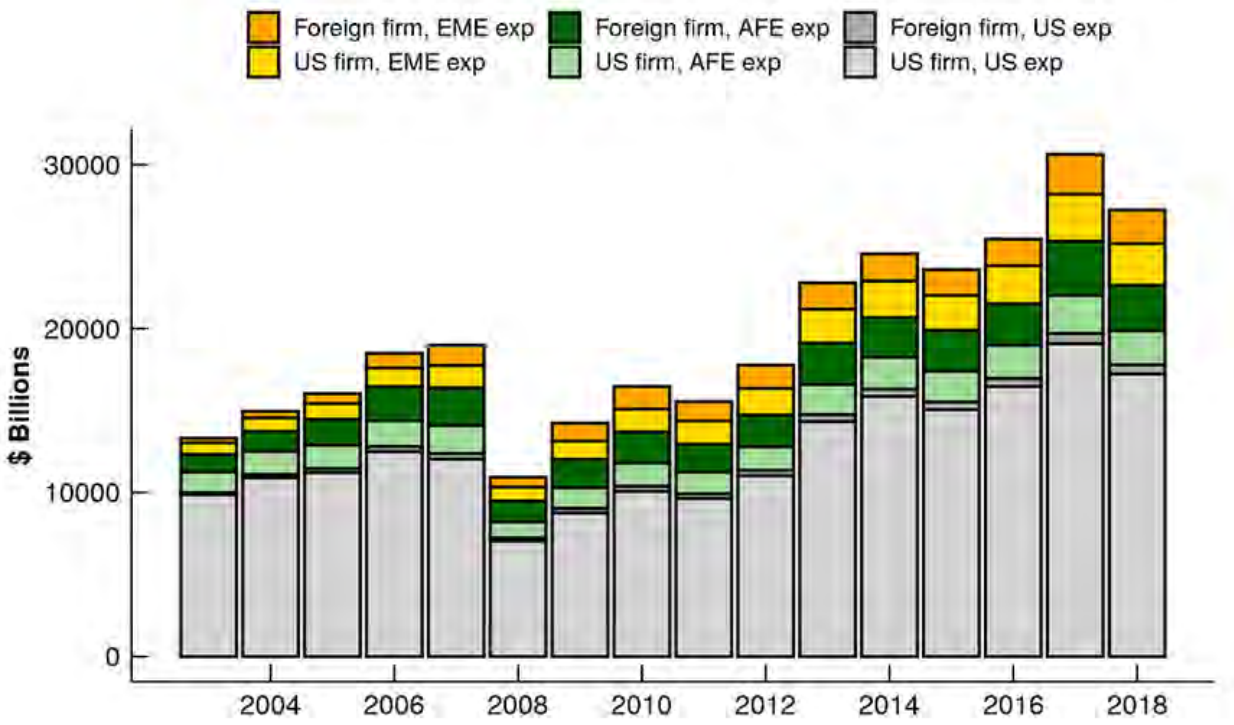
Source: Treasury International Capital System; Bloomberg; Refinitiv Worldscope Fundamentals; Authors' calculations.

Figure 2b. U.S. holdings of common stock, Difference between revenue-exposure and nationality basis



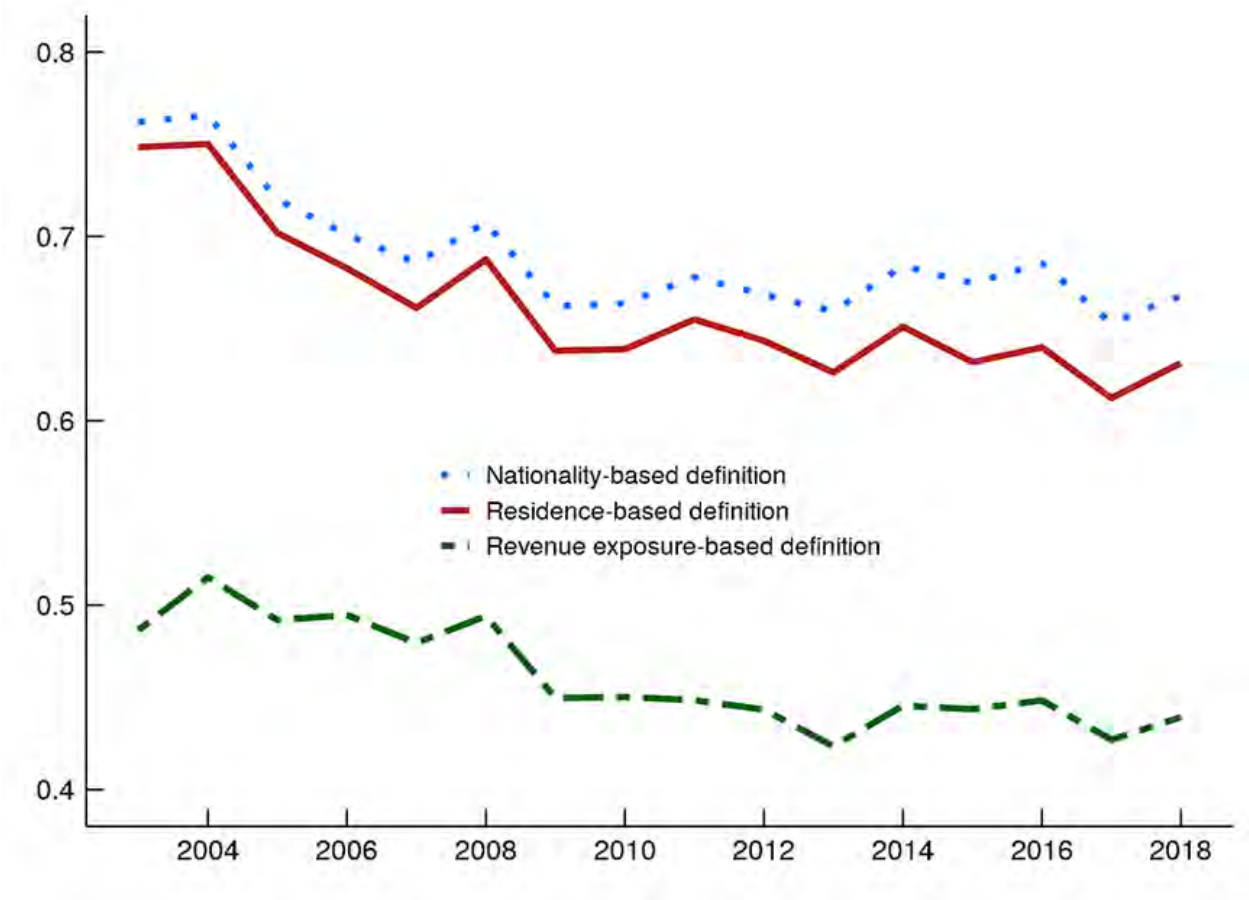
Source: Treasury International Capital System; Bloomberg; Refinitiv Worldscope Fundamentals; Authors' calculations.

Figure 3. U.S. holdings of common stock, Revenue exposure basis by type of economy and nationality of firm



Source: Treasury International Capital System; Bloomberg; Refinitiv Worldscope Fundamentals; Authors' calculations.

Figure 4. U.S.home bias in common stock



Home bias estimates from equation (1):

$$1 - \frac{\frac{(holdings\ of\ foreign\ equity)}{(total\ equity\ portfolio)}}{\frac{(foreign\ equity\ market\ cap)}{(world\ equity\ market\ cap)}}$$

for alternative measures of holdings of foreign equity.

Table 1. Descriptive statistics, U.S. investor country-level relative portfolio weights

Portfolio weight	Residence Basis	Nationality Basis	Revenue-Exposure Basis
Mean	0.248	0.238	0.570
Standard deviation	0.240	0.206	0.188
Minimum	0.001	0.001	0.081
Median	0.203	0.205	0.554
Maximum	1.570	1.435	1.370
N	861	861	861
Correlation with Nationality	0.915		
Correlation with Revenue-Exposure	0.419	0.373	

Table reports statistics on relative portfolio weights from equation (2):

$$\frac{\frac{(holdings\ of\ country\ i\ equity)}{(total\ equity\ portfolio)}}{\frac{(country\ i\ equity\ market\ cap)}{(world\ equity\ market\ cap)}}$$

for alternative measures of holdings of foreign equity over 2004-2017.

Table 2. Factors driving U.S. investor country-level relative portfolio weights

	1		2		3	
Portfolio weight	Residence basis		Nationality basis		Revenue-exposure	
Internet use	0.002 **	(0.001)	0.001 **	(0.001)	0.001	(0.001)
English as official language	0.154 ***	(0.041)	0.135 ***	(0.035)	0.007	(0.051)
Common legal framework	0.009	(0.035)	-0.006	(0.031)	0.018	(0.048)
Distance	-0.102 **	(0.043)	-0.111 **	(0.044)	-0.107 ***	(0.041)
Listed companies	0.000	(0.014)	-0.001	(0.013)	-0.032 **	(0.014)
Lagged GDP growth	-0.002	(0.003)	-0.004 *	(0.002)	-0.005 *	(0.003)
Consumer sector share of country market	0.227 **	(0.103)	0.068	(0.084)	0.541 ***	(0.207)
Industrial sector share of country market	0.147 **	(0.058)	0.199 ***	(0.055)	0.198	(0.157)
Financial center	0.437 ***	(0.132)	0.312 **	(0.122)	0.142 **	(0.068)
Constant	0.905	(0.399)	1.022	(0.424)	1.521 ***	(0.458)
N	861		861		861	
F(9, 75)	11.15		17.75		6.12	
Prob > F	0		0		0	
R^2	0.555		0.457		0.310	

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Table reports estimates of β from equation (3):

$$Relative\ Portfolio\ Weight_{i,t} = \alpha_i + \boldsymbol{\beta X}_{i,t} + \varepsilon_{i,t}$$

Robust standard errors clustered at the country level in parentheses. Estimates from 2004-2017.

Table 3. Divers of U.S. investor country-level relative portfolio weights, revenue-exposure basis

	1		2		3	
Internet use	0.001 *	(0.000)	0.001 **	(0.000)	-0.001	(0.001)
English as official language	0.063 **	(0.026)				
Common legal framework	-0.013	(0.022)				
Distance	-0.050 ***	(0.019)				
Listed companies	-0.001	(0.007)	-0.020	(0.020)	-0.009	(0.014)
Lagged GDP growth	-0.004 ***	(0.001)	-0.001	(0.001)	0.000	(0.001)
Consumer sector share of country market capitalization	0.314 ***	(0.101)	0.373 ***	(0.129)	0.254 *	(0.149)
Industrial sector share of country market capitalization	0.242 ***	(0.082)	0.262 ***	(0.090)	0.141	(0.119)
Financial center	0.109 **	(0.052)				
Share of sales revenue from U.S. firms	1.622 ***	(0.125)	1.322 ***	(0.174)	1.674 ***	(0.253)
Constant	0.525 **	(0.209)	0.213	(0.170)	0.141	(0.137)
N	861		861		861	
	F(10, 75):	55.7	F(6,75):	53.99	F(18,75):	74.68
Prob > F	0		0		0	
R^2	0.765					
R-sq:						
within			0.605		0.734	
between			0.730		0.690	
overall			0.690		0.674	
Country fixed effects	no		yes		yes	
Year fixed effects	no		no		yes	

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Table reports estimates of β from equation (3):

$$Relative\ Portfolio\ Weight_{i,t} = \alpha_i + \boldsymbol{\beta X}_{i,t} + \varepsilon_{i,t}$$

Robust standard errors clustered at the country level in parentheses. Estimates from 2004-2017.

Appendix A: Description of the geographic segment allocation for firm sales

For each geographic segment provided for location of sales revenue, we calculate the share of total sales revenue attributable to that segment, and then use each share to allocate market capitalization exposures and U.S. portfolio exposures. When geographic segments list individual countries, we assign sales shares to that particular country. When geographic segment data lists regions or combinations of countries, we allocate across countries by GDP shares. If no geographic segment data is listed, we assume all sales are domestic. When sales data is missing in one year, we use the prior year sales shares.

Appendix B: Control variables used in the relative weight estimation

	Mean	Standard Deviation
Internet use: Percentage of individuals using the internet in country i in year t. Source: WDI database.	53.53	27.27
English as official language: Dummy variable indicating whether country i shares an official language with the US. Source: CEPII's Language database .	0.25	0.43
Common legal framework: Dummy variable indicating whether the country has shared legal origins with the US.	0.30	0.46
Distance: Log of geographic distance between New York City and the largest city in country i	9.10	0.40
Listed companies: log of the number of listed companies in country i in year t. Source: World Bank Financial Structure Database	6.98	1.39
Lagged GDP growth: country i's year-on-year GDP growth in year t-1.	3.54	3.70
Consumer sector share of country market capitalization: share of market capitalization from firms in apparel, food & beverages, health care, electronics, pharmaceutical, publishing, retail, recreation, or tobacco industries in country i at time t. Source: Authors' calculations from Worldscope data.	0.18	0.20
Industrial sector share of country market capitalization: share of market capitalization from firms in aerospace, automotive, chemical, construction, electrical, machinery, oil and other commodities, paper production, transportation, and utilities industries in country i at time t. Source: Authors' calculations from Worldscope data.	0.53	0.24
Financial center: Dummy variable for countries Bahamas, Bermuda, British Virgin Islands, Cayman Islands, Curacao/Netherlands Antilles, Ireland, Luxembour, Netherlands, and Switzerland.	0.08	0.27
Share of sales revenue from U.S. firms: share of total sales reported by U.S. (by nationality) firms in country i at time t. Authors' calculations from Worldscope data.	0.17	0.09

Globalization and the Reach of Multinationals: Implications for Portfolio Exposures, Capital Flows, and Home Bias

by Carol Bertaut, Beau Bressler, and Stephanie Curcuru
Federal Reserve Board and U.C. Davis

Banco de España-BIS-ECB Conference on External Statistics

February 12-13, 2024

The views expressed here are solely our own and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System.

Challenges with official balance-of-payments, IIP statistics

- Increased efforts to provide more information on "exposures"
- Several post-GFC data gaps:
  - Improvements to IMF CPIS: increased coverage, frequency, sector of issuer/holder
- The problem:
  - BOP framework uses **legal residence** (country of incorporation)
  - Legal residence may not provide useful information on exposures
  - Not a new problem, but getting worse

Growing problem reflects increasing globalization

Multinationals and globalization more generally are contributing to growing problem:

- Multinationals incorporate in low-tax countries
- Emerging market firms issue debt out of financing arms in offshore centers for improved market access
- Investment funds incorporate in financial centers

Awareness is growing

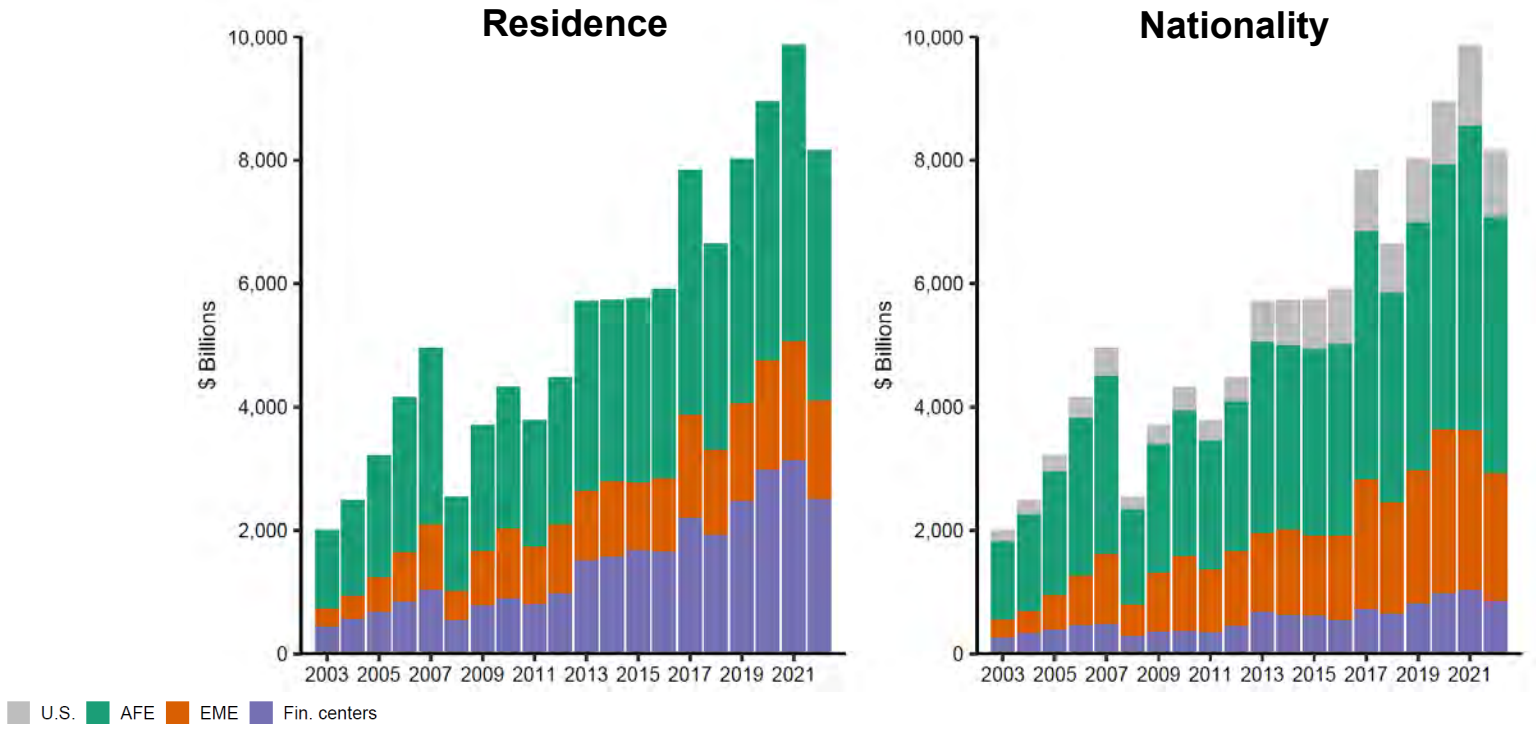
- BIS produces international debt securities on both residence & nationality basis
- Recent papers address distortions:
  - Lane & Milesi-Ferretti (2018): financial center intermediation
  - Avdjiev, Everett, Lane, Shin (2018): complexity of multinational firms and effect on economic statistics
  - Coppola, Maggiori, Neiman & Schreger (2019): restate cross-border investment positions based on global mutual fund allocations (about half of the US foreign holdings portfolio)
  - Beck, Coppola, Lewis, Maggiori, Schmitz & Schreger (2023): restate euro area investment positions by disentangling intermediation by euro area "onshore offshore financial centers"

Recasting US investor exposures

- Bertaut, Bressler and Curcuru (2019)
  - Exploit our access to underlying security-level data on U.S. foreign portfolio investment
  - Combine security-level data with commercial data sources (MSCI) for country assignments
  - Recast portfolio holdings to reflect how standard investment benchmarks view country exposures
    - TIC Team at the Federal Reserve Board produces residence to nationality reallocation as a standard policy product
    - annually updated files are available on Board's website at link to our FEDs note as well as Treasury's TIC website

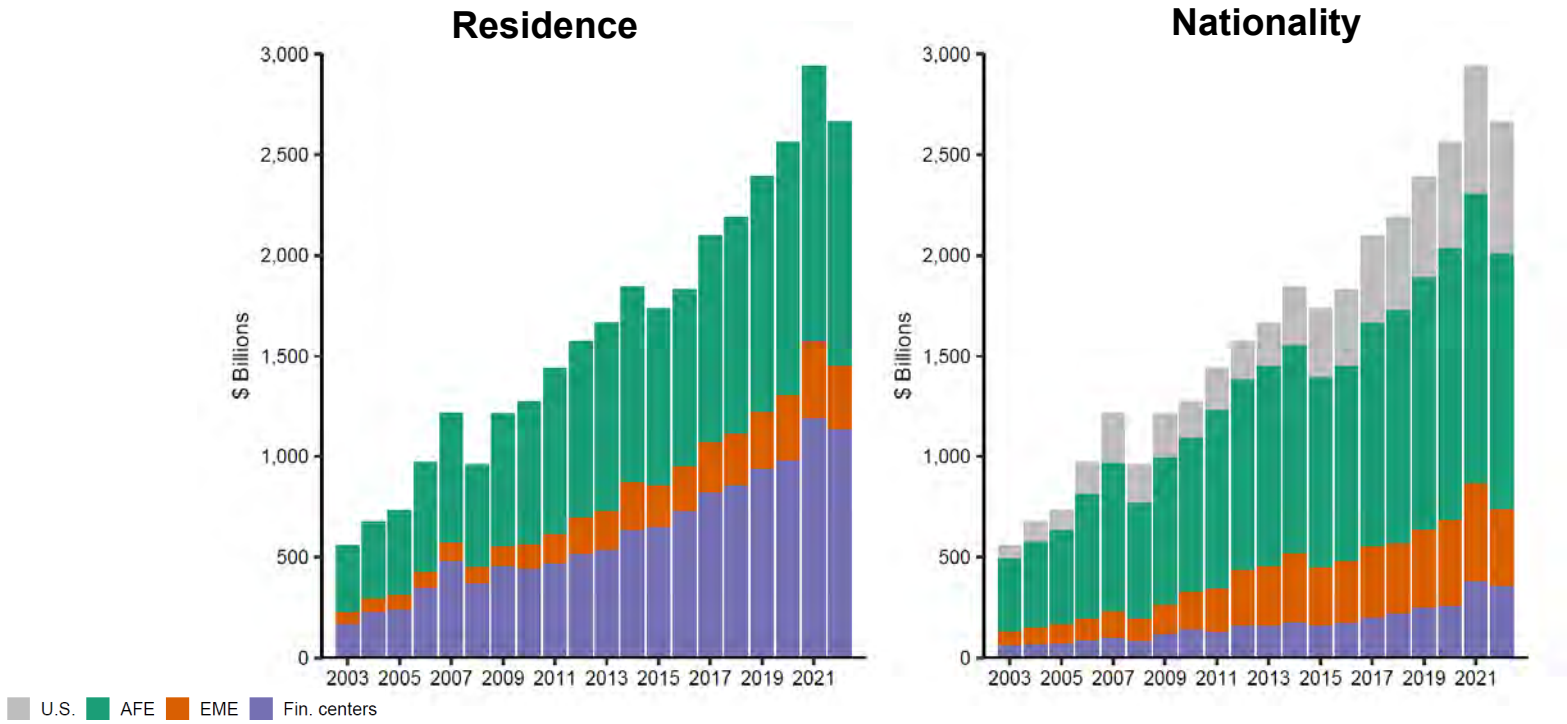
Common stock reallocations

- Reallocation to US: multinationals incorporated abroad; includes high-profile US corporate "inversions" in Ireland
- Reallocation to EMEs: includes large-cap Chinese firms incorporated in the Caymans



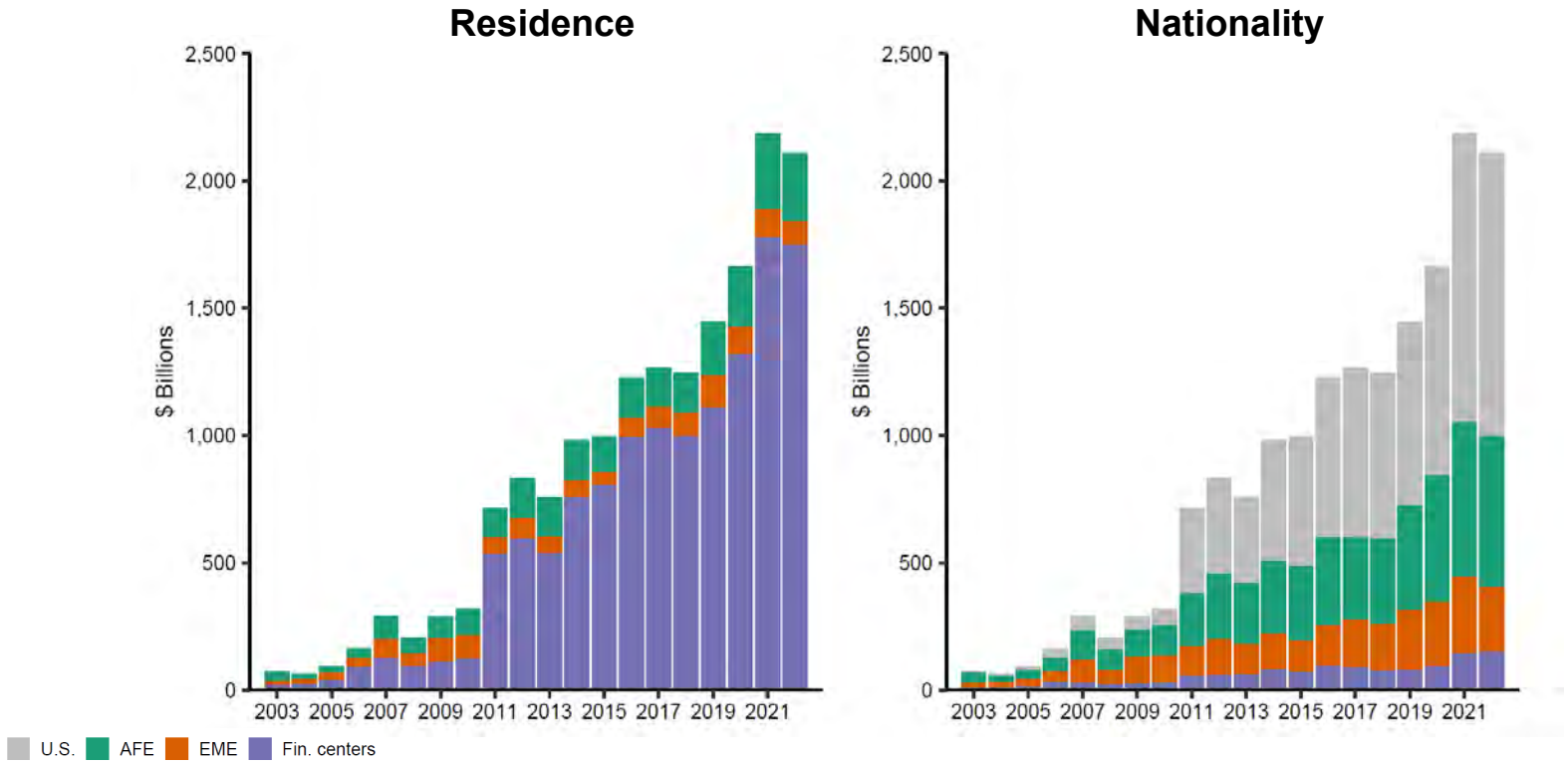
Corporate bond reallocations

- Reallocation to US: primarily from SPVs in the Caymans issuing CLOs, other ABS
- Reallocation to EMEs: bonds issued via financing vehicles in offshore centers



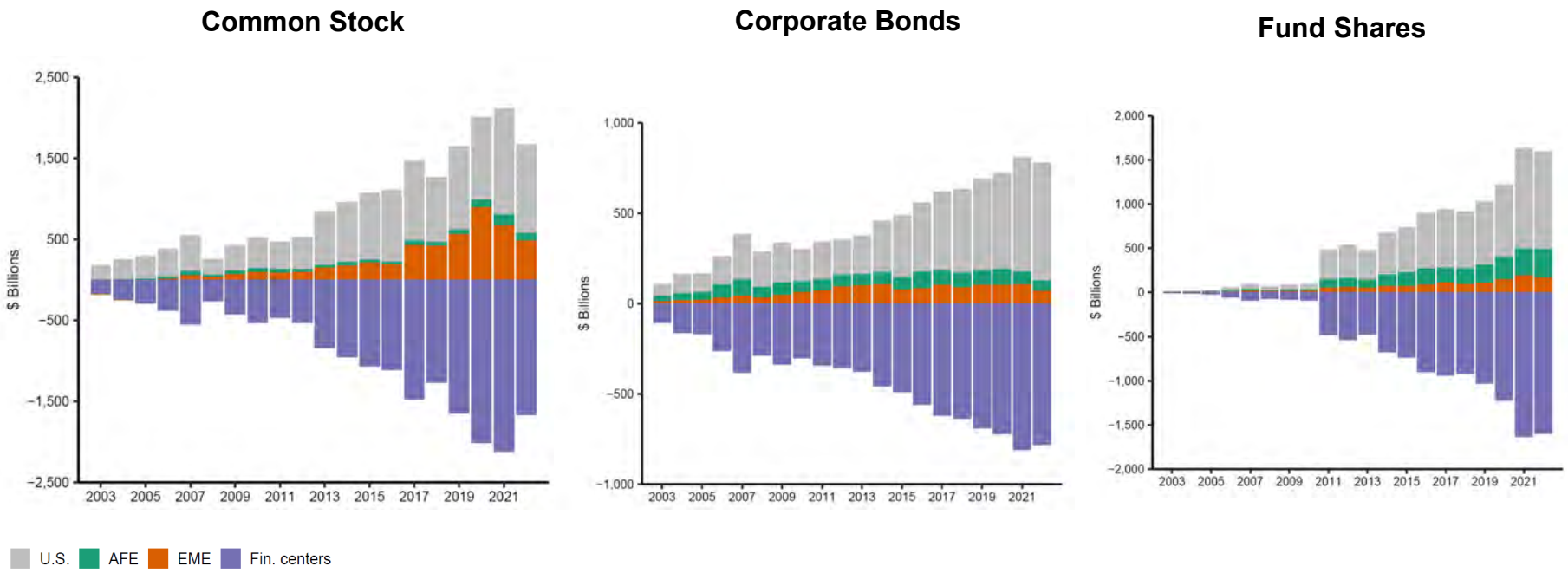
Fund share reallocations

- Reallocation based on “mirror data”: holdings reported for fund industries in financial centers



Overall distortions in US portfolio are large

- Roughly $4 trillion (30 percent) of U.S. cross-border holdings in 2022 ends up getting reallocated to a different country
- In aggregate, EME holdings are ~ 30 % higher

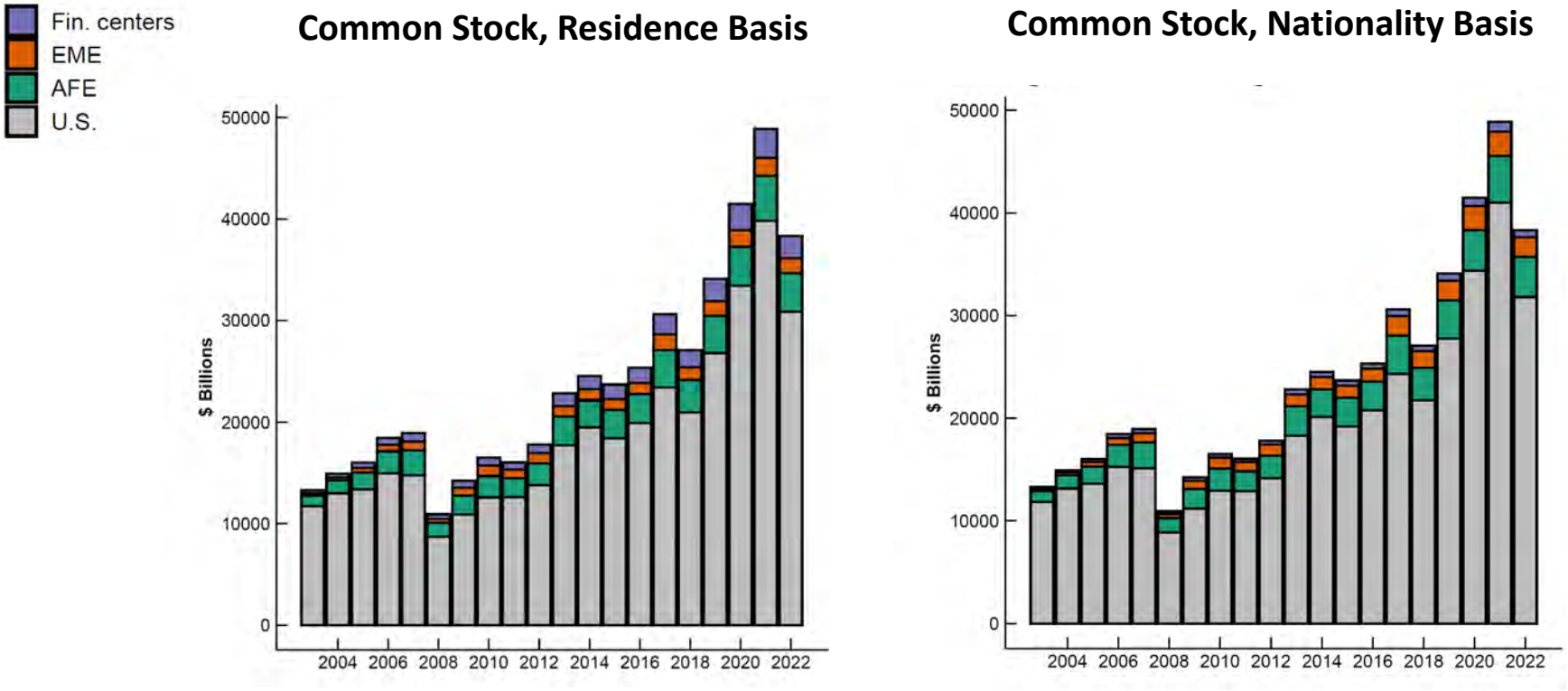


Global portfolios are similarly distorted

- Portfolio distortion is a global phenomenon
- Difficult to assess:
  - drivers of portfolio allocations and capital flows
  - resilience of different types of capital flows
  - effectiveness of capital controls
  - components of and sustainability of current account
  - spillovers of monetary policy
  - many other issues

Broader measure of “exposure”

- Nationality may be improvement over residence, but does it fully capture investor exposures to other countries?
- Bulk of US portfolio is domestic securities, including of US multinationals



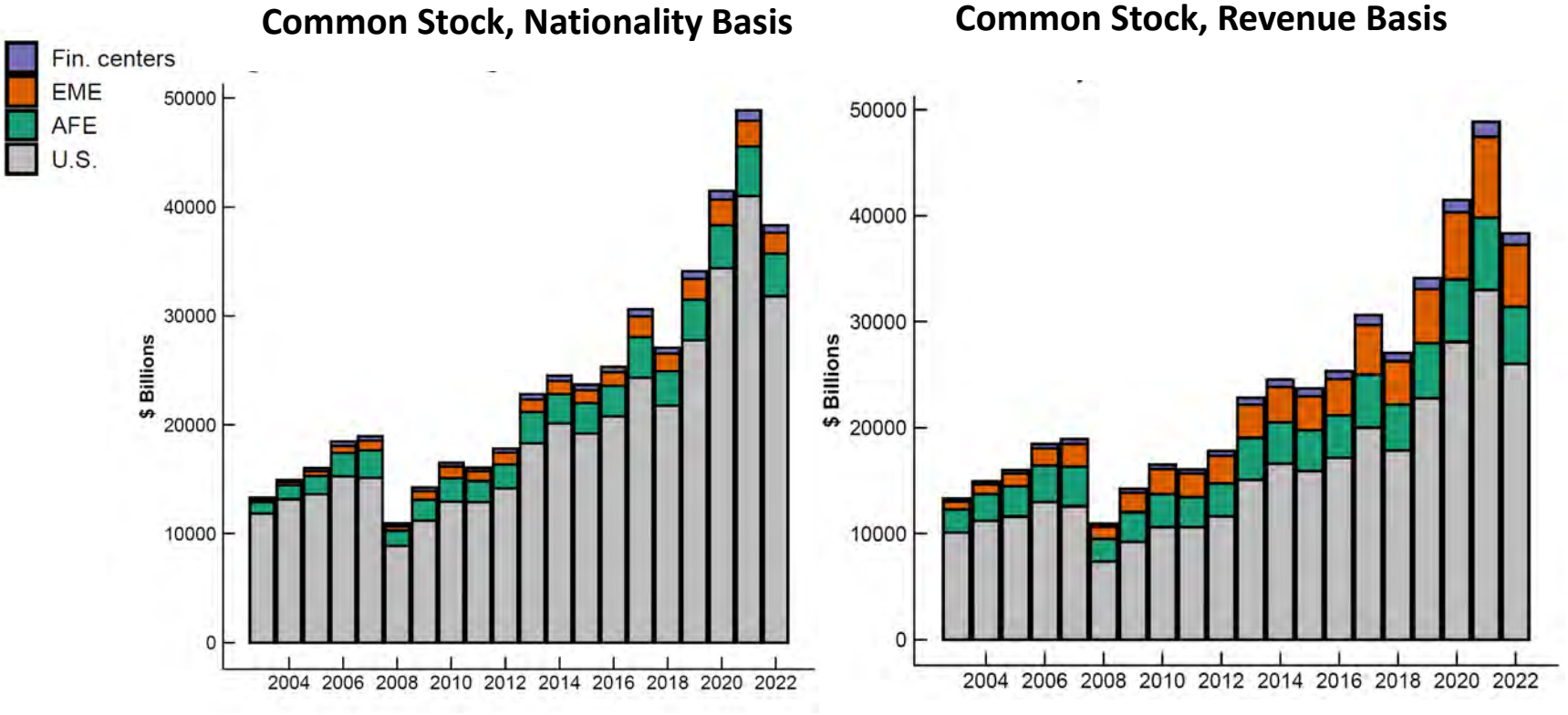
Nationality to revenue-exposure

Bertaut, Bressler, Curcuru (2020, 2021): Nationality to revenue-exposure remap:

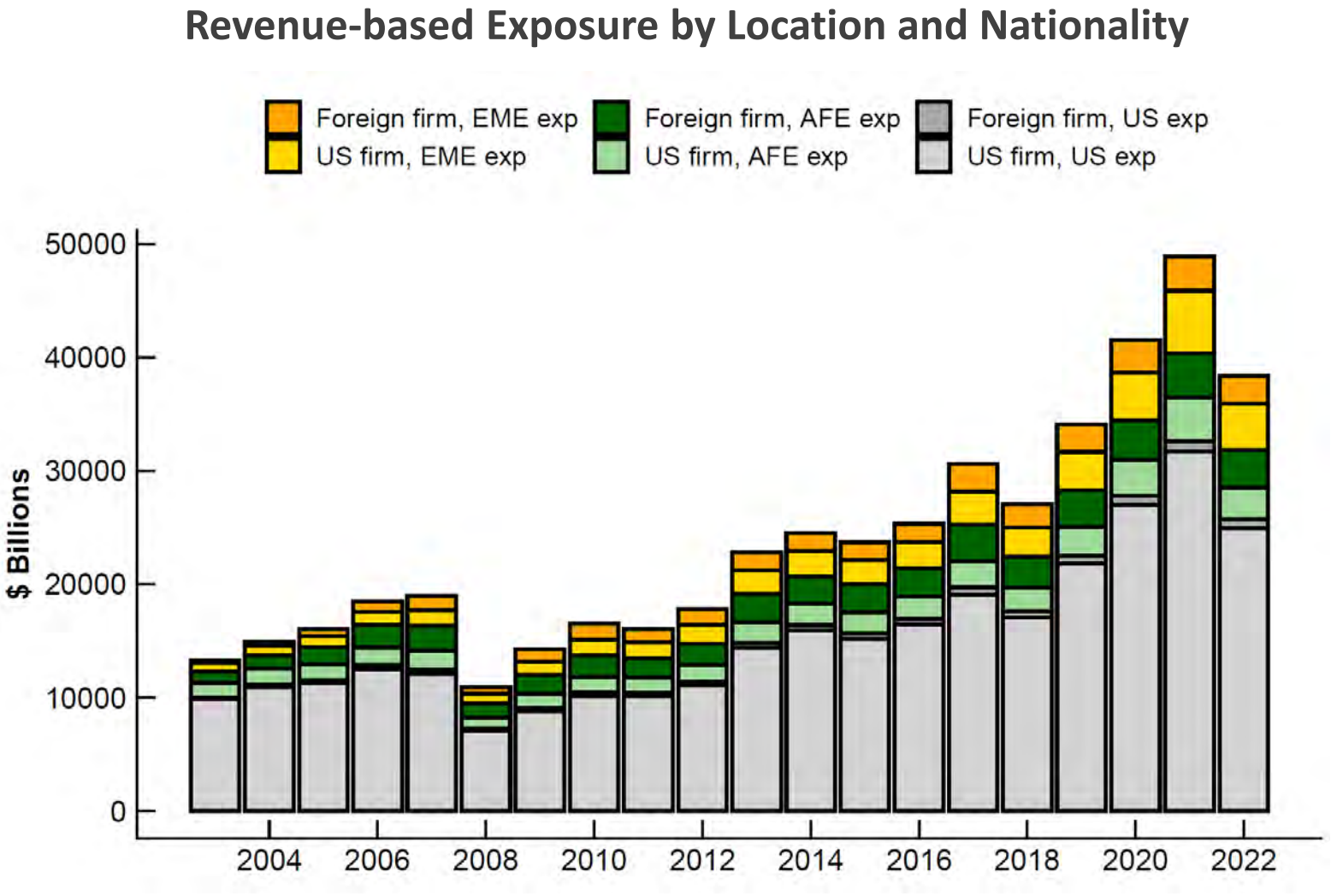
- US investors have substantial exposure to rest of the world through global activities of US multinational firms
- Foreign multinationals are likewise active around the globe
- Match security-level stock holdings (US & foreign) to Refinitiv Worldscope firm-level data
- Use geographic sales revenue information reported in firm disclosures to distribute holdings by country of revenue exposure
  - Very good coverage for US firms (reporting requirement)
  - Good coverage for foreign firms that list on US exchanges

Broader measure of “exposure”

- Revenue basis roughly doubles foreign exposure for US investors
- Exposure to emerging markets comparable to advance economies, in large part because of activities of multinationals



Indirect foreign exposure as large as direct exposure



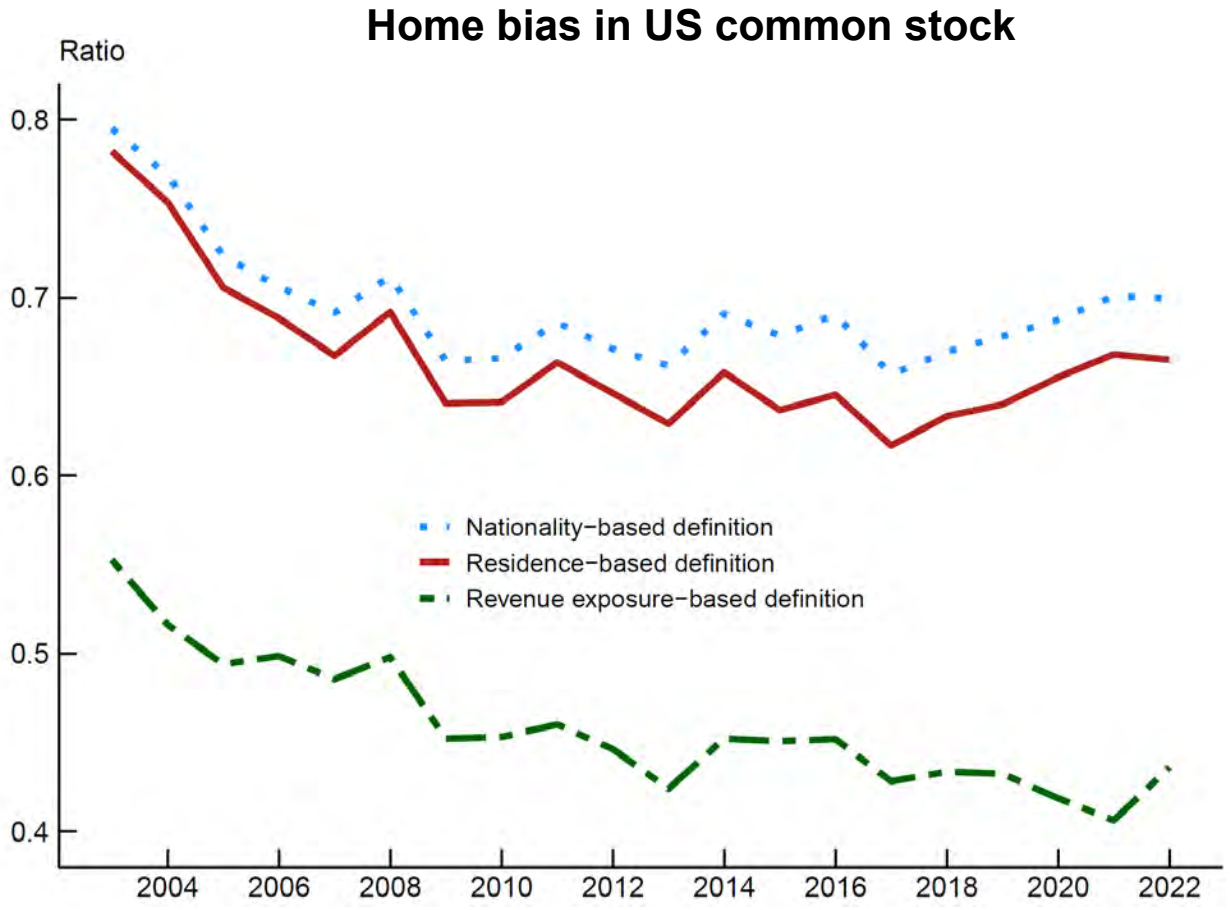
Our findings have implications for "Home Bias"

- ICAPM: in frictionless world, global investors should hold market cap in portfolio:

$$Home\ Bias = 1 - \frac{\frac{(holdings\ of\ foreign\ equity)}{(total\ equity\ portfolio)}}{\frac{(foreign\ equity\ market\ cap)}{(world\ equity\ market\ cap)}}$$

- But investors don't: widespread "home bias"
  - Literature: frictions, hedging costs, market access, information advantages of home country firms
- Country allocation of equity holdings and market cap will affect these calculations

Dramatically different home bias estimates across measures



- **Residence basis:**
  - high home bias; trended down since 2003 but some reversal
- **Nationality basis:**
  - higher home bias, less pronounced trends
- **Exposure basis:**
  - Much lower level of home bias, more stable

Drivers of home bias depend on the measure

- Econometric exercise to compare drivers of US country bias in common stock using different data constructions (residence, nationality, revenue exposure) in standard gravity model
- Very different results for importance of factors such as distance & trade links; common language, access to information
- Has implications for conclusions we draw for drivers of investor allocations
- Ongoing work: exploit match to firm level data to allow for richer exploration of firm characteristics in determining portfolio allocations

Conclusions

- Cross-border statistics are increasingly distorted
- Our results are based on US investors & US portfolios, but global portfolios will be similarly affected
- Our findings have important implications for any work in international finance which relies on these data
- Better exposure measures could possibly change our understanding of the drivers of capital flows, exchange rate movements, and global asset returns more generally

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

The geography of capital allocation in the euro area[1]

Roland Beck and Martin Schmitz,
European Central Bank;

Antonio Coppola,
Stanford University Graduate School of Business and SIEPR;

Angus Lewis,
Stanford University Graduate School of Business,

Matteo Maggiori,
Stanford University Graduate School of Business, NBER, and CEPR,

Jesse Schreger,
Columbia Business School, NBER, and CEPR

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

The Geography of Capital Allocation in the Euro Area*

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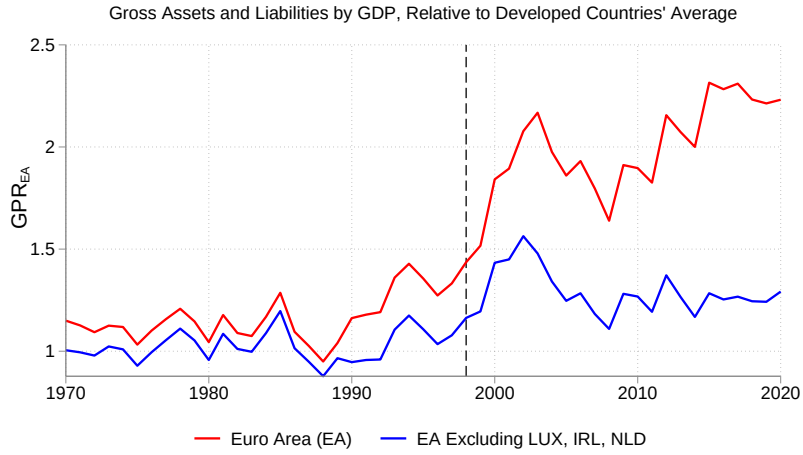
External Statistics Conference, Madrid
12 February 2024

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1. Euro area Onshore Offshore Financial Centers (OOFCs)
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Excess Growth in EA Gross Positions largely due to IRE, LUX and NLD



$$\text{GP}_{\text{EA}} = \frac{\sum_{i \in \mathbf{EA}} (A_i + L_i)}{\sum_{i \in \mathbf{EA}} \text{GDP}_i} \quad \rightarrow \quad \text{GPR}_{\text{EA}} = \frac{\text{GP}_{\mathbf{EA}}}{\sum_{i \in \mathbf{DM}} \text{GP}_{\mathbf{i}} \frac{\mathbf{GDP}_i}{\sum_{i'} \mathbf{GDP}_{i'}}}$$

DM = {USA, JPN, GBR, CHE, AUS, NZL, KOR, NOR, CAN}

Back

The Dual Role of OOFCs

- **IRE, LUX and NLD**: "Onshore offshore financial centers" (OOFCs)
  - Onshore markets within euro area, but with parallels to offshore financial centers
- Two major roles of OOFCs in euro area financial intermediation
  1. Hubs for euro area **investment fund** industry
     - LUX and IRL funds manage 40% of cross-border equity and bond holdings of euro area
     - LUX and IRL fund assets €7.5tn, compared to €2tn for Germany, €240bn for Italy
     - Opaque ownership: 43% of LUX, IRL fund shares have unknown owners in int'l statistics
  2. **Securities issuance** by affiliates of foreign companies
     - Account for a third of intra-euro area cross-border corporate bond holdings
- Looking through these dual roles of OOFCs crucial to understand euro area cross-border investment patterns and financial integration

Related Literature

- **Nationality-Based Statistics:** Avdjiev, McCauley, Shin (2016); Bertaut, Bressler, Curcuru (2019); Damgaard, Elkjaer, Johannesen (2019); Coppola, Maggiori, Neiman, Schreger (2021)
- **Fiscal and Monetary Unions:** Farhi, Werning (2016, 2017); Kehoe, Pastorino (2017); Farhi, Tirole (2018); Fornaro (2022); Ando, Dell'Ariccia, Gourinchas, Lorenzoni, Peralta, Roch (2023)
- **Tax Havens, Firm Capital Structure:** Hines, Rice (1994); Desai, Foley, Hines (2005); Huizinga, Laeven, Nicodeme (2008); Zucman (2013, 15); Hanlon, Maydew, Thornock (2015); Fuertes, Serena (2016); Alstadsater, Johannesen, Zucman (2019); Bilicka (2019); Guvenen, Mataloni, Rassier, Ruhl (2019); Aminadav, Papaioannou (2020); Altshuler, Boller, Suarez-Serrato (2023)
- **European Financial Integration:** Kindleberger (1973); Eichengreen (1993); Lane (2006); Coeurdacier, Martin (2009); Kalemli-Ozcan, Papaioannou, Peydro (2010); Coeurdacier, Rey (2013); Hale, Obstfeld (2016); Gopinath, Kalemli-Ozcan, Karabarbounis, Villegas-Sanchez (2017); Lane, Milesi-Ferretti (2018); Koijen, Richmond, Yogo (2018); Hoffman, Kremer, Zaharia (2019)
- **Cross-Border Investment and Euro Area Portfolios:** Lane, Milesi-Ferretti (2001); Portes, Rey (2005); Forbes (2010); Lane, Shambaugh (2010); Benetrix, Lane, Shambaugh (2015); Koijen, Yogo (2019); Coletta and Santioni (2019); Monti and Felettigh (2008); Vivar, Lambert, Wedow, Giuzio (2020); Carvalho, Schmitz (2021); Boermans (2022); Boermans, Cooper, Sercu, Vanpee (2022); Jiang, Richmond, Zhang (2020); Maggiori, Neiman, Schreger (2020); Darmouni, Papoutsi (2022); Liu, Redding, Yogo (2022); Faia, Salomao, Veghazy (2022); Fang, Hardy, Lewis (2022); Pacheco (2022); Pellegrino, Spolaore, Wacziarg (2022)

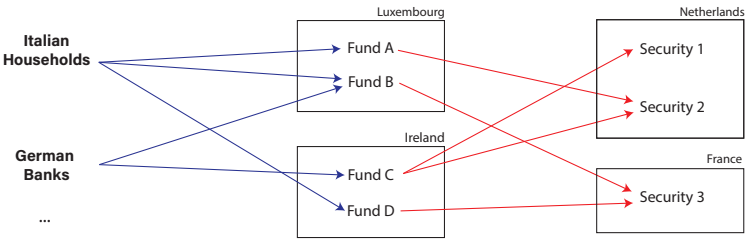
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Methodology: Unwinding Holdings Intermediated Through OOFCs

- Throughout, we rely on multiple data sources:
  - **ECB SHS**: Each EA country's security holdings, including of fund shares in LUX and IRL
  - **Morningstar, Refinitiv**: Each fund's complete holdings of securities worldwide

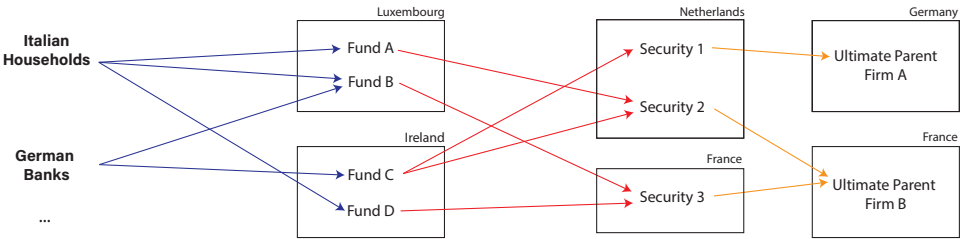
- Merging them allows us to look through entire intermediation chain



Aggregation

Methodology: Unwinding Holdings Intermediated Through OOFCs

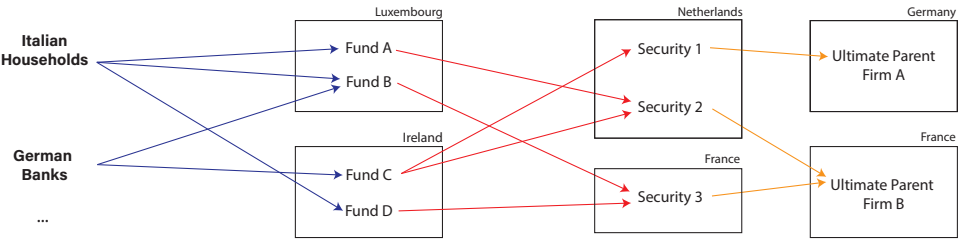
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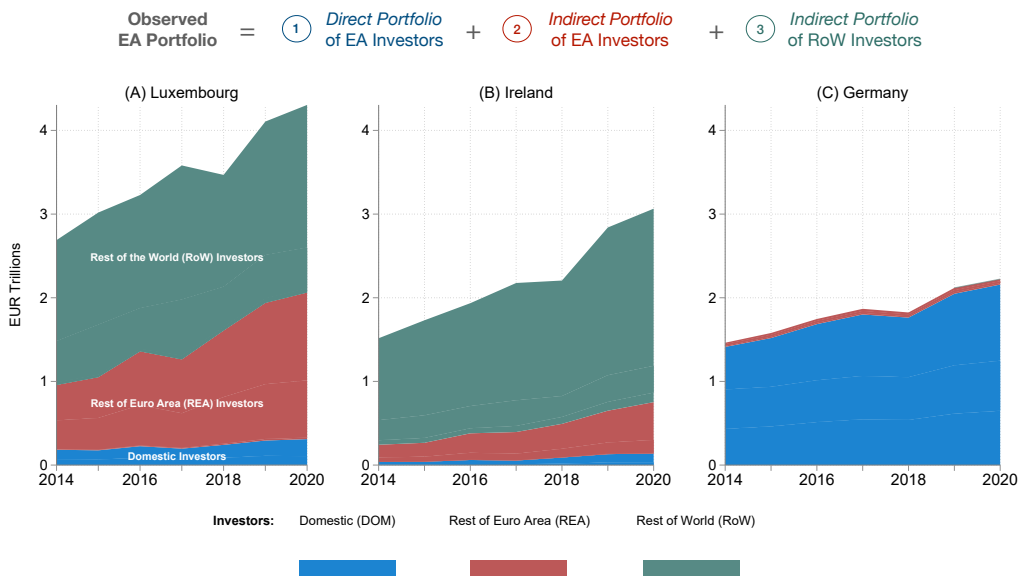


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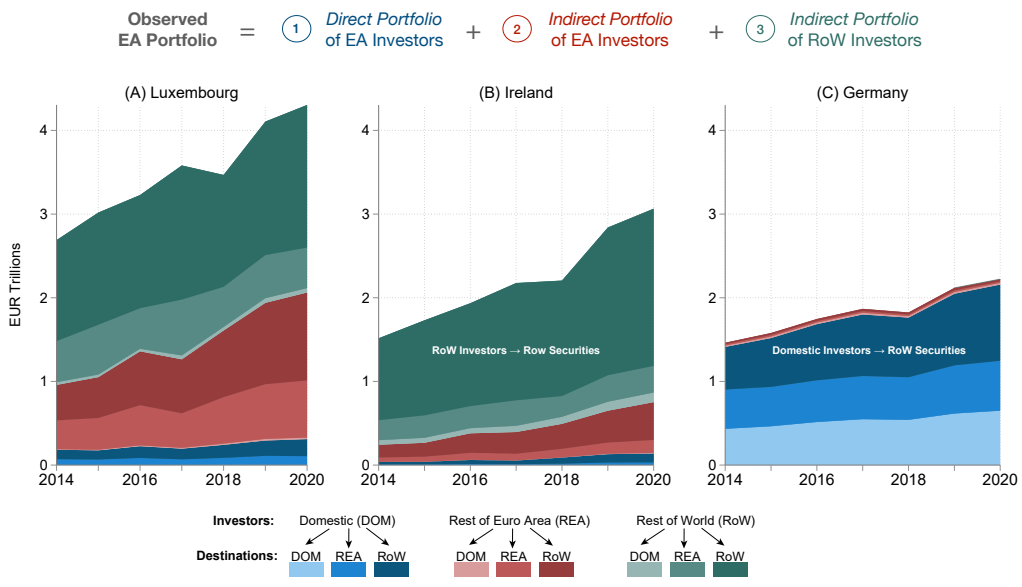
RoW and Euro Area Investors: An Organizing Framework

Observed EA Portfolio = ① *Direct Portfolio* of EA Investors + ② *Indirect Portfolio* of EA Investors + ③ *Indirect Portfolio* of RoW Investors

RoW and Euro Area Investors: Different Destinations via LUX, IRL Funds



RoW and Euro Area Investors: Different Destinations via LUX, IRL Funds



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Restatements Essential for Assessing Exposures: Italian Portfolio Holdings

		Restated Statistics (EUR Billions)			
Destination	**Official (CPIS)**	**Nationality Adj.**	**Funds Adj.**	**Both**	**Δ**
A. Euro Area Countries					
France	140	142	184	192	+38%
Germany	57	62	85	98	+71%
Greece	3	3	5	5	+98%
B. Non-EA					
China	1	4	7	22	+1,545%
Japan	12	14	28	32	+167%
Russia	1	3	5	7	+518%
United States	127	137	247	279	+120%
C. OOFCs					
Ireland	150	146	48	35	-77%
Luxembourg	644	645	153	60	-91%
Netherlands	55	28	76	45	-18%

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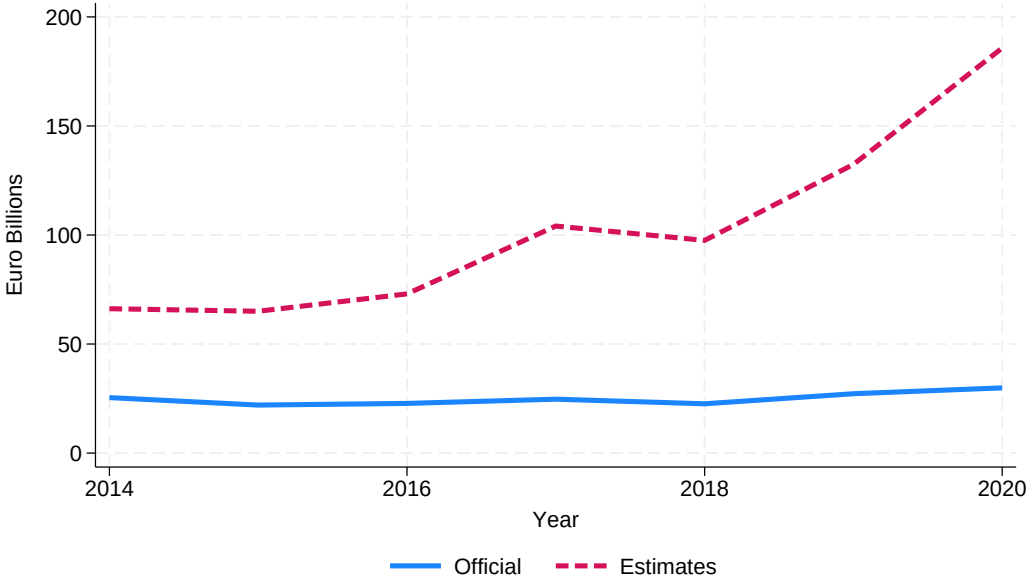
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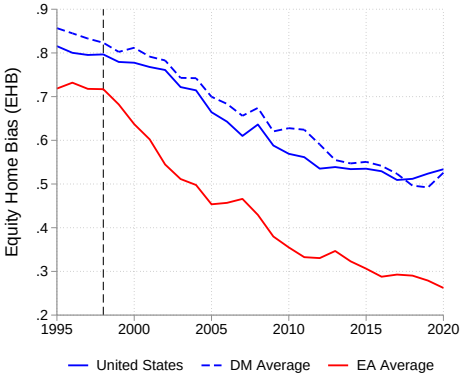
Restated Data shows larger Euro Area Portfolio Investment in China



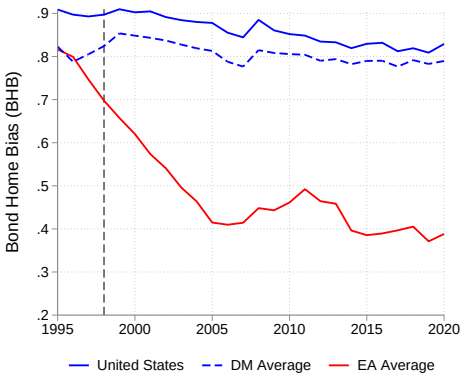
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Revisiting Home Bias in the Euro Area



(a) Equity Home Bias



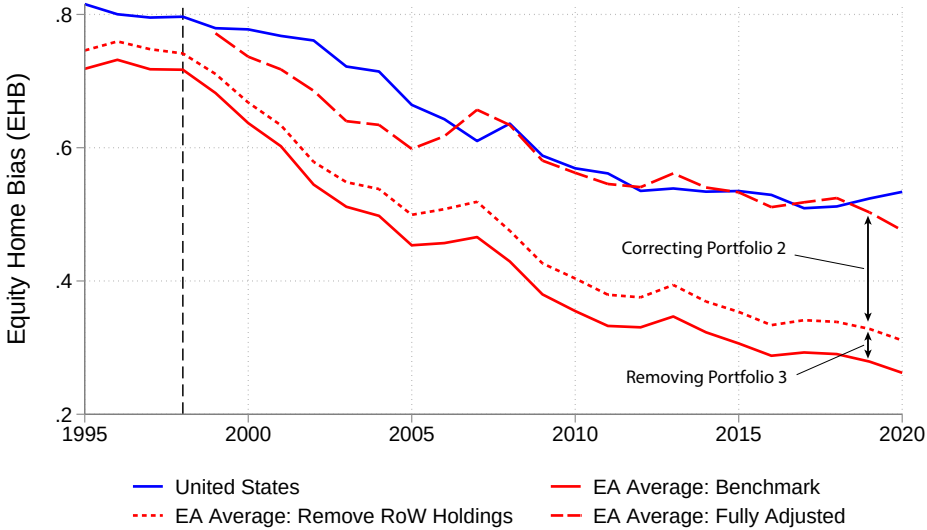
(b) Bond Home Bias

$$\text{Home Bias}_j = 1 - \frac{\text{Share of Foreign Securities in Country } j \text{ Portfolio}}{\text{Share of Foreign Securities in World Market Portfolio}}$$

Revisiting Equity Home Bias in the Euro Area

- Literature had to estimate indirect portfolio via investment funds (portfolio #2)
- Standard method assumes LUX, IRL fund shares = claims on foreign equity. Two biases:
  1. Fund holdings actually include domestic equity (small)
  2. Fund holdings actually include claims on bonds, cash, and non-securities (big)
- Additionally, equity holdings of Luxembourg and Ireland biased by RoW investments (portfolio #3)
- Historical time series: assume *constant fraction* of non-domestic equity for each fund share

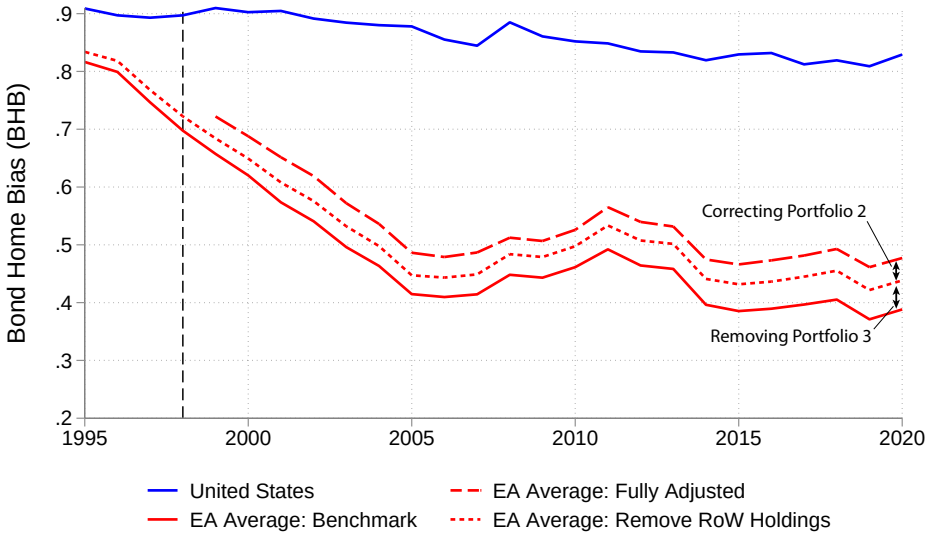
Adjustments Reveal No Specialness of Euro Area Equity Home Bias Trend



Revisiting Bond Home Bias in the Euro Area

- Literature ignored indirect portfolio (portfolio #2)
- Implications of omitted fund share holdings. Two biases:
  1. Fund holdings actually include domestic bonds (small)
  2. Fund holdings actually include foreign bonds (also small)
- Additionally, holdings of Luxembourg and Ireland biased by RoW investments (portfolio #3)

After Adjustment, Euro Area Bond Home Bias Still Special



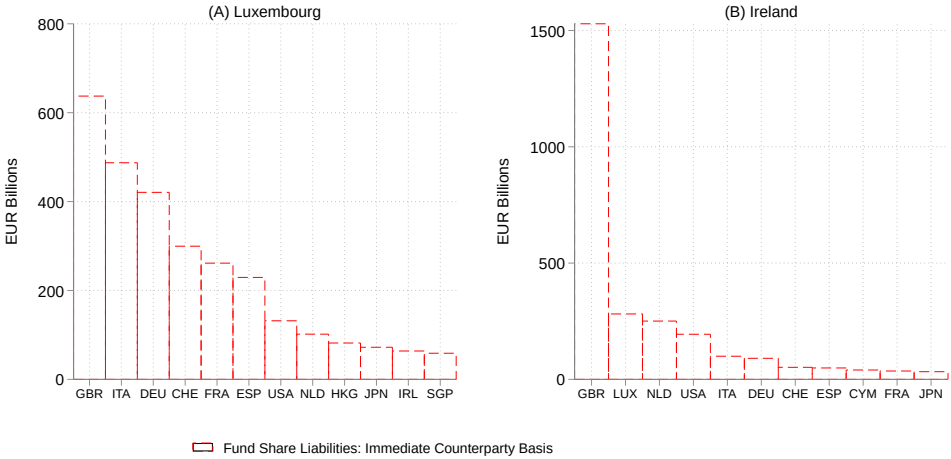
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RoW Investors in Luxembourg and Ireland

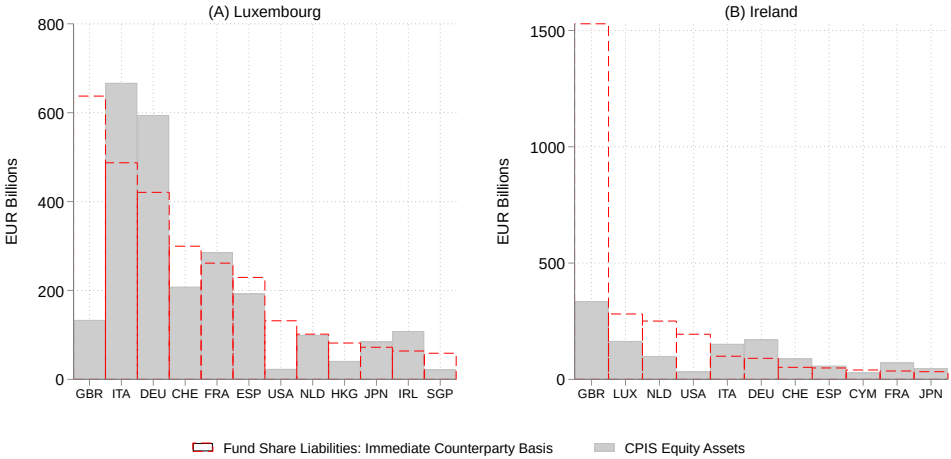
- Well-known discrepancy:
  - Globally declared holdings in LUX and IRL fund shares far below LUX and IRL declared liabilities
  - Difference $>$ €3 trillion
- *Missing wealth* may be accounted for by hidden assets in Switzerland and in other financial centres (Zucman, 2013)
- We use new administrative data from Luxembourg and Ireland on the geography of *immediate* fund ownership
  - Data provided by Central Bank of Ireland and Luxembourg regulator (CSSF)
  - CSSF data additionally interacts geography of Luxembourg fund owners and of investments
- Revealed preference approach to investigate *ultimate* ownership

Administrative Data Reveals Crucial Role of UK in OOFC Fund Ownership



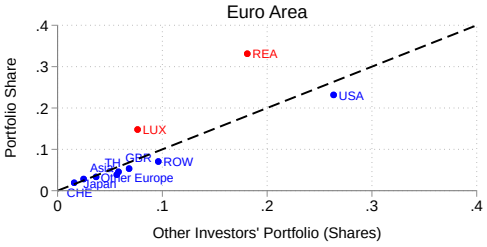
- Key new question: who is the UK investing on behalf of?

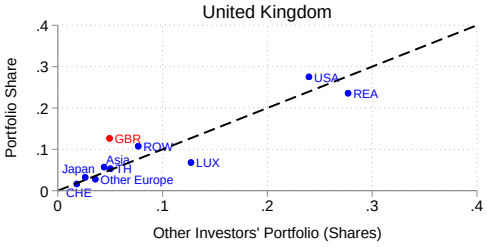
Administrative Data Reveals Crucial Role of UK in OOFC Fund Ownership

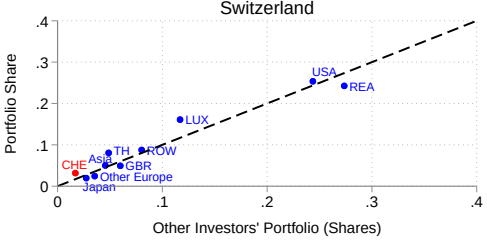


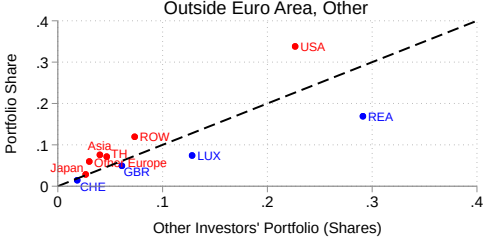
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What Each Immediate Counterpart Region Holds via Luxembourg Funds

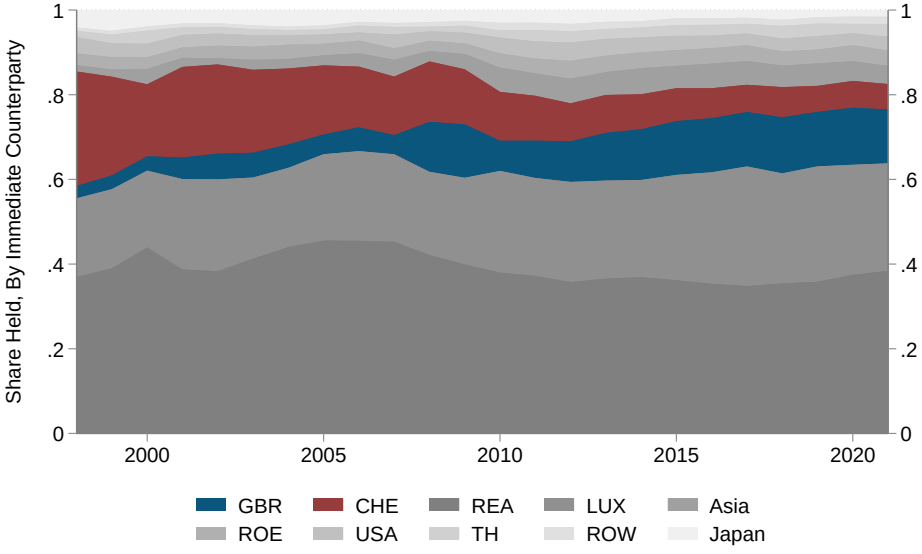








Ownership of Luxembourg Funds: Transition From Switzerland to UK



RoW Investors in Luxembourg and Ireland

- Largest non-EA immediate counterparty for IRL and LUX is now the UK
- UK-intermediated funds overweight UK and RoW assets
- Very likely that UK-intermediated funds reflect underlying investments by UK and RoW (in particular non-EA) investors

Much More in the Paper

- Allocative Effects
- North-South Allocations
- Portfolio Allocations Through Micro-Data (ICAPM)

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Conclusion

- A new view of capital allocation in the Euro Area
  - Large role of **onshore offshore financial centers**: Luxembourg, Ireland, Netherlands
  - Resolve intermediation chains through OOFCs using new data and methods
- New estimates allow for proper assessment of Euro Area countries' exposures
- Enhanced measurement of extent of euro area financial integration
- Role of currency in bond markets vs. equity home bias
- New evidence on ownership of LUX and IRL funds: pivotal role of the UK

Extra Slides

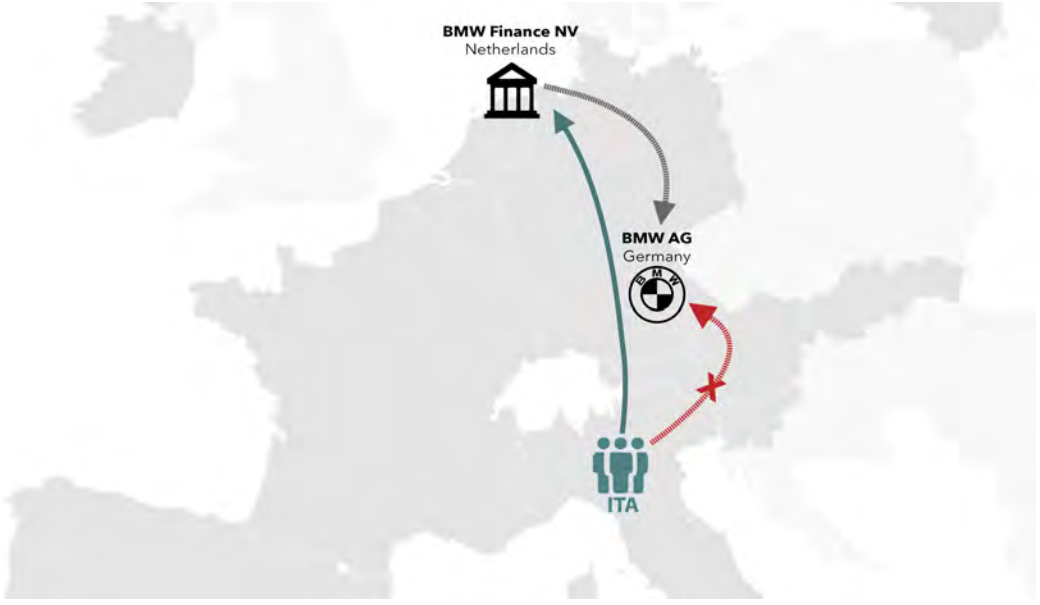
The Role of European Financial Centers in Capital Allocation



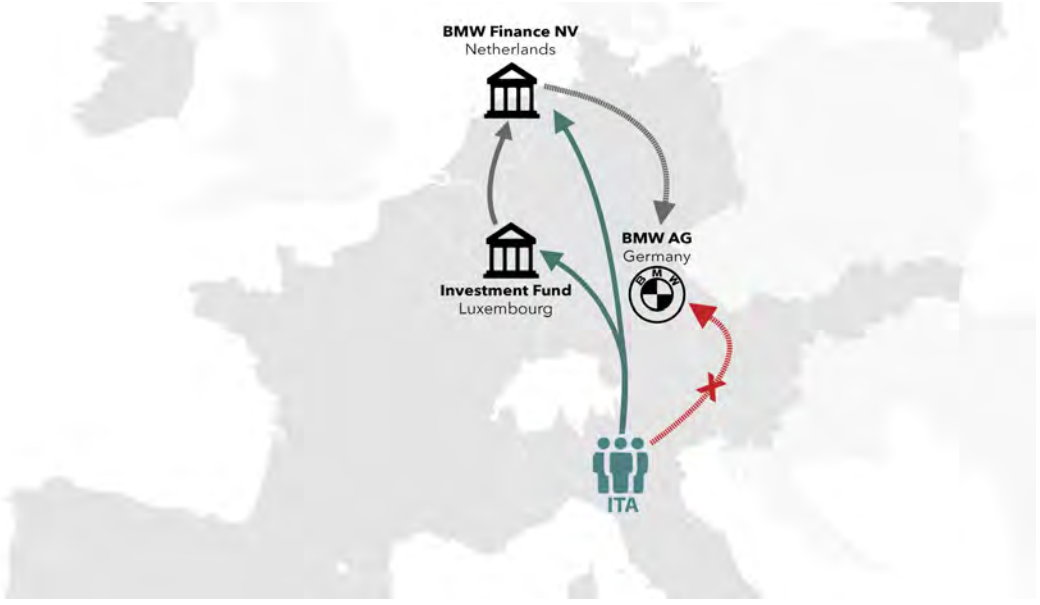
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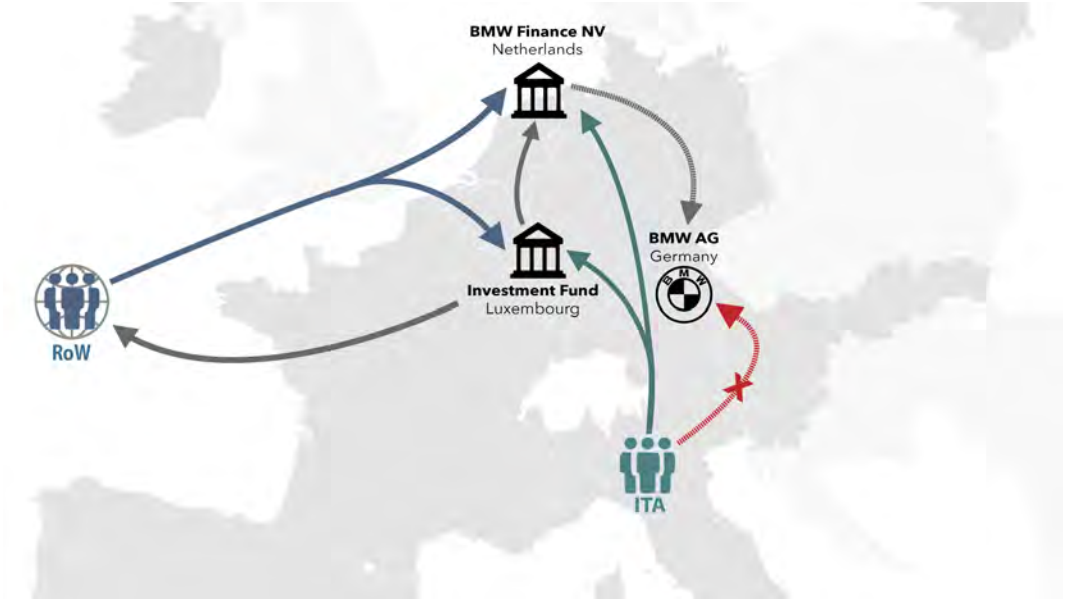
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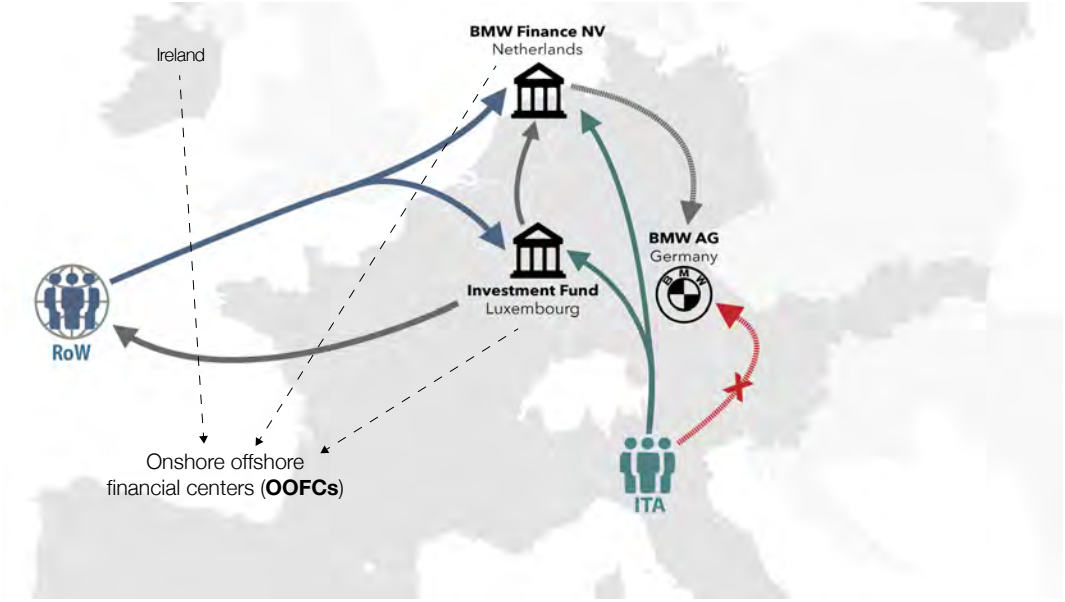
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The Role of European Financial Centers in Capital Allocation



The Role of European Financial Centers in Capital Allocation



Using Within-Firm Variation to Establish Impact on Allocations

Back

With $\theta_{k,i,t}$ the *domestically held share* of firm k's bonds issued via subsidiaries in country i:

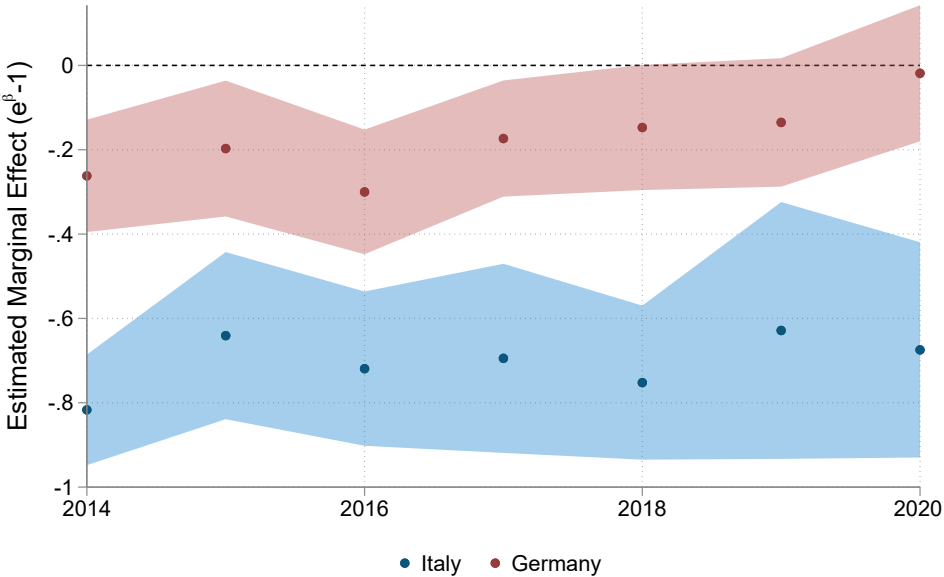
$$\theta_{k,i,t} = \exp\{\alpha_t + \gamma_k + X_{k,i,t}\,\beta\} + \varepsilon_{k,i,t}$$

	Domestically Held Share ($\theta_{k.i.t}$)	
	(1)	**(2)**
OOFC Dummy†	$-.48^{***}$	$-.33^{***}$
	(.04)	(.06)
Firm FE	N	Y
Year FE	Y	Y
Nationality FE	Y	Y
Identifying Observations	12,930	11,827
R^2	.22	.84

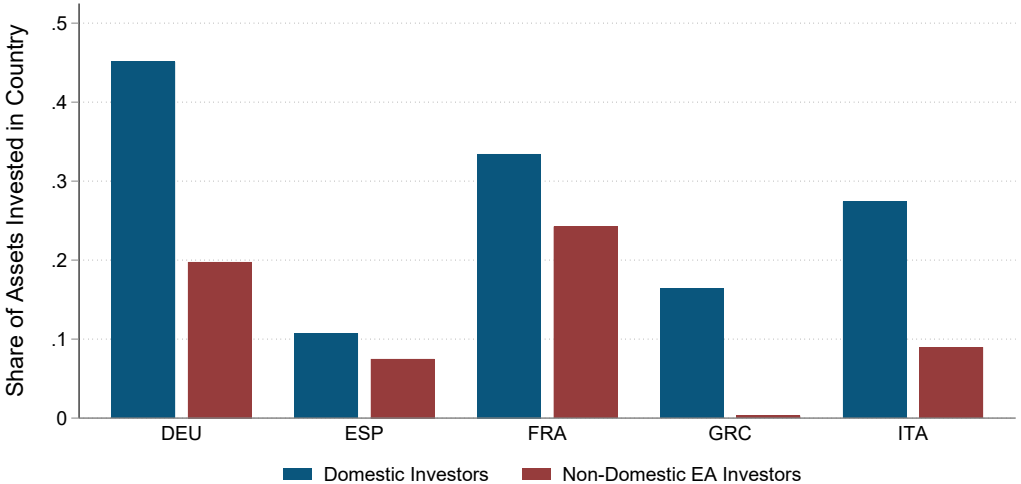
† *PPML estimator, marginal effect* $e^{\hat{\beta}} - 1$ *shown*

North-South Heterogeneity in Within-Firm Allocative Effects

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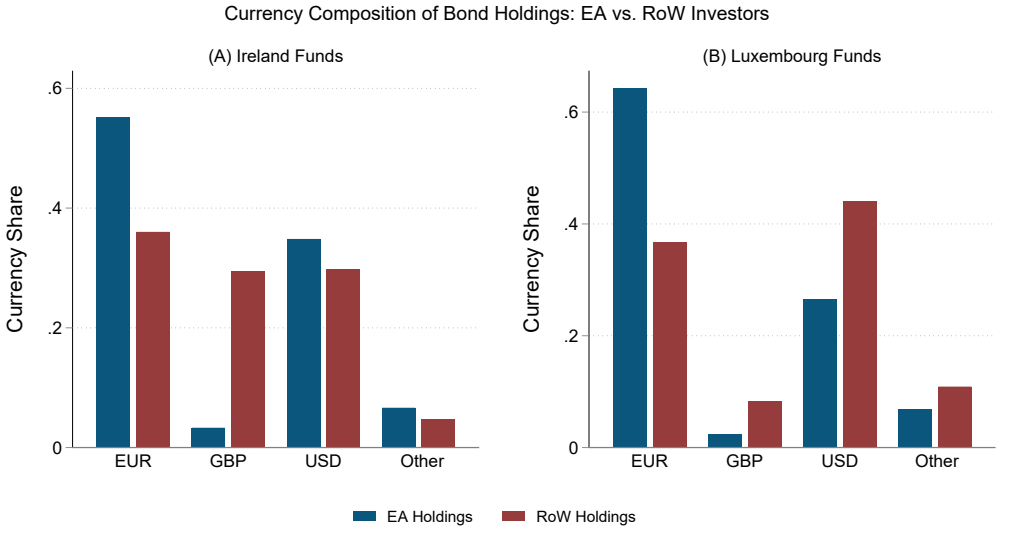


Home Bias in Each EA Country's Holdings Through LUX and IRL Funds



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Large Home Currency Bias in Holdings Through LUX and IRL Funds



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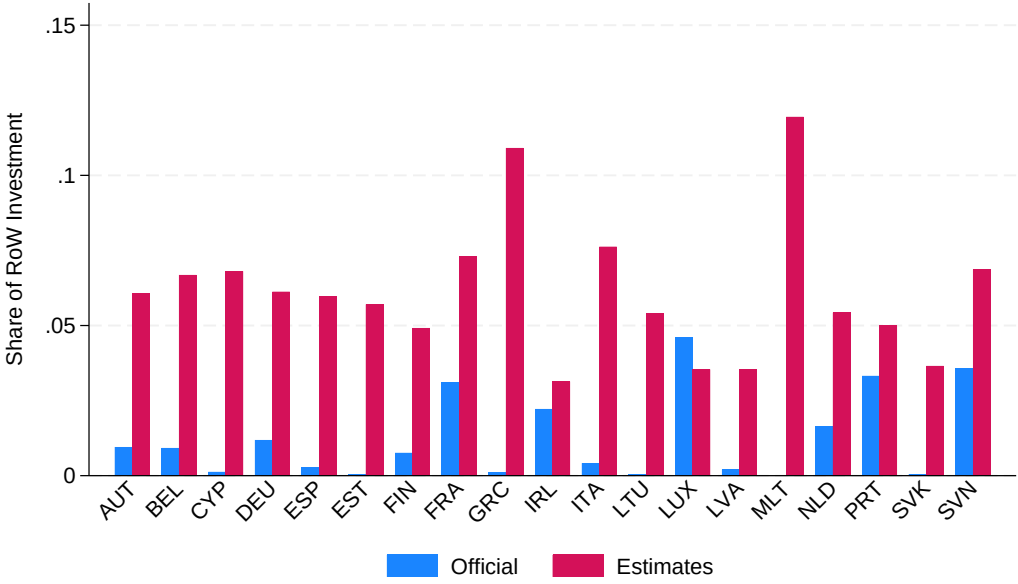
Residency-Based vs. Nationality-Based Statistics

- What is meant by Residency and Nationality?
- Cases where Nationality $\succ$ Residency:
  - Issue in OOFCs through foreign shell company (BMW Finance NV)
  - Tax inversions to Ireland (Medtronic)
- Cases where Nationality $\overset{?}{\succ\prec}$ Residency :
  - Issue through foreign operating subsidiary (T-Mobile US)
- Use algorithm of Coppola et al. (2021): map universe of securities from issuer (Residency) to ultimate parent (Nationality) using multiple commercial data sources

Issuer	Residency	Parent	Nationality	Value (€B)
BMW Finance NV	NLD	BMW AG	DEU	48
Petrobras Global Finance BV	NLD	Petroleo Brasileiro SA	BRA	36

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Restated Data shows larger Euro Area Portfolio Investment in China



IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

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Consolidated foreign wealth of nations: nationality-based measures of international exposure[1]

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[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Consolidated Foreign Wealth of Nations: Nationality-based measures of international exposure[1]

André Sanchez Pacheco[2]

Abstract

This paper presents novel estimates of foreign holdings from a consolidated-by-nationality perspective for a sample of fourteen developed countries over multiple years. It describes the stylized facts that emerge from this new data-set on the international exposure of countries. It shows that aggregate international financial integration is larger from a nationality-based approach relative to the conventional residence-based data. These novel data are used to analyze (1) profit shifting activities and (2) spillovers from U.S. monetary policy shocks. I find evidence suggesting that nationals of relatively high-tax countries may shift assets to low-tax countries in ways not fully captured in residence-based statistics. I also find that a tightening in U.S. monetary policy is associated with a decline in consolidated-by-nationality foreign asset holdings by non-financial multinational enterprises. Such findings highlight the usefulness of this new data-set in international macroeconomics.

Keywords: International financial integration, financial globalisation, consolidated-by-nationality statistics.

JEL classification: F36, F21, F23.

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1. Introduction

How can policymakers assess the exposure its households and firms have to international risk factors? The conventional approach uses data on countries' foreign holdings to sort out these exposures. These data are collected using the residence of economic agents as the key criterion. For any given country, its external assets (liabilities) represent claims (liabilities) its residents have with respect to non-residents. It follows that only cross-border positions are recorded in residence-based statistics. Furthermore, this approach does not consider ties that exist between entities within the same corporate group. The local positions held by the affiliate of a multinational enterprise operating abroad may not be part of the foreign holdings of its home and host countries using this approach.

These two features of the residence-based approach pose a challenge given the increasing importance of multinational enterprises (MNEs). These corporate groups have affiliates operating in multiple countries. The local assets held by these affiliates in host countries represent investments made by an MNE away from its home country. Yet they may only be recorded in foreign balance sheets of host and home countries if there are cross-border transactions involved. If these investments are funded by raising resources with local agents, no exposure would be recorded for both home and host countries.

Decisions made by MNEs can affect employment and production in foreign countries hosting their affiliates. Blomstrom and Kokko (1998) provide evidence of these spillovers from activities of MNEs. Avdjiev et al (2020) have shown how monetary policy changes in the home country of multinational banks affect conditions in foreign countries hosting their affiliates. These studies point to the need for developing measures able to capture these international linkages more comprehensively.

The alternative used in this paper is to adopt a consolidated-by-nationality approach when computing foreign assets and liabilities. Under such approach, assets and liabilities held by affiliates operating abroad are consolidated to the parent group. It considers local and cross-border positions. These positions are then sorted according to the nationality of the ultimate owners of such investments. The fact that all positions are taken into account and that positions held by the affiliate are consolidated provide a more nuanced view around countries' international exposure.

The recent literature on nationality-based foreign holdings have revealed important stylized facts. Coppola et al (2021) show that China's net foreign assets position is substantially smaller from a nationality-based perspective. Bénétrix and Sanchez Pacheco (2023) show that the U.S. economy is more financially integrated with the rest of the world when compared to the conventional residence-based data. Despite the recent progress, there is currently no dataset containing information on the entire foreign balance sheet of countries from a consolidated-by-nationality perspective.

In this paper, I construct estimates of foreign assets and liabilities from a consolidated-by-nationality perspective for a group of 14 developed countries. This data contribution contains yearly estimates for the period between 2012 and 2019. It

is the first such dataset containing nationality-based estimates of foreign holdings for any group of countries.

Then I compare these novel data on foreign holdings with the residence-based ones from Lane and Milesi-Ferretti's External Wealth of Nations. A key variable in this analysis is the index of international financial integration (IFI). It measures the relative size of a country's foreign balance sheet and is equal to the sum of its foreign assets and liabilities divided by its GDP.

One relevant stylized fact that emerges from the analysis is that on aggregate these fourteen countries present a larger foreign balance sheet from a nationality-based perspective relative to the residence-based one. This result indicates these economies are more internationally financially integrated than previously thought. Such difference is associated with the fact that the consolidated-by-nationality approach considers both local and cross-border positions. In contrast, the residence-based approach only considers the latter.

Individually, most but not all countries present a larger consolidated-by-nationality foreign balance sheet. Countries with a sizeable presence of foreign companies engaging in international financial intermediation tend to have larger residence-based foreign balance sheets. These companies' cross-border holdings inflate their host country's residence-based foreign balance sheet. Meanwhile, these holdings are instead consolidated to their parent country using the nationality approach. Most notably, Ireland stands out as having a substantially larger residence-based balance sheet in line with Sanchez Pacheco (2022). Lane (2019) argues that the presence of these financial intermediaries opaques the positions held by Irish nationals in the residence-based data. In this sense, the nationality-based approach provides a clearer view on the international exposure these agents have.

These novel data are then used to study two macroeconomic issues. The first one is on profit shifting from high-tax countries to low-tax countries. Wier and Zucman (2022) estimate that around 37% of profits earned by multinational enterprises are shifted to tax havens. Dischinger and Riedel (2011) have shown that multinational firms tend to shift their intangible assets to affiliates located in low-tax countries. I use consolidated-by-nationality estimates of foreign holdings and the existing residence-based data to focus on their relationship with differences in corporate income tax rates.

A key variable in this analysis is the difference between the consolidated-by-nationality and residence-based measures of foreign holdings. Such difference is a proxy of the foreign holdings not captured by the residence-based approach. I find that the difference between these two measures of foreign holdings is negatively correlated with corporate income tax differentials in a sample of low-tax countries. In contrast, the coefficient estimate is positive when estimated in a sample of high-tax countries. These results provide indirect evidence that nationals from high-tax countries may shift assets and profits to low-tax countries in ways that are not entirely captured by the residence-based approach. This finding is in line with Bénétrix and Sanchez Pacheco (2023) and points to the relevance of consolidated-by-nationality data when analyzing profit shifting activities.

The second application of these novel data presented in this paper is on assessing spillovers from U.S. monetary policy shocks on multinational enterprises. Bergant et al. (2023) show that a tightening in U.S. financial conditions is associated

with a decline in global cross-border M&A activities. In this paper, I analyze the relationship between U.S. monetary policy shocks and foreign asset holdings by non-financial multinational enterprises.

I find that a tightening U.S. monetary policy shock is correlated with a decrease in consolidated-by-nationality foreign asset holdings by non-financial multinationals. This result is robust with respect to alternative estimation methods for these monetary policy shocks. Such result suggests that a tightening in U.S. monetary policy generates spillovers that are associated with multinationals reducing their foreign asset holdings.

More broadly, these two sets of results indicate that consolidated-by-nationality estimates of foreign holdings can be useful in tackling important questions across different topics in international macroeconomics. As noted by Lane (2021), the consolidated approach should complement the existing residence-based data given each approach offers advantages depending on the question at hand.

2. Nationality- and residence-based statistics

There are two main data dimensions in which the consolidated-by-nationality approach differs from the residence-based approach. The first one relates to the set of positions that are considered when estimating foreign assets and liabilities. In residence-based statistics, external holdings are recorded when there is an exposure of a resident economic agent relative to a non-resident economic agent. As a result, the residence-based approach focuses exclusively at cross-border positions. Local positions that represent exposures between resident agents of different nationalities within the same country are not captured by this approach. In contrast, the consolidated-by-nationality approach takes into consideration both local and cross-border positions when estimating foreign holdings.

The second difference relates to how entities within the same corporate group are treated under each approach. In residence-based statistics, an affiliate of a foreign multinational enterprise operating in a given host country is seen as a resident of that country. There is no direct linkage between that entity and the corporate group it belongs to. Cross-border assets and liabilities held by this affiliate will be recorded as external holdings of the host country even if the company is controlled by foreign agents. Meanwhile, the consolidated-by-nationality approach takes the assets and liabilities held by this affiliate and consolidates them to the parent company.

One example can illustrate how these differences impact the measurement of foreign assets and liabilities. Consider an affiliate of a foreign multinational enterprise from country A that is operating in host country B. Through this affiliate, the multinational enterprise wants to buy a factory in country B worth $5 million. Such investment is entirely financed by taking a loan from a local bank in country B.

Under the consolidated-by-nationality approach, this factory is an asset the foreign MNE owns in country B. Therefore, it would be recorded as a foreign asset of country A and a foreign liability of country B. Meanwhile, the loan taken by the affiliate to finance this investment represents a liability the MNE from country A has relative to a bank from country B. This loan would be recorded as a foreign liability of country

A and a foreign liability of country B. In this example, both foreign assets and liabilities of countries A and B rise by $5 million as a result of this investment.

Meanwhile, no exposure would be recorded under the residence-based approach. This affiliate operating in country B is not seen as a foreign entity. There is no cross-border transactions taking place as the investment made by the foreign MNE is funded locally. Crucially, this international exposure a foreign multinational from country A takes on country B would not be recorded in residence-based statistics. Similarly, the exposure the local bank B has relative to a foreign multinational would also not be recorded.

These two data differences are associated with a set of issues raised in the international finance literature. The first one relates to the identification of the ultimate exposure to financial risks. Under the residence-based approach, the foreign affiliate of country A's MNE is treated as a separate entity. Its local exposure is not captured in external residence-based statistics. As a result, relying exclusively on residence-based data pose a challenge for policymakers in country A to identify the exposure its multinational enterprises have. In contrast, local and cross-border positions held by this and others affiliates relative to foreign agents would appear in country A's consolidated-by-nationality foreign balance sheet. This feature makes it easier for policymakers to evaluate the ultimate exposure their agents have when using the consolidated data. In this context, Borio (2013) points to the need for constructing consolidated statistics in order to assess the exposure global firms have to different risk factors, countries and sectors.

During the Global Financial Crisis, European banks held a sizeable exposure to U.S. mortgage-backed securities through their U.S. affiliates as noted by McCauley (2018). Such exposure would not be captured by residence-based measures of foreign exposure but would appear in consolidated-based data. The consolidated-by-nationality approach also provides a more detailed view on the banking developments that came after the crisis. Using nationality-based data, McCauley et al. (2019) show that what appears to be a broad-based decline in international lending post-crisis was in fact related to European banks reducing their global footprint. These two studies highlight that the identification of exposure to financial risks can change in important ways when assessed from a consolidated perspective.

A second issue relates to the triple coincidence literature as in Avdjiev et al. (2016) and Avdjiev et al. (2018). In the standard international finance models, the decision-making unit coincides with the GDP area and currency area. In reality, however, multinational enterprises make decisions at the home country that affect production in foreign countries where their affiliates operate in. These affiliates may be spread across different currency areas. As a result, treating each entity separately according to their residence fails to capture this complex decision-making and production structure. In contrast, the consolidated-by-nationality approach provides a more nuanced view on these global corporate structures.

The consolidated-by-nationality offers an advantage relative to the residence-based approach when considering the ultimate exposure to financial risks. It also provides a more detailed view on the global footprint of multinational enterprises. This is particularly useful given their increased relevance over the past decades. However, there are also some relative disadvantages too. Unlike the residence-based approach, there is still no unified manual on how national authorities should collect

consolidated-by-nationality data. In this sense, Lane (2021) notes that the consolidated-by-nationality approach should complement rather than replace the existing residence-based framework.

Furthermore, residence-based statistics have proven useful in different applications in international finance. For example, Catão and Milesi-Ferretti (2014) show that residence-based data can be employed to construct informative early warning systems around the risk of an external crisis. This is particularly helpful for policymakers when considering how to set macroeconomic policy appropriately.

Another important relative disadvantage of the consolidated-by-nationality approach is that there is no data-set containing estimates of foreign holdings from a nationality perspective for multiple countries as in Lane and Milesi-Ferretti's seminal External Wealth of Nations (2001, 2007, 2018). This paper seeks to fill this gap by producing the first dataset on estimates of consolidated-by-nationality foreign holdings for a group of countries over multiple years. Relative to Coppola et al. (2021), this paper presents estimates for the entire foreign balance sheet of countries while their work focuses on portfolio investment.

3. Data

I construct consolidated-by-nationality estimates of foreign holdings for a group of countries using data from the U.S. Bureau of Economic Research, the International Monetary Fund, the Bank for International Settlements and from Orbis Europe. Foreign assets and liabilities are divided into similar functional categories as in BIS (2015) and Sanchez Pacheco (2022). More specifically, foreign assets and liabilities are divided into holdings related to the activities of national companies operating abroad; holdings related to activities of foreign companies operating in the country; portfolio investment and official assets. Furthermore, holdings related to these multinational enterprises are divided according to their activities into three sectors: banks, financial non-banks and non-financial companies.

The dataset includes the following countries: the United States, the United Kingdom, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Sweden and Switzerland. For most countries, data is available from 2012 to 2019 while for some the first observation starts later due to data limitations. Data for Ireland are taken from Sanchez Pacheco (2022) while data for the U.S. are taken from Bénétrix and Sanchez Pacheco (2023).

In section 4, I compare these novel nationality-based data to conventional residence-based holdings. Residence-based estimates of foreign assets and liabilities come from Lane and Milesi-Ferretti's External Wealth of Nations dataset.

3.1 Bank-related holdings

Consolidated-by-nationality estimates of foreign holdings related to the banking sector are constructed using data from the Bank for International Settlements (BIS). The methodology follows that employed in BIS (2015) also used in Bénétrix and

Sanchez Pacheco (2023) and Sanchez Pacheco (2022). Bank-related holdings are associated to the activities of both national banks as well as to foreign banks.

For any country i, foreign assets related to its national banks are equal to the claims held by them relative to all counterparts except those with same nationality. Foreign assets of country i related to foreign banks operating in it are given by the local liabilities of such banks relative to country i nationals.

Foreign liabilities of country i related to its national banks are estimated as the local liabilities of these banks operating abroad plus their cross-border liabilities excluding those to related offices. Foreign liabilities related to foreign banks are equal to the total claim of foreign banks on country i nationals.

3.2 Non-financial MNEs

3.2.1 Foreign MNEs

The holdings associated with foreign MNEs operating in European countries are computed using Orbis Europe. For a given country i, I download financial, employment and ownership data for all entities operating in it that have foreign nationals as their ultimate owners. I also download data on companies; status which indicates whether they are active or have been liquidated. Companies are sorted according to their 4-digit NACE code into two groups: financial non-banks and non-financial multinational enterprises.[3] Companies identified as banks are excluded from the sample as the assets and liabilities related to their sector are computed using BIS data.

The financial data used in this paper are companies' total asset holdings and shareholders' equity. These data may contain reporting gaps. Whenever there is a reporting gap, I follow the same procedure used in Sanchez Pacheco (2022). If a company is active, a reporting gap in period T would be filled with data from period $T - z$ where $z > 0$ is the smallest possible. If a company's status is not listed as active, then a reporting gap in period T would be filled with data from $T - z$ only if there is at least one future period $T + k$, $k > 0$ in which financial information is available. In case there is no financial information available for subsequent periods, it is assumed that this company became inactive in period T. Therefore, its total assets and shareholders' equity will be set to zero for all $t \geq T$. Such decision rule generates inputted data whenever there is a reporting gap in the sample.

Nationality-based foreign liabilities of country i related to foreign non-financial MNEs operating in it are estimated as the sum of these companies' total assets. Meanwhile, nationality-based foreign assets related to these companies are computed as the sum of their total assets minus their shareholders' funds. Given existing data limitations, such calculations imply that the estimates of foreign holdings presented in this paper represent upper bound estimates. More specifically, these calculations imply that the total asset holdings of foreign multinationals operating in country i have country i nationals as counterparts. They also imply that the financing these companies receive other than shareholders' funds come from

[3] The NACE codes used to identify financial non-banks are all of those included in group K 'Financial and Insurance' activities excluding the codes 6411 and 6419.

country i nationals. As it is possible that these assumptions may not always hold for all companies, the estimates related to the activities foreign multinationals represent upper bounds.

3.2.2 National MNEs operating abroad

Consolidated-by-nationality foreign assets and liabilities related to national MNEs operating abroad are computed using data from Orbis Europe and the U.S. BEA. These data sources contain information on multinational activities in Europe and the United States. It is possible that a given country has many of its MNEs operating outside of these two regions. This would pose a challenge when computing assets and liabilities related to these companies given this regional coverage limitation. Therefore, I first construct a proxy of how well the two data sources cover the activities of MNEs using the IMF Coordinated Direct Investment Survey.

For country i and year y, I compute the share of outbound FDI position to countries included in these two regions relative to the total outbound FDI made by country i. I exclude non-EU tax haven countries from this analysis.[4] Then I compute the average of such share for the period between 2009 and 2020. A share equal to one would indicate that these two regions receive all the FDI made by country i. Meanwhile, a share equal to zero would indicate that all the FDI made by country i is received by countries outside of Europe and the United States. The highest average share value in our sample comes from Ireland at 95%. The lowest share comes from the U.K. with 78%. Even at this lower bound, the two regions represent the vast majority of the direct investment made by the United Kingdom. While the regional coverage could potentially pose a challenge to this methodology, this does not appear to be the case for the countries included in the dataset given the elevated average coverage share across countries.

Foreign holdings related to affiliates of country i companies operating in Europe are constructed using Orbis Europe. First, I download financial and sectoral data on all companies who have country i as the country of its ultimate owner. I exclude companies located in country i and focus instead on those located elsewhere in the region. Then I apply the same procedure described in the subsection above to fill any reporting gaps that might exist. It is possible that the ultimate owners of some of these companies are not from country i but rather have redomiciled there for tax-related purposes. In this case, Orbis Europe will inaccurately indicate that these affiliates have country i as the country of its ultimate owner. To correct for this, I use the Bloomberg Tax Inversion Tracker from Mider (2017) to identify companies that have redomiciled. If an ultimate owner is identified as having redomiciled from country j to country i, the country of its affiliates are changed from j to i in the dataset.

[4] For country i, the share is computed as the sum of outbound FDI position to all countries in the Orbis Europe database plus the United States divided by the total outbound FDI position of that country excluding to non-EU tax havens. The countries included in Orbis Europe are: Albania, Andorra, Austria, Belarus, Belgium, Bosnia and Herzegovina, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Greenland, Hungary, Iceland, Italy, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom. The non-EU tax havens are Bermuda, Cayman Islands and Jersey.

Country i's consolidated-by-nationality foreign assets related to its companies operating in Europe are computed as the sum of their total asset holdings. Its foreign liabilities related to these entities are calculated as the sum of the difference between their total asset holdings and shareholders' funds.

Consolidated-by-nationality foreign assets related to country i's non-financial MNEs are equal to the sum of country i's foreign assets related to these companies operating in the U.S. plus in Europe. Similarly, its foreign liabilities related to its non-financial MNEs are equal to the sum of its foreign liabilities related to these companies operating in these two regions.

3.3 Financial non-bank holdings

3.3.1 Foreign Financial non-banks

Consolidated-by-nationality foreign assets and liabilities related to foreign financial nonbanks operating in European countries are computed using Orbis Europe. For a country i, I proceed by focusing on the group of companies whose NACE code is associated with financial non-banking activities as described in subsection 3.2.1. I use the same procedure described in that subsection to fill any reporting gaps that may exist.

Before computing aggregate holdings, an additional step is taken to address the potential presence of Special Purpose Entities (SPEs) in the sample. These financial non-bank companies often engage in cross-country financing as documented by Galstyan et al. (2021). Their presence inflate residence-based foreign balance sheet of host country i but virtually no economic to country i nationals or firms. As a result, these companies must be identified and removed when estimating the consolidated-by-nationality foreign holdings related to foreign financial non-banks. The procedure adopted in this paper follows that in Sanchez Pacheco (2022). In particular, a financial non-bank is removed from the sample if it has never reported a number of employees or it has last reported having zero employees.

Once potential SPEs are removed, country i's consolidated foreign assets related to foreign financial non-banks operating in it are given by the sum of the difference between their total asset holdings and their shareholders' funds. Analogously, country i's foreign liabilities are given by the sum of these companies' total asset holdings.

3.3.2 National Financial non-banks operating abroad

Foreign holdings related to country i's financial non-banks operating abroad are constructed using data from Orbis Europe and the U.S. BEA. The procedure adopted is akin to that used in section 3.2. We separately estimate the foreign holdings that result from the activities of these companies operating in Europe and the holdings that come from activities in the United States.

For country i's companies operating in Europe, its foreign holdings related to its financial non-banks are computed using the same procedure as that described in subsection 3.2.2. Accordingly, ultimate owners who are identified as having redomiciled to country i are excluded from the sample. Country i's consolidated foreign assets related to its financial non-banks operating in Europe are equal to the sum of their total asset holdings. Its foreign liabilities related to these companies are

equal to the sum of the difference between their total asset holdings and shareholders' funds.

3.4 Portfolio Investment

I rely on data from the International Monetary Fund's Coordinated Portfolio Investment Survey when estimating foreign assets and liabilities. Notwithstanding the important contribution by Coppola et al. (2021), relatively little is known regarding the nationality of the ultimate owners of global portfolio investments. As a result, I use the residence-based estimates of portfolio holdings when constructing the consolidated-by-nationality balance sheet of countries. For a given country, its foreign portfolio assets are equal to the total investment assets from the CPIS survey. Its foreign liabilities are equal to the total investment liabilities from the CPIS survey.

3.5 Official assets

Official assets are equal to the official reserve assets from the International Monetary Fund International Reserves and Foreign Currency Liquidity database. For the United States, official assets are equal to the U.S. reserve assets from its International Investment Position released by the U.S. BEA.

4. Stylized Facts

4.1 Aggregate dynamics

To assess broad dynamics, I construct aggregate indices of international financial integration using both the consolidated-by-nationality approach as well as the residence-based one. For any given year, the aggregate index is calculated as the sum of foreign assets and liabilities of selected countries divided by the sum of their GDP. The countries included when computing the aggregate index are the United States, the United Kingdom, Austria, Belgium, France, Germany, Italy, Netherlands, Sweden, Switzerland, Finland, Greece and Ireland. Denmark is removed from the sample given its nationality-based data starts in 2016. This index is computed for the period between 2013 and 2019 using both approaches.

Figure 1 shows the evolution of this aggregate IFI under the nationality-based and residence-based approach for the period between 2013 and 2019. It reveals that the consolidated-by-nationality aggregate IFI is larger than the residence-based one for all years in this period. This stylized fact indicates that these developed economies are more financially integrated with foreign agents than what resident-based measures suggest. Such result is due to the fact that the consolidated-by-nationality approach takes into account both cross-border as well as local positions while the residence-based approach focuses exclusively on the former. As such, an important part of the international exposure of countries is not captured by the residence-based approach.

Figure 2 shows the difference between the nationality-based and residence-based aggregate IFI over time. This figure reveals that the nationality-based IFI is not only

larger than the residence-based one but the difference between the two increased between 2013 and 2019. There is an important increase in the difference between 2014 and 2017 while it remained largely unchanged from then to 2019.

4.2 Country-level analysis

Figure 3 shows the index of international financial integration (IFI) under both the nationality-based and residence-based approaches per country for 2019. It reveals that most countries present a larger consolidated-by-nationality IFI relative to their residence-based balance sheet. This result is expected as the consolidated-by-nationality approach considers both cross-border and local positions while the residence-based one only considers cross-border positions.

The two exceptions to that are Ireland and Greece. In addition, Switzerland and the Netherlands have a nationality-based foreign balance sheet approximately the same size as their residence-based analogues as of 2019. In general, a country will have a relatively smaller consolidated-by-nationality foreign balance sheet if they are host to proportionally relevant number of foreign-owned entities whose activities involve holding cross-border assets and liabilities. These holdings inflate the size of the host country's residence-based foreign balance sheet. However, they are identified as being foreign-owned under the nationality-based approach. Therefore, these cross-border holdings do not appear in the host country's consolidated-by-nationality foreign balance sheet.

Ireland stands out as having a substantially smaller nationality-based foreign balance sheet relative to its residence-based one. Galstyan (2019) and Sanchez Pacheco (2022) discuss how the vast presence of SPEs in Ireland inflate its residence-based balance sheet. These companies have virtually no economic ties to Irish agents and are often involved in international financial intermediation. Their relatively large cross-border holdings enter Ireland's residence-based foreign balance sheet and opaque the positions held by Irish nationals as noted by Lane (2018). In contrast, these holdings do not enter Ireland's consolidated-by-nationality foreign holdings.

Figure 4 shows the evolution of the consolidated-by-nationality and residence-based IFI for all countries over the sample period. While the two measures of IFI are positively correlated across countries, the difference between them is not constant over time. Bénétrix and Sanchez Pacheco (2023) show that the time varying difference between the U.S. consolidated-by-nationality and residence-based IFI is positively correlated with tax differentials between the U.S. and the rest of the world. In the sections 5 and 6, these data on multiple countries are used in a panel setting to study profit shifting and spillovers of U.S. monetary policy shocks respectively.

Figure 5 shows the evolution of consolidated-by-nationality foreign assets and liabilities per country over time. In general, consolidated-by-nationality foreign assets and liabilities move in tandem. However, the difference between foreign assets and liabilities in Greece, Italy and Belgium moved in important ways during the sample period.

5. Tax differentials and foreign holdings

Multinational enterprises have an incentive to shift assets and profits to affiliates located in low-tax countries. Dischinger and Riedel (2011) document that the lower an affiliate's corporate tax rate is relative to other subsidiaries within the same group, the higher the level of intangible assets held by this affiliate. Wier and Zucman (2022) estimate that 37% of profits earned by such companies were booked in tax havens in 2019. That compares to only 2% in the 1970s, according to their estimates.

Using data for the United States, Bénétrix and Sanchez Pacheco (2023) provide indirect evidence that asset/profit shifting activities by U.S. multinational enterprises may extend beyond what residence-based statistics can capture as local positions are also considered in the consolidated approach.

In this section, I examine whether consolidated-by-nationality foreign assets are associated with corporate income tax differentials using a panel of fourteen developed countries. I proceed by examining the relationship between foreign holdings and corporate income tax differentials. This analysis is done using both the existing residence-based data as well as the novel consolidated-by-nationality data. Then I focus on the difference between the consolidated-by-nationality and residence-based measures of foreign holdings to assess whether these time-varying differences are also associated with tax differentials. Such difference is a proxy for the foreign exposure countries have that is not captured by the residence-based approach. The regressions also include control variables that have been documented to such as GDP per capita and trade openness as in Lane and Milesi-Ferretti (2001).

Data on GDP per capita comes from the World Bank. Trade openness also comes from the World Bank and is measured as a country's trade in goods and services divided by GDP. The difference in the corporate income tax rate for country i is computed as its statutory corporate income tax rate minus the median statutory tax rate from the set of countries included in the OECD Tax database.

These empirical relationships are examined through panel regressions shown in equation 1. The dependent variables $Y_{i,t}$ used are foreign assets, liabilities and IFI under both the consolidated-by-nationality as well as the residence-based approach. Furthermore, I also estimate this regression using the difference between the nationality-based and the residence-based measures as dependent variables as well. The panel dataset includes observations on fourteen developed countries over the period between 2012 and 2019.

$$Y_{i,t} = \alpha_i + \beta_1 * GDPpc_{i,t} + \beta_2 * Open_{i,t} + \beta_3 * TaxDiff_{i,t} + \epsilon_{i,t} \quad (1)$$

The coefficient αi captures country i fixed effect. $GDPpc_{i,t}$ is the GDP per capita of country i at time t, $Open_{i,t}$ is country i's trade in goods and services as a % of GDP at time t. $TaxDiff_{i,t}$ is the difference between country i's statutory corporate income tax rate at time t minus the median corporate tax rate from the OECD Tax database for the same year.

Table 1 shows the regression results using data for all countries in the sample. The coefficient estimate associated with income per capita is positive and statistically significant at the 5% level for both nationality-based foreign assets, liabilities and IFI. This result is in line with Lane and Milesi-Ferretti (2001) that shows a positive

correlation between income per capita and foreign assets in a cross-section analysis using residence-based data.

Importantly, this table shows that the difference between nationality- and residence-based measures are also positively correlated with income per capita. The coefficient estimates in the regressions that use the difference between the two approaches are positive and statistically significant for foreign assets, liabilities and IFI. This result indicates that the time-varying difference between foreign holdings using these two alternative approaches is related to macroeconomic factors rather than being orthogonal to them.

The coefficient estimates associated with corporate income tax differentials are not statistically significant across specifications. At a first glance, this result seems to be at odds with Bénétrix and Sanchez Pacheco (2023) that show a positive correlation between the difference in U.S. nationality- and residence-based IFI and U.S. corporate income tax differentials.

One possibility for such result is that the sample used in Table 1 includes both high and low-tax countries. Consider a high-tax country A and a low-tax country B. Nationals of country A want to benefit from lower taxes in country B thus they shift holdings to that country. If country A nationals shift assets and profits to low tax country B, there would be a positive relationship between country A's tax rate and its foreign holdings. However, there would be a negative relationship between country B's tax rate and its foreign holdings. Therefore, including both high tax country A and low tax country B in the same sample could result in coefficient estimates that are not statistically significant.

To overcome such challenge, I divide the countries into two groups: a relatively high-tax group and a relatively low-tax group. A country i will be in the relatively high tax group if its statutory corporate income tax rate is greater than the median tax rate from the OECD database for most years in the sample. Conversely, it will be in the relatively low-tax group if its statutory corporate income tax rate is smaller than the median tax rate for most years in the sample.

This criterion puts the United States, Austria, Belgium, Denmark, France, Italy, the Netherlands, Sweden and Greece into the relatively high tax group. The United Kingdom, Germany, Switzerland, Finland and Ireland are in the relatively low tax group. I then estimate regression 1 focusing on the difference between nationality- and residence-based measures of foreign holdings for these different country sub-samples.

The coefficient β_3 should be positive for high-tax countries and negative for low-tax countries if MNEs shift profits due to differences in taxation. Consider an economy with a high-tax country A and low-tax country B with respective corporate income tax differentials $TaxDiff_{iA}$ and $TaxDiff_{iB}$. As country A has a relative higher tax rate, $TaxDiff_{iA} > 0$ and $TaxDiff_{iB} < 0$.

Consider a tax cut in country B. Such reduction increases $TaxDiff_{iA}$ for country A while $TaxDiff_{iB}$ for country B becomes more negative. If this tax cut encourages companies in country A to shift profits and holdings to country B, this increase in $TaxDiff_{iA}$ should be multiplied by a positive coefficient β3 to increase the dependent variable measuring foreign holdings for country A (Y_A). In a sample of relatively high

tax countries, a positive β3 would be consistent with profit shifting away from these countries.

The tax cut in country B makes $TaxDiff_{iB} < 0$ more negative. Crucially, the decision by companies in country A to shift holdings to country B following the tax cut implies an increase in foreign holdings in both countries A (Y_A) and B (Y_B). This can only be achieved if $\beta_3 < 0$ when estimated in a sample of low tax countries. Therefore, profit shifting would be consistent with $\beta_3 > 0$ when estimated in a sample of high-tax countries and $\beta_3 < 0$ when estimated in a sample of low-tax countries.

Table 2 shows the regression results for the difference between the nationality- and residence-based foreign assets, liabilities and IFI estimated using these sub-samples. The coefficient estimates associated with $TaxDiff$ are negative and statistically significant in the regressions focused on relatively low tax countries. Meanwhile, the coefficient estimates are positive albeit not statistically significant in the regressions focused on relatively high tax countries.

Taken together, these results are consistent with the notion that nationals of relatively high tax countries shift holdings to relatively low tax countries in a way that is not completely captured by conventional residence-based data. A policy implication of such finding is that there could be more asset and profit shifting activities than what policymakers can observe if focused only on the residence-based data. Similarly, tax differentials may generate an even more significant incentive for agents to shift assets than what analysis relying on existing residence-based data suggest.

6. U.S. monetary policy spillovers and non-financial MNEs

The dominant role the U.S. dollar plays in international finance indicates that U.S. monetary policy can generate spillover effects in non-U.S. economic agents. Miranda-Agrippino and Rey (2020) demonstrate how U.S. monetary policy shocks generate co-movements in international financial variables. They also show that a tightening in U.S. monetary policy generates a decline in global capital flows to both banks and non-banks.

Focusing on the banking sector, Avdjiev et al. (2018) show that an easing in U.S. monetary policy increases cross-border bank lending. Similar results analyzing spillovers to cross-border capital flows in the banking sector were found by Bruno and Shin (2015). In this sense, an easing in U.S. monetary policy would be associated with an increase in foreign asset holdings by global banks.

Recent research has also focused on the U.S. monetary policy spillovers to non-bank multinationals. Arbatli-Saxegaard et al. (2022) examine different channels through which U.S. monetary policy shocks affect companies' investments in foreign countries. They find that U.S. monetary policy shocks have a larger effect on firms that present higher share of debt denominated in foreign currency and on firms that are more leveraged. Bergant et al. (2023) document spillover effects from U.S. financial conditions to cross-border merger and acquisition activities.

In this section, I investigate whether U.S. monetary policy shocks are associated with changes in consolidated-by-nationality foreign assets by non-financial

multinational enterprises. The novel data on such assets for the sample group of developed countries are used in a panel regression setting.

I proceed by estimating the following panel regression of the change in foreign assets by these companies on a series of U.S. monetary policy shocks identified by Bu, Rogers and Wu (2021) as well as some control variables. Among such variables, I include the real exchange rate, the home country's monetary policy rate and an index of U.S. financial conditions. In the robustness check subsection, I use different series of U.S. monetary policy shocks based on alternative estimation methodologies.

$$\Delta FA^{MNES}_{i,t} = \alpha_i + \beta * USMP_t + \gamma * USFCI_t + \delta \Delta REER_{i,t} + \theta * HomeMP_{i,t} + \epsilon_{i,t} \quad (2)$$

The dependent variable $\Delta FA^{MNES}_{i,t}$ is computed as the first difference in consolidated-by-nationality foreign asset holdings by country i's non-financial MNEs as a percentage of GDP between year t and $t-1$. $USMP_t$ captures changes in U.S. monetary policy. In the baseline specification, it is equal to the sum of the unified U.S. monetary policy shocks estimated by Bu, Rogers and Wu (2021) in year t. An alternative specification is presented in which $USMP_t$ is equal to the average U.S. effective Federal Funds rate for any given year t. $USFCI_t$ is the average U.S. National Financial Conditions Index computed by the Federal Reserve Bank of Chicago. $\Delta REER_{i,t}$ is the percent change in the real exchange rate of country i between years t and $t-1$. $HomeMP_{i,t}$ represents the average monetary policy rate in country i at year t. α_i captures country fixed effects[5].

Table 3 shows the regression results for the baseline specification shown in column (3) as well as alternative specifications. The coefficient estimates associated with $USMP_t$ defined as the unified monetary policy shocks are negative and statistically significant at the 5% level across specifications. Similarly, the coefficient estimates associated with the U.S. effective Fed Funds Rate is also negative. These results suggest that a tightening shock in U.S. monetary policy is associated with a decrease in foreign asset holdings by non-financial multinational enterprises. Such finding stands even when incorporating U.S. financial conditions in the regression analysis.

Furthermore, these regression results suggest that the home country's monetary policy is not correlated with changes in foreign asset holdings by non-financial multinationals. They also indicate there is a negative correlation between the changes in the real exchange rate of the home country and the change in foreign assets.

Taken together, I interpret these results as indicating that U.S. monetary policy appears to be a relevant factor in the decision-making of non-financial multinationals. Tighter (easier) U.S. monetary policy is associated with a decrease (increase) in consolidated-by-nationality foreign assets by these companies.

This finding complements the well-documented spillovers of U.S. monetary policy on global financial firms. Using firm level data, this paper provides evidence that U.S. monetary policy shocks also produce spillovers to non-financial multinational enterprises.

[5] For Euro Area countries, the policy rate is the ECB's deposit rate. For Switzerland, it is the Swiss overnight average rate. For Sweden, it is the Swedish effective repo rate. For the U.K., the policy rate is the BoE's official bank rate. For Denmark, it is the Danish repo rate.

The empirical strategy adopted in this subsection does not allow for the disentanglement of the underlying channels through which a tightening U.S. monetary policy shock is associated with a reduction of foreign holdings by non-financial MNEs. A tightening in U.S. monetary policy is often associated with rising funding costs. It is possible that nonfinancial multinational enterprises react to this by reducing investment and/or shedding assets abroad.

It is also possible that a part of this reduction in foreign assets is driven by valuation effects. A tightening in U.S. monetary policy is associated with lower asset prices. These lower asset prices could potentially explain this decline in foreign assets. Further research is needed to better understand the channels through which U.S. monetary policy shocks affect investment decision by nonfinancial MNEs.

6.1 Robustness

It is possible that the negative and statistically significant coefficients associated with U.S. monetary policy shocks may be related to the estimation method adopted to compute these shocks. As a robustness check, I use different measures of U.S. monetary policy shocks when estimating equation 2. One such measure is the U.S. monetary policy news shocks from Nakamura and Steinsson (2018). The other set of measures are the target and path policy shocks from Gurkaynak, Sack and Swansson (2005). These updated series are taken from Acosta (2023). For each year, the monetary policy shocks used in the regression are equal to the sum of the respective shocks that took place during that year.

Table 4 shows the regression results for equation 2 using these different measures of policy shocks. These results show that these alternative measures of U.S. monetary policy shocks are also negatively correlated with changes in foreign asset holdings by nonfinancial multinationals. They indicate that the association between U.S. monetary policy shocks and changes in foreign assets is not related to the specific identification strategy used by Bu, Rogers and Wu (2021). Rather, such negative correlation also emerges once different estimation methodologies are adopted.

In sum, I find evidence that a tightening shock in U.S. monetary policy is associated with a decrease in foreign asset holdings by non-financial multinational enterprises. Such negative correlation is robust with respect.

7. Conclusion

Consolidated-by-nationality data on foreign holdings can be particularly helpful for policymakers to identify the ultimate exposure its national economic agents have relative to several risk factors. This approach also provides a more detailed view on the decision-making units as affiliates operating abroad are consolidated to their ultimate parent. In this paper, I construct the first dataset containing nationality-based estimates of foreign holdings for a group of developed economies over time. This dataset should complement the existing residence-based data from the seminal External Wealth of Nations project by Lane and Milesi-Ferretti (2001, 2007, 2018).

These novel data reveal that these developed economies are on aggregate more internationally financially integrated to the world than what is shown in the residence-based data. Such difference comes from the fact that all positions are taken into account when constructing consolidated-by-nationality data. In contrast, only cross-border positions are considered in residence-based statistics. The country-level data reveals that most but not all countries present a larger foreign balance sheet from a consolidated-by-nationality perspective relative to the residence-based approach. Countries with a significant presence of SPEs - most notably Ireland - can have a smaller consolidated-by-nationality balance sheet. Such result comes from the fact that the cross-border holdings related to these foreign entities do not enter their host's nationality-based balance sheet but still appears in their residence-based one.

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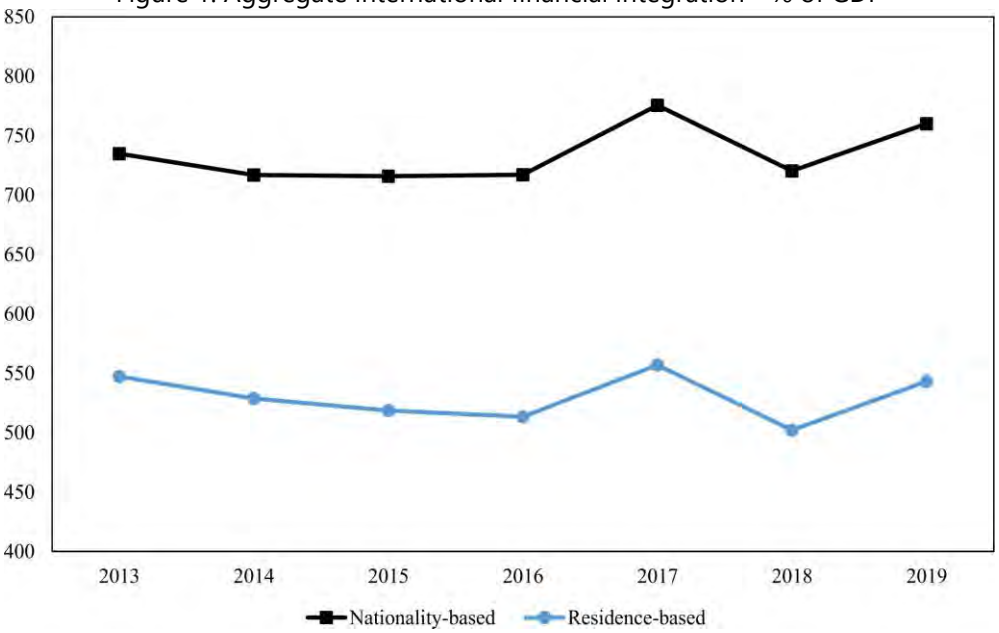
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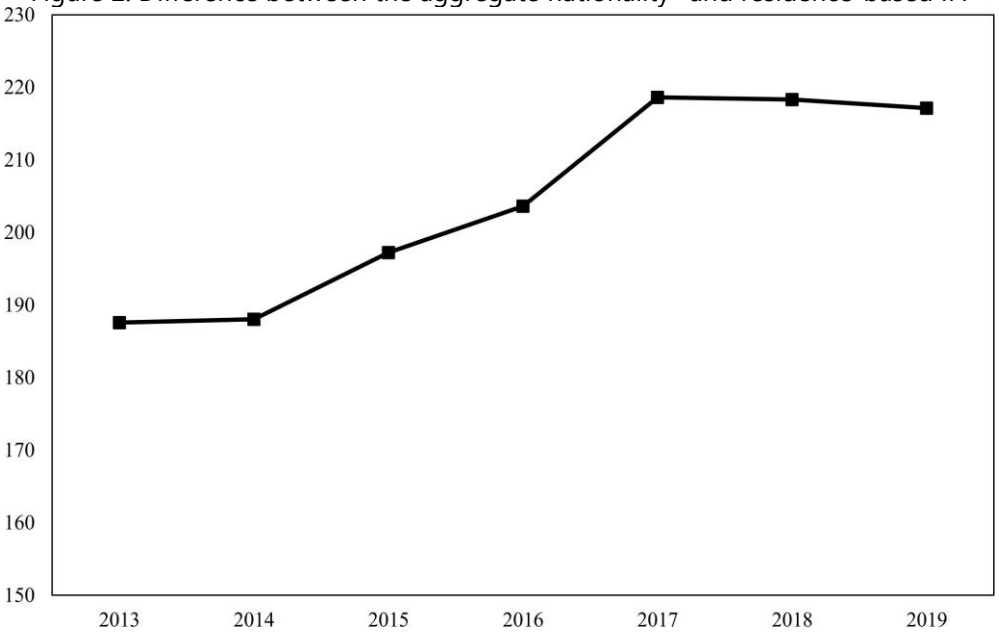
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Figure 1: Aggregate international financial integration - % of GDP



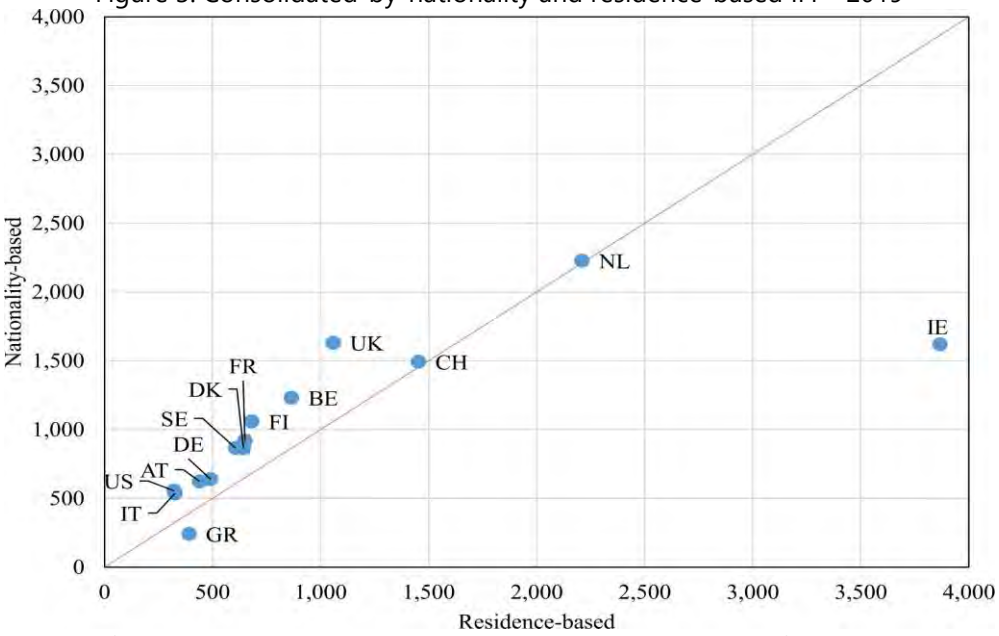
Note: This figure shows the aggregate index of international financial integration under the consolidated-by-nationality and residence-based approach. For a given year, the aggregate index is calculated as the sum of foreign assets and liabilities of selected countries divided by their GDP. It is expressed as a percentage of GDP. The countries included are the United States, the United Kingdom, Austria, Belgium, France, Germany, Italy, Netherlands, Sweden, Switzerland, Finland, Greece and Ireland. The residence-based measures come from Lane and Milesi-Ferretti's External Wealth of Nations database.

Figure 2: Difference between the aggregate nationality- and residence-based IFI



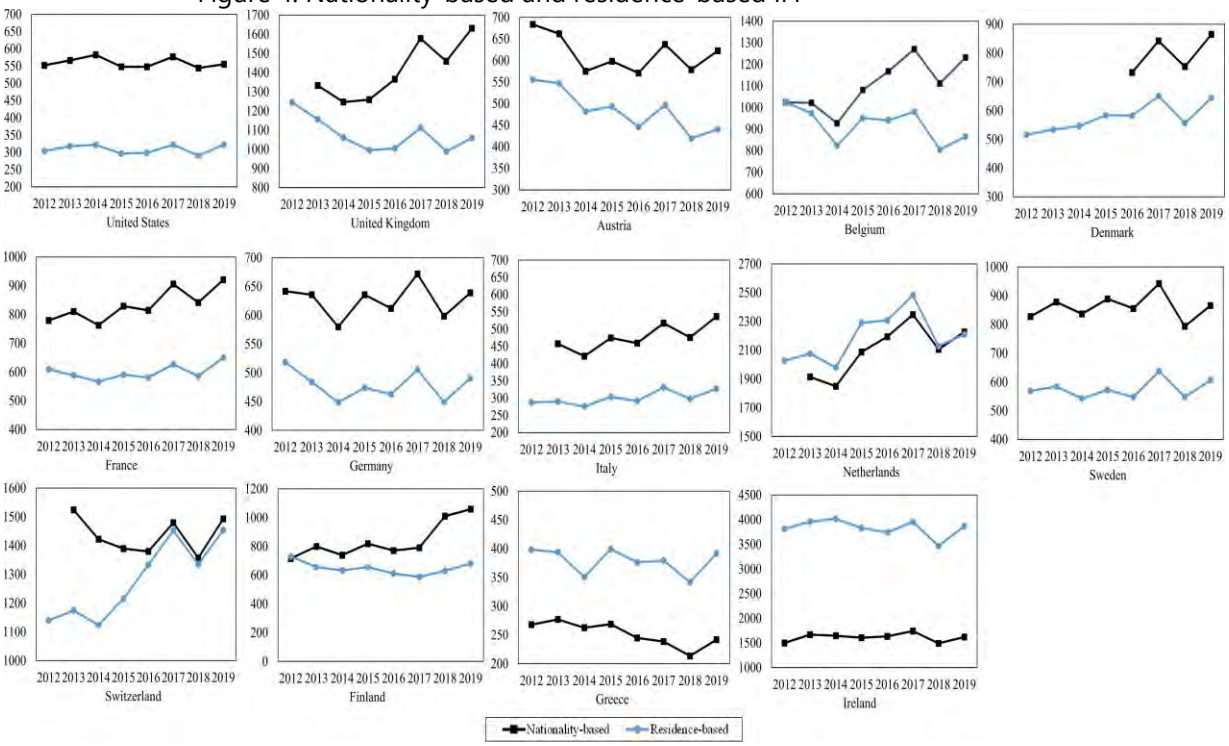
Note: This figure shows the difference between the aggregate index of international financial integration under the consolidated-by-nationality relative to the residence-based approach. It is expressed as a percentage of GDP. The countries included to construct the aggregated are the United States, the United Kingdom, Austria, Belgium, France, Germany, Italy, Netherlands, Sweden, Switzerland, Finland, Greece and Ireland. The residence-based measures come from Lane and Milesi-Ferretti's External Wealth of Nations database.

Figure 3: Consolidated-by-nationality and residence-based IFI – 2019



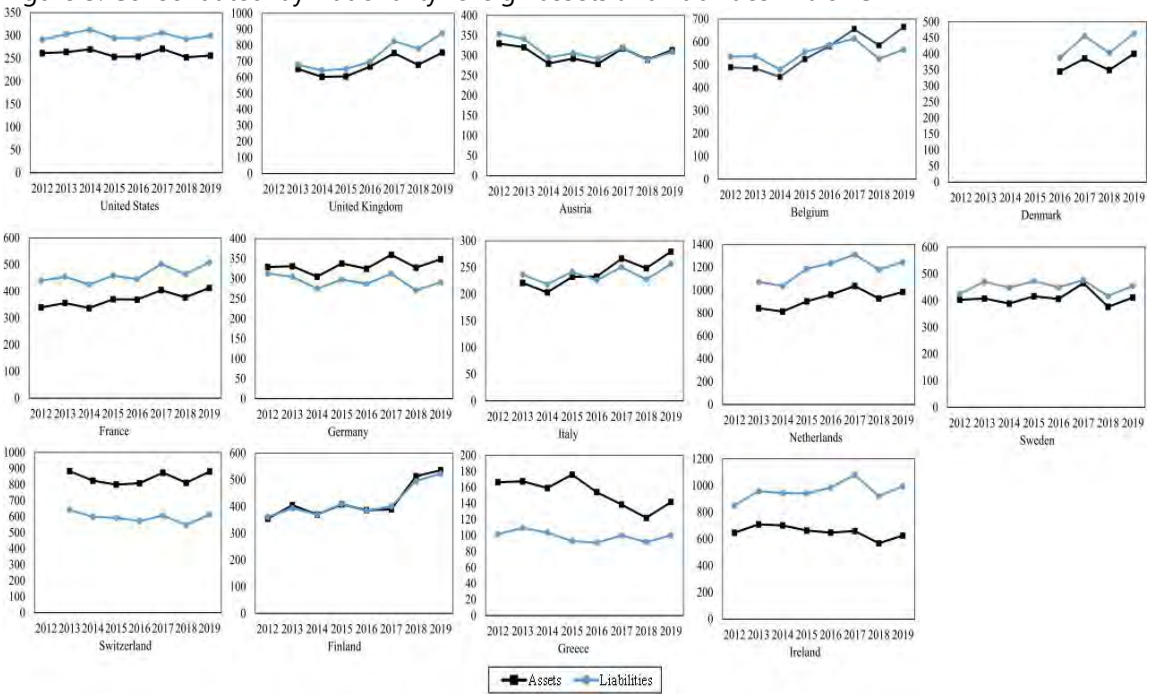
Note: This figure shows the consolidated-by-nationality and residence-based IFI for all countries in the dataset for 2019. The residence-based measures come from Lane and Milesi-Ferretti's External Wealth of Nations database. Data is computed as the sum of foreign assets and liabilities divided by GDP and is expressed as percentage of GDP. Countries located above the 45 degree line presented a larger consolidated-by-nationality foreign balance sheet in 2019 relative to their residence-based foreign balance sheet.

Figure 4: Nationality-based and residence-based IFI



Note: This figure shows the index of international financial integration under both the consolidated-by-nationality and residence-based approaches. It is computed as the sum of a country's foreign assets and liabilities divided by GDP. It is expressed as a percentage of GDP. The residence-based measures come from Lane and Milesi-Ferretti's External Wealth of Nations database.

Figure 5: Consolidated-by-nationality foreign assets and liabilities - % of GDP



Note:This figure shows estimates of consolidated-by-nationality foreign assets and holdings per country. These holdings are expressed as a percentage of GDP.

Table 1: Regression Results using full sample of countries

	Assets			Liabilities			IFI		
	Nationality	Residence	Difference	Nationality	Residence	Difference	Nationality	Residence	Difference
GDP pc.	2.52**	-0.95	3.94***	2.59**	-1.34	4.10***	5.11**	-2.29	8.04***
	(1.19)	(1.05)	(1.07)	(1.12)	(0.98)	(1.00)	(2.19)	(2.01)	(1.94)
Open	-1.31	0.06	-1.50	0.50	0.45	0.06	-0.82	0.51	-1.44
	(1.03)	(0.94)	(0.93)	(0.97)	(0.88)	(0.87)	(1.90)	(1.81)	(1.69)
Tax Diff.	0.09	1.27	-0.75	0.09	0.83	-0.32	0.18	2.10	-1.06
	(2.05)	(1.89)	(1.85)	(1.94)	(1.77)	(1.73)	(3.78)	(3.62)	(3.35)
R^2	0.19	0.23	0.31	0.44	0.34	0.12	0.00	0.00	0.03
Obs.	105	112	105	105	112	105	105	112	105

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Note: This table shows regression results of foreign assets, liabilities and IFI under both the consolidated-by-nationality as well as the residence-based approach. Dependent variables as expressed as a percentage of GDP. The independent variables are GDP per capita, trade as a percentage of GDP and the difference between the statutory corporate income tax rate relative to the median of a large set of countries. All regressions include country fixed effects. The number of observations vary due to missing data for some country-year pairs in the *Consolidated Foreign Wealth of Nations* dataset.

Table 2: Regression Results of the difference between nationality- and residence-based measures

	Difference in Assets			Difference in Liabilities			Difference in IFI		
	Full Smpl.	High Tax	Low Tax	Full Smpl	High Tax	Low Tax	Full Smpl.	High Tax	Low Tax
GDP pc.	3.94***	5.93***	5.00**	4.10***	4.14***	6.89***	8.04***	10.07***	11.89***
	(1.07)	(1.31)	(1.82)	(1.00)	(0.84)	(1.78)	(1.94)	(1.93)	(3.43)
Open	-1.50	-0.75	-1.82	0.06	-0.42	-0.37	-1.44	-1.18	-2.18
	(0.93)	(1.23)	(1.41)	(0.87)	(0.78)	(1.38)	(1.69)	(1.80)	(2.66)
Tax Diff.	-0.75	1.06	-24.04**	-0.32	1.77*	-35.13***	-1.06	2.83	-59.17***
	(1.85)	(1.45)	(9.60)	(1.73)	(0.92)	(9.36)	(3.35)	(2.13)	(18.10)
R^2	0.31	0.10	0.06	0.12	0.50	0.19	0.03	0.41	0.04
Obs.	105	66	39	105	66	39	105	66	39

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Note: This table shows regression results of the difference in foreign assets, liabilities and IFI between the consolidated-by-nationality approach relative to the residence-based approach. Regressions are estimated using (1) the full sample of countries, (2) a sample of relatively high tax countries and (3) a sample of relatively low tax countries. Relatively high tax countries are the United States, Austria, Belgium, Denmark, France, Italy, the Netherlands, Sweden and Greece. Relatively low tax countries are the United Kingdom, Germany, Switzerland, Finland and Ireland. The independent variables are GDP per capita, trade as a percentage of GDP and the difference between a country's statutory corporate income tax rate and a median of a large sample of countries. All regressions include country fixed effects. The number of observations vary due to missing data for some country-year pairs in the *Consolidated Foreign Wealth of* Nations dataset.

Table 3: Regression Results of the first difference in foreign assets related to national non-financial MNEs (% of GDP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
U.S. Monetary Policy Shock	-0.579**	-0.510**	-0.923***				
	(0.070)	(0.251)	(0.256)				
U.S. FCI			-0.420***	-0.162	-0.249**	-0.231**	
			(0.111)	(0.107)	(0.108)	(0.107)	
U.S. Fed Funds Rate						-0.128*	-0.142**
						(0.070)	(0.071)
Real Exchange Rate		-0.011*	-0.015**		-0.018***	-0.015**	-0.012**
		(0.006)	(0.006)		(0.006)	(0.006)	(0.006)
Home Policy Rate		0.052	0.019		-0.080	0.066	0.134
		(0.122)	(0.113)		(0.118)	(0.141)	(0.141)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.07	0.10	0.23	0.03	0.10	0.15	0.09
Obs.	91	91	91	91	91	91	91

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Note: This table shows regression results of first difference in foreign assets related to national non-financial MNEs as a percentage of GDP. The independent variables are (1) the unified measure of U.S. monetary policy shocks by Bu, Rogers and Wu (2021), (2) the U.S. National Financial Conditions Index from the Federal Reserve Bank of Chicago, (3) the U.S. Effective Federal Funds Rate, (4) the real exchange rate for the home country from the International Monetary Fund and (5) the monetary policy rate from the home country. For Euro Area countries, the monetary policy rate is the ECB's deposit rate. For Switzerland, the rate is the Swiss overnight average rate. For Sweden, it is the Swedish effective repo rate. For the U.K., the monetary policy rate is the BoE's official bank rate. For Denmark, the policy rate is the Danish repo rate. All regressions include country fixed effects.

Table 4: Regression Results of the first difference in foreign assets related to MNEs using alternative measures of policy shocks

	(1)	(2)	(3)
BRW - Unified Policy shock	-0.923***		
	(0.256)		
NS - Policy News shock		-1.277**	
		(0.561)	
GSS - Target shock			-0.910*
			(0.458)
GSS - Path shock			-0.579**
			(0.265)
US Financial Conditions Index	-0.420***	-0.427***	-0.458***
	(0.111)	(0.131)	(0.139)
Real Exchange Rate	-0.011*	-0.015**	-0.016**
	(0.006)	(0.006)	(0.006)
Home Monetary Policy	0.019	-0.001	0.033
	(0.113)	(0.120)	(0.130)
Country Fixed Effects	Yes	Yes	Yes
R^2	0.23	0.16	0.17
Obs.	91	91	91

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Note: This table shows regression results of first difference in foreign assets related to national nonfinancial MNEs as a percentage of GDP. Three different measures of U.S. monetary policy shocks are used in this analysis. The baseline specification uses the unified monetary policy shocks from Bu, Rogers and Wu (2021). Another specification uses the policy news shock from Nakamura and Steinsson (2018). A third specification uses the target and path U.S. monetary policy shocks from Gurkaynak, Sack and Swansson (2005). The independent variables are (1) a measure of U.S. monetary policy shock, (2) the U.S. National Financial Conditions Index from the Federal Reserve Bank of Chicago, (3) the U.S. Effective Federal Funds Rate, (4) the real exchange rate for the home country from the International Monetary Fund and (5) the monetary policy rate from the home country. For Euro Area countries, the monetary policy rate is the ECB's deposit rate. For Switzerland, the rate is the Swiss overnight average rate. For Sweden, it is the Swedish effective repo rate. For the U.K., the monetary policy rate is the BoE's official bank rate. For Denmark, the policy rate is the Danish repo rate. All regressions include country fixed effects.

Consolidated Foreign Wealth of Nations: Nationality-based measures of international exposure

André Sanchez Pacheco

FGV São Paulo School of Economics

BIS-ECB-Banco de España External Statistics Conference

12 February 2024

Multinationals and international exposure: Ford do Brasil

Ford set up its affiliate in Brazil in 1919.

Ford do Brasil has relied heavily on local funding to finance its expansion.

Until recently, Ford employed over 5,000 workers in the country.

Multinationals and international exposure: Ford do Brasil

REBOOT-LIVE JANUARY 11, 2021 / 6:57 PM / UPDATED 2 YEARS AGO

Ford to close Brazil manufacturing operations, take $4.1 billion in charges

By Ben Klayman, Alberto Alerigi 3 MIN READ

DETROIT/SAO PAULO (Reuters) - Ford Motor Co said on Monday it will close its three plants in Brazil this year and take pretax charges of about $4.1 billion as the COVID-19 pandemic amplified the company's under use of its manufacturing capacity.

Despite this significant presence in the country, relatively little exposure appeared in the U.S. and Brazil external balance sheet. **Why?**

Features of the residence-based data

Residence: Foreign assets and liabilities are booked according to the residence of the immediate counterparts.

(1) Only cross-border transactions are taken into account.
Local positions Ford has do not enter U.S. nor Brazil's foreign balance sheet.

(2) Does not consider ties that exist between entities within the same corporate group.
Assets and liabilities owned by Ford do Brasil are not consolidated to the U.S. parent company Ford.

Takeaway: External accounts of both countries did not fully capture the international exposure created by Ford's operation in Brazil.

How to assess the international exposure of countries?

Conventional approach: Use **residence**-based data of foreign holdings.

This paper: Constructs the first dataset on **consolidated-by-nationality** estimates of foreign holdings for 14 countries between 2012 and 2019.

Findings:

(1) Countries are on aggregate more internationally financially integrated than what residence-based data indicate.

(2) Countries heavily engaged in international financial intermediation have smaller nationality-based exposure.

(3) Data can be used to analyze monetary and fiscal policy spillovers.

Consolidated-by-nationality approach

Consolidated-by-nationality: Foreign assets and liabilities are booked according to the **nationality** of the ultimate counterparts.

Consolidated-...: All local and cross-border positions held by Ford do Brasil are attributed to its parent company Ford.

...by-Nationality: Exposures sorted according to nationality of ultimate counterparts (US vis-a-vis Brazil).

Key measures of gross international exposure

International Financial Integration - Lane and Milesi-Ferretti (2003):

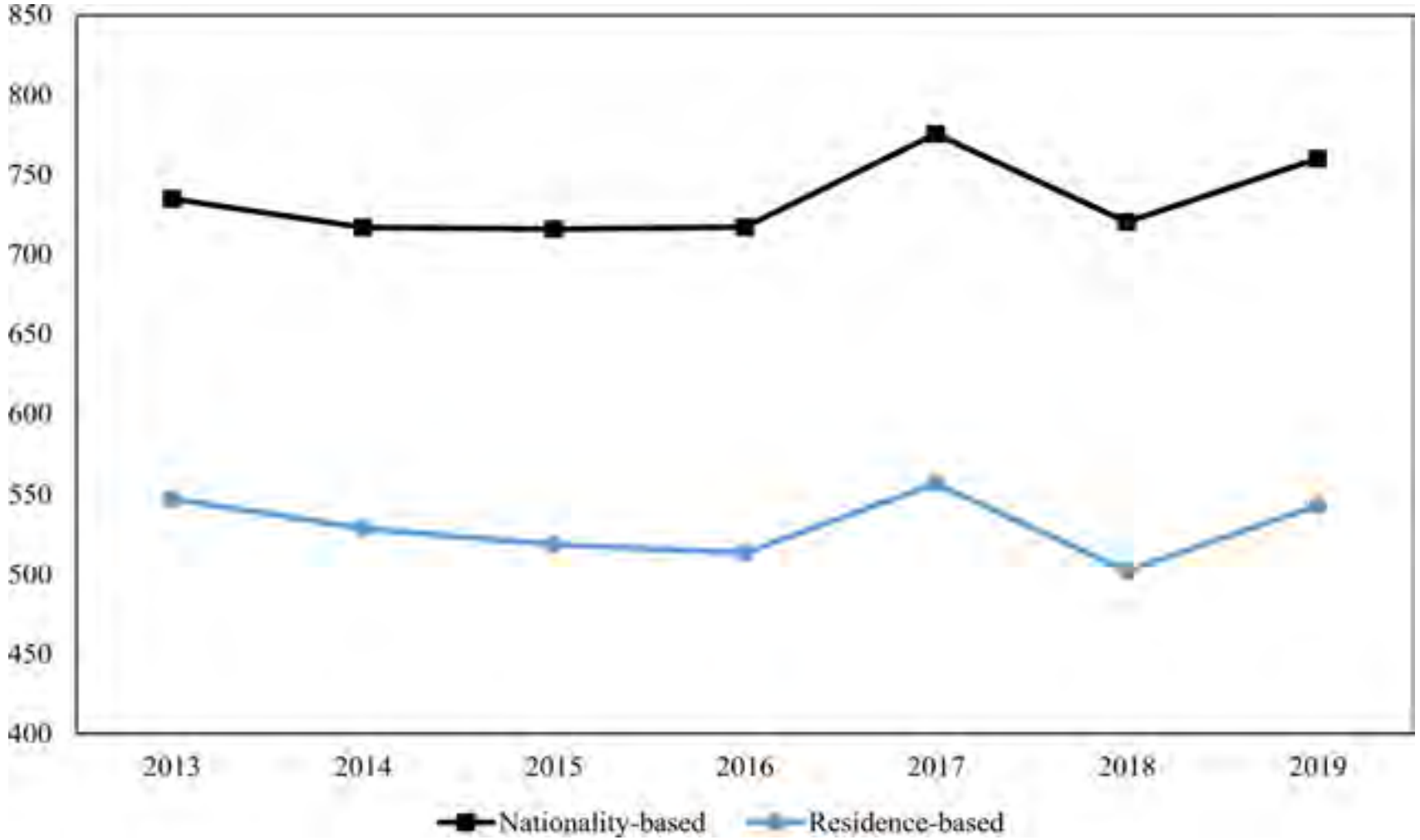
$$IFI_t^i = \frac{(FAssets_t^i + FLiab_t^i)}{GDP_t^i} \tag{1}$$

Aggregate IFI - Bénétrix and Sanchez Pacheco (2022):

$$IFI_t^{AGG} = \frac{\sum_{i=1}^{N}(FAssets_t^i + FLiab_t^i)}{\sum_{i=1}^{N} GDP_t^i} \tag{2}$$

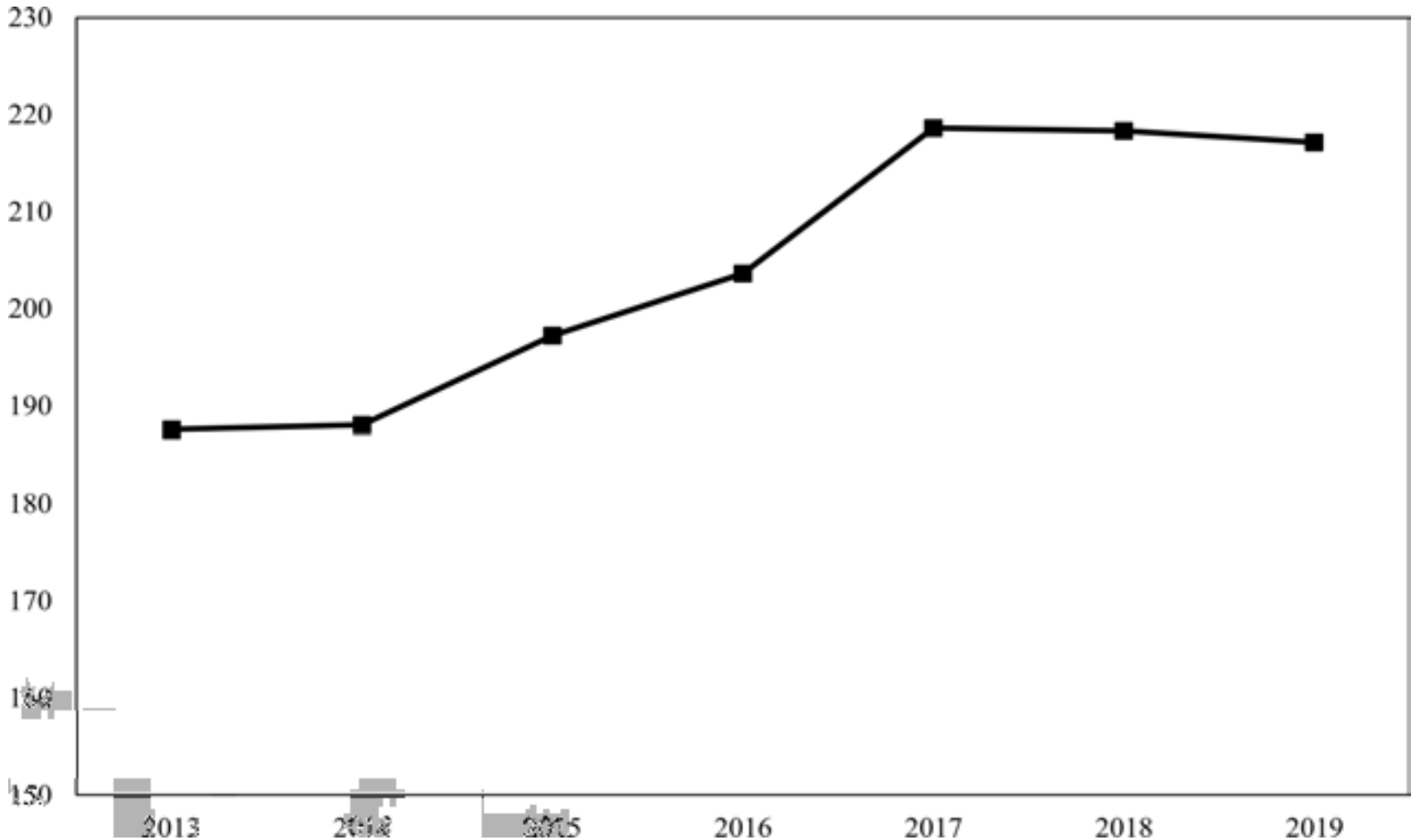
Aggregate IFI larger from a nationality-based perspective

Figure: **Consolidated-by-Nationality** and **Residence**-based IFI (% of GDP)



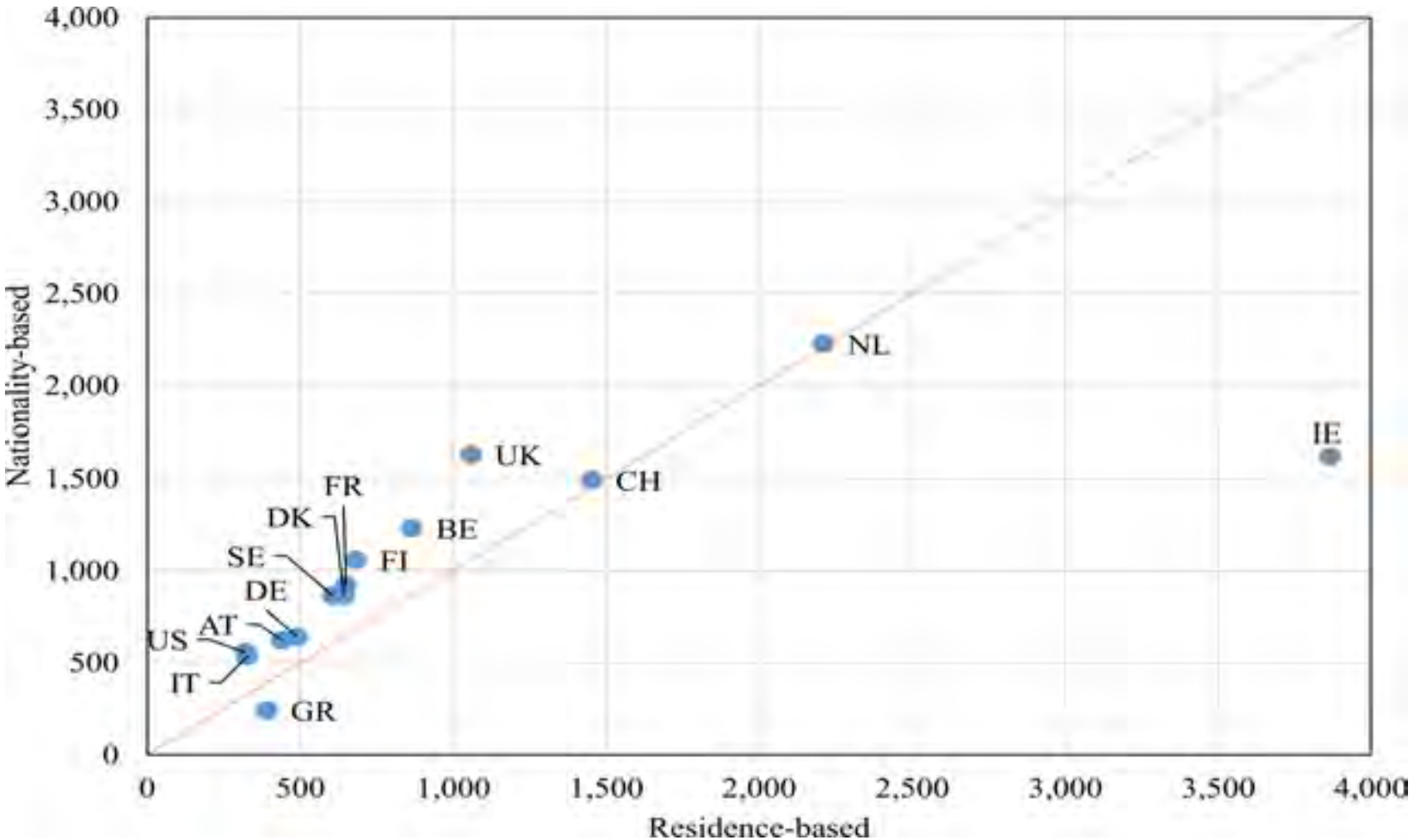
Difference is not time-invariant

Figure: Difference between **Consolidated-by-Nationality** and **Residence** IFI



Heterogeneity across countries

Figure: **Consolidated-by-Nationality** and **Residence**-based IFI per country



Data-set characteristics

Data sources: BIS, IMF, U.S. BEA, Orbis Europe.

Time frame: 2012 - 2019 (yearly).

Countries: United States, United Kingdom, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Sweden and Switzerland.

Methodology similar to BIS (2015) and Sanchez Pacheco (2022).

Consolidated-by-nationality foreign balance sheet (Non-US)

Bank-reported	**Assets**	**Liabilities**
Domestic banks	BIS	BIS
Foreign banks	BIS	BIS
Financial non-banks		
Domestic Multinationals		
Operating in the U.S.	U.S. BEA	U.S. BEA
Operating in Europe	Orbis Europe	Orbis Europe
Foreign Multinationals	Orbis Europe	Orbis Europe
Non-financial		
Domestic Multinationals		
Operating in the U.S.	U.S. BEA	U.S. BEA
Operating in Europe	Orbis Europe	Orbis Europe
Foreign Multinationals	Orbis Europe	Orbis Europe
Portfolio Investment	IMF	IMF
Official assets	IMF	

Foreign MNEs operating in Country X

Use Orbis Europe dataset to download financial and ownership information for all companies located in the host country X.

Remove companies that never reported total assets and have a country X national as ultimate owner.

Identify and remove foreign-owned special purpose entities.

Use industry codes to separate entities accordingly.

From company-level data to country aggregates

Orbis Europe makes available data on firms' total asset holdings and shareholders' equity.

Rationale behind the methodology is similar to BIS (2015): Infer local positions based on available data.

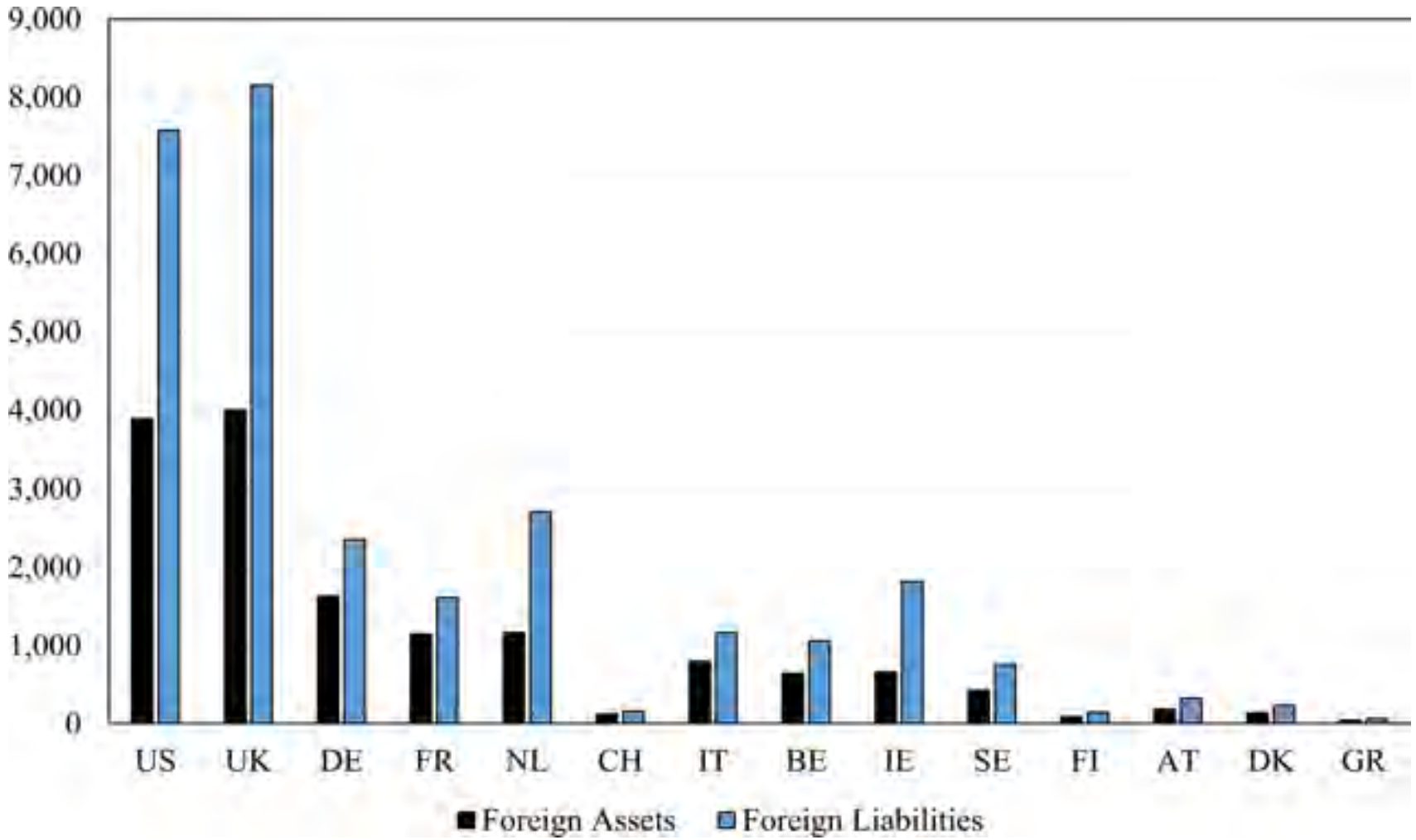
Country X foreign assets and liabilities related to **F**oreign **MNE**s:

$$FA_{X,t}^{FMNE} = \sum_{i=1}^{N} Liabilities_t^i - Equity_t^i \tag{3}$$

$$FL_{X,t}^{FMNE} = \sum_{i=1}^{N} Assets_t^i \tag{4}$$

Holdings related to foreign non-financial MNEs

Figure: Consolidated foreign holdings related to foreign non-financial MNEs



Empirical Analysis

Two exercises using these novel data:

- Correlation between tax differentials and foreign holdings for low and high-tax countries.
- Correlation between U.S. monetary policy shocks and foreign asset holdings.

U.S. Monetary Policy Shocks and Foreign Assets

Panel regression to analyze the relationship between changes in foreign assets holdings by non-financial MNEs and U.S. monetary policy shocks:

$$\Delta FA_{i,t}^{MNES} = \alpha_i + \beta * USMP_t + \gamma * USFCI_t + \delta \Delta REER_{i,t} + \theta * HomeMP_{i,t} + \epsilon_{i,t} \quad (5)$$

$USMP_t$: U.S. Monetary Policy shocks (Bu, Rogers and Wu (2021); Gürkaynak, Sack and Swansson (2005) and Nakamura and Steinsson (2018).)

$USFCI_t$: U.S. National Financial Conditions Index

$REER_{i,t}$: Real Effective Exchange Rate

$HomeMP_{i,t}$: Home country monetary policy rate.

U.S. Monetary Policy Shocks and Foreign Assets

Table 4: Regression Results of the first difference in foreign assets related to MNEs using alternative measures of policy shocks

	(1)	(2)	(3)
BRW - Unified Policy shock	-0.923***		
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	(0.113)	(0.120)	(0.130)
Country Fixed Effects	Yes	Yes	Yes
R^2	0.23	0.16	0.17
Obs.	91	91	91

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Conclusion

First data-set on consolidated-by-nationality foreign holdings for multiple countries and years.

Countries are on aggregate more internationally financially integrated than what residence-based data indicate.

Countries heavily engaged in international financial intermediation have smaller nationality-based exposure.

U.S. Monetary Policy Shocks are associated with a decrease in foreign asset holdings by MNEs.

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

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International investment income: patterns, drivers, and heterogeneous sensitivities[1]

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Geneva Graduate Institute

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

International investment income: patterns, drivers, and heterogeneous sensitivities

Giovanni Donato *& Cedric Tille †

July 16, 2024

Abstract

Financial globalization has led to a large increase in international asset holdings. While the rise of associated dividend and interest flows has until now been muted by the decreasing trend in interest rates, this pattern could change, leading to a larger role of investment income flows in the balance of payments. We use a broad sample of countries to document the heterogeneous evolution of the various components of investment income flows, with a rising role of FDI and equity income, especially in advanced economies. We then assess the impact of various variables on yields with a panel analysis. Various drivers have highly heterogeneous effects across investment categories and country groups, often impacting the yields on both assets and liabilities. This translates into substantial heterogeneity in the response of countries' income balance, due to different compositions of asset and liabilities. This heterogeneity is amplified if we consider country-specific estimates in complement to the panel ones. Focusing on the impact of changes in interest rates, we find that higher rates only had a limited impact in the 2013 taper tantrum, investment income balances are likely to benefit from higher US rates in the current phase of higher rates, with offsetting effects of higher domestic rates.

Keywords: Financial integration, primary investment income flows, interest rates, exchange rates
JEL classification: F32, F36, F40

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1. Introduction

Financial globalization has been a major development since the mid-1990s, leading to large increases in countries' external assets and liabilities (Lane and Milesi-Ferretti, 2018, Milesi-Ferretti, 2022a). One would then expect a similar rise in the associated dividend and interest streams - the primary investment income. However, this is not the case, at least not to the extent one may expect. Figure 1 contrasts the rise in trade flows over the last twenty years (until 2023) against investment income flows. In the median advanced economy (left panel), the sum of exports and imports has steadily increased relative to GDP (red line). By contrast, while the sum of investment income receipts and payments also increased until 2008, it has then dropped back and remained steady up until a surge in 2023 when interest rates increased worldwide (blue line). A similar pattern is seen in the median emerging economy (right panel), with the recent rise in investment income taking place earlier than in advanced economies.

The link between asset income flows and the international investment position is not as tight as one may expect. Figure 2 shows the net investment income position (horizontal axis) and the net investment (vertical axis), each point corresponding to a country average value over the first decade of the 21st century (red dot) and subsequent years. Among advanced economies (top panel), we observe a clear correlation, but with some dispersion, as well as a flatter relation post-crisis with the net income being less sensitive to the NIIP. The pattern is even more striking among emerging economies (bottom panel) where the connection between the two measures is quite loose.

In this paper, we analyze the drivers of the yields on assets and liabilities (income flows in percentage of association investment positions). In the context of rising interest rates, investment income flows may start accounting for a larger share of the current account. In fact, the decrease in the magnitude of investment income flows since 2008 seen in figure 1 substantially reflects the downward trend in nominal interest rates over these years, and the subsequent sharp reversal of policy rates in response to the recent inflation episode. Furthermore, the composition of countries' external assets and liabilities has substantially changed through time, with for instance a sizable increase in foreign direct investment positions in emerging economies, as detailed by Milesi-Ferretti (2022b). These various changes imply that

one cannot simply rely on the net international investment, scaled by a yield factor, to inform us reliably on the investment income flows. Instead, understanding what drives investment income at the level of individual categories of assets and liabilities, and distinguishing between advanced and emerging economies is warranted. Such is the focus of this paper.

We undertake a panel analysis of yields on various categories of assets and liabilities over a large sample of advanced and emerging economies to assess the role of a range of drivers (exchange rates, interest rates, and macroeconomic variables).

We find a substantial heterogeneity of the sensitivity of yields on the various driving forces, across investment categories and country groups. Higher interest rates in the US raise the yield on other (banking investment), reserves, and portfolio debt (for US long-term yields), but have little effect beyond. This is consistent with the dominant presence of the dollar in banking and international debt markets. Inflation also leads to higher yields in these categories. An increase in risk perception, proxied by a higher VIX index, reduces yields across the board. By contrast, the impact of a broad appreciation of the dollar is concentrated in foreign direct investment and portfolio equity (in advanced economies), and leads to a reduction in yields. This could indicate that companies connected to international investors are also more linked to international trade flows, which are reduced by a dollar appreciation. This could be because the currency dominates the invoicing of international trade, or is associated with changing risk appetites that also affect investment and profits, or that multinational companies alter the pattern of profit transfers among their affiliates when the exchange rate moves. We complete our panel estimates with country-specific estimates, that display substantial heterogeneity.

The impact of the various drivers on a country's net investment income is heterogeneous, as it reflects the balance of offsetting forces. Our estimates show that several drivers impact the yields on both assets and liabilities, which implies that the effect on the net investment income can be positive or negative depending on the specific structure of the country's international financial exposure. This is a major difference from trade flows, as the latter are less subjected to such offsetting influences.

Focusing on the impact of the VIX, interest rates, and dollar exchange rate, we show that a higher VIX raises net investment income in emerging economies. While higher US

short-term rate raise the net income in emerging countries, the effect is the opposite for US long-term rates. A broad dollar appreciation has a detrimental effect for advanced economies, and a small positive one for emerging economies. All these effects tend to be larger and more heterogeneous when using country-specific estimates. We finally illustrate the impact of interest rates by looking at two specific episodes of rising rates. We estimate that the 2013 taper tantrum had only a moderate impact on net investment income, and the current phase of rising US rates and inflation could lead to improvement in the income balances.

While there is a rich literature looking at the determinants of the current account and the trade balance, the analysis of primary investment income flows is more recent. Our paper contributes to this growing literature. Joyce (2021) documents the growing income deficit, driven by FDI, in 26 emerging economies. Behar and Hassan (2022) present the comovements of trade and investment income balance, and look at the impact of exchange rates, which are also the focus of Colacelli et al. (2021). We expand on these contributions by considering a broader range of drivers of the yields on assets and liabilities. Eugster and Donato (2022) present the impact of the exchange rate on the trade and investment income balances in Switzerland. Auer (2019) shows how monetary policy shocks impact the investment receipt and payment flows, both overall and across categories, in the United States and Canada. In contrast to these papers, we take a broad perspective with a large sample of advanced and emerging economies.

The rest of the paper is structured as follows. Section 2. reviews the related literature. Section 3. presents the analytical framework, data, and stylized facts. The results from the econometric analysis are presented in section 4., and section 5. discusses the heterogeneous impact of selected variables on countries' net trade and investment income flows. Section 6. considers the impact of specific episodes of rising interest rates, and section 7. concludes.

2. Literature review

Our analysis relates to several branches of the literature on the drivers of external accounts. The first is the analysis of determinants of "global imbalances". Before the global financial crisis, a large literature assessed the imbalances where the United States ran a large a persistent current account deficits mirrored by surpluses in emerging economies. Panel

analyses of current account balances found a role for public deficits, financial development, and the experience of financial crises (Chinn and Prasad, 2003; Gruber and Kamin, 2007). Asymmetries in the development of financial markets have been pointed as a source of the persistent US deficit (Caballero et al., 2008). Subsequent contributions to the literature have taken a more granular look. Alfaro et al. (2014) show that capital flows driven by sovereign investors behave differently than flows driven by private investors. Ito and McCauley (2019) point to the need to take account of the world's main currency zones, as imbalances within and across zone show different patterns. While the researchers' interest in global imbalances decreased in the eve of the 2008 crisis, as capital flows retrenched (IMF, 2014), recent contributions have provided additional angles on the topic. Chinn and Ito (2022) show that the pattern has evolved, with the role of China and oil exporters becoming less important, fiscal variables taking a relevant role, and financial development having a heterogeneous effect. Other contributions point to the role of determinants of portfolio choice by global investors (Devereux et al., 2020; Jiang et al., 2022). Finally, several contributions have taken a broader view in terms of both flows and stocks. While flow imbalances (in terms of current accounts) have stayed broadly steady, stock imbalances (in terms of international investment positions) remain on the rise (Alberola et al., 2020; Lane and Milesi-Ferretti, 2014; Milesi-Ferretti, 2022b).

The second line of literature that we connect to covers the impact of major economic shocks on the current account. The exchange rate is a variable that has received a lot of attention, as models indicate that narrowing imbalances relies on exchange rate movements, with a focus on the impact on the trade balance. Obstfeld and Rogoff (2007) find that the US imbalances calls for a weakening of the dollar. The empirical evidence on the impact of exchange rate is however contrasted. Devereux and Genberg (2007) point that exchange rate movements are unlikely to play a sizable role for emerging Asian economics. Taking a medium run perspective, Chinn and Prasad (2003) find that exchange rates only play a role for industrial countries, and a small one. Gruber and Kamin (2007), Chinn and Ito (2007) and Chinn and Lee (2009) also find mixed results, and Beckmann and Czudaj (2017) shows that the link between exchange rates and current accounts is ambiguous, especially at a shorter horizons. Cubeddu et al. (2019) estimate the REER-elasticity of the Current

Account as part of the IMF's ESR using the so-called *CGER-inspired approach*, and find a moderate average elasticity of -0.26 with substantial heterogeneity. The limited impact of the exchange rate can be explained by a moderate transmission to import prices when these are set in currencies that are not the one of the importing country, as in the "dominant currency pricing" (Boz et al., 2022; Georgiadis et al., 2021; Gopinath et al., 2020).

Movements in interest rates are another important source of fluctuations. Antràs (2023) develops a framework where lower interest rates provides an incentive to invest in longer but more productive production processes, leading to larger trade flows. Schuler and Sun (2022) consider the co-movements of the current account and interest rates in Euro area countries. They show that these are specific to the shocks driving fluctuations. Shocks to consumption and investment financial frictions (which are shocks to domestic demand) move interest rates and the current account into the same direction, while shocks to foreign demand and TFP have the opposite effect.

Finally, our works contributes to the literature on the determinants of the primary income, and especially the income from assets (investment income flows). While there has been an extensive literature on the drivers of trade flows, the analysis of primary income flows remains at a relatively early stage. Joyce (2021) focuses on the pattern in 26 emerging economies, and shows a growing deficit in net investment income, especially for direct investment. Countries with higher trade and financial openness are characterized by larger FDI income payments. Behar and Hassan (2022) present a multi-country assessment of the dynamics of the primary income balance. They show that it is an important element of the current account, exceeding the trade balance in 20 percent of countries in the sample. Fluctuations in the primary income balance tend to be negatively correlated with the ones in the trade balance, thereby stabilizing the overall current account. In times of crises however, the income balance does not improve, in contrast to the trade balance. The authors finally assess the sensitivity of the income flows to the exchange rate. While the exchange rate impacts both gross components of the income (receipts and payments), these effect offset each other with a limited impact on the primary income balance. The impact of the exchange rate on the current account thus operates primarily through the trade channel. Colacelli et al. (2021) consider the drivers of the primary income using annual data for 1999-2018 over 40 countries. They also find

that exchange rate movements have a sizable impact on receipts and payments flows, with a moderate impact in net terms.

An important element in the impact of exchange rates in Behar and Hassan (2022) and Colacelli et al. (2021) is a "mechanical" effect. As a country's assets and liabilities are often denominated in foreign currency, exchange rate movement affects the domestic currency value of the associated flow of earnings, even when the yield in terms of the currency of denomination is not changed. This effect is similar to the well-know valuation effect of exchange rate movements on the international investment position, with the difference that these valuation effects are capital gains that do not enter the current account (Bénétrix et al., 2015; Bénétrix et al., 2020; Gourinchas and Rey, 2007; Lane and Milesi-Ferretti, 2004; Tille, 2008). Behar and Hassan (2022) and Colacelli et al. (2021) show that the mechanical effect is a major aspect of the impact of exchange rates, and the residual "economic" effect is small and heterogeneous.

Eugster and Donato (2022) document the impact of exchange rate movements on the Swiss current account, focusing on movements that reflect the Swiss safe haven property. They confirm the offsetting movements of trade and trade and primary income balances of Behar and Hassan (2022), with a stronger Swiss franc reducing the trade surplus and improving the primary income balance. The later is driven by an improvement in the net FDI income, as expenses fall more that receipts.

While the previous studies focus on the impact of the exchange rate, Auer (2019) assesses the impact of monetary policy shocks in the United States and Canada. A tightening of monetary policy appreciates the currency, and has a J-curve effect on the trade balance. It leads to a reduction of both investment income receipts and payments, as well as the net receipts. The effect on income flows gradually builds up and reaches a peak after 1-2 years. A finer assessment shows that the higher interest rates temporarily raise the income flows for the "other" investment category (which are mostly banking holdings), leading to a positive net effect, but lower the income flows on FDI holdings, leading to a negative net effect.

3. Empirical framework

3.1 Primary income dynamics

3.1.1 General setting

Consider the primary income flows on a country's external asset holdings (the flows on the liability sides are computed similarly). As described below, we rely on the IMF data for the balance of payments, as well as the international assets and positions data from Milesi-Ferretti (2022c) which are measured in US dollar. The asset position on which the income flows apply is denominated in a currency basket D which is in general different from the country's own currency and the dollar.

We denote the exchange rate between the dollar and the currency of denomination of the asset by $S^{\$,D}$ with an increase representing a depreciation of the dollar. The primary investment income flows in the denomination currency reflects the effective return in that currency $r^{eff,D}$, so we write $P_t^D = r_t^{eff,D} A_{t-1}^D$ where A^D is the asset position expressed in the currency of denomination. The dollar flows are written as $P_t^{\$} = r_t^{eff,D} \left(S_t^{\$/D} / S_{t-1}^{\$/D} \right) A_{t-1}^{\$} = r_t^{eff,\$} A_{t-1}^{\$}$.

The portfolio of a country consist of fixed income assets, indexed by F, and assets with variable yield, indexed by V. A share α^F of fixed income assets mature in each period. The gross capital flows in period t consist of a purchase of assets replacing the maturing ones, and net capital flows $K_t^{net,\$}$ (measured in dollar).

3.1.2 Income flows and yields

At the beginning of period t, a share $1 - \alpha^F$ of fixed income assets has not matured and delivers the same yield (on the face value in the currency of denomination) in period t than in period $t-1$. The investment income flows on these assets in period t is the same as in the previous period. The newly purchased assets deliver a new yield $r_t^{new,F,D}$ in period t. The primary income in the currency of denomination is thus (see the appendix for details):

$$P_t^{F,D} = \left(1 - \alpha^F\right) P_{t-1}^{F,D} + r_t^{new,F,D} \left(\left(1 - \alpha^F\right) K_{t-1}^{net,F,D} + \alpha^F A_{t-1}^{F,D} \right)$$

where denotes the net capital flows. The expression for variables yield asset is similar, setting $\alpha^F = 1$. The overall investment income ($P_t^D = P_t^{F,D} + P_t^{V,D}$) is then, in currencies of denomination and in dollar:

$$\begin{aligned} P_t^D &= \left(1-\alpha^F\right) P_{t-1}^{F,D} + r_t^{new,F,D}\left(1-\alpha^F\right) K_{t-1}^{net,F,D} + r_t^{new,F,D}\alpha^F A_{t-1}^{F,D} + r_t^{new,V,D} A_{t-1}^{V,D} \\ P_t^{\$} &= \frac{S_t^{\$/D}}{S_{t-1}^{\$/D}}\left[\left(1-\alpha^F\right) P_{t-1}^{F,\$} + r_t^{new,F,D}\left(1-\alpha^F\right) K_{t-1}^{net,F,\$} + r_t^{new,F,D}\alpha^F A_{t-1}^{F,\$} + r_t^{new,V,D} A_{t-1}^{V,\$}\right] \end{aligned}$$

The yield on the overall asset position, $r_t^{\$} = P_t^{\$}/A_{t-1}^{\$}$, is written as:

$$\begin{aligned} r_t^{\$} &= \frac{S_t^{\$/D}}{S_{t-1}^{\$/D}}\frac{A_{t-1}^{F,\$}}{A_{t-1}^{\$}}\left[\left(1-\alpha^F\right)\frac{A_{t-2}^{F,\$}}{A_{t-1}^{F,\$}} r_{t-1}^{F,\$} + \left(\alpha^F + \left(1-\alpha^F\right)\frac{K_{t-1}^{net,F,\$}}{A_{t-1}^{F,\$}}\right) r_t^{new,F,D}\right] \\ &\quad + \frac{S_t^{\$/D}}{S_{t-1}^{\$/D}}\frac{A_{t-1}^{V,\$}}{A_{t-1}^{\$}} r_t^{new,V,D} \end{aligned} \tag{1}$$

3.1.3 Approximation

We express the yield (1) in terms of a linear approximation around a steady growth path, where asset prices and exchange rates are constant, all variables grow at a rate ρ_{ss}, and the fixed income assets represent a share δ_{ss}^F of the overall assets. Hatted variables denote log deviations from the growth path, while hatted yields are deviations in absolute value. [1] The linear approximation of (1) gives:

$$\begin{aligned} \frac{\hat{r}_t^{\$}}{r_{ss}} &= \left(\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}\right) + \frac{\left(1-\alpha^F\right)\delta_{ss}^F}{1+\rho_{ss}}\frac{\hat{r}_{t-1}^{F,\$}}{r_{ss}} \\ &\quad + \left(1 - \frac{1-\alpha^F}{1+\rho_{ss}}\right)\delta_{ss}^F\frac{\hat{r}_t^{new,F,D}}{r_{ss}} + \left(1-\delta_{ss}^F\right)\frac{\hat{r}_t^{new,V,D}}{r_{ss}} \\ &\quad - \frac{\left(1-\alpha^F\right)\delta_{ss}^F}{1+\rho_{ss}}\left(\widehat{S}_{t-1}^{\$/D} - \widehat{S}_{t-2}^{\$/D} + \widehat{Q}_{t-1}^{F,D} - \widehat{Q}_{t-2}^{F,D}\right) \end{aligned} \tag{2}$$

where $\widehat{Q}_t^{F,D}$ is asset price of fixed income assets in the currency of denomination, which enters

[1] Specifically, $\hat{A}_t^{\$} = \left(A_t^{\$} - A_{ss,t}^{\$}\right)/A_{ss,t}^{\$}$, $\widehat{S}_t^{\$/D} = \left(S_t^{\$/D} - S_{ss}^{\$/D}\right)/S_{ss}^{\$/D}$, $\left(\hat{K}_{t-1}^{net,F,\$} = K_{t-1}^{net,F,\$} - \frac{\rho_{ss}}{1+\rho_{ss}}A_{ss,t-1}^{F,\$}\right)/\left(\frac{\rho_{ss}}{1+\rho_{ss}}A_{ss,t-1}^{F,\$}\right)$, $\widehat{r}_t^D = r_t^D - r_{ss}$, $\hat{Q}_t^{F,D} = \left(Q_t^{F,D} - Q_{ss}^{F,D}\right)/Q_{ss}^{F,D}$, where the ss subscript denotes the value of variables along the steady growth path.

because the fixed yield is in term of face value and not market value. $\hat{r}_t^{\$}/r_{ss}$ indicates the effect on the yield in percent, instead of percentage points. [2] (2) shows that the yield in the currency of measurement is affected by several factors. First, there is a valuation effect reflecting movement of the exchange rate between the currency of measurement (the dollar) and the currency in which the assets are denominated, with a dollar depreciation raising the primary income. This is the effect identified in Colacelli et al. (2021). Second, as shown by the last block in the first row, the yield is affected by the lagged yield to the extent that there are long maturity fixed income assets. The second row present the impact of changing yields on specific assets market value in the currency of denomination. This applies to variable yield assets, as well as fixed income assets to the extent that their maturity is short (α^F is high). Finally, the lagged dynamics of the exchange rate between the currency of denomination and the dollar enter, as do the the lagged dynamics of the fixed income asset price, in the currency of denomination. These two terms indicate the lag of capital gains on fixed income assets in the currency of denomination, and their presence is linked to fixed assets that do not yet mature, and for which the market value changes relative to the face value, the later being the one on which the fixed yield applies. By contrast, movements in assets prices in the currency of denomination for assets with variables yields do not enter, as these are already reflected in the value of the positions included in the computation of yields.

3.1.4 Empirical specification

We implement an estimation of (2) for total assets, as well as at for specific investment categories: FDI, portfolio equity, portfolio debt, other investment excluding reserves (mostly banking), and foreign exchange reserves. For each category, the estimates are done separately for yields on external assets and on external liabilities. The specification is as follows:

$$\begin{aligned} ln\left(r_t^{\$}\right) &= \alpha + \beta_{lag} ln\left(r_{t-1}^{\$}\right) + \beta_{valS}\Delta ln\left(S_t^{\$,D}\right) \\ &\quad + \beta_{valSL}\Delta ln\left(S_{t-1}^{\$,D}\right) + \beta_{vaQL}\Delta ln\left(Q_{t-1}^{D}\right) \\ &\quad + \delta_{glob}\mathrm{X}_t^{global} + \delta_{local}\mathrm{Z}_t^{local} \end{aligned} \tag{3}$$

[2] If for instance the steady state yield is 4% and a variable moves the yield to 4.5%, we have $\hat{r}_t^{\$} = 0.005$ (0.5 percentage points) and $\hat{r}_t^{\$}/r_{ss} = 0.005/0.04 = 0.125$ (12.5 percent of steady state value).

where $r_t^{\$}$ is the yield, measured in dollar (we take the log to correspond to $\hat{r}_t^{\$}/r_{ss}$ in (2)), $\Delta ln\left(S_t^{\$,D}\right)$ is the first difference of the log of the exchange rate between the dollar and the currency of denomination of assets (with an increase representing a depreciation of the dollar), $\Delta ln\left(Q_{t-1}^{D}\right)$ is the first difference between the log of the asset price in the currency of denomination ($\Delta ln\left(S_{t-1}^{\$,D}\right) + \Delta ln\left(Q_{t-1}^{D}\right)$ drive the valuation effect on the asset position, expressed in dollar), X_t^{global} is a vector of global controls and Z_t^{local} is a vector of controls specific to the country. These two vectors include variables that can affect the yields on the currency of denomination.

The global controls X_t^{global} include:[3]

- First difference of the log of the broad trade-weighted exchange rate index of the US dollar, to capture its movements against all other currencies. A positive value denotes an appreciation of the US dollar.
- US short-term interest rate (3 months money market) to capture monetary policy in the major economy.
- US long-term interest rate (10 year Treasury yield) to capture changing long rates in the major economy.
- VIX index (normalized), to capture changing risk perceptions and appetite.
- World inflation (first difference of the log CPI), for regressions of income receipts.
- World real GDP growth, for regressions of income receipts.

We include the broad dollar exchange rate for three reasons. First, the literature points to it as a global factor due to the dominant role of the dollar in international financial markets (Avdjiev et al., 2019), with a strong dollar leading to tighter funding conditions. This is a distinct channel than the revaluation of income flows on dollar-denominated financial holdings, which are captured by $\Delta ln\left(S_t^{\$,D}\right)$. Second, given the dominant use of the dollar in the invoicing of international trade (the Dominant Currency Paradigm, Boz et al., 2022, Gopinath et al., 2020), an appreciation of the US currency reduces all international trade activity, and the associated profits of exporting firms. The dividends paid by these firms can in turn be reduced. Third, movements in the dollar exchange rate can reflect fluctuations of risk appetite (switch from "risk on" and "risk off" periods) that also impact real investment activity.

[3]In earlier specifications, we included the first difference of the log of the SP500 index, and the dividend yield on that index, but they proved not statistically significant.

The US interest rates proxy for interest rates in advanced economies, which we expect to directly impact earning on countries' assets, and possibly on their liabilities to the extent that they are dollar denominated, or that US interest rate affect yields in other currencies. The VIX index is included as a recognized measure of global risk attitude, which can have real economy effects as pointed above. World real growth and inflation differ are expected to impact the yield on assets abroad especially for investment categories that are state contingent.

The local controls Z_t^{local} include (for regressions of income payments):

- Inflation (first difference of the log CPI).
- Real GDP growth.
- Domestic short-term interest rate (for advanced economies).
- Domestic long-term interest rate (for advanced economies).

Domestic inflation and real growth are expected to affect the yield of the country's liability to foreign investors, especially for contingent investments. Short and long-term interest rate impact the yield on the liabilities, to the extent that they are denominated in domestic currency.

In terms of the estimation method for (3), we compute panel OLS estimates for all countries, as well as for advanced and emerging economies separately. Errors are clustered at the country level, and we include country fixed effects. The estimations are conducted both for the overall asset, as well as at the level of individual asset categories. In addition to our panel estimates, we undertake the estimation countr-by-country to assess the heterogeneity of the coefficients.

Our estimates of the coefficients in (3) indicate the impact of each right-hand side variable on the log yield for the specific asset category. We can convert this impact to express the effect in terms of the ratio of investment income flows to GDP (in percentage points), as explained in section 5.

3.2 Data sources and stylized fact

3.2.1 Data sources

We take our data from the standard sources, as indicated in table 1. Specifically, current

account figures on investment income (in US dollar), exchange rates, interest rates, GDP and inflation are from the IMF International Financial Statistics and World Economic Outlook. The values of countries' external assets and liabilities (in US dollar) are from the External Wealth of Nations database (Milesi-Ferretti, 2022c).[4] The balance of payments and position data allow to conduct the analysis at the level of the usual categories of assets, namely foreign direct investment, portfolio investment (total, equity, debt), other investment (excluding foreign reserves), and reserves. The currency of denomination of the assets and liabilities is from Bénétrix et al. (2020), with the 2017 values kept in subsequent years. The US broad dollar exchange rate is from the Board of Governors. When data are missing, other sources are used as described in table 1.

The computation of the exchange rate between the currency of denomination and the dollar, $\Delta ln\left(S_t^{\$,D}\right)$, follows the steps of Colacelli et al. (2021), based on the currency composition data of Bénétrix et al. (2020). As detailed in the appendix, the data provide us with the weights of the US dollar, Euro, Pound, Yen, Renminbi and domestic currency for assets and liabilities. They include the currency weights for the overall assets (liabilities), as well as for "debt" positions (portfolio debt and other investment). Based on these weights and the investment position data, we consider four sets of currency weights: one for the total (from the data), one for portfolio debt and other (also from the data), one for FDI, portfolio equity and reserves (computed based on the previous two), and one for overall portfolio (also computed).[5]

We compute the price valuation effect ($\Delta ln\left(Q_{t-1}^D\right)$ in 3) by taking the first difference in the dollar value of positions from Milesi-Ferretti, 2022c, removing the associated capital flows to get a residual valuation adjustment, and express in in percentage of the corresponding position to get a rate of capital gain. Two observations are warranted on this point. First, our measure of residual valuation includes the "other" valuations that are due to other factors than exchange rate and asset prices. This limits the precision of our measure, but more precise decomposition are not available for a broad range of countries. Second, the dollar

[4]While the positions in banking and portfolio investment can be measured using asset prices, it is well known that FDI investment are harder to gauge as they entail holdings that are not publicly traded. We rely on the IFS data, with different approaches of measuring FDI, as they are the most widely available ones.

[5]While our approach of computing the non-debt yields as a residual likely overlooks heterogeneous currency composition of FDI and equity, for instance, the Bénétrix et al. (2020) are the standard references on the issue, and computing an additional detailed currency composition would go beyond the scope of this paper.

valuation change we compute includes the impact of both exchange rate and asset prices movements, and thus corresponds to $(\Delta ln\left(S_{t-1}^{\$,D}\right) + \Delta ln\left(Q_{t-1}^{D}\right))$. As we however directly control for $\Delta ln\left(S_{t-1}^{\$,D}\right)$ in our regressions, the coefficient on our residual valuation captures movement in asset prices that are orthogonal to the exchange rate.

We compile the data for a broad range of 45 countries, listed in table 2, which does not include financial centers, very small countries, and countries for which the data on the currency composition of assets and liabilities are missing. We split countries between and advanced groupe (23 countries) and an emerging economies group (22 countries), using the WEO classification (with narrower coverage for some categories of assets in emerging economies).

3.2.2 Stylized facts on investment income flows

Before turning to our econometric estimates, we present some stylized facts on the primary investment income to GDP ratio since 1999. Figures 3-7 present the pattern for the median country in each group, and appendix figures 20-25 take a more detailed view.

We illustrate the patterns by presenting the gross investment income flows (sum or receipts and payments) and the net flows (difference), scaled by GDP. The first measure shows the extent of bidirectional integration in income flows, while the second indicates whether a country is a net earning or not. Figures 3 presents the pattern for the total investment income flows, for advanced economies (left panel) and emerging countries (right panel). In terms of gross flows, we see again the pattern presented in figure 1 (blue lines, which are the same as in figure 1), with an increase prior to 2008, followed by a decrease, which has reversed since 2023 in advanced economies, and since 2017in emerging countries. In net terms (red lines), the median advanced economy moved from being a net payer to a net earner, while the median emerging market remains a net payer.

Turning to specific asset categories, figures 4 and 5 show the pattern for FDI and portfolio equity, respectively. For both categories, the gross investment income flows (blue lines in the left panels) show a clear positive trend, indicating that investment income flows have indeed moved in the same direction as the rising investment positions. The pattern in net terms is more contrasted, Advanced economies moved from balance or deficit towards surpluses, while emerging economies remain in deficit territory, with a downward trend for FDI.

The pattern is different when looking at portfolio debt and other investment (figures 6 and 7). The blue lines show that growth flows have a clear cyclical pattern, with increases prior to the global financial crisis of 2008, followed by decreases that lasted until the interest rate increases of recent years (with the exception of portfolio debt for emerging economies). This shows that initially the investment flows were moving in a direction consistent with financial globalization, before being dominated by movements in interest rates, both during the sustained period of lower rates following the global crisis and during the recent rise in interest rates related to the inflation surge.

Figures 20-25 in the appendix present the two gross income flows (payment and receipts) separately, as well as net flows, and for each show the bottom and top quartile in the distribution in addition to the median. These figures show that the situation is quite heterogeneous across countries of the same group. For instance, the top quartile of FDI and portfolio equity receipts in emerging economies show sizable increases. As pointed above the gross payments associated with portfolio debt have increased in emerging economies in recent years. Figure 23 shows that payments flows dominate have have been on a steady increase since the 2010's. Figure 25 shows that the income flows on foreign exchange reserves shows a decreasing trend, especially since the global financial crisis for emerging economies.

Overall we observe a contrasted pattern, both across country groups and types of assets. Income flows linked to FDI and equity has broadly increased relative to GDP for both advanced and emerging economies. By contrast, income flows on debt and banking asset have shown a decrease since the global financial crisis especially in advanced economies, but less so in emerging markets where payments have instead increased in recent years.

4. Econometric analysis of the drivers of investment income

This section presents our estimates of the drivers of the (log) yield on assets and liabilities following (3). We first present panel estimates for the entire sample, and then focus on advanced and emerging economies. We then compute country-specific estimates and present their distribution to give a sense of heterogeneity.

4.1 Overall sample

The results of the panel estimations of (3) for the entire sample of advanced and emerging economies are given in table 3. Columns (1) and (2) shows the estimates for the (log) yield for receipts (credits) and payments (debits) respectively for the overall asset and liability holdings. The subsequent columns show the results for specific categories of assets, namely FDI, portfolio investment (total, then split into equity and debt), other investment, and reserves.

The yields are characterized by clear inertia with the coefficient on the lag being significant in all specifications.

The exchange rate between the dollar and the currency of denomination of the asset is expected to have a coefficient of +1 according to (2).[6] While it is not the case for FDI income yields, it is confirmed for portfolio and other income, both for receipts and payments. A finer assessment of the portfolio shows that the effect is most significant for debt payments, and marginally significant for equity payments. This could reflect the fact that our currency composition for FDI and equity relies on our computed residual which could mask additional heterogeneity in the currency composition between FDI, equity and reserves. Our results are thus partially in line with the finding of Colacelli et al. (2021) who find a strong mechanical effect.

The broad exchange rate of the dollar has a strong effect concentrated in the FDI payments. An appreciation of the US currency reduces yields both for receipts and payments, which leaves the net impact uncertain. This adverse effect of a dollar appreciation on FDI income could reflect several factors. First, large firms, including multinational, are more active in international trade than others. If the strengthening of the dollar leads to a reduction of trade flows (and associated profits), the return on multinational firms would be particularly affected. The effect of the dollar on trade flows can reflect the dominant currency paradigm, as shown in Boz et al. (2022). It can also be the sign of a "risk off" period where economic activity, and especially investment, is reduced. Firms which are more internationally oriented could be affected more than firms with a domestic focus.

[6] As exchange rates are measured as the first difference in logs, a 10% movements of the exchange rate is read as a change of 0.1 of the explanatory variable.

Turning to US interest rates, an increase raises the yields on both assets and liabilities (especially for short rates), with substantial heterogeneity across categories.[7] An increase in the short-term rate raises overall yields, with the effect concentrated among other investment and foreign reserves. This is expected, as other investment consists mostly of banking positions of short maturity while reserves are often placed in short-maturity liquid assets, and the dollar plays a dominant role as a funding and investment currency. By contrast, there is little effect in the portfolio investment. Higher US long-term rates have a similar, but broader effect. In addition to raising yields on other investment and reserves, the affect the yields on portfolio debt, as well as portfolio equity payments.

Movements in the VIX index have a broad impact, with an increase in risk reducing yields. This is seen across all types of flows, both on the receipts and payments sides, with the exception of equity and FDI receipts. This broad effect is consistent with the "risk off" view indicated above, as a more prudent attitude of investors can lead to a broad economic slowdown that adversely affect the returns of all assets. One may be concerned that the VIX, US interest rates, and the broad exchange rate of the dollar proxy for the same underlying factor of risk appetite. The correlation between them is however limited.[8] In addition, computing our estimates without the VIX, as in table 4, shows that the results are broadly unchanged for all variables.

Turning to the impact of inflation and real GDP growth, we consider the values for the world in the regressions for receipts, and the domestic values for the regressions for payments. Higher inflation raises the yields on other investment receipts, as well as foreign reserves. A similar effect is seen for the portfolio equity payments.[9] This could reflect the fact that inflation leads to higher interest rates on private investments, that go beyond the interest rates on money markets and Treasury yields that we control for. As the effect are sizable on both sides, the impact of a global inflation increase on net income flows are uncertain. Higher real growth worldwide raises FDI yields, especially for payments. They also reduce yields on other and reserves receipts.

[7] Interest rates enters in levels, so an increase by 1 percentage point translate in a value of +1 for the explanatory variable.

[8] In the appendix, table 8 shows that correlations are limited, with the exception of the two US interest rates.

[9] Inflation enters as the first difference of the log CPI. An increase of inflation by 2 percentage points then implies an increase of 0.02 of the explanatory variable

The presence of non-maturing fixed income assets implies that lagged movements in exchange rates and asset prices should have a negative coefficient. While the effect of the exchange rate is limited, there is evidence that the price valuation effect has the predicted effect, primarily for portfolio investment and other payments. The presence of the effect for portfolio equity yields is somewhat puzzling given the absence of fixed income in this category.

Overall our results show effects that are quite heterogeneous across drivers and categories of investments. Given this heterogeneity, it is questionable whether much can be inferred from a sample that combine advanced and emerging economies. We therefore turn to results for each of these two set of countries.

4.2 Advanced economies

Table 5 presents the results for the sample of advanced economies. For brevity, we focus on the salient dimensions of the results. As for the overall sample, we observe a clear effect of the lagged yield.

The exchange rate between the dollar and the currency of denomination has the expected sign (+1) on a broader basis, namely for overall yields, as well as for portfolio debt and other investment. The adverse impact of a broad dollar appreciation now extends beyond FDI to portfolio equity.

Higher US short-term and long-term interest rates raise yields on both sides in other investment and reserves. Long-term interest rates also impact the yields on portfolio debt, which reflects the longer maturity of these investments. These findings are consistent with the relevance of dollar funding in international banking, as well as the dominant role played by dollar bonds in debt security markets. As the effects occur for both receipts and payments, the impact on the net income balance remains uncertain. The adverse impact of the VIX on yields is confirmed, and observed on a broader range with yield on FDI now being both impacted.

Higher inflation raises the yields on other investment and reserves, due to the strong presence of short-maturity assets in these categories with a rapid adjustment of the interest rates on newly issued instruments. Higher global growth again boost the yield on FDI,

especially regarding payments. The lagged movements in capital gains again have a negative impact on portfolio and other investments, while the lagged exchange rate has no effect.

Given the availability of domestic interest rates for advanced economies, we also include the countries' short- and long-term interest rates. Only short-term rate have an effect, concentrated on portfolio debt and other investments payments.

4.3 Emerging economies

We now turn to the evidence for emerging economies, presented in table 6. Overall, several drivers have impact that are less significant than for the overall samples and advanced economies. The impact of lagged yields is similar to the overall sample.

The exchange rate between the dollar and the currency of denomination has a much less significant effect, and matters only for portfolio debt payments. This puzzling result could reflect a higher dominance of the dollar for these countries (with the associated exchange rate set at unity) implying that the movements of the exchange rate are driven by currencies that play a marginal role in the composition of the investment basket.

A broad appreciation of the dollar lowers the yield on FDI payments, but has no impact beyond, including on FDI receipts. This could reflect companies in these countries being more affected by lower trade flows and associated profits, while the companies in which emerging economies invest are less affected (as would be the case if they operate in the United States).

Turning to US interest rates, the pattern is similar to the advanced countries. The impact is concentrated on other investment and reserves, as well as portfolio debt for the long-term rate. While an increase in the VIX index also reduces yields, the effect is somewhat narrower than for advanced economies and more concentrated on yields on other investment, reserve, and portfolio debt.

Turning to macroeconomic variables, higher inflation again raises the yields on reserve and other investments, while growth impact primarily FDI yields, especially on the payment side. The lagged movement in asset prices have the expected negative effect across all categories, while the lagged exchange rate movement has barely any significant effect.

4.4 Country specific estimates

We build on our panel results by estimating (3) country by country. Figures 8-11 show the distribution of the coefficients using box and whiskers diagrams, focusing on the VIX, US interest rates, and the US broad dollar exchange rate. Overall, the exercise shows a substantial heterogeneity of the coefficients, especially among emerging markets.

The distribution of the VIX coefficients are in figure 8 for the advanced economies (left panel) and the emerging economies (right panel), with rows corresponding to the yield on receipts and payments for the various asset categories. The country specific coefficients are dispersed, especially among emerging economies. The advanced economies panel shows that the negative effect of the VIX is broadly seen, with the boxes being relatively similar across different yields (with the exception of reserves). The situation is more contrasted in emerging economies. While a higher VIX lowers the yield on other investment and reserves for most countries, the impact is more heterogeneous for portfolio debt, and especially receipts of portfolio equity with several countries showing positive coefficients.

Figure 9 shows the impact of an increase in the short-term US rate. The heterogeneity of the effect is similar in the two groups of countries. Coefficients are mostly positive for other investment and reserves, and are otherwise distributed around zero. We observe a high heterogeneity for portfolio equity and debt receipts in emerging economies, as well as FDI yield in advanced economies with a majority of coefficients showing positive values. Turning to the impact of long-term rates (figure 10, we again see positive coefficients for other investment and reserves, as well as (but more marginally so) for portfolio debt. Yields on receipts for portfolio equity and debt are again highly heterogeneous in emerging economies.

The impact of the broad exchange rate of the dollar is displayed in figure 11. The distribution of coefficients falls around zero, but the ones for FDI are more in negative territory, but with a lot of heterogeneity, especially among advanced economies. Again we observe a high dispersion of coefficients on portfolio equity and debt receipts in emerging countries.

4.5 Taking stock

Several elements can be taken from our econometric results. First, there is a high degree

of heterogeneity of the impact of various drives across different categories of investment, and across countries. Second, we observe a valuation effect of the exchange rate with the currency of denomination of assets, but primarily in advanced economies for other investment and portfolio debt. The limited significance beyond could reflect a lack of precision of the estimates of currency composition.

Third, a broad appreciation of the dollar has an adverse effect that is concentrated in FDI holdings, as well as equity holdings for advanced economies. This pattern could reflect several mechanisms. First, the dominant currency paradigm implies that international trade, invoiced in dollar, contracts when the currency appreciates. As large firms, including multinationals, are the ones most active in international trade, the strong dollar would impat their sales and profits. This is in line with our results, but we could expect trade of multinational firms to be primarily intra firm, and thus less impacted by exchange rate movemenets than arms-length trade.

A second possible mechanism is that a strong dollar indicates a "risk off" time where investors are more cautiouns in funding real investment, leading to a contraction of economic activity. As investment goods account for a large share of trade, multinationals involved in international exchanges see a contraction of their sales and profits. While the pattern is similar to the dominant currency pricing, the mechanism differs as the strong dollar is more a consequence of a higher risk aversion that also reduces economic activity than a direct cause of weaker trade.

Another mechanism is that multinational firms may affect their internal allocation of profits following exchange rate movements. If a strong dollar puts pressure on business, parent companies may opt to keep more profits in their subsidiaries to strengthen the financial resources of their foreign operations. This would translate into lower investment income payments and yields. An interesting pattern of the results is that among emerging economies the reduction in FDI yield occur only on the payments side. This is consistent with parents in advanced economies being less demanding on their subsidiaries in emerging countries in terms of profit payments when economic conditions become more challenging.

The fourth salient element is that US interest rates have a clear impact on yields, which is concentrated on fixed-income categories, as can be expected. Specifically, higher short-term

interest rates raise the yield on other investment and reserve, and higher long-term rates also do so and further impact portfolio debt yields. US monetary conditions have a robust impact on international investment income, reflecting the large presence of the dollar in loans and security debt markets. The effect is seen in both advanced and emerging economies.

A fifth point is that risk conditions matter, with a higher vIX reducing yields. The effect is if anything stronger in advanced economies, where all yields are affected while in emerging economies the effect is concentrated on portfolio debt, reserves, and other investment.

Macroeconomic conditions are also relevant, with higher growth raising the yield on FDI, especially on payments. Higher inflation robustly raises the yields on portfolio debt, other investment and reserves, which is consistent with interest rates raising beyond the US government rates.

The seventh salient pattern is that country-specific estimates show a low of heterogeneity. This tends to be more pronounced in emerging economies, especially for the impact of US interest rates, the VIX and the US dollar exchange rate on the receipts of portfolio equity and debt. This suggests that the composition of external equity investment, in terms of sectoral or regional exposure, could be very differentiated across countries, leading to very different sensitivity to global variables.

Finally, when variables have a statistically significant effects, they tend to do so for both receipts and earnings, leaving the net impact ambiguous. Assessing it requires combining the yields and position, as we do now.

5. Impact on net investment income flows

This section computes the impact of the various variables considered in the econometric exercise on the investment income flows, relative to GDP. Doing so requires combining the estimated impact on yields or the various assets and liabilities (from the panel or country-specific regression) with the corresponding asset and liabilities positions of each country. We first present the method, and then illustrate the impact of selected variables (VIX, US interest rates, and US dollar exchange rate).

5.1 Linking yields and income flows

We take the estimates of yields from section \ref{Econometric results} convert them in terms of trade and primary income flows relative to GDP, which vary by countries. Our estimates provide us with fitted values of the (ln) yield in dollar, $\hat{r}_t^{\$}/r_{ss}$. We convert them into effects in terms of income flows relative to GDP by taking the approximation of the relation between flows, GDP, yields and positions:

$$\hat{p}_t^{\$} = -p_{ss}^{\$}\left(\widehat{Y}_t^{\$} - \widehat{Y}_{t-1}^{\$}\right) + p_{ss}^{\$}\frac{\hat{r}_t^{\$}}{r_{ss}} + \frac{r_{ss}}{1+\rho_{ss}}\hat{a}_{t-1}^{\$}$$

where lower-case letter denote ratios to GDP. [10] Starting from a period $t-1$, we compute the impact of a shock at time t through the yield $\hat{r}_t^{\$}/r_{ss}$ on the income flows $\hat{p}_t^{\$}$, in terms of percentage point to GDP. We proxy $p_{ss}^{\$}$ by the value of primary income to GDP, taking the average over five years. The effect on income flows (in percentage points of GDP) is then $\hat{p}_t^{\$} = p_{ss}^{\$}\left(\hat{r}_t^{\$}/r_{ss}\right)$. Throughout the section, we measure $p_{ss}^{\$}$ using the 2017-2021 average of the ratio of investment income to GDP for the specific asset categories.

The impact of movements in the exchange rate between the dollar and the currency of denomination, $\widehat{S}_t^{\$/D}$, have an impact also through the value of assets. A change starting at period t impacts $\hat{p}_t^{\$}$ through the yield $\hat{r}_t^{\$}/r_{ss}$. If the exchange rate movement is persistent, it has an additional impact in subsequent period through the revaluation of asset positions $\hat{a}_{t+h}^{\$}$. For instance, a permanent change of the exchange rate ($\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D} \neq 0$, $\widehat{S}_{t+1}^{\$/D} = \widehat{S}_t^{\$/D}$) impacts yields only in the first period ($\hat{r}_t^{\$}/r_{ss} = \widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}$, $\hat{r}_{t+1}^{\$}/r_{ss} = \hat{r}_{t+2}^{\$}/r_{ss} = 0$). It however affects the value of assets starting at time t ($\hat{a}_{t-1}^{\$} = 0$ and $\hat{a}_t^{\$} = \hat{a}_{t+1}^{\$} = a_{ss}^{\$}\left(\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}\right)$). These two effects lead to a permanent change in the ratio of income to GDP, as we can show that $\hat{p}_{t+h}^{\$} = p_{ss}^{\$}\left(\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}\right)$ for $h \geq 0$. The appendix presents more details on the computations for specific variables.

5.2 Results

Figure 12 shows the impact of an increase of the VIX by 1 standard deviation. The effect on the net investment income to GDP is shown for advanced economies (left panel) and

[10] Specifically, $\hat{Y}_t^{\$} = \left(Y_t^{\$} - Y_{ss,t}^{\$}\right)/Y_{ss,t}^{\$}$, $\hat{p}_t^{\$} = p_t^{\$} - p_{ss}^{\$}$ and $\hat{a}_t^{\$} = a_t^{\$} - a_{ss}^{\$}$.

emerging countries (right panel).[11] For each we show the effect based on our panel estimates for the impact on yields (red bars) and the effect using the country-specific estimates blue bars). We compute the effects taking all related coefficients from our regressions, without focusing on the ones that are statistically significant. A common pattern across the figures is that using country-specific estimates leads to much more heterogeneity, as can be expected.

Among advanced economies, higher uncertainty tends to push the net investment income towards a deficit or a small surplus. The pattern is sensitive, as several countries show the opposite pattern when using country-specific estimates. Emerging economies by contrast see their investment income balance improve following an increase on the VIX, as the yield reductions weights more on their liabilities than on their assets. Considering country-specific estimates raises the magnitude of the effect, but switches its sign for a few countries.

Turning to US interest rates, figure 13 shows that the movements on the short-term rate have little effect in advanced economies when we use panel estimates. While the coefficients are significant, the highly leverage position in other investment for instance leads to effects on payments and receipts to largely offset each other. The situation is more contrasted when using country-specific coefficients, as several countries, such as Switzerland and he Netherlands, see a deterioration of their income balance. Emerging economies tend to benefit, in terms of the net investment income, from an increase in the short-term US interest rate. Allowing for different coefficient across countries amplifies the magnitude of the effect for several of them, but flips its sign for others.

Figure 14 shows the impact of an increase in the US long-term interest rate. Among advanced economies, the effect remains moderate, unless we consider country-specific estimates in which case several see a sizable improvement in their net investment income. The situation is reversed for emerging economies with deterioration of the investment balance. Using country-specific estimates raises the magnitude of this adverse effect substantially, even though it changes direction for a few countries. Overall, we see that while US interest rate movements have significant effects on yields, these occur for both payments and receipts and a results the impact on the net investment income is moderate for advanced economies (except for a few of them when we consider country specific estimates). The situation is more

[11] A value of 0.2 indicates 0.2% of GDP

contrasted among emerging markets. Temporary increases of US interest rates improve their income balance, but this effect is overturn if the increases are expected to be lasting and also show up in long-term rates. Considering country-specific estimates amplify the magnitude of the effect for most countries, but overturns it for others.

Turning to the impact of exchange rates, figure 15 considers the effect of a 10% appreciation of the dollar.[12] This affects several of the drivers in our econometric specification, namely the broad dollar exchange rate, and the exchange rate between the dollar and the currency of denomination. A strengthening of the dollar has a very contrasted impact. It reduces the net investment balance for advanced economies, reflecting the large presence of FDI for this group. Considering country-specific estimates amplifies the effect for most, but overturns it for a few countries. Emerging economies by contrast are not much affected (when using panel estimates), and several of them see an improvement in their net investment when we consider country-specific coefficients. This reflects the sizable negative effect of the dollar appreciation that is concentrated on the payment side for FDI.

Overall, combining the estimated impacts on yields with the specific asset positions shows that the effect on the net investment income is heterogeneous across country groups. Allowing for coefficients to differ across countries brings substantial additional heterogeneity, and for most countries tends to amplify the impact on net investment income, especially in emerging economies.

6. Case studies of the impact of interest rates

The world economy is recently experienced a rapid increase in interest rates and inflation. In addition, sharp movements in interest rates have long been a cause of concern for policy makers. We use our estimates to shed light on the possible impact on investment income through two case studies, namely the 2013 taper tantrum and the current increase in interest rates.

[12] In the figure we do not display the impact for Guatemala using country-specific estimates, as they lead to very large values.

6.1 The 2013 taper tantrum

Announcements by the Federal Reserve in May 2013 that it was considering gradually halting the expansion of its balance sheet led to a rapid increase in US interest rates (mostly long-term) at the end of the second quarter, and episode referred to as the "taper tantrum".

Using our estimates, we assess the impact of the interest rate movements on the net investment income. Specifically, we take the observed changes in US short and long-term interest rates between 2012 and 2013, combine them with our estimates for the impact on the (log) yield, as well as with the 2012 ratio of investment income to GDP by asset categories.

Figure 16 shows our estimates of how the movements in US interest rates would have impacted the net investment income relative to GDP (blue bars). We also present the actual change of the net income to GDP between 2012 and 2013 (red bars). We do the exercise relying on country-specific estimates for the coefficients (top panel) or on panel estimates (bottom panel).

Using our panel estimates shows that the direct impact of higher US rates had only a limited impact, with some deterioration of the net investment income in emerging economies. These effects proved to be much smaller that the changes in the income balance that actually took place.

If we rely on country-specific estimates (top panel), the estimated effects of the higher interest rate are larger for advanced economies, and mostly beneficial. The actual movements in the net income proved however smaller. In emerging economies, the higher rates had a negative effect, which is larger than when using panel estimates but still of moderate magnitude with the impact remaining below 0.5% of GDP for most.

Overall, the rise in US rates did not have a detrimental impact, according to our estimates. It actually raised the net investment income in advanced economies, and only moderately reduced it in emerging markets. Our estimates of the direct effect are mostly smaller, and less positive, than the the actual changes This pattern likely reflects the fact that the sharp movements in the US interest rates in 2013, albeit noteworthy and much discussed, were limited to long-term rates.

6.2 The current interest rate and inflation surge

Our second case study covers the sharp increase in interest rates and inflation observed since early 2022. We first consider the impact of US rates, before adding the one of interest rates in other countries (for advanced economies), and looking at the direct impact of inflation.

Specifically, we take 2021 as our starting point, and compute the path of the various drivers until 2025, as described below. We combine these with our panel estimates for the impact on yields, and the 2021 ratio of investment income to GDP by asset categories.[13]

6.2.1 Impact of US interest rates

We start with the impact of higher US interest rates. We take actual rates until May from Fred, and subsequent forecasts from Statista, for the US Fed Fund, the 3 months Treasury yield, and the 10 years Treasury yield.[14]. Combining these, we compute the paths of the 3 months and 10 years rates from 2021 to 2025.

Figure 17 shows the impact on the investment income balance for advanced economies (left panel) and emerging markets (right panel). For each country, it displays the estimates of the effect in 2023 (blue bars) and 2025 (red bars). We again undertake the analysis using country-specific estimates of the coefficients (top panel) or panel estimates (bottom panel).

Among advanced economies, we estimate that the increase in US interest rates should lead to an improvement of the net investment income for several of them, with the effect building up over time. This pattern is however somewhat sensitive to the specifications. Considering panel estimates shows a more balanced pattern between positive and negative impacts. Turning to emerging economies, we estimate a positive impact on the net investment balance, as the increase in yields has a stronger effect on the receipt side. The effect build up over time. Considering country-specific estimates shows that while most countries still see a beneficial effect, several of them face a deterioration of their net investment income.

[13] We consider impact of the interest rates for all categories, even if the estimate is not statistically significant.

[14] These are found at https://econforecasting.com/forecast/ffr, https://econforecasting.com/forecast/t03m, and https://econforecasting.com/forecast/t10y, respectively

6.2.2 Impact of domestic interest rates

The increase in interest rates is a global phenomenon that goes well beyond the United States. We therefore expand our analysis to take account of the changes in interest rates in the other economies, focusing on advanced countries as the availability of domestic rates is limited for emerging markets.

Specifically, we rely on 3 months and 10 years interest rates for the United Kingdom and the Euro area. The central bank rates are taken from Statista.[15]. The interest rates on 3 months and 10 year bonds are taken from Fred until May 2024, with forecasts for later values the World Government Bonds site.[16] These rates are used to compute paths of domestic rates for the United Kingdom and the euro area. For other advanced economies we consider a 50-50 weighting of the path of US and Euro area rates starting from their 2021 values.

Figure 18 shows the impact on advanced economies investment income balance. The left panel shows the impact of domestic rates alone, while the right panel shows the overall effect of higher rates in the US and the country itself. We again compute the effects in 2023 and 2025, and contrast the findings depending on whether we use estimates specific to countries (top panel) or from the panel regression (bottom panel).

Higher domestic interest rates lower the net income for advanced economies, the more so as time passes. The effect are even larger when we consider country-specific estimates. When we consider the impact of both US and domestic rates, the estimates point to a deterioration of the net investment income, but with substantial heterogeneity. While the pattern based on the panel estimates mostly points towards lower net income, using the country specific estimates shows a more constrasted situation, with quite a few countries seeing an improved situation.

6.2.3 Impact of inflation

The current increase in interest rates is happening in the context of a broad surge of

[15] https://econforecasting.com/forecast/ukbankrate, and https://econforecasting.com/forecast/estr

[16] http://www.worldgovernmentbonds.com/bond-forecast/germany/10-years/ and http://www.worldgovernmentbonds.com/bond-forecast/united-kingdom/10-years/, respectively. The site gives forecasts for every third month until June 2025, and values for intermediate months are interpolated. As these forecasts end in June 2025, we assume that 10 year rates remain unchanged until end 2025 and 3 months rates parallel the evolution of the policy rates over the second half of 2025.

inflation, which itself impacts the net investment income. We assess the direct impact of inflation by combining our econometric estimates for the sensitivity of yields with the inflation forecasts from the IMF World Economic Outlook.

Figure 19 shows a highly contrasted impact of global and domestic inflation. As before, we show the results for advanced and emerging economies (left and right panels), and based on country-specific or panel estimates (top and bottom panels). Higher inflation lead to higher yields on other investment, reserves, and portfolio debt. In advanced economies the impact on the payment side is stronger, leading to an improvement of the net investment income. The situation is more contrasted when using country-specific estimates, with several seeing a deterioration. We observe more heterogeneity among emerging economies. While most see an improvement, a sizable minority faces a deterioration. Using country-specific estimates reduces the positive effect for most countries, with Tunisia being an outlier.

6.3 Taking stock of the case studies

Several elements emerge from our analysis. First, using country-specific estimates leads to larger and highly contrasted patterns. As these estimates rely on a narrower sample, the coefficients are likely to be less precisely estimated than in the panel. We thus focus the rest of our discussion on the panel estimates.

The taper tantrum, while spectacular, had only a moderate impact as the effect of the higher US short-term rates on yields largely offset each other on the receipt and payments sides. Even in emerging economies, the magnitudes barely reach a third of a percent of GDP, and was small also in comparison to the changes in net income that actually occurred, driven by several factors.

The current increase in US interest rates is expected to improve the net investment income for most advanced and emerging economies, with several seeing an effect between 0.5% and 1% of GDP. This effect is however offset by the parallel increase in domestic interest rates (in advanced economies) which leads to deteriorating balances. Combining US and domestic interest rates, we estimate that several countries will see a deterioration, exceeding 1% of GDP for a few. On the other hand, higher inflation should lead to an improvement in the net asset income among advanced economies, but a more heterogeneous pattern in emerging

ones.

7. Conclusion

Financial globalisation has opened the door for a growing role of dividend and interest flows as channels of international transmission, in addition to trade flows. While the downwards trend of interest rate until 2021 has acted has an offsetting force, the current rapid increase in interest rates in the fact of higher inflation could change the picture.

In this paper, we document the evolving pattern of investment income flows and their drivers, for the various asset categories in advanced and emerging economies. Our analysis points to substantial heterogeneity. Flows linked to FDI and equity have shown a rising trend, in contrast to decreasing flows linked to debt and international banking, albeit with different path across country groups. Our econometric analysis of the drivers of yields shows that their effect is highly contrasted across types of investment, receipts and payment flows, and country groups. Specifically, in our panel analysis we find that a broad appreciation of the dollar reduce yields for FDI and equity investment, while higher US interest rates and global inflation raise yields on other investment, reserves and portfolio debt, and an increase in the VIX broadly reduce yields. Allowing the coefficients to differ across countries shows that their effect can be quite heterogeneous, in particular for the impact of interest rates and the exchange rate on portfolio investment receipts in emerging economies.

Assessing the impact of drivers on the net investment income leads to heterogeneous results across countries. This reflects the fact that several drivers impact yields on both receipts and payments, which affect the net income in offsetting ways. Depending on the specific composition of a country's assets and liabilities, the net effect can be positive or negative. Using our estimates, we assess the net investment income in two specific episodes. While US interest rates increased during the 2013 taper tantrum, this only had a moderate effect on income balances. The ongoing increase in US interest rates should actually lead to an improvement in the net income, albeit with offsetting effects of domestic rates..

Our analysis provides a first look at how income flows associated with financial asset behave in response to policy and macroeconomic shocks. It can be expanded in several directions. In terms of data, our knowledge of the currency composition of countries' assets

and liabilities can be refined at the level of specific categories, allowing for a more precise estimation of the impact of exchange rate movements. Our analysis shows that using panel or country-specific estimates affects the results, and additional research is needed to strike a balance between allowing for effects that reflects countries specific situations and relying on a large enough sample to compute robust estimates.

Another avenue of work is to model the joints movements in interest rate, exchange rate, stock prices, and the other drivers to compute a broader view of the impact of specific underlying shocks. Future research can also take account of the global adding-up constraints of surpluses and deficits to conduct a joint estimation across countries. We have also considered a linear setting, but movements in interest rates and exchange rate can have non-linear effects by triggering borrowing constraints and risk premia.

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Table 1: Data and Sources

Variable	**Source**	**Time period / Frequency**
Current Account Data in USD	IMF BOPS	1990-2022 / annual, quarterly
Exchange Rates	IMF IFS	1990-2022 / annual, quarterly
Nominal and Real GDP	IMF IFS IMF WEO UNCTAD	1990-2021 / annual, quarterly 2022 / annual 1990-2022 / annual
Trade Weights	BIS ITC	1993-2018/ multi-annual 2001- / annual
Currency of Invoicing of Assets and Liabilities	Benetrix et al. 2020	1990-2017 / annual
Assets and Liabilities, decomposition	External Wealth of Nation Database	1990-2021 / annual
Short-term interest rates (3-month Money Market & CB Policy rate)	IMF IFS OECD	1990-2022 / annual, quarterly 1990-2022 / annual, quarterly
Long-term interest rates (10-year Government Bond Yield)	IMF IFS OECD	1990-2022 / annual, quarterly 1990-2022 / annual, quarterly
VIX	FRED	1990-2022 / daily
Broad US Index	FED Board Author's calculation	2006-2022 / monthly 1990-2006 / monthly
CPI	IMF IFS UNCTAD OECD	1990-2022 / annual, quarterly 1990-2022 / annual, quarterly 1990-2022 / annual, quarterly
S&P 500 Index	Macrotrends: https://www.macrotrends.net/2324/sp-500-historical-chart-data	1990-2022/ annual
S&P 500 Dividend Yield	https://www.multpl.com/s-p-500-dividend-yield/table/by-year	1990-2022 / annual

Table 2: List of Countries

Advanced Economies		**Emerging Economies**	
Australia	Japan	Argentina	Pakistan
Austria	Korea	Brazil	Peru
Belgium	Netherlands	Chile	Philippines
Canada	New Zealand	Colombia	Poland
Czech Rep.	Norway	Egypt	Russia
Denmark	Portugal	Guatemala	South Africa
Finland	Spain	Hungary	Thailand
France	Sweden	India	Tunisia
Germany	Switzerland	Indonesia	Turkey
Greece	United Kingdom	Malaysia	Uruguay
Israel	United States	Mexico	
Italy		Morocco	

Table 3: Drivers of (ln) Yields - All Countries

	Investment Income		**FDI**		**Portfolio (total)**		**Portfolio Equity**		**Portfolio Debt**		**Other Investment**		**Reserves**
	Receipts (1)	Payments (2)	Receipts (3)	Payments (4)	Receipts (5)	Payments (6)	Receipts (7)	Payments (8)	Receipts (9)	Payments (10)	Receipts (11)	Payments (12)	Receipts (13)
L.ln Yield	0.638***	0.685***	0.494***	0.605***	0.624***	0.708***	0.589***	0.571***	0.659***	0.736***	0.832***	0.621***	0.613***
	(0.0436)	(0.0492)	(0.0449)	(0.0531)	(0.0552)	(0.0781)	(0.0794)	(0.0594)	(0.0837)	(0.0475)	(0.0514)	(0.0283)	(0.0410)
Δln $-Denomination XR	0.672***	0.236	0.0520	-0.638***	1.209**	1.778***	0.980	0.992**	0.333	1.391***	0.837**	1.188***	0.185
(increase = $ depreciation)	(0.232)	(0.196)	(0.594)	(0.232)	(0.485)	(0.506)	(0.741)	(0.399)	(0.337)	(0.358)	(0.358)	(0.332)	(0.568)
L.Δln $-Denomination XR	-0.131	-0.0382	-0.101	0.165	-0.278	-0.0859	-0.210	0.00713	-0.227	-0.0292	-0.219	-0.355**	-0.130
(increase = $ depreciation)	(0.108)	(0.0772)	(0.152)	(0.136)	(0.307)	(0.250)	(0.140)	(0.174)	(0.217)	(0.139)	(0.144)	(0.152)	(0.0802)
Δln USD Broad Index	-0.456	-1.272***	-0.929	-2.158***	-0.577	0.135	-0.826	0.152	-0.410	0.338	0.297	0.193	0.241
(increase = $ appreciation)	(0.298)	(0.265)	(0.651)	(0.289)	(0.554)	(0.454)	(0.729)	(0.755)	(0.489)	(0.237)	(0.386)	(0.343)	(0.678)
US 3-month interest rate	0.0479***	0.0485***	0.00586	-0.0253***	0.0205	-0.0139*	-0.00873	-0.0438**	0.0115	-0.00852	0.0366***	0.0877***	0.109***
	(0.00788)	(0.00789)	(0.0151)	(0.00803)	(0.0153)	(0.00796)	(0.0223)	(0.0170)	(0.0134)	(0.00895)	(0.00906)	(0.00689)	(0.0228)
US 10-year treasury yield	0.0138	0.00389	0.00653	0.0371***	0.0650***	0.0601***	0.0537*	0.0839***	0.102***	0.0818***	0.0839***	0.0969***	0.147***
	(0.0100)	(0.00942)	(0.0195)	(0.0136)	(0.0213)	(0.0172)	(0.0291)	(0.0261)	(0.0200)	(0.0159)	(0.0188)	(0.0231)	(0.0287)
VIX	-0.0280**	-0.0570***	-0.0154	-0.0508***	-0.0229	-0.0321***	-0.0270	-0.0481***	-0.0559**	-0.0223***	-0.155***	-0.0380***	-0.0848***
(normalized)	(0.0109)	(0.0106)	(0.0227)	(0.00879)	(0.0245)	(0.0110)	(0.0428)	(0.0132)	(0.0219)	(0.00799)	(0.0176)	(0.0100)	(0.0223)
Inflation(Δln CPI)	0.288	0.382**	0.662	1.082***	-0.833	0.249	0.637	1.260***	0.881	-0.0236	12.63***	0.293	4.813**
	(0.577)	(0.162)	(1.095)	(0.330)	(1.042)	(0.288)	(2.264)	(0.300)	(1.200)	(0.214)	(1.519)	(0.211)	(2.008)
RGDP growth	0.0296***	0.359**	0.0553***	1.577***	-0.00137	0.424*	-0.0133	1.158**	-0.0136	0.0971	-0.0373***	0.0745	-0.0406***
	(0.00583)	(0.150)	(0.0158)	(0.349)	(0.0113)	(0.240)	(0.0231)	(0.562)	(0.0108)	(0.206)	(0.00971)	(0.253)	(0.0101)
L. Capital Gains	-0.00286***	-0.00468***	-0.000106	-0.00269***	-0.00301	-0.00634***	-0.00104**	-0.00411***	-0.000290***	-0.00398***	-0.00223	-0.00668***	-0.000402
	(0.000795)	(0.00106)	(0.0000995)	(0.000945)	(0.00235)	(0.000917)	(0.000384)	(0.000659)	(0.0000261)	(0.00110)	(0.00201)	(0.00140)	(0.00369)
Constant	-1.536***	-1.353***	-1.789***	-1.255***	-1.505***	-1.153***	-1.797***	-1.815***	-1.401***	-1.091***	-1.344***	-1.976***	-2.382***
	(0.156)	(0.193)	(0.155)	(0.167)	(0.196)	(0.293)	(0.355)	(0.265)	(0.265)	(0.174)	(0.222)	(0.165)	(0.197)
Country FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1056	1059	1011	1044	1014	1044	863	891	922	981	1025	1024	560
Countries	45	45	45	45	45	45	42	41	43	44	44	44	31
Adj. ($R\hat{\{}2\}$	0.721	0.693	0.362	0.546	0.527	0.616	0.376	0.378	0.584	0.746	0.824	0.790	0.764

Notes: OLS panel estimates, errors clustered at the country level. *, **, *** indicates significance at the 10, 5 and 1% level respectively. Inflation and real GDP growth are values for the rest of the world in the Receipt regressions, and values for the country in the Payment regressions.

Table 4: Drivers of (ln) Yields - All Countries, no VIX index

	Investment Income		**FDI**		**Portfolio (total)**		**Portfolio Equity**		**Portfolio Debt**		**Other Investment**		**Reserves**
	Receipts (1)	Payments (2)	Receipts (3)	Payments (4)	Receipts (5)	Payments (6)	Receipts (7)	Payments (8)	Receipts (9)	Payments (10)	Receipts (11)	Payments (12)	Receipts (13)
L.ln Yield	0.622***	0.646***	0.495***	0.603***	0.598***	0.727***	0.574***	0.586***	0.602***	0.739***	0.780***	0.568***	0.574***
	(0.0434)	(0.0439)	(0.0424)	(0.0550)	(0.0576)	(0.0779)	(0.0826)	(0.0612)	(0.0896)	(0.0473)	(0.0690)	(0.0595)	(0.0519)
Δln $-Denomination XR	0.810***	0.233	0.112	-0.476*	1.289***	1.667***	0.933	0.890**	0.356	1.232***	1.540***	1.029***	0.598
(increase = $ depreciation)	(0.245)	(0.192)	(0.532)	(0.244)	(0.438)	(0.492)	(0.823)	(0.402)	(0.384)	(0.352)	(0.372)	(0.339)	(0.615)
L.Δln $-Denomination XR	-0.223*	-0.0757	-0.0885	0.163	-0.420	-0.1000	-0.0963	0.0543	-0.269	0.0431	-0.233	-0.0731	-0.195*
(increase = $ depreciation)	(0.127)	(0.0853)	(0.152)	(0.148)	(0.328)	(0.297)	(0.144)	(0.206)	(0.258)	(0.128)	(0.159)	(0.168)	(0.109)
Δln USD Broad Index	-0.246	-1.265***	-0.970*	-2.065***	-0.371	0.0199	-0.811	-0.173	-0.367	0.182	1.231**	0.196	0.997
(increase = $ appreciation)	(0.325)	(0.255)	(0.554)	(0.258)	(0.496)	(0.424)	(0.814)	(0.649)	(0.643)	(0.222)	(0.477)	(0.343)	(0.712)
US 3-month interest rate	0.0533***	0.0547***	0.00595	-0.0138*	0.0288**	-0.0134	-0.0136	-0.0449**	0.0241*	-0.00559	0.0723***	0.0613***	0.122***
	(0.00768)	(0.00809)	(0.0121)	(0.00809)	(0.0138)	(0.00860)	(0.0168)	(0.0177)	(0.0125)	(0.00998)	(0.00935)	(0.00910)	(0.0247)
US 10-year treasury yield	0.00527	-0.00693	0.00286	0.0195	0.0579***	0.0568***	0.0417	0.0838***	0.0942***	0.0738***	0.0302	0.128***	0.136***
	(0.0111)	(0.00957)	(0.0201)	(0.0143)	(0.0206)	(0.0210)	(0.0303)	(0.0269)	(0.0226)	(0.0172)	(0.0255)	(0.0432)	(0.0333)
Inflation(Δln CPI)	0.756	0.200	0.0598	0.365	0.0889	0.107	-1.535	1.289**	0.284	0.169	7.041***	1.167**	5.493***
	(0.590)	(0.189)	(0.996)	(0.235)	(1.256)	(0.334)	(2.392)	(0.518)	(1.056)	(0.203)	(1.456)	(0.521)	(1.854)
RGDP growth	0.0401***	0.995***	0.0610***	2.684***	0.00137	0.527	-0.00338	0.103	0.00583	-0.0666	0.0320***	-0.0706	-0.00976
	(0.00644)	(0.217)	(0.00909)	(0.473)	(0.0123)	(0.343)	(0.0136)	(0.768)	(0.00810)	(0.259)	(0.0117)	(0.409)	(0.0109)
L. Capital Gains	-0.00287***	-0.00482***	-0.000117	-0.00293***	-0.00287	-0.00630***	-0.00102***	-0.00383***	-0.000273***	-0.00381***	-0.000992	-0.00583***	-0.00389
	(0.000847)	(0.00119)	(0.0000986)	(0.00106)	(0.00231)	(0.000938)	(0.000372)	(0.000706)	(0.0000278)	(0.00105)	(0.00175)	(0.00143)	(0.00350)
Constant	-1.617***	-1.498***	-1.769***	-1.234***	-1.617***	-1.085***	-1.775***	-1.747***	-1.616***	-1.068***	-1.459***	-2.265***	-2.641***
	(0.170)	(0.176)	(0.160)	(0.171)	(0.224)	(0.297)	(0.409)	(0.247)	(0.308)	(0.172)	(0.321)	(0.344)	(0.289)
Country FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1009	1019	966	1004	966	1002	819	853	881	941	983	985	528
Countries	45	45	45	45	45	45	42	41	43	44	44	44	31
Adj. R^2	0.727	0.675	0.362	0.550	0.502	0.638	0.348	0.384	0.537	0.742	0.805	0.731	0.760

Notes: OLS panel estimates, errors clustered at the country level. *, **, *** indicates significance at the 10, 5 and 1% level respectively. Inflation and real GDP growth are values for the rest of the world in the Receipt regressions, and values for the country in the Payment regressions.

Table 5: Drivers of (ln) Yields - Advanced Economies

	Investment Income		**FDI**		**Portfolio (total)**		**Portfolio Equity**		**Portfolio Debt**		**Other Investment**		**Reserves**
	Receipts (1)	Payments (2)	Receipts (3)	Payments (4)	Receipts (5)	Payments (6)	Receipts (7)	Payments (8)	Receipts (9)	Payments (10)	Receipts (11)	Payments (12)	Receipts (13)
L.ln Yield	0.593***	0.635***	0.396***	0.393***	0.706***	0.763***	0.660***	0.628***	0.751***	0.782***	0.747***	0.590***	0.643***
	(0.0520)	(0.0491)	(0.0417)	(0.0569)	(0.0502)	(0.0188)	(0.0698)	(0.0754)	(0.0448)	(0.0239)	(0.0254)	(0.0346)	(0.0537)
Δln $-Denomination XR	0.568***	0.595***	-0.601	-0.509	0.780***	1.117***	0.441	0.350	0.680***	1.468***	1.257***	1.339***	-0.763
(increase = $ depreciation)	(0.193)	(0.166)	(0.462)	(0.366)	(0.230)	(0.349)	(0.357)	(0.298)	(0.230)	(0.509)	(0.371)	(0.269)	(0.666)
L.Δln $-Denomination XR	0.0491	0.0686	-0.129	-0.00188	-0.235	-0.138	-0.0156	0.0529	-0.248	-0.300***	-0.123	-0.325**	-0.118
(increase = $ depreciation)	(0.114)	(0.106)	(0.130)	(0.143)	(0.260)	(0.108)	(0.0832)	(0.228)	(0.219)	(0.103)	(0.130)	(0.129)	(0.0847)
Δln USD Broad Index	-0.708***	-0.976***	-2.139***	-1.981***	-0.610***	-0.394*	-1.561***	-0.781**	-0.235	0.288	0.134	0.495	-1.220
(increase = $ appreciation)	(0.188)	(0.168)	(0.586)	(0.410)	(0.205)	(0.224)	(0.273)	(0.298)	(0.274)	(0.279)	(0.435)	(0.404)	(0.901)
US 3-month interest rate	0.0182***	0.0145**	0.00730	0.0180	-0.0109	-0.00855	-0.00201	-0.0277**	-0.0136	0.00216	0.0378***	0.0688***	0.0762***
	(0.00627)	(0.00614)	(0.0160)	(0.0146)	(0.00980)	(0.00948)	(0.00945)	(0.0106)	(0.00998)	(0.0116)	(0.00989)	(0.0112)	(0.0235)
US 10-year treasury yield	0.0386***	0.0204	-0.00117	-0.000789	0.0650***	0.0325**	0.00744	-0.00291	0.0938***	0.0636***	0.109***	0.115**	0.159***
	(0.0101)	(0.0141)	(0.0235)	(0.0253)	(0.0203)	(0.0149)	(0.0160)	(0.0216)	(0.0164)	(0.0190)	(0.0223)	(0.0409)	(0.0297)
VIX	-0.0287***	-0.0504***	-0.0600**	-0.0379**	-0.0393***	-0.0360***	-0.0642***	-0.0664***	-0.0460***	-0.0372***	-0.113***	-0.0729***	-0.0929***
(normalized)	(0.00977)	(0.00785)	(0.0253)	(0.0147)	(0.00820)	(0.00965)	(0.0144)	(0.0125)	(0.0115)	(0.00922)	(0.0126)	(0.0135)	(0.0271)
Inflation(Δln CPI)	0.189	1.506***	1.306	1.120	-0.482	1.250*	-0.146	0.398	1.614*	1.524	12.12***	5.927***	5.088*
	(0.616)	(0.341)	(1.199)	(0.754)	(0.628)	(0.605)	(0.865)	(0.695)	(0.840)	(0.898)	(1.618)	(1.122)	(2.892)
RGDP growth	0.0226***	1.128***	0.0339**	2.872***	-0.00801	1.148***	-0.00679	1.419***	-0.0171***	0.0609	-0.0283***	-0.737	-0.0521***
	(0.00549)	(0.311)	(0.0147)	(0.451)	(0.00522)	(0.375)	(0.00654)	(0.477)	(0.00442)	(0.594)	(0.00774)	(0.763)	(0.0163)
L. Capital Gains	-0.00302**	-0.00450***	-0.00147	-0.00165	-0.00465***	-0.00663***	-0.00626***	-0.00535***	-0.00294*	-0.00552***	-0.00537***	-0.00539***	-0.00353
	(0.00133)	(0.00138)	(0.00100)	(0.00112)	(0.00161)	(0.000417)	(0.000561)	(0.00100)	(0.00144)	(0.00121)	(0.00122)	(0.00163)	(0.00314)
Domestic Long-term IR		-0.000109		0.0334**		0.0143**		0.000892		0.0186**		0.0139**	
		(0.00431)		(0.0130)		(0.00589)		(0.00510)		(0.00884)		(0.00649)	
Domestic Short-term IR		0.00403		-0.0254		0.00745		0.0340**		-0.00275		0.0361**	
		(0.00884)		(0.0184)		(0.0134)		(0.0160)		(0.0114)		(0.0163)	
Constant	-1.644***	-1.440***	-1.921***	-1.940***	-1.201***	-1.031***	-1.259***	-1.338***	-1.148***	-1.078***	-1.769***	-2.424***	-2.212***
	(0.180)	(0.182)	(0.146)	(0.184)	(0.201)	(0.0740)	(0.254)	(0.238)	(0.170)	(0.0962)	(0.160)	(0.252)	(0.214)
Country FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	542	541	527	531	542	541	526	520	529	529	542	541	324
Countries	23	23	23	23	23	23	23	23	23	23	23	23	17
Adj. R^2	0.790	0.753	0.344	0.400	0.722	0.798	0.532	0.549	0.799	0.862	0.881	0.864	0.773

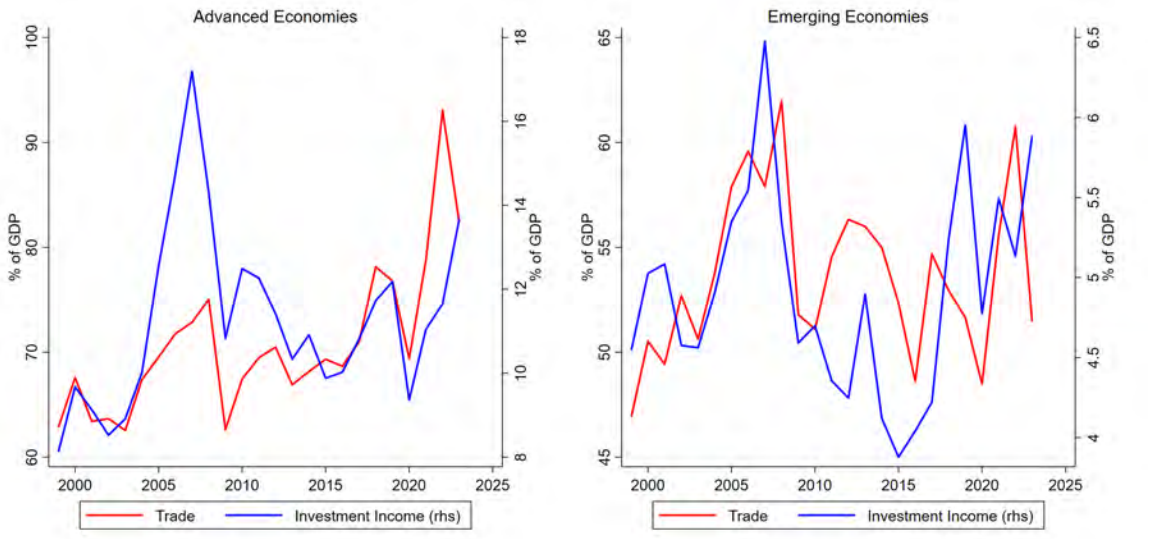
Notes: OLS panel estimates, errors clustered at the country level. *, **, *** indicates significance at the 10, 5 and 1% level respectively. Inflation and real GDP growth are values for the rest of the world in the Receipt regressions, and values for the country in the Payment regressions.

Table 6: Drivers of (ln) Yields - Emerging Economies

	Investment Income		**FDI**		**Portfolio (total)**		**Portfolio Equity**		**Portfolio Debt**		**Other Investment**		**Reserves**
	Receipts (1)	Payments (2)	Receipts (3)	Payments (4)	Receipts (5)	Payments (6)	Receipts (7)	Payments (8)	Receipts (9)	Payments (10)	Receipts (11)	Payments (12)	Receipts (13)
L.ln Yield	0.636***	0.694***	0.525***	0.688***	0.603***	0.695***	0.583***	0.533***	0.625***	0.667***	0.856***	0.644***	0.567***
	(0.0571)	(0.0598)	(0.0525)	(0.0586)	(0.0569)	(0.0966)	(0.100)	(0.0755)	(0.104)	(0.104)	(0.0613)	(0.0499)	(0.0407)
Δln $-Denomination XR	0.813	0.0358	0.885	-0.670*	4.626**	2.848**	4.698*	2.535*	0.986	1.516***	0.579	0.894*	1.452
(increase = $ depreciation)	(0.583)	(0.368)	(1.380)	(0.383)	(2.162)	(1.257)	(2.565)	(1.245)	(1.673)	(0.487)	(1.292)	(0.454)	(1.500)
L.Δln $-Denomination XR	-0.489*	-0.0675	0.833	0.399**	0.00347	-0.152	0.277	0.416	0.551	0.749**	-0.0103	-0.122	-0.298
(increase = $ depreciation)	(0.242)	(0.132)	(0.564)	(0.171)	(1.006)	(0.733)	(1.008)	(0.411)	(1.200)	(0.337)	(0.405)	(0.294)	(1.505)
Δln USD Broad Index	-0.328	-1.443***	-0.120	-2.189***	0.282	0.758	0.407	1.480	-0.579	0.498	0.303	0.255	1.520
(increase = $ appreciation)	(0.466)	(0.485)	(1.074)	(0.406)	(1.108)	(0.826)	(1.476)	(1.643)	(0.858)	(0.376)	(0.698)	(0.465)	(0.877)
US 3-month interest rate	0.0809***	0.0800***	0.00440	-0.0386***	0.0670**	-0.0132	0.0109	-0.0707*	0.0494	-0.0169	0.0344**	0.0770***	0.157***
	(0.0113)	(0.0114)	(0.0276)	(0.0125)	(0.0320)	(0.0168)	(0.0566)	(0.0386)	(0.0287)	(0.0136)	(0.0132)	(0.0104)	(0.0411)
US 10-year treasury yield	-0.00641	-0.0167	0.0128	0.0516**	0.0441	0.0493*	0.0741	0.169***	0.0896**	0.0642***	0.0765**	0.0402**	0.138**
	(0.0166)	(0.0156)	(0.0324)	(0.0205)	(0.0425)	(0.0282)	(0.0741)	(0.0578)	(0.0375)	(0.0222)	(0.0298)	(0.0159)	(0.0565)
VIX	-0.0252	-0.0621***	0.0222	-0.0402***	0.00239	-0.0312	0.0504	-0.0259	-0.0720	-0.0174	-0.182***	-0.0471***	-0.0735*
(normalized)	(0.0203)	(0.0188)	(0.0361)	(0.0117)	(0.0520)	(0.0204)	(0.111)	(0.0285)	(0.0449)	(0.0126)	(0.0317)	(0.0159)	(0.0384)
Inflation(Δln CPI)	0.215	0.191	0.360	0.835***	-0.499	0.173	1.153	1.227**	1.045	-0.0327	11.75***	0.175	3.996
	(1.008)	(0.137)	(1.984)	(0.277)	(2.078)	(0.298)	(5.385)	(0.497)	(2.178)	(0.234)	(2.463)	(0.179)	(2.440)
RGDP growth	0.0353***	0.152	0.0703**	1.208***	0.0139	0.375	0.00623	1.167	-0.00638	0.146	-0.0447**	0.0977	-0.0297*
	(0.00996)	(0.164)	(0.0288)	(0.322)	(0.0225)	(0.296)	(0.0584)	(0.879)	(0.0233)	(0.269)	(0.0191)	(0.194)	(0.0149)
L. Capital Gains	-0.00327***	-0.00565***	-0.000103	-0.00356***	-0.00270	-0.00602***	-0.000818*	-0.00352***	-0.000288***	-0.00360***	-0.00185	-0.00665***	0.00870
	(0.000905)	(0.00169)	(0.0000973)	(0.00100)	(0.00272)	(0.00122)	(0.000441)	(0.000794)	(0.0000324)	(0.000965)	(0.00209)	(0.00176)	(0.0121)
Constant	-1.603***	-1.416***	-1.836***	-1.002***	-1.590***	-1.091***	-2.157***	-2.277***	-1.381***	-1.097***	-1.172***	-1.592***	-2.613***
	(0.213)	(0.249)	(0.216)	(0.186)	(0.228)	(0.341)	(0.580)	(0.445)	(0.287)	(0.319)	(0.261)	(0.203)	(0.285)
Country FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	514	517	484	512	472	502	337	370	393	451	483	482	236
Countries	22	22	22	22	22	22	19	18	20	21	21	21	14
Adj. (R^2	0.710	0.692	0.377	0.642	0.510	0.562	0.363	0.349	0.532	0.570	0.797	0.699	0.758

Notes: OLS panel estimates, errors clustered at the country level. *, **, *** indicates significance at the 10, 5 and 1% level respectively. Inflation and real GDP growth are values for the rest of the world in the Receipt regressions, and values for the country in the Payment regressions. We do not include domestic interest rates for the Payments regressions due to data availability issues in EMEs.

Figure 1: International integration (receipts + payments, % GDP)



Note: Sum of receipts and payments flows in the balance of payments, trade (red line, left scale) and investment income (blue line, right scale).

Figure 2: Net Investment Income and Net International Investment Position (averages % GDP)

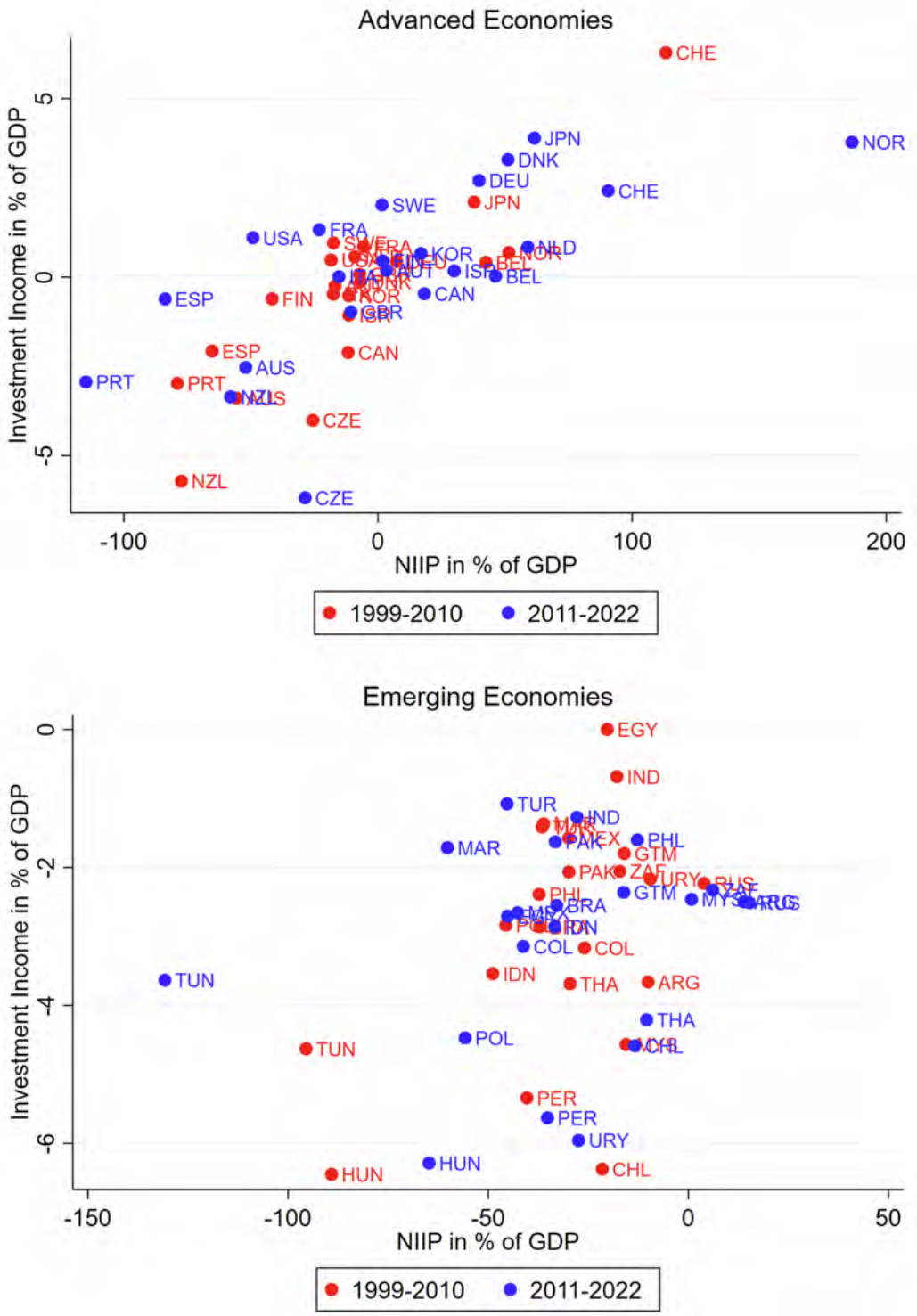
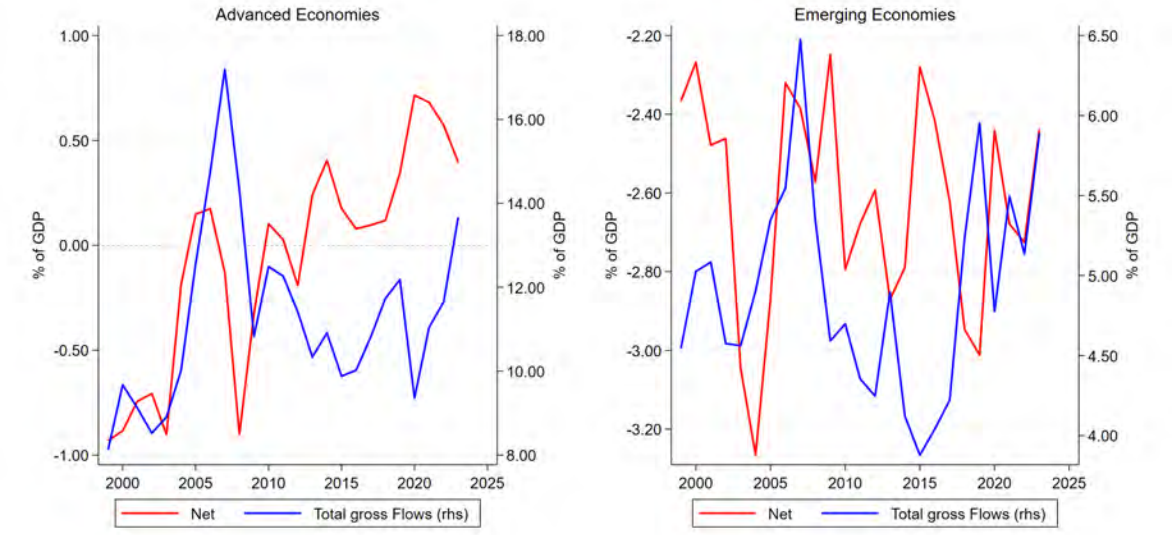
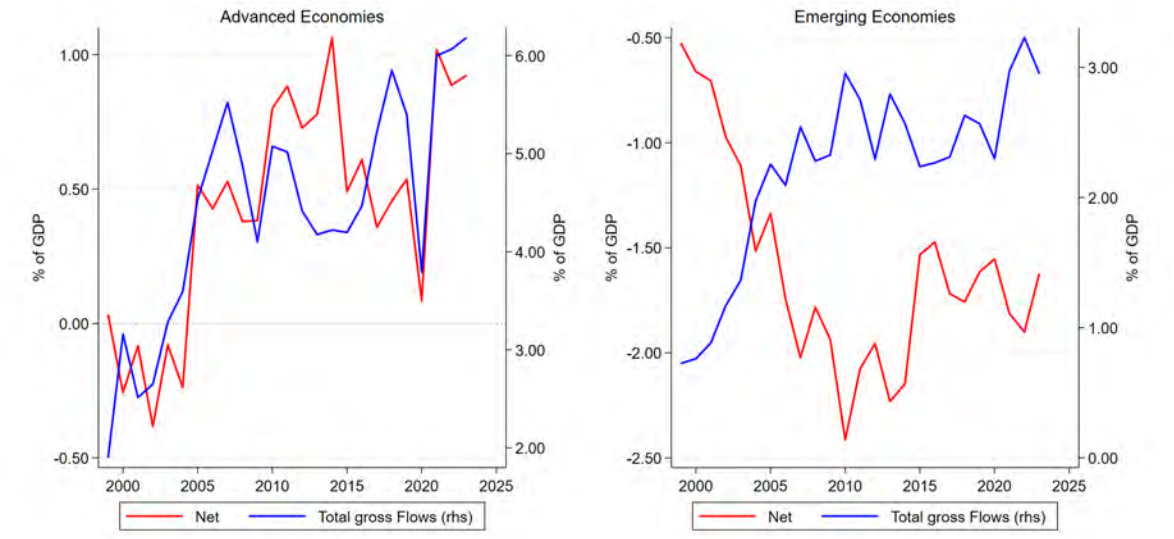


Figure 3: Gross and net income flows, total (% GDP)



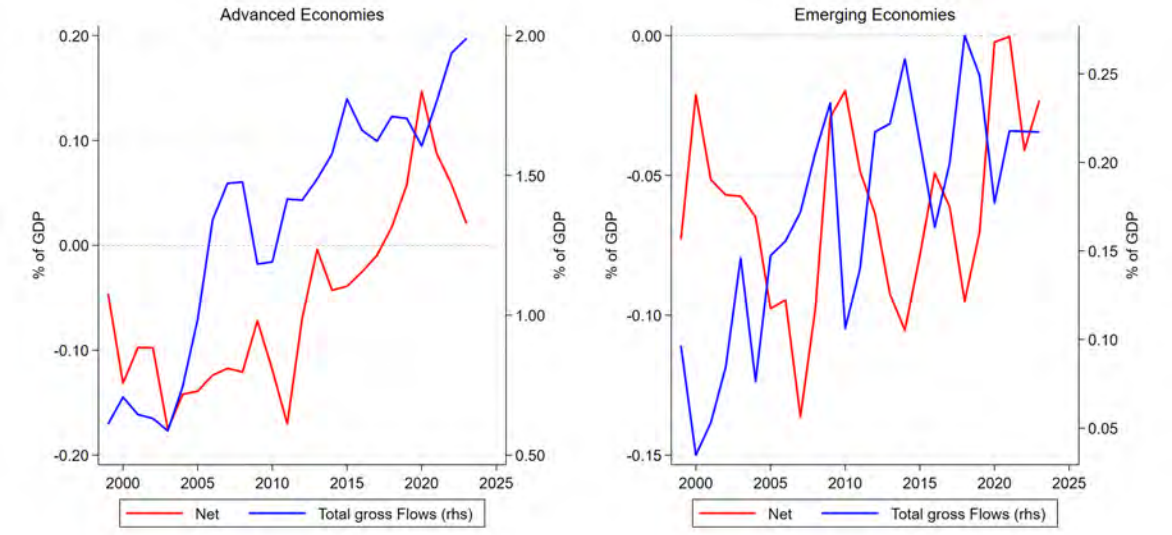
Note: Difference between receipts and payments income flows (red line, left scale) and sum of receipts and payments income flows (blue line, right scale).

Figure 4: Gross and net income flows, FDI (% GDP)



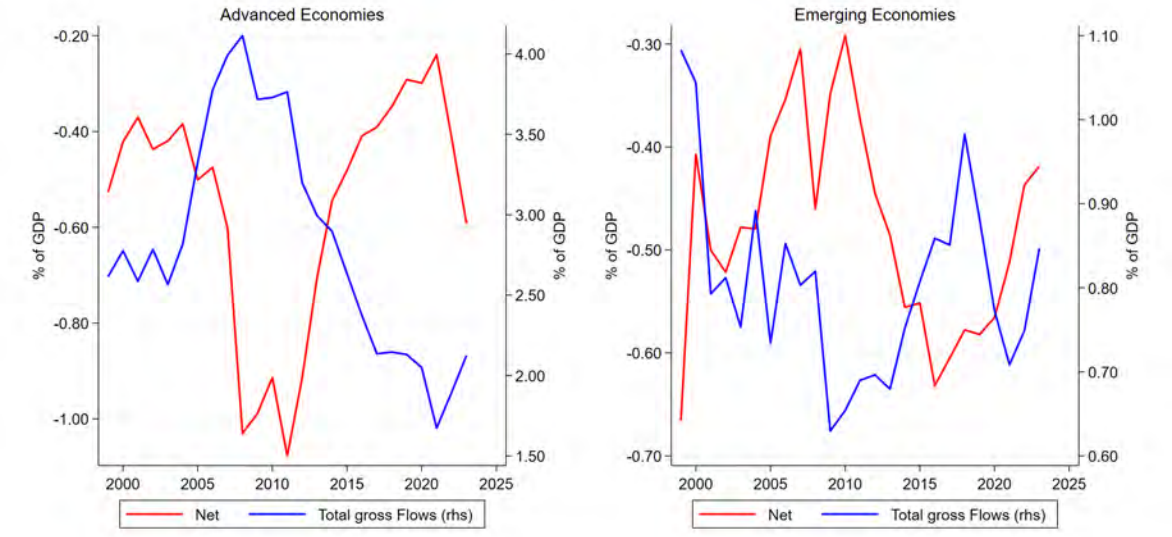
Note: Difference between receipts and payments income flows (red line, left scale) and sum of receipts and payments income flows (blue line, right scale).

Figure 5: Gross and net income flows, Portfolio equity (% GDP)



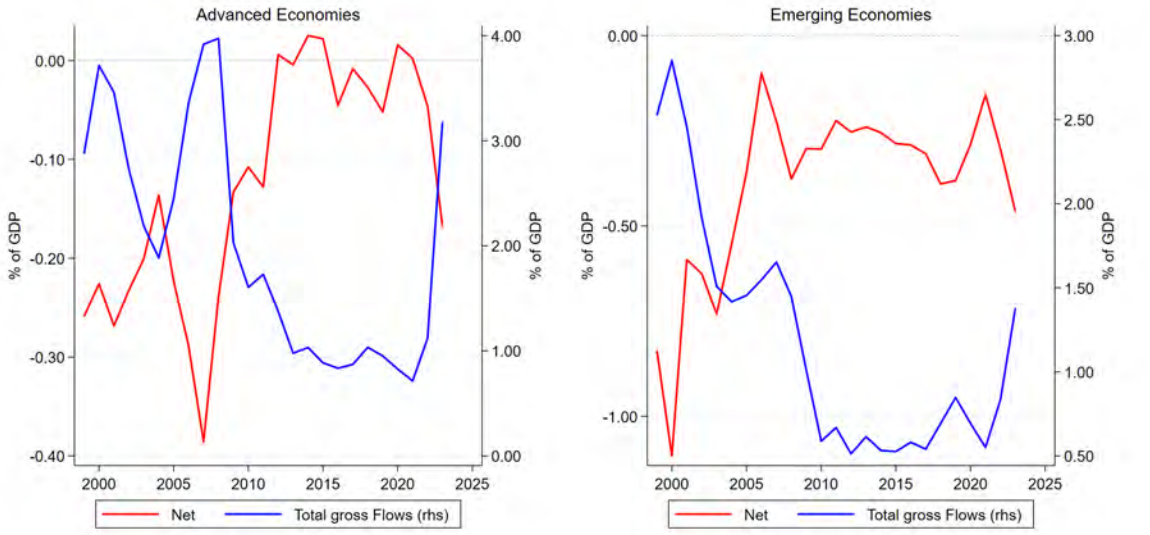
Note: Difference between receipts and payments income flows (red line, left scale) and sum of receipts and payments income flows (blue line, right scale).

Figure 6: Gross and net income flows, Portfolio debt (% GDP)



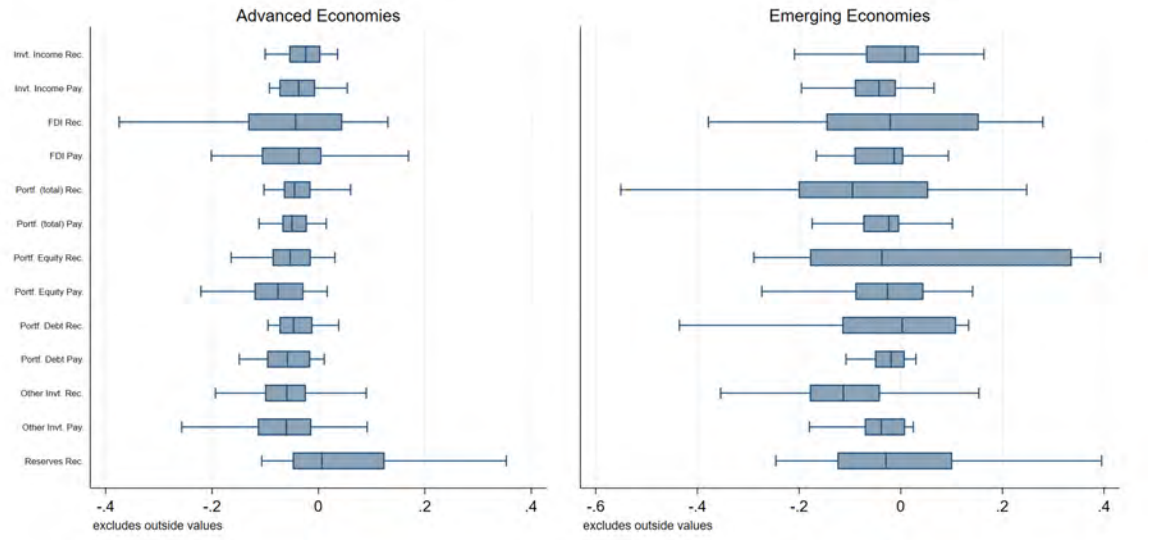
Note: Difference between receipts and payments income flows (red line, left scale) and sum of receipts and payments income flows (blue line, right scale).

Figure 7: Gross and net income flows, other investment (% GDP)



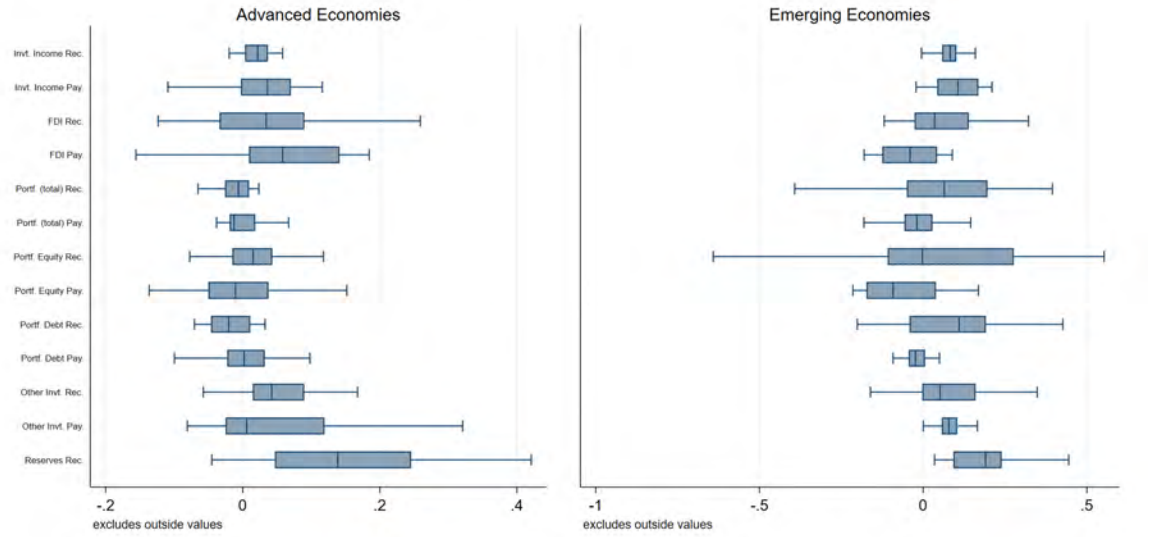
Note: Difference between receipts and payments income flows (red line, left scale) and sum of receipts and payments income flows (blue line, right scale).

Figure 8: Distribution of coefficient, VIX



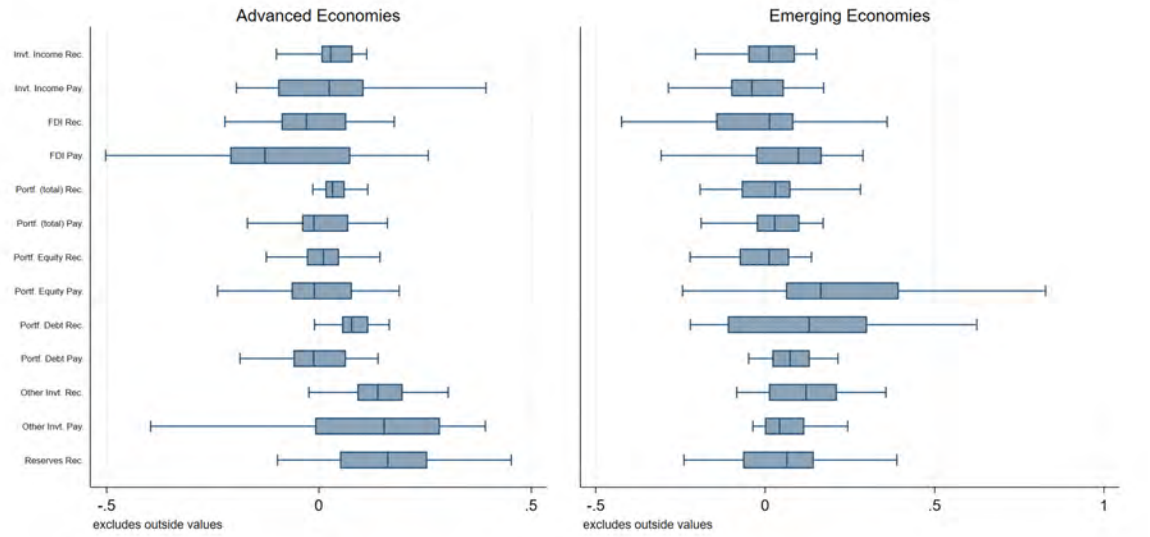
*Note:*Distribution of the coefficients estimated country-by-country for receipts and for payments for the specific type of asset income.

Figure 9: Distribution of coefficient, short-term US interest rate



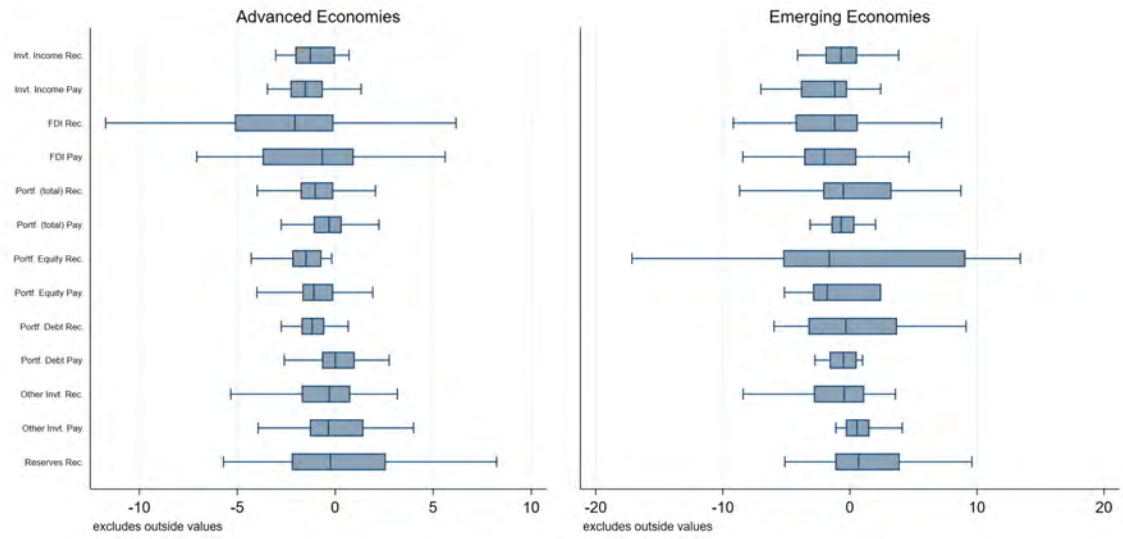
*Note:*Distribution of the coefficients estimated country-by-country for receipts and for payments for the specific type of asset income.

Figure 10: Distribution of coefficient, long-term US interest rate



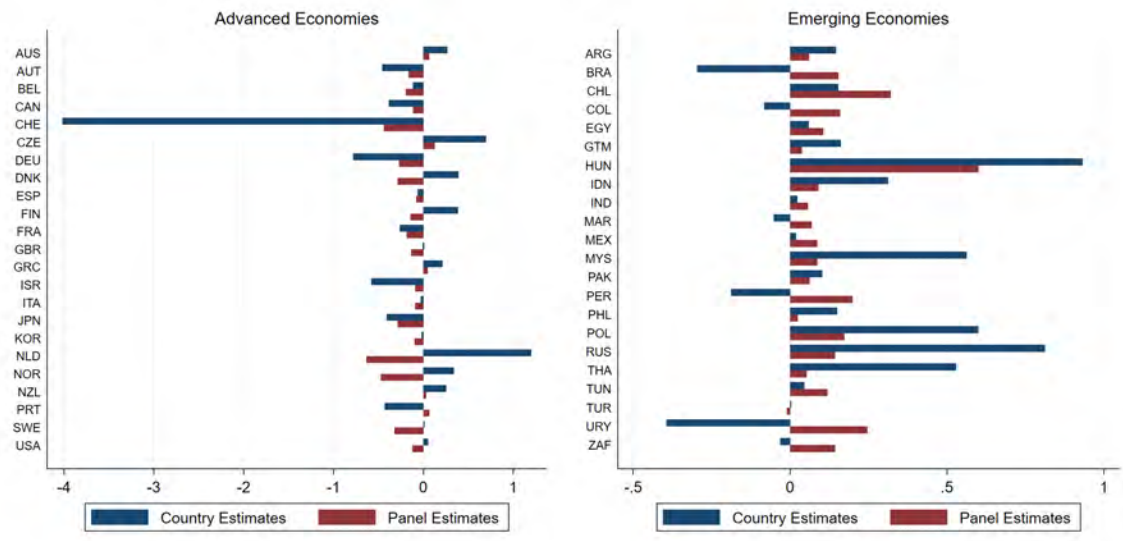
*Note:*Distribution of the coefficients estimated country-by-country for receipts and for payments for the specific type of asset income.

Figure 11: Distribution of coefficient, US dollar broad exchange rate



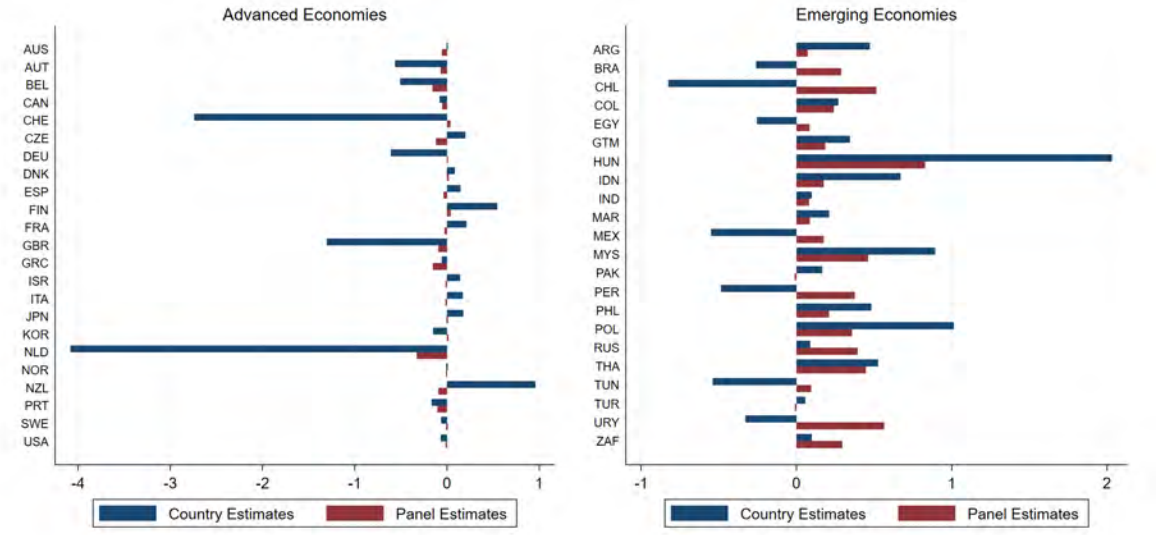
*Note:*Distribution of the coefficients estimated country-by-country for receipts and for payments for the specific type of asset income.

Figure 12: Impact of a VIX increase



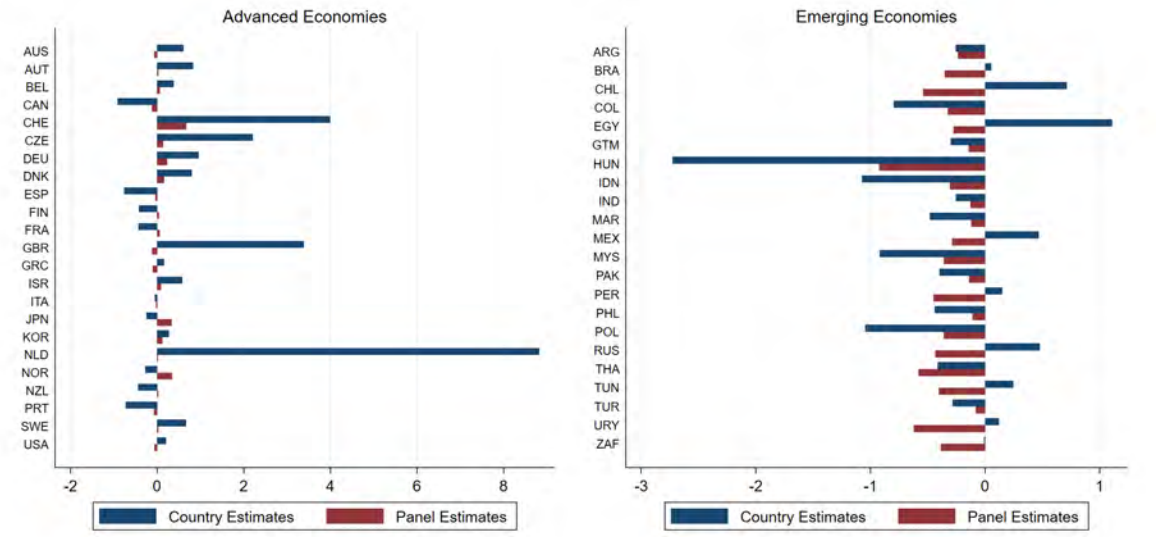
*Note:*Impact of a 1 standard error increase in the VIX index on the net primary asset income (% of GDP), based on country-specific coefficients (blue bars) or panel coefficients (red bars).

Figure 13: Impact of a US short-term interest rate increase



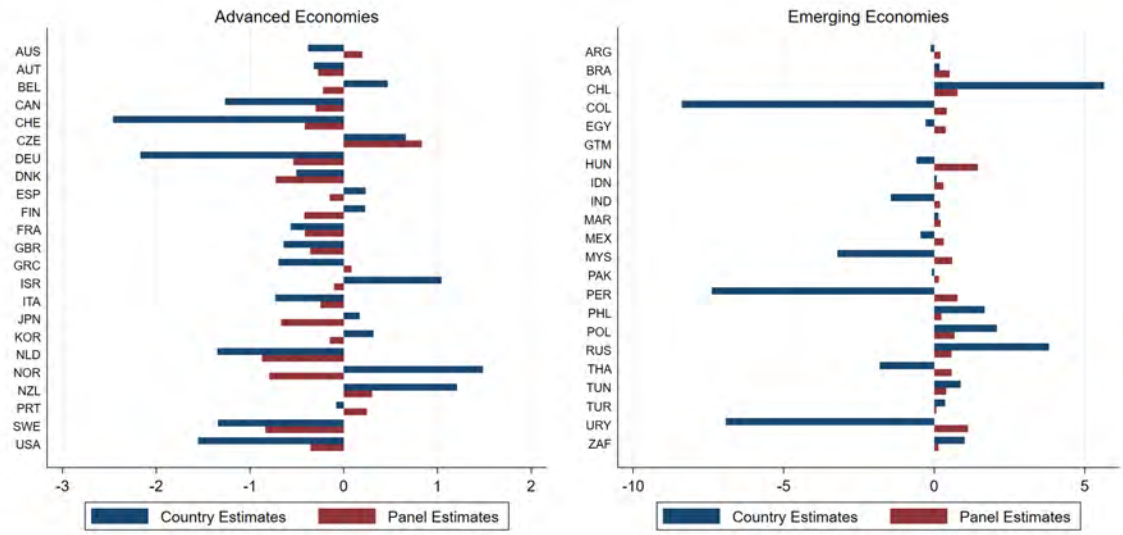
*Note:*Impact of a 1 percentage point increase in the US 3 months interest rate on the net primary asset income (% of GDP), based on country-specific coefficients (blue bars) or panel coefficients (red bars).

Figure 14: Impact of a US long-term interest rate increase



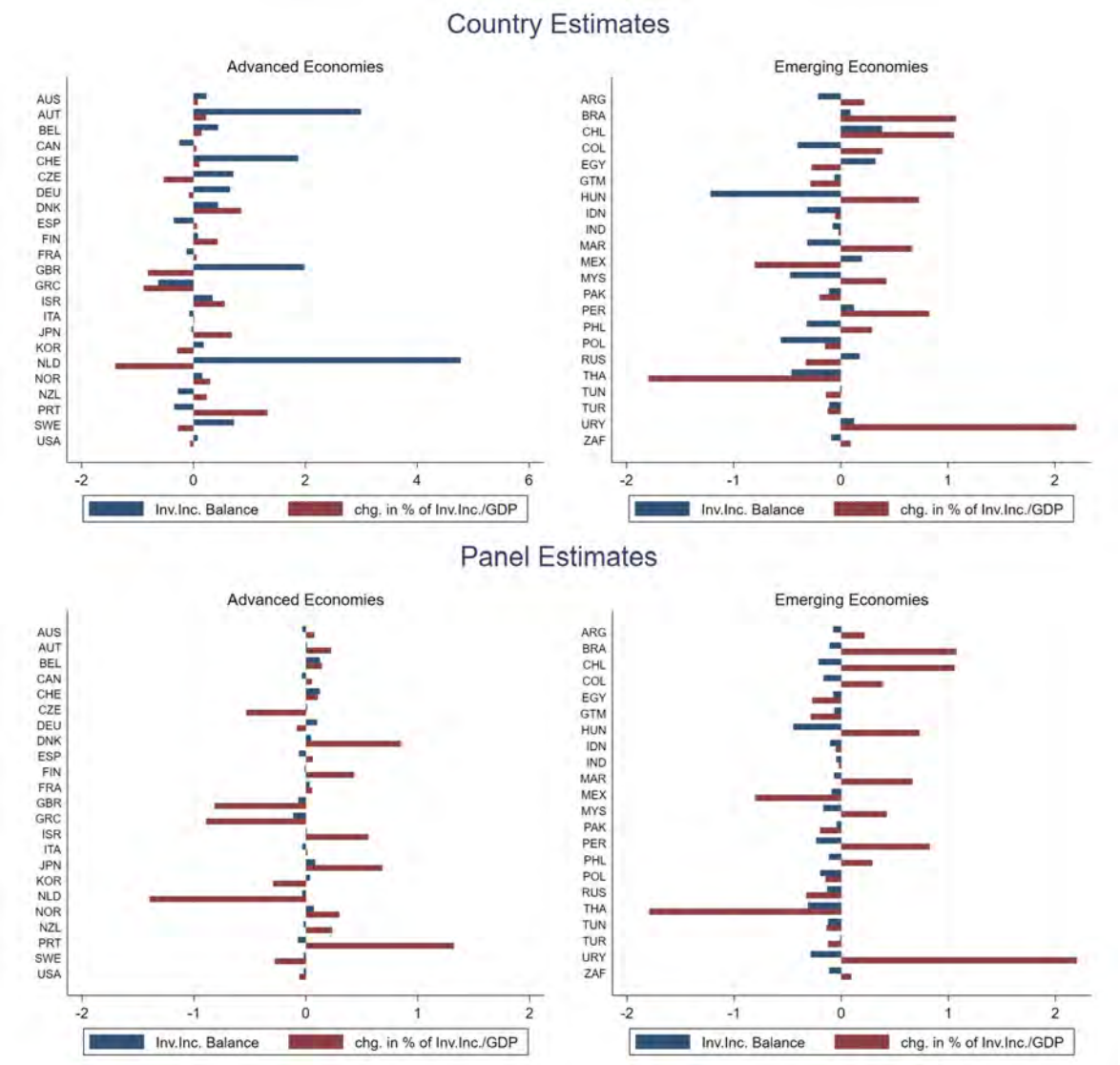
*Note:*Impact of a 1 percentage point increase in the US 10 year interest rate on the net primary asset income (% of GDP), based on country-specific coefficients (blue bars) or panel coefficients (red bars).

Figure 15: Impact of a dollar appreciation



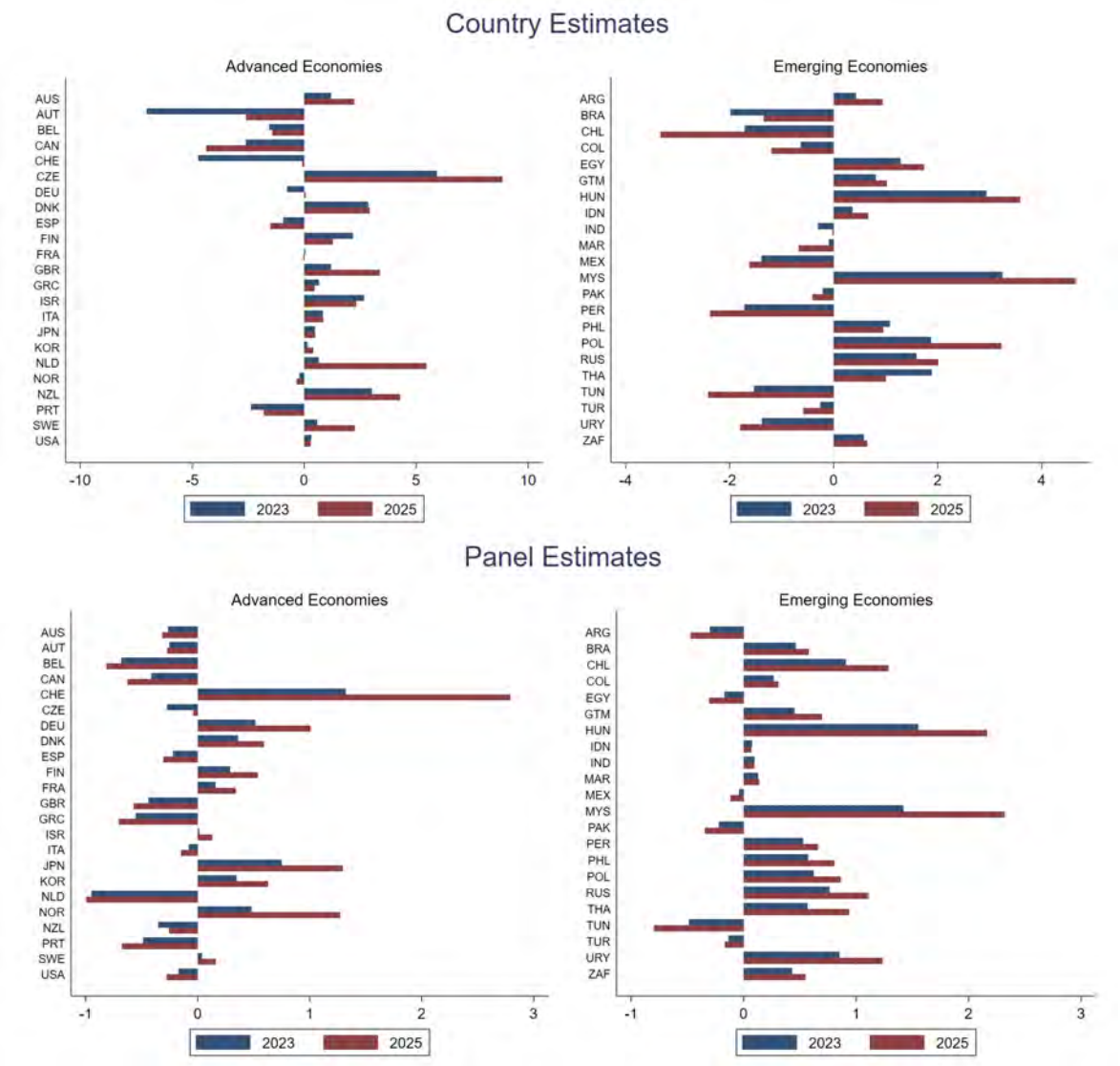
*Note:*Impact of a 10 percentage point appreciation of the US dollar against all currencies on the net primary asset income (% of GDP), based on country-specific coefficients (blue bars) or panel coefficients (red bars).

Figure 16: Taper Tantrum



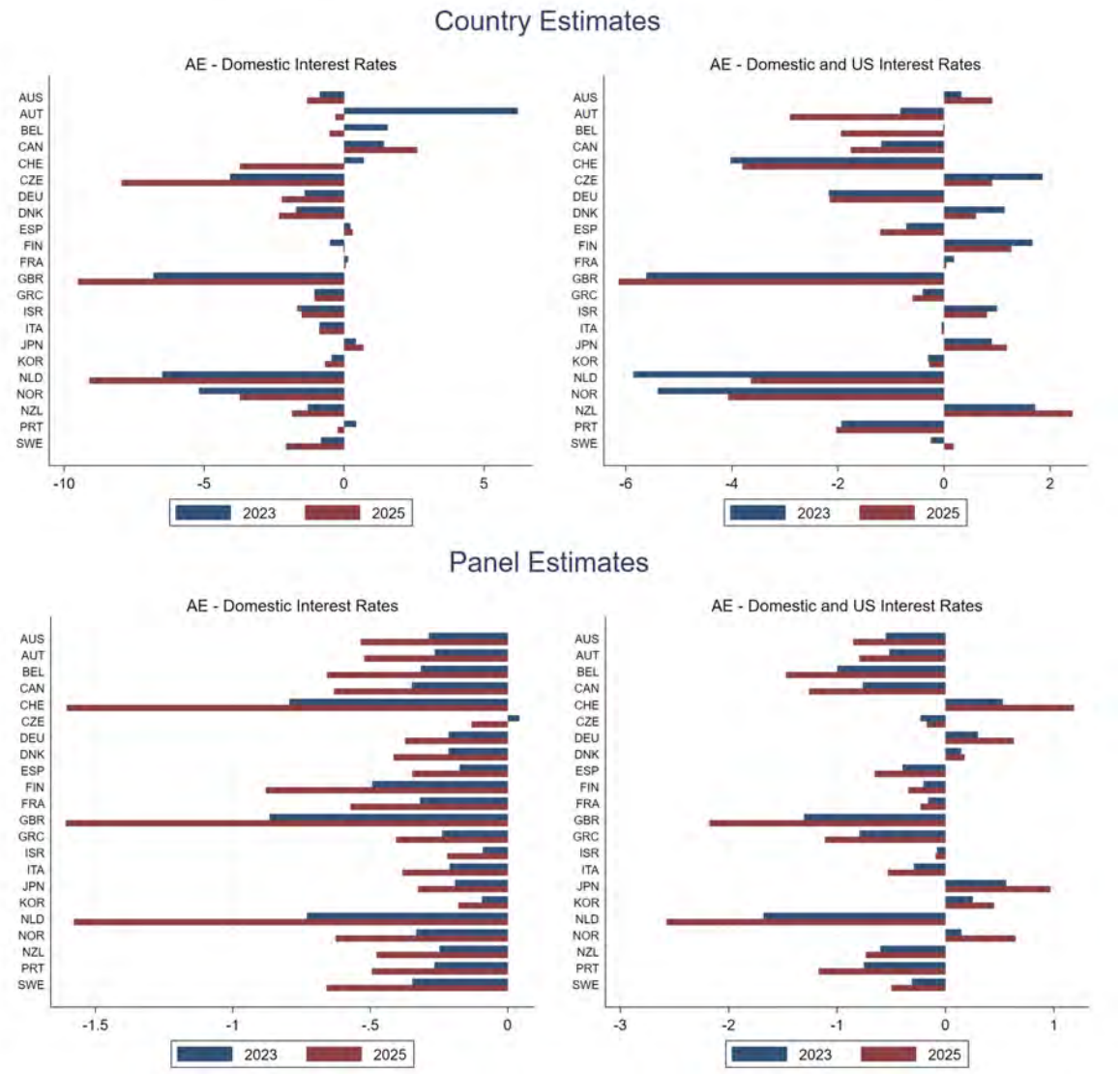
*Note:*Impact of the 2012-2013 increase of US short and long-term interest rates on the net primary asset income (% of GDP), estimated effect (blue bar, based on country-specific coefficients (top panel) or panel coefficients (bottom panel), and observed 2012-2013 change in the net primary asset income (red bar, % of GDP).

Figure 17: Impact of rising US interest rates since 2021



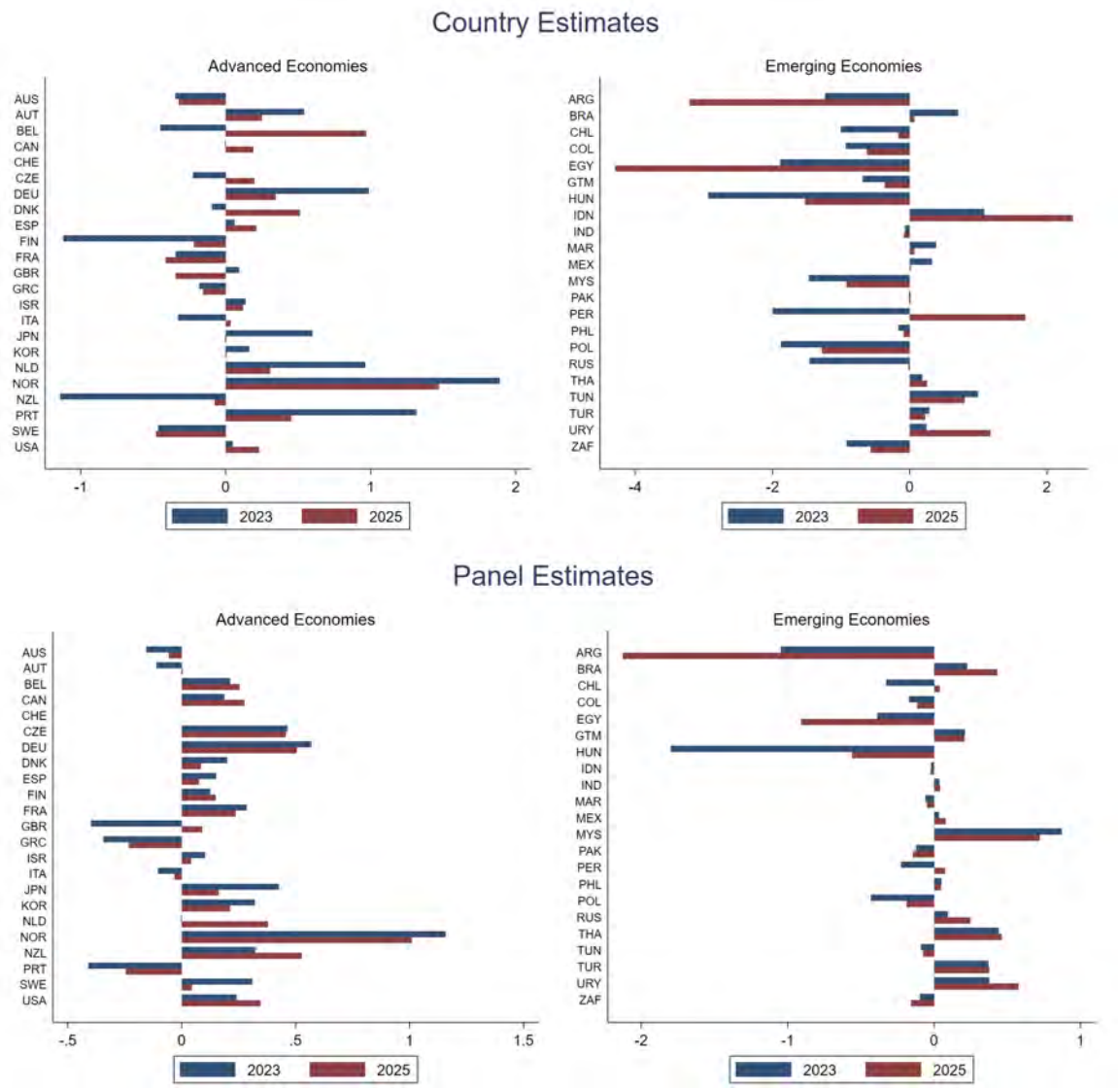
*Note:*Impact of the actual and expected increase of US short and long-term interest rates since 2021 on the net primary asset income (% of GDP), in 2023 (red bars) and 2025 (blue bars). Estimates based on country-specific coefficients (top panel) or panel coefficients (bottom panel).

Figure 18: Impact of rising US and domestic interest rates since 2021



*Note:*Impact of the actual and expected increase of US and domestic short and long-term interest rates since 2021 on the net primary asset income (% of GDP), in 2023 (red bars) and 2025 (blue bars). Effect of domestic interest rates (left panel) and total effect of US and domestic interest rates (right panel). Estimates based on country-specific coefficients (top panel) or panel coefficients (bottom panel).

Figure 19: Impact of world and domestic inflation since 2021



*Note:*Impact of the actual and expected increase of of world and domestic inflation since 2021 on the net primary asset income (% of GDP), in 2023 (red bars) and 2025 (blue bars). Estimates based on country-specific coefficients (top panel) or panel coefficients (bottom panel).

A Appendix: Dynamics of yields

1.1 Income flows and dynamics of assets

The income flow associated to the variable-yield asset in period t is simply the yield $r_t^{new,V,D}$ on the market value at the end of the previous period, $A_{t-1}^{V,D}$. The change in the asset position in the currency of denomination reflects net capital flows and capital gains from changes in asset prices in the currency of denomination, $Q_t^{V,D}$:

$$A_t^{V,D} = \frac{Q_t^{V,D}}{Q_{t-1}^{V,D}} A_{t-1}^{V,D} + K_t^{net,V,D} \qquad ; \qquad P_t^{V,D} = r_t^{new,V,D} A_{t-1}^{V,D}$$

Turning to fixed-income assets, we distinguish between the face value, $\tilde{A}_t^{F,D}$, on which the fixed yield applies, and the market value$A_t^{F,D} = Q_t^{F,D} \tilde{A}_t^{F,D}$ of the holding, in the currency of denomination. A share α^F of assets mature. The value of the asset position at the end of period t is the part of the previous position that has not matured, valuated at the new asset price, and the gross capital flows equal to the sum of net flows and replacement of the matured asset, $K_t^{gross,F,D} = K_t^{net,F,D} + \alpha^F Q_t^{F,D} \tilde{A}_{t-1}^{F,D}$:

$$\begin{aligned} A_t^{F,D} &= \left(1-\alpha^F\right) Q_t^{F,D} \tilde{A}_{t-1}^{F,D} + K_t^{gross,F,D} \\ A_t^{F,D} &= \frac{Q_t^{F,D}}{Q_{t-1}^{F,D}} A_{t-1}^{F,D} + K_t^{net,F,D} \end{aligned}$$

In period t, the assets purchased in the previous period, $K_{t-1}^{gross,F,D}$, earn a new yield $\widetilde{r}_t^{new,F,D}$ on the face value. The asset that have not matured in period $t-1$ earn the old yield $\widetilde{r}_{t-1}^{eff,F,D}$ on the face value $\left(1-\alpha^F\right) \tilde{A}_{t-2}^{F,D}$. Using the fact that $P_{t-1}^{F,D} = \widetilde{r}_{t-1}^{eff,F,D} \tilde{A}_{t-2}^{F,D}$, the income flow

is:

$$\begin{aligned}
P_t^{F,D} &= \left(1-\alpha^F\right)\widetilde{r}_{t-1}^{eff,F,D}\,\tilde{A}_{t-2}^{F,D} + \widetilde{r}_t^{new,F,D}\left(\frac{K_{t-1}^{net,F,D}}{Q_{t-1}^{F,D}} + \alpha^F\,\widetilde{A}_{t-2}^{F,D}\right)\\
P_t^{F,D} &= \left(1-\alpha^F\right)P_{t-1}^{F,D} + \frac{\widetilde{r}_t^{new,F,D}}{Q_{t-1}^{F,D}}\left(K_{t-1}^{net,F,D} + \alpha^F\frac{Q_{t-1}^{F,D}}{Q_{t-2}^{F,D}}A_{t-2}^{F,D}\right)\\
P_t^{F,D} &= \left(1-\alpha^F\right)P_{t-1}^{F,D} + \frac{\widetilde{r}_t^{new,F,D}}{Q_{t-1}^{F,D}}\left(K_{t-1}^{net,F,D} + \alpha^F\left(A_{t-1}^{F,D} - K_{t-1}^{net,F,D}\right)\right)\\
P_t^{F,D} &= \left(1-\alpha^F\right)P_{t-1}^{F,D} + r_t^{new,F,D}\left(\left(1-\alpha^F\right)K_{t-1}^{net,F,D} + \alpha^F A_{t-1}^{F,D}\right)
\end{aligned}$$

1.2 Approximation

Along the steady growth path, exchange rates and asset prices are constant and all variables grow at the same rate ρ_{ss}. Yields are equalized across all assets at r_{ss}. Asset holdings grow through net capital flows:

$$\begin{aligned}
K_{ss,t}^{net,F,D} &= \rho_{ss}A_{ss,t-1}^{F,D} \quad ; \quad K_{ss,t}^{net,V,D} = \rho_{ss}A_{ss,t-1}^{V,D}\\
K_{ss,t}^{net,F,\$} &= \rho_{ss}A_{ss,t-1}^{F,\$} \quad ; \quad K_{ss,t}^{net,V,\$} = \rho_{ss}A_{ss,t-1}^{V,\$}
\end{aligned}$$

The linear approximation of income flows, measured in dollar, on variable yield assets, fixed yield assets and overall assets gives:

$$\begin{aligned}
\widehat{P}_t^{V,\$} &= \left(\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}\right) + \frac{\hat{r}_t^{new,V,D}}{r_{ss}} + \widehat{A}_{t-1}^{V,\$}\\
\widehat{P}_t^{F,\$} &= \left(\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}\right) + \frac{1-\alpha^F}{1+\rho_{ss}}\widehat{P}_{t-1}^{F,\$} + \frac{\left(1-\alpha^F\right)\rho_{ss}}{1+\rho_{ss}}\widehat{K}_{t-1}^{net,F,\$}\\
&\quad + \left(1 - \frac{1-\alpha^F}{1+\rho_{ss}}\right)\frac{\hat{r}_t^{new,F,\$}}{\rho_{ss}} + \alpha^F\,\widehat{A}_{t-1}^{F,\$}\\
\widehat{P}_t^{\$} &= \left(\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}\right) + \frac{\left(1-\alpha^F\right)\delta_{ss}^F}{1+\rho_{ss}}\widehat{P}_{t-1}^{F,\$} + \frac{\left(1-\alpha^F\right)\delta_{ss}^F\rho_{ss}}{1+\rho_{ss}}\widehat{K}_{t-1}^{net,F,\$}\\
&\quad + \left(1 - \frac{1-\alpha^F}{1+\rho_{ss}}\right)\delta_{ss}^F\frac{\hat{r}_t^{new,F,D}}{r_{ss}} + \left(1-\delta_{ss}^F\right)\frac{\hat{r}_t^{new,NF,D}}{r_{ss}}\\
&\quad + \alpha^F\delta_{ss}^F\widehat{A}_{t-1}^{F,\$} + \left(1-\delta_{ss}^F\right)\widehat{A}_{t-1}^{V,\$}
\end{aligned}$$

The yield s given by $\hat{r}_t^{eff,\$} = r_{ss}\left(\hat{P}_t^{\$} - \hat{A}_{t-1}^{\$}\right)$. The linear approximation of (1) is then:

$$\begin{aligned}\frac{\hat{r}_t^{\$}}{r_{ss}} &= \left(\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}\right) + \frac{\left(1-\alpha^F\right)\delta_{ss}^F}{1+\rho_{ss}}\left(\frac{\hat{r}_{t-1}^{F,\$}}{r_{ss}} + \hat{A}_{t-2}^{F,\$}\right) - \left(1-\alpha^F\right)\delta_{ss}^F\widehat{A}_{t-1}^{F,\$} \\ &+\frac{\left(1-\alpha^F\right)\delta_{ss}^F\rho_{ss}}{1+\rho_{ss}}\widehat{K}_{t-1}^{net,F,\$} + \left(1-\frac{1-\alpha^F}{1+\rho_{ss}}\right)\delta_{ss}^F\frac{\hat{r}_t^{new,F,D}}{r_{ss}} + \left(1-\delta_{ss}^F\right)\frac{\hat{r}_t^{new,NF,D}}{r_{ss}} \\ &+\delta_{ss}^F\left(\widehat{A}_{t-1}^{F,\$} - \hat{A}_{t-1}^{\$}\right) + \left(1-\delta_{ss}^F\right)\left(\widehat{A}_{t-1}^{V,\$} - \hat{A}_{t-1}^{\$}\right)\end{aligned}$$

By definition $\hat{A}_{t-1}^{\$} = \delta_{ss}^F\widehat{A}_{t-1}^{F,\$} + \left(1-\delta_{ss}^F\right)\widehat{A}_{t-1}^{V,\$}$. The dynamics of the asset position in fixed income assets is approximated as $\left(1+\rho_{ss}\right)\hat{A}_{t-1}^{F,\$} = \left(\widehat{S}_{t-1}^{\$/D} - \widehat{S}_{t-2}^{\$/D}\right) + \left(\widehat{Q}_{t-1}^{FD} - \widehat{Q}_{t-2}^{FD}\right) + \hat{A}_{t-2}^{F,\$} + \rho_{ss}\hat{K}_{t-1}^{net,F,\$}$. Using that relation, we obtain (2). For a category without fixed income assets ($\delta_{ss}^F = 0$) the yield simplifies to $\hat{r}_t^{\$}/r_{ss} = \left(\widehat{S}_t^{\$/D} - \widehat{S}_{t-1}^{\$/D}\right) + \hat{r}_t^{new,V,D}/r_{ss}$.

B Appendix: Impact on income flows

2.1 Effect of the Vix index

The impact of a 1 standard deviation in the Vix (+1 increase in the Vix) on the dollar yield in an asset category k (FDI, portfolio equity, portfolio debt, other, reserves) is obtained from the panel regression. For the yield on asset, leading to income receipts, we write:

$$\left[\frac{\hat{r}_t^{\$}}{r_{ss}}\right]_{FIT-Vix,k}^{receipt} = \delta_{VIX,k}^{receipt} * 1$$

This fitted value is the same for all countries. We compute a country-specific fit for the income to GDP for category k in country c following the general steps presented above:

$$\left[\hat{p}_t^{\$}\right]_{FIT-Vix,k,c}^{receipt} = \overline{p}_{k,c}^{\$,asset}\left[\frac{\hat{r}_t^{\$}}{r_{ss}}\right]_{FIT-Vix,k}^{receipt} = \overline{p}_{k,c}^{\$,asset}\delta_{VIX,k}^{receipt}$$

where $\overline{p}_{k,c}^{\$,asset}$ is the reference value of income flows to GDP for category k in country c (we take the average over the 5 years until period t). These values are then summed across

receipts and payments to compute the impact on the primary income balance to GDP:

$$[NPI_t/Y_t]_{FIT-Vix,c} = \sum_k \left[\overline{p}^{\$,asset}_{k,c}\delta^{receipt}_{VIX,k} - \overline{p}^{\$,liabbility}_{k,c}\delta^{payment}_{VIX,k}\right]$$

2.2 Effect of US interest rates

Turning to the effect of US interest rates, we consider a 1 percentage point increase (+1 increase in the US interest rate). We consider a persistent increase, and compute both the immediate impact, as well as the impact one period ahead that takes account of the persistence in the income to GDP ratio.

Start with the immediate impact of an increase in the US long-term interest rate. The effect on yield on assets in an category k is:

$$\left[\frac{\hat{r}^{\$}_t}{r_{ss}}\right]^{receipt}_{FIT-Vix,k} = \delta^{receipt}_{USlong,k} * 1$$

The impact on the primary income balance to GDP is computed as for the Vix:

$$[NPI_t/Y_t]_{FIT-USlong,c} = \sum_k \left[\overline{p}^{\$,asset}_{k,c}\delta^{receipt}_{USlong,k} - \overline{p}^{\$,liabbility}_{k,c}\delta^{payment}_{USlong,k}\right]$$

We now turn to the impact at period $t+1$, taking account of a) that US interest rate remains higher and b) the persistence through the lagged yield. Specifically:

$$\begin{aligned}\left[\frac{\hat{r}^{\$}_{t+1}}{r_{ss}}\right]^{receipt}_{FIT-USlong,k} &= \delta^{receipt}_{USlong,k} * 1 + \beta_{lag}\left[\frac{\hat{r}^{\$}_t}{r_{ss}}\right]^{receipt}_{FIT-USlong,k} \\ &= \left[\left(1+\beta_{lag}\right)\delta^{receipt}_{USlong,k} + \beta_{lag}\delta^{receipt}_{USlong,k}\right] * 1\end{aligned}$$

These effects are then combined to compute the primary income balance to GDP:

$$\begin{aligned}[NPI_{t+1}/Y_{t+1}]_{FIT-USlong,c} = &\sum_k \left[\overline{p}^{\$,asset}_{k,c}\left[\left(1+\beta_{lag}\right)\delta^{receipt}_{USlong,k} + \beta_{lag}\delta^{receipt}_{USlong,k}\right]\right] \\ &- \sum_k \left[\overline{p}^{\$,liabbility}_{k,c}\left[\left(1+\beta_{lag}\right)\delta^{payment}_{USlong,k} + \beta_{lag}\delta^{payment}_{USlong,k}\right]\right]\end{aligned}$$

2.3 Effect of dollar exchange rate

We finally compute the effect of a permanent change in the dollar exchange rate, considering its transmission through the Broad dollar index as well as through the dollar exchange rate against the currency of denomination. For illustration, consider a 10% appreciation of the dollar, which implies a +0.1value for the broad index and a $-0.1\left(1-w_{t,k,c}\right)$ value for the exchange rate between the dollar and the currency of denomination, where $w_{t,k,c}$ is the weight of the dollar in the denomination basket.

The effect on the dollar yield in an category k in country c is (the presence $w_{t,k,c}$ of makes the effect country specific):

$$\left[\frac{\hat{r}_t^{\$}}{r_{ss}}\right]^{receipt}_{FIT-USD,k,c} = \delta^{receipt}_{USDbroad,k} * (0.1) + \beta^{receipt}_{val,k} * \left(1-w^{asset}_{t,k,c}\right) * (-0.1)$$

The impact on the primary income balance to GDP is then computed as:

$$\begin{aligned}[NPI_t/Y_t]_{FIT-USD,c} &= \sum_k \left[\overline{p}^{\$,asset}_{k,c}\left[\delta^{receipt}_{USDbroad,k} - \beta^{receipt}_{val,k} * \left(1-w^{asset}_{t,k,c}\right)\right]\right] * (0.1) \\ &\quad - \sum_k \left[\overline{p}^{\$,asset}_{k,c}\left[\delta^{payment}_{USDbroad,k} - \beta^{payment}_{val,k} * \left(1-w^{liability}_{t,k,c}\right)\right]\right] * (0.1)\end{aligned}$$

We now turn to the impact at period $t+1$, considering a permanent exchange rate movement. This combine a) the persistence through the lagged yield and b) the impact through the value of assets, which enters separately. Specifically:

$$\begin{aligned}\left[\frac{\hat{r}_{t+1}^{\$}}{r_{ss}}\right]^{receipt}_{FIT-USD,k,c} &= \beta_{lag}\left[\frac{\hat{r}_t^{\$}}{r_{ss}}\right]^{receipt}_{FIT-USD,k,c} \\ &= \beta_{lag}\left(\delta^{receipt}_{USDbroad,k} - \beta^{receipt}_{val,k} * \left(1-w^{asset}_{t,k,c}\right)\right) * (0.1)\end{aligned}$$

The impact on the primary income balance to GDP is then computed as:

$$
\begin{aligned}
[NPI_{t+1}/Y_{t+1}]_{FIT-USD,c} &= \sum_k \left[\overline{p}^{\$,asset}_{k,c}\beta_{lag}\left[\delta^{receipt}_{USDbroad,k} - \beta^{receipt}_{val,k} * \left(1 - w^{asset}_{t,k,c}\right)\right]\right] * (0.1) \\
&\quad + \sum_k \left[\frac{\overline{r}^{\$,receipts}_{k,c}}{1+\overline{g}_c}\left(1 - w^{asset}_{t,k,c}\right)\right] * (-0.1) \\
&\quad - \sum_k \left[\overline{p}^{\$,liabilities}_{k,c}\beta_{lag}\left[\delta^{payment}_{USDbroad,k} - \beta^{payment}_{val,k} * \left(1 - w^{liability}_{t,k,c}\right)\right]\right] * (0.1) \\
&\quad - \sum_k \left[\frac{\overline{r}^{\$,paiments}_{k,c}}{1+\overline{g}_c}\left(1 - w^{liabilities}_{t,k,c}\right)\right] * (-0.1) \\
&= \beta_{lag}\left[NPI_t/Y_t\right]_{FIT-USD,c} \\
&\quad - \sum_k \left[\frac{\overline{r}^{\$,receipts}_{k,c}}{1+\overline{g}_c}\left(1 - w^{asset}_{t,k,c}\right) - \frac{\overline{r}^{\$,paiments}_{k,c}}{1+\overline{g}_c}\left(1 - w^{liabilities}_{t,k,c}\right)\right] * (0.1)
\end{aligned}
$$

C Appendix: Construction of Currency-of-Investment (CIW) Weighted Exchange rate indices

This appendix presents the steps in constructing the exchange rate between the dollar and the currency of denomination of financial assets and liabilities. We rely on the Bénétrix et al. (2020) data on the currency of invoicing of Assets and Liabilities for 50 countries between 1990 and 2017. As the Bénétrix et al., 2020 data are available only until 2017, we keep the currency composition of that year unchanged until 2022. Our approach follows the steps of Colacelli et al., 2021, focusing on the period since 1999 to better handle the role of the euro.

As in Colacelli et al., 2021 indices are geometric averages of the ratios of bilateral exchange rates with respect to the US dollar around the base year 2010. Specifically, for country i, $R_{i,t}/R_{i,2010}$ is the exchange rate of currency i relative to the US dollar, set to 1 in 2010, with a value above units denoting a depreciation of the country's currency against the dollar. The ratio $(R_{i,t}/R_{i,2010})/(R_{j,t}/R_{j,2010})$ is exchange rate currency of i against the currency of j, with a value above unity denoting a depreciation of i. We weight this ratio by the share of the external assets (liabilities) of country i that are denominated in currency j, $W^{A,L}_{i,j,t}$. We have information of the weights of the USD, EUR, GBP, CNY and JPY, as well as domestic currency, with the balance consisting of other currencies (OTH). We assume that the OTH

currency has the same composition across the currencies (other than the domestic one), and adjust the weights of USD, EUR, GBP, CNY and JPY accordingly,[17] leaving the share of domestic currency $S^{A,L}_{i,DC,t}$ unchanged.

These exchange rates are then weighted using the share of assets (and liabilities) invoiced in USD, EUR, GBP, CNY and JPY, as well as domestic currency, with the assumption that foreign assets (and domestic liabilities) invoiced in other (OTH) currencies are actually invoiced in the known currencies by re-weighting the other shares in a proportional way (leaving the share of domestic currency unchanged).

The weighted exchange rate between the dollar and the basket in which the assets of country i are denominated, $R^{\$,D,A,L}_{i,t}$ is as follows, with a value $R^{\$,Di}_{t} > 1$ indicating that since 2010 the dollar has depreciated against depreciated against the currencies in which country i's assets (liabilities) are denominated

The currency of investment weighted exchange rate for assets (and liabilities) is then of the following form, with a value of $\mathrm{ER}^{A,L}_{i,t} > 1$ indicating that since 2010 the currency of country i has depreciated against the currencies in which its assets (liabilities) are denominated:

$$\mathrm{R}^{\$,D,A,L}_{i,t} = \Pi_j \left(\frac{1}{R_{j,t}/R_{j,2010}} \right)^{W^{A,L}_{i,j,t}}$$

where $R_{\$,t} = 1$ and:

$$W^{A,L}_{i,j,t} = S^{A,L}_{i,j,t} \times \frac{\sum_{k\in(\mathrm{USD,EUR,GBP,CNY,JPY})} S^{A,L}_{i,k,t} + S^{A,L}_{i,OTH,t}}{\sum_{k\in(\mathrm{USD,EUR,GBP,CNY,JPY})} S^{A,L}_{i,k,t}}$$

$$W^{A,L}_{i,j,t} + S^{A,L}_{i,DC,t} = 1$$

We consider a serie of weights across different categories of assets and liabilities, with each set of weight giving an different measure of $\mathrm{ER}^{A,L}_{i,t}$. Specifically, we rely on Bénétrix et al. (2020) for weights for all assets, as well as weights for "debt" assets, which include portfolio debt and other investment. Combining these two sets of weights with the holdings from Milesi-Ferretti (2022c), we can compute the values of the "non-debt" assets (FDI, Portfolio equity, reserves) across the various currencies, as well as the corresponding weights.

[17] $W^{A,L}_{i,j,t}$ are the weight after the adjustment, and $S^{A,L}_{i,j,t}$ are the weights before

This gives us an exchange rate $\mathrm{ER}_{i,t}^{A,L}$ for these specific categories. Finally, combining the weighted exchange rates of debt and non-debt assets, and the holdings of portfolio equity and portfolio debt, we constructs weights and the corresponding exchange rate for the overall protfolio category. Similar steps are done on the liability side.

D Appendix: Tables and figures

Table 7: Overview of the Primary Income Account

	Receipts/ Credits	Expenses/ Debits
Compensation of employees		
Investment Income		
Direct Investment		
Income on equity and investment fund shares		
Dividends and withdrawals from income of quasi-corporations		
Reinvested earnings		
Interests		
Portfolio Investment		
Income on equity and investment fund shares		
Dividends on equity other than investment fund shares		
Investment income attributable to investment fund shareholders		
Dividends on investment fund shares		
Reinvested earnings on investment fund shares		
Interest		
Other Investment		
Income on equity and investment fund shares		
Interest		
Investment income attributable to policyholders in insurance, standardized guarantees, and pension funds		
Reserve assets		
Other primary income		
Rent		
Taxes on production and imports		
Subsidies		

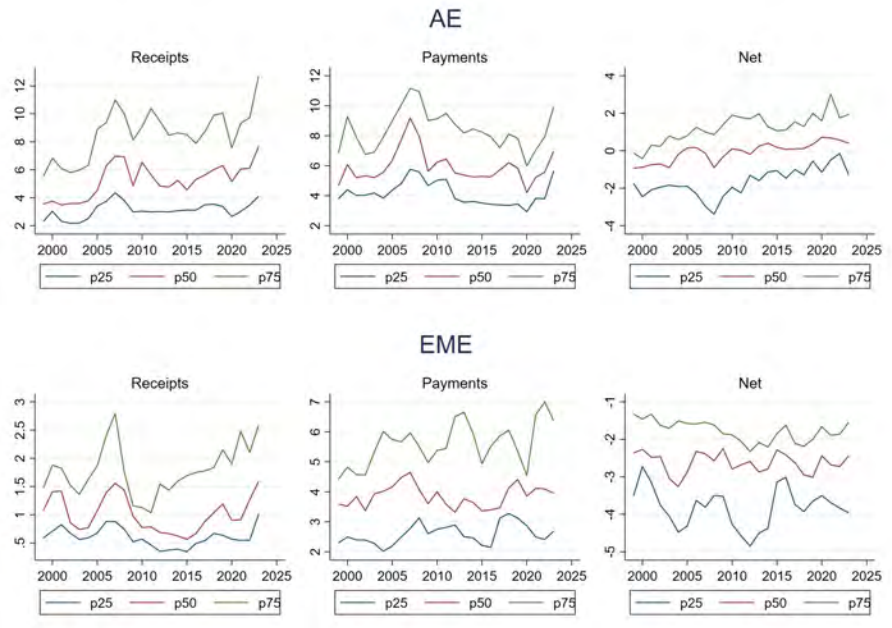
Source: International Monetary Fund, BPM6, 2009.

Table 8: Correlation of VIX and US variables

	VIX	USD broad	US long-term rate	US short-term rate
VIX	1			
USD broad	-0.0012	1		
	(0.709)			
US long-term rate	0.171***	-0.039	1	
	(0.000)	(0.236)		
US short-term rate	0.036	0.086***	0.824***	1
	(0.277)	(0.009)	(0.000)	

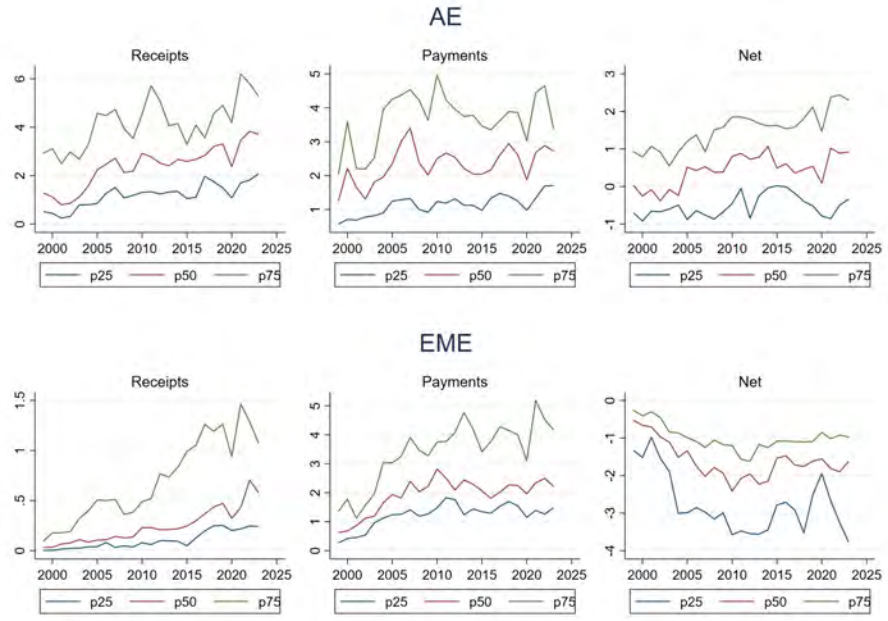
Notes: p-values in parentheses. *, **, *** indicates significance at the 10, 5 and 1% level respectively.

Figure 20: Gross and net income flows, total (% GDP)



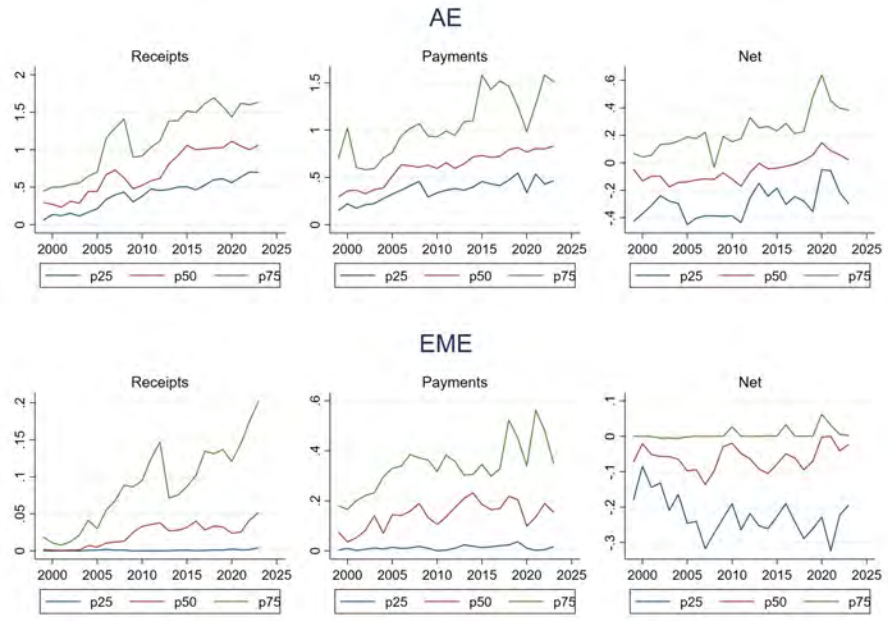
*Note:*Bottom quartile (blue line), median (red line) and top quartile (green line) of country group. AE and EME and denote advanced and emerging economies

Figure 21: Gross and net income flows, FDI (% GDP)



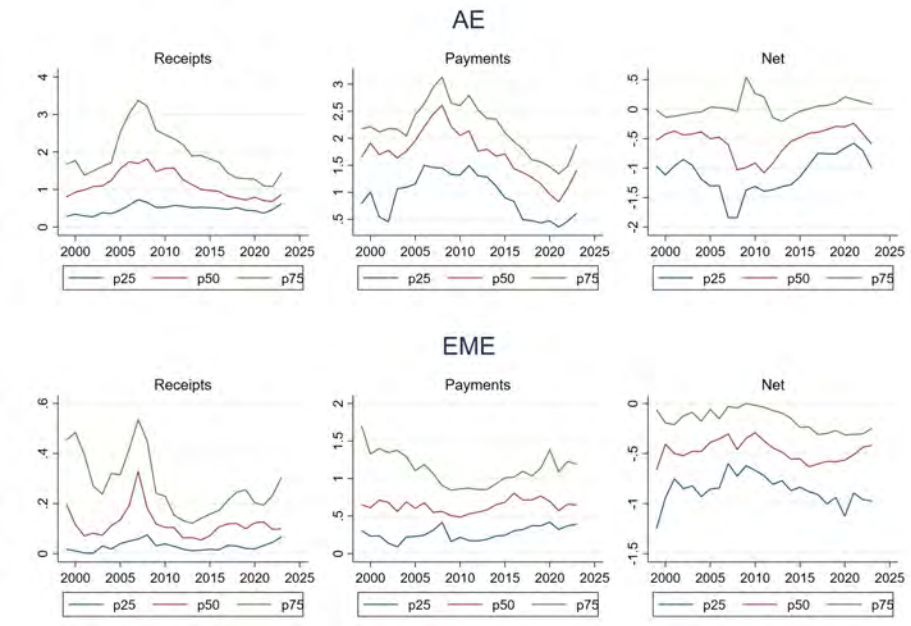
*Note:*Bottom quartile (blue line), median (red line) and top quartile (green line) of country group. AE and EME and denote advanced and emerging economies

Figure 22: Gross and net income flows, Portfolio equity (% GDP)



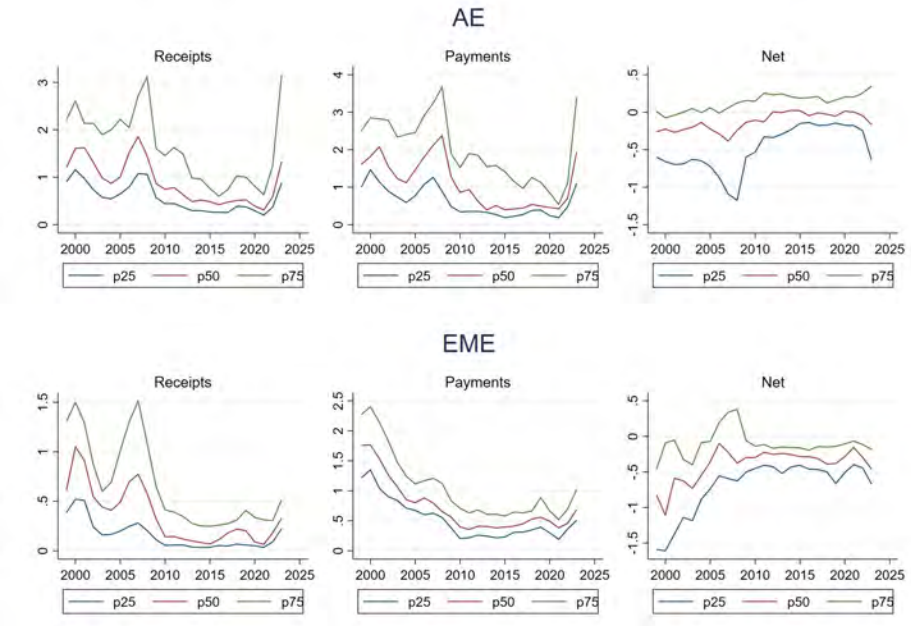
*Note:*Bottom quartile (blue line), median (red line) and top quartile (green line) of country group. AE and EME and denote advanced and emerging economies

Figure 23: Gross and net income flows, Portfolio debt (% GDP)



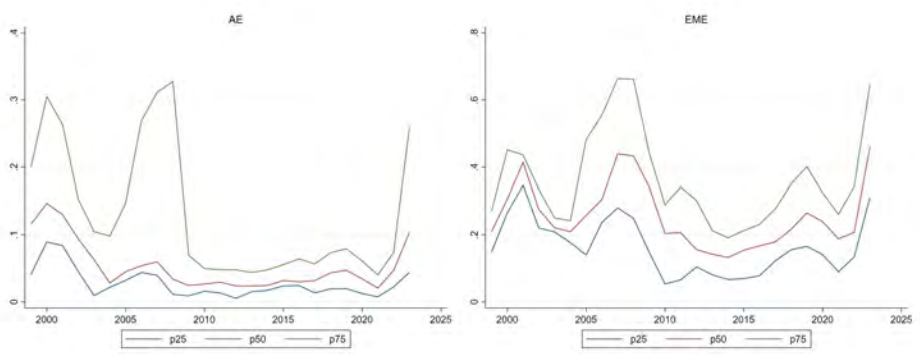
*Note:*Bottom quartile (blue line), median (red line) and top quartile (green line) of country group. AE and EME and denote advanced and emerging economies

Figure 24: Gross and net income flows, Other investment (% GDP)



*Note:*Bottom quartile (blue line), median (red line) and top quartile (green line) of country group. AE and EME and denote advanced and emerging economies

Figure 25: Gross (also net) income flows, Reserves (% GDP)



*Note:*Bottom quartile (blue line), median (red line) and top quartile (green line) of country group. AE and EME and denote advanced and emerging economies

International Investment Income: Patterns, Drivers, and Heterogeneous Sensitivities

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***Graduate Institute Geneva** ****Graduate Institute Geneva & CEPR**

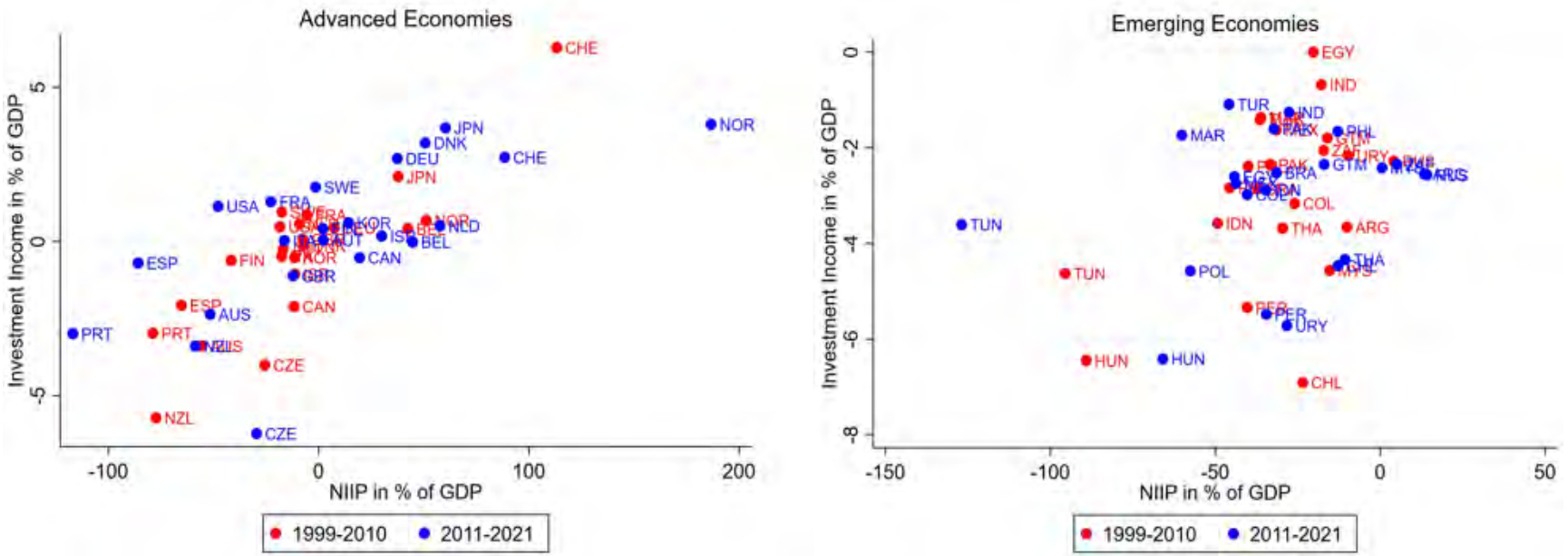
12th February 2024

Conference of the Irving Fisher Committee on Central Bank Statistics of the BIS, ECB, Banco de España, *External statistics after the pandemic: addressing novel analytical challenges*, Madrid, February 12-13, 2024

Motivation

- Financial globalisation since the mid-1990's, with much larger cross-border assets and liabilities (Lane and Milesi-Ferretti, 2018)
  - Movements in position should be reflected in investment income, but it is not the case
- What drives investment income? What can we expect in the current episode of rising interest rates?

Figure 1: Net Investment Income and NIIP (% GDP, averages)



Outline

- Relation to the literature
- Data and stylised facts on investment income
- Econometric analysis of drivers of yields
  - Conversion to country-specific impact on net income / GDP
- Case studies $\Rightarrow$ higher (US and domestic) interest rates
  - 2013 Taper Tantrum
  - Current episode (including projections)

What we do and what we find

- Stylized facts of the evolution of primary investment income since 1999
  - Rising FDI and equity flows offset by decreasing debt and other (banking) flows
- Econometric analysis drivers of yields: panel (AEs vs EMEs) and by country
  - Broad US dollar appreciation reduces FDI and equity yields
  - Higher US interest rates raise other (banking), debt, and reserves yields
  - Higher VIX reduces all yields
- Heterogeneous impact on net income due to different portfolios
  - Stronger dollar reduces net investment income for AEs but raises it for EMEs
  - Higher short US interest rate raises net income for EMEs
  - Higher long US interest rate reduces net income for EMEs
- Effect of interest rates on net income in specific episodes
  - Limited in the 2013 Taper Tantrum
  - Larger in the current episode

Related literature

- Global imbalances in current accounts and investment positions
  - Determinants of flow imbalances pre-2008 (Chinn and Prasad, 2003, Gruber and Kamin, 2007, Caballero et al., 2008)
  - Re-focus on stock imbalances (Alberola et al., 2020, Milesi-Ferretti, 2022), and recent evolving patterns (Ito and McCauley, 2019, Chinn and Ito, 2022)
- Impact of shocks on current accounts
  - Exchange rates (Obstfeld and Rogoff, 2007, Devereux and Genberg, 2007, Cubeddu et al., 2019) $\Rightarrow$ within a Dominant Currency Paradigm (Gopinath et al., 2020, Boz et al., 2022)
  - Interest rate transmission (Schuler and Sun, 2022, Antràs, 2023)
- Drivers of primary investment income
  - Role of exchange rate, with mechanical valuation effect (Colacelli et al., 2021, Behar and Hassan, 2022, Eugster and Donato, 2022)
  - Effect of monetary policy (Auer, 2019)

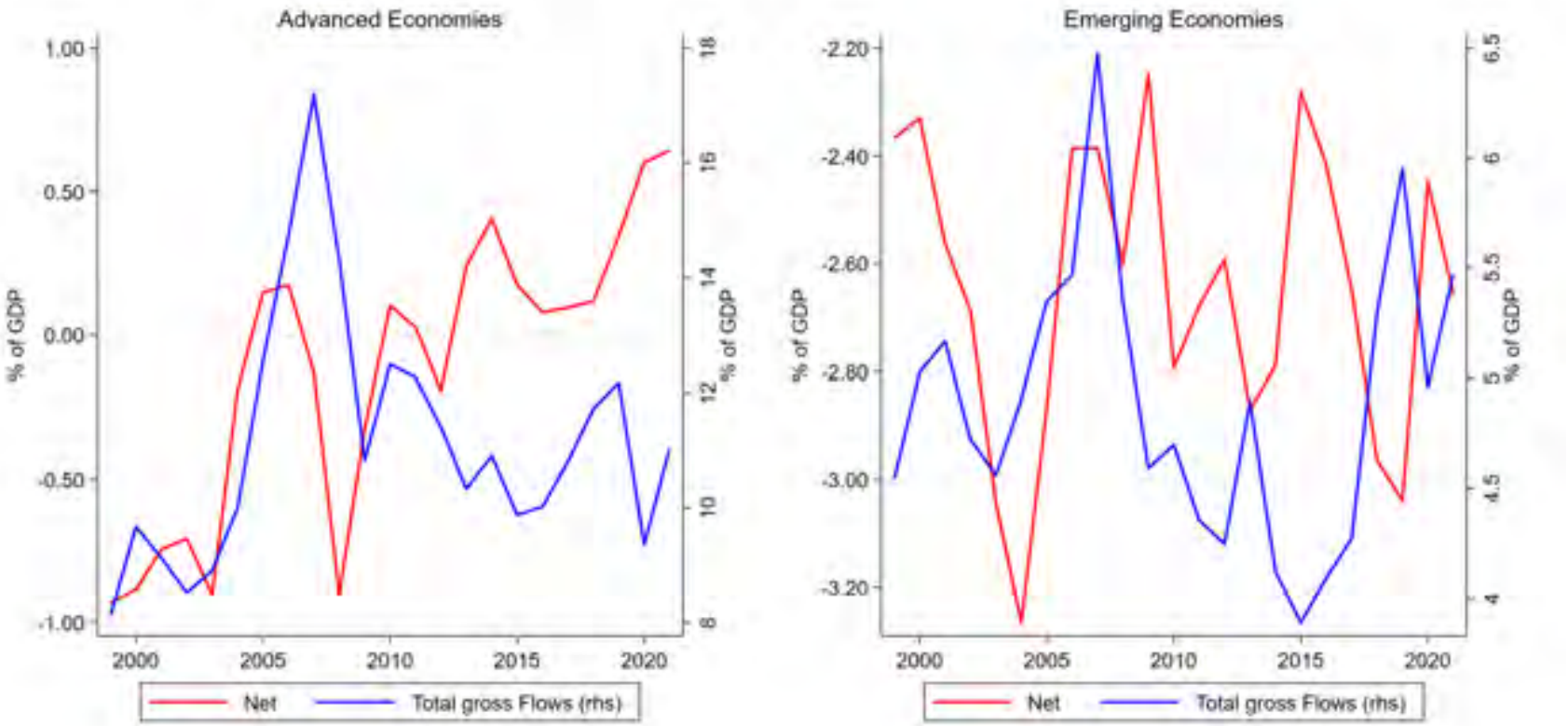
Data sources

- Trade and primary investment income flows from IFS
  - Total, FDI, equity, debt, other, and reserves
- Investment positions from EWN database
- Exchange rate composition from Bénétrix et al. (2020)
  - Until 2017, values kept for subsequent years
  - Total and debt, as well as residuals (authors' own calculations)
  - Used to compute exchange rate with respect to currency of basket of investment denomination
- Interest rates from IFS and OECD
- Macroeconomic data from IFS
- Sample of 45 countries (23 AE, 22 EME) since 1999

Stylised facts - total investment income flows

- Gross flows (receipts + payments) increased until 2008, but not since then
- Net flows: from deficit to surplus in advanced, deficit in emerging economies

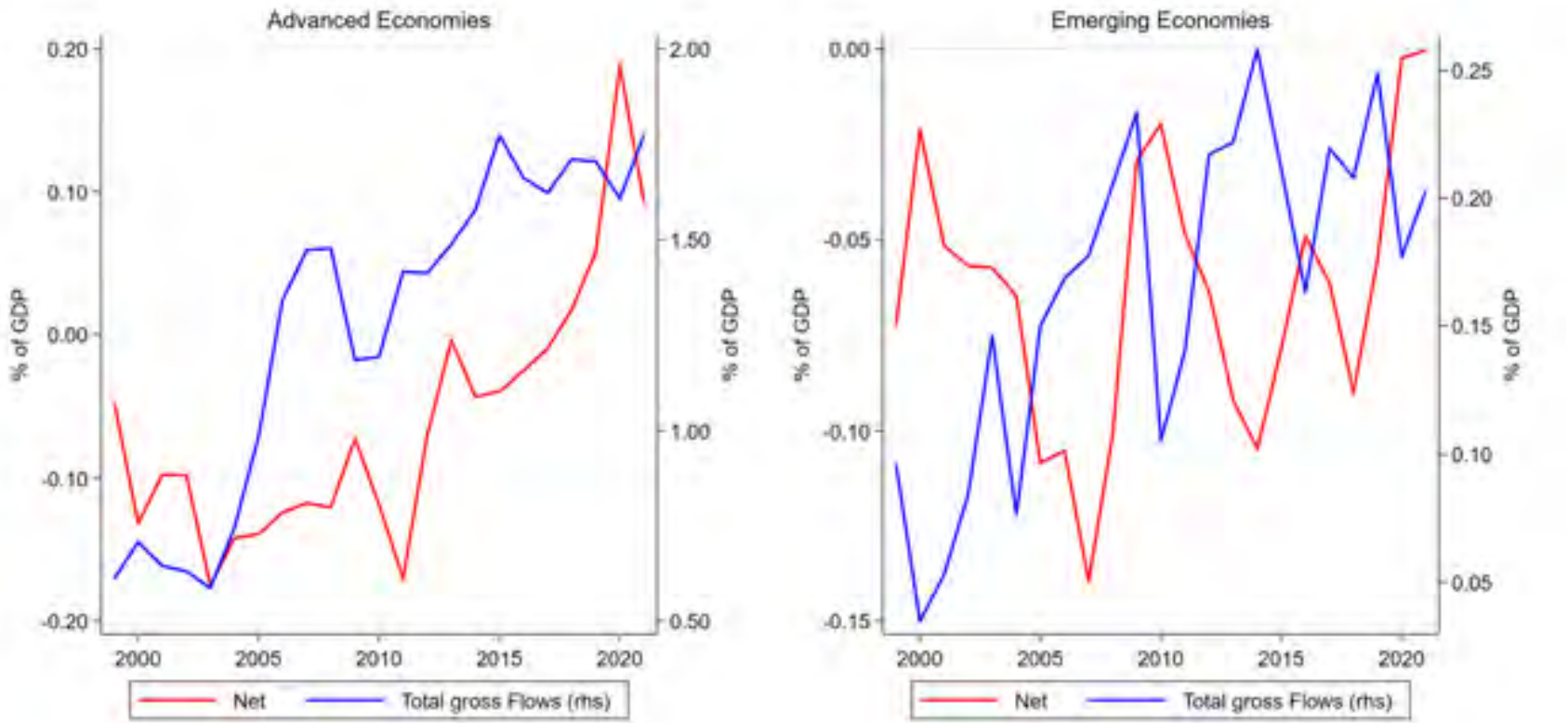
Figure 2: Total asset income (% GDP, median)



Stylised facts - portfolio equity income flows

- Rising gross flows in all countries (similar for FDI)
  - Consistent with globalisation
  - Switch into surplus for advanced, deficit in emerging economies

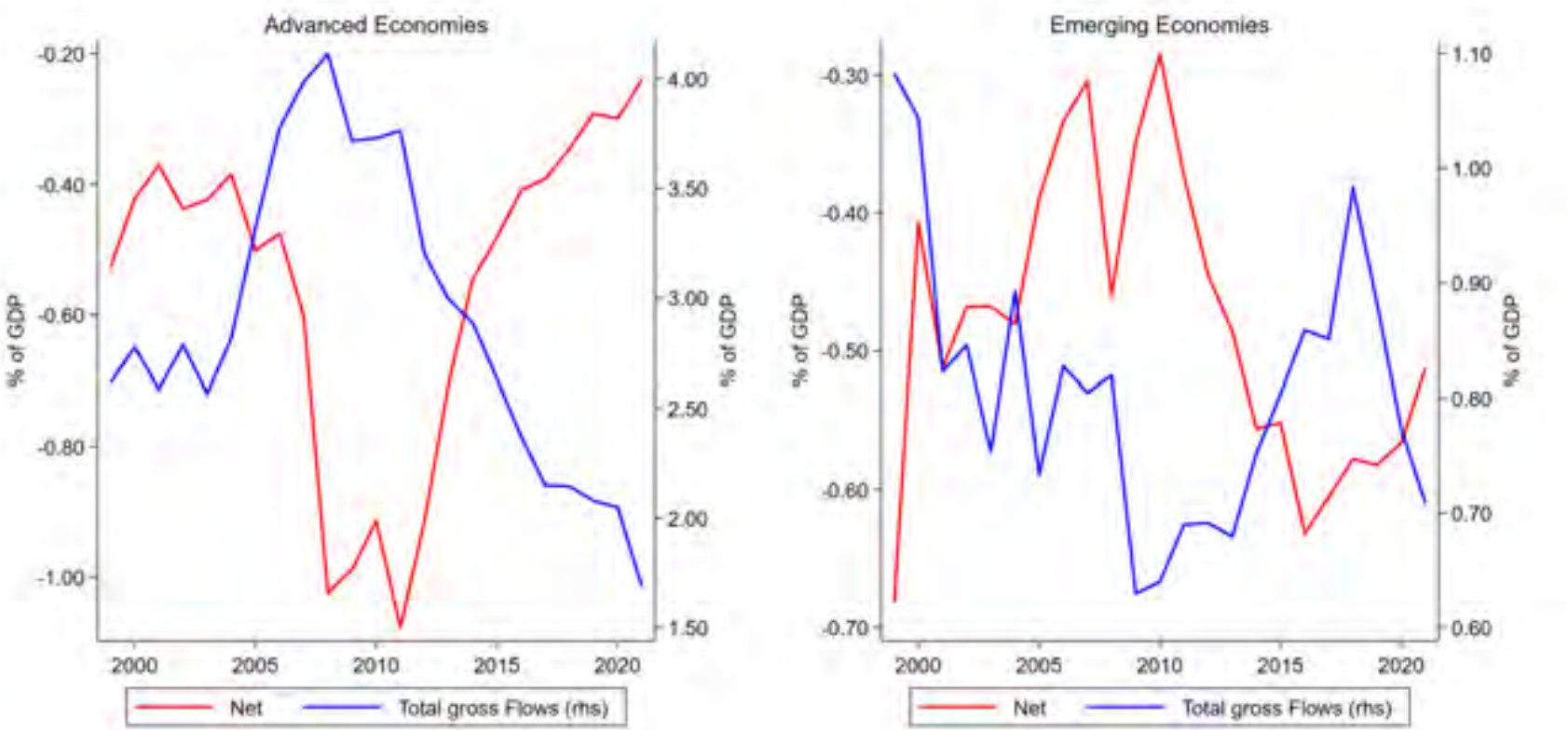
Figure 3: Portfolio equity asset income (% GDP, median)



Stylised facts - portfolio debt income flows

- Gross flows increased until 2008, subsequent decrease in AE (similar for Other investment flows (banking))
- Narrowing deficit for AE, increasing deficit for EME in recent years

Figure 4: Portfolio debt asset income (% GDP, median)



Econometric assessment

- Log of yields r (percent of relevant lagged stock position) of invt. income, and its components, denominated in USD for country i are regressed on:

$$ln\left(r^{\$}_{i,t}\right) = \alpha + \beta_{lag} ln\left(r^{\$}_{i,t-1}\right) + \beta_{valS}\Delta ln\left(S^{\$,D}_{i,t}\right) + \beta_{valSL}\Delta ln\left(S^{\$,D}_{i,t-1}\right) + \quad (1)$$
$$+\beta_{valQL}\Delta ln\left(Q^{D}_{t-1}\right) + \delta_{glob}\mathbf{X}^{global}_{t} + \delta_{local}\mathbf{Z}^{local}_{i,t} + \epsilon_{i,t}$$

- where S is the *mechanical effect*: XR between the dollar and the currency of denomination of assets
- Q identifies capital gains through valuation
- $\mathbf{X}$ is a vector of global variables: the log difference of the US Broad dollar index, US short and long ir, VIX, and world Real GDP growth and global inflation (the latter for Receipts only)
- $\mathbf{Z}$ is a vector of local variables including country f.e., domestic Real GDP growth and inflation (for Payments only) and domestic short and long ir (for AE only)
- Standard errors clustered at the country level

Panel results - Effect of the broad dollar index

- A dollar appreciation reduces yields
  - Concentrated in FDI, and in equity
  - Stronger on advanced economies
- Consistent with dominant invoicing currency (if multinats. dominate trade), or with strong dollar in "risk off" times that depress investment and trade

Figure 5: Broad dollar appreciation

	Total		FDI		Equity	
	Receipt	Payment	Receipt	Payment	Receipt	Payment
All	-0.486	-1.179***	-1.138*	-2.031***	-0.844	-0.173
ADV	-0.710***	-0.963***	-2.310***	-2.009***	-1.658***	-0.830**
EME	-0.347	-1.252**	-0.346	-1.996***	0.316	0.492
	Debt		Other investment		FX res.	
	Receipt	Payment	Receipt	Payment	Receipt	
All	-0.779	0.199	0.405	0.229	0.611	
ADV	-0.171	0.324	0.254	1.029*	-0.719	
EME	-1.267	0.255	0.478	0.212	1.885*	

Panel results - Effect of the US short-term interest rate

- Higher US 3 months rate raises yields
  - Concentrated in other payments, and reserves
  - Negative effect on equity payments

Figure 6: US 3-month interest rate

	Total		FDI		Equity	
	Receipt	Payment	Receipt	Payment	Receipt	Payment
All	0.0425***	0.0416***	0.000168	-0.0237**	-0.0148	-0.0583***
ADV	0.0154**	0.00912	0.00164	0.0161	-0.00378	-0.0333***
EME	0.0728***	0.0738***	9.65E-05	-0.0331**	-0.00979	-0.111**
	Debt		Other investment		FX res.	
	Receipt	Payment	Receipt	Payment	Receipt	
All	0.0064	-0.0115	0.0338***	0.0539***	0.0963***	
ADV	-0.0125	-0.00519	0.0363***	0.0510***	0.0710***	
EME	0.0412	-0.00988	0.0308**	0.0571***	0.141***	

Panel results - Effect of the US long-term interest rate

- Higher rate has limited overall impact
  - Raises yields on debt, other investment yields and reserves
  - Also yield on FDI and equity payments in emerging countries

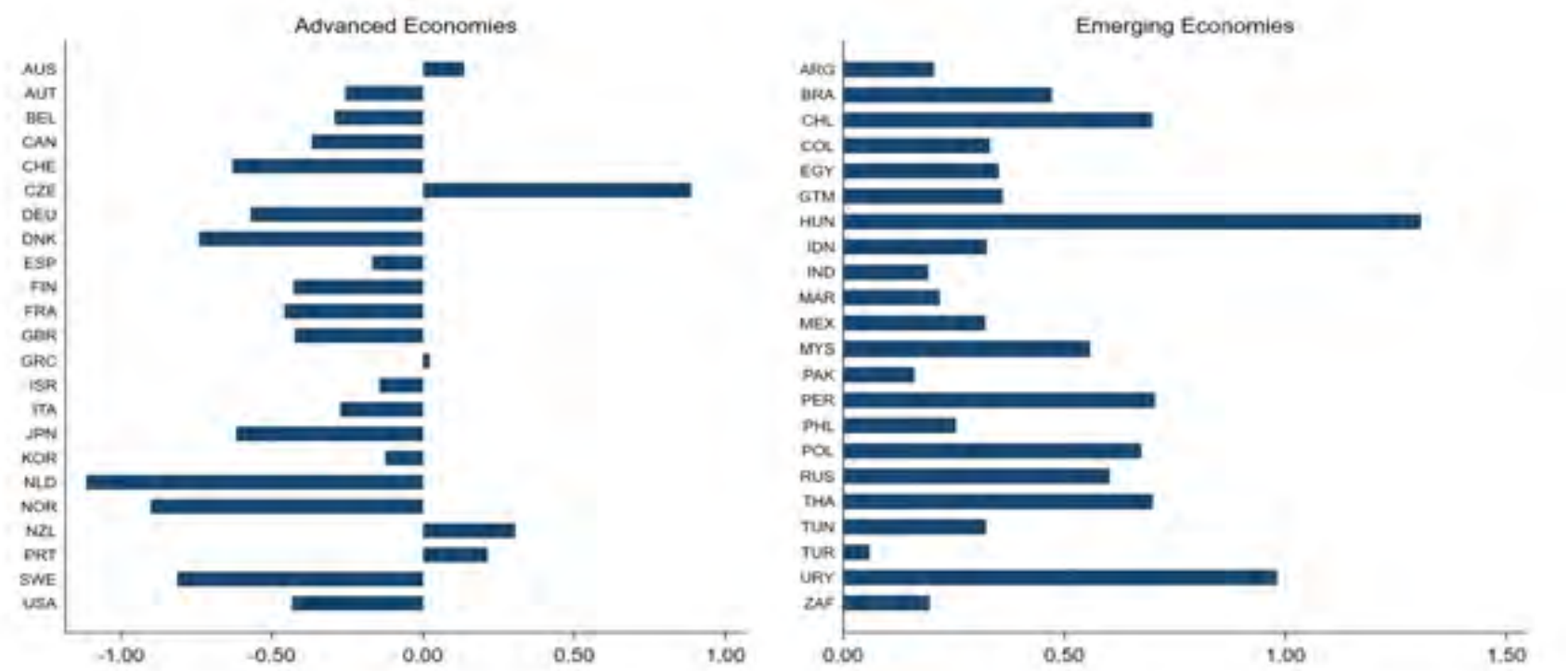
Figure 7: US 10-year interest rate

	Total		FDI		Equity	
	Receipt	Payment	Receipt	Payment	Receipt	Payment
All	0.0238**	0.00884	0.0146	0.0366**	0.0439	0.107***
ADV	0.0398***	0.0185	0.00687	-0.00048	0.0101	-0.0104
EME	0.0112	-0.0118	0.0202	0.0476**	0.0604	0.233***
	Debt		Other investment		FX res.	
	Receipt	Payment	Receipt	Payment	Receipt	
All	0.128***	0.0832***	0.0955***	0.134***	0.162***	
ADV	0.0886***	0.0555***	0.112***	0.156**	0.142***	
EME	0.141***	0.0628**	0.0949**	0.0538***	0.193**	

Net Income Results - Effect of a dollar appreciation

- Combine fitted yields with the (average) positions of the different components to obtain net income effects
- Stronger dollar lowers yields with contrasted net effects
  - Positive effect for EMEs vs Negative effect for AEs (with exceptions)

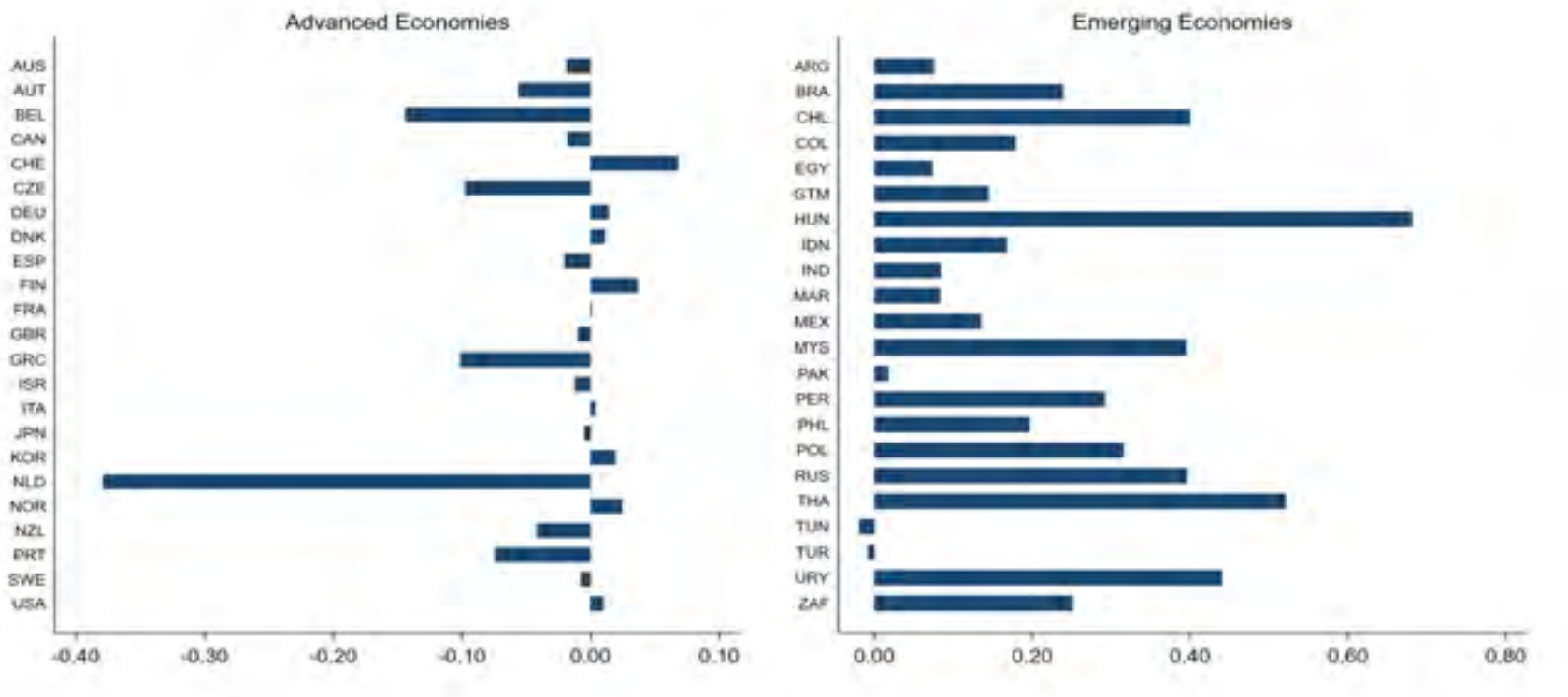
Figure 8: Impact of a 10% dollar appreciation on net asset income (% of GDP)



Net Income Results - Effect of US short-term ir increase

- Limited (heterogeneous) effect on net income in AEs
- Higher net income in EMEs

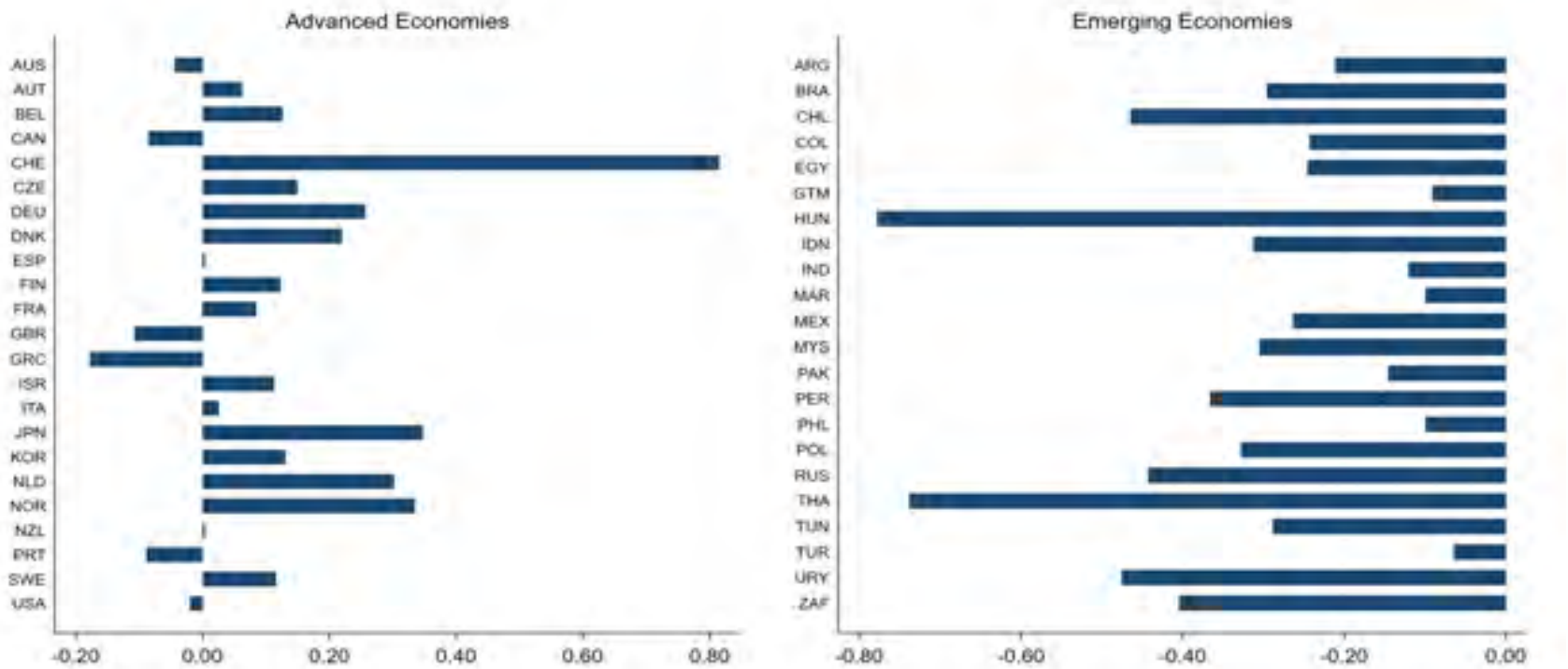
Figure 9: Impact of a 1 ppt increase of US 3-month rate on net asset income (% of GDP)



Net Income Results - Effect of US long-term ir increase

- Moderate increase in AEs (with some exceptions)
- Decreases in EMEs

Figure 10: Impact of a 1 ppt increase of US 10-year rate on net asset income (% of GDP)



Case studies

- 2013 Taper Tantrum: rapid increase in the long-term rate, not the short-term
  - Heterogeneous effects across the board, with a more widespread decrease in EMEs
  - Limited estimated effect, smaller than the actual change in net income
- Current cycle of rising rates $\rightarrow$ 2021 as the initial period and ir projections for mid-2023 to 2025 Graph
  - Higher US rates increase EMEs' net investment income
  - Heterogeneous effects in AEs, with a shift towards more positive outcomes as time passes
  - Higher domestic rates (in AEs only) worsen net income Graph

Conclusion

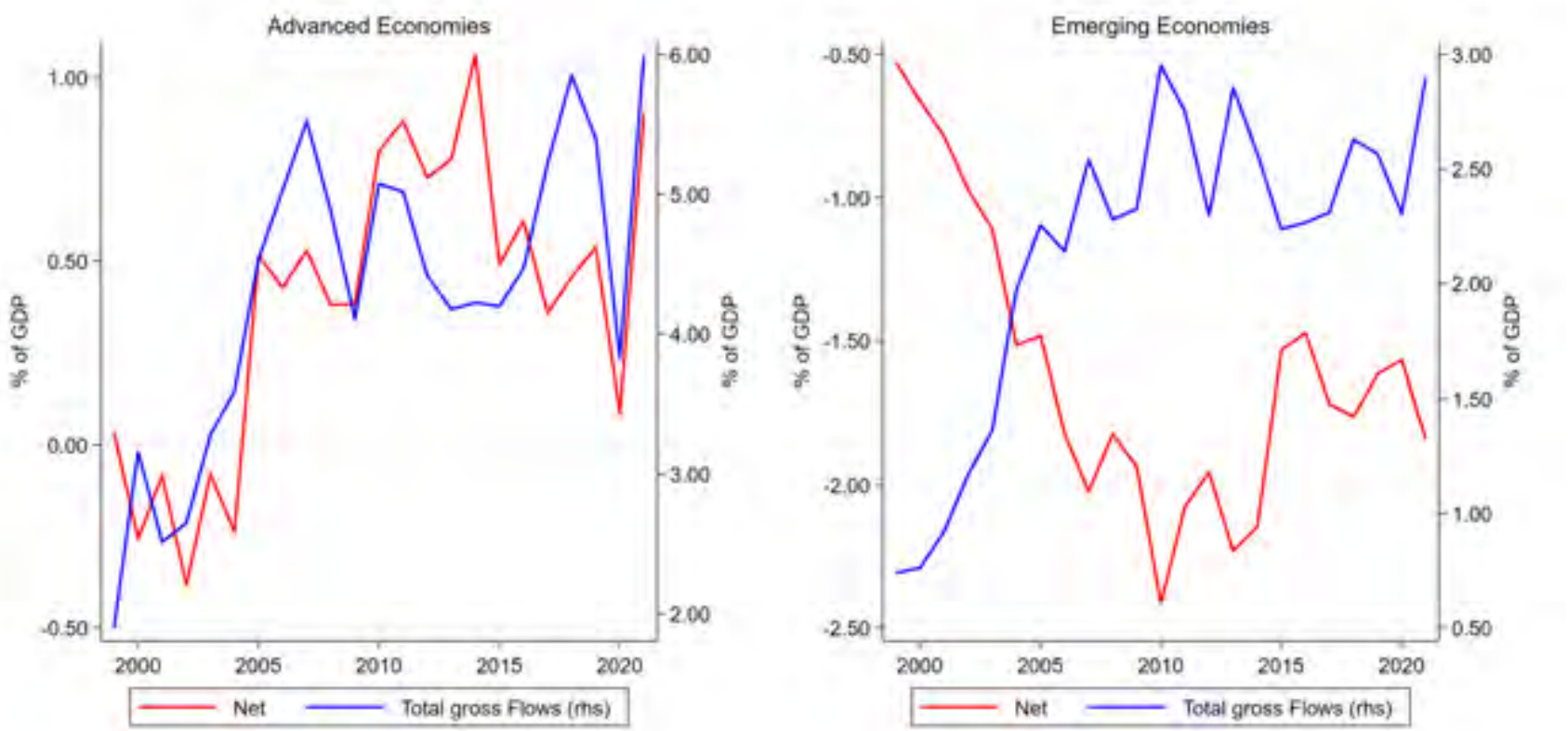
- Financial globalisation should have boosted the role of primary investment income in the current account
  - This is the case for FDI and equity but not for debt and other investment, due to offsetting trend reductions in interest rates
- Panel analysis over several drivers on yields
  - Contrasted across economies group, and across types of assets
  - Similar impact on both receipts and payments
  - Contrasted impact on net asset income, due to heterogeneous assets and liabilities (size, composition)
  - Limited impact of higher rates in taper tantrum, more pronounced in the current phase
- Contribution to growing literature on asset income flows and future work:
  - Improve data on currency composition
  - Adding up constraints (in panel, deficits vs surplus)
  - Models of shocks impact on dividends, interest rates and exchange rates

ADDITIONAL SLIDES

Stylised facts - FDI income flows

- Growing trend of gross flows, widening deficit in EMEs
- Similar growth of gross flows of equity income in AE

Figure 11: FDI asset income (% GDP, median)

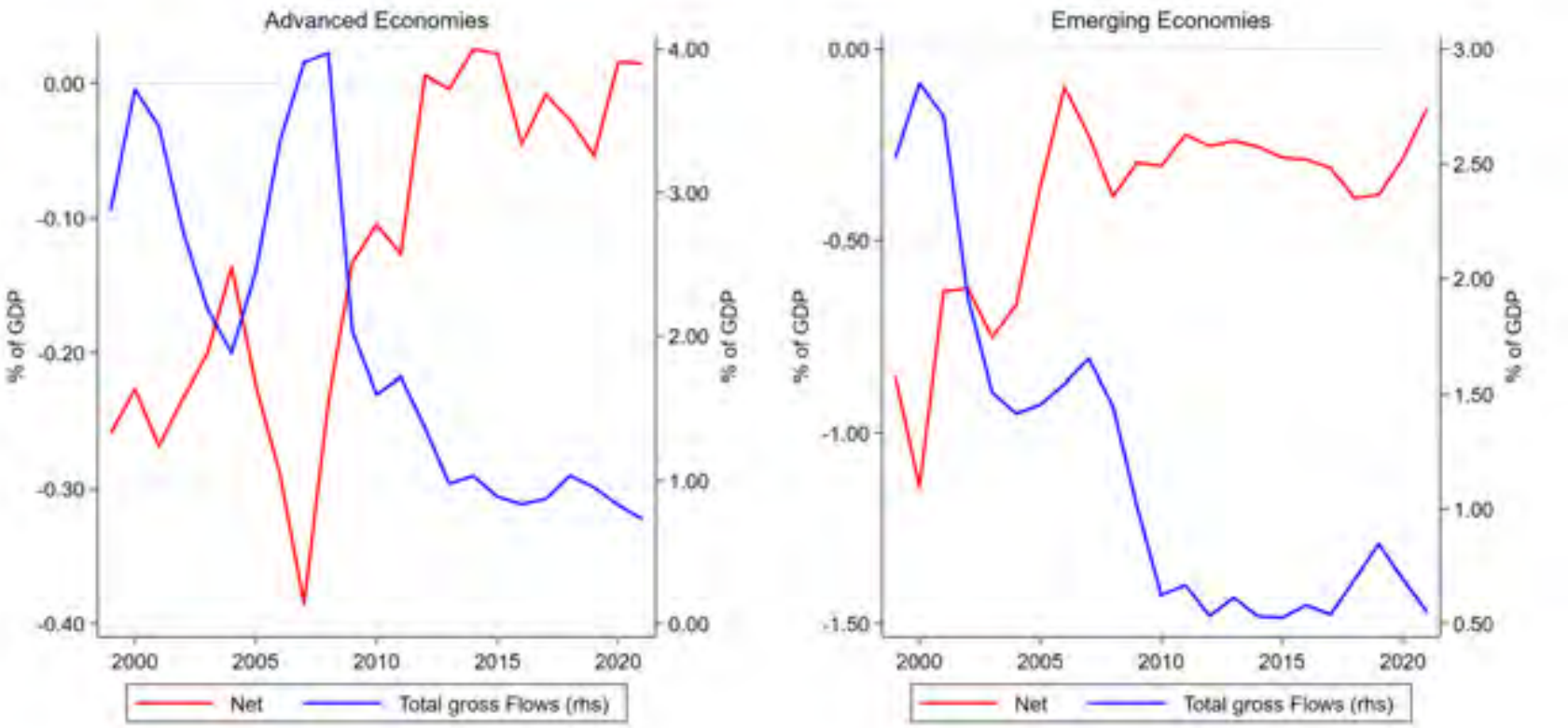


Back

Stylised facts - Other investment income flows

- Growing trend of gross flows, widening deficit in EMEs
- Similar growth of gross flows of equity income in AE

Figure 12: Other investments asset income (% GDP, median)



Back

Panel results - Effect of the VIX

- Higher VIX leads to a broad decrease in yields
  - On receipts and payments, with no clear effect in net terms (at this stage)
  - Stronger in equity and other investment flows

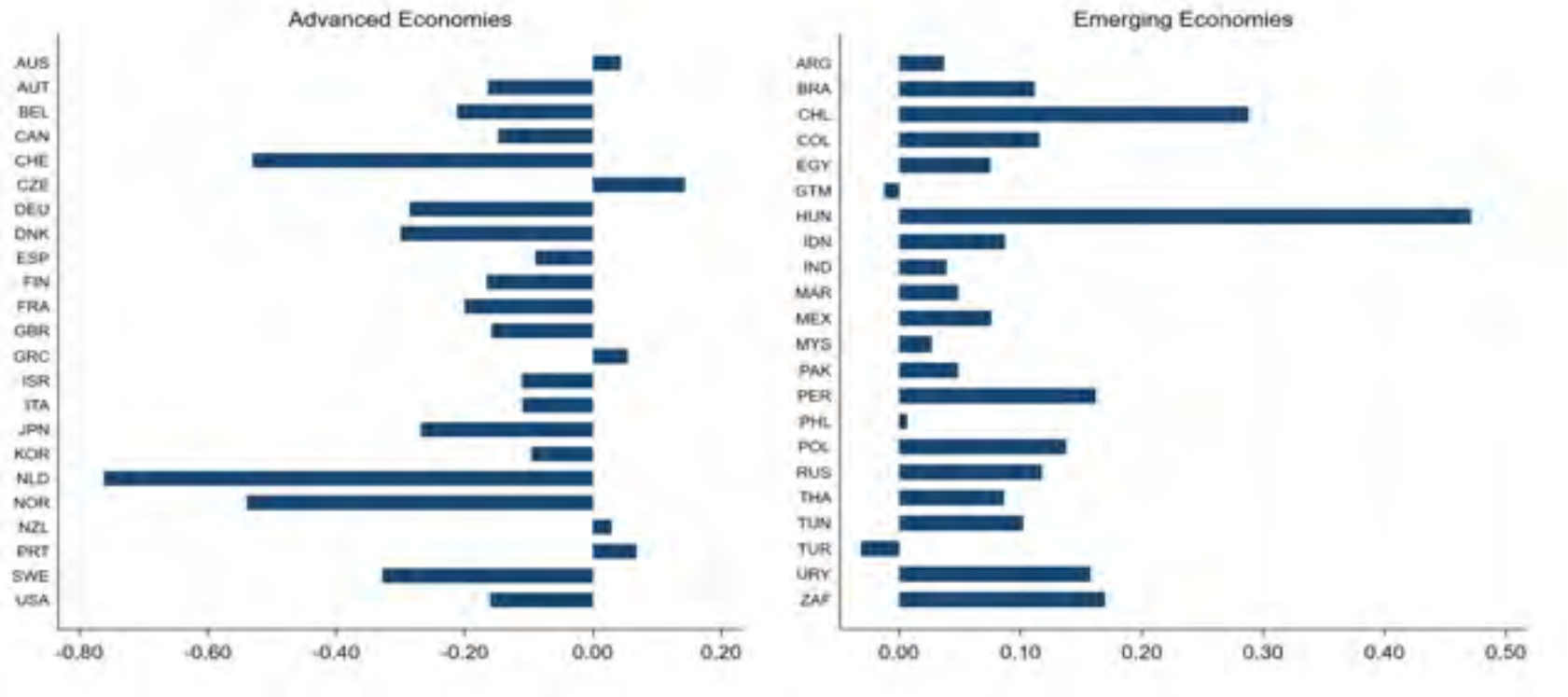
Figure 13: VIX (normalized)

	Total		FDI		Equity	
	Receipt	Payment	Receipt	Payment	Receipt	Payment
All	-0.0435***	-0.0557***	-0.0242	-0.0466***	-0.00462	-0.0689***
ADV	0.0317***	-0.0505***	-0.0685***	-0.0410**	-0.0686***	-0.0678***
EME	0.0542***	-0.0595***	0.0139	-0.0347**	0.0916	-0.0627*
	Debt		Other investment		FX res.	
	Receipt	Payment	Receipt	Payment	Receipt	
All	-0.0745**	-0.0294***	-0.166***	-0.0353***	-0.0949***	
ADV	-0.0393***	-0.0321***	-0.121***	-0.0754***	-0.0718*	
EME	-0.121*	-0.0263**	-0.202***	-0.0401**	-0.120**	

Net Income Results - Effect of a VIX increase

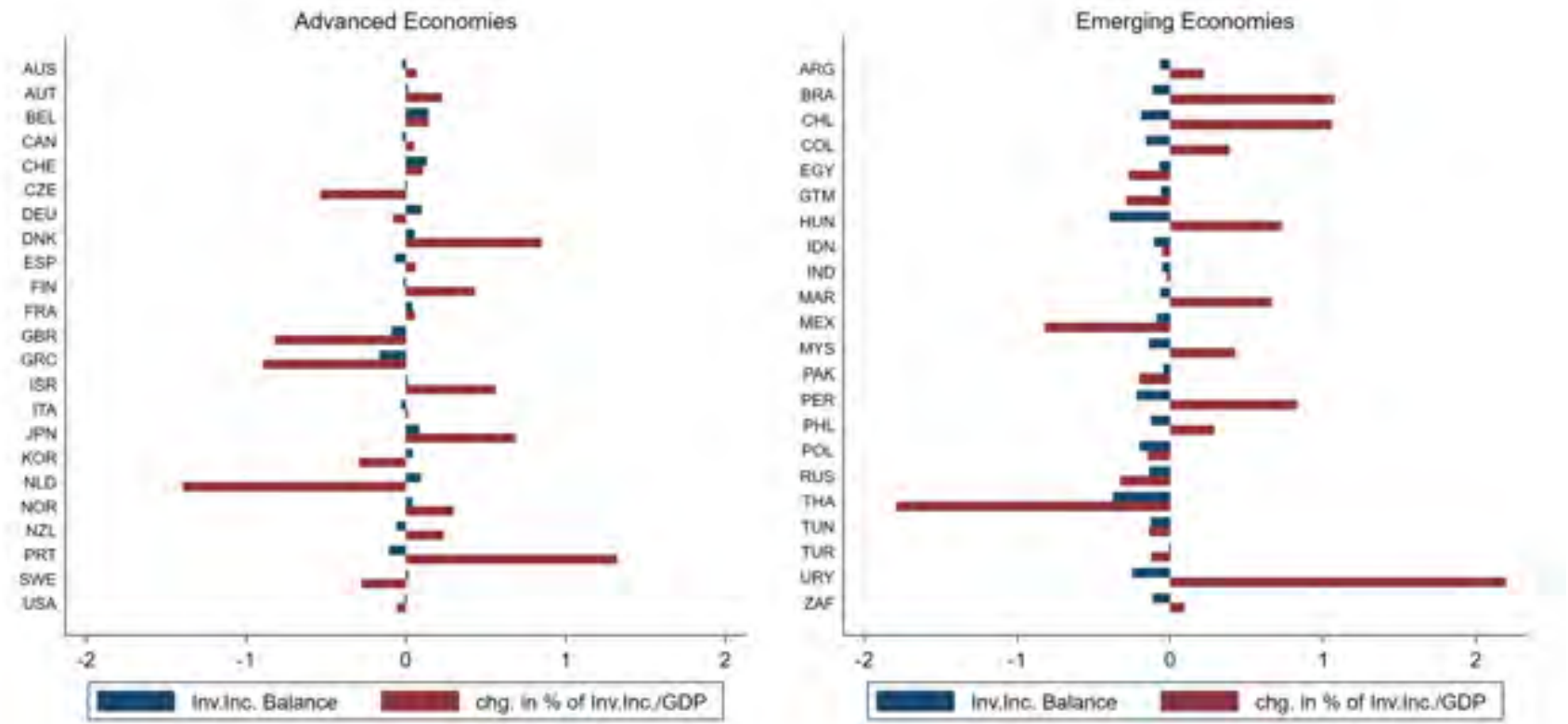
- Lower in AEs
- Higher in EMEs as negative effect on payments dominates

Figure 14: Impact of a 1 std error VIX increase on net asset income (% of GDP)



Case studies - Taper Tantrum

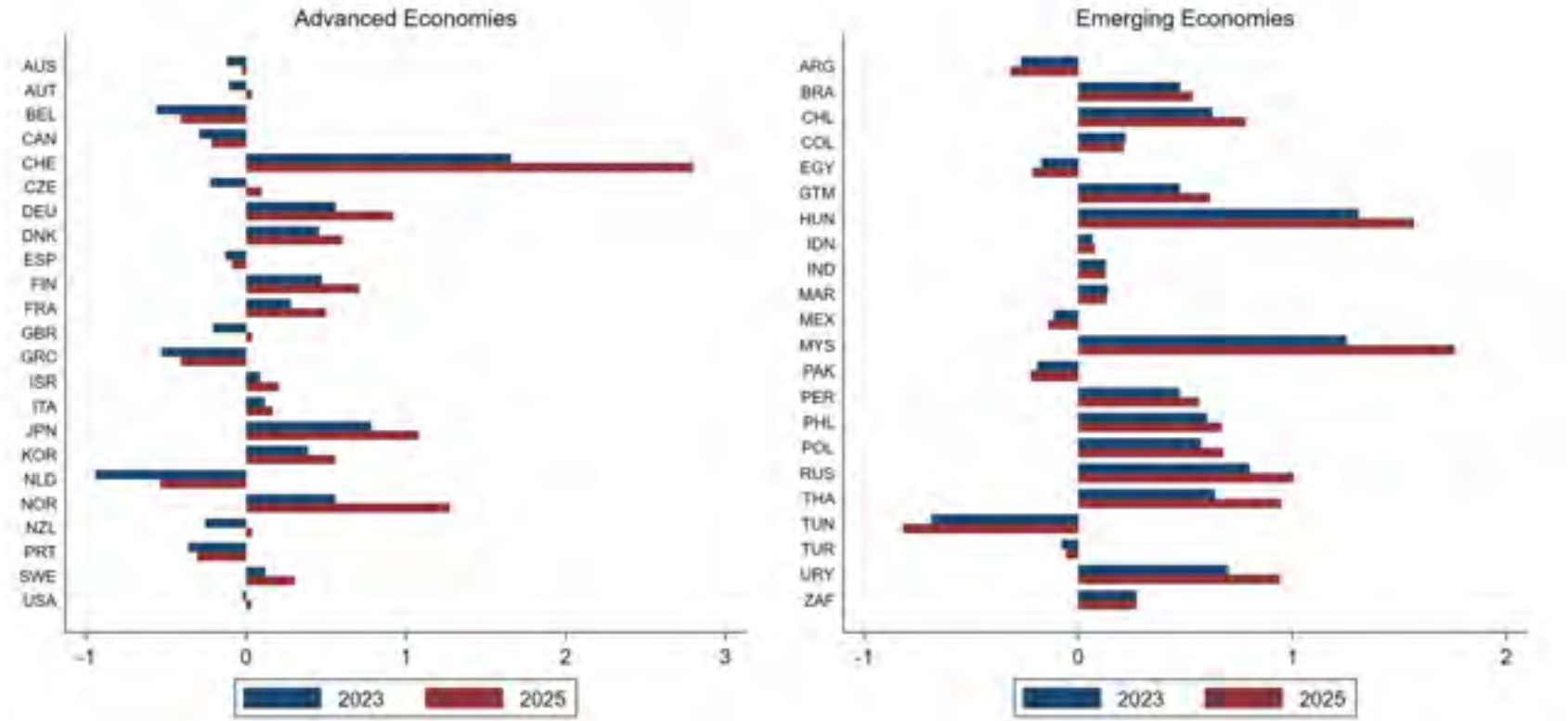
Figure 15: Fitted and actual change in net asset income (% of GDP)



Back

Case studies - Current rise of US ir

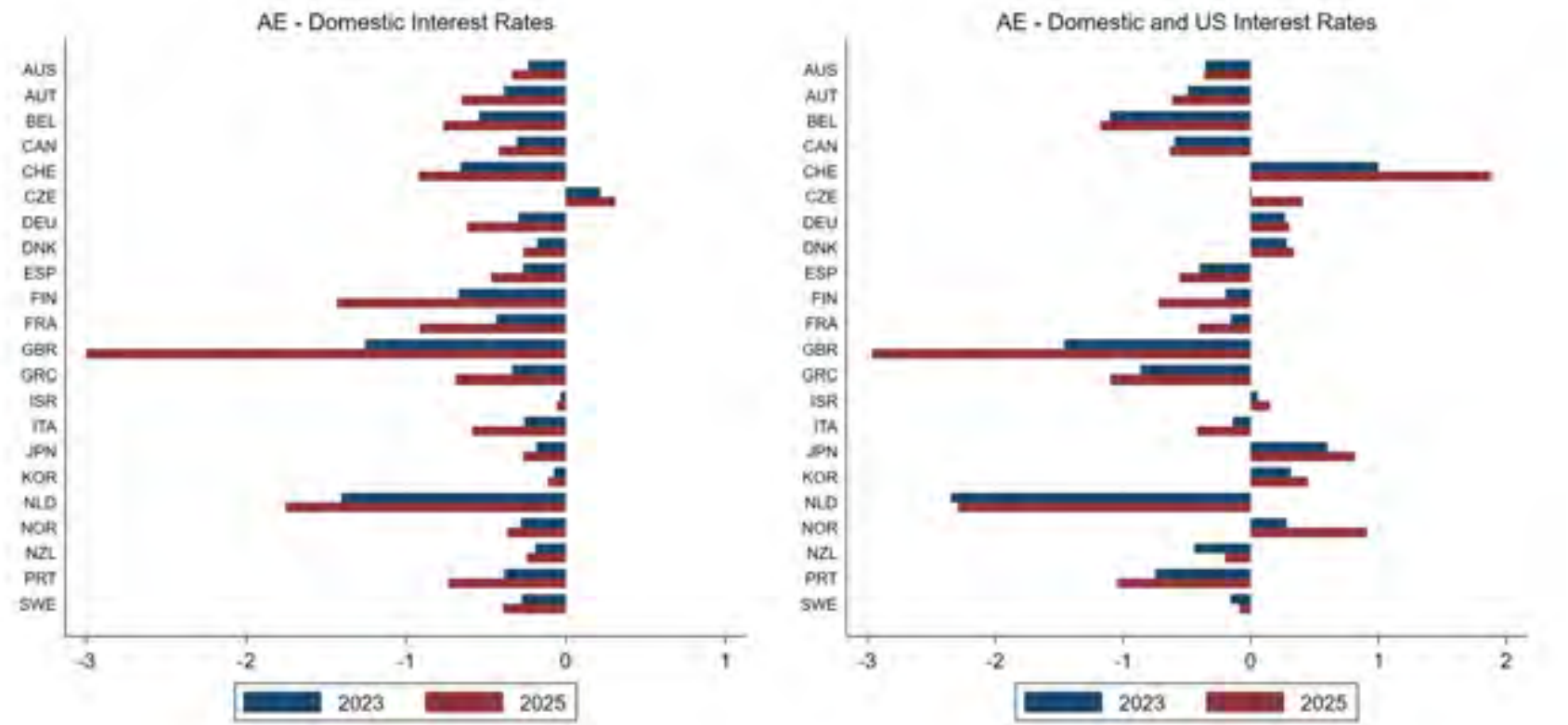
Figure 16: Effect of US rates (2021-2023 and 2021-2025) on net asset income (% of GDP)



Back

Case studies - Current rise of US and domestic ir

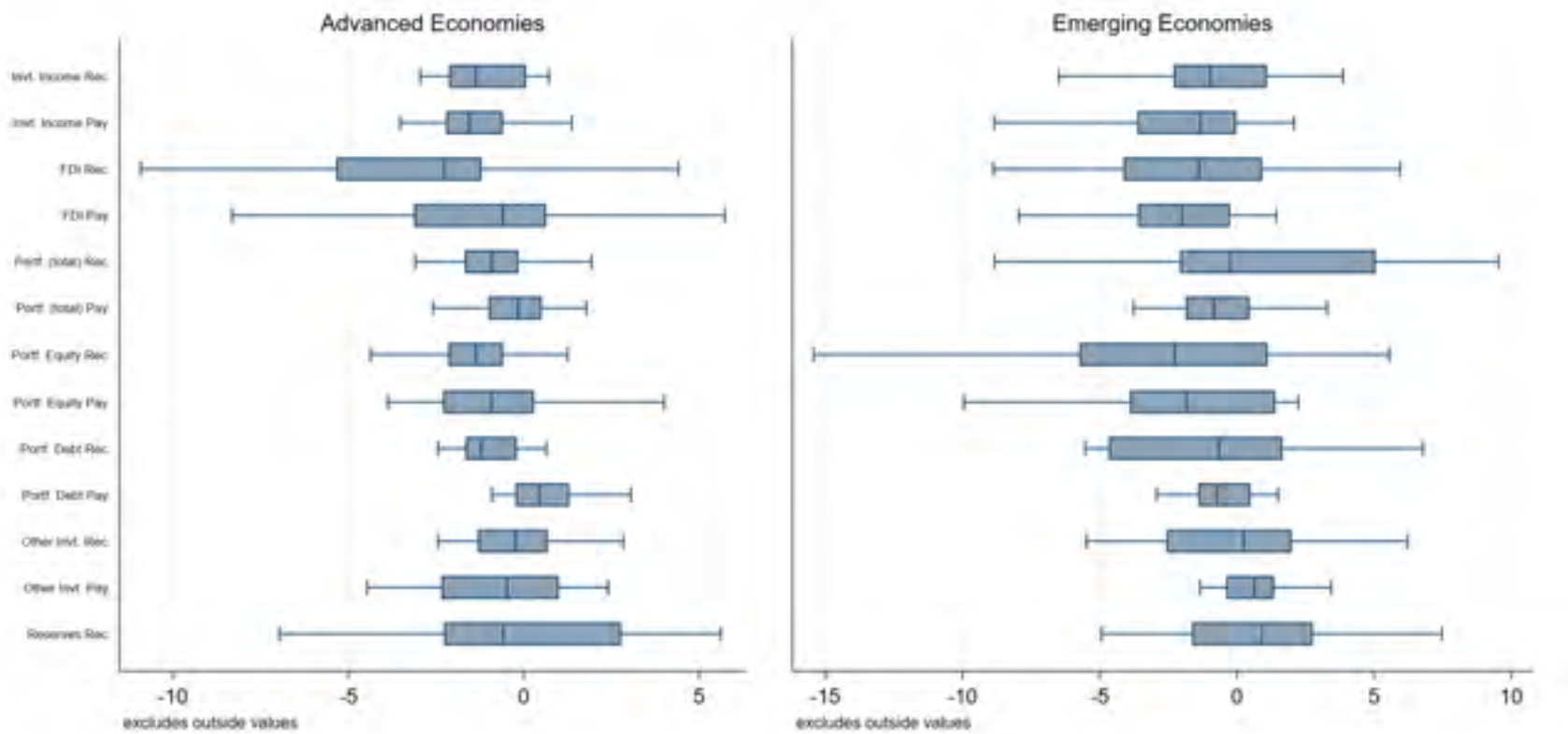
Figure 17: Effect of US rates (2021-2023 and 2021-2025) on net asset income (% of GDP)



Back

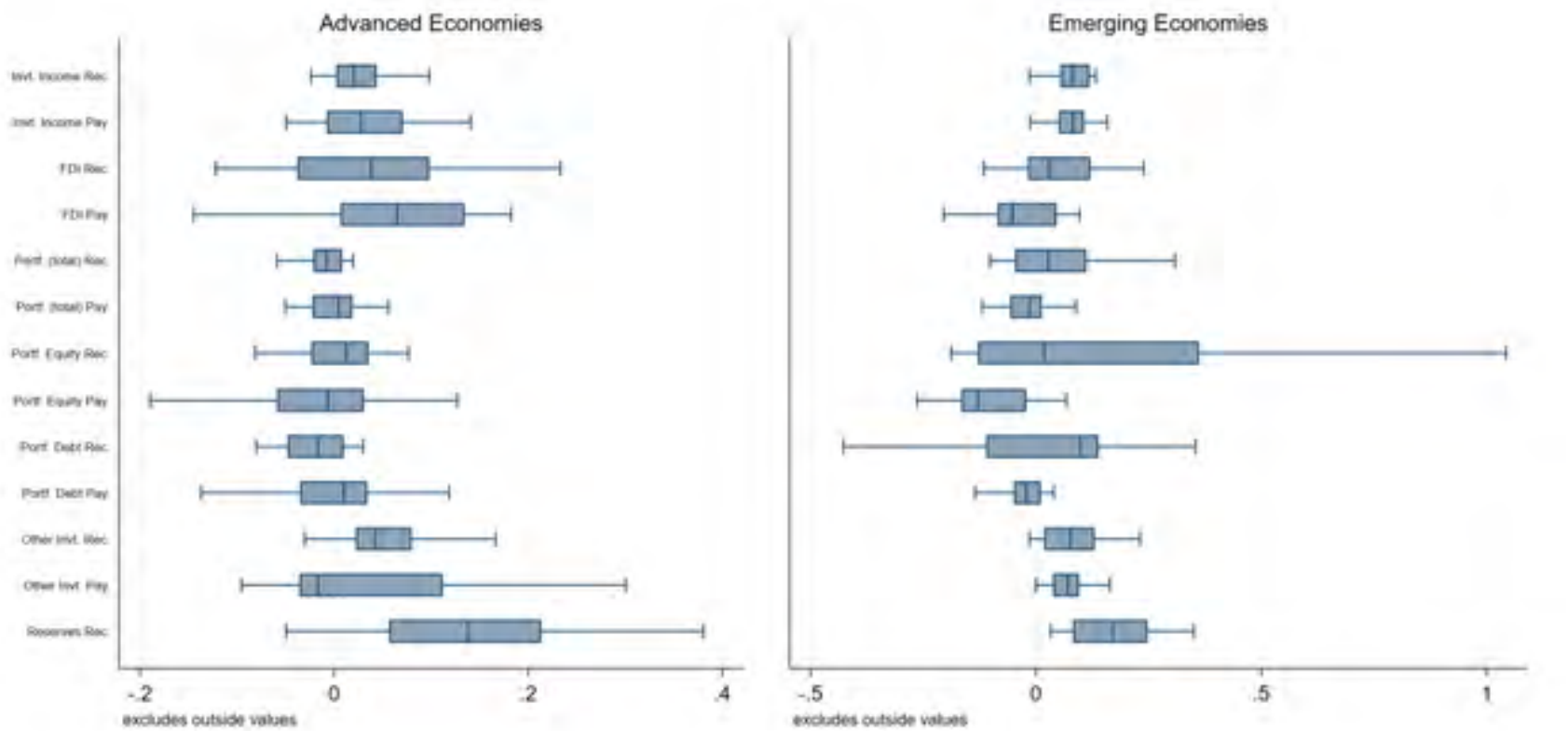
Country-level estimates - Broad dollar index

Figure 18: Box-and-Whiskers of US Broad coefficients



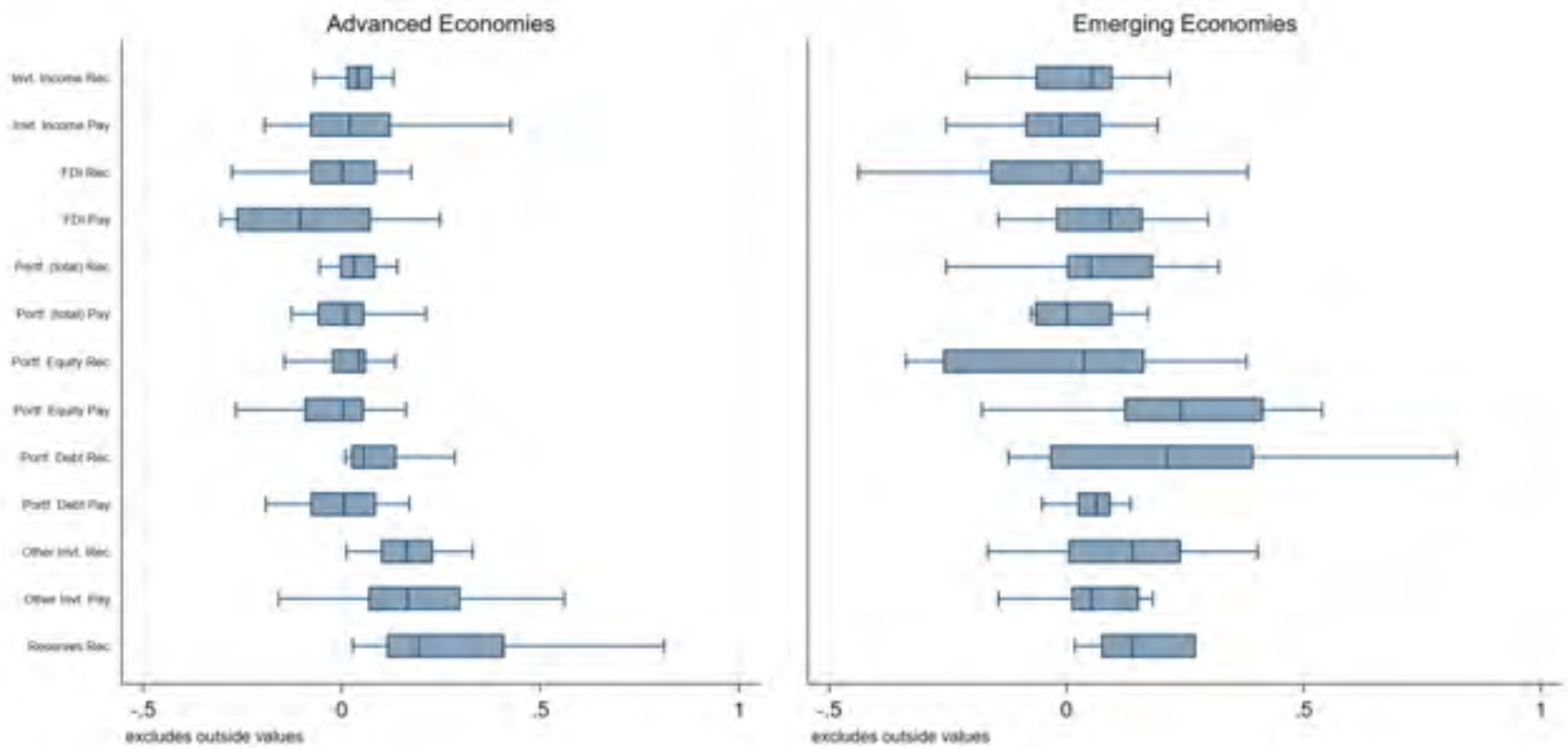
Country-level estimates - US short ir

Figure 19: Box-and-Whiskers of US short ir coefficients



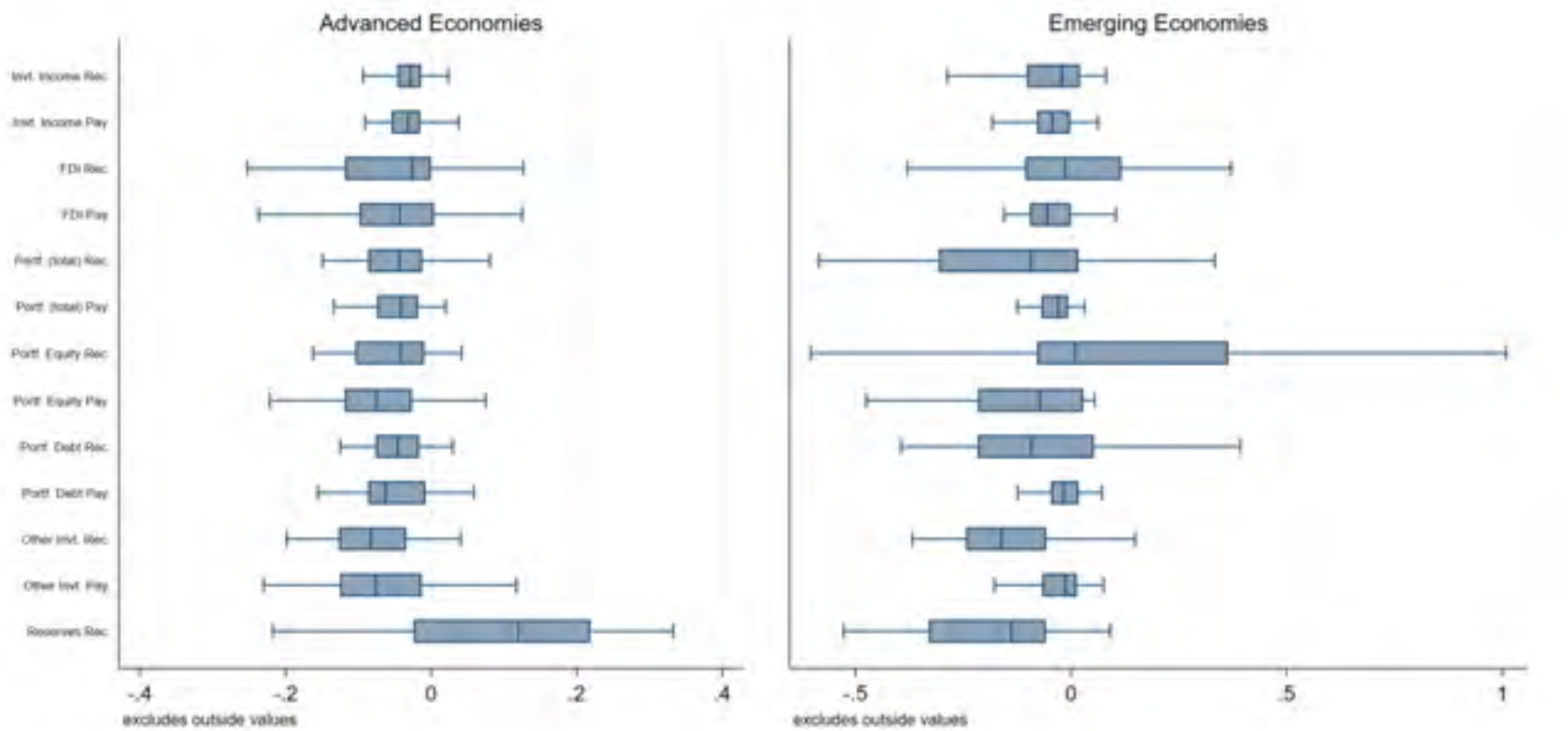
Country-level estimates - US long ir

Figure 20: Box-and-Whiskers of US long ir coefficients



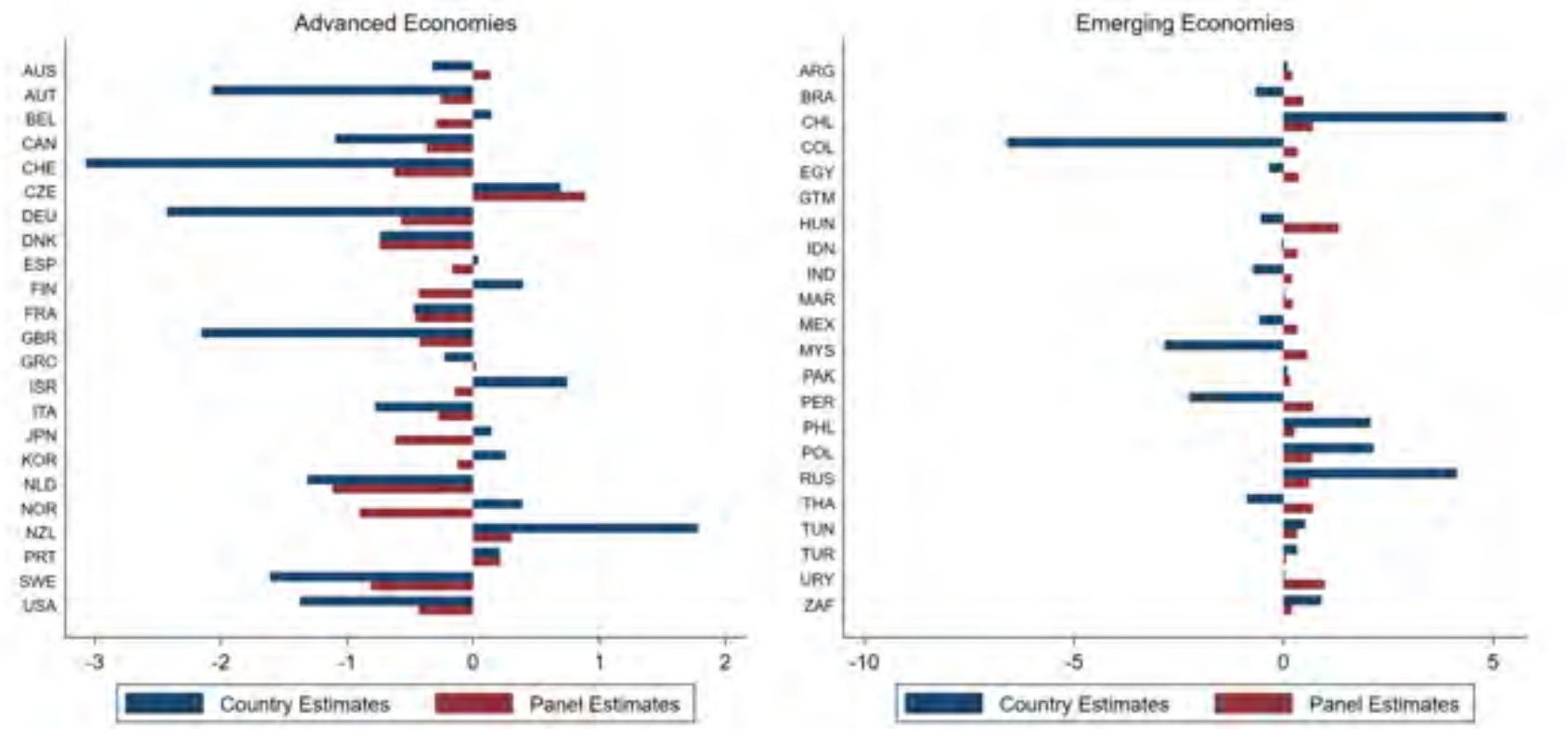
Country-level estimates - VIX

Figure 21: Box-and-Whiskers of VIX coefficients



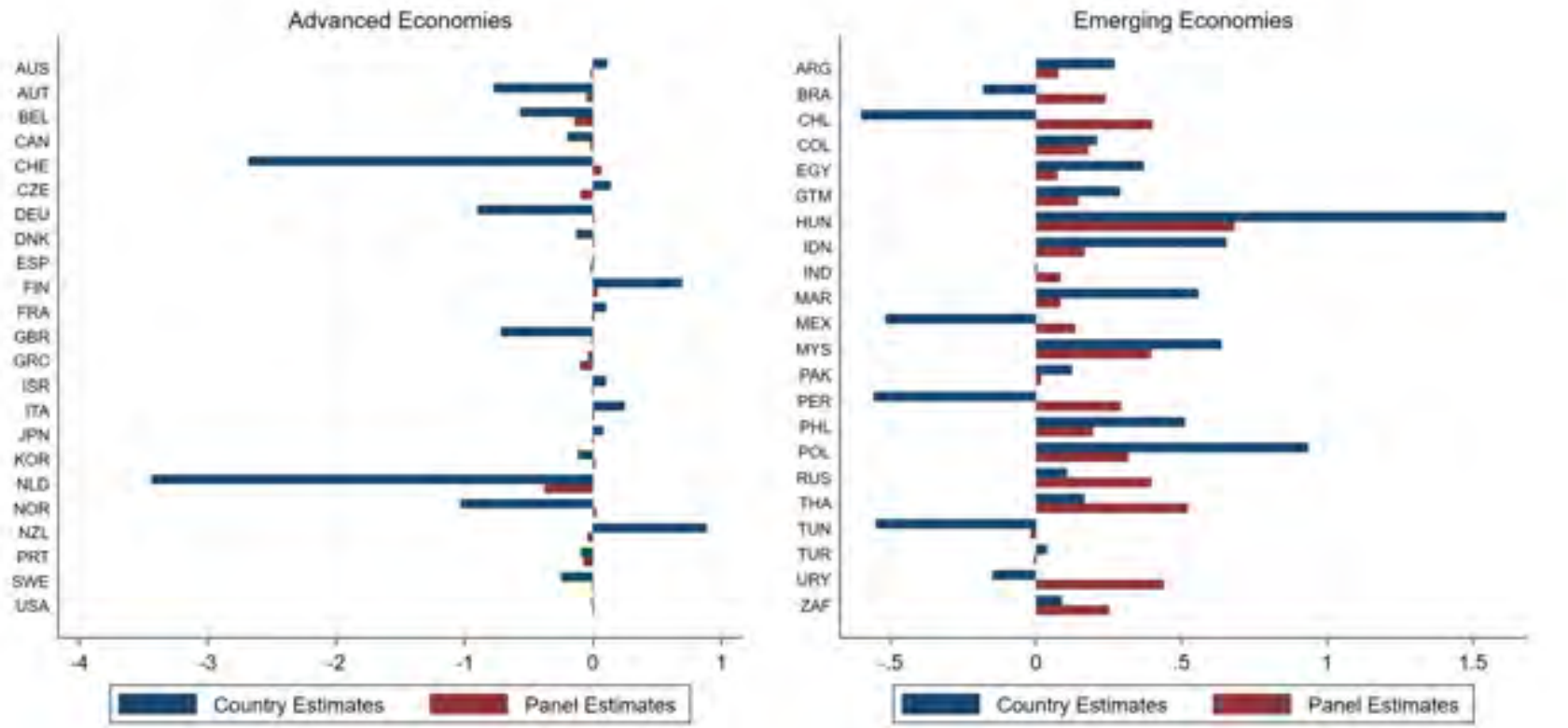
Country-level net income effects - US broad dollar

Figure 22: Country vs panel estimates: US broad dollar



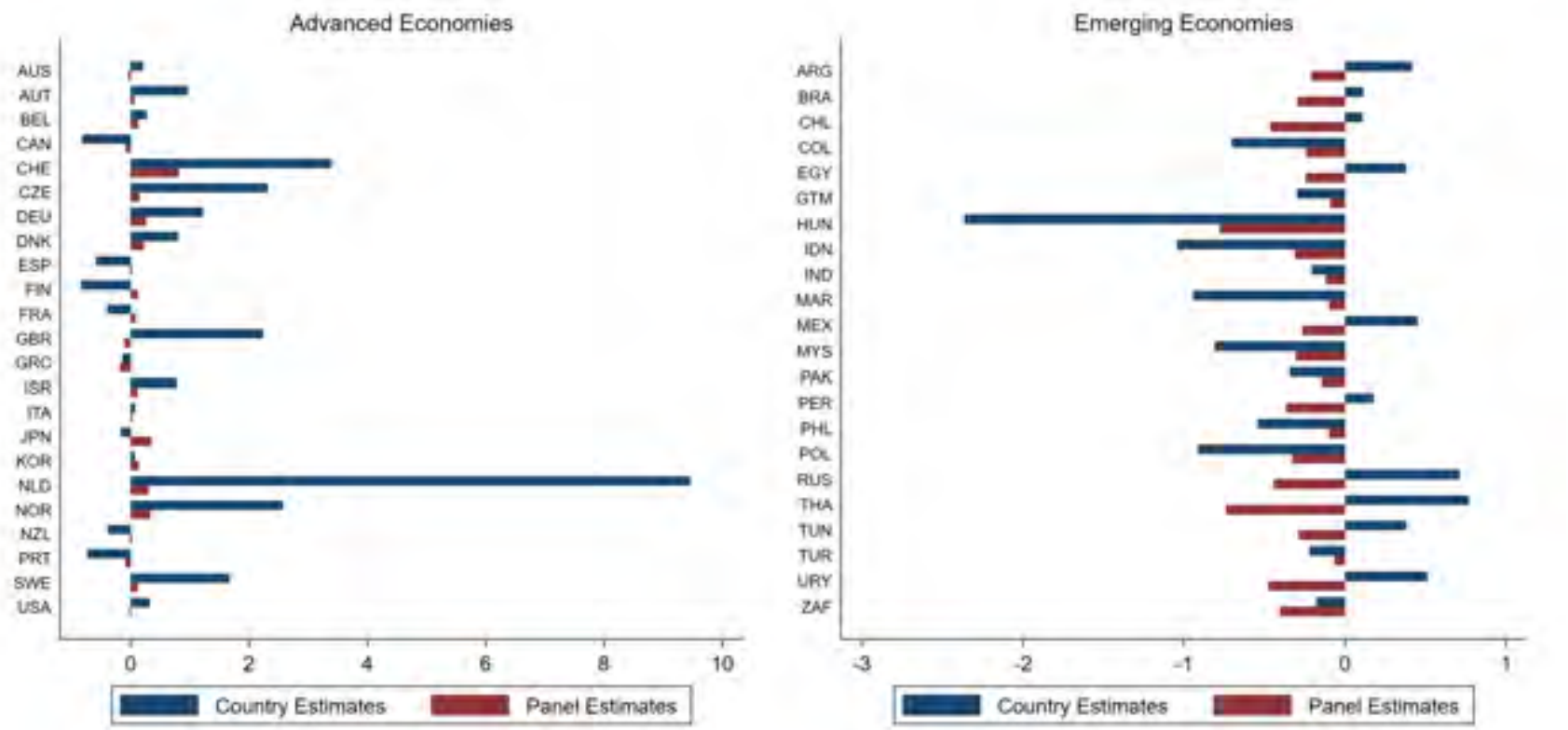
Country-level net income effects - US short ir

Figure 23: Country vs panel estimates: US short ir



Country-level net income effects - US long ir

Figure 24: Country vs panel estimates: US long ir



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IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

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Unravelling household financial assets and demographic characteristics: a novel data perspective[1]

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Trinity College Dublin;

Tara McIndoe-Calder,
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[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Unravelling household financial assets and demographic characteristics: a novel data perspective

Simone Arrigoni, Agustín Bénétrix, Tara McIndoe-Calder, Davide Romelli[1]

Abstract: This paper presents a novel dataset that combines granular information on financial assets from the Security Holdings Statistics (SHS) with household characteristics from the Household Finance and Consumption Survey (HFCS). We illustrate one of its potential uses by studying the link between portfolio returns and risk with education. First, we provide a non-parametric exercise taking Ireland as a case study and report a robust link between high education levels and returns. Moreover, we find that more educated households exhibit higher risk tolerance and portfolios structured to realise greater gains in periods of elevated positive risk, albeit being more susceptible to losses in challenging times. Second, we expand the illustrative example to a country panel setting and address the previous question following non-parametric as well as parametric methods. Interestingly, the previous results for education and returns also emerge in this setting. These are robust to the inclusion of unobserved conditioning factors and macro-financial controls. We outline avenues for potential research and analysis that our novel dataset may contribute to in the future.

Keywords: household finance, international macroeconomics, portfolio return, investment risk.

JEL classification: G50, G11, E22, F21.

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1. Introduction and related literature

International financial integration measured through cross-border positions varies across countries and over time. This is due to differences in the depth of financial systems, the scale of balance sheets, the structure (type of investments, currency of denomination, location, maturity, etc) and the role played by macro-financial factors affecting these systems (exchange rates, stock markets, interest rates, inflation, etc). The various ways in which these elements are linked with international gross positions, net positions, flows and valuation effects, has been extensively documented in the relevant literature. However, most of those characterisations take an aggregate country perspective. Little is known about the link between international financial integration and sectoral characteristics, in particular for the household sector. To the best of our knowledge, only few papers have studied the sectoral heterogeneity in asset holdings (see Giofré, 2013; Roque and Céu Cortez, 2014; Galstyan et al., 2016; Galstyan and Velic, 2018; Boermans and Vermeulen, 2020). Among these papers, even fewer focus on the household sector.

Household finances are important in assessing the macroeconomy, as decisions taken by households affect aggregate outcomes. For example, household income determines aggregate private spending (Deaton, 2008; Muellbauer, 1994). Moreover, saving decisions play a role in the transmission of monetary policy (Lane, 2019). Household indebtedness can drag on or support aggregate output, depending on the value of their assets as well as their debts, i.e., their net wealth (Kim, et al, 2015). During business cycle turning points, household finances can play a role in financial stability. For instance, the role of mortgages was of great importance in the global financial crisis (Mian and Sufi, 2018). The financial behaviour of households at the top of the wealth distribution compared to those lower down the distribution may contribute to persistent wealth inequality trends (Bach et al, 2020).

However, many of the insights into the interactions between household finances and the macroeconomy are generated by information on real assets, outstanding debts, labour income and/or ownership of small firms. Instead, the role of households in the macroeconomy via their holdings of financial assets is less well understood (Santoso and Sukada, 2006). This is despite the substantial holdings of financial assets by this sector. In the euro area households hold 20.1% of their gross wealth as financial assets in 2021 (ECB, 2023).

To bridge this gap, the focus of this project is to use microdata and multiple information sources to study the link between international financial integration and the household sector. To accomplish this, we provide a methodology to combine two key sources for the analysis: financial information data on domestic and cross-border investments from the Security Holdings Statistics (SHS) and household-level data from the Household Finance and Consumption Survey (HFCS). The Security Holding Statistics (SHS) dataset is a Eurosystem database with information on securities held by selected categories of euro area investors, broken down by country of residence. These data are collected by national central banks directly from reporting investors and indirectly from custodians. The Household Finance and Consumption Survey (HFCS) collects cross-sectional household-level data on wealth (real and financial assets, liabilities, and credit constraints), income, consumption, saving and other household characteristics.

We use this augmented dataset to illustrate the potential research and policy applications arising from the combined insights into financial assets and the characteristics of their holders. We showcase the power of this augmented data by examining the role of education in household financial returns. A compelling narrative emerges, revealing that households with higher levels of education exhibit a distinctive investment behaviour that significantly impacts their portfolios. More educated households not only display a greater likelihood of positive returns but also a higher risk tolerance. This might be expected, but interestingly we find that this result derives from market price changes rather than exchange rate fluctuations. This underlines the pivotal role of education in shaping investment strategies and risk management among households.

Disaggregated information on the financial asset holdings of households will be useful on several dimensions. For example, facilitating the identification of risks and imbalances within the sector concerning financial assets. Moreover, it enables a comprehensive examination of the impact of shocks on households through the financial system. Together, these insights will be informative for policy design and impact including supporting household welfare.

Graph 1 compares financial participation in financial assets and their significance in total financial portfolios across euro area countries. Notably, 80% to 100% of households have deposits, making it the most common financial asset. Participation rates in investment assets are lower, yet they constitute a significant portion of households' financial portfolios in terms of value. To align the instrument coverage in the security database (SHS) with the household survey (HFCS), this paper focuses on Investment Funds (IF) and Money Market Funds (MMF) shares, Quoted Shares, and Debt Securities. On average, these assets collectively represent 22% of the total gross financial assets held by households in euro area countries, with almost one in five households owning at least one of these investment assets. Deposits, not included in the financial assets explored in this paper, account for 44% of total gross financial wealth in euro area countries, on average.[2]

The remainder of this paper is organised as follows. Section 2 describes the two main data sources in detail, while Section 3 explain how we merge the information from these to create an augmented dataset. Section 4 provides two applications to showcase the usage of the augmented dataset. Section 5 concludes.

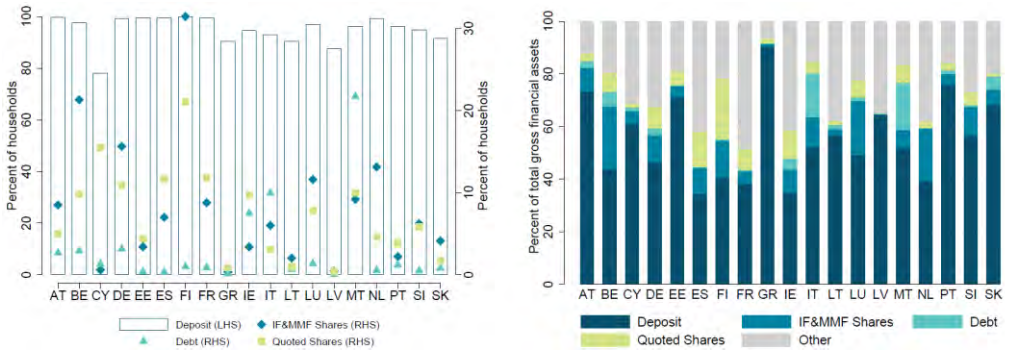
2. Data

This Section describes in detail the two datasets used in our analysis.

[2] Apart from deposits and investment assets, households hold "other" financial assets. This includes non self-employment private business, managed accounts, money owed to households, voluntary pension/whole life insurance, and other financial assets.

Households' portfolios in the euro area[1]

Financial participation (left) and financial portfolio composition (right) Graph 1



[1] The left panel illustrates household participation in financial assets, by instrument type. The right panel shows the composition of financial portfolio, using the total by instrument type over the total of gross financial assets. "Other" includes non self-employment private business, managed accounts, money owed to households, voluntary pension/whole life insurance, and other financial assets.

Sources: HFCS (Wave 3 – 2017/18).

2.1 Security Holdings Statistics (SHS)

The Security Holding Statistics (SHS) dataset is a Eurosystem database which provides information on securities held by selected categories of euro area investors, broken down by country of residence. These data are collected by national central banks directly from reporting investors and indirectly from custodians.

The database consists of two different data sources, the *Centralised Securities DataBase (CSDB)* and the *Securities Holdings Statistics by Sector (SHS-S)*, that provide information about the issuer and the holder of securities, respectively. We link them using the unique common International Securities Identification Number (ISIN) identifier of each instrument.

While SHS collects data for various economic sectors, in this paper we focus on the household sector.[3] Data at the security level are grouped into the following instrument types:

1. *Investment Funds (IF) & Money Market Funds (MMF) Shares*: shares and units issued by investment funds and trust funds, and shares issued by MMF (i.e. collective investment schemes), respectively.

[3] The household sector consists of individuals or groups of individuals (consumers and entrepreneurs), provided that the production of goods and services is not by separate entities treated as quasi-corporations. It also includes the non-profit institutions serving households, which are separate legal entities that serve households under voluntary contributions.

2. *Debt Securities*: short-term (original maturity of at most one year or repayable on demand of the creditor) and long-term (original maturity of more than one year or with no stated maturity).
3. *Quoted Shares*: shares listed either on a recognised stock exchange or any other form of organised secondary market.

Data are available at quarterly frequency starting from 2013Q4. The SHS sample covers the euro area countries and four additional participating non-euro area countries (Bulgaria, Czech Republic, Denmark, and Romania).

SHS provides two area concepts: holder area and reference area. Holder area is the country of residence of the holder, while reference area is the reporting country. This means that two types of holdings are available. On the one hand, securities held by a resident household that are reported by domestic custodians (i.e., where holder area = reference area). On the other hand, securities holdings by non-financial residents from euro area or participating non-euro area countries which are in custody in another euro area or participating non-euro area country (i.e., third party holdings, where holder area is different than reference area). An example of the latter would be a security held by an Irish household via a German custodian. To provide a more complete view of investment positions and given that for the household sector double reporting is not an issue (Boermans, 2022), we include both observation types. This choice is in line with the guidelines provided in the ECB's User Guide.

2.2 Household Finance and Consumption Survey (HFCS)

The Household Finance and Consumption Survey (HFCS) collects cross-sectional household-level data on wealth (real and financial assets, liabilities and credit constraints), income, consumption and saving. Alongside these economic dimensions, HFCS provides a rich set of demographic characteristics. Among the most relevant for household portfolio decisions, which is the focus of this paper, are education level, age, labour status, and housing tenure status. This European System of Central Banks survey is coordinated by the European Central Bank (ECB) and conducted at the national level by the national central banks of the Eurosystem and several national statistical institutes.

So far, four waves of the survey have been completed. The fieldwork for the first HFCS survey (2010 wave) was conducted for most countries in 2010 and 2011, the second wave (2014) took place between 2013 and the first half of 2015, the third (2017) wave was conducted between the last quarter of 2016 and the last quarter of 2018, while the fourth (2021) wave was carried out between the first half of 2020 and the first half of 2022. Anonymised microdata from these four waves was made available to researchers in April 2013, December 2016, March 2020, and July 2023 respectively. For this paper we will use data from the third wave.

The set of questions asked in the HFCS survey are ex-ante harmonised across euro area countries and the household sample is designed to ensure representativeness of each country population and a probabilistic sample design is applied. The latter means that the ex-ante probability that each household in the target population takes part in the survey is non-zero (see HFCS Methodological Report). However, to account for the high concentration of financial instruments

towards the top of the wealth distribution, an oversampling of wealthy households is implemented.

For the purpose of our analysis, we consider the following instruments to match the security types in SHS: *Mutual Funds* (equivalent to IF & MMF Shares in SHS), *Debt*, and *Quoted Shares*.[4] Note that households are asked to report both domestic and international investments in these instruments.

3. Combining SHS and HFCS information to assess valuation effects and risk

Before describing how we merge the information provided by SHS and HFCS, we want to assess the comparability of the two datasets. For this purpose, we compute portfolio shares by country in both datasets and compared them. In SHS we sum over all holdings by country and asset class in the period that overlaps with the specific fieldwork for that country in HFCS. In HFCS we take the total of reported holdings in wave 3. Graph 2 illustrates the comparison. From this exercise it emerges that for the vast majority of the countries households' portfolio on aggregate are similar in the two databases. Although there are level differences between totals in the two data sources, portfolio shares appear to be consistent. This information is relevant for the paper because our exercise will be based on portfolio shares. Moreover, we can see that there is large heterogeneity between countries. While between country heterogeneity is a feature of both datasets, the merged database will allow to explore within country heterogeneity as well. This will be one relevant dimension of our contribution.

3.1 Data cleaning

We perform a set of data cleaning procedures on the full SHS dataset before proceeding to the merge with HFCS. Many of these procedures follow Boermans (2022), who suggests a set of cleaning rules specific to this database, while others are tailored to our exercise.

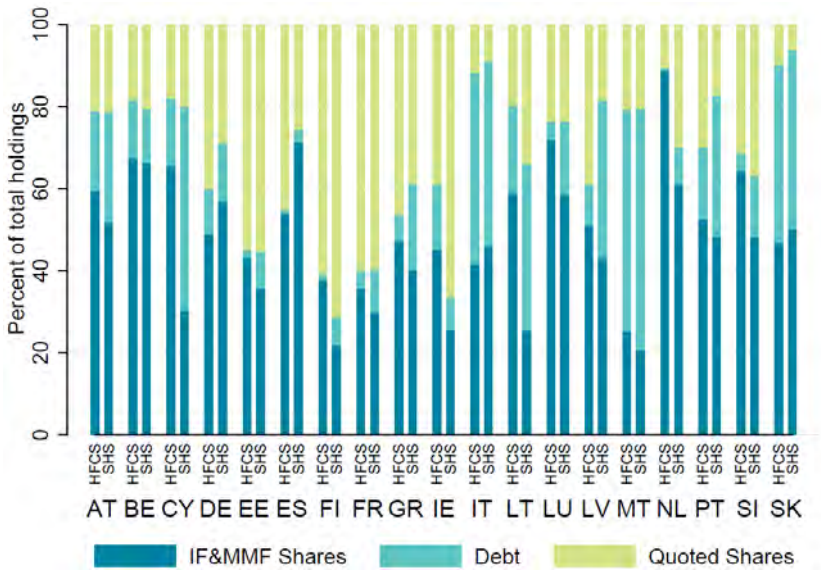
We exclude securities that fall in one or more of these categories: unknown instrument type, short positions, missing stock amount, issued by tax heavens countries or with an ISIN related to a tax heaven, unallocated or unknown issuer country, issued by institutions, issued by Luxembourg or with Luxembourg as a reference area.[5]

[4] Differently from SHS, HFCS does not disaggregate mutual funds into investment funds and money market funds shares nor debt into short- and long-term. HFCS identifiers are DA2102, DA2103, and DA2105 for quoted shares, debt, and mutual funds, respectively (see HFCS User Database Documentation for details.)

[5] Positions are defined as short when the stock amount is lower or equal to zero. Tax heavens are United States Virgin Islands, Curaçao, Cayman Islands, The Bahamas, Bermuda, British Virgin Islands, Isle of Man, Marshall Islands, Guernsey, Gibraltar, Jersey, Liechtenstein. Reference area is the nationality of the custodian the household used to invest.

Instrument shares, HFCS vs SHS[1]

Wave 3, portfolio shares of total in percent — Graph 2



[1] Percent of total holdings by country for each asset class. We match the full SHS sample with HFCS using the average of the quarters in which HFCS fieldwork was conducted in each country.

Sources: HFCS, SHS, and authors' calculations.

3.2 Combining SHS and HFCS: an augmented dataset

To combine the SHS data with the HFCS data, we proceed in three steps. First, we compute quarter-on-quarter valuation rates at the security level using SHS data over the period 2019Q1-2022Q4 as follows:[6]

$$Valuation\ Rate_{v,s,t} = \left(\frac{Valuation\ Amount_{v,s,t}}{Stock\ Amount_{v,s,t-1}}\right) \times 100$$

where *v* is the valuation type, *s* denotes the unique security as identified by the ISIN, and *t* is the quarter. We distinguish three valuation types, based on the richness of information offered by SHS. *Market price* valuation refers to changes in the value of end-period positions that occur because of holding gains or losses. *Exchange rate*

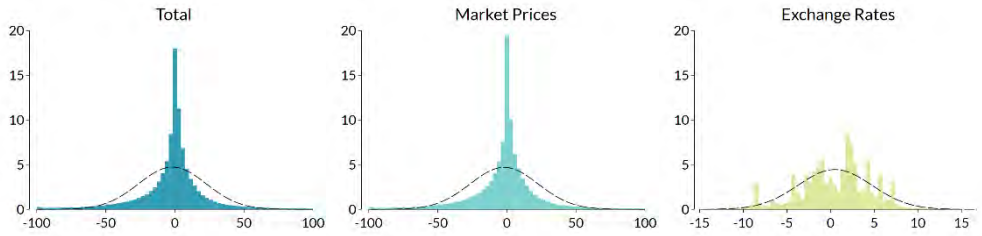
[6] Valuation rates/returns, as used in this context, encompass any capital gains or losses arising from fluctuations in market prices and exchange rates. The selected time frame for computing returns corresponds to the aftermath of the HFCS fieldwork, considering the last country in the sample. Separately, when looking at each type of valuation, we only keep securities for which that type of valuation is non-zero and non-missing. To reduce the impact of sensitive outliers, we remove observations outside the 1-99 percentile range, computed on the entire sample of countries.

valuation is due to movements in the exchange rates of the currency of denomination of the security against the euro. We define *total* valuation as the sum of the two.

Graph 3 shows the distribution of valuation rates for each valuation type. The sample includes euro area countries, excluding Luxembourg. Commenting on the magnitude, we can see that valuation changes due to market prices are larger than valuation changes due to exchange rates. As a result, total valuation rates reflect the former more than the latter. Moreover, the distributions of total and market prices valuation changes are more volatile than that of valuation changes due to exchange rates. On average, the standard deviation for total and market prices valuation is three times higher than the one for exchange rates. These two descriptive pieces of information follow the fact that stock prices are generally, and in our period as well, more volatile than exchange rates.[7] This means that valuation gains and losses connected to changes in stock prices, i.e., market prices valuation, would tend to be larger on average than those derived from changes in exchange rates vis-à-vis the currency of denomination. As an example, following the outbreak of the Covid-19 pandemic, the S&P500 lost around 20% in the first quarter of 2020, while the EUR/USD exchange rate only fell by 1.9%.

Distribution of valuation rates from SHS[1]

Euro area countries, 2019Q4-2022Q4, percent — Graph 3



[1] Percent on the y-axis, valuation rates in percent on the x-axis. Quarter-on-quarter valuation rates computed over the period 2019Q4-2022Q4 using all securities. The black dashed line is a standard normal distribution.

Sources: SHS and authors' calculations.

It is important to note that 70% of the observations in our sample for total valuation are not issued by the holder country, which means they are cross-border (including other euro area countries). Except for Spain and Germany, for which this ratio is less than 50%, for the remaining 16 countries it is over 85%. 27% of these are denominated in USD, and 22% of observations are issued by the United States. This data is also heterogeneous by country.

Turning to the distributions of the valuation rates themselves, none of them is normally distributed. This is in line with the stylised facts of financial returns (see Fan and Yao, 2015 for a summary). In particular, financial returns tend to display heavier tails compared to normal distributions, with asymmetry, i.e., returns are often

[7] For example, using data over the same horizon of interest, the coefficient of variation (Standard Deviation/Mean x 100) of the S&P500 is 17, compared to 5 for the EUR/USD exchange rate. A larger coefficient of variation denotes higher volatility of the underlying time series.

negatively skewed, and a larger mass concentrated around the mean.[8] It is worth noting that these stylised facts apply to all the countries in the sample (see Graphs A1, A2, A3 in Appendix).

Second, we compute summary statistics of these valuation rates, namely the mean, median, standard deviation, 5th and 95th percentiles. Then, we merge them with the HFCS data. Our merging assumption is that every household invests in the same pool of international securities within a given instrument type. In this case, heterogeneity arises from the portfolio allocations across instruments for each household. We take this information from the HFCS dataset.

Third, we compute household-level valuation rates for each country as a weighted average of the SHS summary statistics using household-specific portfolio shares (w_i^c) as weights:

$$Return_{i,v} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{mean(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

$$Return_{i,v}^{median} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{median(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

where i is the household identifier, v is the valuation type (total, market prices, and exchange rates), s denotes the unique security as identified by the ISIN, t is the quarter, and c denotes the asset class (IF&MMF shares, debt, quoted shares). The mean return will be our baseline measure of return. Note that there is no time subscript in the return metrics, as we compute them at the time of the HFCS fieldwork for wave 3, using ex-post valuation rates.[9]

Alongside returns, in a similar way, we compute two types of risk. One is based on realised volatility (the standard deviation, SD) to measure the capacity of households to diversify risk on an ongoing basis. The other one is based on the tails of the distribution, representing the tail risk associated with big shocks. The justification for this secondary category of risk stems from the concept of Value-at-Risk (VaR), a risk management metric pioneered by JP Morgan in 1996. VaR quantifies the potential profit or loss in the value of a portfolio within a specified confidence interval. Precisely, we designate the 5th percentile (P5) to represent significant valuation losses and the 95th percentile (P95) for substantial valuation gains.

$$Risk_{i,v} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{SD(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

$$Negative\ Tail\ Risk_{i,v} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{P5(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

[8] In addition, one must keep in mind that the period over which we compute valuation effects has been characterised by a series of exogenous shocks, such as the Covid-19 pandemic, the war in Ukraine, and the return of high inflation.

[9] To exploit the largest information set from HFCS, we average over the values of all five implicates provided for each household.

$$Positive\ Tail\ Risk_{i,v} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{P95(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

We exclude from our analysis households that do not have any investment in the three asset classes we consider. Moreover, given that our goal is to investigate investment diversification, we focus only on households that report holding at least two of the three instrument types. While financial participation from the survey is generally high, most of the households either have all their savings in bank accounts or they invest in only one of the three assets we are considering for our exercise. On average in the euro area, 10.2%, 3.2%, and 8.6% of households holds mutual funds, bonds, and shares respectively (ECB, 2020). These holdings account for an average of around 5% of the aggregate household net wealth and are mostly owned by wealthier households. Therefore, our sample includes a restricted number of households only (5,266 households) and we focus on countries with at least 50 households, i.e., Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, Netherlands, Portugal.[10]

Before using the augmented dataset for our empirical analysis, we provide a visualisation of the dataset. We generate Cumulative Distribution Functions (CDFs), to highlight how valuation rates and the risk associated with them evolve alongside the household distribution.[11] The CDF provides the share of households (probability) for which the variable of interest, i.e., the valuation rate or the risk measure, is less than or equal to a certain value x (on the x-axis). Graph 4 shows the cumulative distributions of total valuation effects and risk across households for our sample of euro area countries. The distribution of valuation rates is somewhat convex, while risk evolves in a concave form across households. The shape of the valuation rate suggests positive skewness in the distribution of portfolio valuations and the steeper increase at the right side of the CDFs suggest a higher likelihood of observing valuation rates that are higher than the average. Instead, the CDFs of risk suggest a negative skewness in the distribution of realised risk of valuation rates. The slower increase at the end of the distribution of the CDFs reflects a higher likelihood of lower-risk outcomes.

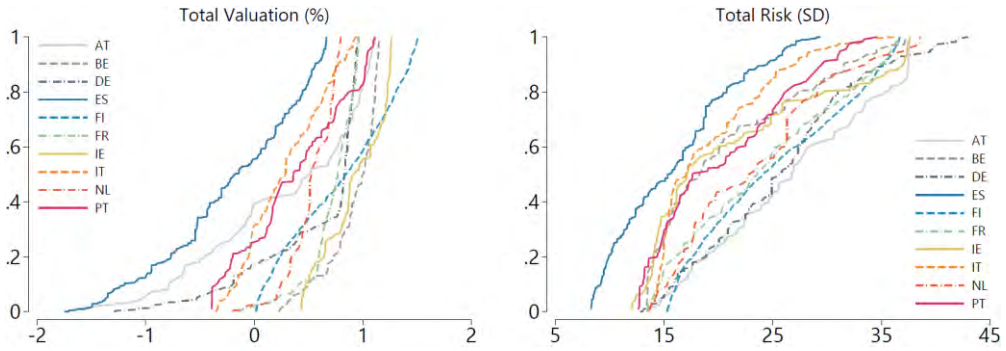
Visual comparison reveals substantial heterogeneity both *between* and *within* countries. Heterogeneity between countries is highlighted by the fact that countries have different return and risk profiles. Spanish households for example have the lowest return and risk. In contrast, countries like Ireland and Finland have the highest return and risk. Other countries show a mixed profile. Austrian households for example don't receive particularly high return but have the highest risk profile. Heterogeneity within countries can be assessed by the shape and the length of the CDF. For example, Spanish households' mean returns span from negative to positive on a range of 3 percentage points, while Irish households only show positive mean returns and the difference between the lowest and the highest household is within 1 percentage point.

[10] The household sample by country is as follows: Austria 75, Belgium 171, Germany 701, Spain 754, Finland 1782, France 1068, Ireland 239, Italy 281, Netherlands 92, Portugal 103.

[11] All statistics derived from HFCS data are weighted using household weights that are representative of the country's population.

Cumulative distributions of total valuation (left) and risk (right)[1]

Percent (left), Standard Deviation (right) Graph 4



[1] Cumulative share of households on the y-axis.

Sources: SHS, HFCS, and authors' calculations.

4. Empirical analysis: the role of education

In this Section, we provide two empirical exercises that showcase how the augmented dataset constructed as above can be implemented for both non-parametric and parametric empirical analysis to assess how portfolio performances are related to household characteristics.

More specifically, our empirical applications focus on one of the main determinants of household investments, i.e., their education level. However, HFCS provides a wide range of household demographics, which makes this approach straightforward to implement on several other dimensions, e.g., labour status, age, housing tenure status, wealth, income, gender, and so on. As a starting point, we focus on education because it allows us to explore the connection between financial literacy and investment decisions.

We split our sample between households with high and low levels of education, exploiting the education level of the reference person in the household. The reference person in HFCS is designated as the most financially knowledgeable person within the responding household. *Low education* is defined as no education/early childhood, primary, lower secondary, upper secondary, or post-secondary non-tertiary education, while *high education* includes short-cycle tertiary education, Bachelor, Master, or Doctoral. While the goal of this paper is to illustrate what can be done with these augmented data taking education as an example, we acknowledge that education might be correlated with other factors which in turn are associated with portfolio performance.

4.1 A non-parametric analysis through conditional CDFs

The first application of our dataset is to produce cumulative distribution functions conditional on the education level. We take Ireland as an illustrative example and then compare results with a panel of euro area countries. According to the latest data from the Eurobarometer, Ireland demonstrates a relatively high level of financial literacy compared to the EU27 average.[12]

We comment on the results on two dimensions, i.e., return and risk. In each case, we will use the properties of the CDF to explain our results. When comparing two CDFs that are strictly increasing and differentiable, one (F) is said to *first-order* stochastically dominate the other one (G) if, *for any outcome* x, F returns a probability of receiving x which is at least as high as the one given by G ($P[F \geq x] > P[G \geq x]$). Graphically, this would be highlighted by a CDF being lower or equal to the other for all possible outcomes. We opted to start with a non-parametric approach to present findings from the augmented dataset because this enables us to convey results that do not rely on a singular statistical measure, such as the mean or median household, but rather capture the entire distribution of outcomes. We believe that this approach helps in mitigating estimation uncertainty and bias more effectively than a narrow focus on a specific point within the distribution.

Graph 5 reports the CDFs of mean and median returns conditional on household education level being low or high.[13] A compelling narrative emerges. The CDF for households with high education levels *first-order* stochastically dominates the CDF for those with low education levels (top-left panel). This suggests that the likelihood of observing positive valuation rates is consistently higher for households with higher education. The message is consistent when looking at the two sub-components of the total return as well, with market prices showing the largest difference among the two groups (centre- and bottom-left panels). This evidence corroborates the intuition behind investment decisions. Remember that our exercise assumes that households invest in the same pool of securities (from SHS), but in different amounts (from HFCS). Thus, we can rationalise our finding suggesting that higher-educated households exhibit a greater ability to diversify their portfolios towards asset classes characterised by higher returns. For instance, on average, lower-educated households tend to allocate a larger share of their portfolios to debt securities (31% compared to 23% for high-educated households). In contrast, higher-educated households show a more substantial investment in quoted shares and IF&MMF shares (43% and 34%, respectively, for the high-education group, compared to 40% and 29% for the low-education group). This implies that, in the low education group, the total valuation return lean more towards debt, which typically has a lower rate (0.43%). Conversely, households in the high-education group benefit from higher returns attributed to investments in quoted shares and IF&MMF shares (0.88% and 1.26%, respectively). This evidence suggests that education levels are associated with portfolio

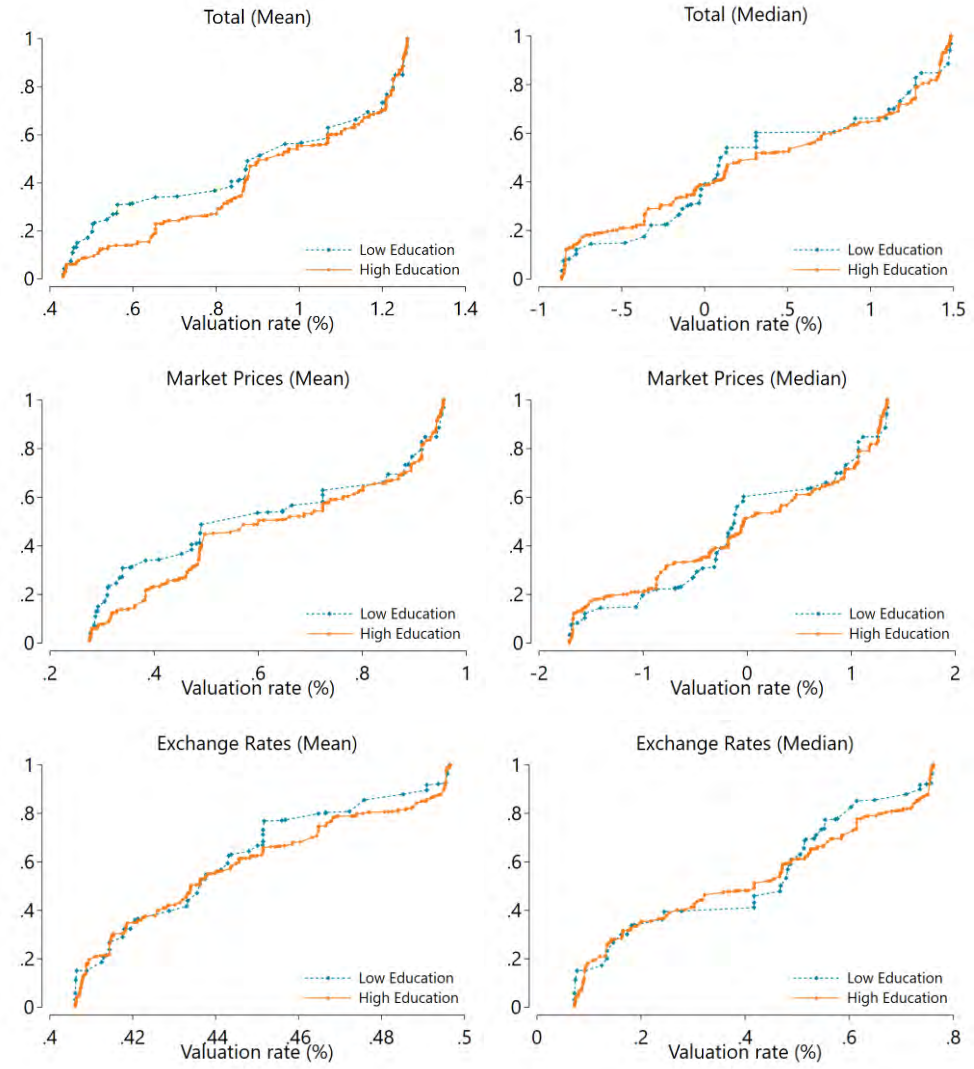
[12] A detailed report of the results from the Eurobarometer is available here.

[13] While the two groups are unbalanced, their means are not statistically different in terms of net total wealth, gross and net financial wealth — the focus of our analysis — and gender. Instead, their means are statistically different in terms of other household characteristics such as income, labour, and housing status. We assess mean differences using household-weighted adjusted Wald tests.

diversification, impacting the distribution and composition of returns across different asset classes.

Return, by valuation type[1]

Ireland, Cumulative Distribution Functions (CDFs) Graph 5



[1] Cumulative share of households on the y-axis. Education level of the reference person in the household. Low Education is defined as no education/early childhood, primary, lower secondary, upper secondary, or post-secondary non-tertiary education. High Education is defined as short-cycle tertiary education, Bachelor, Master, or Doctoral.

Sources: HFCS and authors' calculations.

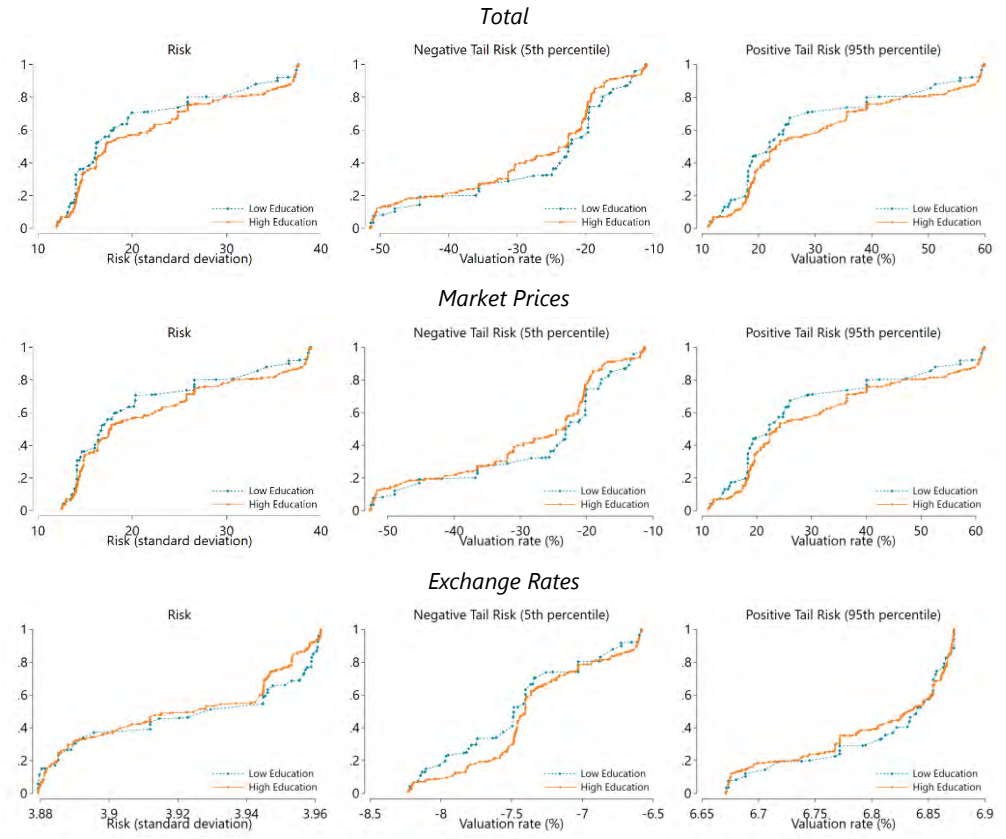
The CDFs of the *median* return complement the findings and rationales discussed above (right panels). Our data show that households with high education levels exhibit a lower probability of negative rates and a higher probability of positive *median* rates. Households with higher education levels tend to outperform those with

lower education when median returns are positive. Instead, lower-educated households have a higher likelihood of getting negative valuation rates.

Graph 6 visually depicts the dimension of risk, with each row in the panel offering insights into different risk metrics for various valuation types. The left side shows the distribution of risk in terms of standard deviation, offering a conventional understanding of risk. Meanwhile, the middle and right sides delve into negative and positive tail risks, respectively. While comprehending standard deviation is relatively straightforward, we aim to offer a more detailed interpretation of the other two risk metrics. The focus is on the cumulative distribution of the tails of returns, providing a detailed perspective on how households experience non-standard times. This emphasises the returns received during periods characterised by negative and positive outliers, shedding light on the broader spectrum of risk scenarios. The frequency of these scenarios can help us rationalise our findings.

Risk, by valuation type [1]

Ireland, Cumulative Distribution Functions (CDFs) Graph 6



[1] Cumulative share of households on the y-axis. See Graph 4 for a description of education groups.

Sources: HFCS and authors' calculations.

When examining total risk, three messages emerge. First, households with higher levels of education exhibit higher exposure to risk across the entire distribution (top-

left panel). This relates to the concept of risk tolerance. As education and financial literacy are correlated (Kaiser and Menkhoff, 2017), we can expect higher-educated households to display higher willingness and ability to embrace investment risk. Second, In the event of major negative shocks, higher-educated households are impacted more severely than lower-educated households (top-centre panel). Third, however, higher-educated households realise greater returns in situations of elevated positive risk (top-right panel).

Delving into sub-components, similar to what we had for returns, the magnitude of risk primarily stems from market price valuation rather than changes in exchange rates. Notably, in the context of high-low education comparisons, market price valuation exhibits similar behaviours to total valuation, while for exchange rate valuation the story of tail risks seems to be reversed. Higher-educated households experience larger losses in the face of negative tail risk but also realise greater gains when significant positive shocks occur. This might be explained by the fact that hedging exchange rates possibly requires less knowledge than hedging market prices or that exchange rates only explain a minor part of the variance in total valuation.

We chose to discuss the results for this non-parametric approach using Ireland as an illustrative example. Is Ireland an outlier? Or do euro area countries display a similar pattern? To bridge this first analysis with the following one, Graph 7 shows the CDFs for the euro area aggregate, using all the households and countries in our sample. The key messages are consistent with what we have discussed in the Irish examples. Compared to their lower-educated peer, higher-educated euro area households display greater returns and exhibit higher risk tolerance. Graphs A4 and A5 in Appendix, show the disaggregation into market prices and exchange rates.

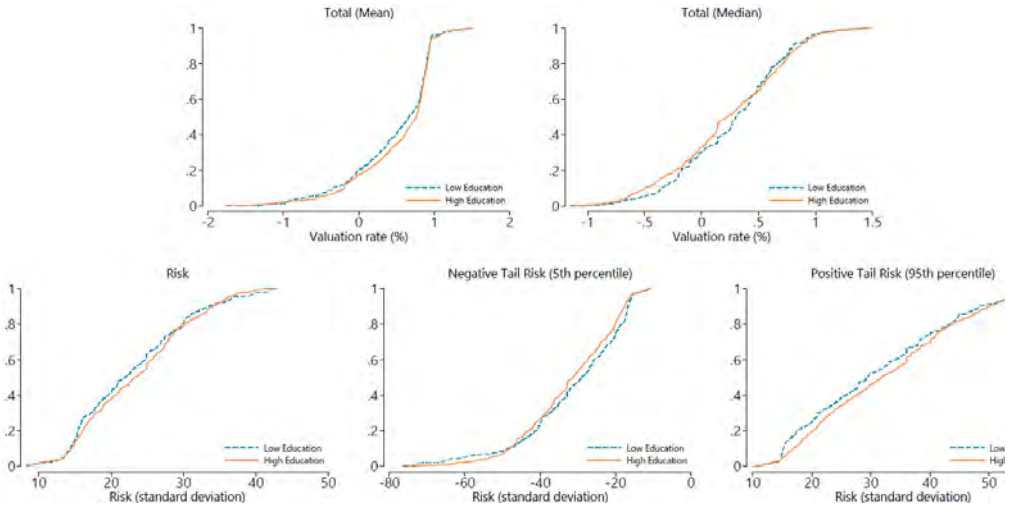
4.2 A parametric analysis through panel regressions

The empirical exercise discussed in the previous section allowed us to look at the link between education and portfolio return and risk from a non-parametric perspective, i.e., looking at the entirety of the distribution. While this methodology is different (and more powerful) than parametric approaches, it might not be the best approach when *jointly* studying the differences between the two groups for a panel of countries once additional conditioning factors are included. Thus, as a second exercise to generalise our analysis to euro area countries, we focus on point estimates as opposed to the overall distribution. As previously discussed, the sample includes 10 euro area countries: Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, Netherlands, and Portugal. As for the data, we use the same data methodology as implemented above when explaining the SHS-HFCS merge. The only difference here is that, alongside the country and household dimension, we exploit the time dimension as well. This means that return and risk measures are computed at the quarterly frequency, using SHS summary statistics computed each quarter and HFCS data for wave 3, which remains constant over time. Therefore, our panel is defined by 10 countries, 5,266 households, and 16 quarters (2019Q1-2022Q4). The model we estimate using OLS is defined by the following equation:

$$Return_{c,i,t} = \alpha + \beta Education_{c,i,t} + \gamma X_{c,t} + \delta_c + \theta_i + \eta_t + \varepsilon_{c,i,t}$$

Total return (top panel) and risk (bottom panel)[1]

Euro area, Cumulative Distribution Functions (CDFs) Graph 7



[1] Cumulative share of households on the y-axis. Countries included are Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, Netherlands, Portugal. Education level of the reference person in the household. See Graph 4 for a description of education groups. We use country-level household weights as representative of the euro area aggregate.

Sources: HFCS and authors' calculations.

$Return_{c,i,t}$ is the return measure computed using the augmented dataset methodology, for each valuation type (total, market prices, exchange rate), for household i of country c in quarter t. *Education* is the level of education of the household's reference person as described in the previous section (1=high education, 0=low education). X is a set of macro-financial controls at the country level.[14]

We have two sets of controls. The first group captures the dynamics of local financial systems. This includes the quarterly growth rate of domestic market capitalisation, credit to the household sector as a percentage of GDP, and households' deposits to GDP. The second set accounts for macroeconomic condition and features the Nominal Effective Exchange Rate (NEER), 10-year government bond yields, quarterly GDP growth, and the inflation rate.[15] Time fixed effects account for global factors that change over time but are common to the country sample. See Table A1 in Appendix for details on data sources and descriptions.

[14] For this specification, we only report results for return and not for risk because the latter is a second-moment measure, requiring the use of standard deviation controls. This prevents us from exploiting the time dimension as we do for return, making comparisons difficult and reducing the number of observations significantly in the regressions themselves. In future versions of this paper, we plan to extend the analysis to risk as well in a complementary manner.

[15] Rather than the NEER, it would be ideal to use debt weighted exchange rate indices for our context. However, these are not available for our period of interest. Thus, we proxy them with the NEER. However, we plan to construct our own measure of currency-weighted exchange rates using SHS data.

We include country, household, and quarter fixed effects ($\delta_c, \theta_i, \eta_t$). Standard errors are clustered at the country-household pair level.

Table 1 reports the coefficient estimates, for each valuation type. Education is strongly associated with higher returns. This complements the findings from the previous Section and generalises them to euro area countries. While the previous result was about the entire distribution, the coefficient here is the point estimate of the average effect. Households with tertiary education benefit from a total return that is 34% higher compared to households without tertiary education (column 1). Confirming descriptive evidence from the previous sections, total valuations mainly arise from market price valuation as no significant effect of education appears when looking at valuation due to exchange rates (columns 2 and 3).

Regression results[1]

Dependent variable: Return (percent) Table 1

	(1) *Total*	*(2)* *Market Prices*	*(3)* *Exchange Rates*
Education	0.343**	0.314**	-0.001
	(0.147)	(0.138)	(0.010)
Market Cap	0.019***	0.014***	0.008***
	(0.005)	(0.005)	(0.001)
Credit	-0.016***	-0.013***	-0.005***
	(0.005)	(0.005)	(0.001)
Deposits	-0.041***	-0.048***	-0.003***
	(0.004)	(0.004)	(0.000)
NEER	0.583***	0.675***	0.159***
	(0.069)	(0.077)	(0.009)
Gov bond yield	0.011	-0.095	0.055***
	(0.073)	(0.075)	(0.010)
Inflation	0.121***	0.188***	-0.028***
	(0.031)	(0.033)	(0.005)
GDP growth	-0.044***	-0.056***	-0.012***
	(0.011)	(0.011)	(0.001)
Observations	84,256	84,256	84,256
R^2	0.924	0.932	0.983
Country FE	YES	YES	YES
Household FE	YES	YES	YES
Quarter FE	YES	YES	YES

[1] Clustered standard errors in parenthesis. * p<0.1, ** p<0.05, *** p<0.01.

Market capitalisation is positively associated with returns that household receive in their (mostly) cross-border positions, in line with the fact that stock markets comove across countries. The coefficient for credit suggests that the more developed the domestic financial system, the more households are incentivised to invest locally. Given that our valuation sample from SHS has a large component of cross-border investments, this explains why credit is negatively associated with returns. A similar interpretation applies to deposits, for higher levels of household deposits one would expect less that less money is available for investments.

We also find that an appreciation of the NEER is positively associated with total returns. Given that the majority of holdings in SHS for our sample of valuations are cross-border, this is due to the fact that these investments would be issued in foreign currency and then converted into euro. Thus, when the domestic currency appreciates, we households will experience an increase in the performance of their portfolio. Although not significant, the higher the yield on government bonds the higher the return. This follows from the fact that debt securities are themselves part of the portfolio and this indicates that they contribute positively to the performance of the entire portfolio. Higher prices (inflation) increase the total and market-based returns but reduce the exchange rates based one.

To summarise, the parametric approach showed a robust association between education and portfolio returns. This result is confirmed by the non-parametric specification as well, showing robustness to the addition of country-specific conditioning factors. The two approaches also deliver the same finding that these differences emerge in market-based valuations rather than exchange rates based ones. As we mentioned above, exchange rate returns are generally harder to predict than market price ones, independently of the education levels. Moreover, most of the variation in total returns comes from the component arising from market price changes.

5. Conclusion

In this paper we contribute to the literature on households and international finance by building a dataset obtained by combining the Security Holding Statistics (SHS) with Household Finance and Consumption Survey (HFCS) data. This comprehensive dataset allows us to better understand the links between households and international finance and their implications for financial stability.

First, focusing on the role of education as a conditioning factor for Irish households, our study reveals that households with higher levels of education exhibit a distinct investment behaviour that significantly impacts their portfolios. More educated Irish households not only display a greater likelihood of positive returns but also a higher risk tolerance. This underlines the pivotal role of education (and potentially financial literacy) in shaping investment strategies and risk management among households.

Beyond its immediate implications for understanding households' financial decisions in Ireland, our research carries broader significance. Could similar patterns be observed in other European countries? As such, we extend our analysis to a panel of euro area countries, and we find that these results can be generalised.

Overall, this preliminary analysis encourages further exploration of the conditioning factors beyond education, such as employment status, age, gender, income, and wealth, in the context of household finance. While this work could be the basis for valuable academic contributions, it could also be used as an input for policymakers. Understanding household finances is relevant, considering its implications for various economic behaviours such as consumption, labour supply, macro-financial linkages, and more. Therefore, the insights derived from our unique dataset can serve as a valuable resource for policymakers seeking to assess the implications of households' decisions and enhance financial stability. For example, informed policy decisions that mitigate household exposure to risk and promote responsible financial behaviour are well within reach.

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Appendix

Data description and sources: macro controls

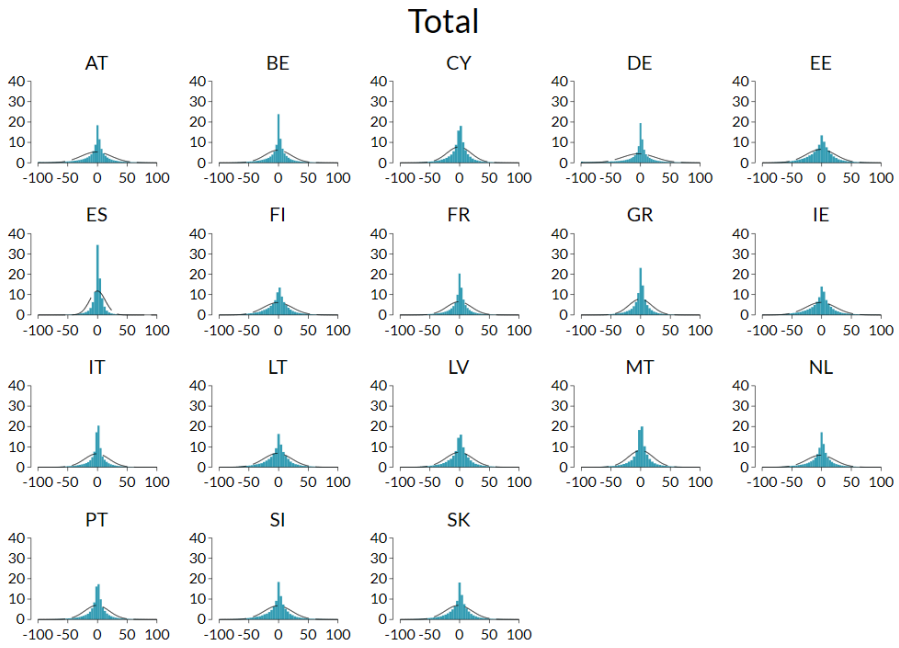
Table A1

- *Market capitalisation*. Total capitalisation of the domestic market index, end of the period, Euro. Quarter on quarter growth rate.
  - Source: Bloomberg.
- *Credit to GDP*. Total credit to households and non-profit institutions serving households, adjusted for breaks, end of the period, Euro.
  - Source: BIS (via FRED).
- *Deposits to GDP*. Stock of deposits held in bank accounts by households, Euro.
  - Source: ECB.
- *NEER*. Broad nominal effective exchange rate (2020=100).
  - Source: BIS (via FRED).
- *10-year government yields*. Long term yields on government bonds.
  - Source: Refinitiv Datastream.
- *Inflation*. Year on year growth rate of CPI index.
  - Source: OECD.
- *GDP growth*. Real GDP (2010 chained Euro), seasonally adjusted. Quarter on quarter growth rate.
  - Source: Eurostat (via FRED).

Distribution of total valuation rates from SHS (%)[1]

2019Q4-2022Q4, percent

Graph A1



[1] Percent on the y-axis, valuation rates in percent on the x-axis. Quarter-on-quarter valuation rates computed over the period 2019Q4-2022Q4 using all securities. The black dashed line is a standard normal distribution.

Sources: SHS and authors' calculations.

Distribution of market prices valuation rates from SHS (%)[1]

2019Q4-2022Q4, percent

Graph A2



[1] See Graph A1 for details and description.

Distribution of exchange rates valuation rates from SHS (%)[1]

2019Q4-2022Q4, percent

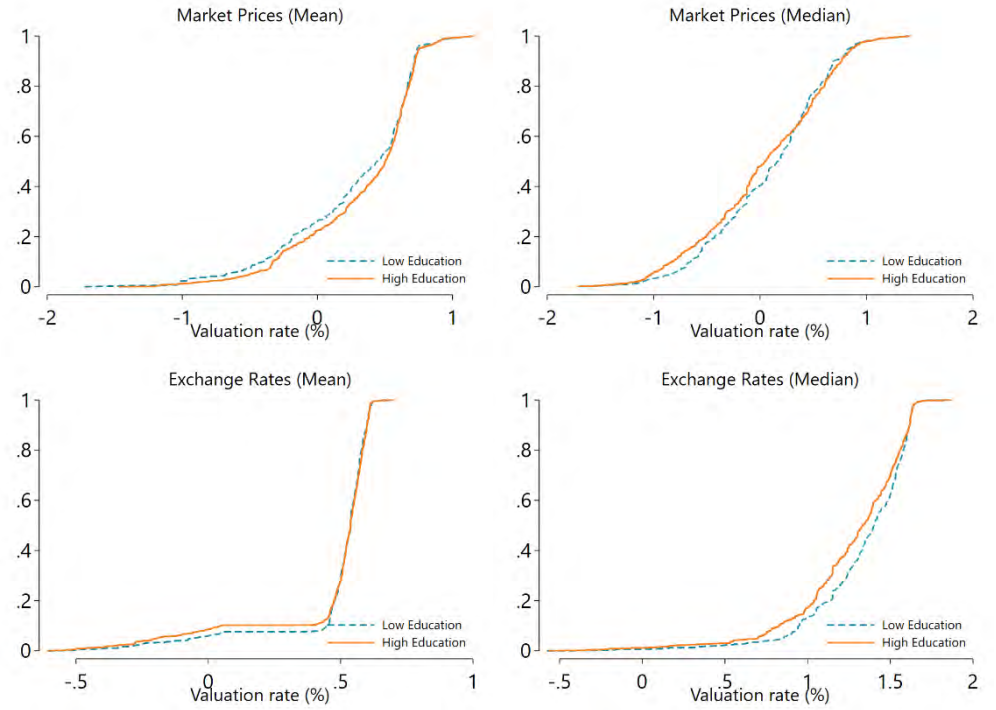
Graph A3



[1] See Graph A1 for details and description.

Return, market prices and exchange rates[1]

Euro area, Cumulative Distribution Functions (CDFs) Graph A4



[1] Cumulative share of households on the y-axis. Countries included are Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, Netherlands, Portugal. Education level of the reference person in the household. Low Education is defined as no education/early childhood, primary, lower secondary, upper secondary, or post-secondary non-tertiary education. High Education is defined as short-cycle tertiary education, Bachelor, Master, or Doctoral. We use country-level household weights as representative of the euro area aggregate.

Sources: HFCS and authors' calculations.

Risk, market prices and exchange rates[1]

Euro area, Cumulative Distribution Functions (CDFs) Graph A5



[1] Cumulative share of households on the y-axis. Countries included are Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, Netherlands, Portugal. Education level of the reference person in the household. Low Education is defined as no education/early childhood, primary, lower secondary, upper secondary, or post-secondary non-tertiary education. High Education is defined as short-cycle tertiary education, Bachelor, Master, or Doctoral. We use country-level household weights as representative of the euro area aggregate.

Sources: HFCS and authors' calculations.

BANCO DE ESPAÑA Eurosistema | Irving Fisher Committee on Central Bank Statistics | BIS | EUROPEAN CENTRAL BANK EUROSYSTEM

Household portfolios in the spotlight: what can augmented data tell us?

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BdE-IFC-ECB 'External statistics after the pandemic'
Banco de España 12th February 2024

The views expressed are those of the authors and do not necessarily reflect those of the Central Bank of Ireland or the Eurosystem. The data have been cleared by the Eurosystem for non-disclosure of confidential data.

Introduction

Motivation

- International financial integration varies across countries and over time.
  - However, most of the literature take an aggregate perspective.
  - Little is known about sectoral characteristics, in particular for the household sector.
    Giofré (2013); Roque and Cortez (2014); Galstyan et al. (2016); Galstyan and Velic (2018); Boermans and Vermeulen (2020)
  - How do households' portfolios differ? What explains these differences?

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  - How do households' portfolios differ? What explains these differences?

- Why relevant? Household finances are important in assessing the macroeconomy, as decisions taken by households affect aggregate outcomes.
  Muellbauer (1994); Kim et al. (2015); Deaton (2017); Mian and Sufi (2018); Lane (2019); Bach et al. (2020)
  - However, the role of households via their holdings of financial assets is less well understood, despite substantial holdings (20% of gross wealth, euro area).
    Santoso et al. (2009); ECB-HFCN (2023)

This paper

- We study the link between international financial integration and household sector heterogeneity, *between* and *within* countries.
- We provide a methodology to **combine** two key data sources:
  - Financial information on investments from the Security Holdings Statistics (SHS).
  - Household level data from Household Finance and Consumption Survey (HFCS).
- We use this **augmented dataset** to illustrate research and policy applications arising from the combined information.

Data

1. Security Holdings Statistics (SHS)

- Eurosystem database which collects security-by-security information for euro area countries by holding sector. We focus on the household sector.
- Two sources of information:
  - Securities Holdings Statistics by Sector (SHS-S): **holder** view.
  - Centralised Securities Database (CSDB): **issuer** view.
- Information:
  - Stock-flow-**valuation(prices & exchange rates)**, **asset type**, issuer, currency.
  - Market value (€). euro area + BG, CZ, DK, RO. 2013Q4 onward.
- Investment Funds & MMF shares (IFMMF), Debt Securities (D), Quoted Shares (QS).

Holder Area vs Reference Area

2. Household Finance and Consumption Survey (HFCS)

- Cross-sectional household-level Eurosystem survey.
- Information: wealth (real and **financial assets**, liabilities, credit constraints), income, consumption and saving, household characteristics.
- Mutual Funds (=IFMMF), Debt Securities (D), Quoted Shares (QS).
- Survey design:
  - Waves: 2009/10 (W1), 2013/14 (W2), **2017/18 (W3)**, 2020/21 (W4). Fieldwork (W3)
  - Ex-ante harmonised across euro area countries.
  - Population representative sample and probabilistic sample design.
  - Oversampling of wealthy households.

Augmented Dataset

Combining SHS and HFCS

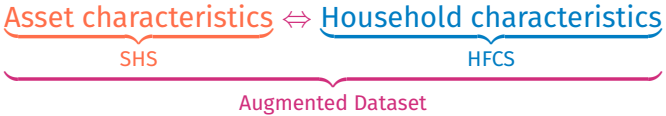
- In **SHS** we have detailed disaggregated information on **security holdings** at the sectoral level (household)
  … **but** no demographic information on who holds them.

Combining SHS and HFCS

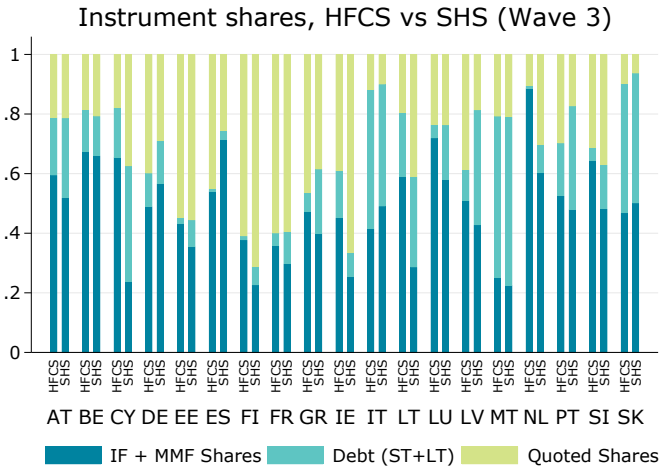
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Combining SHS and HFCS

- In **SHS** we have detailed disaggregated information on **security holdings** at the sectoral level (household)
  ... **but** no demographic information on who holds them.
- In **HFCS** we have detailed disaggregated information on **household characteristics**
  ... **but** no information on valuation and risk.
- The goal of the **augmented dataset** is to complement the missing information in a comparable manner for a panel of euro area countries



Rationale for merging: level differences, but shares are consistent



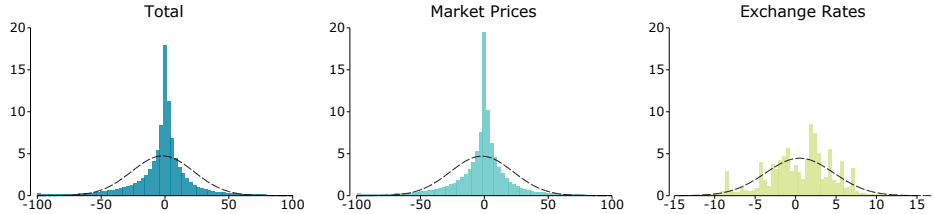
Notes: We match SHS with HFCS using the average of the quarters in which HFCS fieldwork was conducted in each country. *Source:* SHS, HFCS.

Step 1

- We compute quarter-on-quarter valuation rates at the security level using SHS data over the period 2019Q1-2022Q4:

$$Valuation\ Rate_{v,s,t} = \left(\frac{Valuation\ Amount_{v,s,t}}{Stock\ Amount_{v,s,t-1}} \right) \times 100$$

  - v is the valuation type: total, market prices, exchange rates.
  - s is the unique security as identified by the ISIN.
  - t is the quarter.



Step 2

- We compute summary statistics of valuation rates: Mean, P50, SD, P5, P95.
- Then, we merge these information with HFCS data (W3).
  - *Assumption: every household in a country invests in the same pool of securities* ***within*** *each asset class (equity, debt, IF shares).*
  - **Heterogeneity** arises from the portfolio allocations across instruments for each household (in HFCS).

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  - **Heterogeneity** arises from the portfolio allocations across instruments for each household (in HFCS).
- Sample:
  - We focus on households that holds *at least two* of the asset classes.
  - We consider countries with at least 50 households.
  - $\Rightarrow$ 10 countries, 5266 households.

Step 3: Return

- We compute household-level returns for each country as a weighted average of the SHS summary statistics using HFCS household-specific portfolio shares (w_i^c) as weights:

$$Return_{i,v} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{Mean(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

$$Return_{i,v}^{median} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{P50(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

Step 3: Risk

- Capacity of households to diversify risk on an **ongoing basis**:

$$Risk_{i,v} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{SD(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

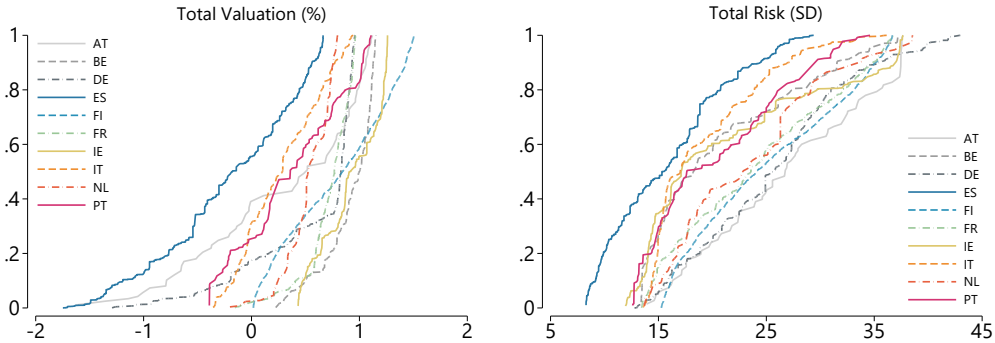
- **Tail risk** associated with big shocks (VaR):

$$Negative\ Tail\ Risk_{i,v} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{P5(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

$$Positive\ Tail\ Risk_{i,v} = \frac{1}{\sum_c w_i^c = 1} \sum_c \underbrace{w_i^c}_{HFCS} \underbrace{P95(Valuation\ Rate_{v,s,t}^c)}_{SHS}$$

Visualisation

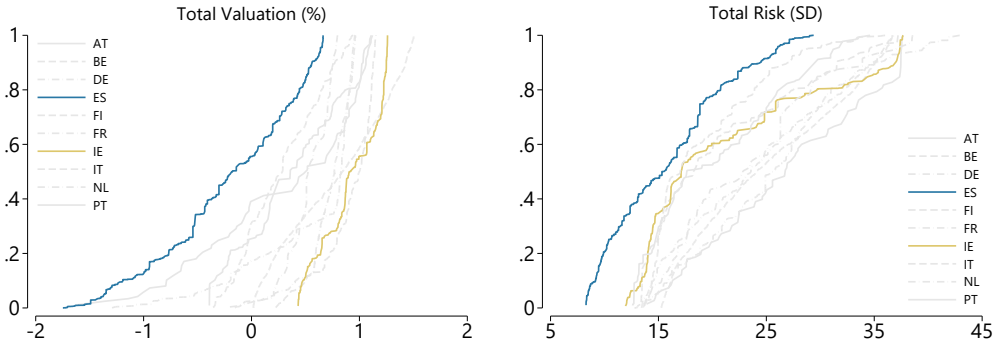
- **Cumulative Distribution Functions (CDF)**: how valuation rates and the risk associated with them compares *between* and *within* countries.



Notes: Cumulative share of households on the y-axis.

Visualisation

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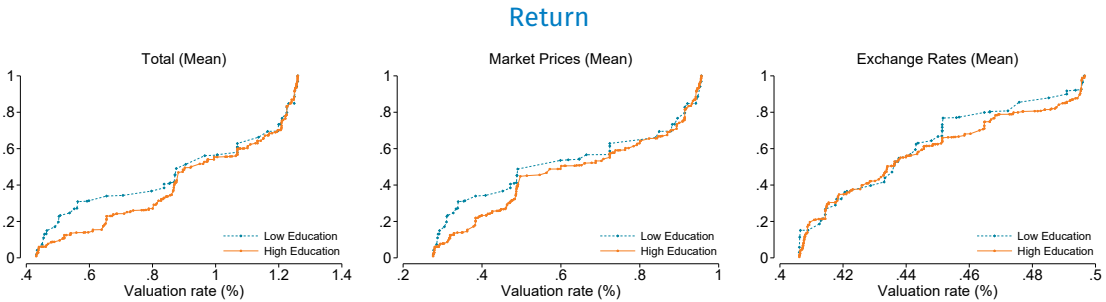
Applications

Why useful?

- The augmented dataset allows us to condition portfolio performances to **household characteristics** (of the reference person).
- We take **education** as an *illustrative example*, as it is a crucial dimension of portfolio choices (education $\rightarrow$ financial literacy $\rightarrow$ investment choices).
  Finke and Huston (2014)
  However, HFCS allows to extend to a wide range of dimensions, e.g., *labour status, age, housing tenure status, income.*
- **Low Education**: non-tertiary, **High Education**: tertiary.[1]
- We propose two **applications:**
  - 1. *Non-parametric*: conditional distributions (CDF) of returns/risk.
  - 2. *Parametric*: point estimates using regressions.

[1] Low: none/early, primary, secondary, post-secondary non-tertiary. High: short-cycle tertiary, Bachelor, Master, Doctoral

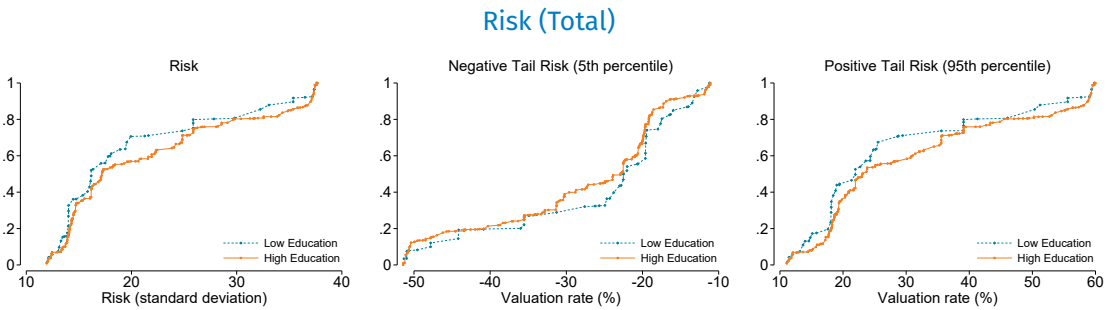
1. Conditional CDFs, Ireland – Return



Notes: Cumulative share of households on the y-axis.

- The message is consistent with *median* CDFs too. CDFs (Median)

1. Conditional CDFs, Ireland – Risk



Notes: Cumulative share of households on the y-axis.

- Similar for market prices, reversed for exchange rates. CDFs

1. Conditional CDFs, Ireland – Summary

- Robust link between high education levels and returns.
- This link is consistent for both market prices and exchange rates.
- More educated households exhibit higher risk tolerance.
- Is Ireland an outlier? CDFs - Euro Area

2. Panel regressions, euro area

- CDF methodology is more powerful than parametric approaches, *but* it might not be the best approach for a panel of countries and once considering additional conditioning factors.
- To generalise the analysis, we turn to point estimates.

2. Panel regressions, euro area

- CDF methodology is more powerful than parametric approaches, *but* it might not be the best approach for a panel of countries and once considering additional conditioning factors.
- To generalise the analysis, we turn to point estimates.

$$Return_{c,i,t} = \alpha + \beta Education_{c,i,t} + \gamma X_{c,t} + \delta_c + \theta_i + \eta_t + \epsilon_{c,i,t}$$

- c, i, t country, household identifier, and quarter.
- $Return_{c,i,t}$ is the **quarterly** return measure computed using the augmented dataset.
- $Education_{c,i,t}$ is a dummy: 1 = high education, 0 = low education.
- $X_{c,t}$ is a set of macroeconomics controls at the country level. Sources and decription
- 10 countries, 5266 household, 16 quarters (2019Q1-2022Q4)

2. Panel regressions, euro area

	(1)	(2)	(3)
Return:	Total	Market Prices	Exchange Rates
Education	0.314**	0.314**	-0.001
	(0.147)	(0.138)	(0.010)
Market Capitalisation	0.019***	0.014***	0.008***
	(0.005)	(0.005)	(0.001)
Credit to GDP	-0.016***	-0.013***	-0.005***
	(0.005)	(0.005)	(0.001)
Deposits to GDP	-0.041***	-0.048***	-0.003***
	(0.004)	(0.004)	(0.000)
NEER	0.583***	0.675***	0.159***
	(0.069)	(0.077)	(0.009)
10Y Government bond yield	0.011	-0.095	0.055***
	(0.073)	(0.075)	(0.010)
Inflation	0.121***	0.188***	-0.028***
	(0.031)	(0.033)	(0.005)
GDP growth	-0.044***	-0.056***	-0.012***
	(0.011)	(0.011)	(0.001)
Observations	84,256	84,256	84,256
R^2	0.924	0.932	0.983

Notes: Country, households, and quarter fixed effects. Clustered standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

- Results are in line with those of the non-parametric approach.
  - Strong link education–return.
  - Market prices driving total returns.
  - Exchange rates not significant (High and Low CDFs crossing each other).

Conclusion

Conclusion

- We contribute to the literature on **households and international finance** by building an augmented dataset obtained by combining SHS and HFCS data.
- This **comprehensive dataset** allows us to better understand the links between households and international finance and their implications for policy.
- As an illustrative example, using two different methodological applications, we find a **positive link** between household education and portfolio performance.
- Our analysis encourages **further exploration** of conditioning factors and serves as input for **academic** contributions and **policymaking**. E.g., mitigate household risk exposure and promote responsible financial behaviour.

Thank you!

Any feedback is gratefully appreciated.

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Appendix

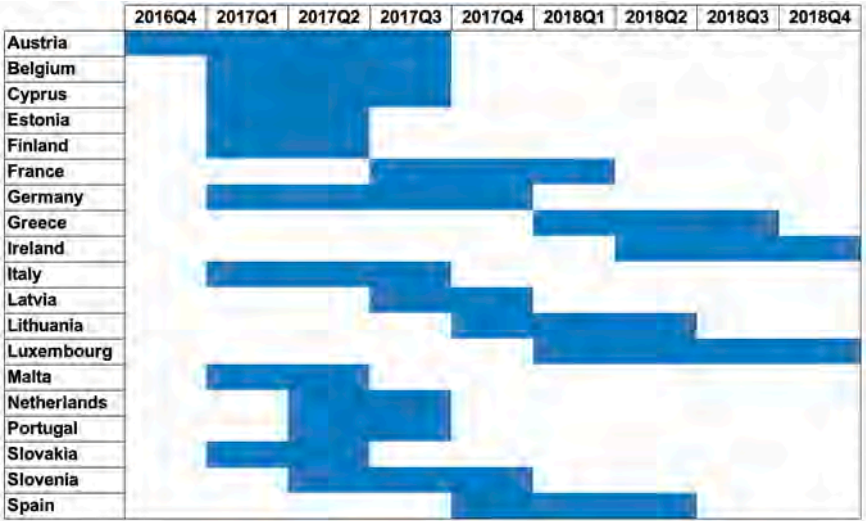
Holdings by currency of issue

Back

- Two concepts:
  - **Holder Area** = residency of the investor.
  - **Reporting Area** = country of the custodian.
- Example:
  - US assets (US issuer country) held by Irish Household sector via a German custodian.
  - $\rightarrow$ Holder Area is IE, Reference Area is DE, Issuer Area is US.
- For all sectors *except Households* - where double counting cannot occur.
- In our case, for the household sector, we include all information (i.e., both when Holder Area is equal and different than Reference Area)

HFCS fieldwork period (wave 3)

Back



	# Households
Austria	3,072
Belgium	2,329
Cyprus	1,303
Estonia	2,679
Finland	10,210
France	13,685
Germany	4,942
Greece	3,007
Ireland	4,793
Italy	7,420
Latvia	1,249
Lithuania	1,664
Luxembourg	1,616
Malta	1,004
Netherlands	2,556
Portugal	5,924
Slovakia	2,179
Slovenia	2,014
Spain	6,413
	78,059

SHS data cleaning

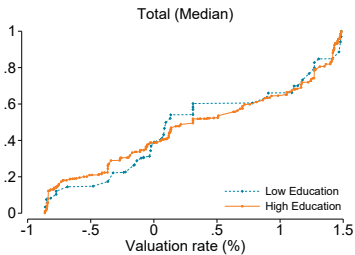
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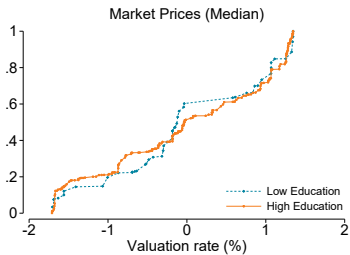
- Reference: Boermans et al. (2022) + tailored adjustments for our analysis.
- We *exclude* securities that fall in one or more of these categories: unknown type, short positions, missing stock amount, issued by tax heavens / ISIN related to a tax haven, unallocated/unknown issuer country, issued by institutions, issued by LU / LU as a reference area.[2]
- We *restrict* the time sample to 2019Q1-2022Q4 (following HFCS W3).
- When looking at each type of valuation, we only keep securities for which that type of valuation is *non-zero and non-missing*.
- To reduce the impact of sensitive outliers, we *remove* observations outside the 1-99 percentile range (computed on the entire sample of all countries).

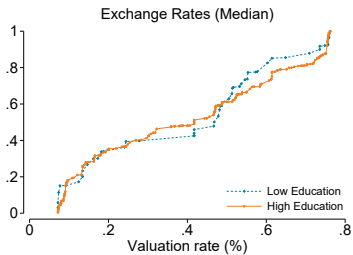
[2] Positions are defined as short when the stock amount is lower or equal to zero. Tax heavens are United States Virgin Islands, Curaçao, Cayman Islands, The Bahamas, Bermuda, British Virgin Islands, Isle of Man, Marshall Islands, Guernsey, Gibraltar, Jersey, Liechtenstein. Reference area is the nationality of the custodian the household used to invest.

1. Conditional CDFs, Ireland – Return

Back





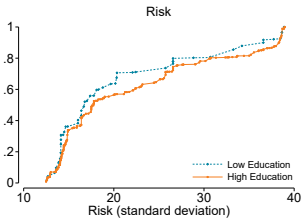


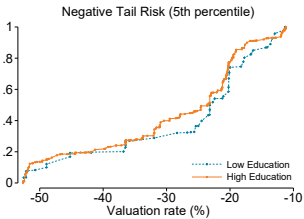
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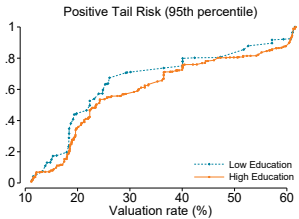
Conditional CDFs, Risk – Ireland

Back

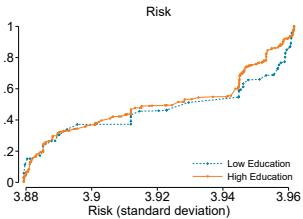
Market Prices

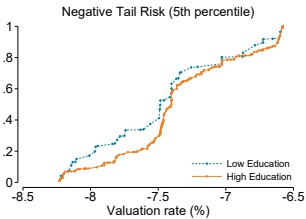


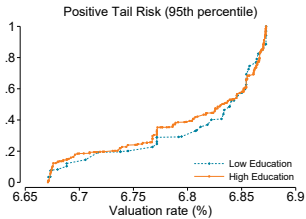




Exchange Rates

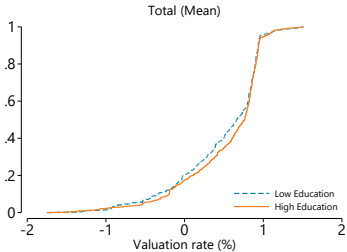


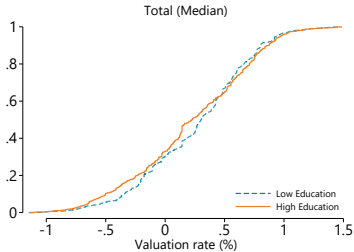


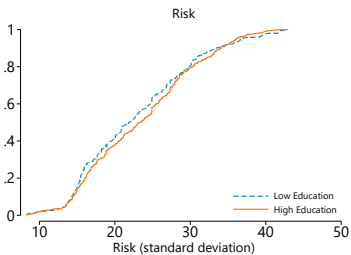


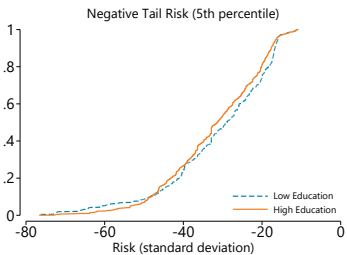
1. Conditional CDFs, euro area

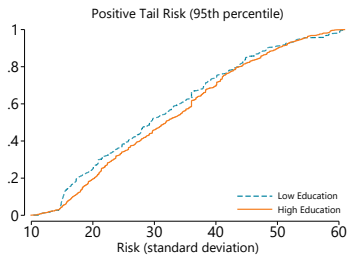
Back











Data sources

Back

- **Market capitalisation.** Total capitalisation of the domestic market index, end of the period, Euro. Quarter on quarter growth rate. *Source: Bloomberg.*
- **Credit to GDP.** Total credit to households and non-profit institutions serving households, adjusted for breaks, end of the period, Euro. *Source: BIS (via FRED).*
- **Deposits to GDP.** Stock of deposits held in bank accounts by households, Euro. *Source: ECB.*
- **NEER.** Broad nominal effective exchange rate (2020=100). *Source: BIS (via FRED).*
- **10-year government yields.** Long term yields on government bonds. *Source: Refinitiv Datastream.*
- **Inflation.** Year on year growth rate of CPI index. *Source: OECD.*
- **GDP growth.** Real GDP (2010 chained Euro), seasonally adjusted. Quarter on quarter growth rate. *Source: Eurostat (via FRED).*

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Are goods and services trade complementary? Evidence from a new micro dataset[1]

Flavia Ciccioli, Stefano Federico and Enrico Tosti,
Bank of Italy

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Are goods and services trade complementary?

Evidence from a new micro dataset

Flavia Ciccioli, Stefano Federico and Enrico Tosti
Bank of Italy

IFC, ECB, Banco de España External Statistics Conference
Madrid - February 12-13, 2024

Motivation

- Trade in goods and services have been usually considered separately (e.g. statistical collection, economic analysis, trade agreements)...
- ... but they are instead likely to be quite interconnected:
  - Output complementarities (bundling)
  - Input complementarities (e.g. services inputs used for exports of goods)
- We combine customs data on trade in goods and granular survey data on trade in services for a representative sample of Italian firms
- We investigate to what extent goods and services trade are complementary

Related literature

- Trade in goods and services
  - Ariu et al. 2020, Aquilante and Vendrell-Herrero 2021, Berlingieri et al. 2021 We report the first systematic evidence covering the last decade
- Trade in services
  - Breinlich and Criscuolo 2011, Kelle 2013, Federico and Tosti 2017, Moro and Tosti 2019, Tito 2019, Benz et al. 2020 We focus on the interconnection with trade in goods
- 'Servicification' in the manufacturing sector
  - Crozet and Milet 2017, Blanchard et al. 2017, Breinlich et al. 2018 We focus on the cross-border component of servicification

Data

- Trade in goods, by firm, partner country and 8-digit product
  - Universe of exporters/importers (except for sole proprietorships)
  - Source: Customs and Monopolies Agency
- Trade in commercial services, by firm, partner country and service category
  - Quarterly survey on a stratified sample of firms
  - Includes firms that do not export or import services
  - Source: Bank of Italy
- Balance sheet data
  - Universe of incorporated firms
  - Source: Cerved
- Ownership structure (Foreign ultimate owner, affiliates abroad)
  - Source: BvD Orbis

Sample

- Our sample covers roughly 2,800-3,300 firms each year between 2013 and 2021
- Mainly medium-large firms in manufacturing and services sectors
- The sample accounts for 37-42% of aggregate exports and imports of goods and services (excl. travel, transport and minor items) according to official statistics

% Coverage wrt to universe			
	Goods	Services	Goods & Services
Exports	36.2	45.4	36.9
Imports	41.9	38.9	41.6

Empirical analysis

- Which **firms** are more likely to export goods and services ('bi-exporting' or 'bundling')?
- For which **products**?
- To which **destinations**?
- Has bundling increased over **time**?
- Does trade in services **boost** exports of goods?

Bi-exporting: Firms

	Number of firms	Exports G&S	Exports G	Exports S
Bi-exporters	32.3	66.8	64.6	85.8
Only goods exp.	33.4	31.8	35.4	0.0
Only services exp.	9.7	1.5	0.0	14.2
Non-exporters	24.6	0.0	0.0	0.0

- 32% of firms in our sample are 'bi-exporters' (i.e. export both goods *and* services in a given year), accounting for 67% of exports
- For manufacturing firms, provision of services is ancillary to exports of goods (average share of services on total exports: 13%)
- Compared to 'only goods exporters', bi-exporters:
  - Are larger and more productive
  - Have a more skilled labor force
  - Have less tangible capital per worker, more intangibles
  - Are more likely to be foreign-owned

Bi-exporting: Products

Product group	Service type	Bundleability
Motor vehicles	Other business services	.170
Other transport equipment	Maintenance and repair	.149
Electrical equipment	Other business services	.132
Machinery	Maintenance and repair	.126
Motor vehicles	Maintenance and repair	.119
Other transport equipment	Other business services	.119
Electrical equipment	Maintenance and repair	.115
Other manufacturing	Computer services	.109
Electrical equipment	Computer services	.107
Machinery	Other business services	.105

- Some products are more 'bundleable' (i.e. sold together with services) than others
- Agriculture and food products almost never bundled. Transport equipment and machinery products more likely to be bundled...
- ... especially with maintenance and repair, other business services and computer services

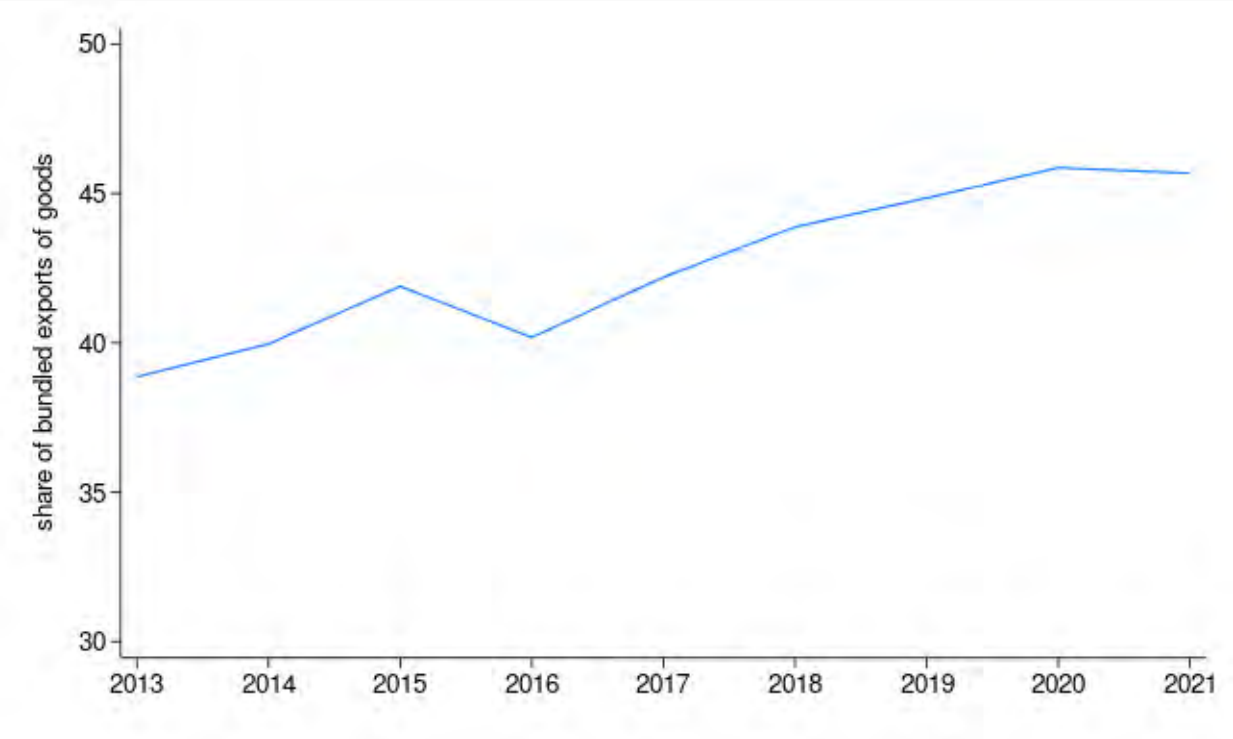
Bi-exporting: Destinations

	Bi-exporting (firm-country-year)
Population	0.044***
GDP per capita	0.053***
Distance	-0.050***
Parent	0.517***
Affiliates	0.187***
Firm-year FE	Yes
No. obs.	261,156

- Bi-exporters sell goods and services to only 20% of the countries that they serve (compared to 67% where they sell only goods)
- In these countries, median share of services is 5% (mean: 22%)
- Bi-exporting more frequent in larger, richer and less distant countries and countries where parent and affiliate companies are located

Bi-exporting: over time

- Bi-exporting has become more frequent over the last decade
- 46% of goods export flows are 'bundled' with services in 2021 (i.e. sold by firms that also sell services to the same country), up 7 pp since 2013 (balanced panel of 1,464 firms)



Does trade in service boost exports of goods?

- Regress exports of goods on dummies indicating whether a firm exports or imports services to each country

$$\ln Y_{ipct} = \beta_1 XServ_{ict} + \beta_2 MServ_{ict} + Z_{ict} + \alpha_{pct} + \alpha_{it} + \epsilon_{ipct} \quad (1)$$

	Value	Unit values	Volumes	Volumes per customer (EU only)	Number of customers (EU only)
Exports services	0.18***	-0.01	0.19***	0.28***	-0.03**
Imports services	0.19***	-0.01	0.19***	0.04**	0.16**
Parent	0.08***	-0.03*	0.11***	0.18***	0.03
Affiliates	0.18***	-0.04***	0.22***	0.22***	0.05***
Prod-ctry-year FE	Yes	Yes	Yes	Yes	Yes
Firm-year FE	Yes	Yes	Yes	Yes	Yes
Obs.	4,077,228	4,041,004	4,041,004	2,573,973	2,595,917

- Exports of services enable firms to sell larger volumes per customer
- Imports of services allow companies to reach a larger number of customers

Concluding remarks

- We build a new micro data set which allows to study the interconnection between trade in goods and services at a granular level (firms, products, destinations)
- We find evidence of significant complementarities between goods and services trade...
- ... that are growing over the last decade
- Trade in goods and services should not be looked at separately (by statisticians, economists and trade negotiators)

Thank you for your attention

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Goods and services: definitions

- System of National Accounts (SNA) 2008
- Goods:
  - 'Physical, produced items over which ownership rights can be established and whose economic ownership can be passed from one institutional unit to another by engaging in transactions'
- Services
  - 'Result of a production activity that changes the conditions of the consuming units, or facilitates the exchange of products or financial assets'
- Key distinction: in contrast to goods, services 'cannot generally be separated from their production'

Trade in goods and services: concepts

- Goods
  - Trade statistics concept, based on border crossing
  - Exports/imports: goods that leave/enter an economic territory
- Services
  - National accounts / Balance of payments concept, based on residence principle
  - Exports/imports: transactions between resident unit and non-resident unit
- Memo: Sales through foreign affiliates (e.g. GATS mode 3 for services) are not included

Methodological and statistical issues

- Transaction-level data available only for (intra-EU) goods, not available for services: we do not know whether both goods and services are sold to the same buyer
- Timing of services provision/purchase may differ with respect to timing of goods sale
- Thresholds differ between (intra and extra-EU) trade in goods and trade in services
- Customs valuation rules: might valuation of goods also include the value of services?
    - Provision of additional complementary services is regarded as a separate service export in the customs valuation process (WTO 2018)

Complementarities between goods and services?

- Yes
  - Demand complementarities (e.g. maintenance services on a product after purchase)
  - Services as input in production process for goods (e.g. advertising services)
- No
  - Adjustment costs from moving factors from goods to services or viceversa (trapped factors)
  - Product/service cannibalizations
  - Adapting services in response to provision in Restrictions to trade in goods

Service categories

EBOPS*	Description
SB	MAINTENANCE AND REPAIR
SC4	POSTAL AND COURIER
SG	FINANCIAL
SH	CHARGES FOR THE USE OF INTELLECTUAL PROPERTY
SI1	TELECOMMUNICATIONS
SI2	COMPUTER
SI3	NEWS AND INFORMATION
SJ1	R&D
SJ211, SJ212	LEGAL, ACCOUNTING, AUDITING, BOOKKEEPING AND TAX CONSULTING
SJ213	BUSINESS AND MANAGEMENT CONSULTING AND PUBLIC RELATIONS
SJ22	ADVERTISING, MARKET RESEARCH AND PUBLIC OPINION POLLING
SJ311, SJ312	ARCHITECTURAL AND ENGINEERING
SJ313, SJ321	SCIENTIFIC AND OTHER TECHNICAL
SJ33	OPERATING LEASING
SJ34	TRADE-RELATED
SJ35OBS	OTHER BUSINESS N.I.E.
SJ35SRE	BETWEEN RELATED ENTERPRISES NOT INCLUDED ELSEWHERE
SK, SL	PERSONAL, CULTURAL, AND RECREATIONAL SERVICES, GOVERNMENT

Further details on sample

- Sample covers medium-large firms...

Variables	Mean	p25	p50	p75
Employees (persons)	767	50	199	555
Sales (EUR mln)	381	53	135	297

- ... in both manufacturing and services sectors

Sector	% No. of firms	% Exp G	% Exp S	% Imp G	% Imp S
Manufacturing	42.2	86.7	43.2	56.5	40.6
Services	46.8	10.5	53.8	34.6	55.2
Construction	3.6	0.2	1.4	0.1	1.3
Others	7.4	2.6	1.5	8.8	2.9

Sample: firms with null services trade

Year	No. firms	of which: null trade
2013	2869	797
2014	2784	762
2015	2909	832
2016	2823	783
2017	2899	817
2018	2808	812
2019	3358	1256
2020	3317	1256
2021	3319	1244

Balanced sample

Year	No. firms	% Sample Exports G&S	% Sample Imports G&S
2013	1464	71.0	76.8
2014	1464	71.5	76.1
2015	1464	70.9	73.6
2016	1464	73.4	75.9
2017	1464	74.1	76.7
2018	1464	74.5	78.6
2019	1464	74.0	75.9
2020	1464	75.6	77.0
2021	1464	73.8	72.3

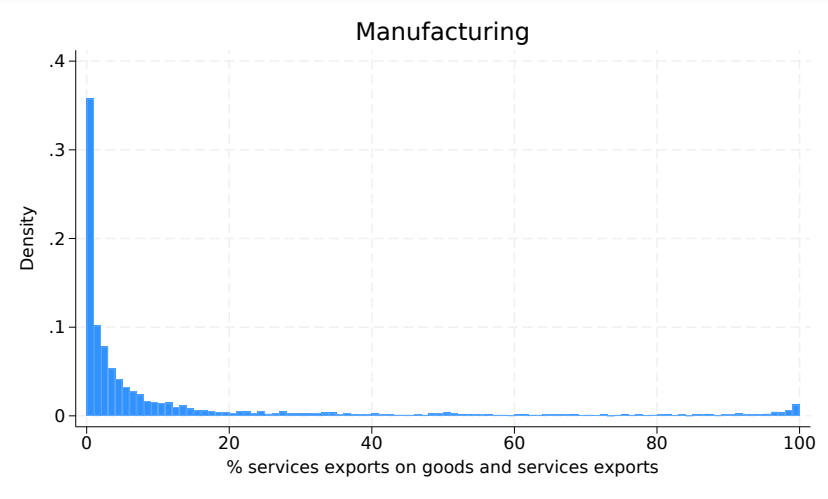
Firms (1)

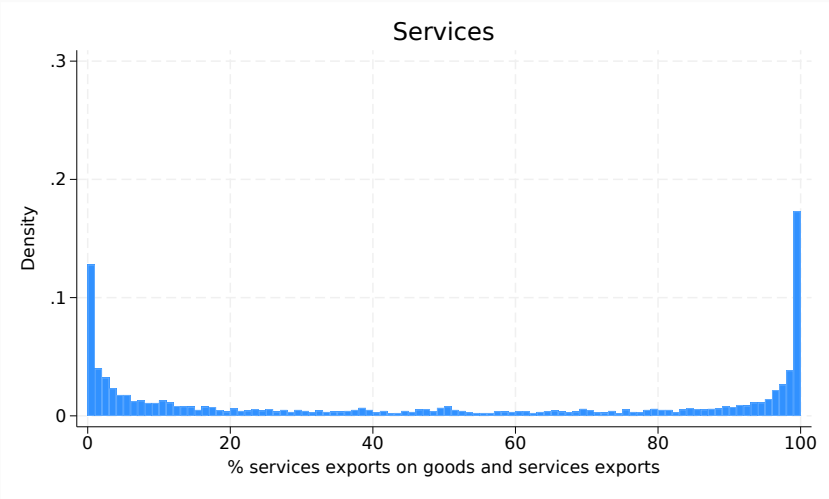
- Bi-exporters: Firms that export both goods *and* services in a given year
  - 32% of firms in our pooled sample...
  - ... accounting for 67% of exports
  - Bi-exporting less frequent than bi-importing (53% of firms) Bi-importers
  - Share of bi-exporters higher in manufacturing than in services (47% versus 29%)

	Number of firms	Exports G&S	Exports G	Exports S
Bi-exporters	32.3	66.8	64.6	85.8
Only goods exp.	33.4	31.8	35.4	0.0
Only services exp.	9.7	1.5	0.0	14.2
Non-exporters	24.6	0.0	0.0	0.0

Firms (2)

- We compute the share of services exports on exports of goods and services at the firm level for bi-exporters
- For manufacturing firms, services represent a minor share of exports (13% for average firm)...
- For services, services exports' share rises to 50%, but bimodal distribution (wholesale and retail trade to the left, business services to the right)





Firms (3)

- Which firms are more likely to be bi-exporters?
- Regress firm-level characteristics on trade status and industry-year FE
- Omitted category: 'only goods exporter' (non-exporters dropped from sample)
- Bi-exporters are larger, employ more skilled labor, have lower tangible capital intensity but more intangibles, more likely to be foreign-owned than 'only goods exporters'

	Empl	Sales	VA prod.	% White collars	Tang. K/L	% Intang.	Foreign
Only services	-0.01	-0.19***	-0.05**	0.08***	-0.71***	0.09***	0.09***
Bi-exporter	0.66***	0.53***	0.03**	0.09***	-0.16***	0.04***	0.22***
Ind-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. obs.	19,734	19,814	19,074	19,734	19,424	19,545	19,815

Bi-importers

- Bi-importers: Firms that import both goods *and* services in a given year
  - 53% of firms in our pooled sample...
  - ... accounting for 86% of imports
  - Bi-importing more frequent than bi-exporting (32% of firms)

	Number of firms	Imports G&S	Imports G	Imports S
Bi-importers	53.4	86.0	85.6	89.1
Only goods imp.	19.8	12.9	14.4	0.0
Only services imp.	11.5	1.1	0.0	10.9
Non-importers	15.3	0.0	0.0	0.0

Products (1)

- 'Bundleability' (Ariu et al. 2020): frequency of firm-product-country-year combinations with positive services exports
- Highest for transport equipment and machinery products, lowest for agriculture and food products

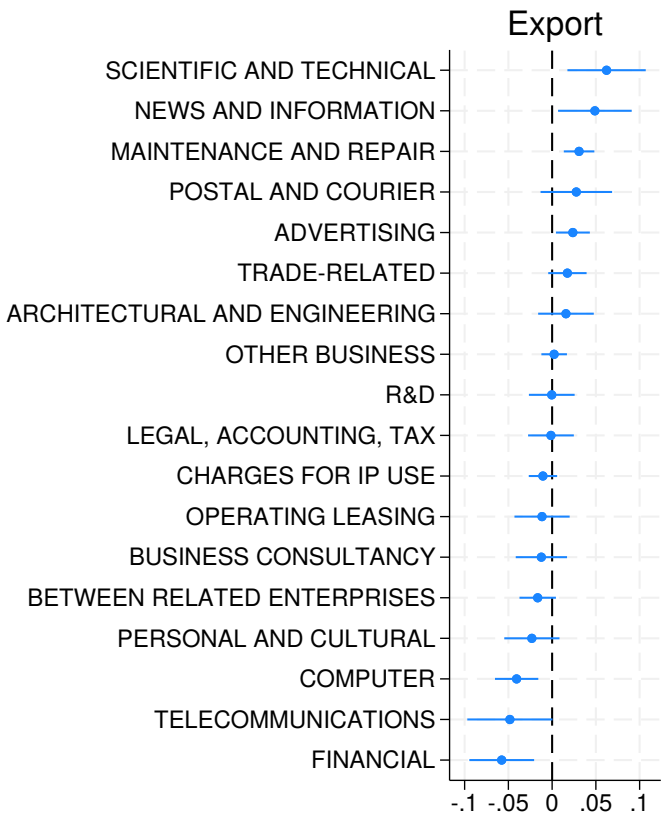
Product group	Bundleability
Motor vehicles	.376
Electrical equipment	.362
Other transport equipment	.344
Machinery	.332
Other manufacturing	.314
Plastics and rubber	.304
Leather	.291
Apparel	.283
Energy	.281
Metals	.276
Stone and Glass	.241
Chemicals	.232
Pharmaceuticals	.205
Textiles	.203
Food and beverage	.086
Agriculture	.075

Products (2)

- Going at a more granular level (6-digit product - service type pair), much starker differences in bundleability
- Highest values of bundling for machinery products (HS6: 84...) bundled with maintenance and repair services

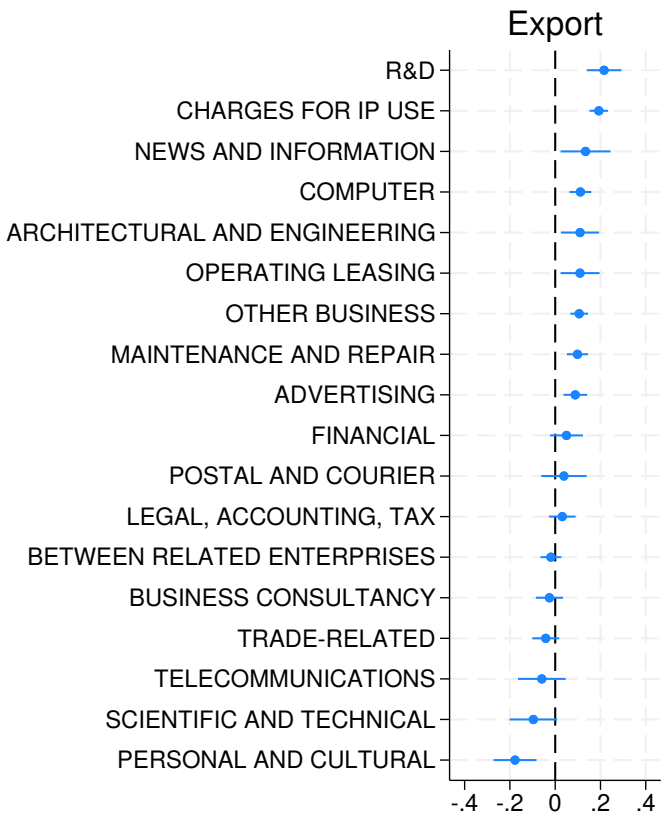
HS6	HS6 description	Service type	Bundleability
846595	Drilling or mortising machines	Maintenance and repair	.802
846490	Machine tools for working stones	Maintenance and repair	.724
845929	Drilling machines for working metal	Other business services	.718
848060	Moulds for mineral materials	Maintenance and repair	.691
848060	Moulds for mineral material	Financial services	.623
846594	Bending or assembling machines	Maintenance and repair	.619
846591	Sawing machines	Maintenance and repair	.611
400110	Natural rubber latex	Other business services	.606
846592	Planing, milling machines	Maintenance and repair	.605
846593	Grinding, sanding machines	Maintenance and repair	.598

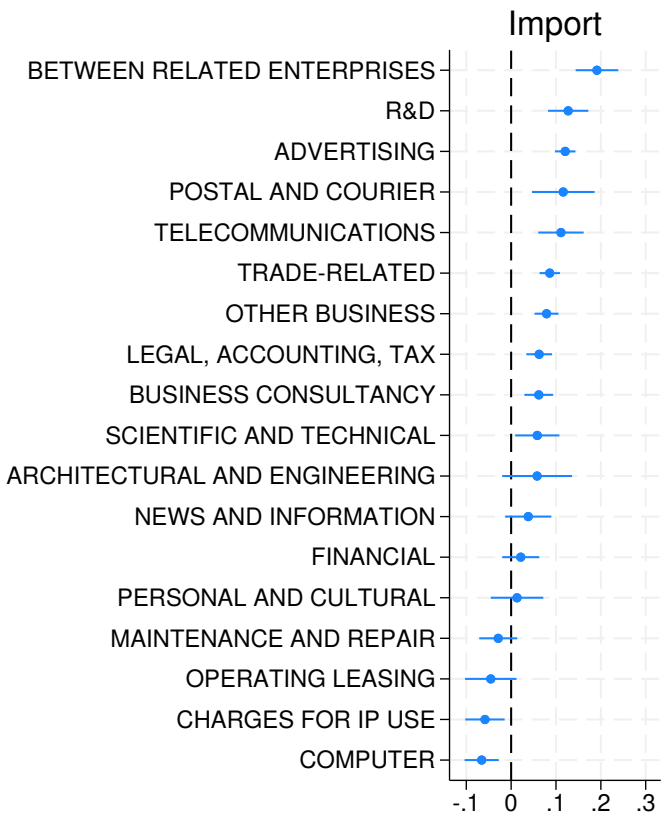
Unit values


Export
SCIENTIFIC AND TECHNICAL
NEWS AND INFORMATION
MAINTENANCE AND REPAIR
POSTAL AND COURIER
ADVERTISING
TRADE-RELATED
ARCHITECTURAL AND ENGINEERING
OTHER BUSINESS
R&D
LEGAL, ACCOUNTING, TAX
CHARGES FOR IP USE
OPERATING LEASING
BUSINESS CONSULTANCY
BETWEEN RELATED ENTERPRISES
PERSONAL AND CULTURAL
COMPUTER
TELECOMMUNICATIONS
FINANCIAL
-.1 -.05 0 .05 .1


Import
TELECOMMUNICATIONS
BUSINESS CONSULTANCY
BETWEEN RELATED ENTERPRISES
MAINTENANCE AND REPAIR
CHARGES FOR IP USE
SCIENTIFIC AND TECHNICAL
TRADE-RELATED
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NEWS AND INFORMATION
PERSONAL AND CULTURAL
POSTAL AND COURIER
ADVERTISING
R&D
OPERATING LEASING
FINANCIAL
ARCHITECTURAL AND ENGINEERING
-.1 -.05 0 .05 .1

Volumes


Export
R&D
CHARGES FOR IP USE
NEWS AND INFORMATION
COMPUTER
ARCHITECTURAL AND ENGINEERING
OPERATING LEASING
OTHER BUSINESS
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BETWEEN RELATED ENTERPRISES
BUSINESS CONSULTANCY
TRADE-RELATED
TELECOMMUNICATIONS
SCIENTIFIC AND TECHNICAL
PERSONAL AND CULTURAL
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Import
BETWEEN RELATED ENTERPRISES
R&D
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POSTAL AND COURIER
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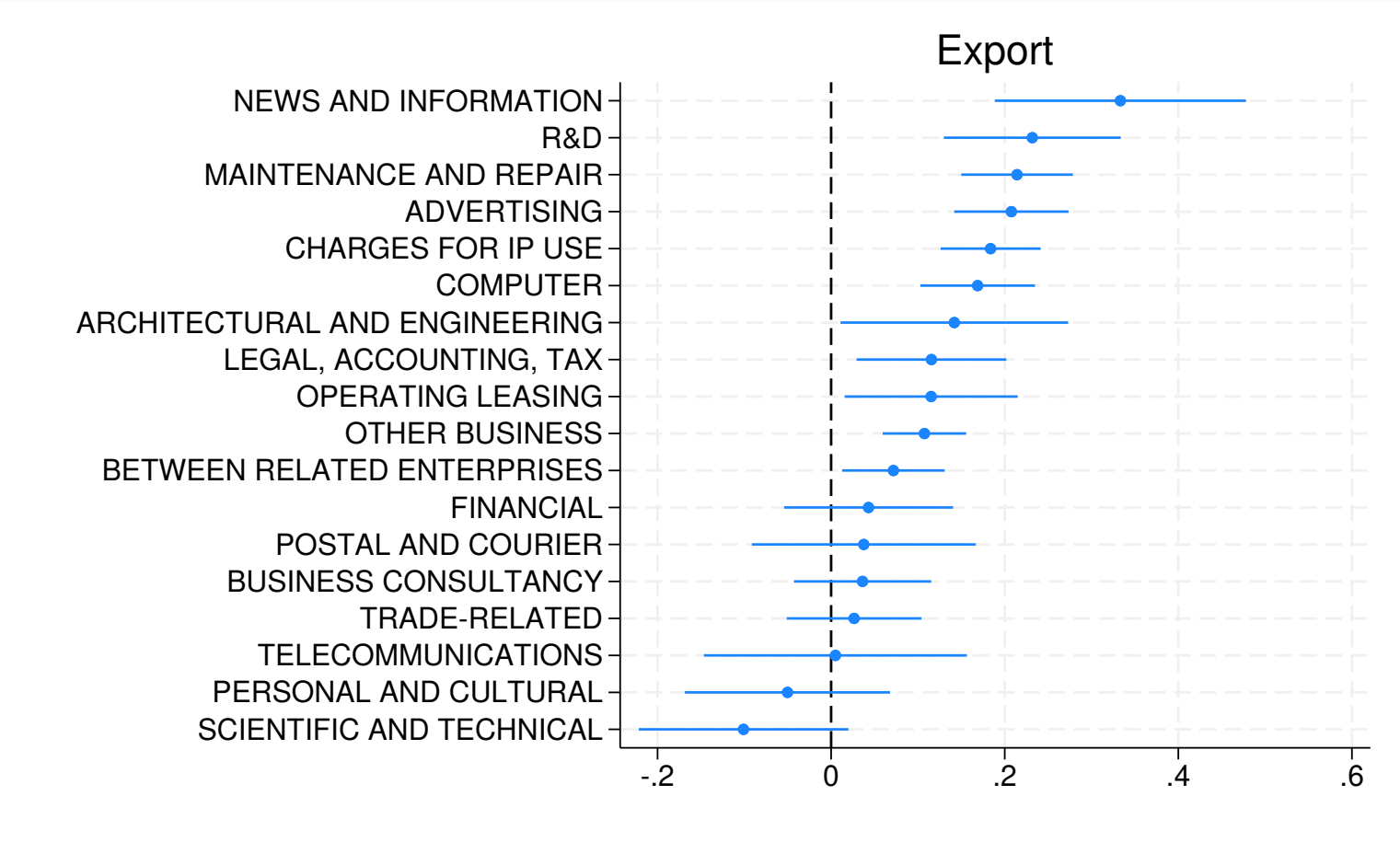
Number of customers

- Imports of services help firms reaching a larger number of customers for goods exports: esp. trade-related, intra-group, advertising, news, legal and accounting



Average volume per customer

- Exports of services help firms selling larger volumes per customer: esp. news, R&D, maintenance and repair



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International sourcing during Covid-19: how did Chilean firms fare?[1]

Jennifer Peña,
Central Bank of Chile;

Elvira Prades,
Bank of Spain

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

International Sourcing during COVID-19: How did Chilean firms fare? *

Jennifer Peña †
Central Bank of Chile

Elvira Prades ‡
Bank of Spain

August, 2023

Abstract

COVID-19 has proven to be a unique and complex shock for firms. In this paper we analyze the performance of individual Chilean firms during this episode drawing on administrative datasets. In particular we empirically characterize the international trade adjustment at the firm and product level. Importer firms, specially in the manufacturing sector, have adjusted their import flow through three margins along 2020/21. In 2020 imports declined as some firms either stopped their import activity, or they imported less product varieties (product and country of origin) or by reducing the intensity of imported varieties. In this period importers faced a short-lived increase in imported input costs. In 2021 imports rebound strongly. While exporter firms (excluding mining) kept their export activity as well as their selling price stable. We also explore if foreign factors such as the incidence of COVID-19 and containment measures in partner countries had an impact on Chilean trade during 2020. We find that these foreign factors had an impact on intermediate rather than consumption goods imports.

JEL Codes: D22, F10.

Keywords: COVID-19, lockdowns, firm-level trade, international sourcing, Chilean firms.

*We are very grateful for useful comments to CEMLA Joint Research Progamme participants, 2021 Virtual Intermediate Meetings on June and November, and also internal seminar participants, both in Bank of Spain and the Central Bank of Chile. We are also thankful for comments and suggestions from three anonymous referees. The views expressed are those of the authors and do not necessarily represent the views of the Banco de España nor the Central Bank of Chile or their board members. This study was developed within the scope of the research agenda conducted by the Central Bank of Chile (CBC) in economic and financial affairs of its competence. The CBC has access to anonymized information from various public and private entities, by virtue of collaboration agreements signed with these institutions. To secure the privacy of workers and firms, the CBC mandates that the development, extraction and publication of the results should not allow the identification, directly or indirectly, of natural or legal persons. Officials of the Central Bank of Chile processed the disaggregated data. All the analysis was implemented by the authors and did not involve nor compromise the Banco de España. The information contained in the databases of the Chilean IRS is of a tax nature originating in self-declarations of taxpayers presented to the Service; therefore, the veracity of the data is not the responsibility of the Service.

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1 Introduction

Since the start of the pandemic international trade has faced several challenges with different degrees of intensity during 2020 and 2021. The closure of production plants or ports from main global suppliers, with different degrees of intensity throughout this period; higher transport costs; longer delivery times; difficulties in finding key intermediate inputs led to some firms not being able to keep up with production targets. In a relatively short time span, firms have faced dramatic declines in demand, and from the production side, have faced labor shortages, the need to re-organize their tasks to keep up with health restrictions, and have dealt with supply disruptions in their input materials. In addition the shortage of finished/consumer goods lead to price pressures. Along 2021 production problems were coupled with a swift demand recovery–a product of relatively high rates of vaccination and its fairly good performance against variants.

By analyzing monthly and highly detailed firm-level micro trade data, we disentangle the channels through which the crisis initially affected aggregate international trade outcomes in Chile. From a policy point of view, it is interesting to analyze which trade margins were driving trade developments. As aggregate developments can hinder different margins through which firms are adjusting. This can be either by the number of trading firms, the number of traded products, the number of trade transactions or associated shipments (the so-called extensive margin), or by a collapse in the trading values of certain trading firms, products and transactions (that is, the intensive margin). By looking into this dissection we can anticipate the smoothness of reaching pre-crisis levels during the recovery for firms, as broken links might be more difficult to recover than a temporary decline in trade volumes and can lead to more severe scarring effects.

An additional open issue is whether and to what extent firms will pass-through the observed increases in input material costs or in transport freights to final prices. We also exploit firm-level variation in the usage of inputs. Firms have heterogeneous production functions, and their sourcing decisions expose them unevenly to foreign shocks. The simple idea is that firms/sectors that are more dependent on imported inputs, should also be more affected by supply chain disruptions stemming from the initial COVID-19 crisis.

We make use of three different firm-level administrative datasets. The first source is the form "F29" that contains firm-level monthly information used for tax purposes on sales revenues, expenditures, material purchases, etc. The second source we use is “Customs data" with information on imports and exports at a very narrowly defined products (at HS-8digit level), country of origin or destination, values, and quantities.[1]Finally, the third

[1]Form “F29" also provides information on purchases and sales abroad but without such detailed information. To cross-check the two sources we have kept the information from both sources and they show a high correspondence and correlation.

source is the Matched Employer-Employee dataset, where we obtain information on the number of employees in each firm, that will allow to estimate the firm labor productivity.

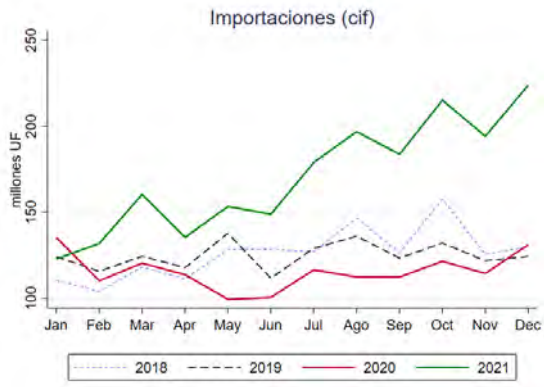
Among firms that trade abroad, the pandemic impacted differently to exporters and importers. In Figure 1 we show how trade flows have evolved from 2018 to 2021. In value terms, exports-excluding Mining- in 2020 and 2021 have performed relatively similarly to previous years. Notwithstanding, imports show a noticeably different pattern, showing a sharp decline in 2020 followed by a strong recovery in 2021[2]. While domestic factors might explain this sharp recovery, in the context of supply shortages it is of interest to exploit the granular data to understand the drivers and macroeconomic implications of this recovery.

Figure 1: Aggregate Trade

(a) Exports



(b) Imports



Notes: We plot traded volumes in each year in Panel (a) exports and in Panel (b) imports. While exports exhibit a similar pattern along 2020 and 2021, import behavior is radically different. There was a significant drop in Q2 2020. And there was a sharp recovery by the end of the year and along 2021. This information is based on the Customs dataset after applying the cleaning procedure detailed in Section 2. We exclude firms in the Mining and Public Administration sectors. Transactions in USD have been converted to CLP and deflated using a CPI inflation indexed unit of account called *Unidades de Fomento* calculated and published by the Central Bank of Chile (see https://si3.bcentral.cl/estadisticas/Principal1/metodologias/EC/IND_DIA/ficha_tecnica_UF_EN.pdf).
Sources: Chilean Customs and own calculations.

This work relates different strands of the literature. First, this paper is related to (the prolific) empirical literature on the impact of COVID-19 on international trade, the exposure to other countries like China and the consequences of supply disruptions: from a sectoral perspective (Cerdeiro & Komaromi (2022), Meier & Pinto (2020)), from a product-level perspective (Jaravel & Mejean (2021)) and with a focus on granular data on French firms (Brussevich, M. and Papageorgiou, C. and Wibaux, P. (2022) and Bricongne, J.C., Carluccio, J. , Fotagnè, L., Gaulier G. and Stumpner, S (2023)). Second, this paper is also related to the firm-level literature that explores firm-dynamics during

[2]For more details on trade developments see https://si3.bcentral.cl/estadisticas/Principal1/enlaces/Informes/AnuariosBDP/anuario_BDP_2021.html

COVID-19. In de Lucio et al. (2022), by combining Spanish firm-level monthly trade data with country-level COVID-19 containment measures over February-July 2020, they show that strict containment measures in a partner country increased the probability of a firm ceasing to trade with it. Negative effects were concentrated between March and May 2020, and the detrimental effect of containment on exports was larger for goods consumed outside the household; for wholesalers and retailers; and for manufacturers not participating in global value chains. A common finding is that the pandemic has negatively affected international trade flows, although the details of the results vary significantly across papers.

Our paper is also connected to the literature that focuses on the impact of cost shocks on prices. The pass-through of costs, such as tariffs changes, has been analyzed by Cavallo et al. (2021). They find that the degree of pass-through is higher at the border than at the retail level. Ganapati et al. (2020), Duprez & Magerman (2018) and Amiti et al. (2014) document how firms change their prices in response to cost shocks and other price changes and their relationship with buyers and suppliers in a production network. This paper is also linked to other articles that exploit Chilean granular data for the study of various topics such as the role of production networks in the propagation of foreign shocks (Huneeus (2018)), the estimation of the pass-through of exchange rate movements to domestic prices (Giuliano & Luttini (2020)), and the characterization of the adjustment of firms during the pandemic through different margins (Albagli et al. (2022)).

The contributions and distinctions between our work and the existing empirical studies are that (i) we use both COVID-19 cases and lockdown policies. In contrast, most existing papers focus either on one or the other. While COVID-19 cases are an intuitive proxy for the impact of the pandemic, it is well known that lockdowns are implemented as a reaction to the pandemic, often precisely when the number of cases is high or is expected to rise soon. Other studies such as König & Winkler (2021) work with deaths and lockdown measures. (ii) We focus on the sample of Chilean firms participating in international trade in goods, and (iii) with recent data (until 2021).

We compare the performance along 2017-2020, and 2021. The data reveals the following: at the beginning of the pandemic, exports were less affected than imports. However, since the end of 2020, imports showed dynamics that exceeded the performance shown at least during the study period. This recovery in imports has been broad based in terms of the type of goods: intermediate goods, consumption, capital, etc., perhaps influenced by the liquidity provided in Chile by the support programs created to face the pandemic. At the aggregate level, the intensive margin was reduced for both imports and exports during the onset of the pandemic. Within imports, firms in the distribution sector, which comprises wholesale firms, recovered their intensive margin faster than manufacturing

firms. It is also worth highlighting the increase displayed by distribution firms in their new products margin. This increase has been sharp and has been present across all good categories of goods.

The rest of the paper is organized as follows. In Section 2 we describe with more detail the data, the cleaning process and the variable definitions used for the analysis. In Section 3 we report the main stylized facts about trading firms. In particular, we characterize the behavior of trading firms according to the extensive and intensive margins of trade adjustment and according to their size and the economic sector in which they operated. In Section 4 we proxy the impact on costs that firms have faced by using unit values. In Section 5 we explain the empirical strategy to explore to what extent health conditions in partner countries have influenced trade developments and in Section 6 we present the results. Finally, in Section 7 we conclude.

2 Datasets

This section introduces the data, cleaning, and merging process used in the analysis. We make use of 2 different administrative datasets: (1) the Standard tax form F29 (*Declaración Mensual y Pago Simultáneo de Impuestos*) from "Servicios de Impuestos Internos" (SII) and (2) Customs declarations and which are described below. The datasets are merged by each firm's identifier and we compare them with official statistics to check that they are representative. Our monthly panel dataset compiles information on Chilean firms from 2017 to 2021 which allows us to compare the performance of the firms before and during the COVID-19 pandemic.

1. **VAT form - F29**.– The first source of information employed is the Firm Production Dataset with firm-level information used for tax purposes on total sales revenue, expenditures on intermediate goods, and investment in machinery and equipment. Chilean firms must submit their form F29 by law, therefore the dataset covers the universe of formal firms in Chile and has been available since the mid 2000s. The source is the F29 form collected by the Chilean tax authority (*Servicio de Impuestos Internos*, SII). The F29 form is presented on a monthly basis. The information contained there is of a tax nature coming from the self-declarations of contributors submitted to the SII, therefore the truthfulness of aforementioned data is not the responsibility of the SII.

2. **Customs data**.– The dataset provides information at the firm level on a monthly basis on the universe of international transactions, both exports and imports, at highly dis-aggregated levels in terms of country -as of its destination/origin- and in terms of products -at international HS8 nomenclature system-. The dataset pro-

vides information regarding the value of the transaction in USD (which is converted into CLP) and the quantity. We aggregate the data up from HS8 to HS6 (the 6-digit level). In the rest of the paper we use the terms "product" and "good" to refer to an HS6 category. We make use of Broad Economic Categories (BEC) classification which is a goods classification of foreign trade statistics. The classification correlates the goods to macroeconomic categories (capital goods, intermediates goods, and consumer goods). We are interested in the classification of goods as intermediate goods, industrial supplies, or capital good parts.[3]

We also make use of the **Employer-Employee Dataset** that contains firm-month level information on all formal labor contracts in Chile with detailed information on the contract (wage, start and end dates, etc.) and the ID of employees and firms. We use this dataset to keep in the sample those firms that active productive units and we exclude self-employment. The dataset has been available since 2005 and the source is the Superintendencia de Pensiones that is the Chilean pension regulator [4].

2.1 Merging and Cleaning Methodology

We merge the aforementioned data sets using unique tax IDs of firms that are common across sources. To secure the privacy of workers and firms, we observed anonymized micro datasets.

With the aim of removing outliers and remaining errors that are common in large-scale microdata sets, we apply a cleaning procedure based on previous work with similar datasets such as Kalemli-Ozcan et al. (2015) and Almunia et al. (2018) for the balance-sheet dataset and Bergounhon et al. (2018) for the Customs dataset. To clean the data, we proceed in two steps. In the first step, we remove firm observations that report employment, sales, imports or exports as either negative or above the maximum reported values by the firm with the most employees nationwide.

In the second step, we merge monthly information with annual observations in order to discard observations that imply extreme labor productivity by firms. So we replace turnover with a missing value for those firms with less than 50 employees and whose turnover/employees ratio is above the 99.5th percentile in the sample (i.e., small firms with unusually high labor productivity). Analogously, we replace employment with a missing value for those firms with more than 50 employees and whose turnover/employees ratio is below the 0.5th percentile in the sample (i.e. large firms that appear to have unusually low productivity). The rationale for these two criteria is that small firms with

[3]To convert HS to Broad Economic Categories (BEC) we use the concordance from World Integrated Trade Solution (WITS). WITS offers information about various product nomenclatures and help with mapping between various product nomenclatures.

[4]For more details on datasources and analysis on Chilean labor market see Albagli et al. (2023)

huge productivity ratios are suspicious of having undetected and misreported output units; also, large firms with excessively low productivity ratios are candidates for having misreported employment figures. In all of these cases, we replace the corresponding variable with a missing value, but the remaining firm variables are kept in the database.

2.2 Representativeness of the Dataset

After all the cleaning steps, we keep track of the representativeness of the microdata compared to the official data, allowing us to guarantee consistency in the conclusions obtained from the microdata. The benchmark data are the official statistics from the Central Bank of Chile (Balance of Payments) and Instituto Nacional de Estadísticas (Employment). The firm level data can replicate the growth rates of output, employment, wage bill and trade flows (see Appendix A). The merge with Customs data covers between 80% and 90% of imports and exports in the official data.

2.3 Variable Transformations

- **Exchange rates**.– Customs data are reported in USD, independently of the currency in which the transactions were made. We convert all the flows into CLP so as to compare them with the data from other sources used. As shown by Giuliano & Luttini (2019) on average, 90% of international transactions, by value, are denominated in USD and therefore the use of imported inputs and import intensities are affected by exchange rate movements. In regression analysis we control for exchange rates movements.
- **Deflators**.– All monetary variables have been deflated and are expressed in constant terms. To deflate the variables, we have used the *Unidades de Fomento (UF)*, whic is a unit of account indexed to inflation.[5]
- **Sectors**.– In the database, we have the International Standard Industrial Classification of all Economic Activities (ISIC) code for each firm. Through parity with the Economic Activity Code defined by EAC (CAE in Spanish) we obtain the economic sector which each firm belongs to. We focus the analysis on the productive sector of the economy without Mining. Thus, we exclude firms whose main sector of activity is related to Mining as well as Public Administration, as the number of firms within each category does not comply with the requirement of statistical secrecy as well as their specific characteristics of these activities that can bias the analysis.

[5]The *Unidades de Fomento (UF)* is a unit of account used in Chile that exchanges with the Chilean Peso which is constantly adjusted for Consumer Price Index developments so that the value of the Unidad de Fomento.

- **Firm size**.– Chilean firms are classified by size bins according to their annual firm turnover in real terms. They are considered a micro firm if turnover is below $<$ 2,400 UF, a small firm if turnover lies between 2,400 and 25,000 UF. They are categorized as medium sized firms when turnover lies between 25,000 and 100,000 UF. Finally they are considered large firms when turnover is above $>$ 100.000 UF. This classification is made according to what is currently established in the Statute of the Ministry of Economy of Chile (Law No. 20.416).

2.4 Sample Definitions

We work with several samples throughout the paper. First, we label the sample of firms after applying the basic cleaning steps as the *full sample*. Then we make use of the subset of firms that report sales each and every month which we label it *permanent sample*. This sub-sample avoids the issue of results driven by composition changes, although it may imply losing information.

In addition we break down the sample into *exporting* firms and *importers*. We also focus on the firms in sectors that account for the bulk of international trade firms in the *manufacturing* sector and those in the *distribution* sector. We use this distinction given the heterogeneous nature of the purpose of trading, mainly on the import side. While *manufacturing* firms import intermediate goods to be included in its processing activity, firms in the *distribution* sector import consumption goods or intermediates at the wholesale level.

Finally, the time sample used in each section varies according to the question. To characterize firms trade developments we use the data along 2017-2021 in sections 3 and 4. In section 5 we restrict the sample to 2019-2021 to capture the impact on trade growth during the period were COVID-19 started. All COVID-related variables are available only for the year 2020; for years before 2020, they are set to zero.

3 Stylized facts

In this section we will provide some stylized facts about Chilean firms. We document some facts about firms' international trade behavior in the data.

3.1 Data at a Glance

In Tables 1 and 2 we report the main characteristics of the firms used in the analysis. We use the *full sample* and the *permanent sample*, the latter of which only considers those firms that are reporting sales each and every month.[6]

- **Firm Heterogeneity**.– There is substantial heterogeneity between firms that import compared to those that are non-importers. In Table 1, we compare several statistics that are standard in the literature.[7] This heterogeneity is reflected in terms of size, as sales and number of employees are, on average, 33 and 8 times higher, respectively. Importers are more capital intensive and more likely to export; when they do, they do so in larger volumes. Importing firms register higher labor productivity, as measured by sales per worker. This ratio is, on average, around three times higher. Another aspect of heterogeneity is the number of products by destination/origin that exists depending on the sectors (see Table 2). It is worth highlighting the number of firms in "Wholesale and Retail Trade". In general, the stylized facts remain unchanged if we consider the permanent firms' sub-sample.
- **Imports and Exports**.– The bulk of the imported and exported volume is concentrated in the largest firms (see Figure E.9). The negative impact of the pandemic was not absorbed homogeneously. Small and medium-sized companies were in the hardest hit segment, both of which were in the proportion of firms that experienced a drop in international trade. This conclusion is obtained by comparing the reduction in the number of firms during the start of the pandemic (Figure E.10) and the volume of imports and exports (Figure E.11).
- **Export and Import shares**.– On average, an exporting firm exports 50% of its output. Moreover, the propensity of firms to purchase inputs outside the firms boundaries, that is, the propensity to import, can account for 50% of total materials. Notwithstanding, it is possible that some firms use imported inputs not bought directly abroad but sourced through locally based distributors.

3.2 A Focus on Trade Dynamics

The pandemic has had a significantly negative impact on international trade. From a policy perspective, an interesting issue is on which are the within-firm margins of trade that are driving aggregate developments. In 2020 there was a decline in the number of traded products, and the number of associated trade transactions or shipments and to a lesser extent in the number of firms trading (the extensive margin). The decline in trade values for given trading firms, products, and transactions (the intensive margin)

[6] This provides a sample that is free of composition effects, and excludes the entry and exit of firms.
[7] See Amiti & Konings (2007), Bernard et al. (2009), Halpern et al. (2015) and Kee & Tang (2016).

Table 1: Summary Statistics (2018)

	Full sample					
	Full Sample		***non-Importers***		***Importers***	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	16.45	150.15	13.67	126.40	83.68	435.34
Sales (thousands)	1.88	174.99	1.16	169.40	33.75	883.30
Capital per worker (thousands)	0.28	0.73	0.27	0.72	0.40	0.91
Sales per worker (thousands)	0.18	0.30	0.17	0.28	0.40	0.50
Export (thousands)	0.14	11.69	0.05	3.26	3.64	69.67
Export share in output	0.51	0.40	0.60	0.38	0.29	0.34
Imports (thousands)	0.19	18.46	0.00	0.00	7.15	112.96
Import share in materials	0.50	0.31	.	.	0.49	0.30
	Permanent sample					
	Full Sample		***non-Importers***		***Importers***	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	18.09	160.97	14.87	134.79	87.04	446.97
Sales (thousands)	2.65	214.03	1.61	207.96	36.93	932.56
Capital per worker (thousands)	0.29	0.75	0.28	0.73	0.40	0.91
Sales per worker (thousands)	0.19	0.31	0.18	0.29	0.40	0.50
Export (thousands)	0.20	14.28	0.07	3.98	4.02	73.45
Export share in output	0.48	0.39	0.57	0.38	0.28	0.34
Imports (thousands)	0.28	22.54	0.00	0.00	7.74	119.00
Import share in materials	0.49	0.30	.	.	0.49	0.30

Note: Summary statistics based on dataset after the cleaning procedure detailed in Section 2.*Non-Importers* is computed for firm-years in which the firm does not import. *Importers* is computed for firm-years in which the firm does import. Employment is the average number of employees per month. Firms in the Mining and Public Administration sectors have been excluded. Monetary values are in Unidades de Fomento (UF). Table 1 disaggregated by firm size can be found in Appendix B.
Sources: Merged SII, Superintendencia de Pensiones and Customs data.

contributed more intensively to the trade fall in 2020. We have analyzed high-frequency and highly detailed firm-level micro trade data to disentangle the channels through which the crisis initially affected aggregate trade outcomes in Chile. Based on our firm-level sample in Figure 2, we plot the aggregate dynamics in imports, panel (a), and exports, panel (b), from 2018 to 2021. We can observe a differentiated pattern. Exports fared relatively well during the pandemic, while imports showed a sharp decline during 2020, followed by a sharp recovery in 2021, possibly related to fiscal packages.

In light of this, we focus on import dynamics in Figure 3, and we break the sample into

Table 2: Number of Products and Origin/Destination by Sector (2018)

	Importer firms					
	Number of Products			Countries of Origin		
sectors	Mean	Median	Max	Mean	Median	Max
Agro (n=11,069)	3.5	1.0	142	1.8	1.0	26
Manu (n=46,533)	6.6	2.0	427	2.6	1.0	42
Const (n=9,726)	3.3	1.0	107	1.5	1.0	23
Wholesale/retail(n=140,235)	5.7	2.0	387	1.9	1.0	34
Transp (n=12,128)	2.3	1.0	79	1.4	1.0	23
Finan Act (n=2,969)	2.0	1.0	51	1.3	1.0	13
Hous Act (n=1,014)	1.6	1.0	23	1.1	1.0	9
Busi Act (n=20,601)	2.1	1.0	186	1.3	1.0	30
Pers Serv (n=20,788)	1.4	1.0	80	1.1	1.0	12
Total (n=265,063)	4.9	2.0	427	1.8	1.0	42
	Exporter firms					
	Number of Products			Countries of Destinations		
sectors	Mean	Median	Max	Mean	Median	Max
Agro (n=5,990)	2.0	1.0	26	4.4	2.0	50
Manu (n=10,948)	3.2	2.0	125	3.2	2.0	72
Const (n=505)	3.2	1.0	70	1.3	1.0	7
Wholesale/retail (n=15,025)	2.8	1.0	154	2.4	1.0	86
Transp (n=1,864)	2.1	1.0	96	2.7	1.0	77
Finan Act (n=286)	1.0	1.0	5	2.8	1.0	13
Hous Act (n=48)	1.0	1.0	2	1.3	1.0	4
Busi Act (n=986)	2.3	1.0	85	2.0	1.0	18
Pers Serv (n=51)	1.2	1.0	5	1.3	1.0	2
Total	2.7	1.0	154	3.0	1.0	86

Note: Based on the dataset obtained by using the cleaning procedure detailed in Section 2. We exclude the following sectors: Mining and Public Administration.
Source: Merged SII and Customs database.

imports by *Manufacturing firms* and imports from *Wholesale and Retail Trade*. We do so since we observe a heterogeneous behavior among manufacturing firms acting as direct importers of intermediate goods compared to firms that act as distributors. These firms purchase both finished goods for consumption and intermediate goods sold to domestic

firms to be embedded in their production process.[8] Recent literature is pointing to the differentiated impact of input trade or trade in final goods (see (Comin & Johnson 2020)).

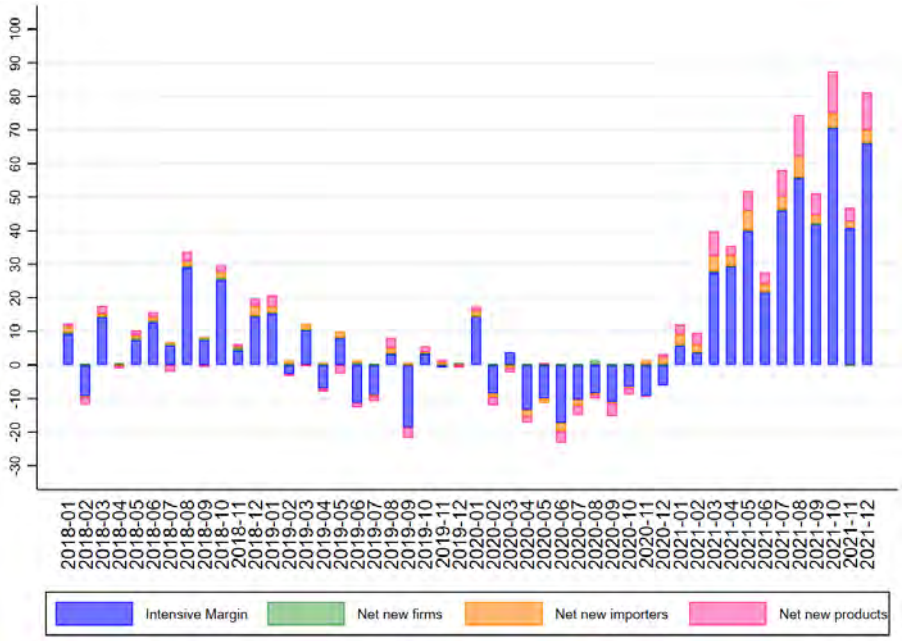
We decompose growth in imports into a within-firm intensive component (blue) and three different net extensive margins: net new firms[9], net new importers, and net new products. We can observe that import dynamics are mainly driven by the intensive margin. Notwithstanding, the extensive margins have played an important role since the start of the lockdown period and along the recovery initiated at the beginning of 2021, led mainly by distributing firms (wholesalers and retailers). The large magnitude of the extensive margin calls for an explicit analysis of the decision to enter/leave additional import markets, i.e., whether it reflects recovering pre-pandemic trading links or new links.

[8] In Figure E.7 we show that the main type of imported goods according to BEC are intermediates goods. A further breakdown shows that a limited fraction of firms act as direct importers and that firms have access to imported inputs through distributors. Indirect importers could be flagged using the information from the "Factura Electrónica" in the same vein as indirect exporters as in Marcel & Vivanco (2021).

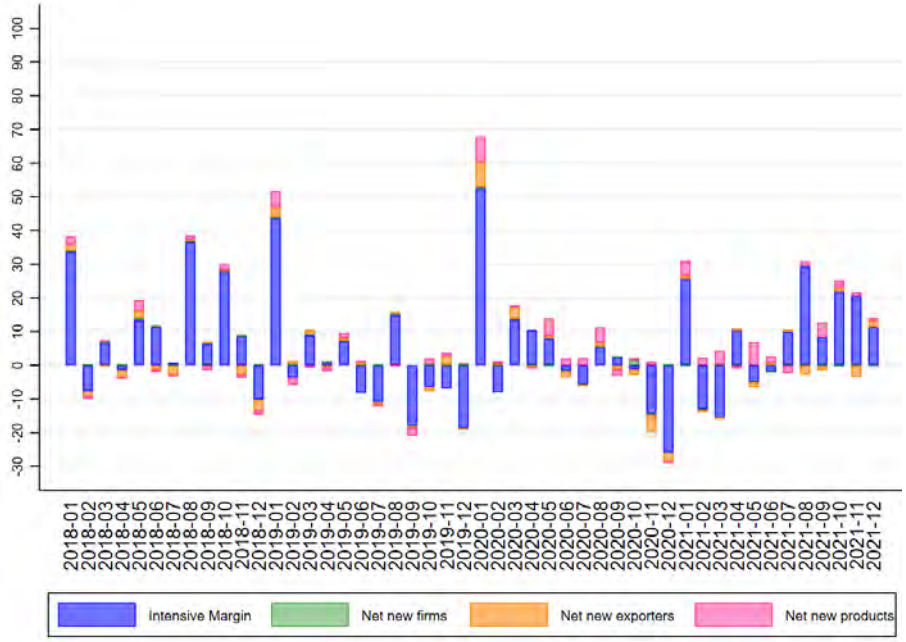
[9] Note that given the monthly frequency of the data it is difficult to capture the new entrant margin as it is not common for a recently founded firm to start import activities the same month it starts its activities, this margin is better captured in annual data.

Figure 2: Import and Export Dynamics: Trade Margins

(a) Imports by firms



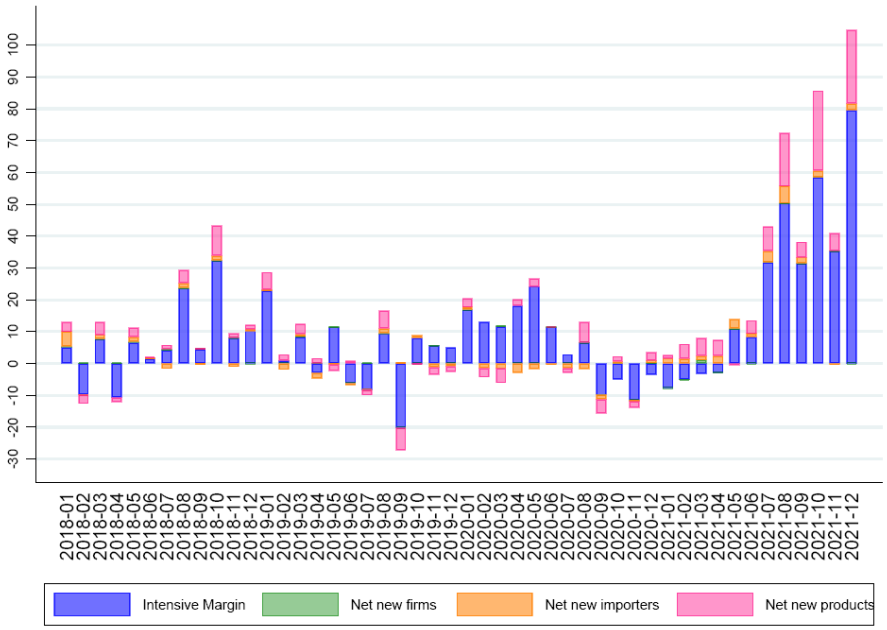
(b) Exports firms



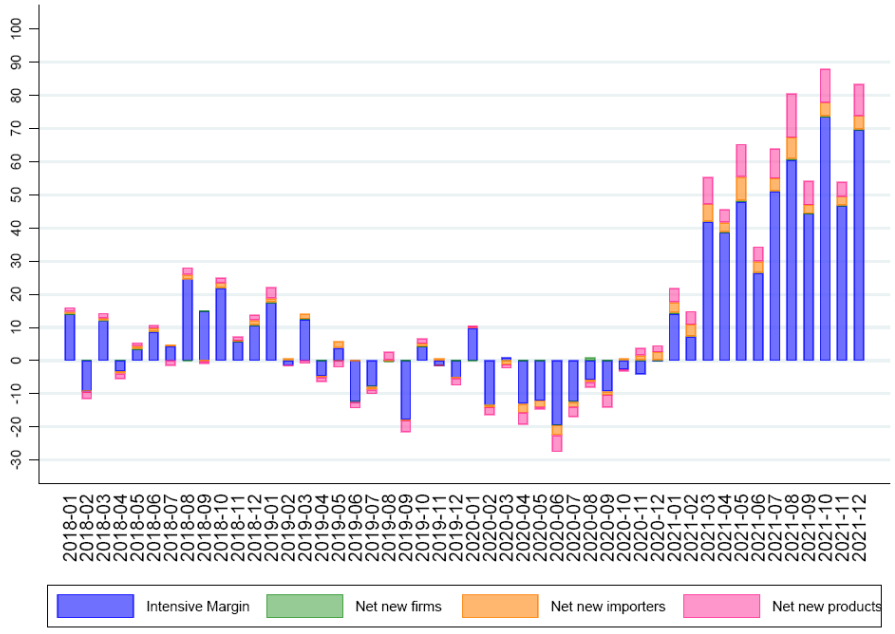
Notes: Decomposition of exports and imports growth rates. The contributions measure in pp increase attributable to different margins. The intensive margin measures (net) growth in exports/imports of products that a firm also imported in the previous period (the previous year, and at the beginning of the sample period analyzed). "New firms" are firms that did not exist and start to trade. "New importers" are firms that did exist in the previous period but did not import. And finally, "New product" are newly imported products. Based on merged dataset after the cleaning procedure detailed in Section 2.
Source: Chile's National Custom Data and own calculations.

Figure 3: Import Dynamics by Sector: Trade Margins

(a) Imports by Manufacturing firms



(b) Imports by Distribution/Wholesale and Retail firms



Notes: Decomposition imports growth rates. The contributions, either positive or negative, measured in pp are attributable to different mechanisms. The intensive margin measures (net) growth in imports of products that the firm also imported during the previous period (the previous year, and at the beginning of the sample period analyzed). "New firms" are firms that did not exist and had not started to trade. "New importer" are firms that did exist in the previous period but did not import. And finally, "New product" are newly imported products. Based on the dataset after the cleaning procedure detailed in Section 2. We exclude the sectors: Mining and Public Administration. In *Unidades de Fomento*. In Appendix C we breakdown the sample according the size of firms.
Source: Chile's National Custom Data and own calculations.

The firm's extensive margin—measured by net new importers (in orange)—registered reductions in both manufacturing and distribution firms throughout 2020. This indicates that based on net value, more firms stopped their importing activities completely. The product's extensive margin consistently shrank more in distribution firms than in manufacturing firms. However, at the end of 2020, the recovery of imports was stronger in wholesalers and retailing firms, possibly driven by domestic demand and the greater liquidity available to households due to aid given during the pandemic.

Figure 3 illustrates the within-firm changes in the mix of imported varieties and supplier countries, regardless of whether other importers drop those same varieties, play a significant role in trade adjustment.

3.3 A Focus on Varieties

In Table 2, we report the main stylized facts for Chilean firms in terms of traded varieties in 2018. That year firms imported from up to 42 countries and exported to 86 destinations. However, on average, firms that engage in trading activities imported from 1.8 and exported to 3 countries. This hints that there is substantial heterogeneity in the number of international links. Given the observed contribution of the extensive margin on products in Figure 3, especially in small and medium firms (SMEs) (see Figure C.4), we exploit the information on imported products at the firm level.

We estimate the following specification at the firm level:

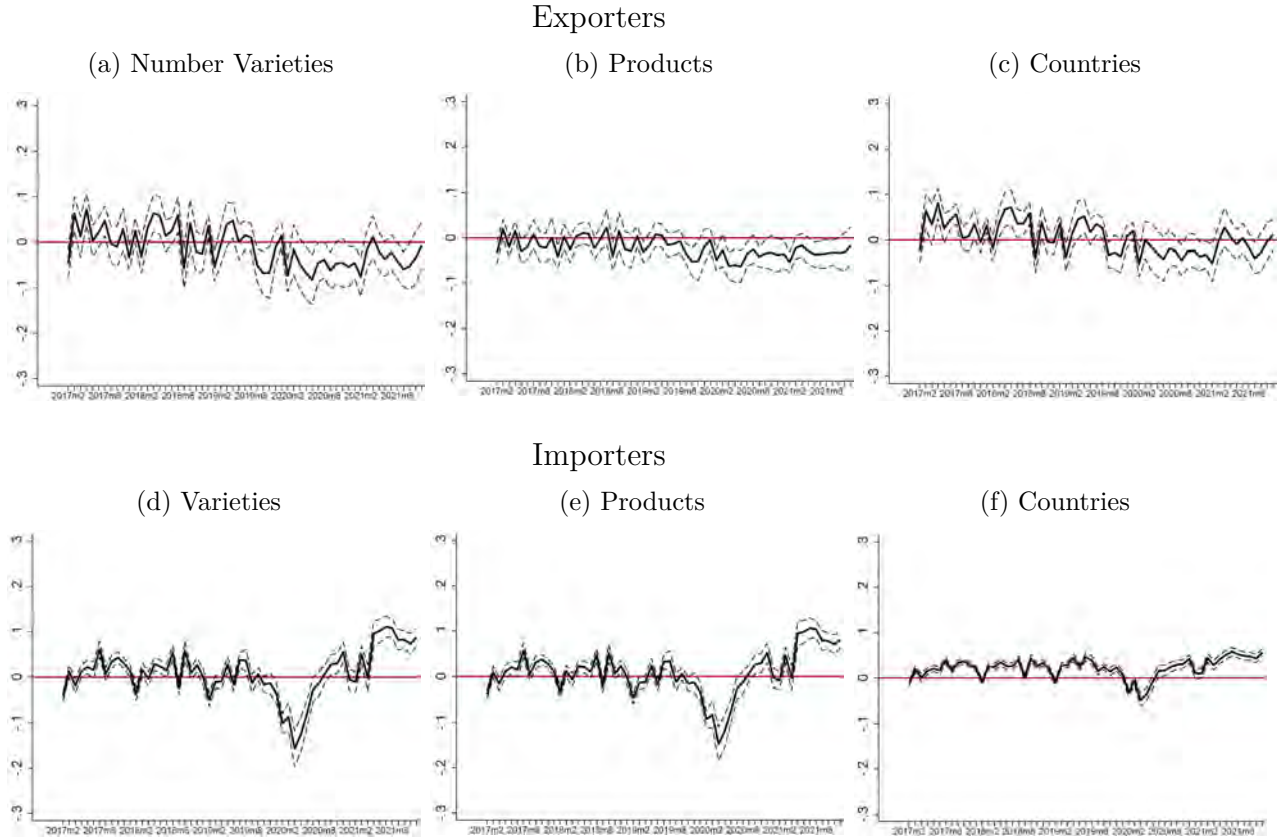
$$lnx_{it} = \nu_i + \beta_t + \gamma_X X_{it} + \epsilon_{it}, \tag{1}$$

where x_{it} is the number of varieties, the number of products or number of countries, ν_i firm fixed-effects and $\gamma_X X_{it}$ captures the control variables. We drop the time dummy for January 2017 and use it as the benchmark average value. The coefficients β_t are the monthly dummies in a regression where the dependent variable is either the (log) number of export or import varieties by each firm. A positive and rising β_t implies that varieties are increasing over time, while a negative β_t implies that they are decreasing.

In Figure 4 we plot the monthly time dummies at the firm-level of the average (ln)number of varieties. We consider variety as the combination of a product and a country of origin. The evolution of the monthly-time dummies suggests that firms, on average, imported fewer import varieties at the start of the pandemic but recovered quickly to pre-crisis levels. When looking at the behavior of exporting firms we can observe that, on average, firms reduced the number of varieties, but to a lesser extent, and this was mainly driven by the number of destination countries. As for the sample mean, the number of import varieties declined by 0.15 log points in March 2020 compared to

early 2017.

Figure 4: Number of Exported/Imported Varieties



Notes: Graphs plot the monthly time dummy coefficients by estimating the following equation: $lnx_{it} = \nu_i + \beta_t + \gamma_X X_{it} + \epsilon_{it}$, where x_{it} is the number of varieties, the number of products or number of countries, ν_i firm fixed-effects and $\gamma_X X_{it}$ captures the control. The coefficient β_t represents the monthly dummies in a regression of the number of varieties exported or imported. **Exports:** a small decline in the average number of products exported, mainly driven by the number of destinations. **Imports:** a sharp decline in the number of products. The dashed lines indicate 95% confidence intervals.
Sources: Merged SII and Customs and own calculations.

We also find substantial heterogeneity when considering the size of firms (see Figure D.5), as large firms show the largest declines in varieties for a longer time period, while SMEs showed rapid recovery. This difference may be due to the fact that the SMEs were the firms that mostly accessed the support policies deployed by the Chilean authorities to mitigate the economic impacts of the COVID-19 crisis. Two of these policies were directly aimed at firms: the FOGAPE-COVID program of state guarantees for loans to firms, and the Employment Protection Law (LPE in Spanish) that allowed firms to temporarily suspend relations with their workers. Since its inception (May 2020), a large proportion of firms massively accessed the FOGAPE-COVID credit program. Most were SMEs, with the Commerce (Wholesale/Retail) and Manufacturing industry sectors leading access. The evidence also shows that firms that accessed the FOGAPE program at the beginning of the COVID-19 pandemic experienced a faster recovery in their sales

than those that did not access it. It was the same for firms that had at least one worker under the LPE (see Monetary Policy Report December 2021, Central Bank of Chile).

Graphs in Figure 4 also serve to explore the idea of whether and to what extent the reduction of import varieties does not need to imply an impact on production costs under the scenario where there is a similar reduction in final good varieties. It can be the case that a multiproduct firm reduces its number of output varieties. By looking at the number of exported varieties we do not observe a decline in the same proportion as the decline in imported input varieties.[10]

4 Unit Values

Now we turn to analyze the behavior of import prices during this period. Import prices can be used to proxy import costs and to analyze whether firms faced cost-push shocks and whether they were paid or instead had to find alternative supply sources. In the first step we compute the unit values for each transaction as follows:

$$\mathrm{p}_{ijkt}^{(mx)} \approx \mathrm{uv}_{ijkt}^{(mx)} = \frac{\mathrm{value}_{ijkt}}{\mathrm{quantity}_{ijkt}},$$

where $p_{ijkt}^{(mx)}$ stands for the export (import) price of product k to (from) destination (origin) j at time t for each firm i.

For each firm i we compute each firm's marginal cost using the unit values:

$$mc_{it} = \sum_{j \in J_{f,t}} \sum_{k \in K_{f,t}} \omega_{ijkt} uv_{ijkt}, \tag{2}$$

from all source countries weighted by respective expenditure shares as in Amiti et al. (2014). Where uv_{ijkt} is the price in USD (unit value) of firm i imports of intermediate good k from country j at time t, the weights ω_{ijkt} accounts for the average share between period t and t-1 of import values in the firm's total variable costs, and $K_{f,t}$ and $J_{f,t}$ denote the set of all imported goods and import source countries for the firm at a given time. Note that this measure of the marginal cost is still a proxy since it does not reflect the costs of domestic inputs and firm productivity.

Similarly to the exercise done to the number of imported/exported varieties, we explore how the average unit values faced by firms evolved. In Figure 5 we plot the time dummies from firm level regressions.[11] It can be observed that there was a sharp increase in the average cost of imports at the start of the lockdowns by mid March 2020, followed

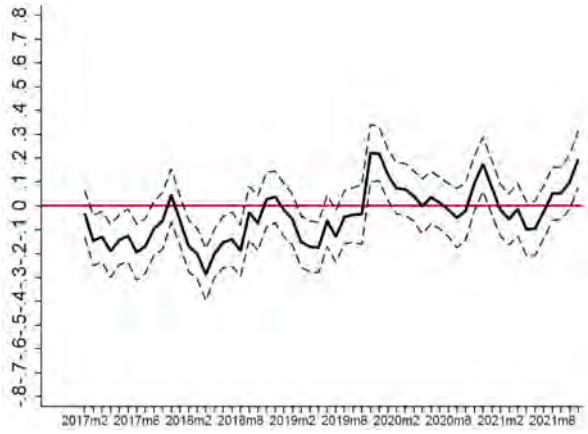
[10] These evidence has been highlighted by Gopinath & Neiman (2014) for the Argentinian case in 2002 devaluation.

[11] We apply fixed effects, and errors are clustered at the industry level.

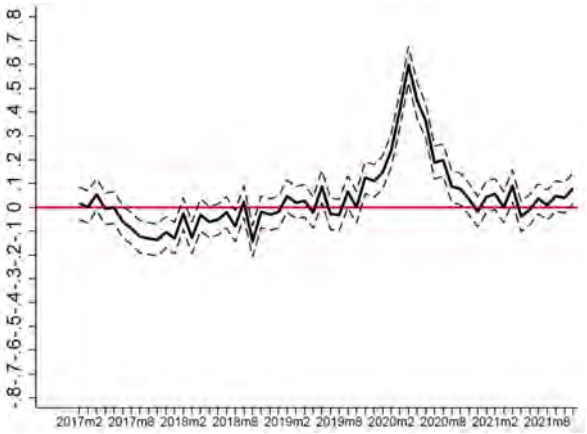
Figure 5: Impact on (average) Unit Values

Full Sample - in CLP

(a) Exports

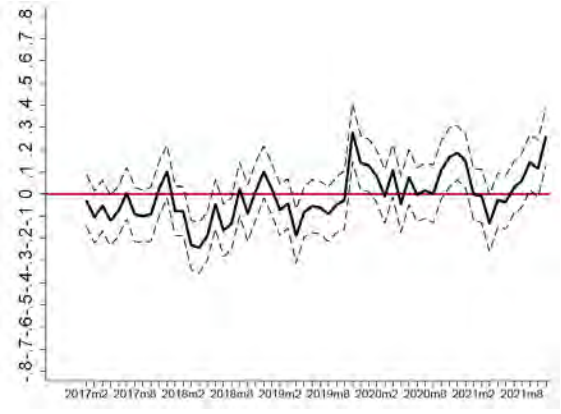


(b) Imports

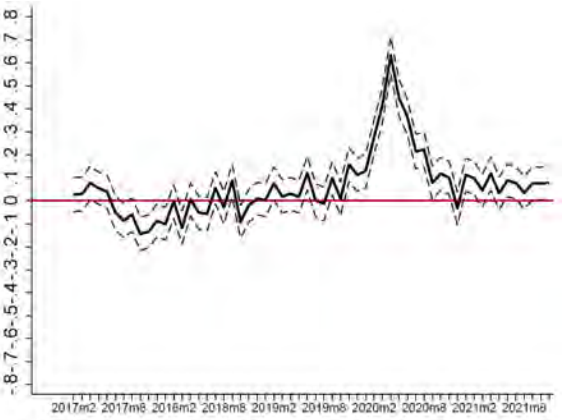


Permanent Sample - in CLP

(c) Exports

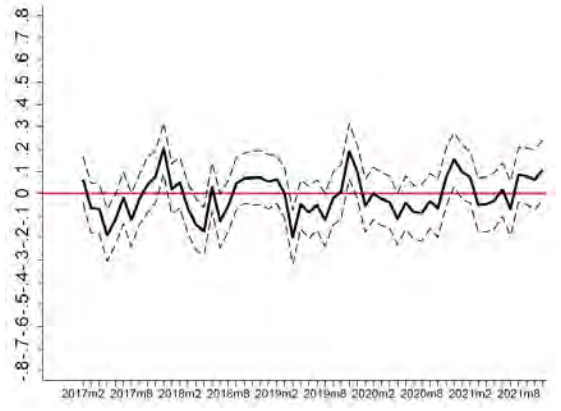


(d) Imports

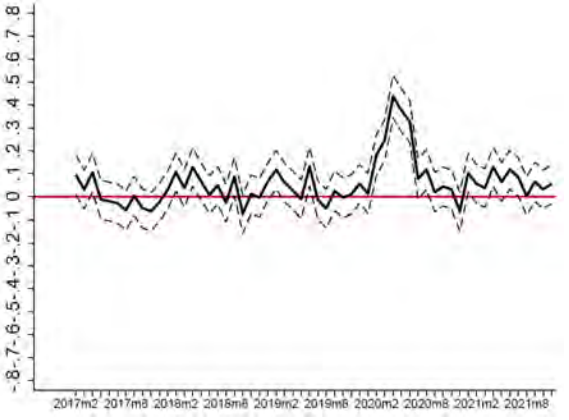


Permanent Sample - in USD

(e) Exports



(f) Imports



Notes: Shows the impact on unit values of exports and imports. It can be observed that before the COVID-19 crisis, the β_t coefficients are consistently close to zero and statistically indistinguishable from zero. At the start of the crisis, the average unit values of imports faced by firms increased substantially.

by a return to pre-pandemic levels. The Chilean peso (CLP) depreciated against the USD throughout this period, which would increase the price of imported inputs. To address this potential problem, we run the regressions with unit values expressed in CLP and in USD and keep the permanent sample so as to avoid compositional effects. Regarding the behavior export unit value, a different pattern is observed, as it remains stable over time.

5 Empirical analysis

After providing stylized facts with this rich administrative data we want to explore the role of some possible explanatory variables. In the previous section we made use of firm level regressions, in this section we turn to analyze the firm-product level.

Firstly we explore whether the health situation or stringency measures taken by partner countries has affected import and export developments. As shown in Figure 6 the evolution of the health situation and measures taken by each government has been quite heterogeneous over time. An important distinction between our paper and the existing empirical literature is that we use both COVID-19 incidence and policy indicators while most existing papers focus on one or the other. While COVID-19 incidence measures are an intuitive proxy for the impact of the pandemic, it is well known that lock-downs (of various degrees of stringency) are implemented as a reaction to the pandemic, often exactly when the number of cases/deaths is high or is expected to rise soon. As a result, studying either variable in isolation can lead to misleading results, for example with large negative effects associated to Covid-19 cases/deaths due to the omission of lock-down measures and vice-versa. Our estimation framework is similar to Liu et al. (2022), with measures of a country's own COVID incidence, own lockdown restrictions, and the same variables for the country's main trading partners. We also take full advantage of the highly-detailed data and its monthly frequency, therefore we can exploit additional information on the importer firms characteristics.

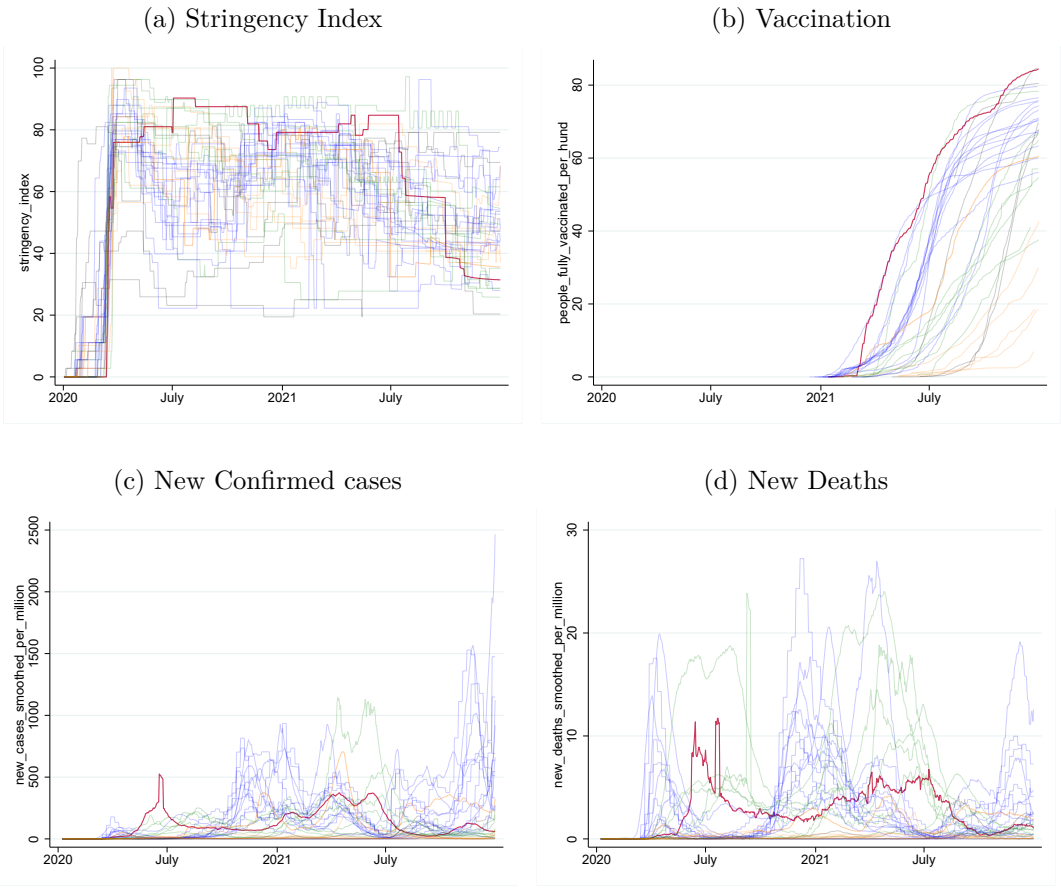
5.1 Firm-product regressions.

For each firm we run the following specification:

$$\begin{aligned} \Delta \mathrm{X}_{ijkt} \quad = \quad & \\ & \beta_1 \mathrm{Stringency}_{jt} + \beta_2 \mathrm{COVIDC}_{jt} + \\ & \beta_3 \mathrm{Stringency}_{\mathrm{chl},t} + \beta_4 \mathrm{COVIDC}_{\mathrm{chl},t} + \\ & \alpha_{jk} + \sigma_i + m_t a_t + \varepsilon_{ijkt}, \end{aligned} \tag{3}$$

where the dependent variable, $\Delta \mathrm{X}_{ijkt+h}$ is the h (if 1 monthly, if 12 yearly) variation of

Figure 6: Stringency index and health situation 2020/21



Notes: In panel (a) the stringency index, in panel (b) the share of population fully vaccinated. In panel (c) new confirmed cases per million (smoothed) and in panel (d) the number of new deaths per million (smoothed). Chilean figures are shown in red versus all other countries in the sample, in blue developed countries, in green Latin American economies and in orange Asian economies.
Source: Oxford COVID tracker and Our World in Data (OWID)
https://ourworldindata.org/covid-deaths.

X, which can be: (i) imports values or (ii) exports export values by firm i, of product k from/to country j. In sum, we consider the h month import/export growth in month t of each exporter i for each destination-product pair j, k.

The dependent variable growth rates are computed as a mid-point so as to keep symmetric growth rates to lie in the closed interval $[-2, 2]$ so as to avoid extreme statistical outliers when some outcome drops close to zero.[12] The mid-point growth is computed as follows:

[12]This metric allows to account for the extensive margins, compared to the common growth calculation. In addition the individual growth rates adds up to the aggregate growth rate. For more details on the advantages of using this metric see Bricongne, J.C., Carluccio, J. , Fotagnè, L., Gaulier G. and Stumpner, S (2023)

$$\Delta \mathrm{X}_{ijkt} = \frac{x_{ijkt} - x_{ijkt-h}}{1/2(x_{ijkt} + x_{ijkt-h})}, \tag{4}$$

where t is a monthly time index, $h = 1$ for monthly growth rates, and $h = 12$ for yearly (12-month) growth rates. Mid-point growths allows to take into account entry and exit at the product-country-level that is frequent in this type of datasets.

We explore the effects of stringency measures set in trading partners j on firms import activity. We use the index constructed by Hale et al. (2021). This $Stringency_{jt}$ measure, which lies between 0 and 1, is based on a subset of sub-indexes which ranges from stay at home requirements, school closures to restrictions on international travelling.[13]

Given that policy measures may not provide a complete picture of the underlying health situation we also control for the health situation in terms of cases by taking into account "the number of new cases per million" ($COVIDC_{jt}$) and as an alternative to "new deaths per thousand" ($COVIDD_{jt}$).[14]

We also control for the local health conditions $Stringency_{\mathrm{chl},t}$ and $COVIDC_{\mathrm{chl},t}$ to capture the fact that they can affect imports through channels that are not related to the containment measures of trading partners. These can encompass lockdowns imposed locally that, for example, can disrupt the ability of domestic ports to receive imports or voluntary isolation or depressed consumer confidence which can affect demand.

Fixed effects and controls.– To control for other contemporaneous shocks and characteristics, we rely on a large set of fixed effects.

- We consider a set of fixed effects at the country-product-month level (α_{jk}), which represents any factor that affects imports from a particular country-product pair in the same way over the months of a year. These effects capture differences in imports due to specific characteristics of the exporting/importing country, such as its size, and due to specific characteristics of the product, such as those that make it more or less appealing. They also capture similar effects at the country-product level—for example, factors that cause a country to have a particular large or small demand for imports of a specific product. Furthermore, they are allowed to vary over time.
- firm-product (σ_i) we compare the imports behavior of a firm importing the same product in the same month with a trading partner that has increased its stringency measures compared to a country of origin not taking any additional measures.

[13] Raw data can be retrieved from the Oxford COVID tracker https://www.bsg.ox.ac.uk/research/research-projects/COVID-19-government-response-tracker.

[14] These two indicators along 2020 where highly correlated, but since the introduction of the vaccines in 2021 the proportion of deaths to cases has declined. When using ($COVIDD_{jt}$) results are similar in terms of sign and significance.

- firm-country different products coming from the same country.
- In turn, m_t refers to time (year-month) fixed effects, which capture worldwide and Chilean-specific macro and health factors, as well as seasonal elements.

With this wide set of fixed effects, the variation that our coefficients capture comes only from within-country or within country-product pairs over time.

To sum up, the sources of variation that we exploit are the following:

- The evolution over time of lockdown policies and health conditions as imposed by trading partners.
- The heterogeneity in trade exposures by each firm prior to the crisis.

6 Results

In Table 3 we report the results from our baseline specification in Equation 3. We assess the impact on the year-on-year log difference of imports at the six-digit (HS6) product level from each partner country on a monthly basis. Column (1) reports the baseline results with the estimates of the effect on the health situation and the lockdown measures taken in Chile. This provides information on the correlation between import growth and domestic conditions. This also provides information on the extent to which import developments are domestically demand driven. In column (2) we explore the role of the health situation and restrictions imposed by the local authorities on each trading partner country. This may proxy international sourcing disruptions. All the coefficients are negative and statistically significant, meaning that they have a negative effect on import growth from a country of origin that is facing an increase in the number of cases and is imposing restrictions. In column (3) we include both domestic and partner country controls. The impact on import growth remains negative and significant. In all three of these specifications, we include a control for the exchange rate of the CLP against the USD as a year on year change to capture the role of exchange rate developments. Although statistically significant, quantitatively it has a limited impact.

As anticipated in Section 5 we make use of several controls and fixed effects. In column (4) we control for firm (α_i) and year (α_t) fixed effects, in column (5) we add for product (α_k) fixed effects , in column (6) for product effects (α_j) and in column (7) for country-product fixed effect (α_{jk}). The coefficients associated with the variables of interest show some changes.[15]

[15]Given that our dataset is at the firm-product level we also control for the firm's ID. This will allow us to compare firms importing the same product from countries which are differentiated by the degree and the health measures taken by the trading partner. For this regression we will make use of a sub-sample where we just keep firms import from at least two countries of origin.

Table 4 explores the impact of COVID-19 containment measures on exports. Domestic containment measures had a significant effect on exports, but containment measures in the partner country or the number of cases did not have a significant impact on exports.

Table 3: Baseline Regression
Lockdown spillovers effect on import growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Δ Import_ijkt	Δ Import_ijkt	Δ Import_ijkt	Δ Import_ijkt	Δ Import_ijkt	Δ Import_ijkt	Δ Import_ijkt
$COVIDC_{chl}$	-0.522***		-0.450***	-0.385***	-0.370***	-0.375***	-0.373***
	(0.033)		(0.042)	(0.042)	(0.044)	(0.043)	(0.055)
$Stringency_{chl}$	-0.316***		-0.403***	-0.151***	-0.170***	-0.143***	-0.148***
	(0.014)		(0.023)	(0.031)	(0.033)	(0.032)	(0.056)
$COVIDC_j$		-0.048**	-0.192***	-0.134***	-0.135***	-0.125***	-0.127*
		(0.022)	(0.023)	(0.026)	(0.030)	(0.029)	(0.064)
$Stringency_j$		-0.176***	0.194***	0.057*	0.060	0.034	0.036
		(0.018)	(0.025)	(0.034)	(0.038)	(0.037)	(0.081)
$log(tc_d12)$	-0.007***	0.000	-0.005***	0.005***	0.005***	0.005***	0.005***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	647,320	443,213	435,054	430,773	423,979	430,771	430,461
R-squared	0.002	0.000	0.002	0.041	0.086	0.041	0.050
number of firms	21718	15646	15525	11244	10990	11244	11226
number of products	4023	3841	3837	3794	3375	3794	3501
Firm FE				✓	✓	✓	✓
Year FE				✓	✓	✓	✓
Country FE						✓	✓
Product FE					✓		✓

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is the mid-point year-over-year growth between an import from firm i of product k from country j in month t of 2020 compared to the corresponding import value in the same month of 2019, divided by the average sum and multiplied by 100. *Stringency* accounts for the lockdown index in Chile and in the partner country j, this index is re-scaled to be between 0 and 1. $COVIDC$ is the confirmed cases per thousand people in the population in each month. $COVIDC_{chl}$ controls for the health situation in Chile and $COVIDC_j$ for the situation in partner country j. Various set of country (α_j), HS6 product (α_k), or country*HS6 (α_{jk}) fixed effects are included. Robust standard errors, in parentheses, are clustered at the HS6 product level in the first three regressions (at country-HS6 level in the last regression).

Table 4: Baseline Regression
Lockdown spillovers effect on export growth

	(1)	(2)
VARIABLES	Δ Export_ijkt	Δ Export_ijkt
$COVIDC_{chl}$	-0.121	
	(0.144)	
$Stringency_{chl}$	0.027	
	(0.067)	
$COVIDC_j$		-0.098
		(0.146)
$Stringency_j$		0.079
		(0.072)
$log(tc_d12)$	0.016***	0.016***
	(0.002)	(0.002)
Observations	106,035	101,254
R-squared	0.039	0.040
number of firms	2557	2518
number of products	1839	1807
Firm FE	✓	✓
Year FE	✓	✓
Product FE	✓	✓

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is the mid-point year-over-year growth between an export from firm i of product k from country i in month t of 2020 compared to the corresponding export value in the same month of 2019, divided by the average sum and multiplied by 100. *Stringency* accounts for the lockdown index in Chile and in the partner country j, this index is re-scaled to be between 0 and 1. $COVIDC$ is the confirmed cases per thousand people in the population in each month. $COVIDC_{chl}$ controls for the health situation in Chile and $COVIDC_j$ for the situation in partner country j. Various set of country (α_j), HS6 product (α_k), or country*HS6 (α_{jk}) fixed effects are included. Robust standard errors, in parentheses, are clustered at the HS6 product level in the first three regressions (at country-HS6 level in the last regression).

We explore whether goods respond differently based on their type. We split the sample by type of good according to the Broad Economic Categories (BEC) classification (see Table 5). Foreign indicators keep their sign and significance. Notwithstanding the role of domestic indicators show some variation, with intermediate inputs being more affected by the health situation and imports of consumption goods more related to restrictions imposed by the authorities.

At the firm level, we check whether firms in the manufacturing sector, which are more reliant on intermediate goods, behave differently from firms in the wholesale and retail trading sector which import both final consumer and intermediate goods (see Table 6). We can observe that the impact of contagion cases is much stronger than the stringency measures on Manufacturing firms, possibly as the restrictions were targeted to activities that involve higher social interactions.[16]

Throughout 2020, consumer patterns changed, lockdowns favored the consumption of indoor goods rather than outdoor related goods. To explore whether there are differences we use the classification proposed by de Lucio et al. (2022) and it can be observed that imports of indoor related goods sharply increased while outdoor ones sharply declined (see Figure E.12). When breaking the sample into these two types of goods in the regression we observe that domestic indicators, specially stringency measures, had a higher impact on indoor goods (see Table 7).

Finally, we explore the role of firm size in Table 8. As expected, the number of observations are concentrated within large firms, as shown previously in the stylized facts large firms are more likely to trade. Small firms are less affected by health conditions. Medium sized firms are affected by domestic health conditions and trading partner stringency conditions. Finally, large firms maintained the negative sign and significance in all the indicators.

[16] Another avenue to explore is the ability by firms to substitute inputs for production it will much depend on its degree of specificity. To explore this the classification proposed by Rauch (1999) can by used in line with other works that have explored the role of input specificity such as Barrot & Sauvagnat (2016) and Boehm & Oberfield (2020).

Table 5: Product heterogeneity
Broad Economic Categories (BEC)

VARIABLES	(1) Consumption Δ Import_ijkt	(2) Capital Δ Import_ijkt	(3) Intermediates Δ Import_ijkt
$COVIDC_{chl}$	-0.500***	-0.193**	-0.392***
	(0.132)	(0.092)	(0.056)
$Stringency_{chl}$	-0.344**	-0.198***	-0.094
	(0.132)	(0.054)	(0.066)
$COVIDC_j$	0.007	-0.100*	-0.168**
	(0.101)	(0.057)	(0.082)
$Stringency_j$	0.043	0.179*	-0.002
	(0.158)	(0.107)	(0.086)
$log(tc_d12)$	-0.002	0.005**	0.008***
	(0.003)	(0.002)	(0.001)
Observations	78,225	89,721	259,675
R-squared	0.095	0.051	0.054
number of firms	4371	3207	7981
number of products	766	504	2207
Country FE	✓	✓	✓
Product FE	✓	✓	✓
Year FE	✓	✓	✓
Firm FE	✓	✓	✓

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table presents the estimates from panel regressions of firm's import growth relative to the same month in the previous year using a set of variables accounting for the health situation due to COVID-19. The sample is broken down according to the type of good imported following the Broad Economic Categories (BEC): [1] consumption , [2] capital and [3] intermediates.

Table 6: Firm level heterogeneity: Manufacturing vs. Distributors

	(1)	(2)
	Manuf	Distributors
VARIABLES	Δ Import_ijkt	Δ Import_ijkt
$COVIDC_{chl}$	-0.281**	-0.430***
	(0.122)	(0.070)
$Stringency_{chl}$	-0.035	-0.186***
	(0.075)	(0.066)
$COVIDC_j$	-0.094	-0.140*
	(0.089)	(0.077)
$Stringency_j$	-0.046	0.037
	(0.106)	(0.088)
$log(tc_d12)$	0.011***	0.004***
	(0.002)	(0.001)
Observations	82,804	313,428
R-squared	0.062	0.050
number of firms	1908	6962
number of products	2193	3103
Country FE	✓	✓
Product FE	✓	✓
Year FE	✓	✓
Firm FE	✓	✓

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: This table presents the estimates of firms in the manufacturing sector and firms in the distribution sector.

7 Conclusions

In this paper we have analyzed how Chilean firms have performed during COVID-19, with a focus on their international trade links. By using firm-level customs data on exports and imports from Chile to and from each trading partner, we carry out the analysis at the firm-product-country level. We found that exports were resilient in 2020, maintaining similar dynamics to that of previous years. However, imports showed a different pattern, with a clear drop at the beginning of 2020 due to this crisis, followed by a strong recovery in 2021. The granularity of the data allows to dissect the margins through which firms have adjusted their purchases and sales abroad. In a first step we explored the different behavior by firms in terms of the intensive and extensive margins of international trade, with the aim of capturing the sources of adjustment during this episode. We find that firms primarily adjusted through the intensive margin, i.e. reducing the intensity of their purchases from the same variety (defined as the product-partner country), and through the extensive margin, either dropping/adding varieties or by stopping/starting the international trade activity. We observe a differentiated pattern from manufacturing firms and firms in the distribution sector and by firm size, where the small and medium firms (SMEs) relied more heavily on the extensive margins to adjust their trade volumes. When we exploit the information on imported products at the firm level and consider the

Table 7: Product level heterogeneity: Consumption
Indoor vs. Outdoor

VARIABLES	Indoor Δ Import_ijkt	Outdoor Δ Import_ijkt
$COVIDC_{chl}$	-0.468***	-0.702***
	(0.144)	(0.129)
$Stringency_{chl}$	-0.559**	-0.255**
	(0.219)	(0.110)
$COVIDC_j$	0.157	-0.041
	(0.232)	(0.109)
$Stringency_j$	0.086	-0.016
	(0.257)	(0.151)
$log(tc_d12)$	-0.006	-0.002
	(0.005)	(0.003)
Observations	28,816	58,434
R-squared	0.105	0.089
number of firms	1628	2887
number of products	305	567
Country FE	✓	✓
Product FE	✓	✓
Year FE	✓	✓
Firm FE	✓	✓

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Sample is breakdown into [1] Indoor and [2] Outdoor consumption goods.

size of firms, we also find heterogeneity: SMEs registered a rapid recovery in varieties. A possible explanation is that SMEs were the ones that had an important participation in at least two of the policies aimed at firms to respond to the COVID-19 crisis (the FOGAPE-COVID credit program and the Employment Protection Law - LPE in Spanish). Notwithstanding, the share of total imports by this type of firm is relatively small (see Figure E.9 in Appendix E.).

Then, by means of regression analysis we exploit time dummies to explore the average behavior of firms in terms of the number of exported and imported varieties and the average costs paid on imported goods. While exports (excluding the Mining sector) were relatively stable, imports registered a more dynamic pattern, a sharp decline in the number of varieties, together with a high average import cost at the beginning of the pandemic but very short lived over time.

In a second step, we explore the role of the health situation and measures taken by partner countries (namely the lockdowns) and explore different sources of heterogeneity such as the type of imported product, the type of firm in terms of size or operating sector. We find, that domestic measures as well as foreign factors have played an important role. The measures taken by trading partners have not been a major source of supply disruptions but we also find some evidence that a higher degree of lockdown by a country's

Table 8: Size heterogeneity: Large vs. SMEs

	(1)	(2)	(3)
	Small	Medium	Large
VARIABLES	Δ Import_ijkt	Δ Import_ijkt	Δ Import_ijkt
$COVIDC_{chl}$	-0.047	-0.403**	-0.402***
	(0.158)	(0.161)	(0.067)
$Stringency_{chl}$	-0.214*	-0.001	-0.173***
	(0.123)	(0.097)	(0.062)
$COVIDC_j$	-0.023	-0.001	-0.151*
	(0.074)	(0.122)	(0.077)
$Stringency_j$	0.080	-0.126	0.064
	(0.117)	(0.112)	(0.086)
$log(tc_d12)$	-0.004	0.004	0.006***
	(0.003)	(0.003)	(0.001)
Observations	39,940	49,198	340,656
R-squared	0.189	0.108	0.035
number of firms	4873	2551	3662
number of products	1611	1814	3170
Country FE	✓	✓	✓
Product FE	✓	✓	✓
Year FE	✓	✓	✓
Firm FE	✓	✓	✓

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Sample is breakdown by firm size into [1] small, [2] medium and [3] large.

trading partner is also associated with lower import growth, that is to say imports from countries with higher stringency measures imply a reduction of imports. The development of vaccines during 2021 does not seem to be playing a major role for the moment.

In spite of the good process of vaccines, the recovery is posing some challenges and it has been far from a smooth recovery to the "new" normality. Firms are still facing some disruptions, such as the ongoing closures on certain ports, new outbreaks, an uneven pace in global vaccination, the appearance of new variants which are leading to heightened uncertainty. The evidence provided in this article shows the heterogeneous reaction by firms and how shocks propagate using international supplier-customer links. Looking ahead, this type of analysis can extended to evaluate other type of shocks such as climate related events and could also explore the adjustment in the labor market.

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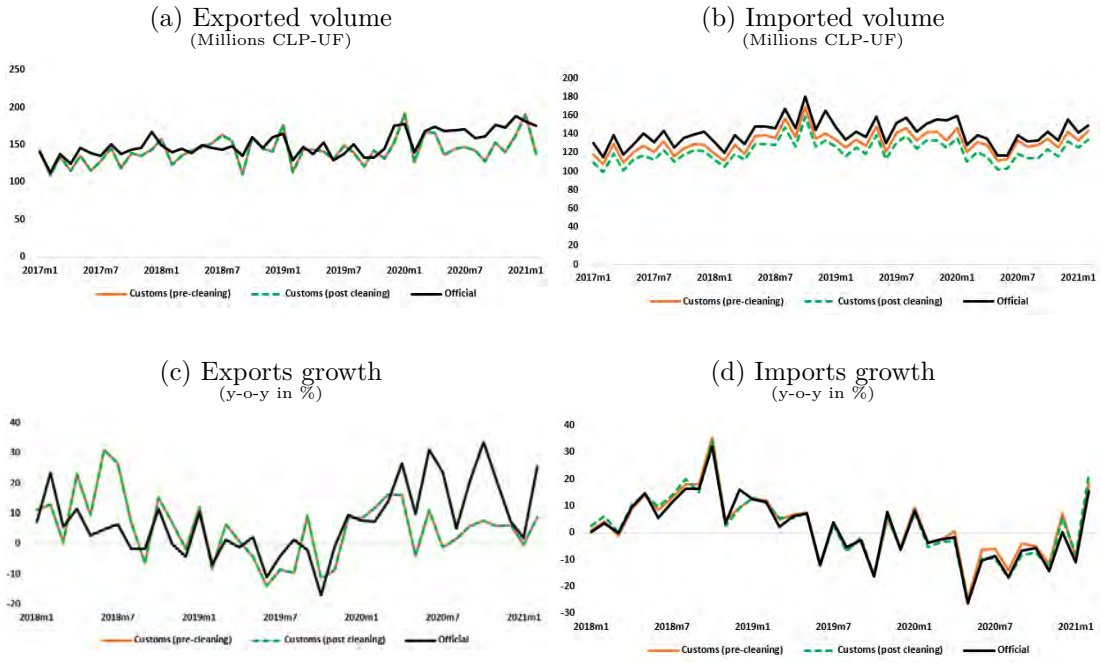
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Appendix

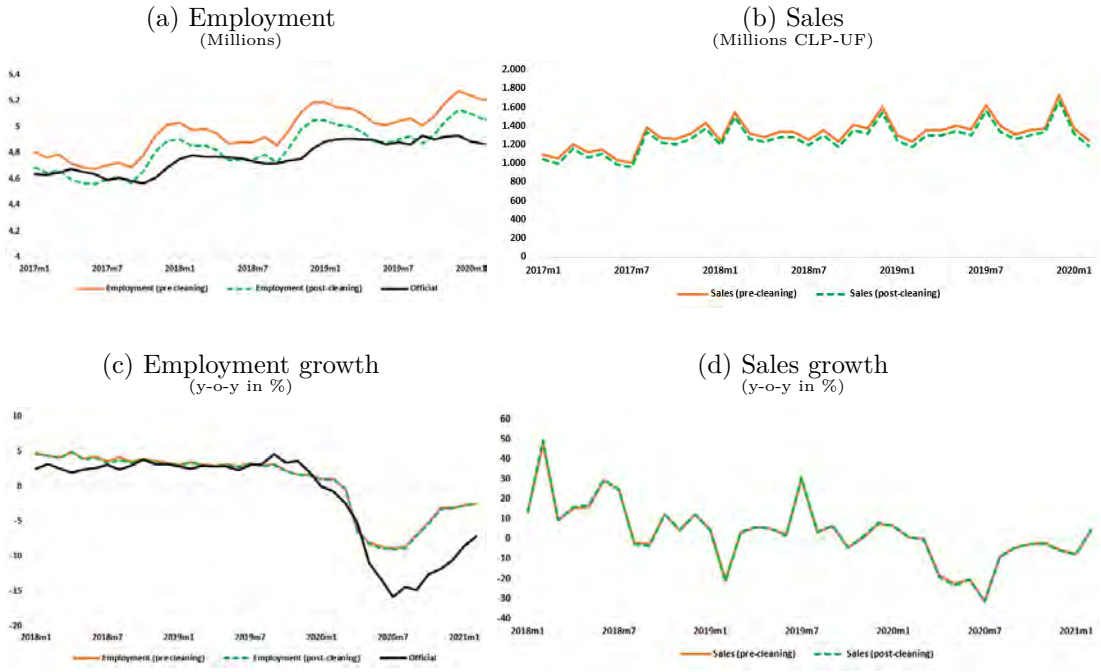
A Data coverage

Figure A.1: Trade Coverage and Dynamics
(before and after cleaning)



Notes: Panels (a) and (b) show the aggregate developments of exports and imports, in million of CLP in constant terms by Chilean firms, before and after the basic cleaning, compared with the official data sources. In panels (c) and (d) we compare year-on-year growth rates of the aggregate official source and aggregates obtained with granular data.
Sources: Chile's National Customs Data.

Figure A.2: Employment and Sales
(before and after cleaning)



Notes: Panels (a) and (b) shows the aggregate evolution of employment (in million) and sales (in million of CLP in constant terms) by Chilean firms, before and after the basic cleaning, compared with the official data sources. In panels (c) and (d) we compare year on year growth rates of the aggregate official source and aggregates obtained with granular data.
Sources: Instituto Nacional de Estadísticas (INE) de Chile and Servicio de Impuestos Internos (SII).

B Summary statistics by firm size

Table B.1: Summary Statistics - 2018
Large firms

	Full sample					
	Full Sample		***non-Importers***		***Importers***	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	199.79	669.23	195.89	663.56	236.90	752.73
Sales (thousands)	77.59	1294.74	57.37	1504.68	125.56	1755.06
Capital per worker (thousands)	0.44	1.04	0.36	1.00	0.57	1.16
Sales per worker (thousands)	0.48	0.61	0.42	0.59	0.56	0.62
Export (thousands)	6.72	85.95	3.02	25.96	14.01	137.94
Export share in output	0.37	0.38	0.55	0.40	0.25	0.32
Imports (thousands)	9.55	136.69	0.00	0.00	25.69	223.38
Import share in materials	0.40	0.30	.	.	0.41	0.30
	Permanent sample					
	Full Sample		***non-Importers***		***Importers***	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	200.57	671.03	196.75	665.43	237.51	754.29
Sales (thousands)	78.24	1303.07	58.01	1516.71	125.88	1760.37
Capital per worker (thousands)	0.43	1.04	0.36	0.99	0.56	1.15
Sales per worker (thousands)	0.48	0.61	0.42	0.59	0.56	0.61
Export (thousands)	6.77	86.48	3.02	26.07	14.08	138.35
Export share in output	0.37	0.38	0.54	0.40	0.25	0.32
Imports (thousands)	9.60	137.52	0.00	0.00	25.63	223.99
Import share in materials	0.40	0.30	.	.	0.41	0.30

Note: We keep only large firms, with an annual turnover above > 100.000 UF.Based on dataset after the cleaning procedure detailed in Section 2. Mining and Public Administration sectors have been excluded. Monetary values are deflated using Unidades de Fomento (UF).
Source: Merged SII and Customs data.

Table B.2: Summary Statistics - 2018
Small and medium-sized enterprises

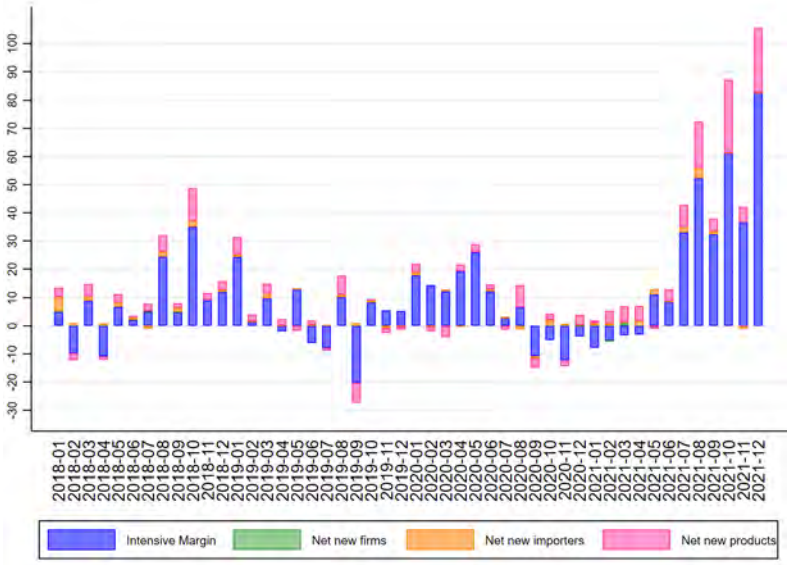
	Full sample					
	Full Sample		***non-Importers***		***Importers***	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	8.10	39.92	7.94	39.39	14.20	55.36
Sales (thousands)	0.48	14.42	0.45	14.31	2.76	18.28
Capital per worker (thousands)	0.27	0.70	0.27	0.70	0.29	0.69
Sales per worker (thousands)	0.17	0.27	0.16	0.26	0.33	0.42
Export (thousands)	0.01	1.55	0.01	1.43	0.14	4.77
Export share in output	0.58	0.39	0.61	0.38	0.36	0.36
Imports (thousands)	0.02	1.22	0.00	0.00	0.89	8.51
Import share in materials	0.54	0.30	.	.	0.53	0.30
	Permanent sample					
	Full Sample		***non-Importers***		***Importers***	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	8.15	29.44	8.00	28.93	13.11	42.78
Sales (thousands)	0.58	16.60	0.54	16.71	2.40	8.52
Capital per worker (thousands)	0.27	0.71	0.27	0.71	0.29	0.69
Sales per worker (thousands)	0.17	0.27	0.17	0.27	0.33	0.42
Export (thousands)	0.02	1.73	0.02	1.74	0.12	1.97
Export share in output	0.55	0.39	0.58	0.38	0.35	0.35
Imports (thousands)	0.02	0.53	0.00	0.00	0.79	3.11
Import share in materials	0.52	0.30	.	.	0.52	0.29

Note: We keep only large firms, with an annual turnover below < 100.000 UF. Based on dataset after the cleaning procedure detailed in **Section 2**. Mining and Public Administration sectors have been excluded. Monetary values are deflated using *Unidades de Fomento* (UF).
Source: Merged SII and Customs data.

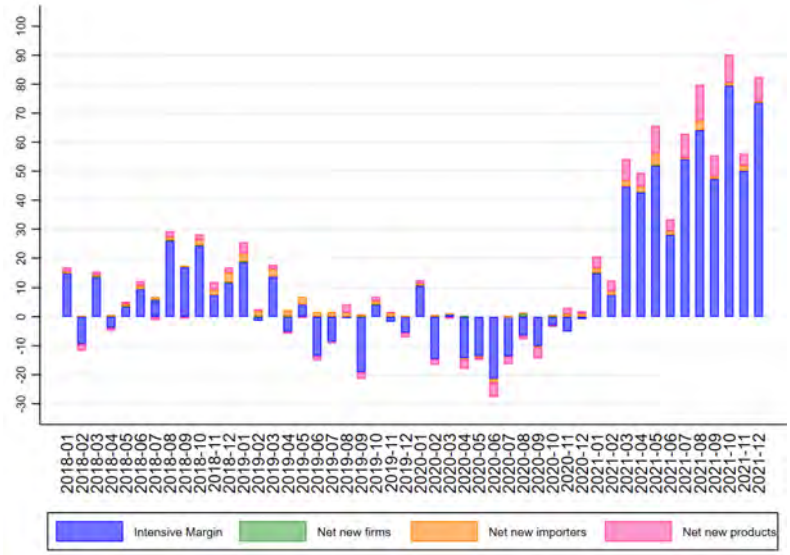
C Import Dynamics by Firm Size

Figure C.3: Import Dynamics - Large firms

(a) Imports by Manufacturing firms



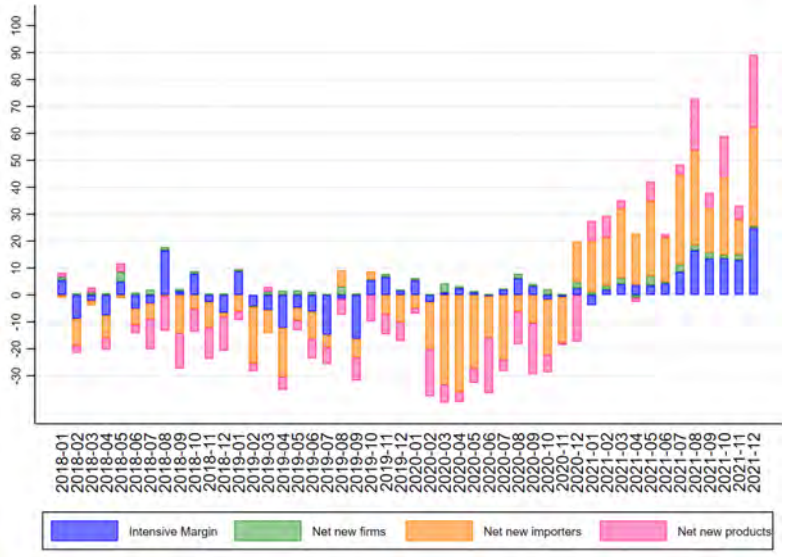
(b) Imports by Distribution/Retail firms



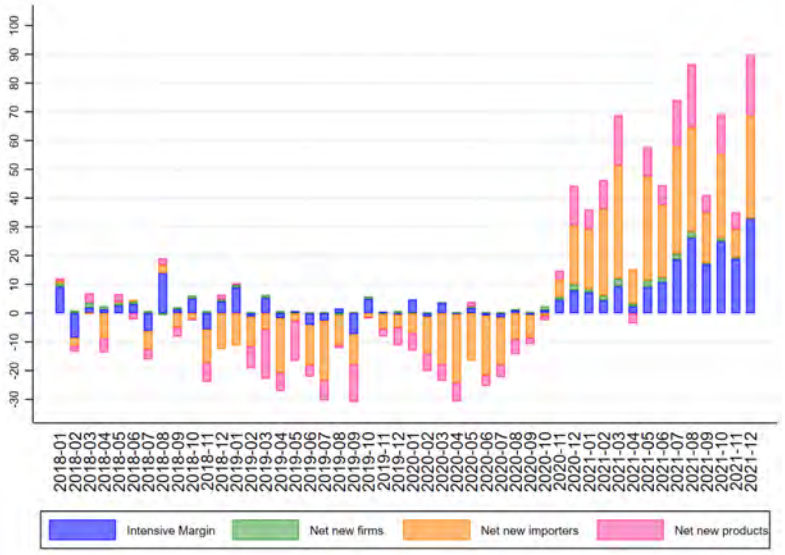
Notes: Decomposition imports growth rates. The contributions measure in pp increase attributable to different mechanisms. The intensive margin measures (net) growth in imports of products that the firm also imported in the previous period (the previous year, and at the beginning of the sample period analyzed). "New firms" are firms that did not exist and start to trade. "New importer" are firms that did exist in the previous period but did not import. And finally, "New product" are newly imported products. Based on dataset after the cleaning procedure detailed in **Section 2**. We exclude the sectors: Mining and Public Administration. Monetary values are deflated using *Unidades de Fomento*. The within-firm extensive margin or sub-extensive margin play a smaller role in trade dynamics.
Sources: Chile's National Customs Data.

Figure C.4: Import Dynamics - Small and medium-sized enterprises

(a) Imports by Manufacturing firms



(b) Imports by Distribution/Retail firms



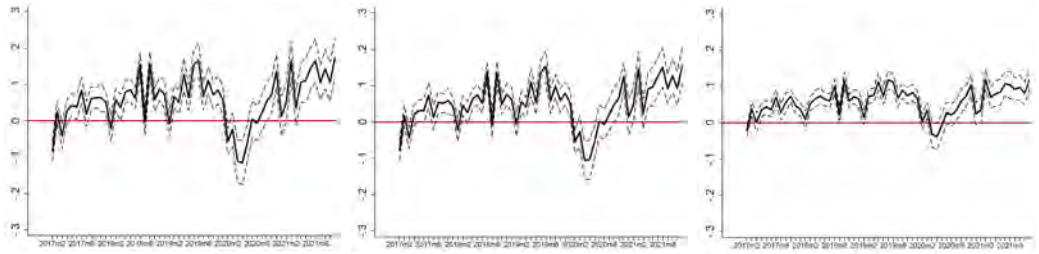
Notes: Decomposition imports growth rates. The contributions measure in pp increase attributable to different mechanisms. The intensive margin measures (net) growth in imports of products that the firm also imported in the previous period (the previous year, and at the beginning of the sample period analyzed). "New firms" are firms that did not exist and start to trade. "New importer" are firms that did exist in the previous period but did not import. And finally, "New product" are newly imported products. Based on dataset after the cleaning procedure detailed in **Section 2**. We exclude the sectors: mining and public administration. Monetary values are deflated using *Unidades de Fomento*. The most prevalent margin of external adjustment in smallest firms is the extensive margin.
Sources: Chile's National Custom Data.

D Number of exported/imported varieties by Firm Size

Figure D.5: (Average) number of imported varieties - Large firms vs. small firms

Large importers

(a) Varieties (b) Products (c) Countries



SMEs Importers

(d) Varieties (e) Products (f) Countries

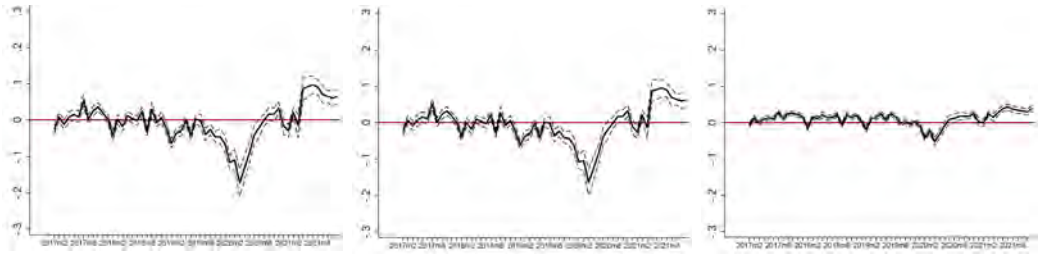
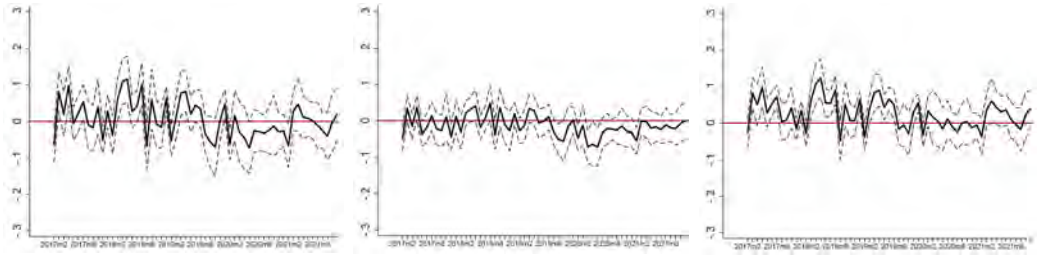


Figure D.6: (Average) number of exported varieties - Large firms vs. small firms

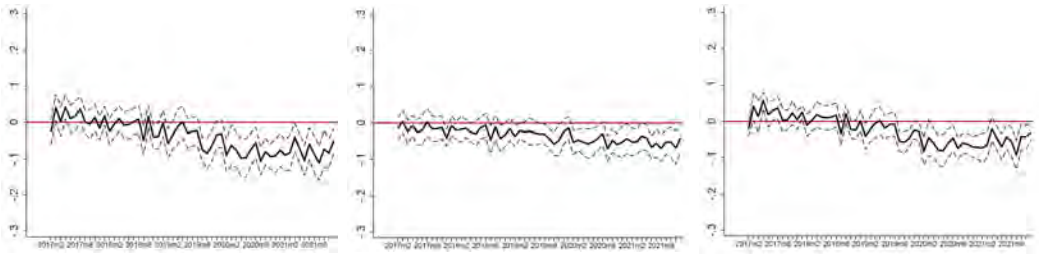
Large Exporters

(a) Varieties (b) Products (c) Countries



SME Exporters

(d) Varieties (e) Products (f) Countries



E Additional tables and graphs

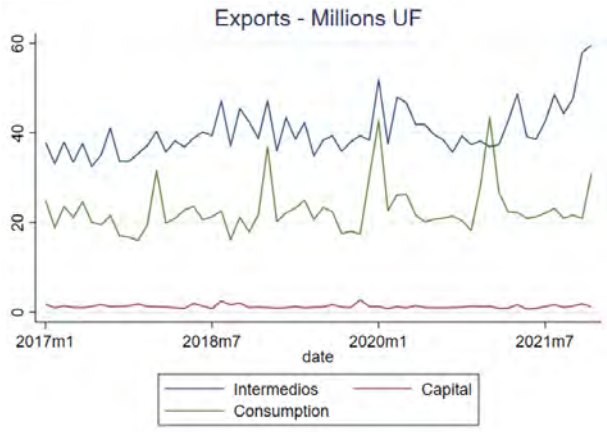
Table E.3: Summary statistics - regression

	Obs	Mean	S.d.	min	max
Δ Import_pkt	714.544	0.16	1.94	-2.00	2.00
CovidC_j	1.865.522	0.15	0.16	0.00	1.44
Stringency_j	1.909.422	0.59	0.19	0.00	1.00
CovidC_chl	2.859.161	0.14	0.11	0.00	0.35
Stringency_chl	2.859.161	0.71	0.19	0.00	0.85
Standardized values of (tc)	4.463.070	3.92	10.37	-18.70	24.58
Observations	4.463.070				

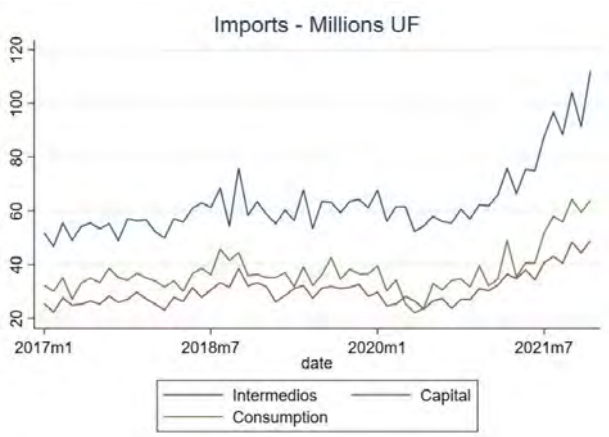
Note: Summary statistics of the variables used in the regressions of Table 3. Confirmed cases are the number of new cases (smoothed) per thousand. The number of observations corresponds to the number of transactions.

Figure E.7: Exports and Imports by Type BEC - Total

(a) Exports



(b) Imports

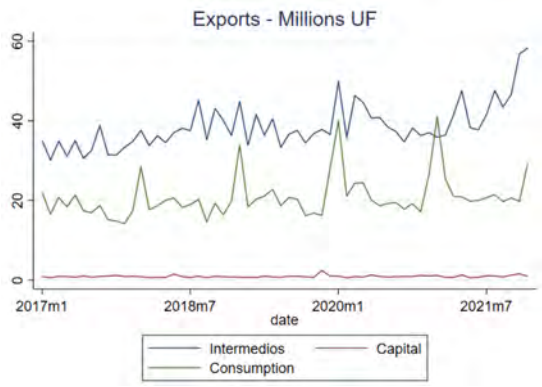


Notes: Trade flows classified according to Broad Economic Categories (BEC). Imports in Panel (b) show that import trade consists primarily of intermediate inputs. Based on dataset after the cleaning procedure detailed in Section 2. We exclude the sectors: Mining and Public Administration.
Sources: Chilean Customs.

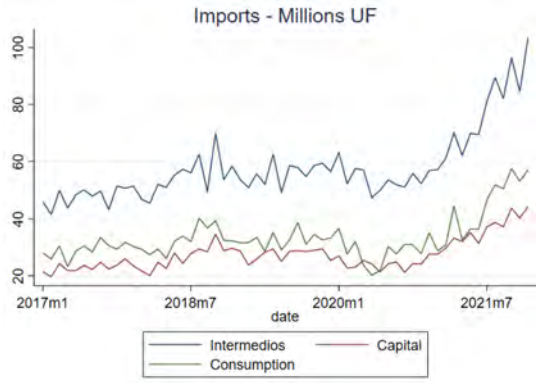
Figure E.8: Exports and Imports by Type BEC and Firm Size

Large firms

(a) Exports

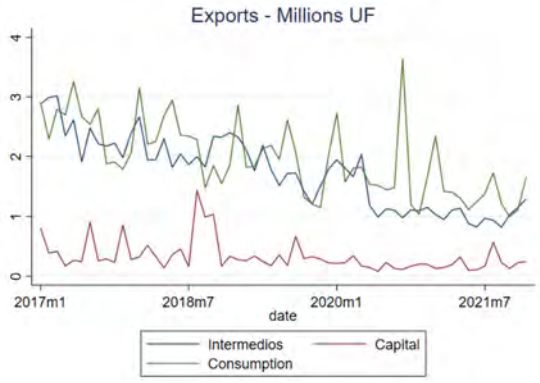


(b) Imports

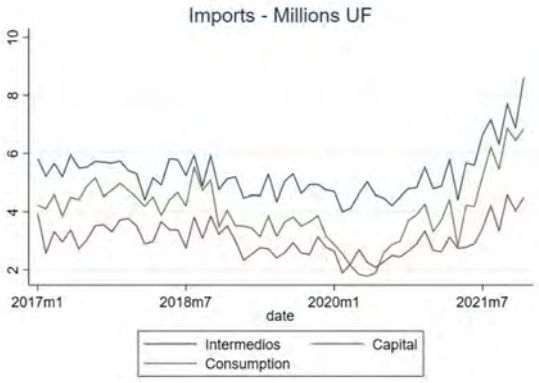


Small and medium-sized enterprises

(c) Exports



(d) Imports

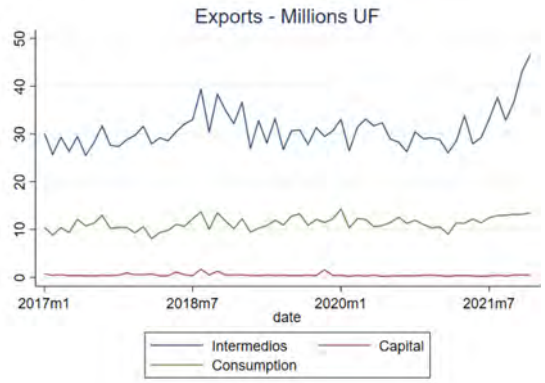


Notes: Based on dataset after the cleaning procedure detailed in Section 2. We exclude the sectors: Mining and Public Administration. Based on Broad Economic Categories (BEC). Imports in Panel (b) show that import trade consists primarily of intermediate inputs as shown the higher share of imports. *Sources:* Chilean Customs.

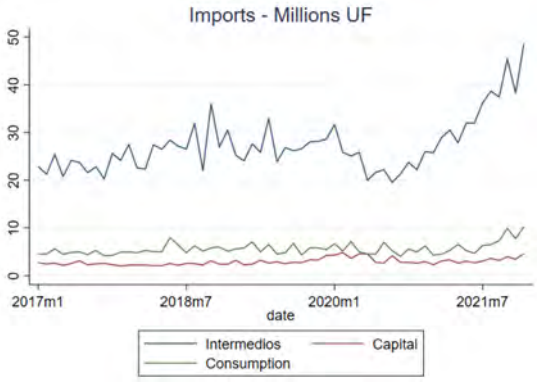
Figure E.9: Exports and Imports by Type BEC and Sector

Manufacturing firms

(a) Exports

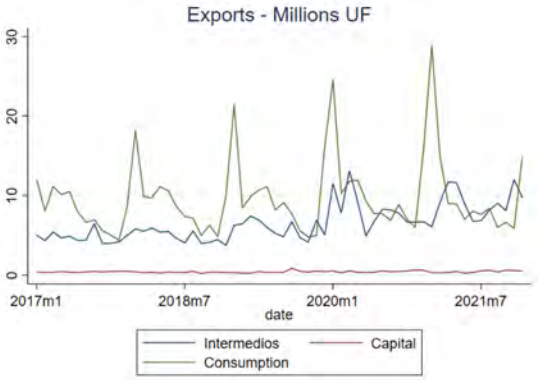


(b) Imports

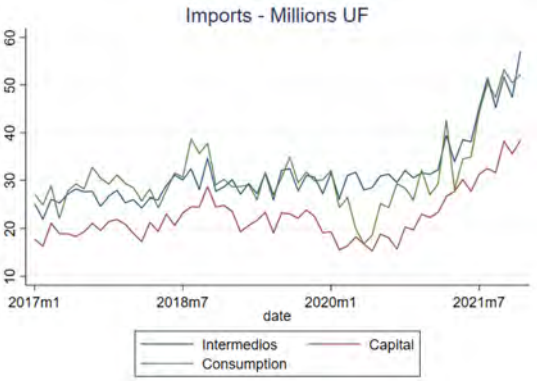


Distribution/retail firms

(c) Exports



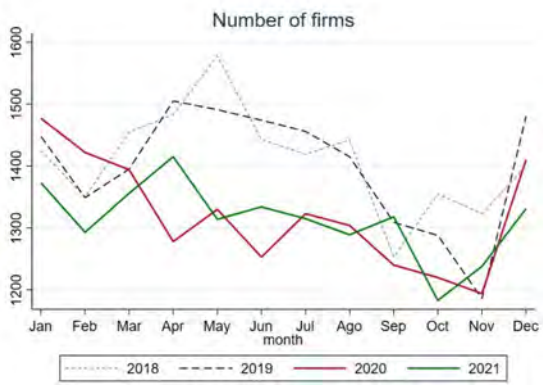
(d) Imports



Notes: Based on dataset after the cleaning procedure detailed in Section 2. We exclude the sectors: mining and public administration. Based on Broad Economic Categories (BEC). Imports in Panel (b) show that import trade consists primarily of intermediate inputs as shown the higher share of imports. *Sources:* Chilean Customs.

Figure E.10: Number of Firms

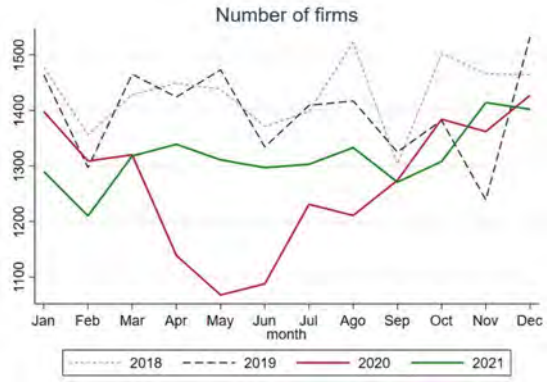
(a) Only exporters



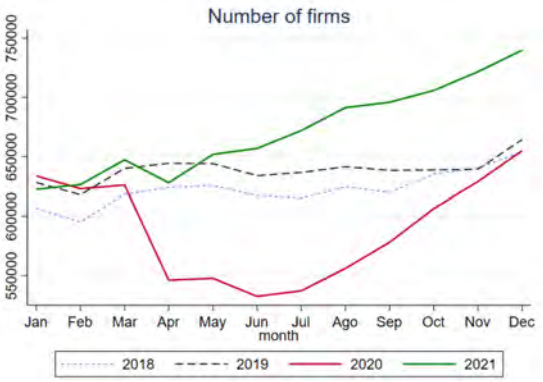
(b) Only importers



(c) Two-way traders



(d) Do not Export - Import



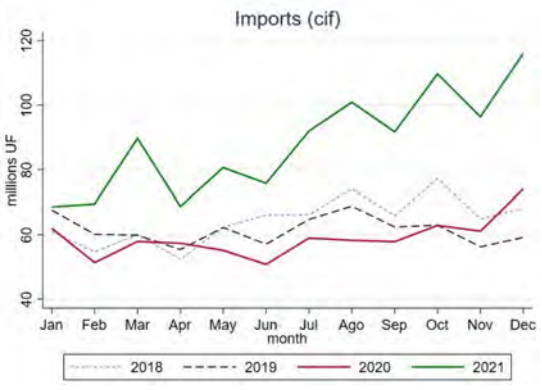
Notes: Panel (a) reports the number of firms that only report exporting activity. In Panel (b) the number of firms that only import and in Panel (c) firms that declare to participate on both types of activity. In Panel (d) the number of firms that neither export nor import. Based on dataset after the cleaning procedure detailed in Section 2. We exclude the sectors: Mining and Public Administration.
Sources: Chilean Customs.

Figure E.11: Exported/imported Volumes by type of firm

(a) Only exporters



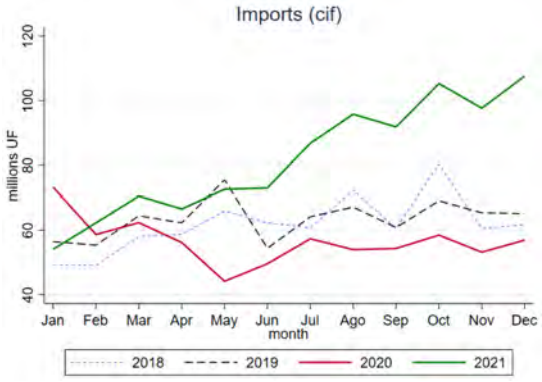
(b) Only importers



(c) Two-way traders



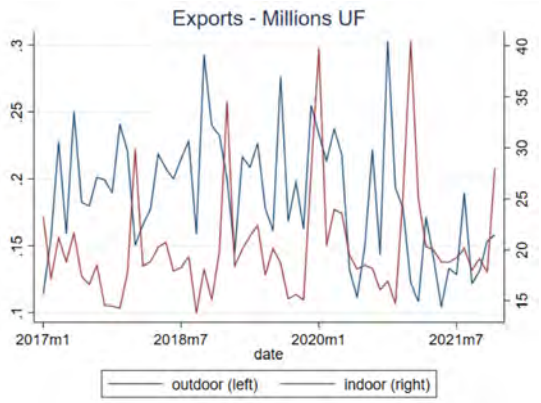
(d) Two-way traders



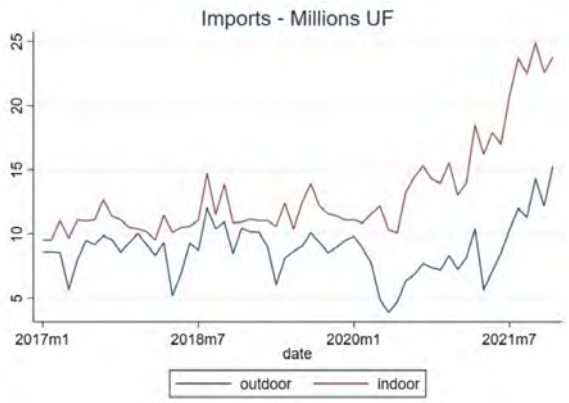
Notes: Panel (a) plots the exported volume by only exporter firms. Panel (b) only importers. In Panels (c) and (d) the volumes traded by firms that are both exporters and importers. Based on dataset after the cleaning procedure detailed in Section 2. We exclude the sectors: Mining and Public Administration. *Sources:* Chilean Customs.

Figure E.12: Consumer goods by Type (Outdoor - Indoor)

(a) Exports



(b) Imports



Notes: Consumption goods according to BEC have been further categorized as indoor or outdoor based on de Lucio et al. (2022). Outdoor goods are those that are consumed outside the household. Dataset after the cleaning procedure detailed in Section 2. We exclude the sectors: Mining and Public Administration.
Sources: Chilean Customs and the list of HS 6-digit consumption goods with the outdoor identification can be downloaded from https://paginaspersonales.deusto.es/aminondo/Research.htm.

International sourcing during Covid-19: How did Chilean firms fare?

Jennifer Peña[§] and Elvira Prades[*]

Central Bank of Chile Banco de España

External Statistics After the Pandemic: Addressing Novel Analytical Challenges
Irving Fisher Committee on Central Bank Statistics — BIS-ECB-BdE

Madrid, 12 February 2024

[§] The views and conclusions presented do not necessarily reflect the position of the Central Bank of Chile or its Board members.
[*] The views and conclusions presented do not necessarily reflect the position of the Bank of Spain or the Eurosystem.

Motivation

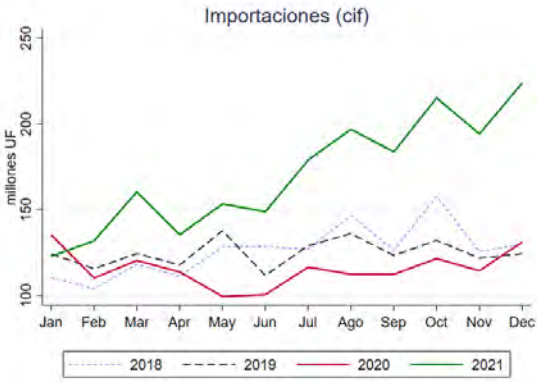
- Covid-19 unprecedent shock: demand/supply.
- How have Chilean firms swiftly pivoted and transformed their activities to navigate the challenges posed by the COVID-19 pandemic? Through which margins?
  - **Domestic margins** → Data on firm turnover, employment, domestic supplier/clients Albagli, Fernández, Guerra-Salas and Huneuus (2023).
  -  This paper:
    - We empirically characterize the mechanics of trade adjustment during the Covid crisis and its aftermath.
    - **International links** → In this paper we explore the links with foreign suppliers/clients. Exports and import dynamics *intensive margin* and *extensive margin*.
    - Why do we care on international supply churning? Input varieties have an impact on productivity and costs for production for a firm.
    - Regression based approach, "let (micro) data speak".

The Dataset

- Massive effort by the CBCh to build in a repository anonymous administrative data for Policy&Research.
- We make use of a combination of two sources of data (at the firm-level):
  - **VAT form - F29 SII:** Data on sales/turnover, material, wagebill, number of employees, sector, ...
  - **Customs - DIN and DUS formulaires:** Detailed Transaction based Trade Data from Customs. Information on firm-level transactions at HS-8 digit and country of origin/destination of the trading partners, this allows to obtain more details on the relationships with foreign suppliers/clients. Info on Volumes and Quantities, we can recover Unit Values.
- **Time span:** 2017m1-2021m12 (up dated regularly: 2023m9).
- Sectors excluded: Mining, EGW and Public Administration.
- Basic cleaning ▸ CLEANING STEPS to guarantee consistency and keep high coverage

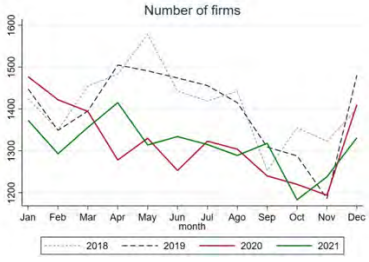
International Trade Developments





Few firms are engaged in international trade

(a) Only Exporter



(b) Only Importer



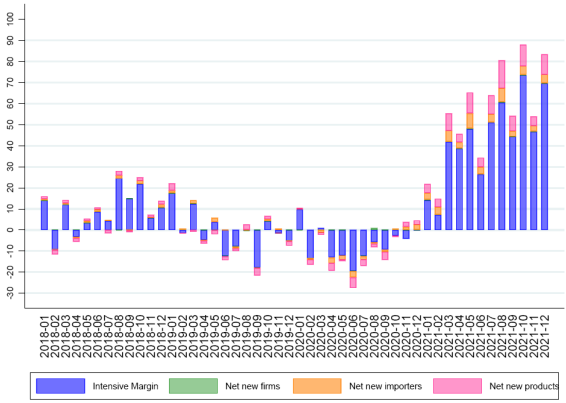
(c) Two-way trader



Import dynamics and margins of adjustment

(a) Import growth dynamics: product margin

Distribution firms: wholesale/retail

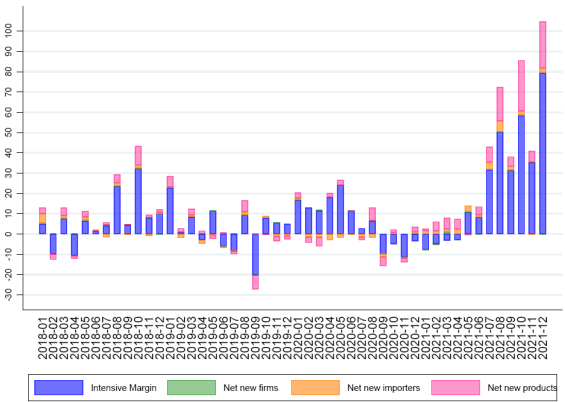


- Sharp recovery in imports by firms operating in the distribution sector.
- Those firms that were already importers in $t - 12$, increased their product portfolio.
- The net contribution of firms entering import activities is small.
- ▸ by BEC

Import dynamics

(b) Import growth dynamics: product margin

Manufacturing firms

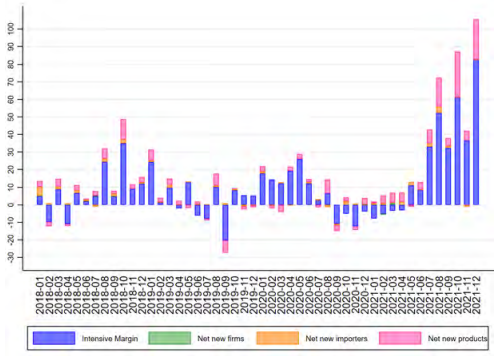


- Dynamics mainly driven by the intensive margin.
- Negative net entry in new products and firms exiting their import status. This has implications for the recovery. Concerns as regards international production network broken links, how easy will be to re-establish them (Huneuus (2019)) and possibly with new prices.
- by BEC

Import dynamics: by firm size

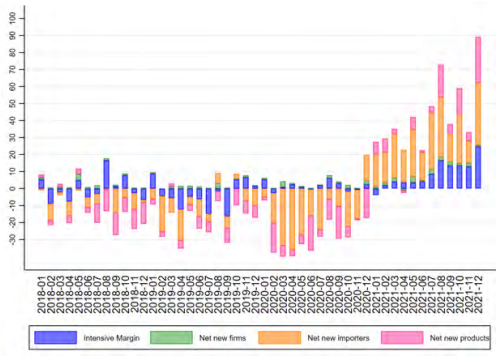
(b) Import growth dynamics: product margin

Manufacturing: Large firms



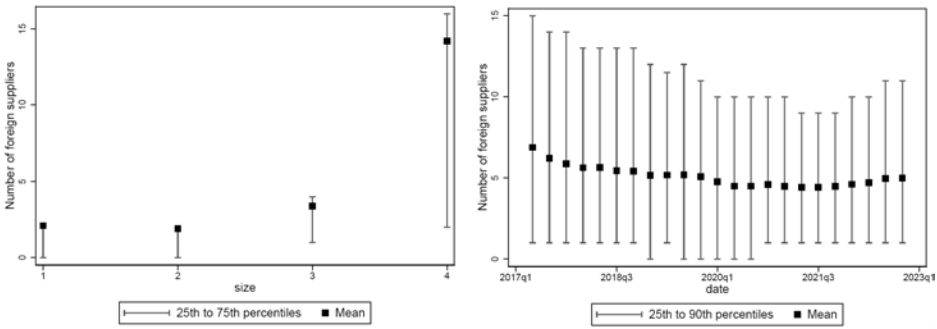
(b) Import growth dynamics: product margin

Manufacturing: Small-Medium sized firms



Number of suppliers

Figure: Number of suppliers by importer firms - Manufacturing



Sources: Merged SII and Customs and own calculations.

Empirical analysis: Firm level

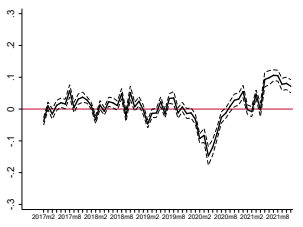
$$lnx_{it} = \nu_i + \beta_t + \gamma_X X_{it} + \epsilon_{it} \tag{1}$$

- **Dependent variables x_{it}:** (log) number of products/countries and varieties, (log) growth in exported/imported volumes, quantities, or unit values by a firm i, at time t.
- **Dummies:** time dummies.
- **Fixed effects:** (firm) (industry) (firm#time).
- **Standard errors cluster:** industry level.

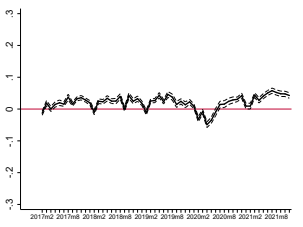
Import dynamics: Firm-level

- Time dummies (with firm fixed effects) show a sharp drop in the average number of products imported relative to early 2017.

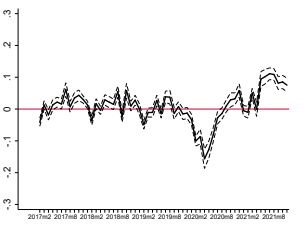
(a) Number of Products



(c) Number of Countries



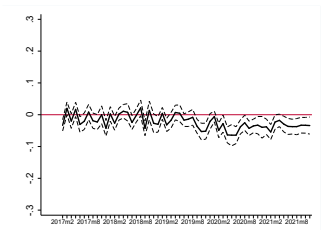
(b) Number of Varieties



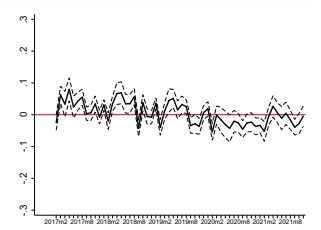
Export dynamics: Firm-level

- Time dummies show that Chilean firms slightly reduced the average (ln) number of exported products, the number of destination countries and varieties (product#destination) since the start of the covid outbreak.

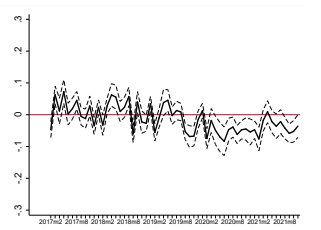
(a) Number of Products



(c) Number of Countries

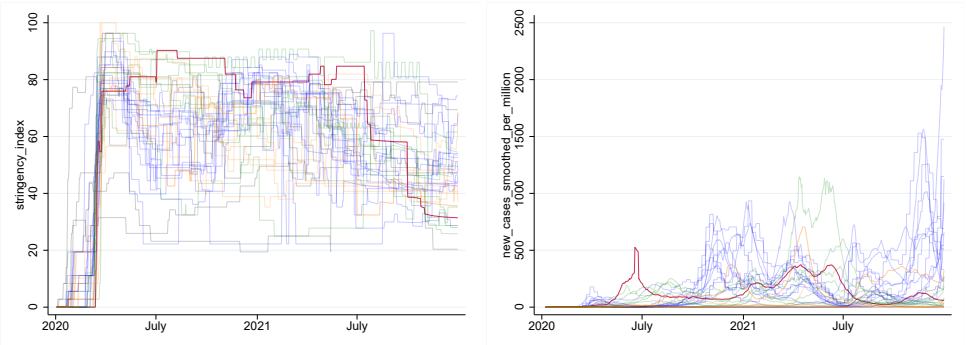


(b) Number of Varieties



The role of trading partners...

Figure: Stringency index and health situation 2020/21



Source: Oxford COVID tracker and Our World in Data (OWID)
`https://ourworldindata.org/covid-deaths`.

Empirical analysis: Firm-Product-Country level

$$\begin{aligned}\Delta \mathsf{X}_{ijkt+h} \quad = \quad & \beta_1 \mathsf{Stringency}_{jt} + \beta_2 \mathsf{COVIDC}_{jt} + \\ & \beta_3 \mathsf{Stringency}_{\mathsf{chl},t} + \beta_4 \mathsf{COVIDC}_{\mathsf{chl},t} + \\ & \alpha_{jk} + \sigma_i + m_t a_t + \varepsilon_{ijkt},\end{aligned} \tag{2}$$

- **Dependent variable:** $\Delta \mathsf{X}_{ijkt+h}$ is the h (if 1 monthly, if 12 yearly) variation of X, which can be: (i) imports values or (ii) export values by firm i, of product k from/to country j.
- **Variable of interest:** Health situation/containment measures in/taken by trading partners ▸ Oxford
- Similar approach to Cerdeiro and Komaromi (2020) → daily, country, product and to Meier and Pinto (2021) analyze the exposure to China.

Import growth

VARIABLES	(1) Δ Import$_{ijkt}$	(2) Δ Import$_{ijkt}$	(3) Δ Import$_{ijkt}$	(4) Δ Import$_{ijkt}$	(5) Δ Import$_{ijkt}$	(6) Δ Import$_{ijkt}$
$COVIDC_{chl}$	-0.522***		-0.450***	-0.385***	-0.370***	-0.375***
	(0.033)		(0.042)	(0.042)	(0.044)	(0.043)
$Stringency_{chl}$	-0.316***		-0.403***	-0.151***	-0.170***	-0.143***
	(0.014)		(0.023)	(0.031)	(0.033)	(0.032)
$COVIDC_j$		-0.048**	-0.192***	-0.134***	-0.135***	-0.125***
		(0.022)	(0.023)	(0.026)	(0.030)	(0.029)
$Stringency_j$		-0.176***	0.194***	0.057*	0.060	0.034
		(0.018)	(0.025)	(0.034)	(0.038)	(0.037)
$log(tc_d12)$	-0.007***	0.000	-0.005***	0.005***	0.005***	0.005***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Observations	647,320	443,213	435,054	430,773	423,979	430,771
R-squared	0.002	0.000	0.002	0.041	0.086	0.041
number of firms	21718	15646	15525	11244	10990	11244
number of products	4023	3841	3837	3794	3375	3794
Firm FE				✓	✓	✓
Year FE				✓	✓	✓
Country FE						✓
Product FE					✓	

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Export growth

VARIABLES	(1) Δ Export$_{pkt}$	(2) Δ Export$_{pkt}$	(3) Δ Export$_{pkt}$	(4) Δ Export$_{pkt}$	(5) Δ Export$_{pkt}$	(6) Δ Export$_{pkt}$
$COVIDC_{chl}$	-0.121		-0.085	-0.041*	-0.085	-0.053*
	(0.144)		(0.148)	(0.034)	(0.148)	(0.034)
$Stringency_{chl}$	0.027		0.019	0.021	0.019	0.015
	(0.067)		(0.069)	(0.071)	(0.069)	(0.072)
$COVIDC_j$		-0.098	-0.060	-0.059	-0.055	-0.059
		(0.146)	(0.148)	(0.151)	(0.157)	(0.151)
$Stringency_j$		0.079	0.015	0.074	0.012	0.074
		(0.072)	(0.070)	(0.074)	(0.069)	(0.074)
$log(tc_d12)$	0.016***	0.016***	0.017***	0.017***	0.017***	0.017***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	106,035	101,254	106,035	101,254	106,035	101,254
R-squared	0.039	0.040	0.038	0.039	0.038	0.039
number of firms	2557	2518	2557	2518	2557	2518
number of products	1839	1807	1839	1807	1839	1807
Firm FE				✓	✓	✓
Year FE				✓	✓	✓
Country FE						✓
Product FE					✓	

Imports by Broad Economic Category

VARIABLES	(1) Consumption Δ Import$_{ijkt}$	(2) Capital Δ Import$_{ijkt}$	(3) Intermediates Δ Import$_{ijkt}$
$COVIDC_{chl}$	-0.511***	-0.190**	-0.403***
	(0.111)	(0.097)	(0.053)
$Stringency_{chl}$	-0.340**	-0.186***	-0.106***
	(0.091)	(0.058)	(0.039)
$COVIDC_j$	-0.014	-0.089*	-0.179***
	(0.058)	(0.061)	(0.033)
$Stringency_j$	0.046	0.162**	0.027
	(0.098)	(0.068)	(0.042)
$log(tc_d12)$	-0.002	0.005**	0.007***
	(0.003)	(0.002)	(0.001)
Observations	78,225	89,721	259,675
R-squared	0.095	0.051	0.054
number of firms	4371	3207	7981
number of products	766	504	2207
Country FE			
Product FE	✓	✓	✓
Year FE	✓	✓	✓
Firm FE	✓	✓	✓

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

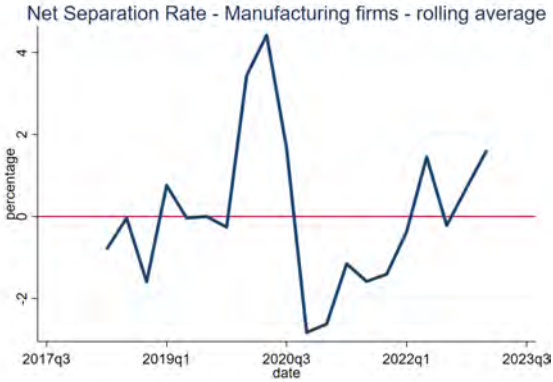
Note: Based on dataset after basic cleaning. EGW, Mining and Public Administration sectors have been excluded. Monetary values are in Unidades de Fomento (UF).

International Supply Chains

- On separation rates, entry rates and net separation rates.

$$X_{it} = \alpha + \beta_{2020} \times I_{2020} + \beta_{2021} \times I_{2021} + \beta_{2022-23} \times I_{2022-23} + FE_i + \varepsilon_{it} \quad (3)$$

Net separation rates



International Supply Chains

Table: Difference-in-differences estimates for key outcomes

	Separation Rate	Entry Rate	Net sep.	Distance (in Km)	HHI (mean)
$1(t = 2020)$	0.015***	0.008	0.010***	120.7***	0.003
	(0.004)	(0.004)	(0.007)	(25.896)	(0.001)
$1(t = 2021)$	-0.005	-0.007*	0.002	23.7	-0.002
	(0.004)	(0.004)	(0.006)	(25.776)	(0.001)
$1(t = 2022\text{-}23)$	0.020***	-0.004	0.030***	39.3	0.002
	(0.004)	(0.004)	(0.006)	(27.296)	(0.001)
Constant	0.566***	0.572***	-0.007***	1,875.5***	0.922***
	(0.002)	(0.002)	(0.002)	(11.485)	(0.001)
Observations	25,020	25,020	25,020	25,020	25,020
R-squared	0.198	0.204	0.050	0.708	0.487
number of firms	2132	2132	2132	2132	2132
Firm FE	yes	yes	yes	yes	yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Firm-level characteristics (I)

$$\begin{aligned} X_{it} = \alpha + \gamma_{2020}[1(t = 2020)] + \gamma_{2021}[1(t = 2021)] + \gamma_{2022\text{-}23}[1(t = 2021)] + \\ \beta_{2020}[1(t = 2020) \times (Z_i)] + \\ \beta_{2021}[1(t = 2021) \times (Z_i)] + \\ \beta_{2022\text{-}23}[1(t = 2022\text{-}23) \times (Z_i)] + \\ FE_i + \varepsilon_{ikt} \end{aligned} \quad (4)$$

- Distance
- Input concentration, at the product level or at overall suppliers
- Number of suppliers
- Specificity of imported inputs (Rauch99)

Firm-level characteristics (II)

Table: The role of distance

VARIABLES	(1) sep_rate	(2) entry_rate	(3) sep_rate_net
2020	0.024***	0.003	0.024***
	(0.004)	(0.004)	(0.007)
2021	-0.005	-0.009**	0.005
	(0.004)	(0.004)	(0.006)
2022-23	0.025***	-0.003	0.032***
	(0.004)	(0.004)	(0.006)
1(t=2020) $\times$(Distance$_j$)	-0.063***	0.037***	-0.130***
	(0.013)	(0.013)	(0.029)
1(t=2021) $\times$(Distance$_j$)	-0.012	0.018	-0.042
	(0.012)	(0.012)	(0.026)
1(t=2022-23) $\times$(Distance$_j$)	-0.034***	0.001	-0.034
	(0.013)	(0.012)	(0.029)
Constant	0.568***	0.571***	-0.005*
	(0.002)	(0.002)	(0.003)
Observations	25,020	25,020	21,335
R-squared	0.199	0.205	0.051
number of firms	2132	2132	1917
Firm FE	✓	✓	✓

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Firm-level characteristics (III)

VARIABLES	(1) sep_rate	(2) entry_rate	(3) sep_rate_net
Distance			
1(t=2020) $\times$(Distance$_j$)	-0.063***	0.037***	-0.130***
	(0.013)	(0.013)	(0.029)
1(t=2021) $\times$(Distance$_j$)	-0.012	0.018	-0.042
	(0.012)	(0.012)	(0.026)
1(t=2022-23) $\times$(Distance$_j$)	-0.034***	0.001	-0.034
	(0.013)	(0.012)	(0.029)
Concentration product level			
1(t=2020) $\times$(HHI$_{jk}$)	-0.033***	0.020*	-0.052**
	(0.012)	(0.012)	(0.025)
1(t=2021) $\times$(HHI$_{jk}$)	0.006	-0.006	0.025
	(0.011)	(0.011)	(0.020)
1(t=2022-23) $\times$(HHI$_{jk}$)	-0.012	0.000	0.003
	(0.012)	(0.011)	(0.024)
Concentration firm level			
1(t=2020) $\times$(HHI$_j$)	-0.044***	0.018*	-0.076***
	(0.011)	(0.010)	(0.020)
1(t=2021) $\times$(HHI$_j$)	-0.015	0.015	-0.043**
	(0.010)	(0.010)	(0.018)
1(t=2022-23) $\times$(HHI$_j$)	-0.044***	0.003	-0.046**
	(0.011)	(0.010)	(0.020)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Main takeaways

- In this work we offer a detailed account on the international sourcing behaviour of Chilean firms using very dis-aggregated level data. We cover Covid-19 period and the aftermath $\rightarrow$ evidence of heterogeneous behavior among firms.
- We explore the role of partner countries as well as firm characteristics to follow-up the importing activity.
- Up to know, we have analyzed the behavior of **direct international links**...
- ... but we are missing the indirect exporting/importing, the role of wholesalers, and exploit the information on B2B transactions ("FE") (see Marcel and Vivanco (2021) and Albagli, Fernández, Guerra-Salas y Huneuus (2023)).
- **Further work:** A focus on the implications on of supply disruptions on firm-level imported input costs and to firm productivity.

Thanks!

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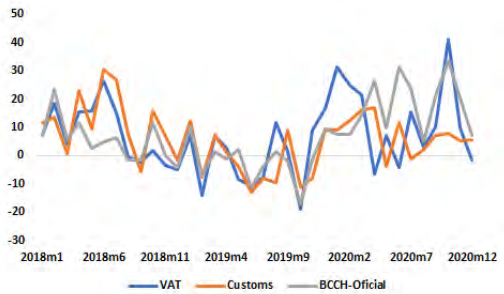
Cleaning steps DATASET

- We take away firms with negative values in sales or wage bill.
- We take away firms with just one employee .
- We take away firms with highly volatile capital stock growth or value added. Winsorized at the 90th percentile.
- We take away firms with implausible sales to labor and sales to capital.
- Compute lpr and trim the distribution 1th and 99th percentile.
- We exclude sectors: mining, utilities: Electricity, Gas and Water and Public Administration.

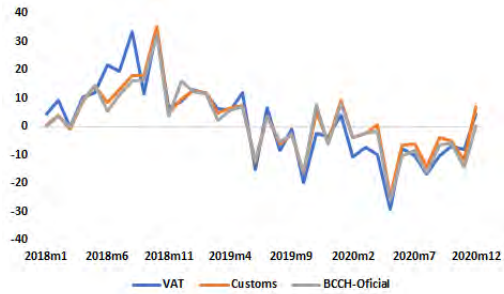
Coverage

DATASET

(a) Exports (year-on-year growth)



(b) Imports (year-on-year growth)



Summary statistics

Table: Summary Statistics

	Full sample					
	Full Sample		**non-Importers**		**Importers**	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	16.45	150.15	13.67	126.40	83.68	435.34
Sales (thousands)	1.88	174.99	1.16	169.40	33.75	883.30
Capital per worker (thousands)	0.28	0.73	0.27	0.72	0.40	0.91
Sales per worker (thousands)	0.18	0.30	0.17	0.28	0.40	0.50
Export (thousands)	0.14	11.69	0.05	3.26	3.64	69.67
Export share in output	0.51	0.40	0.60	0.38	0.29	0.34
Imports (thousands)	0.19	18.46	0.00	0.00	7.15	112.96
Import share in materials	0.50	0.31	.	.	0.49	0.30

Note: Based on dataset after basic cleaning. EGW, Mining and Public Administration sectors have been excluded. Monetary values are in Unidades de Fomento (UF).

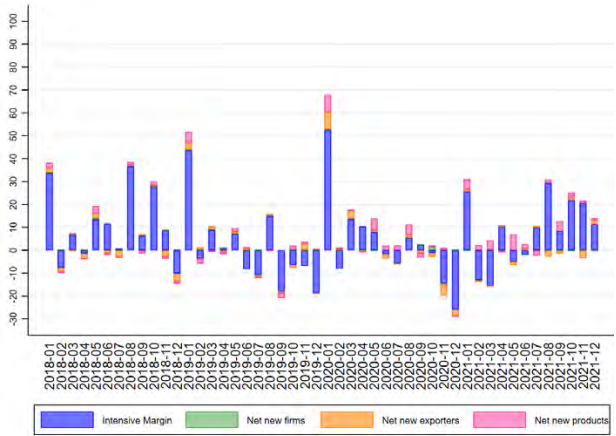
Imported varieties

	Importer firms					
	Number of Products			Countries of Origin		
sectors	Mean	Median	Max	Mean	Median	Max
Agriculture (n=11,069)	3.5	1.0	142	1.8	1.0	26
Manufacturing (n=46,533)	6.6	2.0	427	2.6	1.0	42
Construction (n=9,726)	3.3	1.0	107	1.5	1.0	23
Wholesale/retail(n=140,235)	5.7	2.0	387	1.9	1.0	34
Transportation (n=12,128)	2.3	1.0	79	1.4	1.0	23
Financial Activities (n=2,969)	2.0	1.0	51	1.3	1.0	13
Housing Activities (n=1,014)	1.6	1.0	23	1.1	1.0	9
Business Services Activities (n=20,601)	2.1	1.0	186	1.3	1.0	30
Personal Services (n=20,788)	1.4	1.0	80	1.1	1.0	12
Total (n=265,063)	4.9	2.0	427	1.8	1.0	42

Note: Based on dataset after basic cleaning. EGW, Mining and Public Administration sectors have been excluded. Monetary values are in Unidades de Fomento (UF).

Export dynamics and margins of adjustment

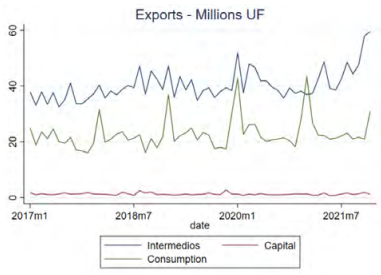
(a) Exports growth dynamics: product margin



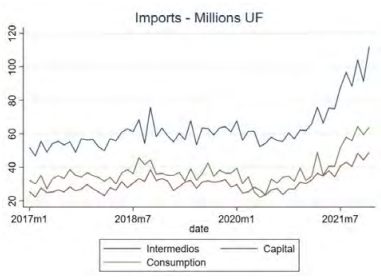
- Aggregate dynamics, decomposed into:
  1. intensive margin
  2. net extensive margins:
     (a) new products
     (b) new exporter.
- Exports fared relatively well.
- Dynamics mainly driven by the intensive margin.
- Net entry in new products/new destinations.
- Firms stopping their exporting activity.

By type of good: Broad Economic Categories (BEC) DATASET

(a) Exports



(a) Imports



IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Intangible assets of multinational enterprises in Ireland and their impact on euro area activity[1]

Malin Andersson, Nina Blatnik, Lorenz Emter, Valerie Jarvis,
Belén Gonzalez Pardo, Martin Schmitz, Nico Zorell
and Christoph Zwick,
European Central Bank;

Stephen Byrne,
Central Bank of Ireland

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Intangible assets of multinational enterprises in Ireland and their impact on euro area activity

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Abstract

The activities of multinational enterprises (MNEs) have become an increasingly important feature of the euro area economy, affecting output, trade and financial linkages. MNEs contribute to domestic output by maintaining large production facilities, offering high-paid jobs, bringing in new technologies and generating tax revenues. Following statistical changes implemented in 2015 to better capture the increasing importance of intangible investment, the economic impact of MNE activities has become much more evident in measures of intellectual property product (IPP) investment and external IPP trade flows. MNE activities, which often entail large and instantaneous transfers of IPP, are frequently highly volatile and can blur real-time assessment – and forecasting – of the business cycle, the current account and the capital stock in the euro area. Focusing on Ireland, given the strong prevalence of MNE activities in that economy and their importance for the euro area aggregate, this paper assesses the usefulness of the "modified" series for Irish non-construction investment and services imports. Using the modified series would provide a more accurate picture of the domestic dynamics of the Irish economy and enhance real-time assessment of the euro area business cycle, current account and capital stock. This paper brings insights into the unwinding of IPP shocks, which is a more straightforward exercise than seeking to anticipate the shocks themselves. The conclusions of this work underline the urgent need for more granular and internationally harmonised data on MNE activities to gain a clearer understanding of the dynamics of IPP operations and the implications for both short and long-term macroeconomic developments.

Keywords: Intangible capital, multinational firms, macroeconomic impact of globalisation
JEL classification: E22, F23, F62

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Executive summary

Over the past few decades, a multitude of MNE activities have become increasingly important for economic activity in the euro area and across countries. MNEs[1] are companies producing goods or delivering services in more than one country, spanning all economic sectors and encompassing a wide range of operational patterns. Foreign-owned firms' share of total output in euro area countries increased from 12% in 2000 to 18% in 2019. Through their activities, MNEs contribute to domestic output, typically by maintaining large production facilities, offering high-paid jobs, bringing in new technologies and generating tax revenues. At the same time, some MNE activities are intrinsically volatile. As MNE activities have become more prevalent and increasingly involve intangible knowledge-based assets, national accounting standards have been adapted to better capture this phenomenon. The implementation of the European System of National and Regional Accounts 2010 (ESA 2010) in 2015 has meant that investment in, and imports of, intellectual property assets now directly affect measures of gross domestic product (GDP) and expenditure components. However, the resulting changes in the level, growth rate and volatility of measures of activity increasingly pose challenges to assessment, at both national and euro area level, of the business cycle, current account and capital stock, and complicate monitoring and forecasting at both levels. This is of great importance to national central banks and the European Central Bank (ECB) in conducting their economic assessments (see Section 2).

Ireland stands out as a country in which MNE activities both disproportionately affect measures of national output and result in visible and unpredictable impacts on euro area GDP and its components. These impacts stem from the volatility of IPP investment and import data, as well as from subsequent exports of goods and services, often themselves driven, in large part, by imported IPPs. In euro area countries other than Ireland, estimates point to IPP transfers having a relatively limited impact on overall country-level output for the present, and little effect on euro area GDP or its expenditure components. This is the case even for Cyprus, Luxembourg, the Netherlands, Malta and Slovakia, which have substantial MNE activities (see Section 3).

Transfers of intangible assets to and from Ireland have caused significant volatility in the expenditure components of euro area GDP. In most cases, the impact on real euro area GDP of such transfers broadly nets out in the quarter in which they take place, given that the investment concerned is fully offset by the associated imports. However, by boosting capital stock and exports, IPP inflows contribute positively to euro area GDP over time. These effects have propelled Ireland from a weight of approximately 1% of euro area GDP in 1999 to around 5% by 2023. The euro area current account and capital stock are also affected by MNE activities (see Section 4). . The same methodology may be used to derive a modified series for imports. Complementing the headline series with these smoother modified series facilitates economic assessment of the euro area (see Section 5).

[1] See the definition given in the glossary on the "Statistics explained" page of the Eurostat website.

Turning to macroeconomic projections, it is very difficult to anticipate intangible asset transfers by MNEs given that they are firm specific, often confidential and may result from corporate tax-efficiency considerations. Looking more specifically at the ex post patterns of Irish IPP transfers and the resulting shocks, large transfers typically take place within a single quarter and have increased in frequency and amplitude in recent times. Although surrounded by significant uncertainty, the historical pattern would suggest, as a rule of thumb, that IPP growth broadly reverts to its historical average in the quarter following the shock concerned. Out-of-sample simulations of the unwinding of the last seven Irish IPP shocks suggest that there would be some merit in applying a parametric modelling approach to assessing post-shock dynamics (see Section 6).

This paper summarises the findings of a Eurosystem expert group on MNEs.[2] The conclusions reached by the group were, first, that the modifications to the national accounts data compiled and published by the CSO in Ireland to address the specific features of the Irish economy contribute positively to economic assessment of the euro area. Second, while it is extremely difficult to foresee transfers of intangible assets ex ante, a rule of thumb approach based on historical regularities, and simulation exercises have proven to be of benefit in capturing more accurately the ex post patterns of large Irish IPP transfers. Third, there is a strong need for more granular and internationally harmonised data on MNE activity (see Section 7).

[2] The expert group is a subgroup of the Eurosystem Working Group on Forecasting.

1. Introduction

Multinational Enterprises (MNEs) have become an increasingly important feature of the euro area economy. In addition, the profits of some of the world's largest MNEs derive mainly from intangible assets (software, patents and other IPPs). This, coupled with increasingly complex cross-border corporate structures, means that some MNE activities may introduce significant volatility into measures of economic activity. While national accounting standards have made great strides in incorporating new metrics to account for these phenomena, the resulting changes to measures of activity, such as GDP, investment and imports, pose increasing challenges to the assessment of the business cycle, current account, and capital stock. This has been the focus of an expert group on multinational enterprises composed of staff from several national central banks and the ECB and reporting to the Eurosystem Working Group on Forecasting.

Ireland stands out as a country in which MNE activities both disproportionately affect national output measures and have visible impacts on euro area GDP and its components, owing to volatile IPP investment and imports and to subsequent exports of services and goods.

This paper points to the urgent need for more granular and internationally harmonised data on MNE activities to improve understanding of the dynamics of these operations and their implications for both short and long-term macroeconomic developments.

2. MNE activities and measurement issues

MNE activities represent an increasing share of economic activity globally and in the euro area. These activities take several forms, including production for domestic or export markets, cross-border production, supply chains and the provision of financial and consultancy services.[3] For example, the share of euro area gross output produced by firms not headquartered in the country in which their production takes place increased from 12% in 2000 to 18% in 2019, according to data produced by the Organisation for Economic Co-operation and Development (OECD). Most of this increase is driven by global corporations across a wide range of sectors with head offices that are established outside the euro area. The activities of these MNEs are particularly important in Ireland, Luxembourg, Slovakia, Malta and the Netherlands (Chart 1). For some countries, such as Slovakia, MNE activity is mostly driven by companies headquartered in other euro area countries, while Ireland stands out with the highest share of MNEs with headquarters outside the euro area. Within the euro area, foreign-controlled MNE activities are particularly prevalent in the pharmaceutical, refined petrol product, information and communications technology (ICT) and chemical sectors (Chart 2). The increasing importance of MNEs represents structural changes driven, for instance, by digitalisation, economic integration, financial liberalisation and increased competition.[4] This trend is likely to persist, despite moves in certain areas towards deglobalisation, as reflected in reshoring and the shortening of supply lines on the grounds of strategic autonomy.[5]

A particularly important MNE activity affecting national accounts is related to the creation and transfer of intangible assets, which have typically grown more strongly than tangible assets over the past two decades. This is especially the case in knowledge-intensive industries, such as ICT and pharmaceuticals, where a large proportion of the value of a product lies in its intellectual property. There is an increasing divergence between the market capitalisation of many large firms in certain sectors and their investment in tangible assets.[6] For many firms, know-how and intangible assets, such as digitised information and resources (software, databases) and innovative property (e.g. research and development (R&D) and artistic originals), are the primary drivers of their profits.

While intangible assets are an important factor in production in knowledge-intensive industries, they also play a pivotal role in the tax-optimisation activities of MNEs. By transferring such assets to countries with an attractive corporate tax system, MNEs can reduce the tax burden on income streams they derive from these assets. The decisions taken by MNE groups on their corporate structure may,

3 More broadly, such activities also entail transfers of IPPs, redomiciliation of headquarters, goods sent abroad for processing/contract manufacturing, merchanting, quasi-transit trade, transfer pricing and aircraft leasing. For more information, see Table A in the Annex.

4 With the increasing importance of intangible assets, firms are likely to operate in MNE structures with foreign affiliates under their control in order to retain IPPs within their structures (Rugman, 1981).

5 See Attinasi et al. (2023).

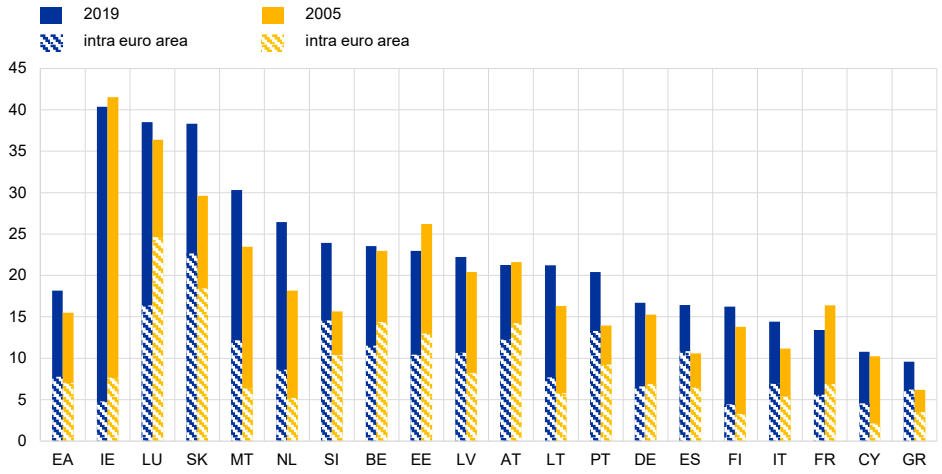
6 See Corrado et al. (2022).

in turn, trigger large shifts in aggregate investment and import expenditures, given that macroeconomic statistics are compiled on a residency basis.

Chart 1

Non-domestic MNE share of output across euro area countries

(percentages of gross national output)



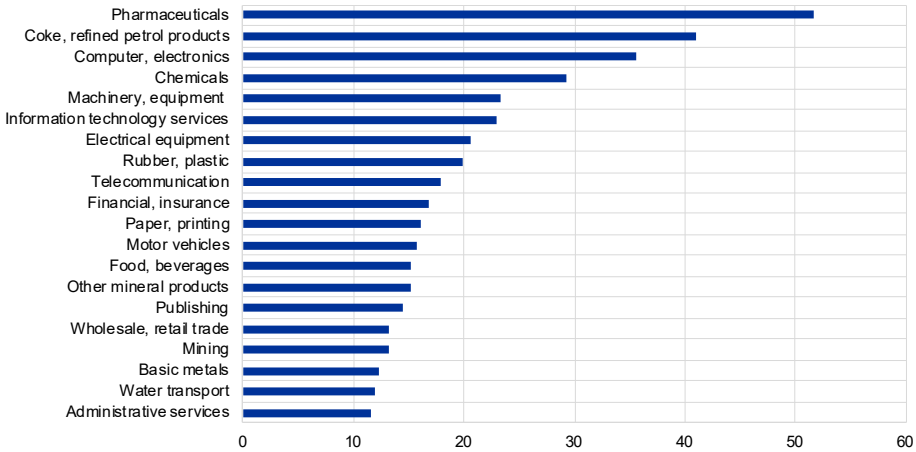
Sources: Organization for Economic Co-operation and Development – Activity of Multinational Enterprises (OECD AMNE) database and own calculations.

Notes: EA stands for euro area. The countries are in descending order based on the size of their MNE output in 2019. The share of total gross output produced by firms not headquartered in their respective home countries is calculated on the basis of the total output for the country concerned. Intra-euro area refers to production in the respective country by firms headquartered in another euro area country. Gross output refers to turnover before deduction of the value of intermediate goods used up in production by the 41 industries, including the financial and insurance sectors, covered by the OECD AMNE database.

Chart 2

Foreign MNE activities across sectors in the euro area

(percentages of euro area gross output in 2019)



Sources: Organization for Economic Co-operation and Development – Activity of Multinational Enterprises (OECD AMNE) database and own calculations.

The sharp increase in the importance of intangible assets and MNE activities has been partly addressed by more accurate measurement of these transactions

by statistical agencies.[7] These cross-border activities are, however, intrinsically complex and the operations of international networks are highly diverse, posing major challenges for national economic statistics. The European System of National and Regional Accounts (ESA 2010) introduced conceptual and practical changes to the ways in which economic activity and various facets of globalisation are measured. Chief among these, in terms of their effect on euro area measures of output, is the classification of R&D as capital formation of IPPs. As a result, the movement of intellectual property assets across borders between subsidiaries of MNEs has led to large spikes in gross fixed capital formation and related services imports in certain countries since 2015.[8]

Work in the statistical field is ongoing to ensure a more accurate picture of these MNE activities. For instance, Eurostat is working on: (1) an early warning system[9] to detect the restructuring of MNEs and ensure consistent reporting; and (2) a pilot scheme covering data on selected MNEs to enhance measurement of gross national income (GNI). It has also set up a task force on integrated global accounts and established a joint task force on IPPs in conjunction with the OECD.[10] At this stage, no major changes to the core national accounts are planned as part of the ongoing review of the system of national accounts (SNA), the European system of accounts (ESA) and the balance of payments manual (BPM).[11] Any changes contemplated in the next ESA review (ESA 2025) would be of a granular nature and relate to sectoral accounts, with a view to revised national accounts data being published in 2029.

With regard to special-purpose entities (SPEs), which are often sponsored by foreign-controlled MNEs in the euro area, an international definition was agreed in 2018 by the dedicated International Monetary Fund Committee on Balance of Payments Statistics (IMF BOPCOM) Task Force with the aim of collecting comparable cross-country data that separately identify SPEs in cross-border statistics. The ECB started publishing euro area and national balance of payments data on SPEs in April 2024.[12]

ECB statistical working groups are also developing data enhancements in both national accounts and balance of payments to capture the role of foreign-controlled non-financial corporations. In parallel, Ireland's CSO has developed a set of indicators that are designed to remove specific MNE-related data distortions from Irish national and international accounts (see Section 5.1).

7 See UNECE (2011).

8 See, for example, Connolly (2017).

9 See the article entitled "Globalisation of Businesses: Early Warning System", published on the Eurostat website.

10 See Eurostat-OECD (2020).

11 See IMF (2021) and IMF (2022).

12 See ECB (2024).

3. MNE activities across euro area countries with area-wide impacts

MNE activities may have a disproportionate impact on national output, especially for smaller countries. Three types of MNE activities are particularly important in this regard.

First, *intangible investment and imports of* R&D services, reflecting the growing importance of intangible assets and the relative ease with which these can be relocated across borders (see Section 2).

Second, *contract manufacturing* agreements, where a firm in the euro area contracts another firm abroad to produce a good that is then sold in a third country without ever crossing the border of that firm's home country. During the production process, ownership of the inputs remains with the firm and hence no trade flows are recorded in the balance of payments (b.o.p.) and national accounts, other than an import by the firm of manufacturing services from the foreign company that is producing the good concerned. The sale of the final good to the third country is, however, included in the b.o.p. and national accounts, which is consistent with the change in ownership principle.

Third, *merchanting,* which refers to a merchant company purchasing a good from an entity resident abroad and subsequently selling it to a buyer in a third country without the good itself crossing the border of the country in which the merchant is based.[13] Merchanting therefore also adds to exports even though the purchased good does not enter the merchant's economy.

The impacts are often more visible for small open economies than for larger countries. For instance, the share of IPPs to GDP is larger in Ireland and Malta, as well as in France[14] and Austria, than in the euro area as a whole (Chart 3). Merchanting as a share of GDP is also relatively high in Ireland, Luxembourg and Cyprus.[15] MNE activities in Ireland are reviewed in detail in the sub-section below. While Ireland is by no means unique in having sizeable MNE intangible investment activity, the level in other countries is typically lower and rarely affects measured euro area aggregates to the same degree.[16]

[13] The difference between revenues from the sale and purchase of the good (net of any expenses incurred to finance, insure, store and transport the good) is recorded as net exports of merchanting in the goods balance of the country in which the company resides.

[14] Some caution is warranted in interpreting literally the high share of intangible investment in France. This reflects different accounting practices by national statistics offices: software and databases are much more likely to be classified as capital in French data than in other euro area countries, see Guilou and Mini (2019).

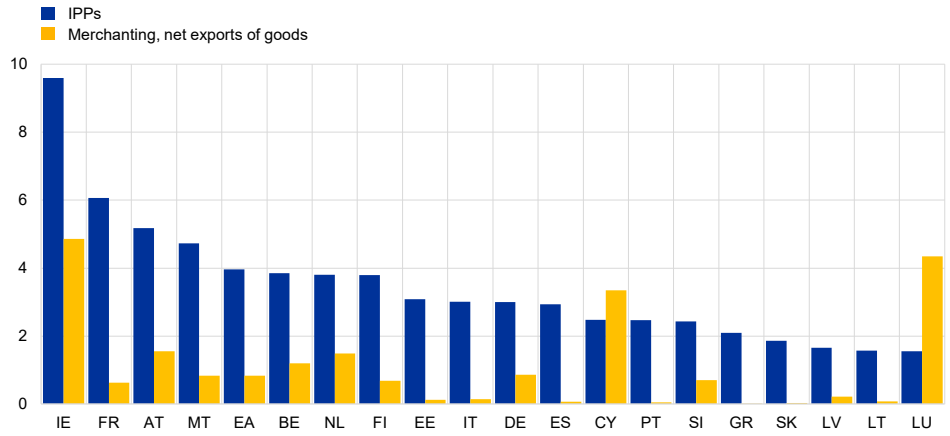
[15] In contrast to *merchanting,* data for the exact contribution of *contract manufacturing* to the b.o.p. goods trade is not available for most euro area countries.

[16] The occasional volatility in intangible investment in the Netherlands may be related to tax discounts (under the "Innovation Box" scheme) on IPP-related business (patents, copyrights, software, etc.) from 2010 onwards. In Cyprus, SPE activities relating to the provision of ship-

Chart 3

IPPs and merchanting

(percentages of gross national output in 2023)



Sources: Eurostat, ECB and own calculations.

Notes: Intellectual property products (IPPs) shows the share of intangible investment assets in nominal GDP based on national accounts data, the countries being shown in descending order. IPP values for Belgium relate to 2020. The values for merchanting are based on balance of payments data over four quarters up to the third quarter of 2023.

3.1 Impact on Ireland

Measures of economic activity in Ireland are particularly affected by the activities of MNEs, and the size and volatility of these transactions are sufficiently large to influence euro area aggregates visibly and regularly. Net primary income from abroad has represented a large and growing wedge between GDP and GNI for decades. In recent years, however, other factors - such as the size and structure of aircraft leasing firms, the very large profits of redomiciled[17] firms and the practice of moving intellectual property and other intangible assets to Irish subsidiaries - have all been playing an increasingly important role, thereby inflating Ireland's GDP.

Regarding the expenditure components of GDP, the statistical distortions are concentrated in investment, imports and exports. Most notably, lumpy investments in intangible assets by foreign-owned MNEs frequently lead to

owning services affect several national accounts sub-categories, including investment, and external statistics data. Luxembourg is generally considered highly globalised due to high levels of financial flows (e.g. related to the presence of investment funds) and foreign direct investment (FDI), while for other countries, such as Germany, Spain and Italy, the impact of MNE-related activities is reported to be increasing but still minor. France has a relatively high proportion of intangible investment related to the aerospace sector and has somewhat different accounting practices in this domain, see Guilou and Mini (2019).

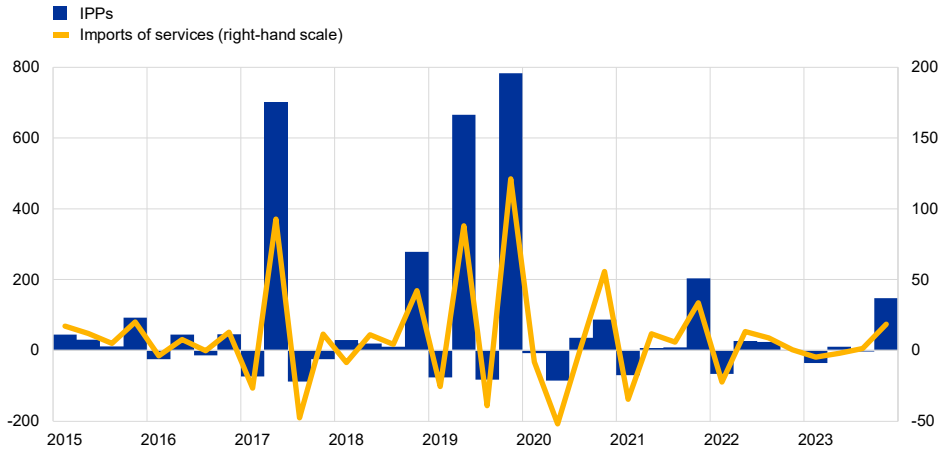
17 In Ireland, the CSO reports that "beginning in 2008 [...], a number of multinational corporations relocated their group headquarters to Ireland. As far as tax authorities were concerned, these firms were then domiciled in Ireland. These were mainly public limited companies whose shares trade on international stock exchanges. These are redomiciled Private Limited Companies in Ireland" – see the article entitled "Redomiciled PLCs", published on the CSO website in 2023. A redomiciled PLC is a company that owns large subsidiary companies which are still established overseas. The Irish headquarter holds shares or equity in these subsidiaries, and, as the owner, receives the profits of these branches abroad.

pronounced swings in Ireland's total investment and imports of services (Chart 4). Estimates of these transactions are also prone to large retroactive revisions from time to time. However, these transactions are usually GDP-neutral, given that IPP investments are generally imported and hence incorporated into IPP imports (typically resulting in broadly similar – but offsetting – percentage contributions to GDP within the same quarter). The issue is not unique to Ireland, given that it also affects the Netherlands, but Ireland has accounted for a disproportionate share of euro area IPP investment in recent years (Chart 5). Investment in and imports of aircraft for leasing purposes also usually result in offsetting contributions to GDP. By contrast, contract manufacturing (Box 1), and to a lesser extent merchanting, tends to boost both exports and GDP.

Chart 4

IPPs and import dynamics in Ireland

(quarter-on-quarter percentage changes)



Source: Eurostat.
Notes: IPP stands for intellectual property product. Estimates were used for missing values for Irish intangibles in the official data for the first quarter of 2020.
Latest observation: Fourth quarter of 2023.

Over time, the onshoring of intangible assets has boosted Ireland's GDP by generating large exports highly concentrated with certain firms. Between 2014 and 2022, exports of goods and services increased by €470 billion. The most pronounced increase was in *computer* (ICT) services (Chart 6), a category covering services related to hardware, software and data-processing, as well as cloud services, sales of software transmitted electronically and software licence fees. Such services are often provided within individual MNE groups as part of a tax-optimisation strategy.[18] Other IPP-related income streams were classified as *royalties*, i.e. charges for the use of IPP, and *business services*. The latter category includes, for instance, advertising services (a key source of revenue for some ICT companies), together with legal, accounting, and other professional services, as well as operational leasing. IPP-based exports are highly concentrated with a few MNEs, to judge from the related data on corporate tax revenues.[19]

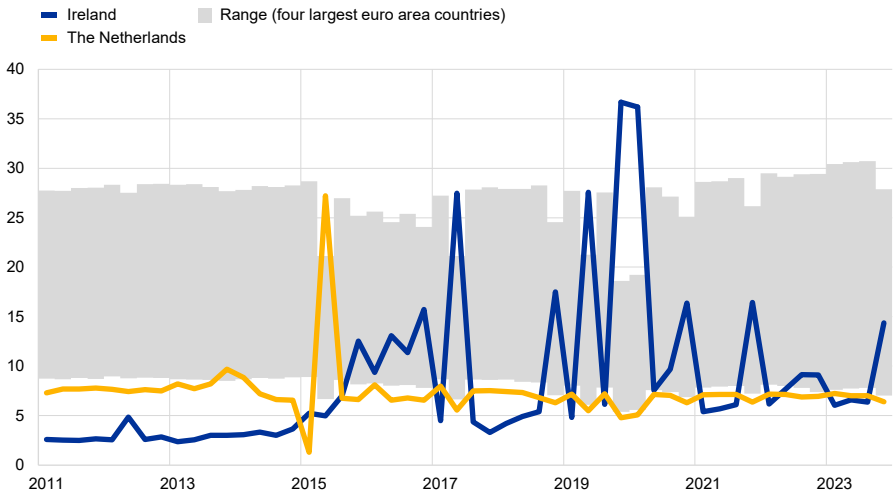
18 For a discussion of tax planning by MNEs in OECD countries, see Johansson et al (2017).

19 See Wier and Zucman (2022) and EU Tax Observatory (2024).

Chart 5

Contributions of Ireland and the Netherlands to euro area IPP investment

(percentages of euro area IPP investment)

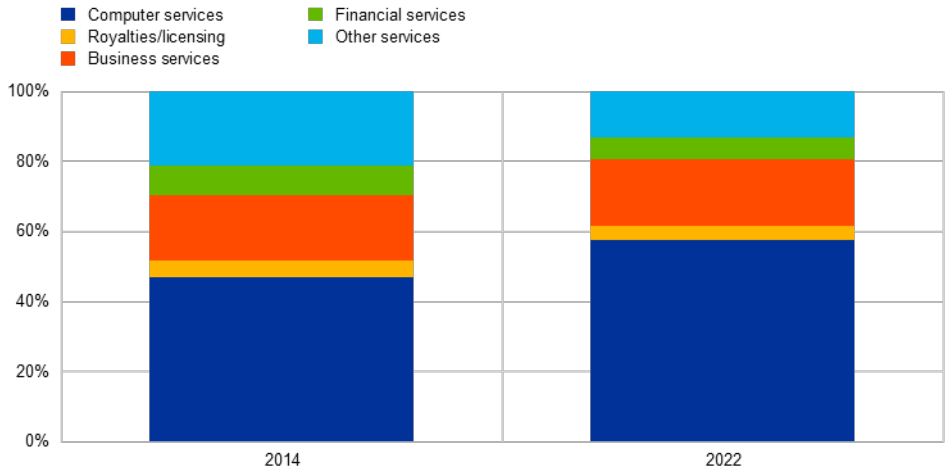


Sources: Eurostat and own calculations.
Notes: Estimates were used for missing values for Irish intangibles in the official data for the first quarter of 2020. The grey range shows the minimum and maximum values for the four largest euro area countries, namely Germany, France, Italy and Spain.
Last observation: Fourth quarter of 2023.

Chart 6

Ireland's services exports

(percentages)



Source: Central Statistics Office, Ireland.

Box 1

Contract manufacturing, merchanting and Ireland's ICT value chain

Prepared by Nico Zorell

Contract manufacturing abroad has become an important source of IPP-based export income in Ireland. Foreign contract manufacturers produce IPP-intensive goods (such as smartphones or pharmaceuticals) abroad on behalf of Irish-resident MNEs without acquiring ownership of the products. Once the goods are sold to a third party, an export is recorded in Ireland's trade balance, although the goods never enter Irish territory. Contract manufacturing exports have increased almost five-fold since 2015 and now account for almost one-quarter of total exports. Notably, contract manufacturing is also included in Ireland's industrial production data despite actual production taking place elsewhere (e.g. China).

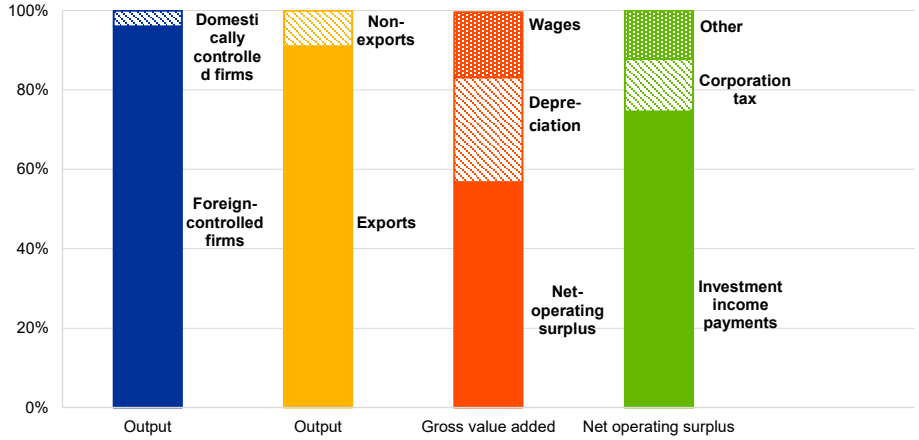
Besides contract manufacturing, Irish-resident MNEs are also involved in merchanting. This means that they acquire ownership of goods from manufacturers abroad for resale without these goods physically entering Ireland. However, the impact on GDP is more limited than for contract manufacturing given that the large quantities of goods sold under merchanting arrangements are broadly offset by goods acquired under merchanting arrangements.

Much of the IPP-related exports in Ireland require only minor domestic inputs and are thus only loosely connected with the domestic economy. Even so, they are included in Ireland's GDP, in line with international (residency-based) reporting standards.

Chart A

Ireland's ICT value chain

(percentages)



Source: Central Statistics Office, Ireland (2019).

Note: The data relate to 2019, the most recent year for which the requisite data are available.

For contract manufacturing, the loose link between exports and domestic activity is evident given that production is undertaken abroad. However, even IPP-based services exports can be scaled up and down without major effects on the domestic economy, as illustrated by a recent value chain analysis for Ireland's ICT sector[20]. In brief, the ICT sector transforms 'purchased' and 'rented' IPP capital from abroad into exported computer services while the income generated largely accrues to foreign residents. The domestic footprint, in the form of wages and taxes, is limited, although still significant for a small country like Ireland. More specifically, in 2019 (the latest available observation), foreign-controlled MNEs accounted for 96% of the output produced by the ICT sector (Chart A). Ninety-one percent of total output was exported. In terms of gross value added (GVA), 16% was paid to workers and 26% covered depreciation, while the remaining 57% was net operating surplus ('profit'). After deduction of corporation tax, this profit accrued almost entirely to foreign owners in the form of investment income.

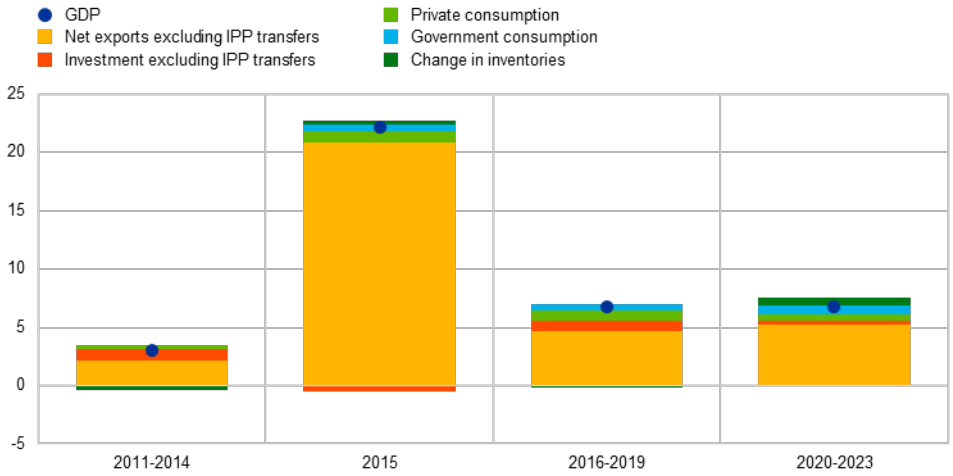
[20] See Central Statistics Office, Ireland (2019).

Propelled by IPP assets, net exports have become the main driver of Ireland's GDP. Since the statistical changes in 2015, net exports have accounted for most of the cumulated GDP growth (Chart 7). Given that they are also a particularly volatile GDP component, net exports have lifted the Irish economy on a steeper, but more volatile, growth path. They tend to grow particularly strongly in the quarters following a large IPP transfer.[21] This direct statistical relationship is fragile, however, in terms of its strength and timing, and is therefore difficult to exploit in forecasting.[22]

Chart 7

Average annual real GDP growth in Ireland

(percentage changes, percentage points)



Sources: Eurostat and own calculations.
Note: The data are based on annualised quarter-on-quarter growth rates. Intellectual property product (IPP) transfers have been netted out.

21 See FitzGerald (2018).

22 Specifically, this link is statistically insignificant in a trade model relating export growth to standard control variables and various lags of a variable capturing large IPP transfers.

4. Impact of MNE activities on the euro area

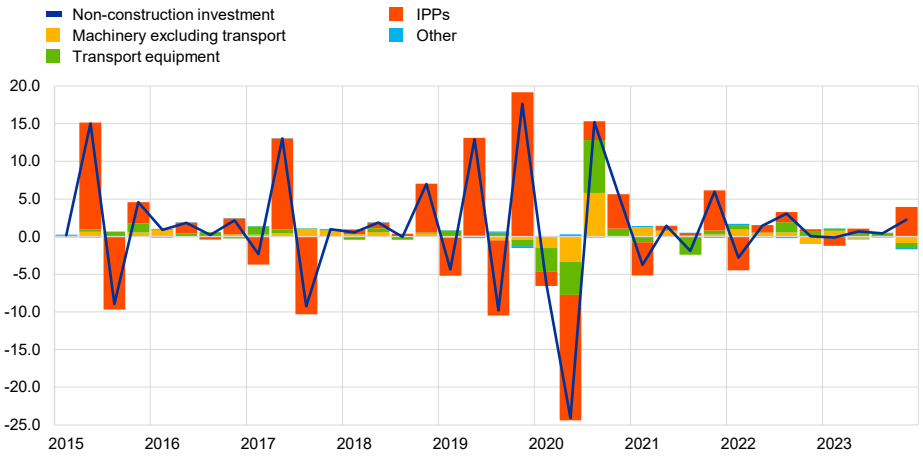
4.1 Impact on euro area GDP components

The impact of intangible investment in Ireland on euro area aggregates has been considerable in recent years in terms both of headline growth rates and of measures of levels for non-construction investment and imports. While trending upwards, reflecting the increasing importance of intangibles for the euro area, real non-construction investment growth rates have been particularly volatile since 2015, with Irish intangible investment contributing to the major part to this volatility (Chart 8 and Chart 9, panel a). In most other countries, the contribution of IPP investment to quarterly euro area non-construction growth is small. IPP-related transactions have also had a marked effect on euro area imports over the same period (Chart 9, panel b).

Chart 8

Euro area real non-construction investment across assets

(quarter-on-quarter percentage changes and percentage point contributions)



Sources: Eurostat and own calculations.

Notes: IPP stands for intellectual property product. Estimates were used for missing values for Irish intangibles in the official data for the first quarter of 2020.

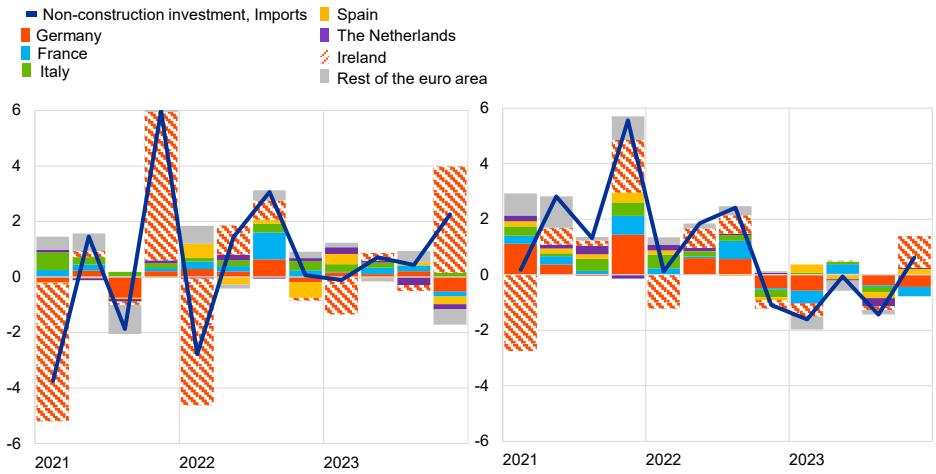
Latest observation: Fourth quarter of 2023.

Chart 9

Euro area real non-construction investment and imports by country contribution

(quarter-on-quarter percentage changes and percentage point contributions)

a) Non-construction investment b) Imports



Sources: Eurostat and own calculations.
Latest observation: Fourth quarter of 2023.

Turning to the level of investment, the fact that the pre-pandemic benchmark, i.e., the fourth quarter of 2019, was heavily affected by transfers of intellectual property resulted in a distorted assessment of the post-pandemic recovery in non-construction investment and, more especially, in intangible investments (Chart 10, panel a). By the fourth quarter of 2023, non-construction and intangible investments remained about 8% and 18% below their respective pre-pandemic levels in the euro area using the official euro area series. However, if Irish IPPs are excluded from the series, the pre-pandemic levels would appear to have been reached already by the end of 2020.[23] The volatility in the level of IPP investment is fully mirrored in the import series (Chart 10, panel b), as evidenced by the marked increase in euro area import volumes in the last quarter of 2023.[24]

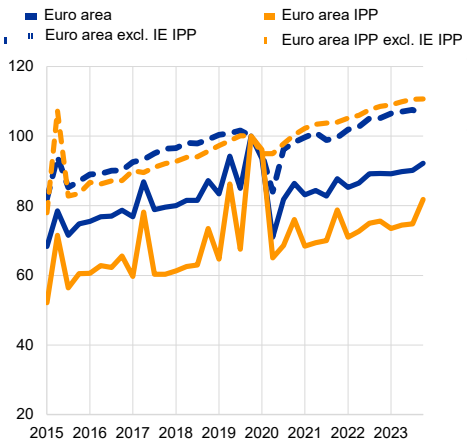
23 See also **Box 1** in Andersson et al (2023).

24 While full details for the last quarter of 2023 are not yet available, b.o.p. data reveal that the spike in euro area imports in the fourth quarter of 2021 was due to MNEs resident in Ireland importing IPPs in the form of R&D services from the United States amounting to 1.2% of euro area GDP. This resulted in a sizeably negative net trade contribution (-1.1 percentage points.) to euro area growth (-0.4 percentage points excluding Ireland).

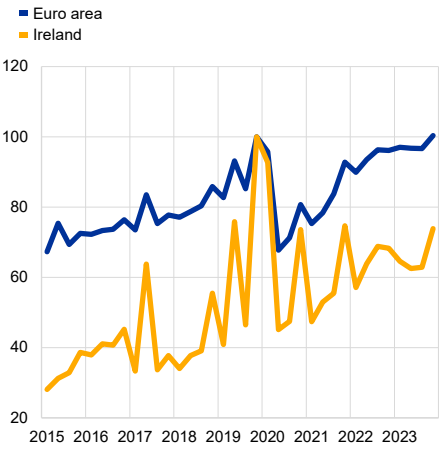
Chart 10

Real non-construction investment, IPPs and import dynamics
(Q4 2019 = 100)

a) Non-construction investment



b) Imports



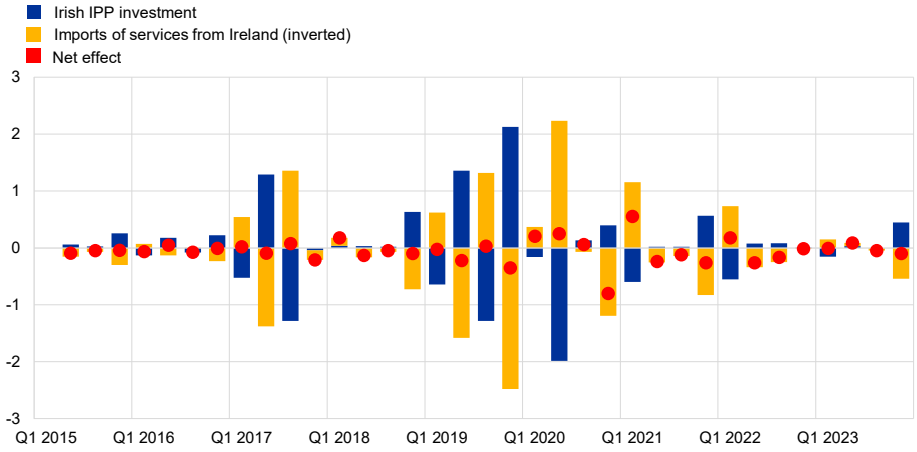
Sources: Eurostat and own calculations.
Notes: IPP stands for intellectual property product. Estimates were used for missing values for Irish intangibles in the official data for the first quarter of 2020.
Latest observation: Fourth quarter of 2023.

4.2 Impact on euro area GDP

Taken together, the percentage contributions to euro area GDP growth from IPP investment and imports of services broadly nets out, e.g., when R&D investment is imported from outside the euro area in the form of IPPs (Chart 11).

Chart 11

Contribution to euro area GDP of Irish IPP and services imports, and the net effect
(percentage point contributions)



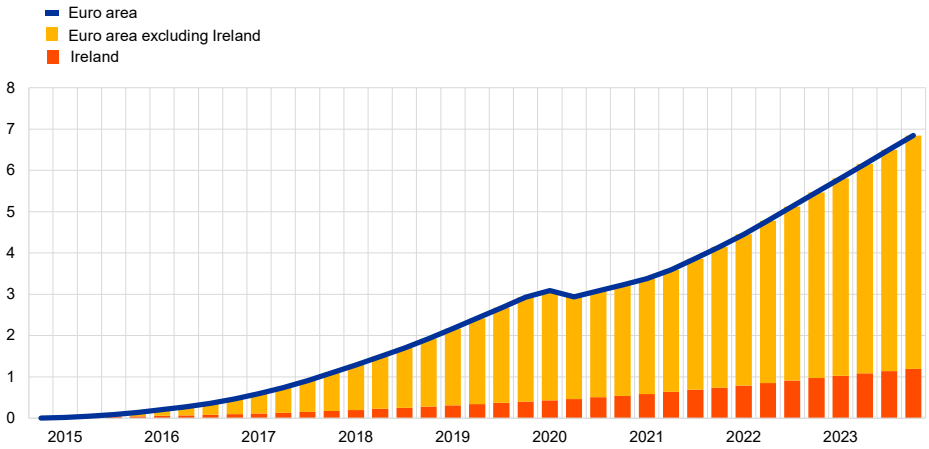
Sources: Eurostat and own calculations.
Note: IPP stands for intellectual property product. Estimates were used for missing values for Irish intangibles in the official data for the first quarter of 2020.
Latest observation: Fourth quarter of 2023.

IPP inflows nevertheless contributed positively to euro area GDP growth in quarters subsequent to the IPP transfers. Ireland, which accounted for about 5 percent of euro area GDP in 2023, contributed disproportionately (around 18 percent) to the cumulative increase in euro area GDP between the fourth quarter of 2014 and the fourth quarter of 2023 (Chart 12). This largely reflects the long-term positive impact on euro area GDP growth of onshored IPPs, which (i) boost capital stock, increasing both productivity and depreciation (consumption of capital); and (ii) generate higher export streams (as well as net factor flows, given that the profits accrue to foreign direct investors).[25] Moreover, IPPs brought into Ireland have increasingly meant that certain royalty imports are no longer needed. As a result, imports of royalties no longer offset contract manufacturing exports to the same extent as in the past. As a result, they are adding to GDP, leading to very high growth rates.[26] The income generated by IPPs held in Ireland accrues mainly to foreign residents.

Chart 12

Contribution of Ireland to changes in euro area real GDP

(cumulated increases in euro area GDP from Q4 2014 to Q4 2023 in € trillions)



Sources: Eurostat and own calculations.
Latest observation: Fourth quarter of 2023.

4.3 Impact on the euro area current account

Cross-border production arrangements and merchanting activities related to MNEs affect the trade balance in the euro area current account (see Box 1). Such arrangements may involve foreign subsidiaries of MNEs through offshoring or the use of an unrelated foreign company (i.e. outsourcing). Like national accounts, b.o.p. statistics are based on the concept of changes in economic ownership. Consequently, trade in goods recorded in b.o.p. statistics includes contract manufacturing and merchanting, in contrast to international trade statistics that measure all goods crossing a country's border.[27]

25 See Andersson et al (2023).

26 See Connolly (2017).

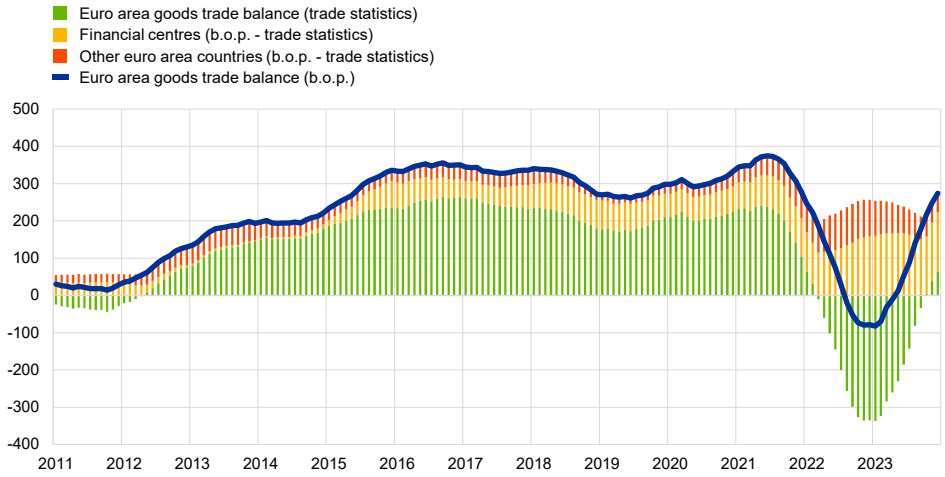
27 See Lane (2020) and Di Nino et al. (2020).

Contract manufacturing and merchanting conducted by entities resident in euro area financial centres – i.e. those economies with a high MNE and SPE presence – have contributed to a growing discrepancy between b.o.p. statistics and international trade statistics for the euro area goods trade balance. In the euro area, the gap between these two datasets has been growing over time, in particular since 2015 (Chart 13). This increase is explained, to a significant extent, by merchanting and the effect that IPP onshoring to Ireland has had on net exports under contract manufacturing arrangements from 2015 onwards. Merchanting – i.e. the process whereby a company purchases a good from abroad, and subsequently sells it to a buyer in a third country without the good crossing the border of the country where the merchant is based – is only recorded in the b.o.p., but not in trade statistics. Overall, net exports (including services trade) are typically less affected by contract manufacturing exports which are usually offset by the associated services imports, particularly royalty payments for the use of intellectual property. However, in the case of Ireland, the onshoring of certain IPPs means that fewer such payments are needed and hence services imports have ceased to increase in line with the exports produced by contract manufacturers (see also Box 1).

Chart 13

Euro area goods trade balance

(€ billion; 12-month moving total)



Sources: ECB, Eurostat and own calculations.

Notes: The green area is the net exports of the euro area as recorded in trade statistics. The yellow and red areas depict the difference between balance of payments (b.o.p.) and trade statistics in financial centres and other euro area economies respectively. The group of financial centres includes Ireland, Belgium, Luxembourg, the Netherlands, Malta and Cyprus. This chart is based on 12-month cumulative monthly data.

Latest observation: December 2023.

Another illustration of the impact of MNE activities is the large shift into deficit of the euro area goods balance in 2022, before rebounding in 2023. The broad-based fall in 2022 was due mainly to larger imports of energy products, driven by elevated energy prices.[28] The recorded deficit was, however, much larger in trade statistics than in the b.o.p. (Chart 13). This difference was attributable principally to the larger net exports of euro area financial centres recorded in the b.o.p.,

[28] See Emter et al. (2023).

which, in turn, primarily reflected MNE activities such as contract manufacturing and merchanting.[29]

MNE activities also increasingly affect the services trade balance of the euro area, particularly for items related to the transfer of IPPs. The euro area recorded an increasing surplus in services trade, which rose from 0.4 percent of GDP in 2008 to 0.9 percent of GDP in the third quarter of 2023. This increase was driven partially by the surplus in ICT services exports widening from 0.2 percent of GDP to 1.1 percent of GDP over the same period Chart 14, panel a). This, in turn, reflected, in part, the rapidly expanding surplus that Ireland recorded in ICT services, including services related to hardware, software and data-processing, as well as cloud services, sales of software transmitted electronically and software licence fees. As mentioned above, exports of such services from Ireland increased after the IPPs underlying those services were transferred to Irish resident subsidiaries of MNEs. As more IPPs accumulate in Ireland, the offsetting effect of the corresponding imports of IPPs - recorded as imports of R&D services under other business services - declines. At the same time, MNEs in Ireland are still paying royalties for the use of IPPs owned by other MNE subsidiaries (or other companies). Such payments increased, particularly to the United States, following the 2017 Tax Cuts and Jobs Act, which provided incentives for repatriating offshore profits (Chart 14, panel b).

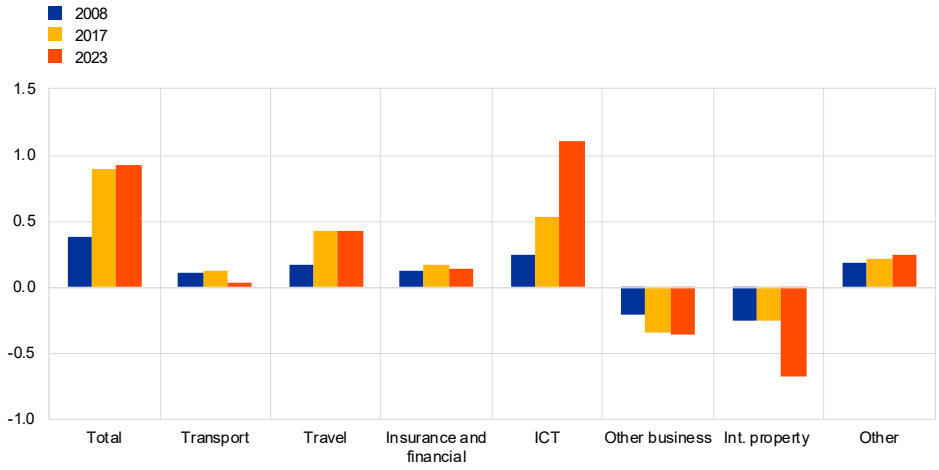
[29] Another factor driving the difference between trade statistics and the b.o.p. during this period , and in particular for "other euro area countries", was the increase in transportation prices which affected the Cost, Insurance and Freight (CIF)/Free On Board (FOB) adjustment. The CIF/FOB adjustment reduces the value of imports and consequently results in an increase in net goods exports in the b.o.p. figures.

Chart 14

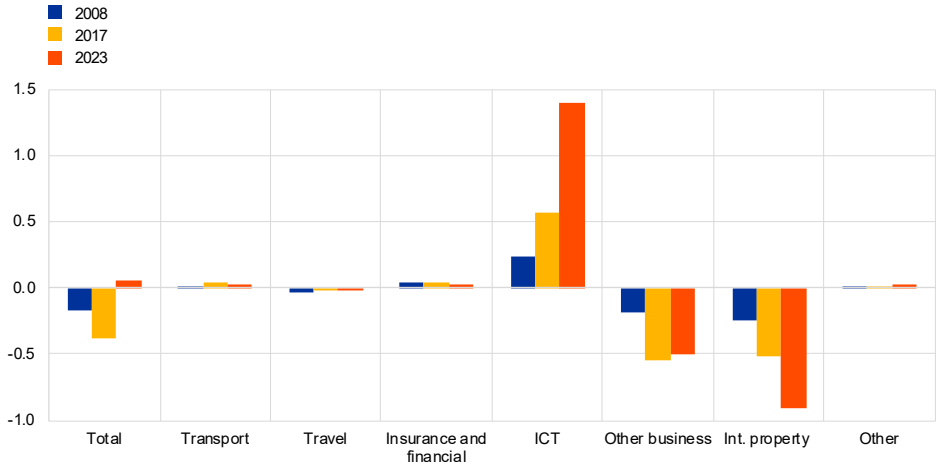
Services trade balance by component for the euro area and Ireland

(four quarter moving totals; percentages of euro area GDP)

a) Euro area



b) Ireland



Sources: ECB and own calculations.

Notes: ICT stands for information and communications technology. The values for intellectual property products (IPPs)relate to charges for the use of IPPs. Other business services includes research and development services. The transfer of IPP is recorded under other business services The values for 2023 relate to the data for the four quarters up to the third quarter of 2023.

The current account primary income balance, and in particular investment income, is also affected by MNE activities through FDI income and portfolio investment in equity.[30] Euro area financial centres usually have large trade surpluses that are partly counterbalanced by income deficits, reflecting the redistribution of profits to foreign shareholders.[31] Moreover, MNEs' pricing of intra-group transactions has a decisive impact on the amount and location of

[30] Investment income reflects the receipts and payments generated by an economy's external assets and liabilities (such as dividends and interest), and can be further broken down into functional categories of the b.o.p. (FDI, portfolio investment, other investment and reserve assets).

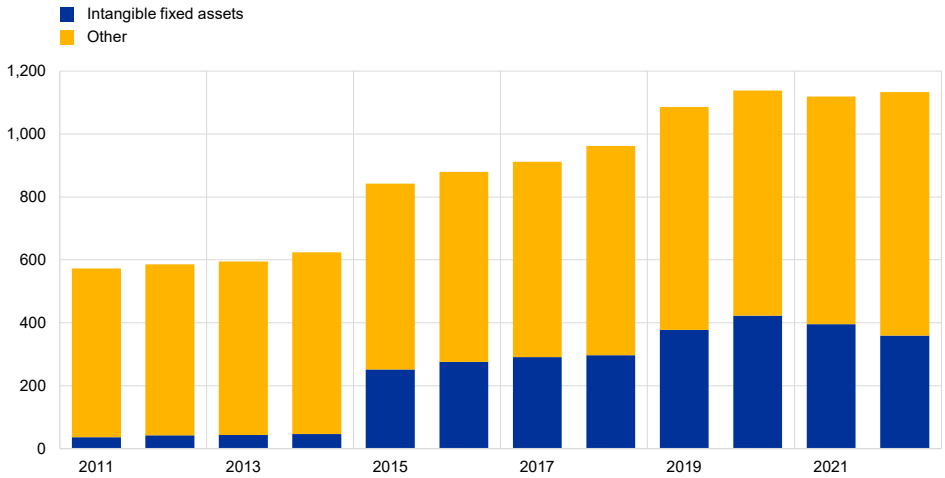
[31] For further details see Di Nino et al. (2020).

profits booked, which is in line with the well-established concept of transfer pricing.

4.4 Impact on euro area capital stock

Intangible asset transfers also affect euro area capital stock. IPP transfers have contributed decisively to the doubling of Ireland's net capital stock since the implementation of the ESA 2010 (Chart 15).[32] Unlike physical capital, intangibles may support large and variable quantities of production, both in Ireland and abroad, and drastically alter an economy's productive capacity within a short period of time. This reflects the fact that IPP capital can be transferred almost instantaneously, used repeatedly and separately from other factors of production.[33]

Chart 15
Net capital stock in Ireland
(€ billions; constant prices)



Source: Central Statistics Office, Ireland.
Latest observation: 2022.

Measurement of the euro area capital stock has shown a degree of volatility over the past few years, stemming mainly from the fluctuating growth of the capital contribution from IPPs (Chart 16).[34] The resulting volatility in capital per worker – or capital intensity - which is key to assessing labour productivity trends, blurs assessment of such trends.

32 With the introduction of the ESA 2010, R&D expenditure by firms on own account for own use is no longer regarded as intermediate consumption but is treated as investment in intellectual property products and allocated to capital stock.

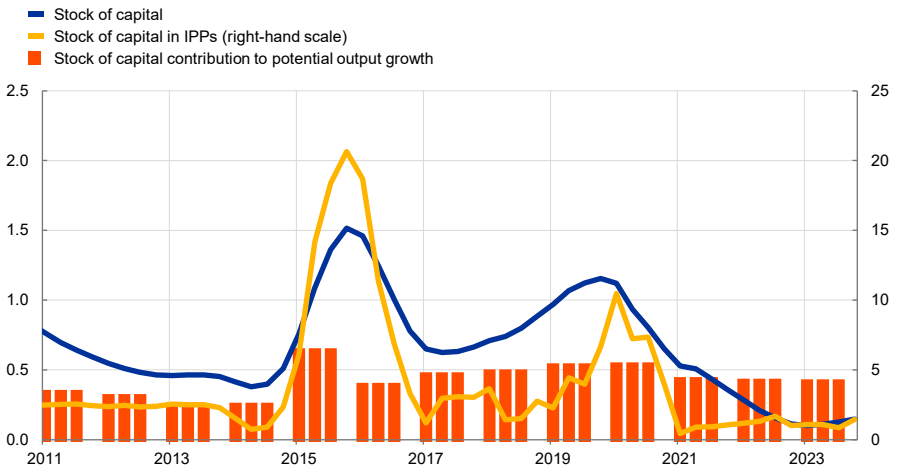
33 See Haskel and Westlake (2017) and Crouzet et al. (2022).

34 See Le Roux (2021).

Chart 16

Euro area stock of total and IPP capital

(year-on-year percentage changes and contributions in annual percentage points)



Source: ECB estimates.

Notes; IPPs stands for intellectual property products. ECB quarterly estimates of capital stock based on a constrained optimisation model using annual data from Eurostat (with a lag of two years) and temporal disaggregation techniques (see Hofmeister and van der Helm, 2017).

Latest observation: 2023 (contribution); Fourth quarter of 2023 (stock of total and IPP capital).

5. Dealing with the impact of MNE activities in real-time assessments

Assessment of the euro area economy should take into consideration the aggregate developments of all the participating economies. However, given the high volatility of MNE activity in Ireland and the lack of sufficiently detailed information on the driving factors, analysts have had to rely, on occasion (although sub-optimally), on euro area aggregates that exclude Ireland in order to be able to assess more accurately the underlying economic developments in the euro area in real time. This chapter therefore proposes that, for analytical purposes, the assessment of headline numbers be complemented by modified euro area series, using existing national metrics adjusted for the volatile items for Ireland.

5.1 Using alternative metrics excluding volatile items

The Irish CSO has developed a system of supplementary economic indicators that seek to address MNE-related data distortions. It is now a regular and well-established method applied in Ireland to report on series excluding particularly volatile items of investment, in addition to headline numbers. An important step in this direction was made in December 2016 when an expert team, chaired by Philip Lane in his capacity as Governor of the Central Bank of Ireland at that time, presented its recommendations on how to address the relevant data challenges.[35] Since then, the CSO has developed a set of coherent indicators designed to remove specific MNE-related data distortions from the national and international accounts. The indicators complement standard metrics and are tailored to Ireland. The CSO in Ireland has defined and is publishing modified domestic demand,[36] modified investment[37] and modified current account[38] measures to assess real domestic activity more accurately. Modified domestic demand is domestic demand adjusted for investments in aircraft purchased by leasing companies in Ireland[39] and intellectual property purchases.[40] This adjustment significantly reduces volatility at the euro area level (see Chart 17 and Chart 18). The ECB typically excludes Irish IPP data in reporting on euro area non-construction investment in many of its regular publications, such as the Economic Bulletin.

35 See Central Statistical Office in Ireland (2016) and the conceptual considerations in Lane (2017).

36 Modified domestic demand = consumption + modified Investment + government spending + inventories.

37 Modified investment (expenditure method used) = gross fixed capital formation - IPP investment - investment in planes related to aircraft leasing.

38 Modified current account = current account minus depreciation on R&D service imports and trade in IPPs + aircraft leasing depreciation + redomiciled incomes + R&D related IPP exports plus net aircraft related to leasing + R&D related IPP imports + R&D service imports.

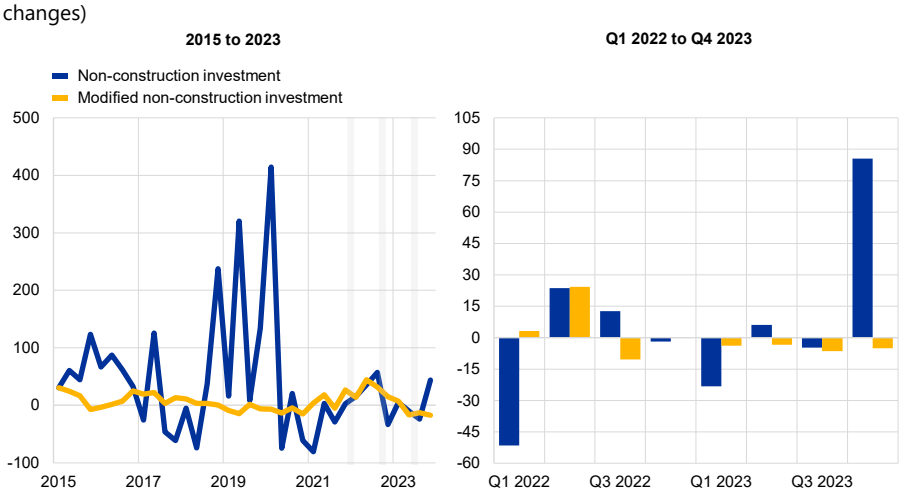
39 This relates to aeroplanes used for flights in other countries purchased by leasing companies that are resident in Ireland.

40 As regards seasonality, headline gross fixed capital formation in Ireland is seasonally adjusted in the standard way (X-13 Arima), with adjustments made to account for outlier transactions that do not have a seasonal pattern. The focus is, however, on annual growth rates rather than seasonally adjusted quarter-on-quarter series.

Chart 17

Irish non-construction investment

(left-hand panel: year-on-year percentage changes; right-hand panel: quarter-on-quarter percentage changes)

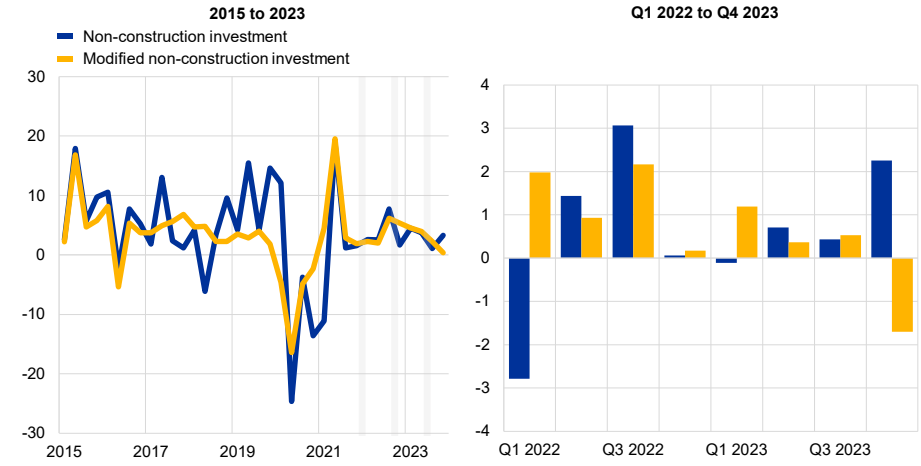


Sources: Eurostat and own calculations.
Notes: Modified investment excludes intellectual property product (IPP) investment and investment in planes related to aircraft leasing. Estimates were used for missing values for Irish intangibles in the official data for the first quarter of 2020. The grey area corresponds to the time range of the right-hand panel.
Latest observations: Fourth quarter of 2023.

Chart 18

Euro area investment

(left-hand panel: year-on-year percentage changes; right-hand panel: quarter-on-quarter percentage changes)



Sources: Eurostat, Central Bank of Ireland and own calculations.
Notes: Modified imports excludes intellectual property product (IPP) transfers and imports of planes related to aircraft leasing. Estimates were used for missing values for Irish intangibles in the official data for the first quarter of 2020. The grey area corresponds to the time range of the right-hand panel.
Latest observations: Fourth quarter of 2023.

Making statistical adjustments for MNE activities is a complex issue. Investments made by foreign-owned MNEs in Ireland may still be reflected in modified domestic demand. That investment may relate to specific areas - such as machinery used to produce semiconductors - and involve, for instance, machinery used in factories, data centre equipment, renewables or transport equipment other than leased aircraft. Where this is the case, modified domestic demand may still give imperfect signals about the state of the Irish and euro area economy.

However, as these investments are likely to be imported, they would typically be GDP-neutral for a given quarter.[41]

Modified gross national income (GNI*) is an indicator that adjusts Irish GNI for the depreciation of intellectual property and aircraft owned by leasing firms. It also subtracts the net factor income of redomiciled PLCs. GNI* is currently only around half the size of GDP. The first element of the indicator adjusts for the fact that the depreciation costs add to the gross operating surplus of MNEs and to GDP, although those costs are borne by foreign investors. The second element ensures that GNI* is not affected by whether redomiciled companies distribute or reinvest their profits.[42] GNI* is only available at an annual frequency and with a significant publication lag. In the period from 2015 to 2022, real GDP increased by 112%, GNI by 75% and GNI* by 35% (Chart 19). Hence, only one-third of income growth benefited domestic residents, which is much less than indicated by conventional GNI. The wedge is largely explained by the standard net factor income and the adjustment for depreciation on IPPs (Chart 20). However, even after these adjustments, Ireland recorded one of the fastest increases in income per capita across euro area countries in the period under consideration.

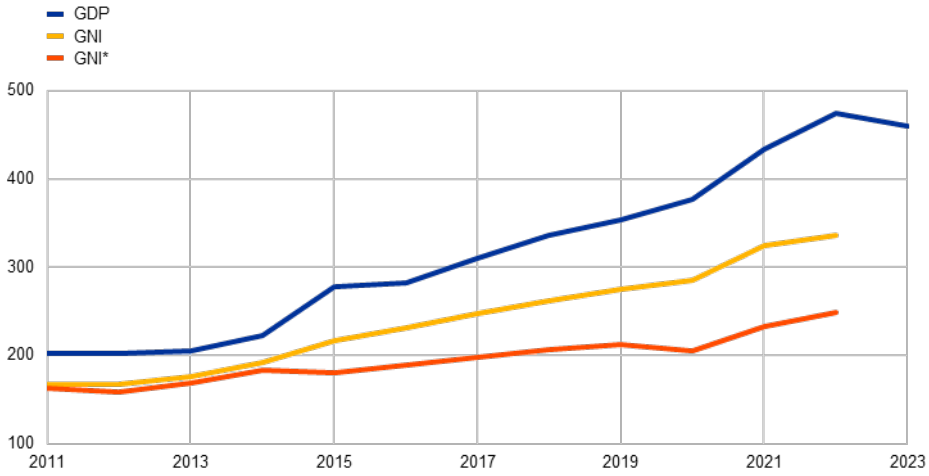
41 See Casey (2023).

42 **Several foreign-owned MNEs have moved their group headquarters to Ireland** in a process known as "corporate inversion". More specifically, Irish-resident subsidiaries of MNE groups have swapped roles with their original parent companies in other economies. As a result, MNEs have transferred large corporate balance sheets, including IPP assets, to Ireland. Through their ownership of foreign affiliates, the redomiciled companies also own around half of Ireland's stock of direct investment abroad. By current statistical conventions, their direct investment income is fully recorded in the b.o.p.. However, their investment income outflows on portfolio equity exclude undistributed profits. This asymmetry is relevant, given that the redomiciled companies have retained substantial profits over recent years and thus recorded net inflows of investment income.

Chart 19

Real GDP, GNI and GNI*

(EUR billions)



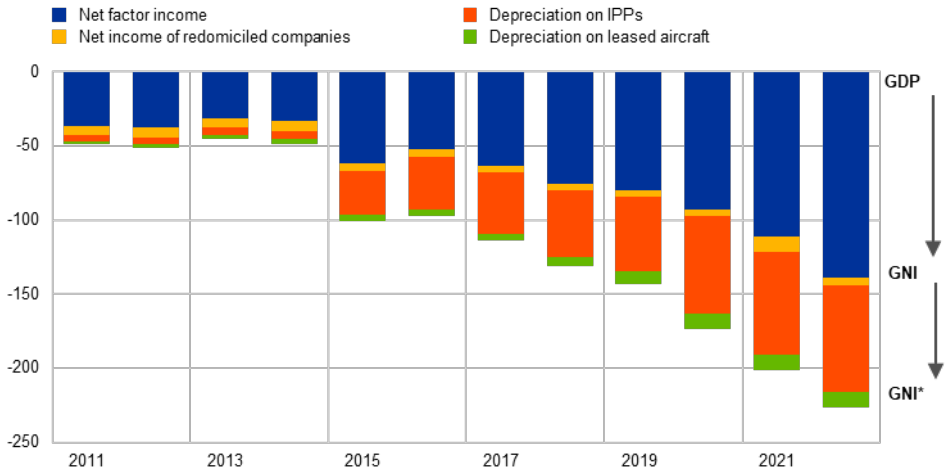
Source: Central Statistics Office, Ireland.

Notes: GNI* stands for modified gross national income. Latest observation: 2022 (GNI, GNI*) and 2023 (GDP).

Chart 20

Discrepancy between real GDP and GNI*

(EUR billions)



Source: Central Statistics Office, Ireland.

Note: GNI* stands for modified gross national income. GNI* adjustments are deflated with a common deflator.

Latest observations: 2022.

Since 2023, Eurostat has been including a public estimate of Irish GDP in the euro area preliminary flash national accounts release at t+30 days. Modified Irish domestic demand and investment series are available from the Irish CSO on a quarterly and seasonally adjusted basis on the same day as the release of the GDP breakdown in Ireland, at t+65 days. Modified Irish data can then be used to adjust the euro area expenditure breakdown.

Turning to euro area services imports, excluding distorted components of such imports using quarterly b.o.p. data would be possible theoretically but would entail practical challenges. In the b.o.p., these components would generally be imports of R&D services (which includes imports of IPPs) but would also include

other services imports (such as charges for the use of IPPs). However, there are two practical limitations to this approach. First, the b.o.p. data are released with a lag of one month compared to national account data. Monthly b.o.p. data for services imports do not provide full details of the services import categories and, in the case of Ireland, do not usually reflect large MNE transactions given that these are only included in quarterly releases. Second, detailed b.o.p. data are only available in nominal terms, complicating the matching with services import volumes in national account data. For Ireland, the CSO publishes a modified current account balance annually. This is calculated as follows.

$$\begin{aligned}&\text{Modified current account } (CA*)\\&= \text{Current account } (CA) - (\text{Depreciation on R\&D service imports and trade in IP}\\&+ \text{aircraft leasing depreciation} + \text{redomiciled incomes}\\&+ \text{R\&D related to IP exports}) + (\text{net aircraft related to leasing}\\&+ \text{R\&D related IP imports} + \text{R\&D service imports})\end{aligned}$$

This metric is the primary measure used by the Central Bank of Ireland in assessing the external position of the Irish economy, excluding the distortionary effects of some multinational activities unrelated to the Irish economy.

A modified concept of the Irish capital stock is not systematically and publicly available currently. However, when estimating potential output, the capital stock series could be replaced by a series adjusted for the impact of globalisation activities where the data are available. Alternatively, they could be derived using a permanent inventory approach[43] whereby gross fixed capital formation would be adjusted for Irish IPPs, in line with the suggestion as regards Irish non-construction investment.[44] Another option would be to revise the estimated total factor productivity (TFP) trend given that it is questionable whether a stock of capital that primarily reflects non-domestic factors should have a large effect on that trend. Finally, a more systematic use of the "capital services" concept[45] might lead to lower volatility of the capital stock contribution to potential output growth.

[43] See Kostarakos (2022). The authors control for distortions in the official investment data series while also incorporating intangible assets, which are not currently included in the national accounts.

[44] From about 2013 onwards, the official Irish capital stock and an estimated capital stock generated using the perpetual inventory method (with modified investment) would differ significantly since the modified data would exclude all IPP additions to the capital stock. The latter is used by the Central Bank of Ireland to compute a measure of domestically relevant potential output consistent with the factors of production available to firms contributing to the Irish economy.

[45] See OECD (2009) and Koszerek (2007).

6. Dealing with the impact of MNE activities in projections

MNE activities - particularly volatile flows of intangible assets - are a recurring challenge, especially as regards producing economic projections of affected series, and merit a deeper focus. This volatility raises issues related to both the size of the ex ante IPP shock and the ex post unwinding of that shock. The options for forecasting large transfers of IPPs and how they will unwind are considered below. The reasoning could also be applied, and further investigated, for services imports.

6.1 Forecasting large transfers

Transfers of intangible assets between countries are firm specific and, as such, very difficult to forecast. The Eurosystem is, however, required to make a credible forecast of gross fixed capital formation (GFCF), including IPPs, and imports. The approach adopted by the Central Bank of Ireland is, necessarily, multi-faceted but, in the main, includes models for the underlying (non-distorted) components.

$$\begin{aligned} &Modified\ investment \\ &= Construction \\ &+ Machinery\ and\ equipment\ (excluding\ aircraft\ related\ to\ leasing) \end{aligned}$$

Headline GFCF is then:

$$GFCF = Modified\ investment + Intangibles + Aircraft\ related\ to\ leasing$$

The forecasts for intangible assets and aircraft leasing are largely based on the best judgement of forecasters. This judgement is derived from statistical models, where the data generating process could best be described as a random walk with drift, and from market intelligence exercises, including monitoring the investor communications of the largest MNEs. The starting point is generally to assume that, beyond the short term, the level of IPPs does not affect the growth rate of total investment over the forecast horizon. The assumption is then that the baseline level will not include any sizeable IPP transfers in the years $t + 1$ and beyond.

Incoming cross-border transfers of intangible assets are, by definition, imports. As a result, the forecasts for total Irish imports also include an underlying component (related to modified final domestic demand), to which imports of intangible assets and other MNE-related imports are added using a methodology similar to that described above.

It is very difficult to forecast shocks to intangible investment, given that they are firm-specific and may have little to do with business cycle dynamics but instead reflect the tax-optimising behaviour of individual firms. The greater harmonisation of tax regimes, such as that envisaged under the joint OECD-G20 Base Erosion and

Profit Shifting Project (BEPS Project) to be launched in 2024, could help to reduce the incentives for sizeable profit sharing in the future.[46]

6.2 Forecasting the unwinding of large transfers

While ex ante forecasting of IPP transfers is very difficult, somewhat more can be said about their ex-post pattern. Below, we assess the usefulness of two methods to estimate the unwinding of shocks: (i) a simple rule of thumb approach based on historical precedents; and (ii) a parsimonious parametric approach. Nevertheless, conclusions based on very few events and considerable ex ante uncertainty in advance of IPP shocks, as well as the sometimes very high volatility in actual outcomes and recent sizeable revisions, warrant caution in interpreting the results.

Sizeable IPP transfers have tended to occur more frequently since the mid-2010s. Such shocks have typically been entirely unwound in the quarter immediately after the transfer. In a context of very strong volatility of the Irish IPP series, an Irish IPP "shock" is defined as any quarterly rise of more than three standard deviations above average growth rates, such increases in Ireland's IPP inflows having led to marked spikes in the quarterly growth of euro area investment.[47] The latest data point to eight such episodes since 2015, with the latest occurring in the fourth quarter of 2023 (though the unwinding of this episode was not clear at time of publication). This compares with just one spike in the first 14 years of Economic and Monetary Union (EMU). Chart 21 traces the path of each shock since 2015 in level terms from the quarter before impact until its unwinding. Except for the last quarter of 2019, when Brexit-related disturbances may also have played a role, pre-shock levels of Irish IPPs have, for the most part, been fully restored in the quarter immediately following the shock. Chart 22 shows the associated quarterly growth rates surrounding these episodes.

Given the regularity to date of the unwinding of the shocks seen, a simple rule of thumb approach - whereby shocks to real IPP levels in any given quarter are assumed to be entirely offset in the subsequent quarter - could provide a working estimate for forecasting Irish IPPs in the aftermath of a given shock. An alternative approach is to derive historical estimates from the available episodes and apply the parameters when forecasting the unwinding of an IPP shock. Box 2 presents such an exercise and compares it with the forecast performance of the rule of thumb approach.

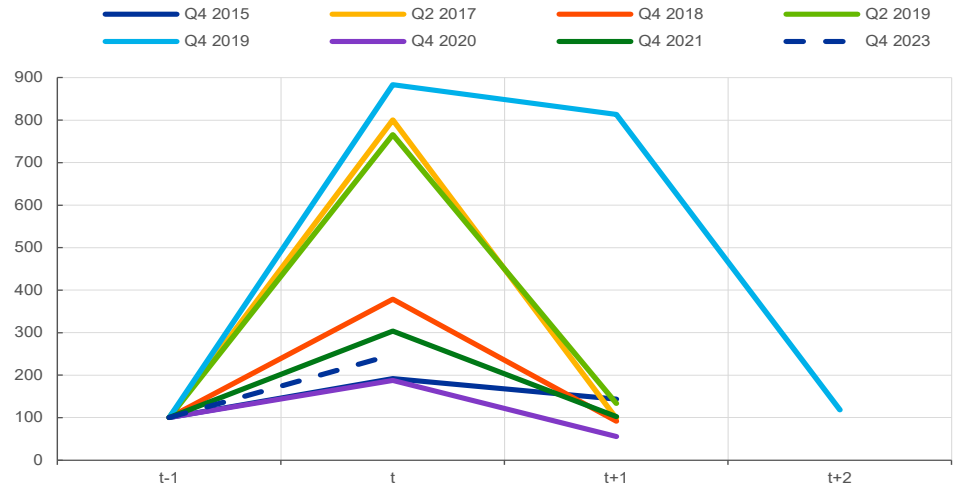
[46] The BEPS Project is a joint OECD-G20 initiative that establishes an international framework to combat tax avoidance by MNEs using base erosion and profit-shifting tools. One of the aims of this project is to ensure that company profits are more closely aligned with their economic substance (the function, assets and risks that generate those profits). For example, US MNEs that held IPP assets in offshore financial centres have had little economic substance in the US. For a detailed report on US MNEs, see Coffey (2021).

[47] The average quarter-on-quarter growth rate is 29% and the standard deviation is 131 over the period from 1999 to 2023. Without the spikes and accompanying unwinding, the average falls to 5.3%, with a standard deviation of 21. Three standard deviations represent the standard deviation of the lowest quarterly growth rate observed among the seven peak quarters identified.

Chart 21

Irish IPP investment levels around shock episodes

(t-1 = 100)

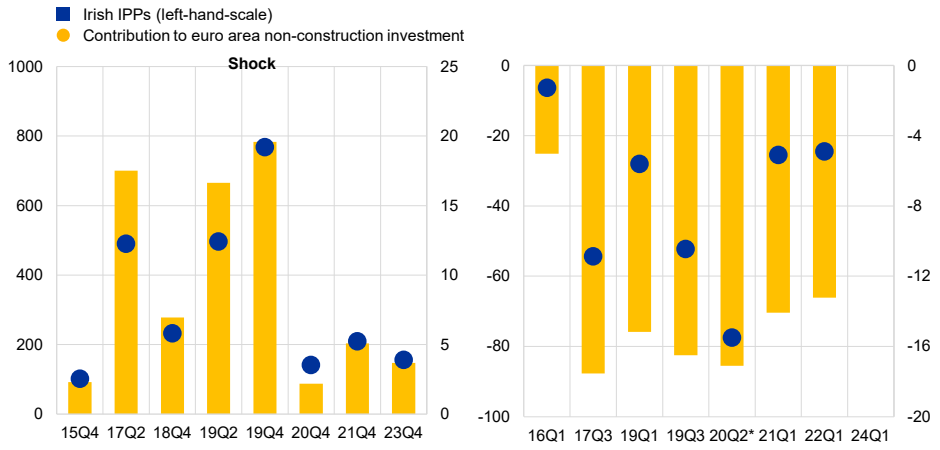


Source: Own calculations based on Eurostat data.
Note: Estimates were used for missing values for Irish intangibles in the official data for the first quarter of 2020.
Last observation: Q4 2023.

Chart 22

Irish IPP investment in shock and unwinding episodes

(quarter-on-quarter percentage changes; percentage point contributions)



Source: Own calculations based on Eurostat data.
Notes: IPPs stands for intellectual property products. The shock in the fourth quarter of 2019 took two quarters to unwind. Data were not yet available for the first quarter of 2024 at the time of writing.
Last observations: Q4 2023.

Box 2

A simple parametric approach to the unwinding of IPP shocks

Prepared by Jarvis Valerie

The rule of thumb provides a parsimonious approach to estimating the real-time unwinding of past shocks to Irish IPPs. However, an application of this approach missed the unusual unwinding in response to the large IPP inflow in the final quarter of 2019 and would have suggested a far stronger decline in euro area investment in the first quarter of 2020. A simple parametric approach could serve as a useful alternative for cross-checking, conditional on knowing the size of the shock that has occurred. To facilitate the use of the parametric approach for forecasting purposes, a viable model was drawn up that was expressed solely in terms of lagged values of the explanatory variables and dummies for IPP shocks. As a starting point, this model took the following form:

$$\mathbf{IPP_t} = f\,(\mathbf{IPP_{t-i}},\ \mathbf{SHOCK_t},\ \mathbf{SHOCK_t \cdot IPP_t},\ \mathbf{SHOCK_{t-1}},\ \mathbf{SHOCK_{t-1} \cdot IPP_{t-1}})$$

where the dependent variable – the quarterly growth rate of Irish IPPs in period t – was regressed on: lags of itself (where i = 1…4) and a dummy variable (SHOCK), set to 1 in each of the quarters in which the quarterly change in Irish IPPs exceeded 87% (over three standard deviations above average growth rates and reflecting the lowest quarterly growth rate observed among the seven peak quarters identified) and 0 for all other quarters. The estimation sample reported here covers a period from the first quarter of 1998 to the third quarter of 2023 (with a data cut-off date of 13 December 2023).

A variety of specifications and time spans were used to assess the robustness of the parameters, particularly on the unwinding variables (highlighted in blue in Table 1 below). Here, we highlight three simple variants: a "basic model" taking the form outlined above; an augmented "preferred" version that included a structural break in the IPP series from the fourth quarter of 2019 (as suggested by Augmented Dickey Fuller tests); and an "alternative" specification that incorporated an additional shock parameter designed to capture the impact of the exceptionally large (cited in the table as "MEGA") IPP inflows seen in the second quarters of 2017 and 2019 and in the fourth quarter of 2019[48].

The estimations generated highlighted the huge variation in the quarterly series, despite substantial variation in the dependent variable. Importantly, parameter estimates on the contemporaneous shock interaction terms, $SHOCK_t*IPP_t$, fully captured the extreme variation in the Irish data and were highly significant. The unwinding dummy, on $SHOCK_{t-1}$, was also correctly signed and statistically significant across the three models described above over various samples, with the parameters of interest broadly stable across specifications. Simulations of the unwinding of the seven shocks to Irish IPPs seen since 2015 suggest that there would be some merit in applying the parametric approach in assessing post-shock dynamics. In addition, the models have typically also replicated the data effectively during "normal" times, suggesting that these models may be useful as an additional satellite forecasting tool for this volatile variable.

A comparison between the rule of thumb approach and various forecasting models showed that the parametric approach outperformed the rule of thumb in five of the seven most recent episodes[49], while the "alternative" model lacks intuitive simplicity (Chart A). The parametric approach proved particularly efficient in capturing the

[48] The inclusion of the contemporaneous dummies when interacting with the dependent variable (in order to adequately capture all of the variations in the data generated by the shocks) was not problematic, given that these terms are set to 0 in any quarter where no shock occurs (i.e. they drop out of the equation). Given that the aim was not to predict shocks ex ante but merely to determine the magnitude of the unwinding of shocks that occurred in period t-1, new values of IPP(t) can take explicit account of both the occurrence of the earlier shock and its magnitude without compromising forecasting ability at these points in time.

[49] The episode following the large shock in the fourth quarter of 2023 cannot yet be tested and is therefore excluded.

unusually delayed unwinding following the shock in the fourth quarter of 2019 (due to its stronger reliance on lags of the dependent variable). The rule of thumb approach was more effective, however, for prediction than the parametric method in two of the seven cases (in 2017 and the unwinding of early 2022). Given the few observations and wide variability in the outcomes, no single approach appears to capture fully the dynamics of unwindings. From a comparison of the two approaches, where the estimations generated by the models and the rule-of-thumb approach converge, they clearly narrow the range of possible outcomes with a high degree of accuracy. For now, therefore, we conclude that there is merit in combining both approaches.

Table 1

Parameterisation of Irish IPP investment shock and unwinding episodes

(dependent variable: quarter-on-quarter percentage rates of IPPs; estimates for period from Q1 1999 to Q3 2023)

	Basic approach	Preferred approach	Alternative approach
C	5.54 **	6.18 ***	6.23 ***
IPP_{t-1}	-0.29 ***	-0.37 ***	-0.39 ***
IPP_{t-2}	-0.06 **	-0.11 ***	-0.11 ***
$SHOCK_t \cdot IPP_t$	0.99 ***	0.98 ***	1.02 ***
$SHOCK_{t-1}$	-35.98 ***	-35.45 ***	-22.14
$SHOCK_{t-1} \cdot IPP_{t-1}$	0.20 *	0.27 ***	0.18
$BREAK \cdot SHOCK_t \cdot IPP_t$		0.08 *	0.18
$BREAK \cdot SHOCK_{t-1}$		-47.13 **	-46.75 *
$BREAK \cdot SHOCK_{t-1} \cdot IPP_{t-1}$		0.18 ***	0.19 *
MEGA			415.73
$MEGA \cdot IPP_t$			-0.65
$MEGA_{t-1}$			72.06
$MEGA_{t-1} \cdot IPP_{t-1}$			-0.01
Adjusted R-squared	0.983	0.981	0.980
Akaike info criterion	8.756	8.771	8.823
Durbin-Watson statistic	1.966	1.796	1.771
RMSE	158.7	169.5	169.5

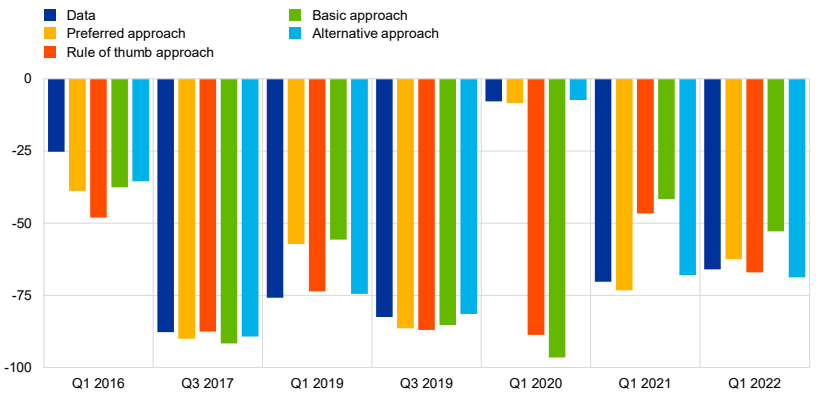
Sources: Eurostat and own calculations.

Notes: IPP stands for intellectual property product. MEGA refers to major IPP inflows (above 200% quarter on quarter). RMSE stands for root mean squared error. This is a simplified table showing only variables of economic relevance and/or statistical significance (while additional lagged dependent variables were included in some equations). *, **, *** refer to statistical significance at 10%, 5% and 1% levels, respectively. The basic model is estimated on data up to the fourth quarter of 2019 only.

Chart A

Estimated growth rates in the aftermath of large IPP shocks

(quarter-on-quarter percentage changes following a shock)



Sources: Eurostat and own calculations.

Note: The cut-off for data was 13 December 2023.

7. Conclusions

This paper summarises the findings of the Eurosystem expert group on MNEs under the umbrella of the Eurosystem Working Group on Forecasting. It sets out the important challenges associated with assessing and forecasting euro area economic developments owing to the increasing importance of MNE activities, primarily stemming from Ireland.

The first conclusion reached is that the modifications made by the CSO in Ireland to national accounts data to address the special features of the Irish economy improve the assessment of the euro area business cycle. Complementing the use of headline numbers, these modified series are now widely used in the regular reporting of statistical data in the publications issued by the ECB.

Second, it is very difficult to forecast ex ante transfers of intangible assets. However, this paper investigates the ex post patterns of large Irish IPP transfers and finds that there would be merit in using a rule of thumb approach based on historical precedents in combination with a parameterised approach in order to capture more effectively the unwinding of transfer shocks in the quarter following their occurrence.

To gain a better understanding of the dynamics and their implications for both short and long-term macroeconomic developments, more granular and internationally harmonised data on such activities, including across sectors, are urgently needed. Further collaboration between economists and statisticians is key in this field.

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Annex

Table A

Key globalisation activities with a bearing on national accounts

Activity	Characteristics and issues	National accounts items most affected
Intellectual Property Products (IPPs)	Own account reasearch and development (patents, trademarks and copyrights). Measuring the value of these assets and the associated services payments (in the form of fees or royalties payable for their use) is difficult. The challenges are even more formidable when the owner is an MNE and the benefits of holding and using the assets are spread throughout affiliates across the world. IPP may reflect profit shifting but there is uncertainty surrounding data and assumptions	GVA/GDP; capital formation; international trade in assets and related services
Redomiciliation	Large MNEs transferring domicile abroad (esp. NL)	GNI
Goods sent abroad for processing/contract manufacturing	Only a service fee for the processing work is to be recorded in the accounts, and not the import and export of goods on a gross basis (given that no transfer of economic ownership takes place). This complies with the principle of recording trade flows only where ownership of the goods changes, but will be at odds with the gross recording of goods shown in the International Merchandise Trade Statistics (IMTS) not included in national accounts/b.o.p. flows (creating a 4% gap in 2019-21). Considered as exports or imports of processing services and are recorded on a net basis; data available with some lags	GVA/GDP; international trade in goods and services
Merchanting	In accordance with the principle that a change of ownership should be recorded as a transaction, merchanting will be recorded in the country of residence of the merchant as a negative export of goods when it acquires them, and as a positive export when they are sold on. The treatment may be difficult to apply in practice, given that the goods concerned never cross the borders of the merchant's country of residence. Included in International Merchandise Trade Statistics and registered as net exports	International trade in goods (and possibly services)
Quasi-transit trade	Quasi-transit trade concerns goods imported into a country by an entity considered to be non-resident, and then exported to a third country within the same economic union or customs area. At the first point of entry in the economic union, the goods are cleared for free circulation within the union – it is at this point that any import duty is levied. There is often a significant difference in value between that declared at the point of entry to the economic union, and that observed on entry to a second country within the union	GVA/GDP; international trade in goods
Arrangements within MNEs, including transfer pricing	Transfer pricing may cause GDP to be misallocated between countries if the transfer prices are not true reflections of the market price	Allocation of GVA/GDP across countries; international trade in goods and services; investment income and financial flows
Special purpose entities (financial and non-financial SPEs)	SPEs are subsidiaries of parents in a different country, established to hold assets, incur liabilities, and receive and pay out income on behalf of the parent, often for tax reasons. SPEs are to be classified as resident in the country in which they are incorporated or registered even in the absence of a physical presence there. At the same time, SPEs have limited interaction with the economy they are established in and have limited employment	GDP in relation to GNI, international trade in goods and services; investment income and financial flows; international investment position
Transfer pricing	Transactions within a MNEs, the breakdown of value added is done on the basis of transfer pricing	GVA
Aircraft leasing	Depreciation is an issue	GDP

Source: Extended version of Table 1.1. in UNECE (2011).
Note: Globalisation activities related to the household sector, such as remittances, are not included.

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EUROPEAN CENTRAL BANK
EUROSYSTEM

Banc Ceannais na hÉireann
Central Bank of Ireland
Eurosystem

Impact of multinational enterprises activities on euro area macroeconomic aggregates and their forecasting

Conference: External statistics after the pandemic: addressing novel analytical challenges

Banco de España,
12 February 2024

Stephen Byrne, Central Bank of Ireland
Malin Andersson, Nina Blatnik, Lorenz Emter, Belén Gonzalez Pardo, Valerie Jarvis, Martin Schmitz, Nico Zorell and Christoph Zwick (all ECB) and EG on MNEs

Motivation and main messages

- **Activities of multinational enterprises (MNEs) in Ireland contribute increasingly to domestic output**, but sizeable and volatile transfers of intangible assets may also blur real-time signals about the euro area business cycle
- **Modified investment and import series** that exclude erratic transfers of intangibles in Ireland **better illustrate the underlying trends** in these expenditure components
- While the immediate within-quarter impact on euro area real GDP growth from intellectual property products (IPP) flows captured in investment and import volumes is broadly neutral, **onshoring of intangible assets boosts euro area GDP over time**


Opinion **Global Insight**

Ireland's wild data is leaving economists stumped

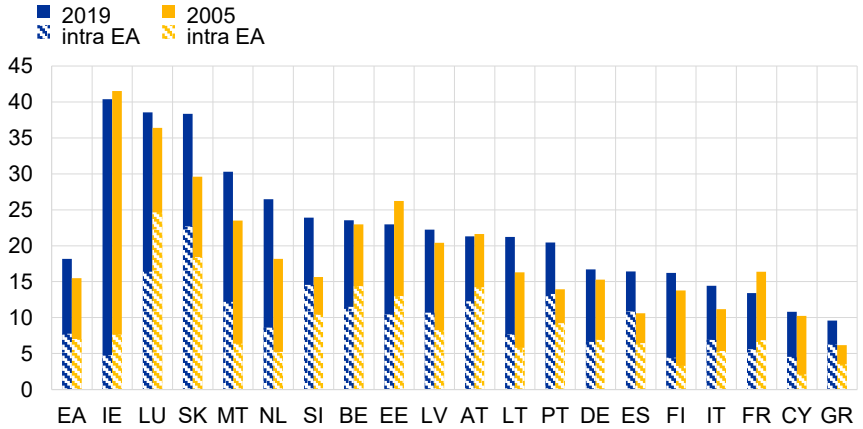
Eurozone statistics have been seriously distorted by US tech and pharma groups that found a home in Dublin

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MNE activities make up an important share of euro area output

Non-domestic MNE share in output across euro area countries

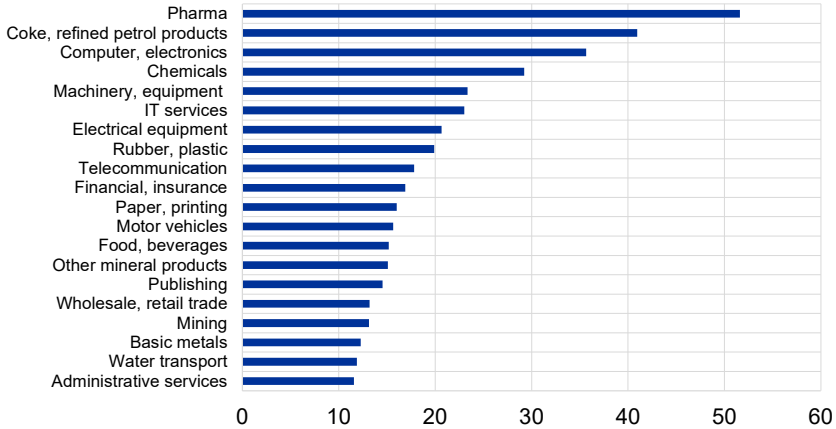
(% of country gross output)



Sources: OECD AMNE and authors' calculations.

Non-domestic MNE share in output across euro area sectors

(% of euro area gross output, in 2019)



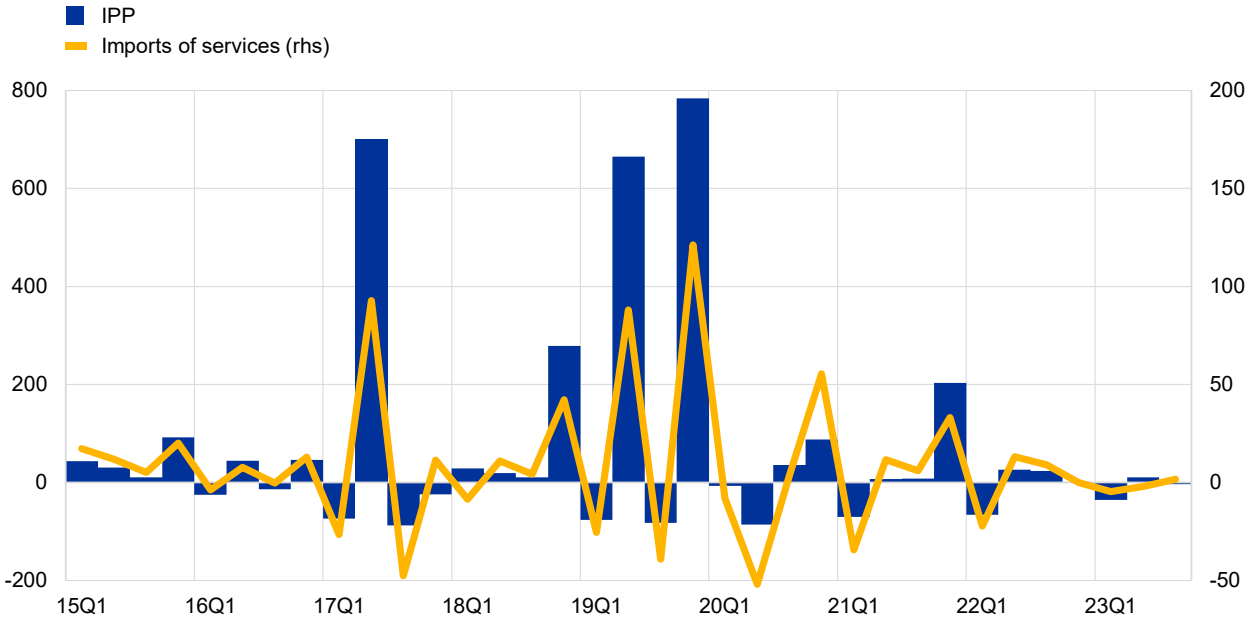
Sources: OECD AMNE and authors' calculations.

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Growth in IPP and services imports in Ireland is intrinsically volatile

IPP and import dynamics in Ireland

(quarter-on-quarter percentage changes)



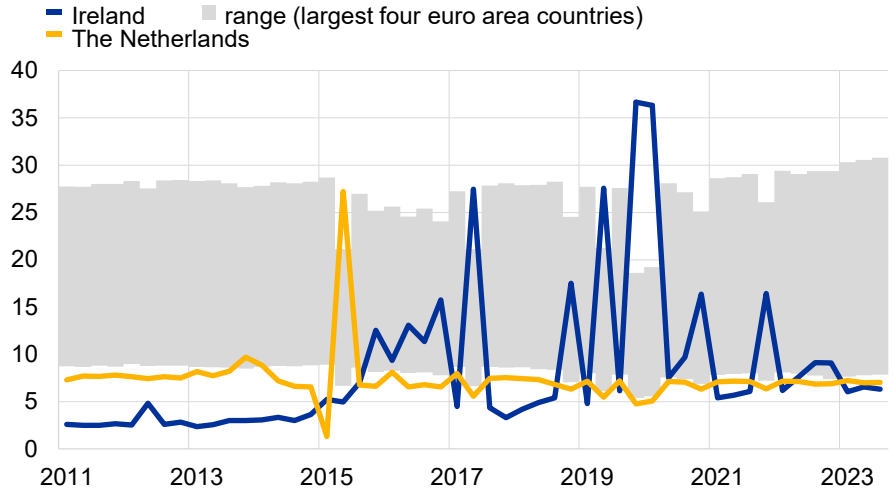
Sources: Eurostat and ECB staff calculations.
Notes: Last observation 2023 Q3.

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IPP investment in Ireland is large, generating substantial exports

Share of Ireland and the Netherlands in euro area IPP investment

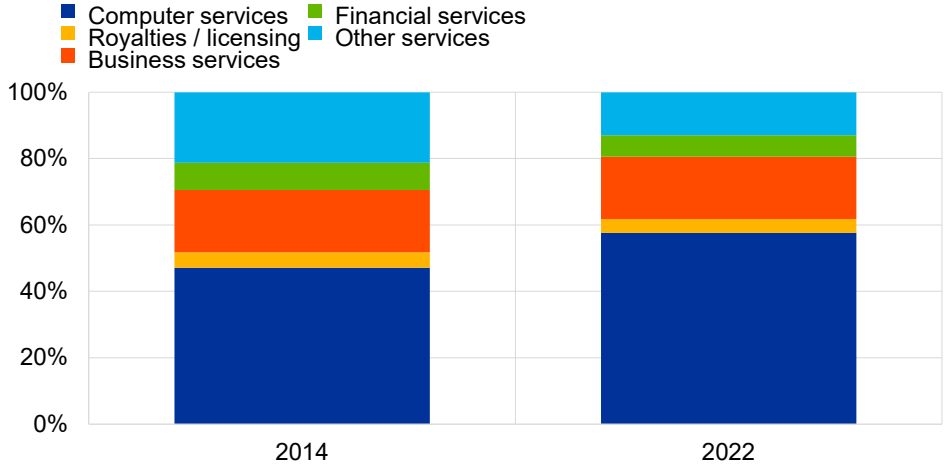
(% of euro area IPP investment)



Sources: Eurostat and ECB staff calculations.
Notes: Irish IPP dynamics are estimated for missing data. The grey range refers to the minimum and maximum of the largest four euro area countries, Germany, France, Italy and Spain.
Last observation: 2023 Q3 .

Breakdown of Ireland's services exports

(percent)



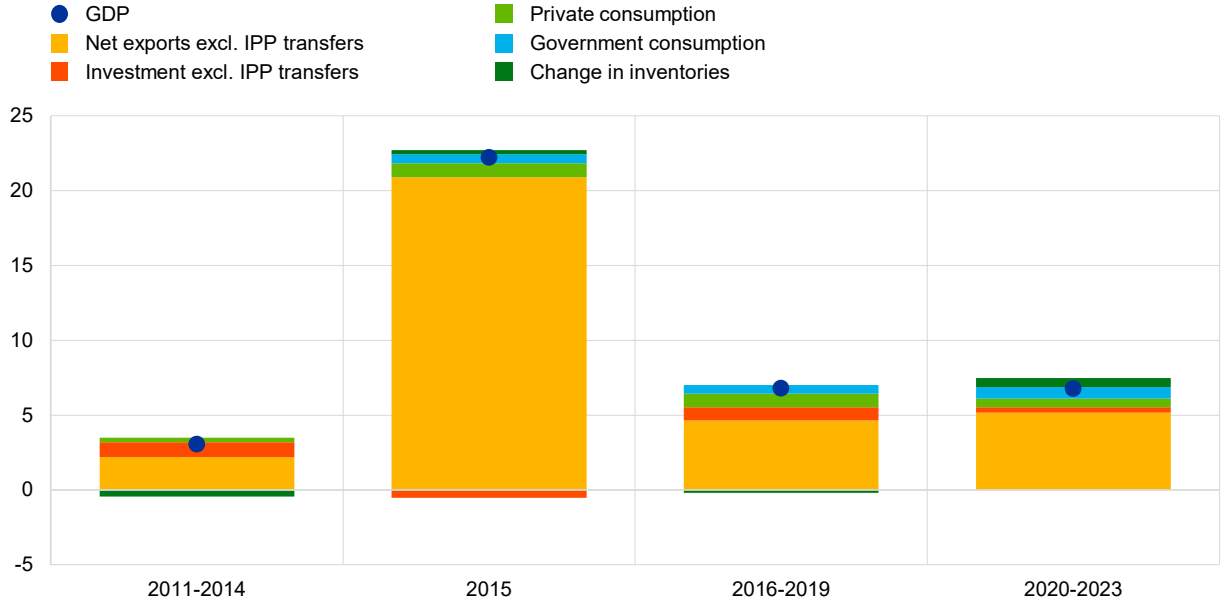
Source: Central Statistics Office Ireland.

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Even excluding IPP transfers, net exports grow sizeably in Ireland

Breakdown of average real GDP growth in Ireland

(percentage changes, percentage points)



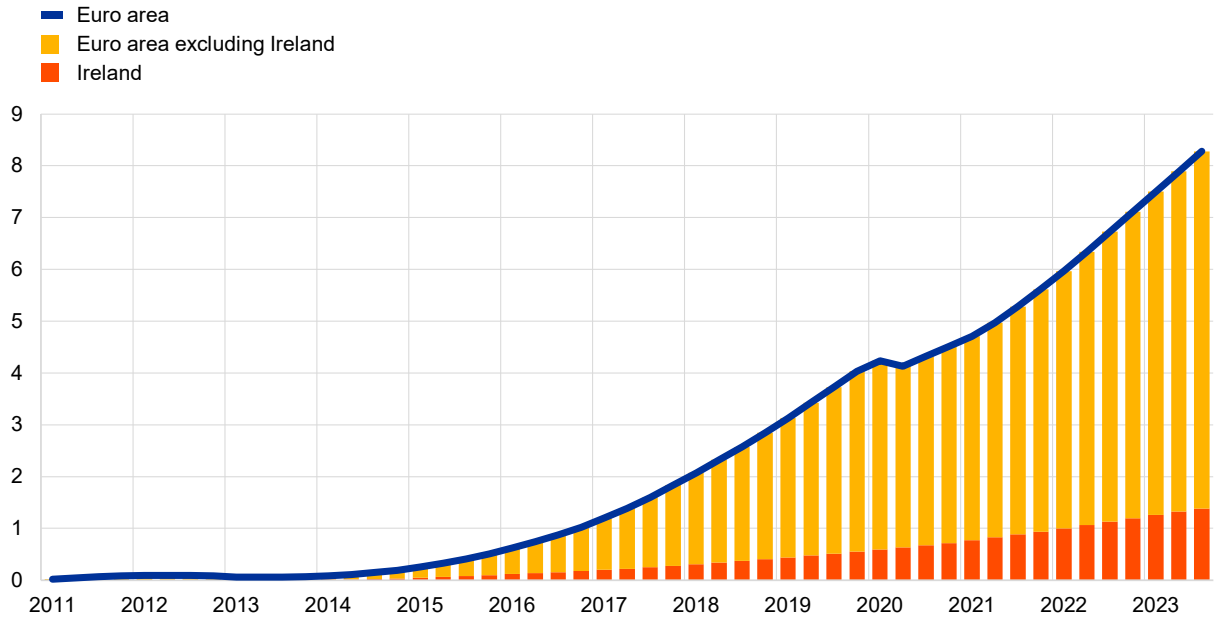
Source: Eurostat.
Note: Based on annualised quarter-on-quarter growth rates. IPP transfers have been netted out.

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These dynamics have increased Ireland's share in euro area GDP

Euro area GDP and contributions from Ireland

(cumulated euro area GDP from 2011 to Q3 2023, EUR trillions; contributions from Ireland and the rest of the euro area)



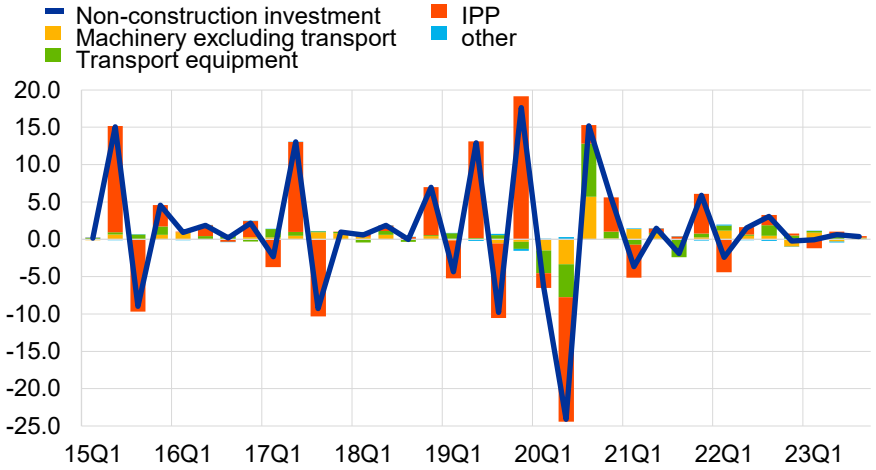
Sources: Eurostat and ECB staff calculations.
Last observation: 2023 Q3.

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Transfers impact euro area expenditure components

Euro area real non-construction investment across assets

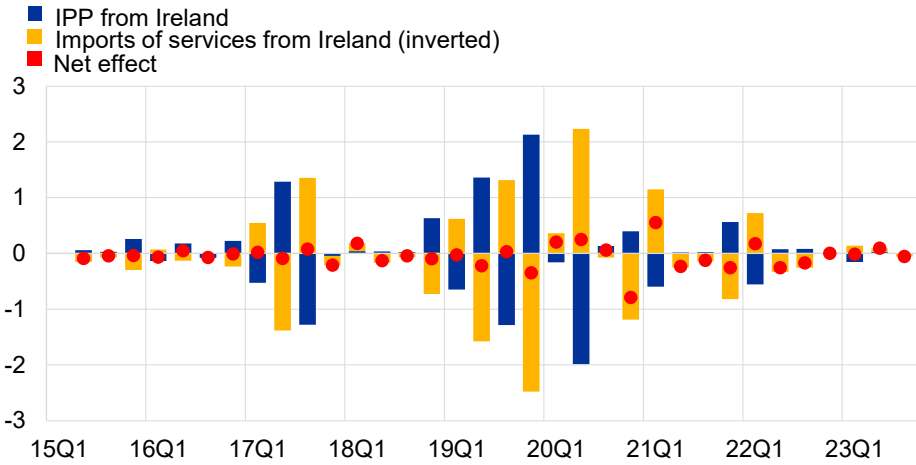
(q-o-q % changes and percentage point contributions)



Sources: Eurostat and ECB staff calculations.
Latest observation: 2023 Q3.

Contribution to euro area GDP from IE IPP, and services imports and net effect

(percentage point contributions)



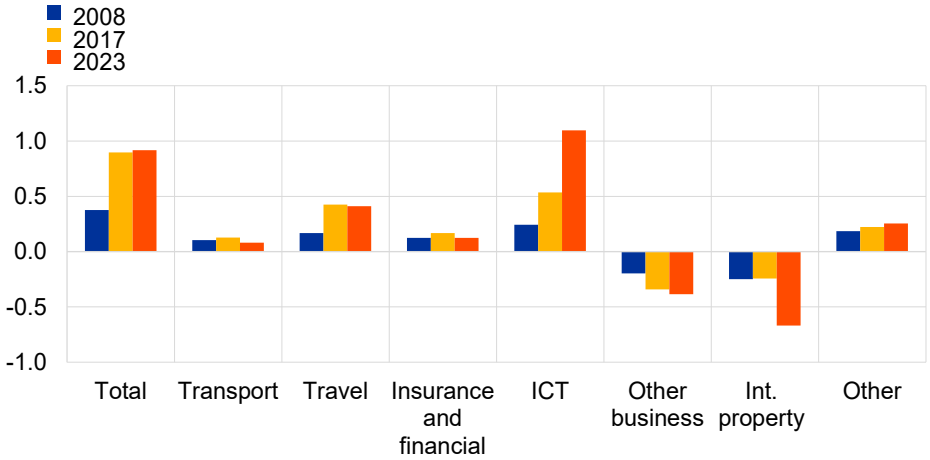
Sources: Eurostat and ECB staff calculations.
Latest observation: 2023 Q3.

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Increase in services trade balance partly due to rise in ICT services in Ireland

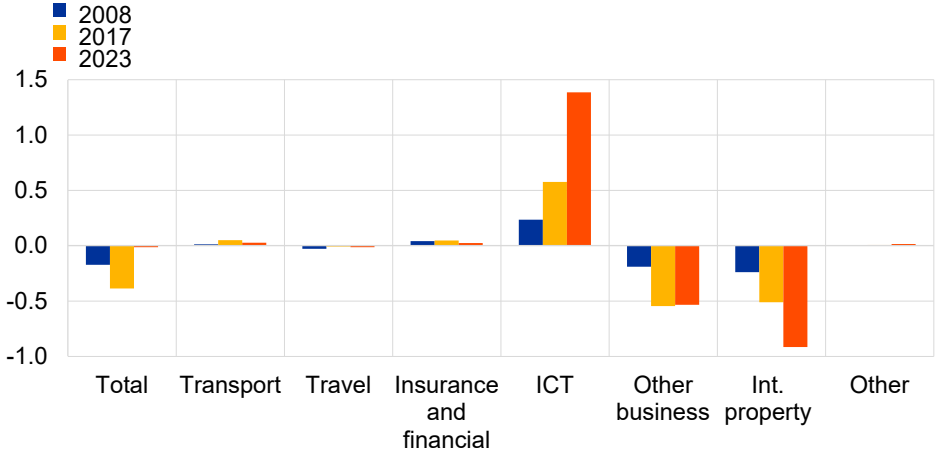
Euro area services trade balance by component

(four quarter moving sums, % of euro area GDP)



Ireland services trade balance by component

(four quarter moving sums, % of euro area GDP)



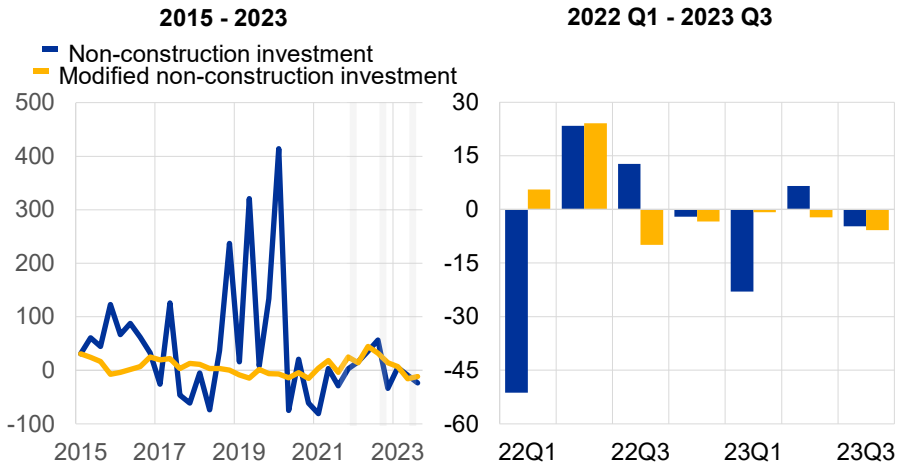
Sources: ECB and ECB staff calculations.
Notes: Int. property refers to charges for the use of intellectual property. Other business services include research and development services. Values for 2023 refer to four quarters up to 2023 Q2.

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Modified series smooth the impact of MNE activities, helping the real-time assessment

(Modified) non-construction investment in Ireland

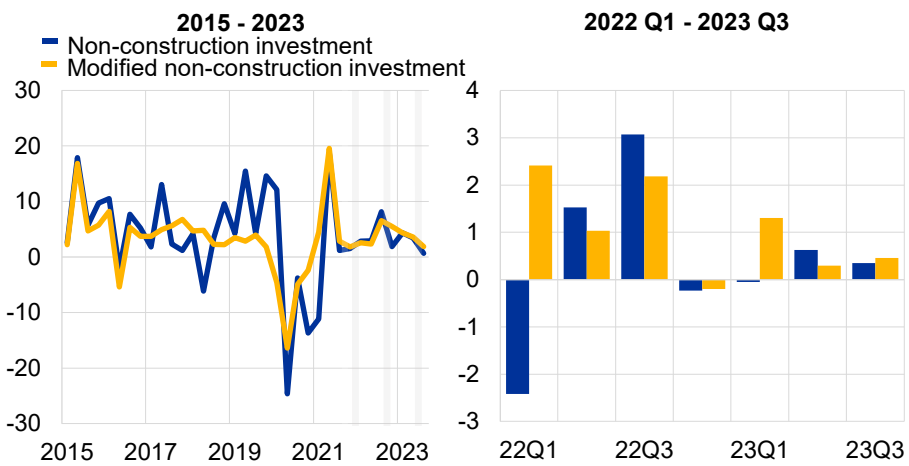
(lhs: y-o-y % changes; rhs: q-o-q % changes)



Sources: CSO Ireland, Eurostat, ECB staff.
Latest observation: 2022 Q3.

(Modified) non-construction investment in the euro area

(lhs: y-o-y % changes; rhs: q-o-q % changes)



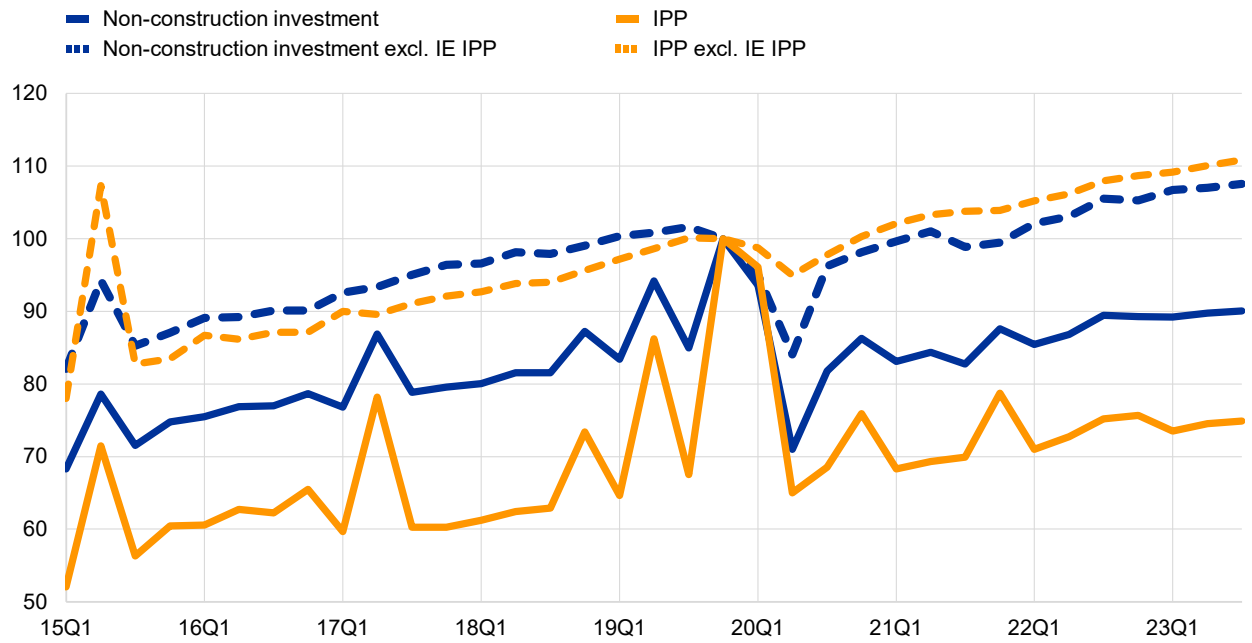
Sources: CSO Ireland, Eurostat, ECB staff
Latest observation: 2022 Q3.

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Levels of IPP affect the interpretation of post pandemic recovery

Real non-construction investment and IPP dynamics

(2019Q4=100)



Sources: Eurostat and ECB staff calculations.
Note: Data for IPP in Ireland in 2020 Q2 are estimates.
Latest observation 2023 Q3.

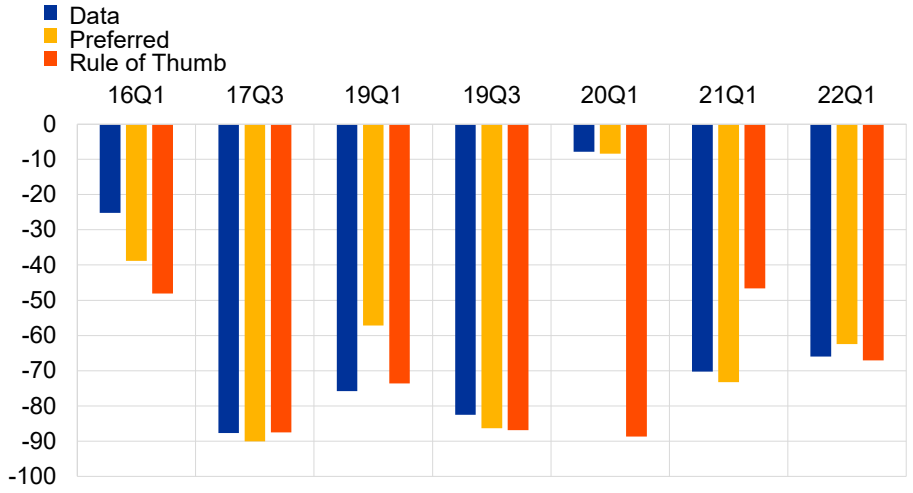
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Forecast: Estimations of IPP patterns

- **Rule of thumb**: IPP in Ireland broadly returns to pre-shock level after one quarter
- **Parametric Estimation** (99Q2 – 23Q3) often outperforms the rule of thumb:
- $IPP_t = f(IPP_{t-i,}\ SHOCK_t,\ SHOCK_t*IPP_t,\ SHOCK_{t-1},\ SHOCK_{t-1}*IPP_{t-1},)$

Estimated growth rates in aftermath of large IPP shocks

(q-o-q % change)



Sources: Eurostat and ECB staff calculations.

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Conclusions

- Improved statistical measurement of **globalisation activities of MNEs imply large fluctuations** in Irish GDP, with knock-on implications for the euro area
- **Modifications of national accounts data** to address the specificities of the Irish economy, carried out and published by the CSO in Ireland, **help in assessing the euro area business cycle**
- While it is **difficult to foresee transfers of intangible assets ex ante**, we find merit in using a rule of thumb as well as a simulation approach to better capture the unwinding of such shocks

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THANKS FOR YOUR ATTENTION!

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IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Which countries own/control your supply chain?[1]

Dennis Dahlmans, Oscar Lemmers, Tom Notten, Leen Prenen and Khee Fung Wong,
Statistics Netherlands

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Which countries own/control your supply chain?

External statistics after the pandemic: addressing novel analytical challenges

Madrid, 12 February 2024

Oscar Lemmers, Tom Notten, Khee Fung Wong, Leen Prenen, Dennis Dahlmans

Disclaimers

- All authors are employed at Statistics Netherlands
- Part of the research was financed by the Dutch Ministry of Economic Affairs and Climate Policy
- The opinions expressed in this paper/presentation are those of the authors and are not necessarily in accordance with the policies of Statistics Netherlands or the Ministry of Economic Affairs and Climate Policy.

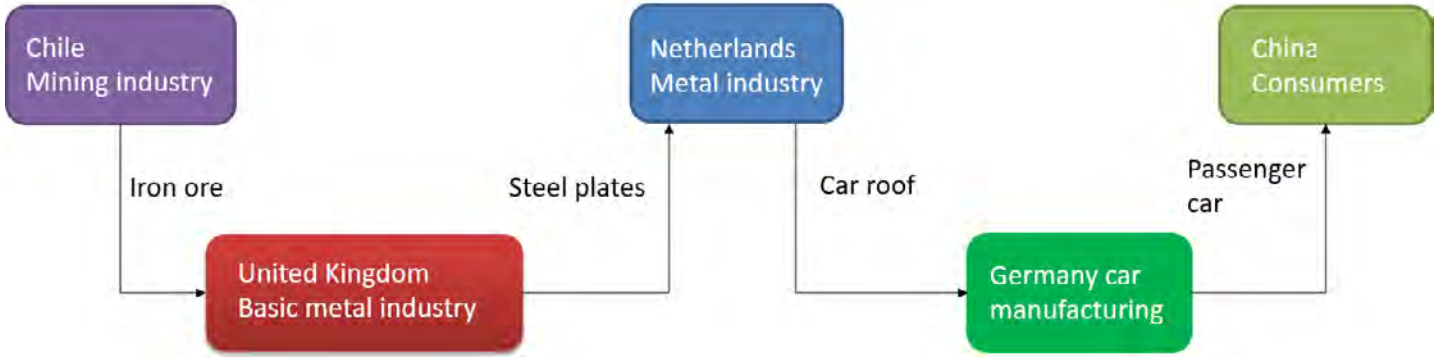
Global value chains (GVCs) create dependencies

Who is dependent on whom for supplies of energy, food, materials for the energy transition, high tech production etc.?

- At the start of the COVID-19 pandemic, there were export restrictions of pharmaceuticals and masks by several countries
- EU dependency on Russian gas became clear when supply was cut
- EU strategic autonomy, a.o. related to economic resilience, foreign and security policies
- Strategic dependencies, Critical Raw Materials Act, European Chips Act

This presentation: who produces for you and who owns that production

Standard analysis of GVC dependencies



Production in several countries –> dependencies. See, e.g., Kuzmenko & Čechura (2023). If something happens in an industry in a country that produces in your supply chain, you can be affected. Adaptation takes time.

Could be a natural disaster, a strike, geopolitics, and so on.

Location, location, location?

Location of production in supply chain - only this matters for dependencies?

Everyone who ever rented, knows dependency on the owner of the property!

- UNCTAD (2022): “national security concerns about foreign ownership of critical infrastructure, core technologies or other sensitive domestic assets”
- Firms might move production at home to foreign affiliates to circumvent issues with country of production (Alfaro and Chor, 2023)
- European Commission proposed improved screening of foreign investment into the EU to protect against risk (24 January 2024)

Novel analytical challenges

Country of ownership of production in your supply chains matters

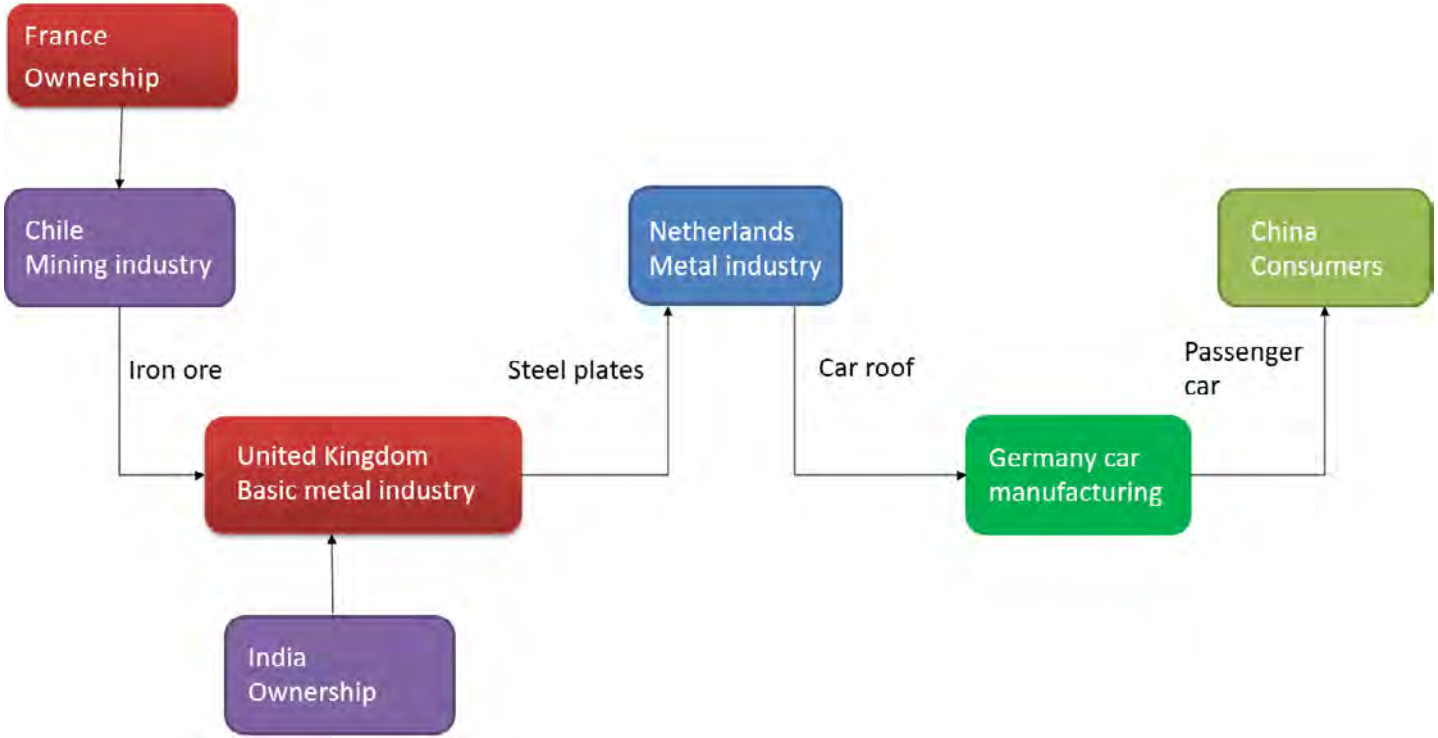
If country A owns production somewhere in the world that ultimately ends up in your supply chain, there is a dependence of country A

New information is necessary to map these dependencies

Use which data and methods to estimate ownership in the supply chain?

This presentation provides answers and suggestions for improvement.

Our new approach



Adding the ownership dimension brings another type of dependency to light

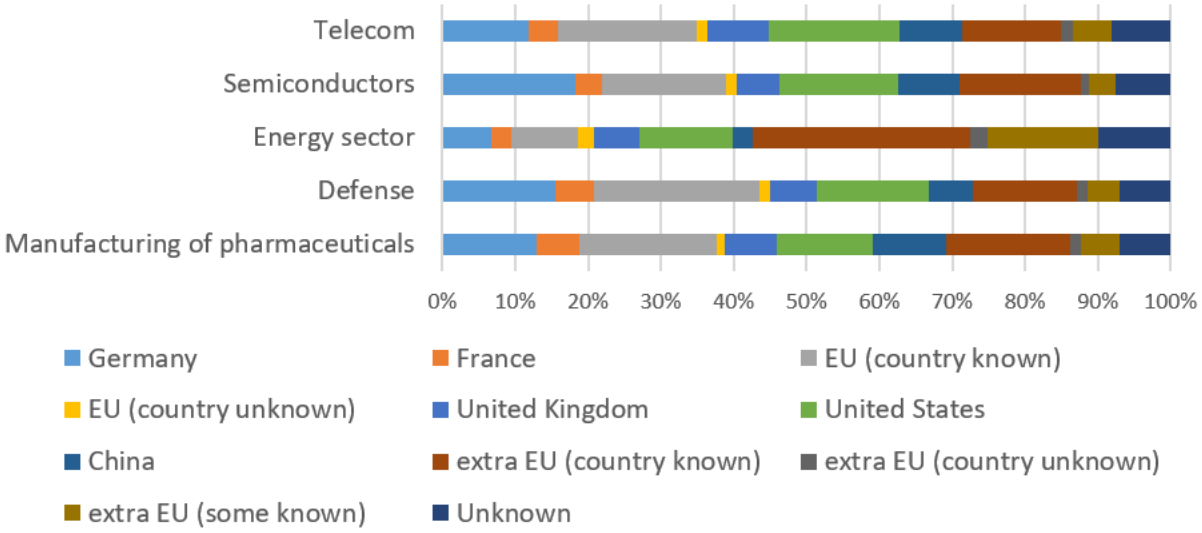
Data to map global value chains and ownership

- Inter-country input-output table, over 60 countries and 35 industries, from Asian Development Bank
- Eurostat Inward FATS: for each industry in each EU country, what is domestically owned, what is foreign owned, by country
- Eurostat Outward FATS: for each EU country, given an industry in a foreign country, how much is owned by the EU country
- BEA: similar data as Inward/Outward FATS for the United States
- OECD AMNE (Cai et al. 2023): for each industry in each country, what is domestically owned, what is foreign owned by which country. Based on sources above and FDI ***with estimates for the confidential part -> complete***

Method in a nutshell

- Used microdata for much better quality for the Dutch part of the GVC
- Map the supply chain of an industry in a country with data from the Asian Development Bank: how much is produced in which industry in which country? Standard input-output analysis.
- If 5% of production in British metal manufacturing is owned by firms from India, we assume that 5% of British metal manufacturing in any supply chain is owned by firms from India.

Ownership in supply chain 5 Dutch industries, 2019



Value added in foreign part supply chain of Dutch telecom is 12%, 4%, 18% and 9% under German, French, US and Chinese ownership, respectively.

Energy sector is very different from the rest; much production and ownership outside EU, e.g. Norway, Russia, Saudi Arabia

China/USA related content in EU production

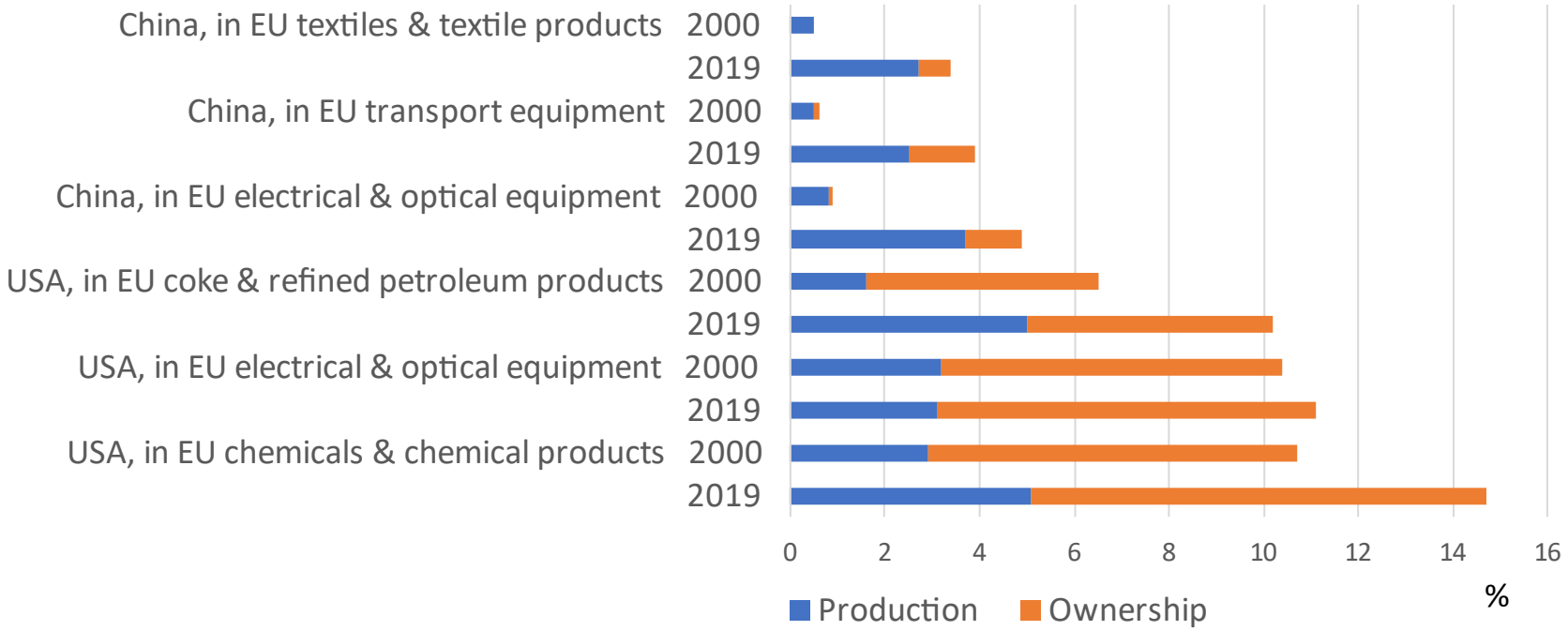
Consider the 2 largest trading partners of the EU: China and USA

USA related content: inputs that are **produced in USA** and/or were under **American ownership** (similar: China related content)

Research questions:

- How large is China/USA related content in EU production?
- How did this change over time?
- What are factors behind this change?
- Are there opportunities for policy involvement?

China/USA related content in EU production



Of inputs of 2019 EU chemical production, 5.1 % was produced in the USA and 9.6 % was produced elsewhere under USA ownership. Total 14.7 %.

Decomposing changes over time, 2000-2019

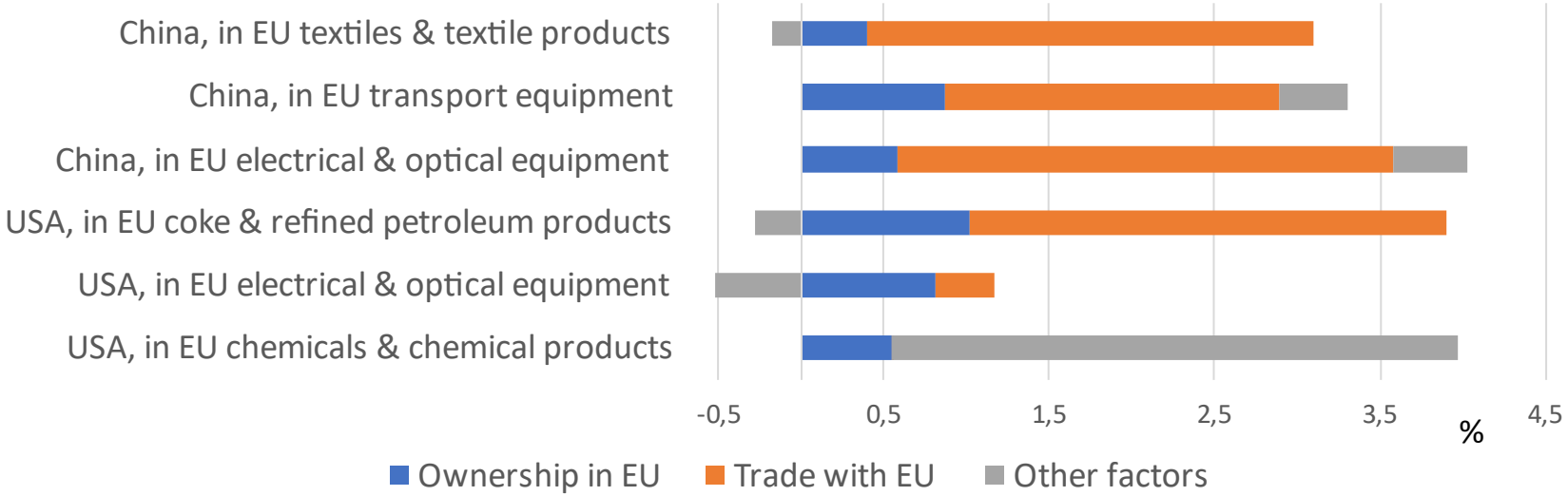
Factors that can be influenced by EU policies

- Investments by a country in the EU
- Exports by a country to the EU

Factors that cannot be, or difficult to be, influenced by policies (*the rest*)

- General trade fragmentation
- Changing technology
- Trade with both countries involved outside the EU
- Investments with both countries involved outside the EU

Decomposing changes China/USA related content, 2000-2019



- China related content in EU manufacturing of transport equipment rose 3.3%. 0.9%pt, 2.0%pt and 0.4%pt due to changes in Chinese ownership in the EU, Chinese trade with the EU and other factors, respectively.
- Size of factors that can be influenced by policies: generally large.

Conclusion & way forward

- One can map ownership in the supply chain of individual industries
- This ownership can be sizeable
- Changes USA/China related content in EU production mostly explained by changes in trade with/ownership in EU; can be influenced by policy

Policy makers ask for more detail in industry and country of ownership.

- Data improvement: using confidential Eurostat/ECB data
- Data improvement: more industry and country (Africa!) detail IO-table
- Methodological improvement: take into account that foreign affiliates trade relatively often with the home country

Questions, remarks, comments?

Now (if time permits), or later via

o.lemmers@cbs.nl

The structural decomposition analysis (I)

- USA related value added = S * V * L * F
- S = share_US = (s_1, s_2, …, s_m), s_i is a vector with the share of American ownership by industry in country i
- V = (v_1, v_2, …, v_m), v_i is value added per unit production by industry in country i
- F = (F_1, F_2, …, F_m) is final use, normalised by embodied value added
- B = m identical matrices $\tilde{B}$ stacked on each other. $\widetilde{b_{i,jk}}$ = production of global industry i purchased by industry j in country k / output industry j in country k.
- T, trade matrix, such that T * B = A with A the usual technical coefficient matrix
- X = (x_1, x_2, …, x_m) is production necessary to produce F
- I is the identity matrix
- (I –T◦B) x = F and x = (I – T◦B)$^{-1}$ F. Set L = (I – T◦B)$^{-1}$. Then x = LF.

The structural decomposition analysis (II)

$$\Delta(USA\ related\ value\ added) = \Delta(S * V * L * F)$$

$$= \frac{1}{2}((\Delta S)V_1L_1F_1 + (\Delta S)V_0L_0F_0) + \frac{1}{2}(S_0(\Delta V)L_1F_1 + S_1(\Delta V)L_0F_0)$$
$$+\frac{1}{2}(S_0V_0(\Delta L)F_1 + S_1V_1(\Delta L)F_0) + \frac{1}{2}(\mathrm{S_0V_0L_0}(\Delta F) + S_1V_1L_1(\Delta F)) \quad (1)$$

$$\Delta L = \frac{1}{2}L_1(T_0 + T_1) \circ (\Delta B)L_0 + \frac{1}{2}L_1(\Delta T) \circ (B_0 + B_1)L_0 \quad (2)$$

Plug (2) into (1) and split ΔS and ΔT each into two parts: one related to ownership in the EU/trade with the EU, one related to ownership outside the EU/trade outside the EU.

The structural decomposition analysis (III)

The shift in US related content in an industry is decomposed into factors

- Ownership (ΔS_EU) of US firms in the EU
- Intermediate trade linkages of the US ($\Delta(US_EU)$) with the EU

- General defragmentation (ΔV)
- Technology (ΔB)
- Ownership (ΔS_nEU) of US firms outside the EU
- Intermediate trade linkages of the US ($\Delta(US_nEU)$) with non-EU countries
- Intermediate trade linkages of other countries ($\Delta(Rest_of_world)$)
- Trade structure of total EU production by this industry for final use (ΔF)

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Where is the real impact of foreign direct investment? The case of the Portuguese outward foreign direct investment[1]

Carlos Figueira,
Banco de Portugal

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Where is the real impact of Foreign Direct Investment? - The case of the Portuguese outward FDI

Carlos Figueira, Banco de Portugal[1]

Abstract

Complex ownership structures of Multinational Enterprises (MNEs) often hinder the interpretation of classic Foreign Direct Investment (FDI) statistics both geographically and in terms of allocation by economic activity. MNEs usually channel their investments through a large number of companies until it eventually reaches the actual investment target. For that reason, FDI statistics should also be compiled in a different approach, in which the Ultimate Host Economy (UHE) is identified, in lieu of the Immediate Host Economy. This new set of data is needed to enhance the meaning and usefulness of FDI statistics. The present paper presents the different approaches for measuring outward FDI statistics by UHE and discusses the results obtained for the three approaches that were tested. The results show that the geographic distribution of the Portuguese outward FDI is significantly different when looking at UHE statistics, in particular, due to countries that are mainly used as intermediaries, showing the importance of looking through non-operational legal units. The insights of this study seek to contribute to the development of methodological guidance on the compilation of UHE statistics and to assess the feasibility of using the available information to produce such statistics with a high quality.

Keywords: Globalization, Foreign Direct Investment, Ultimate Host Economy, Data linking

JEL classification: C80, F21, F23, F60

[1] The views expressed in this paper are those of the author and do not necessarily represent those of the Banco de Portugal.

1. Introduction

Complex ownership structures of Multinational Enterprises (MNEs) are hindering the interpretation of classic Foreign Direct Investment (FDI) statistics both geographically and in terms of allocation by economic activity. MNEs do not always channel their investments through a single holding company or special purpose entity (SPE) but, instead, through a large number of companies (holding or SPE chains as well as operating units) until it reaches the actual investment interest. This occurs due to several factors, such as tax optimization, free flow of capitals, and optimization of production chains. For that reason, FDI statistics may also be compiled in a different approach, in which the Ultimate Host Economy (UHE) is identified, in lieu of the Immediate Host Economy. This new set of data is needed to enhance the meaning and usefulness of FDI statistics.

Theoretically, the ideal objective of UHE statistics is to allocate the investment to the economy where FDI is generating its real economic effects. However, this is a challenging task since ownership structures are increasingly intricate and even more because "near-SPEs"[2] are increasingly more common. Therefore, the data needed for the allocation of FDI to the correct UHE are quite significant in terms of both volume and complexity. As a result, practical guidance and a more pragmatic and feasible approach is needed, always bearing in mind that increasing reporting burden should be avoided and cross-country comparability should be ensured.

With that in mind, Banco de Portugal recently conducted a pilot study on the compilation of Outward FDI positions by UHE, making use of the information available in the EuroGroups Register (EGR) database. The present paper is an extension of the work initiated with that pilot study.

This paper discusses and presents the options for overcoming the aforementioned challenges and for compiling high quality statistics on FDI in a modern, highly globalized corporate sector. The paper also presents the results of the different approaches of measuring outward FDI statistics by UHE, showing the importance of looking through non-operational legal units (holding companies and Special Purpose Entities - SPEs). The results show that the geographic distribution of Portuguese outward FDI is significantly different when looking at UHE statistics instead of immediate counterparty data, in particular, due to countries that are mainly used as intermediaries. The paper relies on the combination of granular information available in the EGR database and micro data coming from the internal FDI database of Banco de Portugal. The insights of this study seek to contribute to the development of methodological guidance on the compilation of UHE statistics and to assess the feasibility of using the available information to produce such statistics with a high quality.

The paper is organized as follows: the next section provides a brief overview of the methods available to compile UHE statistics, identifying the methods used in the paper. Section 3 presents the data sources Banco de Portugal has at its disposal, how they can be used to compile this new set of statistics and it also presents some of the

[2] Near-SPEs are "hybrid companies displaying both SPE-like (financial intermediation) and non-SPE-like activities". For more details, see the Final Report of the Task Force on Special Purpose Entities: https://www.imf.org/external/pubs/ft/bop/2018/pdf/18-03.pdf

advantages and challenges of using each data source. In section 4, we discuss the results obtained and the last section concludes and discusses some potential next steps.

2. Methods to produce UHE statistics

The present section aims at presenting the different methods that can be used to reallocate outward FDI positions from the Immediate Host Economy (the economy of the immediately held subsidiary) to the Ultimate Host Economy (the economy that ultimately receives the investment). According to the IMF's Direct Investment Task Team (DITT)[3] Guidance Note "D.6 – Ultimate Investing Economy, Ultimate Host Economy and Pass-through Funds", the different possible approaches are the following[4]:

1. To show how the influence of the ultimate direct investor flows down the investment chain using balance sheet information and ownership shares at each link in the chain;
2. To use the value the direct investor would receive if that subsidiary were acquired by another enterprise (that is, measuring the ultimate investor's position in the Direct Investment Enterprise (DIE) in the specific economy where it is located)[5];
3. To define the UHE as the last economy in the chain;
4. To define the UHE as the first operating unit (even if it is not the end of an investment chain).

The fourth option, i.e., the first operating unit approach, was the one recommended by the DITT as its method of choice, mainly for practical reasons.

Alternatively, the U.S. Bureau of Economic Analysis (BEA) groups the methods to produce UHE statistics under three broad categories[6]:

1. Push-down methods;

[3] The Direct Investment Task Team (DITT) is one of the four Task Teams established by the IMF's Committee on Balance of Payments Statistics to contribute to the work related to revising the IMF's Balance of Payments and International Investment Position Manual, sixth edition (BPM6). This team has the mission of providing technical inputs and making recommendations on the methodology of direct investment within the framework of the BPM6 revision process.

[4] For further details on these four possible approaches, see Annex I from the DITT Guidance Note "D.6 – Ultimate Investing Economy, Ultimate Host Economy and Pass-through Funds": https://www.imf.org/-/media/Files/Data/Statistics/BPM6/approved-guidance-notes/d6-ultimate-investing-economyultimate-host-economy-and-passthrough-funds.ashx

[5] This presentation would result in statistics by UHE that are symmetric to the UIE (UIE data consistent with its UHE mirror data). For more details on this topic, see Borga and Caliandro (2018).

[6] For a more in-depth discussion on these methods, see the BEA's working paper on "Experimental Ultimate Host Economy Statistics for U.S. Direct Investment Abroad": https://www.bea.gov/system/files/papers/BEA-WP2023-9.pdf

2. Financial structure methods;
3. Apportionment methods

As the name suggests, push-down methods push the position down the ownership chain to either the first operating unit (or units) or the last unit in the investment chain.

In the financial structure methods, the position of the directly held affiliate is distributed along the affiliates in the chain, reflecting how much of the position "stays" at each tier. Even though these methods could arguably provide a better picture of MNEs' global financial structure, they are the most information-intensive methods because compilers would need accurate and detailed information on every foreign affiliate of the MNE, in particular, ownership percentages and affiliates' equity positions.

The least demanding methods in terms of informational requirements are the apportionment methods. Following these methods, the position can be apportioned using a third dataset, such as the Activity of Multinational Enterprises (AMNE) database or the Foreign Affiliates Statistics (FATS)[7]. The immediate outward FDI position can be apportioned using data on affiliates' economic variables, such as employment or turnover.

The present study explores an apportionment method where the Outward Foreign Affiliates Statistics (OFATS) are used to allocate the immediate outward FDI position to the countries and industries of the ultimate host entities. In addition, this paper also explores hybrid methods, which combine aspects from both push-down and apportionment methods. The hybrid methods developed make use of the ownership chain obtained from the EGR database to determine the ultimate host entity, which we define as being either the first-operating unit or the last unit in the investment chain. After determining the ultimate host entities, the immediate outward FDI position is apportioned to those ultimate host units using a key metric, in particular, employment data. The next section will describe in more detail the different methods used in this study.

It is worth noting that in this paper we defined an entity as being an "operating" unit when it is not classified as an SPE or a holding company. As explained in the next section, this aspect is only relevant when using data from the EGR database.

Lastly, it is important to mention that the selection of the methods to use in this study was made with the perspective of allowing in the future for a regular compilation system and, therefore, was mainly determined by data availability and practical reasons. The data sources available do not allow for the production of estimates following financial structure methods, since information on each affiliate's equity position would be needed. In contrast, the methods used are less-data intensive and relatively easy to implement.

[7] AMNE and FATS data are based on data reported to OECD and Eurostat in the framework of annual surveys on the activities of foreign-controlled enterprises and foreign affiliates abroad controlled by residents of the compiling country. These statistics provide economic measures of activities, such as number of affiliates, turnover, and employment.

3. Data Sources for the compilation of UHE Statistics

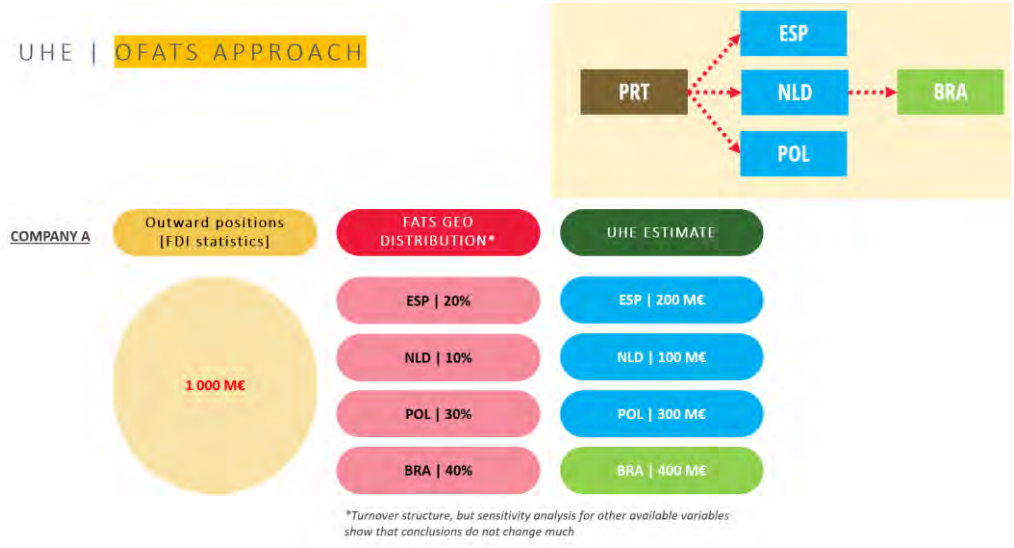
3.1 Two available data sources: OFATS vs. EGR

The first UHE estimates for Portugal were produced within the context of the EU FDI Pilot Studies carried out in 2019. The purpose of these studies was to determine the conditions, including the methodological framework, for introducing new data collections on annual FDI statistics, where UHE was included. Methodological guidance for these FDI statistics was developed by the Joint ESS/ESCB Task Force on FDI.

At that stage, the compilation of UHE statistics relied entirely on the information available in the Outward Foreign Affiliates Statistics (OFATS), since Banco de Portugal did not wanted to increase reporting burden. OFATS information, combined with our granular FDI database, allowed for respecting almost all requirements established by the Joint ESS/ESCB Task Force on FDI: i) outward FDI positions (directional principle); and, ii) UHE statistics for cases where the domestic investor is the ultimate parent. However, OFATS data did not allow for meeting one of the requirements: going through non-resident SPEs to locate the operating affiliates.

OFATS approach (example for company A)

Figure 1



OFATS data gives access to information on several economic variables (number of employees, turnover, etc.) for all foreign affiliates controlled by a resident enterprise. Taking the example presented in figure 1, in the OFATS data we would have information regarding the affiliates of company A that are resident in Spain, the Netherlands, Poland and Brazil. These data would be used to apportion the outward FDI position to the Ultimate Host Economies. Assuming an outward FDI position of

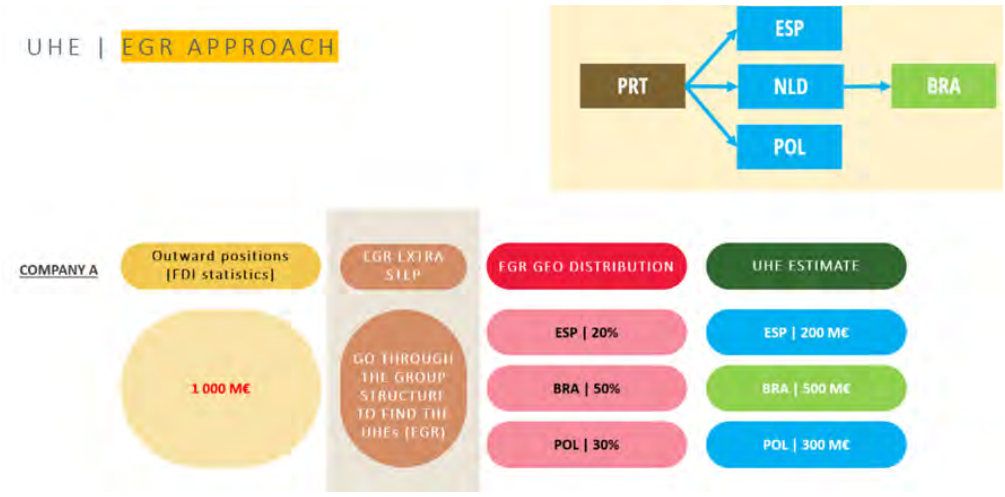
€1000 million and assuming that company A reported in OFATS a total turnover[8] of €10 million, where 20% of it was generated in Spain, 10% in the Netherlands, 30% in Poland and 40% in Brazil, then we would allocate the total outward FDI using this same structure, resulting in 20% of the outward FDI position to Spain (€200 million), 10% to the Netherlands (€100 million), 30% to Poland (€300 million) and 40% to Brazil (€400 million).

It is important to point out that in this case, there is no information about the group structure of company A (this is illustrated in the upper-right corner of figure 1 by the dotted lines). This aspect is crucial for the comparison between the OFATS approach and the methods based on the use of the EGR, since it represents one of the main differences between those methods.

The first estimates for 2014 and 2015 based on OFATS data showed a high concentration of Portuguese FDI positions by ultimate host economy in European countries (61% of the outward FDI positions, in 2015). Since the EGR database contains structural economic information on multinational enterprise groups with presence in the EU/EFTA (with at least one legal unit) and on their enterprises, the new pilot study had the objective of using the EGR database to produce new UHE estimates and compare the new results with the ones obtained with the OFATS data.

EGR method (example for company A)

Figure 2



When using the EGR database, the method used to produce UHE statistics is similar to the one followed when using OFATS data, but it has an additional step: going through the group structure (given by the EGR) to find the ultimate host economies. The example in figure 2, which is an extension of the one in figure 1, is

[8] The turnover structure was applied, but sensitivity analysis for other available OFATS variables showed that conclusions do not change significantly. Personnel costs, intra-group exports, intra-group imports, total exports, total imports, gross investment in tangible goods, number of employees and value added were some of the economic variables used in this sensitivity analysis.

useful to illustrate this EGR method. In this case, the full lines in the upper-right corner tell us that we have information on the ownership chain.

Based on the example in figure 2, Spain, Brazil and Poland[9] would be defined as the ultimate host economies and the outward FDI position of company A would be allocated to each of these countries based on employment weights (employment data comes from the EGR database), meaning that the results are different from the ones of the OFATS approach.

Deriving the UHE from a group's database (the EGR database)

Figure 3

YEAR	LEU_LEID	GEG_GGH_LEID	link1	link1_NACE	link1_aux	link2	link2_NACE	link2_aux	link3
2020	PT2	PT2	NL	K.64.20	01	PT2	M.70.10	N;02	NL31	
2020	PT2	PT2	NL	K.64.20	01	PT2	M.70.10	N;02	CH23	
2020	PT2	PT2	NL	K.64.20	01	PT2	Q.86.22	N;02		
2020	PT2	PT2	NL	K.64.20	01	PT2	M.70.10	N;02	NL31	
2020	PT2	PT2	NL	K.64.20	01	PT2	M.70.10	N;02	NL31	
2020	PT2	PT2	NL	K.64.20	01	PT2	M.70.10	N;02	NL31	
2020	PT2	PT2	NL	K.64.20	01	PT2	M.70.10	N;02	NL31	

YEAR	LEU_LEID	LEU_SPE_CODE	LEU_NACE_CODE	REL_P_LEU_LEID	LEU_GLOBAL_LEVEL	GEG_GGH_LEID	country_code_UHE	UHE
2020	PT2	N	K.64.20		0	PT2	PT	PT2	
2020	PT2	N	K.64.20		0	PT2	PT	PT2	
2020	PT2	N	K.64.20		0	PT2	PT	PT2	
2020	PT2	N	K.64.20		0	PT2	PT	PT2	

	UHE	UHE_link	UHE_NACE	SPE_CODE_UHE	GLOBAL_LEVEL_UHE	EMPL_UHE	TURN_ESTI	EMPL_UHE_Total	TURN_UHE_Total	Weight_EMPL
PT22		2	M.70.10	N	2	194		370		0.524324324
PT22		2	G.46.39	N	2	85		370		0.22972973
PT22		2	L.68.10	N	2	0		370		0
PT22		2	Q.86.22	N	2	91		370		0.245945946

To further illustrate how the EGR data was used to produce UHE estimates, figure 3 presents some extracts from the database that was compiled using EGR information. Basically, we built a database where we have the complete group structure enabling us to go through it, looking through non-resident SPEs and holding companies, until we reach the first operating entity or the last unit in the investment chain, which we will define as the ultimate host (UH). In the second table presented in figure 3, it is possible to observe, in the last column, the ultimate host entities for a particular resident investor. After defining the ultimate host entities, employment weights are computed (using data from the EGR). Those weights are then used for the allocation of each outward FDI position, as it is possible to observe in the last table of figure 3.

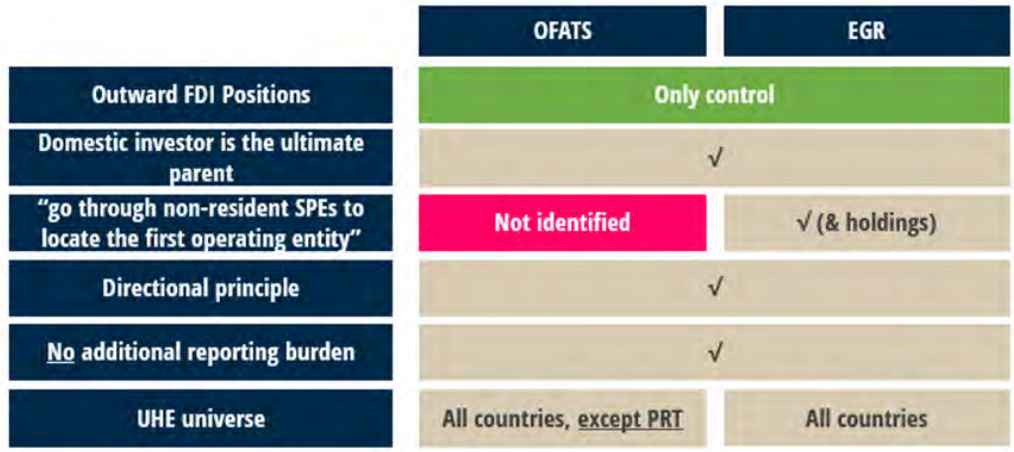
Figure 4 allows for a brief comparison of the two methods. In summary, both methodologies are based only on control relationships and in both cases outward FDI statistics by UHE are produced only for entities that are domestically-controlled, meaning that the ultimate controlling parent is resident in the compiling country, in this case Portugal. As mentioned before, in the OFATS approach, it is not possible to look through non-resident SPEs since that information is not available, but this is

[9] When defining the ultimate host entity as the first operating unit, looking through the affiliate located in the Netherlands can be justified by the fact that this entity is an SPE or a holding company.

precisely one of the advantages of using the EGR database. With the EGR we can go through the groups' structure and look through both SPEs and holding companies. In addition, in both cases, we are using the directional principle, because it better reflects the direction and degree of influence, and there is no additional reporting burden imposed on respondents. Lastly, in the OFATS approach, there is another limitation related to the fact that it is not possible to have the compiling economy, in this case Portugal, as the UHE. Conversely, this is possible when using the EGR. Indeed, this is an important advantage of using the EGR because in the case of Portugal there is some degree of round-tripping.

Two potential data sources

Figure 4



These two data sources (OFATS and the EGR) allow for the use of three different approaches to compile outward FDI statistics by UHE. The possible approaches are summarized in figure 5.

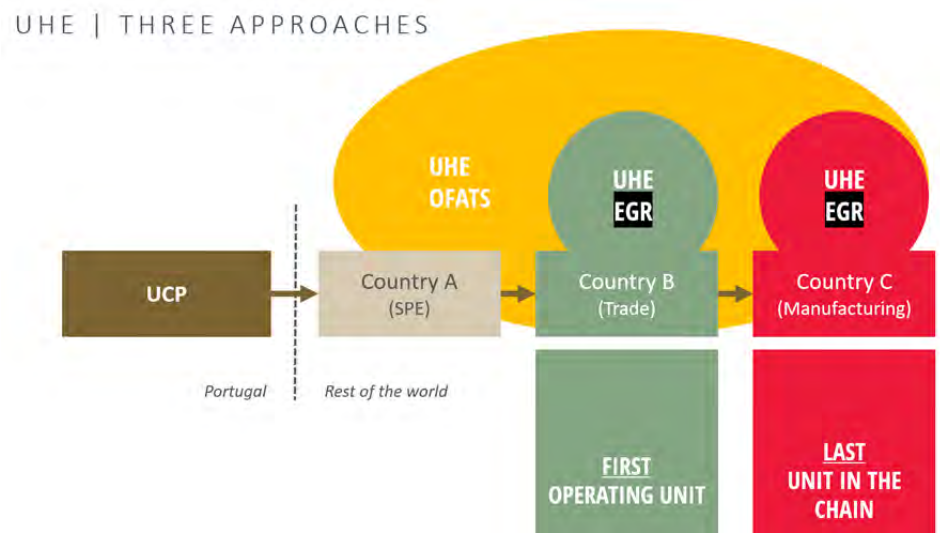
The first possible approach is the OFATS one. Based on the example presented in figure 5, according to this approach, countries A, B and C would be considered the ultimate host economies.

In case the EGR is used, given the fact that the group structure is available, two different approaches are possible, depending on how the ultimate host entity is defined. Considering the example from figure 5, if the ultimate host entity is defined as the first operating unit, country B is the UHE, because we would be looking through the SPE located in country A. If, instead, the ultimate host unit is defined as the last unit in the investment chain, then the UHE would be country C.

As it is possible to infer, the results from the three approaches may differ significantly, both geographically and in terms of economic activity allocation.

The three different approaches

Figure 5



3.2. Advantages and challenges of using the EGR database

The EGR database is a very useful tool to produce UHE statistics because it allows to go through non-resident SPEs and holding companies. It also allows to go to the bottom of the investment chain, since information on the group structure is available. Additionally, it is possible to allocate outward FDI positions to the compiling economy when this reflects the economic reality (round-tripping cases).

However, the use of EGR also poses some challenges. There are some missing values for the variable that tells us whether the non-resident entity is an SPE and some missing information for non-EU/EFTA entities. Regarding this last aspect, it is relevant to point out that some missing employment values were filled with data from the last year available.

Another challenge is related to the fact that turnover data is only available by "enterprise"[10] and not by "legal unit", making it difficult to conduct a sensitivity analysis. This is a challenging aspect because FDI data is produced by legal unit.

[10] The enterprise is the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations. An enterprise may be a sole legal unit (Council Regulation (EEC) No 696/1993 of 15 March 1993 on the statistical units for the observation and analysis of the production system of within the Community).

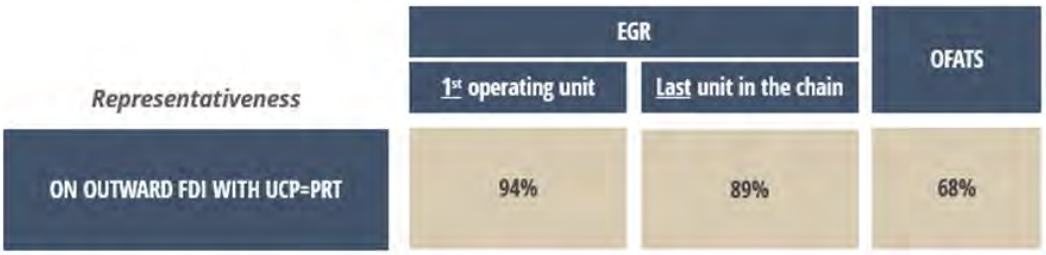
4. Result analysis

4.1 Main assumptions and general results

To start the analysis of the results, it is important to look at their representativeness on the total outward FDI positions in which the UCP is Portuguese. Those results are shown in figure 6.

Representativeness of the results (reference year: 2020)

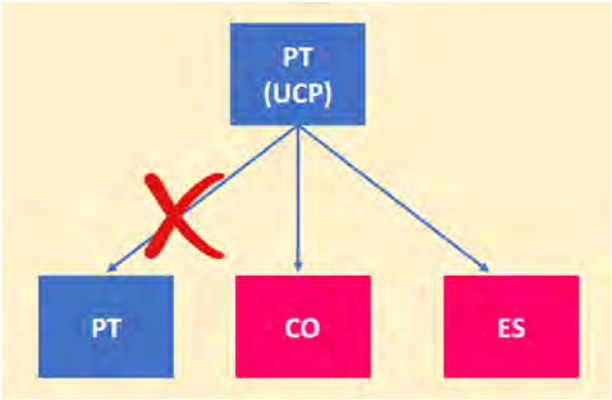
Figure 6



For the OFATS approach, 68% of the outward FDI where the UCP is Portuguese are allocated to a UHE. When using the EGR, the representativeness is much higher in both cases. When the ultimate host is defined as the first operating unit, 94% of the outward FDI positions are allocated and, when going until the last unit in the investment chain, 89% of those positions are allocated to a UHE.

Excluding immediate relations between a resident UCP and its resident subsidiary

Figure 7



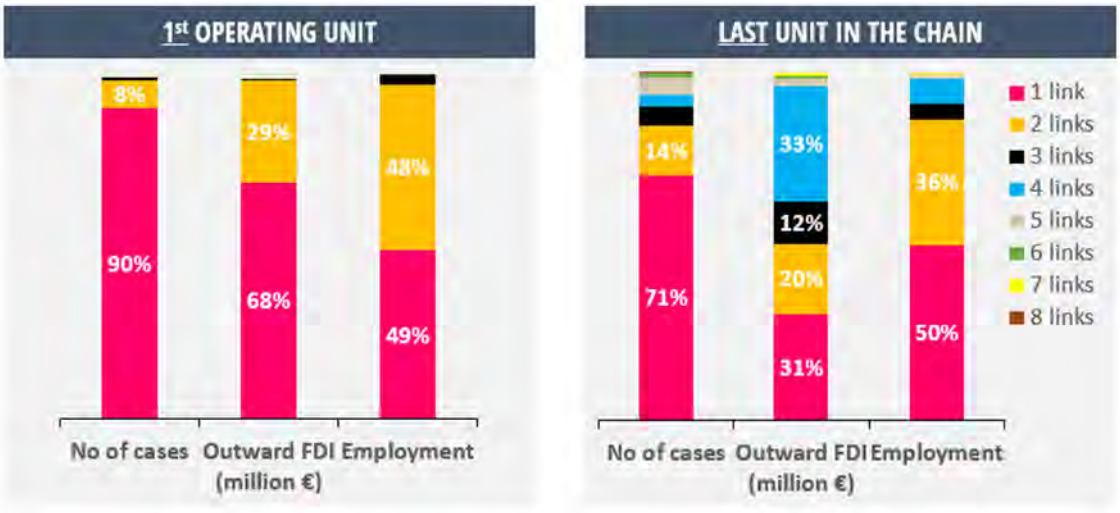
Two other important aspects help us to better understand the results. On one hand, we excluded from this exercise immediate relations between a Portuguese UCP and its resident subsidiaries (figure 7) since those relations are not inside the FDI

border. Considering the example in figure 7, we would move down along the group structure only for the links below non-resident entities, in this case below the entities located in Colombia and Spain. On the other hand, it was assumed that, for real estate investment, the immediate host economy corresponded to the UHE.

When considering the two approaches based on the EGR database, the first question that may come to our minds is: "how many units we have to look through to find the UHE?". Figure 8 provides the answer to that question.

How many links we need to look through until the UHE? (reference year: 2020)

Figure 8



In case we stop at the first operating unit, it is possible to observe that for the vast majority of cases (90%), the immediate subsidiary is also the first operating entity, that is, the ultimate host. Those cases represent 68% of the outward FDI positions and 49% of the employment. For this approach, there is also a significant part of the outward FDI for which the UHE is found at the second link (8% of the outward FDI position). In addition, using this approach, the maximum number of links needed to found the UHE was 4 (those cases represent around 2% of the outward FDI positions).

When going until the last unit in the investment chain, the ultimate host is still found at the first link in most cases (71%), and this can be better understood if we take into account that in the EGR most of the Portuguese groups have only one link. However, following this approach, these cases correspond to only 31% of the outward FDI positions in which the UCP is Portuguese, and this means a reduction to less than half. It is also important to highlight that, with this approach, there is a significant percentage of the outward FDI positions that is allocated to a unit found at the 3rd or 4th link, 12 and 33% of the outward FDI, respectively.

4.2 Outward FDI by UHE

Before looking at the outward FDI positions by UHE, it is important to have an idea of the most relevant immediate host economies in the case of Portugal. Figure 9 presents the outward FDI positions for the top 13 immediate host economies. It is possible to observe that 52% of the Portuguese outward FDI is directed to the Netherlands, 10% to Spain and 6% to Luxembourg. This means that there is a great part of the Portuguese outward FDI that is directed, in immediate terms, to financial centers.

Outward FDI positions for the top 13 immediate host economies (reference year: 2020)

Figure 9

Rank	Immediate Partner	Outward FDI Stocks (MEUR)	% of Outward FDI Stocks
1	NL	17 805	52%
2	ES	3 506	10%
3	LU	2 012	6%
4	BR	1 427	4%
5	AO	1 312	4%
6	MZ	921	3%
7	FR	909	3%
8	MO	758	2%
9	US	581	2%
10	GB	470	1%
11	DE	470	1%
12	CL	360	1%
13	PL	353	1%
TOP13		30 883	91%

When looking to outward FDI by UHE (figure 10), the Netherlands represents a much lower percentage of the Portuguese outward FDI, 1% for the OFATS approach. Also for the OFATS approach, it is possible to see that the two main destinations of Portuguese outward FDI are Poland, with 24%, and Spain, with 17%.

In the EGR approach, when stopping at the first operating unit, the Netherlands also reduces its importance (to 14%), but not as much as in the OFATS approach. Portugal becomes the main destination for the Portuguese outward FDI (round-tripping), and Poland and Spain also account for a significant share of the Portuguese Outward FDI (12% and 14%, respectively).

Still in the EGR approach, but now going until the last unit in the investment chain, Brazil becomes the main destination for the Portuguese outward FDI, accounting for 19% of the total. Colombia comes next with a weight of 17% and only then one can find Spain (12%) and Poland (8%). Additionally, it is possible to observe that Portugal decreases its importance, comparing with the first operating unit results, meaning that the round-tripping phenomenon is less relevant, and it accounts only for 6% (which compares with 17% for the first-operating unit approach).

As expected, countries that are relevant financial centres, like the Netherlands and Luxembourg, lost much of their importance when looking to FDI statistics by UHE. Luxembourg is no longer part of the top 13, in the three different approaches and, when it comes to the Netherlands, it is not part of the top 13, only when going until the last unit in the investment chain.

It is noteworthy that countries with important pass-through activities are even less relevant when the ultimate host is defined as the last unit in the investment chain. This is even more meaningful when combined with the fact that countries where productive activities likely take place, such as Brazil and Colombia, increase their relevance as main destinations for the Portuguese outward FDI.

Outward FDI positions by UHE (TOP 13 host economies for 2020)

Figure 10

RANK	OFATS		EGR 1st operating unit		EGR Last unit	
	UHE	Value (%)	UHE	Value (%)	UHE	Value (%)
1	PL	24%	PT	17%	BR	19%
2	ES	17%	ES	14%	CO	17%
3	MZ	5%	NL	14%	ES	12%
4	BR	3%	PL	12%	PL	8%
5	AO	3%	BR	6%	PT	6%
6	CO	2%	US	4%	US	4%
7	CV	2%	AO	3%	AO	3%
8	FR	1%	MO	2%	MO	2%
9	CI	1%	GB	2%	FR	1%
10	DE	1%	MX	2%	MX	1%
11	US	1%	FR	2%	CH	1%
12	NL	1%	CO	2%	RU	1%
13	GB	1%	RU	1%	DE	1%
TOP13		61%		80%		79%

4.3 Outward FDI by NACE of the ultimate host

Figure 11 presents the results by NACE[11] section, foccusing on the comparison between stopping at the first operating unit and going until the last unit in the chain. It is possible to observe that a significant part of the Portuguese outward FDI is not allocated to any NACE section and that this is more relevant when going until the last unit in the chain (25% when stopping at the first unit; 43% when going until the bottom of the investment chain). This happens because moving further down the

[11] The Statistical classification of economic activities in the European Community, abbreviated as NACE, is the classification of economic activities in the European Union (EU); the term NACE is derived from the French *Nomenclature statistique des activités économiques dans la Communauté européenne*.

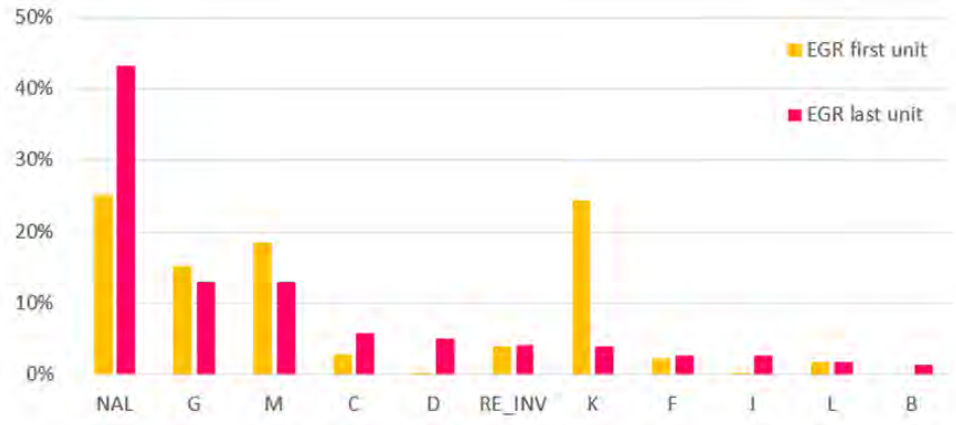
group structure lead us more frequently to non-EU/EFTA countries and information for companies from those countries is not always available in the EGR database.

It is also possible to notice a significant decrease in the Financial sector, section K from NACE ("Financial and Insurance Activities"), when comparing the two approaches. This means that for some cases the ultimate host moves away from the financial sector, when going until the last unit in the investment chain.

Moreover, it is important to highlight that sectors like Mining and Quarrying (section B), manufacturing (section C), Electricity (section D), and Construction (section F), increase their share on the Portuguese outward FDI.

Outward FDI positions by NACE section of the ultimate host (reference year: 2020)

Figure 11



[1] Notes: B – Mining and quarrying, C – Manufacturing, D – Electricity, gas, steam and air conditioning supply, F – Construction, G – Wholesale and retail trade; repair of motor vehicles and motorcycles, J – Information and communication, K – Financial and insurance activities, L – Real estate activities, M – Professional, scientific and technical activities, NAL – Not allocated, RE_INV – Real estate investment

5. Conclusion

The present paper presents the results of Banco de Portugal exploratory work on the production of outward FDI positions by UHE. Based on available data sources, three different methods were explored: an apportionment method and two hybrid methods. The hybrid methods studied make use of the ownership chain obtained from the EGR database to determine the ultimate host entity, which we define as being either the first operating unit or the last unit in the investment chain. Then, the immediate outward FDI position was apportioned to those ultimate host units, using employment data.

The results of this study show the importance of looking through non-operational legal units (holding companies and Special Purpose Entities - SPEs). Countries with important pass-through activities like the Netherlands and

Luxembourg have a much lower relevance when looking at outward FDI by UHE and this is even more the case when we go to the bottom of the investment chain. As a result, the geographic distribution of the Portuguese outward FDI is significantly different when looking at UHE statistics.

Moreover, the last unit method presents some important results compared to the other two methods explored. In particular, when going to the last unit in the investment chain, the round-tripping phenomenon (Portugal as UHE) reduces its importance and countries where productive activities likely take place, such as Brazil and Colombia, increase their relevance as main destinations for the Portuguese outward FDI. Additionally, the Financial sector (Section K) also reduces its importance as a final destination for the Portuguese outward FDI and non-financial sectors, like manufacturing, become more relevant.

However, this study also demonstrates that UHE estimates largely depend on the method applied. As a result, Banco de Portugal intends to continue exploring further refinements of the methods applied so that some of the existing limitations are overcome (e.g., missing data for entities located in non-EU/EFTA countries). In addition, UHE statistics can be produced for a larger time span so that it is possible to analyze the consistency of the results obtained.

Lastly, Banco de Portugal intends to use the insights obtained with this exercise to contribute to the development of the methodological guidance on the compilation of FDI statistics by UHE, including the development of a formal definition of "first operating unit" (different definitions can lead to different results).

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WHERE IS THE REAL IMPACT OF FOREIGN DIRECT INVESTMENT? THE CASE OF THE PORTUGUESE OUTWARD FDI

2ND EXTERNAL STATISTICS CONFERENCE

12-13 FEBRUARY 2024, MADRID

CARLOS FIGUEIRA

BANCO DE PORTUGAL
EUROSISTEMA

AGENDA

01	WHY UHE STATISTICS?
02	METHODS TO PRODUCE UHE STATISTICS
03	DATA SOURCES: OFATS vs. EGR
04	RESULTS
05	THOUGHTS ON EGR AND WAY FORWARD

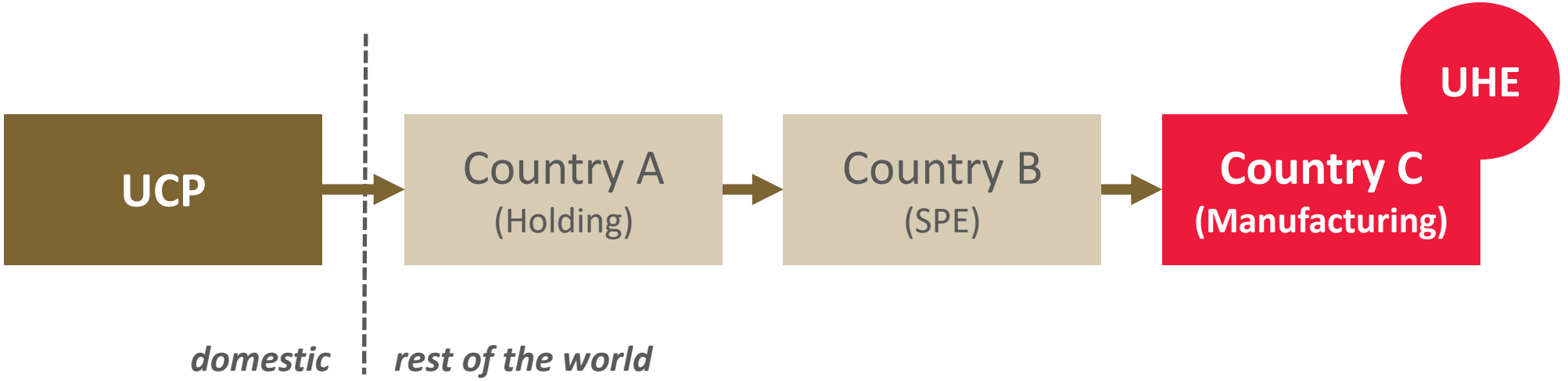
WHY UHE STATISTICS?

01

GUIDANCE ON UHE STATISTICS | UNDER DEVELOPMENT…

…theoretically we know what we want

…but we still need practical guidance



METHODS TO PRODUCE UHE STATISTICS

02

THREE METHODS TO PRODUCE UHE STATISTICS

Apportionment method	Hybrid methods
***(1)** Allocating the immediate outward FDI positions using economic variables from a third dataset*	***Apportionment** using a key metric* + ***Pushing** the positions down the ownership chain to either **(2) the first operating unit** or **(3) the last unit in the investment chain***

DATA SOURCES FOR UHE STATISTICS

03

UHE | TWO POTENTIAL DATA SOURCES

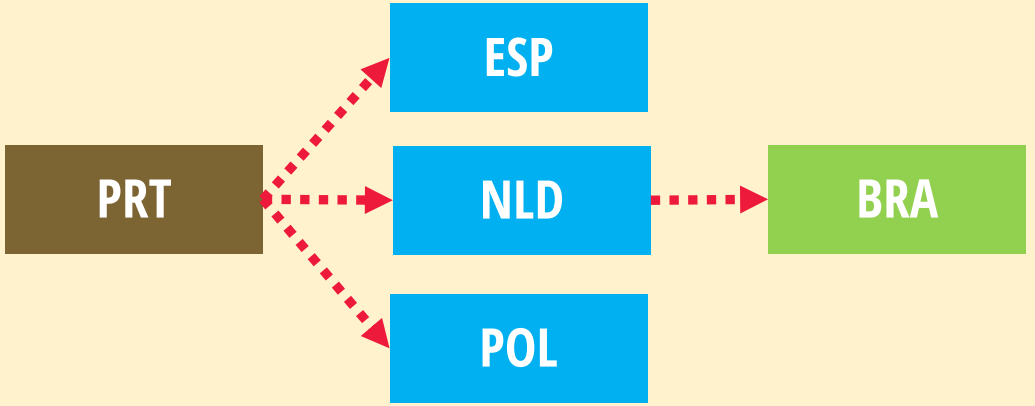




UHE | TWO POTENTIAL DATA SOURCES

OFATS	EGR
OFATS **[Outward Foreign AffiliaTes Statistics]** *Activity of foreign affiliates abroad controlled by the compiling country*	**EGR** **[EuroGroups Register]** *European statistical register on multinational enterprise groups*

UHE | OFATS APPROACH

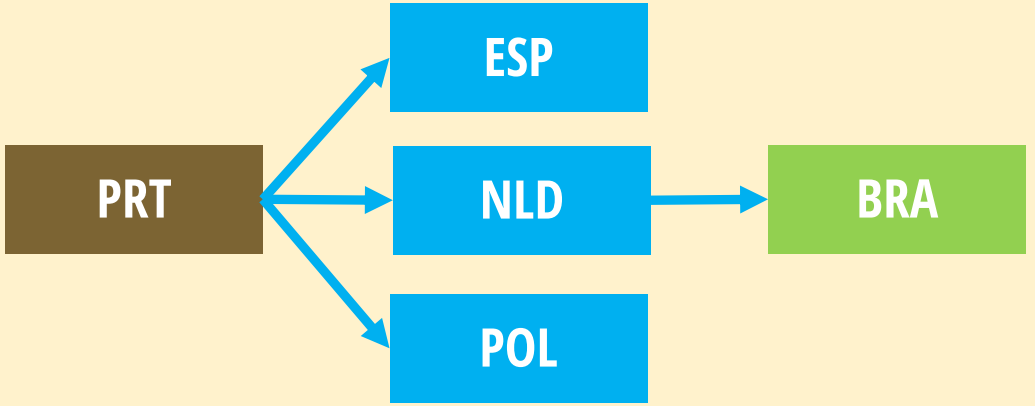


COMPANY A

Outward positions [FDI statistics]	FATS GEO DISTRIBUTION*	UHE ESTIMATE
1 000 M€	ESP | 20%	ESP | 200 M€
	NLD | 10%	NLD | 100 M€
	POL | 30%	POL | 300 M€
	BRA | 40%	BRA | 400 M€

**Turnover structure, but sensitivity analysis for other available variables show that conclusions do not change much*

UHE | EGR APPROACH



COMPANY A

Outward positions [FDI statistics]	EGR EXTRA STEP	EGR GEO DISTRIBUTION	UHE ESTIMATE
1 000 M€	GO THROUGH THE GROUP STRUCTURE TO FIND THE UHEs (EGR)	ESP | 20%	ESP | 200 M€
		BRA | 50%	BRA | 500 M€
		POL | 30%	POL | 300 M€

WHAT IS THE EGR?

Deriving the UHE from a group's database

YEAR	LEU_LEID	GEG_GGH_LEID	link1	link1_NACE	link1_aux	link2	link2_NACE	link2_aux	link3
2020	PT22 98	PT22 98	NL3 61	K.64.20	01	PT22 44	M.70.10	N;02	NL31
2020	PT22 98	PT22 98	NL3 61	K.64.20	01	PT22 44	M.70.10	N;02	CH23 49
2020	PT22 98	PT22 98	NL3 90	K.64.20	01	PT22 32	Q.86.22	N;02	
2020	PT22 98	PT22 98	NL3 61	K.64.20	01	PT22 44	M.70.10	N;02	NL31
2020	PT22 98	PT22 98	NL3 61	K.64.20	01	PT22 44	M.70.10	N;02	NL31
2020	PT22 98	PT22 98	NL3 61	K.64.20	01	PT22 44	M.70.10	N;02	NL31
2020	PT22 98	PT22 98	NL3 61	K.64.20	01	PT22 44	M.70.10	N;02	NL31

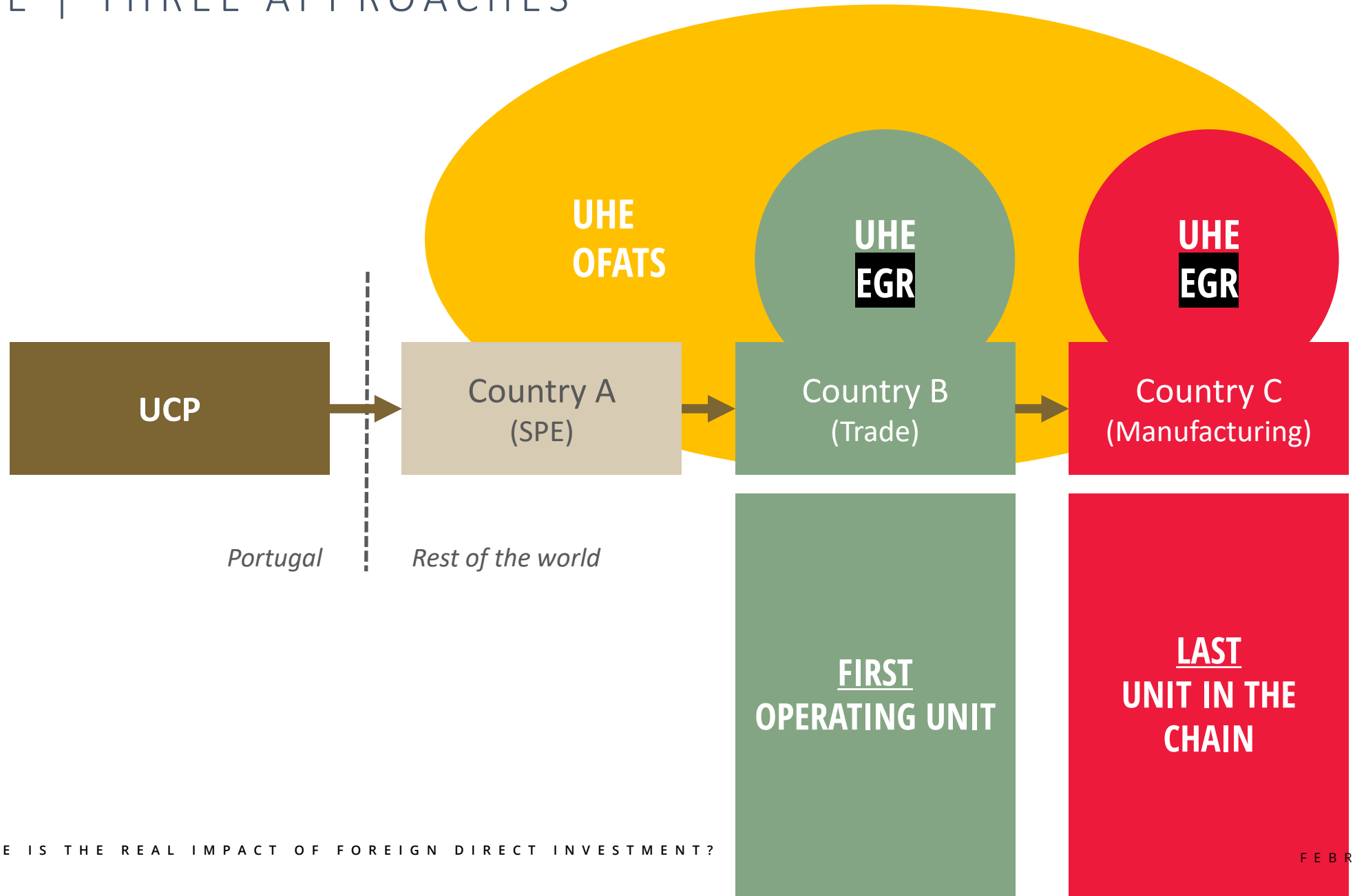
YEAR	LEU_LEID	LEU_SPE_CODE	LEU_NACE_CODE	REL_P_LEU_LEID	LEU_GLOBAL_LEVEL	GEG_GGH_LEID	country_code_UHE	UHE
2020	PT2 98	N	K.64.20		0	PT2 98	PT	PT2 44
2020	PT2 98	N	K.64.20		0	PT2 98	PT	PT2 57
2020	PT2 98	N	K.64.20		0	PT2 98	PT	PT2 34
2020	PT2 98	N	K.64.20		0	PT2 98	PT	PT2 32

UHE	UHE_link	UHE_NACE	SPE_CODE_UHE	GLOBAL_LEVEL_UHE	EMPL_UHE	TURN_ESTI	EMPL_UHE_Total	TURN_UHE_Total	Weight_EMPL
PT22 44	2	M.70.10	N	2	194		370		0.524324324
PT22 57	2	G.46.39	N	2	85		370		0.22972973
PT22 34	2	L.68.10	N	2	0		370		0
PT22 32	2	Q.86.22	N	2	91		370		0.245945946

UHE | TWO POTENTIAL DATA SOURCES

	OFATS	EGR
Outward FDI Positions	Only control	
Domestic investor is the ultimate parent	√	
"go through non-resident SPEs to locate the first operating entity"	Not identified	√ (& holdings)
Directional principle	√	
No additional reporting burden	√	
UHE universe	All countries, except PRT	All countries

UHE | THREE APPROACHES



RESULTS

04

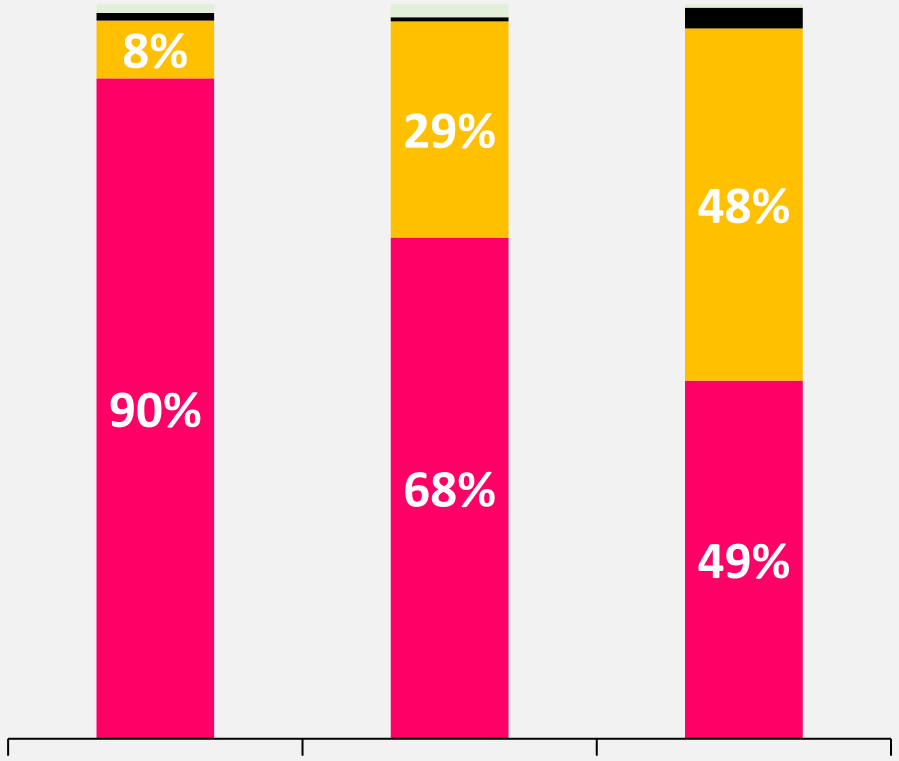
UHE | OFATS VS EGR APPROACH

Reference year: 2020

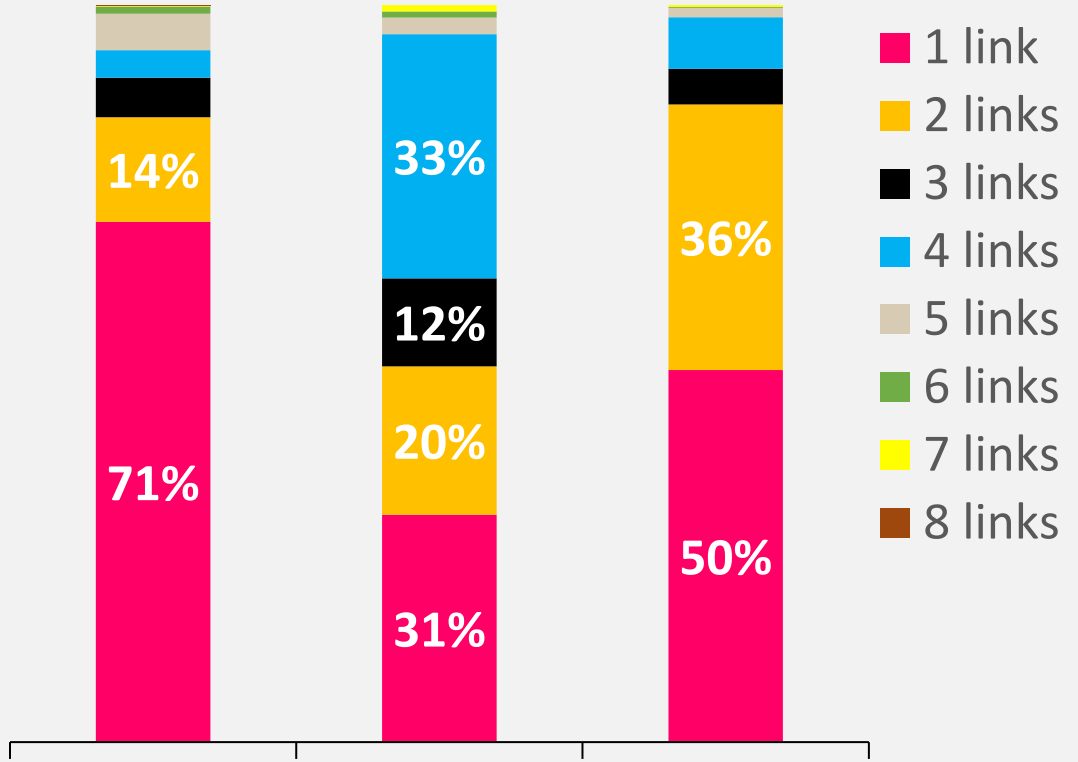
Representativeness (employment)	EGR		OFATS
	1st operating unit	Last unit in the chain	
ON OUTWARD FDI WITH UCP=PRT	94%	89%	68%

EGR | HOW MANY LINKS TO LOOK THROUGH?

1st OPERATING UNIT

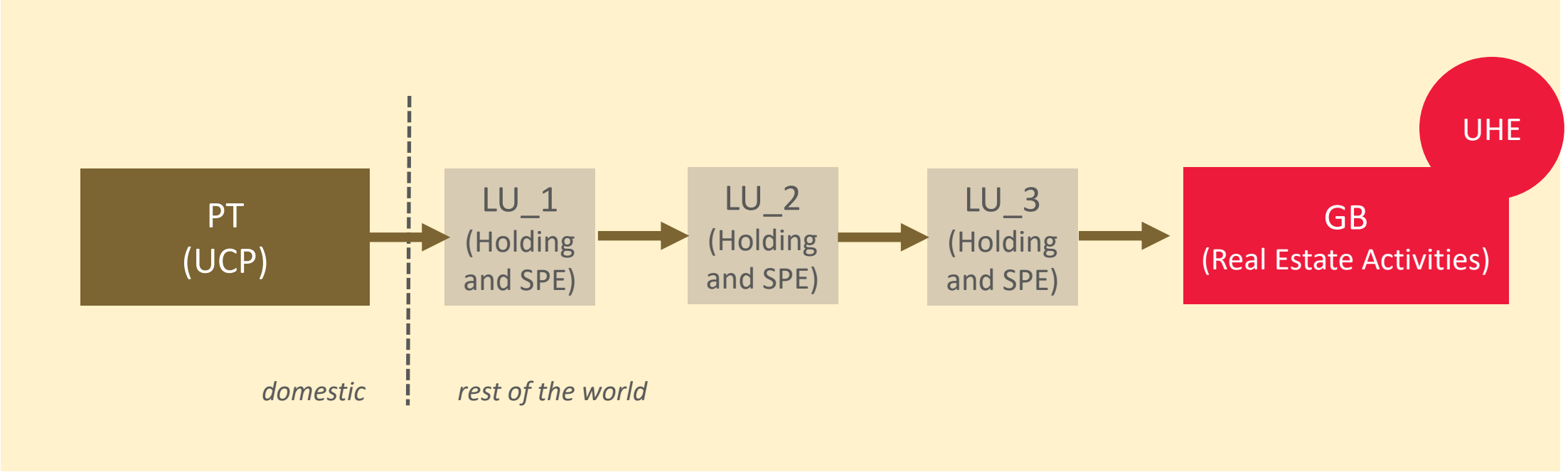


LAST UNIT IN THE CHAIN



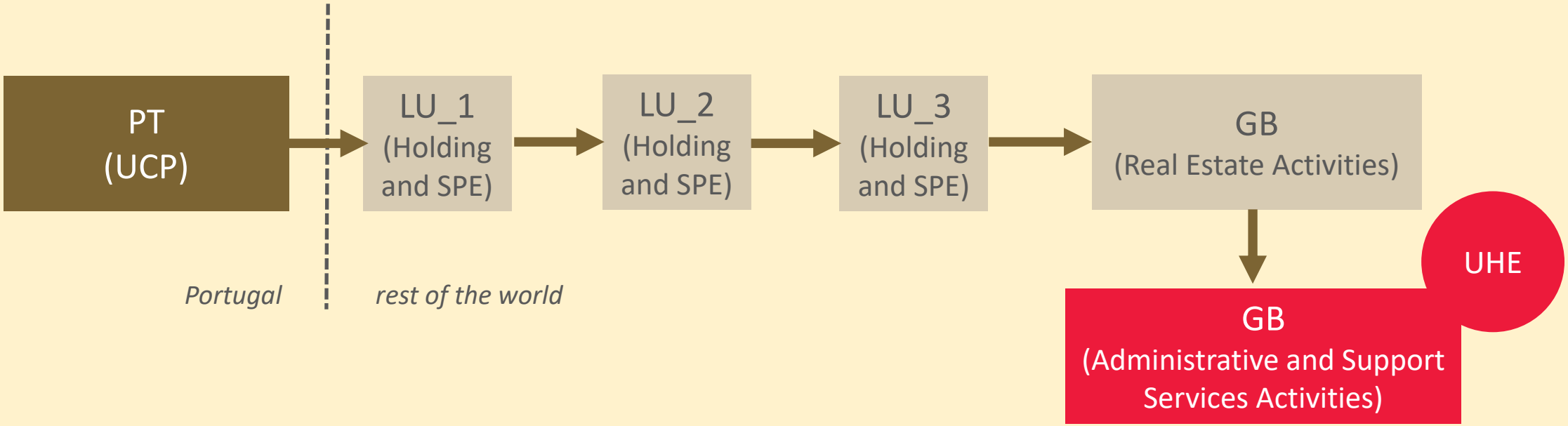
REAL EXAMPLE: IF WE STOP AT THE 1ST OPERATING UNIT

With this assumption, we go up to 4 links…



With 4 links: 38 cases (1%) that correspond to 568 MEUR of outward FDI (2%)

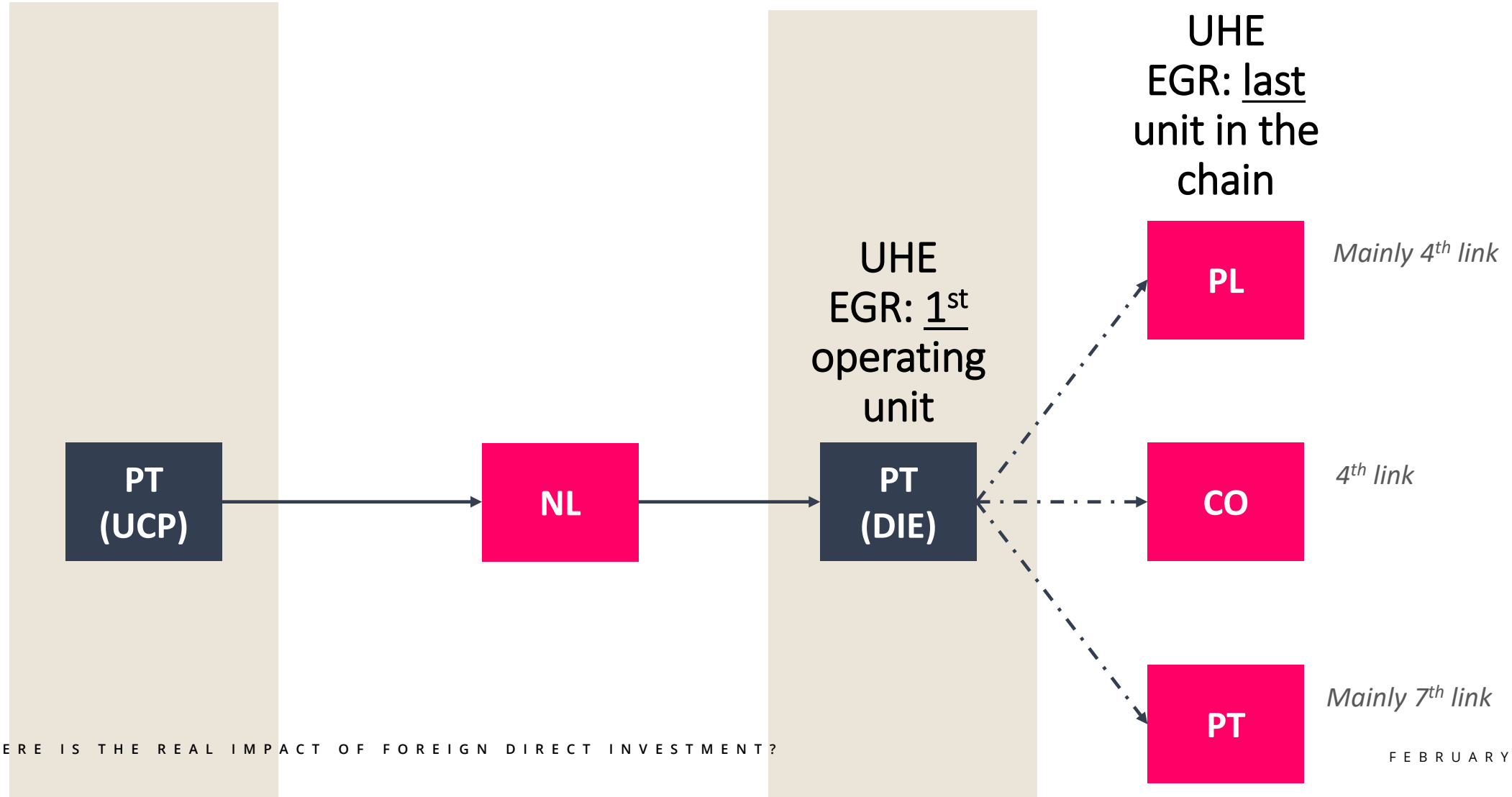
REAL EXAMPLE: IF WE STOP AT THE LAST UNIT IN THE CHAIN



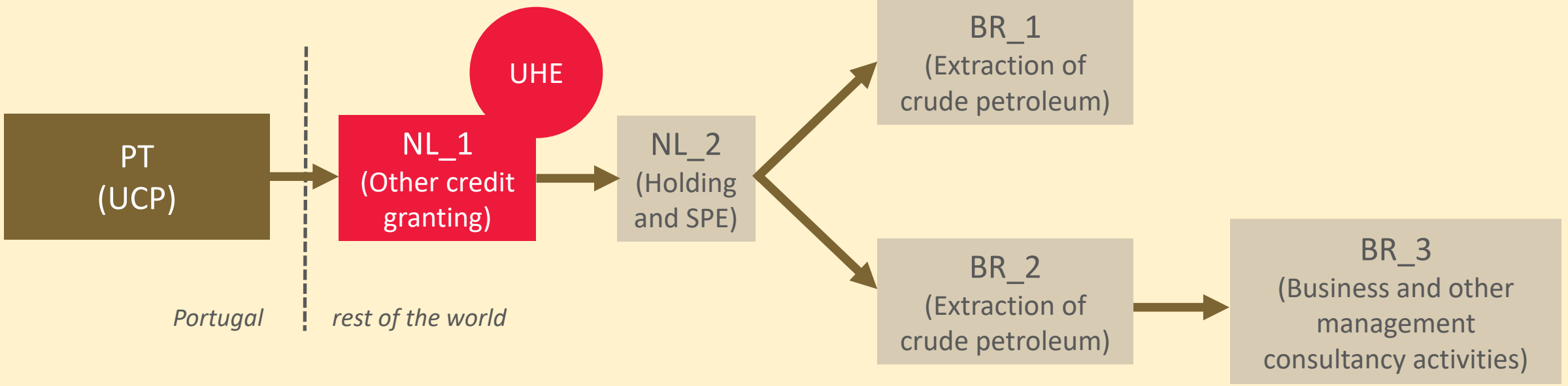
With 5 links: 165 cases (5%) that correspond to 1350 MEUR of outward FDI (5%)

THE VALUE OF THE EGR

Deriving the UHE from a group's database: **Simplified example**

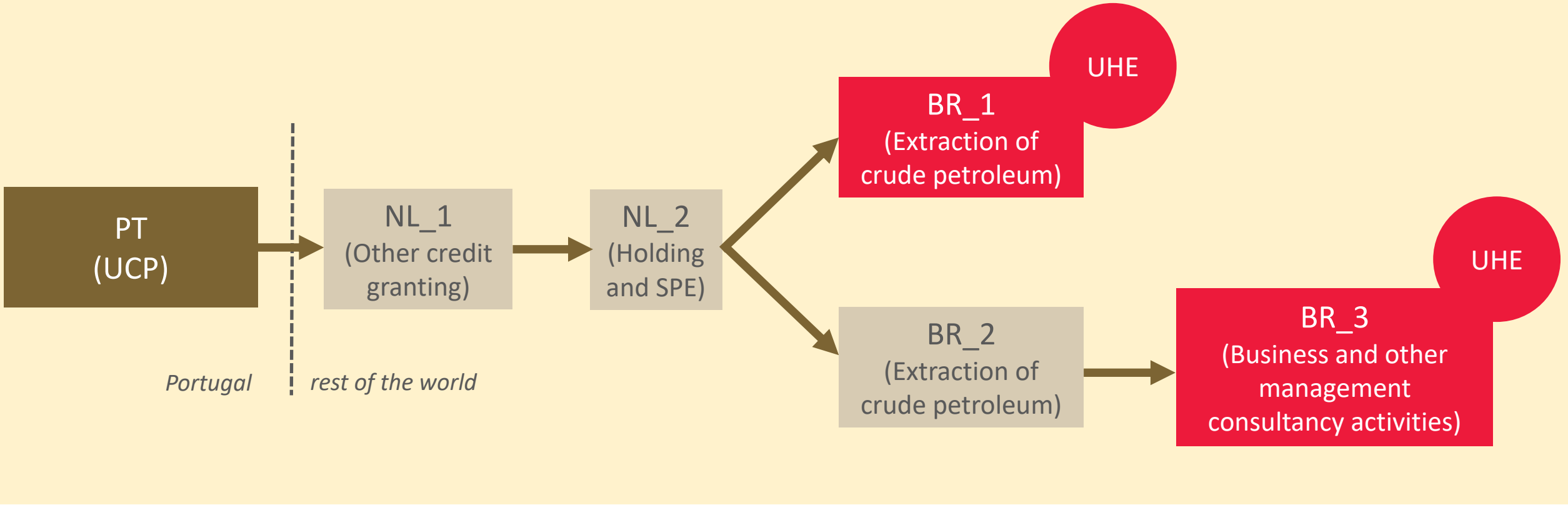


REAL EXAMPLE: IF WE STOP AT THE 1ST OPERATING UNIT



Can financial intermediaries be considered operating units?

REAL EXAMPLE: IF WE STOP AT THE LAST UNIT IN THE CHAIN



Potential problem: ending up in units outside the main economic activity of the group

TOP OUTWARD FDI, WHERE UCP=PRT (2020)

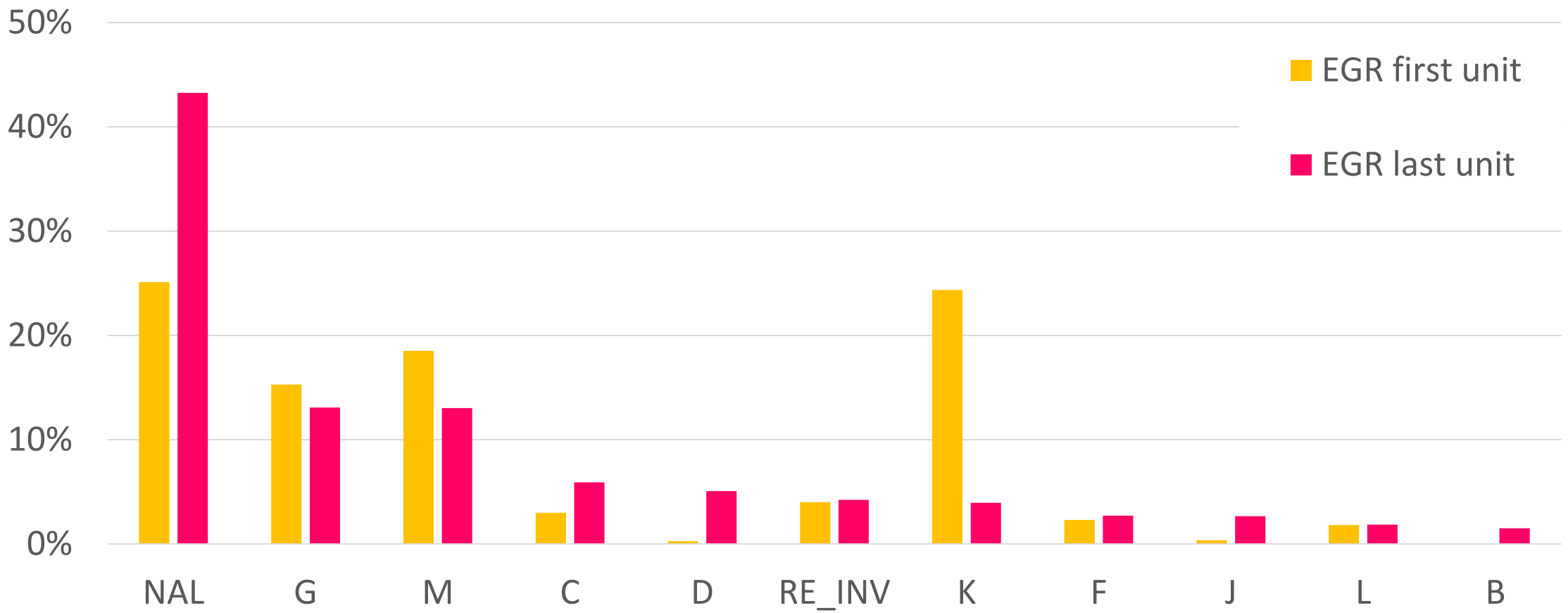
Rank	Immediate Partner	Outward FDI Stocks (MEUR)	% of Outward FDI Stocks
1	NL	17 805	52%
2	ES	3 506	10%
3	LU	2 012	6%
4	BR	1 427	4%
5	AO	1 312	4%
6	MZ	921	3%
7	FR	909	3%
8	MO	758	2%
9	US	581	2%
10	GB	470	1%
11	DE	470	1%
12	CL	360	1%
13	PL	353	1%
TOP13		30 883	91%

UHE RESULTS, UCP=PRT | RANKINGS (2020)

RANK	OFATS		EGR 1st operating unit		EGR Last unit	
	UHE	Value (%)	UHE	Value (%)	UHE	Value (%)
1	PL	24%	PT	17%	BR	19%
2	ES	17%	ES	14%	CO	17%
3	MZ	5%	NL	14%	ES	12%
4	BR	3%	PL	12%	PL	8%
5	AO	3%	BR	6%	PT	6%
6	CO	2%	US	4%	US	4%
7	CV	2%	AO	3%	AO	3%
8	FR	1%	MO	2%	MO	2%
9	CI	1%	GB	2%	FR	1%
10	DE	1%	MX	2%	MX	1%
11	US	1%	FR	2%	CH	1%
12	NL	1%	CO	2%	RU	1%
13	GB	1%	RU	1%	DE	1%
TOP13		61%		80%		79%

Immediate	%
NL	52%
ES	10%
LU	6%
BR	4%
AO	4%
MZ	3%
FR	3%
MO	2%
US	2%
GB	1%
DE	1%
CL	1%
PL	1%
TOP13	91%

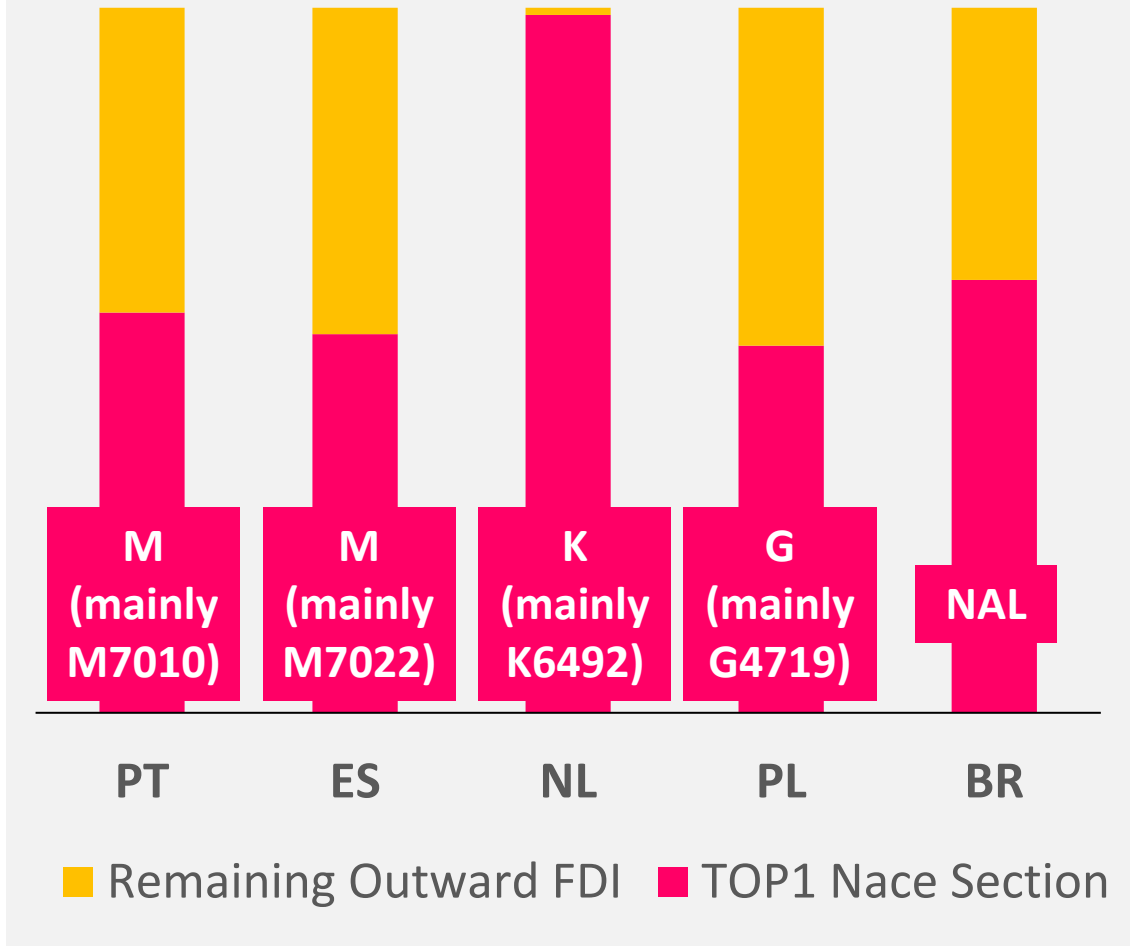
OUTWARD FDI BY NACE OF THE UHE (2020)



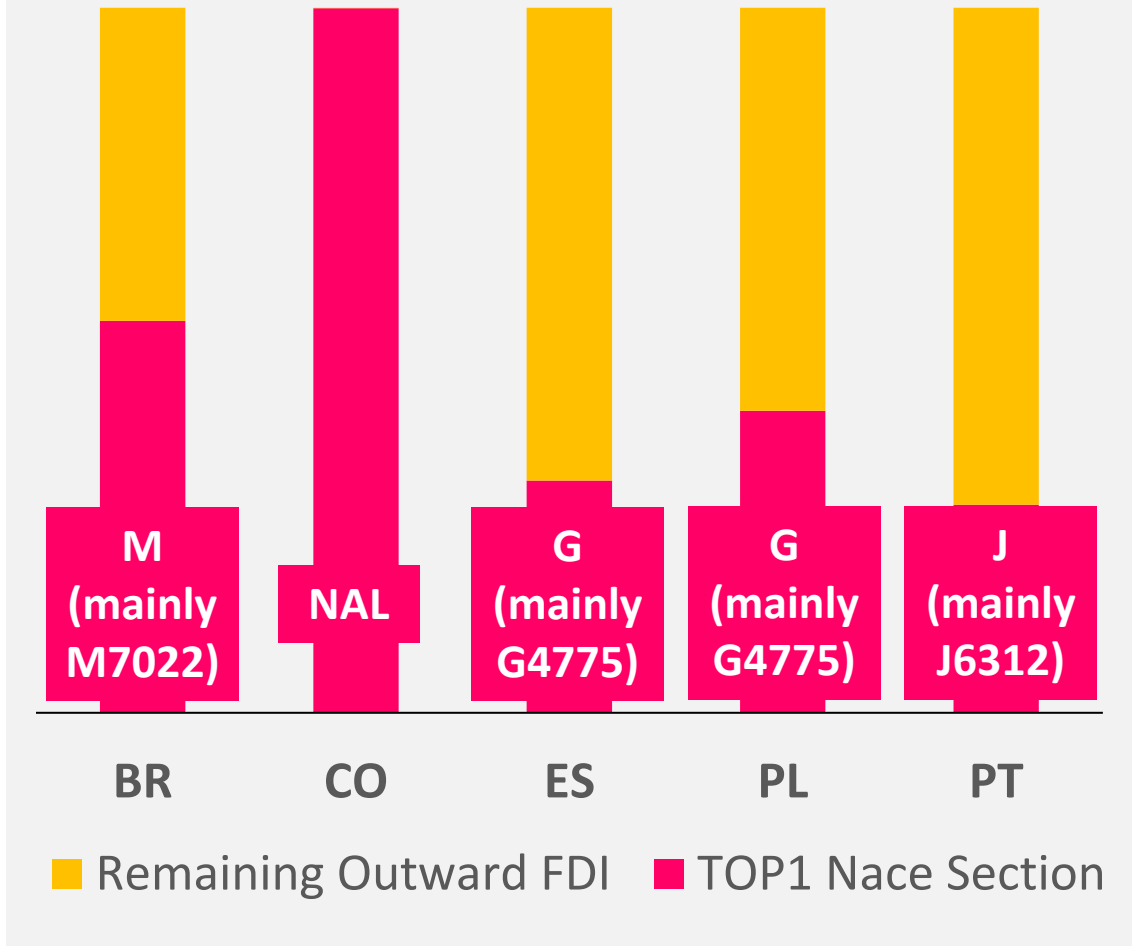
Notes: B – Mining and quarrying, C – Manufacturing, D – Electricity, gas, steam and air conditioning supply, F – Construction, G – Wholesale and retail trade; repair of motor vehicles and motorcycles, J – Information and communication, K – Financial and insurance activities, L – Real estate activities, M – Professional, scientific and technical activities, NAL – Not allocated, RE_INV – Real estate investment

EGR | TOP1 NACE SECTION CONCENTRATION (2020)

1st OPERATING UNIT



LAST UNIT IN THE CHAIN



CHALLENGES FACED WHEN FINDING THE UHE

Reference year: 2020

	1st operating unit		Last unit in the chain	
	Outward FDI (MEUR)	No of cases	Outward FDI (MEUR)	No of cases
UH is SPE	0	0	-1723	477
UH is a holding	0	0	-1716	578
UH is a head office	3061	80	48	92
UH has employment missing	0	760	0	1353
UH has zero employment and it is not a SPE	0	1304	0	3152

THOUGHTS ON EGR AND WAY FORWARD

05

ADVANTAGES OF USING EGR

- Go through SPEs and holding companies
- Go to bottom of the investment chain (groups' structure available)
- Allocate outward investment to the compiling economy

CHALLENGES OF USING EGR

- Missing values for non-resident SPE
- Missing values for non-EU/EFTA countries (some missing values were filled with data from previous years)
- Turnover data available by "enterprise" and FDI data by "legal unit"

CONCLUSIONS

- UHE estimates largely depend on the chosen method
- NL and LU have a (*very*) low share of the PRT outward FDI by UHE
- The EGR allows identifying PRT as UHE
- PRT as UHE has a lower importance, when going to the bottom of the investment chain
- When going to the last unit in the chain, section K reduces its importance

POSSIBLE NEXT STEPS

- Treat cases of investors that have an UH with no employment but there is only one UHE and produce UHE statistics for a larger time span

- Use the insights obtained with this exercise to contribute to develop the methodological guidance on the compilation of FDI statistics by UHE

- Explore other methods to compile Outward FDI statistics by UHE

- Develop a formal definition of “first operating unit”

QUESTIONS FOR DISCUSSION

1) To find the UHE where should we stop (e.g., SPE and holdings as UH)? Should this decision be based on the main economic activity of the group?

2) Should we consider head offices (NACE M7010) as operating entities?

3) Besides excluding holding companies, should we exclude other types of companies (e.g., financial intermediaries)?

4) Is it a problem if the economic activity of the UH has nothing to do with the main activity of the group?



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IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Experimental ultimate host economy statistics for US direct investment abroad[1]

Kirsten Brew, Jessica Hanson, Ricardo Limes, Ryan Smith and Larkin Terrie,
US Bureau of Economic Analysis

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Experimental Ultimate Host Economy Statistics for U.S. Direct Investment Abroad

Kirsten Brew, Jessica Hanson, Ricardo Limes, Ryan Smith, and Larkin Terrie

U.S. Bureau of Economic Analysis

Abstract

Following international guidelines, BEA statistics on bilateral U.S. direct investment abroad are compiled and presented by immediate partner economy. While this approach is well suited for many purposes, it can lead to difficulty in interpreting direct investment statistics, especially in identifying the economies that are the ultimate destinations, or hosts, of direct investment. BEA's initial effort to produce U.S. direct investment abroad statistics by ultimate host economy (UHE), described in this paper, focused on producing statistics on equity position by UHE using six different methods to reallocate the equity position by immediate host economy. The methods are implemented using direct investment data reported on BEA's Quarterly Survey of U.S. Direct Investment Abroad and activities of multinational enterprises data reported on BEA's Benchmark Survey of U.S. Direct Investment Abroad. The paper concludes that three of the six methods merit further exploration and presents summary country and sector-level results for the selected methods.

Keywords: foreign direct investment, official statistics

JEL classification: F21, F23

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1. Introduction

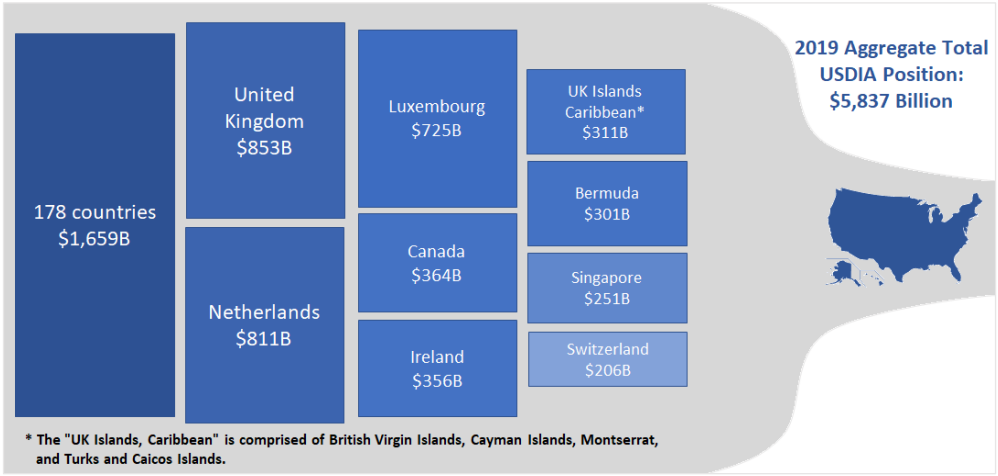
The U.S. Bureau of Economic Analysis (BEA) produces statistics on direct investment that are essential to the compilation of the U.S. economic accounts and for the analysis of multinational enterprises (MNEs). Statistics produced include direct investment by country and industry, which supplement the direct investment financial transactions and income statistics presented in the International Transactions Accounts (ITAs) and the direct investment position statistics in the International Investment Position (IIP) Accounts. Statistics are produced for both U.S. direct investment abroad (USDIA or "outward" investment) and for foreign direct investment in the United States (FDIUS or "inward" investment).[1]

Following international guidelines for the compilation and presentation of bilateral direct investment statistics, BEA produces statistics on direct investment income, financial transactions, and positions by immediate partner economy, which is the economy where the first entity in the ownership chain outside of the United States is located. While this approach is well suited for ITA purposes in understanding the countries involved in cross-border flow of funds with the United States, it can lead to difficulties in interpreting bilateral direct investment statistics, especially in identifying the ultimate origin or destination of direct investments.[2] On the immediate partner economy basis, U.S. direct investment abroad is highly concentrated with the top nine host countries accounting for over 71 percent of the position (figure 1). The rest of the world combined accounted for less than 29 percent of the position in 2019.

1 The direct investment by country and industry statistics are generally consistent with the counterpart measures featured in the ITAs and the IIP Account. For a discussion of the differences between these statistics, see Chapter 32 of BEA's U.S. International Economic Accounts: Concepts and Methods.

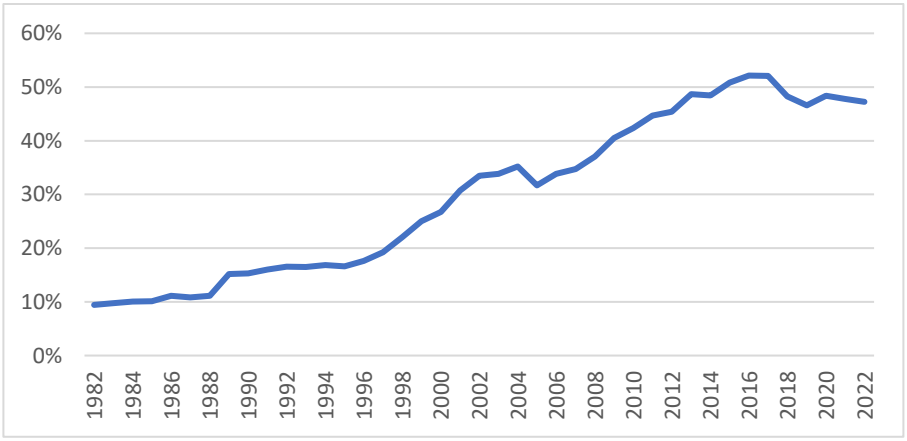
2 These data are needed on an immediate counterparty basis to adequately monitor cross-border flows and positions. For instance, if a jurisdiction of convenience that is the home to large SPEs were to experience a currency or other financial crisis, data users would find data sets that look through the SPEs (or that net data for SPEs without separate identification of gross levels) to be of limited help. SPEs and other entities may transform debt to equity, a long-term instrument to short-term, local currency to foreign currency, fixed to variable rates, and so on, and these transformations alter risk characteristics in important ways. (BPM6 paragraph 6.44)

Figure 1. U.S. Direct Investment Position Abroad, by Country



The primary reason for this concentration of investment is that MNEs increasingly set up complex global structures to maximize their worldwide profits. These structures include holding companies and other special purpose entities (SPEs)—legal entities with little or no employment or physical presence—that are set up to take advantage of different tax or regulatory regimes and are used to channel investments to third (or fourth, etc.) countries. The prevalence of holding companies in U.S. outward direct investment has increased from 9.4 percent in 1982 to 52.1 percent at its peak in 2017 and currently accounts for 47.3 percent in the preliminary 2022 USDIA position (chart 1).

Chart 1. Holding Companies as a Share of the U.S. Direct Investment Abroad Position



The increased prevalence of holding companies and other SPEs heightened the need for separate statistics on their activities to facilitate the analysis and interpretation of macroeconomic statistics. The International Monetary Fund's (IMF's) Task Force on Special Purpose Entities encouraged national statistical compilers to

produce statistics on resident SPEs.[3] BEA produced those statistics in December 2021 and expanded the SPE presentation for the United States to include foreign SPE affiliates of U.S. MNEs in June 2022 due to their prevalence in the ownership structures of U.S MNEs. Foreign SPEs accounted for 44.7 percent of the U.S. direct investment asset position in 2022.[4, 5]

One result of the prevalence of holding companies is that outward direct investment statistics may not reflect where foreign affiliates of U.S. MNEs produce and sell goods and services. Bilateral outward direct investment statistics reflect the industries and countries of the foreign affiliates with which the U.S. parent companies have direct transactions and positions, but these industries and countries do not represent the full range and distribution of the industries and countries of the affiliates whose operations the U.S. parents ultimately own or control.

Data from BEA's activities of U.S. multinational enterprises (AMNE) dataset show the degree to which indirect ownership structures may affect the country and industry distributions of the outward position data.[6] The AMNE statistics are collected for every entity in the outward ownership chain regardless of whether they are directly or indirectly owned by the U.S. MNE. AMNE statistics are classified in the country where the foreign affiliate's physical assets are located or where its primary activity is carried out and in the industry that reflects the affiliate's primary activity based on its revenues. Thus, the AMNE statistics more closely reflect the countries and industries in which the goods and services are produced by the foreign affiliates than the direct investment statistics classified by the country and industry of the affiliate with which the parent company has a direct position.

The 10 countries with the largest U.S. direct investment abroad positions in 2019 are included in chart 2, which shows each country's share of the total position (in orange) and share of total value added from the AMNE statistics (in blue). The value-added statistics measure where U.S. MNEs produce goods and services. For example, while foreign affiliates in the Netherlands accounted for 13.9 percent of the total outward position in 2019, they accounted for 3.9 percent of total value added of foreign affiliates. On the other hand, there are countries, such as Canada and Ireland, that account for proportionally more value added than position, suggesting that investments are likely routed there through third countries.

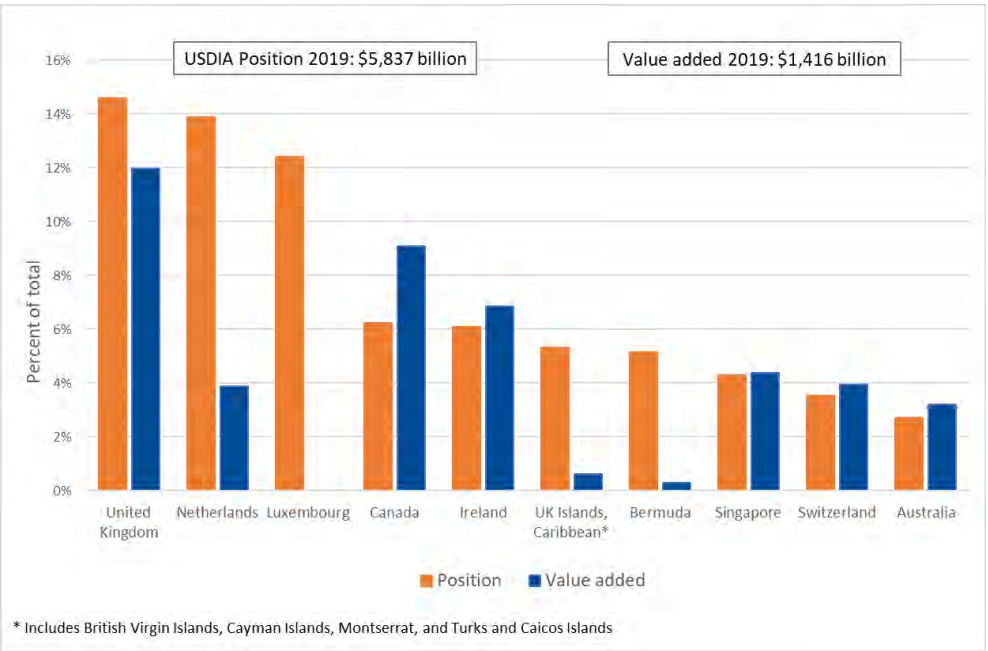
3Final Report of the Task Force on Special Purpose Entities (https://www.imf.org/external/pubs/ft/bop/2018/pdf/18-03.pdf)

4 U.S. Bureau of Economic Analysis, "Table 2.2. U.S. Direct Investment Positions in Special Purpose Entities (SPEs) at the End of the Year" (accessed Tuesday, August 15, 2023).

5 In accordance with international guidelines, BEA's direct investment by country and industry statistics are presented on the directional basis, which is organized according to the direction of the direct investment relationship (outward versus inward). The direct investment statistics featured in BEA's ITAs and IIP Accounts are presented on the asset/liability basis, which is organized according to whether the investment relates to a U.S. asset or U.S. liability.

6 BEA's activities of U.S. multinational enterprises statistics are available on BEA's website at https://www.bea.gov/data/intl-trade-investment/activities-us-multinational-enterprises-mnes

Chart 2. Comparison of U.S. MNE Outward Position and Value Added by Country



BEA's statistics on inward direct investment are also affected in a similar manner. However, BEA produces inward direct investment income and position statistics classified by the country of ultimate beneficial owner (UBO), which is the controlling entity at the top of the global ownership chain, in addition to the country of the foreign parent, which is the country of the first entity outside the United States with direct ownership in the U.S. affiliate. The statistics by UBO identify the country and industry of the entity that ultimately owns or controls and thus ultimately derives the benefits and assumes the risks from owning or controlling a U.S. affiliate.

This paper is BEA's initial effort to produce statistics on the ultimate host economy (UHE) of U.S. direct investment abroad. It explores six different approaches to producing UHE statistics. Each approach represents a distinct method for reallocating the direct investment abroad position to its ultimate destination from the country where the immediate, or directly owned, foreign affiliate is located. The rest of the paper proceeds as follows: Section II reviews related research at BEA, international organizations, and foreign national statistical compilers to develop UHE statistics. Section III explains each of the six position reallocation methods that are investigated in this paper and discusses the merits and limitations of each approach. Section IV provides the technical details regarding how each of the six reallocation methods was implemented and the BEA survey data that were used in the analysis. Section V presents the results of the analysis and provides a discussion of the paper's key findings. Section VI discusses reallocation methods that BEA is planning to pursue. Section VII concludes and discusses potential next steps.

2. Related Research

This project builds on Noonan's (2019) work on SPEs and passthrough equity in BEA's direct investment data. SPEs are legal entities with little or no employment or physical presence, and passthrough equity is equity that passes through an economy before arriving at its destination in another country. Noonan found that the use of both is widespread among U.S. MNEs, indicating that BEA's published statistics on outward direct investment equity position by immediate partner economy are likely to be meaningfully different from positions by UHE. Noonan also found that U.S. MNEs' passthrough equity in majority-owned foreign affiliates accounted for slightly more than half of all owners' equity in majority-owned foreign affiliates in 2016.

Recently, the IMF's Direct Investment Task Team and the Organisation for Economic Cooperation and Development's (OECD's) Working Group on International Investment Statistics recommended that national statistical compilers develop supplemental presentations of direct investment statistics by UHE.[7] These recommendations are part of the process to update the IMF's Balance of Payments Manual, 6th edition (BPM6) and the OECD's Benchmark Definition of FDI, 4th edition (BD4).

Few countries have produced outward direct investment statistics by UHE. Germany is the only country that produces UHE statistics as part of its regular direct investment statistical releases.[8] Brazil produced a special official release that included outward direct investment statistics by UHE covering 2017.[9] Denmark and Portugal have produced pilot studies of outward direct investment statistics by UHE. Some of the common themes between the different approaches used by these countries to produce the statistics include the focus on redistributing the position, particularly the equity position, and doing so for only majority-owned/controlled foreign affiliates of domestically controlled parents, both due to data source constraints and other practical considerations. In all cases, these reallocations tended to result in decreases in the equity position in financial centers and increases in the position in countries where productive activities are more likely to be carried out, although positions in the former do not decrease to zero and can remain significant in some cases.

3. Position Reallocation Methods

There are several methods that could be used to reallocate the U.S. direct investment abroad position from the immediate countries and industries—that is, the countries and industries of the affiliates that are directly owned by the U.S. parent and hence are the first entities outside the United States in the ownership chain—to the country

7 https://www.imf.org/-/media/Files/Data/Statistics/BPM6/approved-guidance-notes/d6-ultimate-investing-economyultimate-host-economy-and-passthrough-funds.ashx

8 https://www.bundesbank.de/en/press/press-releases/german-foreign-direct-investment-in-2021-2022-903736

9 https://www.bcb.gov.br/content/publications/directinvestmentreport/2017/dir_2017.pdf

and industry of the affiliates where the investment ultimately is located. While the eventual goal is to reallocate the total position, as a practical first step, this paper explores using these methods to distribute the equity position only.[10] The methods investigated here can be conceptualized in terms of three broad categories: (1) push-down methods, (2) financial structure methods, and (3) apportionment methods. The six specific methods investigated, which include a hybrid of categories 2 and 3, are summarized in table 1.

Table 1. Position Reallocation Methods

<table>
<tr><th>Category</th><th>1. Push-down</th><th>2. Financial structure</th><th>3. Apportionment</th></tr>
<tr><td rowspan="3">Sub-type</td><td rowspan="2">First operating affiliate</td><td>Passthrough with ownership chains</td><td rowspan="2">Employment / fixed capital / sales</td></tr>
<tr><td rowspan="2">Parent's equity share of affiliate's assets (PESAA)</td></tr>
<tr><td>Last affiliate</td></tr>
<tr><td colspan="3">Hybrid: passthrough-apportionment</td></tr>
</table>

Within the push-down category, there are two main sub-types: the first-operating affiliate method and the last affiliate method. Push-down methods, as the name implies, move (push) the position down the ownership chain to a single entity, without considering intermediate or subsequent linkages, if any. Push-down methods include the first-operating unit method, in which the position of the directly held affiliate gets assigned to the first unit that engages in productive (non-holding) activities, and the last-unit method, where the entire position of the directly held affiliate gets assigned to the last unit at the bottom of that chain. There are different possible approaches to defining an "operating" entity, but the approach adopted by the present analysis is to define it as any entity not classified as a holding company.[11]

One of the main advantages of the methods in the push-down category is that, since they only require information on a subset of the entities in a U.S. MNE's ownership structure, they are relatively easy to implement, at least when compared to the financial structure methods. This practical consideration was a major reason the IMF's Direct Investment Task Team recommended the first-operating unit method as its method of choice.[12] The drawback of push-down methods, though, is that, since

10 The U.S. direct investment abroad position is comprised of equity and net debt instruments positions—that is, U.S. parents' equity in, and net outstanding loans to, their affiliates. In addition to practical considerations that make the reallocation of the equity position more straightforward, the equity position is also vastly larger than the net debt position, particularly for more recent periods. In 2019, the year covered by this study, the equity position accounted for 98.5 percent of the total outward position.

11 BEA data indicate there is significant overlap between holding companies and SPEs. In 2019, 91 percent of the direct equity position in SPEs was accounted for by holding companies, and 98 percent of the direct equity position in holding companies was accounted for by SPEs.

12 D.6 Ultimate Investing Economy/Ultimate Host Economy and Pass-through Funds (https://www.imf.org/-/media/Files/Data/Statistics/BPM6/approved-guidance-notes/d6-ultimate-investing-economyultimate-host-economy-and-passthrough-funds.ashx)

these methods do not involve all of the units in an MNE's ownership chain, they may fail to capture many of the details of its global financial structure, which could be of interest to data users. Other potential downsides are that there are likely to be some cases where the first-operating or last unit may not be large enough to support the U.S. parent's equity position in the directly held affiliate (e.g., due to external financing in affiliates further down the chain). There might also be affiliates with negative positions in the ownership chain that can complicate the reallocation.

Methods that look at the financial structure of U.S. MNEs can provide the best picture in terms of how U.S. parents organize their global financial structure. Under these methods, the position of the directly held affiliate is distributed *along* the affiliates in the chain, reflecting how much of the position "stays" at each tier. While these methods could arguably provide a better picture of MNEs' global financial structure, they are the most information-intensive methods because compilers would need accurate and detailed information on every foreign affiliate of the MNE. These methods could also create difficulties from a statistical compilation perspective because of the complex organizational structures MNEs use to maximize their worldwide profits. For example, distributing the ownership of the directly held foreign affiliate can be tricky if a unit along the chain has negative equity or an affiliate in a lower tier is larger than the one above, so all methods would need to account for these scenarios.[13]

The present analysis examines two main types of financial structure methods: the passthrough with ownership chains and the parent's equity share of affiliates' assets (PESAA) methods. The passthrough with ownership chains method attempts to reallocate the U.S. parent's equity position in the directly held affiliate by calculating the proportion of the equity position that "passes through" to the affiliate(s) beneath it in the ownership chain, while also performing a similar calculation for all indirectly held foreign affiliates with at least one child affiliate. This method produces a new, adjusted equity position for every affiliate in the ownership structure. As will be explained in section IV, the passthrough method uses detailed information on every unit in the U.S. MNE's ownership chain (i.e., for every foreign affiliate, the affiliates that own it and their voting ownership percentages are identified) to iteratively calculate passthrough equity and the resulting adjusted equity position for each foreign affiliate.

The other financial structure method is the parent's equity share of affiliates' assets method. In the PESAA method, the parent's equity position in directly owned affiliates is reallocated to indirectly owned affiliates in proportion to the equity ownership shares connecting the affiliates to each other and to the parent company, and in proportion to the share of the total financing of the affiliates accounted for by equity funding supplied directly or indirectly by the parent company. The equity position for directly owned foreign affiliates is then adjusted by subtracting that portion of the unadjusted position that has been reallocated to the indirectly owned affiliates. In cases where the ownership chain extends beyond the second tier, this

13 MNEs can structure their worldwide operations with affiliates that consistently report losses or are net lenders to their parent companies and have negative positions. Additionally, an affiliate in a lower tier might be larger than the affiliate in a higher tier due to investment from unaffiliated parties ("external financing"). The two financial structure methods presented here can account for these situations.

process becomes an iterative one, in which the reallocation procedure is repeated at each tier.

The third category analyzed here, the apportionment method, is distinct from the other methods in that it does not require micro-level data. As such, it is the least demanding of the methods in terms of its informational requirements and is arguably the easiest to implement. One method in this category involves reapportioning the directly held positions based on a third dataset, such as the AMNE statistics. The position could be apportioned using country-level statistics, such as foreign affiliates' employment, physical assets (property, plant, and equipment), or sales/turnover. If employment were used, for example, then the value of U.S. parents' position in a given country would be calculated as the worldwide total of their positions in directly held foreign affiliates multiplied by the proportion of their total worldwide foreign employment that occurs in the country in question. Potential drawbacks of this approach include that, like the push-down methods, it will not provide a full picture of MNEs' financial structure. In addition, its results can be sensitive to the metric chosen for the reapportionment. As an example, the apportioned position could be skewed towards countries and industries with labor-intensive affiliates if employment is used to apportion, or it could be skewed towards countries and industries with capital-intensive affiliates if physical assets are used to apportion.

Lastly, it is possible to combine aspects of the methods presented above to develop hybrid methods. For this analysis, a sixth, hybrid, method was also tested. This method made use of aspects of the passthrough and apportionment methods discussed above. Using BEA's AMNE company-level data, the amount of owners' equity, scaled by the U.S. parent's ownership in the affiliate, that stays in each foreign affiliate was calculated. The equity remaining in affiliates was then aggregated by country to arrive at the percent of total owners' equity accounted for by each country. Those percentages were then used to apportion the immediate outward direct investment position by country.

It is worth noting the methods that other countries have used to produce or attempt to produce outward direct investment statistics by UHE. Germany and Brazil, the only countries to have included UHE statistics as part of their official direct investment publications so far, both use the first-operating method. Denmark and Portugal, on the other hand, have used hybrid methods that reallocate the outward position by apportioning the directly held position along a direct investors' ownership chain based on a key metric (for example, non-financial assets).

4. Data and Methodology

This analysis makes use of direct investment data reported on BEA's Quarterly Survey of U.S. Direct Investment Abroad and AMNE data reported on BEA's Benchmark Survey of U.S. Direct Investment Abroad. The quarterly survey must be submitted by any U.S. person (in the broad legal sense including an individual, partnership, corporation, or other form of organization) that has direct transactions or positions with a foreign business enterprise in which it has an ownership interest of 10 percent or more and that meets other reporting requirements related to the size of its foreign

affiliate(s).[14] The benchmark survey is only conducted every 5 years (in place of the Annual Survey of U.S. Direct Investment Abroad). It was most recently conducted in 2019, which is why data for 2019 were chosen for the present analysis. The Benchmark Survey of U.S. Direct Investment Abroad is collected from all U.S. persons (referred to here and in BEA publications as U.S. parents) that have at least a 10 percent voting ownership interest in one or more foreign affiliates. A separate survey form is submitted for each affiliate for which the 10-percent ownership threshold is passed, where the detail and complexity of the form depends on the size of the affiliate and whether it is majority- or minority-owned by the U.S. parent.

The key difference, for present purposes, between the benchmark survey and the annual survey is that the benchmark uses lower thresholds for determining whether detailed balance sheet and ownership information is collected on each foreign affiliate. The benchmark survey thus provides data on the universe of foreign affiliates. Two survey items are of particular importance in this regard. First, this paper's analysis uses information collected on each affiliate's direct and indirect ownership to reconstruct the ownership chain of each MNE. This ownership chain information is used by all of the methods except for the apportionment method, though some methods require more detailed information on the ownership chain than others. The benchmark survey collects the information used to construct ownership chains for each affiliate whose assets, sales, or net income (loss) is greater than $25 million, whereas the annual survey only collects this information on affiliates for which one of these items is above $60 million. Second, the passthrough with ownership chains and the passthrough-apportionment hybrid methods use data collected on affiliates' equity investments in other foreign affiliates (i.e., equity in subsidiaries or child affiliates). The benchmark survey collects this information for majority-owned foreign affiliates whose assets, sales, or net income (loss) is greater than $80 million, while the annual survey only collects this information for majority-owned affiliates whose assets, sales, or net income (loss) is greater than $300 million.

First Operating Affiliate

The first approach to reallocating the equity position involves identifying, for each affiliate that is directly owned by the U.S. parent, the first operating affiliate beneath it in the ownership structure and reassigning all of the U.S. parent's equity position in the directly held affiliate to the operating affiliate. Operating affiliates are defined as affiliates whose primary industry,[15] defined by largest sales, is not classified as a holding company.[16] If an affiliate directly held by the U.S. parent was an operating

14 The Quarterly Survey of U.S. Direct Investment Abroad is collected through the BE-577 form. A BE-577 form is required for every directly owned foreign affiliate whose assets, annual sales, or annual net income(loss) is greater than $60 million and for every indirectly owned foreign affiliate that meets the $60 million threshold and has an intercompany receivable or payable balance with the U.S. parent that exceeds $10 million.

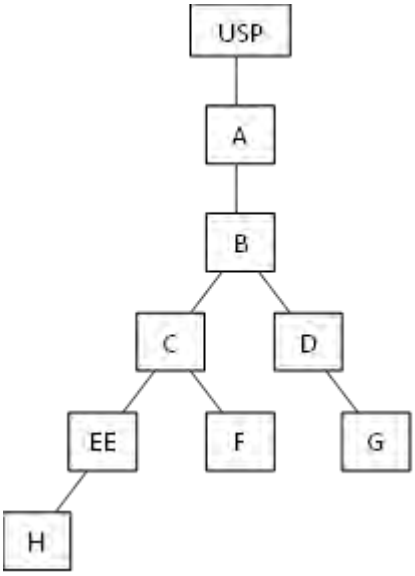
15 BEA's direct investment statistics uses industry classifications adapted from the North American Industry Classification System (NAICS). In 2019, BEA survey industry classifications were adapted from the 2017 NAICS.

16 Holding companies are businesses engaged in holding the securities or financial assets of companies and enterprises for the purpose of owning a controlling interest in them or influencing their

company, then the U.S. parent's equity in that affiliate was not reassigned. Appendix B provides an example of how to apply the first operating affiliate method, as well as the other methods that use ownership chain data (last affiliate, passthrough with ownership chains, and PESAA), using a hypothetical MNE.

Due to the complexity of MNE ownership structures, it is not always possible to identify a single operating affiliate that unambiguously comes first beneath a given directly held affiliate. Operating affiliates were treated as being "first" if a direct line could be drawn to them through the MNE ownership chain from the directly held holding company affiliate without passing through another operating affiliate. Consider the hypothetical ownership structure in figure 2, where affiliate A is the affiliate in which the U.S. parent (USP) has a direct equity position that potentially needs to be reallocated. If affiliate A is an operating company, then the equity position is not reallocated. If affiliate A is a holding company and affiliate B is an operating company, the entire equity position is reassigned from A to B, even if there are additional lower tier affiliates owned by B. If affiliates A and B are holding companies and affiliates C and D are operating companies, then the equity position in A is split between C and D (the methodology for dividing equity is explained below). If A, B, and D are holding companies and C and G are operating companies, then the equity in A is split between C and G. Finally, if A, B, C, D, and E are holding companies and F, G, and H are operating companies, then the equity position in A is split between F, G, and H.

Figure 2. Hypothetical MNE Ownership Structure



When an equity position is reassigned to multiple first operating affiliates, the quantity reassigned to each affiliate is proportional to the ownership interest of the directly held affiliate. If there are n first operating affiliates and if the ownership interest of a directly held affiliate is denoted as *PctOwnership*, then the proportion of

management decisions. Businesses in this industry do not manage the day-to-day operations of the firms whose securities they hold.

the immediate equity position, *PositionEquityDirect*, reassigned to the *i*th first operating affiliate is calculated as:

$$ReassignedEquityPosition_i = \frac{PctOwnership_i}{\sum_{l=1}^{n} PctOwnership_l} \times PositionEquityDirect \quad (1)$$

Last Affiliate

The second method for reallocating the equity position involves reassigning it to the last affiliate (or affiliates) beneath the affiliate directly held by the USP. Last affiliates are defined as any affiliates that the USP holds directly or holds indirectly (through a directly held affiliate) and that do not have an ownership interest in any other affiliates. With this reallocation method, the industries in which affiliates operate are not considered. In the example in figure 2, the USP's equity in A would be reallocated to affiliates F, G, and H regardless of the industry codes reported by each affiliate. The method for splitting the equity position when multiple last affiliates are identified is the same as the method for splitting equity in the case of multiple first operating affiliates.

Passthrough With Ownership Chains

The passthrough with ownership chains method builds upon the work of Borga and Caliandro (2018) by applying their passthrough methodology to BEA data on U.S. MNEs' ownership chains. In this method, the USP's directly held equity position is reallocated by taking into account the equity investments that its foreign affiliates have in one another. The basic idea behind this approach is to calculate the USP's share of its affiliates' equity investment(s) in their child affiliates and to use this information to reallocate some or all of the directly held direct investment equity position among indirectly held affiliates.

As indicated above, passthrough equity refers to the portion of the USP's equity position in a given affiliate that "passes through" the affiliate and can thus be treated as a position in the next affiliate(s) down the ownership chain. For each affiliate, the value of the USP's passthrough equity is a function of the equity that the USP has in it (inward equity), the equity that it has in its subsidiaries (outward equity), and the USP's ownership interest in the affiliate in question. Once inward equity and passthrough equity have been determined for each affiliate, the final adjusted equity position in the affiliate can be calculated as inward equity minus passthrough equity—a subtraction that ensures there is no double (or triple, etc.) counting of equity positions along an ownership chain. Passthrough equity is calculated according to the following formulas, where *PTE* = passthrough equity, *IE* = inward equity, *OE* = outward equity, and *USPPctOwn* is the USP's ownership share (out of 100 percent) in the affiliate in question:

$$If\ IE \geq 0\ and\ OE \geq 0, then\ PTE = \min(IE, OE \times USPPctOwn). \quad (2)$$

$$Else\ if\ IE \leq 0\ and\ OE \leq 0, then\ PTE = \max(IE, OE \times USPPctOwn). \quad (3)$$

$$Else\ PTE = 0. \quad (4)$$

The passthrough equity method is similar to the PESAA method in that it draws on detailed ownership chain information to determine what proportion of the USP's equity position in the directly held affiliate to reallocate to each affiliate along the chain. Also, like the PESAA and push-down methods, its focus is on reallocating, at the micro-level, the equity positions reported on the Quarterly Survey of U.S. Direct Investment Abroad. This reported equity position of the USP is, for affiliates that are directly (and only directly) held by the USP, treated as the value of inward equity. In the case of affiliates that are only indirectly held by the USP, their inward equity equals the passthrough equity of the affiliate (or affiliates) that directly own them. Passthrough equity is thus calculated iteratively, beginning with directly held affiliates and then moving down the ownership chain affiliate by affiliate. For affiliates that are both directly and indirectly owned by the USP, inward equity is the sum of the USP's direct equity position and any passthrough equity from affiliate(s) that are direct owners.

When an affiliate has two or more child affiliates, its passthrough equity is divided among its children affiliates (to become their inward equity) in a manner that is proportional to its direct ownership interest in each child affiliate and the total owners' equity of each subsidiary. If there are m affiliate subsidiaries, then the inward equity for the *j*th subsidiary is calculated as follows:

$$IE_j = PTE \times \frac{PctOwnership_j \times owners' \ equity_j}{\sum_{l=1}^{m} PctOwnership_l \times owners' \ equity_l} \qquad (5)$$

When an affiliate has multiple parents, its inward equity is the sum of the passthrough equity received from each of its parents.

PESAA

The third method for reallocating the equity position derives its name from the fact that it is based, in part, on the U.S. parent's equity share in affiliates' assets (PESAA). This method involves a two-part algorithm, which is laid out in detail below. The first part calculates an "unadjusted" equity position for each affiliate. This unadjusted position is equivalent to the value of the equity position that the method assigns to the affiliate in question plus the value of the equity positions the method assigns to the affiliates in which it has a direct or indirect ownership interest. The second part of the algorithm calculates, for each affiliate, the portion of its unadjusted equity position that belongs to its child affiliates and then subtracts this amount from the unadjusted position–thereby preventing double (or triple, etc.) counting of equity positions that must be reallocated multiple times along an ownership chain–to determine the final adjusted equity position.

1. Each affiliate's unadjusted equity position is calculated by working iteratively downward through the ownership structure, starting with directly held affiliates. As explained in steps a, b, and c below, the calculation of unadjusted equity position differs according to whether an affiliate is directly (and only directly) held by the USP, directly and indirectly held by the USP, or only indirectly held by the USP. For each affiliate with child affiliates, after unadjusted equity position is calculated, the value of PESAA is calculated as unadjusted equity position

divided by assets.[17] Its PESAA value is then used in the calculation of its directly held child affiliates' unadjusted equity positions.

a. For affiliate *k* that is directly (and only directly) held by the USP, its unadjusted equity position, $UnadjEqPos_k$, equals the USP's reported equity position.

b. For affiliate *k* that is directly and indirectly held by the USP and has $i = 1, \dots, n$ affiliate parents each of whom has $PctOwned_i$ interest in affiliate *k*, unadjusted equity position is calculated as:

$$UnadjEqPos_k = USP's\ direct\ equity_k + \sum_{i=1}^{n} PctOwned_i \times PESAA_i \times owners'eq_k \quad (6)$$

c. For affiliate *k* that is only indirectly held by the USP, the unadjusted equity position is calculated using a modified version of equation 6:

$$UnadjEqPos_k = \sum_{i=1}^{n} PctOwned_i \times PESAA_i \times owners'equity_k \quad (7)$$

2. After unadjusted equity position is calculated, the algorithm calculates the portion of each affiliate's unadjusted equity position that belongs to the affiliate(s) beneath it, designated here as $ReassignedPortion$. The final adjusted equity position of affiliate *k* is equal to $UnadjEqPos_k - ReassignedPortion_k$. Note that while an affiliate's unadjusted equity position partly depends, if it is indirectly held, on the PESAA value of its affiliate parent(s), the amount of its unadjusted equity position that belongs to the affiliates beneath it in the ownership chain is a function, in part, of its own PESAA value.

   a. For affiliates that do not own any other foreign affiliates, $ReassignedPortion$ equals zero, and unadjusted equity position thus equals the final adjusted equity position.

   b. For affiliate k with $j = 1, \dots, m$ directly owned child affiliates where its ownership in each is represented as $PctOwnership_j$, the value to subtract from unadjusted equity position is:

$$ReassignedPortion_k = \sum_{j=1}^{m} PctOwnership_j \times PESAA_k \times owners'equity_j \quad (8)$$

It is important to note that a shortcoming of the PESAA method is that, in certain circumstances, the second step—the calculation and subtraction of equity positions

17 The assets and owners' equity of each affiliate were reported on the 2019 Benchmark Survey of U.S. Direct Investment Abroad.

belonging to child affiliates—can lead to the creation of negative equity positions even when the initial direct investment equity position is positive.[18] When a child affiliate is larger than its parent affiliate in terms of its owners' equity, then the PESAA algorithm has a tendency to reallocate more equity from the parent affiliate to the child than exists in the parent affiliate, thereby making the equity position in the parent affiliate negative. The calculation of country and industry-level reallocated equity positions can then be misleadingly skewed by the inclusion of these negative equity positions produced by the PESAA method.

Apportionment

The apportionment method was implemented using three different data items from the 2019 Benchmark Survey of U.S. Direct Investment Abroad: net property, plant, and equipment (PP&E), sales, and employment. That is, three different sets of results were created, each of which reallocated country-level position data based on one of the above three metrics. For each of these data items, the percentage that each country and industry accounts for of the total was then applied to the total immediate outward direct investment position to reallocate it accordingly.

Passthrough-Apportionment Hybrid

The hybrid reallocation method combines aspects of the passthrough and apportionment methods. Instead of reallocating the USP's immediate equity position at the micro-level by moving down the ownership chain, it involves calculating an estimate of the passthrough in each affiliate based on each affiliate's owners' equity and equity investment in other foreign affiliates, both scaled by the USP's ownership interest in the affiliate from the 2019 Benchmark Survey of U.S. Direct Investment Abroad. The owners' equity of each affiliate, scaled by the direct and indirect ownership interest the USP has in the affiliate, is treated as its inward equity similar to the passthrough method described above. Passthrough equity is then calculated, using equations 2 to 4, as the minimum (or maximum) of owners' equity and equity investments in other foreign affiliates, both of them scaled by the direct and indirect USP ownership interest. The amount of equity that stays in each affiliate, designated here as $EstEqPos$, is calculated as the USP's share of the affiliate's owners' equity (i.e., the product of the affiliate's owners' equity and the USP's ownership interest in it) minus the affiliate's passthrough equity.

These estimates of the equity remaining in every affiliate are aggregated within each country and then across all n countries to determine the percentage of the global total of owner's equity that stays for country k. These percentages are then used to recalculate the country-level totals for the outward direct investment equity positions. For all n countries, the adjusted equity position of country k, $AdjEqPos_k$, is the product of the global total of the U.S. direct investment abroad equity position, $USDIAEqPos$, and the proportion of the global total estimated equity position

18 It can also lead to the creation of positive equity positions when the initial direct investment position is negative, though that scenario is less common.

accounted for by country *k*. The procedure described in this paragraph is represented in the following equation.

$$AdjEqPos_k = USDIAEqPos \times \frac{EstEqPos_k}{\sum_{l=1}^{n} EstEqPos_l} \quad (9)$$

5. Results

Tables 2 through 6 provide a summary of some of the key similarities and differences between the results produced by the reallocation methods analyzed. Table 2 provides information on the proportion of the total U.S. direct investment abroad equity position—$5.75 trillion in 2019—that is reallocated by each of the methods based on the reallocation of micro-level data. The quantity under the "Equity reallocated" heading includes any part of the position in a directly held affiliate that is reallocated to an indirectly held affiliate. Double (or triple, etc.) counting of equity that is reallocated multiple times along a chain in the PESAA and passthrough (with chains) methods has been eliminated so that each dollar of equity position is only counted as being reallocated once or not at all. Note that these figures cannot be computed for the apportionment and the hybrid passthrough-apportionment methods because these methods are not based on reallocating directly held equity positions at the micro level.

The results in table 2 indicate that the first operating affiliate, PESAA, and pass-through methods all reallocate roughly similar proportions of the total U.S. direct investment equity position abroad—approximately $2.17 to $2.35 trillion of the total $5.75 trillion equity position in 2019. The last affiliate method is distinct in that it reallocates over half—approximately $3.34 trillion—of the total equity position abroad. These results suggest that the adjusted equity positions generated by the last affiliate method are likely to differ more significantly from the published directly held equity positions than are the adjusted equity positions generated by the other three methods – a conclusion that is borne out by the results in table 3.

Table 2. Total Equity Position Reallocated by Method [Billions of dollars]

Reallocation method	Equity reallocated	% of total
First operating affiliate	2,351	40.88
Last affiliate	3,336	58.01
PESAA	2,171	37.76
Passthrough with ownership chains	2,274	39.54

Table 3 provides the correlation of the country-level U.S. direct investment abroad equity positions in BEA's published data with the country-level adjusted equity positions resulting from each of the reallocation methods analyzed in this paper. Values close to one indicate that the country-level totals resulting from the reallocation method are relatively similar to the country-level totals in the published data, while values farther from one indicate relatively different country-level values. The three financial structure methods – PESAA and the two passthrough methods –

led to country-level equity positions that have the highest correlation with the original directly held country-level positions, as all three of these methods have a correlation coefficient of 0.93 or higher. Next come the push-down methods, with the last affiliate method having a value that is well below any of the non-apportionment methods at approximately 0.86, indicating its country-level results are significantly different from the published country-level totals. The apportionment methods, and especially apportionment based on employment, have country-level correlations that are significantly lower than those created by any of the other methods, indicating the largest difference in the country level results from the published statistics.

Table 3. Correlations with Direct Investment Equity Position at Country Level by Method

Reallocation method	Correlation coefficient
First operating affiliate	0.9127
Last affiliate	0.8547
PESAA	0.9586
Passthrough with ownership chains	0.9479
Apportionment (employment)	0.4591
Apportionment (sales)	0.7172
Apportionment (net PP&E)	0.6248
Passthrough-apportionment hybrid	0.9310

The results in Table 4 further explore the differences between the country-level results generated by each of the reallocation methods. This table presents correlations between the country-level equity positions generated by each method and total employment and net PP&E (property, plant, and equipment) attributable to foreign affiliates in each country.[19] For comparison, the table also provides the correlations between the directly held country-level equity positions in BEA's published data and foreign affiliate employment and net PP&E. The results in table 4 indicate that every reallocation method tends to reallocate equity position away from entities that are primarily engaged in holding securities toward entities engaged in activities traditionally considered productive (i.e., pursuits that involve employing workers and physical plant and equipment). In other words, for every reallocation method, the correlations between country-level adjusted equity positions and foreign affiliate employment and net PP&E are higher than the correlations between directly held equity positions and foreign affiliate employment and net PP&E. The results are also consistent with those in the previous two tables in that the financial structure methods tend to change the country-level equity positions the least and the apportionment methods tend to change them the most, while the last affiliate method also produced relatively significant changes in the country-level equity positions.

19 Foreign affiliates' employment and net PP&E were collected on the 2019 Benchmark Survey of U.S. Direct Investment Abroad.

Table 4. Correlations with Total Employment and Net PP&E at Country Level by Method

Reallocation method	Employment	Net PP&E
Directly held equity position	0.4591	0.6248
First operating affiliate	0.6543	0.8017
Last affiliate	0.7265	0.8383
PESAA	0.5656	0.7279
Passthrough with ownership chains	0.5853	0.7485
Apportionment (employment)	1.0000	0.7846
Apportionment (sales)	0.7856	0.8874
Apportionment (net PP&E)	0.7846	1.0000
Passthrough-apportionment hybrid	0.5698	0.7402

Table 5 provides insight into another important difference between the reallocation methods: their relative tendencies to create additional dollars of positive and negative equity position.[20] The results in table 5 indicate that the push-down methods never create additional dollars of positive and negative equity position but that the financial structure methods, and especially the PESAA method, tend to do so.[21] As explained in section IV, PESAA often does this when a child affiliate is larger than its parent affiliate in terms of its owners' equity. To be sure, when these additional positive and negative positions are created, they always cancel one another out at the aggregate level so that the total net equity position is unchanged. Nonetheless, the presence of these "invented" positions in the microdata have the potential to skew the results when calculating country and industry-level aggregates, and the tendency of PESAA to generate these additional positions is thus a severe limitation of the method.

Table 5. Total Positive and Negative Equity Positions Before and After Reallocation [Billions of dollars]

Reallocation method	Total of positive equity positions	Total of negative equity positions
Published	5,963	-213
First operating affiliate	5,961	-211
Last affiliate	5,960	-210
Passthrough with ownership chains	6,043	-293
PESAA	6,507	-757

20 Direct investment positions are usually positive but can be negative. A negative position means that U.S. parent companies are in a net liability position vis-à-vis their foreign affiliate(s). This can occur because the USPs' foreign affiliate(s) have incurred sufficiently large losses or the parent has removed equity in excess of their investment. For more information, see www.bea.gov/help/faq/1189.

21 The reason the total positive and negative equity positions that result from the push-down methods are lower in magnitude than the published positive and negative positions is that sometimes an indirectly held affiliate is reassigned both positive and negative equity positions from different directly held affiliates. When that happens, the positive and negative positions are combined, which does not change their net value, but does reduce the total of positive and negative equity positions when considered separately.

An important caveat regarding the results in the preceding tables is that a portion of the equity position that remained with directly held affiliates did so not for methodological reasons but because of shortcomings in the microdata. In some cases, a directly held affiliate's equity could not be reallocated, because BEA did not have all of the data needed to determine how much to reallocate and/or to which child affiliates it should be reallocated. To be sure, the lion's share of the equity that remained with directly held affiliates did so for valid methodological reasons—such as directly held affiliates that are operating affiliates in the case of the first operating affiliate method or directly held affiliates without child affiliates in the case of the last affiliate method. Table 6 provides information on the proportion of the U.S. direct investment abroad equity position, divided into positive and negative components, that could not be reallocated due to data limitations.

To an extent, the four methods faced the same data limitations. None of them could reallocate direct equity positions in affiliates for which ownership chains could not be constructed due to respondents to the 2019 Survey of U.S. Direct Investment Abroad not providing all of the requested ownership information. These affiliates accounted for $237 billion, or 4 percent, on a net basis in directly held equity positions. The last affiliate method, arguably the method with the fewest information requirements, did not face any other data limitations.

The financial structure methods require more data than the push-down methods, and, as a result, the former were able to reallocate fewer direct equity positions than the latter due to data limitations. Before discussing the precise data limitations faced by the financial structure methods, it is important to note that future iterations of this project will continue to attempt to overcome some of these limitations by making reasonable assumptions about the missing data. In other words, not all data limitations are the same and some may be overcome by making informed assumptions about what the missing data are likely to be. The feasibility of increasing the proportion of the direct equity position that can be reallocated through such assumptions is a topic for future research.

One key limitation faced by the financial structure methods is that they require more detailed information about ownership percentages between the USP and affiliates and between parent affiliates and child affiliates—meaning that ownership chains that are usable by the push-down methods might not be useable by the financial structure methods if these percentages were not provided by survey respondents. In addition, the PESAA method cannot be applied when PESAA takes a negative value, which happens when the USP's equity position is negative, and the affiliate's assets are not negative or vice versa (a situation that accounts for –$26 billion on a net basis of the direct equity position). Regarding the passthrough method, there was $113 billion on a net basis, or 2 percent, in directly held equity positions that could not be reallocated due to directly held affiliates with zero equity in child affiliates (even though the ownership chain data indicated they owned other affiliates) or having equity in child affiliates that had a different sign (i.e., positive or negative) than the USP's direct equity position, making it impossible to compute a value for the directly held affiliate's passthrough equity.

Table 6. Equity Position Not Reallocated Due to Data Limitations [Billions of dollars]

Reallocation method	Positive	Negative	Net	Net as % of total
First operating affiliate	259	-22	237	4.13
Last affiliate	258	-21	237	4.12
PESAA	326	-55	271	4.72
Passthrough with ownership chains	460	-51	409	7.11

Finally, even though the different methods' results are similar in a variety of ways, the results in this section clearly demonstrate that there is considerable variation among them, in terms of both the amount of directly held equity that is reallocated and the economies to which it is reassigned. In other words, the choice of reallocation method does matter. Although there are many nuances in regard to how the methods' results differ, at a broad level, the financial structure methods produce results that are most similar to the published direct investment equity positions on an immediate counterpart basis. Of all of the methods examined here, the apportionment methods produce results that tend to differ the most from the published outward direct investment positions on an immediate basis. The push-down methods occupy a middle position, between the financial structure and the apportionment methods in terms of how much they differ from the published, directly held equity positions.

VI. Preferred Methods

One of the purposes of this paper is to guide BEA's future efforts to produce official statistics for U.S. direct investment abroad by ultimate host economy. BEA proposes to further explore the two push-down methods and the passthrough with ownership chains method. A key strongpoint of these three methods is that they make use of BEA's rich survey microdata and especially of detailed data on the structure of U.S. MNEs' ownership chains. The use of the ownership chain data is particularly valuable since it allows these methods to reallocate each piece of the U.S. direct investment abroad equity position based on the actual relationships between the U.S. parent and its foreign affiliates.

To be sure, the PESAA method also has these features, and, as can be seen in table 6, the PESAA method currently faces fewer data limitations than the passthrough with ownership chains method in regard to the proportion of the total position it is able to reallocate. This method is not included in the group that merits further exploration primarily because of its tendency to generate additional positive and negative positions (see table 5). These additional positions, although they do not have a significant impact at the global aggregate level, are a major drawback given their likely impact on the country and industry-level aggregates that BEA is ultimately aiming to produce. Moreover, as indicated above, many of the shortcomings currently faced by the passthrough with ownership chains method in regard to data limitations

can likely be overcome in future iterations of this project by making informed assumptions about likely values of missing data.

The hybrid method also makes use of survey microdata, although, like the apportionment method, it does not use ownership chain data to guide the reallocation of direct equity positions. The fact that the hybrid and apportionment methods do not use ownership chain data means that they ultimately have to make more assumptions than do the methods that use the ownership chain data about where it is appropriate to reallocate each dollar of the U.S. direct investment abroad equity position. Regarding the apportionment methods in particular, tables 3 and 4 indicate that the post-reallocation country-level equity positions generated by these methods differ enormously from the post-reallocation positions generated by the methods that use ownership chain data, strongly suggesting that the assumptions on which the former methods rely may be problematic.

Country and Industry Results

Appendix tables A1 through A6 present summary country-level and sector-level experimental statistics for the first operating affiliate, last affiliate, and passthrough with ownership chains methods. This information is also presented graphically in charts 3 to 6. The country tables provide information, for each method, on the five countries whose total equity position decreased the most and the 10 whose position increased the most.[22] One key takeaway is that there are broad areas of agreement between the different methods' results. For all methods, the Netherlands and Luxembourg are the two countries with the largest decrease in their equity positions. Beyond these two countries, the decreases are concentrated and countries with the largest decreases for all methods tend to be countries that are known as financial centers. The countries with the largest increases are, in general, not known as financial centers and are thus countries where productive activities are likely taking place.

Despite the shift of equity positions away from financial centers in all methods, significant equity still remains in financial centers, as shown in tables A1 through A3. This finding is consistent with those obtained by national statistical compilers in other countries that have attempted to reallocate outward direct investment positions to ultimate host economies (see section II).

22 While this presentation choice is asymmetric, it allows us to show the vast majority of the decreases without confidentiality concerns. Expanding the decreases to the top ten countries would result in confidentiality protections for some countries due to the limited number of affiliates impacting the changes in those countries.

Chart 3. Largest Country Changes Using the First-Operating Affiliate Method

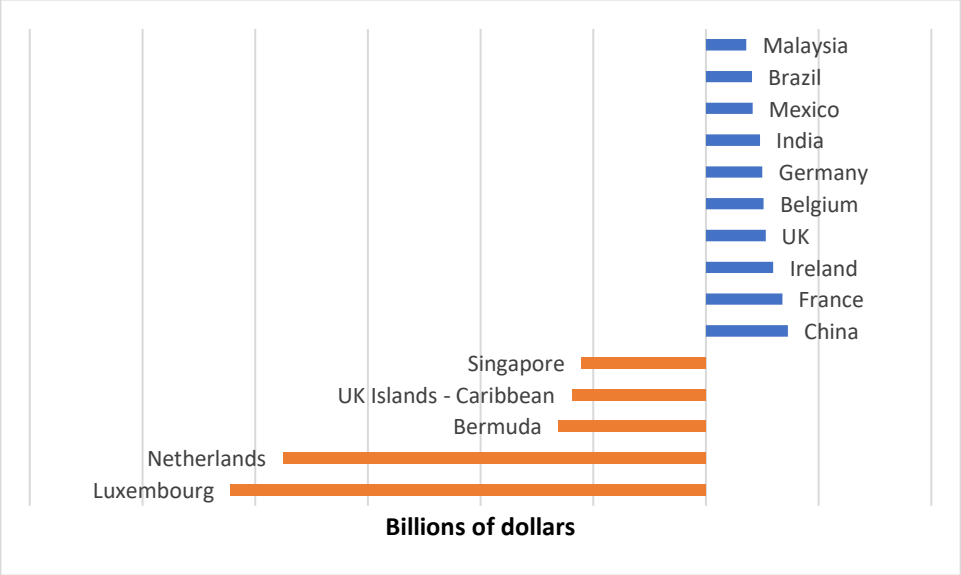


Chart 4. Largest Country Changes Using the Last Affiliate Method

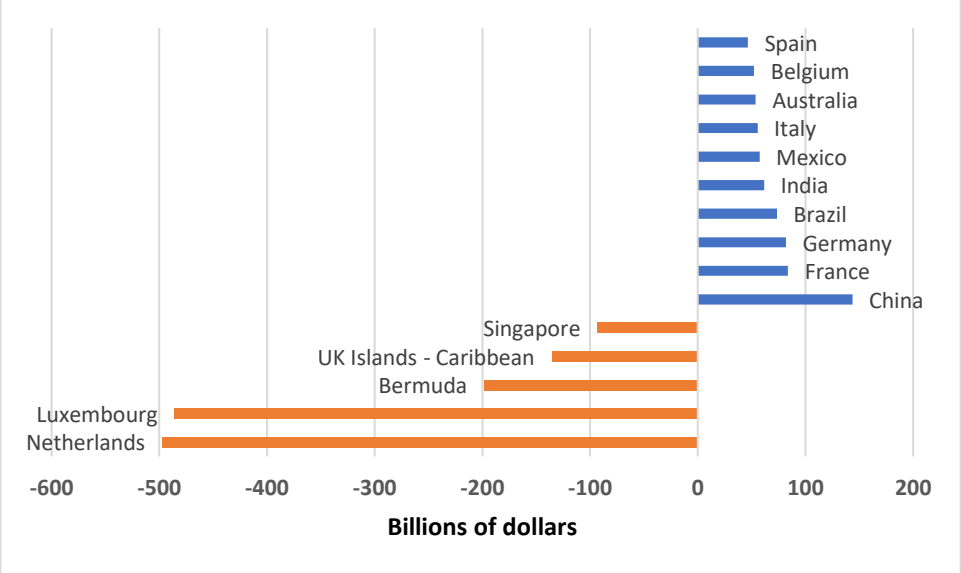
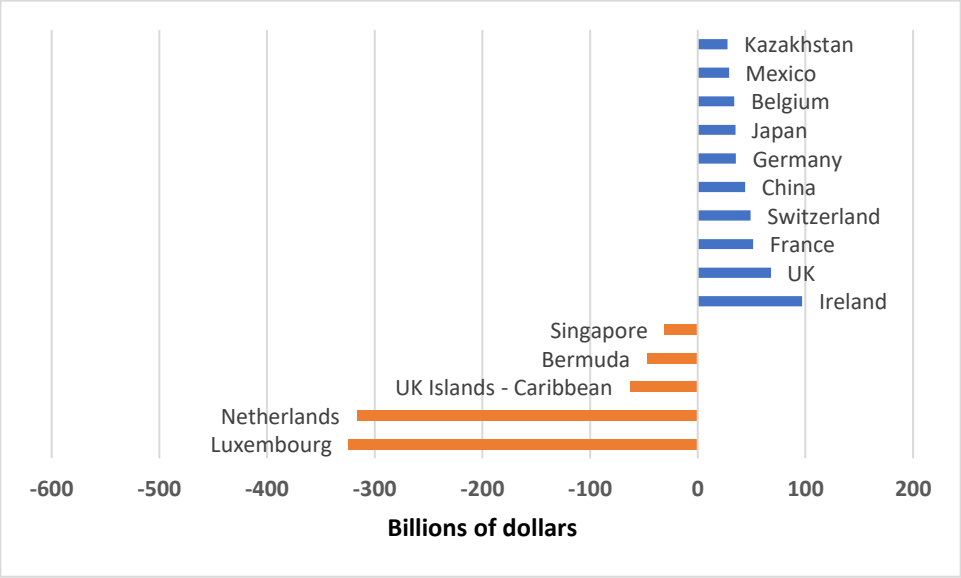


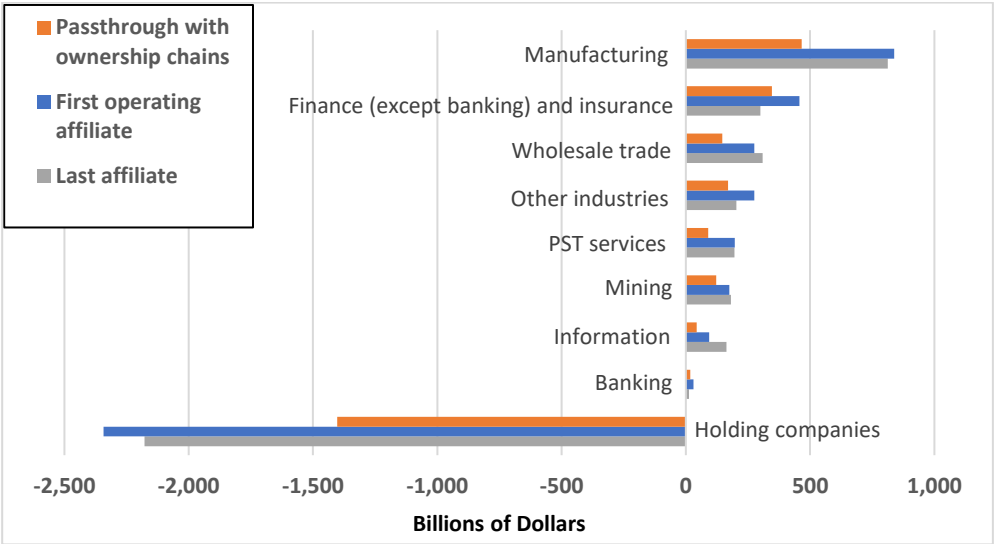
Chart 5. Largest Country Changes Using the Passthrough with Ownership Chains Method



The sector results indicate that all three methods had the effect of decreasing the equity position in holding companies and increasing the position in all other sectors. While some detailed industries (4-digit ISI codes) also saw decreases, they accounted for between 1 and 6 percent of the directly held equity position across the three methods.

It is noteworthy that some of the industries with the largest increases in equity positions are finance related. For three of the four microdata-based methods, "Other financial investment activities and exchanges" was the detailed industry with the largest increase in equity position, and, for all four methods, this code and, "Non-depository credit intermediation, except branches and agencies" and, "Securities and commodity contracts intermediation and brokerage" were among the 10 detailed industries with the largest increases in equity position. These industries, which include foreign affiliates performing intra-company financing, such as holding portfolio securities or providing loans to other affiliates, can be in financial centers. However, on a sector level, such as the statistics presented in chart 6 and Appendix A, affiliates in manufacturing received the largest amount of reallocated equity positions. At the detailed industry level, the manufacture of "pharmaceuticals and medicines" and "semiconductors and other electronic components" were both among the 10 industries with the largest increases for all three methods. At the sector level, the finance sector receives the second or third largest amount of reallocated equity position, depending on the method.

Chart 6. Sector Changes by Method



VII. Conclusion and Next Steps

This paper presents the results of BEA's initial attempt to re-allocate the U.S. direct investment abroad position on an immediate basis to the countries and industries where it is ultimately invested. It presents six different broad methods on how the direct investment position could be reallocated, how these methods were applied to BEA's circumstances, and presents summary results. It then proposes three methods for BEA to further explore: the two push-down methods and the passthrough with ownership chains methods.

BEA will continue to explore producing outward direct investment statistics by UHE for these three methods, which includes the possibility of further refining these methods to alleviate some of their limitations. In addition to some of the limitations specific to each method which are further explained above, there are additional aspects of the project that affect all the methods proposed for further exploration that could be further studied. For example, as was briefly mentioned in section III, these three methods only distribute the equity position but do not intrinsically distribute the debt position. Also, as currently implemented, these methods do not account for ownership chains where a U.S. parent routes its investment through the United States at some point along the ownership chain. BEA's statistics on the activities of U.S. multinational enterprises collect information on U.S. parents and their foreign affiliates (defined as the foreign business enterprises it owns), so they do not include information on U.S. operations and affiliates further down the chain, if any.[23]

23 BEA's statistics on foreign direct investment in the United States (FDIUS) position by country of ultimate beneficial owner (UBO), the controlling entity at the top of the global ownership chain, can shed light on this phenomenon. The UBO ultimately owns or controls, and thus ultimately derives the benefits and assumes the risks from owning or controlling, an affiliate. The country of the UBO is often the same as that of the foreign parent, but it may be a different country or the United States. This last

Any further analysis on these and other aspects will have to balance its relative importance within the statistics, data availability and resource requirements, and data user interest.

scenario occurs when a U.S. parent owns its U.S. operations through a foreign entity, which can happen for worldwide profit maximization strategies or as the product of merger and acquisition activity where a U.S. parent acquires a foreign business which itself already had U.S. operations. Until (or if) the company re-structures their global ownership structure the U.S. operations they own through the foreign entity will be presented in BEA's statistics as an inward investment with a U.S. UBO. In 2019, 1.8 percent of the FDIUS position was accounted for by U.S. UBOs, but the number has increased, and in 2022, the latest year available, U.S. UBOs accounted for 4.7 percent of the total FDIUS position.

Appendix A. Country and Industry Results[24]

Table A1. Largest Increases and Decreases in Equity Position by Country for First Operating Affiliate Method [Preliminary results, billions of dollars]

	New position	Difference		New position	Difference
Decrease in position			Increase in position		
Luxembourg	260	–420	China	170	70
Netherlands	400	–380	France	150	70
Bermuda	210	–130	Ireland	400	60
U.K. Islands–Caribbean	180	–120	United Kingdom	890	50
Singapore	180	–110	Belgium	110	50
			Germany	180	50
			India	90	50
			Mexico	140	40
			Brazil	110	40
			Malaysia	50	40

Table A2. Largest Increases and Decreases in Equity Position by Country for Last Affiliate Method [Preliminary results, billions of dollars]

	New position	Difference		New position	Difference
Decrease in position			Increase in position		
Netherlands	280	–500	China	240	140
Luxembourg	200	–490	France	170	80
Bermuda	150	–200	Germany	210	80
U.K. Islands–Caribbean	170	–140	Brazil	140	70
Singapore	190	–90	India	100	60
			Mexico	160	60
			Italy	80	60
			Australia	160	50
			Belgium	110	50
			Spain	80	50

24 Preliminary results in this appendix have been rounded to the nearest tens of billions as an extra layer of confidentiality protection for these experimental results.

Table A3. Largest Increases and Decreases in Equity Position by Country for Passthrough with Ownership Chains Method [Preliminary results, billions of dollars]

	New position	Difference		New position	Difference
Decrease in position			Increase in position		
Luxembourg	360	–320	Ireland	440	100
Netherlands	460	–320	United Kingdom	910	70
U.K. Islands–Caribbean	240	–60	France	140	50
Bermuda	300	–50	Switzerland	270	50
Singapore	260	–30	China	150	40
			Germany	170	40
			Japan	180	30
			Belgium	100	30
			Mexico	130	30
			Kazakhstan	50	30

Table A4. Changes in Equity Position by Sector for First Operating Affiliate Method [Preliminary results, billions of dollars]

	New position	Difference
Holding companies (nonbank)	300	–2,340
Depository institutions (banking)	180	30
Information	370	90
Mining	340	180
Professional, scientific, and technical services	360	200
Other industries	680	270
Wholesale trade	510	280
Finance (except depository institutions) and insurance	1,400	460
Manufacturing	1,620	840

Table A5. Changes in Equity Position by Sector for Last Affiliate Method [Preliminary results, billions of dollars]

	New position	Difference
Holding companies (nonbank)	460	–2,180
Depository institutions (banking)	160	10
Information	440	160
Mining	340	180
Professional, scientific, and technical services	360	200
Other industries	610	200
Finance (except depository institutions) and insurance	1,240	300
Wholesale trade	540	310
Manufacturing	1,600	810

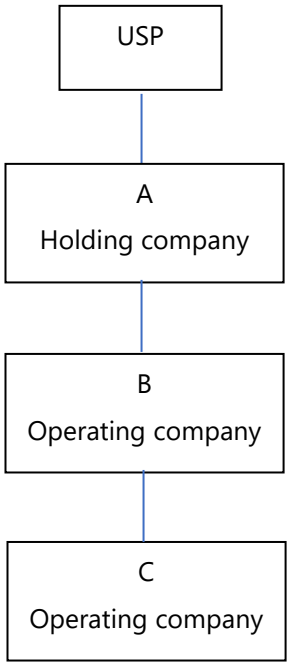
Table A6. Changes in Equity Position by Sector for Passthrough with Ownership Chains Method [Preliminary results, billions of dollars]

	New position	Difference
Holding companies (nonbank)	1,240	–1,400
Depository institutions (banking)	160	20
Information	320	40
Professional, scientific, and technical services	250	90
Mining	280	120
Wholesale trade	380	150
Other industries	580	170
Finance (except depository institutions) and insurance	1,290	350
Manufacturing	1,250	470

Appendix B. Example Calculations

This appendix uses a hypothetical MNE to provide example calculations for the four methods that use ownership chain data (first operating affiliate, last affiliate, passthrough with chains, and PESAA). Consider the MNE in figure B1 where the USP has, on an immediate basis, a $100 million equity position in affiliate A, which is a holding company. Under the first operating affiliate method, the entirety of this position is reallocated to affiliate B, despite the existence of another operating affiliate beneath B, because B is the first operating affiliate after A in the ownership chain. Under the last affiliate method, the entire $100 million position is reallocated to affiliate C, despite the existence of B, because C is the last affiliate in the ownership chain. If affiliate A were an operating company, the first operating affiliate method would leave the entire $100 million position with A, but the last affiliate method would still give affiliate C the entire equity position.

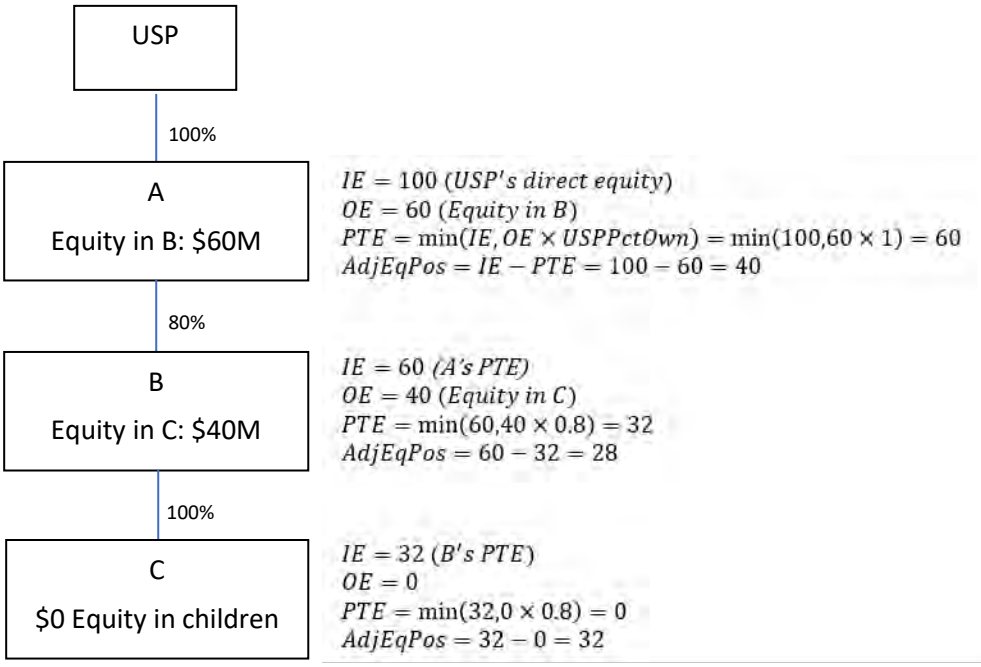
Figure B1. First Operating Affiliate and Last Affiliate Example



To apply the passthrough with ownership chains method, additional information is needed, including ownership percentages for each link in the ownership chain and the equity investment of affiliates A and B in their respective child affiliates. Suppose that the USP still has a $100 million direct equity position in affiliate A and that we have the following additional information (see figure B2): Affiliate A is 100 percent directly owned by the USP and has $50 million in equity in affiliate B, of which A owns 80 percent. In turn, affiliate B has $40 million in the equity of C of which affiliate B owns 100 percent. The passthrough equity (*PTE*) of each affiliate is calculated as the minimum of inward equity (*IE*) and outward equity (*OE*) times the USP's ownership interest (see equation 2), and its adjusted equity position (*AdjEqPos*) is then calculated as its inward equity minus its passthrough equity. After reallocating the equity

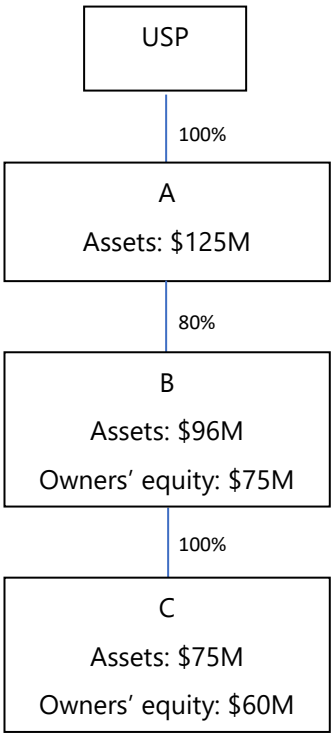
position with this procedure, the USP has a $50 million equity position in affiliate A, $18 million in affiliate B, and $32 million in affiliate C.

Figure B2. Passthrough with Ownership Chains Example



Applying the PESAA method requires additional information on the value of the assets of affiliate A and on the value of the assets and owners' equity of affiliates B and C. Suppose that, as shown in figure B3, affiliate A has $125 million in assets, B has $96 million in assets and $75 million in owners' equity, and C has $75 million in assets and $60 million in owners' equity. Using this information in addition to the same ownership percentages as in the passthrough example and the same $100 million direct equity position of the USP in affiliate A, the PESAA reallocation method is applied as follows.

Figure B3. PESAA Example



The first step is to calculate the unadjusted equity positions (*UnadjEqPos*) for A, B, and C. For A, the unadjusted equity position equals the USP's direct equity position, while, for B and C, unadjusted equity position is calculated using equation 7. For A and B, after unadjusted equity position is calculated, PESAA is calculated and used in the calculation of unadjusted equity position for their respective child affiliates.

PESAA step 1: Calculate unadjusted equity position

Affiliate A	$UnadjEqPos = USP's\ direct\ equity = 100$ $PESAA = \frac{UnadjEqPos}{Assets} = \frac{100}{125} = 0.8$
Affiliate B	$UnadjEqPos = A's\ ownership\ \% \times A's\ PESAA \times B's\ owners'equity$ $= 0.8 \times 0.8 \times 75 = 48$ $PESAA = \frac{48}{96} = 0.5$
Affiliate C	$UnadjEqPos = B's\ ownership\ \% \times B's\ PESAA \times C's\ owners'equity$ $= 1 \times 0.5 \times 60 = 30$

The second step is to calculate the final adjusted equity position for A, B, and C. This step involves using equation 8 to calculate the portion of each affiliate's unadjusted equity position that belongs to the affiliate(s) beneath it, denoted *ReassignedPortion*. The final adjusted equity position for each affiliate is then calculated as its unadjusted equity position minus the portion to be reassigned to the

affiliates beneath it in the ownership chain. After the equity position has been reallocated with these steps, the USP has a $52 million equity position in affiliate A, $18 million in affiliate B, and $30 million in affiliate C.

PESAA step 2: Calculate final adjusted equity position

Affiliate A	$ReassignedPortion = Ownership\ \%\ of\ B \times A's\ PESAA \times B's\ owners'equity$ $= 0.8 \times 0.8 \times 75 = 48$ $AdjEqPos = UnadjEqPos - ReassignedPortion = 100 - 48 = 52$
Affiliate B	$ReassignedPortion = Ownership\ \%\ of\ C \times B's\ PESAA \times C's\ owners'equity$ $= 1 \times 0.5 \times 60 = 30$ $AdjEqPos = 48 - 30 = 18$
Affiliate C	$ReassignedPortion = 0$ $AdjEqPos = 30 - 0 = 30$

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Experimental Ultimate Host Economy Statistics for U.S. Direct Investment Abroad

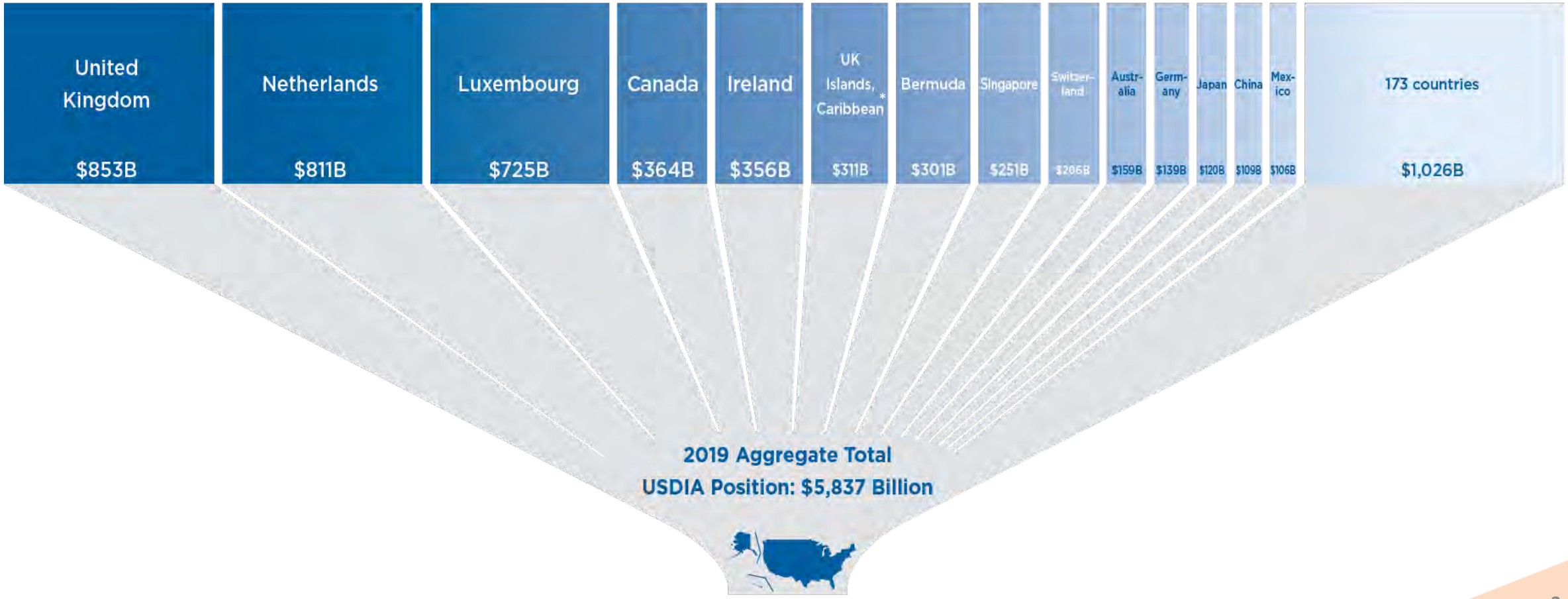
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External Statistics Conference, February 12-13, 2024



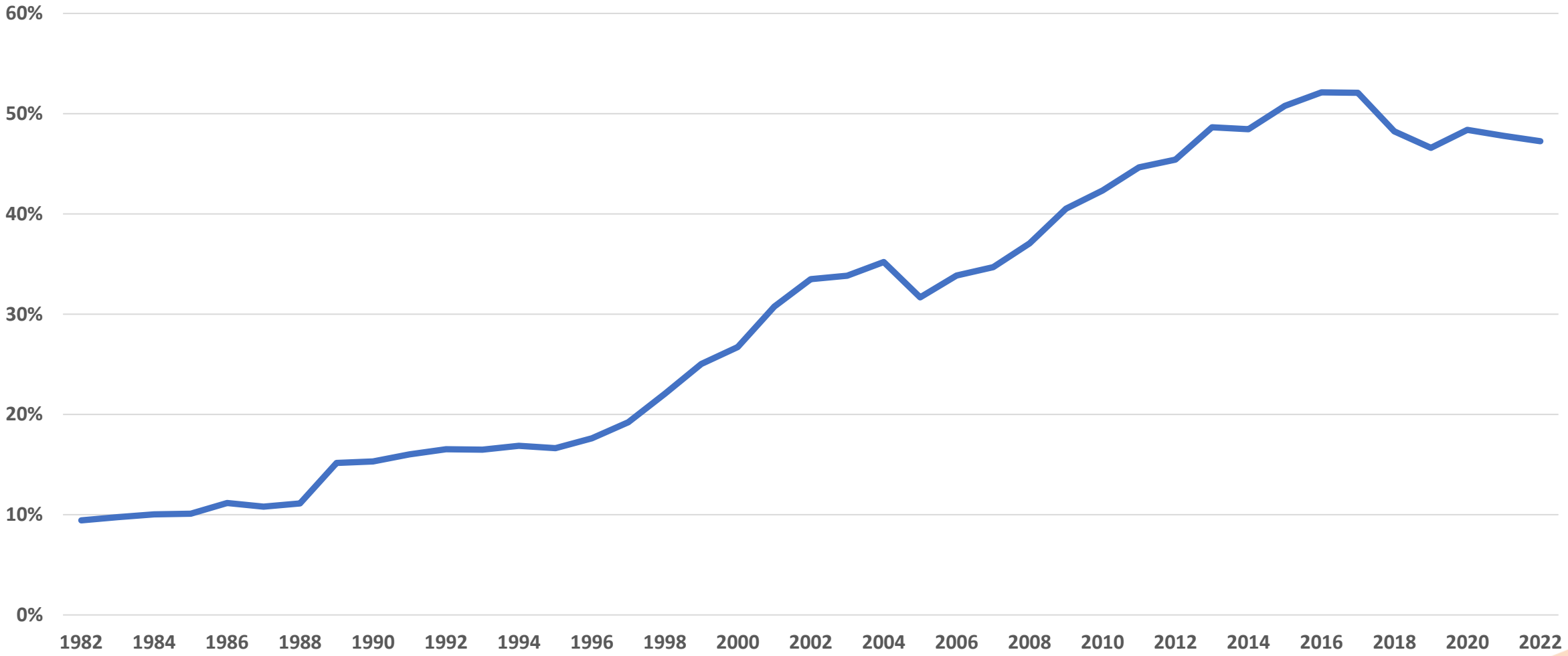
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U.S. direct investment position abroad — Where does it go?

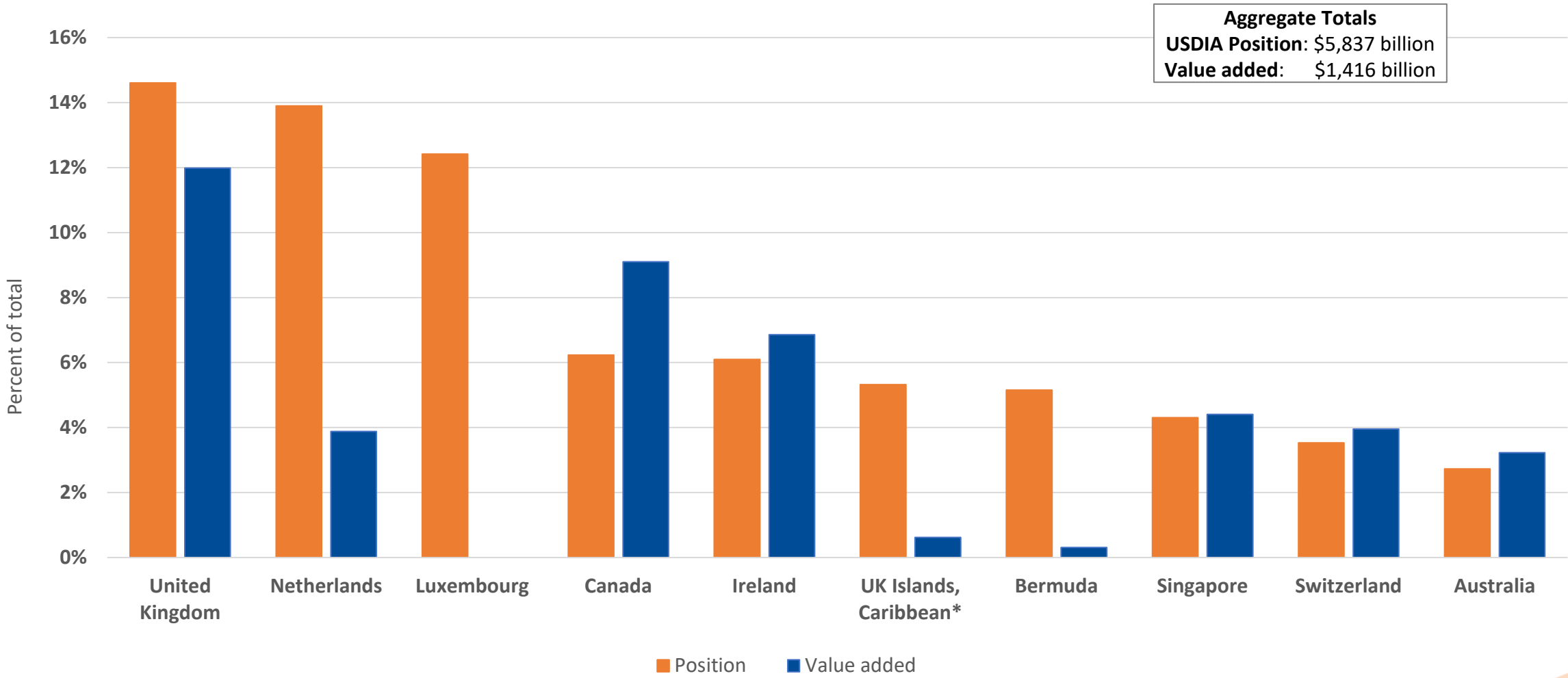


* Includes British Virgin Islands, Cayman Islands, Montserrat, and Turks and Caicos Islands

Holding Companies as a share of USDIA position

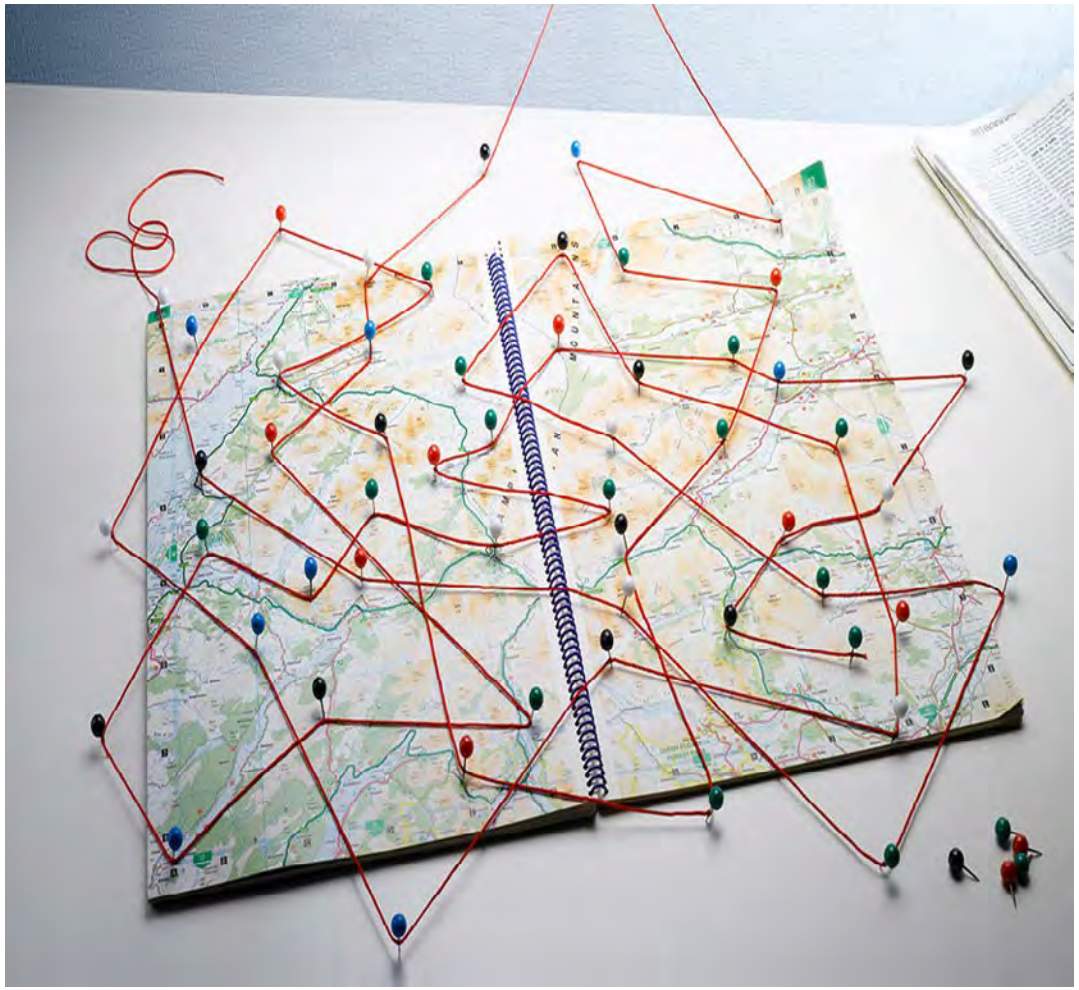


U.S. MNE outward position and value added by country, 2019



* Includes British Virgin Islands, Cayman Islands, Montserrat, and Turks and Caicos Islands

How do you do it?



Ultimate host economy (UHE): position reallocation methods

Method:	Push Down	Financial Structure	Apportionment
Sub-type	First Operating Affiliate	Passthrough with Ownership Chains	Employment / Fixed Capital / Sales
	Last Affiliate	Parent's Equity Share of Affiliate's Assets (PESAA)	
		Hybrid: Passthrough-Apportionment	

UHE: push down methods

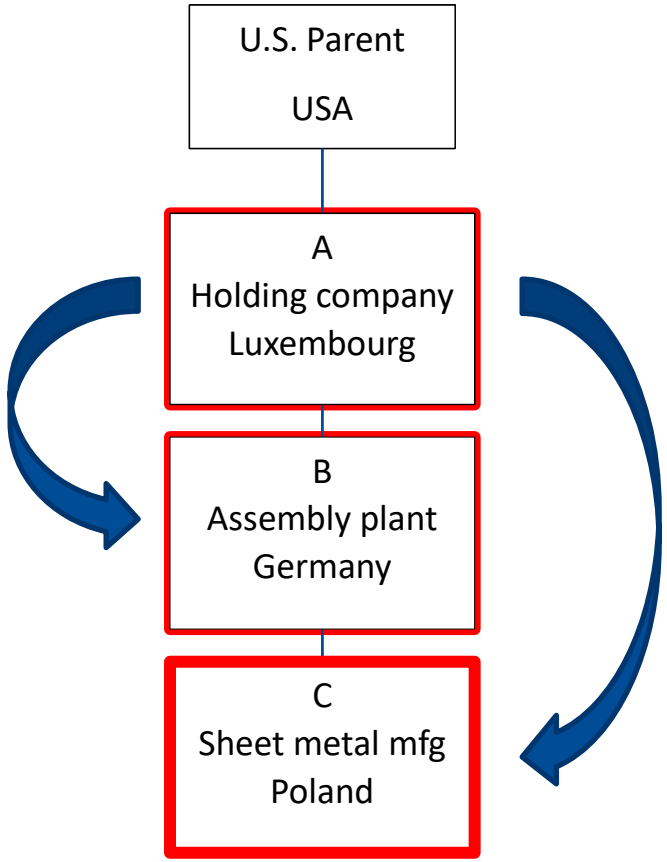
- First operating affiliate
  - Position reallocated from directly-owned holding companies to first non-holding company affiliate in ownership chain
    - Regardless of the number or size of affiliates further down the chain
  - If the first entity is not a holding company, the position is not reallocated
  - Method to be recommended in the next edition of the IMF Balance of Payments and International Investment Position Manual

- Last affiliate
  - Position reallocated from directly-owned companies to last affiliate in the ownership chain
    - Regardless of size or industry of intermediate affiliates

UHE: push down methods

First-operating method

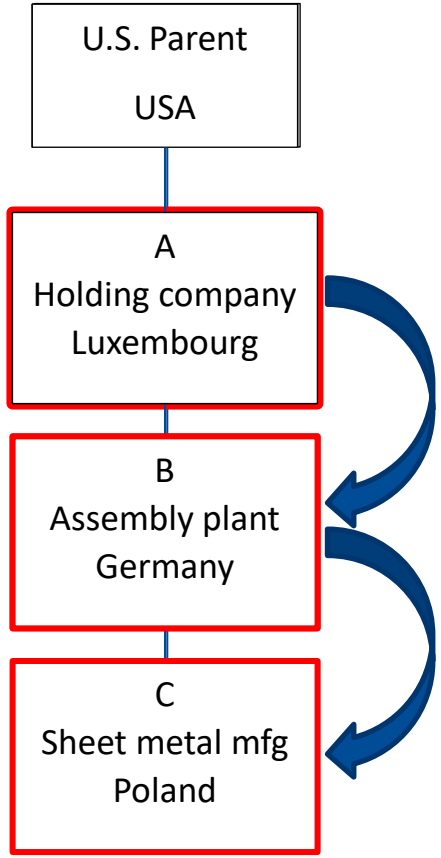
Last affiliate method



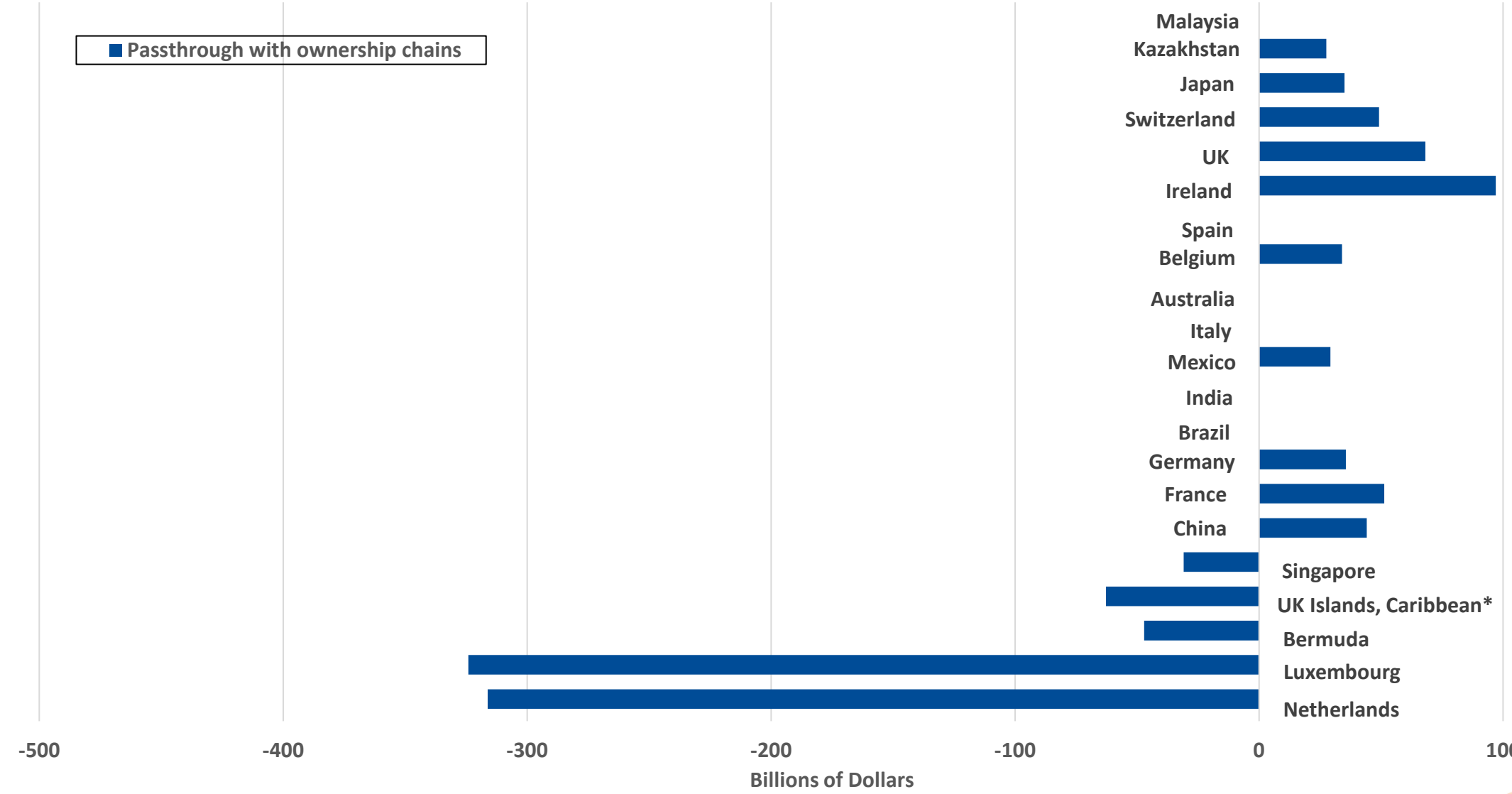
UHE: passthrough with ownership chains

- Builds on Borga and Caliandro (2018) passthrough approach
- Data intensive
- Position remaining in affiliate equals equity received from parent *less* equity that passes through to other affiliates down the ownership chain

UHE: passthrough with ownership chains

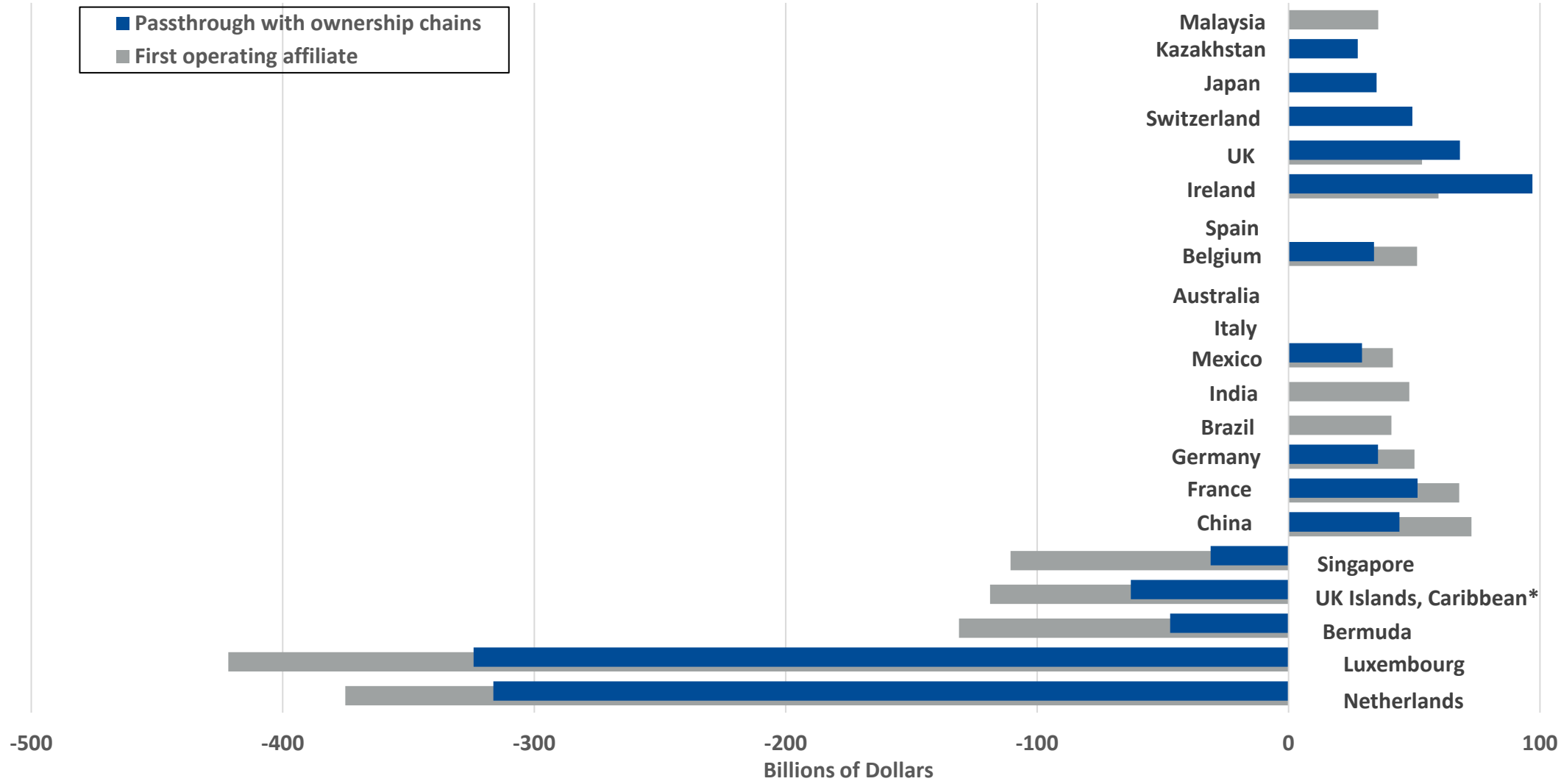


UHE results: largest reallocations by country, by method



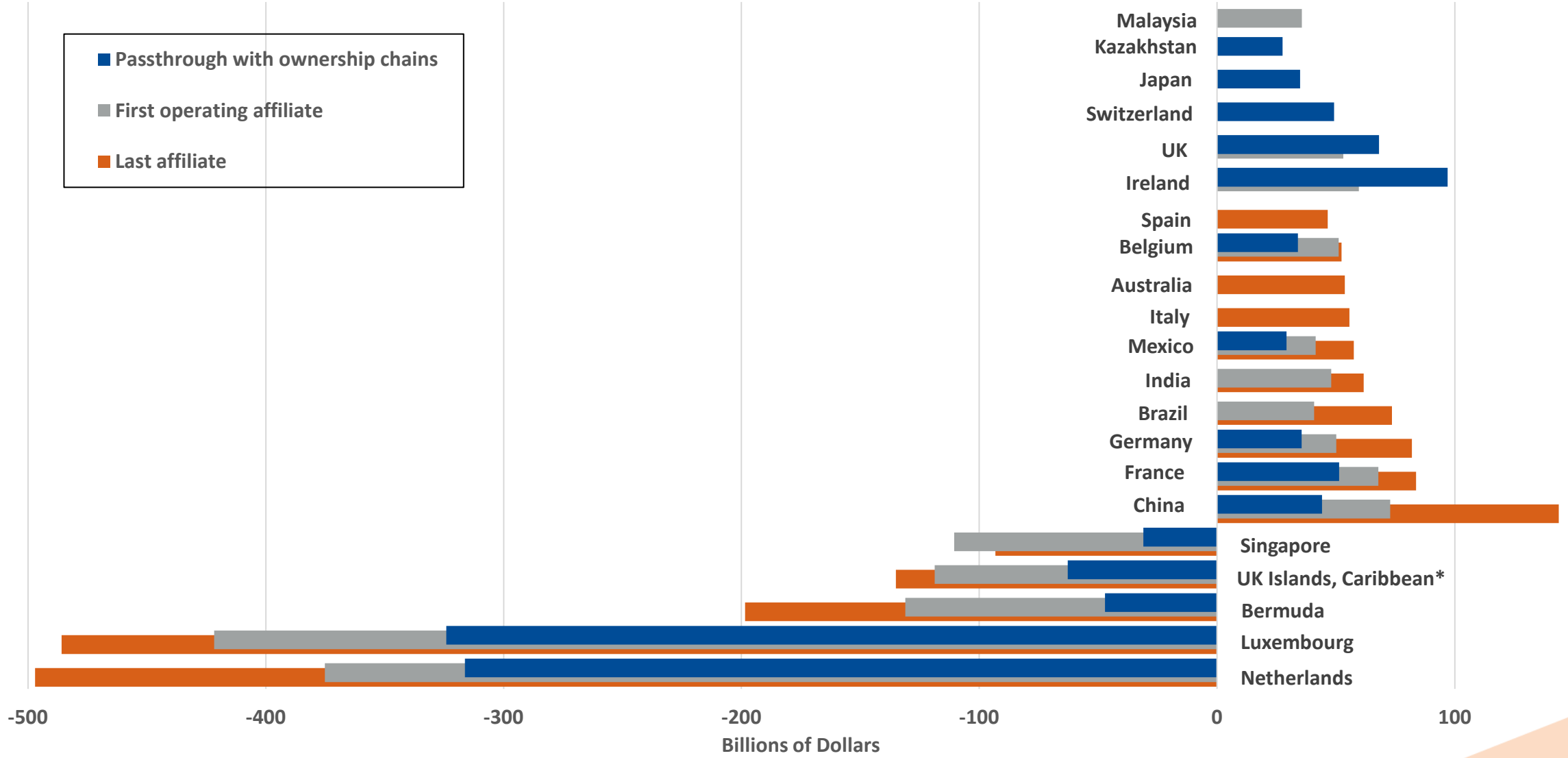
* Includes British Virgin Islands, Cayman Islands, Montserrat, and Turks and Caicos Islands

UHE results: largest reallocations by country, by method



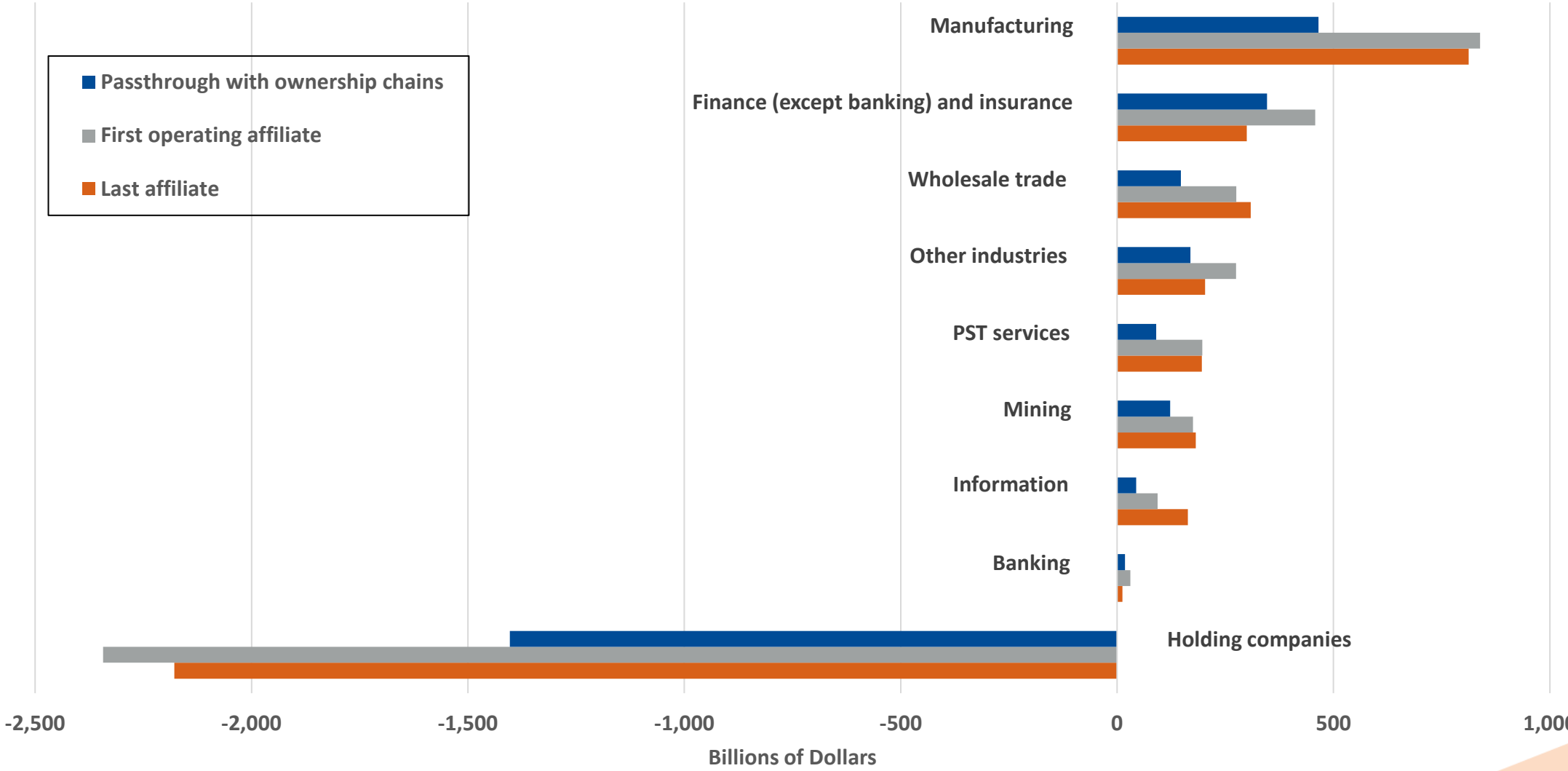
* Includes British Virgin Islands, Cayman Islands, Montserrat, and Turks and Caicos Islands

UHE results: largest reallocations by country, by method



* Includes British Virgin Islands, Cayman Islands, Montserrat, and Turks and Caicos Islands

UHE results: reallocations by sector, by method

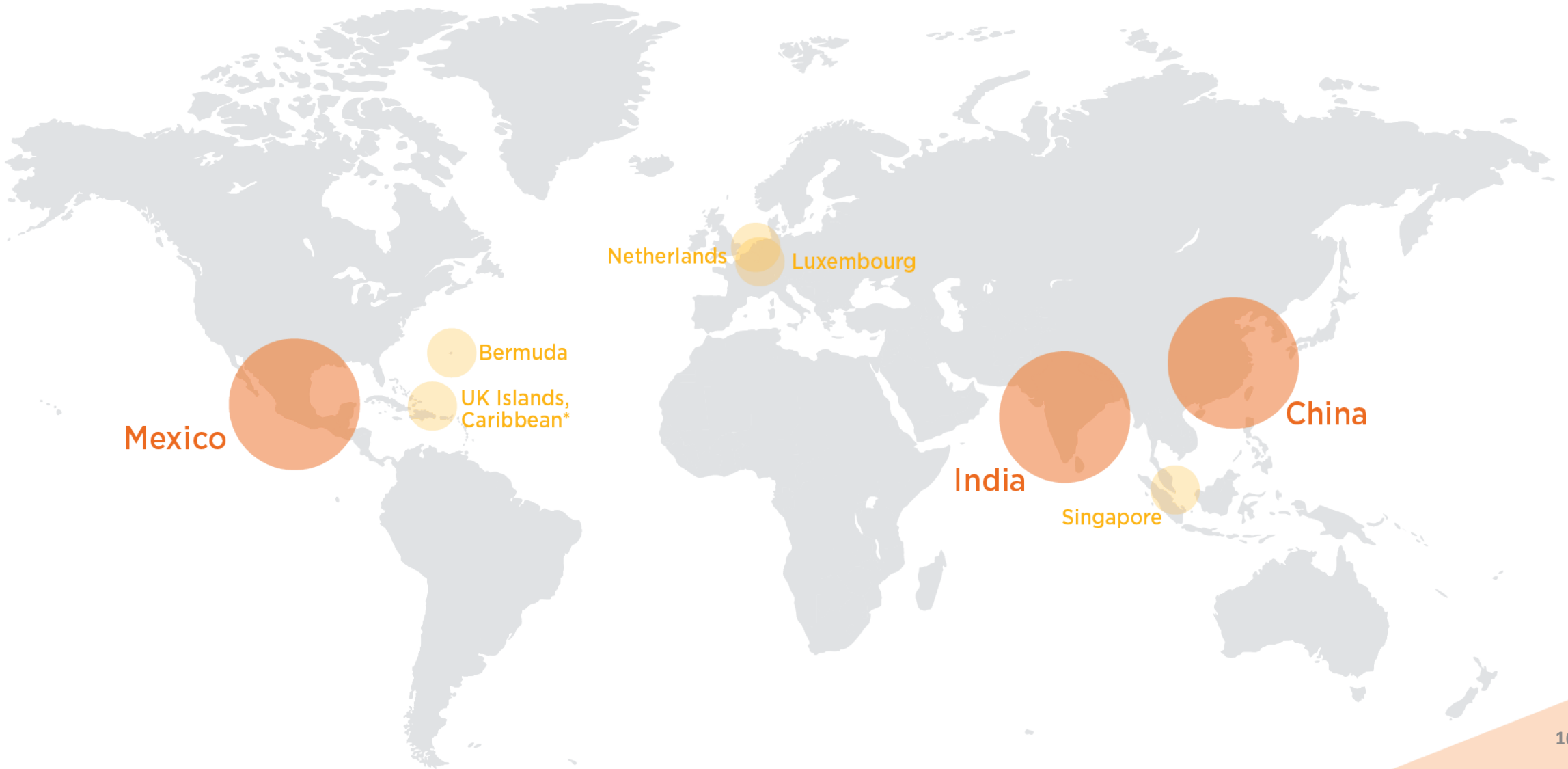


UHE: in summary



* Includes British Virgin Islands, Cayman Islands, Montserrat, and Turks and Caicos Islands

UHE: in summary



* Includes British Virgin Islands, Cayman Islands, Montserrat, and Turks and Caicos Islands

UHE: next steps

Feedback

- Solicit feedback from data users
- Present research at conferences and international working groups

Decide

- Based on feedback, select method(s)
- Resolve minor outstanding methodological questions

Advance

- Incorporate into production systems
- Include in annual Direct Investment by Country and Industry release

Discussion questions

- Are there other questions related to Ultimate Host Economy (UHE) that we should explore?
  - Additional methods to attempt?

- Of the six methods for calculating UHE that we explored, do you think that we selected the correct three to further pursue?

- Which method do you prefer? Which method meets your needs?

Contact information

- Please reach out to me with any feedback at:
  - Larkin.Terrie@bea.gov

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Introduction: BPM7 - external sector statistics address new challenges[1]

Jannick Damgaard, Venkat Josyula, and Carlos Sánchez-Muñoz,
International Monetary Fund

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.



STATISTICS

BPM7 – External Sector Statistics Address New Challenges

CARLOS SÁNCHEZ-MUÑOZ (*BPM7* PROJECT MANAGER)

FEBRUARY 13, 2024

Conference on *External statistics after the pandemic: Addressing novel analytical challenges*

Irving Fisher Committee on Central Bank Statistics of the Bank for International Settlements, European Central Bank, Banco de España

AGENDA



Road to BPM7: Main Features



Why Update the Standards?



Key Update Themes



Update Process and Timeline

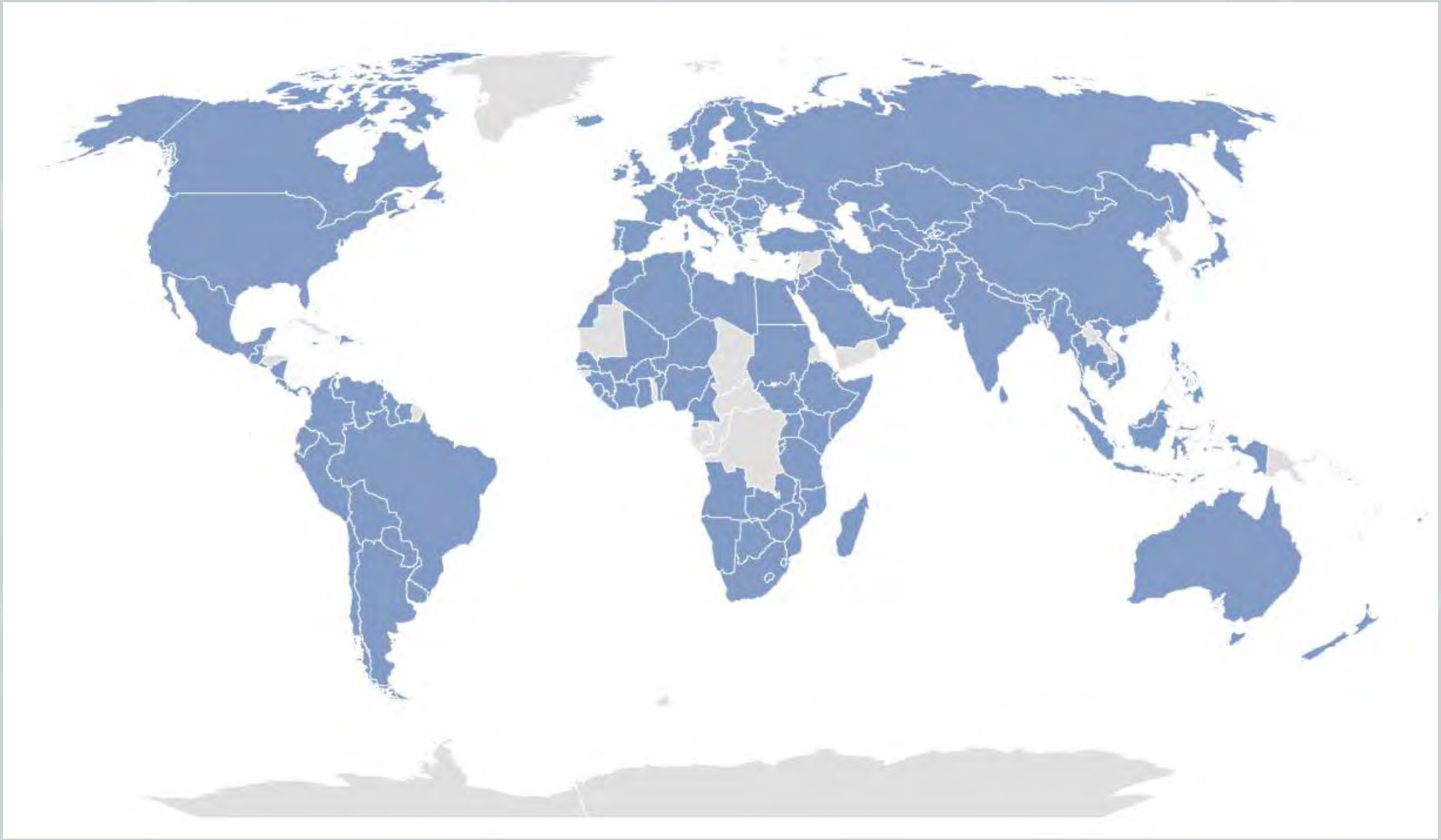


Support to Our Members and Outreach

Road to *BPM7*: Main Features

- Follows the **standard revision cycle** (~15 years between editions)
- First BPM update to be done in **full coordination with the SNA update**
- Increased **collaboration with other statistical domains**, including common glossary
- **Country participation**: extensive outreach and global consultations
- **Early implementation simulations and country experiences** to test some proposals before agreeing them
- The **integrated international investment position** will be at the center of the *Manual*
- **Anticipating future developments**, e.g., the use of invoice values for goods and reinvestment of earnings for portfolio investment in *BPM8*
- **Most changes** to address new developments will be handled through **supplementary presentations**.

Worldwide Participation in SNA/BPM Global Consultations



Thus far, 176 economies have participated in at least one of them

Why Update the Standards?

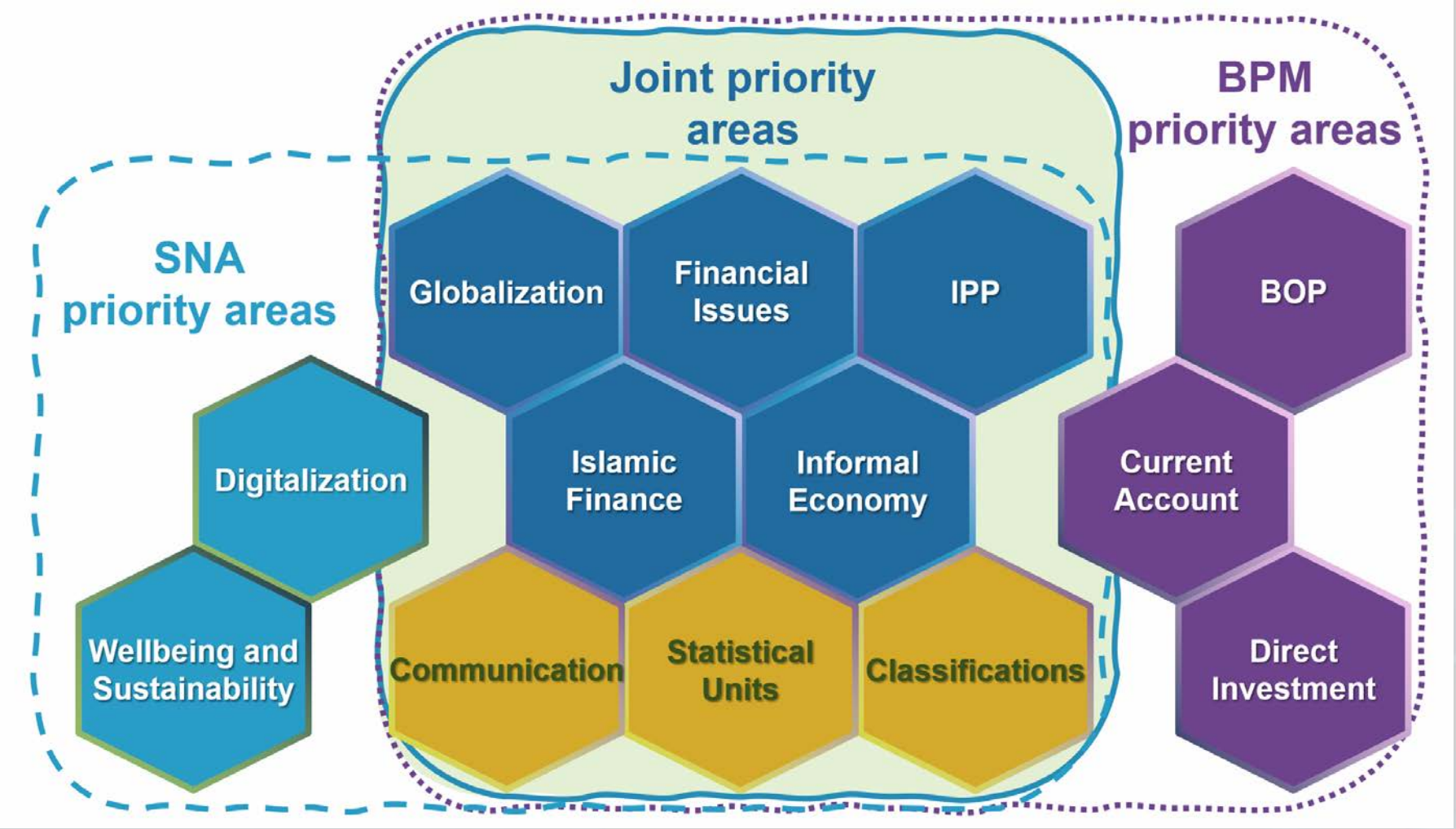
- **Tectonic shifts in the global economy**
  - 2008 global financial crisis highlighted data shortcomings
  - The COVID-19 pandemic showed vulnerabilities
  - Increasing demand for data to address climate change
- **The conceptual frameworks designed to be robust and resilient**
  - But shortcomings in analytical usefulness exposed
  - Digitalization and globalization posed new challenges to data compilation
- **Respond to data needs identified through global reviews**
  - The G20 Data Gaps Initiative
  - The Stiglitz-Sen-Fitoussi Commission

Ensure that policy makers' data needs and key topics for surveillance and broader policy analysis are addressed in the updated manuals



Why Update the Standards?

Key Update Themes



Key Update Themes

Digitalization and Financial Innovation

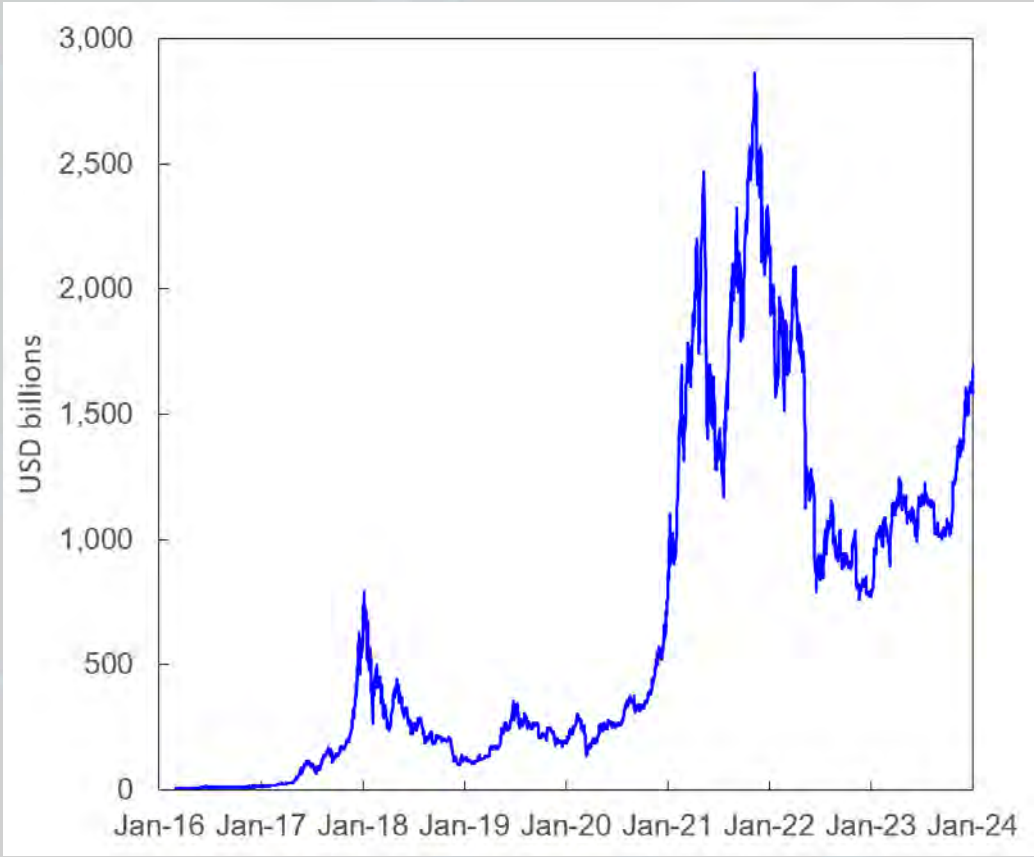
Selected Update Issues

- Recording fintech
- Recording crypto assets
- Financial derivatives by type
- Non-bank financial institutions

Related Policy Work

- Macrofinancial surveillance
- Fintech
- Digital money

Global market capitalization of crypto assets
(In USD billions)



Source: Coin Dance.

Globalization

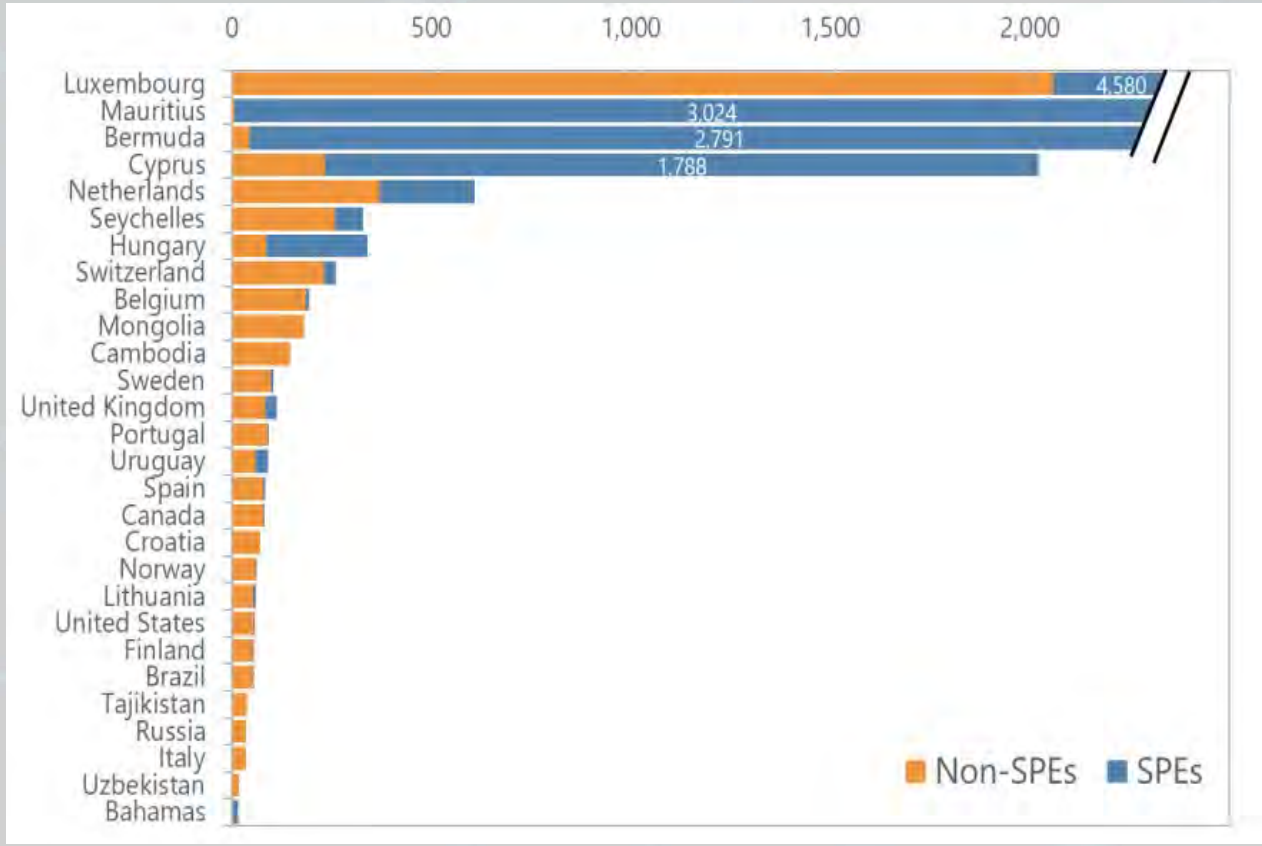
Selected Update Issues

- Global value chains
- Multinational enterprises
- Special purpose entities (SPEs)

Related Policy Work

- Trade
- International taxation
- Capital flows

Foreign Direct Investment breakdown
(Percent of GDP; end-2020)



Source: IMF staff calculations based on the IMF SPE Database.

External Sector Sustainability

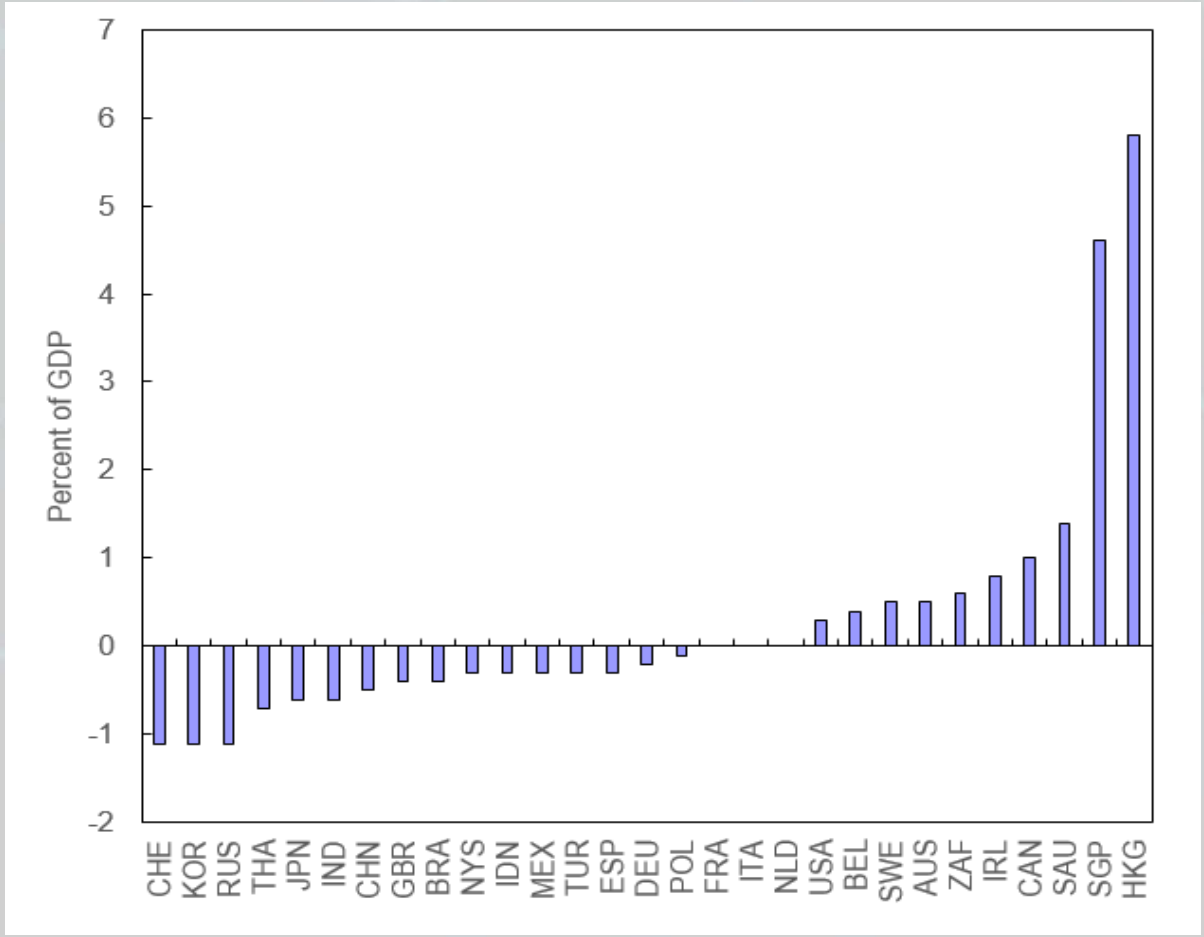
Selected Update Issues

- Stock/flow reconciliation
- Trade classified by currency
- Net international reserves
- Reinvested earnings (RIE)
- Unlisted equity

Related Policy Work

- External balance assessments

Estimated current account impact when including RIE on portfolio investment
(In percent of GDP; 5-year average)



Source: IMF, “External Sector Report,” 2018.

Sustainable Finance

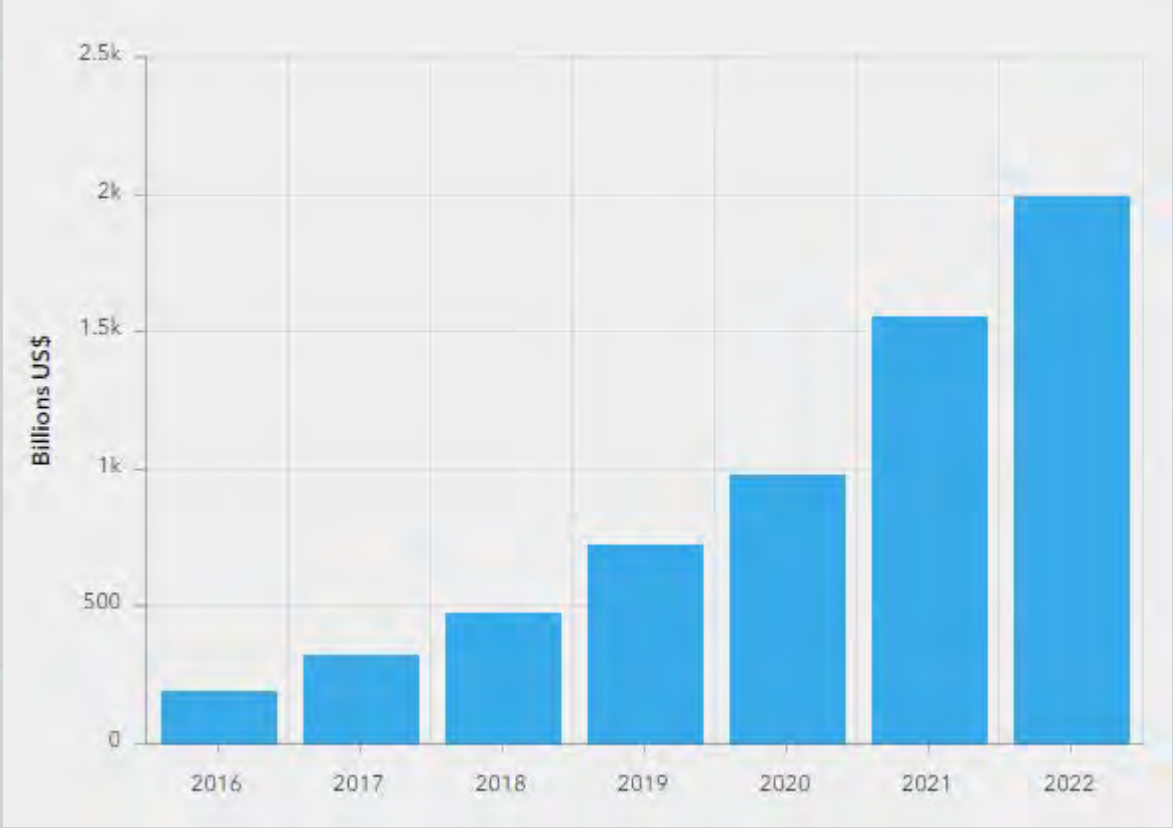
Selected Update Issues

- Type of investments (“green label”)
- Physical location of investments
- Investments in specific industries
- International cooperation grants to low-income countries

Related Policy Work

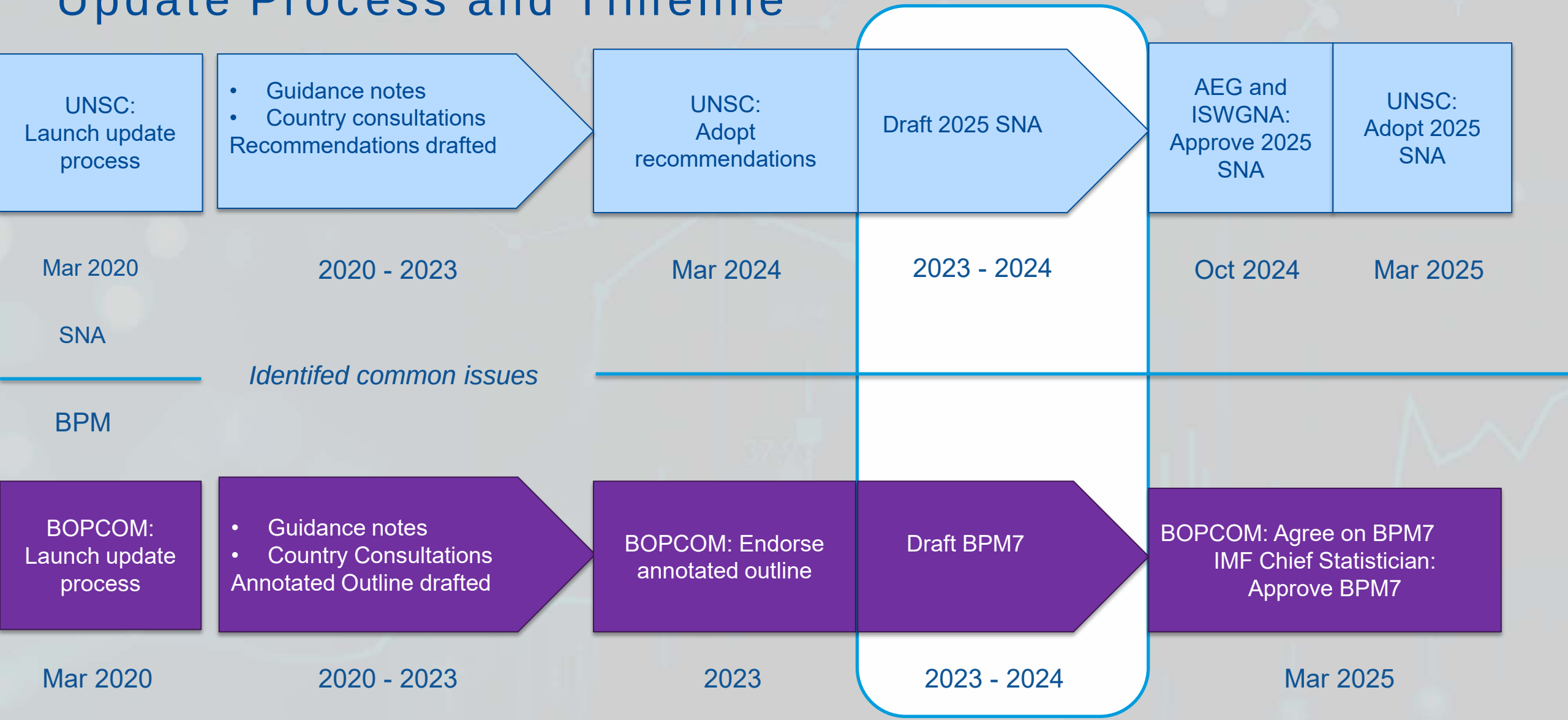
- Climate change

Green bonds outstanding
(In USD billions)



Source: IMF Climate Change Indicators Dashboard (Refinitiv; Country authorities; IMF staff calculations).

Update Process and Timeline



Support to Our Members and Outreach

- **Implement multipronged capacity development strategy**
  - Organize regional workshops
  - Provide technical assistance and training
  - Develop methodology handbooks and compilation guides
  - Coordinate capacity development with other international organizations

Tailor implementation approach considering the needs and limitations of fragile and conflict-affected states

- **Utilize new digital platform for collaboration**
  - Development of a compilers' hub to facilitate sharing of best practices
  - Transition to electronic publications
  - Share common concepts across all statistical domains, including glossary of terms and definitions
  - Host a forum for interaction between compilers and users and peer-to-peer collaboration



Support to Our Members and Recommendations

Thank you very much for your attention!

BACKGROUND SLIDES

Key Changes to the Core Framework

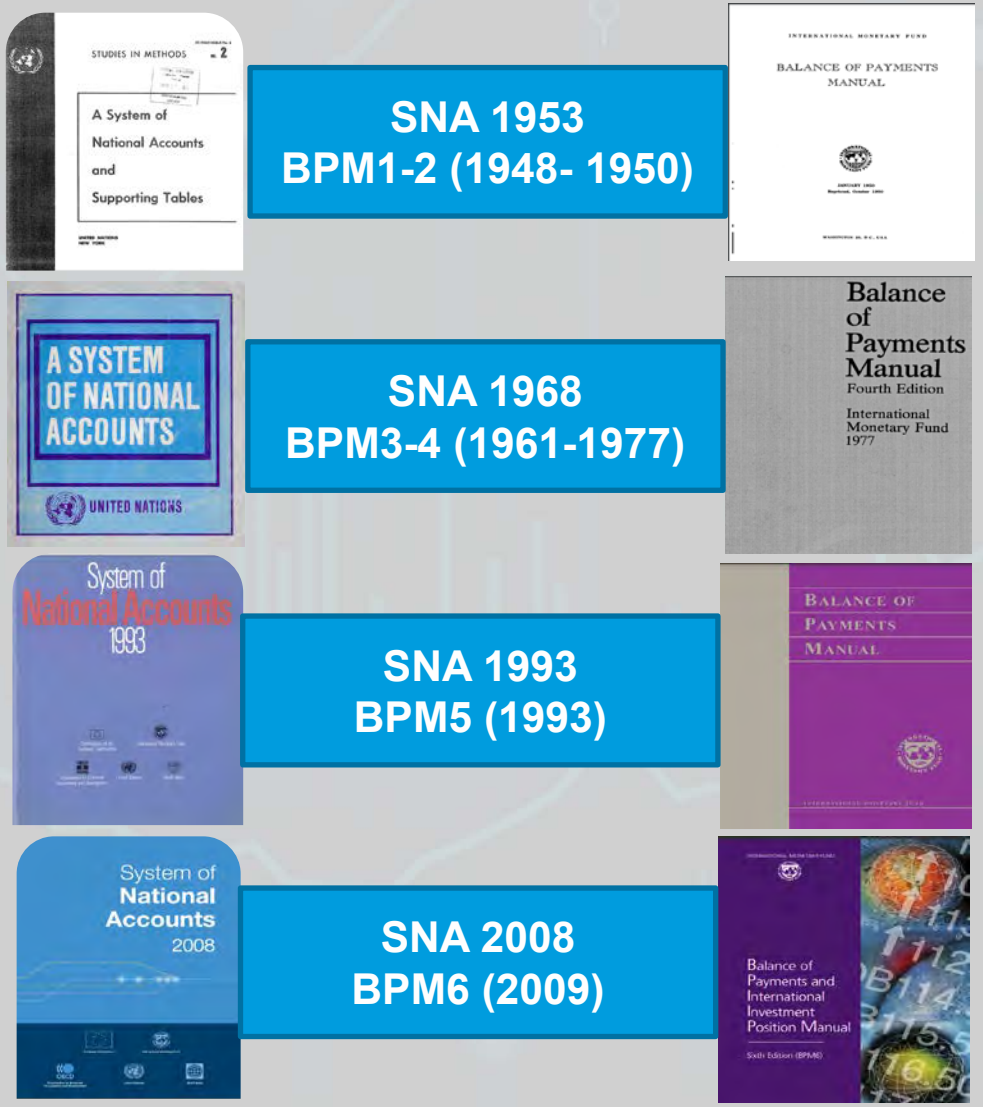
- The **integrated international investment position** will be at the center of the *Manual,* with exchange rate changes, other price changes, and other changes in volume becoming standard components.
- **Crypto assets without a counterpart liability** designed to act as a general medium of exchange (e.g., Bitcoins) will be recorded in a separate category in the capital account.
- **Marketing assets** will be treated as produced nonfinancial assets instead of nonproduced nonfincial assets (i.e., transactions should be included in the current account rather than the capital account).
- More detailed breakdowns of **services** in the standard components.
- **Direct investment** will be broken down by sector.
- **Nonfinancial corporations** will be separated from **households and nonprofit institutions serving households**.

Updating Macroeconomic Statistical Standards

- Macroeconomic statistical standards are regularly updated **to reflect changes in the economy**

- The "updates" can be categorized into three main groups:
  1. **Conceptual updates** (i.e., change in what is measured)
  2. **Methodological updates** (i.e., change in how activities are measured)
  3. **Presentational updates** (i.e., change in how the statistics are presented)

- In the past decades, more and more attention to arrive at **consistency with other standards** (e.g., GFSM and MFSM, SEEA)



Governance Arrangements—SNA and BPM

United Nations Statistical Commission (UNSC)	Inter-Secretariat Working Group on National Accounts (ISWGNA)	Advisory Expert Group on National Accounts (AEG)	IMF Committee on Balance of Payments Statistics (Committee)
Provides the mandate on national accounts, endorses and monitors the work program.	Carries out the mandate and reports progress on its work program to the UNSC. Membership comprises international agencies, including the IMF. Engages technical expert groups to carry out the work program.	Assists the ISWGNA in carrying out its work program. Resolves issues on the SNA research agenda. Membership represents global community of national accounts compilers in their personal capacity.	Advises the IMF on methodological and compilation issues in external sector statistics. Membership represents global community of external statistics compilers in their personal capacity.

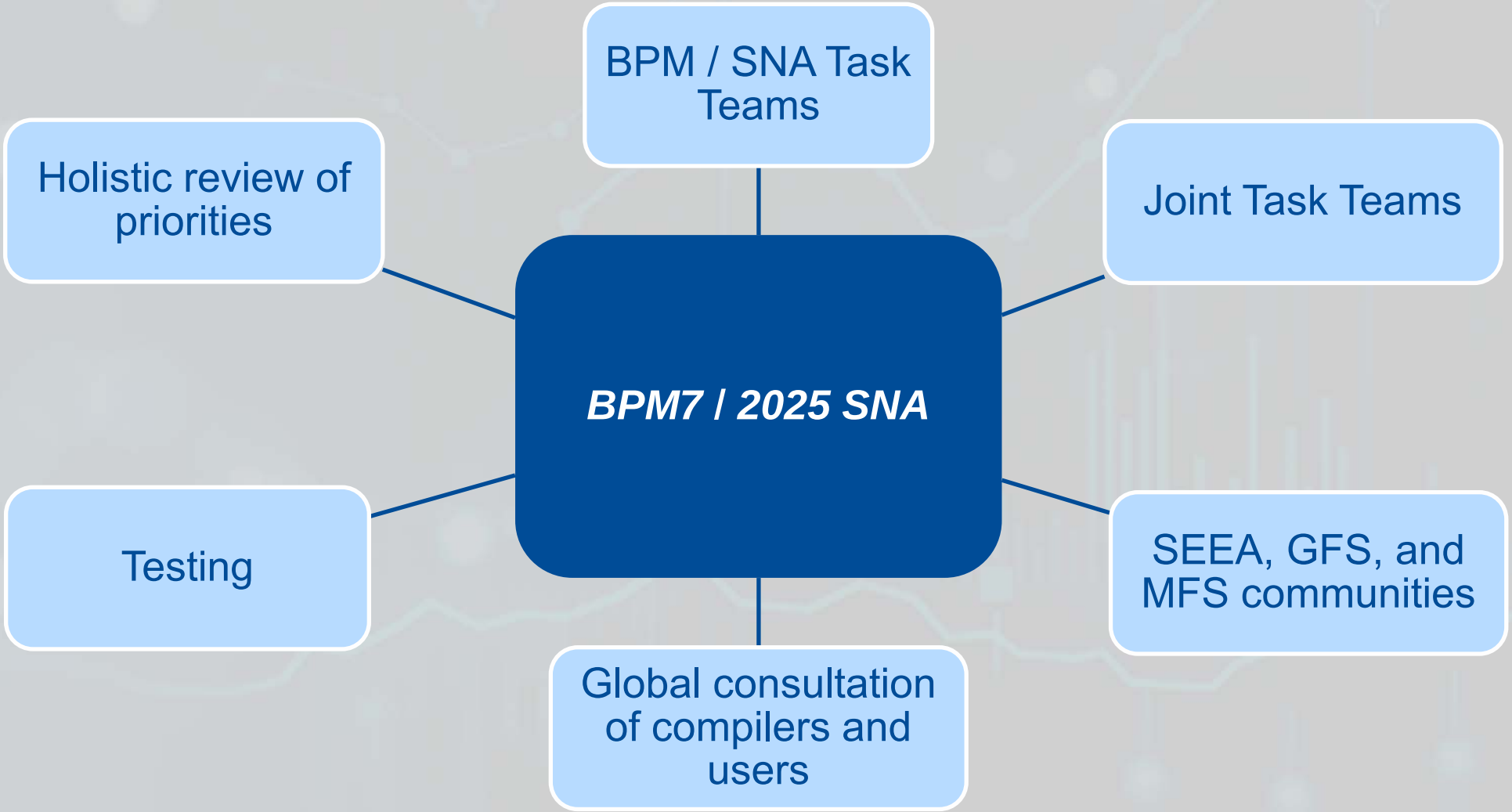


Update Process

Update Process and Cooperation between the BPM and SNA Drafting Teams

- **Research agenda: joint expert groups (Task Teams)**
  - Participation of GFS, MFS, SEEA, classification updates (ISIC, CPC), and users
- **Joint meetings of the AEG and the Committee**
  - Decisions taken together / key role of editors in the event of disagreements
- **Coordinated drafting of annotated outlines (AOs) of new / substantially revised chapters)**
  - Including four joint SNA/BPM chapters
  - AOs circulated for global consultation
  - Consolidated *BPM7* AO (English) already posted—to be made available other languages
- **Common glossary and common text for general principles**
  - Preliminary glossary of around 850 terms and definitions posted on the *BPM6*/*2008 SNA* update websites

Coordination and Involvement of Stakeholders



Implementing the updated SNA/BPM



More Information on the Update of *BPM6*

https://www.imf.org/en/Data/Statistics/BPM



INTERNATIONAL MONETARY FUND

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UPDATE OF THE SIXTH EDITION OF THE BALANCE OF PAYMENTS AND INTERNATIONAL INVESTMENT POSITION MANUAL (BPM6)

Compendium of Research Issues

Task Teams (BOPCOM)

Balance of Payments Task Team (BPTT)

Current Account Task Team (CATT)

Direct Investment Task Team (DITT)

Joint Task Teams (BOPCOM/ISWGNA)

Financial and Payments Systems Task Team (FITT)

Joint Globalization Task Team (GZTT)

Informal Economy Task Team (IETT)

Islamic Finance Task Team (IFTT)

Joint Communications Task Team (CMTT)

Approved Guidance Notes

Update of the sixth edition of the Balance of Payments and International Investment Position Manual (*BPM6*)

The IMF Statistics Department has launched the update of the sixth edition of the *Balance of Payments and International Investment Position Manual (BPM6)* targeting to publish an updated version of the Manual *(BPM7)* by March 2025. The *BPM6* update is being coordinated with the update of the *System of National Accounts 2008* (*2008 SNA*), which was officially launched by the United Nations Statistical Commission (UNSC) also with a target release date of March 2025.

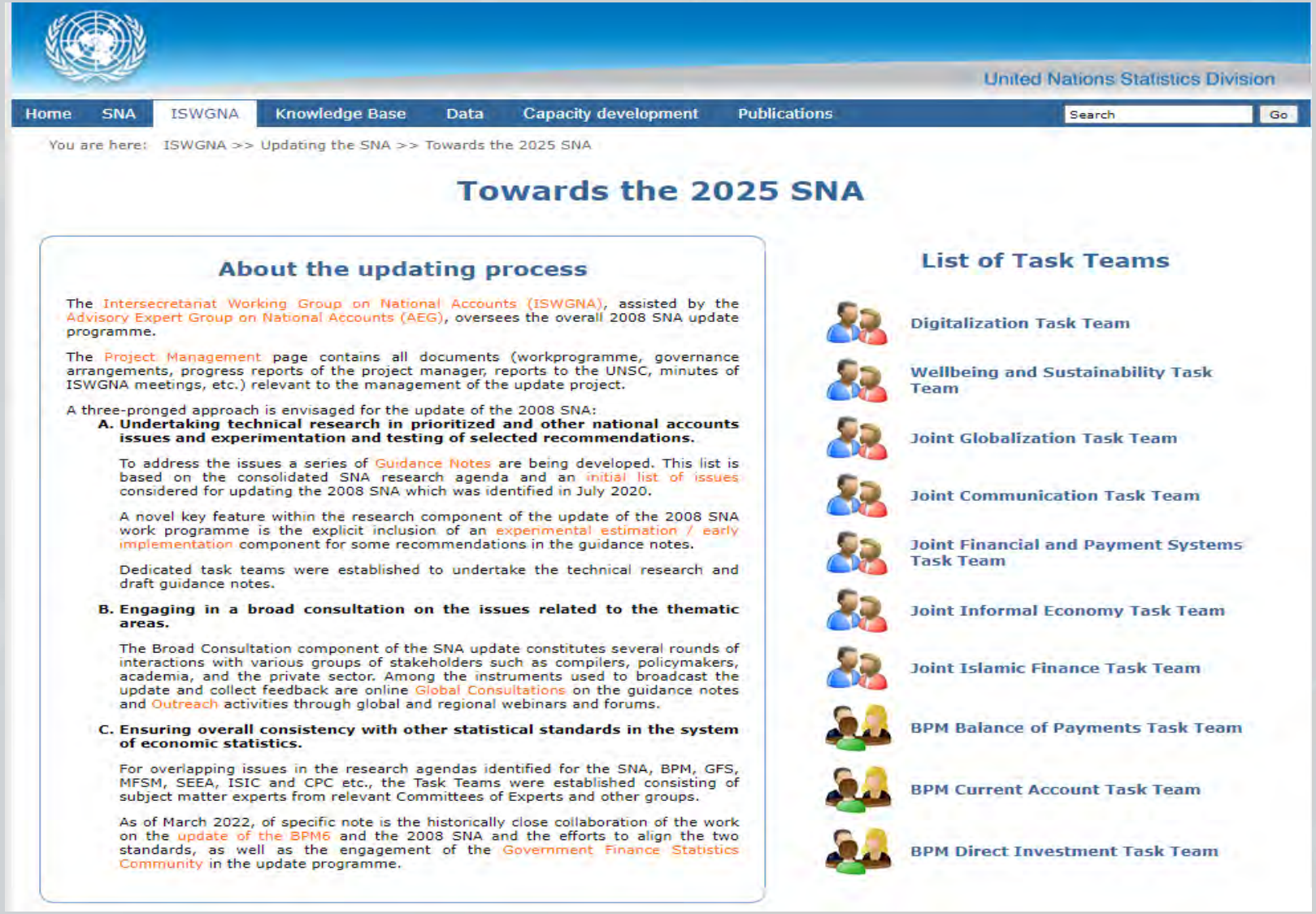
Key elements of the *BPM6* Update process and the timetable were endorsed by the IMF's Committee on Balance of Payments Statistics (BOPCOM) at its Thirty-Third Meeting in March 2020.

The two phases of the update process are:

- **Phase I** (March 2020–March 2022): finalization of the detailed research on the issues identified in the *Compendium of Research Issues* and discuss how they would impact the new version of the Manual *(BPM7)* and
- **Phase II** (April 2022–March 2025): finalization of the Annotated Outline and drafting of the chapters/appendixes of the *BPM7*, and extensive consultations about the proposed changes;

More Information on the Update of the 2008 SNA

https://unstats.un.org/unsd/nationalaccount/towards2025.asp



United Nations Statistics Division

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You are here: ISWGNA >> Updating the SNA >> Towards the 2025 SNA

Towards the 2025 SNA

About the updating process

The Intersecretariat Working Group on National Accounts (ISWGNA), assisted by the Advisory Expert Group on National Accounts (AEG), oversees the overall 2008 SNA update programme.

The Project Management page contains all documents (workprogramme, governance arrangements, progress reports of the project manager, reports to the UNSC, minutes of ISWGNA meetings, etc.) relevant to the management of the update project.

A three-pronged approach is envisaged for the update of the 2008 SNA:

A. Undertaking technical research in prioritized and other national accounts issues and experimentation and testing of selected recommendations.

To address the issues a series of Guidance Notes are being developed. This list is based on the consolidated SNA research agenda and an initial list of issues considered for updating the 2008 SNA which was identified in July 2020.

A novel key feature within the research component of the update of the 2008 SNA work programme is the explicit inclusion of an experimental estimation / early implementation component for some recommendations in the guidance notes.

Dedicated task teams were established to undertake the technical research and draft guidance notes.

B. Engaging in a broad consultation on the issues related to the thematic areas.

The Broad Consultation component of the SNA update constitutes several rounds of interactions with various groups of stakeholders such as compilers, policymakers, academia, and the private sector. Among the instruments used to broadcast the update and collect feedback are online Global Consultations on the guidance notes and Outreach activities through global and regional webinars and forums.

C. Ensuring overall consistency with other statistical standards in the system of economic statistics.

For overlapping issues in the research agendas identified for the SNA, BPM, GFS, MFSM, SEEA, ISIC and CPC etc., the Task Teams were established consisting of subject matter experts from relevant Committees of Experts and other groups.

As of March 2022, of specific note is the historically close collaboration of the work on the update of the BPM6 and the 2008 SNA and the efforts to align the two standards, as well as the engagement of the Government Finance Statistics Community in the update programme.

List of Task Teams

- Digitalization Task Team
- Wellbeing and Sustainability Task Team
- Joint Globalization Task Team
- Joint Communication Task Team
- Joint Financial and Payment Systems Task Team
- Joint Informal Economy Task Team
- Joint Islamic Finance Task Team
- BPM Balance of Payments Task Team
- BPM Current Account Task Team
- BPM Direct Investment Task Team

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Changes in the capital account of the balance of payments regarding transactions in CO_2 emission allowances[1]

Grzegorz Dobroczek and Jacek Kocerka,
Narodowy Bank Polski

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Changes in the capital account of the balance of payments regarding transactions in CO_2 emission allowances

Grzegorz Dobroczek, Department of Statistics, Narodowy Bank Polski
Jacek Kocerka, Department of Statistics, Narodowy Bank Polski[1]

Abstract

The EU-ETS (European Union Emission Trading System) is a key EU instrument used to limit the amount of greenhouse gases released into the atmosphere. Trading CO_2 emission allowances has gained importance over the last few years due to the strong increase in the price of carbon allowances. On September 30, 2023, the Department of Statistics of the National Bank of Poland revised the data of the Polish balance of payments for the years 2013-2022 in the field of trade in CO_2 emission allowances classified in the capital account. Trading in allowances is cross-border, and the platform where auctions are held is the EEX (European Energy Exchange) in Leipzig. The article shows new data sources for the balance of payments, the method of recording emissions trade, and the impact on the size of data revisions. In addition, attention was paid to derivatives related to CO_2 emissions, which have also increased significantly recently. The article touches on classification issues, contributing to the current discussion on the shape of BPM7, and also addresses other challenges related to trading in CO_2 emission allowances.

Keywords: permits for emission, allowances, balance of payments, capital account

JEL classification: C82 (Methodology for Collecting, Estimating, and Organizing Macroeconomic Data; Data Access); F29 (International Factor Movements and International Business; Other)

Contents

1. Introduction 2
2. European Union Emission Trading System 2
3. Classification of allowances for emission in BPM6 7
4. Revision of the Polish balance of payments data due to CO2 emission allowances 8
5. Lessons learned 10
6. Practical recommendation about future classification of permits for emissions 10

[1] The views expressed in the article are those of authors and do not necessary reflect the views of the National Bank of Poland. Authors would like to thank the staff of Department of Statistics, especially Anna Szulim, Aleksandra Hałka, Marcin Sienicki for ideas, valuable discussions and comments.

1. Introduction

The increase in greenhouse gases emissions, particularly CO_2, poses a serious problem recognized by the international community. To mitigate global warming, the Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted in 1997. Under this protocol, individual countries committed to reducing CO_2 emissions. In the European Union, this commitment was implemented through the Climate and Energy Package, which aims to reduce greenhouse gas emissions, increase the share of renewable energy, and enhance energy efficiency. One of the tools to achieve these goals is the European Union Emissions Trading System (EU ETS), established in 2005. The assumptions of the system were outlined in Directive No. 2003/87/EC, which established a system for trading greenhouse gas emission allowances in the Community and amended Council Directive 96/61//EC11.

2. European Union Emission Trading System

The EU ETS is the largest emission trading system (ETS) globally, with approximately 90% of the value of allowances traded within the system compared to all other global ETS. It is the world's first international emissions trading system which include all EU countries as well as Norway, Liechtenstein and Island. The European Union Emission Trading System is based on the assumption that the environment, particularly the air, should be treated as a common good. Therefore, similar to any common good, there is a risk of its excessive use and negative externalities. The primary goal of the ETS is to reduce CO_2 emissions by internalizing their costs. To achieve this, the ETS system sets an upper limit for CO_2 emissions for the entire European economy (the cap). Entrepreneurs covered by the ETS receive some allowances for free, while the rest must be purchased at auction or on the secondary market. Proceeds from auctions contribute to the budget revenues of the Member States, with at least half of these funds allocated to activities aimed at reducing greenhouse gas emissions.

The system is designed to incentivize enterprises to reduce CO_2 emissions, with the first reductions coming from installations where it is least expensive to do so. Companies that reduce their emissions can either keep the saved allowances to cover their future needs or sell them on the market. Consequently, companies for which reducing CO_2 emissions is relatively simple and low-cost opt for the former strategy, while those for whom modernization is unprofitable or impossible must buy allowances at auctions or on the secondary market

The European Union Allowance (EUA) represents the amount equivalent to 1 tonne of CO_2 emitted during a technological process. This allowance serves as a virtual unit for accounting carbon dioxide emissions from stationary installations or aircraft operators. The operator of a stationary installation is required to have an operator holding account in the Union Registry, while the aircraft operator must have an aircraft operator holding account in the Union Registry. Entities obligated to surrender allowances for CO_2 emissions include cement plants, heating plants, coking plants, iron and steel works, chemical plants, pulp and paper industries, power plants generating energy from fossil fuels with a capacity of at least 20 MW,

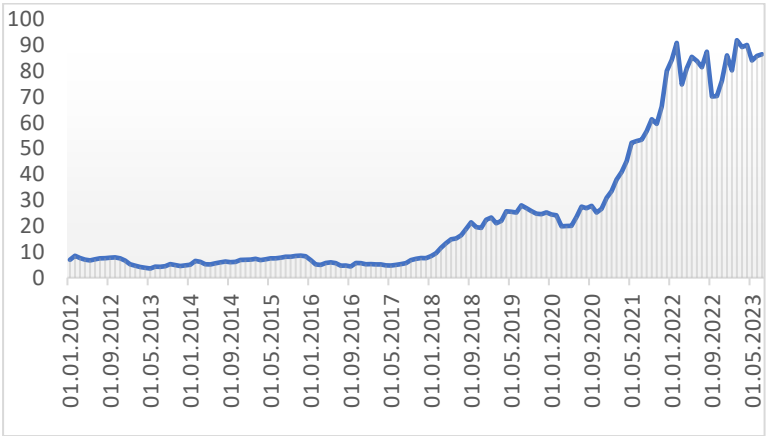
The final allocation of free allowances depends on various factors, with current practices primarily considering efficiency standards for certain installations or industries. Installations in the EU demonstrating the highest efficiency in CO_2 emissions are identified using benchmarks. Less efficient installations, despite requiring more permits, receive a free allocation limited to the benchmark set for them.

Sectors or products at risk of carbon leakage are provided with a 100% free allocation, based on benchmarking criteria. Conversely, electricity producers, capable of passing on emissions trading costs to consumers, are ineligible for free allocations.

Each year, companies are required to surrender enough permits to cover their total emissions for the previous year; failure to do so results in penalties. When a company reduces its emissions, it can retain additional allowances for future use or sell them to another entity in need. The remaining 55% of emissions originate from sectors not covered by the ETS system, known as non-ETS sectors (see the Effort Sharing Regulation). These sectors include households, waste, agriculture and transport (excluding air transport), which are challenging to control due to the high fragmentation of issuers.

Trading in CO_2 emission allowances has gained significant importance in recent years due to the strong increase in the price of carbon dioxide emission allowances. Until the end of 2017, the price for European Union Allowances was below 15 euros. In 2018, the price increased to around 25 euros, remaining at a similar level through the third quarter of 2020. Since then, there has been a rapid increase, resulting in the price exceeding three times its value in 2023, reaching around 80 euros per EUA. This increase was caused by several factors, including fundamental aspects such as the decreasing cap for EUAs each year. Speculation may have played a role, especially given the increase in uncertainty following the Covid-19 pandemic.

Figure 1. Price for 1 EUA on the secondary market in 2012-2023 (in euro).



Source: EEX

The introduction and development of the ETS system in the European Union occurred over four phases. Phase I (2005-2007), known as the pilot phase, focused on establishing infrastructure for monitoring emissions and trading allowances. However, oversupply led to a drastic drop in prices from EUR 20-30 in 2005 and 2006 to almost zero by 2007.

Phase II (2008-2012) adjusted allowances based on actual emissions data from Phase I. Despite efforts to address oversupply, prices remained low, around EUR 5, due to reduced emissions during the economic crisis.

Phase III (2013-2020) marked a significant departure, with a uniform EU-wide emission ceiling and reduced free allocations. While 52% of permits were issued free of charge, the remainder was purchased through auctions or the secondary market. Despite emissions reduction goals, prices remained relatively low until 2018, reaching approximately EUR 20. Due to the Covid-19 pandemic and the recession it caused, allowance prices did not increase significantly until the end of Phase III.

Phase IV (2021-2030) strengthens the ETS by further limiting allowances and reducing free allocations. The starting emission ceiling for 2021 was set at 1,572 million tonnes, with prices stabilizing around EUR 80-90/t by 2023.

Certificate management in the EU ETS

Operators of installations participating in the EU-ETS are required to have an account in the EU Registry for their installation in the European Emissions Trading System (EU-ETS), managed by the EU and intermediaries appointed by the operator. This facilitates monitoring the allocation of free allowances from the EU, surrendering of allowances, and transfer of incoming and outgoing allowances (purchase/sale) on the registry account.

The Union Registry aims to ensure accurate accounting of all allowances issued under the EU-ETS, enabling tracking of changes in owners of permits stored in electronic accounts, similar to how a bank records its clients and their account balances.

Regulated entities within the EU-ETS must surrender one EUA unit for each 1 tonne of CO_2 emitted in the following year. Surrender typically occurs by April 30 each year, though as of 2024, surrender will take place by September 30.

If fewer EUAs are submitted for surrender in a given year than CO_2 was emitted in the previous year, this will result in penalties. Each EUA certificate not presented for surrender by the end of April may incur a penalty, typically EUR 100 per certificate or per tonne of CO_2 emitted. However, enterprises are still obligated to submit the missing allowances for surrender despite the penalty. Allowances that can be voluntarily removed from the Registry account are not counted toward the refundable quantity.

In Poland, the National Centre for Emission Balancing and Management (Krajowy Ośrodek Bilansowania i Zarządzania Emisjami, KOBiZE) maintains a national database collecting data on greenhouse gas emissions and other substances. One of KOBiZE's primary tasks is to administer the European Union Emission Trading System (EU ETS) in Poland, including maintaining the Polish part of the EU emission allowance registry.

All European Union Allowances got ISIN codes, unfortunately these ISIN codes does not get possibility to distinguish which EU government issued that allowance and date of issuance.

Table 1 List of general EU-prefix ISINS for EUA

ISIN	Description
EU000A1RRN98	EU ALLOWANCE UNITS (EUA)
EU000A1RN5R34	EU Aviation Allowance Units (EUAA)
EU000A1PPRA6	EU ALLOWANCE UNITS (EUA) Period 3
EU000A2QMW50	EU ALLOWANCE UNITS (EUA) Period 4
EU000A2QMW68	EU Aviation Allowance Units (EUAA) Period 4

Source: European Commission

After EUA allowances are introduced to trading, they can be traded on the secondary market. Any entity, whether an individual or a company, that has opened an account in the EU Registry can buy and sell EUA, regardless of whether it is itself covered by the EU ETS. In particular, they may also be banks and other financial entities. Trading in the carbon market can take place directly between buyers and sellers or through exchanges and other intermediaries. Although all EUAs share the same properties and are therefore interchangeable, markets trade different EUA-related instruments that differ in terms of delivery time and settlement method. After EUA allowances are introduced to trading, they can be traded on the secondary market.

Trading in emission allowances

Each Member State receives a pool of emission allowances and, in principle, all these allowances should go to the stock exchange and be sold on the primary market. Auctions are organized by the EEX stock exchange, income is transferred to member states.

EEX is the main auction platform for EU countries. For Polish emission of EUA, separate auctions are held on EEX every two weeks (on Wednesdays). Similar but weekly (on Fridays) auctions for Germany government are held. For other the remaining 25 EU countries, auctions are held every Monday, Tuesday and Thursday.
Both London's ICE and Leipzig's EEX offer also derivatives (futures) on emission permits. These instruments are settled only by delivery of the underlying instrument. It can be called hybrid. Until the expiry date of a given series of futures, they are settled like typical futures, i.e. through daily financial settlements after the end of each trading session. However, holders of positions that remain open on the expiry date of the contracts are obliged - depending on the direction of their position (long/short) - to purchase or sell a specific number of emission permits at the price on the expiry date of the contracts. This method of settlement is rare in futures markets, where cash settlements predominate and there is usually no purchase or sale of the underlying instruments at the end of the contract.

In practice, the price on the expiry date of the contracts is very close to the price of emission permits on the spot market on a given day. This is possible, as with any type of futures, due to the possibility of arbitrage between the futures market and the cash market of the underlying instrument. The advantage of futures contracts,

apart from the ability to hedge against EUA price changes, is also, unlike auctions, a guarantee of purchasing or selling a predetermined number of allowances. The execution of transactions is guaranteed by clearing houses associated with stock exchanges, while in the case of auctions there is a risk of order reduction.
The following futures series are available at any time:

- annual, settled in December; nine (EEX) or seven (ICE) series settled in the current year and the coming years,
- quarterly, settled in March, June and September; eleven (EEX) or nine (ICE) series settled in the current and upcoming quarters, except for quarters ending years,
- monthly, settled at the end of each month, except for the months ending quarters; three series settled in the current and next months,
- daily, with a lifetime equal to one trading session.

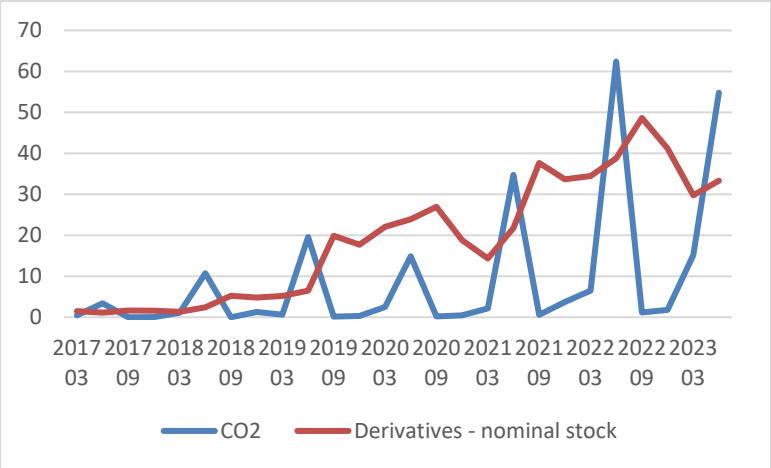
The most frequently traded futures contract on the CO_2 market is the December contract.

In addition to futures contracts, futures options are traded on the stock exchanges in London and Leipzig. They are settled on the expiry date by delivery of the underlying instrument - in this case, an appropriate number of futures for emission permits (of course, if the option holder decides to exercise them). Before the expiration date, options are settled similarly to futures, i.e. through daily financial settlements after the end of each trading session.

Derivatives for EUA

As it has been mentioned before, on certain markets there are possibilities to issue and trade with the use of financial derivatives CO_2 permits, either on regulated markets or OTC. Large international financial intermediaries are present on that market. Our experience shows that Polish enterprises quite often use derivatives for buying and selling CO_2 permits. Nominal value of derivatives is comparable with the value of CO_2 permits to be surrender in the near future. The value also shows seasonality – there is a decline of nominal value of derivatives before the period when permits will be surrender.
It has to be underlined moreover, that our analysis on CO_2 derivatives is limited due to some constrains of data sources used by the NBP to compile bop statistics. In the survey there is no possibility to distinguish between CO_2 permits and other type of commodities derivatives. We have decided to filter only those companies, that we think are involved in buying and selling CO_2 permits, however nominal value of derivatives should be treated as a proxy.

Figure 3. Derivatives vs surrendering of EUA in PLN billions



Source: NBP, KOBiZE

3. Classification of allowances for emission in BPM6

According to Balance of Payments par.13.14: *Emissions permits can be classified in the balance of payments in different ways, including the following:*

- *If a nonresident enterprise purchases an emission permit from a resident government, the payment is classified as a cross-border tax on production in most circumstances.[…]*
- *If the permit is tradable (*as European Union Allowances for emissions*), then it is an economic asset. A resale of this asset by resident to a nonresident enterprise is recorded under contracts, leases, and licenses in the capital account*[2].

During the process of classification of cross border trade of EUA it should be taken into account that allowance allow to emit one tonne of CO_2 equivalent during one year. The EUA are fully register in EU Registry and are transferable. Another crucial issue that should be taken into account is that EUA are tradable. There is primary and secondary market. EEX supports primary market, during the auctions companies could buy EUA. The secondary market is also supported by stock exchanges, but also OTC transactions are important.

The next issue it is that permits does not have a corresponding liability. According to BPM6 par. 5.8 nonfinancial assets do not have a corresponding liability. For example, emission permits and commodities may be traded on organized markets similar to those of traded financial assets, but do not have a corresponding liability.

Summing up based on BPM6 EUA should be classified as nonproduced nonfinancial assets.

[2] IMF (2009), "Balance of Payments and International Investment Position Manual – 6th edition"

4. Revision of the Polish balance of payments data due to CO_2 emission allowances

Before the revision, data on trading in CO_2 emission allowances was not fully included in the Polish Balance of Payments (BoP). Specifically, the BoP lacked information on revenues from the primary market for trading CO_2 emission allowances, which is facilitated by the EEX in Leipzig.

Previously data for trade on a on CO_2 emission allowances came from quarterly reports on the international trade of services DNU-K (component 481 - acquisition/disposal of non-produced and non-financial assets). These data concern revenues and expenses from trading in allowances. The DNU-K reports do not clearly indicate what part of nonproduced and nonfinancial assets relates to the purchase/sale of CO_2 emission allowances. Additionally, the form reports entities that meet certain reporting thresholds regarding revenues from providing services abroad or expenses from purchasing services abroad. The threshold caused that there was the coverage for that transactions could be questionable.

The way of recognizing EUA trade according to the new method

Data on allowances coming to the Polish part of the registry and leaving the Polish registry were obtained from KOBIZE. The requests were divided into: geographical structure (country of registry), number of units and period. According to the new method of recognizing transactions related to trading in CO_2 emission allowances, it is assumed that each transfer of allowances from the Polish registry to a foreign one or from a foreign registry to the Polish one is a sale or purchase of permits. Revenues include revenues from the primary market (revenues from Polish auctions on the EEX) and the secondary market (the number of allowances flowing from the Polish registry to foreign registries multiplied by the spot price from the secondary market). It was assumed that all Polish allowances are sold on the Leipzig stock exchange only to foreign entities. Outflows are the number of allowances transferred from foreign parts of the registry to the Polish registry, multiplied by the price of allowances from the secondary market. The price used to calculate revenues and expenses from the secondary market applies to trading on the secondary market on the European Energy Exchange and is a spot price.

According to the new method, starting from 2021 Poland is net importer of EUA. In 2022, Polish companies bought EUA for almost 50 billions of zlotys. At the same year Polish government sold EUA on primary market for 22 billions of PLN and on secondary market Polish companies sold EUA for around 8 billons of PLN.

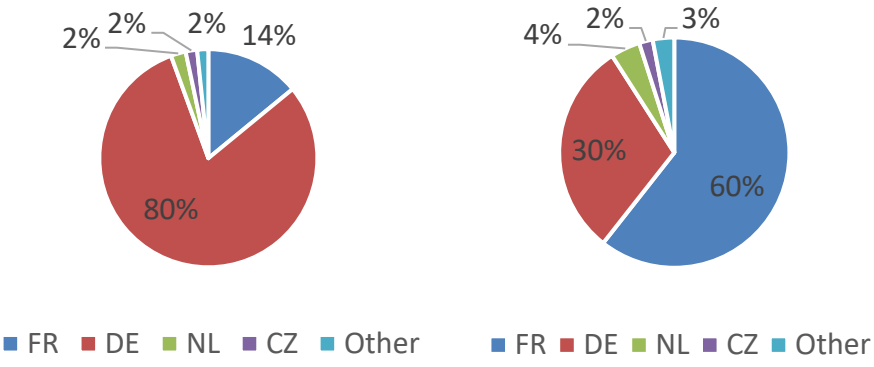
Figure 4. Trade of EU allowances in BoP in PLN billions



Source: NBP

Based on new method it could be noticed that most of Polish income form selling EU allowances from abroad come from Germany, in 2022 it was around 80%. Most of that income come from primary income, only part is from secondary market (when Polish companies sell EUA to German companies). In debits almost 60% of EUA are bought from French companies, Germany took second position with 30% of debits.

Figure 5. Geographical structure for credits (on left) and debits in EUA trade in 2022



Source: NBP

Changing the data source results in an adjustment to the capital account balance, but does not affect the current account balance. The scale of revision of revenues and expenditures in the capital account from 2013 to 2018 is the same and has an insignificant impact on the balance. Since 2019, revenues have been revised more strongly than expenses, which results in an increase in the balance. The increase in the balance in 2022, as a result of the change in methodology, amounted to PLN 5.9 billion, which results from a large adjustment in revenues from trading in CO_2 emission allowances (an increase of PLN 27 billion) and a large adjustment in expenses (an increase of PLN 21 billion). In 2022, the capital account balance amounted to PLN 15.2 billion.

5. Lessons learned

There is a market for EU allowances with buyers and sellers and a market price. In the European case the allowances are indistinguishable between countries and date of issuance. There is a derivatives market for CO_2 allowances. Both markets are important from macroeconomic perspective, and required attention from macroeconomic statisticians. Moreover it is expected that both markets will grow in the foreseeable future. The cross border activity is crucial for EUA and derivatives for them. It cannot be limited only to resident – resident transactions. As the unification of statistics is one of the objectives for updating the manuals, the common treatment of CO_2 allowances is necessary.

In our view the treatment of Emission Trading Scheme should be easy to adopt and consistent with accounting framework of enterprises.

The method of reporting the allowances should easily give the use an information on: what is the cost for the economy to buy the essential permits for production, as well as what is the revenue for the government resulted from sell the allowances. It is important to note that the cost for nonfinancial enterprises is different from the revenue for government due to the following factors: (i) some of permits are granted free of charge; (ii) there are price changes during the life of CO_2 allowances and financial intermediaries are involved in this trade, (iii) there is a net imports of allowances.

6. Practical recommendation about future classification of permits for emissions

a) From balance of payments point of view the simplest solution is to do not implement any change to BPM6 recommendations. EU Registry for allowances support information to regular and on time produce statistical data with proper quality. Based registers from each EU country we could get information about inflow and outflow of EUA and knowing country of registers we could produce geographical breakdown.

   In such concept the moment of surrender could be classified as resident - resident transaction and it will not be included in bop. Unfortunately that simplification requires that income of governments from auctions will, with no delay, influence on budget deficit.

b) Thinking about transactions about permits for emissions we should take into account the moment of transactions when they are sold on primary market and when they are surrendered.

   That moment of surrendering of allowances is crucial from National Account perspective. It reflects moment of paying of taxes due to production.

So thinking about allowances we should take into account that double nature of that issue:

- The moment of issuance of allowances on primary market and tradable on secondary market (either on stock exchange or OTC).
- And the moment when allowances are surrendered.

In that context second best solution for balance of payments compilers in EU will be:

- recognize allowance as nonproduce nonfinancial assets (only for secondary market)
- recognize government income from issuing allowances on primary market – as pre payment of taxes – liability of government foreign companies (usually that assumption is truth because primary market is highly concentrated with dominance of financial intermediaries)
- in the moment of surrendering we will have to make recalculations via other changes – it will not influence bop, but International Investment Position only. From foreign government liabilities we will deduct value of surrendered allowances (for simplification on issuance value, some additional revaluation in NA for companies will be needed). The taxes will be recognizes as resident vs resident transaction.

c) If allowances during its tradable period of life would be recognized as financial instrument another problems would be met. As we present in our article allowance do not have corresponding liability, so they should not be recognized as financial instrument according to BPM6. But bookkeeping perspective the picture is much more complicated. Some companies classified allowances as intangible assets, some as financial instruments (In accordance with the EU MIFIR regulation, CO_2 emission allowances are treated as financial instruments.). Based on analysis of few balances of Polish enterprises we find that companies have intention to surrender allowances classified them as intangible assets, financial intermediaries (companies which do not have intention to surrender allowances) classified them as financial instruments. But that analysis was done on only few companies and it could not be treated as representative, rather as suggestion.
If allowances will be recognized as financial instrument BoP and NA compilers will face a lot of new difficulties. Government issuing financial instrument on foreign market will know that stock exchange second site of transaction. But government will not have information that transactions of his instrument on secondary market. On the other hand enterprises which bought EUA will not have knowledge which EU government issued that instrument, we will have no possibility to make proper geography breakdown or even we will have not information whether e.g. Polish company bought financial instrument issued by Polish government. From practical reasons it will be impossible to record these transactions. That conception will be only feasible if another simplification will be made that not EU governments, but EU Commission is issuing allowances.

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NARODOWY BANK POLSKI

Challenges in compiling CO2 emission allowances in the bop statistics in Poland

Jacek Kocerka, Grzegorz Dobroczek (Narodowy Bank Polski)

Madrid, 13th February 2024



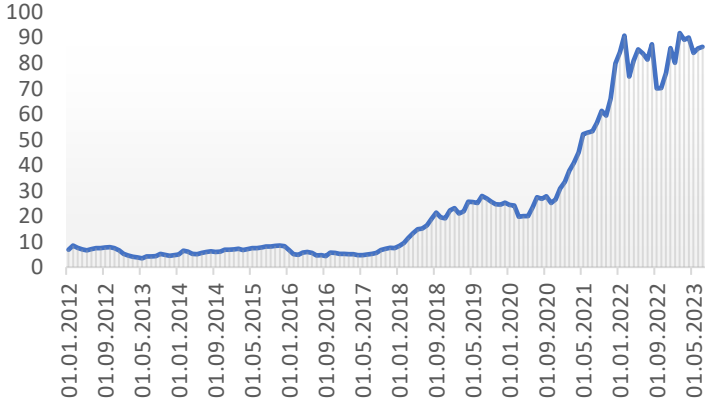
Outline:

- Emission Trading System
- Current BoP classification
- Data sources
- Results
- Lessons learned

Emission Trading System – key issues (1)

- EU Emissions Trading System (EU ETS) sets an overall limit (the „cap”) on the greenhouse gas emissions.
- Cap decreases each year. Companies are either given ot buy allowances whithin the cap.
- European Union Allowance (EUA) is a tradable unit which entitle an installation to emit 1 tonne of carbon dioxide equivalent during one year.
- By 30 September each year installations must surrender EUA to cover each unit of emissions from the previous year.
- Primary market- EU governments sell permits at auctions organized by EEX. There is secondary market supported by stock exchanges but also OTC.
- Most of the trading on the secondary market takes place through derivatives (EEX, ICE).

Price for 1 EUA on EEX in euro



In 2022, the price was more than 8 times higher than in 2016.

Emission Trading System – key issues (2)

- EUA cannot by linked to a specific issuing country or to even an issue date.
- Every EU permit issued maybe surrendered in any EU country (e.g. permit issued by Germany in 2017 may be surrendered by Polish company in Poland in 2024.
- BOP perspective - trade in emission allowances between residents and non-residents (accounting for changes in economic ownership).
- National Accounts focus mainly on issuance of emission allowances by government and surrender of allowances by resident companies.

List of general EU-prefix ISINs:

ISIN	Description
EU000A1RRN98	EU ALLOWANCE UNITS (EUA)
EU000A1N5R34	European Union Aviation Allowance (EUAA)
EU000A1RRPA6	EU Allowance Units Periode 3
EU000A2QMW50	EUA Allowance Units Periode 4
EU000A2QMW68	EUAA Allowance Units Periode 4

Current BoP classification of emissions permits

- Allowance entitles the holder to do a certain activity: to "emit 1 tonne of carbon dioxide equivalent during a specified period“
- Allowance does not grant property rights
- Allowance is registered and transferable
- Allowance is tradeable
- Allowance does not have a corresponding liability

Allowances should be classified in

nonproduced nonfinancial

assets

Based on IMF BPM6, nonproduced nonfinancial assets include:

Contracts, leases and licences – marketable operating leases, permissions to use natural resources, permisions to undertake specific activities, entitelmant to future goods on an exclusive basis.

Trade on emission permits: data sources (1)

- The National Centre for Emissions Management (KOBiZE)
  - One of the basic obligations of KOBiZE is to manage and administer the Polish part of the EU ETS in Poland, including operation of Polish part of the Union Registry.
  - KOBiZE operates the National Database, where data on emissions of greenhouse gases (GHG) and other substances is collected. The Database is a constantly improved tool offering unique information on emission sources, their spatial location and detailed data on operation of every installation covered by the reporting system. It also enables acquiring precise information based on real data, which is submitted by the entities in the process of annual reporting.
- European Energy Exchange (EEX) – common auction platform

Trade on emission permits: data sources (2)

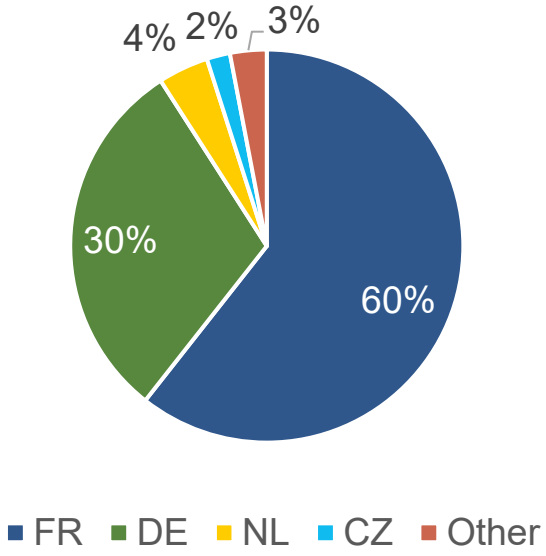
- EEX
  - Number of permits sold by Polish government
  - Price of permits on Polish auctions
  - Average price of permits on secondary market
- The National Centre for Emissions Management (KOBiZE)
  - Inflow of permits to the Polish register from abroad (including geographical breakdown)
  - Outflow of permits from the Polish register abroad (including geographical breakdown)
  - But also
    - Number of permits surrendered
    - Number of permits granted free of charge by Polish government to Polish enterprises
    - Number of permits held by Polish enterprises

Results

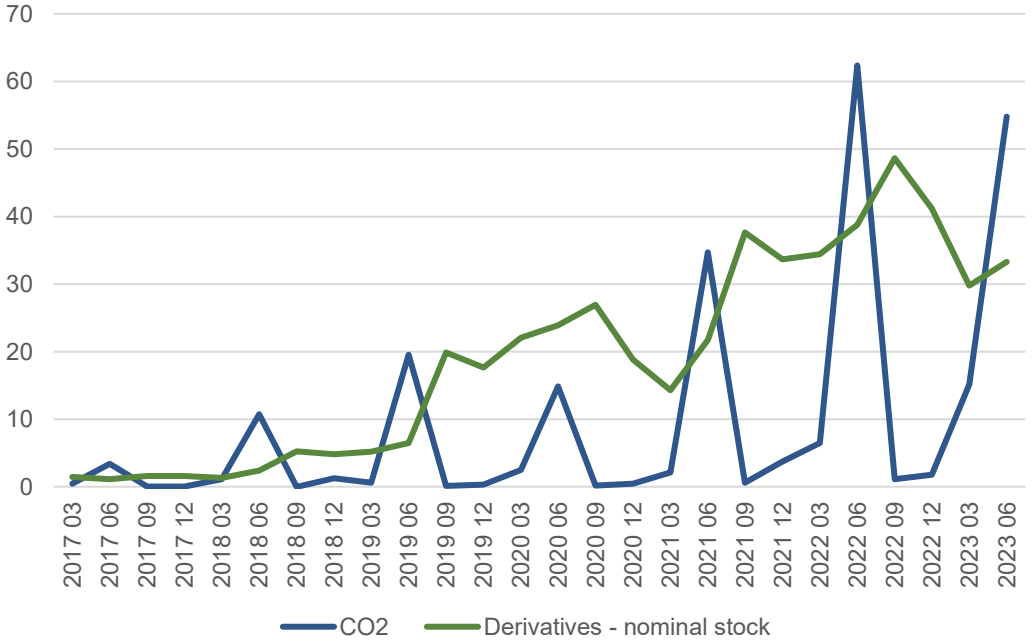
Trade of EU allowances in BoP in PLN billions



Geographical structure for debits in 2022



Derivatives vs surrendering of EUA in PLN billions



- Value of permission rights surrounded – seasonality (to be changed in the future)
- Increasing nominal value of derivatives for CO_2 emission permits

Lessons learned (1)

1. There is a market for EU allowances with buyers and sellers and a market price. In the European case the allowances are indistinguishable between countries and date of issuance.
2. There is a derivatives market for CO_2 allowances.
3. Both markets are important from macroeconomic perspective. It is expected that both markets will grow in the foreseeable future.
4. The cross border activity is crucial for EUA and derivatives for them. It cannot be limited only to resident – resident transactions.

Lessons learned (2)

5. The treatment of Emission Trading Scheme should be easy to adopt and consistent with accounting framework of enterprises.

6. The method of reporting the allowances should easily give the use an information on: what is the cost for the economy to buy the essential permits for production, as well as what is the revenue for the government resulted from sell the allowances. It is important to note that the cost for nonfinancial enterprises is different from the revenue for government due to the following factors: (i) some of permits are granted free of charge; (ii) there are price changes during the life of CO_2 allowances and financial intermediaries are involved in this kind of trade, (iii) there is a net imports of allowances.


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IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

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Compiling external statistics in Egypt: challenges and way forward[1]

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Central Bank of Egypt

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Compiling External Statistics in Egypt:

Challenges and Way forward

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Central Bank of Egypt

Abstract

This paper sheds light on the challenges faced by statistical compilers with regard to data collection, compilation, and dissemination of external statistics. We address country-specific experience – the Egyptian Case. This paper provides details on the current methods used to compile External Sector Statistics (ESS) in Egypt, presenting the main challenges faced and suggesting possible way forwards to overcome such challenges. The paper tackles the standard Components of the Balance of Payment (BOP) as its main aim is to take a critical look at some of the issues in compilation and analysis with the intention of developing new efficient estimation techniques. The demand for precise, comprehensive, and timely external sector data has increased to account for times of high economic uncertainty especially since the Covid-19 pandemic had a huge impact on external statistics. The paper will suggest several way forwards and possible initiatives to produce high quality reliable data where statistical sources such as: surveys, micro and macro data are blended and used to complement the traditional sources of data.

Key words: External Statistics, Balance of Payments, Compilation

[1] The views expressed in this paper are those of the authors and do not necessarily represent the views of the CBE

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List of abbreviations:

BOP: Balance of Payment

CAPMAS: Central Agency for Public Mobilization and Statistics

CBE: Central Bank of Egypt

FRA: Financial Regulatory Authority

GAFI: General Authority for Investment & Free Zones

Introduction:

The pandemic and, more recently, geopolitical conflicts, among which is the Russian-Ukrainian war, posed significant challenges to the compilation and dissemination of external statistics, necessitating, among other things, the creation of new, more effective estimation techniques and dissemination channels during periods of high economic uncertainty.

Reliable statistics are of major importance for evidence-based policymaking. The Central Bank of Egypt (CBE) is responsible for the compilation of the external sector statistics (ESS) in Egypt, as they play a major role as key economic indicators and determinants for policy formulation, providing an overview and comprehensive information on a country's economic relationships with the rest of the world.

However, reliance on regular sources of data for compiling ESS became challenging, particularly after the outbreak of the COVID-19 pandemic. The CBE concluded that traditional methods of compilation have significant limitations as the pandemic's emergence underlined the need for reliable alternative external sector data sources to ensure continuity in the production of ESS even during times of high economic uncertainty. The sudden stop in the economic activity impacted the main data sources used to compile ESS, which shed light on several challenges that were exacerbated by the pandemic, such challenges include delays in processing and compiling of data, lack of coordination between regulatory authorities, in addition to the impacts on the level of detail and quality of external sector data.

This paper sheds light on the challenges faced by statistical compilers with regard to data collection, compilation, and dissemination of external statistics. We address country-specific experience – the Egyptian Case. The paper will tackle the compilation practices in Egypt and will mainly focus on the data sources of ESS, the current status of compiling external statistics, the challenges facing the compilation and dissemination process, along with several way forwards and possible initiatives to produce reliable data to overcome current challenges.

Compilation Practices in Egypt:

Data sources of ESS

The compilation of ESS in Egypt is managed mainly by the central bank, with the cooperation of other institutions **as shown in Table 1**. In Egypt, data related to the trade balance in the current account, such as the proceeds and payments of general merchandise exports and imports, are reported by banks, while petroleum exports and imports are reported by the Ministry of Petroleum. Data concerning the service balance in terms of the travel item is mainly based on a survey conducted in collaboration between Central Agency for Public Mobilization and Statistics (CAPMAS) and the Ministry of Tourism, and data concerning the transportation item is mainly extracted from ITRS. Moreover, data concerning official transfers is mainly derived from foreign exchange records as well as the Ministry of International Cooperation, while data concerning private transfers, of which workers' remittances, is derived from foreign exchange records in addition to the Banking Supervision Sector at the CBE; however, a fixed percentage (20%) of informal remittances is estimated using a survey conducted by CAPMAS. The CBE derives data for the financial account mainly from foreign exchange records, Financial Regulatory Authority (FRA), and General Authority for Investment & Free Zones (GAFI). Finally, the CBE derives data for the capital account from foreign exchange records.

Table (1): Data sources of ESS in Egypt

BOP Components	Data source
BOP	The Fifth Edition of the BOP Manual (BPM5)
Trade Balance Exports & imports (petroleum and other)	Banks and Ministry of Petroleum
Services Balance Transportation 2)Travel 3) Government Other services: 4) Insurance	ITRS 2)Survey collaborated by Ministry of Tourism and CAPMAS 3) Foreign exchange records 4) Foreign exchange records 5) Foreign exchange records

5) Other business services (communication services, Royalties and license fees, computer services, subscription to magazines, newspapers, Insurance services, others)	
Current transfers: Official transfers Private transfers (of which worker's remittances)	Foreign exchange records and Ministry of International Cooperation. Foreign exchange records, the Banking Supervision Sector at the CBE, while the informal transfers are estimated by a survey conducted by CAPMAS
Capital Account	Foreign Exchange Records
Financial Account 1)Direct Investment abroad 2)Direct Investment in Egypt 3) Portfolio Investment abroad 4) Portfolio Investment in Egypt 5) Other Investment and Reserve Assets	1)Foreign Exchange Records 2) Foreign Exchange Records, Ministry of Petroleum, GAFI and FRA. 3) Foreign exchange records 4) FRA, CBE External Debt Statistics Department & Department for Securities. 5) CBE External Debt Statistics Department, Banking Supervision Department, Ministry of Petroleum, CBE Accounting Department & Foreign Exchange Records.

Source: SDDS-Economic Research-Central Bank of Egypt

ESS Compilation Current Status in Egypt:

The CBE collects and analyzes the monetary, banking and financial data, information and statistics, and solely prepares and publishes the BOP data by virtue of Law No. 194 for the year 2020 regarding the Central Bank and the Banking Sector. The compilation of Egypt's BOP statistics, concepts and definitions follows the BOP Manual 5th edition issued by the IMF. This section reveals the current status of CBE's methodology of compiling the BOP data as follows:

First: Current Account Components:

Trade balance:

- **Goods:**

In Egypt, data on goods transactions are accounted for in the BOP such that entries for general merchandise exports f.o.b. cover proceeds of exported goods and are adjusted to include petroleum exports. While entries for general merchandise imports c.i.f. cover payments for imported goods and are adjusted to include imports financed by foreign in-kind loans and grants, in addition to petroleum imports excluding purchases of bunker fuel by Egyptian ships and aircraft abroad; such imports are adjusted on a f.o.b. basis by deducting freight and insurance at an estimated rate of 12.5 percent of the c.i.f. value (i.e., 2.5 percent for insurance and 10 percent for freight). Accordingly, Credit entries for goods procured at ports by carriers cover sales of bunker fuel to foreign ships and aircraft, whereas debit entries cover purchases of bunker fuel by Egyptian ships and aircraft abroad.

Services balance

- **Transportation:**

The compilation of the credit entries for the transportation item in the BOP covers amounts received by Egyptian shipping and airline companies for navigation and passenger services. Other transportation covers receipts of Suez Canal dues and receipts of the Sumed Oil Pipeline (Suez Mediterranean Pipeline) for transporting foreign companies' oil. As for the debit entries, they cover amounts transferred to foreign navigation and airline companies for freight and passenger services, repairs of aircrafts & ships and rental of planes from abroad, as well as payments for freight adjusted by adding 10 percent (the value of payments, on c.i.f. basis).

- **Travel:**

As for the compilation of the Travel item in the BOP, the credit entries are based on multiplying the number of nights spent by tourists in Egypt and the average expenditure per night based on a survey conducted in collaboration between CAPMAS and the Ministry of Tourism. However, separate details are not available for business and personal travel. On the other hand, debit entries cover expenditures of government officials and private employees traveling abroad, pilgrimage, expenditures of students studying abroad, training, technical and educational missions, and expenditures abroad for medical care.

Investment Income balance

Current transfers:

- **Net Unrequited Current Transfers:**

The Compilation of Net Unrequited Current Transfers depends on whether these transfers are official, private transfer or other transfers. First, **Official Transfers** data are collected so that credit entries cover grants and donations received in cash and in kind by the Egyptian government, the entries also include receipts for social security contributions. Conversely, debit entries cover contributions to international organizations for administrative and budgetary expenditures, and

grants and donations paid by the Egyptian government. Second, **Private Transfers, particularly Workers Remittances,** are compiled so that credit entries cover remittances received from Egyptians working abroad in addition to 20 percent representing the transfers through informal channels, estimated by the Egypt Household International Migration Survey (Egypt-HIMS) conducted by the CAPMAS. Whereas debit entries cover remittances abroad by foreign workers in Egypt. Third, other transfers data (for credit entries) cover grants and donations received from charitable and religious organizations and transfers recorded as pensions to residents, while debit entries cover pensions paid to non-residents by Egyptian insurance companies, as well as grants, donations and gifts given by Egyptian residents to charitable and religious organizations abroad.

Second: Capital and Financial Account Components:

- **Capital Account:**

The capital account (on a net basis) is broken down into: capital transfers (including the transfer of ownership of fixed assets or debt forgiveness), and acquisition or disposal of non-produced nonfinancial assets (land, subsoil assets, patents, copyrights, trademarks and franchises).

- **Portfolio Investment:**

Entries for portfolio investment abroad cover net amounts transferred abroad by residents for the purchase of foreign securities (which cover interest and dividends earned on bonds and securities). Portfolio investment in Egypt covers net transactions in foreign currencies (sales and purchases) of Egyptian securities (less than 10%) by nonresidents.

- **Foreign Direct Investment (FDI):**

Entries for direct investment abroad cover net amounts remitted abroad for investment and purchases of real estates and loans provided to Egyptian companies branches abroad, while entries for direct investment in Egypt cover cash inflows, net outflows, as recorded in the capital and operation accounts of the joint venture companies operating in Egypt, loans from mother company as well as remittances received for the purchase of real estate in Egypt by nonresidents. Data are drawn from the foreign exchange records. The entries for direct investment in Egypt also covers direct investment in petroleum sector (inflows) net outflows according to the data of the Ministry of Petroleum, reinvested earnings for direct investment in Egypt provided by the GAFI (which updated the data in accordance with a new method for compiling FDI and its earnings to include all undistributed realized earnings, according to Law No. (141/2019) that was passed in July 31, 2019 and Clause No. (14) of Article No. (74) of the Investment Law No. (72) for 2017..The new method allows GAFI to request information and data needed to calculate flows and stocks of direct and indirect foreign investments, starting from Q1 2018/2019). The entries also include data of foreigners' purchases of Egyptian securities (that are equal or greater than10%) according to the (FRA).

Challenges facing the compilation of ESS in Egypt

ESS concerns and challenges are constantly evolving, particularly post COVID-19 pandemic, reflecting new data sources in compiling and disseminating external statistics. This section provides detailed challenges that face Egypt in compiling ESS as follows:

First: Goods;

- **Digital products:**

- In recent years, e-commerce has flourished in Egypt as a result of the outbreak of COVID-19 pandemic which forced social isolation. The e-commerce market size reached USD 7.88 billion in 2023[2]. This has accelerated the process of strengthening the digital transformation and created challenges for accurately measuring cross-border e-commerce involving goods, related to high-frequency and low-value transactions.
- Overseas e-commerce should technically be captured in the BOP statistics as either a good or a service an import or an export. However, digital products purchased over the Internet are intangible and often not declared to customs. Shipments below a certain amount may also not be captured in trade statistics.
- Data on cross border e-commerce is poorly collected in Egypt and isn't clearly classified in BOP statistics. Challenges[3] in measuring international e-commerce transactions, in particular those undertaken by the households are: (1) these are usually small-scale transactions that may not be captured via ITRS; (2) settlement payments may be on a net basis (possibly via a clearing house) or nontraditional payment systems—payment card network—may be used; (3) households surveys may not properly capture these transactions; (4) shipment of goods may be made via postal and courier services; and (5) it is difficult to estimate the fees associated with transactions intermediated by trade e-platforms, such as eBay or Amazon. In principle, charges for electronically delivered products are included in services, while goods ordered by electronic means and supplied across the border are generally classified as goods.

- **Data accuracy:**

- There is discrepancy between data of exports and imports collected from bank records (by the CBE for compiling BOP data) and data collected by the Customs authority. This dissimilarity in data sources could lead to some discrepancies in definition of trade, trade partners and in the valuation of goods traded between countries concerned.

[2] https://www.mordorintelligence.com/industry-reports/egypt-ecommerce-market

[3] https://www.imf.org/external/pubs/ft/bop/2014/pdf/guide.pdf

Second: FDI:

- **Data Accessibility:**

The division of duties for compilation and dissemination between different agencies, which are the FDI Unit (FDIU) of GAFI and CBE, presents several challenges for the quality of the FDI statistics in Egypt.

- **Data accuracy:**

- Not all of the components of the FDI statistical series, released by the CBE, are published. FDI inflows include the two major components of FDI: equity and reinvestment of earnings and debt, but only reinvestment of earnings is included in the former category. Income receipts cover only dividends from abroad while income payments should cover dividends, reinvested earnings for sectors other than petroleum, as well as interest from the petroleum sector.
- Direct investment relationships identification problem: because the ownership structures of multinational enterprises (MNEs) can be quite complicated, it can be difficult to make sure that all of the entities under the influence of a common direct investor are identified. In Egypt, Major investors use different methods for identifying direct investment relationships, for example, the United Kingdom uses the FDIR (Framework for Direct Investment Relationships); the United States use the Participation Multiplication Method (PMM); Italy uses a simplified Direct Influence/Indirect Control (DIIC) method.
- Outward FDI statistics which are disseminated by the CBE as part of BOP and IIP statistics do not separately identify debt, while inward statistics cover loans from foreign investors to their Egyptian affiliates but appear to mix them with equity capital.
- Most, if not all, of the financial transactions of SPEs[4] (which are funds that are simply passing into and out of an economy on its way to other destinations, which are also called pass-through capital or capital-in transit) distort the country patterns of FDI statistics and cause double-counting in the statistics. While the funds that pass through SPEs do not have much impact on the economy in which they are resident, BPM6 points out that it is important to cover them in the BOP and IIP accounts because (1) they are an integral part of a direct investor's financial transactions with affiliated enterprises; (2) the exclusion of these funds from direct investment would distort and understate direct investment financial flows at the aggregate level; and (3) the inclusions of these data in direct investment promotes symmetry and consistency among economies" (BPM6, paragraph 6.34). This would result in accurate measures of direct investment into and out of the economy by removing FDI that involves funds simply passing through the economy via SPEs on their way to other destinations, which have little or no impact on the host economy.
    - Although GAFI indicated that SPEs are present in Egypt, and the new system developed by GAFI allows for the identification of SPEs; however, information related to SPEs in Egypt is not yet separately available nor published.

[4] Special Purpose Entities (SPEs) are entities whose role is to facilitate the internal financing of the MNE but that have little or no physical presence in any economy. As such, it can be difficult to identify the residency of SPEs

Third: Net Unrequited Current Transfers:

The are several challenges facing the compilation of remittances such as:

- **Estimation of informal remittances:**
  Remittances are a challenge to measure because there are many ways for individuals to send and receive money in numerous small transactions through various channels. Estimates of informal remittances in Egypt currently depend on a fixed percentage of 20% estimated based on Egypt Household International Migration Survey (HIMS)[5] conducted by CAPMAS representing transfers through informal channels. The latest HIMS was published in 2013, and was conducted then against a background of a lack of detailed data on the determinants and consequences of international migration in Egypt. Consequently, the percentage of 20% might not reflect current figures of informal remittances especially since the percentage is not being updated on a regular basis.
- **Identifying transaction channels:** Transaction channels are wide and varied, and accounting for all the various channels is extremely difficult, especially the informal sources through which remittances are sent.
- **Comparison of Remittances Data with other countries:** Egypt is still currently depending on BPM5 to compile its BOP statistics and carry out its analysis, while other countries have fully migrated to BPM6, which makes it extremely hard to compare remittances data across countries. This problem will be further accentuated with counties migrating to BPM7 when Egypt hasn't even fully migrated to BPM6 yet.

[5] The survey was carried out as part of the 'Mediterranean Household International Migration Survey' Programme (MED-HIMS), which is a joint initiative of the European Commission /Eurostat, ILO, IOM, LAS, UNFPA, UNHCR, and the World Bank, in collaboration with the National Statistical Offices of the Arab Countries in the southern and eastern Mediterranean region.

Moving forward:

This paper presents the techniques used by Egypt to tackle the aforementioned challenges and make progress in enhancing the external statistics compilation framework in Egypt. The paper will suggest several ways forward and possible initiatives to produce high-quality, reliable external sector data where statistical sources such as micro and macro data are blended and used to complement the traditional administrative sources of data, as follows:

1) Regarding meeting the international guidelines in compiling data:

The CBE is in the final stages of migrating to the 6th edition of the BOP Manual issued by the IMF (BPM6).

2) Regarding enhancing private transfers (worker's remittances):

- The CBE is planning to further enhance the usage of ITRS depending on the direct approach of reporting, as direct reporters have greater knowledge of their transactions and are able to convey more accurate information.

- The CBE is also planning to further collect transactional-level data through ITRS enabling in-depth analysis of remittance data. The quality control will be designed to ensure the robustness of the statistics based on bank settlements, taking advantage of the fact that banks will continue to report information on international settlements on an operation-by-operation, client-by-client basis, where each SWIFT message, incoming and outgoing, is captured by the central bank's statistical system and aggregated for BOP compilation for analytical purposes to better measure the origin, destination, currency, sex, volume, and value; hence, resulting in a micro database for each settlement to enhance the compilation of private transfers.

- The CBE is planning to reach out for technical assistance in conducting a remittances survey in collaboration with other concerned authorities as an additional step in the CBE's initiatives of obtaining population-based estimates and collecting valuable information to improve the quality of remittance statistics. (Sample questions from the suggested survey can be found in the appendix of the study.)

- Several initiatives were taken under the supervision of the CBE to make access to financial services easier, safer, and less expensive with their main aim being the formalization of remittance flows and encouraging the switch from informal to formal channels. For instance, several service providers in Egypt either launched or are in their final stages of launching an international money remittance service, such as InstaPay, Fawry, and Orange as follows:

- InstaPay[6]:

The CBE is in advanced negotiations with the central banks of Saudi Arabia, the United Arab Emirates, and Jordan to allow financial transfers to customer accounts instantly in Egypt using mobile phones via the "InstaPay" application, starting 2024.

A memorandum of understanding has already been signed with both the central banks of the UAE and Jordan, and the CBE is now negotiating with the Saudi Central Bank to reach a final agreement. The agreement includes allowing financial transfers from banks operating in the three countries, which are the densest in terms of the number of Egyptian workers abroad, to bank accounts in Egypt using the application, where an electronic link will be made with the banks of those countries and entered into the electronic system of the application.

The CBE is studying the viability of adding new features to the application allowing for the collection of detailed data on remittances received or sent abroad. The new features will allow capturing of in-depth information about the transaction with the objective of presenting more granular data in an attempt to improve remittances statistics.

- Fawry[7]:

Fawry is currently in negotiations with Banque Du Caire and Abu Dhabi Islamic Bank to create a digital mechanism for transferring the money of Egyptian workers abroad and disbursing it through the Fawry network, which includes more than 90% of Egypt-based banks. The system is expected to be completed by the end of 2023. The company is putting the final touches on providing the money transfer system for workers abroad in a number of Arab countries, most notably the UAE, as Fawry signed a memorandum of understanding with the "Botim" application, affiliated with the UAE company Astra Tech, and is also in the process of signing similar agreements with other companies in the UAE market. Parallel to the UAE, the company is anticipated to enter a second Gulf country and another in the Arab Levant.

- Orange[8]:

Orange launched an international money remittance service on its digital service Orange cash wallet under the supervision of the CBE, where the service allows the customer to receive any international transfer in the same day free of charge. The customer can receive their international money

[6] InstaPay is an application with more than 6.2 million users that allows bank customers in Egypt direct access to their local bank accounts, allowing them to transfer money instantly using their mobile device.

[7] Fawry represents the first banking agent to obtain a license from the CBE to provide banking and financial services to individuals and companies and is the largest financial technology and electronic payments company in Egypt, serving an estimated customer base of 50 million users.

[8] Orange is one of the world's leading telecommunications operators and is present in 26 countries with a total customer base of 288 million customers worldwide.

remittance in EGP on their Orange cash wallet, and this is available through National Bank of Egypt agencies around the world, customers are also able to cash in and out through ATMs.

3) Regarding measuring digital goods:

To enhance the data on the current account of the BOP, Egypt is looking forward to including cross-border transactions of digital goods and services by households and businesses, through applying the following measurements:

- **Measuring cross-border merchandise E-commerce using customs data**:
  Egypt is studying the implication of applying the clearance system named **Cross-border E-commerce Information System (CBEIS)** to capture e-commerce transactions (following the Chinese experience). The Customs authority is studying the introduction of a new customs procedure to identify cross border e-commerce transactions through a new code. For this code to be applied, enterprises or their agents must consolidate their declarations in terms of value and quantity by exporter, mode of transport, country of consignment, country of last-known destination, commodity code and port of export.

- **Using pilot survey for Goods cleared as mail parcels and courier deliveries**:
  For Goods cleared as mail parcels and courier deliveries rather than through CBEIS, **the Egyptian Customs Authority and the Egypt Post in collaboration with the Ministry of Commerce and CAPMAS are contemplating the possibility of carrying out a pilot survey,** targeting enterprises heavily involved in digital trade **using sampling methods to determine the proportion of e-commerce postal parcels.** The statistical value will be derived by multiplying the average price indicated on the parcels by the number of parcels, thus minimizing the impact of price outliers caused by declaration error. Finally, the Egyptian Customs Authority will compile statistics on digital trade in goods by combining customs records and survey information.

- **Granular dataset using the Mastercard network**: Since the Mastercard network has a presence in 210 countries and territories, connected to 20,000 financial institutions and over 80 million merchant locations with more than 2.9 billion cards in force, switching roughly 100 billion transactions in a year, aggregated transaction level data will be used from this network at an industry & sector level by market, measured as a monthly time series. Using the sum of transactions that occur each month, share of e-commerce spending will be estimated, considering that these transactions are strictly cross border, which means they include payments by Egyptian-issued cards to non-resident merchants. The estimation is based on the definition of e-commerce provided by the IMF, OECD, UN, and WTO (2023)" "Handbook on Measuring Digital Trade" which is: "The international sale or purchase of a good or service, conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders." The data that can be used from the Mastercard network is; date & time: the date and time in which the transaction occurred; type of card: whether the card is a credit, debit, or pre-paid card; merchant location: the address on record for the merchant where the transaction took place; industry classification: the industry which the merchant is classified as; transaction amount: the value of the transaction made.

4) Regarding enhancing the quality of FDI data:

- Further improvement of data quality is considered to improve FDI statistics through new working arrangement for the data compilation between the CBE, GAFI, the Ministry of Petroleum, CAPMAS, and FRA. With the signing of the protocol between the Ministry of Investment, CBE, and the Ministry of Petroleum in September 2016, **the CBE will begin to disseminate the FDI position statistics compiled by the FDIU in Egypt's International Investment Position once the transition to BPM6 has been completed**. Under the protocol, the FDIU will be responsible for compiling and disseminating the detailed FDI position statistics by partner country and by industry (OECD).

- In terms of coverage, it will be necessary for the FDIU to work closely with the CBE to ensure consistent coverage between the statistics under the responsibility of each agency.

- Coverage of FDI could be improved by ensuring that SPEs[9] are covered in the aggregate statistics and further by the separate identification of SPEs through benefiting from other country experiences such as the Central bank of Hungary, which adopted some criteria to examine that (1) the number of employees are low (1 to 3 employees); (2) the share of nonfinancial to financial assets is minimal, and these assets consist mostly of equity, long-term loans and securities; (3) they have high capital reserves which they immediately lend or use to purchase equity and branches abroad; and (4) material costs are negligible. This would improve the usefulness and quality of FDI statistics as well as reducing bilateral asymmetries[10].

[9] Special Purpose Entities (SPEs) are entities whose role is to facilitate the internal financing of the MNE but that have little or no physical presence in any economy. As such, it can be difficult to identify the residency of SPEs.

[10]Country experience in this concern: The Central Bank of Hungary works with the Central Statistics Office of Hungary to identify resident SPEs. They use available indicators that capture the main characteristics of the enterprises and to determine that they have minimal links to the domestic economy. The main criteria they examine are: in their balance sheet, the ratio of nonfinancial to financial assets is minimal and these financial assets consist mostly of equity, long-term loans, and securities; they report little turnover, and the turnover they do have derives primarily from exports; the number of staff is very low (1 to 3 persons); they have high capital reserves which they immediately lend or use to purchase equity abroad or establish branches abroad; they have no subsidiary in Hungary or, if they do have a subsidiary in Hungary, it also meets the criteria of an SPE; material costs are negligible; and, finally, the name of the enterprise refers to the offshore nature of the enterprise.

Conclusion:

This paper presented the techniques used by Egypt to tackle the challenges that arose in compiling ESS, particularly post Covid-19 pandemic. Egypt has started a mitigation plan to enhance the quality of external statistics in the fields of remittances, e-commerce and FDI. First, to accurately measure the informal remittances, several initiatives were launched under the supervision of the CBE to encourage the switch of remittances from informal to formal channels through applications like Instapay, Fawry and Orange. Second, to accurately measure e-commerce data, Egypt is studying the implication of applying the clearance system named Cross-border E-commerce Information System (CBEIS) to capture e-commerce transactions, where the Egyptian Customs authority is planning to use the information on orders provided by e-commerce platforms to develop statistical estimates on the overall scale of cross-border e-commerce, using big-data methodologies; besides, Mastercard network will be used to specify e-commerce transactions at granular basis. Third, further improvement of data quality is considered to improve FDI statistics through new working arrangement for the data compilation between the CBE and other institutions to compile and disseminate the detailed FDI position statistics by partner country and by industry.

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Appendix

worker's remittances' Survey Questionnaire:

Section (1): General Information

i. Name of the respondent (optional)
ii. Telephone Number (optional)
iii. Email Address (optional)
iv. Sex of the respondent
v. Current marital status
vi. In which country are you currently residing?
vii. In which year did you leave Egypt?
viii. What was your main reason for leaving Egypt?

Section (2): Education and Employment

i. Highest level of education attainment
ii. In which sector are you currently working?
iii. Which income category describes your total income?

Section (3): Cash Remittance

i. In the past 12 months, did you provide any support in cash to family members or friends/ relatives who reside in Egypt?
ii. In the past 12 months, how often did you send money to Egypt?
iii. How is the recipient related to you and what is their current economic status?
iv. In the past 12 months, for what purpose(s) did you send money to recipients in Egypt?
v. In the past 12 months, how much money in total did you send to the recipients in Egypt?
vi. In the past 12 months, which service provider(s) did you use to send the cash to recipients in Egypt?
vii. What was the main reason for choosing a certain service provider?
viii. How long did it take to avail the cash remitted to the recipient?
ix. What do you consider as the main challenges of sending money to your recipient in Egypt?

Section (4): Non-Cash/ In-kind Remittance

i. In the past 12 months, did you provide any support in kind (non-cash items/goods) to family members/friends/ relatives who reside in Egypt?
ii. If yes, what was the approximate value of the non-cash items/ goods to recipients in Egypt in the past 12 months?
iii. In the past 12 months, what type of non-cash items/ goods did you send to the recipients in Egypt, the channel used and the main reason for using the selected channel?

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Compiling External Statistics in Egypt: Challenges and Way forward

Shireen Fahmy, Sara Mahmoud, Rehab Abdelfattah

Compilation Practices in Egypt:

- Data sources of ESS
- ESS Compilation Current Status in Egypt
- Challenges facing the compilation of ESS in Egypt
- Moving forward
- Concluding

BOP Components	Data source
BOP	The Fifth Edition of the BOP Manual (BPM5)
Trade Balance Exports & imports (petroleum and other)	Banks and Ministry of Petroleum
Services Balance 1) Transportation 2)Travel 3) Government Other services: 4) Insurance 5) Other business services (communication services, Royalties and license fees, computer services, subscription to magazines, newspapers, Insurance services, others)	1) ITRS 2)Survey collaborated by Ministry of Tourism and C 3) Foreign exchange records 4) Foreign exchange records 5) Foreign exchange records
Current transfers: 1) Official transfers 2) Private transfers (of which worker's remittances)	1) Foreign exchange records and Minist International Cooperation. 2) Foreign exchange records, the Banking Supe Sector at the CBE, while the informal transf estimated by a survey conducted by CAPMAS
Capital Account	Foreign Exchange Records
Financial Account 1)Direct Investment abroad 2)Direct Investment in Egypt 3) Portfolio Investment abroad 4) Portfolio Investment in Egypt 5) Other Investment and Reserve Assets	1)Foreign Exchange Records 2) Foreign Exchange Records, Ministry of Petroleu and FRA. 3) Foreign exchange records 4) FRA, CBE External Debt Statistics Departm Department for Securities.

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ESS Compilation Current Status in Egypt

- Current Account Components
- Capital and Financial Account Components

Challenges facing the compilation of ESS in Egypt

- Goods: Digital products and Data accuracy
- FDI: Data Accessibility and Data accuracy
- Net Unrequited Current Transfers
- Estimation of informal remittances

Moving Foreword

- Enhancing the ITRS System
- Measuring cross-border merchandise E-commerce using customs data
- Granular dataset using the Mastercard network
- Using pilot survey for Goods cleared as mail parcels and courier deliveries
- Ensuring that Special Purpose Entities (SPEs) are covered in the aggregate statistics

The Main Message

CBE is deliberate on achieving the goals of the mitigation plan to enhance the quality of external statistics in the fields of remittances, e-commerce and FDI given that these flows are main determinants of the development of Egypt.

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Personal transfers in the balance of payments: estimation under changing migration patterns[1]

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[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Personal Transfers in the Balance of Payments: Estimation under Changing Migration Patterns

Maria P. Cobián∗ Joerg Feuerhake†

January 15, 2024

Abstract

Personal transfers as part of remittances are becoming increasingly relevant due to growing migration movements influenced by rising income inequalities, political conflicts and increasing environmental challenges. Their impact on countries´ economies call for reliable estimations to be used in policy decision making and economic analysis. After a revision of recent demographic changes in Germany, evidence of growing migration and heterogeneity in its diaspora composition lead to a revision of the current personal transfers estimation approach in the Balance of Payments framework. As Germany is a net sender country, the revision is focused on the debit side. Within the revision approach, alternative data sources are analysed, from which the socio-economic panel (SOEP) conducted on German households is selected together with additional administrative data on population statistics to develop an alternative estimation approach. The proposed new method uses SOEP information on socioeconomic markers such as age, employment status or migration background, which allow for a deeper understanding of personal transfers dynamics in Germany. First results appear to be more accurate and enhanced although showing a decrease in total volume of personal transfers and a slight change in country composition compared to the current estimation approach.

Keywords: remittances, personal transfers, demographic changes, estimation approach, socio-economic panel, administrative data

JEL classification: F22, F24, O11

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Introduction

Increasing economic inequality, growing political conflicts and tensions, climate change and rising environmental challenges around the globe are some of the reasons for increasing worldwide migration. As a consequence, remittances, which are an important source of income for many families, are also on the rise and playing an increasing role in international payments. Therefore, reliable information on remittance flows becomes key for policy decision making and economic analysis.

Remittances are one of the indicators of the sustainable development goals of the United Nations 2030 Agenda[2], and have reached a volume three times the amount of official development assistance provided by official donors worldwide[3] (USD 222 billion vs. USD 645 billion in remittances in 2022). These flows amount in some countries up to 50 percent of their GDP[4] and can therefore have a stabilising effect in several economies. Hence the importance of an accurate, timely and granular estimation of remittance flows.

The Balance of Payments is currently the most relevant source of information on remittances. Within remittances[5], personal transfers refer to transfers between households of two different economies. Their compilation is especially challenging, because single transfers are often below reporting thresholds and may be routed through unregulated channels, making it difficult to obtain reliable information. Therefore direct reporting often needs to be augmented by further estimation methods.

In Germany an estimation method is in place that uses bank reports and employment data by German labour authorities to estimate personal transfer debits. As a country with relatively high income[6] and wages[7], it has a long history of work migration [Hanewinkel, Oltmer; 2018]. With the presence of diasporas in Germany

[2] Remittances are an indicator contained in objective "17.3 Mobilize additional financial resources for developing countries from multiple sources". United Nations Sustainable Development Goals, available at https://www.un.org/sustainabledevelopment/globalpartnerships/ (cited on 04.01.2024)

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[4] Personal remittances received as percentage of GDP. World Bank, available at https://data.worldbank.org/indicator/BX.TRF.PWKR.DT.GD.ZS?most_recent_value_desc=true (cited on 04.01.2024)

[5] Personal transfers are part of remittances, which also include compensation of employees, less Taxes and social contributions payable that are related to compensation of employees, and less Transport and travel expenditures plus Capital transfers receivable from households [BPM6 12.27].

[6] Since 1970 Germany ranks among the top 20 countries with respect to Adjusted net national income per capita (current US$), World Development Indicators, Data Bank, World Bank, available at https://databank.worldbank.org/reports.aspx?source=2&series=NY.ADJ.NNTY.PC.CD&country=# (cited on 27.12.2023)

[7] Since 1991 Germany ranks among the top 20 available countries with respect to Gross Average Monthly Wages, UNECE Statistical Database, available at https://w3.unece.org/PXWeb2015/pxweb/en/STAT/STAT__20-ME__3-MELF/60_en_MECCWagesY_r.px/table/tableViewLayout1/ (cited on 27.12.2023)

from the 1950ies and 1960ies[8] *Gastarbeiter* ("guest-worker"), to the EU's freedom of movement act, effective since 2005[9], and migration partly driven by the conflicts in the Balkans, Syria and Ukraine, the composition of diasporas in Germany has become more heterogeneous. With a growing number of migrants and increasing heterogeneity of migrant communities in Germany, a revision of the current estimation method and the search for further data sources becomes worthwhile.

This paper introduces a revised estimation approach that combines further data sources from German labour authorities, official migrant registers and the German Socio-Economic Panel (SOEP) to estimate personal transfers for the years 2016 to 2020. To achieve this, current demographical developments in Germany are discussed, for the estimation to take these changing migration patterns into account. Available data sources are studied, and subsequently the SOEP data is analysed, since it allows incorporating various socioeconomic markers like age, employment status, and citizenship or migration background. These characteristics give an insight on the drivers of personal transfers in Germany, and allow for a derivation of an estimation approach whose results are presented and discussed.

Changing Migration Patterns

According to the *Ausländerzentralregister* (AZR), Germany´s foreign population amounted to just over 13 million people in 2022, 16% of the country´s population, and it has grown by 85.5% in the last decade. To understand the current patterns of migration in Germany, it is important to understand Germany's several migration inflows, which play a role when analysing the population engaged in making personal transfers.

Germany´s first post World War II wave of immigration started in the mid-1950ies and lasted until the end of the1960ies. In this period, Germany had a high demand for labour which was partly met by recruiting *Gastarbeiter* ("guest-workers"). During this time, Germany had bilateral agreements with several countries that included the recruitment of workers. Guest-workers under these treaties came from Turkey, Italy, Greece, Portugal, former Yugoslavia, Morocco, Tunisia and Spain, and the purpose of their stay was regulated work. Though guest-worker agreements were intended to be temporal, many of these people settled permanently in Germany, thus still representing a large part of Germany's foreign diaspora (see Figure 1). It is safe to assume that migrants that arrived with these first immigration inflows had high participation rates in the German labour market and also had a very high inclination to remit.

Germany´s second migrant influx happened during the mid-1990ies due to the Balkan War. Probably because of the already present Yugoslavian diaspora, a notable number of persons sought refuge from this conflict in Germany. This migration can

[8] Germany recruited guest-worker via treaties with Italy (1955), Greece and Spain (1960), Turkey (1961), Morocco (1963), Portugal (1964), Tunisia (1965) as well as Yugoslavia (1968).

[9] Directive 2004/38/EC of the European Parliament and of the Council of 29 April 2004 on the right of citizens of the Union and their family members to move and reside freely within the territory of the Member States.

be seen in Figure 1 as an increase in the number of persons from guest-workers' countries in the mid19990ies. It is worth noting that the number of persons from guest workers' countries decreases after 1995 with the end the Bosnian war. This is largely due to migrants returning to their countries.

In 2015, the armed conflict in Syria led to an additional inflow of population. The most recent demographic development has been the increase of the Ukrainian population in 2022 due to the war. All these migration inflows have impacted the population in Germany, making its foreign population larger by numbers and more diverse. Note for example the declining share foreign citizens from guest workers' countries compared to total foreign citizens in Germany, and how these recent demographic developments are reflected in the foreign population composition.

Figure 1: Number of Persons with Foreign Citizenship in Germany

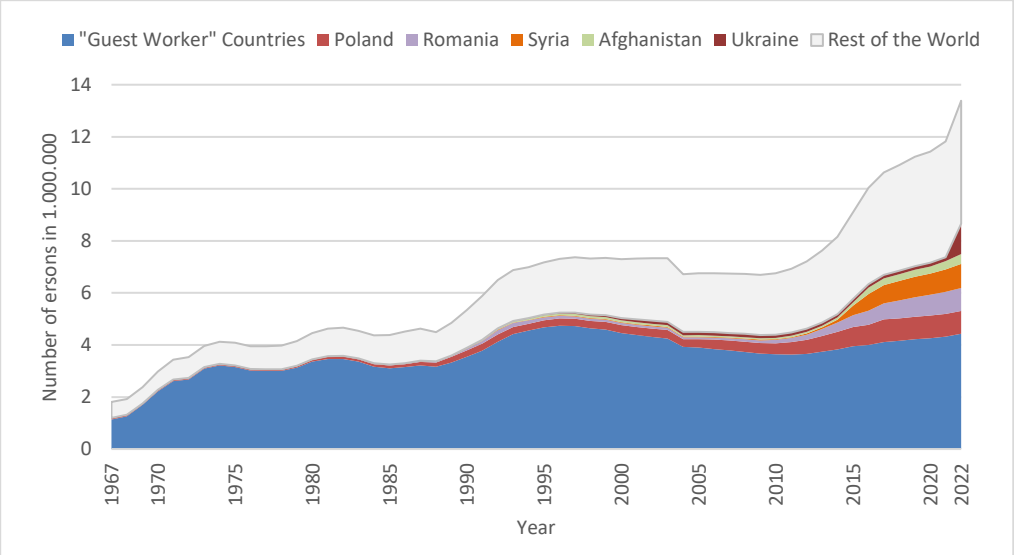
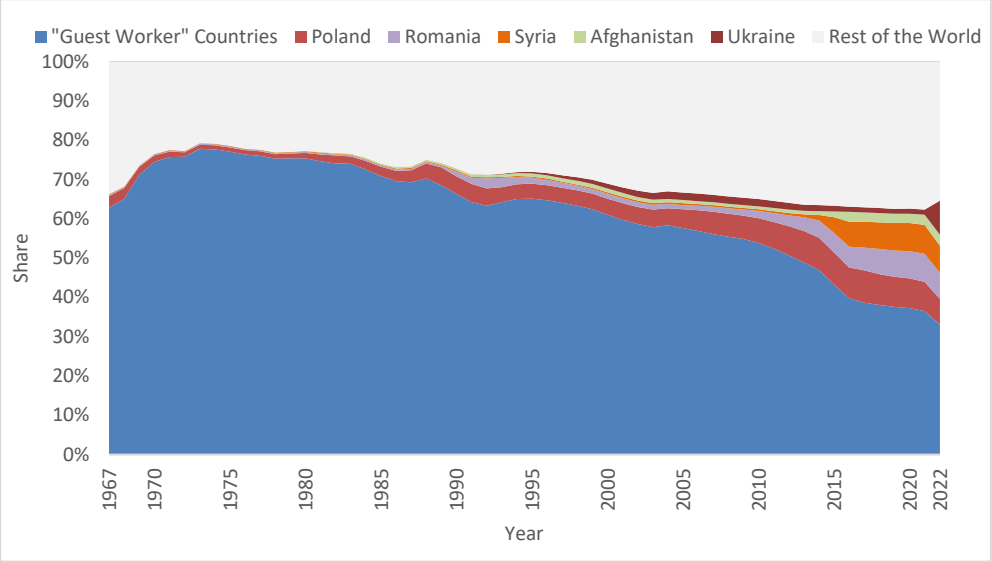


Figure 2: Persons with Foreign Citizenship in Germany (Share of Selected Groups)



Focusing on working-age foreign population (18 to 65 years of age), which is traditionally more likely to remit, this group represents 12% of Germany´s population in 2022, and has grown 74% over the last decade. This group is diverse and accounts for 75% of total foreign population in 2022. It contains people from over 200 different countries, though half of the foreign population is citizen of eight of them: Turkey, Poland, Ukraine, Romania, Syria, Italy, Bulgaria and Croatia.

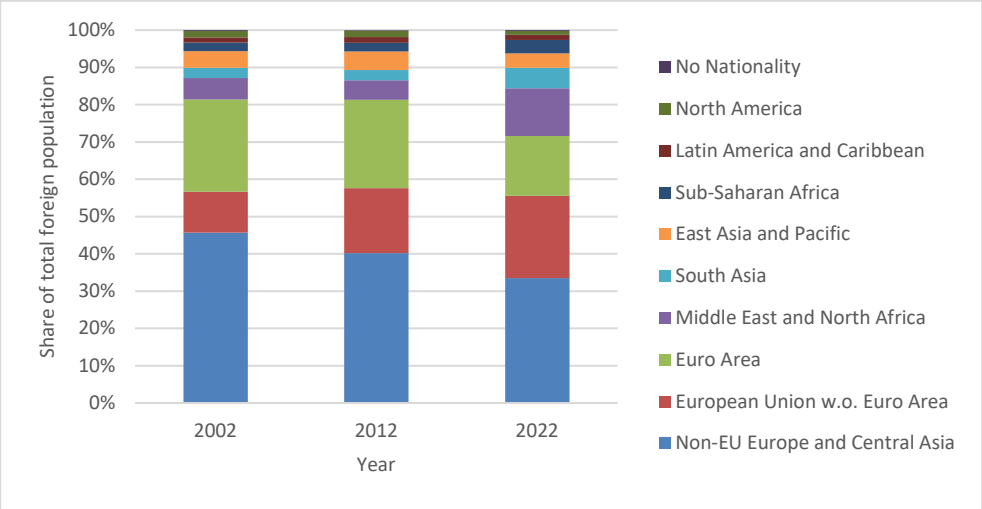
Around 75% of the total population with foreign citizenship in Germany comes from 21 countries. Turkey is, since many years and by a wide margin, the largest group with foreign citizenship, amounting, to 12 % of it in 2022, and followed by Poland with 7 %. However stable these nationalities might be, the German foreign population has seen a significant increase in Ukrainian citizens due to the war, increasing a staggering 506 % in 2022, reaching a 7% of total foreign citizenship[10].

These countries would be expected to be the main counterpart economies of personal transfers. When looking at the population with foreign citizenship by region over time, the increase in heterogeneity can be seen when comparing 2002 foreign population composition to that of 2022 (see Figure 3). In 2002, three main regions accounted for 80% of total population with foreign citizenship in Germany: non-EU Europe and Central Asia, European Union not from the Euro Area, and Euro Area countries. In 2022 a fourth group emerges to account for the same percentage: Middle East and North African countries, which reflects the influx of Syrian and Afghan citizens over the past decade. Moreover, during this period, the proportion of non-EU Europe and Central Asia countries experience a decrease despite the Ukrainian influx, European Union without Euro Area countries increase due to the influx of the Balkan countries, and the share of Euro Area countries is reduced. It should be pointed out, that persons with citizenships mentioned above often migrated at different times with different incentives and have reached different levels of integration into the

[10] See "Tables" section for further details.

German society. Therefore statistics compilers may have to treat them differently when attempting to estimate personal transfers.

Figure 3: Foreign population composition in Germany by region



Additionally, macroeconomic factors may influence the inclination to make personal transfers. Among them is the possibility gain income. As mentioned above, Germany ranks relatively high in average gross monthly Wages as well as in adjusted net national income per capita. When analysing GDP per capita[11], we find that Germany has a higher ratio than the main foreign nationalities in Germany in 2022: USD 48.718 vs. USD 10.674 in Turkey and 18.688 USD in Poland. Additionally, Germany has one of the lowest unemployment rates of OECD[12] countries. These economic conditions may be an important factor for migrants who want to support their families back home. On the other hand however, integration of extra-EU citizens into the German labour market is below EU-average and faces several challenges as Tangermann and Grote point out [Grote, Tangermann; 2018]. In fact, according to the *Bundesagentur für Arbeit* (BA) Ukrainian, Syrian and Turkish nationals make up 17% of total unemployed citizens in Germany, 47% of all unemployed foreign citizens[13].

[11] World Bank national accounts data, and OECD National Accounts data files. Available at https://databank.worldbank.org/reports.aspx?source=2&series=NY.GDP.PCAP.PP.CD&country= (cited on 05.01.2024)

[12] OECD National Accounts. Rate of Unemployment as % of Labour Force, available at https://stats.oecd.org/BrandedView.aspx?oecd_bv_id=mei-data-en&doi=data-00046-en# (cited on 05.01.2024)

[13] Unemployed according to nationality (monthly data). *Bundesagentur für Arbeit* (BA), available at https://statistik.arbeitsagentur.de/SiteGlobals/Forms/Suche/Einzelheftsuche_Formular.html?topic_f=nat-ins (cited on 04.01.2024)

Moreover, while the guest-workers' cohorts of the 1950ies and 1960ies were predominantly employed by resident employers, recently self-employment becomes a more relevant source of income among migrant communities[14].

In summary, the migrant communities settled in Germany decades ago have changed over time. With increasing numbers of migrants and increasing heterogeneity of migrant groups and migrants' sources of income, the task of estimating personal transfers accurately in the framework of the balance of payments becomes increasingly challenging.

Estimating Personal Transfers

The current estimation of personal transfer debits consists of a combination of voluntary reporting by intermediaries in the personal transfers market, providing information on small volume private transfers, and administrative data on employment of foreign population subject to social security contributions from the *Bundesagentur für Arbeit* (BA). As Friedrich et al. describe in their work, a per capita personal transfer is calculated assuming it falls within a range of amounts to account for payments not included in the reports, and then grossed up assuming all migrants included in BA data engage in personal transfers [Friedrich et.al.; 2007].

As mentioned above, the growing number of persons with family ties abroad, the recent changes in migration patterns in Germany and the trend among migrant communities to earn income from self-employment rather than employment suggest a revision of the current estimation approach for personal transfers is worthwhile.

Data Sources

Estimating personal transfers starts with searching and analysing available sources and choosing one, or a combination of them, that allow for an adequate estimation. Accuracy, timeliness, coverage and frequency are important features to take into account when selecting sources. There are a number of possible data sources for estimating personal transfers in Germany.

Direct reports by Money Transfer Operators (MTOs) can provide information on personal transfers´ flows, both inbound and outbound, and a geographical detail of their origin and destination. However, some of these entities may report net amounts, which can lead to a misinterpretation of the geographical allocation and the volume reported. In addition, MTOs may only represent a portion of the total personal transfer flows, since other channels such as unregulated channels might be also used. Therefore, taking into account only this source might be an underestimation of the actual personal transfer flows. Moreover, according to §67 (2) 1 of the

[14] Migrant Entrepreneurs in Germany from 2005 to 2014 - Their Extent, Economic Impact and Influence in Germany's Länder, Dr. Andreas Sachs, Markus Hoch, Claudia Münch, Hanna Steidl, Bertelsmann Stiftung, 2016, https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Publikationen/GrauePublikationen/NW_Migrant_Entrepreneurs_2016.pdf (cited on 27.12.2023)

Außenwitschaftsverordnung (AWV)[15], the reporting threshold for transactions between residents and non-residents is 12.500€, an amount significantly above of what an average personal transfer would be expected to be. MTOs that report transactions below this amount do so willingly.

Household surveys are second data source available in Germany. The *Deutsches Institut für Wirtschaft* (DIW) provides the SOEP (Socio-Economic Panel)[16] since 1984. The SOEP is an annually conducted private panel survey that is representative of private households in Germany. This survey has taken place for 38 years now and has the advantage of following the same individuals through time, expanding and diversifying the sample each year to keep it representative for Germany. It reached roughly 22.000 interviewed households in 2022. Since questions of migration have become more relevant for researchers, the SOEP started to maintain subsamples that represent migrant communities, thereby allowing for relatively robust estimations concerning them.

One of the numerous questions asked in this survey is if the interviewee has received or has sent financial aid from or to other people from or outside of Germany, and how much. Furthermore, this data-source contains a variety of sociodemographic data that allows for the characterization of senders and receivers of personal transfers. Some examples are gender, education, age, employment, nationality and income. By its questioning it covers regulated as well as unregulated flows, which makes it unique in coverage. However, it has to be mentioned, that though a wide array of socio-demographic information is present in the SOEP and it would theoretically be able to cover numerous personal transfers related questions, error margins tend to increase remarkably when granular results are calculated. Another drawback is the timeliness of available results. Personal transfer related items are published with a three year time lag.

[15] "Außenwirtschaftsverordnung vom 2. August 2013 (BGBl. I S. 2865), die zuletzt durch Artikel 1 der Verordnung vom 27. September 2023 (BGBl. 2023 I Nr. 264) geändert worden ist". Currently in revision.

[16] Website of SOEP: https://www.diw.de/en/diw_01.c.615551.en/research_infrastructure__socio-economic_panel__soep.html (cited on 29.12.2023)

To augment and stabilise the results that can be estimated using the SOEP, some administrative sources and secondary sources of data are available in Germany. An example of them, already cited, are the statistics compiled from the German *Ausländerzentralregister* (AZR)[17]. They provide the number of foreign population living in Germany, by gender and migrant generation in a very timely and granular manner. This source allows to determine the potential migrant population engaged in sending personal transfers and the possible recipient countries. The information is aggregated and disseminated by the Federal Statistical Office of Germany (Destatis). This institution also offers data on naturalizations by country[18], which can be helpful to determine the proportion of persons with German citizenship that send money abroad.

Additionally, the *Bundesagentur für Arbeit* (BA) provides a variety of information concerning migration in the German labour market[19]. Among them are the number employees subject to social security with foreign citizenship, narrowing those foreigners with more economic capacity to engage regularly in making personal transfers. This administrative source also provides very timely and granular information.

Mirror data can be a useful tool to detect bilateral asymmetries and refine the estimation method. However, little information is readily available, and this would entail a more thorough communication with the main counterpart countries.

Another useful source in the estimation of personal transfers are macroeconomic indicators such as GDP per capita or unemployment rates offered by the OECD and Eurostat, which might result helpful in identifying asymmetries, and understand the reasons for migration and the propensity to remit.

Estimation Approach

To estimate personal transfers made from Germany to other countries, the data sources SOEP, AZR and BA can be combined by common items, making it possible to link the sources on aggregated level. Therefore it is possible to take estimates for shares of the population in Germany and average volumes transferred from the SOEP, and apply the results to data from statistics provided by Destatis and AZR for reporting years 2016 to 2020.

In a first step, SOEP is taken to estimate the population share of citizens in Germany involved in personal transfers and average annual amounts of personal transfers made. Breakdowns by citizenship, employment status, migration

[17] AZR statistics can be found using code "12521" at Destatis' data service genesis online: https://www-genesis.destatis.de/genesis/online?operation=find&suchanweisung_language=en&query=12521 (pages in German, cited on 29.12.2023)

[18] Statistics on naturalisations in Germany can be found using code "12511" at Destatis' data service genesis online: https://www-genesis.destatis.de/genesis/online?operation=find&suchanweisung_language=en&query=12511 (pages in German, cited on 29.12.2023)

[19] Statistics on migration in the German labour market, Bundesagentur für Arbeit, https://statistik.arbeitsagentur.de/DE/Navigation/Statistiken/Themen-im-Fokus/Migration/Migration-Nav.html (pages in German, cited on 29.12.2023)

background and other characteristics are useful to allow for linkage with other statistics.

The statistics by Destatis and AZR are full census sources that provide high accuracy and timeliness. They can be used to provide a reliable frame to gross up into, and to make up for timeliness issues of the SOEP that have been already mentioned.

Socio-Demographic Drivers: Evidence from SOEP Results

An analysis of the information provided by the SOEP proves useful for the understanding of personal transfers' drivers and behaviour in Germany[20], and for the selection of relevant characteristics that combined with administrative data will result in a final estimation.

For the review at hand, a five year period from survey year 2017 to the most recent survey year 2021 of the SOEP is taken[21]. In a first step, shares of the population in Germany engaged in personal transfers and surveyed amounts are calculated. Table 1 shows the results. While the share as well as the number of persons making personal transfers yield relatively stable results, most grossed up amounts have double digit relative standard errors. Still, the values can serve as a rough guess for realistic personal transfer amounts.

German Residents Making Personal Transfers

For Reporting Years 2016 to 2020 Table 1

Year	Share of Persons	rel. Standard Error	Number of Persons (Mill.)	rel. Standard Error	Amount transferred in Mill. Euro[22]	rel. Standard Error
2016	2,4%	5,8%	1.667	5,9%	3.282	9,2%
2017	3,3%	5,2%	2.301	5,3%	3.214	8,7%
2018	3,3%	5,7%	2.264	5,8%	4.050	9,9%
2019	3,3%	5,9%	2.277	6,0%	3.546	9,2%
2020	3,4%	7,2%	2.370	7,4%	4.268	9,7%

Sources: Socio-Economic Panel (SOEP) v38

Next, results broken down by citizenship are explored. Vindicating common assumptions, SOEP results show that German residents with foreign citizenship have

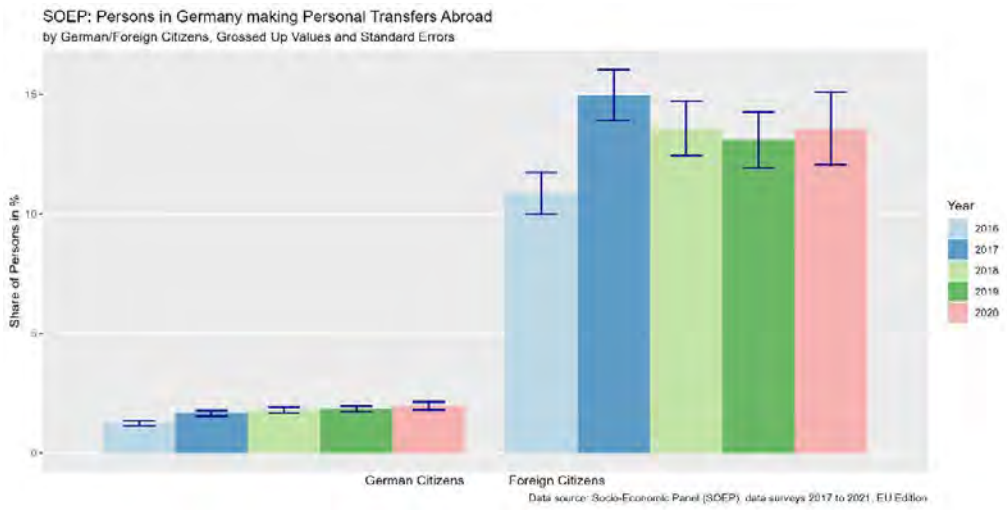
[20] There are publications based on SOEP information that specifically deal with remittances. See [Holst, Schrooten; 2006], [Holst et.al.; 2008] and [Holst et.al.; 2010]

[21] Note that amounts reported as personal transfers are reported for one year prior to the survey year. So information on personal transfers can be investigated for the reporting years 2016 to 2020.

[22] It is important to stress that the amounts shown in this section correspond to calculations made exclusively from SOEP data, and they are obtained differently than the amounts described in the "Results" section, which combine SOEP data with other sources.

significantly larger inclination to make personal transfers than German citizens (see Figure 4).

Figure 3



Although the group of German residents with German citizenship is much larger than the group of foreign citizenship residents, the number of persons as well as the amounts transferred are of similar magnitude for both groups (see Figure 5 and Figure 6). This finding supports the notion that a model for German personal transfer debits should include methods to estimate personal transfers for persons of foreign and German citizenship separately.

Figure 4

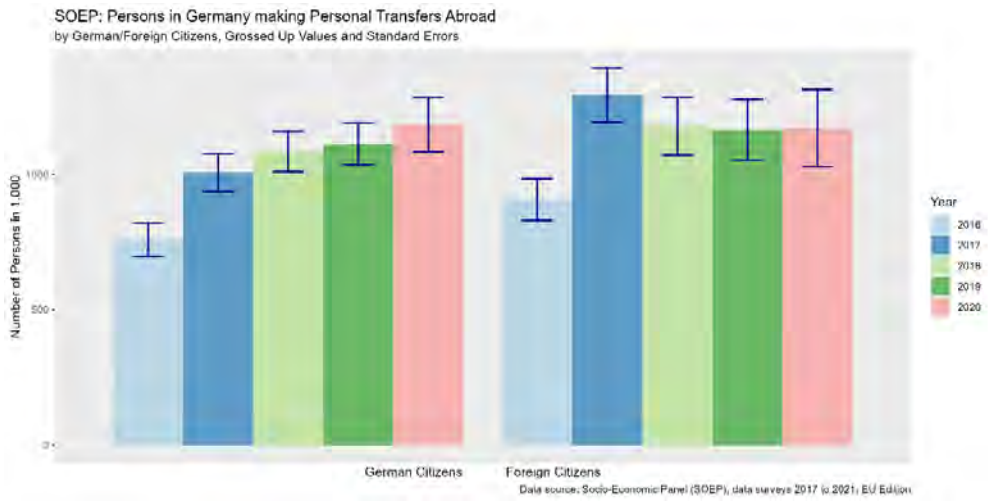
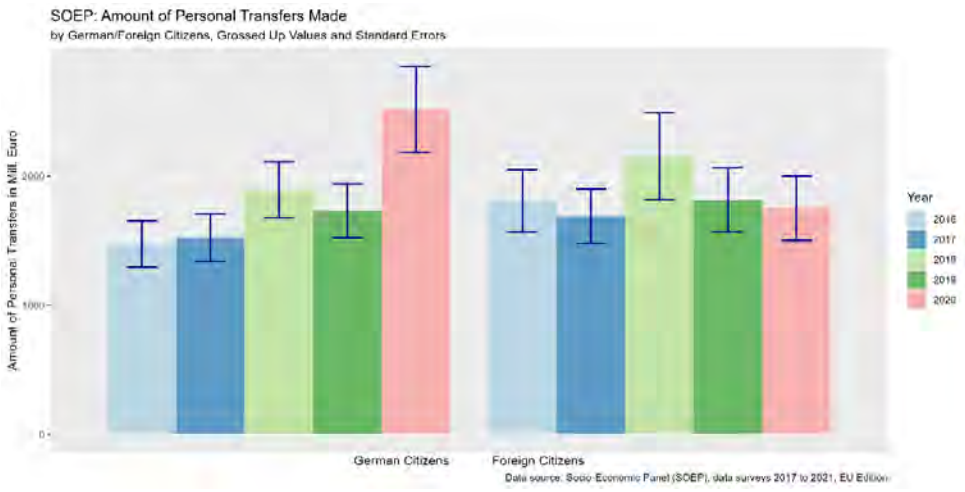


Figure 5



Foreign population

Table 2 shows SOEP results for the share of persons with foreign citizenship living in Germany that make personal transfers, as well as their number and the amounts transferred. The results for amounts are not as robust as desirable but they can serve as rough guesses of the amounts probable.

Foreign Citizens Resident in Germany Making Personal Transfers

For Reporting Years 2016 to 2020 — Table 2

Year	Share of Persons	rel. Standard Error	Number of Persons (Mill.)	rel. Standard Error	Amount transferred in Mill. Euro[1,23]	rel. Standard Error
2016	10,9%	8,0%	907	8,5%	1.807	13,4%
2017	15,0%	7,1%	1.293	7,7%	1.691	12,5%
2018	13,6%	8,4%	1.178	9,0%	(2.155)	15,6%
2019	13,1%	8,9%	1.165	9,6%	1.815	13,8%
2020	13,6%	11,2%	1.182	12,1%	1.751	14,3%

[1] () denote values with more than 15% relative standard error

Sources: Socio-Economic Panel (SOEP) v38

Keeping in mind that BA provides accurate and granular data on persons employed or looking for work by employment status, it is useful to look for stable patterns regarding employment status in the SOEP. Figure 7 to Figure 9 show the shares of persons making personal transfers abroad and their number, as well as the transferred amounts by employment status. It shows that shares are highest among

[23] It is important to stress that the amounts shown in this section correspond to calculations made exclusively from SOEP data, and they are obtained differently than the amounts described in the "Results" section, which combine SOEP data with other sources.

persons in full or part time employment. Persons not employed at all and persons in marginal employment show some inclination to make personal transfers as well.

Figure 6

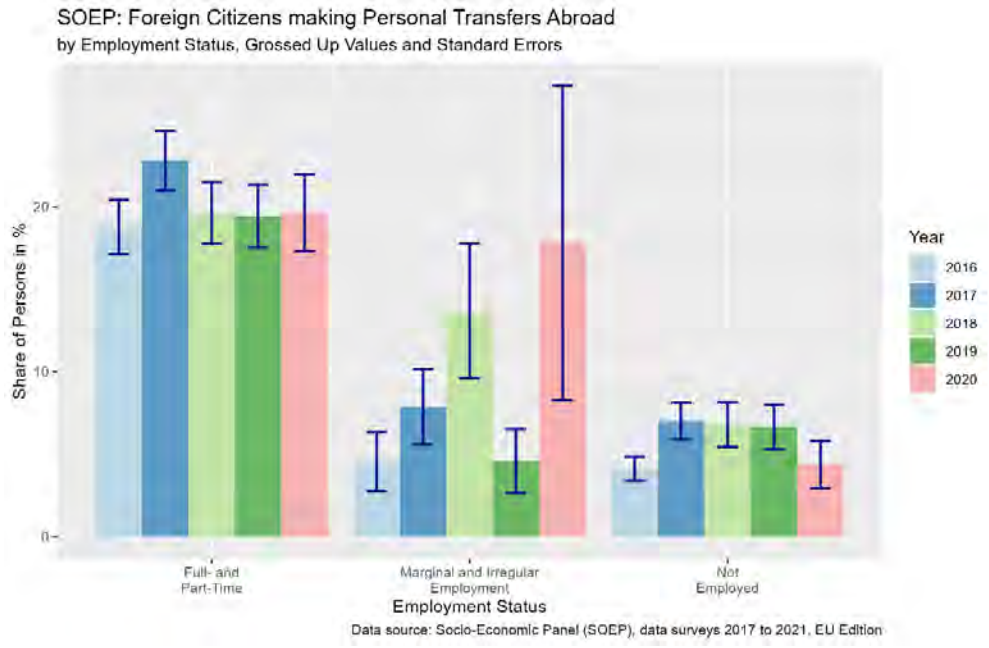


Figure 7

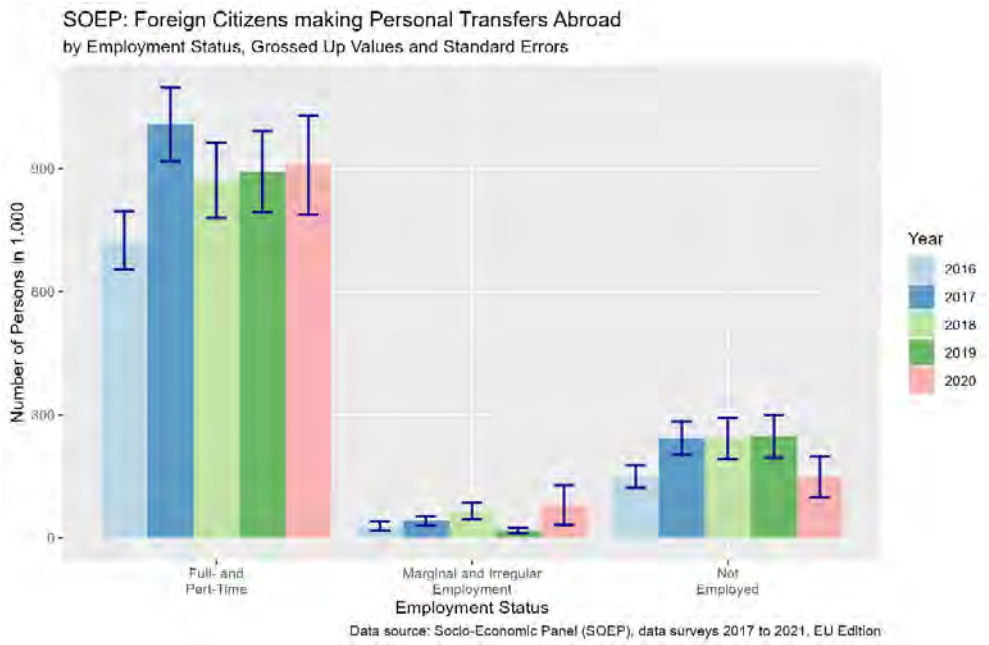
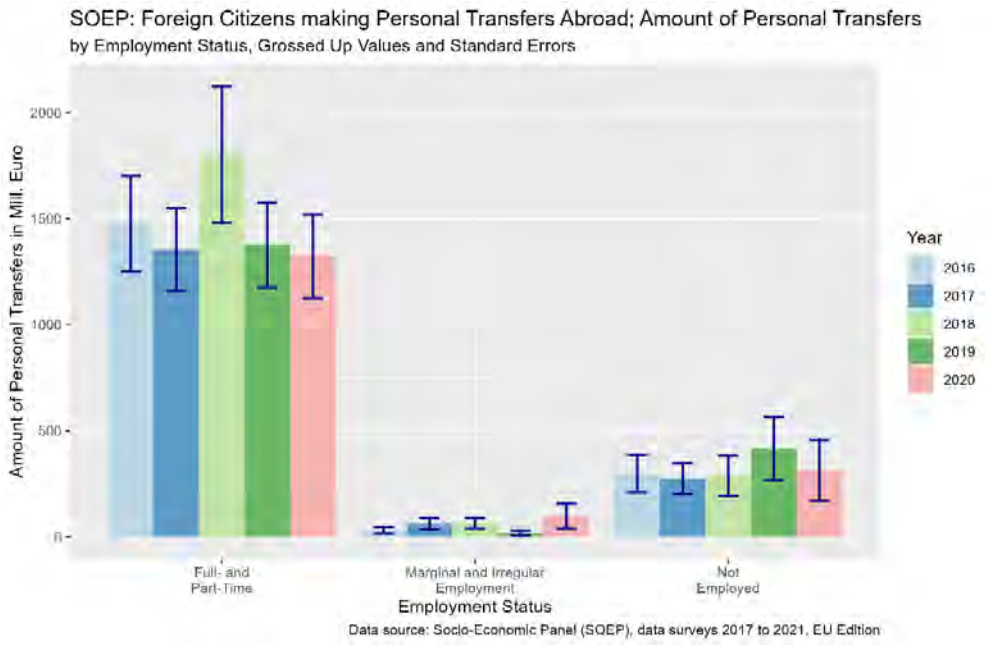


Figure 8



Another driver for the share of persons transferring and for amounts transferred may be the average income in home countries of persons sending personal transfers. To assess possible effects, SOEP results can be aggregated by country income classes according to the World Bank classification[24] for observations concerning foreign citizens. Figure 10 shows that shares of persons making personal transfers is highest among citizens from low and middle income countries, and lowest among citizens of high income as well as of low income countries. Since the number of observations is relatively small for low income countries (see Figure 11*)* it is difficult to calculate robust results, though it can be assumed that amounts for these countries are relatively low. For the other income classes, results seem plausible, though the variation in amounts transferred makes it difficult to estimate robust results for more detailed breakdowns.

[24] World Bank Country and Lending Groups. For simplification income classes for the reference year 2020 have been used. Classification is available online at https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (cited on 2.1.2024)

Figure 9



Figure 10

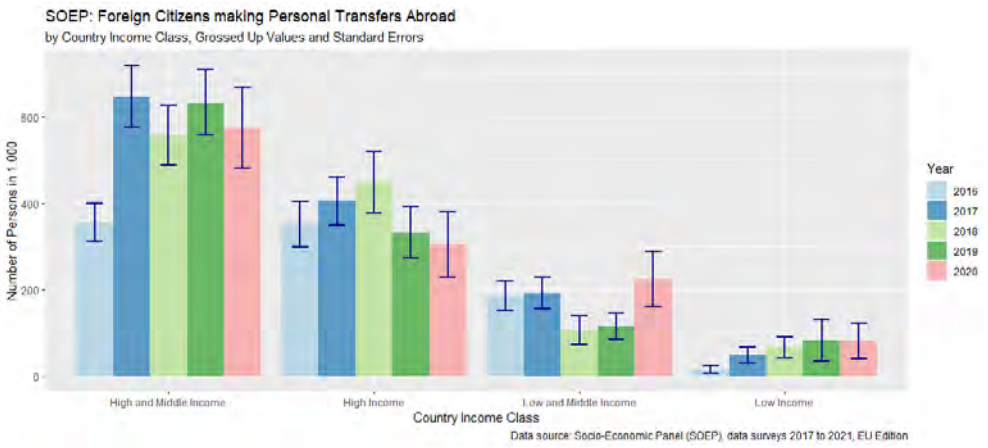
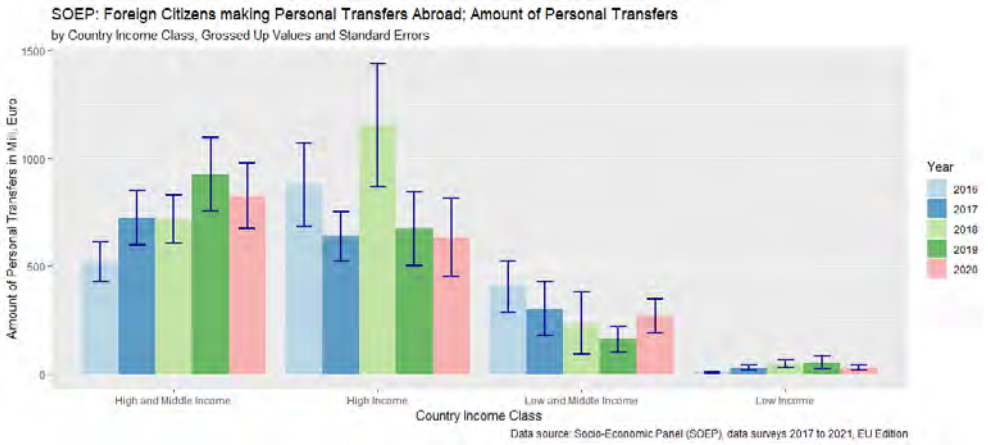


Figure 11



Therefore, to estimate personal transfers made by German residents with foreign citizenship, SOEP results and AZR data are combined in the following steps. Firstly, taking SOEP data, the average personal transfer sent by foreign population living in Germany is modelled according to their employment status and the

income classification of their country of origin, as indicated by the World Bank[25]. Secondly, the number of foreign citizens that potentially make personal transfers is estimated applying SOEP-obtained proportions to the foreign population provided by the AZR, which is subsequently distributed by country according to the AZR. Then, each country amount is distributed according to employment status SOEP proportions. Finally, each employment status per country is multiplied by the modelled SOEP personal transfer amounts according to the income class of each country of origin, because it is assumed they will most likely be sending back to their countries of origin. However, it could be the case that they are sending to another country where their families settled[26]. These cases are not observed separately in this methodology. The output of this process is a yearly amount of personal transfers per country.

German population

For German residents with German citizenship, the share of persons making personal transfers is relatively small, while the numbers of persons and amounts transferred are unneglectable. Table 3 shows results from the SOEP.

German Citizens resident in Germany Making Personal Transfers

For Reporting Years 2016 to 2020 — Table 3

Year	Share of Persons	rel. Standard Error	Number of Persons (Mill.)	rel. Standard Error	Amount transferred in Mill. Euro	rel. Standard Error
2016	1,2%	8,0%	760	8,0%	1.475	12,2%
2017	1,7%	6,9%	1.009	6,9%	1.522	12,2%
2018	1,8%	6,9%	1.085	6,9%	1.895	11,4%
2019	1,8%	6,9%	1.112	6,9%	1.732	12,0%
2020	2,0%	8,4%	1.187	8,5%	2.517	13,2%

Sources: Socio-Economic Panel (SOEP) v38

There are some challenges with estimating personal transfers for the group of German citizens. First off, there is no straight forward assumption for a geographical allocation of the volumes transferred because without a foreign citizenship there is no immediate hint for a probable destination given, and there is little evidence of possible destinations found on the SOEP. Furthermore some recipients of transfers may be persons who are abroad for educational purposes. The volumes transferred to them would fall under travel. Therefore, additional estimation steps are necessary to cover personal transfers of German citizens accurately. After a thorough analysis of SOEP data, a separation between German citizens according to migration

[25] World Bank Country and Lending Groups. For simplification income classes for the reference year 2020 have been used. Classification is available online at https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (cited on 2.1.2024)

[26] These would be the so called re-emigrants: an Afghan family could have moved to Syria and then to Germany, and then, from Germany and still with Afghan nationality they could be sending remittances back to Syria because that is where the rest of the family is.

background is found to be most convenient to estimate volumes and geographical allocation of personal transfers sent, from which a deduction of payments made to support students abroad will be made.

Migration Background

Figure 13 and Figure 14 show the amount of personal transfers and number of German citizens living in Germany by migration background according to SOEP. Migration background is a SOEP-item that does not state a country of origin. However Destatis' statistics on naturalisations provide detailed information on former citizenships of persons naturalised that can serve as a geographical distribution for persons with migration background.

Figure 12

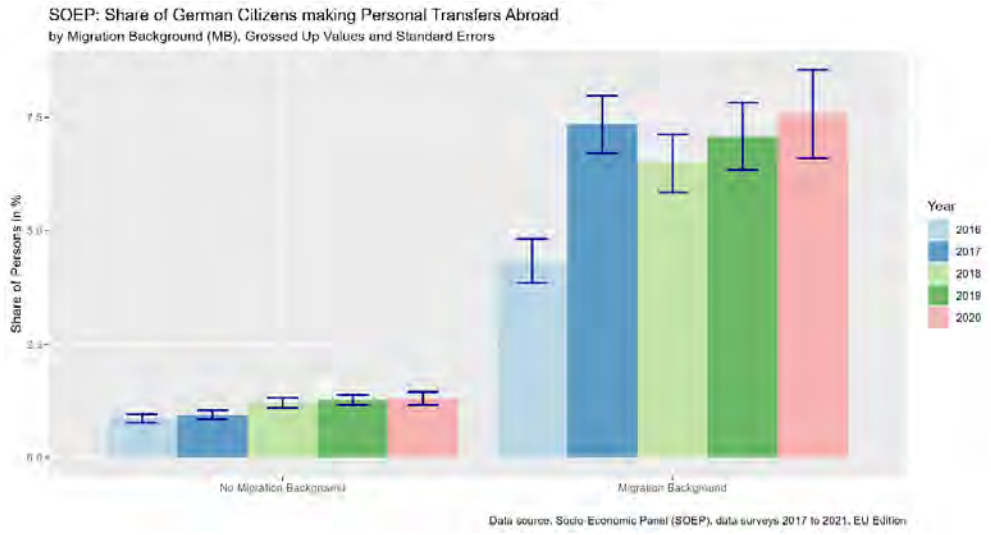
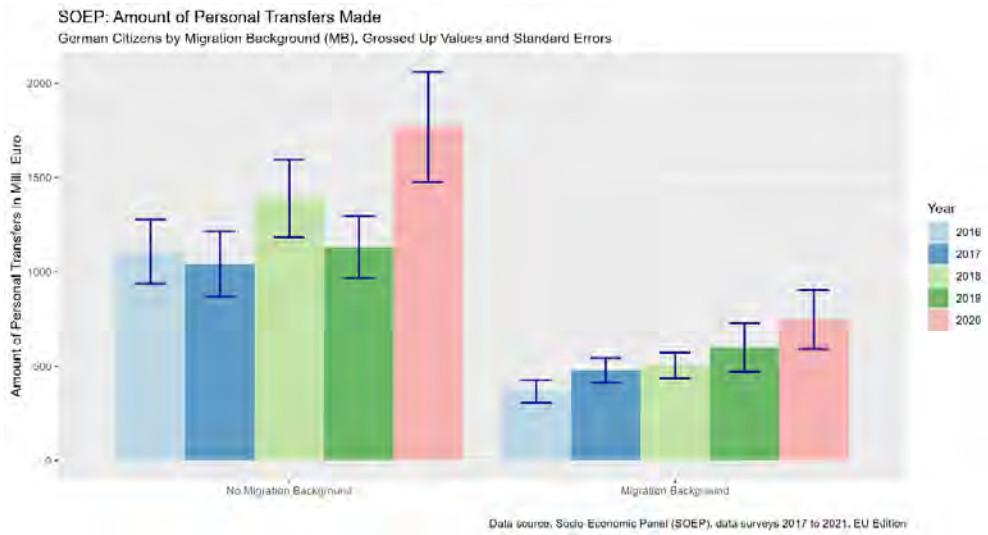


Figure 13



Figure 15



By assuming that persons with migration background will be distributed according to the geographical allocation of persons naturalised in Germany in recent years, it is possible to allocate transfers. Table 4 shows relative numbers of naturalisations in Germany for the years 2017 to 2021 and for the decade 2012 to 2021 combined.

German Naturalisations

For Reporting Years 2017 to 2021 as well as decade 2012-2020 Table 4

Year	2017	2018	2019	2020	2021	2012-2021
Turkey	13,7%	15,1%	12,9%	10,8%	9,9%	17,2%
Poland	6,1%	5,6%	4,8%	4,7%	4,4%	5,2%
Syria	2,3%	2,6%	3,1%	6,2%	15,4%	3,9%
Romania	3,9%	3,9%	4,6%	5,5%	5,6%	3,7%
Iraq	3,2%	3,7%	3,7%	4,4%	3,6%	3,4%
United Kingdom	6,3%	5,7%	10,9%	4,0%	1,9%	3,4%
Italy	3,9%	3,7%	3,6%	3,8%	4,1%	3,3%
Kosovo	3,6%	3,5%	3,0%	3,2%	2,7%	3,3%
Ukraine	2,5%	2,2%	3,4%	2,1%	1,5%	3,0%
Greece	3,1%	2,9%	2,5%	2,5%	2,6%	2,9%
Iran	2,5%	2,8%	3,0%	3,7%	3,3%	2,7%
Rest of the World	49,1%	48,3%	44,5%	49,0%	45,1%	47,9%

Sources: Statistisches Bundesamt (Destatis), 2023 | Stand: 02.01.2024

Therefore, to estimate personal transfers made by German citizens with migration background, SOEP results and Destatis' naturalization statistics are combined in the following steps. Firstly, taking SOEP data, the average personal transfer sent by German nationals is modelled according to whether the citizen has migrant background (direct or indirect) or not. Then, the migration amounts are

multiplied by the number of naturalizations per country of origin and yearly personal transfer amounts per country are obtained.

No Migration Background

The last volumes to allocate are those sent by German citizens without migration background. The SOEP allows to break down these volumes by receivers.

Figure 146

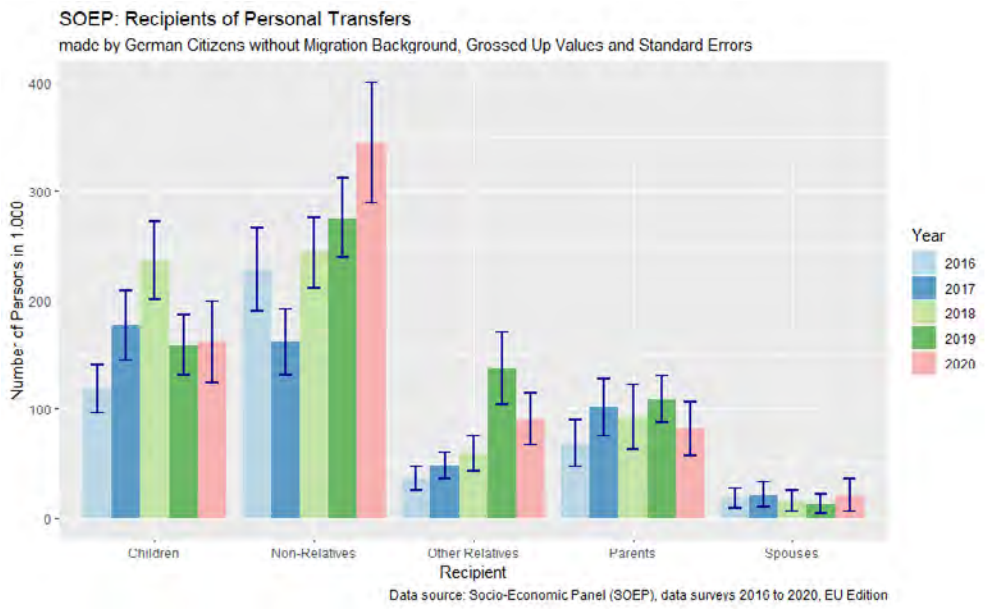
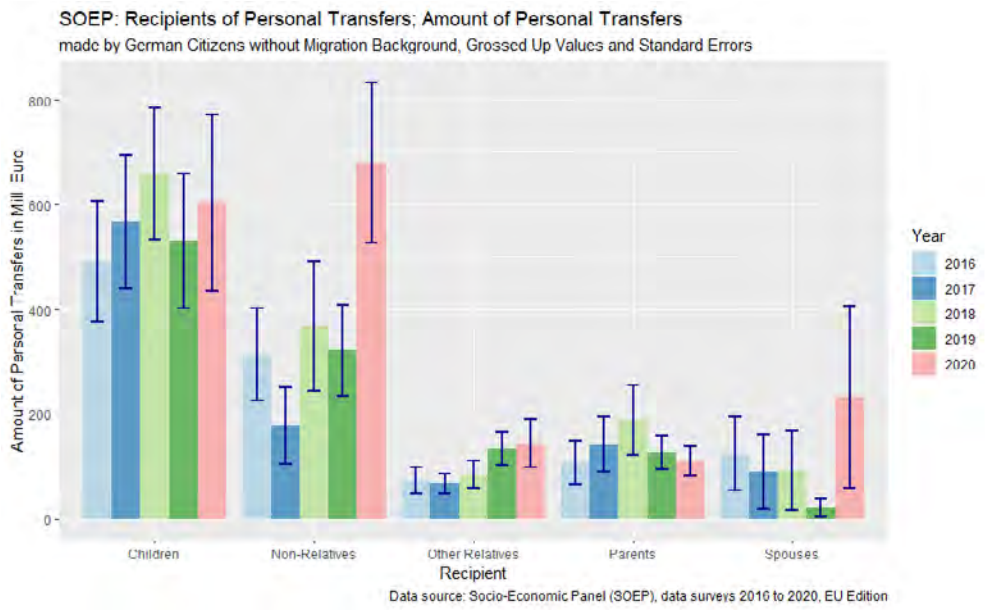


Figure 17



From an analysis on type of receiver, the most volatile type, and with a slightly different behaviour, are the non-relative receivers. Particularly noticeable are increases in transfers to this type of receivers in 2020 coinciding with the first year of the COVID19-Pandemic. This variation together with the assumption that senders lack

of personal ties with the recipients can be an indicator of personal transfers being sent to help alleviate these situations. These payments would no longer be considered personal transfers, as many of them are routed through NGOs.

However, funds that are sent to students have to be deducted, as students are not considered residents of their host country (see BPM6 4.120). The main countries in which German students choose to study are shown in Table 5. These amounts are to be deducted from a total amount for German citizens with no migration background according to their geographical allocation. An 80% of citizens sending no non-relatives is deducted to account for payments not considered personal transfers. Since there is little to no evidence in the SOEP as to the possible ties of Germans with no migration background engaging in personal transfers with persons in other countries, the number of Germans living abroad is taken as a proxy for a possible relationship. This information is taken from UNDESA, which publishes a statistic on current migrant stock by country of origin and destination. To arrive at a probable geographic allocation, the diaspora is weighted with GDP per capita information available at World Bank[27].

German Students Studying Abroad[28]

Most relevant countries for Reporting Years 2017 to 2021 Table 5

Year	2016	2017	2018	2019	2020
Austria	20,0%	20,5%	21,7%	22,1%	25,6%
Netherlands	15,6%	15,7%	15,9%	16,4%	18,5%
United Kingdom	11,2%	11,3%	11,4%	10,4%	9,6%
Switzerland	10,4%	10,4%	8,6%	8,4%	9,0%
United States of America	7,2%	7,2%	6,9%	6,8%	4,1%
China	5,8%	5,6%	6,0%	5,9%	2,6%
France	4,3%	4,6%	3,2%	3,5%	2,9%
Turkey	2,4%	2,6%	2,9%	2,9%	3,2%
Hungary	2,3%	2,3%	2,6%	2,5%	2,6%
Denmark	2,5%	2,2%	2,2%	2,1%	2,5%
Rest of the World	18,5%	17,7%	18,7%	19,0%	19,6%

Sources: Statistisches Bundesamt (Destatis), 2024 | Stand: 02.01.2024

[27] World Development Indicators. DataBank. GDP per capita (current USD), available at: https://databank.worldbank.org/reports.aspx?source=World-Development-Indicators (cited on 08.01.2024)

[28] German students abroad can be found using code "21721-0002" at Destatis' data service genesis online: https://www-genesis.destatis.de/genesis/online?operation=find&suchanweisung_language=en&query=21721-0002 (pages in German, cited on 2.1.2024)

Results

The estimation methods described above are based on SOEP-obtained characteristics, and are calculated for a time horizon spanning from 2016 to 2020. As a result of the combination of demographic statistics and SOEP data, three different population groups are distinguished, one for foreign citizens living in Germany, and two for German citizens living in Germany according to whether they have a migration background or not. To obtain a final personal transfers result, all three estimation results have to be added. Results are then compared with the amounts published by the *Deutsche Bundesbank*, as a benchmark.

Table 6 shows the number of foreign citizens that engage in personal transfers compared to the total foreign population in Germany. Numbers show that, for the studied time horizon, the average proportion of foreign population engaged in personal transfers is 13%, with a peak in 2017 (46% growth from the previous year). When looking at the growth rate of total foreign population, the peak occurs in 2016 with a 10% increase, coinciding with the influx of population from the Middle East. This suggests that migrants do not immediately engage in personal transfers when they first arrive to the country, but sometime later. If this information is contrasted with employment numbers, an increase of 42% and 47% can be observed in 2017 in full-time and part-time employment and in marginal employment, possibly meaning that foreigners start engaging in personal transfers when their employment status becomes relatively stable. Note the fact that foreign population not being employed amounts to 20% of those sending personal transfers, backing the assumption, that income from employment is not the sole driver for making personal transfers.

Foreign population living in Germany

Number of persons. Reporting Years 2016 to 2020 — Table 6

Year	Total foreign population living in Germany	Estimation of foreign population engaging in personal transfers	of which: Full-time and Part-time employed	of which: Marginal and irregular employed	of which: Not employed
2016	10.039.110	1.089.742	871.899	38.433	179.409
2017	10.623.945	1.586.111	1.236.919	50.791	298.400
2018	10.915.440	1.479.929	1.094.021	81.669	304.240
2019	11.228.275	1.468.061	1.124.929	31.136	311.995
2020	11.432.490	1.538.353	1.182.888	148.467	192.987

Source: Ausländerzentralregister (AZR), SOEP, own calculations

On the other hand, German citizens engaging in personal transfers out of total German residents represent a smaller proportion than in the case of foreign citizens, an average of 1% for the studied time horizon. While the population remains stable in relative terms, the number of German citizens engaged in personal transfers increases significantly in 2017 (by 71%), with more emphasis on those without migration background (82%) than on those with it (60%). An increase of 21% occurs in 2020 for German population with migration background, which might be explained

as a support effort to relatives abroad during the COVID19 crisis. It can also be observed that, the proportion of Germans without migration background is slightly higher than the proportion of Germans with migration background.

German population living in Germany

Number of persons. Reporting Years 2016 to 2020 Table 7

Year	German citizens living in Germany	Estimation of German citizens that engage in personal transfers	of which: with migration background	of which: without migration background
2016	71.391.890	612.706	284.689	328.017
2017	71.116.055	1.049.863	454.248	595.616
2018	70.697.560	1.081.650	469.907	611.743
2019	70.619.725	1.084.584	465.761	618.823
2020	70.742.510	1.157.378	565.245	592.133

Source: Destatis, SOEP, own calculations

When comparing the estimated population segments involved in personal transfers with that currently used in the methodology of the *Deutsche Bundesbank*[29], several differences can be found. The estimation method proposed includes the population with German citizenship, as their involvement in personal transfers is confirmed by SOEP data. Moreover, naturalization statistics show that every year an increasing number of foreign citizens obtain the German nationality, and they may still have ties to their countries of origin, or there might be German citizens without migration background who may support family members abroad. As for the foreign population, two different population sources are used, the AZR and the BA. The AZR takes into account the whole population with foreign citizenship and not just those employed subject to social security contributions. There is evidence in SOEP data of foreign citizens in Germany of different employment status sending money back home. Additionally, the approach proposed applies shares to the identified sub populations. The assumption that only a portion of respective sub group is engaged in personal transfers is backed by SOEP data evidence and may have several reasons. For example, the longer the stay of a foreign migrant the weaker the ties to their country of origin. Also, the more immediate family members are together with the migrant in the host country the less reasons he will have make personal transfers.

As for the estimated amounts of personal transfers, when combining amounts from all three populations, the volumes shown in Table 8 are obtained. As expected, amounts sent by foreign citizens are the largest with an average weight of 56% over the observed period, followed by amounts sent by German citizens with no migration background (31%), and Germans with migration background (14%).

[29] Friedrich, Walter, Zeitschel; The German remittance market – an overview"; Deutsche Bundesbank; 2007; https://www.bundesbank.de/resource/blob/615638/5146380aa292d0398096bbdb72e51701/mL/the-german-remittance-market-data.pdf; (cited on 20.10.2023)

Estimated amount of personal transfers

Million Euros. Reporting Years 2016 to 2020 Table 8

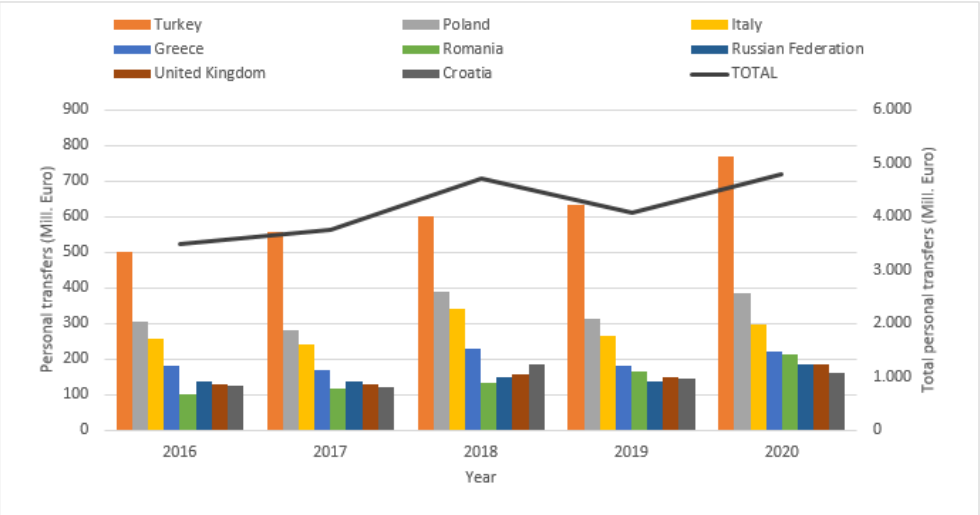
Year	Deutsche Bundesbank estimation of personal transfers	Estimation of personal transfers	of which: from foreign citizens	Of which: from German citizens with migration background	Of which: from German citizens with no migration background
2016	4.196	3.488	2.067	365	1.056
2017	4.613	3.761	2.060	439	1.262
2018	5.142	4.702	2.744	546	1.413
2019	5.431	4.061	2.339	668	1.055
2020	5.908	4.806	2.350	878	1.578

Source: Deutsche Bundesbank, Ausländerzentralregister (AZR), SOEP, own calculations

The amounts show an increasing trend over the observed years. An exception is the year 2018, for which a local peak is estimated. This is mainly explained by relatively high amounts of personal transfers surveyed for foreign citizens in that year in the SOEP. It can be seen that volumes attributed to German citizens with no migration background are higher than those attributed to those with migrant background. This probably occurs because of the higher average personal transfer amounts obtained when modelling SOEP data due to the different dynamics of these two separate population segments. Note further that the amounts obtained by using the population statistics provided by Destatis and AZR as a stable aggregation frame yield very similar to those grossed up from SOEP directly (see Table 1), vindicating the assumption that estimation steps taken to add detailed geographical allocation taken from AZR and Destatis sources, do not bias results remarkably.

Out of the more than 200 countries to which personal transfers have been allocated, 8 concentrate 50% of total volume, 22 account for 75%, and the remaining 25% is greatly dispersed. Country corridors accounting for 50% of all personal transfers in 2020 can be seen in Figure 18, which shows their evolution between the years 2016 to 2020. Turkey stands out as the main counterpart country followed by Poland, Italy, Greece, Romania, the Russian Federation, the United Kingdom and Croatia. Most of these countries match the main nationalities of foreign citizens in Germany reported by the AZR and the BA during those years. In addition, the geographical allocation of personal transfers shows a relatively stable structure throughout the observed period. For the top three countries, Turkey´s weight on total volume stays between 13% and 16%, Poland´s weight stays between 7% and 9%, and Italy´s between 6% and 7%.

Figure 18. Personal transfers by country. Countries representing 50% of total amount.



The estimated personal transfer amounts are 18% smaller than those published by the *Deutsche Bundesbank* in 2020, which seems counter intuitive because the estimation approach described here covers more sub populations than the current estimation method. The methodological difference leading to this outcome is the application of smaller shares of residents engaged in personal transfers based on SOEP findings, which deviates from the current apporach, that assumes that all foreign citizens resident and employed in Germany make personal transfers.

Regarding the geographical allocaton, the estimated amounts being more widely spread among countries than the currently published data by the *Deutsche Bundesbank*[30], since countries accounting for 75% of the data amount to 21 as opposed to 18, respectively. Moreover, due to the assumptions made in this estimation method, the country composition of this 75% changes slightly, although the top three countries remain the same: Turkey, Poland and Italy. Rising through the ranks are the United Kingdom, Spain, France, the United States and Austria, which are more represented with our estimation method, since part of the German population is assumed to send personal transfers to these countries where family members are located.

It can be said that results are reasonable, since volumes and country composition do not vary widely in comparison to current benchmarks. The estimation method proposed constitutes a comprehensive approach to estimating personal transfers, since it covers all German residents, and it allows for a more precise approach thanks to SOEP data, which enables a better understanding of dynamics in German personal transfers.

[30] See "Figures"-section for further details.

Discussion and Outlook

This paper focuses on personal transfers within the German balance of payments, relying on the SOEP as a data source with its wealth of socio-demographic variables, enabling an examination of relevant subpopulations. However, estimating robust average transfer amounts poses a significant challenge due to high variability and limited number observations. To enhance precision, exploration of additional data sources with specific transfer amounts information can be worthwhile.

SOEP's detailed data is available with a delay, impacting timeliness, critical for balance of payments analysis. To address this, integrating forecasting methods based on more prompt data from the AZR and Destatis is necessary, compensating for delayed SOEP releases.

Despite SOEP's advantages, challenges in estimating averages, addressing timeliness, and navigating complexity require exploration of supplementary data sources, implementing forecast methods, and refining the proposed approach. This iterative process can ensure adaptability to evolving data landscapes, contributing to nuanced insights into personal transfers within the German economy.

Looking forward, our focus is on refining the methodology and expanding the analysis scope. The immediate priority is to check the obtained results with mirror data for asymmetries to adjust the model when necessary. Moreover, addressing challenges in estimating robust averages involves a research initiative to identify additional data sources focused on transfer volumes for a more accurate depiction. Emphasizing timeliness, we aim to enhance forecast methods for real-time decision-making.

In conclusion, our strategic outlook focuses on refining the estimation process, enhancing timeliness, and expanding the analysis scope.

Addressing these objectives aims to contribute to a comprehensive understanding of personal transfers and financial activities within the German balance of payments landscape.

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Tables

Working age foreign population in Germany (18-65 years old)

Percentages over total foreign population for Reporting Years 2002, 2012 and 2022 Table A.1

	Share of total working age foreign population			Evolution of working age foreign population	
Citizenship	2002	2012	2022	2012	2022
Turkey	24%	21%	12%	-9%	-2%
Poland	5%	8%	7%	71%	53%
Ukraine	2%	2%	7%	8%	675%
Romania	1%	3%	7%	134%	290%
Syria	0%	1%	6%	57%	1.862%
Italy	8%	7%	5%	-10%	15%
Bulgaria	1%	2%	3%	168%	218%
Croatia	3%	3%	3%	-8%	77%
Greece	5%	4%	3%	-18%	16%
Afghanistan	1%	1%	2%	0%	482%
Russia	2%	3%	2%	35%	38%
Kosovo	-	2%	2%	-	91%
Iraq	1%	1%	2%	1%	224%
India	1%	1%	2%	45%	240%
Serbia	-	2%	2%	-	37%
Hungary	1%	2%	2%	90%	82%
Bosnia Herzegovina	2%	2%	2%	-1%	41%
Spain	2%	2%	1%	-6%	50%
China	1%	1%	1%	31%	57%
Austria	3%	2%	1%	-17%	-6%
Iran	1%	1%	1%	-32%	150%
Total foreign population. Working age. Persons	5.581.162	5.752.314	9.984.360	3%	74%
Total foreign population. Persons	7.335.592	7.213.708	13.383.980	-2%	86%

Sources: Ausländerzentralregister (AZR)

Counterpart country comparison for 2020

Ranking of countries representing 75% of total amount

Table A.2

Deutsche Bundesbank	Own estimation
Turkey	Turkey
Romania	Poland
Poland	Italy
Italy	Greece
Syria	Romania
Croatia	Russian Federation
Serbia (incl. Kosovo)	United Kingdom
Bulgaria	Croatia
Greece	Spain
Hungary	France
Russian Federation	United States of America
Bosnia Herzegovina	Serbia (incl. Kosovo)
Afghanistan	Hungary
Spain	Bulgaria
Iraq	Austria
Portugal	Switzerland
India	Canada
Ukraine	Iraq
	Netherlands
	Portugal
	Bosnia and Herzegovina

Sources: Deutsche Bundesbank, own estimation

German Residents

For Reporting Years 2016 to 2020; Figures 4, 5, 6 — Table A.3

Year	Citizenship	Number of Persons in 1.000	Standard Error	Share of Persons in %	Standard Error	Amount transferred in Mill. Euro	Standard Error
2016	Foreign Citizens	907	77	10,9%	0,9%	1.807	243
2017	Foreign Citizens	1.293	99	15,0%	1,1%	1.691	211
2018	Foreign Citizens	1.178	107	13,6%	1,1%	2.155	337
2019	Foreign Citizens	1.165	112	13,1%	1,2%	1.815	250
2020	Foreign Citizens	1.171	142	13,6%	1,5%	1.751	250
2016	German Citizens	760	61	1,2%	0,1%	1.475	180
2017	German Citizens	1.007	70	1,7%	0,1%	1.522	185
2018	German Citizens	1.085	75	1,8%	0,1%	1.895	216
2019	German Citizens	1.112	77	1,8%	0,1%	1.732	208
2020	German Citizens	1.184	100	2,0%	0,2%	2.517	331

Sources: Socio-Economic Panel (SOEP) v38

German Residents with Foreign Citizenship

By Employment Status, For Reporting Years 2016 to 2020; Figures 7, 8, 9 — Table A.4

Year	Employment Status	Number of Persons in 1.000	Standard Error	Share of Persons in %	Standard Error	Amount transferred in Mill. Euro	Standard Error
2016	Full- and Part-Time	726	71	18,8%	1,7%	1.476	226
2016	Marginal and Irregular Employment	29	11	4,6%	1,8%	31	14
2016	Not Employed	149	27	4,1%	0,7%	300	88
2017	Full- and Part-Time	1.008	90	22,8%	1,8%	1.355	197
2017	Marginal and Irregular Employment	41	11	7,8%	2,3%	62	26
2017	Not Employed	243	40	7,0%	1,1%	274	72
2018	Full- and Part-Time	871	92	19,6%	1,9%	1.803	322
2018	Marginal and Irregular Employment	65	20	13,7%	4,1%	64	24
2018	Not Employed	242	50	6,8%	1,4%	287	95
2019	Full- and Part-Time	893	99	19,4%	1,9%	1.378	200
2019	Marginal and Irregular Employment	18	7	4,6%	1,9%	17	11
2019	Not Employed	248	52	6,7%	1,4%	416	149
2020	Full- and Part-Time	909	121	19,6%	2,3%	1.323	197
2020	Marginal and Irregular Employment	80	49	17,8%	9,6%	99	59
2020	Not Employed	148	50	4,4%	1,4%	313	143

Sources: Socio-Economic Panel (SOEP) v38

German Residents with Foreign Citizenship

By Country Income Class, For Reporting Years 2016 to 2020; Figures 10, 11, 12 Table A.5

Country Income Class	Year	Number of Persons in 1.000	Standard Error	Share of Persons in %	Standard Error	Amount transferred in Mill. Euro	Standard Error
High Income	2016	350,9	52,3	9,9%	1,4%	878,1	193,0
High Income	2017	404,9	54,9	11,0%	1,4%	637,3	115,8
High Income	2018	448,3	70,7	12,5%	1,8%	1.155,5	284,2
High Income	2019	331,7	60,0	9,3%	1,6%	673,6	172,3
High Income	2020	304,2	75,8	8,4%	2,0%	633,3	181,0
High and Middle Income	2016	355,5	44,0	10,7%	1,3%	518,9	90,6
High and Middle Income	2017	646,8	71,7	18,9%	1,9%	724,6	124,9
High and Middle Income	2018	557,7	68,7	15,8%	1,8%	717,6	110,3
High and Middle Income	2019	632,9	75,4	17,7%	1,9%	926,5	168,7
High and Middle Income	2020	573,9	93,9	16,1%	2,4%	827,1	153,0
Low and Middle Income	2016	185,8	34,5	24,9%	3,9%	404,5	116,2
Low and Middle Income	2017	191,5	37,2	24,8%	4,1%	302,2	124,4
Low and Middle Income	2018	106,1	33,5	15,1%	4,3%	236,2	142,3
Low and Middle Income	2019	115,3	30,9	14,1%	3,6%	160,0	58,1
Low and Middle Income	2020	223,7	64,7	31,7%	7,1%	268,7	80,1
Low Income	2016	14,7	9,1	2,1%	1,3%	5,8	3,7
Low Income	2017	48,2	18,7	6,7%	2,4%	27,2	12,2
Low Income	2018	66,3	23,5	8,2%	2,7%	45,3	18,2
Low Income	2019	82,8	49,0	9,8%	5,3%	53,8	28,7
Low Income	2020	80,2	39,8	10,7%	4,7%	26,7	12,9

Sources: Socio-Economic Panel (SOEP) v38

German Residents with German Citizenship by Migration Background

For Reporting Years 2016 to 2020; Figures 13, 14 and 15 — Table A.6

Year	Migration Background	Number of Persons in 1.000	Standard Error	Amount transferred in Mill. Euro	Standard Error
2015	direct mig. backg.	354,6	35,8	692	280
2016	direct mig. backg.	262,4	30,8	490	111
2017	direct mig. backg.	451,1	41,0	515	99
2018	direct mig. backg.	392,5	41,2	504	79
2019	direct mig. backg.	378,6	41,7	530	121
2015	indirect mig. backg.	53,8	22,2	31	12
2016	indirect mig. backg.	28,8	11,1	29	14
2017	indirect mig. backg.	48,4	13,7	41	18
2018	indirect mig. backg.	45,6	13,9	55	18
2019	indirect mig. backg.	39,8	15,2	70	45
2015	no mig. backg.	470,2	53,3	1.429	350
2016	no mig. backg.	469,0	50,5	1.570	253
2017	no mig. backg.	509,0	53,3	1.335	226
2018	no mig. backg.	647,0	59,2	2.526	410
2019	no mig. backg.	694,0	60,8	2.240	624

Sources: Socio-Economic Panel (SOEP) v38

German Residents with German Citizenship without Migration Background

By year and recipient type; Refer to Figures 16 and 17 Table A.7

Year	Recipient	Number of Persons in 1.000	Standard Error	Amount transferred in Mill. Euro1	Standard Error
2016	Children	118,5	21,8	491,1	115,1
2017	Children	176,7	32,3	567,6	127,8
2018	Children	236,5	35,6	658,9	124,7
2019	Children	159,1	27,8	530,6	128,6
2020	Children	161,7	37,2	603,8	168,1
2016	Non-Relatives	228,0	37,7	313,6	88,6
2017	Non-Relatives	161,6	29,8	177,5	73,4
2018	Non-Relatives	243,9	32,6	368,2	123,8
2019	Non-Relatives	275,6	36,9	321,1	86,4
2020	Non-Relatives	344,6	55,1	679,9	152,3
2016	Other Relatives	36,1	11,1	73,5	25,3
2017	Other Relatives	48,3	11,9	65,9	18,8
2018	Other Relatives	59,1	16,2	83,9	26,1
2019	Other Relatives	137,8	33,1	133,8	31,1
2020	Other Relatives	90,8	23,5	144,1	45,8
2016	Parents	68,6	22,0	106,0	42,1
2017	Parents	101,0	26,0	141,6	52,2
2018	Parents	92,5	29,6	187,5	66,6
2019	Parents	108,7	21,5	126,2	33,0
2020	Parents	81,9	24,8	109,3	28,4
2016	Spouses	17,7	8,9	123,4	70,0
2017	Spouses	21,3	11,9	89,7	70,6
2018	Spouses	15,1	9,7	91,5	75,5
2019	Spouses	12,8	9,3	20,1	16,9
2020	Spouses	21,1	14,9	231,8	173,8

Sources: Socio-Economic Panel (SOEP) v38

Personal transfers sent from Germany

Millions of euros. Ranking of countries representing 75% of total amount; Refer to Figure 18 Table A.9

Country	2016	2017	2018	2019	2020
Total personal transfers	3.488	3.761	4.703	4.062	4.806
Turkey	499	556	602	633	771
Poland	304	281	389	312	384
Italy	257	240	340	263	297
Greece	179	168	228	179	219
Romania	100	117	131	164	212
Russian Federation	135	136	147	138	184
United Kingdom	128	128	158	149	184
Croatia	124	119	184	145	159
Spain	111	106	135	105	137
France	105	110	135	102	127
United States of America	108	110	136	100	126
Serbia (incl. Kosovo)	66	73	82	93	109
Hungary	79	73	101	80	99
Bulgaria	49	58	63	78	98
Austria	80	81	114	86	89
Switzerland	54	56	67	51	70
Canada	23	26	64	45	68
Iraq	40	44	47	56	66
Netherlands	58	57	83	62	63
Portugal	50	47	65	50	58
Bosnia and Herzegovina	35	39	44	52	56

Sources: *Ausländerzentralregister (AZR), SOEP*, own estimation

DEUTSCHE BUNDESBANK EUROSYSTEM

Personal Transfers in the Balance of Payments

Estimation under Changing Migration Patterns

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Agenda

Introduction

Changing Migration Patterns in Germany

Estimating Personal Transfers

- Data Sources
- Evidence from Socioeconomic Panel
- Estimation Approach

Results

Outlook



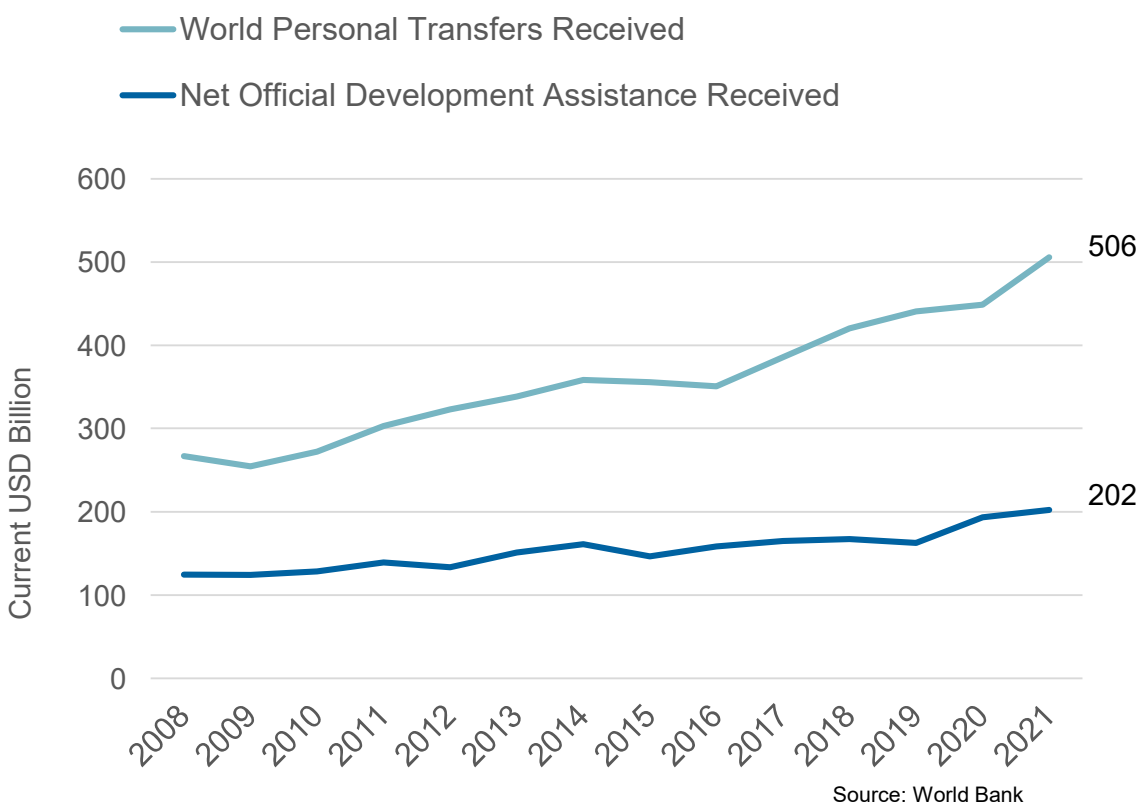
Picture Source: Wikimedia Downloadend on 01/26/2024

Introduction

“Personal transfers consist of all current transfers in cash or in kind made or received by resident households to or from nonresident households.”

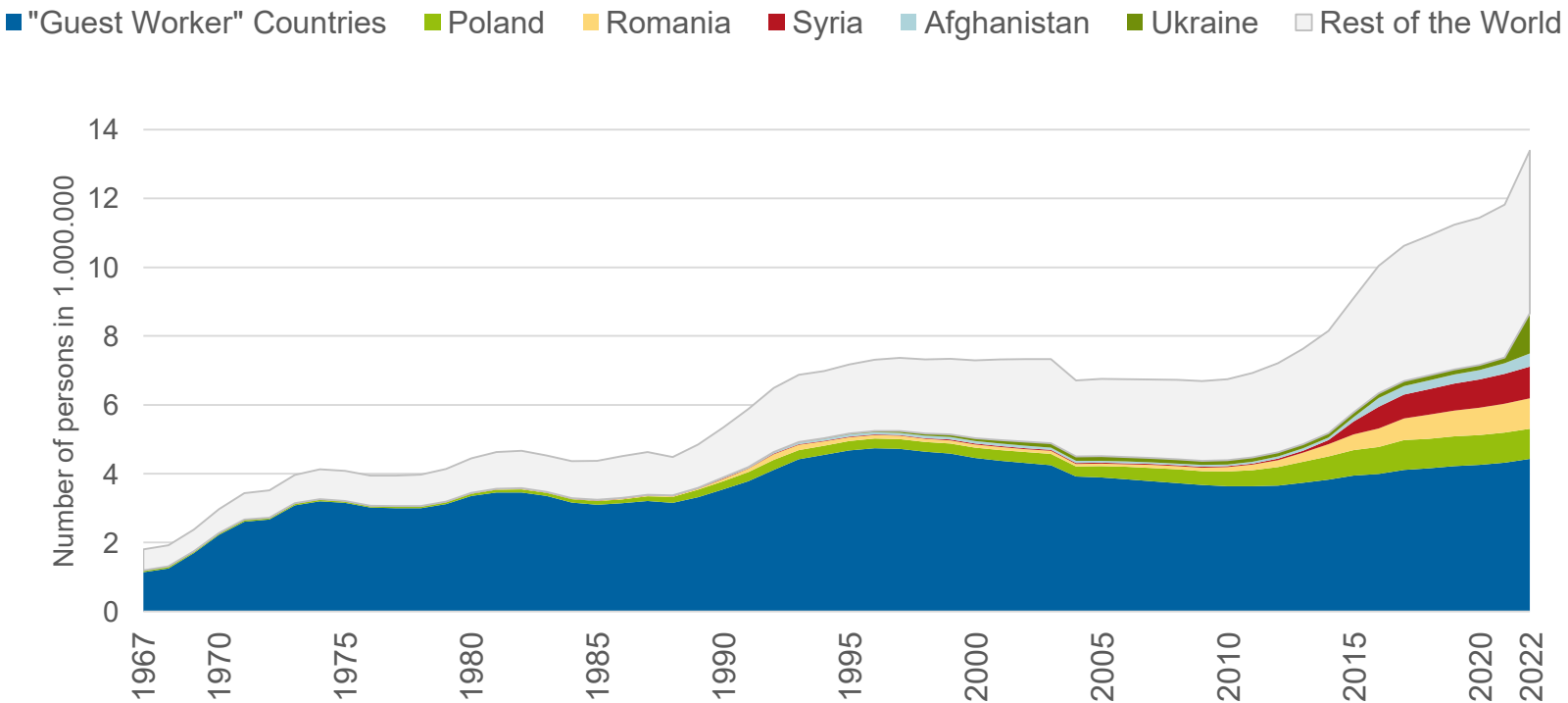
(BPM6; IMF 2019, International Transactions in Remittances: Guide for Compilers and Users)

Selected Global Transfers



Source: World Bank

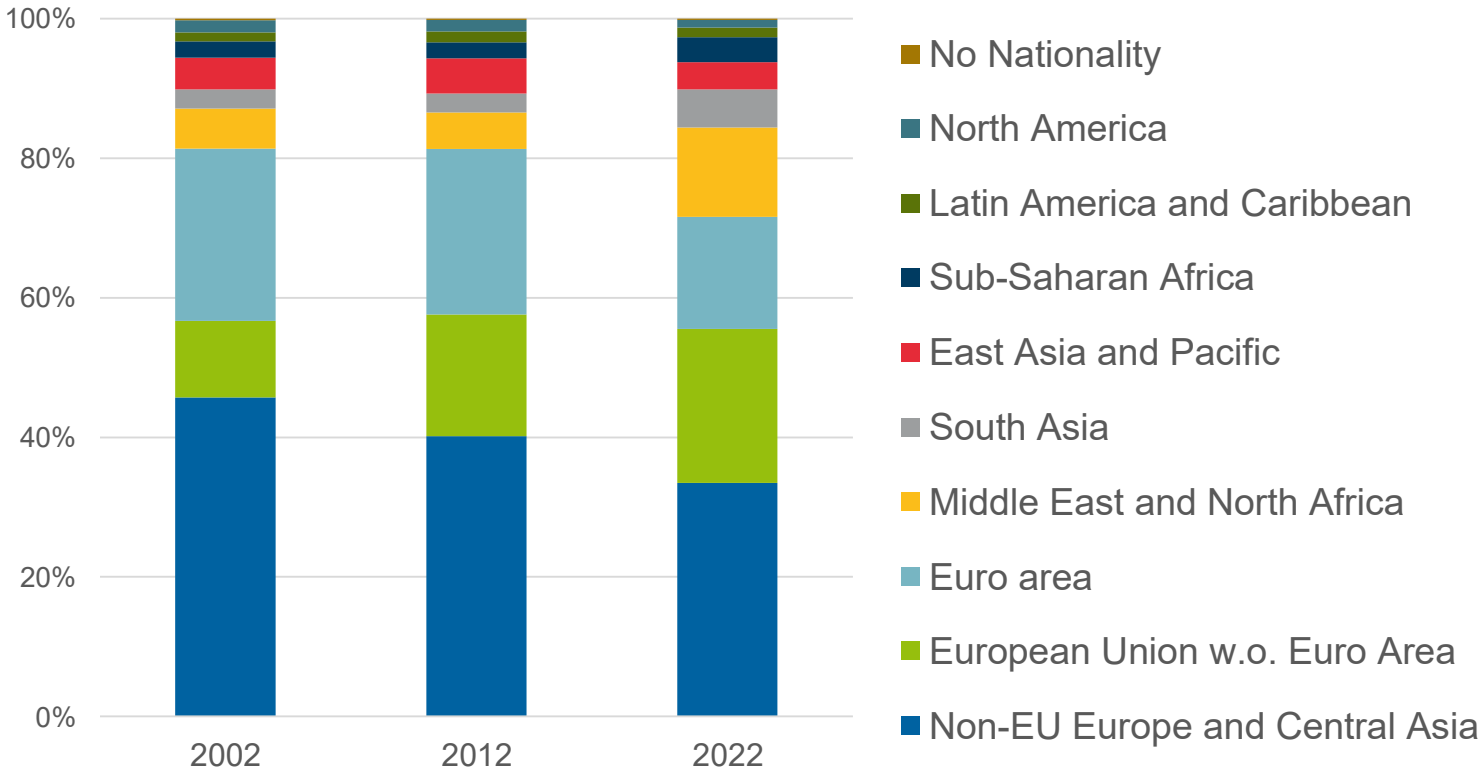
Changing Migration Patterns in Germany



13.02.2024

Source: *Ausländerzentralregister* (AZR)

Changing Migration Patterns in Germany: Relevant Regions



Source: *Ausländerzentralregister* (AZR), World Bank

Estimating Personal Transfers: Data Sources

SOEP: Socio-Economic Panel Survey on German Households. Socio-economic information on respondents available on a microdata level



Ausländerzentralregister (AZR): total foreign population numbers by citizenship, age and sex

Other sources: population statistics and macroeconomic indicators available at Federal Statistical Office Germany (Destatis), the World Bank and UNDESA

Estimating Personal Transfers: Data Sources

Socio-Demographic Patterns



GLM estimates for

Population Shares
and
Average Amount Sent

Estimating Personal Transfers: Data Sources

Socio-Demographic Patterns

SOEP The Socio-Economic Panel

GLM estimates for

Population Shares
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Population Frames
Conceptual Adjustments
Geographic Allocation







THE WORLD BANK



UNDESA

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UNDESA

Personal Transfers Debits

The German Socio-Economic Panel (SOEP)

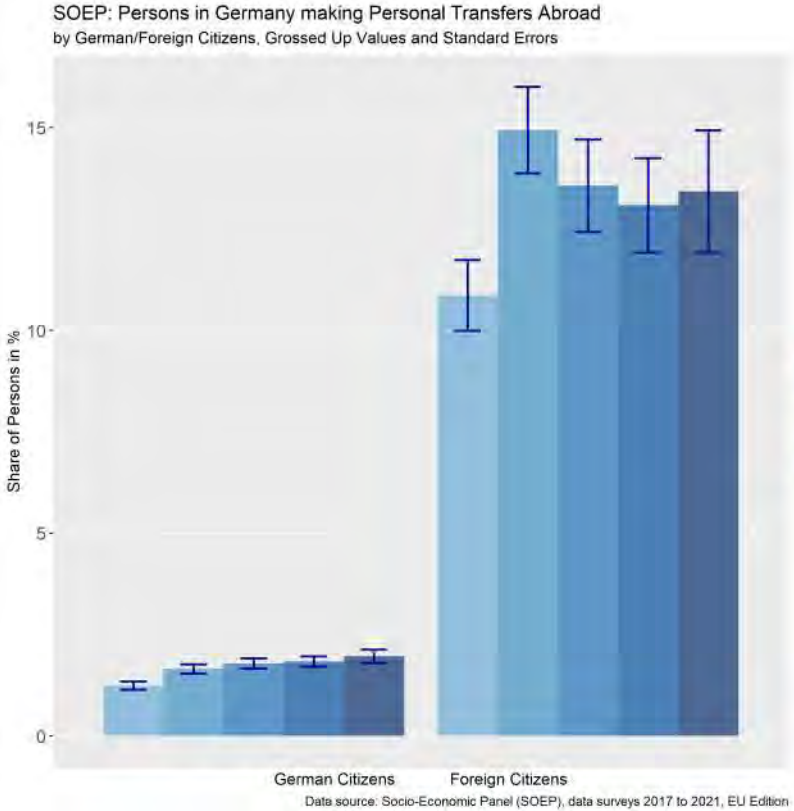
Residents in Germany making personal transfers

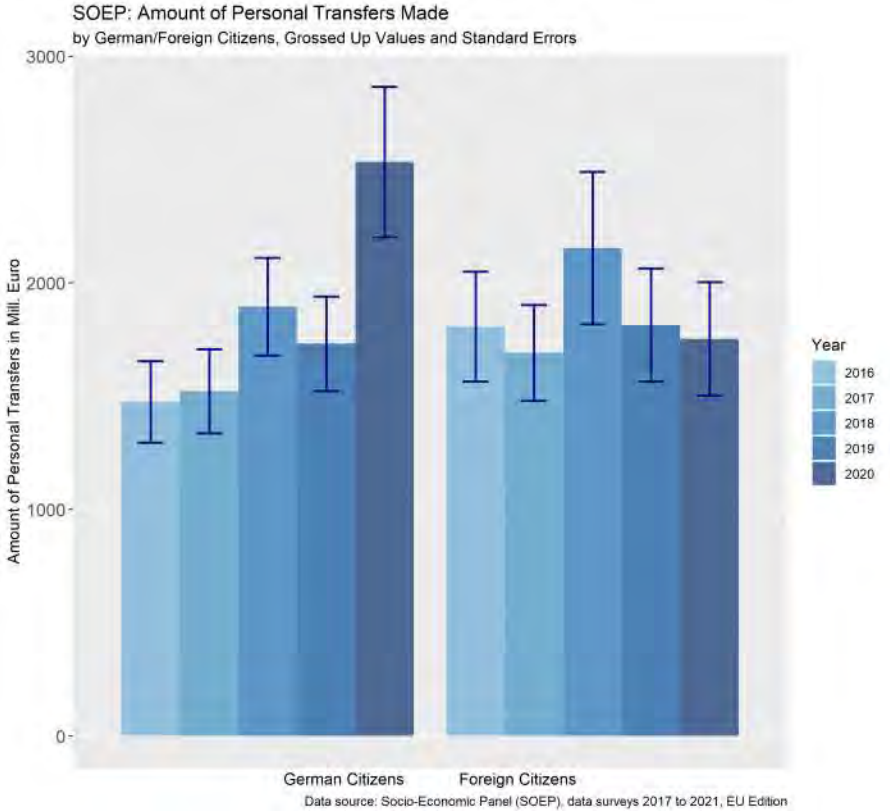
Results using solely SOEP data for reporting years 2016-2020

Year	Share of Persons	rel. Standard Error	Number of Persons (Mill.)	rel. Standard Error	Amount transferred in Mill. Euro	rel. Standard Error
2016	2,4%	5,8%	1.667	5,9%	3.282	9,2%
2017	3,3%	5,2%	2.301	5,3%	3.214	8,7%
2018	3,3%	5,7%	2.264	5,8%	4.050	9,9%
2019	3,3%	5,9%	2.277	6,0%	3.546	9,2%
2020	3,4%	7,2%	2.370	7,4%	4.268	9,7%

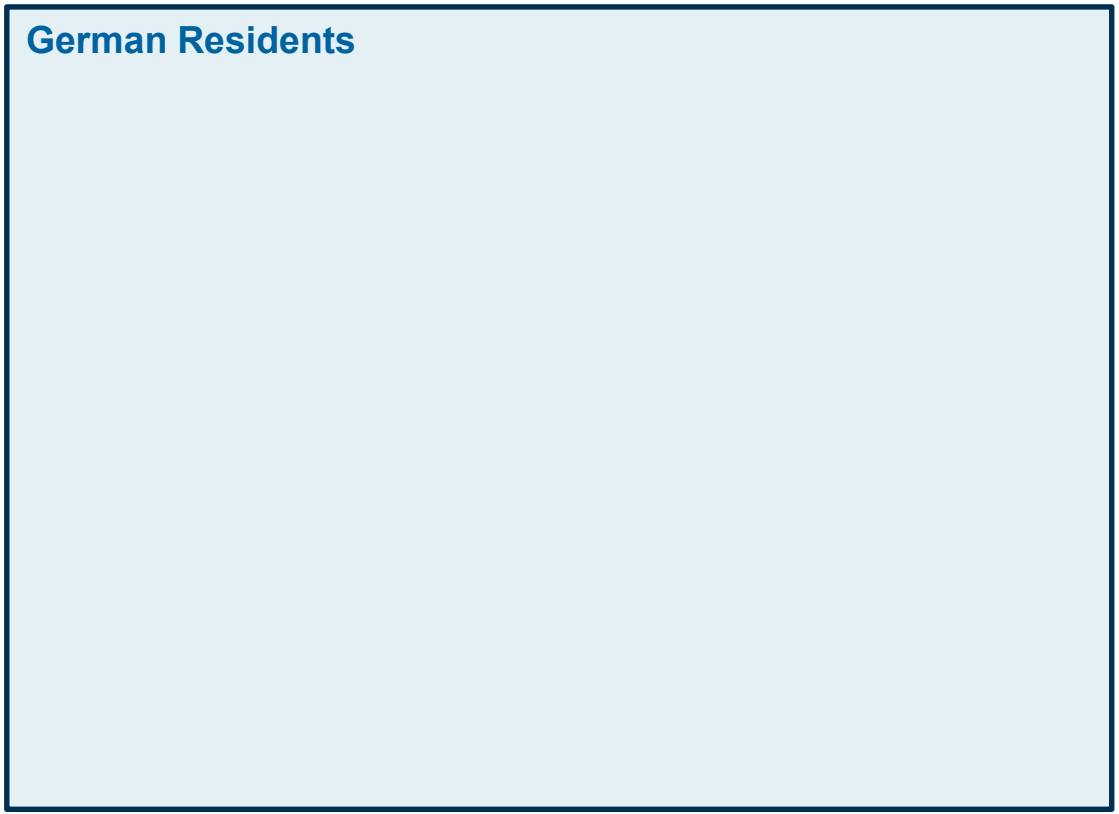
Source: Socio-Economic Panel (SOEP) v38

The German Socio-Economic Panel (SOEP)

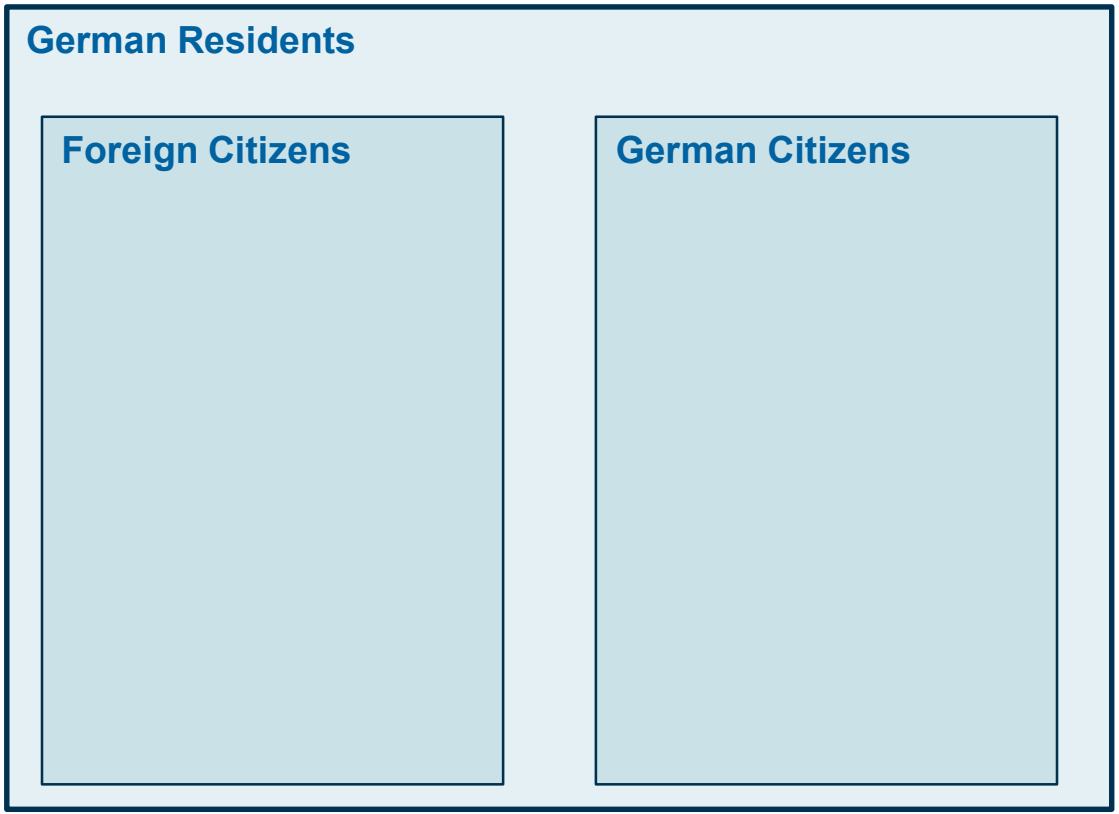




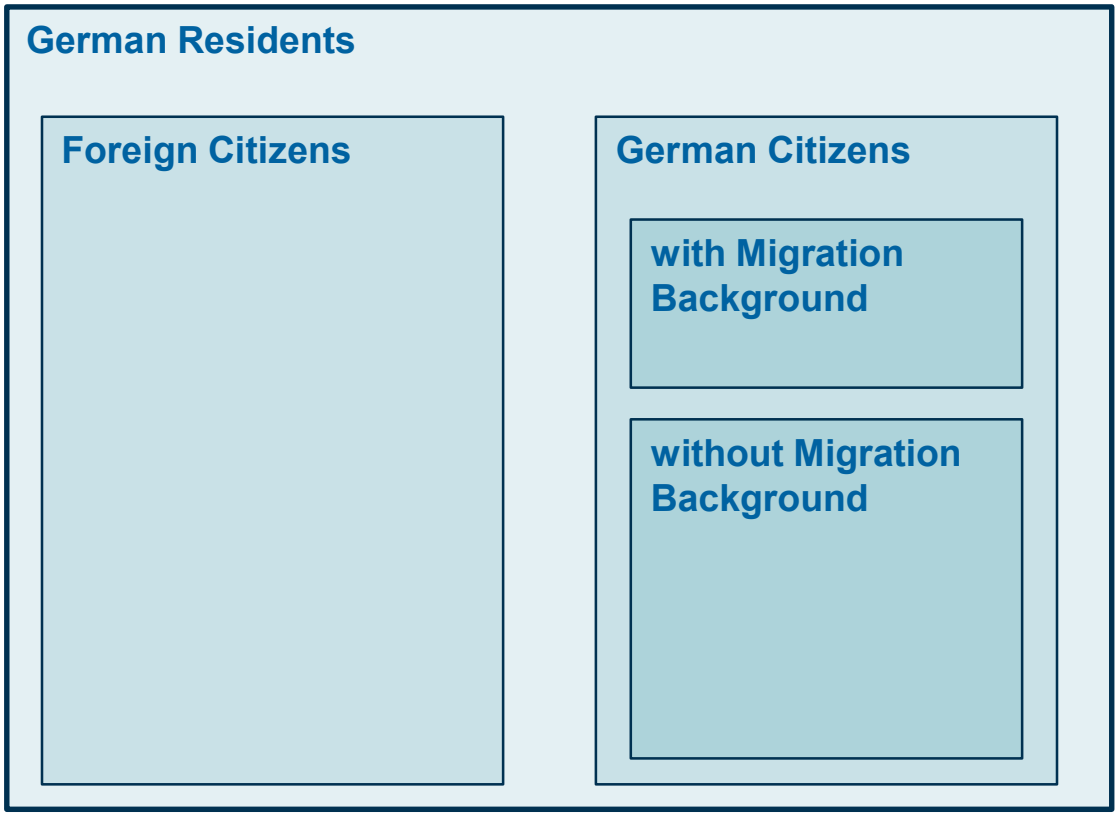
Subpopulations observed within SOEP



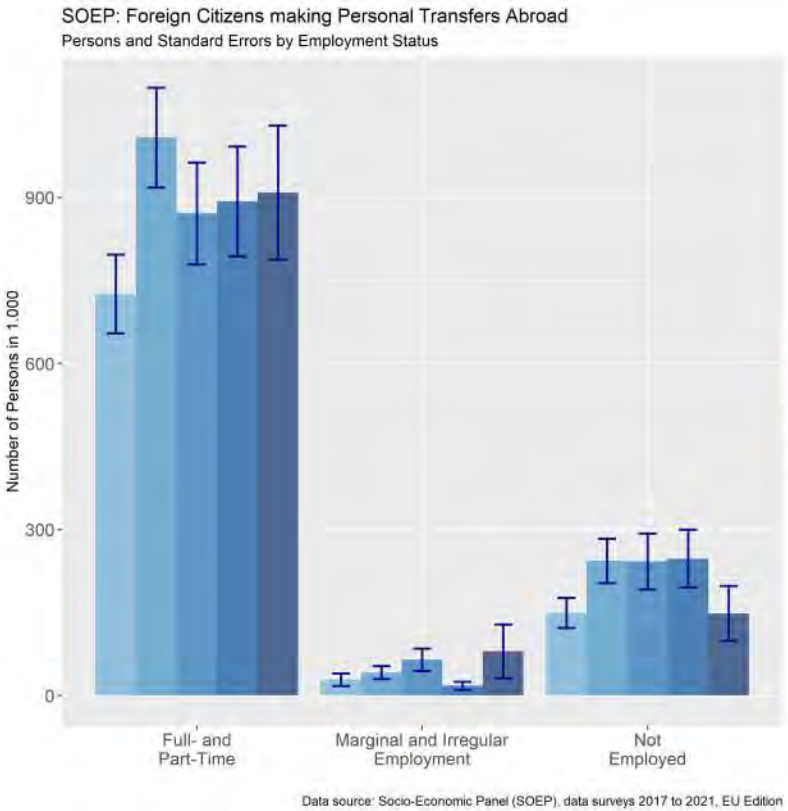
Subpopulations observed within SOEP

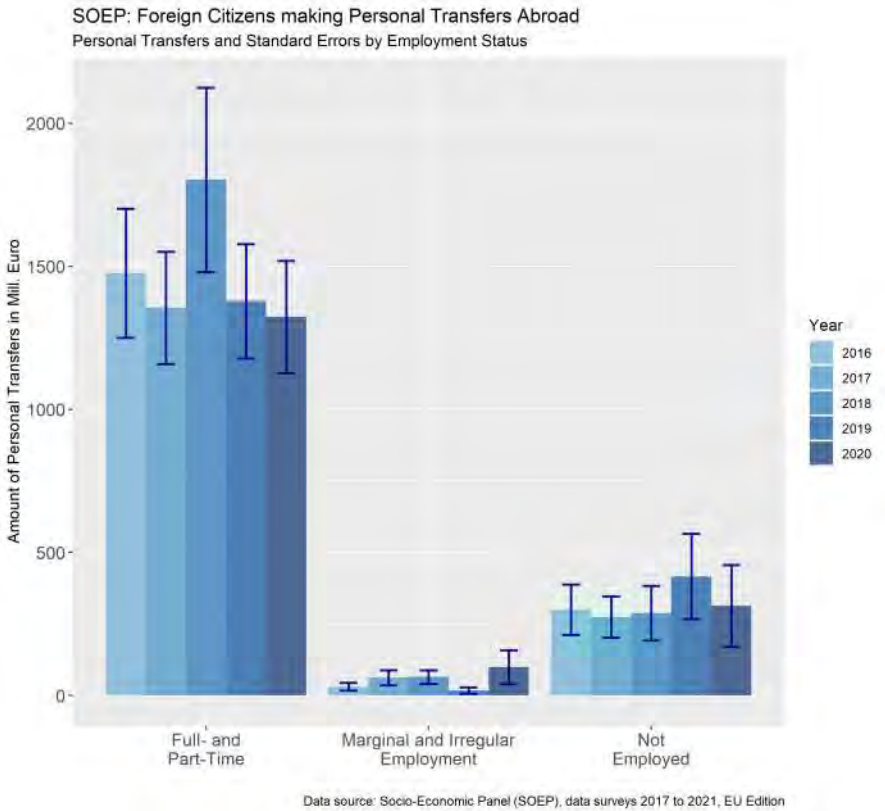


Subpopulations observed within SOEP

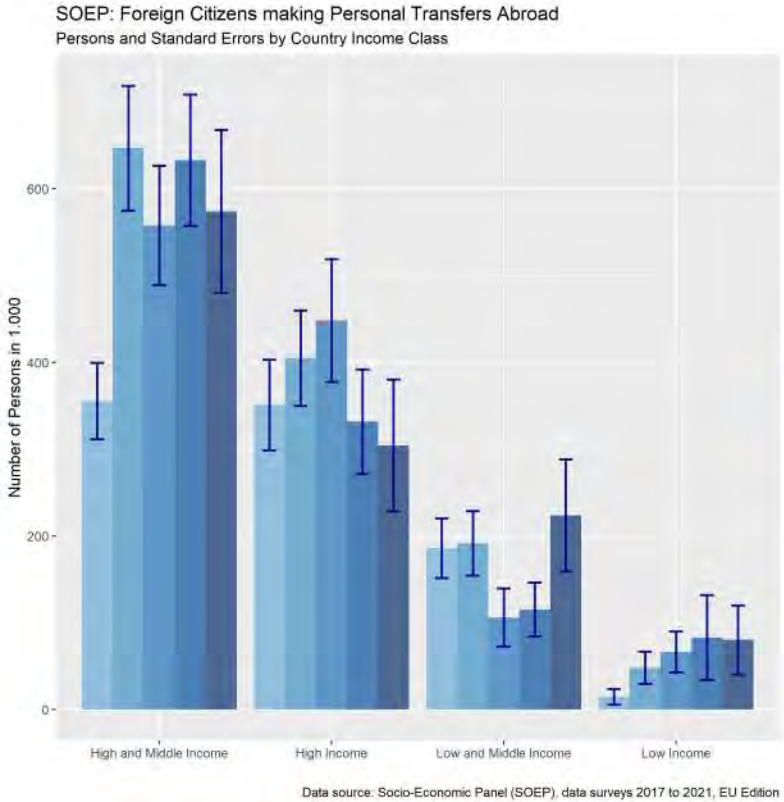


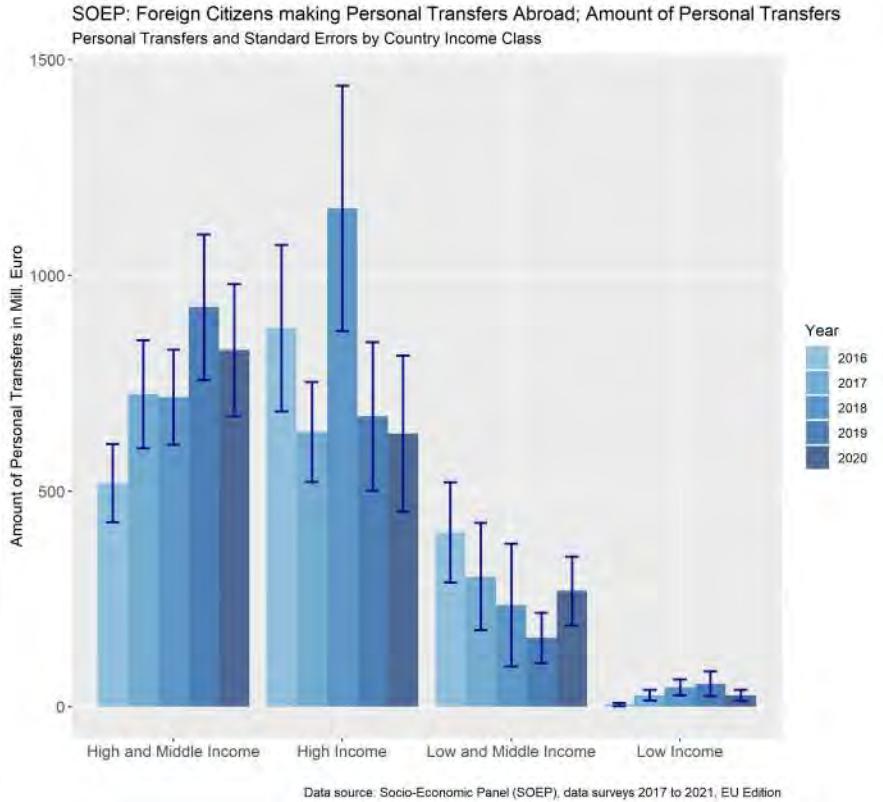
Foreign Citizens – Employment Status





Foreign Citizens – Home Country Income





Estimating Personal Transfers: Foreign Citizens

Socio-Demographic Patterns

SOEP The Socio-Economic Panel

GLM estimates
by Employment Status and
Country Income Class
for

Population Shares
and
Average Amount Sent

13.02.2024

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Population Frame



AZR

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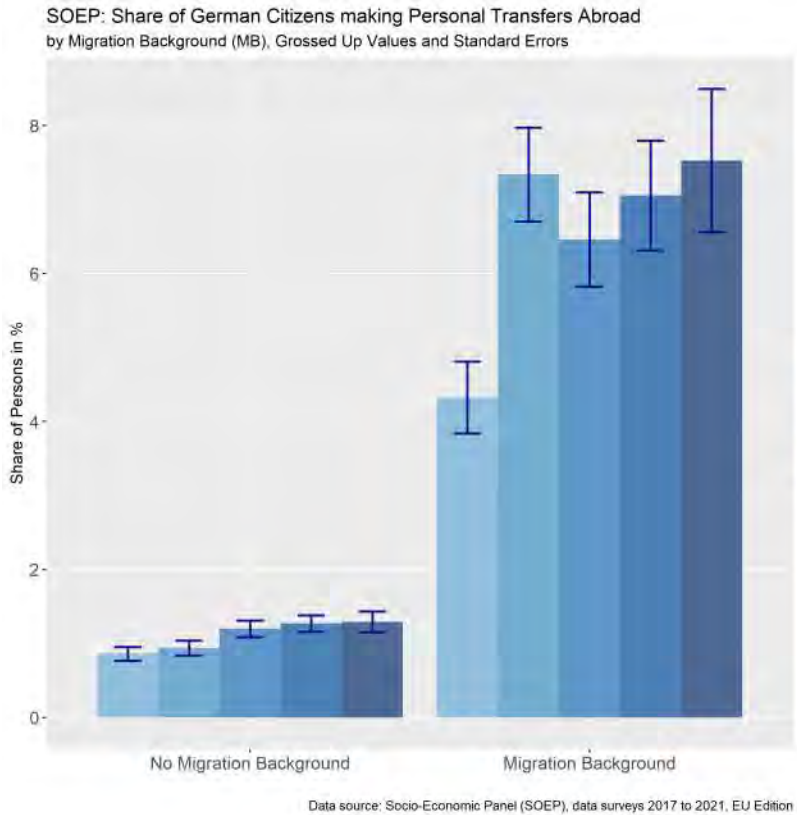
Population Frame

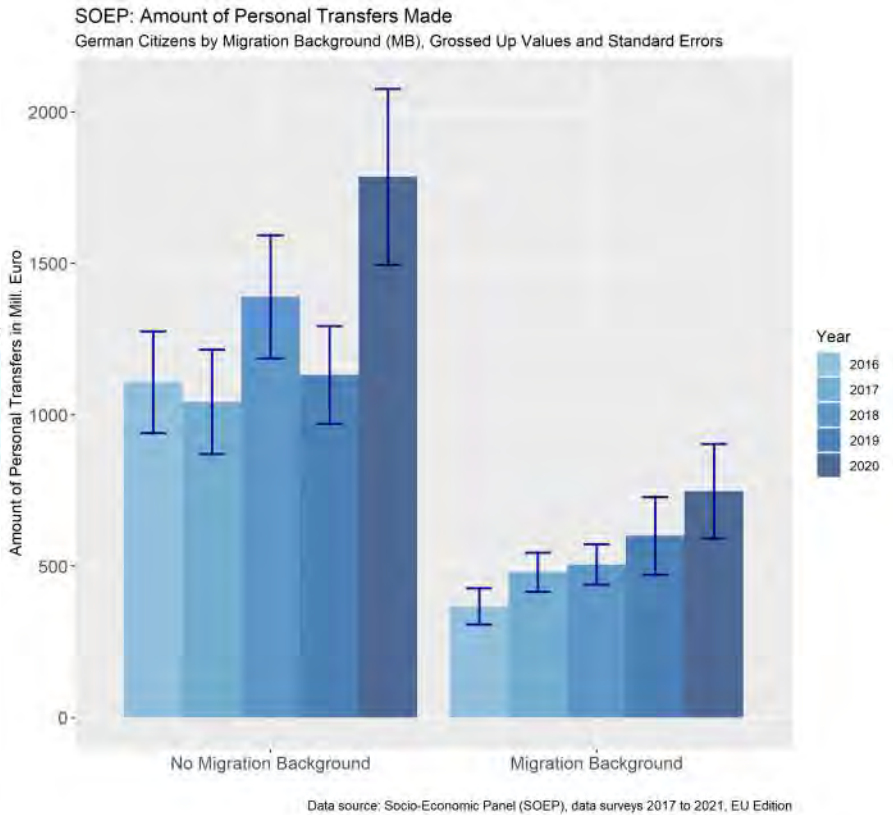


AZR

Personal Transfers Debits

German Citizens – By Migration Background





Estimating Personal Transfers: German Citizens with Migration Background

Socio-Demographic Patterns



GLM estimates
by Migration Background
for
Population Shares
+
Average Amount Sent

13.02.2024

Estimating Personal Transfers: German Citizens with Migration Background

Socio-Demographic Patterns

SOEP The Socio-Economic Panel

GLM estimates
by Migration Background
for
Population Shares
+
Average Amount Sent

Geographic Allocation

Naturalisations

Estimating Personal Transfers: German Citizens with Migration Background

Socio-Demographic Patterns

SOEP The Socio-Economic Panel

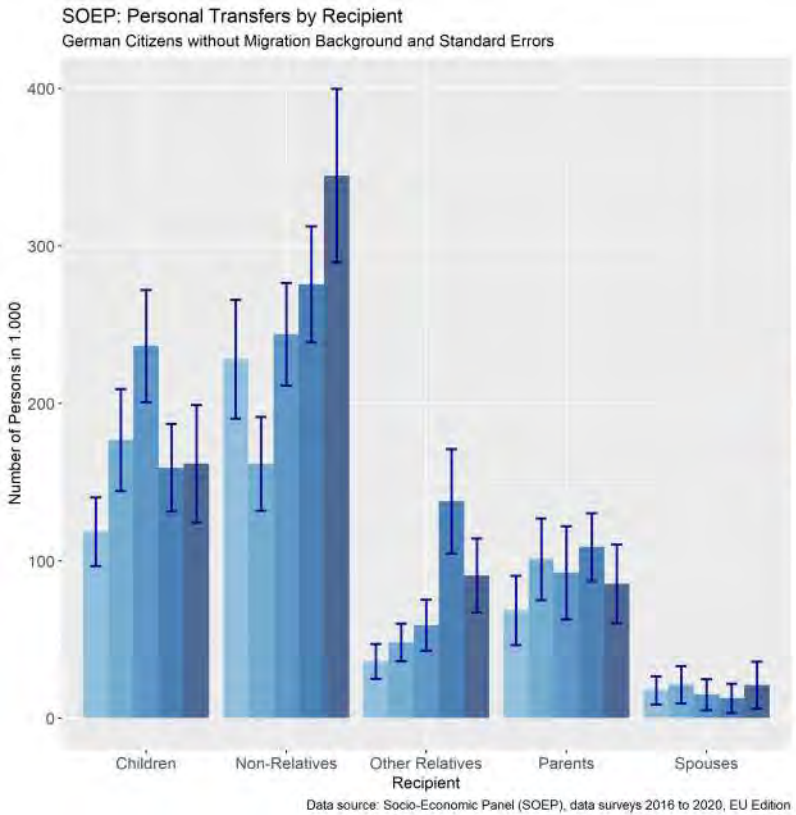
GLM estimates
by Migration Background
for
Population Shares
+
Average Amount Sent

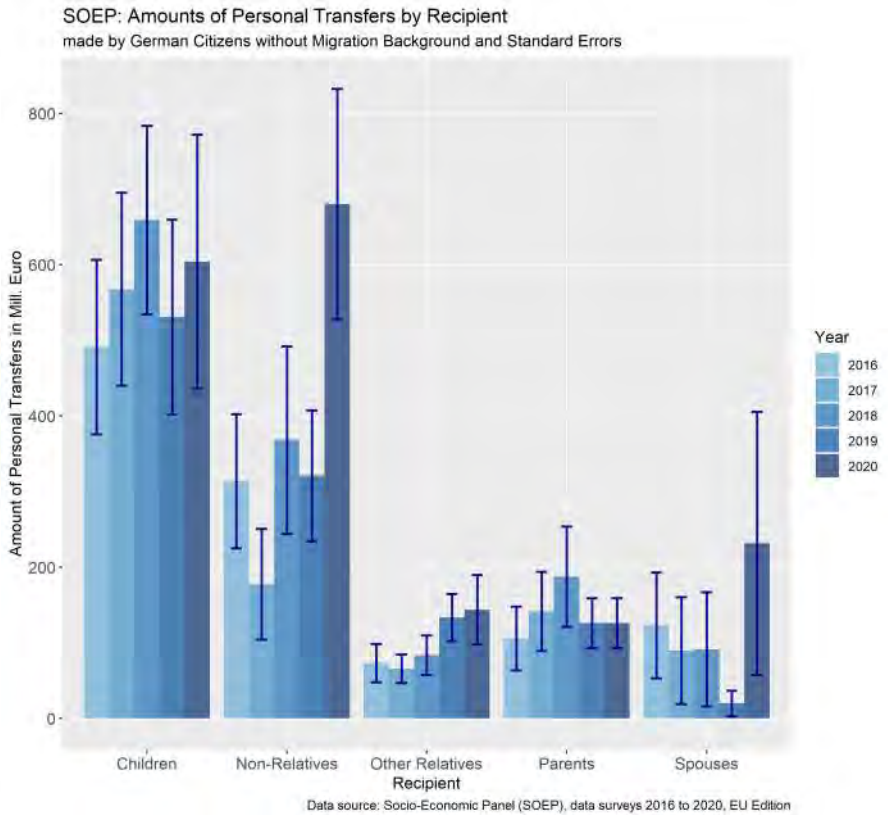
Geographic Allocation

Naturalisations

Personal Transfers Debits

Germans Citizens without Migration Background





Estimating Personal Transfers: German Citizens without Migration Background

Socio-Demographic Patterns



GLM estimates by Migration Background for Population Shares + Average Amount Sent

13.02.2024

Estimating Personal Transfers: German Citizens without Migration Background

Socio-Demographic Patterns

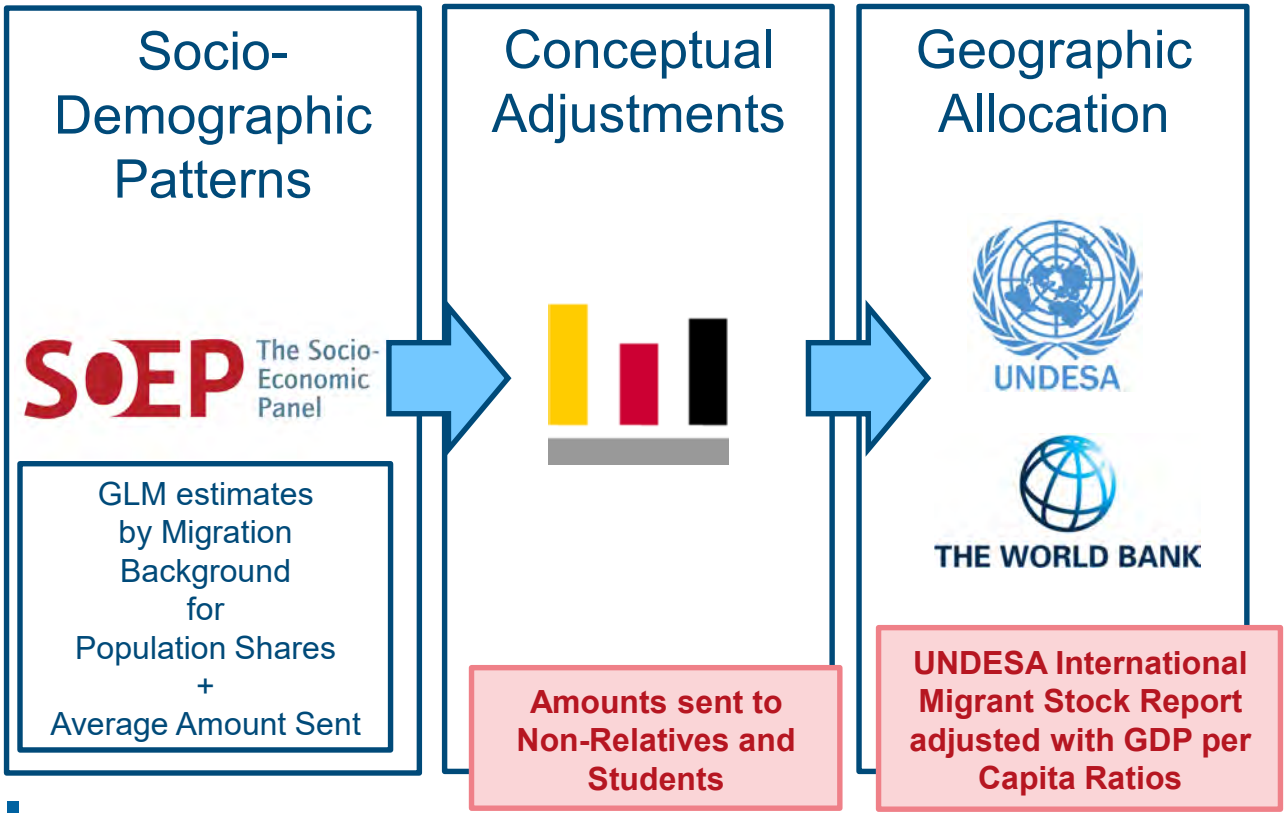


GLM estimates by Migration Background for Population Shares + Average Amount Sent

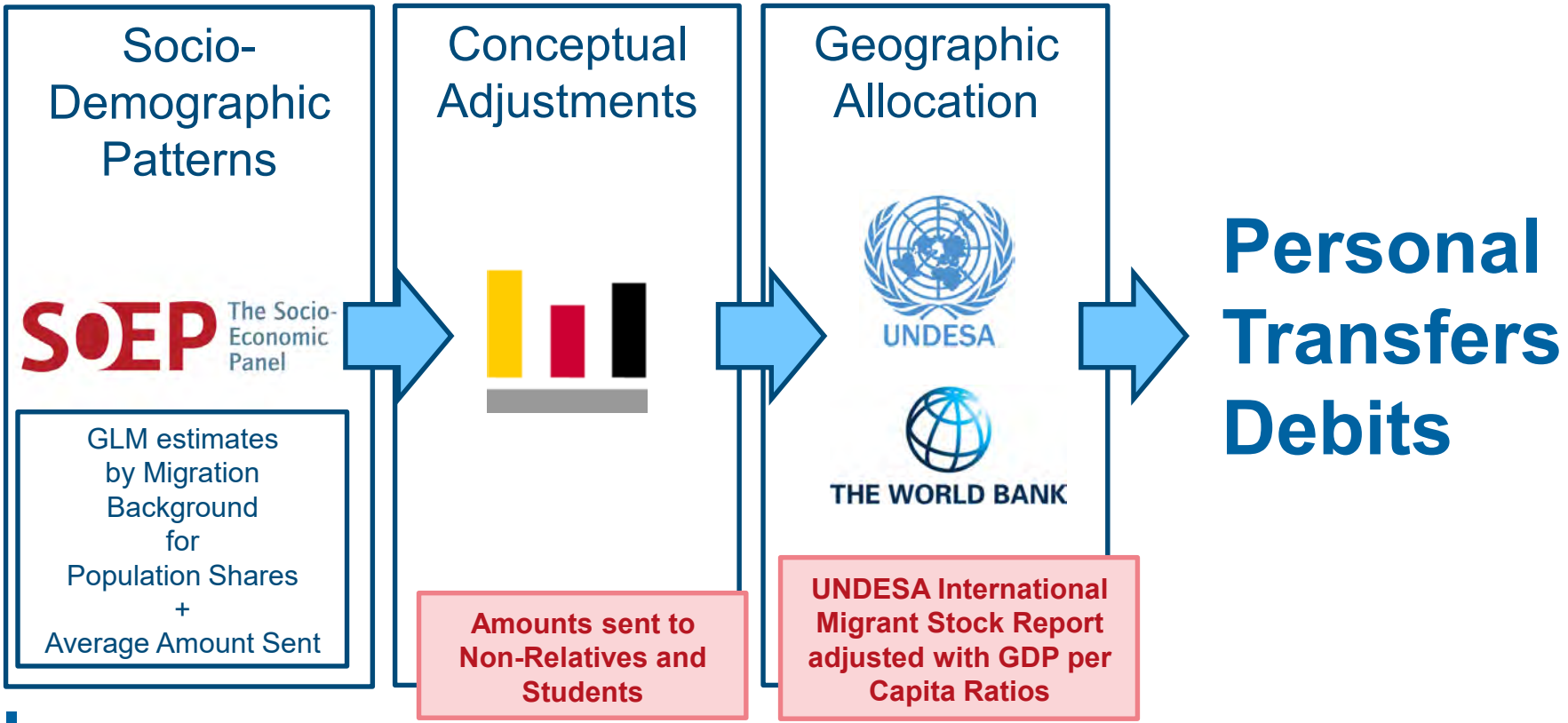
Conceptual Adjustments

Amounts sent to Non-Relatives and Students

Estimating Personal Transfers: German Citizens without Migration Background



Estimating Personal Transfers: German Citizens without Migration Background



Estimating Personal Transfers: Population Frames

Foreign Citizens living in Germany

Number of persons. Reporting years 2016-2020

Year	Total	… engaging in personal transfers	of which: Full-time and Part-time employed	of which: Marginal and irregular employed	of which: Not employed
2016	10.039.110	1.089.742	871.899	38.433	179.409
2017	10.623.945	1.586.111	1.236.919	50.791	298.400
2018	10.915.440	1.479.929	1.094.021	81.669	304.240
2019	11.228.275	1.468.061	1.124.929	31.136	311.995
2020	11.432.490	1.538.353	1.182.888	148.467	192.987

Source: Destatis, SOEP, own calculations

Estimating Personal Transfers: Population Frames

German Citizens living in Germany

Number of persons. Reporting years 2016-2020

Year	Total	German citizens that engage in personal transfers	of which: with migration background	of which: without migration background
2016	71.391.890	612.706	284.689	328.017
2017	71.116.055	1.049.863	454.248	595.616
2018	70.697.560	1.081.650	469.907	611.743
2019	70.619.725	1.084.584	465.761	618.823
2020	70.742.510	1.157.378	565.245	592.133

Source: Destatis, SOEP, own calculations

Personal Transfers: Results

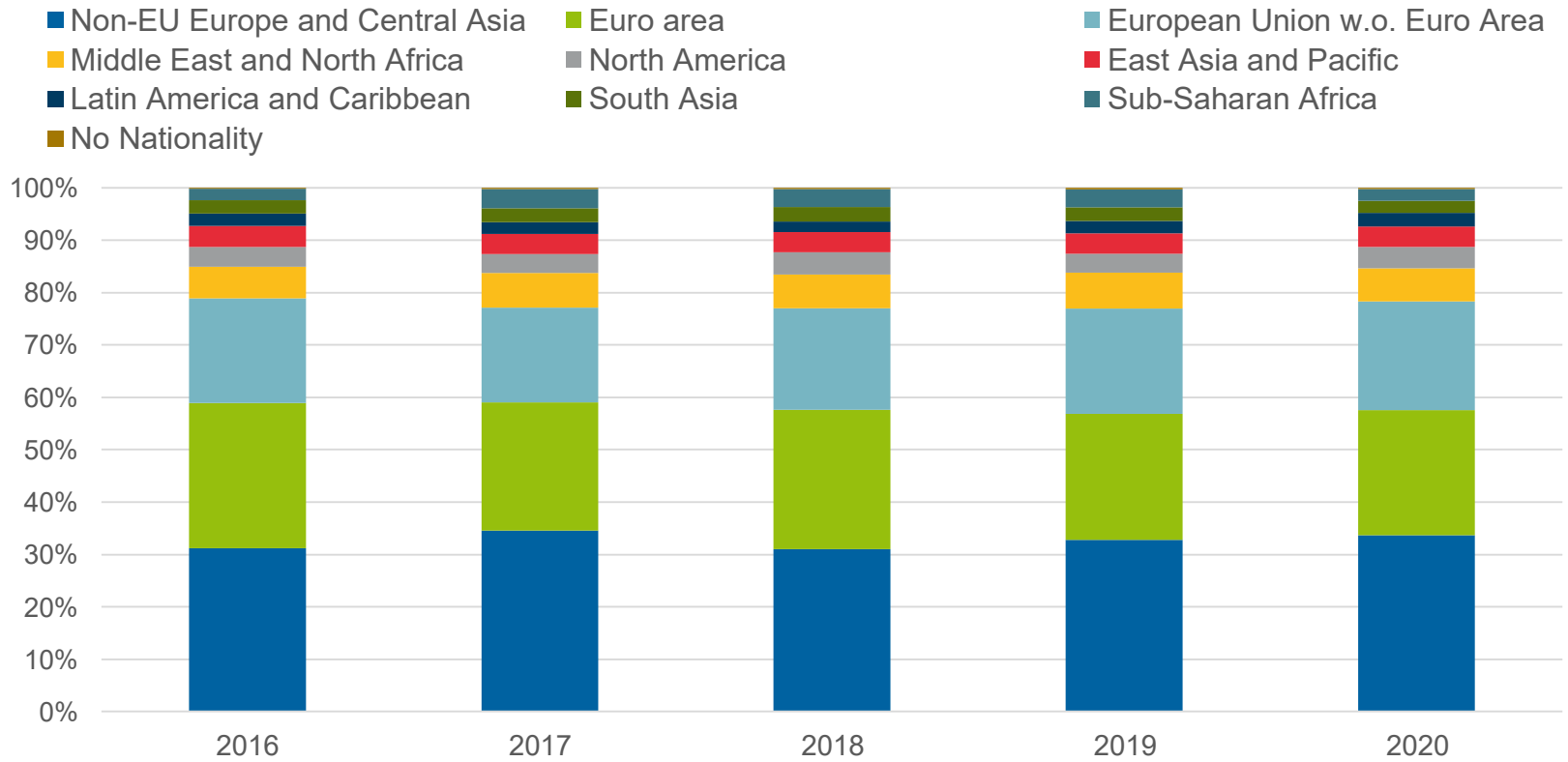
Estimated amount of Personal Transfers

Million Euros. Reporting years 2016-2020

Year	Current Estimation of Personal Transfers	Proposed Estimation of Personal Transfers	of which: by Foreign citizens	of which: by German citizens with migration background	of which: by German citizens without migration background
2016	4.196	3.488	2.067	365	1.056
2017	4.613	3.761	2.060	439	1.262
2018	5.142	4.702	2.744	546	1.413
2019	5.431	4.061	2.339	668	1.055
2020	5.908	4.806	2.350	878	1.578

Source: Deutsche Bundesbank, Ausländerzentralregister (AZR), SOEP, own calculations

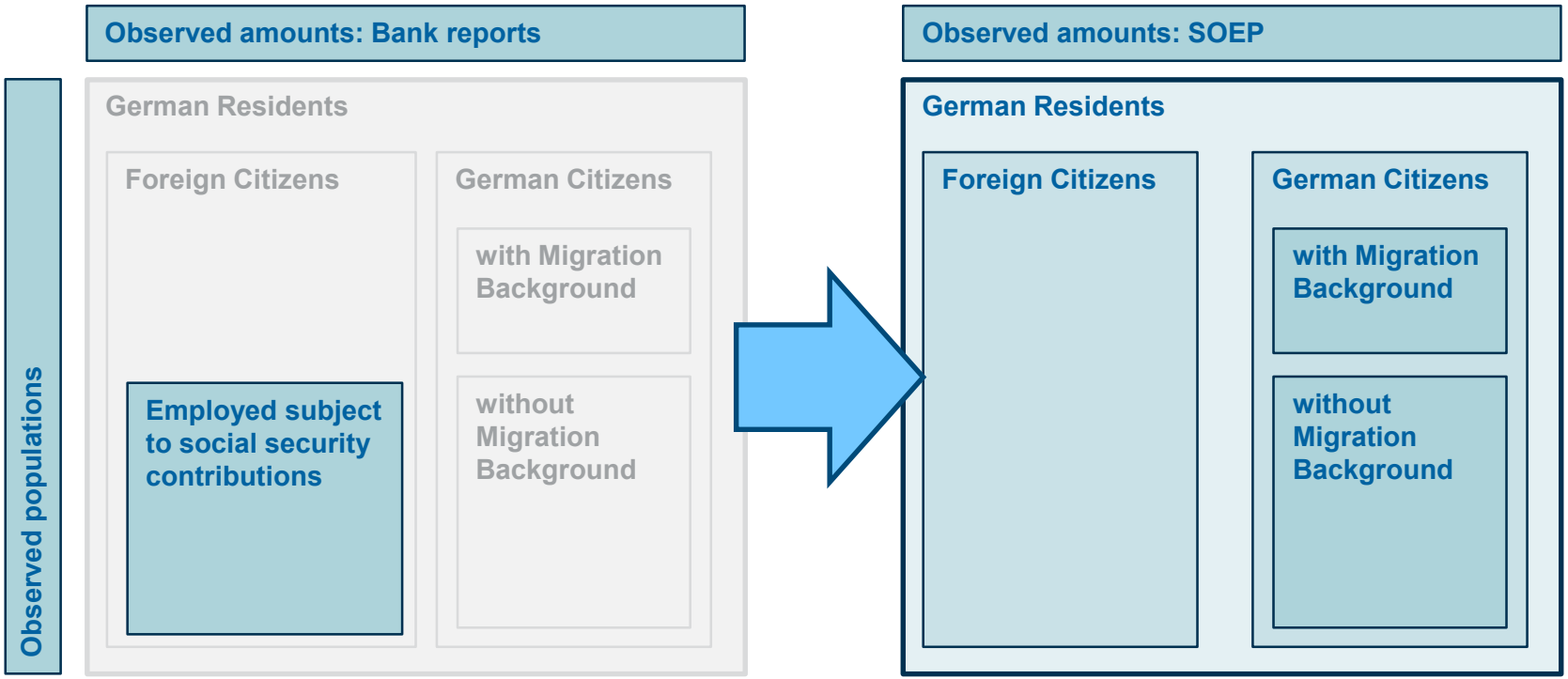
Personal Transfers: Regional Composition



Personal Transfers - Year 2020 - Top 10 Countries by Share

Current Estimation Approach		Proposed Estimation Approach	
Country	Weight	Country	Weight
Turkey	**14%**	**Turkey**	**16%**
Romania	**9%**	**Poland**	**8%**
Poland	**9%**	**Italy**	**6%**
Italy	7%	Greece	5%
Syria	5%	Romania	4%
Croatia	4%	Russian Federation	4%
Serbia (incl. Kosovo)	4%	United Kingdom	4%
Bulgaria	4%	Croatia	3%
Greece	4%	Spain	3%
Hungary	2%	France	3%

Results: Comparing the Current Approach



Shares of Persons making Personal Transfers are much smaller throughout all Subpopulations

Outlook

Bilateral asymmetry checks

Implementing Forecasting Methods

Expanding analysis scope to the credits



Picture Source: Wikimedia Downloaded on 01/26/2024

Thank You!

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Missing assets: exploring the source of data gaps in global cross-border holdings of portfolio equity?[1]

Gian Maria Milesi-Ferretti,
The Brookings Institution and CEPR

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Missing assets: Exploring the source of data gaps in global cross-border holdings of portfolio equity[1]

Gian Maria Milesi-Ferretti

Hutchins Center on Fiscal and Monetary Policy, The Brookings Institution and CEPR

Abstract

Estimates of cross-border portfolio equity liabilities are substantially larger than the corresponding cross-border claims (some $4 trillion in 2021, about 4 percent of world GDP). Resolving this discrepancy would strengthen the understanding of the cross-border implications of changes in asset prices, an important element in maintaining financial stability, and would shed light on whether unreported assets are properly covered by domestic tax systems. We show that the equity discrepancy arises primarily from equity holdings in Ireland, Luxembourg, and the United States whose ownership is not reflected in partner countries' positions. Using data from these countries' surveys of portfolio liabilities and the IMF's Coordinated Portfolio Investment Survey, we show that an important share of unidentified equity holdings (close to $3 trillion in 2021) reflects transactions through intermediaries based in the United Kingdom. This likely reflects some underestimation of UK portfolio equity holdings as well as holdings of foreign equity on behalf of nonresident investors not captured by their countries' statistics. Reducing data gaps would require stronger data collection in financial centers, including provision of information on securities' holdings through domestic custodians also for cases where neither the issuer nor the ultimate holder of the security is a resident of the country.

[1] I am grateful to Sarah Barahona, Carol Bertaut, Don Kohn, Romuald Morhs, David Wessel, and participants to the BIS-ECB-IFC conference on external statistics held in Madrid, the LSE-Oxford workshop in International Macroeconomics and Finance, and seminars at the Central Bank of Luxembourg, the ESM, and the IMF—especially to my discussant Wilson Phiri—for very useful discussions and suggestions. I am also grateful to Bruno Dawance and Johan Marigny of the Commission de Surveillance du Secteur Financier in Luxembourg for kindly providing data on the country of commercialization of Luxembourg investment funds, to Miranda Seath, Richard Hale, and Sarah Shehabi for discussions and clarifications on UK asset management, and to Dragana Ostojic, Topias Leino, and Evrim Bese-Goksu for comments and important clarifications on the CPIS survey. Alex Conner provided excellent research assistance.

I. Introduction

Data availability on cross-border financial transactions and especially cross-border financial positions has improved enormously over the past three decades. The number of countries reporting international investment position data now exceeds 160, and a variety of sources, such as the Bank of International Settlements and the International Monetary Fund, provide data on bilateral cross-border positions for financial instruments such as bank loans and deposits, portfolio equity and debt, and foreign direct investment. Broader data availability has stimulated burgeoning research on various aspects of international financial integration.

With increasingly broad data coverage, we are also better able to identify global trends in cross-border holdings and creditor and debtor positions and explore the extent to which data on global cross-border assets and liabilities are broadly consistent, identifying discrepancies. In turn, increased availability of bilateral data allows us to better understand the potential origins of such discrepancies. The External Wealth of Nations database developed by Lane and Milesi-Ferretti (2001, 2007, 2018) provides estimates of external assets and liabilities for over 210 economies and is a natural vehicle for such an exercise. As discussed in Lane and Milesi-Ferretti (2007), Zucman (2013), and most recently in Milesi-Ferretti (2023), there is a large global discrepancy in estimates of portfolio equity: estimates of global portfolio equity liabilities exceed those of portfolio equity assets by a substantial margin (some $4 trillion in 2021) and have done so for many years.

In this paper we investigate the likely sources of this discrepancy and provide evidence on where data collection efforts can help us identify the residence of holders of portfolio equity instruments which are currently unaccounted for in the asset-side data. Improving the quality of financial and external accounts by addressing this problem would have benefits going well beyond more reliable statistics. It would support financial stability analysis by strengthening the understanding of the cross-border implications of changes in asset prices and would allow an assessment as to whether such assets are properly covered by domestic tax systems. With regard to financial stability, the 2022 turmoil in the UK gilts market, provides a good example. Sales of gilts by so-called Liability-Driven Investment (LDI) funds—used by pension funds as a hedging strategy—played a key role. As documented by Dunne et al. (2023), sterling denominated LDI funds resident in Ireland accounted for a 30 percent share of net sales of gilts by such entities during the crisis period. With regard to public finance aspects, a burgeoning literature including Zucman (2013) discusses unrecorded cross-border holdings and their tax implications.

During the past 30 years, portfolio equity has become an increasingly important category in global cross-border assets and liabilities. Since 2019, portfolio equity liabilities account for over a fifth of total external liabilities and over 40 percent of global GDP. Furthermore, with the vast majority of cross-border portfolio equity reflecting listed shares or investment fund shares, valuation issues are relatively straightforward, especially in comparison with foreign direct investment. [2] Finally, as we document in the paper, the size of the global discrepancy is material (close to $4 trillion in 2021, roughly the size of Germany) and concentrated geographically: it overwhelmingly reflects claims on Ireland, Luxembourg, and the United States for which we don't know the ultimate residence of the investor.

[2] Since FDI affiliates are unlisted, reporting countries use a variety of methodologies to value them (book value, market value, current cost, historical cost) which complicates the task of aggregating and comparing cross-country data. Even for bonds, some countries report data at face value and others at market value.

The paper's main findings can be summarized as follows. A substantial part of the global portfolio equity discrepancy--equity liabilities not reported as holdings by investor countries—is managed in the United Kingdom, with a smaller share held in custody accounts in Switzerland. We present evidence suggesting that part of these shares managed in the United Kingdom reflect under-reported holdings by UK residents, while the largest part reflects holdings by international investors (including "retail" holdings by wealthy household investors) whose residence is difficult to establish. Narrowing the discrepancy would require improved reporting on so-called third-party holdings (claims on nonresidents held by other nonresidents through resident institutions), a long-standing item in discussions of international statistical reporting.[3]

The analysis in this paper for Ireland and Luxembourg is closely related to the fund-level evidence presented in Beck et al. (2024), who re-cast euro area portfolio holdings on a nationality basis, including by "seeing through" investment fund holdings. In that endeavor, they also examine the characteristics of Irish and Luxembourg investment funds reported to be held by euro area investors, contrasting them with those that are not, to assess the likelihood that euro area investor holdings of such shares are significantly under-reported.

We start in Section II with a brief description of data sources. Section III characterizes the size of the global discrepancy, relating it to available bilateral data. Section IV makes use of bilateral data to show in which countries most unrecorded assets are held, as well as in which countries such assets are likely held in custody or traded. Section V concludes.

II. Data Sources

The main data sources for the paper are:

- the Coordinated Portfolio Investment Survey, conducted since 2001 under the auspices of the IMF. currently covers over 80 economies, including the vast majority of large investors in portfolio instruments. The survey provides a destination-country breakdown for portfolio investment in equity and debt instruments, as well as, for some countries, a survey of portfolio liabilities by residence of the asset holder. It also includes a parallel survey on securities held as central bank reserves and assets of international organizations (SEFER-SSIO) which reports aggregate holdings of portfolio instruments on a country of counterparty basis[4];

- Bilateral surveys of portfolio equity liabilities beyond the few reported as part of the CPIS. These additional surveys include the one conducted annually by the United States and a survey of investment fund liabilities conducted by Ireland on an immediate counterparty basis;

- Data on portfolio equity assets and liabilities from countries' international investment positions, as published by the IMF in its Balance of Payments and International Investment Position Statistics;

[3] See for instance Balance of Payments Committee (2003) and Sanchez Muñoz and Israël (2007),

[4] This survey is helpful in reconciling asset and liability figures because shares held by central banks in their reserves would not be reported as portfolio equity assets by investor countries but are included in portfolio equity liabilities by destination countries.

- The External Wealth of Nations (EWN) database, developed by Lane and Milesi-Ferretti (2001, 2007, 2018), with the latest vintage described in Milesi-Ferretti (2024). The database provides estimates of external assets and liabilities for over 210 economies for the period 1970-2022. It relies heavily on international investment position data reported by the IMF for recent years, but also includes other estimates from national authorities. Importantly, it constructs estimates for countries not reporting international investment position statistics (such as the United Arab Emirates, Qatar, the British Virgin Islands) and provides estimates differing from official International Investment Position (IIP) figures for economies where the latter are based on incomplete data coverage or are not in line with other evidence (for instance Bermuda, the Cayman Islands, and Kuwait). These additional estimates rely on partner-country data published by the IMF, the BIS, and national authorities as well as a variety of other data sources. The global coverage of the database makes it easy to check for global discrepancies.

III. Global Discrepancies in Portfolio Equity Securities

Evidence from EWN, discussed in Lane and Milesi-Ferretti (2007) and most recently in Milesi-Ferretti (2023), highlights that during the past three decades global portfolio equity represented the major source of global discrepancy between external financial assets and liabilities (Figure 1).[5] Rising global portfolio equity prices, increased international portfolio diversification, and the concentration of the investment fund industry in financial centers such as Ireland, Luxembourg, and the Cayman Islands have raised the importance of portfolio equity holdings in global financial holdings across borders. While reporting has improved, statisticians still find challenging to fully capture household holdings of foreign shares, especially if these are not channeled through domestic financial intermediaries or held through domestic custodians. These holdings can in principle be an important source of asset under-reporting and hence the global portfolio equity discrepancy.

To gain a better understanding of this discrepancy, we start from the bilateral data from portfolio surveys mentioned above. The CPIS is particularly useful because it provides a quite comprehensive 'match' between portfolio equity assets and liabilities, by identifying the residence of the issuer of shares held by portfolio equity investors. Furthermore, the reported holdings by CPIS countries are generally identical to or in line with those reported in their IIP. If measurement was accurate and participation to the survey was full, the portfolio equity liabilities reported by country X should be equal to the sum of portfolio equity holdings in country X by investors from other countries (which we call derived portfolio equity liabilities). In practice, however, participation to the survey is not full, and some economies participating in the survey report data that only partially cover their portfolio holdings. [6] We proceed by first highlighting headline global figures on assets reported by the CPIS, their shortfall relative to global portfolio equity liabilities, and the extent to which additional data can close the gap between the two. Subsequently, we compare portfolio equity holdings reported by investor countries in a specific destination with the portfolio equity liabilities reported by that destination to get an indication of where unreported assets are likely held.

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[5] As discussed in Milesi-Ferretti (2023) the rising FDI discrepancy since 2017 is likely related to the methodology for valuing US FDI liabilities. In US statistics published by the Bureau of Economic Analysis the value of foreign affiliates in the U.S. is assumed to rise in line with US equity prices, which have increased very sharply since then. Partner-country data, however, does not display the same pattern, suggesting different valuation methodologies.

[6] In addition, there are other factors that need to be considered when comparing estimates of global portfolio equity assets and liabilities, including shares held by central banks in their foreign exchange reserves and holdings by and in international organizations.

Table 1 provides a preview of the orders of magnitude involved for the year 2022. Its bottom line is that estimates of global portfolio equity liabilities ($43.4 trillion) exceed global portfolio equity assets by over $2.8 trillion (with the corresponding figure for 2021 around $4 trillion). The upper part of Table 1 compares portfolio equity liabilities with those derived aggregating by destination the holdings reported by CPIS participants. For these, the starting point are the $37.3 trillion of portfolio equity claims reported in the December 2022 CPIS by individual economies, plus around $400 billion of equity holdings by central banks and international organizations measured in a parallel survey. [7] From this figure we net out $711 billion of portfolio equity holdings for which the counterpart is not specified, and hence not included among the derived liabilities. The country-by-country comparison shows that Ireland, Luxembourg, and the United States are the destinations that explain almost the entire difference between reported liabilities and those derived from reported holdings.

The bottom part of the table shows the extent to which alternative sources of data can increase estimates of global portfolio equity assets beyond those reported in the CPIS, by considering estimates of portfolio equity assets held by non-reporters as well as some clear cases of incomplete reporting of assets in the CPIS.

Incomplete country participation to CPIS

The largest holders of portfolio equity assets that do not participate to the CPIS are the United Arab Emirates (UAE), Taiwan, Qatar, and the British Virgin Islands (BVI). Using reported IIP data for Taiwan and financial flows, estimates from the Sovereign Wealth Funds Institute, and partner country data (particularly from the United States) for the other 3 economies, their collective holdings in 2022 are estimated to be close to $1.4 trillion, out of total estimated holdings for CPIS non-reporters of $1.6 trillion (Table 1). There are wide margins of uncertainty around the holdings of the UAE and Qatar, and the estimate for the BVI is most likely a lower bound because it is put together from identified holdings by partner countries.

Assets reported to CPIS based on incomplete sectoral coverage

The identification of these economies is based on a comparison of database estimates for their portfolio equity assets with the total reported by the CPIS, and hence subject to notable margins of uncertainty. The two most important and clear-cut cases of incomplete CPIS reporting are the Cayman Islands and Kuwait (see Table 1).

- For the Cayman Islands, the CPIS covers the banking sector in full and (in value) less than 70 percent of holdings by investment funds and insurance companies, according to the published metadata. Other sectors (in particular nonfinancial corporations) are not included. Investment funds are by far the largest holders of equity assets. According to the U.S. portfolio liability survey, equity holdings in the U.S. by entities incorporated in the Cayman Islands amounted to over $1.4 trillion, while the Cayman Islands report U.S. holdings of around $700 billion. While under-reporting is likely to be relevant for Cayman holdings in other countries as well, we don't have data like the U.S.-source survey to support additional precise upward revisions to the portfolio equity assets of the Cayman Islands.[8]

[7] Central bank holdings are generally classified as foreign exchange reserves while international organizations (whose holdings of equity instruments are small) are not included in the EWN database.

[8] The Cayman Islands also publishes IIP statistics, but these do not include offshore activities which are the dominant component of the economy's gigantic external balance sheet.

- For Kuwait, reporting excludes most general government holdings, and in particular those of the large sovereign wealth fund (the Kuwait Investment Authority). Kuwaiti holdings are very substantial: around $240 billion in the United States alone in 2022 (according to the U.S. liability survey), compared to $1.7 billion reported in CPIS, and an estimated global total exceeding $430 billion.

Overall, these two economies account for about $1.2 trillion of underreported assets. Under-reporting for other countries (about $500 billion in total) is more limited. In the database it is assumed to be substantial for Saudi Arabia. There is no metadata information on the compilation of the CPIS for Saudi Arabia, and hence it is difficult to assess its comprehensiveness. The reported estimate falls short of what can be estimated by cumulating portfolio equity outflows with valuation adjustments.

Other data issues

As noted above, the CPIS database also includes data for which no country counterpart is identified (between 1 and 2 percent of total holdings for the period 2001-2022). Hence, the aggregation of country-level liabilities derived from CPIS will fall short of assets. CPIS data also includes equity held in international organizations (a much smaller amount than the previous category) which would also not be matched in the derived liability data. Both factors reduce derived liabilities relative to assets by some $800 billion in 2022.

In contrast, holdings of equity by central banks and international organizations are also reported by CPIS on a geographical destination basis, thanks to the SEFER-SSIO survey mentioned in the previous section. These holdings, which reflect primarily central bank reserves, amounted to over $400 billion in 2022. They are included in derived (and reported) portfolio equity liabilities, but on the asset side they are classified as foreign exchange reserves and hence they drive a wedge between global portfolio equity assets and liabilities. [9]

Overall, integrating the information from the CPIS with the estimates for under-reporters and non-reporters narrows the gap between assets and liabilities by about $3 trillion. To better understand the remainder of the gap, we turn in the next section to a country-by-country comparison of portfolio equity liabilities in the EWN database with those that can be derived from asset holdings reported to CPIS.

IV. Understanding the equity discrepancy: bilateral evidence

In most countries reported portfolio equity liabilities are larger than those derived from investor country reporting, as expected given the incomplete coverage of CPIS. But as Table 1 highlights it is striking to see how 3 countries account for the lion's share of the global gap: the United States, Ireland, and Luxembourg. This is not merely a reflection of portfolio size (countries with larger portfolio equity liabilities would be expected to have proportionally larger gaps): the share of total liabilities that cannot be explained by reported CPIS holdings largely exceeds the global average of 15 percent (23 percent for the U.S., 33 percent for Luxembourg, and 39 percent for Ireland). Moreover, the discrepancies for these countries are persistent (Figure 2). Measurement error on portfolio equity liabilities is unlikely to be an explanation. The United States undertakes a detailed portfolio equity liability survey, and for Ireland and Luxembourg domestic holdings of fund shares are well identified and relatively small compared to the multi-trillion size

[9] No information is provided on participation by central banks to the SEFER-SSIO holdings. However, based on the disclosure policies of individual central banks and on the overall size of securities' holdings documented by the survey it is reasonable to infer that advanced economies' central banks are participating to the survey while the Central Bank of China is not.

of total fund shares outstanding, implying that the measurement of fund shares held by nonresidents is likely to be quite accurate.

United States

The U.S. stock market is by far the largest in the world and the one that attracts most foreign investment. Hence holdings in the U.S. are likely to be an important share of equity assets of CPIS non-reporters and also represent an important share of the assets under-reported to CPIS. Furthermore, some central banks hold part of their reserves in equity, with the U.S. being a likely destination for some of those holdings. If the central bank in question participates in the SEFER survey, run in parallel to the CPIS, those holdings would be part of U.S. equity liabilities derived from CPIS, even though they would not be attributed to the country of that central bank. But if the bank does not participate, such holdings would not be captured In CPIS statistics.

In Figure 3 we break down the difference between reported and derived U.S. portfolio equity liabilities into different country groups. These include: 1) economies not reporting to the CPIS (for which the difference equals their holdings as reported by the U.S.); 2) economies with incomplete reporting to the CPIS (specifically Cayman Islands, Kuwait, Bahamas, and Saudi Arabia); 3) financial centers reporting to the CPIS; and 4) the remainder of CPIS reporters. Because for the aggregate of euro area countries U.S.-reported holdings line up well with those reported by the CPIS, we don't include euro area financial centers (Ireland, Luxembourg, Netherlands, Cyprus, Malta) in the financial centers group. The Figure shows that over half of the U.S. discrepancy on average can be explained by holdings of non-reporters or a few large cases of CPIS under-reporting. The remainder of the discrepancy is concentrated in financial centers and hence more difficult to attribute to ultimate holders.

To shed further light on the discrepancy, Table 2 provides a list the largest country-specific differences between the claims that countries report to be holding in the U.S. and liabilities to that country identified by the U.S. survey. The list is dominated by financial centers. The economy with the largest discrepancy in 2021-22 is the United Kingdom, and its magnitude is quite large. [10]

The second largest discrepancy is for Switzerland, another financial center. In this case the discrepancy is likely to reflect in part the equity holdings of the Swiss National Bank. These are classified as foreign exchange reserves and hence not reported as Swiss holdings in CPIS, but rather as holdings of central banks and international organizations. Data reported on the SNB website indicates that holdings of equity by the SNB amounted to about 50 percent of total portfolio equity holdings of central banks and international organizations over the period. If the ratio of U.S. holdings to total holdings for the SNB is assumed to be the same as for the holdings of all CBs and IOs reporting to the IMF survey, this would add over $120 billion to Swiss holdings (Table 3), and hence reduce the Swiss discrepancy by about 1/3. Custody accounts in Swiss institutions belonging to nonresidents are another potential reason for the discrepancy. These accounts' holdings of non-Swiss shares on behalf of nonresidents amounted to over $600 billion, and holdings of non-Swiss investment fund units over $900 billion.

A few countries on the list are not international financial centers. For Canada, the discrepancy could reflect direct purchases of U.S. stocks and investment funds by Canadian households, which would not be captured by surveys of financial institutions and custodians in Canada. [11] In turn, this would imply some under-estimation of Canadian portfolio equity assets in the published IIP. For China, part of the discrepancy

[10] The discrepancy for the United Kingdom is even larger than the one reported in Table 2 but partly offset by discrepancies of the opposite sign for Guernsey and Jersey. The table report the sum of those discrepancies.

[11] I am grateful to Carol Bertaut for this suggestion.

could reflect holdings of equity by the central bank, analogously to the case of Switzerland. But in (likely) contrast to the SNB, the central bank of China does not participate in the SEFER-SSIO survey, and hence its holdings would not be captured. For France, the discrepancy is also positive and large, in contrast with other large euro area economies such as Germany, Italy, and Spain, and less likely to reflect the international financial intermediation role of the country, compared for instance to the United Kingdom or Switzerland.[12]

In summary, U.S. source data provides valuable information on holdings by countries that do not report an IIP or that are likely to be missing part of their residents' equity holdings in their official IIP statistics. While over half of the discrepancy with data from the CPIS can be explained by these cases, there remains an important component which reflects holdings through financial centers—particularly the United Kingdom—which is difficult to attribute to final investors.

Ireland

Ireland is an important financial center, which reported around $4.3 trillion of portfolio equity liabilities in 2022. In contrast, CPIS participants reported about $2.6 trillion in holdings of Irish equity for that same year. Ireland's portfolio equity liabilities have three components. The largest one is investment fund shares (excluding money market funds) held by nonresidents, amounting to $2.8 trillion in in 2022, with the remainder consisting of common shares and money market funds.

Ireland provides statistics on the major holders of its portfolio equity liabilities for investment funds and money market funds on an immediate counterparty basis. The data are less reliable than the U.S. liability survey data for the purpose of identifying ultimate holders of investment fund shares, but still provide very useful information on potential counterparts. As already done for the United States, we compare these data to holdings in Ireland reported to CPIS. In interpreting the findings, we need to take into account that holdings of common shares of Irish companies (mostly U.S. companies that undertook tax inversions) are included in the CPIS total but not in the Irish data, which is limited to funds.

The results are shown in Table 4. For 2022, total nonresident holdings in Irish funds exceed holdings of all portfolio equity in Ireland reported by CPIS by close to $1 trillion. The most striking finding concerns again the United Kingdom: on an immediate counterparty basis, holdings of Irish investment fund shares exceed $1.7 trillion, vis-à-vis holdings by U.K. residents reported in CPIS of $420 billion (Milesi-Ferretti, 2023 and Beck et al, 2024 highlight the same issue). There are much smaller but still meaningful discrepancies in the same direction for financial centers such as Luxembourg, the Netherlands, and the Cayman Islands, but not for Switzerland, despite the importance of custody accounts highlighted earlier. One country where CPIS figures exceed substantially those reported by Irish funds is the United States. Here, however, there is a clear explanation. The U.S. portfolio asset survey indicates that the lion's share of U.S. reported holdings of Irish portfolio equity in 2022 (close to $600 billion out of $678 billion) are common shares. The nationality data constructed by Bertaut, Bressler, and Curcuru, 2019 shows that these U.S. holdings in Ireland are concentrated in companies that are not Irish. These are primarily U.S. companies (many from the pharmaceutical sector) that have undertaken corporate inversions to move the residence of their headquarters to Ireland. The holdings of funds by U.S. investors reported by Ireland instead exceeds those reported in the U.S. survey by over $100 billion.

Overall, aggregate holdings reported by other euro area countries in Ireland are in line with the liabilities reported by Irish investment funds vis-à-vis other euro area countries on an immediate counterparty basis. Beck et al. (2024) investigate in detail the extent to which holdings of Irish fund shares

[12] Among euro area countries the discrepancy is positive and large for financial centers such as Ireland and Luxembourg, but as mentioned in the text, aggregate euro area holdings reported by the US are close to those reported in CPIS.

by euro area investors could account for a sizable share of holdings for which the CPIS does not identify the investor country (and hence, given the immediate counterparty pattern of Irish funds data, shares held through United Kingdom intermediaries). On the basis of fund-level evidence, they conclude that this is unlikely to be the case. We discuss their findings and their consistency with those reported in this paper in the section on the United Kingdom below.

Luxembourg

Data on the residence of holders of Luxembourg investment fund shares, even on an immediate counterparty basis, is not generally available. Here we make use of data kindly shared by the Commission de Surveillance du Secteur Financier (CSSF) on the countries where Luxembourg investment fund shares are commercialized, which is likely to be broadly in line with the immediate counterparty concept.[13] These data cover the vast majority of Luxembourg non-money market investment fund shares—they only exclude shares of those alternative investment funds which are not regulated by the CSSF (some $350 billion in 2021, or about 5 percent of total investment fund shares). Similar data are used in a recent study by Ciccone and Morhs (2023). As the authors note, these data do not provide accurate estimates of the residence of the holders of such shares. Indeed, for euro area investors one can obtain more precise estimates using the security-by-security SHS database of the European Central Bank. For countries outside the euro area, we do not have this information, and we hence provide a simple comparison of data of countries of commercialization with equity claims on Luxembourg reported by the same countries to the CPIS.

Following Ciccone and Morhs (2023) Table 5 compares investor country data on holdings of portfolio equity instruments in Luxembourg reported in the CPIS (which is based in principle on the entire set of portfolio equity liabilities of Luxembourg) with data on the country of commercialization of funds domiciled in Luxembourg covered in the study.[14] Despite the a priori broader coverage of CPIS, the Luxembourg-source data report much larger holdings, especially for the United Kingdom (over $700 billion), with much smaller but still meaningful gaps for other financial centers such as Switzerland, Hong Kong and Singapore. Figure 4 provides a time series comparison for UK holdings, highlighting the size and persistence of the gap between the data on commercialization of funds and reported UK holdings. As for the case of Ireland, we discuss the fund-level evidence on ownership of Luxembourg fund shares by euro area investors versus those owned by the rest of the world in the next sub-section.

United Kingdom

In the discussion of the liability surveys of the United States, Ireland, and Luxembourg, we have provided evidence on the size of their equity intermediated in the United Kingdom. Figure 5a summarizes that evidence, already reported in Tables 2, 4, and 5, for the year 2021. The difference between the liabilities vis-à-vis U.K.-based investors or intermediaries and the portfolio equity claims reported by the U.K. on these three countries is close to $3 trillion dollars, over 5 percent of global portfolio equity liabilities.

Figure 5b adds statistics from the 21 CPIS participants that publish a portfolio equity liability survey (highlighting the largest destinations for portfolio equity investment: Japan, Australia, Singapore, Finland,

[13] I am greatly indebted to Bruno Dawance and Johan Marigny for providing the data.

[14] The analogous table in Ciccone and Morhs is based on a slightly different sample of investment funds and calculation method. The results we obtain with our data are very much in line with theirs.

and Thailand). [15] The CPIS data shows the same general pattern as the data depicted in Figure 5a. Namely, liabilities vis-à-vis the U.K. are much larger than the U.K.-reported claims on these countries. This is not surprising, since portfolio liability surveys have a custodial bias: countries will report larger liabilities vis-à-vis financial centers that act as global financial intermediaries because they cannot establish whether financial centers' holdings are on behalf of clients from other jurisdictions. With the exception of Singapore, CPIS-reported claims on these economies are reasonably close to these economies' reported liabilities, differently from the cases of Ireland, Luxembourg, and the U.S., and hence there is no strong evidence of large under-reporting. The data for Switzerland shows a similar pattern as for the U.K., with reported bilateral liabilities exceeding derived liabilities, but the absolute amounts are smaller and the ratio of derived to reported liabilities is higher.

In order to infer the potential ownership of "missing assets" managed in the United Kingdom we follow two related lines of inquiry. The first consists in comparing the portfolio equity assets reported by the United Kingdom with partner-country data from Ireland and Luxembourg as well as data from a report on asset management in the United Kingdom (Investment Association, 2023), to identify potential under-reporting. The second line of inquiry consists in examining available data on asset management in the United Kingdom on behalf of nonresident investors, from the same report by the Investment Association (IA). Specifically, the report documents how in 2022 investment managers belonging to the IA managed from the UK some $10.6 trillion in assets, of which over $5 trillion on behalf of overseas investors. An additional $1.6 trillion is estimated to be managed in the UK by investment managers not belonging to the IA.[16]

UK portfolio investment abroad

The United Kingdom reported holdings of around $400 billion in Irish equity instruments at the end of 2022. However, several sources suggest that these holdings may be materially higher. The vast majority of money market fund shares in the UK are issued by funds incorporated in Ireland and Luxembourg (Tyrer, 2018; Investment Association, 2023). While there are no current published statistics on money market fund shares held by UK institutions, ONS (2018) estimates that UK investors held close to $300 billion in money market fund shares at the end of 2016, over 90 percent of which in funds registered abroad. Irish money market funds report holdings by UK investors on an immediate counterparty basis of roughly the same amount in 2016, rising to over $400 billion by end-2022.

In addition, a recent paper by the Central Bank of Ireland (Dunne, Ghiselli, Ledoux, and McCarthy, 2023) finds that some $360 billion of Irish Liability-Driven Investment (LDI) funds were held by UK institutions in the fall of 2022. Finally, Irish statistics on non-money market investment funds (which would include the just-mentioned LDI funds) indicate holdings in the UK on an immediate counterparty basis totaling $1.3 trillion at the end of 2022. [17] Even if most of these Irish funds (excluding the LDI component) were ultimately held by non-UK investors, the data on money market funds and LDI funds suggest a substantial undercount of holdings by UK investors in Irish funds. This undercount may occur because the funds in question often have a UK manager and may hold claims on UK residents (such as holdings of UK government bonds for LDI funds)—they could therefore be considered by reporting institutions as domestic funds. If this is the

[15] Other economies include Bangladesh, Bolivia, Bulgaria, Cyprus, Czechia, Estonia, Iceland, Indonesia, Israel, Latvia, Lithuania, Malaysia, Mongolia, New Zealand, Romania, and West Bank and Gaza.

[16] Firms not belonging to the IA specialize in alternative investments including hedge funds, private equity funds, commercial property management, discretionary private client and private debt management, and natural resource management firms. See Investment Association, 2023, p. 23.

[17] This figure is broadly consistent with figures from the Investment Association report, which point to some $1.6 trillion of Irish funds (including money-market funds) being managed in the United Kingdom at the end of 2022.

case, the under-reporting of UK portfolio equity assets may go together with some under-reporting of UK liabilities (namely, the claims on UK residents held by these funds).

The CPIS metadata for the United Kingdom also highlights that coverage of portfolio asset holdings is incomplete. It notes that coverage for other financial corporations (excluding insurance companies, pension funds, and money market funds) and nonfinancial corporation is below 70 percent, and that households are not separately included in the survey (although presumably holdings by households through domestic financial institutions or custodians are captured). In the financial accounts for the United Kingdom published by the UK Office for National Statistics (ONS), reported holdings by households of investment fund shares issued by nonresident entities are tiny (around $30 million in 2022), although additional holdings may be captured by holdings of "shares and other equity" ($214 billion) not identified separately as fund shares. In contrast, statistics from Investment Association (2023) suggest that retail holdings by UK investors of funds domiciled outside the UK totaled $275 billion at the end of 2022, and this amount excludes the increasingly popular Exchange-Traded Funds (ETFs), often domiciled outside the United Kingdom, as well as holdings of non-fund shares. Overall, these figures suggest a likely undercount of household holdings of foreign equity in the UK, in addition to the likely undercount in institutional holdings highlighted above.

The fund-level evidence presented in Beck et al. (2024) corroborates this view. In particular, the authors find that 40 percent of the bond positions of Irish funds not reported to be held by euro area investors are denominated in British pounds (versus less than 5 percent for the bond positions of funds reported by euro area investors). This is consistent with the evidence on LDI funds and money market funds discussed above and given the presumably modest weight of investment in British pounds for non-UK investors outside the euro area suggests that holdings of Irish fund shares by UK residents are likely underestimated. Beck et al. also present evidence on the geographical pattern of investment by Luxembourg-based funds distributed in different jurisdictions, including the United Kingdom, the euro area, and other countries, which shows that funds commercialized in the United Kingdom hold more UK assets and have an investment pattern more similar to the one for those commercialized outside the euro area. In turn, this suggests that funds commercialized in the United Kingdom are more likely to be held by UK investors as well as other investors outside the euro area.

It is more complicated to assess which holdings of shares through UK managers by nonresident investors are not currently captured in IIP statistics. Data from Investment Association (2023) suggests that over $5 trillion in assets held by nonresident investors were managed in the United Kingdom at the end of 2022. From a geographical perspective, investors are from the European Economic Area (which includes European Union countries as well as Iceland, Liechtenstein, and Norway) accounted for about 50 percent of the total, with most of the remainder attributable to investors from the United States, the Asia-Pacific region, and the Middle East. But to determine the likelihood that such assets are missed by the statistics of investor countries it is important to distinguish between institutional and retail holdings.

To do so, we make use of data published in the Appendix of the cited Investment Association report. The data include total assets managed in the United Kingdom, broken down into institutional, retail, and private client holdings, as well as data on the assets managed on behalf of UK institutions (including those managed for such institutions outside the UK). The data are shown in Figure 6 where we consider retail and private holdings jointly, the latter accounting for less than 5 percent of the joint total. To derive the split between institutional and retail holdings for both resident and nonresident investors we assume that 90 percent of assets managed on behalf of UK institutions are managed from the UK. Given total assets managed in the UK on behalf of UK and foreign investors respectively, this allows us to get separate estimates for

institutional and retail holdings, including by nonresidents.[18] Foreign institutional holdings include some $700 billion in public sector holdings, likely investments on behalf of sovereign wealth funds, as well as holdings by non-UK pension funds (around $1.2 trillion). These assets, together with most other corporate holdings, are more likely to be reported in the holding country's IIP statistics or in estimates of sovereign wealth fund holdings for nonreporters. However, this leaves a substantial component of "retail" holdings (shares of investment funds) held by nonresidents (most likely households): around $1.4 trillion, which may not be reflected in the statistics of the countries of residence of investors given that they are managed and held in custody outside their borders. Unfortunately, we cannot reliably establish the country or region of holders of such shares, since the figures on the regional breakdown of nonresident investors cited above include the larger institutional holdings.[19]

Furthermore, as mentioned earlier, another $1.8 trillion of assets are managed in the UK by entities which are not Investment Association members (including hedge funds and ETF operators). Of this total, over $800 billion are managed on behalf of private clients, likely wealthy households. Part of these assets will reflect cross-border claims by international investors not reflected in IIP statistics.

Overall, this analysis highlights how the role of the United Kingdom as a key location for international asset management relates to the difficulty in establishing ownership of cross-border portfolio equity assets in international statistics. While the data from the Investment Association provide a very useful perspective on UK asset management, there is room to strengthen official statistics both in terms of measuring portfolio equity assets held by UK residents abroad and in terms of reporting assets managed in the United Kingdom for nonresident investors broken down by country of origin. This would go a long way towards reducing global discrepancies in portfolio equity statistics.

Switzerland

Switzerland is another financial center where asset management and custody services for nonresidents play an important role. Zucman (2013) emphasized its role in intermediating and holding offshore assets belonging to the wealthy in advanced economies and not properly captured by international accounts.

Figure 7 provides a comparison of portfolio equity claims reported by Switzerland on the U.S., Ireland, Luxembourg, and a group of other destination countries for 2021, together with the portfolio equity liabilities to Switzerland reported by such countries in their liability surveys (analogously to figures 5a and 5b for the United Kingdom). The largest discrepancy by far is the one vis-à-vis the United States, followed by Luxembourg, while for Ireland reported Swiss claims are higher than the liabilities of Irish investment funds to Switzerland. As noted by Beck et al (2024) Switzerland played a larger role in the commercialization of Luxembourg investment fund shares prior to the global financial crisis, but the difference between reported Swiss holdings and fund shares sold in Switzerland has fallen since then.

Switzerland financial institutions hold "custody accounts" on behalf of nonresident investors and provides statistics on security holdings in such accounts—including both securities portfolios which are

[18] Note that a higher figure for UK institutional holdings managed in the UK would reduce our estimate of UK retail holdings and raise our estimate of foreign retail holdings.

[19] As mentioned above, Beck et al. (2024) argue that the characteristics of Irish and Luxembourg funds held in the UK are different from those that euro area investors hold, and hence that those asset holders are likely to originate from outside the euro area. Of course, this does not rule out that some holders are indeed euro area investors since the aggregate asset allocation of such funds will reflect the portfolio of the entire geographical range of unidentified investors.

managed and those which are simply held in custody.[20] The statistics include shares as well as investment fund shares.

We focus first on shares held in custody by nonresidents. Most of those shares (over 60 percent) are issued by Swiss entities. Total non-Swiss shares held by nonresidents were about $830 billion in 2021. Of these, some $365 billion were denominated in U.S. dollars. If these were shares of U.S. firms, the custody figures, together with the central bank holdings (Table 3), would explain the difference between the portfolio equity assets reported by Switzerland and the liabilities reported by the United States.[21] Swiss data also indicates that over 80 percent of custody holdings of shares are on behalf of foreign institutions, with private holdings at about 10 percent. This makes it more likely that such holdings are reported in the IIP statistics of the foreign institution's country.

Over 90 percent of the investment fund shares held in custody for nonresidents ($1.2 trillion at the end of 2021) are instead issued outside Switzerland. Private holdings are more important than in the case of ordinary shares, accounting for about a quarter of the total. Investment fund shares denominated in dollars ($625 billion) are about twice the size of those denominated in euros. While Figure 7 shows that Luxembourg fund shares commercialized in Switzerland are much larger than Swiss holdings and hence likely to account for part of this total, the size of these custody holdings suggests that they also include fund shares sold elsewhere on an immediate counterparty basis. Unfortunately, the lack of information on the country of origin of nonresident investors for security custody accounts makes it impossible to check for a potential undercount of portfolio equity investment in their national IIP statistics.

V. Concluding remarks

We have highlighted a sizable global discrepancy between portfolio equity assets and liabilities at the global level, of around $4 trillion in 2021 and close to 3 trillion in 2022. Using data on IIP and bilateral portfolio surveys, we have shown how this global discrepancy reflects primarily our lack of knowledge on the residence of investors in equity instruments issued in the United States, Ireland, and Luxembourg. The U.S. survey on foreign holders of U.S. portfolio instruments, Irish investment fund data on their share ownership by immediate counterparty, and Luxembourg data on the countries of commercialization of their investment funds provide useful information to reduce these gaps but leave substantial areas of uncertainty given the difficulty of liability surveys in identifying the ultimate owners of securities.

An analysis of bilateral data shows that a substantial part of these "unallocated liabilities" are equity instruments sold through intermediaries in the United Kingdom, while a smaller part likely reflects securities held in custody in Switzerland. For Ireland's investment funds, the liability position vis-à-vis the United Kingdom in 2022 exceeds reported holdings of Irish equity instruments by UK residents by over $1.3 trillion, and the difference for the United States for the same year exceeds $400 billion. Data for Luxembourg shows a UK discrepancy for 2021 exceeding $650 billion. In turn, UK-source data suggests that CPIS-reported portfolio equity assets held by UK residents (particularly money market funds) may be underestimated. This may occur in particular for funds whose shares are held may have UK managers and invest in UK assets, which may lead custodians or holding entities to report them as domestic assets. But assets held through UK asset managers by nonresident investors are likely to account for the majority of holdings in the UK

[20] See Notes – Banks | SNB data portal.

[21] The US-reported portfolio equity liabilities towards Switzerland are mostly in common stock.

identified in Irish and Luxembourg statistics, given the importance of the United Kingdom in asset management for international clients. Unfortunately establishing the likely residence of non-UK holders of Irish and Luxembourg fund shares not reportedly held by CPIS participants remains difficult. The fund-level evidence presented by Beck et al. (2024) suggests that euro area investors are unlikely to be major holders of such shares, but in light of the data on overseas clients presented by the Investment Association some under-reporting of household holdings is clearly possible.

Improving estimates of cross-border positions will require more comprehensive financial sector data from the United Kingdom, including holdings of money market fund shares, an item currently on the agenda of the Office of National Statistics. Importantly, this would also require improving data collection on international investors from the financial institutions in the United Kingdom undertaking intermediation activities on these stocks and investment fund shares. For Switzerland, a geographical breakdown of nonresident investors holding Swiss security custody accounts would help reduce these data gaps. More generally, collecting data on third-party holdings (claims on nonresidents held by other nonresidents through resident institutions) is essential to gain a more accurate picture of the geography of international investment, all the more so given the increasing ease of investing directly across borders. Proposals in this direction are discussed in Balance of Payments Committee (2003) and Sanchez Muñoz and Israël (2007), who highlight in particular the difficulty that existing statistical surveys face in identifying assets held with foreign custodians by the household sector, especially high net-worth individuals. Unfortunately progress on this front appears to have stalled. The findings of this paper suggest that it is high time to reconsider.

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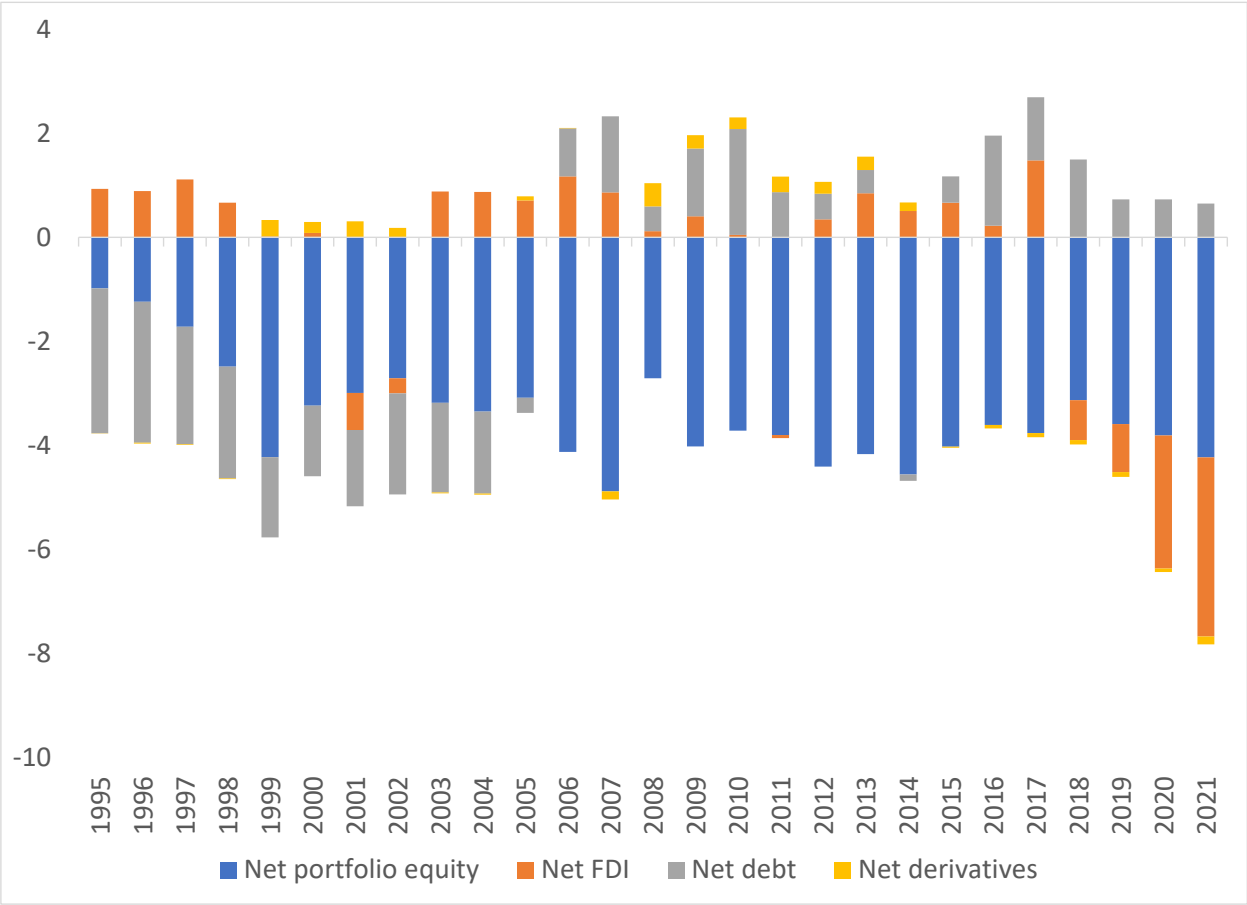
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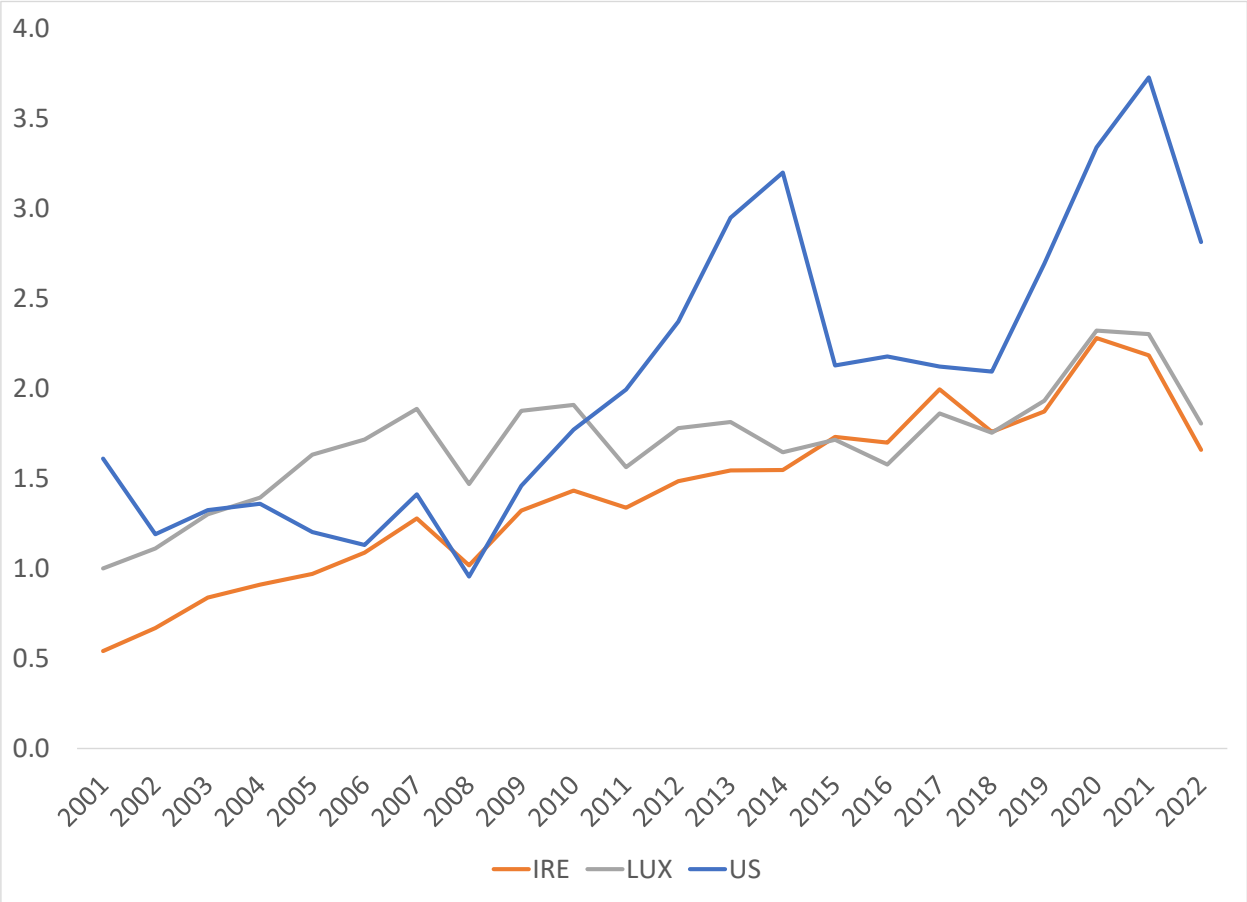
Figure 1. Global IIP discrepancy (percent of global GDP)



Note: the chart shows the difference between global external assets and liabilities for different financial instruments. Net FDI is the difference between global FDI claims and liabilities, and net derivatives are the difference between global derivatives claims and liabilities. Net portfolio equity equals global portfolio equity assets (from the External Wealth of Nations), plus holdings of equity reported by central banks to the SEFER-SSIO survey, run in parallel to CPIS, minus global portfolio equity liabilities. Net debt is the global sum of portfolio debt assets, other investment assets, and foreign exchange reserves net of the equity claims mentioned above, minus the global sum of portfolio debt liabilities and other investment liabilities.

Source: External Wealth of Nations database.

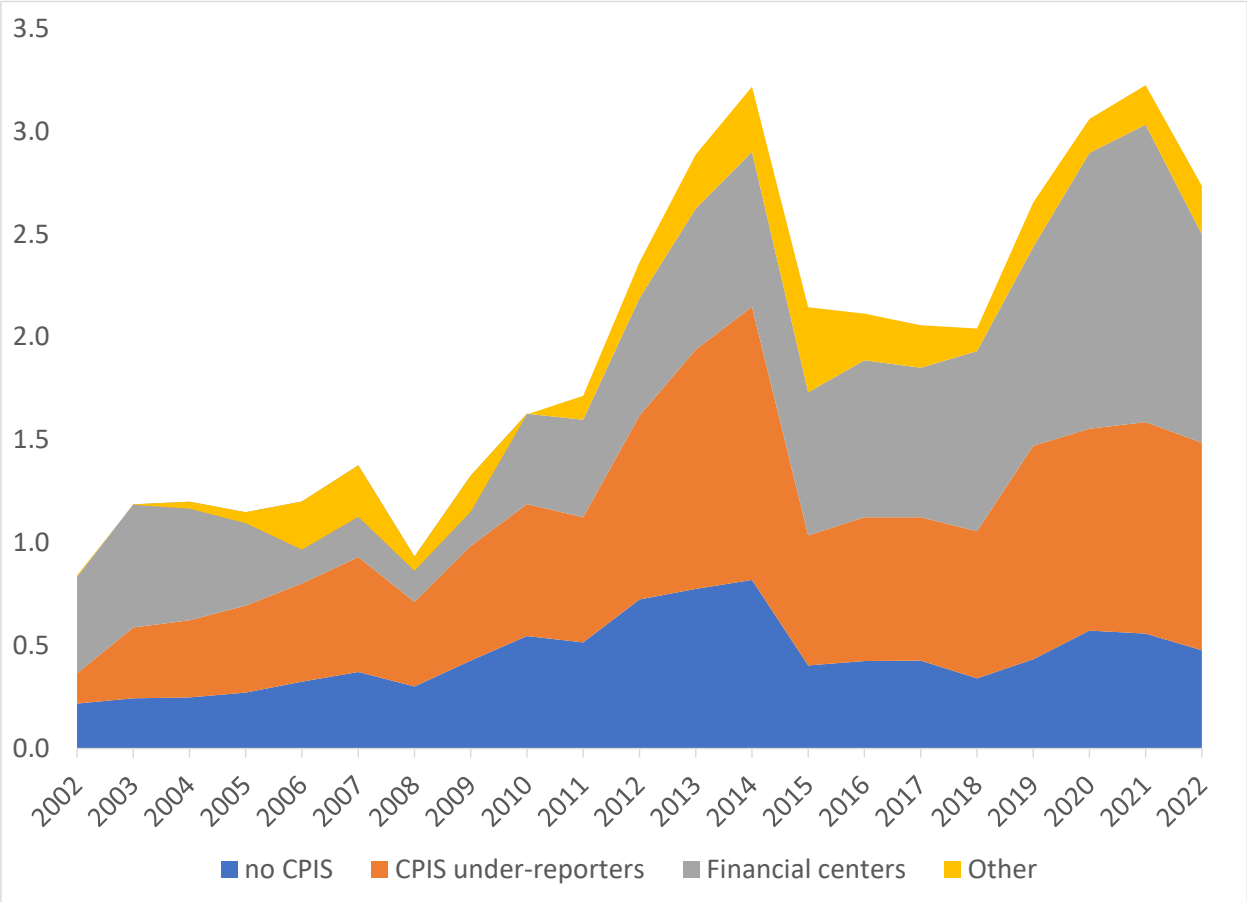
Figure 2. Global portfolio equity discrepancies (percent of world GDP)



Note: the chart shows the difference between portfolio equity liabilities for Ireland, Luxembourg, and the United States (as reported in their IIP) and aggregate claims on these countries as reported by participants to the IMF's Coordinated Portfolio Investment Survey. Data are scaled by world GDP.

Source: author's calculations based on the IMF's Coordinated Portfolio Investment Survey and IMF, Balance of Payments and International Investment Position statistics.

Figure 3. United States: Gap between reported and derived equity liabilities (trillions US$)

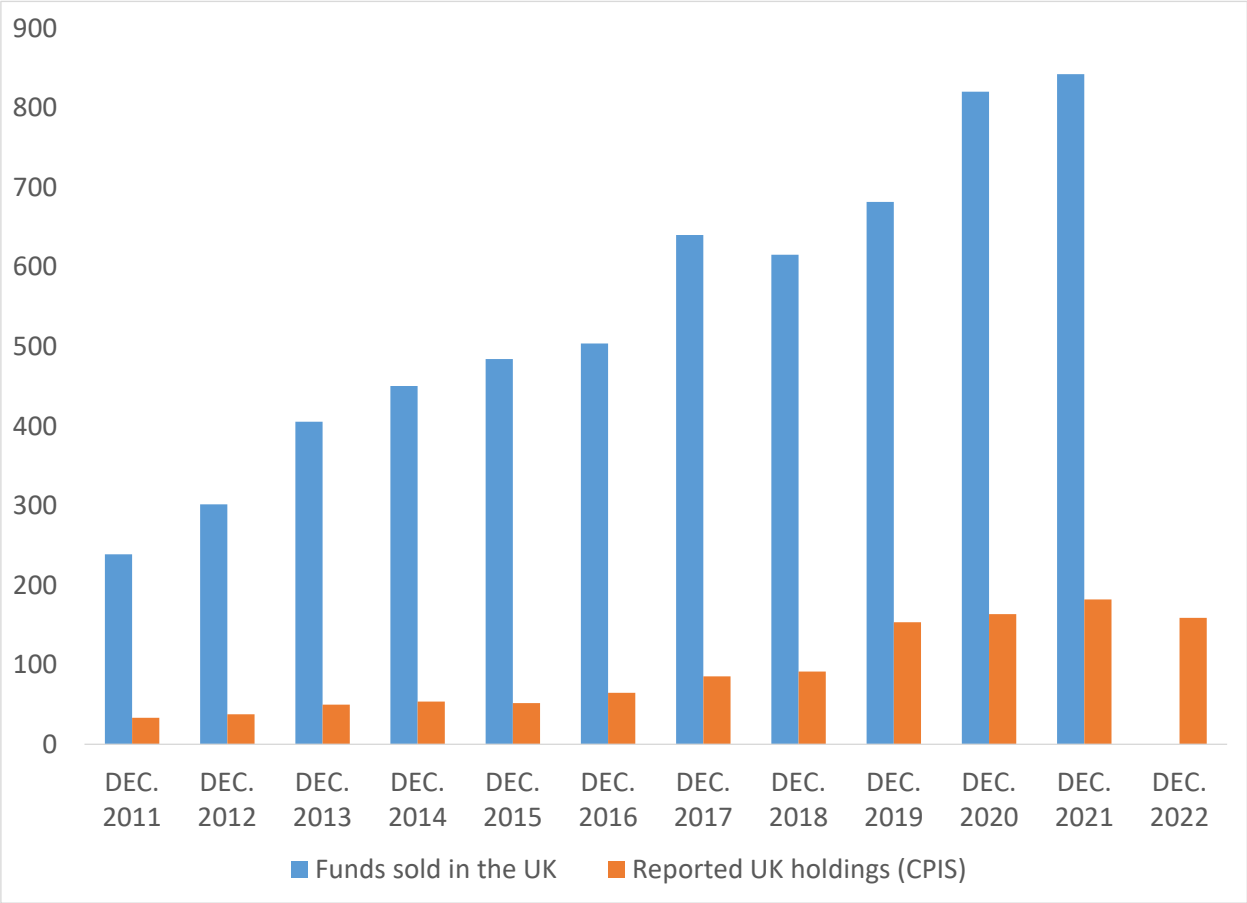


Note: the chart shows the difference between U.S. portfolio equity liabilities (as reported by the U.S. portfolio liability survey) and portfolio equity holdings in the U.S. reported in the IMF's Coordinated Portfolio Investment Survey. For countries not reporting to CPIS (in blue), the chart shows the sum of claims in the U.S. as reported by the U.S. liability survey. CPIS under-reporters include the Cayman Islands, Kuwait, Saudi Arabia, and the Bahamas. Financial centers include Bermuda, Curacao, Gibraltar, Guernsey, Jersey, Macao, Mauritius, Panama, Singapore, Switzerland, and the United Kingdom. The "Other" category includes all other CPIS reporters.

Source: author's calculations based on U.S. Treasury, U.S. portfolio liability survey, and IMF, Coordinated Portfolio Investment Survey.

Figure 4. Luxembourg Funds: Reported UK holdings and Funds sold in the United Kingdom

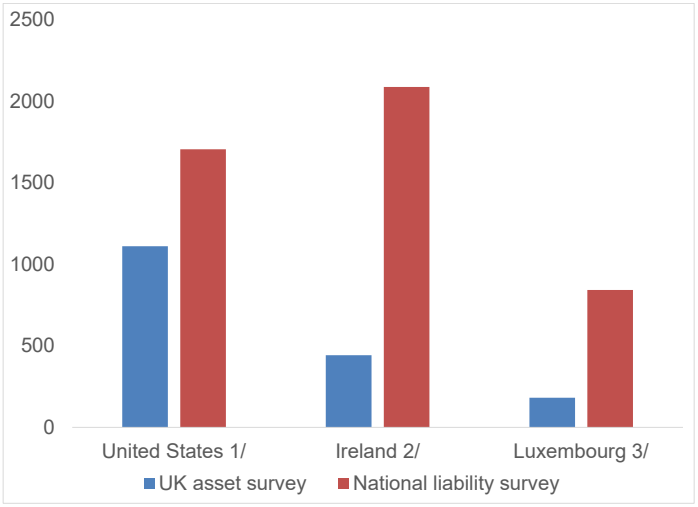
(Billions US$)



Source: Commission de Surveillance du Secteur Financier and IMF, Coordinated Portfolio Investment Survey.

Figure 5. United Kingdom: reported and derived portfolio equity assets, 2021 (Billion US$)

A. Claims vis-à-vis Ireland, Luxembourg, and the United States

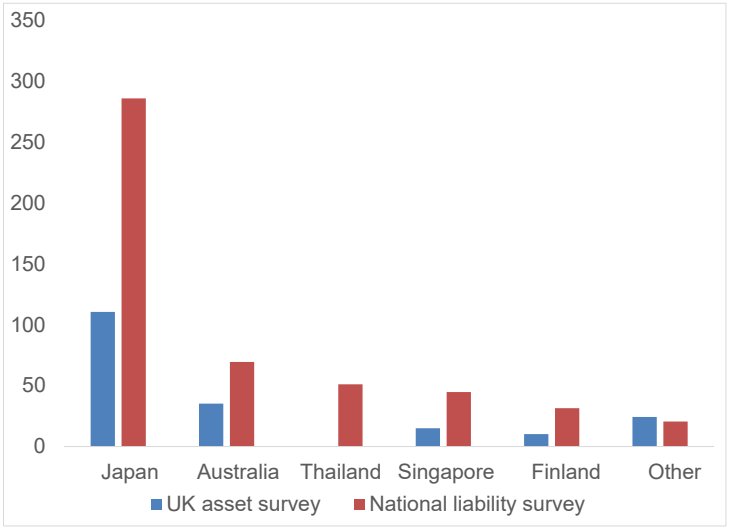


1/ Includes Guernsey and Jersey. The U.S. survey is as of June 30. Values for end-December are estimated using July-December flows and stock market valuation changes.

2/ Ireland liability survey includes investment funds and money market funds, while CPIS also includes other equity claims.

3/ Luxembourg data refers to the country of commercialization of investment fund shares. CPIS data also includes holdings in alternative investment funds.

B. United Kingdom claims and reported liabilities to the United Kingdom, selected countries

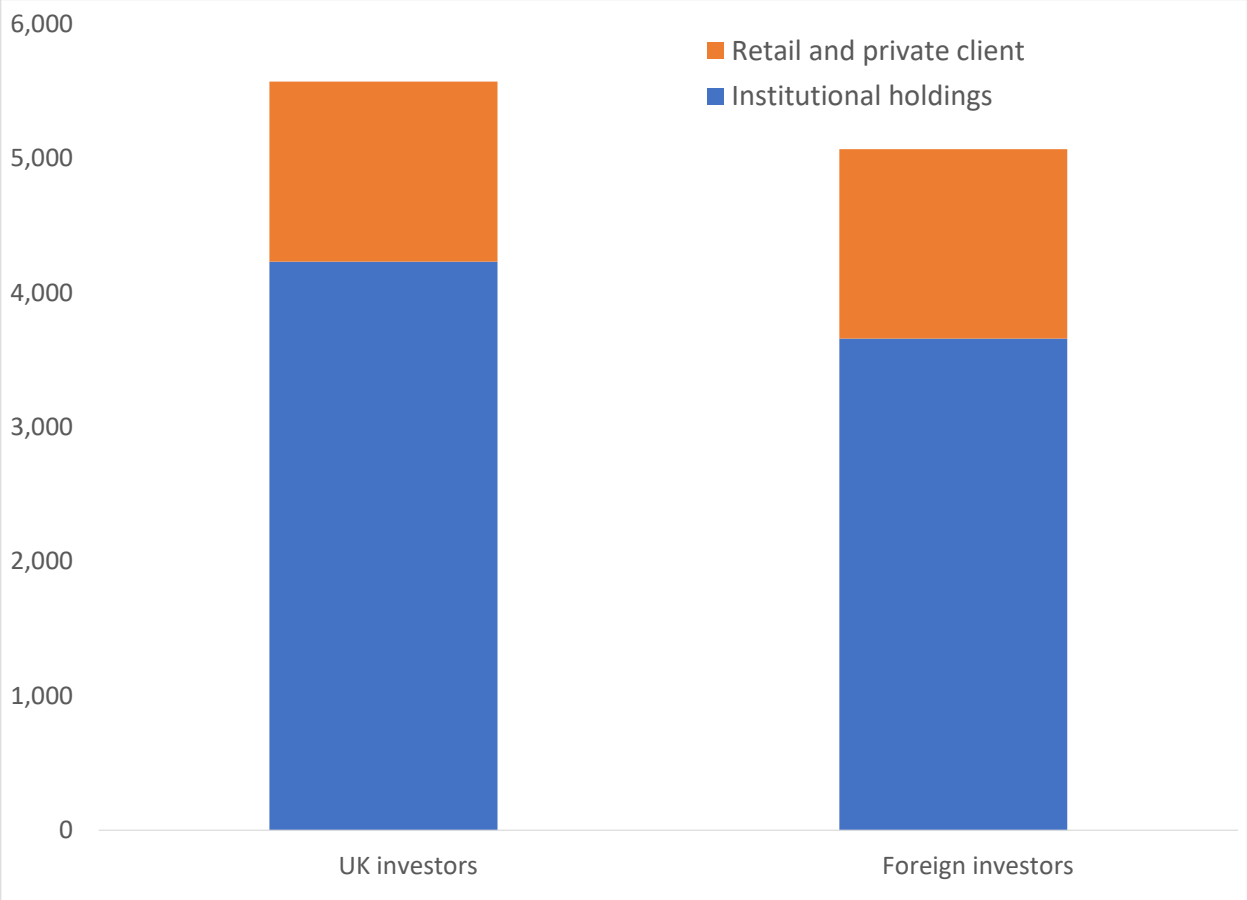


Note: the chart shows portfolio equity claims reported by the U.K. on the indicated destination countries, as well as holdings by U.K. investors reported by destination countries in their portfolio liability surveys.

Source: CPIS, portfolio asset survey and portfolio liability survey.

Figure 6. United Kingdom: estimates of assets under management, 2022

(Billion US$)

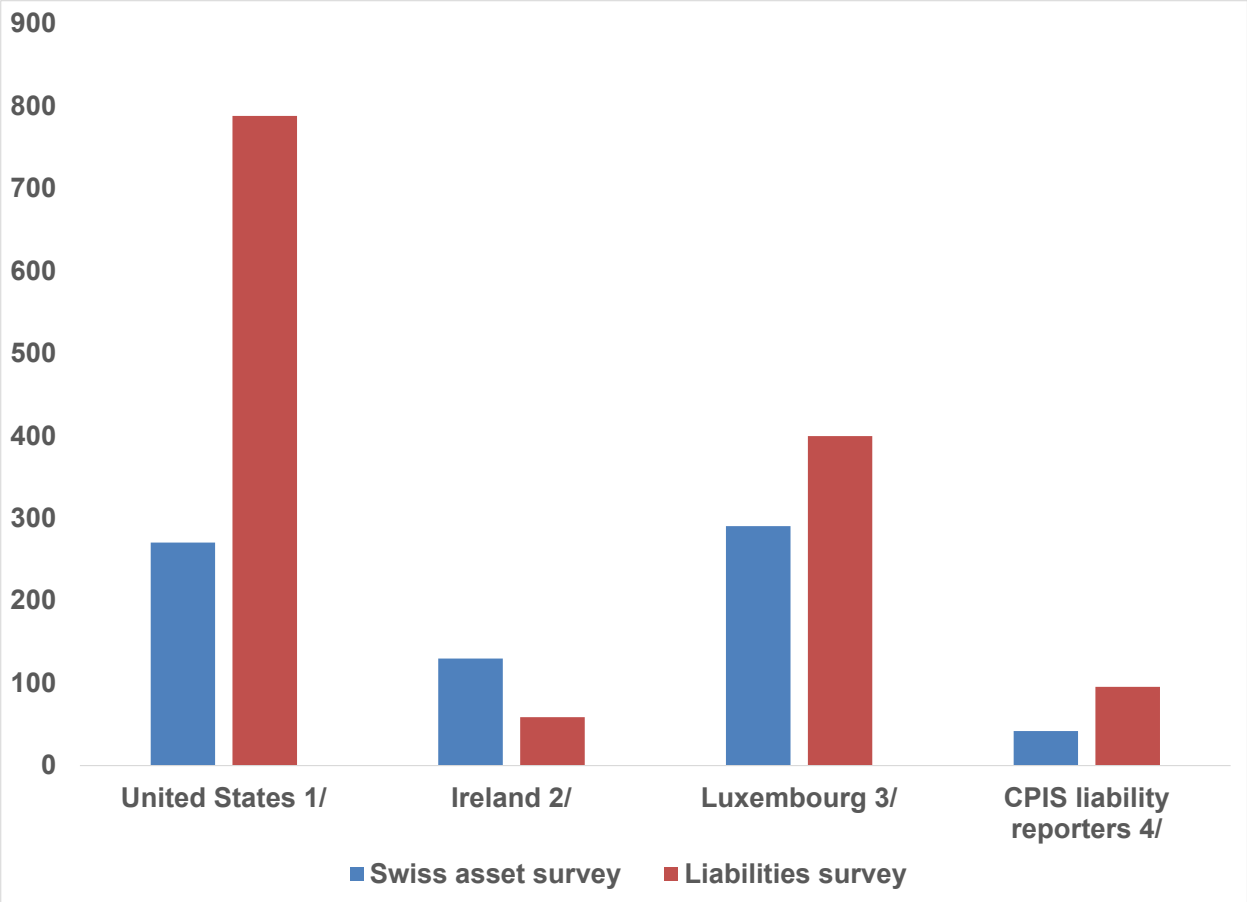


Note: the chart shows assets under management in the United Kingdom on behalf of domestic and foreign investors based on data reported by the Investment Association (IA). IA (2023) reports total assets under management in the UK on behalf of domestic and foreign investors separately, as well as the split between institutional, retail, and private client holdings for the sum of domestic and foreign holdings. Estimates for UK-managed institutional holdings on behalf of domestic institutions assume that 90 percent of assets managed by IA members on behalf of UK institutions are managed in the UK, with the remainder categories determined residually. Total holdings of private client assets are relatively modest (around $120 billion).

Source: Investment Association (IA, 2023, Appendices 1-2) and author's calculations.

Figure 7. Switzerland claims and reported liabilities to Switzerland, 2021

(Billion US$)



Note: the chart shows portfolio equity claims reported by Switzerland on the indicated destination countries, as well as holdings by Swiss investors reported by destination countries in their portfolio liability surveys.

Sources: CPIS, portfolio asset survey and portfolio liability survey; U.S. survey of portfolio liabilities: Irish survey of investment fund shares by immediate counterparty; Luxembourg data on the country of commercialization of investment fund shares (from CSSF).

1/ The U.S. survey is as of June 30. Values for end-December are estimated using July-December flows and stock market valuation changes.

2/ Ireland liability survey includes investment funds only (excluding money market funds, for which data is not reported separately for Switzerland). CPIS also includes other equity claims.

3/ Luxembourg data refers to the country of commercialization of investment fund shares. CPIS data also includes holdings in alternative investment funds.

4/ Australia, Bangladesh, Bolivia, Bulgaria, Cyprus, Czech Republic, Estonia, Finland, Iceland, Indonesia, Israel, Japan, Latvia, Lithuania, Malaysia, Mongolia, New Zealand, Romania, Singapore, Thailand, West Bank and Gaza.

Table 1. Global Portfolio Equity Gaps, 2022

(Billion US$)

Global portfolio equity liabilities	43,426
Portfolio equity liabilities derived from CPIS reporting 1/	36,901
Difference	6,524
Of which:	
United States	2,815
Luxembourg	1,805
Ireland	1,659
Other countries (net)	245
Global portfolio equity assets	40,602
Portfolio equity assets reported in CPIS 2/	37,294
Difference	3,308
CPIS non-reporters	1,622
of which:	
United Arab Emirates	655
Taiwan	319
Qatar	271
British Virgin Islands	141
Gap for CPIS reporters	1,686
of which:	
Cayman Islands	742
Kuwait	423
Global portfolio equity liabilities - global portfolio equity assets	2,824

1/ excludes confidential and non-allocated holdings.

2/ Exclude portfolio equity assets held by central banks (classified as reserves).

Note: global portfolio equity assets and liabilities are calculated from the EWN database (December 18, 2023 vintage). Derived portfolio equity liabilities are calculated from the IMF's Coordinated Portfolio Investment Survey (excluding holdings for which no destination country is reported). CPIS portfolio equity assets exclude holdings by central banks classified as foreign exchange reserves ($408 billion). Liabilities derived from CPIS reporting do not include the unallocated and confidential component of assets ($712 billion) and holdings of equity in international organizations ($90 billion).

Table 2. Differences between reported U.S. equity liabilities and CPIS-reported claims on the U.S.

(2021 and 2022, Billion US$)

	2021	2022
United Kingdom 1/	595	416
Switzerland	503	351
Canada	262	273
France	204	169
China	158	153
Singapore	125	98
Hong Kong	101	79
Luxembourg	93	72
Bermuda	71	63

1/ Includes Guernsey and Jersey.

Note: the table reports the difference by country between U.S. portfolio equity liabilities (reported in Department of the Treasury et al for end-June of each year and updated to end-December with adjustments for stock price changes and net equity transactions) and portfolio equity claims on the U.S. reported by participants to the IMF's CPIS Survey.

Source: U.S. Treasury, IMF, Coordinated Portfolio Investment Survey

Table 3. Holdings of portfolio equity in the United States by central banks

(Billion US$)

		2017	2018	2019	2020	2021	2022
Holdings by central banks and international organizations	World	322	269	351	429	501	408
	U.S.	164	138	176	223	285	237
Holdings by Swiss National Bank	World	160	140	160	203	238	212
	U.S. (estimated)	82	72	80	105	135	123

Note: The holdings by the SNB in the United States are estimated by assuming they are the same ratio of global holdings as for the holdings by all CB and IOs reporting to the IMF survey.

Sources: IMF, Coordinated Portfolio Investment Survey (holdings by central banks and international organizations) and Swiss National Bank (global holdings of portfolio equity as reserves).

Table 4. Holders of Irish funds (immediate counterparty basis) and holdings of Irish equity reported in CPIS, 2022

(Billion US$)

	Investment funds and money market funds	CPIS
United Kingdom	1,726	402
Luxembourg	329	203
Netherlands	328	103
United States	207	672
Germany	114	251
Italy	99	186
Cayman Islands	96	59
Switzerland	48	115
Other euro area	244	172
Other countries	369	451
Global total	3,561	2,615

Sources: Central Bank of Ireland, investment fund statistics, and International Monetary Fund, Coordinated Investment Survey.

Table 5. Luxembourg Investment Funds:

countries of commercialization and reported holdings, 2021

(Billion US$)

	Luxembourg fund data 1/	CPIS
United Kingdom	843	182
Switzerland	400	290
United States	217	155
Sweden	175	150
Japan	105	103
Hong Kong	95	56
Singapore	89	32
Taiwan	80	n.a.
Cayman Islands	70	25

1/ The data refer to the country of commercialization of Luxembourg investment funds (excluding money market funds and unregulated alternative investment funds).

Source: Commission de Supervision du Secteur Financier (CSSF) and CPIS.

BROOKINGS

MISSING ASSETS:

Exploring the source of data gaps in global cross-border holdings of portfolio equity

Gian Maria Milesi-Ferretti

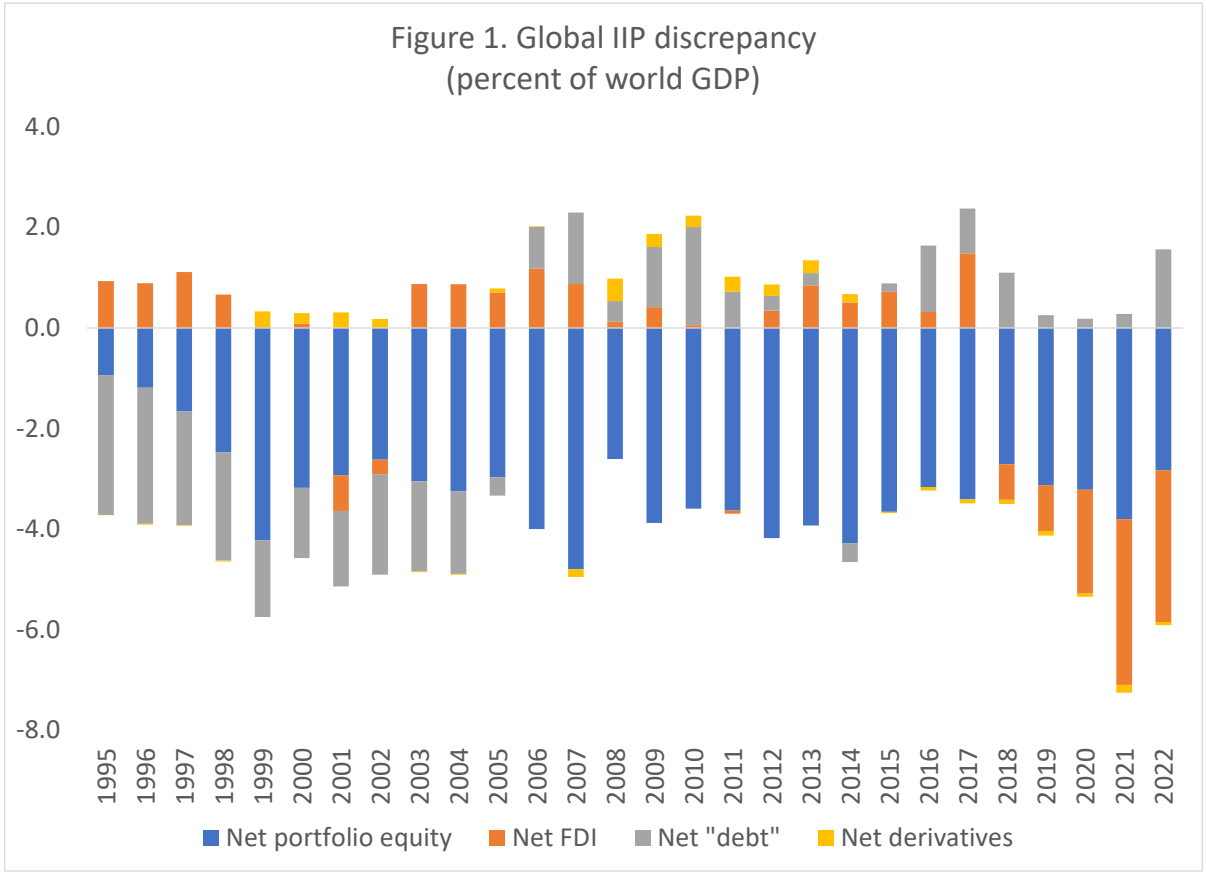
Hutchins Center on Fiscal and Monetary Policy, The Brookings Institution and CEPR

External Statistics After the Pandemic: Addressing Novel Analytical Challenges,

Madrid, February 12-13, 2024

The facts motivating the paper

Global estimates of cross-border portfolio equity holdings show a large and persistent discrepancy between estimated assets and liabilities:



Structure of presentation

- Data sources
- How to identify missing assets
  - *Comparison of total portfolio equity liabilities reported by destination countries with those derived from investor countries reports*
  - *Use of additional information on portfolio equity assets not reported to CPIS (countries not participating to survey, or participating only partially)*
  - *Characterization of remaining gap*

- Use of bilateral liability information for the 3 countries accounting for most of the gap between reported and derived liabilities:
  - *United States*
  - *Ireland*
  - *Luxembourg*

Data sources

- External Wealth of Nations database
- IMF's BOP and IIP Statistics
- Coordinated Portfolio Investment Survey (geographical allocation of portfolio assets by investor countries)
- National liability surveys (esp. US, Ireland, Luxembourg)

The approach to identifying “missing assets”

Use of bilateral data to check sources of the discrepancy

1. Use of Coordinated Portfolio Investment Survey (reported geographical allocation of portfolio assets)
2. Comparison of total portfolio equity liabilities reported by destination countries with those derived from investor country reports
3. Identification of countries accounting for largest differences
4. Corrections for
   a. *CPIS non-participants*
   b. *CPIS under-reporters*

Portfolio equity liabilities and CPIS reporting

2022, billion US$

Global portfolio equity liabilities	43,426
Portfolio equity liabilities derived from CPIS reporting 1/	36,901
Difference	6,524
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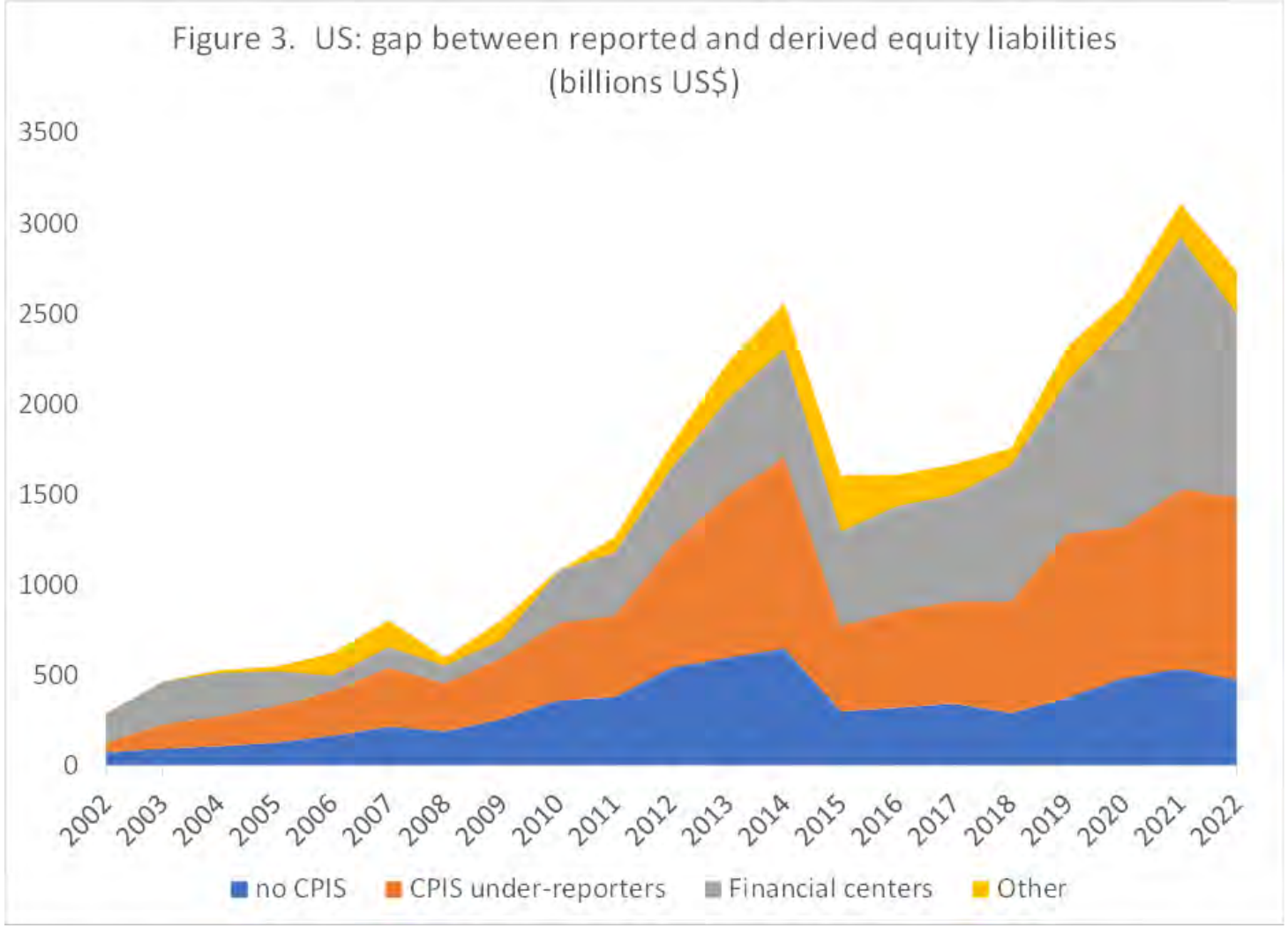
Portfolio equity assets and CPIS reporting

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Liability surveys: United States

2002-2022, billion US$



Differences between reported U.S. equity liabilities and CPIS-reported claims on the U.S.

(2021 and 2022, billion US$)

	2021	2022
United Kingdom 1/	595	416
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Holdings of portfolio equity by central banks: role of SNB

2019-22, billion US$

		2019	2020	2021	2022
Holdings by CBs ad Int. org.	World	351	429	501	408
	U.S.	176	223	285	237
Holdings by Swiss National Bank	World	160	203	238	212
	U.S. (estimated)	80	105	135	123

Non-resident holdings of Irish equity: CPIS and inv. fund surveys on immediate counterparty basis (2022, US$ billion)

	Investment funds and money market funds	CPIS
United Kingdom	1,726	402
Luxembourg and Netherlands	657	306
United States	207	672
Germany and Italy	223	437
Cayman Islands	96	59
Switzerland	48	115
Other euro area	244	172
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Global total	3,561	2,615

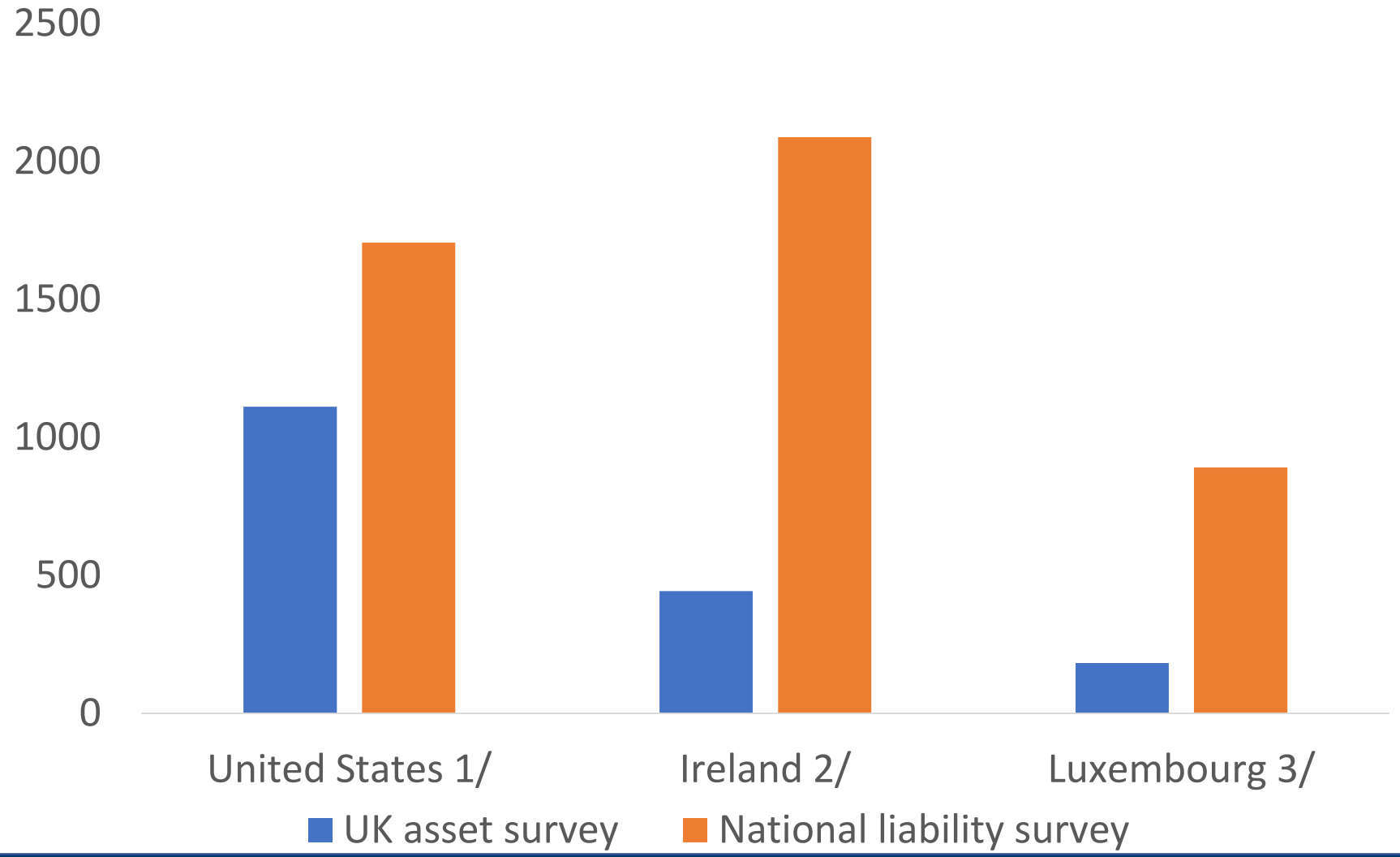
Reported holdings of Luxembourg inv. funds and countries of their commercialization, 2021

(billion US$)

	Lux fund data (country of commercialization)	CPIS
Euro Area 1/	2,627	3,125
United Kingdom	891	182
Switzerland	409	290
United States	255	155
Total	5,139	4,494
Total portfolio equity liabilities (IIP) 2/		6,713

Investment through the United Kingdom: U.S., Ireland, and Luxembourg

(2021, billion US$)



Conclusions

- Large and persistent discrepancy in global equity holdings
- Centered on investment in the US, Ireland, and Luxembourg not captured by portfolio equity data in asset holding countries
- A large share of these claims appear to be intermediated by entities based in the United Kingdom
- Addressing these discrepancies would require financial centers to collect and disclose data securities' holdings through domestic custodians also for cases where neither the issuer nor the ultimate holder of the security is a resident of the country.

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

An ocean of data: the potential of data on vessel traffic[1]

Graham Pilgrim,
Organisation for Economic Co-operation and Development

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

An Ocean of Data

The Potential of Data on Vessel Traffic

Graham Pilgrim, Head of Real-time Data Analytics

External Statistics After the Pandemic:

Addressing Novel Analytical Challenges

Future Forward Session

Motivation

WHAT is AIS?

Automatic Identification System (AIS) is a tracking system for vessels used for safety

- provides position, identification and other information about the vessel
- **Required** in all vessels above 300 gross tonnage used for international voyages, **highly recommended** in others.

AIS signals ('pings') **transmitted** every 2 secs to 6 mins

- each observation represents a ping **received**

Data accessed through the UN Global Platform

- global coverage, from January 2019 onwards
- Available to all NSOs and IOs

WHY use AIS?

Most international merchandise trade is carried by sea

- 80% of volume and 70% of value (UNCTAD, 2017)

Vessel traffic can be monitored in real time to provide policy-relevant insights

- timely: near to real time (database updated every 4 hours)
- Highly granular: By vessel type, ownership and geographic location
- **BUT: Ports corresponding to geographic locations are not defined. We need to derive this!**

© OECD

Deriving Port Boundaries

- A number of methods have been considered:
  - Draw a boundary around a known port location (eg. 1 km circle)
  - Use machine learning (DBSCAN) to cluster static vessels which look like ports
  - Manually define port locations
- OECD approach differs and combines some of the beauty of all methods

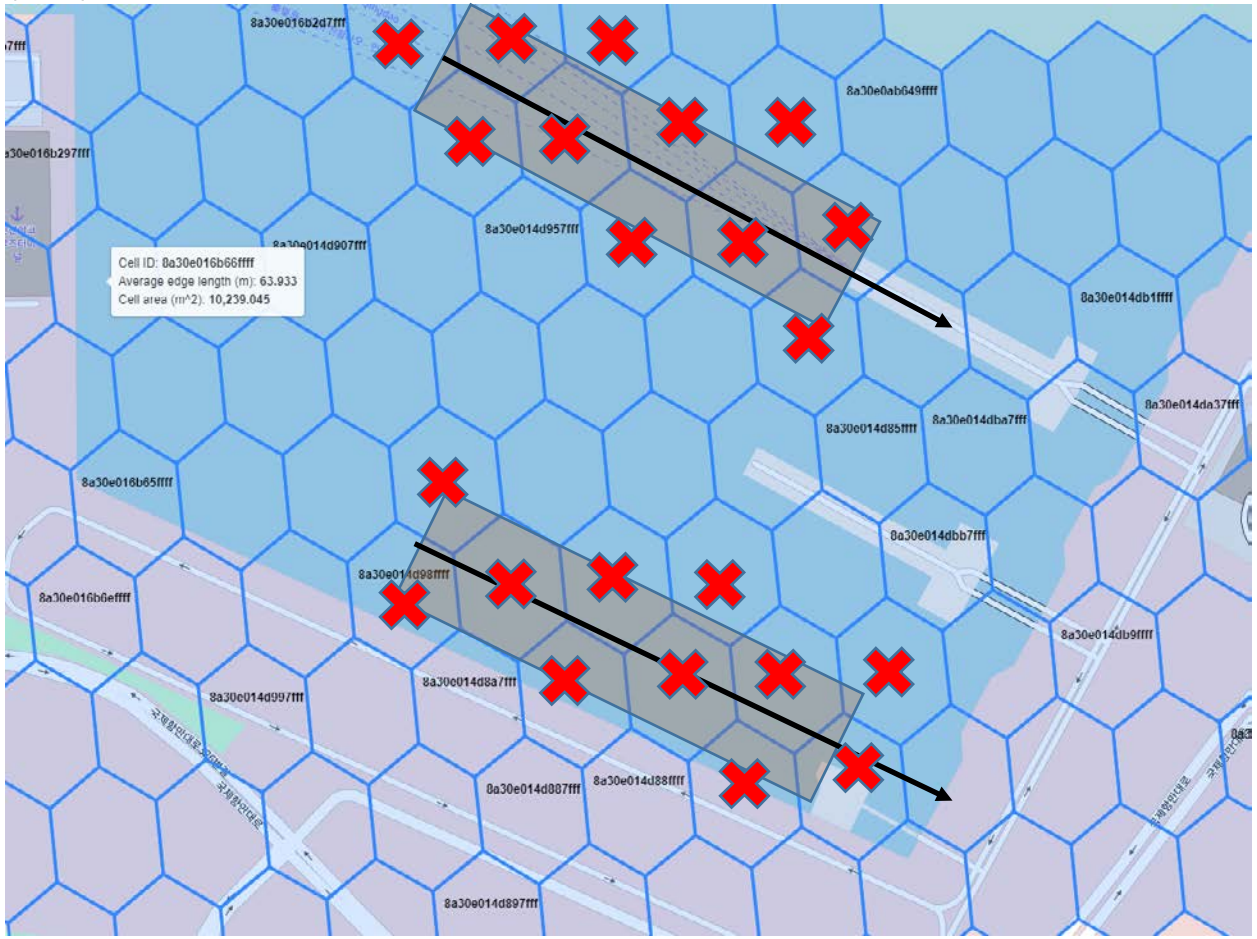
© OECD

Determining ports

- Look for static vessels, which is defined as
  - Previous speed, current and next speed are zero
  - Heading change from previous to next message are less than 1degree
  - Movement change from previous to next are less than 10m
  - Wider location appears to be a port (ie. Large share of static vessels and mostly “moored” rather than “at anchor”)
- Using vessel characteristics determine the range of space the vessel occupies and create a range of “port hexagons”

© OECD

Port Hexagons





© OECD

Assigning Hexagons to port

- Take UNLOCodes for ports
- When co-ordinate data doesn’t exist attempt match with World Port Index
- If unsuccessful use ‘fuzzy matching’ with Geonames to determine the most appropriate location.

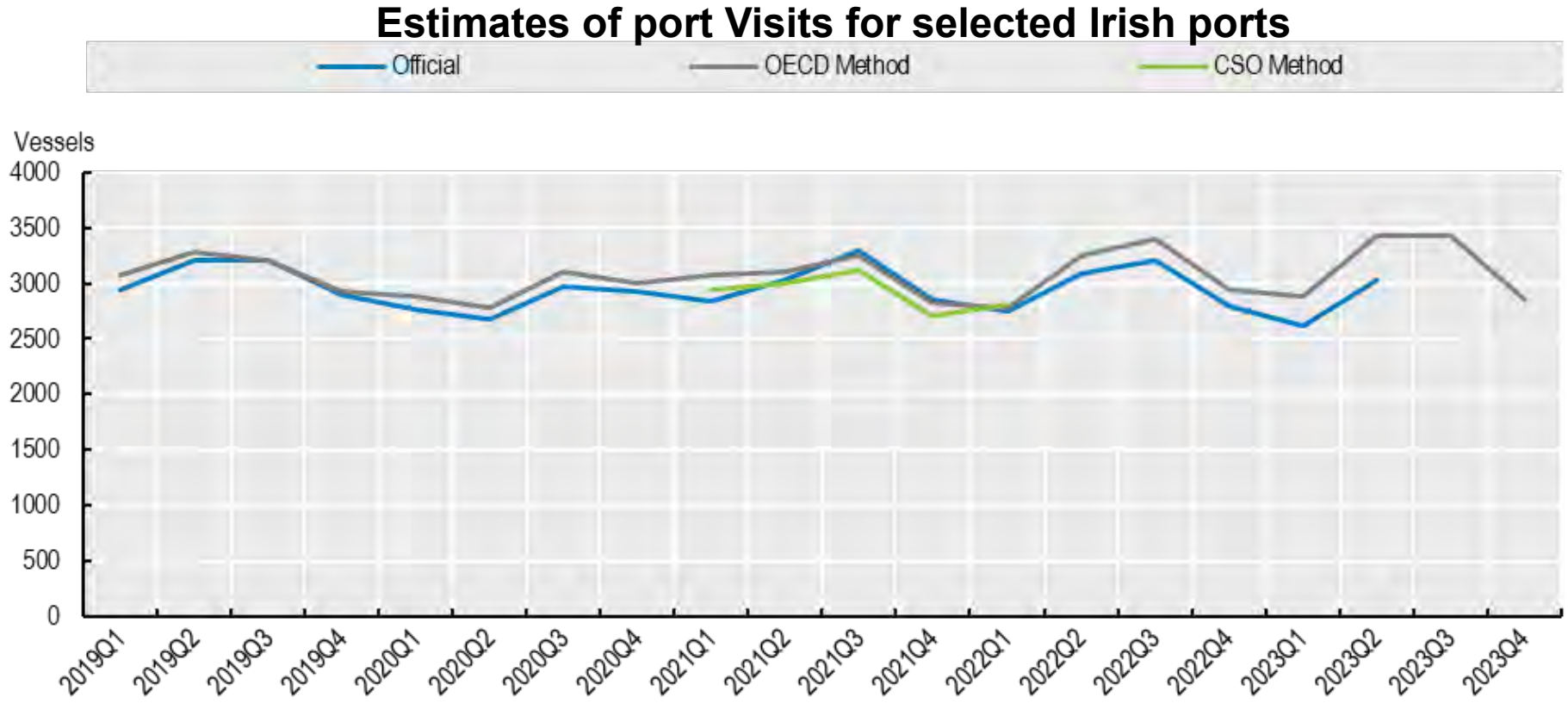
- Assign each hexagon to the closest port

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Insights

Port Visits

- Calculate a port visit by an entry into a “port hexagon”

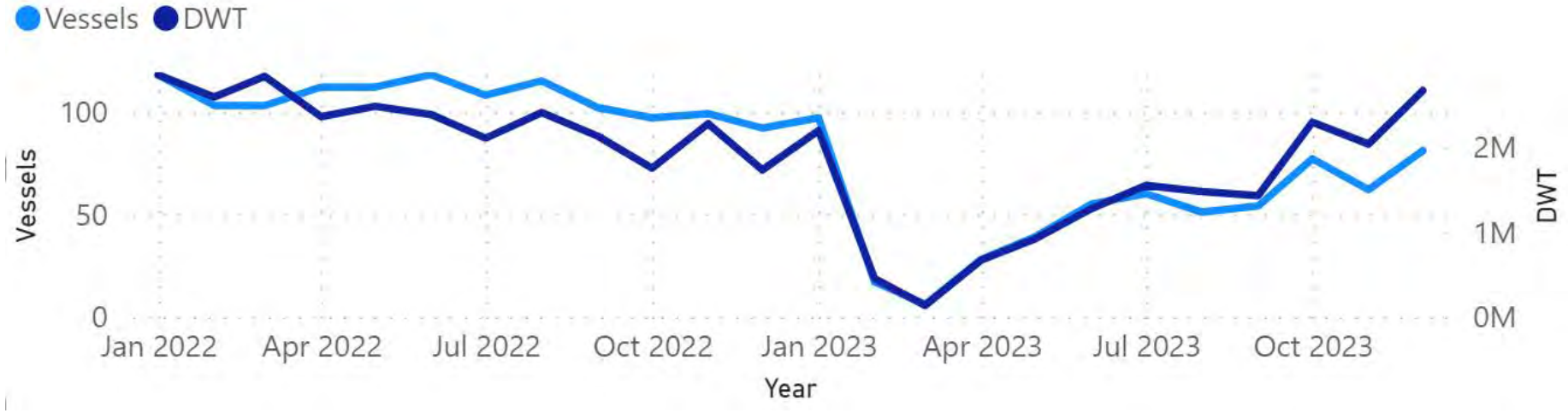


- Extends official stats by 2 quarters, provides framework for granularity

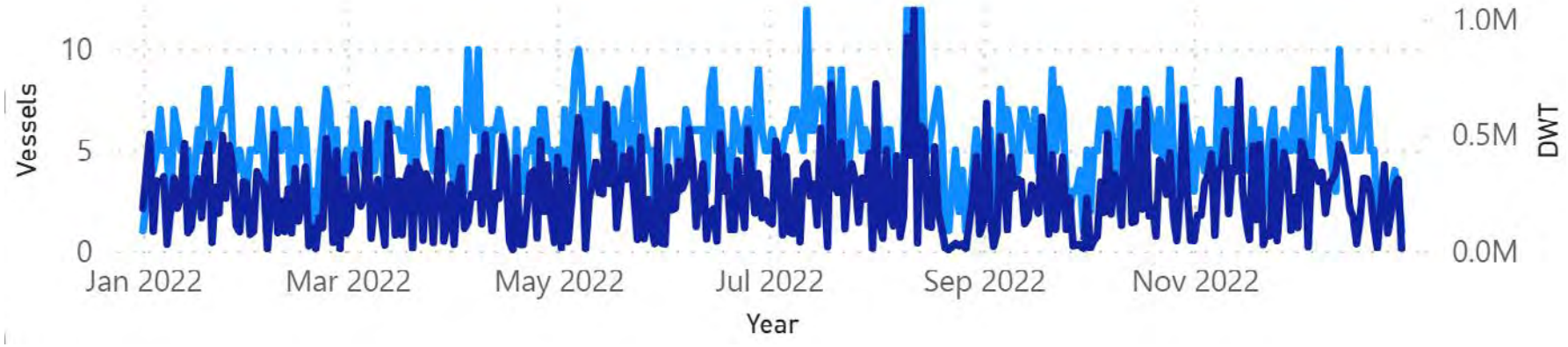
© OECD

Port Visit Applications

Natural Disaster: Iskenderun (TUR) 2022-23



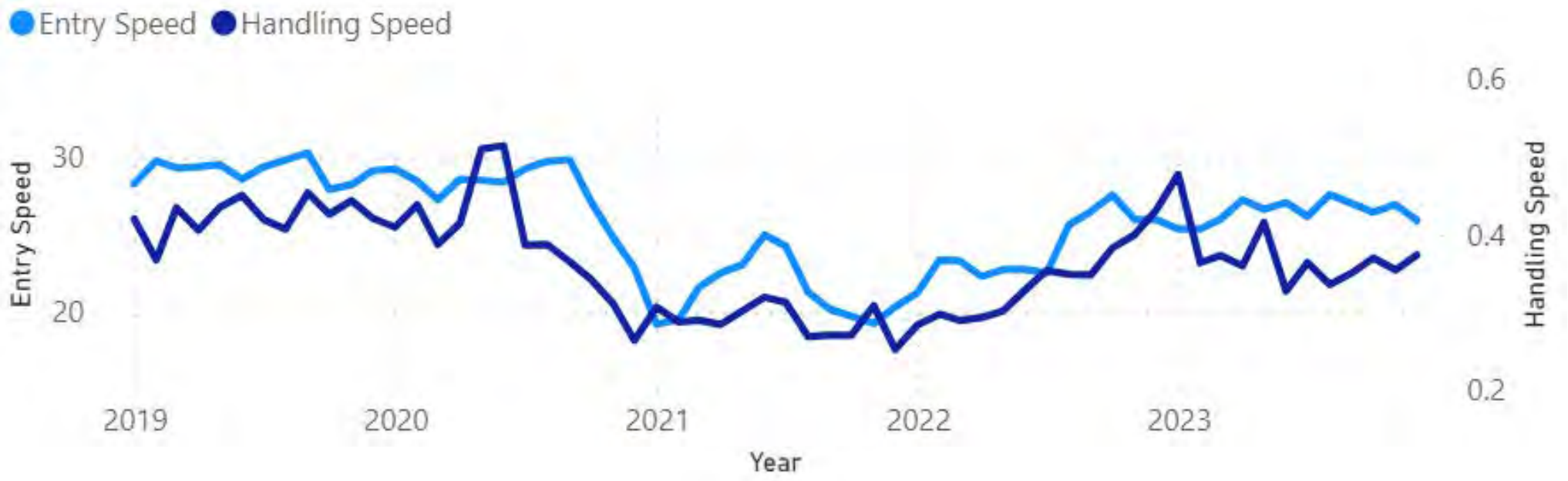
Impact of Strikes: Felixstowe (GBR) 2022



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Trade Metrics: Efficiency

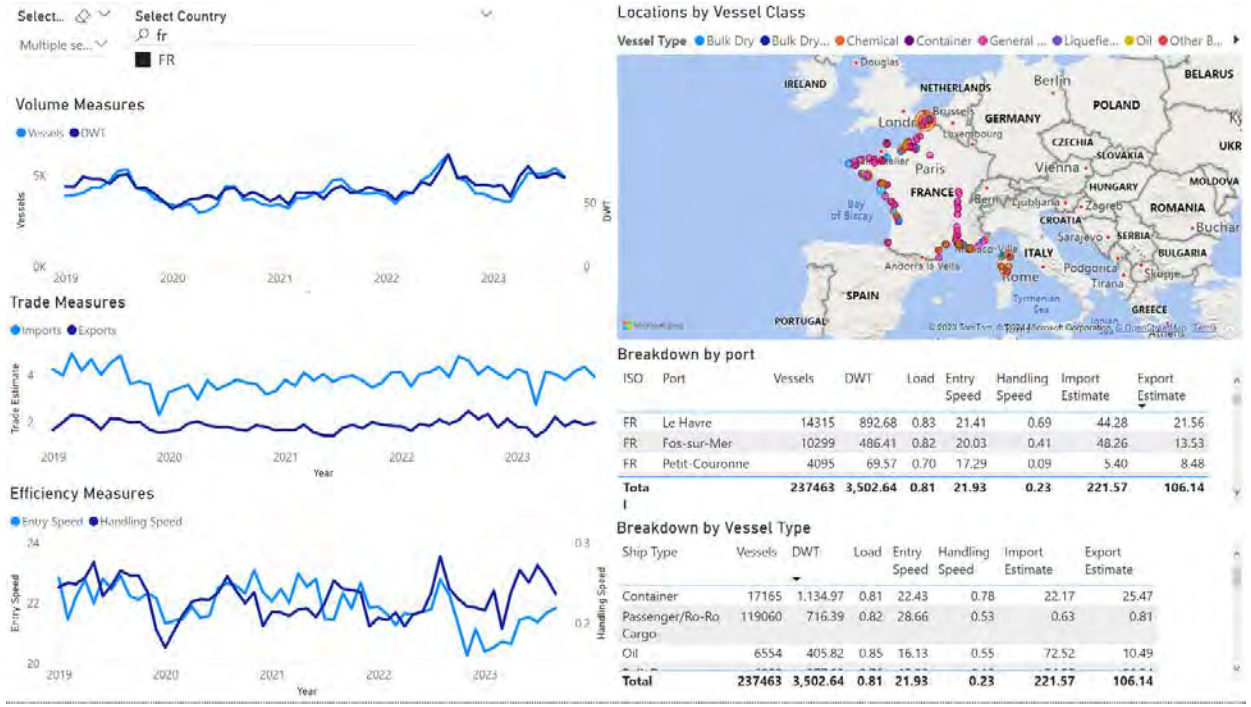
- Los Angeles and Long Beach had well documented issues during 2021 and 2022, and this reflects in our 2 efficiency metrics:



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Next Steps

- Explore the data in our Dashboard
- Forthcoming paper and official release in next few months
- Contact: graham.pilgrim@oecd.org



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IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

PortWatch: monitoring trade disruptions from space[1]

Serkan Arslanalp, Parisa Kamali, Robin Koepke and
Alessandra Sozzi,
International Monetary Fund;

Jasper Verschuur,
University of Oxford

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

IMF | PORTWATCH

A PARTNERSHIP WITH
OXFORD UNIVERSITY

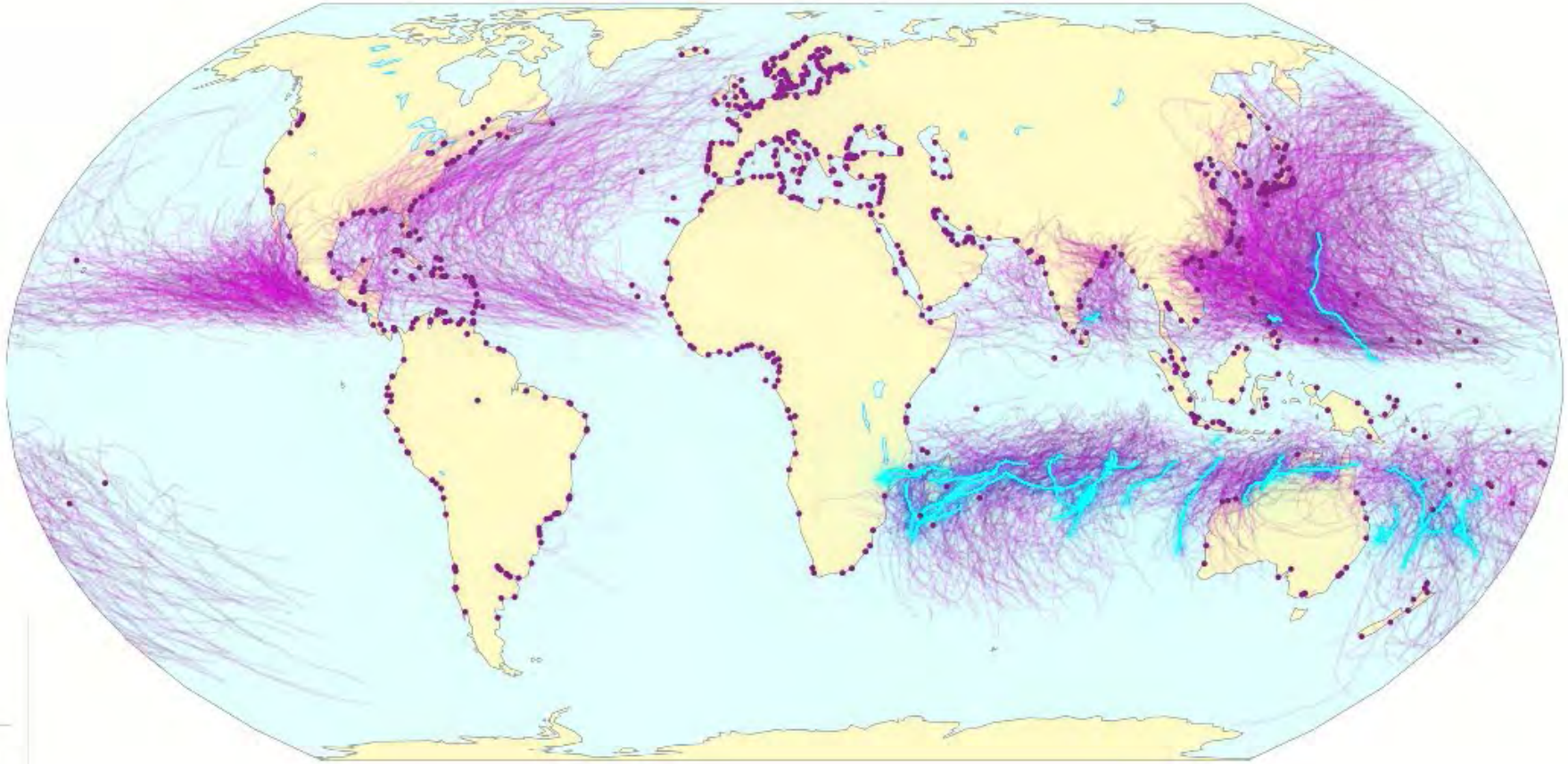
Monitoring Trade Disruptions from Space



Serkan Arslanalp, Parisa Kamali, Robin Koepke, Alessandra Sozzi (IMF)
Jasper Verschuur (University of Oxford)

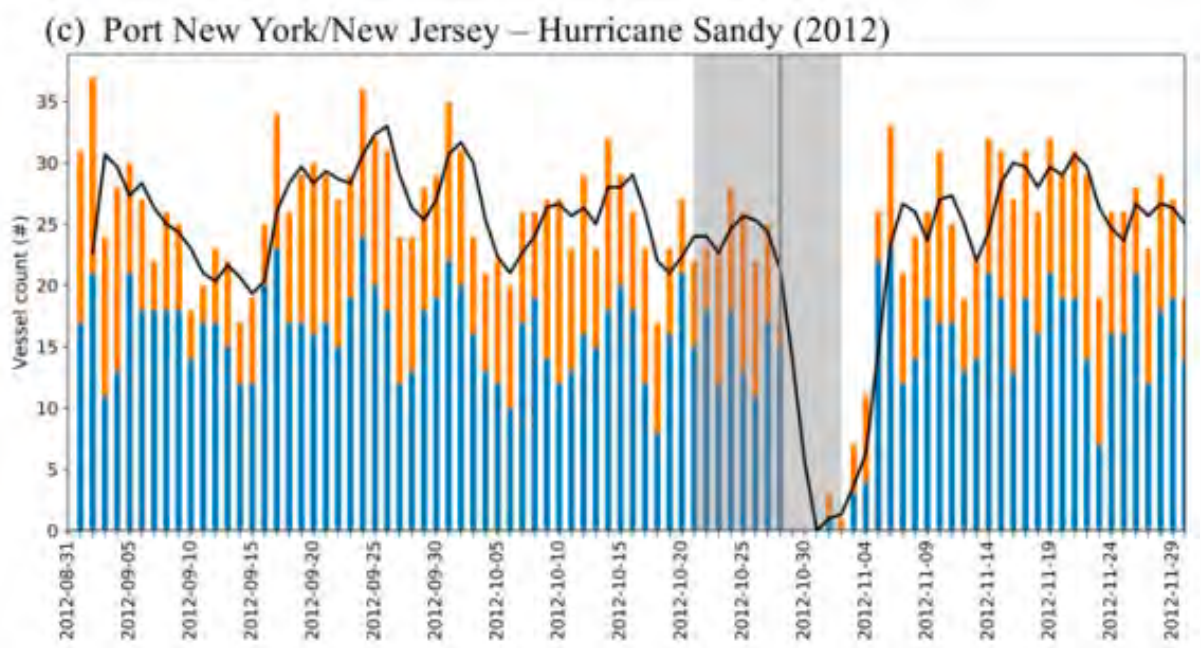
Ports are Frequently Hit by Climate Extremes

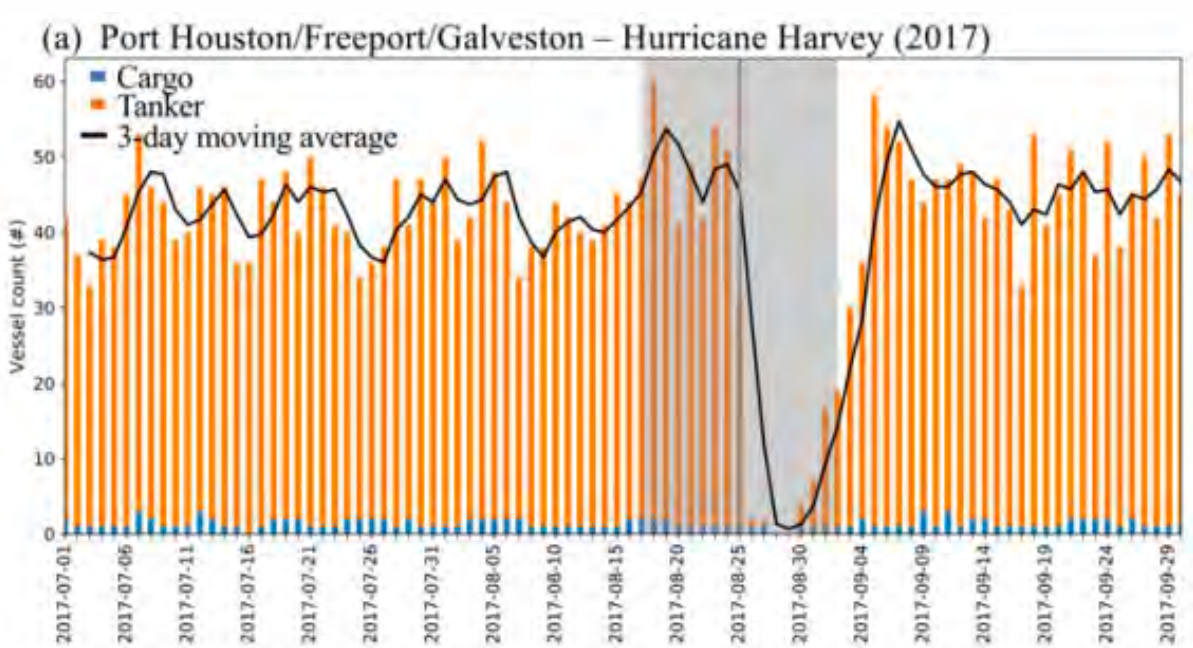
World Ports and Tropical Cyclones (1990-2022)



Climate extremes can cause trade disruptions

- **Impacts** range from **infrastructure damages, delays** to **trade disruptions**
- Median → **6 days,** 95th percentile → **22 days (27 events)**

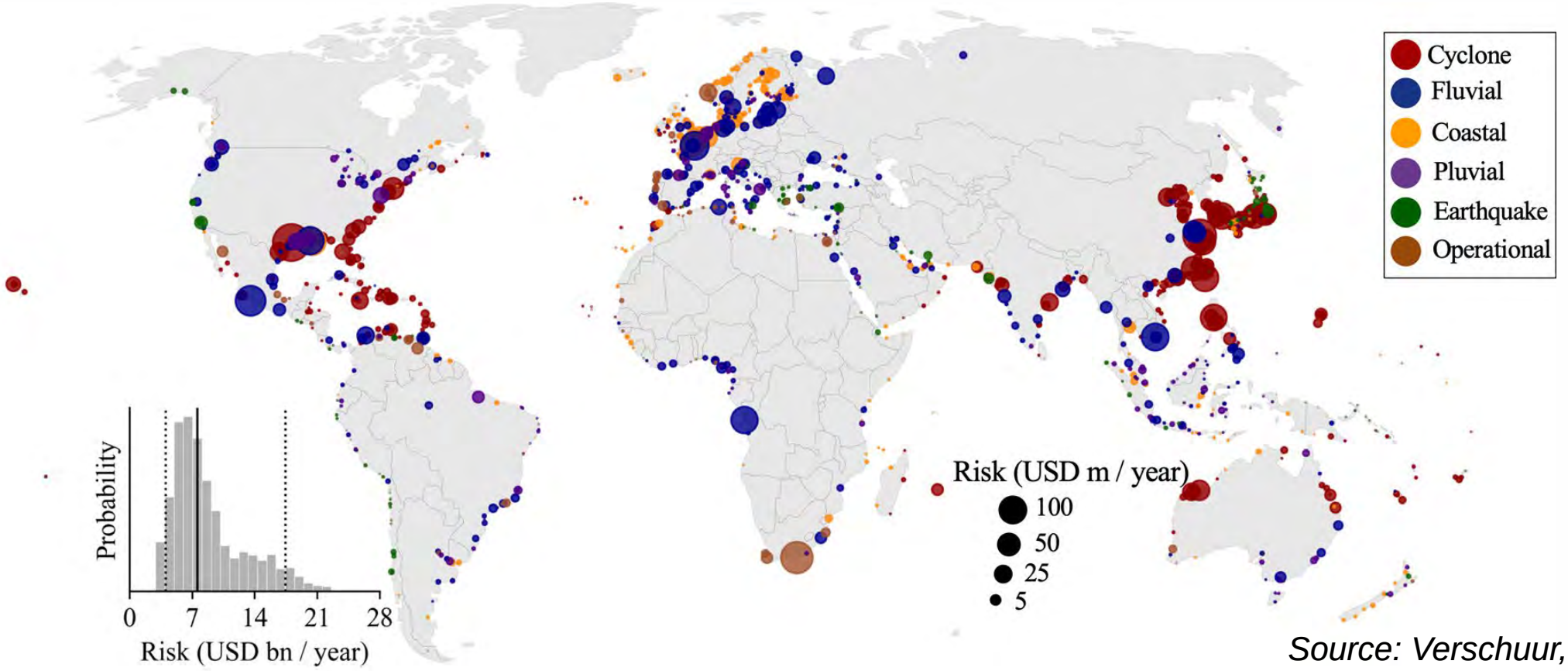




Source: Verschuur, Koks and Hall (2020)

Quantifying climate risk to ports and trade

- Port-level risk at **8.0 USD billion per year**
- **100 USD billion** of **trade disrupted** every year
- **Climate change** will increase this with **60-100% by 2050**



Source: Verschuur, Li, Koks and Hall (2023)

Bringing science in the hands of policymakers

- **Research embedded in three layers:**
  1. Monitor the pulse of the economy during and after climate extremes (**Monitoring**)
  2. Stress-test the global system for low probability but high impact events (**Spillover analysis**)
  3. Evaluate present and future climate risks and trade vulnerabilities (**Climate scenario tool)**

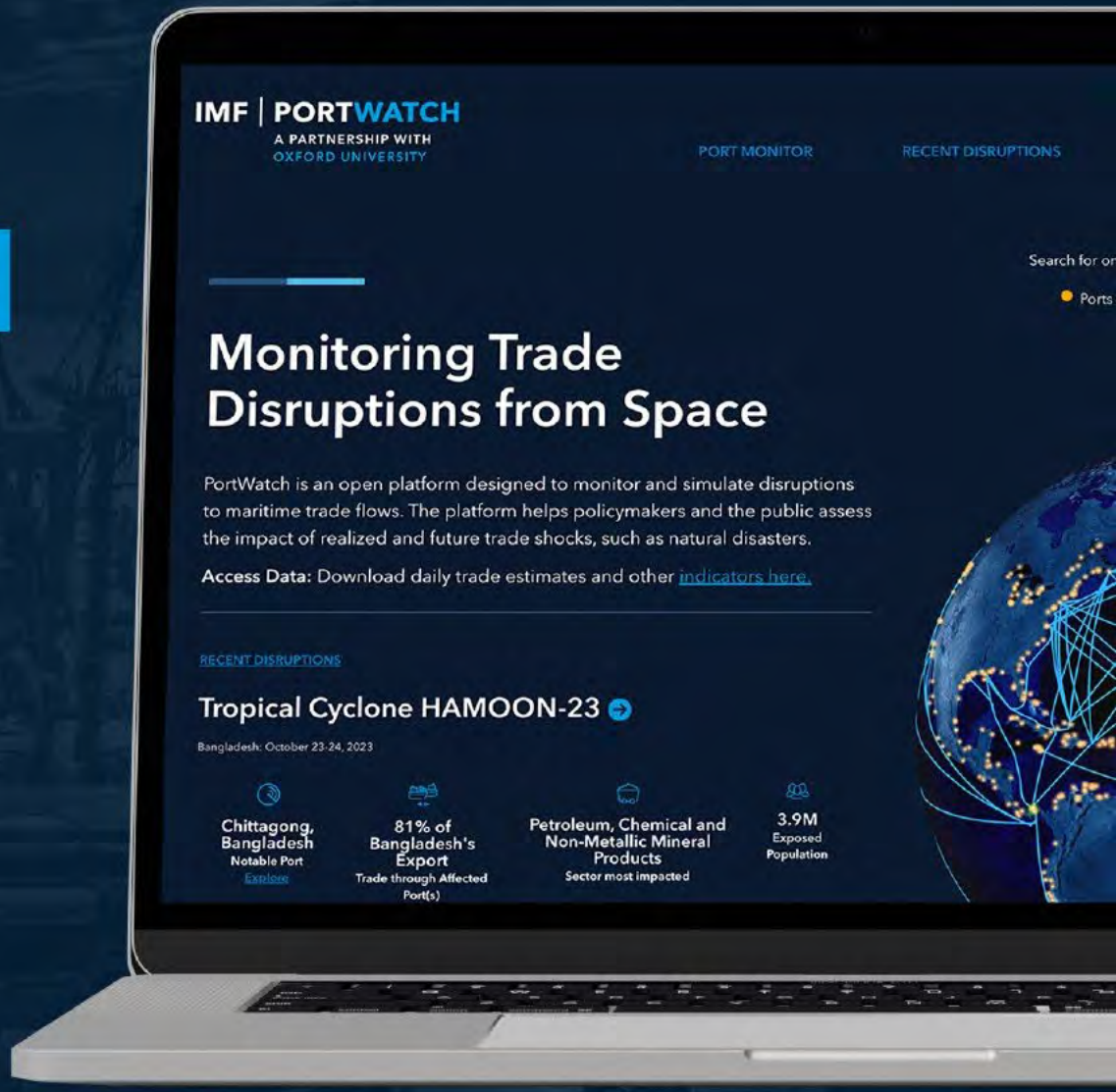


- **PortWatch quantifies the unquantified** → Bringing policymakers together to manage system-wide climate risks

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Monitoring Trade Disruptions from Space

PortWatch is an open platform designed to monitor and simulate disruptions to maritime trade flows. The platform helps policymakers and the public assess the impact of realized and future trade shocks, such as natural disasters, based on real-time data sourced from the UNGP.

Access Data: Access all data that power the PortWatch platform here.



RECENT DISRUPTIONS

Trade Disruptions in the Red Sea

Suez Canal
Notable chokepoint
Explore

11% of Global Maritime Trade
Trade volume through affected chokepoint(s)

Petroleum, Chemical and Non-Metallic Mineral Products
Sector most impacted

Ports & Chokepoints
1391

of Ships Tracked
120K

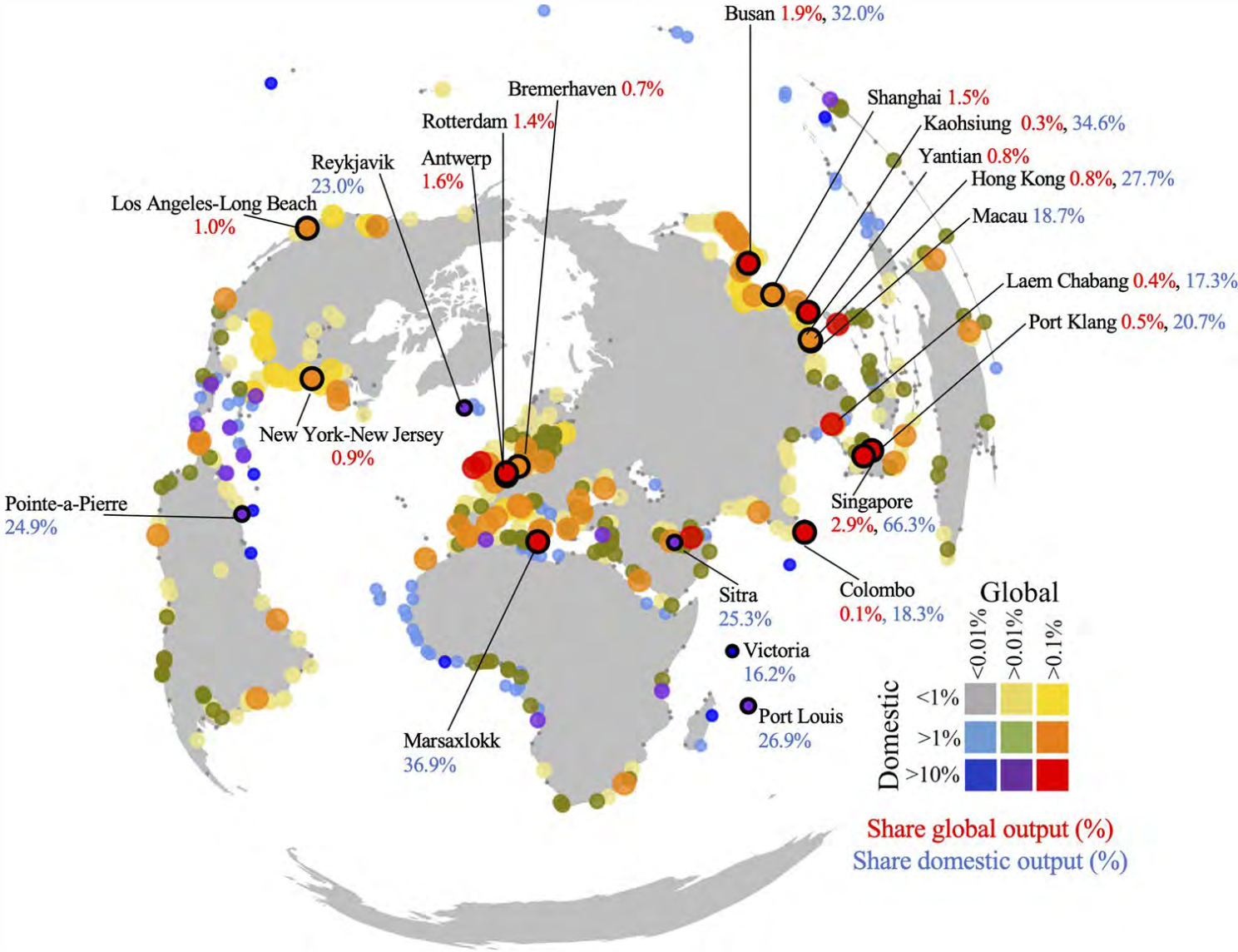
Daily Trade Data Since
2019

Maritime Trade Covered
99%

Annual Maritime Trade Value
$14T

Ports tracked by PortWatch

- **Domestically systemic:**
  - Support trade-dependent economies
- **Globally systemic:**
  - Connect global supply-chains across borders
- **Regionally systemic:**
  - Serve regional economies
  - “Regional Public Goods”



Source: Verschuur, Koks and Hall (2022)

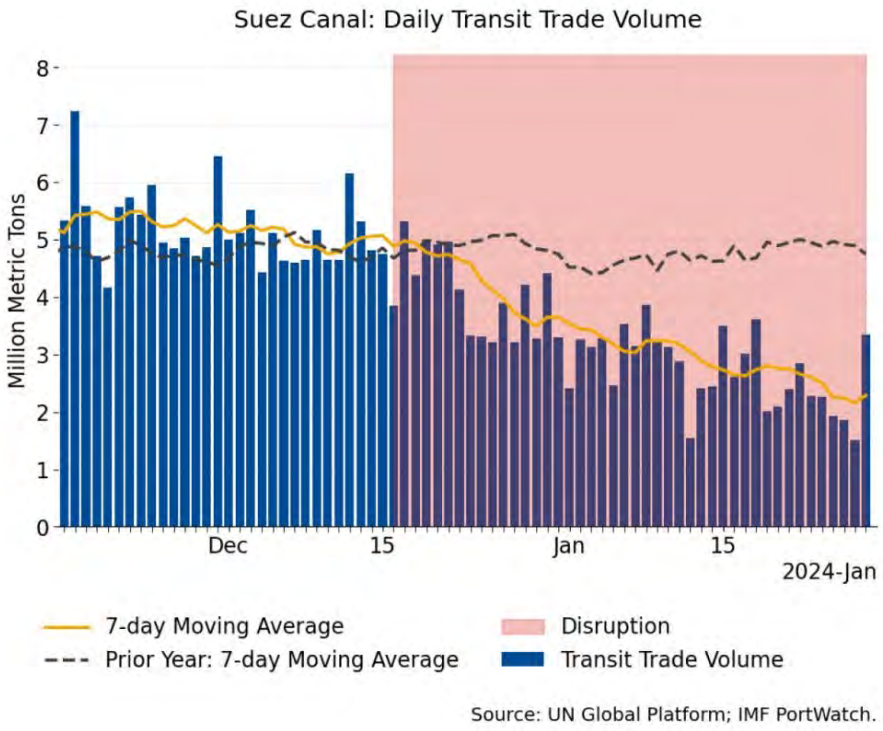
RECENT DISRUPTIONS

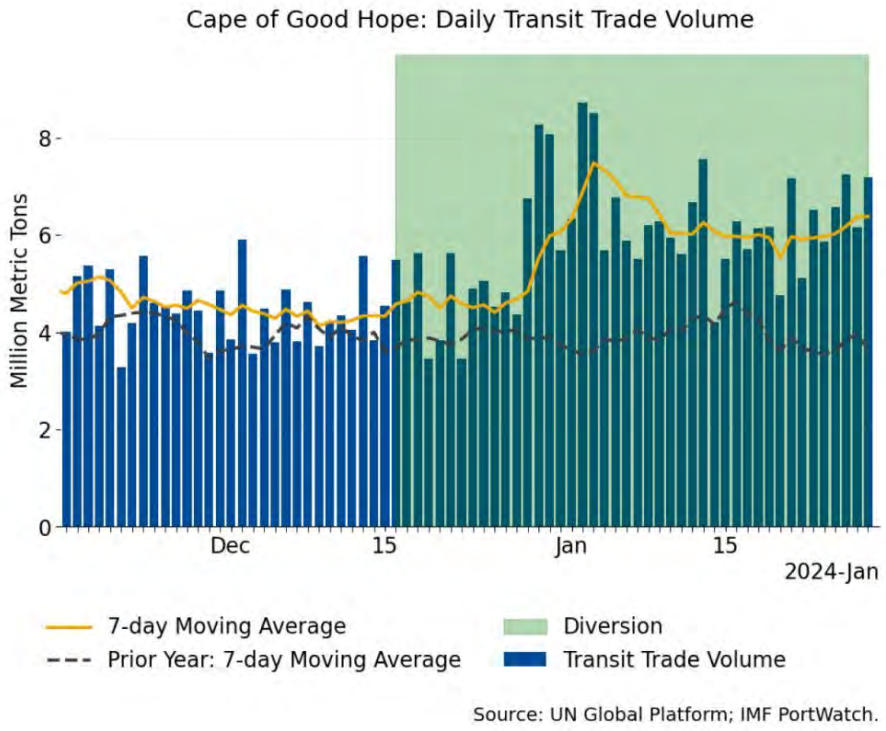
Trade Disruptions in the Red Sea

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DISRUPTION MONITOR

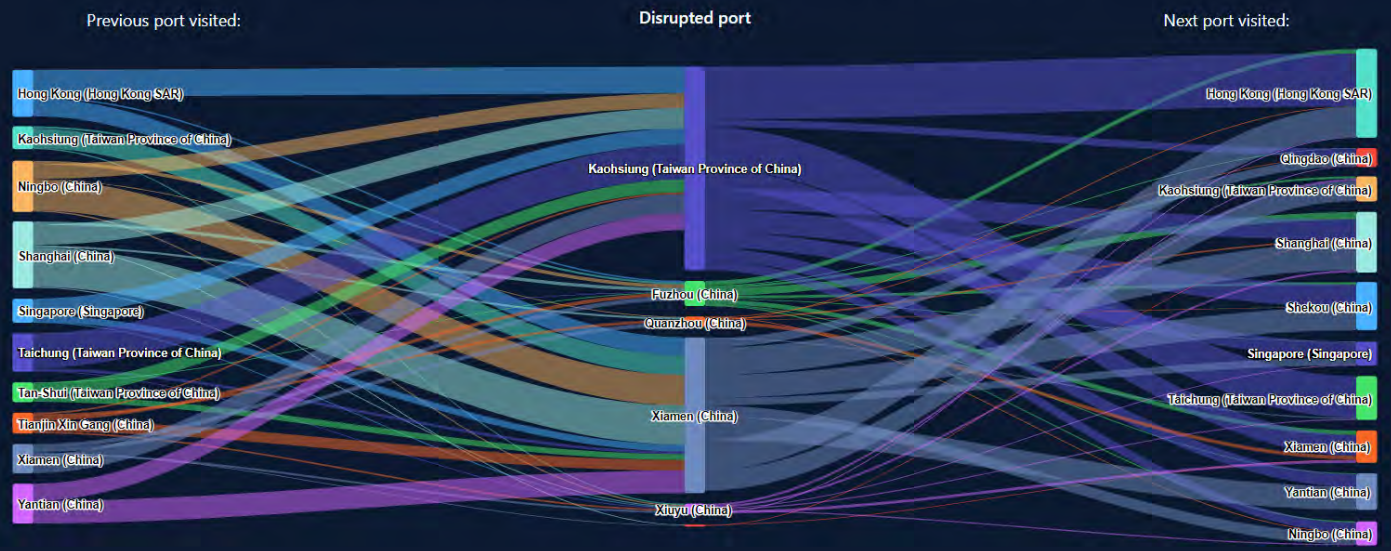
Tropical Cyclone DOKSURI-23

China; Taiwan Province of China | 21 July, 2023 – 28 July, 2023

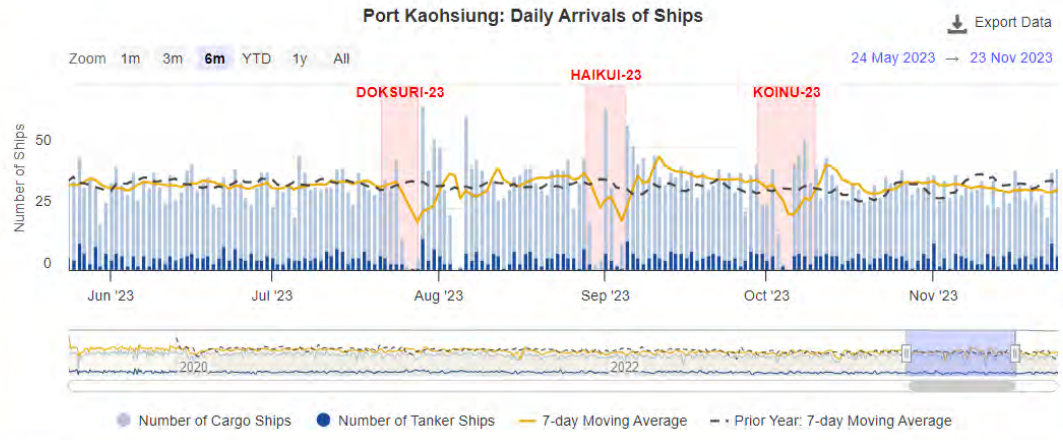


Potential Disruption Spillovers through the Maritime Network

›p 10 ports that export to and import from the ports near the epicenter of the disaster, respectively. As such, the 10 ports shown on the left and on the right might be at risk of indirect trade disruptions from the disaster via spillovers through the maritime trade network. Numbers shown next to the ports refer to the share of total exports to (or imports from) the ports in the disaster area (as % of total).

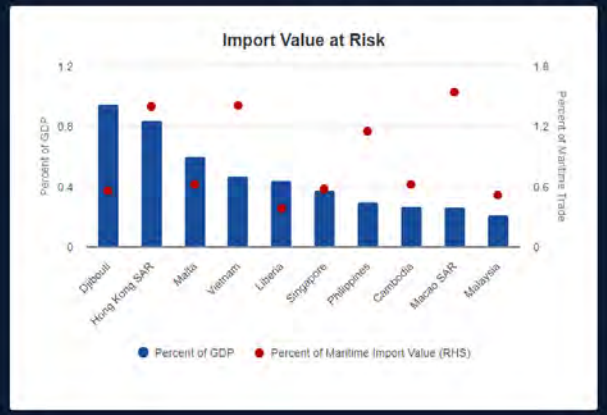


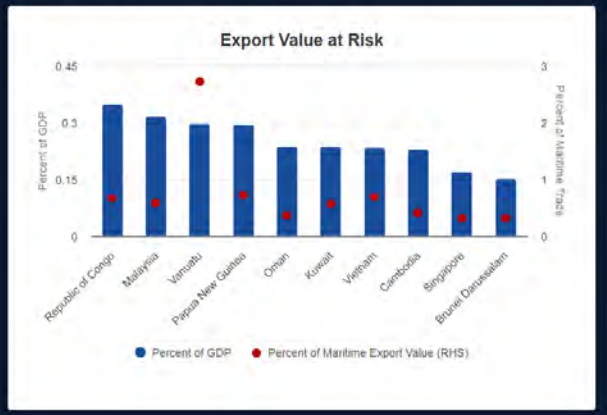
Port Calls | Import Volume | Export Volume



Potential International Spillovers: Trade of Other Countries with Ports in Disaster Area

Aggregate value of trade processed at the disrupted ports, broken down by partner country and expressed as a share of partner country GDP and maritime trade. The charts provide an upper bound estimate of potential international spillover effects via the maritime trade channel, in the sense that these trade values could be at risk of being delayed or lost if disrupted ports are not operational for 30 days.

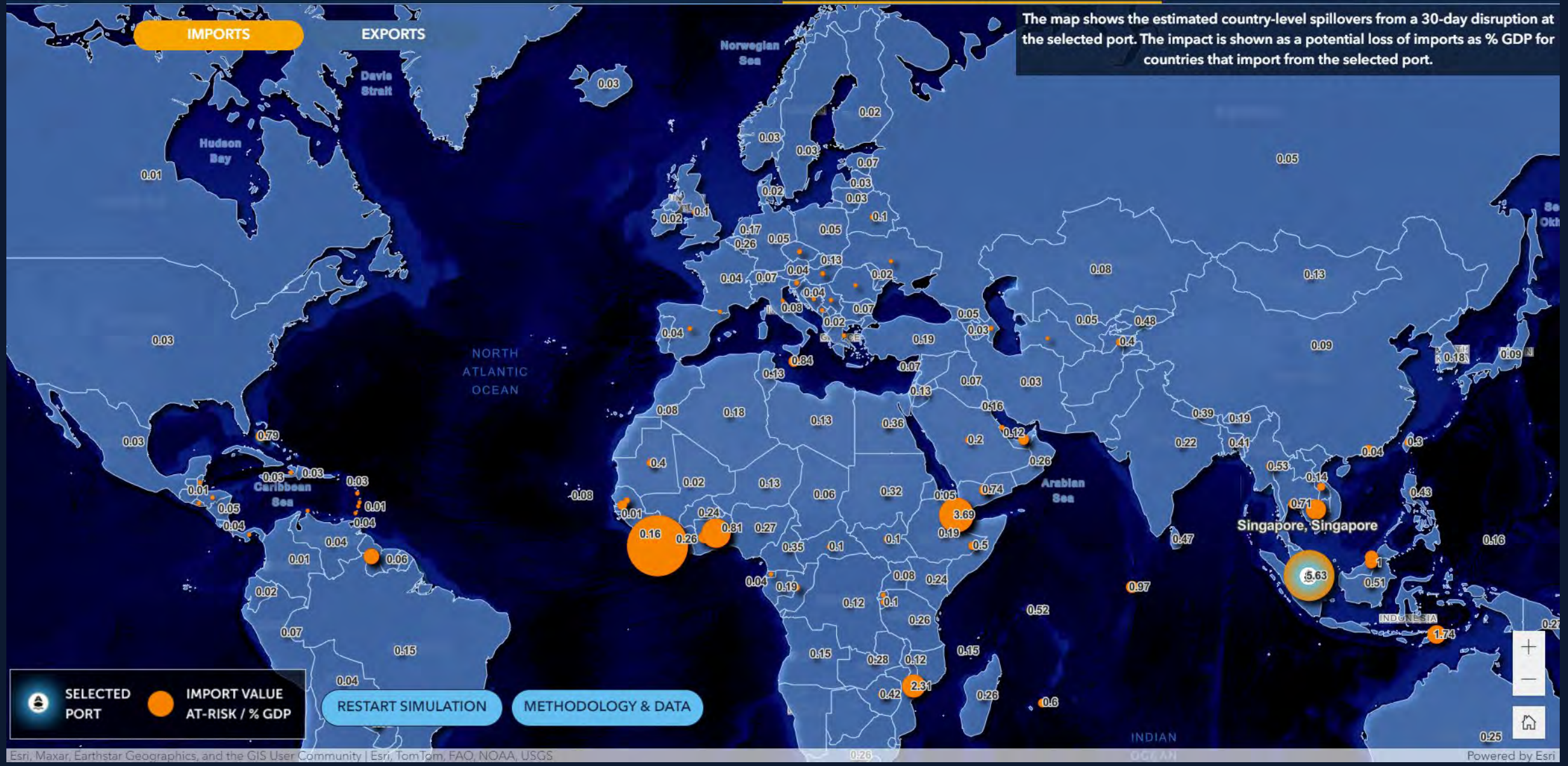




SPILLOVER SIMULATOR

BACK | PORT-LEVEL IMPACT | COUNTRY-LEVEL IMPACT | SUPPLY CHAIN IMPACT

7 days | 14 days | 30 days | 90 days



CLIMATE SCENARIOS

BACK

CLIMATE RISK

COUNTRY TRADE RISK

PRESENT

Stringent decarbonization
2050 - RCP2.6

Middle of the road
2050 - RCP4.5

Fossil fuel-based development
2050 - RCP8.5

IMPORTS

EXPORTS

The map shows the top-100 most climate vulnerable ports for the the selected country's imports, reflecting the annual expected days of downtime due to climate-related hazards and the selected country's imports flowing through the port.



SELECTED COUNTRY

TOP 100 PORTS BY IMPORT VALUE AT-RISK (USD PER YEAR)

RESTART SCENARIO

METHODOLOGY & DATA

Esri, Maxar, Earthstar Geographics, and the GIS User Community | Esri, TomTom, FAO, NOAA, USGS

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12-13 February 2024

FDI true value: experimenting with market capitalisation ratios to value unlisted FDI equity[1]

Véronique Genre, Christophe Guette-Khiter
and François Robin,
Bank of France

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

FDI true value: experimenting with market capitalisation ratios to value unlisted FDI equity

Véronique Genre, Christophe Guette-Khiter and François Robin[1]

Abstract

According to current methodological standards, market valuation should be the basic principle to evaluate FDI equity transactions and positions as well as all other instruments and in coherence with national accounts. While it is easily available in case of equity listed on stock exchanges, compilers need to find a proxy to the value of the equity in case of unlisted equity, which represents the largest part of FDI equity capital.

Current methodological standards recommend a list of methods to approximate the market value with different levels of practical implementation. None of the current manuals clearly indicates which method is preferred leading to potential different choices among countries and, thus, bilateral asymmetries and reduced international comparability.

Many countries rely on the Own Funds at Book Value method (OFBV). Because it is available for all enterprises, it is easy to implement, allows for detailed breakdowns and for smaller asymmetries between countries. However, in the case of France, OFBV values underestimate market values by about half and provide a misleading account of the international net position of the country.

In this paper, we experiment the market capitalisation ratio method using the largest range of available information in order to gauge the costs and benefits, as well as the resources required for such a compilation by external statistics compilers. To do so, we build market ratios from listed shares' data (market value / book value) starting for the Centralised Securities Data Base (CSDB) of the Eurosystem and completed with private databases to get as detailed information as possible regarding sector and country breakdowns across the globe, between 2012 and 2023.

We develop a set of country-by-sector market capitalisation ratios. For robustness purposes and whenever firms' samples are big enough median ratios were applied to individual enterprises to calculate a market value. Whenever the sample of individual firms is too small, we aggregate samples to the upper geography level. This data-intensive method tries to overcome the fact that aggregated capitalisation ratios do not take into account market-specific characteristics. It is also a way to check whether disaggregated series might be published.

[1] The views expressed here are those of the authors and not necessarily that of Banque de France. The authors would like to thank Gian Maria Milesi-Ferretti and other participants at the February 2024 IFC conference on Bank Statistics for their helpful discussions.

Because there are other market valuation methods, we simulate the one relying on market index prices with the same data. Then, we compare both methods.

We finally work on a stock-flow reconciliation model, which should remain valid irrespective of the valuation method. The use of market capitalization ratios now appear in the reconciliation equation, raising a methodological debate. Whereas transactions and exchange rate valuation effects are easy to compile, the allocation of the additional effect between price valuation and other adjustments is not trivial. This experimental exercise raises methodological questions that compilers face in their day-to-day work and may call for additional guidance the background of the current manuals' revision.

Keywords: foreign assets, foreign direct investment

JEL classification: C18, F21, F23, F34

1. Some background

Looking at France's international investment position, foreign direct investment (FDI) in equity is currently published at "mixed value". It means that the listed portion of outstanding FDI, both outbound and inbound, is valued at market value, but the unlisted portion is valued according to own funds at book value (OFBV). In reality, unlisted companies account for 96% of FDI assets and for 77% of liabilities. Hence, the proportion of firms at market value in French data is low.

There usually is a substantial difference between FDI stocks recorded at book value and those recorded at market value, something that is easily spotted whenever an unlisted firm becomes listed on the stock exchange. They often differ for reasons linked to goodwill (such as company's economic development prospects and the valuation of certain intangible assets), some elements of market value that are not taken into account in financial statements. Hence the IMF and the OECD recommend valuing stocks of foreign direct investment at market prices to improve consistency between flows observed at the time of a transaction, - clearly at market value -, and stocks making up the international investment position (OECD, 2009 and IMF, 2015).

In practice, estimating market value for unlisted companies is a complex, data-intensive exercise that only a few countries implement and there is no standardized methodology agreed upon at an international level. Among major OECD countries, Canada and the United States in particular publish aggregate data on their net international investment position at market value, alongside another set of detailed data at book value. European countries, like France, rely on OFBV/mixed value, which allows for relatively homogeneous comparisons within the EU (ECB, 2023).

In France, several experiments in valuing unlisted companies have been carried out (Durant and Massaro, 2004 and Nivat and Topiol, 2010) based on a subset of the enterprise population. Between 2009 and 2013, the annual Balance of Payments Report regularly published aggregate series of FDI at market value in its chapter on the international investment position, in full coherence with national accounts. However, the statistical tables in the appendices only detailed mixed values. From 2014 onwards, this dual publication was discontinued, assumingly due to the difficulty to communicate two different sets of data.

Yet the debate on how to value French FDI stocks remained because of its impact on the overall net investment position. France has a higher density of resident multinational groups than other countries. In 2021, French multinationals (excluding non-market services and banking subsidiaries) controlled 51,000 subsidiaries abroad in more than 190 countries and employed nearly 7 million people abroad (INSEE, 2023), more than a third of domestic employment. They generated over €1,550 billion of annual consolidated sales, just over half of the total consolidated sales of French multinational companies. French FDI assets abroad stood at €1,347 billion, far above inward FDI, at only €834 billion. These imbalances feed into revenue flows for the benefit of the French balance of payments, which together with the US and Japan register among the largest surpluses of FDI revenues in the world (Vicard, 2018). Hence not valuing unlisted equity for France clearly underestimates its actual international net position.

2. Market capitalization valuation

One approach to convert equity book values of unlisted firms to market values involves the use of market capitalization ratios derived from similar listed companies, on a country-by-sector-of-activity basis. In concrete terms, for any given unlisted non-financial corporation, (1) we identity similar listed companies, (2) we calculate a market-to-book value ratio and (3) we multiply the company's equity book value by its corresponding ratio.

This market capitalization valuation is one of the three methods preferred by international organizations to provide estimates of market value (OECD, 2023). It has the advantage of taking into account both trends in the financial markets - the market capitalisation of listed companies - and trends in the actual financial situation of companies - equity. In previous experiments, the method often relied on capitalization ratios derived from as-broad-as-possible stock exchange indices and, consequently, remained limited to those companies used to build such indices. One obvious problem is that market indices may carry a construction bias and may not be fully representative of the country's economic structure.

In this paper, we free ourselves from some of the market indices' biases by using a larger dataset than ever experienced with. The ECB-maintained Centralised Securities DataBase (CSDB) is designed to contain all securities and listed shares issued by euro area and non-euro area EU residents in all currencies at the individual country level, as well as by residents of the rest of the world in euro. Albeit very "European-centred", this database serves our purpose since French foreign direct investment (FDI) is mainly resulting from European interactions. In this exercise, the CSDB provides us with a long list of listed non-financial corporations between 2012 and 2023, for which we can extract an ISIN code, a share price, an issuance country and the NACE sector of activity.

We can then match this dataset with a private data provider using the ISIN code of the company's share found in the CSDB to extract consolidated book values (*total equity*) and the corresponding market value for that same company (*market capitalization*).

Since financial private data providers may be charged with dubious quality (Landis and Skouras, 2021), we run robustness checks by extracting similar data from two different providers and compared them. We directly extract book-to-market ratios in US dollars from Thomson Reuters Datastream that we convert in euros. We then compare these ratios with the ones we build using Bloomberg data, where we extract both market and book values directly in euros. We voluntarily extract data that was not directly comparable and recalculate ratios to ensure robustness. This comparison is run for over 3 000 companies. The average correlation between ratios coming from the two different sources is greater than 0.95 (median is 0.98), convincing us that the data extracted is reliable.

Overall, our data is available from 2013 to 2023[2] (except otherwise). Since this exercise was initially part of a benchmark year revision, data starts in 2012. In total, we extract approximately 70 000 observations per year, for which we can observe both a market and a book value, across 241 geographical regions/countries/zones and 9 sectors of activity.

3. Descriptive statistics

Dealing with outliers

OFBV and market value estimates have to be consistent, in the sense that their ratios have to lie within a reasonable range. In our final working dataset, the average ratio historically stands around 1.98, i.e. on average a company's market value is about twice its book value, which is consistent with previous findings (see for example, Durant and Massaro, 2004).

However, the initial data extraction reveals a distribution skewed to the right, with extreme values. Table 1 gives an overview of the ratios' distribution over the whole period of observation for the initial dataset: the median ratio reaches 1.34, but the mean stands at 68.

Table1

Distribution of individual market capitalisation ratios

(2012-2023)

Statistics	Value
Minimum	0.00
1st percentile	0.00
5th percentile	0.16
1st decile	0.36
1st quartile	0.73
Median	1.34
3rd quartile	2.75
9th decile	5.76
95th percentile	9.86
99th percentile	41.17
Maximum	6 151 912.19

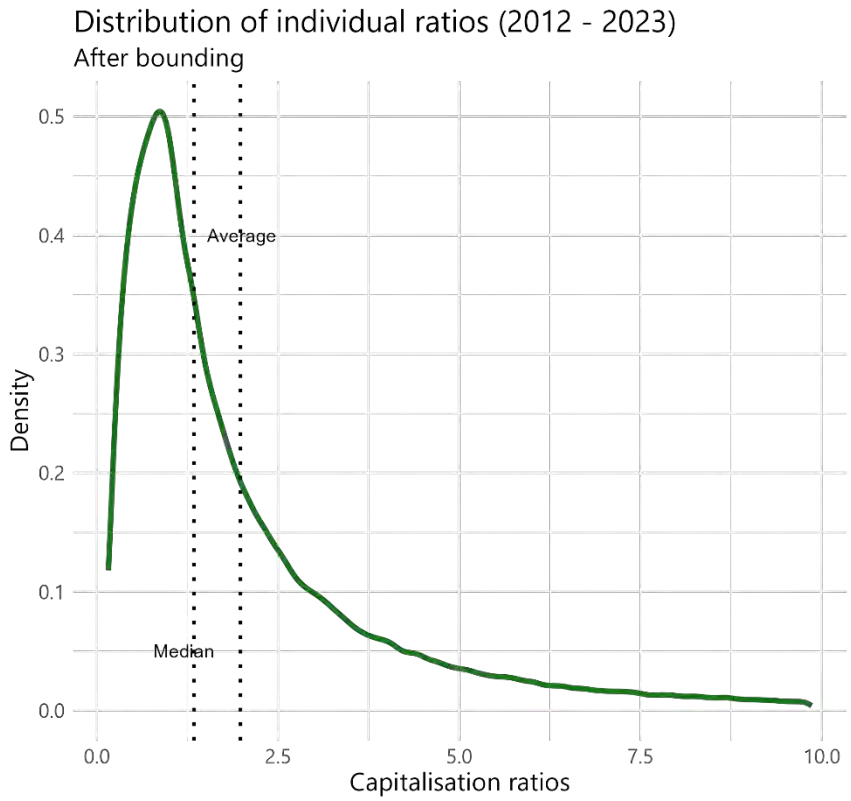
[2] Because the CSDB only provides listed companies starting in 2014, our dataset does not include those companies that left the stock exchange in 2012 and 2013, but only those who were still listed in 2014. The resulting selection bias, however, is expected to be limited as entry-and-exit in the stock exchange is fairly low: on average, individual ISIN codes lasts 7.4 years in the CSDB.

Source: CSDB and Bloomberg data – Banque de France.
Note: the median ratio is 1.34 over the whole period of study.

Table 1 suggests that not all ratios are representative. Indeed, multiplying the OFBV by either 0 or more than 6 million would lead to unreasonable statistics. This is an incentive to detect and remove outliers. In order to keep the shape of the ratios' distribution, we choose to apply symmetric bounds, contrary to Canada for instance where bounds are set to 0.5 and 10 (Canada, 2010). Since the 1st and 99th percentiles' trim still looks meaningless, we choose a 5th and 95th percentiles' trim. Doing so leads to a 10% cut in the data, which looks acceptable given the population size. However, because bounding might have a strong impact on statistics, we also run simulations using the 1st and 99th percentiles' bounds. Bounds have a very low impact: in average over the period, the relative difference over results between both sets of bounds is lower than 1%.

Using 5th and 95th percentiles leads to relatively stable bounds over the years (respective ranges are [0.14; 0.21] to [8.31; 12.10]). Ratios' standard deviation falls from 79.70 without bounds to 0.83 with 5th – 95th percentiles' bounds (1.50 with 1st – 99th percentiles' bounds). Figure 1 provides the distribution ratios after trimming.

Figure 1



Sources : CSDB and Bloomberg data - Banque de France
Note: median and average ratios (1.34 and 1.98) are arepresented by dotted lines.

One may suggest that trimming on absolute values may not guarantee consistent results through time. Indeed, we could also bound ratios by their yearly

variations. After bounding absolute ratios, the range of yearly variations' remains large (from -1 to more than 10). However, after grouping ratios by geographical zones and sectors of activity as we will detail below, yearly variations range from -0.49 to 0.94, which seemed reasonable.

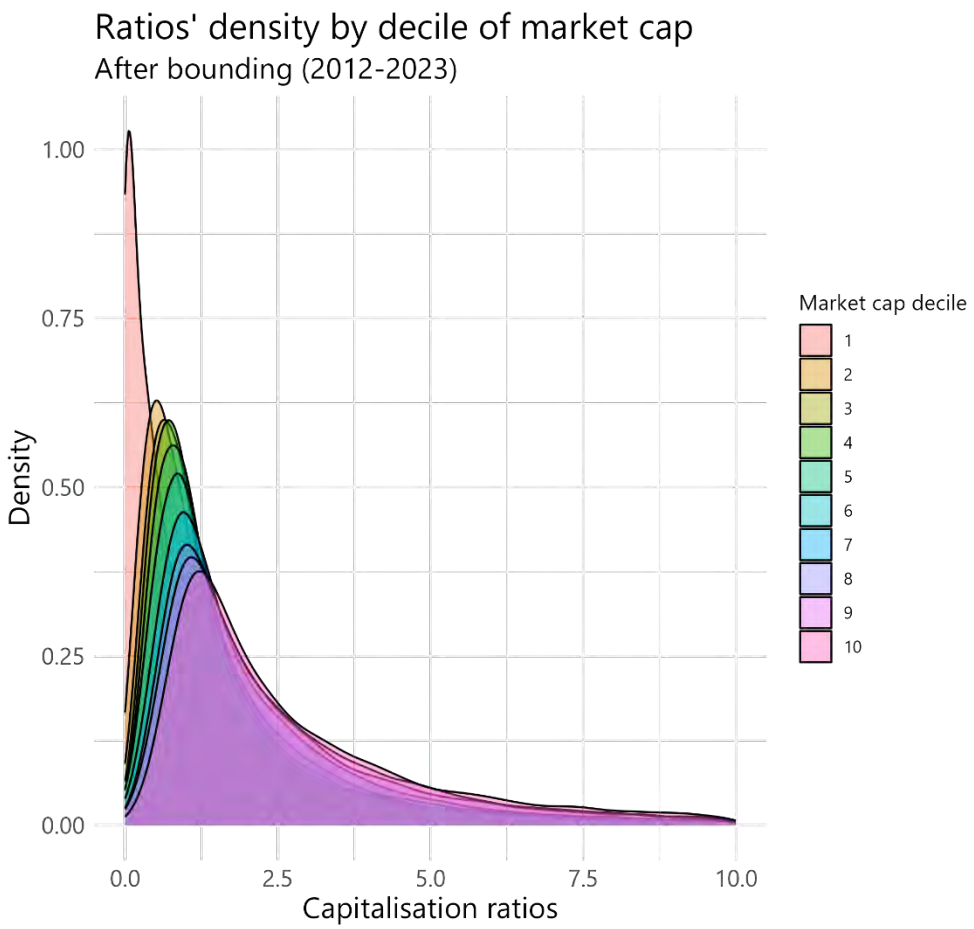
Having calculated our individual market capitalisation ratios, we could now pair every unlisted direct investment enterprise (DIE) with listed companies of the same geographical zone and sector of activity using either a median or an average ratio.

Median or mean? Does it have to do with illiquidity discount?

Usually, using the median instead of the mean ensures robustness as the median is less sensitive to extreme values. Since we already apply bounds to filter out outliers, using the median rather than the mean may be relevant for an additional reason.

Skewness to the right is conspicuous in our data, meaning that higher values strongly pushed the mean upwards. Because large caps tend to have higher ratios than mid to small ones (Figure 2), using the mean rather than the median simply leads to an over-representation of large caps.

Figure 2



Sources : CSDB and Bloomberg data - Banque de France
Note: higher deciles of market cap match with large caps

Note that the entry-and-exit rate between market capitalization deciles, defined as the standard deviation of inter-deciles' changes is 0.55 over the whole period of observation. In other words, population within a decile remains relatively stable from one year to the next and in seven years, about half of companies had remained in the same decile.

Not only large caps remain large caps and small caps remain small caps, but larger caps also tend to have higher capitalization ratios (Table 2).

Table 2

Distribution of individual market capitalisation ratios (2012-2023; trimmed dataset)

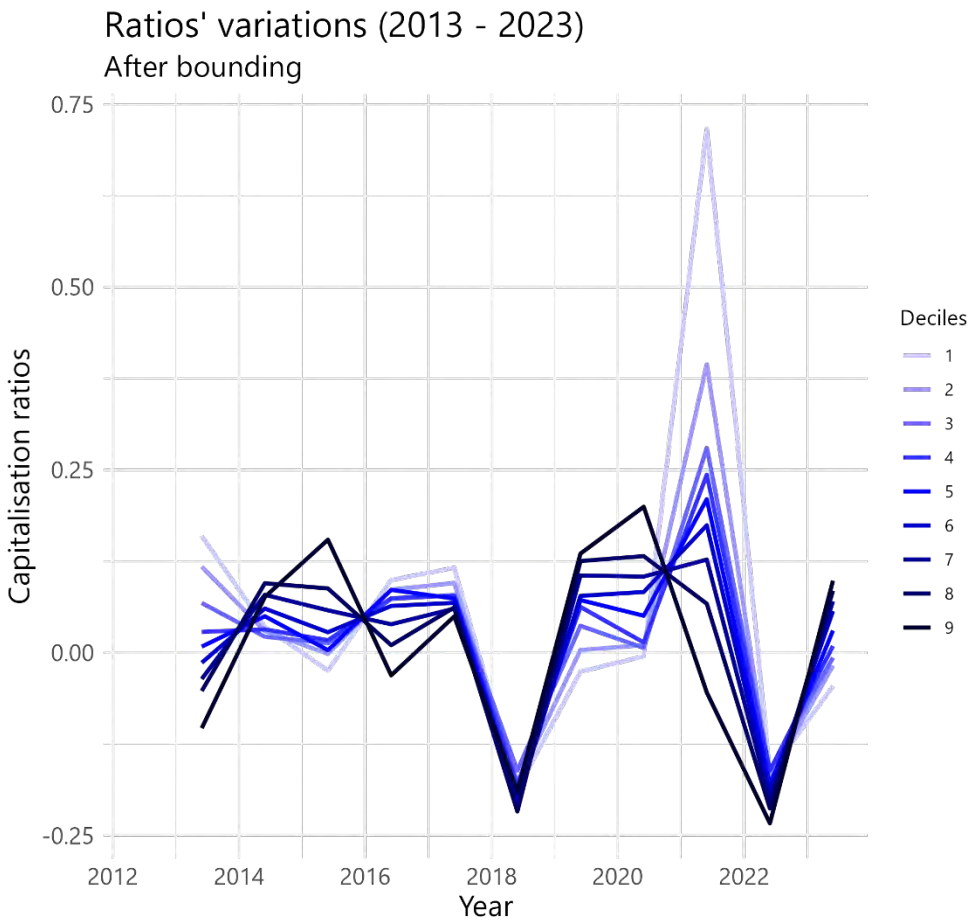
	Small caps *i.e. three first deciles of market cap distribution*	Large caps *i.e. three last deciles of market cap distribution*
Average market cap percentile	*15*	*85*
Average OFBV percentile	24	87
Average ratio percentile	41	69

Source: CSDB and Bloomberg data – Banque de France.
Note: on average, large caps have higher OFBV.

Indeed, let us assume small caps are represented by the first three deciles of the market cap distribution (as in Figure 2) and large caps are represented by the last three deciles. This would mean that large caps market capitalization ratios would stand, on average, at the 85th percentile, fairly close to where their book value would stand in their own distribution (see Table 2) In other words, large caps' book value is overall very consistent with their market value. So is also the case for smaller caps, but slightly less so.

Figure 3 presents capitalization ratios year-on-year variation depending the position in capitalization deciles in the previous year. The darker the colour of the line, the larger the firm's market capitalization. Over the observation period, market capitalization ratios moves differently depending on whether they tend to be high or low.

Figure 3



Sources: CSDB and Bloomberg data - Banque de France
Note: smaller and higher ratios might evolve differently.

Because small caps tend to have lower capitalization ratios, using the median instead of the mean also means better representing variations. Even if the companies for which we estimate a market value are part of multinational groups, they remain unlisted and may not be well represented by large caps. Listed firms' shares are indeed obviously more tradable than unlisted equity and in this respect, size also matters.

In Durant and Massaro (2004), this lack of representativeness was dealt with by using the mean coupled with an illiquidity discount applied to all capitalization ratios when ascribed to unlisted firms. For France, the discount was estimated to amount to 25% (Picart, 2003). In this paper, we do not consider applying such a discount for two reasons. First, the illiquidity discount needs to be (re)estimated and broken down by country and sector of activity. More importantly, large caps, which tend to be more liquid, are over-represented in our dataset when using mean ratios. Since the median better represents small to mid-caps, we are not sure of how relevant an illiquidity discount is. Indeed, one may think that the liquidity of an unlisted direct investment firm is closer to that of a listed small or mid-cap one.

Hence, we pair every unlisted direct investment enterprise with the median ratio of listed companies of the same geographical zone and sector of activity.

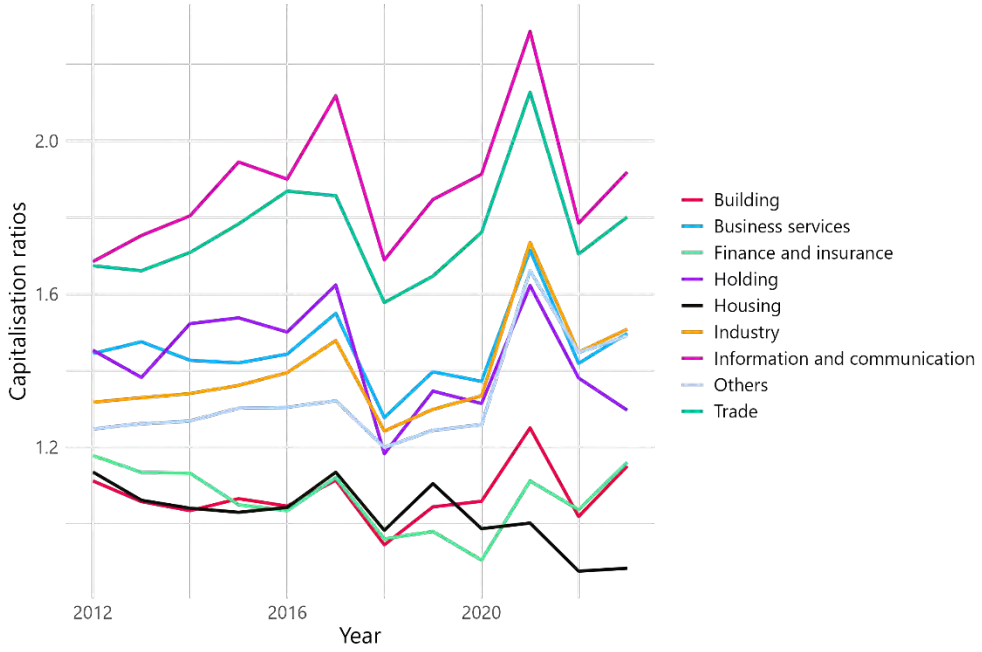
Differentiating the data by sectors and geographical location

As mentioned by Statistics Canada (2010) and confirmed by Figure 4, capitalization ratios vary across sectors of activity. For example, capitalization ratios in the financial sector appear very low, often below 1. Contrary to non-financial corporations, and in the wake of the great financial crisis, financial firms have been subject to tighter prudential rules. Capital requirements to meet regulatory solvency ratios may explain why market capitalization ratios have been decreasing in the financial sector. Inversely, IT and communication firms tend to have high market capitalization ratios, as they are known to hold substantial intangible assets, and may be seen as bearing good prospects, high revenues expectations following an innovative stream. Yet it comes as no surprise that the 2018 dive was larger for the IT and communication sector since tech firms, at the time, went into particular scrutiny for fear of market overvaluation. Financial bubbles and asset price volatility may indeed have a significant impact on market capitalization ratios, as share prices are much more volatile than book values.

Figure 4

Average of final ratios by activity sector

Field: median ratios (from geo-zone-by-sectors' samples, after bounding), 2012-2023

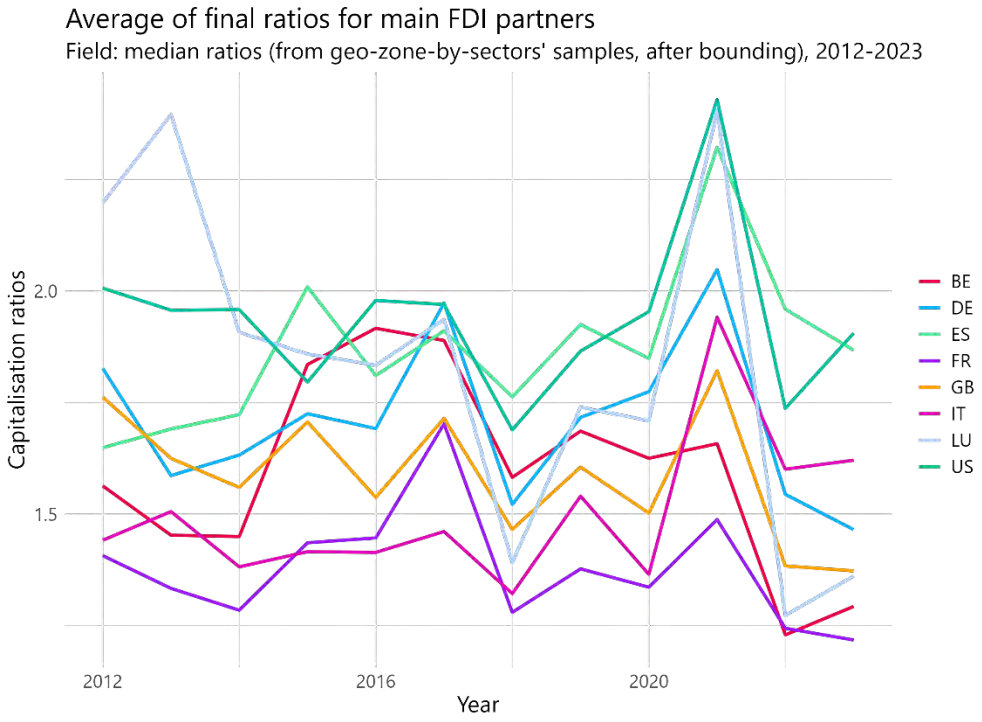


Sources: CSDB and Bloomberg data - Banque de France
Note: trade companies' ratios are higher than for holdings.

Capitalization ratios appear to vary substantially across geographical regions. Among the main FDI partners for France, the Netherlands, Spain and the US were the top three higher ratios' countries in 2023 (Figure 5). One may wonder if a higher ratio can be linked to some greater attractiveness of the US stock market or of certain regional markets, possibly in the same way some sovereigns have been considered safe havens (Gourinchas and Rey, 2016). Debt levels also matter significantly: the relatively low level of French ratios compared with other countries may be explained by the reportedly higher debt of French non-financial corporations: nearly 80% of

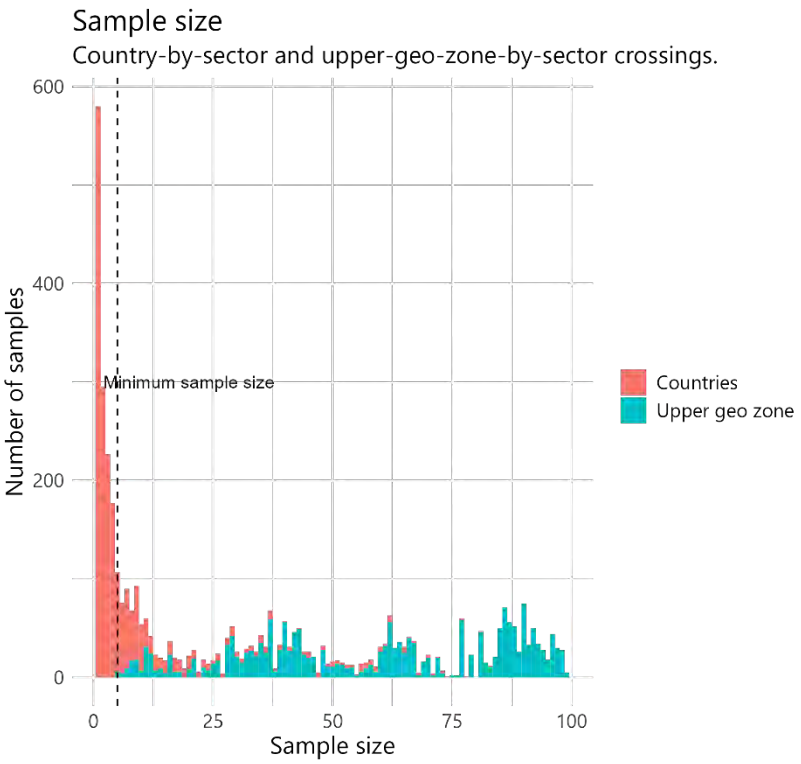
GDP in 2023 compared with less than 60% in most other euro area countries and less than 50% in the US (Banque de France, 2023).

Figure 5



Not all country-by-sector-of-activity cross-tabs are large enough to be considered representative samples. Because sectors might be more discriminating than the country dimension, we suggest grossing up to the upper-level geographical aggregation for smaller samples. By doing so, the minimum direct investment firms' sample size reaches 5 (Figure 6).

Figure 6



We then apply the following rule: every DIE is paired within the country-by-sector-of-activity sample if the sample size is greater than 5. If not, we consider the upper-level-geographical-zone-by-sector sample (then called geo-by-sector sample). Because every DIE has unique characteristics that potentially determine individual capitalization ratios, we then apply the median ratio of the geo-by-sector sample, to the OFBV. In other words, should an unlisted DIE in industry located in Paraguay cannot find its match, we use the corresponding median ratio for industry at the Latin America level.

4. Market valuation methodologies for stocks

Table 3

Notations

Indices & statistics	*BoP quantities*	*Others*
$\boldsymbol{n}$ year	$\boldsymbol{U}$ OFVB stock	$\boldsymbol{p}$ price index
$\boldsymbol{i}$ DIE	$\boldsymbol{V}$ market stock	$\boldsymbol{s}$ in-and-out threshold for price index
$\boldsymbol{j}$ sector	$\boldsymbol{R}$ capitalisation ratio	$\boldsymbol{ls}$ listed share
$\boldsymbol{k}$ geographical zone	$\boldsymbol{F}$ flow	$\boldsymbol{us}$ unlisted share
$\bar{\boldsymbol{x}}$ mean	$\boldsymbol{K7A}$ exchange rate effect	$\boldsymbol{\tau}$ change rate
$\tilde{\boldsymbol{x}}$ median	$\boldsymbol{K7B}$ market effect	
$\boldsymbol{a}$ after	$\boldsymbol{OC}$ other changes	
$\boldsymbol{b}$ before	$\boldsymbol{re}$ reinvested earnings per share	
	$\boldsymbol{S}$ ownership share	

Source: Banque de France.

Note: the median ratio is 1.34 over the whole period of study.

Method 1: using price indices

The US were the first country to publish a market valuation model (Eisner and Pieper, 1990). It basically consists in adjusting the value of FDI stocks to reflect their current market valuation.

$$V^{us}_{1,j,k,n} = R_{1,k,n} * U_{1,n} \quad (1)$$

$$V^{us}_{i,j,k,n} = V^{us}_{i,j,k,n-1}\left({}^{p_n}/_{p_{n-1}}\right) + \left(F_{i,j,k,n} - re_{i,j,k,n}\right)\left({}^{p_n}/_{\bar{p}}\right)$$

For the base year, market value is either assumed to be equal to book value or is estimated with market capitalisation ratios (1). For subsequent years, market values are simply updated along changes of a price index, i.e. the price of traded shares as indicated by stock market transactions (2). The equation is adjusted of retained earnings per share (that is $RE_{i,j,k,n}/V^{us}_{i,j,k,n}$) to avoid double counting[3]. Factorising by $V^{us}_{i,j,k,n}$ leads to the equation later published by Kozlow (2002) and still in use today in the US valuation methodology.

$$V^{us}_{i,j,k,n} = \frac{V^{us}_{i,j,k,n-1}\left({}^{p_n}/_{p_{n-1}}\right) + F_{i,j,k,n}\left({}^{p_n}/_{\bar{p}}\right)}{1 + re_{i,j,k,n}\left({}^{p_n}/_{\bar{p}}\right)} \quad (2)$$

[3] A stock market price index will tend to rise simply due to reinvestment of earnings by companies included in the index.

The US rely on various stock price indices. An obvious caveat of this method is that most listed companies are not part of a stock price index. For instance, in France, only 250 companies form the largest stock price index (the so-called SBF-250), while there are more than 1 000 listed companies overall in France. In other words, SBF-250 only roughly matches with the highest deciles of French listed companies in terms of market cap. More generally, even when stocks are weighted by their market capitalisation, large caps are always those companies making up stock indices (ex: MSCI World).

A way to sum up the building of a market price index could be threshold defining entry-exit movements, such as:

$$p_n = \sum \{V_{j,k,n}^{ls} > s_n\}$$

In other words, entry and exit movements in the stock price index can be described by decreasing capitalizations at the bottom of the list exiting the index, being replaced by increasing ones. This is a selection bias we intent to overcome by building nearly exhaustive price indices, without any threshold, from the CSDB and private data providers.

$$p_n = \sum V_{j,k,n}^{ls}$$

Doing so allows to use exactly the same geo-zone-by-sector samples whatever the valuation method used.

Another caveat of the price index methodology is that it eventually overstates FDI stocks since write-offs of existing capital are not taken into account.

Finally, Kozlow (2002) describes the method as using US price indexes and offsetting local market evolutions with that of exchange rates (local currency vs US dollar[4]). This hinges on a critical assumption that may need to be qualified: aggregate share price indices, reflecting mostly stocks of domestic companies, must offer a reasonable measure of the values of the companies in which the US have made direct investment abroad. Since we use data from all over the world, market caps already reflect local market conditions but this remains an issue to consider.

Method 2: by capitalisation ratios

The valuation method by market capitalization ratios has been gaining traction and is a measure that is not based on an accrual basis.

In concrete terms, for any given unlisted (us) DIE (i), after identifying similar listed companies (ls) – same activity sector (j) and geo zone (k), we calculate a market-to-book value ratio such as:

[4] More precisely, evolutions of the price index applied are $p_n\tau_{n-1}/\tau_n p_{n-1}$ and $p_n\bar{\tau}/\bar{p}\tau_n$

$$R_{j,k,n} = \overbrace{V_{j,k,n}^{ls} / U_{j,k,n}^{ls}}$$

As explained previously, we consider the median ratio of market (V) to book (U) values. We then multiply the company's equity book value by its corresponding ratio:

$$V_{i,j,k,n}^{us} = R_{j,k,n} * U_{i,n}$$

We do this over time (n years) so that the estimate of the market value is both linked to its book value and the evolution of price to book ratios.

Home or host market capitalization ?

At this point, another relevant issue arises when choosing the right market capitalization measure to calculate $\boldsymbol{R}$. FDI is meant to create long-lasting links between economies and are reportedly much more stable capital flows than portfolios or other investment flows. Yet, FDI flows may also reflect arbitrage activity by multinationals due to some mispricing in international capital markets (Shleifer and Vishny, 2003 or Baher, Foley and Wurgler, 2009). In that case, FDI flows either reflect the opportunistic use of a relatively low financial capital available to overvalued home country firms, or inversely, the acquisition of relatively undervalued host country assets. Most likely, the DIE value is linked to both home and host capital markets. So far, we have considered that the DIE value only depends on the host stock exchange. But it might well be that developments at home also matters: the DIE value of a large US tech company may well be closer to similar US entities than to other tech companies of the same country, - whether in terms of levels or changes.

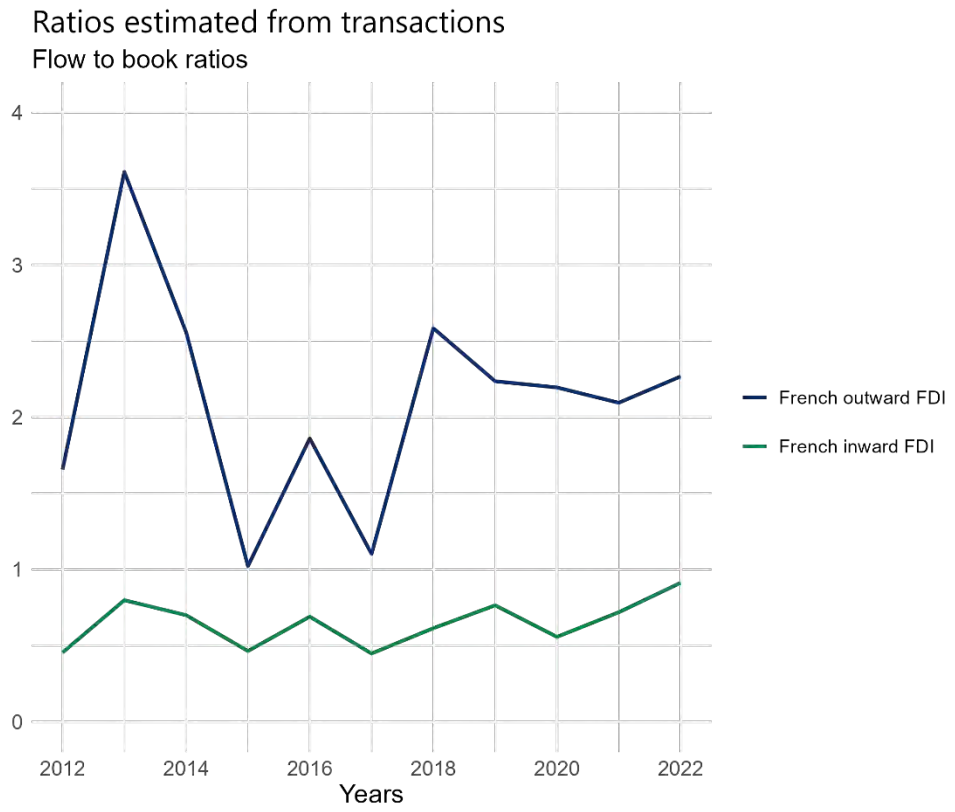
Against this background, using local-based capitalization ratios may misrepresents the true link between the DIE and its parents.

Based on our French FDI data, we can observe "true" capitalization ratios by calculating ratios based on market values directly derived from reported transactions. We calculate transaction-based market value as follows:

$$V_{i,j,k,n}^{us} = \frac{F}{S_a - S_b}$$

Where $\boldsymbol{V}$ is the total market value of the DIE, $\boldsymbol{F}$ the amount paid by the parent company, $\boldsymbol{S_a}$, the ownership share after the transaction and $\boldsymbol{S_b}$, the ownership share before the transaction. Clearly we can only do it for a small subset of data, but the result is striking (Figure 10). Capitalization ratios for outward FDI are close to 2 over the whole period, but capitalization ratios for inward French FDI are lower than 1. This is in line with average capitalizations ratios being lower in France than in other countries, and would endorse the fact that using host capitalization ratios is more in line with actual observations.

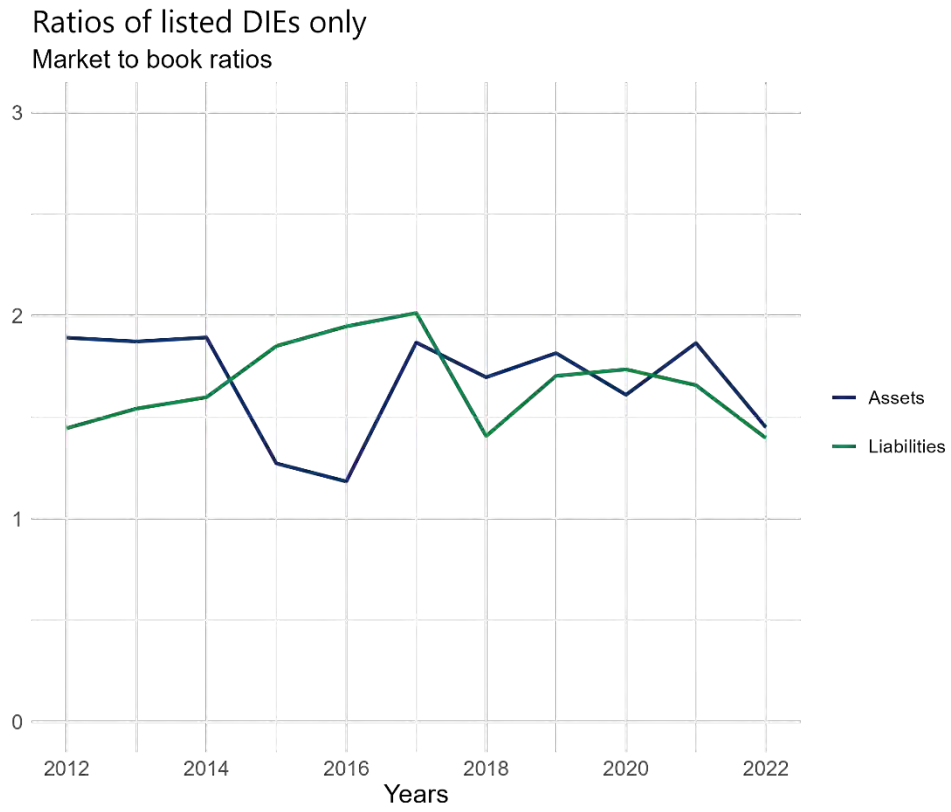
Figure 7



Source: Banque de France
Note: samples' size are 177 outward and 250 inward transactions on a yearly average basis.

However, another way to test this hypothesis is to compare home and host-based market ratios of listed DIEs. Figure 11 computes listed firms median capitalization ratios for assets (host) and liabilities (home) and shows no significant difference in levels calling for a use of both host and home-based capitalization ratios.

Figure 8



Sources: Banque de France, CSDB
Note: samples' size are 64 for assets and 176 for liabilities on a yearly average basis.

As a simplifying rule, we suggest to equally take into account home and host stock markets by defining the market values' estimate' as follows:

$$V_{i,j,k,n}^{us} = (0{,}5 * R_{j,k,n} + 0{,}5 * R_{France,k,n}) * U_{i,n}$$

Applying perfectly symmetric capitalizations ratios, regardless of the FDI direction (inward or outward), allows to focus on the country-to-country economic relationship rather than on the investor/investee relationship.

Simulations comparing all-host, all-home and our "trade-off" capitalization ratios are in Appendix(see Figures 12, 13 and 14).

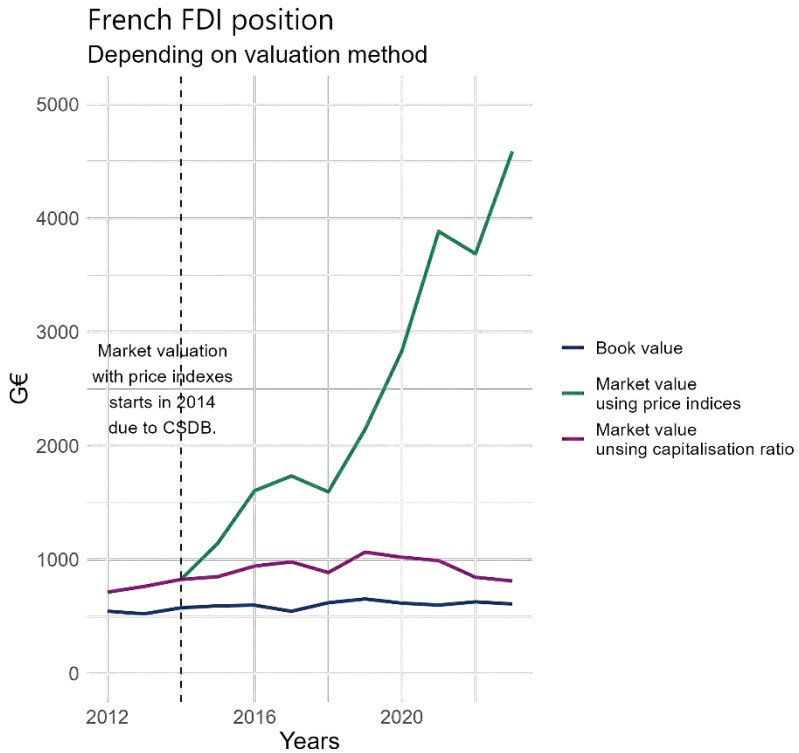
5. Simulations

Aggregated results

Even if we built very encompassing price indices, the larger the market capitalisation, the bigger the weight in that index. As a result, index price variations tend to represent large caps more than any other firms and are actually the same as average year-on-year variations. As expected, both market valuation methods lead to assets and liabilities that are significantly larger than book values (see Figures 10 and 11 in Appendix).

As a result (see Figure 9), the French net FDI external position would have shown an increase that OFBV values do not follow: between 2014 and 2023, the positive external position would have increased from 610 G€ to 4,586 G€ with the price index valuation method and to 812 G€ with the market capitalization ratios method.

Figure 9



Sources: CSDB and Bloomberg data - Banque de France
Note: both market valuation methods lead to greater numbers.

As shown in Figure 9, the trend is quite different depending on the method used. From year two, the price index valuation model mostly relies on market capitalization year-on-year variations, with, by construction, large caps contributing more than small caps. In equation (2), the price index' growth is meant to be partially offset by retained earnings per share. Yet, on average, retained earnings per share was about 3% in our data. In other words, the averaged denominator is 1.03, which might not be enough to compensate for the price index' growth.

We have not applied any liquidity premium in this model, given we were relying on medians. However, in this case, large successful capitalizations drive year-on-year variations in the price index valuation method from year two. Hence we tend to believe a liquidity premium probably needs to be taken into account for this method to be relevant. At this stage, our preferred method would clearly be on the market capitalization ratios.

6. Flow-stocks reconciliation

To our knowledge, countries that estimate a market value for unlisted DIEs in the BoP actually publish both book and market values, but do not necessarily communicate on flow and stock reconciliation.

Should the flow-stock reconciliation be carried out on OFBV values, there would be no valuation effect linked to the value of shares on the stock exchange, so that only an exchange rate effect (K7A) and other changes in volume (OC) would appear in the flow-stock reconciliation equation:

$$U_n = U_{n-1} + F + K7A_n^U + OC^U$$

The question arises on how to reconcile flows and stocks when dealing with market values and several models could be considered. Because our preferred method is that of market capitalisation ratios, we derive the flow-stock reconciliation from that specific model.

Whereas there is no stock market valuation effects when using OFBV, they (K7B) naturally appear when considering listed firms:

$$V_n = V_{n-1} + F + K7A_n^V + K7B_n + OC^V$$

We observe transactions (flows) at their market value, at the time of the transaction. Exchange rate effects are defined as the variation in exchange rate from one end-of-period to the next end-of-period, modifying the value of the stock. While we had the following exchange rate effect when considering OFBV:

$$K7A_n^U = \frac{\tau_n - \tau_{n-1}}{\tau_{n-1}} * U_{i,n-1}$$

It can be written as follows using market values:

$$K7A_n^V = \frac{\tau_n - \tau_{n-1}}{\tau_{n-1}} * V_{i,n-1}$$

When moving from OFBV to market value, exchange rate effects soak up a small part of the difference in stocks' values, but most of the difference between book and market values will be explained by market valuation effect and other changes in volume. The question is how to clearly differentiate between these two effects. On

the following models, we will assume market valuation effects are only due to stock price variations.

The F511 model[5]

When reconciling stocks with flows for listed equity alone, the definition of stock market valuation effects can be written as :

$$K7B_n = \frac{R_{j,k,n} - R_{j,k,n-1}}{R_{j,k,n-1}} V_{n-1} = (R_{j,k,n} - R_{j,k,n-1}) U_{n-1}$$

In such a case, other changes in volumes may be seen as a residual and serve as an adjustment variable:

$$OC^V = V_n - (V_{n-1} + F + \frac{\tau_n - \tau_{n-1}}{\tau_{n-1}} V_{n-1} + K7B_n)$$

The all-valuation effect model

Yet, the Balance of Payments manual and the OECD Benchmark definition for foreign direct investment suggest that each component of the stock-flow reconciliation has economic meaning. Other changes in volume in particular are defined as "*any changes in the asset value that are due neither to transactions nor to revaluation. These changes include those due to cancellation and write-offs, economic appearance and disappearance of assets, reclassification, and the changes in financial assets arising from entities changing their economy of residence*". From this definition, there is no reason why the stock valuation method should modify the value of other changes in volumes, so that:

$$OC^V = OC^U$$

In such a case, valuation effects should really be seen as the adjustment variable:

$$K7B_n = V_n - (V_{n-1} + F + \frac{\tau_n - \tau_{n-1}}{\tau_{n-1}} V_{n-1} + OC^U)$$

The hybrid split model

To better illustrate our conundrum, let us take the following example: say an DIE asset is worth 100 according to its OFBV value at the end of year 0. It is associated with a market capitalisation ratio of 2, constant through time. During the year, the parent company decides to recapitalize it asset and provides 10 as a yearly equity flow.

At the end of year 1, OFBV value reaches 110. At market value, the initial stock (200) is now 220. Yet the recorded flow is only 10. What shall we make of the additional 10? Since the market capitalization ratio remained constant (at 2), one

[5] According to the coding structure of Balance of Payments series, F512 relate to unlisted equity and F511 to listed equity.

could argue that there is no reason for valuation effect to be affected by this residual and that it should be assigned to other changes in volume.

More generally, in equations:

$$OC^V = R_{j,k,n}\, OC^U + \left(\frac{R_{j,k,n} + R_{j,k,n-1}}{2} - 1\right) F$$

$$K7B_n = V_n - (V_{n-1} + F + \frac{\tau_n - \tau_{n-1}}{\tau_{n-1}} V_{n-1} + OC^V)$$

In all three flow-stock reconciliation models, the exact same amount is distributed between valuation effects and other changes in volume. Depending on the model, variations in one component will be mirrored by variations in the other. The F511 model leads to more volatile series of market valuation and other changes in volume than the two other models (see Figures 15 and 16 in Appendix)

7. Conclusion

According to best methodological standards, FDI equity transactions and positions should correspond to their market value. Because most of FDI equity is actually unlisted, Balance of Payments compilers need to find a proxy to the value of the equity in case of unlisted equity.

Current methodological standards recommend a list of methods to approximate the market value with different levels of practical implementation. While none of the current manuals clearly indicates which method is preferred, discussions have been growing against the background of manuals revisions. We took this opportunity to revisit the market capitalization method using a large dataset of listed equity in order to test to which extent a full country-by-sector-of-activity dataset could be implemented for Balance of Payments purposes.

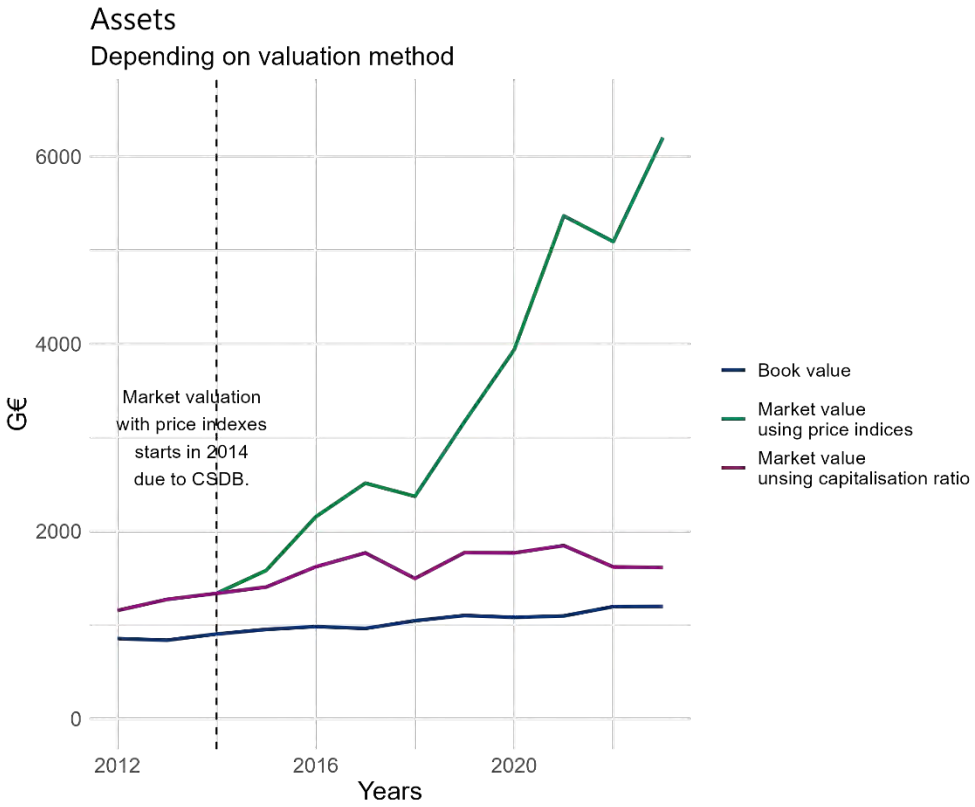
Our experiment raised some methodological issues that we discussed in this note: whether to choose an accrual method or not, how to take into account the economic links between home and host investment country and on how to reconcile flows and stocks from one period to the next. Some other technical aspects are only touched upon and would need further research. As we initially disregard the liquidity premium that was indirectly present due to the overrepresentation of large caps in our data, we realised it may be useful when using price indices to update market capitalization ratios on an accrual basis. This call for additional research on the liquidity premium and how it varies depending on countries and sector of activity. Also a careful treatment of firms' entry-and-exit into various categories of DIEs should certainly be implemented. Finally, since there is no negative market values, and because market capitalization ratios are always positive, the issue of negative equity, which may, in some countries, be legally accepted during a certain period of time, may have to be reconsidered.

As intense theoretical discussions are taking place with the forthcoming revision of international manuals, the issue of market valuation spills over some technical aspects dear to the heart of BoP compilers.

Appendix

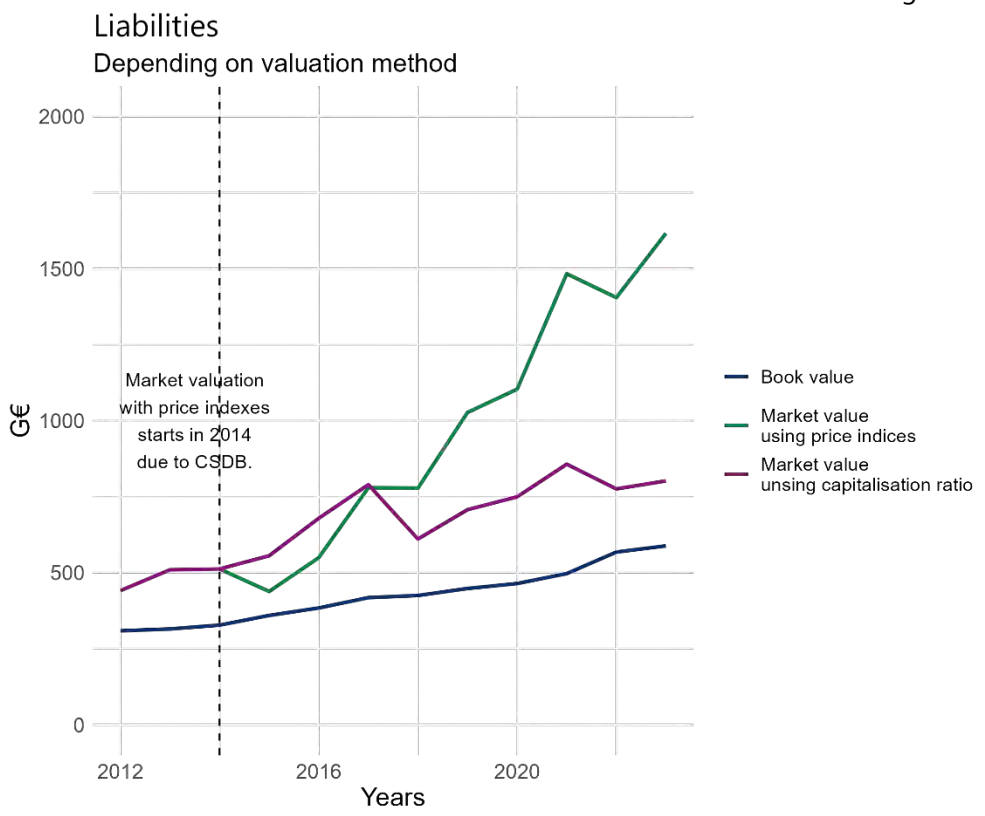
Methods comparison: price index vs ratios

Figure 10



Sources: CSDB and Bloomberg data - Banque de France
Note: both market valuation methods lead to greater numbers.

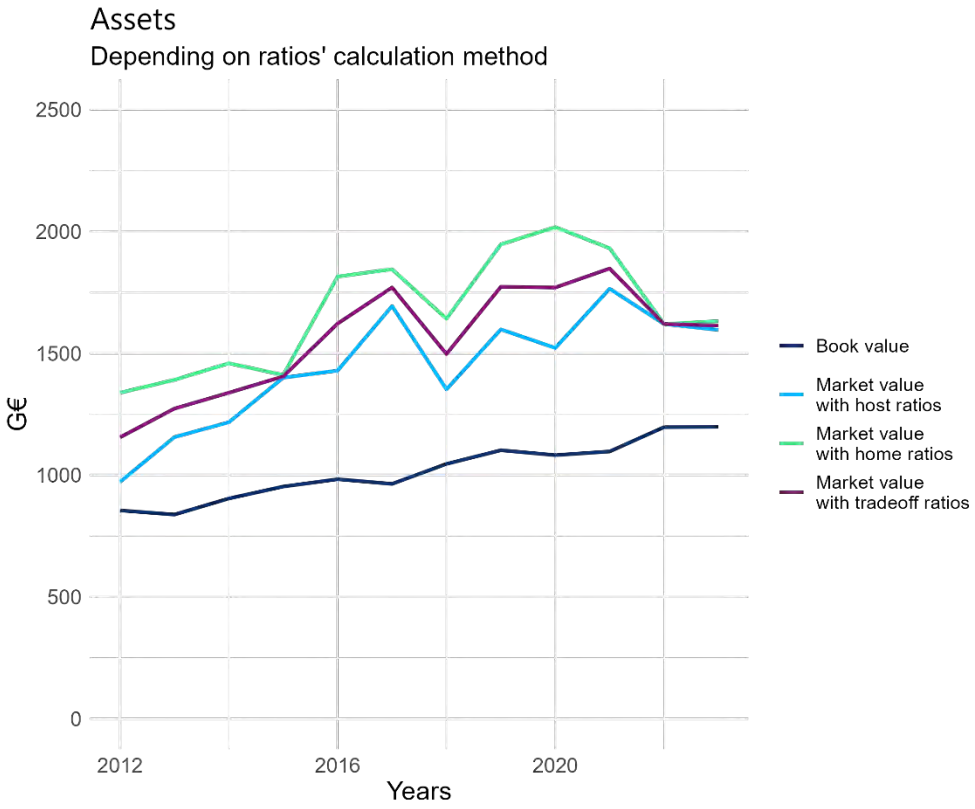
Figure 11



Sources: CSDB and Bloomberg data - Banque de France
Note: both market valuation methods lead to greater numbers.

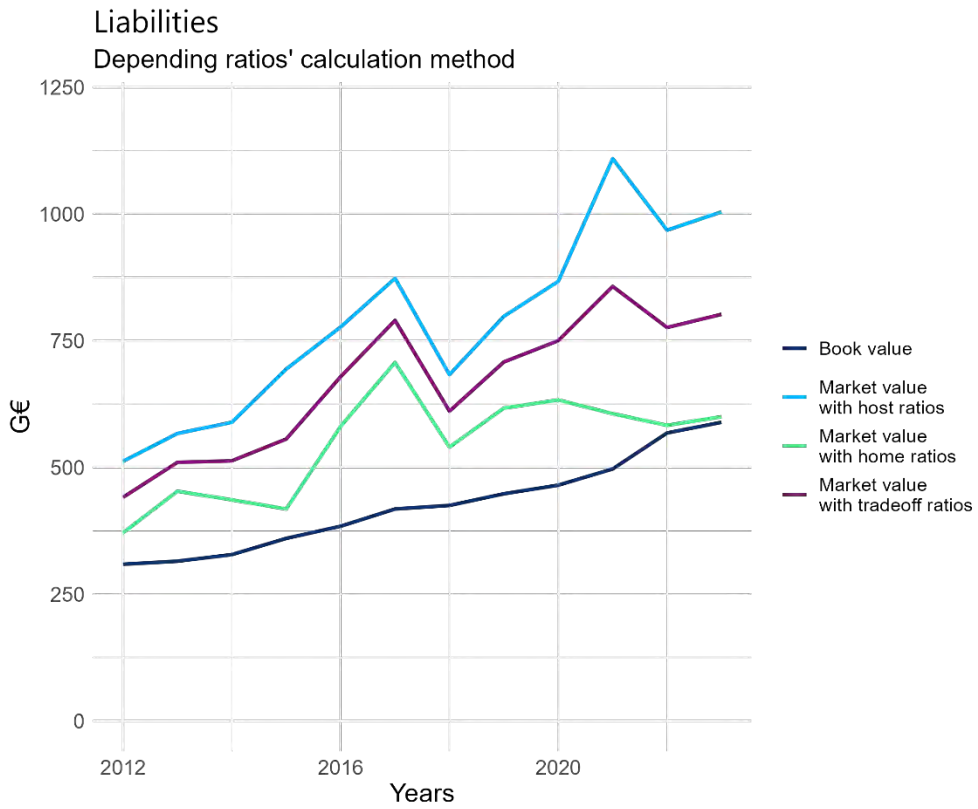
Home vs host capitalization ratios

Figure 12



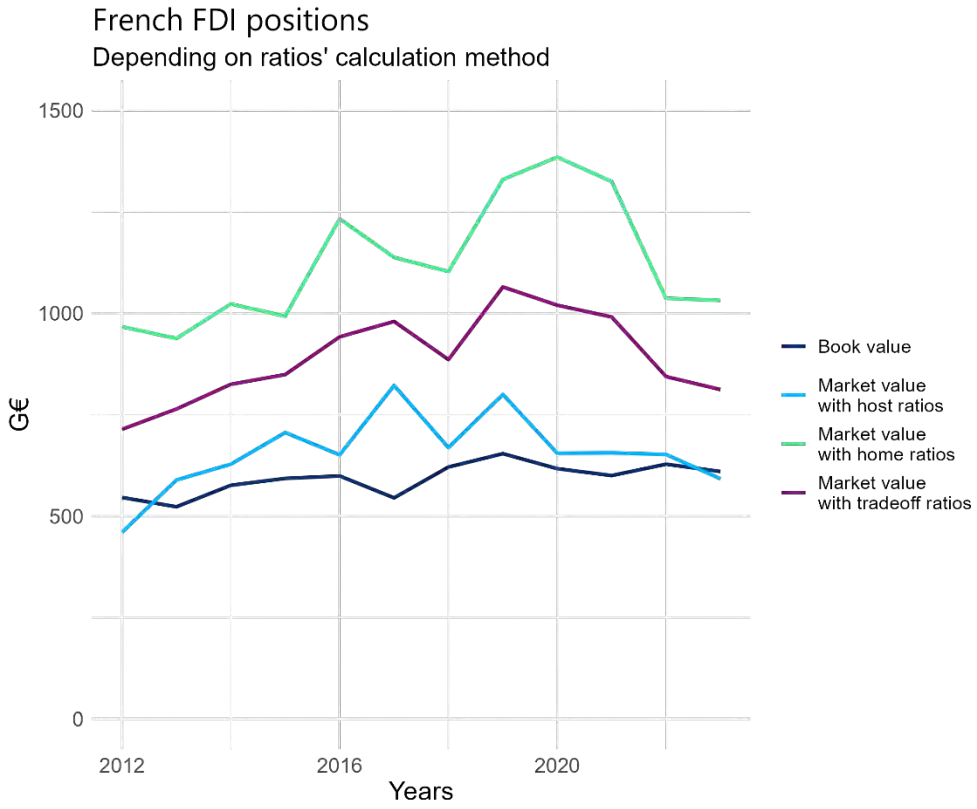
Sources: CSDB and Bloomberg data - Banque de France
Note: since French ratios are lower, using host ratios leads to a greater assets' position.

Figure 13



Sources: CSDB and Bloomberg data - Banque de France
Note: since French ratios are lower, using home ratios leads to a greater liabilities' position.

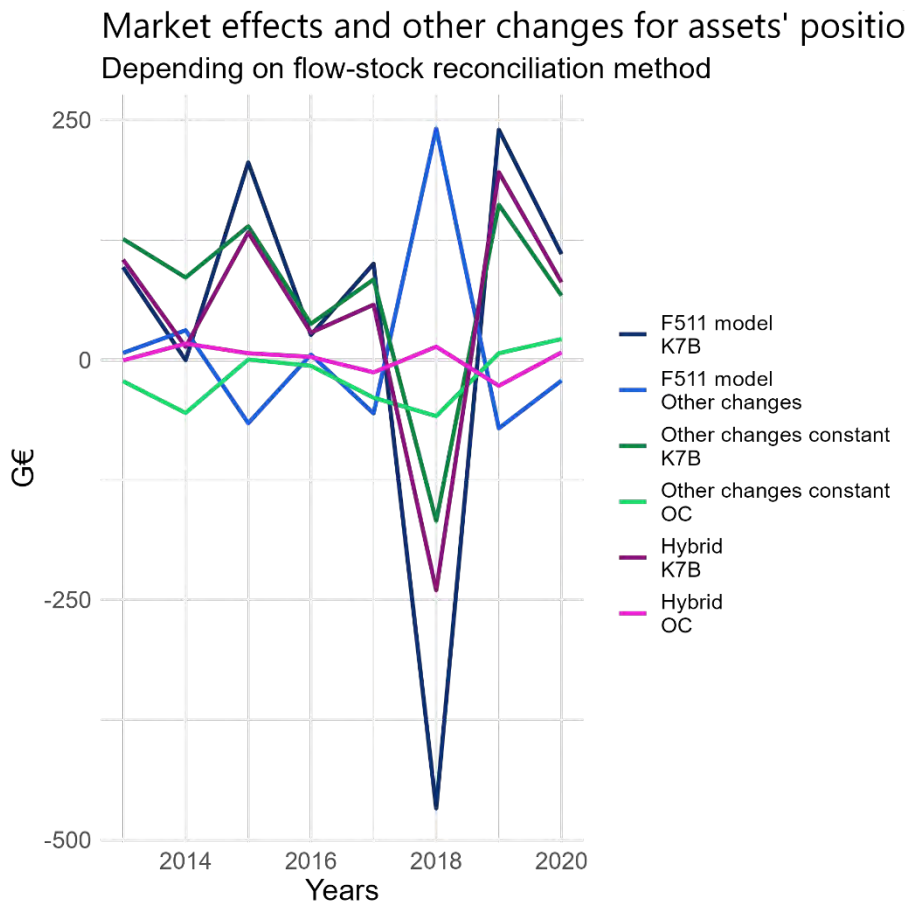
Figure 14



Sources: CSDB and Bloomberg data - Banque de France
Note: French FDI position would be greater using home ratios.

Flow-stock reconciliation

Figure 15

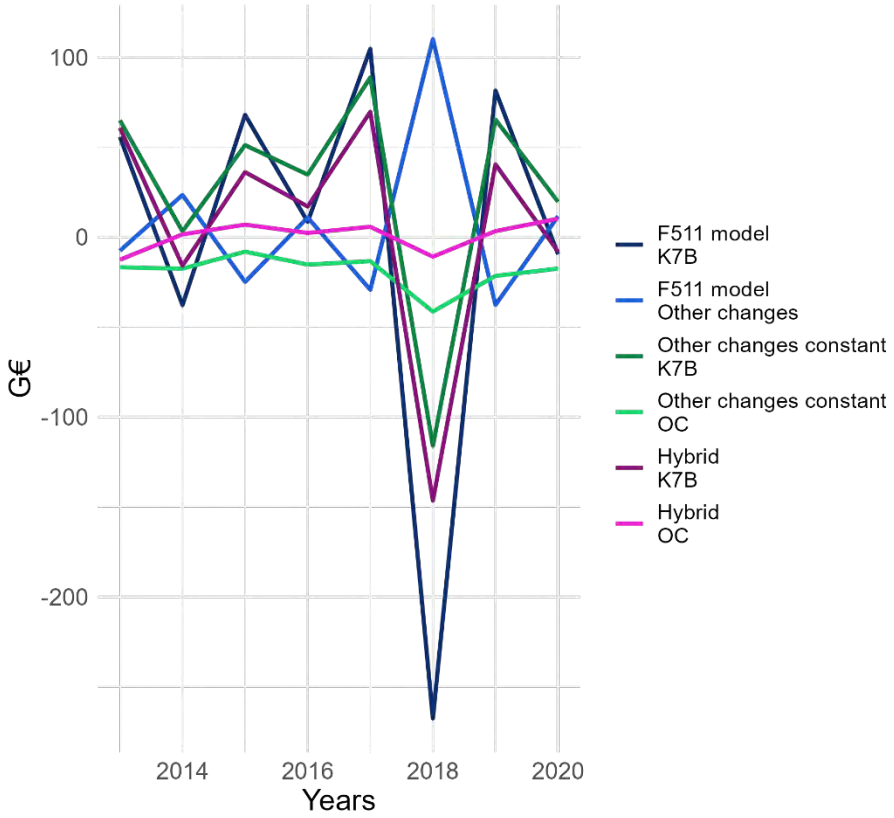


Sources: CSDB and Bloomberg data - Banque de France
Note: market effects and other changes compensate each other, whatever the methoc

Figure 16

Market effects and other changes for liabilities' position

Depending on flow-stock reconciliation method



Sources: CSDB and Bloomberg data - Banque de France

Note: market effects and other changes compensate each other, whatever the methoc

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MARKET VALUATION OF UNLISTED SHARES: AN EXPERIMENTAL EXERCISE

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DEPUTY HEAD OF INTERNATIONAL TRADE AND FOREIGN DIRECT INVESTMENT DIVISION

BALANCE OF PAYMENTS DIRECTION

IFC, MADRID – 13/02/2023

BANQUE DE FRANCE
EUROSYSTÈME

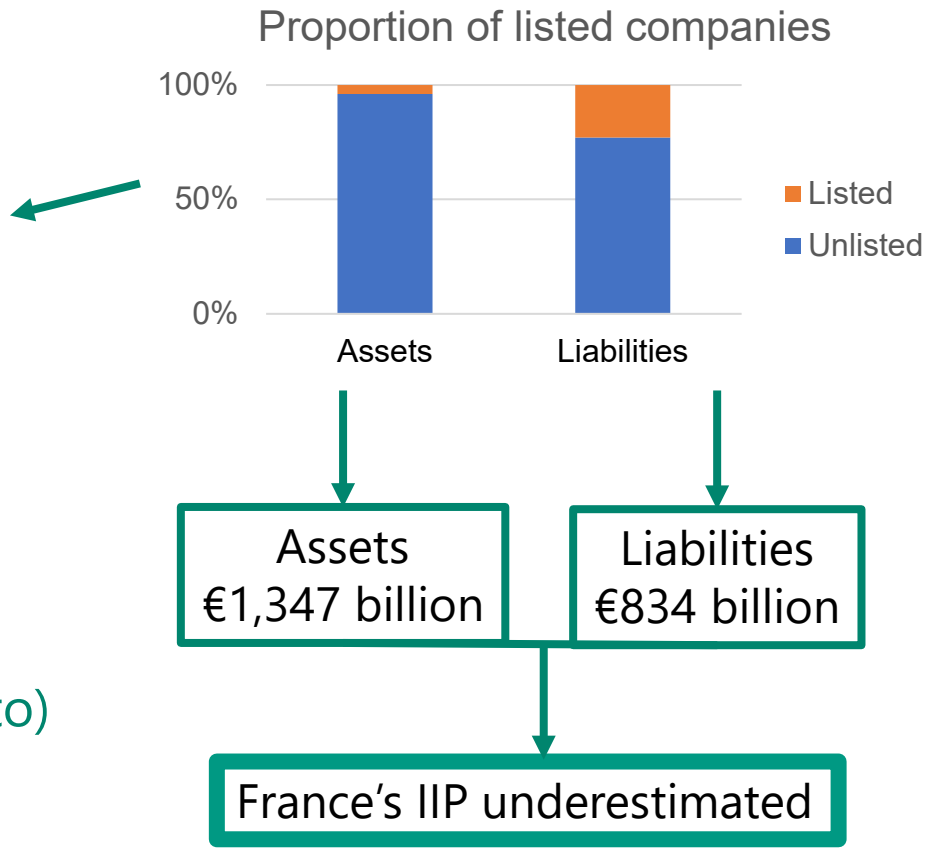
BACKGROUND

France's International Investment Position

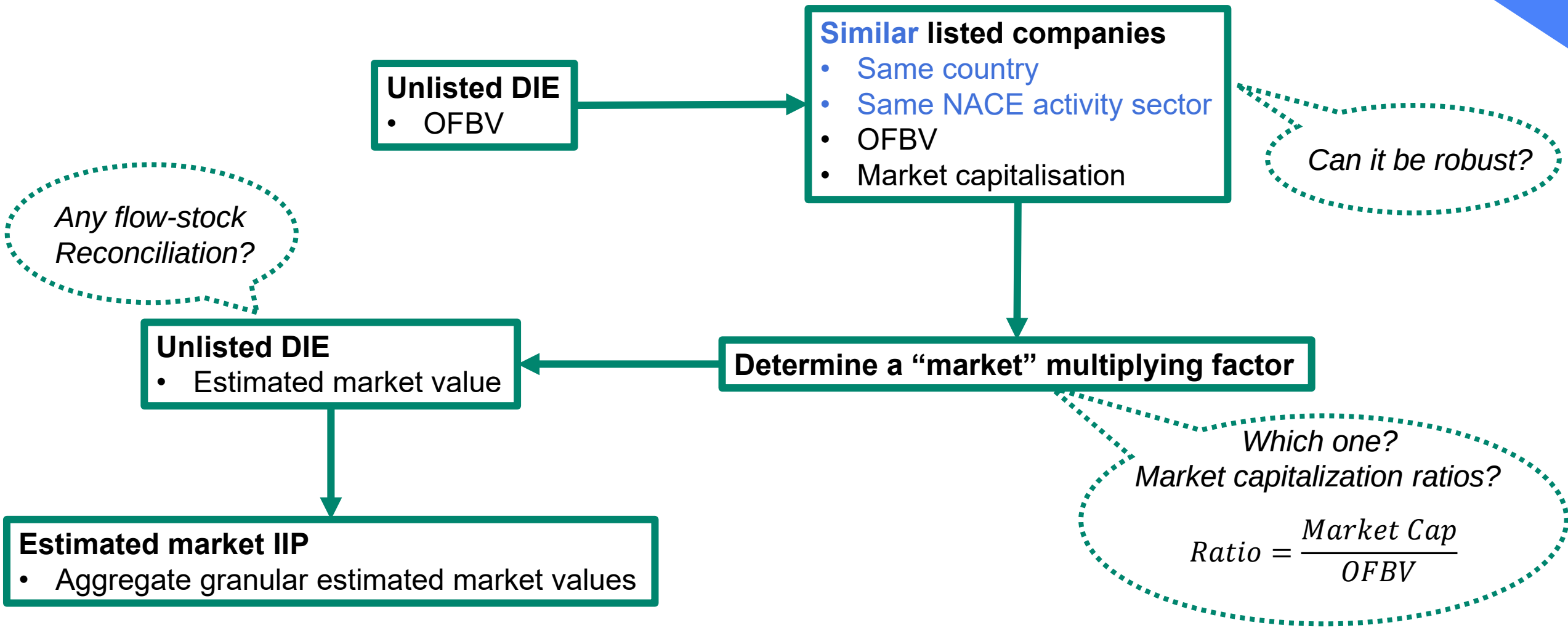
- **FDI** in equity at « mixed value »
  - Market value for listed companies
  - OFBV (Own Funds at Book Value) for unlisted companies

- Difference in valuation methods:
  - Market value > OFBV
  - OFBV reduces asymmetries
  - Market value closer to a "market price"

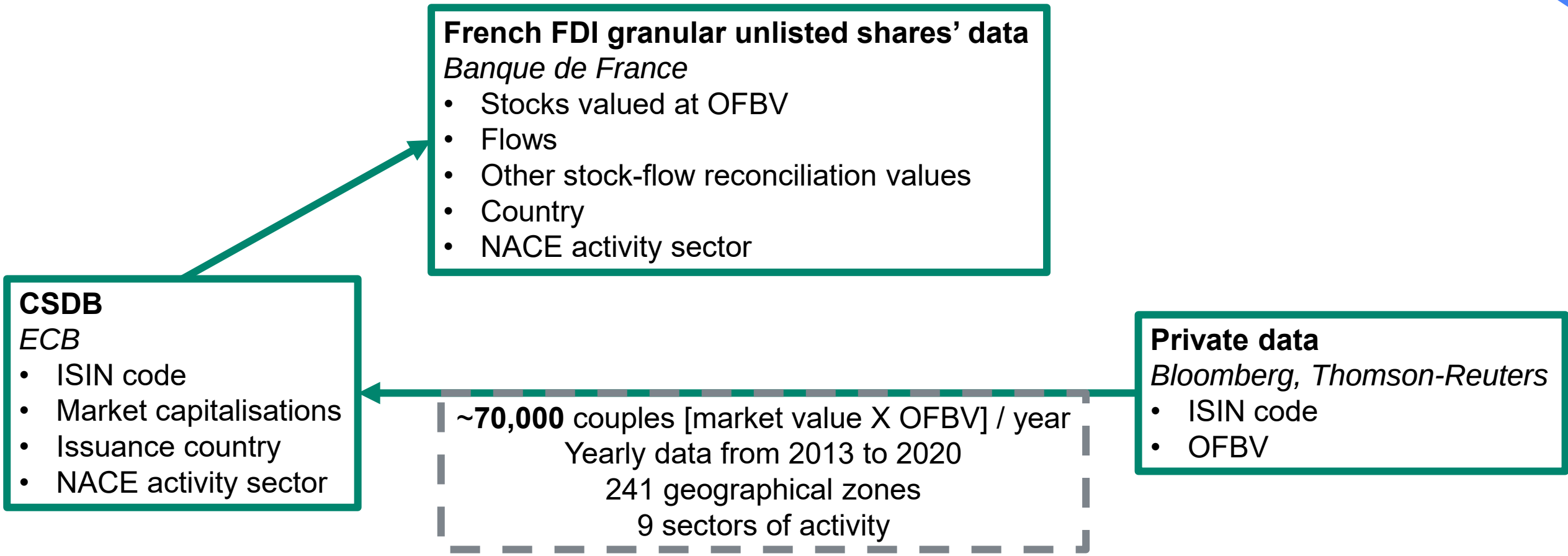
- Some countries publish two values for IIP (France used to)



MARKET VALUATION PRINCIPLE

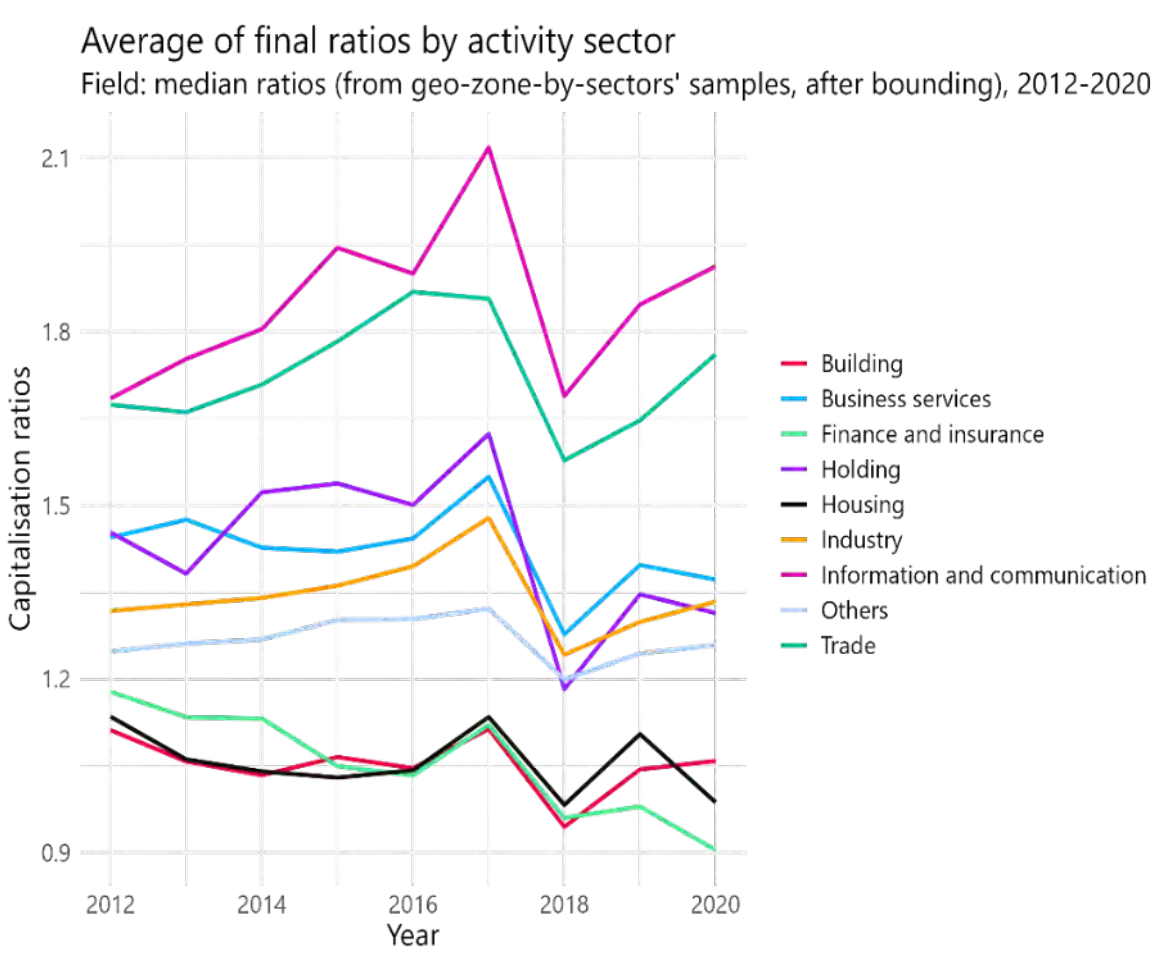


DATA MODEL FOR MARKET CAPITALIZATION VALUATION



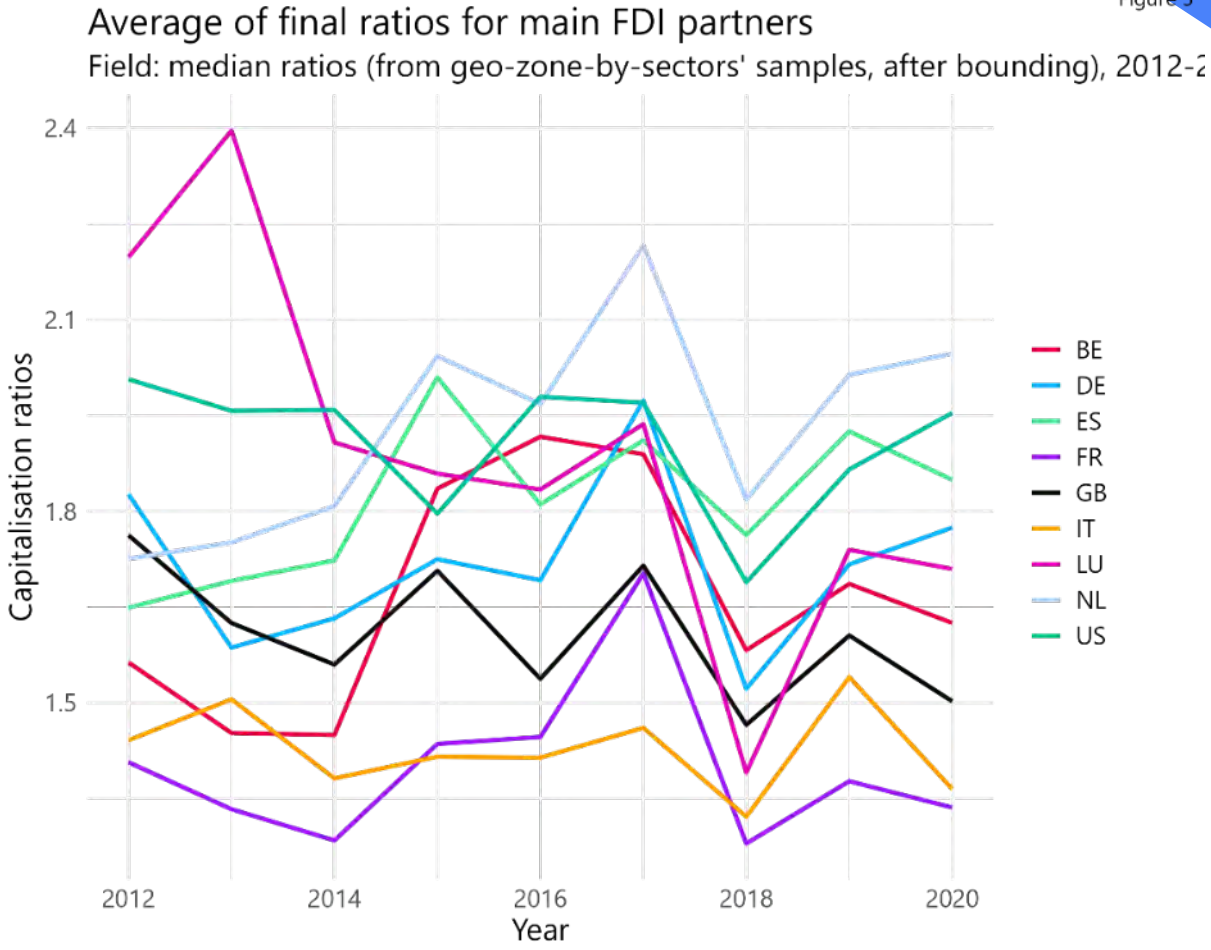
DIFFERENTIATION BY ACTIVITY SECTORS AND GEOGRAPHY

Figure 4



Sources: CSDB and Bloomberg data - Banque de France
Note: IT companies' ratios are higher than financial ones

Figure 5



Sources: CSDB and Bloomberg data - Banque de France
Note: ratios of Italy and France are relatively low.

DATA MODEL FOR MARKET CAPITALIZATION VALUATION

Data quality

- FDI granular unlisted shares' data
  - Banque de France
  - Reliable
- CSDB
  - ECB
  - Reliable
- Private finance
  - Bloomberg *vs* TR
  - Robustness check

Comparison over 3,000 companies
- *Ratios in $ from TR*
- *Ratios computed by us in € from Bloomberg data*

Median ratios' correlation: 0,98



  - Reliable

Data robustness

Distribution of individual market capitalisation ratios (2013-2020)	
Statistics	***Value***
Minimum	**0.00**
1st percentile	**0.00**
5th percentile	**0.16**
1st decile	**0.36**
1st quartile	**0.73**
Median	**1.34**
3rd quartile	**2.75**
9th decile	**5.76**
95th percentile	**9.86**
99th percentile	**41.17**
Maximum	**6 151 912.19**





How to deal with outliers?

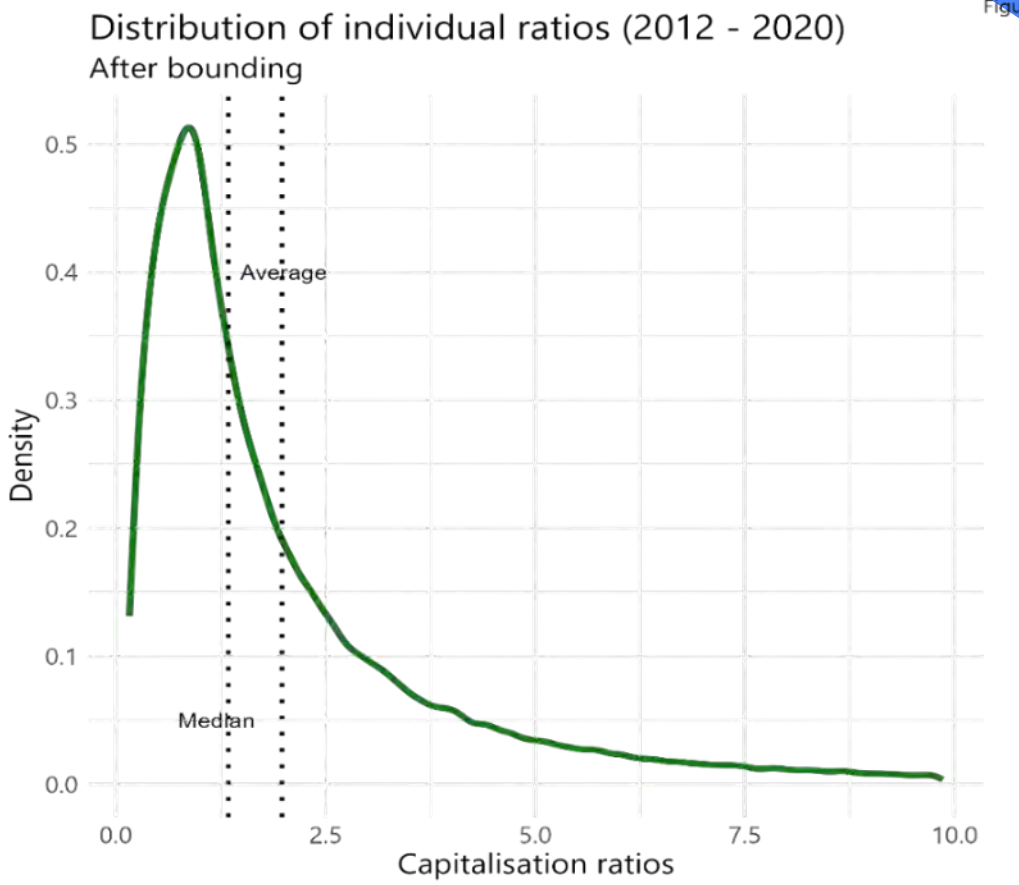
FROM INDIVIDUAL TO FINAL RATIOS

- Bounding from 5th to 95th percentiles
  - Symmetric bounds
  - Yearly bounds
  - Simulation with other bounds (1st-99th percentiles) leads to very close results

- Grouping by geo zone and activity sector
  - After grouping, yearly variations' range falls from [-1:10] to [-0,5:1] ⇒ no need to bound on variations

- Sample size
  - Aggregating to upper geo zone when crossing **[***activity sector* **X** *geo zone***]** size is too small
  - Minimum size **[***activity sector* **X** *geo zone***]** is 5

Figure 1



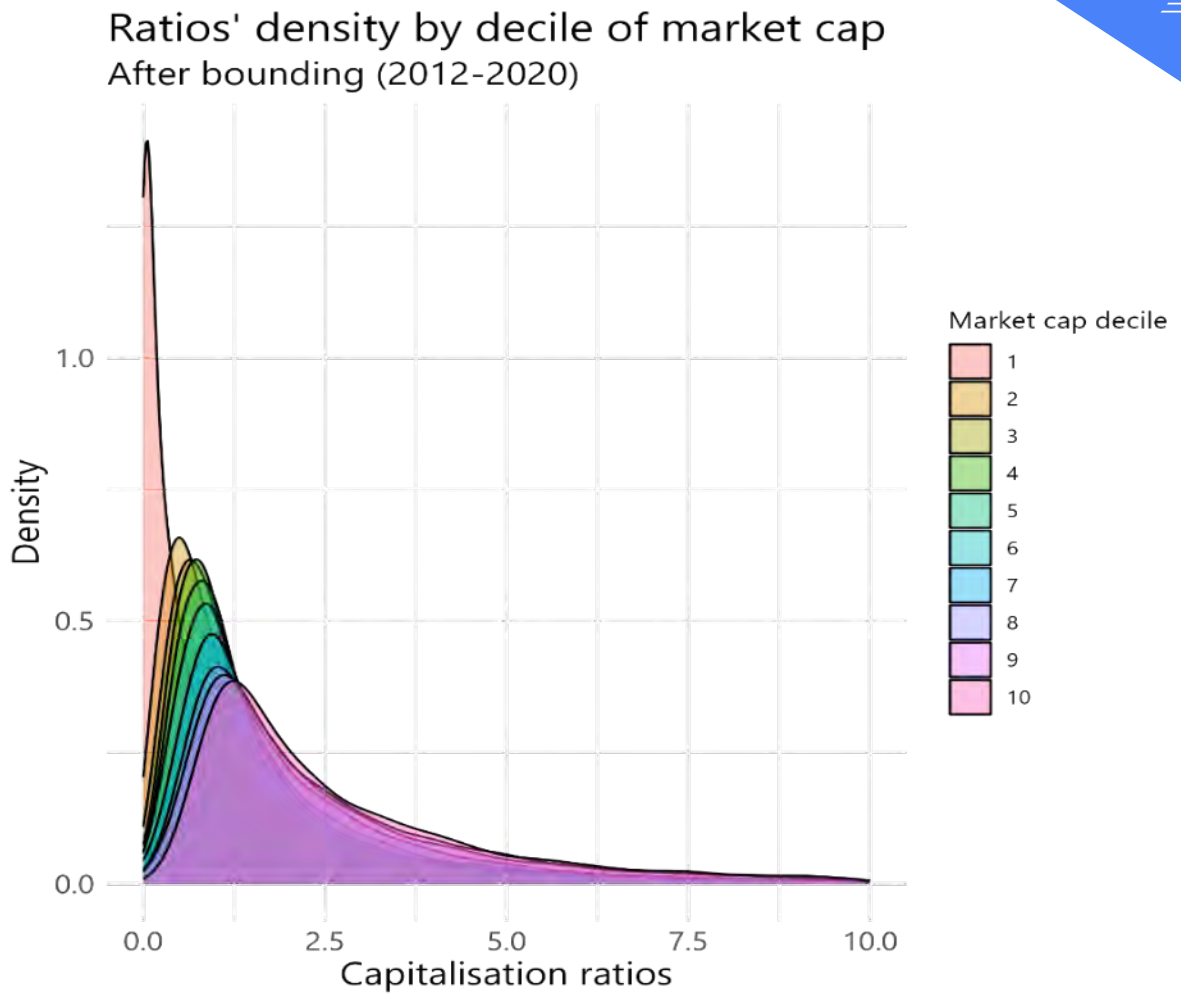
Sources : CSDB and Bloomberg data - Banque de France
Note: median and average ratios (1.34 and 1.98) are arepresented by dotted lines.

AVERAGE OR MEDIAN RATIO?

Size matters

- Unlisted DIEs
  - Are part of MNEs
  - Are closer to small and mid caps
- Small and large caps are different
  - Small caps have smaller ratios
  - Ratios' variations evolve differently
- Average higher than the median
  - Average represents better large caps
  - Median represents better small and mid
- No illiquidity discount
  - Values neither recent nor broken down

Figure



Sources : CSDB and Bloomberg data - Banque de France
Note: higher deciles of market cap match with large caps

TWO MODELS

1) Ratios only

Every year

- Determine ratios from listed shares

$$R_{j,k,n} = {V^{ls}_{j,k,n}}/{U^{ls}_{j,k,n}}$$

- Apply ratios to DIE

$$V^{us}_{i,j,k,n} = R_{j,k,n} * U_{i,n}$$

Market value V

Book value U

Ratio R

Listed shares ls

Unlisted shares us

DIE i

Activity sector j

Geo zone k

Year n

Median $\tilde{\ }$

2) Ratios and price indices

1st year

Use ratios

From year 2

Use price indices

$$V^{us}_{i,j,k,n} = \frac{V^{us}_{i,j,k,n-1}\left({p_n}/{p_{n-1}}\right) + F_{i,j,k,n}({p_n}/{\bar{p}})}{1 + re_{i,j,k,n}({p_n}/{\bar{p}})}$$

Flow F

Retained earnings per share re

Price index p

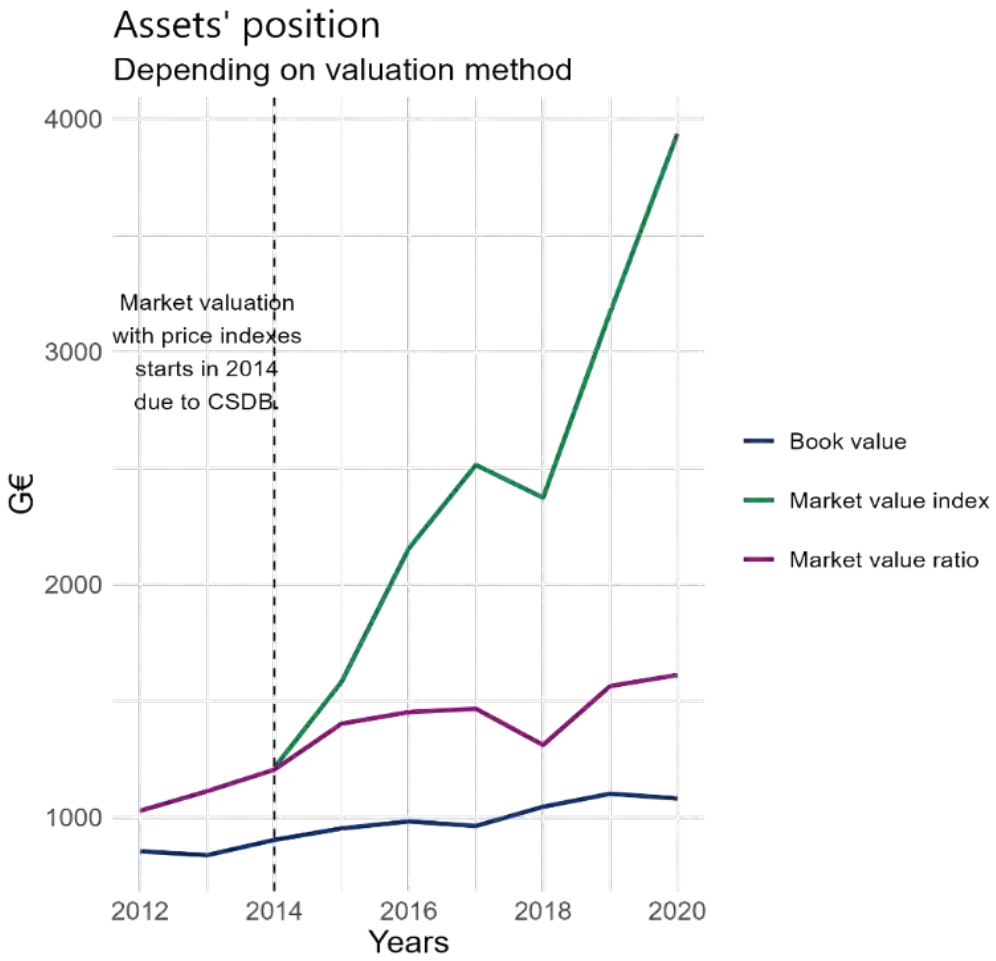
Yearly average $\bar{\ }$

~Same data

- Same listed companies used in both methods
  - Very large price indices
- Price indices start in 2014 since requiring monthly market capitalisation

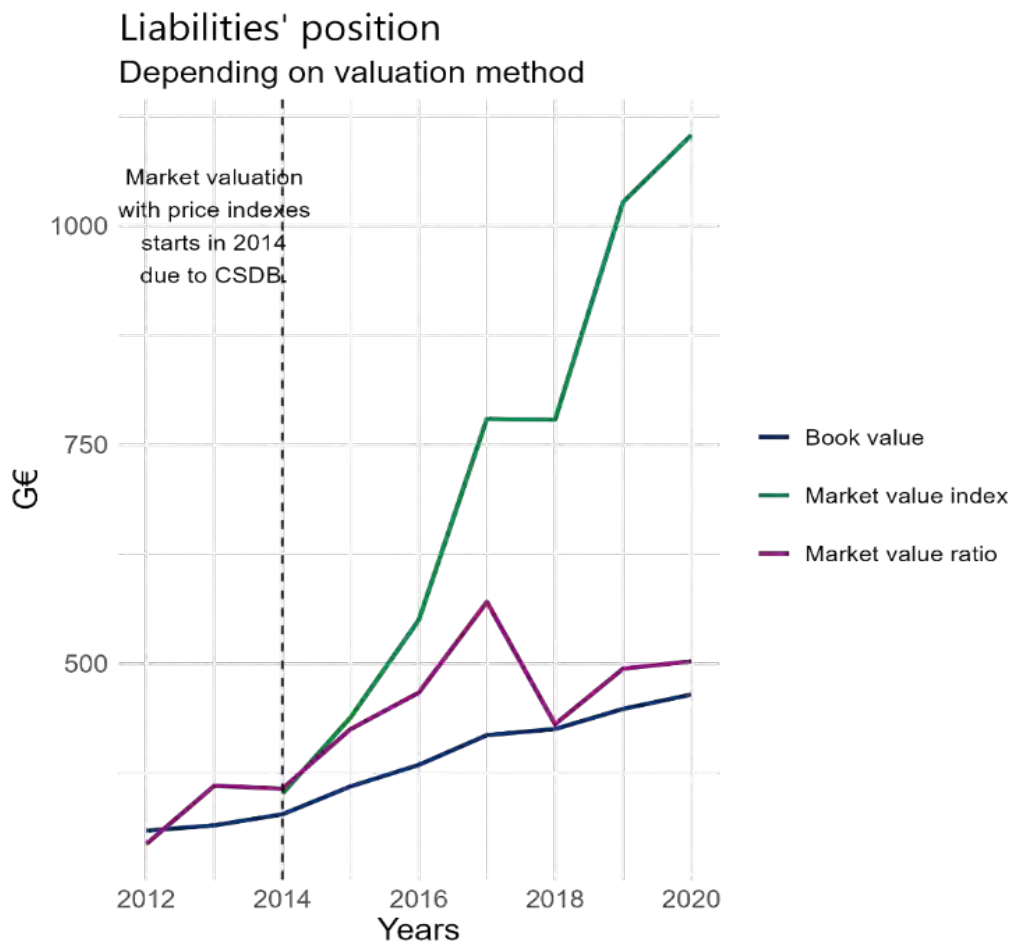
RESULTS

Figure 7



Sources: CSDB and Bloomberg data - Banque de France
Note: both market valuation methods lead to greater numbers.

Figure 8



Sources: CSDB and Bloomberg data - Banque de France
Note: both market valuation methods lead to greater numbers.

INTERPRETATION

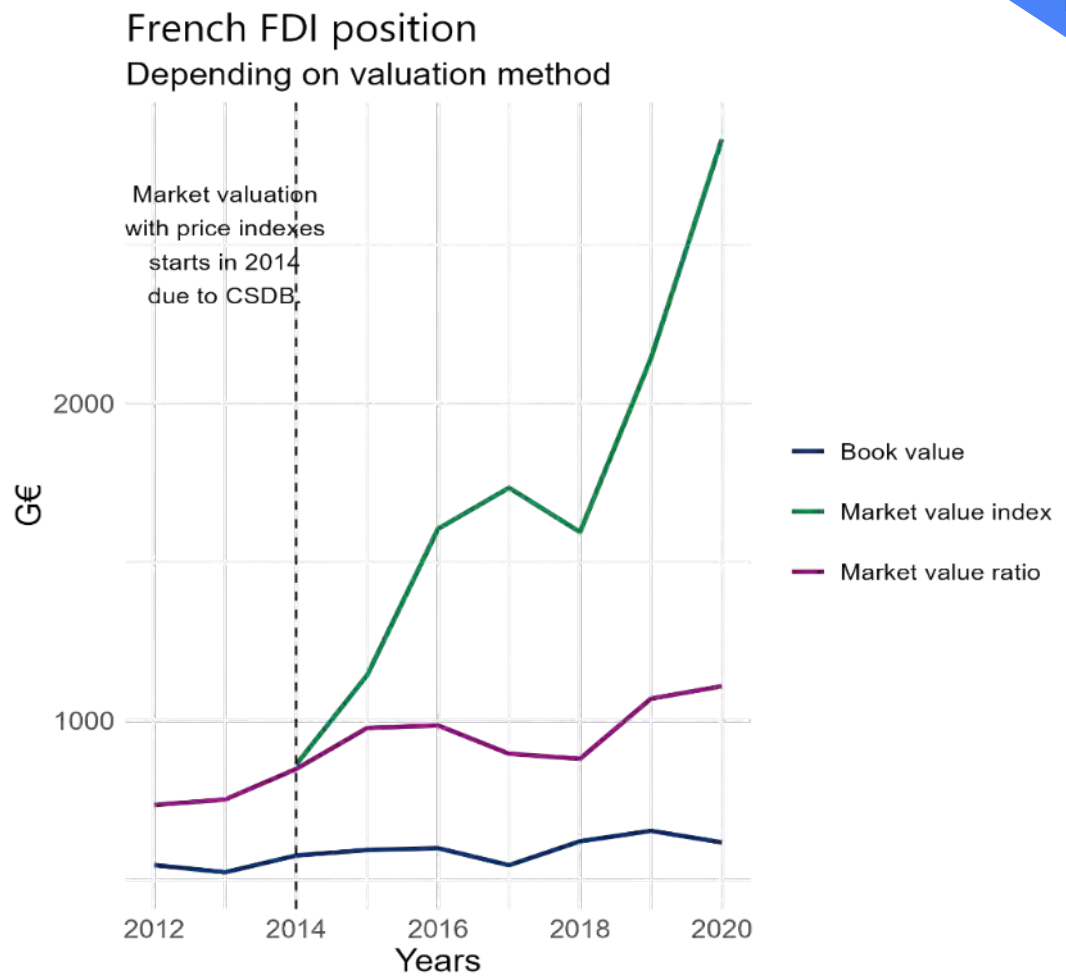
o Ratios' method

- Level change
  - ➢ Most ratios > 1
- Trends remain close
  - ➢ Median ratio closer to small and mid caps
    - Differences in ratios' variations between small, mid and large caps
  - ➢ Book value taken into account every year

o Price index method

- Level change
  - ➢ From year 1, since using ratios
- Trend change
  - ➢ Large caps contribute more
  - ➢ Book value not taken into account from year 2 (except flows)
    - Price indices make variations (and the trend)
  - ➢ *NB: an illiquidity discount could make sense from year 2 and would slightly reduce the trend*

Figure 9



Sources: CSDB and Bloomberg data - Banque de France
Note: both market valuation methods lead to greater numbers.

CLASSIFICATION : PUBLIC/INTERNE/RESTREINT/CONFIDENTIEL/SECRET

FLOW-STOCKS RECONCILIATION?

- Necessary?
  - Already done in book value
    - Quantities are well defined
    - Help at solving asymmetries
  - This estimated market value is more meaningful for aggregates

> *"any changes in the asset value that are due neither to transactions nor to revaluation. These changes include those due to cancellation and write-offs, economic appearance and disappearance of assets, reclassification, and the changes in financial assets arising from entities changing their economy of residence"*

- If yes, adjustment should be made between other changes and market effects
  1. All-valuation effect model
     - No change of other changes; market effects serve as an adjustment variable
  2. F511 model
     - Same definition of market effects as for listed shares; other changes serve as an adjustment variable
  3. Hybrid split model
     - Since flows don't change between valuation methods, this model suggests a way to assign the residual between other changes and market effects

CONCLUSION

- Our choice: ratios' method
  - Looks more reliable and better related to FDI values
  - And, robust enough thanks to big data

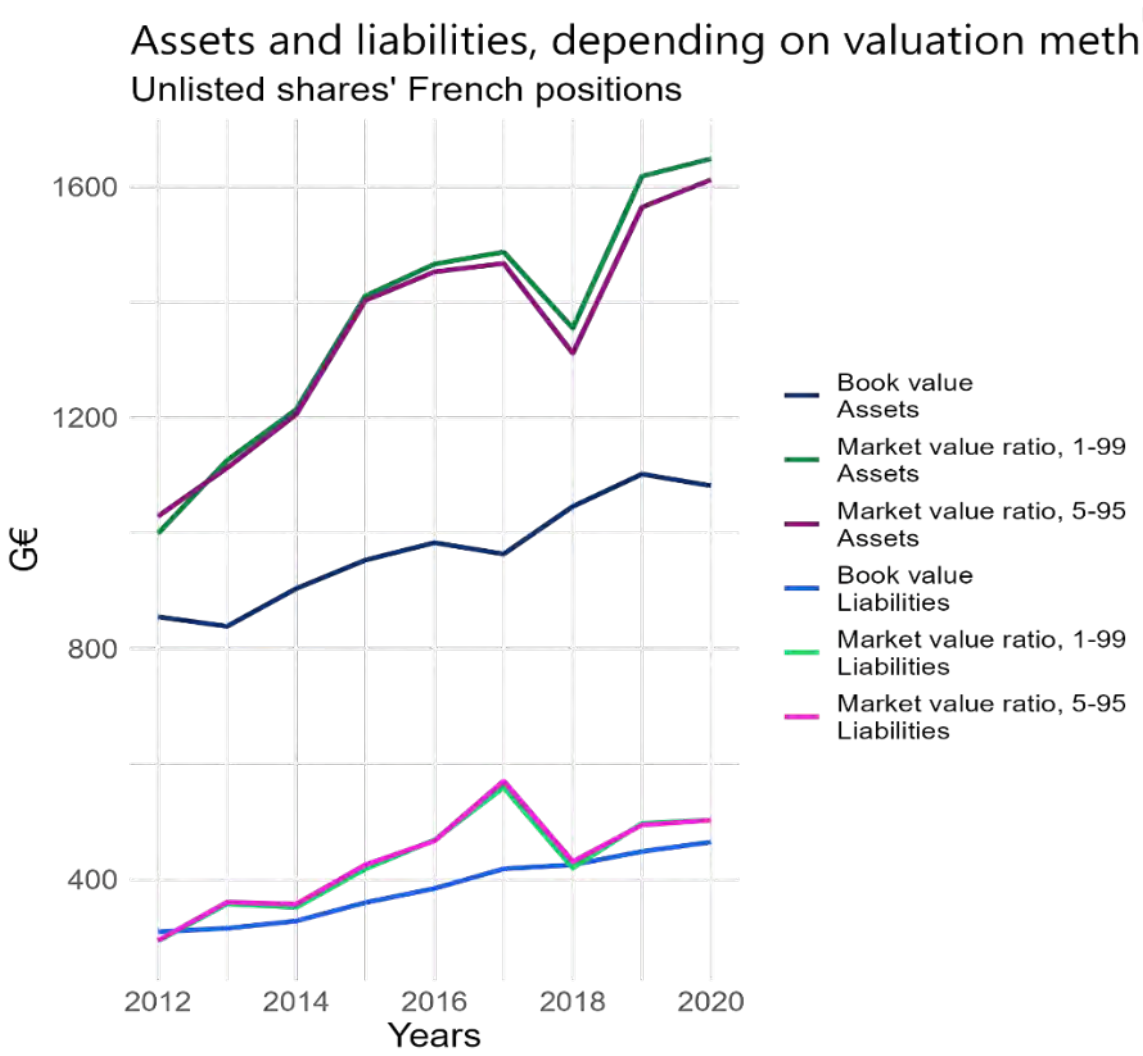
- Both methods can be easily replicated
  - Data availability
  - Simple methodology
    - ➢ Can be improved!

APPENDIX

BOUNDING IMPACT

Bounding individual ratios between 1st and 99th percentiles has a very low impact on final figures

Figure A1

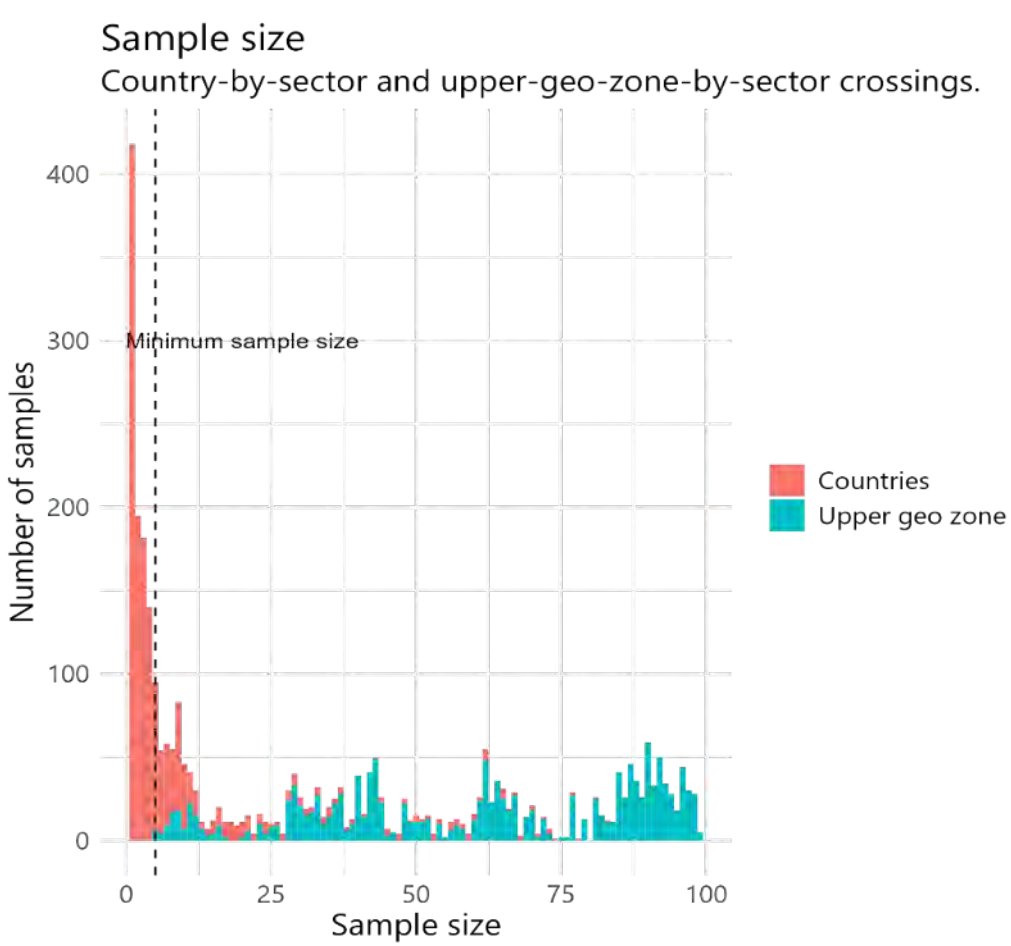


Sources: CSDB and Bloomberg data - Banque de France
Note: 5-95 means bounding ratios between 5th and 95th percentiles.

SAMPLE SIZE

The upper geo zone of France is Europe. For instance, if there are less than 5 listed companies for industry in France, we would consider listed companies for industry in Europe.

Figure 6

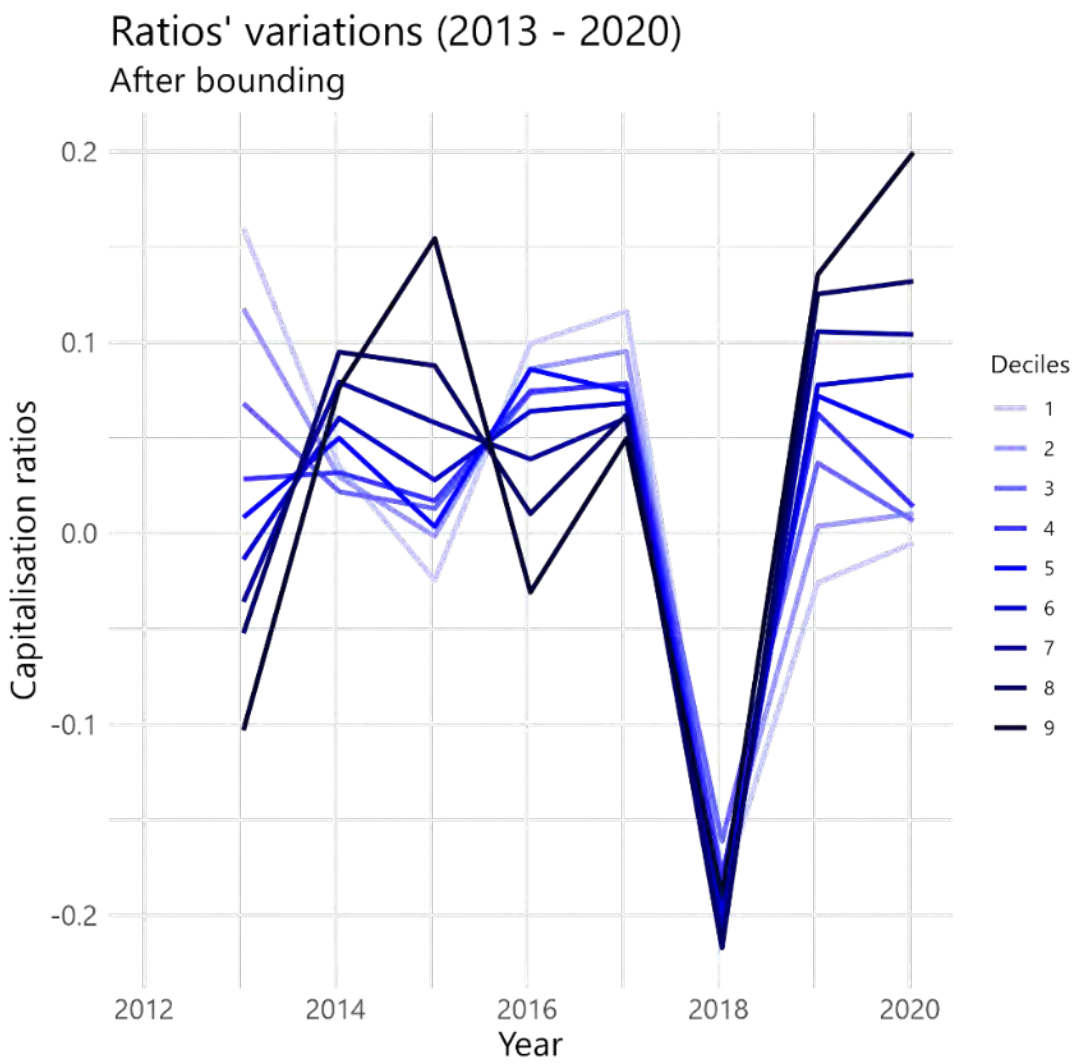


Sources: CSDB and Bloomberg data - Banque de France
Note: to facilitate readibility, samples of size lower than 100 are represented

RATIOS' YEARLY VARIATIONS

Ratios' variations are different depending on their market capitalisation

Figure 3



Sources: CSDB and Bloomberg data - Banque de France
Note: smaller and higher ratios might evolve differently.

FLOW-STOCKS RECONCILIATION – EQUATIONS

1. All-valuation effect model
   - $OC^V = OC^U$
   - $K7B_n = V_n - (V_{n-1} + F + \frac{\tau_n - \tau_{n-1}}{\tau_{n-1}} V_{n-1} + OC^U)$

2. F511 model
   - $K7B_n = \frac{R_{j,k,n} - R_{j,k,n-1}}{R_{j,k,n-1}} V_{n-1} = (R_{j,k,n} - R_{j,k,n-1}) U_{n-1}$
   - $OC^V = V_n - (V_{n-1} + F + \frac{\tau_n - \tau_{n-1}}{\tau_{n-1}} V_{n-1} + K7B_n)$

3. Hybrid split model
   - $OC^V = R_{j,k,n}\, OC^U + \left(\frac{R_{j,k,n} + R_{j,k,n-1}}{2} - 1\right) F$
   - $K7B_n = V_n - (V_{n-1} + F + \frac{\tau_n - \tau_{n-1}}{\tau_{n-1}} V_{n-1} + OC^V)$

X =

Year	OFBV	Ratio	Market	Flow	Residual
1	100	2	200	10	
2	110	2	220		**10**

FLOW-STOCKS RECONCILIATION – CHARTS

Figure 10

Market effects and other changes for assets' position

Depending on flow-stock reconciliation method



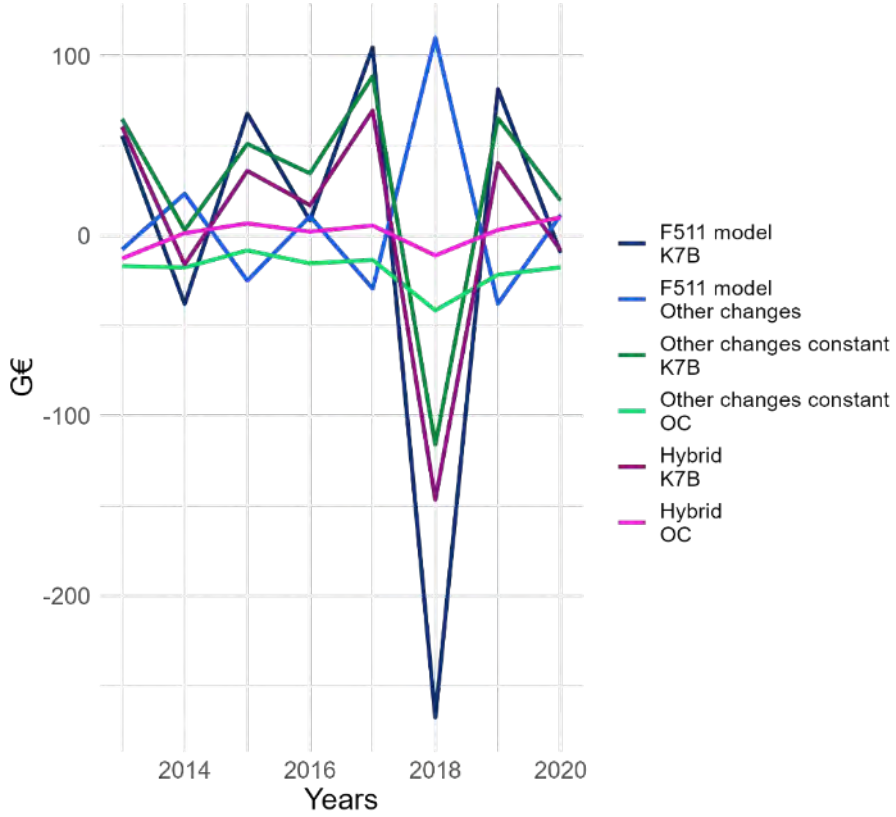
Sources: CSDB and Bloomberg data - Banque de France

Note: market effects and other changes compensate each other, whatever the methoc

Figure 11

Market effects and other changes for liabilities' position

Depending on flow-stock reconciliation method



Sources: CSDB and Bloomberg data - Banque de France

Note: market effects and other changes compensate each other, whatever the methoc


BANQUE DE FRANCE
EUROSYSTÈME

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12-13 February 2024

An early estimation of foreign direct investment income in the balance of payments[1]

Esther López-Espinosa, Luis Molina,
Bank of Spain,

and Helge Schäfer,
Deutsche Bundesbank

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

An early estimation of foreign direct investment income in the balance of payments

Esther López-Espinosa (Bank of Spain), Luis Molina (Bank of Spain), Helge Schäfer (Deutsche Bundesbank)

Abstract

Foreign Direct Investment (FDI) income has a very significant impact on the financing capacity or need of an economy and on its national income. For these important magnitudes to adequately reflect reality, these incomes must be measured accurately. However the information necessary for their calculation is accessible with a long delay, which made necessary to make projections for recent periods. As the studies that have been carried out on the determinants of income from direct investment are limited or almost non-existent, the common solution is to resort to historical means. These estimates have proved to be very inaccurate, producing significant revisions when observed contemporaneous information becomes available.

Based on microdata from the Spanish balance of payments of past FDI income by counterpart country and resident sector, we project the FDI income of Spanish companies operating abroad within the framework of Machine Learning models, and complement this approach with econometric models. We compare the accuracy of these estimates with the one that uses simply the historical data. From a practical point of view, the aim is to have a useful and easy-to-update method to estimate FDI income that leads to posterior lower revisions.

Keywords: FDI, balance of primary income, machine learning, vector autoregressive models

JEL classification: F2, F3, C53

1. Introduction

In the context of accelerated globalization, Foreign Direct Investment (FDI) plays a key role. FDI establishes direct, stable connections between economies, promoting technology transfer and improving competitiveness. It also serves as a vital source of capital. The direct investment income reflects FDI's profitability and influence on a country's balance of payments. For example, in some Latin American economies like Chile and Peru, the balance of primary income—earnings from foreign mining companies—impacts the current account balance significantly.

Direct investment statistics cover cross-border transactions and positions among enterprises within the same multinational group. These stats include direct investment income, which illuminates multinationals' performance, encompassing both equity and debt income. The former is split into dividends distributed to direct investors and reinvested earnings held within the reserves of the direct investment enterprise. These reinvested earnings impact both current account income and financial account transactions, influencing the stocks of the direct international investment position. Meanwhile, direct investment income reveals the profitability of investments from subsidiaries, offering valuable insights for analysts assessing the economic situation in the host country. Reliable, internationally harmonized statistics are crucial for tracking FDI trends and aiding policymakers in addressing global market challenges.

In the context of FDI, direct investment income reflects results from the current activity of the direct investment enterprise. It covers net operating income, net interest, dividend income, reinvested earnings and net current transfers, al of them receivable. Excluded are realized or unrealized gains or losses from valuation changes and exchange rates. For accurate and comprehensive analysis, these factors must be considered when evaluating the impact of FDI on an economy. To compile accurately, the entire ownership chain has to be considered, reflecting the profitability of parent companies' investments in overseas subsidiaries. Passive equity income aligns with resident direct investors' performance. This structure provides a comprehensive view of active and passive income streams in direct investments. This data is available only with a high time delay.

The lack of research on determinants of direct investment income leads to reliance on historical data for projections. However, projecting future income based on past income faces challenges due to market fluctuations, changing revenues and expenses, and external influences. To improve FDI income forecasts, we explore two approaches: machine learning models (LASSO and Random Forest) and traditional econometric models (VAR and panel). These methods leverage data from the Spanish balance of payments and relevant economic variables. We also divide the sample into monetary financial institutions (MFIs) and other resident sectors (ORS). This distinction accounts for unique characteristics and roles within the economy.

Then we employ statistical tests to compare the accuracy of estimations from different models. This assessment not only helps gauge the improvement in projection accuracy by incorporating available economic and financial information during estimation but also enhances our understanding of direct investment income dynamics. By focusing on Brazil and the United Kingdom—representing approximately 30% of Spanish residents' total direct investment income—we gain

insights into determinants across diverse geographical and economic contexts. Our future analysis will expand to include other significant countries, aiming for a sample representing at least 85% of Spain's total direct investment earnings. Ultimately, our goal is to provide an easily updatable and replicable tool for accurate FDI income estimation, rather than a stylized macroeconomic model. Future enhancements may extend its capabilities to include payments.

2. Data

We use annual equity income from FDI data covering the period 1993 to 2021. This data is disaggregated by country and resident sector, and further divided into MFIs and ORS. The choice of annual income data was primarily due to its availability. In most cases, especially for unlisted shares, company income is only available on an annual frequency. Only listed shares have data available on a quarterly basis.

Macro data aggregated by country are prepared based on microdata from companies. This allows us to understand what causes unusual movements each year. This approach provides a granular view of the data, enabling us to identify trends and anomalies that may not be apparent in aggregated data. By examining microdata, we can gain insights into the performance of individual companies, sectors, and countries, and how they contribute to the overall FDI income.

We have made the distinction between MFIs and other companies to cater to the intrinsic differences in activity between these two subgroups. For MFIs, their earnings are conditioned by monetary variables such as official interest rates, reserves, or bond interest rates. Income obtained by the non MFIs companies may be subject to other variables more related to their productive activity such as commodity prices or stock market indices. Understanding these differences allows us to provide a more comprehensive and accurate analysis of FDI income offering valuable insights into the financial dynamics of both MFIs and ORS. Furthermore, we assume that this distinction aids in the development of more precise models for predicting income trends.

The selected data is the income that Spanish companies (direct investors) earn from their foreign subsidiaries (direct investment enterprises). The income from direct investment is divided into the portion that is repatriated by the parent companies, i.e., the distributed dividends, and the portion of this income that is retained within the subsidiary as retained profits. Both items are considered part of the income from direct investment, not just the repatriated dividends. While distributed dividends can be easily collected from companies as they are distributed throughout the year, the annual result of the company is only available when they close their fiscal year and produce their annual accounts. Moreover, since the income from FDI is calculated on the basis of the COPC (Current Operating Performance Concept) only those items of the income statement related to the ordinary activity of the company should be taken into account, excluding provisions, or results from the sale of assets, etc. This implies that obtaining income data of sufficient quality requires access to detailed information from the annual balances of the company, which are available with a considerable time lag, even more so in the case of unlisted firms.

We have initially focused on the income from direct investment assets, as these are the most complex to obtain. This income originates from non-resident subsidiaries, and accessing this information, as well as checking the quality of the data firstly forecasted and then reported, can be challenging. In the first step, we have selected the two main contributors to the Spanish FDI income, Brazil and the United Kingdom. The choice of these countries is strategic, one being a developing country and the other a developed one, helping us understand the differences in the economy dynamics of both countries that affect the results obtained by the companies in them.[1] Figure 1 shows the evolution over time of the FDI income series used in the paper.

As determinants of the FDI income we rely on the main macroeconomic and financial variables of each country. The significance of each macroeconomic variable for Spanish FDI rents differ according to the country of origin. For example, in Brazil, most of the investment is concentrated in the banking sector, so variables like private consumption, real credit growth, or the spread between interest rates for loans and the remuneration of deposits would support FDI rents. In the same vein, FDI income could increase if the equity index of the country -or in concrete the equity index for the banking sector- increases. On the contrary, variables that could increase the risk of the banking sector, like non-performing loans or the loan to deposit ratio, would have a negative effect on those rents. Variables that increase the probability of a sovereign default, or a currency crisis -like the level of public debt or the current account balance-, would also act in the same direction, especially in emerging economies, which are more prone to suffer this kind of turbulences.[2] On the contrary, the Spanish investment in UK is a bit more diversified, as it comprises banks, airlines, and IT firms, so the real GDP would be a better approach to predict FDI income. Finally, the level of wealth of a country could also influence FDI income, as well as good institutions as a proxy for the risk of expropriation of the benefits of the investment. A continuous approach to institutional wellness is made by textual indicators, which have been widely used in recent years to predict GDP and other macroeconomic relevant variables.[3] Table 1 shows the variables included as determinants of FDI income in our exercise.

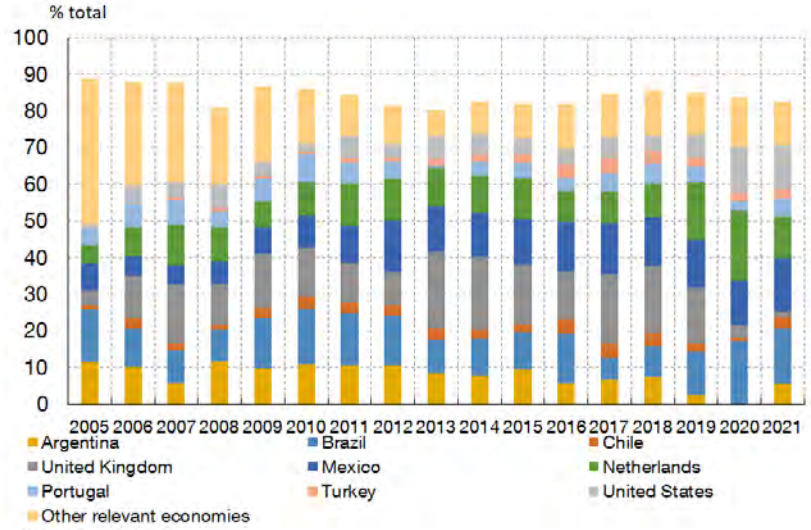
[1] The next step will be to develop similar models for the rest of the countries until we cover 85% of the total income from FDI.

[2] For a complete description of the mechanics behind these arguments and the variables used, see Alonso and Molina (2023).

[3] See Diakonova et al (2023).

CHART 1

FDI INCOME IN SPAIN (a)



SOURCE: Banco de España
(a) Excluding real estate activity.

Variables tested as determinants of FDI income

Table 1

Economic cycle	Investment profitability	Wealth and Institutions	Vulnerabilities
National accounts (% change)	Equity index (% change)	GDP per capita (level, USD PPP)	Sovereign spread (bps)
- GDP	- Total	GDP per capita PPP USD (% change)	Sovereign spread (% change)
- Construction	- Banks	Sovereign rating (level)	Exchange rate (% change and deviation form long term average)
- Real Estate	- Consumer staples	WB indicators for (percentile)	Public sector balance (% GDP)
- IT	- Financial services	- Corruption	Public debt (% GDP)
- Private consumption	- Electricity	- Government effectiveness	Banks net foreign assets (% GDP)
- Fixed investment	- Energy	- Rule of law	Banks non performing loans (% credit)
- Exports	- Airlines	- Accountability	Loan to deposit ratio (%)
Unemployment rate (% labour force)	Yield on 10 year public debt in local currency (%)Yield (%)	- Violence	Banks debt spread (% change)
Inflation (CPI)	Yield on 2 year public debt in local currency (%)Yield on (%)	Textual indicators	Energy firms debt spread (% change)
Industrial production (% change)	Commodity index (level)	- Geopolitical Risk	Short term interest rate (%)
Bank credit (real, % change)	Oil price (level)	- EPU	Current account balance (% GDP)
Banks deposits (real, % change)	Soya price (level)	- Social strains	External debt (% GDP)
FDI received (% GDP)	Metals price (level)	- Political strains	Short term external debt (% reserves)
Portfolio capital inflows (% GDP)	Intermediation margin (loan minus deposits rate, %)		Reserves (% GDP)
Retail sales (% change)	AAA bond yield (%)		External debt service (% exports)
Nominal exports (% change)	BB bond yield (%)		
Capital goods production (% change)			
Consumer confidence (level)			
Business confidence (level)			
Official interest rate (%)			

Sources: authors elaboration.

3. Methodology

Estimating direct investment income poses a significant challenge when observed data is not readily available. This complexity is further compounded by the considerable time lag often associated with the data required for such calculations, around 18 months in the case of Spain and the income of ORS. Then the strategy employed involves analysing the observed income for each company, taking into account the country of investment over the past five years. A weighted average is calculated with a bias towards more recent information. This approach, which we label as the **traditional rule**, used also in other countries, operates under the assumption that a company's income in a given year is largely influenced by the most recent trends in its business operations. As we delve further into the past, this influence is deemed to diminish.

Compilers of external statistics and economists generally dispose of a great number of statistical and economic indicators that could potentially be useful in predicting income from FDI. **Machine learning algorithms** can be of help in selecting the variables with the greatest predictive power based on available data of past income. The approach presented in the following is inspired by Kiley (2020), who uses machine learning techniques to construct a financial conditions index for the USA.

We will apply the LASSO and random forest algorithms to, on the one hand, select important explanatory variables that can serve as orientation for inputs for other approaches and, on the other hand, directly obtain predictions for FDI income. The (simple) LASSO ("least absolute shrinkage and selection operator") algorithm we apply is a variant of linear regression that additionally penalizes the size of coefficients linearly. The resulting regularization that in this case entails variable selection is intended to avoid overfitting. Whereas the LASSO algorithm yields a linear model, random forests consist of ensembles of decision trees, which allows capturing non-linear effects. One downside is that the importance of a predictor can no longer be ascertained as easily as in linear models, but there are alternative measures that try to make up for that fact.

The machine learning algorithms are implemented in Python with the scikit-learn package. Before estimating the models, explanatory variables are centred and normalized. The estimation of the models involves several steps. In order to tune the hyperparameters of the models, we perform a cross-validated grid search over a certain parameter grid in each case. The resulting optimized choice of hyperparameters is then used for the final model. The training data of the final model include all data points except the income of the last two available years, thereby simulating the actual problem of having to predict FDI income up to two years into the future.

As a complement and to robust the results of the machine learning type models, we estimate also some usual econometric models. First of all, we use a **Structural VAR (SVAR) model**. SVARs have become an essential empirical tools for central banks to conduct macroeconomic analysis, and they also have been widely used as forecasting tools and have proven to be a suitable and flexible kit to study the co-movement of macroeconomic variables both in advanced and in emerging economies (Andres-Escayola et al (2023), Estrada et al (2020), Leyva-León (2017 and 2021), Litterman (1986) and Duncan (2019)). Particularly useful in this context is the

Bayesian variant (BVAR), as it allows to estimate robust projections even in very short samples.

SVAR models are specified with one lag, which are then capturing the dynamism of one year for yearly model specifications. Bayes formula is applied to combine information of the prior distribution and the likelihood function, resulting in a posterior distribution. From this latter distribution, one obtains draws to compute the functions and estimates of interest (i.e., impulse response functions (IRFs) and, more relevant in this case, forecasts). In practical terms, the estimation is implemented using Markov Chain Monte Carlo (MCMC) algorithms (i.e., Gibbs sampling). We choose Normal-Wishart priors, which are the most common ones used in the literature, and they assume that the VAR coefficients behave according to a normal distribution. Finally, to estimate all these models we rely on the ECB's BEAR toolbox (Van Roye et al (2016)), and on E-views 12, to get the forecasts evaluation statistics.

Alternatively, we also present results for a panel data model and for a panel SVAR model. The reason for doing so is that these models allow for many more observations, abstracting from the great heterogeneity of the host countries.

4. Results

Machine Learning models

To predict the FDI income of Spanish MFIs in **Brazil**, we rely on 124 explanatory variables in total (see Table 1), also including the 2-year shift of FDI income into the future. Moreover, for each indicator we include both the indicator itself and its first differences. The LASSO algorithm with all indicators included yields a considerable mean absolute error of about 440 million euros for the last two years, but still manages to capture the qualitative trend to the downside during the most recent two years of the dataset. Variables selected for by the LASSO algorithm and their corresponding coefficients are shown in Table 2.

Keeping in mind that indicators are normalized before the models are estimated, we can interpret the (absolute value of the) coefficients as their respective importance. One sees that, surprisingly, the currency reserves of Brazil are the dominant determinant of Spanish MFI FDI income in Brazil according to the model. Some signs of coefficients appear a priori implausible from an economic standpoint, such as in the case of social tensions and government effectiveness, but their importance is relatively minor. The salience of Brazilian currency reserves motivated a further LASSO estimation, this time restricted to the reserves as the only explanatory variable. The resulting score in the sense of mean absolute error during the last two years is very low with only about 50 million euros, but the approximation is worse in previous years.

The random forest algorithm also yields good results with a final score of about 140 million euros. The so-called permutation feature importances, which are a model-based measure of the contribution of the feature to the statistical performance, of the most important indicators are shown in Table 2. It should be noted that the

feature importances of the random forest are somewhat less stable than the coefficients of the LASSO algorithm over different runs of the estimation. Nevertheless, one sees that at least the reserves and the 2-year yield from the LASSO reappear as important features for the random forest. The income of Spanish MFI in Brazil as well as the different estimates are shown in Figure 2.1.

If we want to predict the FDI income in Brazil of the Spanish ORS, it yields much better results to estimate the first differences of the income instead of the income itself. Figure 2.2 shows the income obtained in Brazil by the other resident sectors in Spain as well as the predictions based on the first-differences estimates at the different points in time, including all direct investment income. Nevertheless, there is a rise of the income in the most recent years -due to steelworks- that we fail to capture in our models.

Another salient result is the fact that the LASSO algorithm does not select a single variable, which leads to the LASSO predictions having constant slope. This might also serve as an argument to predict constant income two years into the future as the slope learned over phases that include very low FDI far in the past might not be indicative of future behaviour. The random forest algorithm quite consistently underestimates the absolute value of the first differences, but correctly predicts the sign (with the exceptions of 2020 and 2021). This could make it a conservative choice for predicting the income in the future if we consider the constant prediction as a benchmark. Whether the predictions take into account the steelworks (until 2019) does not change the prediction in a meaningful way. The selected variables are quite unstable in this case, however, and importances are not very high. Inflation and (first differences of) fixed investment and indicators connected to changes in GDP appear in both RF models. Table 2 shows the results for the RF models with and without income from steelworks.

Results for FDI income in Brazil

Table 2

	Coefficient of LASSO: MFI income	Feature importance MFI income [1]	Feature importance ORS income with steelworks [1]	Feature importance ORS no steelworks [1]
Official interest rate (%)		0.101		
Reserves (% GDP)	490.0	0.099		
Bank debt spreads (% change)	-111.5			0.088
Short term external debt (% reserves)	52.9			
Social strains index (level)	13.3			
Government effectiveness (percentile rank)	-15.1			
2 year public debt in local currency yield (%)	-22.7	0.088		
2 year shift of MFI FDI income	5.4			
Violence (percentile rank)		0.064		
Short term interbank rate (%)		0.034		
Energy firms debt spread (% change)			0.027	
Inflation (CPI, % change)			0.018	0.059
Exchange rate (deviation from trend)				0.036
Political strain index (first difference)				0.036
External debt (% GDP)				0.030
Fixed investment (% change, first difference)			0.017	
Unemployment rate (% labour force)			0.017	
Commodity price index (level)			0.014	

[1] Permutation feature importances of random forest estimation. Five more important features.

Sources: authors calculations

Summing up, in order to predict MFI's FDI income from Brazil, important indicators to use are the reserves, the yield of 2 year public debt in local currency, the banks' debt spread, and the official interest rate. Reserves over GDP could be interpreted, in an emerging economy, as a proxy for financial stability and the avoidance of currency crises or sovereign defaults. The benchmark public debt in local currency yield could proxy the income that could be obtained by banks for having domestic debt in their balance sheet, as well as the official rate, since in Brazil almost 25% of public debt is linked to the SELIC (Brazilian official interest rate). In the case of the income of ORS, the best indicators are more related to the general performance of the economy: the rate of inflation, the growth of fixed investment, GDP growth and commodity prices -as Brazil is a big player in some commodity markets like soya-. All results suffer, however, from the drawback of a small sample size (29 or 30 data points). This affects the stability of the results of the ML algorithms, especially if the size of the training sample varies.

In the case of the **United Kingdom**, we include 120 indicators for the MFI and 122 indicators for the ORS.

The income of Spanish MFIs is best predicted by considering the first differences (Figure 2.3). As in the case of the income of ORS in Brazil, the LASSO algorithm selects none of the variables, which results in almost constant predictions. Both algorithms fail to capture the strong increase in 2021 -which is due to the low income obtained in 2020 because of provisions related to the pandemic- and yield very conservative estimates. The importances according to the random forest are shown in Table 3, and they are generally not very high.

Also for the income obtained by ORS we predict the first differences and then derive the income (Figure 2.4). As in the case of Brazil, here we detect another outlier. In this case, airlines play a major role in general and in particular cause the strong decrease of FDI income in 2020. While this fall of income in 2020 is not captured by the ML algorithms, both the LASSO algorithm and the random forest do select the variable(s) connected to airlines. Instead, the algorithms even suggest a slight increase in 2021 (and partially in 2020) while actual income falls precipitously. The selected variables are shown in Table 3.

Results for FDI income in the United Kingdom

Table 3

	Feature importance MFI income [1]	Coefficient of LASSO ORS income	Feature importance ORS income [1]
Private consumption (% change, first difference)	0.045		
Exports (% change, first difference)	0.020		
Business confidence (first difference)	0.019		
GDP (% change, first difference)	0.017		
Construction (% change, first difference)	0.016		
Consumer confidence (level)			0.020
Government effectiveness (percentile, first difference)		-411.9	0.031
Airlines equity index (% change)		318.7	
Airlines equity index (% change, first difference)		290.8	
Portfolio capital inflows (% GDP)		174.1	
AAA bond yield (%, first difference)		81.6	
Bank credit (real change, first difference)		-58.7	0.022
Real estate (% change, first difference)		-28.1	

Financial services equity index (% change)	14.7		
Official interest rate (%, first difference)	1.5		
BB bond yield (%, first difference)		0.058	
Public sector balance (% GDP, first difference)		0.027	

[1] Permutation feature importances of random forest estimation. Five more important features.

Sources: authors calculations

Some variables are selected prominently by both models, such as the first difference of government effectiveness and the change in the equity index of the airlines. Yet, a selected variable might still seem implausible from an economic standpoint. This is especially true in the case of the first difference of government effectiveness since according to the results of the LASSO algorithm, a strong increase in government effectiveness tends to markedly push down (the change of) income. All in all, in the case of the United Kingdom, the ML algorithms yield conservative estimates for both MFI and ORS income, but fail to capture the significant developments of the most recent years.

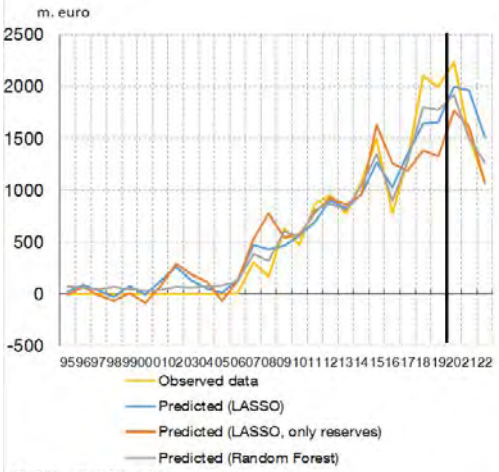
To conclude, fixed investment, consumer confidence, the aggregate equity index, construction, GDP growth, business confidence, exports, and private consumption growth seem to be important indicators in the case of MFI income obtained in the UK. For the OSR, airlines equity index, portfolio capital inflows, corporate bond yields, bank credit growth, and government effectiveness should be considered.

In order to facilitate comparing the different approaches to predicting FDI income, it is useful to not only consider one training sample that permits estimating the data for the most recent time periods. Instead, the exercise should be repeated for as high a number of years as possible. Here, we only give the results for the ML models if they are **trained with data up to 2015**, the predictions of income for the years 2016 and 2017 being of special importance in this case.

Figure 3.1 shows that the LASSO algorithm with the reserves as the only indicator emerges as the best predictor for MFI income in Brazil in this case. The estimates (especially the RF) degrade over time, however, which could serve as an argument to generally estimate the first differences of income and not income directly. The algorithms illustrated in Figure 3.2 yield almost constant first-difference estimates, which leads to conservative results. Figures 3.3 and 3.4 show the results for the UK. Here both LASSO and the random forest yield conservative estimates for the income obtained in the United Kingdom that work reasonably well until the pandemic.

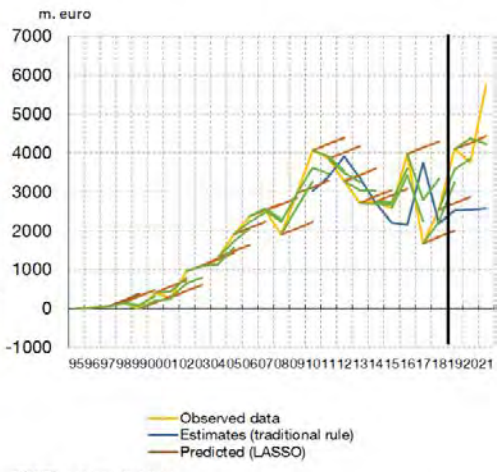
CHART 2

1. FDI INCOME OF MFI: BRAZIL



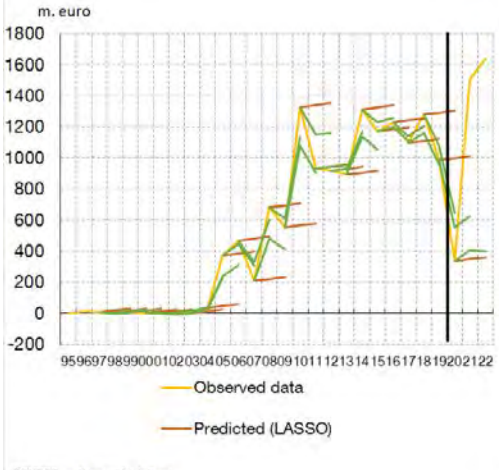
SOURCE: authors calculations.

2. FDI INCOME OF ORS: BRAZIL



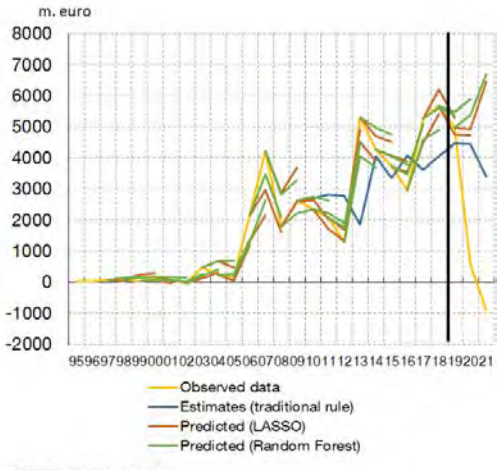
SOURCE: authors calculations.

3. FDI INCOME OF MFI: UNITED KINGDOM



SOURCE: authors calculations.

4. FDI INCOME OF ORS: UNITED KINGDOM



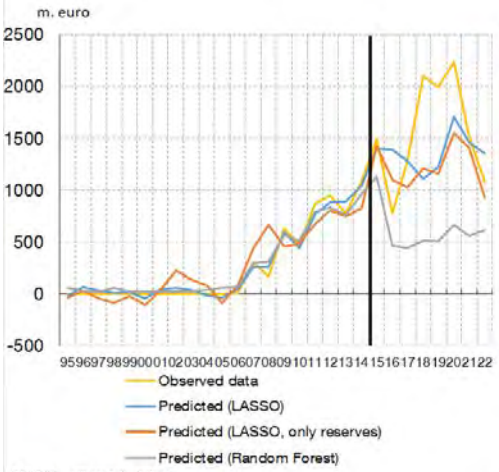
SOURCE: authors calculations.

Black vertical line indicates the last year of the training sample.

For the ML-based selection of indicators that are going to serve as input for one of the SVAR models we rely primarily on the results of the ML algorithms obtained with the full training sample including data up to 2019 and 2020. Nevertheless, we also include the energy firms spread and the percentage change of the energy equity index in the case of income obtained by Spanish MFI in Brazil, as these two variables play an important role in the estimation with training sample up to 2015.

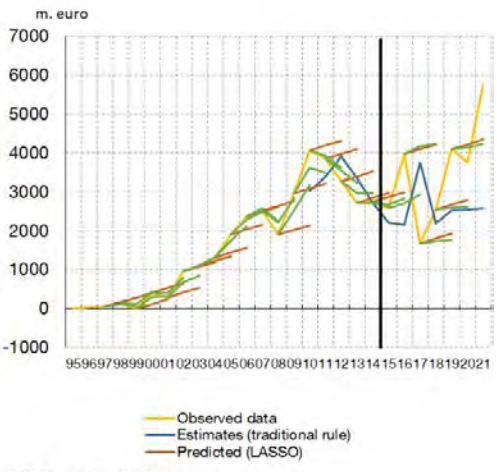
CHART 3

1. FDI INCOME OF MFI: BRAZIL



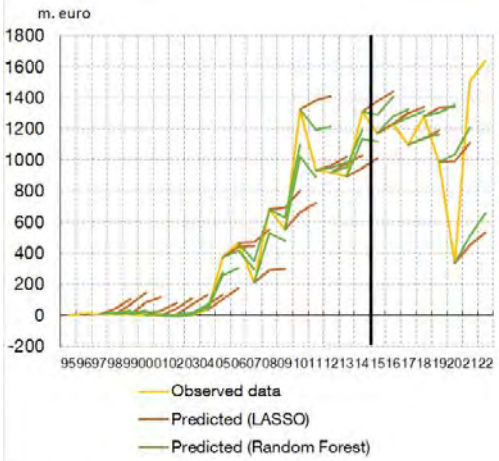
SOURCE: authors calculations.

2. FDI INCOME OF ORS: BRAZIL



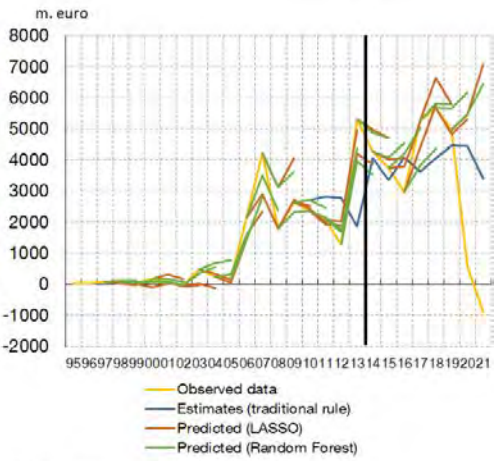
SOURCE: authors calculations.

3. FDI INCOME OF MFI: UNITED KINGDOM



SOURCE: authors calculations.

4. FDI INCOME OF ORS: UNITED KINGDOM



SOURCE: authors calculations.

Black vertical line indicates the last year of the training sample.

Econometric models

We estimate two groups of models, one with those variables previously selected by the Machine Learning algorithms, and another with the variables which a priori -and resorting to the usual economic relations- one would expect to be key determinants of the income obtained by FDI in the host country.

In the case of the economic-like models, we can estimate MFI and ORS rents separately, as the determinants of each one could be different. One can expect that in the case of MFI rents, the equity index for the banking sector in the host country would have a positive effect, as well as the profitability of part of their assets (proxied by the yield of the local currency public debt and the official interest rate). The loan minus deposit rate proxy the intermediation margin for MFIs, and the non performing

loans, the loss that banks could incur due to their usual activity. The real growth of private consumption and investment would proxy the increase of their loans to households and firms, respectively. For the ORS the determinants could be the indicators of an economic cycle -like the real GDP growth, the CPI inflation rate, and the unemployment rate-, the evolution of the equity index, and an indicator of the uncertainty about the economic policies, which would proxy the goodness of the domestic institutional arrangements. We have added in the case of Brazil a commodity price index, as Brazil is a commodity exporter and some Spanish firms have invested in energy and metals sectors, as stated in the previous section, and the ratio of international reserves to GDP, which proxies the absence of financial crisis in emerging economies. Table 4 shows the variables included in each type of model.

With the above mentioned determinants we estimate various types of models. First of all, we apply structural vector autoregressive (SVAR) models, estimated with Bayesian techniques. Second, and just for the economic like specifications, we estimate panel SVAR models, which have the advantage of widen substantially the number of observations at the cost of having a sample with a great heterogeneity.

All the VAR models are estimated with one lag of the endogenous variable and restricting the sample to 1993 to 2019, since the 2020 pandemic and the subsequent rebound could bias the coefficients and therefore invalidate the model for FDI income forecasts in normal times.[4] Also, we have tested for the presence of an unit root in the variables that we introduce in the SVAR specification. The tests indicate that the null hypothesis of the presence of a unit root is rejected for the first differences of the variables, but not for the level of the FDI incomes, which led us to estimate all the models in first differences.

Variables used in the econometric models

Table 4

	ML type: MFI income	ML type: ORS income	Economic like: MFI income	Economic like: ORS income
BRAZIL	- Reserves (% GDP) - Yield on public debt in local currency (%) - Official interest rate (%) - Equity index, energy (% change)	- Inflation (CPI, % change) - Fixed investment (% change) - Commodity prices (level) - GDP per capita USD PPP (% change)	- Equity index, banks (% change) - Yield of public debt in local currency (%) - Official interest rate (%) - Intermediation margin (loan minus deposit rate, %)	- GDP growth (%) - Unemployment rate (% labour force) - Inflation (CPI, % change) - Equity index (% change) - Commodity price (level) [1]
UNITED KINGDOM	- Fixed investment (% change) - Consumer confidence (level)	- Airlines equity index (% change) - Portfolio capital inflows (% GDP)		

[4] In the case of Brazil we miss also 1993 and 1994, as the hyperinflations of those years -almost 2500% and more than 900%- invalidates all estimations. Also, the economic policy uncertainty index, when included, limits the sample to 1997-2019.

	- Equity index (% change) - Construction (% change) - GDP (% change) - Business confidence (level) - Real exports (% change) - Private consumption (% change)	- AAA bond yield (%) - Government effectiveness (percentile) - Bank credit (real, % change)	- Non preforming loans (% credit) - Fixed investment (% change) - Private consumption (% change)	- Reserves (% GDP) [1] - Economic Policy Uncertainty index (level)

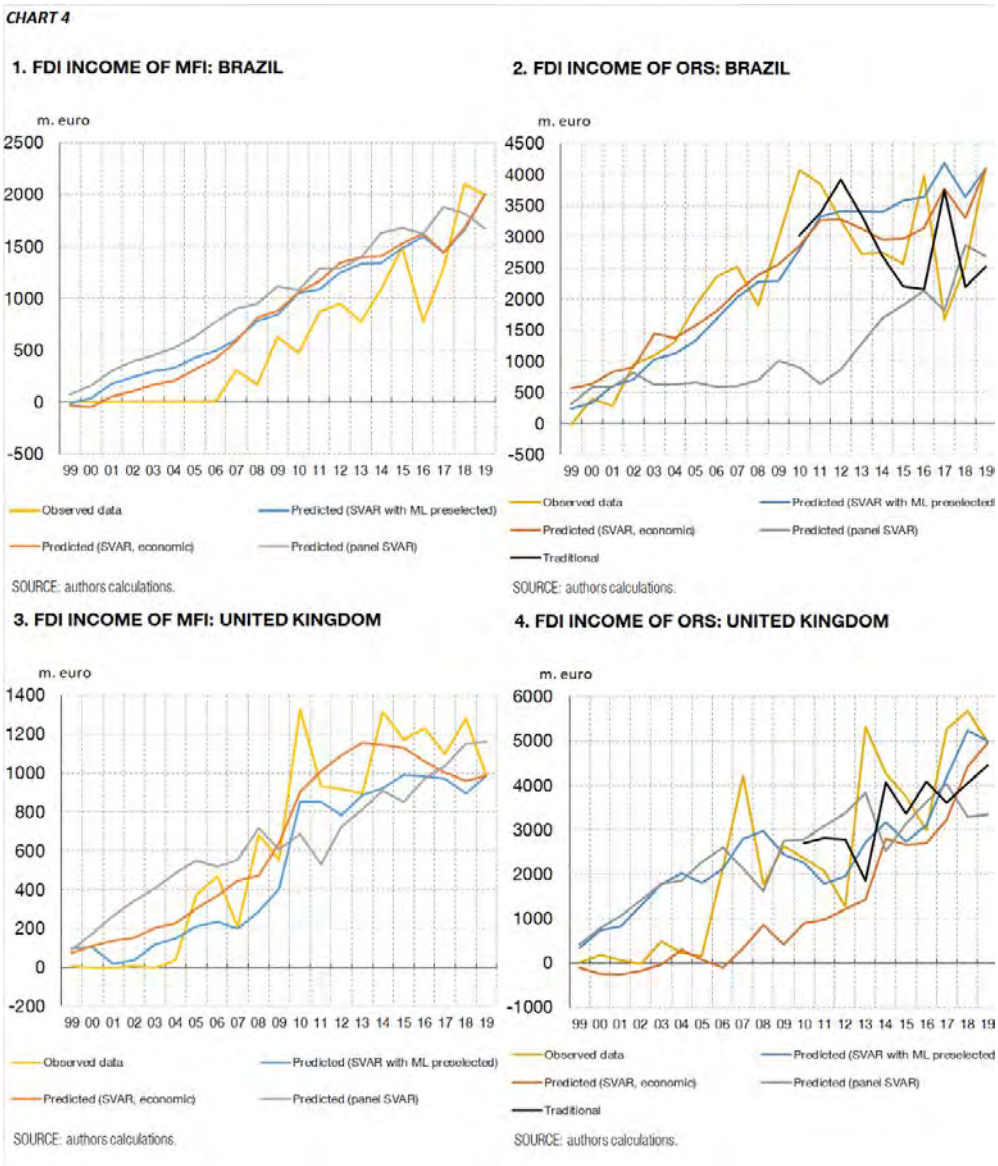
[1] Excluded in the case of United Kingdom.

Sources: authors calculations

Figures 4.1 and 4.2 shows the results for the level of FDI income for all the econometric models, recovered from the estimated first differences of FDI rents, compared with the actual data and the traditional estimation, for **Brazil**. At first glance, the results are not very promising. Thus, the ML preselected and economic like SVAR models yield very similar paths despite the fact that the determinants included in both are different, which may be due to the high coefficient of the first lag of the dependent variable. Moreover, the models overestimate systematically the level of MFI income. Panel SVAR models yield a similar result, although in the case of ORS rents the level of FDI income is underestimated in the first part of the sample. The estimated models also do not seem to correctly capture the turning points in the annual variation rates of Spanish FDI income in Brazil. [5] In the case of the **United Kingdom** (Figures 4.3 and 4.4) the variability of FDI income is not fully captured by any of the SVAR models, nor by the traditional rule, but at least some extreme points and turning points seem to be better captured, especially for the MFI income. ML and economic like, both individual and panel SVAR models, give somewhat different results. [6]

[5] The IRFs reveal that, as in the case of Lasso and Random Forest models, just a shock to the ratio of reserves to GDP generates a response statistically different from zero in the MFI's income ML-model. For the MFI's income economic-model other variables -private consumption and the official interest rate- show the expected sign and are statistically different from zero. For ORS' income, the only shock statistically significant is a shock to the growth of fixed investment, meanwhile in the economic model at least a shock to the EPU and to the unemployment rate presents significant and economically meaningful effects on the annual change of ORS' rents.

[6] The IRFs show that, as in Brazil, the main determinant of MFI income according to ML and economic model is its own past, but in this case some national accounts variables innovations -GDP, investment and export growth in ML models and private consumption and fixed investment growth in economic models- have a positive and significant effect at least in the first year. For economic models the official interest rate and the intermediation margin are significant and with the expected sign. The IRFs for ORS income show a greater coefficient and persistence of the effect of its own past, and some significant variables with the expected sign -the airlines equity index and portfolio capital inflows in ML models and the total equity index and the EPU for economic models-, but some others resulted significant with the wrong sign -the government effectiveness indicator-.



Which model would be selected to improve the estimation resulting from the traditional rule? We have performed statistical tests of in-sample and out-of-sample accuracy [7]. Here we present the results for the Diebold-Mariano test of in-sample forecast accuracy for the differences (Table 5). Beyond the instability of some results depending on the criterion used to measure the difference between the observed

[7] Marginal log likelihood and R2 point to the model with a priori economic relationships as the better choice for both type of rents obtained in the UK, whereas in Brazil the picture is less clear. The main statistical indicators of forecast accuracy out of sample -being this sample the period from 2015 to 2019- also points to economic-like models as the more adequate for Brazil MFI's and ORS' income, as well as for MFI's income obtained in the UK. Nevertheless, the adjustment is not very promising, as for example the Mean Absolute Percentage Error surpasses 100 in almost all cases. Another way to look at this is to take the observed data and compare with the model predicted data. Results are more or less similar: models for Brazil does not work very well, as observed data fall out of the less restrictive band of confidence for predictions, whereas models for the UK seem to perform better, especially for MFI income.

and estimated series, one result emerges clearly: any of the empirical methods presented predict significantly better than the traditional rule. Moreover, in Brazil and for MFI rents Random Forest predictions seem to be more accurate, and panel models outperform individual SVAR models despite the heterogeneity of the sample. On the contrary, individual SVAR models perform better for ORS income. For the UK, direct random forest predictions stand the best for MFI income, and in general models with a component of the machine learning approach estimate better than economic models for ORS income.

Diebold-Mariano test of forecast accuracy[1]

Table 5

	Brazil			**United Kingdom**		
	MSE	MAE	MAPE	MSE	MAE	MAPE
MFI						
- SVAR ML preselected versus SVAR economic like	**Econ.***	**Econ.***	Econ.	ML	ML	Econ.
- LASSO prediction versus SVAR ML preselected	Lasso	**Lasso****	**Lasso***	**ML***	ML	ML
- RF prediction Versus SVAR ML	**RF****	**RF*****	**RF***	**RF****	**RF*****	RF
- LASSO prediction versus SVAR economic like	Lasso	**Lasso****	**Lasso***	Econ.	Econ.	**Econ.***
- RF prediction versus SVAR economic like	**RF****	**RF*****	**RF***	**RF****	**RF*****	RF
- Individual SVAR (ML preselected) versus panel SVAR (economic like)	**Panel***	**Panel***	ML	ML	Panel	ML
- Individual SVAR (economic like) versus panel SVAR (economic like)	**Panel***	Panel	Econ.	Panel	Panel	Econ.
- LASSO predictions versus panel SVAR (economic like)	Panel	Lasso	Lasso	**Panel***	Panel	Lasso
- RF predictions versus panel SVAR	**RF****	**RF*****	RF	**RF****	**RF*****	RF
- RF predictions versus LASSO predictions	RF	RF	RF	**RF*****	**RF*****	**RF*****
ORS						
- SVAR ML preselected versus SVAR economic like	Econ.	Econ.	**ML****	**ML****	**ML***	Econ.
- LASSO prediction versus SVAR ML preselected	**ML***	**ML****	**ML***	**Lasso****	**Lasso****	ML
-RF prediction versus SVAR ML preselected	ML	RF	ML	RF	RF	ML
- LASSO prediction versus SVAR economic like	**Econ.***	**Econ.***	Econ.	**Lasso*****	**Lasso*****	Lasso
- RF prediction versus SVAR economic like	Econ.	RF	RF	**RF***	**RF***	RF
- Individual SVAR (ML preselected) versus panel SVAR (economic like)	Panel	Panel	ML	ML	ML	ML
- Individual SVAR (economic like) versus panel SVAR (economic like)	Panel	Panel	Econ.	**Panel***	Panel	Econ.
- LASSO predictions versus panel SVAR (economic like)	**Panel***	**Panel****	**Panel****	**Lasso***	**Lasso****	Lasso
- RF predictions Versus panel SVAR (economic like)	Panel	RF	**RF****	**RF***	**RF***	RF
- LASSO predictions versus RF predictions	RF	**RF*****	**RF*****	Lasso	Lasso	RF
- Traditional	**ML****	**ML ****	**ML ****	**ML*****	**ML *****	**ML*****

versus SVAR (ML preselected)						
- Traditional versus SVAR (economic like)	**Econ.****	**Econ.****	**Econ.****	**Econ.*****	**Econ.****	Traditional
- Traditional versus panel SVAR (economic like)	**Panel***	**Panel***	**Panel*****	**Panel****	**Panel***	Traditional
- Traditional versus LASSO	Lasso	Traditional	Traditional	**Lasso*****	**Lasso*****	**Lasso*****
- Traditional versus RF	RF	RF	**RF****	**RF***	RF	Traditional

[1] Bolded when H0: forecast accuracy is equal is rejected. *: rejection at 10%. **: rejection at 5%. ***: rejection at 1%.

Sources: authors calculations

5. Conclusions and work ahead

FDI income is a very relevant variable to trace the evolution of the balance of payments, but the lack of data means that estimates have to be made for more recent years, which leads to continuous and sometimes large revisions. In this paper we have tried to estimate FDI income using, in a first step, a Machine Learning approach and, in a second step, structural VAR models with Bayesian techniques, with the aim of having a useful and manageable tool that is easy to update to estimate the income from FDI in the years in which the base information is not yet available, and even to project its evolution into the future. We have started estimating models for the two countries that contribute the most to FDI income in Spain, Brazil and the UK, although the final objective is to extend the models to other relevant countries covering 85% of total FDI income.

Results, nevertheless, are disappointing, at least for these countries and this kind of models. Machine Learning models either do not select any variables (LASSO) or those that are selected have very low relative importance (Random Forest). SVAR models do not have an adequate forecast accuracy according to the usual tests and statistics to measure it. And the reason behind these discouraging results is, most probably, the very short sample that we have, as we are working with annual data from 1993 to 2021. Panel SVAR models improve slightly the forecast accuracy. Nevertheless, this methods of estimation seems to be preferable to the traditional one.

What lies ahead? To improve the results, we could try to get advantage of models that use low frequency data to nowcast annual or quarterly data, like the MIDAS, or we can go one step further towards the more macro and try to estimate total income from FDI, using variables aggregated at the global level as regressors. Finally, another solution would be to estimate FAVAR-like models, which take advantage of all the information available.

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BANCO DE ESPAÑA
Eurosistema

AN EARLY ESTIMATION OF FOREIGN DIRECT INVESTMENT INCOME IN THE BALANCE OF PAYMENTS

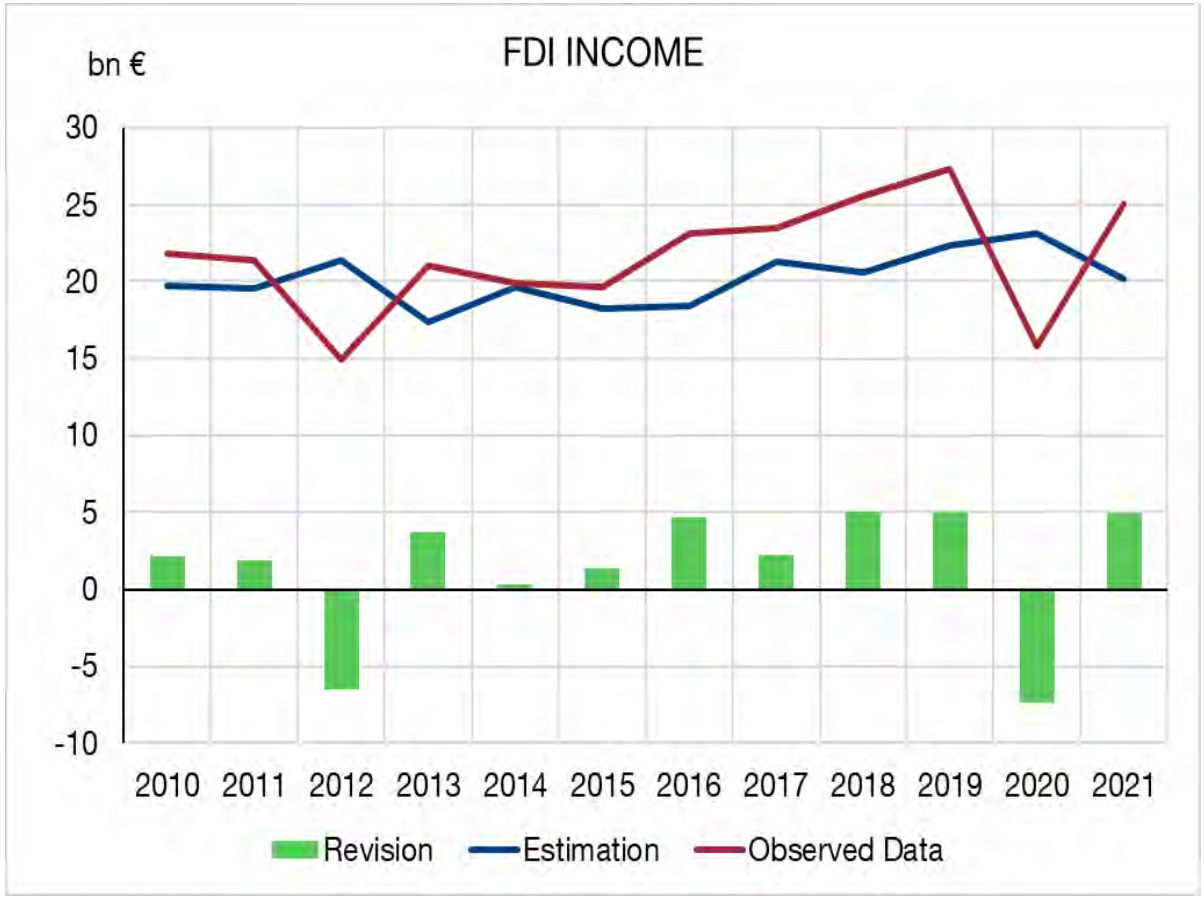
Esther López-Espinosa
Luis Molina
Helge Schäfer

Banco de España and Deutsche Bundesbank

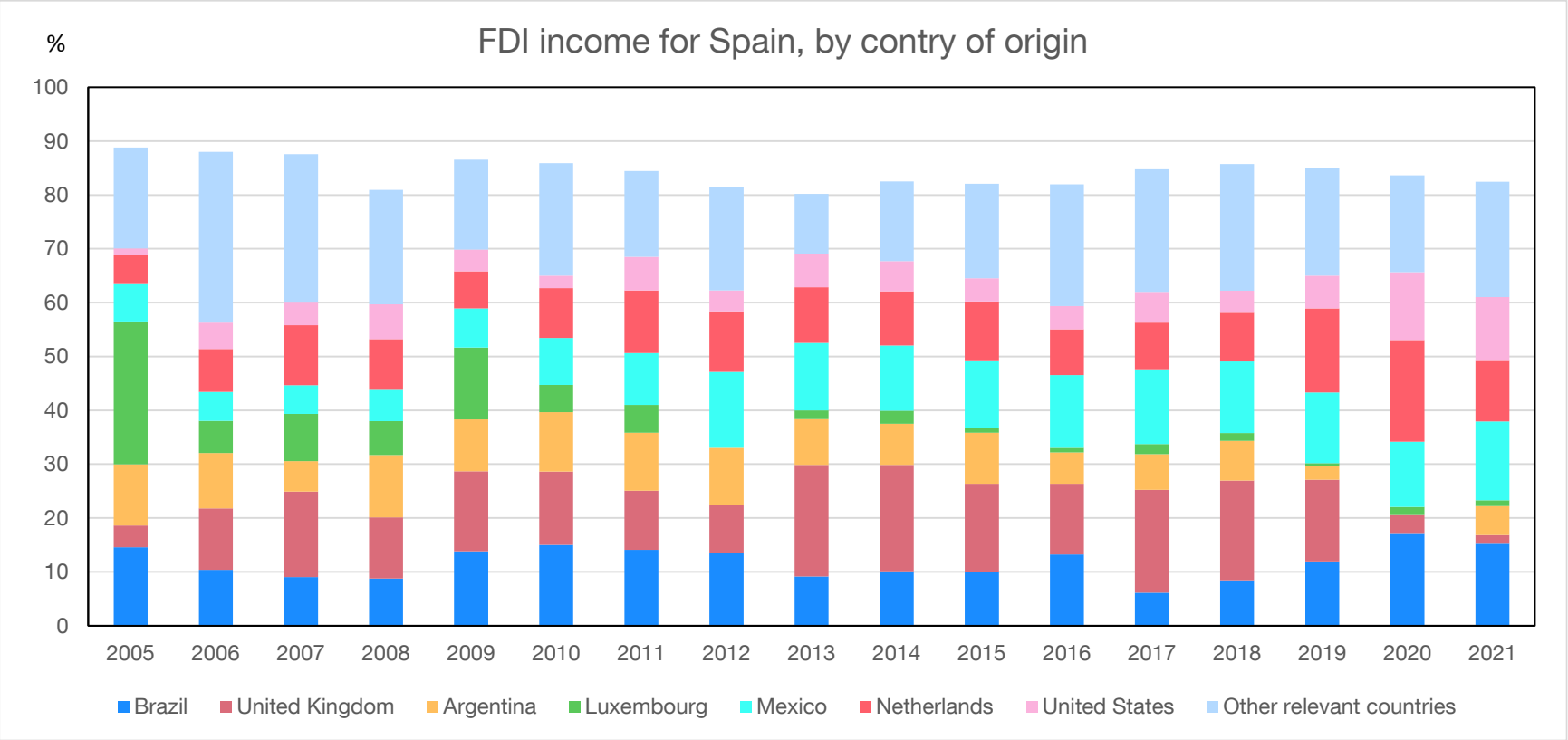
External statistics after the pandemic: addressing novel analytical challenges
Banco de España, Madrid, 12th February 2024



- **Aim of the paper**
  - Estimate earlier and better FDI income
  - Economically coherent and easy-to-update model which could be applicable to other countries
- **Current Method**
  - ORSs: 18-month delay, uses weighted average of historical incomes.
  - MFIs: 9-month delay, repeats previous year's income.
- **Target**
  - To find a better way to estimate the income to reduce the magnitude of these revisions.
- **Spoiler alert!**
  - The results -to date- are not very promising, and we have to continue working to improve them.



- **Data**
  - Annual income Data from 1993-2021 for Spain
  - Revenue side for the moment
  - Brazil and United Kingdom although with the aim to capture 85% of total FDI income
- **Methods**
  - LASSO Regression
  - Random Forest
  - VAR model.



- **Idea: Consider many (about 200) potential indicators and use ML variable selection**
  - As possible input for VAR models
  - To directly project FDI income

- **ML algorithms**
  - LASSO (linear)
  - Random forests (non-linear)

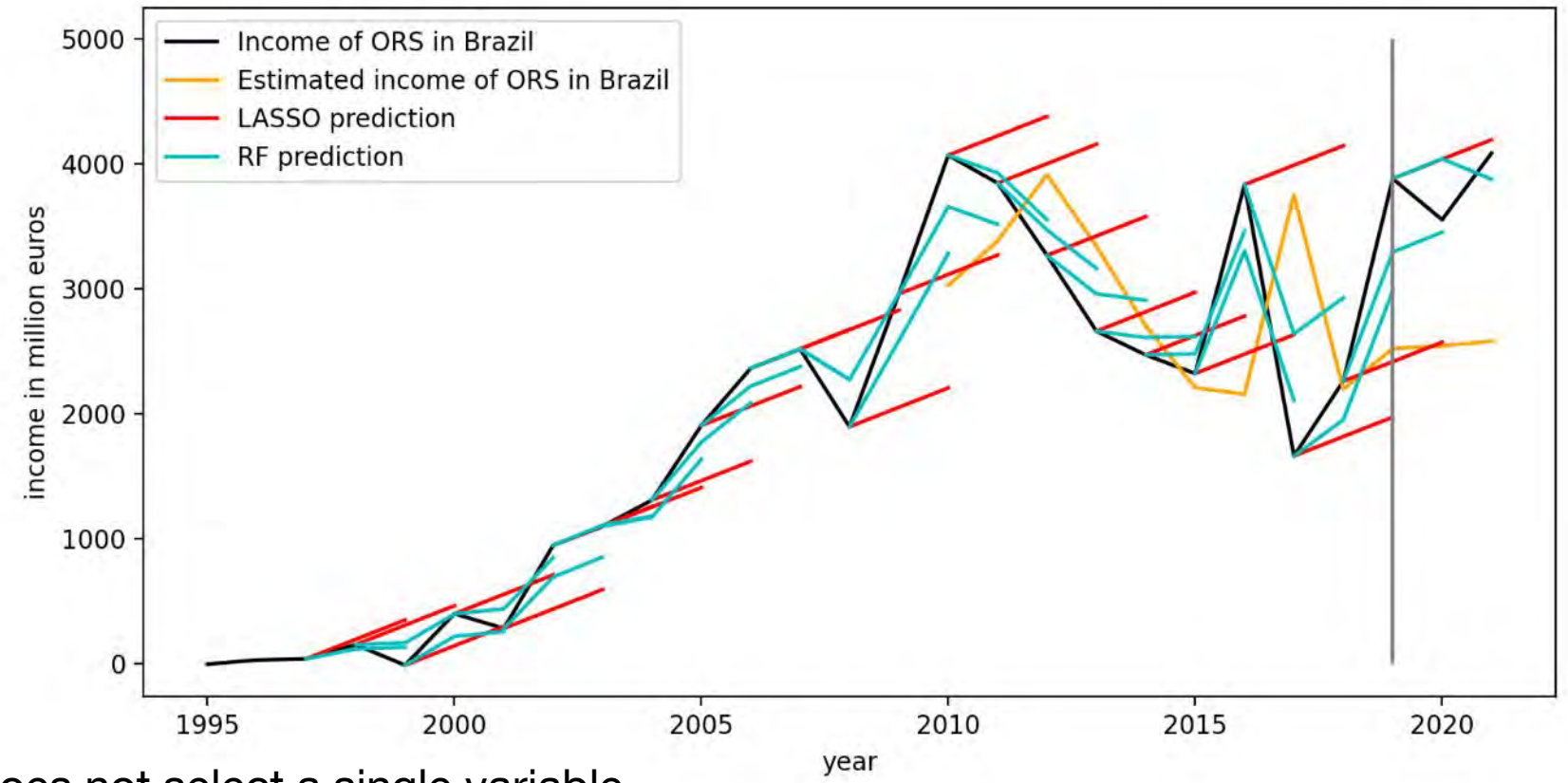
- **Procedure**
  - Grid search with cross validation on training set for hyperparameter tuning
  - Train the algorithm on full training set
  - Project FDI income for most recent periods

- **Problem**
  - Small sample size (28 data points)

EARLY ESTIMATION OF FDI INCOME: MACHINE LEARNING MODELS

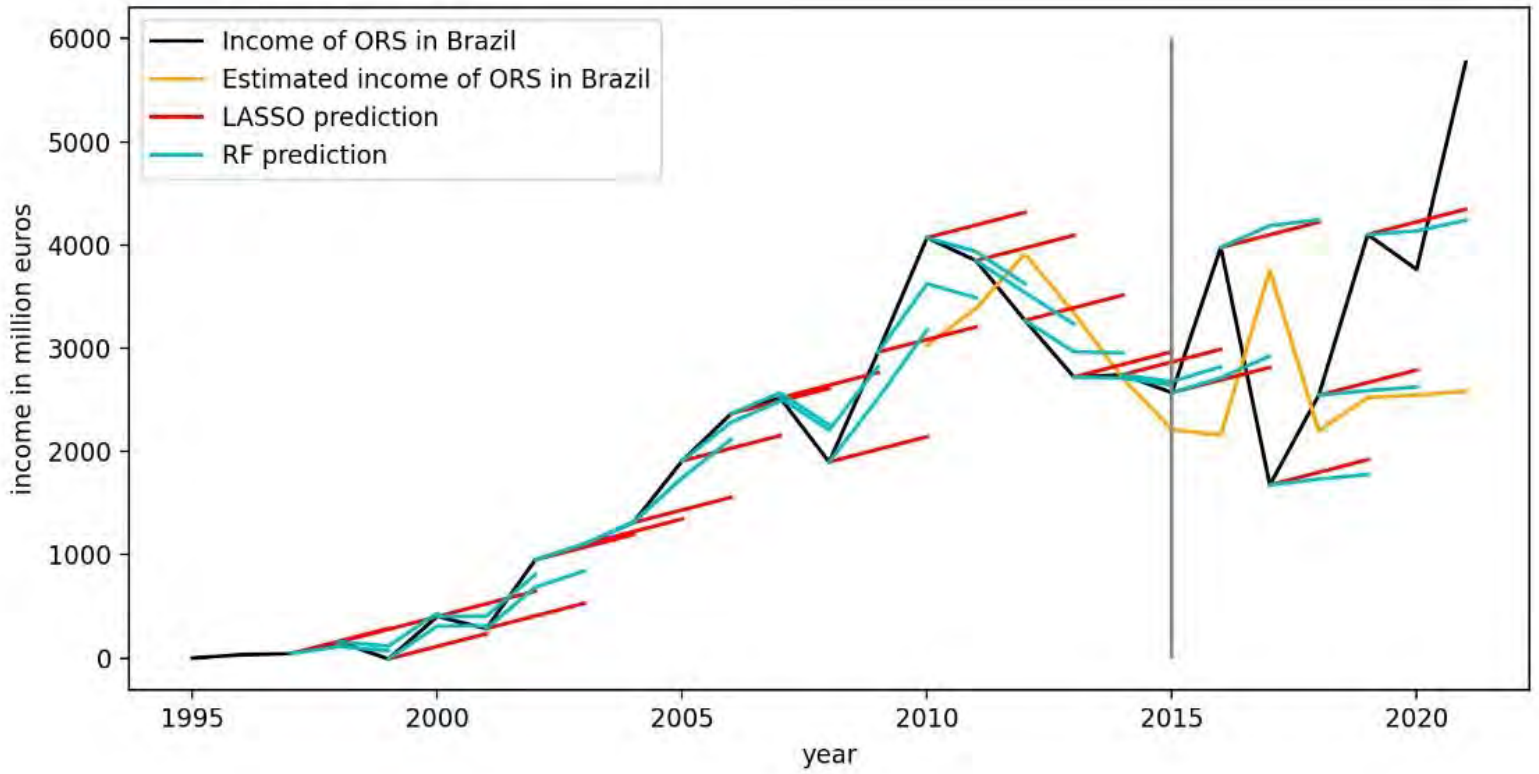
ECONOMIC CYCLE	PROFITABILITY OF THE INVESTMENT	WEALTH AND INSTITUTIONS	RELATED TO VULNERABILITIES	TEXTUAL INDICATORS
National accounts (% change):	Equity Index (% change)	GDP per capita (PPP USD, level)	Sovereign spread (basis points)	Geopolitical risk index (level)
- Real GDP	- Total	GDP per capita (% change)	Sovereign spread (% change)	Social strains index (level)
- Construction	- Banks	Sovereign rating (level)	Exchange rate (% change)	Political strains index (level)
- Real estate	- Consumer staples	World Bank indicator for (percentile rank):	Exchange rate (deviation)	Economic policy uncertainty (level)
- IT	- Financial services	- Corruption	Public sector balance (% GDP)	
- Private consumption	- Electricity	- Government effectiveness	Public debt (% GDP)	
- Fixed investment	- Energy	- Regulatory quality	Bank's net foreing assets (% GDP)	
- Exports	- Airlines	- Violence	Bank's non performing loans (% credit)	
Unemployment rate (% labour force)	Yield of 10 year public debt in local currency (%)	- Rule of law	Loan to deposit ratio	
Inflation rate (CPI % change)	Yield of 2 year public debt in local currency (%)	- Voice and accountability	Bank's debt spread (basis points)	
Industrial production (% change)	Commodity index (level)		Energy firms spread (basis points)	
Bank credit (real % change)	Oil price (level)		Short term interbank rate (%)	
Bank deposits (real % change)	Soya price (level)		Current account balance (% GDP)	
FDI received (% GDP)	Metals price index (level)		External debt (% GDP)	
Portfolio capital inflows (% GDP)	Banks' spread (loan rate minus deposit rate, %)		Short term extenal debt (% reserves)	
Retail sales (% change)	Yield of 10 year AAA bond (%)		Reserves (% GDP)	
Exports (nominal % change)	Yield of 10 year BB bond (%)		External debt service (% exports)	
Capital goods production (% change)				
Consumer confidence (level)				
Bussiness confidence (level)				
Official interest rate (%)				

Example: FDI income of Spanish ORS in Brazil; training sample up to 2019



- LASSO does not select a single variable
- Pandemic effects for recent periods
- RF variable selection not very robust in this case

Example: FDI income of Spanish ORS in Brazil; training sample up to 2015



Conclusion

- Projection not robust w.r.t. change of sample size
- LASSO does not select a single variable
- It is hard to improve upon lagged income as predictor

- **Estimate VAR models with Bayesian techniques (more adequate for short samples)**
- **By type of income (MFI – ORS – all income) and country**
- **Two type of models: agnostic (using the variables selected by the ML methods) or economic (a priori economic determinants of FDI income)**
- **Procedure**
  - SVAR models using the BEAR toolbox
  - Independent Normal Whishart with 1 lag, excluding outliers (Brazil)
  - Estimation in differences as FDI income levels present a untir root
- **Problem (again)**
  - Small sample size (28 data points)

- **Variables for the ML type models**

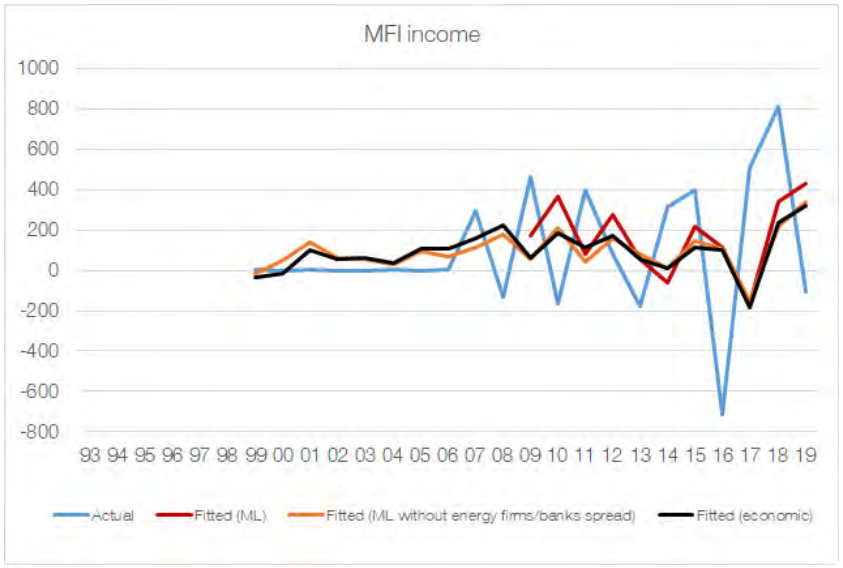
MFI income	ORS income
BRAZIL	
* Reserves (% GDP)	* Inflation rate (CPI % change)
* Yield of 2 year public debt in local currency (%)	* National accounts (% change), fixed investment
* Bank's debt spread (basis points)	* Commodity price index (level)
* Official interest rate (%)	* GDP per capita (% change)
* Equity Index (% change), energy	
* Energy firms debt spread (basis points)	
UK	
* National accounts (% change), fixed investment	* Airlines equity Index
* Consumer confidence (level)	* Portfolio capital inflows (% GDP), first difference
* Equity Index (% change), total	* Yield of 10 year AAA bond (%)
* National accounts (% change), construction	* Government effectiveness (World Bank)
* National accounts (% change), GDP	* Bank credit (real % change)
* Bussiness confidence (level)	
* National accounts (% change), exports	
* National accounts (% change), private consumption	

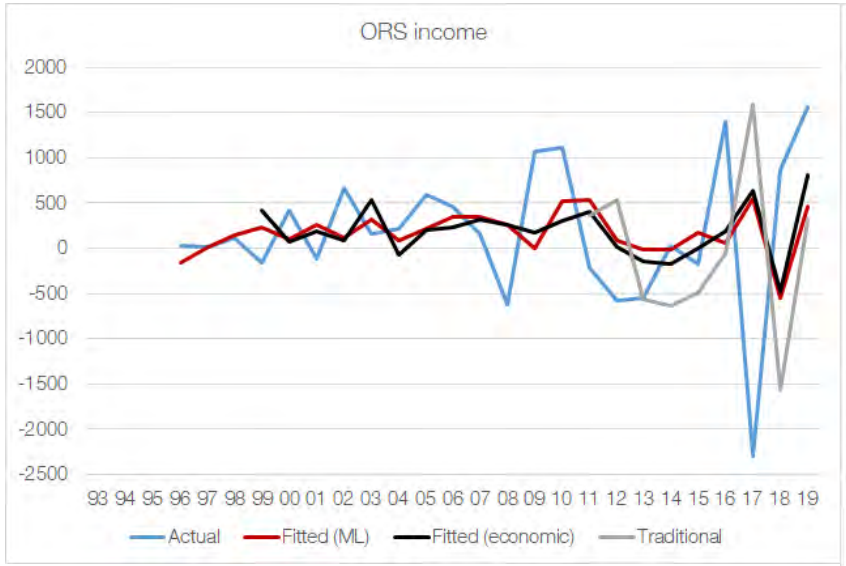
- **Variables for the Economic type models**

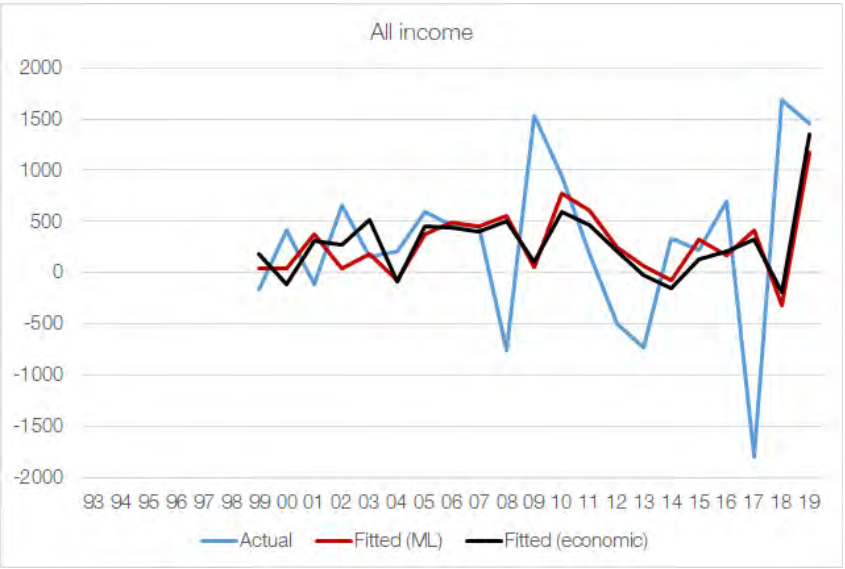
MFI income	ORS income
* Equity Index (% change), banks	* National accounts (% change), GDP
* Yield of public debt in local currency (%)	* Unemployment rate (% labour force)
* Official interest rate (%)	* Inflation rate (CPI % change)
* Loan minus deposit rate (%)	* Equity Index (% change)
* Non performing loans (%)	* Commodity index (level) (*)
* National accounts (% change), fixed investment	* Reserves (% GDP) (*)
* National accounts (% change), private consumption	* Economic policy uncertainty (level)

(*) Excluded in the case of the UK

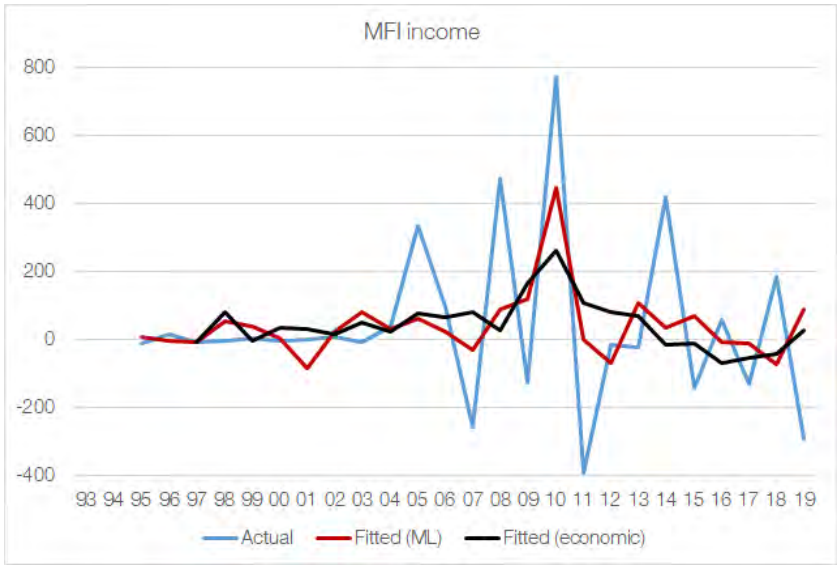
- **Results for Brazil:**

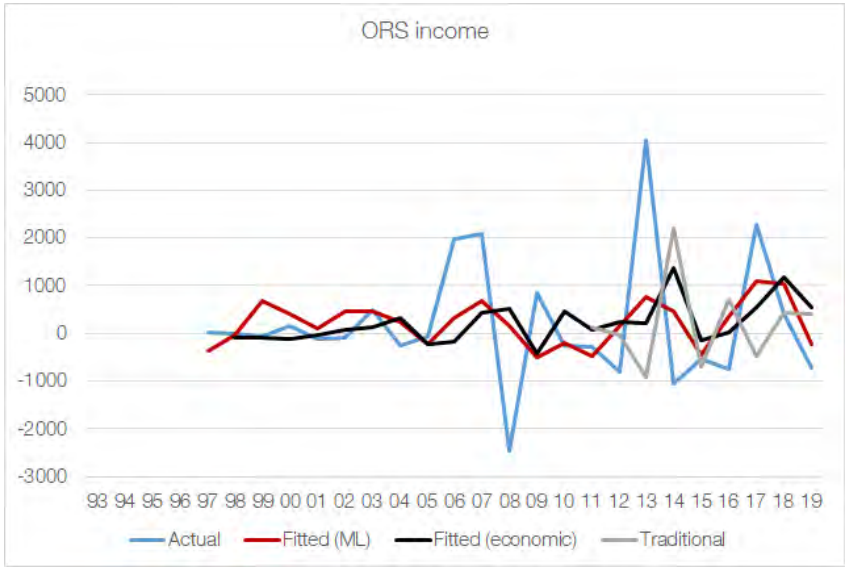


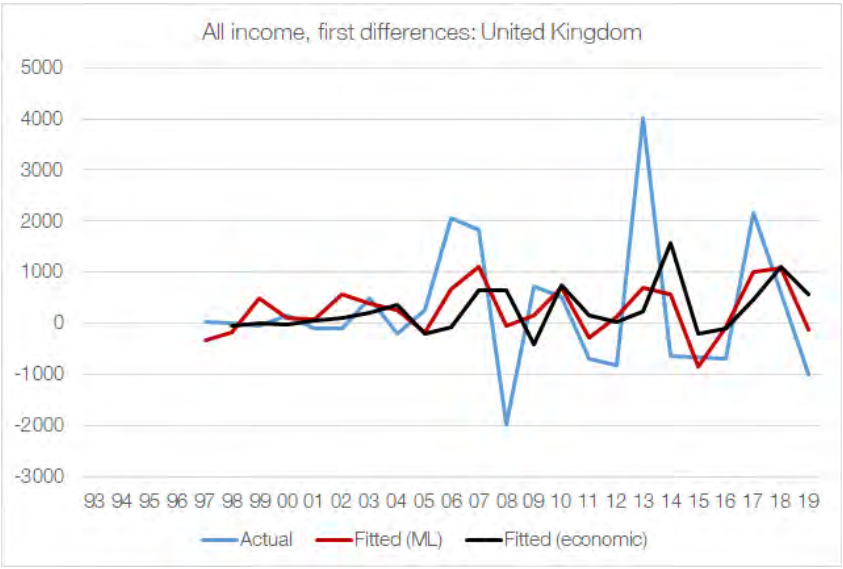




- **Results for the UK:**







- **Forecast accuracy of SVAR models is not as good as desired:**

Forecast Evaluation
Sample 2015-2019

	BRAZIL				UK			
Variable	RMSE	MAE	MAPE	Theil	RMSE	MAE	MAPE	Theil
MFI								
- ML preselected	571.60	522.16	**113.00**	0.89	163.50	126.45	**78.10**	0.61
- Economic	**556.42**	**519.15**	120.52	**0.86**	**146.54**	**123.42**	78.39	**0.49**
ORS								
- ML preselected	1438.31	1251.34	118.21	0.89	**1165.43**	**1011.43**	**117.51**	0.81
- Economic	**1432.26**	**1241.46**	**115.84**	**0.89**	1203.65	1061.60	126.46	**0.77**
All income								
- ML preselected	**1255.06**	**1031.09**	**71.96**	**0.81**	**1193.77**	**1084.21**	**111.06**	0.83
- Economic	1429.24	1232.75	115.70	0.88	1218.55	1112.73	115.95	**0.79**

RMSE: Root Mean Square Error
MAE: Mean Absolute Error
MAPE: Mean Absolute Percentage Error
Theil: Theil inequality coefficient

- **But at least seem to be better than the actual rule:**

	BRAZIL			UK		
	MFI	ORS	All income	MFI	ORS	All income
ML preselected				X	X	X
Economic	X	X	X			
Traditional						

Figure 15: Forecast accuracy: Brazil

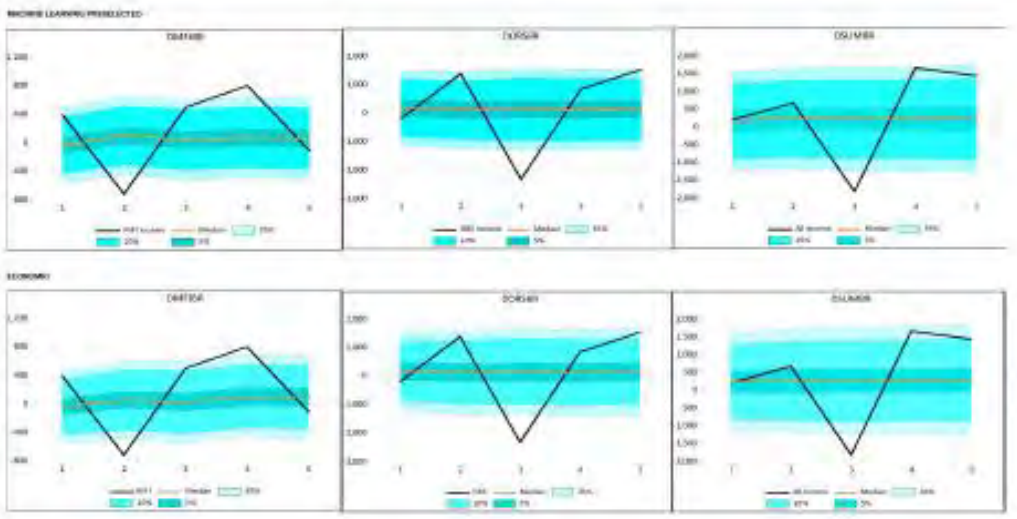
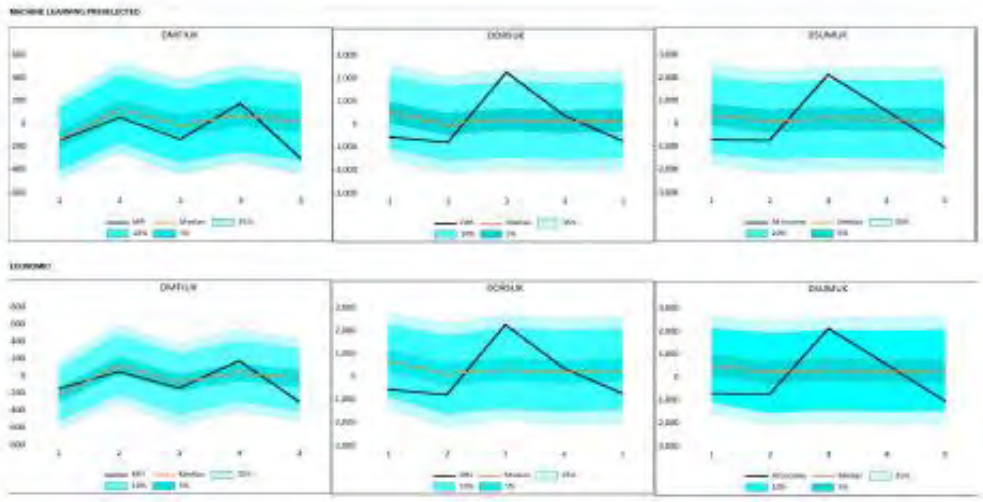


Figure 16: Forecast accuracy: UK



- **Main takeaways:**
  - FDI income is a very relevant variable to trace the evolution of the balance of payments in Spain, but the lack of data means that estimates have to be made for more recent years, which leads to continuous and sometimes large revisions.
  - We have tried to estimate FDI income using Machine Learning and structural VAR models with Bayesian techniques
  - Results, nevertheless, are disappointing, at least for these countries and this kind of models, but at least seem to be preferable to the traditional one.

- **What lies ahead?: add more horses to the race:**
  - MIDAS
  - Panel data
  - Aggregate data
  - Dissaggregate by firm and type of income
  - FAVAR-like models

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Madrid, 12th February 2024



IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Revamping travel estimates in the balance of payments: mid- and post-Covid-19 models[1]

Krit Damrikichakusala,
Bank of Thailand

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Revamping Travel estimates in the BOP: Mid- and Post-Covid 19 Models

Executive Summary

The COVID-19 pandemic has drastically affected tourism sector worldwide due to sudden and prolonged travel restrictions imposed by authorities of most countries. Suspension of airports and border checkpoints have resulted in large number of stranded travelers; and state quarantine imposed in later stage have considerably changed spending pattern and length of stay of travelers from the pre-pandemic behavior, both for inbound and outbound travel. These have triggered a need to rethink and reshape the estimation models for travel receipts and payments in the balance of payments compilation.

This paper discusses the Bank of Thailand's (BOT) adoption of the new methodology in estimating travel receipts and payments, shifting from 'arrival basis' to 'stock basis', which rely on the use of granular data from the Immigration Bureau (IB).

The 'arrival basis' would not allocate travel receipt to the month in which the spending occur, but rather the month in which travelers enter Thailand. The quality of estimates particularly deteriorates when the average length of stay stretches across months, which is a widely observed pattern for mid-pandemic travels. The 'stock basis' was developed to overcome this drawback, as it focuses on the number of 'remaining' travelers each day during respective month, regardless of the arrival date. The estimates based on this approach, thus, reflects a more realistic level of daily travel receipts as well as monthly summation thereof.

This stock approach would not be feasible without availability of granular data from the IB. During the pilot stage (2020 to mid-2023), the stock was estimated based on initial stock from the IB and data on daily arrivals and departures. Starting 2023, granular data (by masked ID of each traveler, date of arrival/departure, and other supplementary information) became available, enabling better data cleansing and a more precise derivation of stock of travelers. Main findings, the way forward in 'refining stock estimates', and potential use for analysis of regional tourism, cross-border workers, and so on are also highlighted in this paper.

Section 1: Introduction

Thailand is considered one of the popular tourist destinations due to its geographical diversity and cultural charm. It has some of the most exquisite beaches, temples and savory foods, ranging from street food to top-rated restaurant cuisines. As such, the tourism industry has long served as one key driving engines for the Thai economy in the past decade.

As the COVID-19 pandemic unexpectedly emerged in late-2019, the global tourism in subsequent years had been severely affected due to travel restrictions imposed by authorities in many countries. Closure of airports and border checkpoints at the early stage had left thousands of travelers stranded in the destination country for unexpectedly prolonged period. Despite no new incoming travelers, stranded visitors still had to shell out their costs of living which, in turn, generating income to the host economy. Conventional estimation model was not able to accommodate such scenario. Similar phenomenon was also observed for outbound travel. This leads to a decision to adopt the "stock basis" model as a new method in estimating travel receipts and payments in the balance of payments. Besides, granular data recently obtained from the Immigration Bureau (IB) were introduced into the model for better measurement of the stock of tourists.

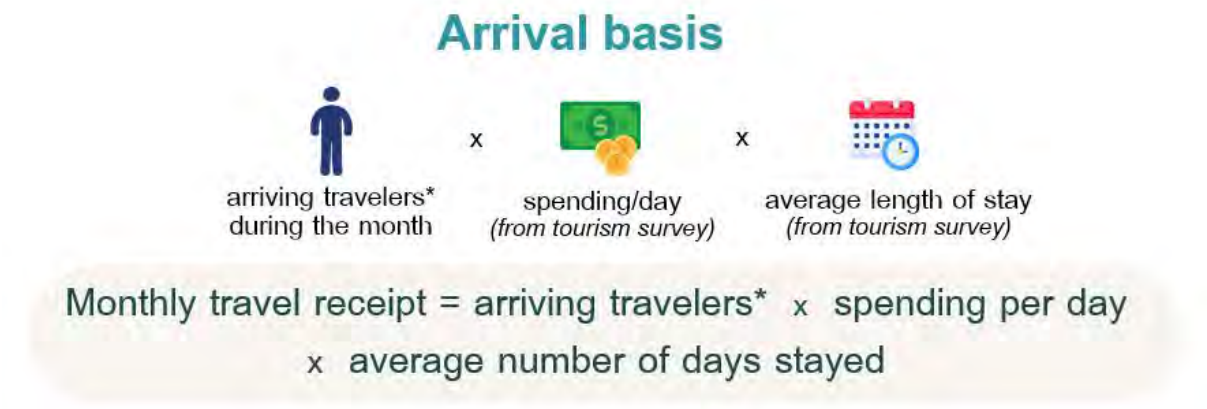
This paper discusses how the 'stock-basis' model was developed and illustrates its pros and cons over the conventional model or 'arrival basis' in approximating the actual level of travel receipts. Section 2 iterates conventional model and its constraints. Section 3 provides conceptual framework of the 'stock basis'. Section 4 introduces the usage of granular data from the IB to enhance the precision of measuring the stock of tourists. Section 5 draws on a conclusion and a way forward.

Section 2: Conventional Model: 'Arrival Basis'

The conventional model has been widely adopted by most national compilers due to its simplicity and ease of use. The model had worked well for decades till the arrival of the global COVID-19 pandemic. During the onset of the crisis, cross-border travelling was highly restricted. Quarantines (both in the host country for the incoming trip, as well as in the home country upon their return) and higher travel costs (particularly, the air fare) induced a complete change in (i) category of travelers, (ii) spending behaviour, and (iii) average length of stay. This deteriorates the validity of the conventional estimation.

Conventional Model: Presumption and Implications

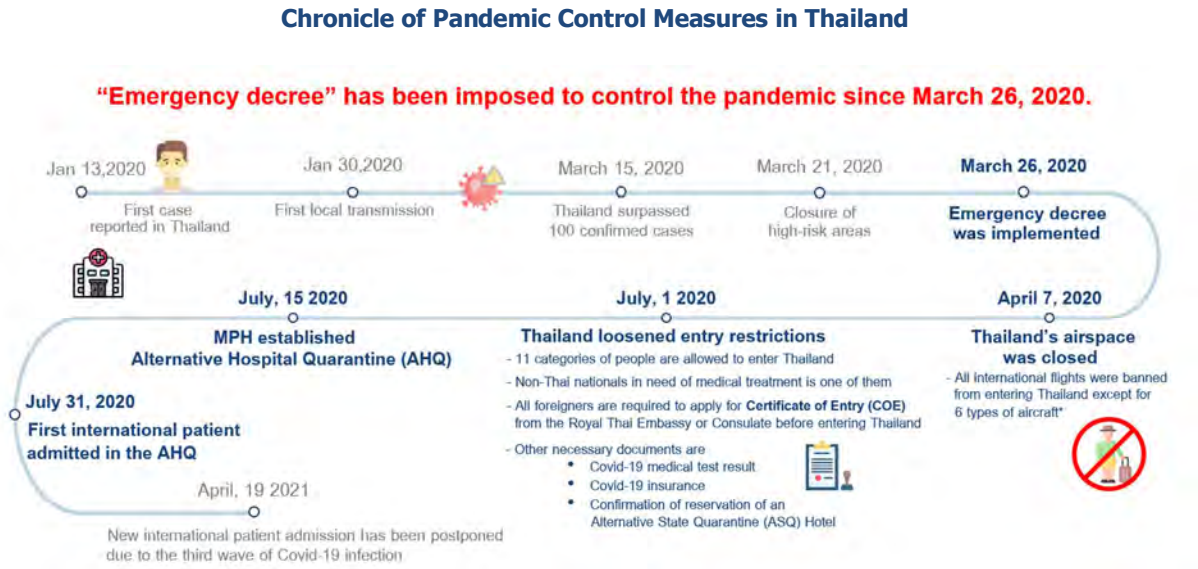
The conventional model involves three variables: 1) number of tourist arrivals; 2) expenditure per day; and 3) average length of stay. The product of the three variables approximate travel receipts as shown below:



The conventional model relies on a strong assumption that all tourism revenue is generated on the same month at which tourists arrived. In other words, compilers record the entire travel receipts in the arrival period. This is behaviorally contrary to the nature of earned income which, in reality, is generated day by day as tourists stay and spend during their entire stay in the destination country. Deviation from the actual level of travel receipts could be worsened in the event that a shift in travelers' behaviour is discernible.

The conventional model works well with short-term and intra-month travelers. However, it is evident that such presumptions are not in line with reality. Usually, visitors taking long-haul fights tend to have extended stay in the destination country compared to those living in countries in the same region and taking short-haul flights. Some even extended their stay across month (or several months), a phenomenon which was more pronounced during the global pandemic. In some countries, checkpoints along the border and airports were temporarily suspended. As situation became more stable, countries started easing travel restrictions, yet with some conditionalities such as a 'state quarantine'.

For instance, certain countries in Asia including Thailand imposed quarantine measures for cross-border travelers. Inbound passengers, regardless of nationality, were required to go through a state quarantine, usually for one, two, or three weeks in designated facilities provided by the government. Given such restrictions, coupled with much higher air fare/travel costs as compared to the pre-pandemic period, tourists tend to spend much longer period in the destination country so as to make the best out of the journey after the mandatory quarantine.



The required state or alternate state quarantine induced travelers to incur additional travel costs, as compared to normal travels. Firstly, travelers were allowed to choose to spend their quarantine in a state or private facilities; i,e., in selected luxury hotels approved by the authority, at their own expenses. Secondly, after the quarantine period, most travelers tend to compensate for the lost period (detention) by having longer stay than usual. Unavoidably higher travel costs (caused by the two aforementioned factors as well as higher air fare), had naturally discouraged common and budget travelers, leaving only those with much higher average daily spending as reflected by the tourism survey conducted by the tourism authority. Put it differently, the adverse effect of having less number of visitors was partially offset by their higher daily spending and longer stay.

Post-pandemic travel behaviour also differs from the pre-pandemic observation. 'Workation' and 'digital nomads' become increasingly observable, both domestically and internationally. Thailand, among others, became a popular destination for this type of travelers. Additionally, many airlines resumed their operation and air fare started to decline towards the pre-pandemic level. Lower travel costs have induced common and budget travelers back into the market. More variety of traveler categories as mentioned above has undoubtedly resulted in a wider range of length of stay and daily spending.

Constraints and Validity of Conventional Model

Incidents stated above exhibit some failures of the conventional estimation model in attributing the estimated travel receipts to respective period. First, 'arrival basis' led to over-estimating travel receipts for the month at which tourists arrived. Since the quarantine measure was imposed, travelers in many cases had extended their stay to two to three months. Hence, the validity of the arrival basis needs to be reassessed against changing travel behaviour/conditions.

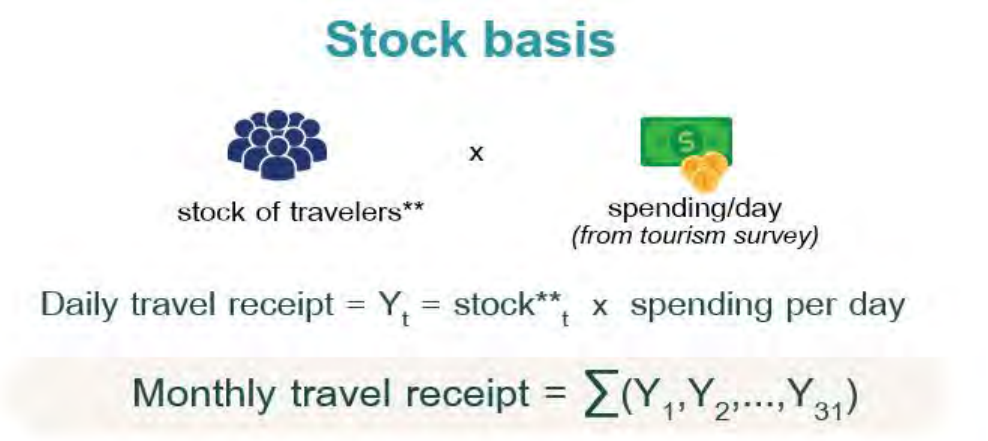
Second, conventional model fails to realise travel receipts even when there is no new tourist arrival. Right after the closure of airports and land checkpoints, no traveler was allowed to enter the country. However, travelers who had entered the country prior to the airport closure unexpectedly had to remain in the host country for some time, awaiting evacuation flights/commercial flights to bring them back to their home countries. These stranded travelers would still incur expenses everyday as long as they remain in the host country. The arrival-basis model fails to capture the revenue generated in subsequent period by these remaining visitors.

Third, even in the post-pandemic period when quarantine measure was lifted, the arrival-basis model could not accommodate the case where tourists stay longer than a month, including but not limited to the case of 'workation' and 'digital nomads'. Based on this model, all revenue would be attributed to the month at which tourists arrived; thus, under-estimating travel receipts of subsequent months over which the same tourists remained in the host country.

Last but not least, the conventional model usually relies on the use of historical data for average length of stay to derive preliminary figures while awaiting actual survey-based results, which are usually made available several months thereafter. Past data may not be a good proxy if structural change or travel behavioral shift is evidenced, such as what we widely observed during mid- and post-pandemic.

Section 3: New Approach: Stock Basis

In an attempt to overcome drawbacks of the 'arrival-basis' model, the BOT explored another method by deriving the existing stock of travelers remaining in Thailand each day, so-called the 'stock basis'.



The advantage of this model is that it is neutral for all length of stay. Daily stock of travelers measures the total number of travelers who remain in the host country, regardless of the month of arrival. Daily travel receipt is the product of the daily stock and daily spending. Monthly travel receipt is derived as a summation of the daily travel receipt during respective month. This way, travel receipts are recorded on the day travelers incur expenses rather than the period at which they enter the host country, in line with the balance of payments' recommended basis for 'time of recording' of the transactions.

The superiority of this new approach is that it can resolve the problem of exceptionally lengthy stay (e.g., when quarantine was imposed, the case of workation and digital nomads, etc.). This applies to both inbound and outbound travel; and valid across all length of stay.

Section 4: Use of Granular Data from the IB

The success behind the 'stock-basis' model largely depends upon the use of granular data from the IB to verify the imputed stock of travelers. To comply with the Personal Data Protection Act (PDPA), the data request had to go through several rounds of intensive discussion and consideration by the management of both the BOT and the IB, as well as technical preparations by IT staff of both organizations (e.g., in masking the IDs; and preparing sufficient data storage and software to handle the processing of this big data).

The individual tourist arrival data (with masked IDs) have been shared to the BOT fortnightly, with breakdown into daily data, starting 1 January 2023. This granular data comprises seven data fields as shown below:

1. Date of Entry / Exit
2. Unique ID (masked ID)
3. Nationality
4. Visa Type/Entry Document Type
5. Direction of Travel (Inbound / Outbound)
6. Airport / Check Point
7. Flight No. (airplane) / License Plate (automotive) / Vessel Registration (ship) / Others

Data Preparation for Imputing Stock of Tourists for Inbound Travel

First, data were processed at the masked ID level to segregate only foreign tourists and detect for their visiting pattern:

1) Filtering only foreign nationals (excluding those with migrant visa)
2) For each ID, detect for frequency of visits for the entire period analyzed (1 January – 15 December 2023)
3) Matching entry and exit dates to calculate length of stay for each ID and each visit (in case of repeated visits)
4) Reversing the entry and exit dates to calculate length of stay outside of Thailand (to detect for potential cases of expats living in Thailand and traveling abroad for leisure/work)
5) Analyzing nationality against the frequently used checkpoints, and proximity to home country
6) Analyzing the length of stay against visa type or type of entry document.

Following the six steps above, a set of IDs were identified as 'plausible cases of expats or informal workers', and hence removed from the imputation of the stock of inbound tourists.

a) Those with longer stay in Thailand, compared to the period they remained abroad during the entire period observed.
b) Those nationals entering Thailand with visa-free status; staying in Thailand for the maximum number of days allowed; exiting and re-entering Thailand on the same day to 'roll-over' the visa-free status; and repeating this pattern many times during the entire period observed.

After removing the IDs in a) and b), the stock of inbound tourists has been estimated, ranging from around 460,000 to 730,000 persons per day. Once having a full year data in the database, additional criteria will be introduced so as to remove those IDs staying in Thailand for longer than a year (and hence become Thai residents).

Stylized Fact

Overview

- From 1 January – 15 December 2023 (50 weeks), there were 88 million cross-border travels (inbound & outbound). Out of this, Thai residents and foreign travelers account for 28% and 72% respectively.
- Mode of Travel (MOT): Apparently, "Air Mode" is the main MOT, accounting for 63%, followed by "Foot & Land" (35%), and "Sea" (2%),
- Number of in- and outbound activities is quite symmetric, with only a small discrepancy between the two categories (around 288,000 records).

Thai Travelers

- There were 3.9 million Thai nationals traveling outbound, crossing the border for around 12.2 million times.
- Based on country of immediate destination, Cambodia, Myanmar and Laos were the most visited countries for Thai travelers, accounting for 70% of total outbound trips.
- Specifically for air travel, Japan was the most visited country by the Thais, followed by Hong Kong and Vietnam. Countries of major transit hub such as the UAE and Qatar ranked 9th and 12th, respectively.
- Average length of stay for "Land Mode" was around four days.

- On continental analytics, Thai travelers had the longest length of stay for North America (20 days), followed by Africa (16 days), Oceania (14 days), Europe (13 days), and East Asia (7 days)
- As of 15 December 2023, 37% of Thai travelers have been staying abroad for less than 2 months, and 63% staying abroad for more than 2 months.

Foreign Travelers

- There were 21.8 million foreign visitors traveling into Thailand, totaling around 22 million entries.
- Majority of foreign travelers were short-stay tourists (89.5%).

Section 5: Conclusion and Way Forward

Conclusion

- Travel receipt has been one major income sources for Thailand for the past decades. Ensuring accurate measurement of travel revenue is, therefore, vital for proper assessment of current account and external sector surveillance.

- In estimating tourism income, the 'arrival basis', the conventional method adopted for many years, could not function properly during the pandemic when travel restrictions were imposed. For instance, in a situation of airport or checkpoint closure, there was no new tourist arrival when airport and checkpoint closure was in effect, but 'arrival-basis' model failed to capture spending of stranded travelers.

- 'Stock-basis' model was developed to better derive the travel receipts (for inbound travel) and travel payments (for outbound travel). This new method requires only two variables: 1) daily stock of travelers, and 2) spending per day. Conceptually, 'stock basis' yields a more realistic outcome since it attributes travel income to the period in which the travelers' spending was incurred, rather than the time at which travelers enter the host country.

- To further enhance the quality of tourist stock computation, the BOT explored the granular data on cross-border visitors recently obtained from the IB. Both the BOT and the IB strictly obliged to the PDPA; the shared data were based on 'masked ID', enabling the BOT to fully utilize the individual/entry-level data and all supplementary details without identifying the person itself.

- Details available in the granular dataset enable inferencing of potential cases of expats and some informal workers and exclude them from the tourist stock.

Way Forward:

- The BOT will further develop a common dataset where these granular inputs are clustered and mapped to provide users with additional useful data dimensions, such as regional block, airlines used, provincial breakdown of border checkpoints, frequency of visits (short-stay, long-stay), etc. This additional information would be of interest to a wider range of data users, not limited to only for external sector.

- The IB is planning towards designing an 'e-immigration' system. Once operationalized, the system should enable collection of more details of cross-border travels, which should potentially provide richer information for the compilation and analysis of tourism statistics and travel receipts/payments as part of the balance of payments.

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Revamping Travel Estimates in the BOP:

Mid- and Post-Covid 19 Models

Prepared for the Conference on

External Statistics after the pandemic: addressing novel analytical challenges

12-13 February 2024

Madrid, Spain

Discussion Topics

1. "Arrival" vs "Stock" basis: Why is a methodological change necessary?
    - Limitation of Conventional Model
    - Understanding Stock Basis
2. Granular Data
3. Key Findings
    - Estimated Stock based on Granular Data
    - Other Stylised Facts from Granular Data
4. Conclusion and Way Forward

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https://www.travelonline.com/thailand/attractions/wat-arunelonline.com

https://bk.asia-city.com/travel/news/thailand-best-mountains

https://theculturetrip.com/asia/thailand/articles/21-beautiful-islands-thailandom

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Limitation of Conventional Model

Arrival basis



Monthly travel receipt = arriving travelers* x spending per day x average number of days stayed

i.e., This model assumes that all travel receipts are generated only in the month of arrival !!

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Limitation of Conventional Model

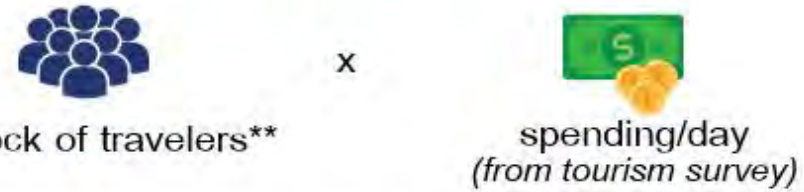
Conventional model inhibits some drawbacks:

- Time of recording of travel receipts
  - Not all tourists stay & complete trips within a month
  - Not all receipts are generated on the month in which tourists arrive
- Not applicable to unusual circumstance or conditions
- Not accommodate long-stay vistors

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New Approach: Understanding Stock Basis

Stock basis



Daily travel receipt = Y_t = stock**$_t$ x spending per day

Monthly travel receipt = $\sum(Y_1, Y_2, \ldots, Y_{31})$

Mechanism

- Daily travel receipt is a product of daily stock and daily spending
- Travel receipt is estimated daily, then accumulated to monthly data

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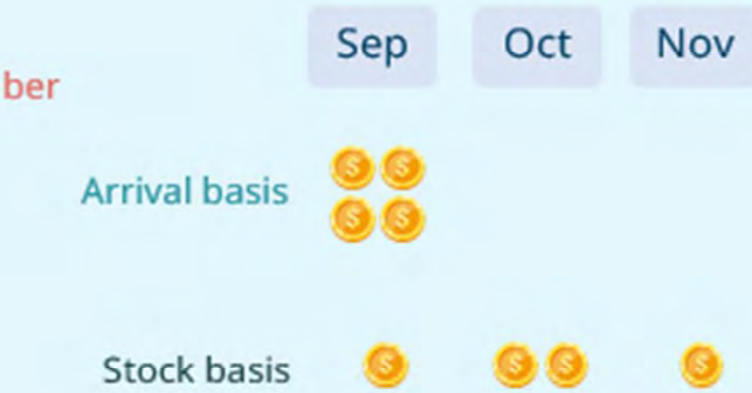
New Approach: Understanding Stock Basis

Recording travel expenses: Arrival vs Stock-basis

Example: Tourists arrive in September and gradually depart in September, October, and November

Arrival basis records all travel expenses in the month tourists arrive (Sep.)

Stock basis records travel expenses in the month which tourists actually incur expenses.



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New Approach: Understanding Stock Basis

Stock basis: Advantages over 'Arrival basis'

- Consistency: Valid across all travel conditions
  - Time horizon
    (neutral results whether tourists arrive on 1st week, mid-month, or last week of the month)
  - Duration of stay
    (short-, long-stay tourists)
  - Exceptional circumstances
    (pre-, mid-, and post-pandemic)
- Quality of Estimation:
  Reflect more realistic level of travel revenue generated (daily → monthly)

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Granular Data

The success behind “stock basis” model depends upon the use of granular data. Verifying the imputed stock of travelers requires:

- Entries and exits are recorded, processed, and used by the Immigration Bureau (IB)
- Previously, data obtained from IB are aggregated by nationality and checkpoints.
- After rounds of intensive discussion between BOT and IB, IB agreed to share granular data, containing individual records of persons entering and exiting Thailand.

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Granular Data

Issues of concern in sharing granular data:

- Confidentiality issue: ***Personal Data Protection Act (PDPA)***
  → Use of 'masked ID', allowing segregation of data by individual traveler without identifying the person
  (i.e, sharing 'UUID' instead of actual passport number)
- Technical issues:
  → Masking ID: IB replacing actual passport number with UUID
  → IB sharing large-size data via *'Secured File Transfer Protocol (Secured FTP) or BOT SecureNet'*
  → BOT processing the data on Hadoop using Python

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Granular Data

Data fields comprising:

1. Date of Entry / Departure
2. Unique ID (masked ID)
3. Nationality
4. Visa Type / Entry Document Type
5. Direction of Travel (Inbound / Outbound)
6. Airport / Checkpoint
7. Flight No. (airplane) / License Plate (automotive) / Vessel Registration (ship) / Others

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Estimated Stock based on Granular Data

Data processing for stock of inbound tourists: Processed at masked ID level, segregating foreign tourists and detecting their visiting pattern

1. Filtering only foreign nationals
2. For each ID, dectect for frequency of visits during entire period in the database (1 January – 15 December 2023)
3. Matching entry and departure dates to calculate length of stay for each ID and each visit (for frequent visitors)

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Estimated Stock based on Granular Data

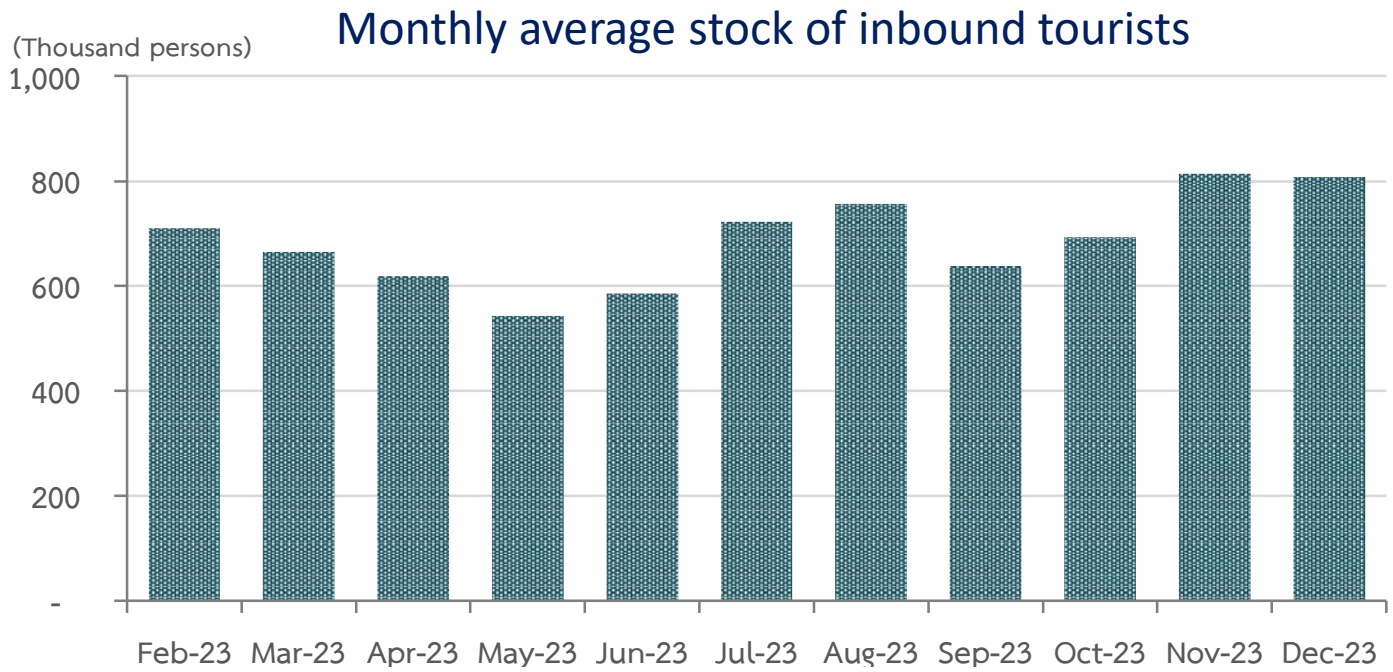
Data processing for stock of inbound tourists: Processed at masked ID level, segregating foreign tourists and detecting their visiting pattern *(cont.)*

4. Reversing the entry and departure dates to calculate length of stay outside Thailand
5. Analalysing nationality against the frequently used checkpoints and proximity to home country
6. Analalysing the length of stay against visa type or type of entry document

A set of IDs were identified as **"possible cases of expats" or "informal worker"** → removed from imputation of stock of inbound tourists

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Estimated Stock based on Granular Data

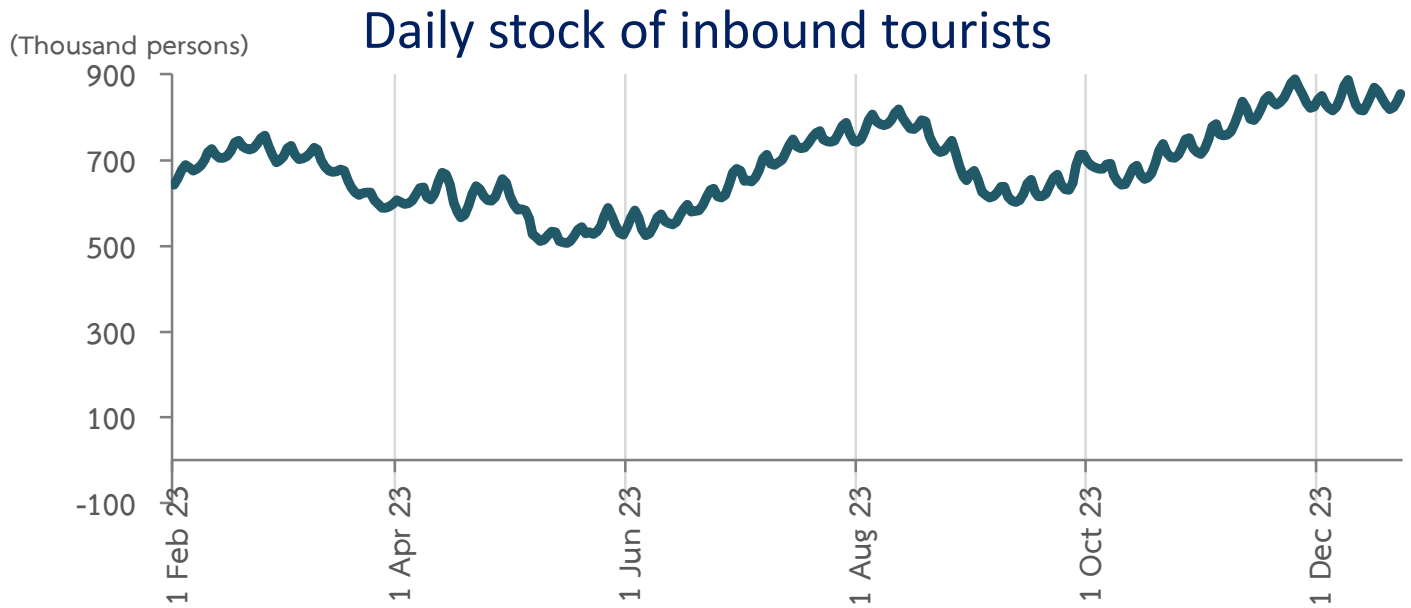


Source: Immigration Bureau, calculated by Bank of Thailand

Note: Data as of 23 December 2023

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Estimated Stock based on Granular Data

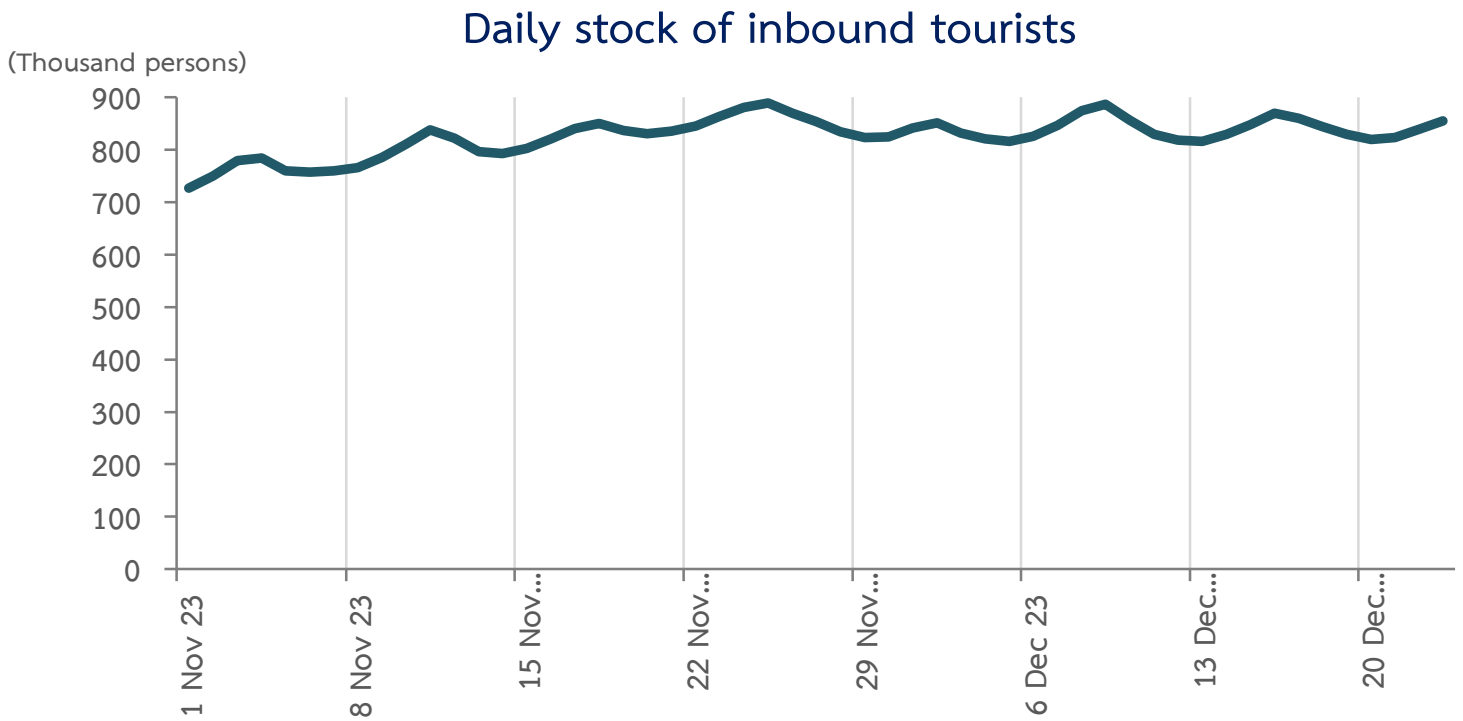


Source: Immigration Bureau, calculated by Bank of Thailand

Note: Data as of 23 December 2023

BANK OF THAILAND

Estimated Stock based on Granular Data



Source: Immigration Bureau, calculated by Bank of Thailand

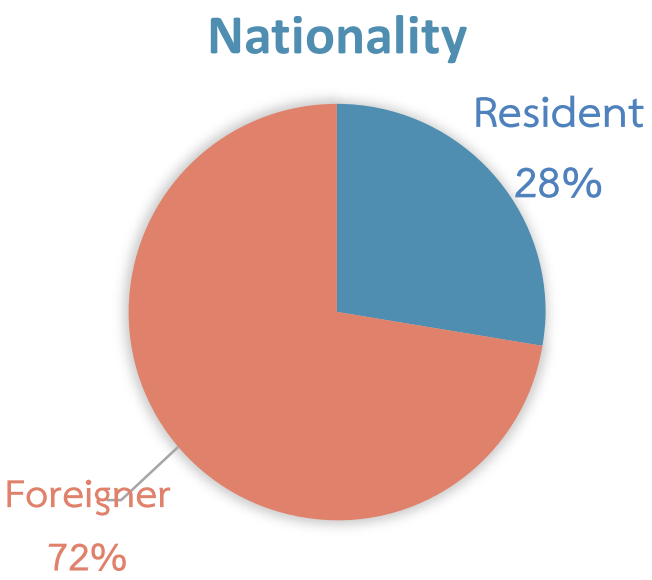
Note: Data as of 23 December 2023

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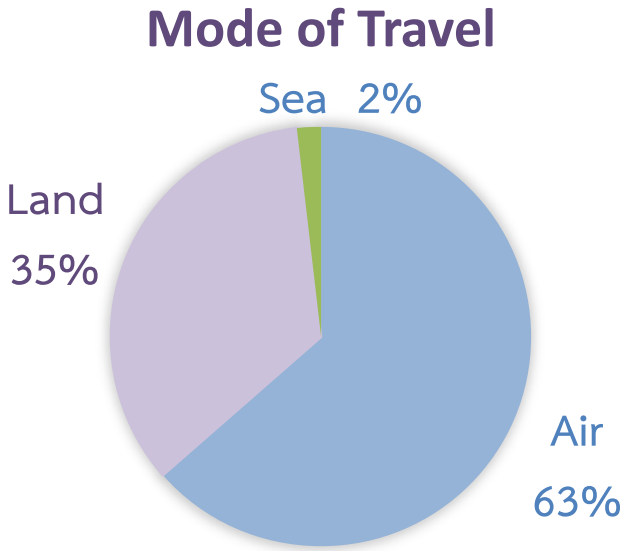
Other Stylised Fact: Granular Data

An Overview of Cross-border Activity

Share of cross-border activity



Share of the MOT



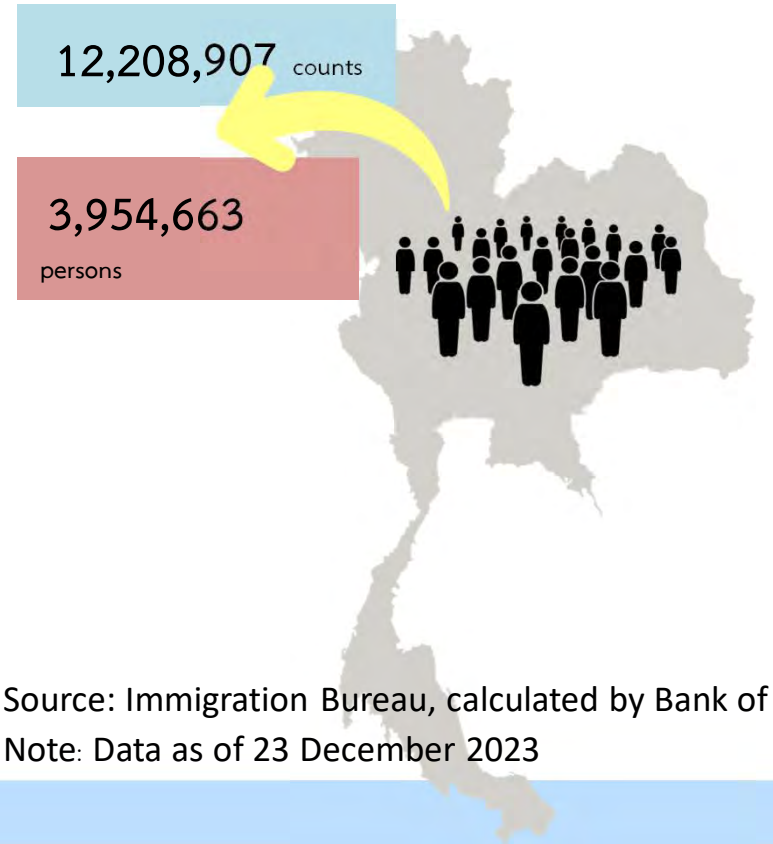
Source: Immigration Bureau, calculated by Bank of Thailand

Note: Data as of 23 December 2023

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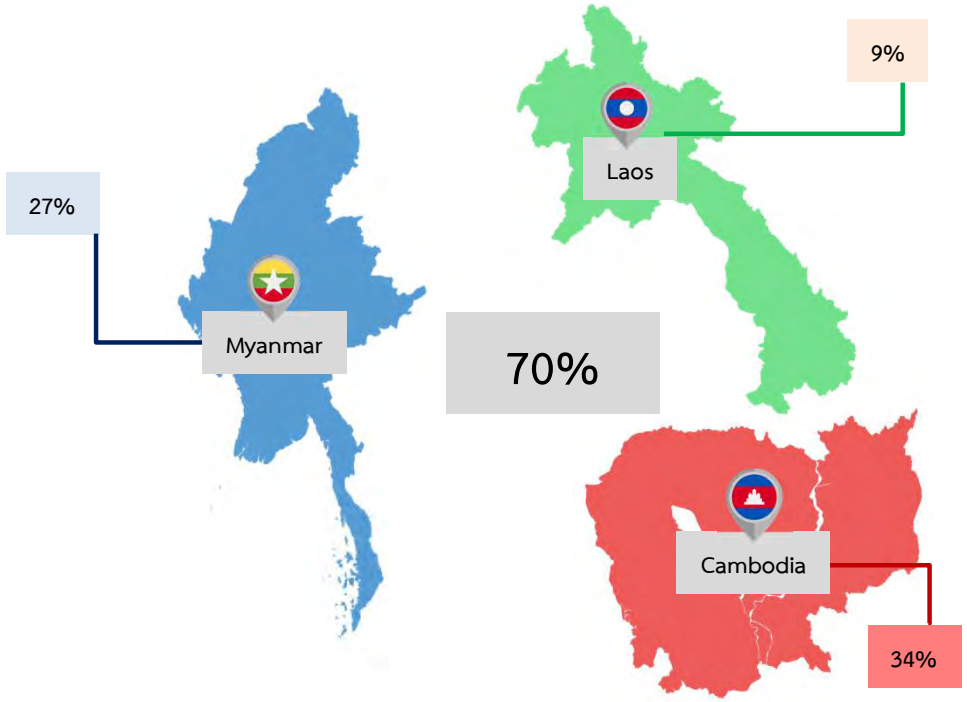
Other Stylised Fact: Granular Data

Total Outbound : Thai Travelers



Top 3: Most visited countries (All MOT)

(Share in Percentage)



Source: Immigration Bureau, calculated by Bank of Thailand

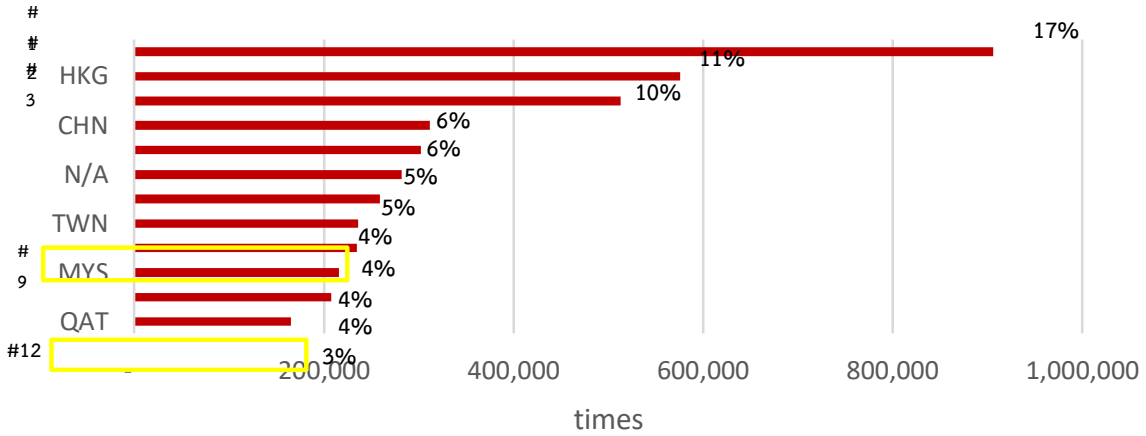
Note: Data as of 23 December 2023

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Other Stylised Fact: Granular Data

Air Mode: Most visited countries

(Share in Percentage)



Average length of stay for "Land Mode"

4 days



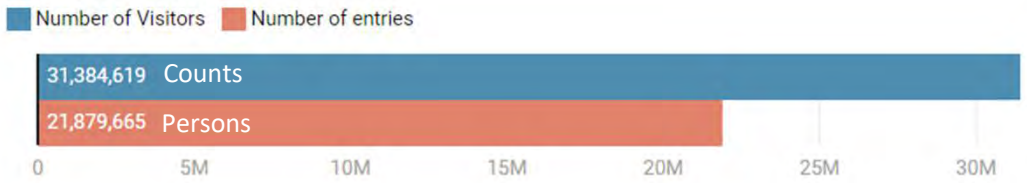
Source: Immigration Bureau, calculated by Bank of Thailand

Note: Data as of 23 December 2023

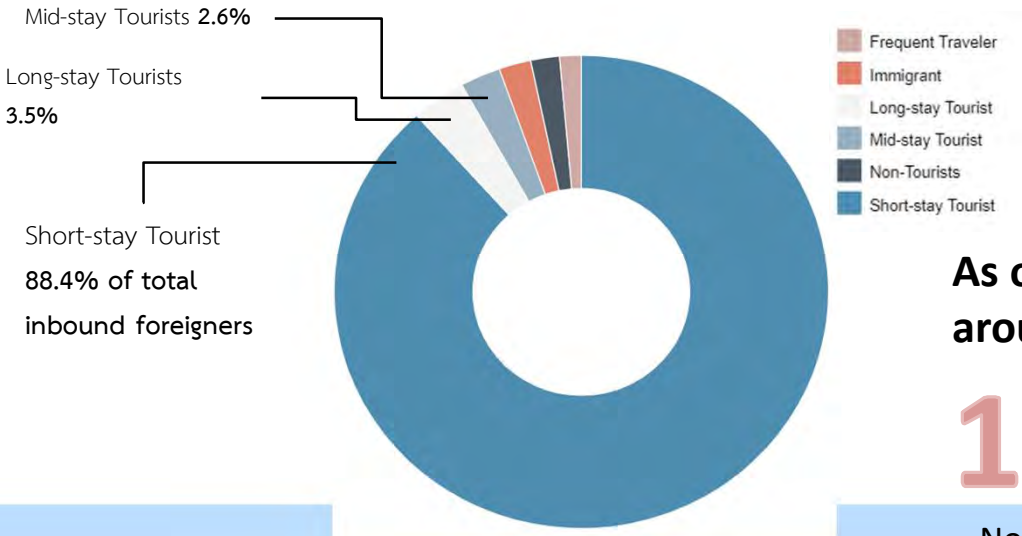
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Other Stylised Fact: Granular Data

Total Inbound : Foreigners



Inbound : By Duration of Stay

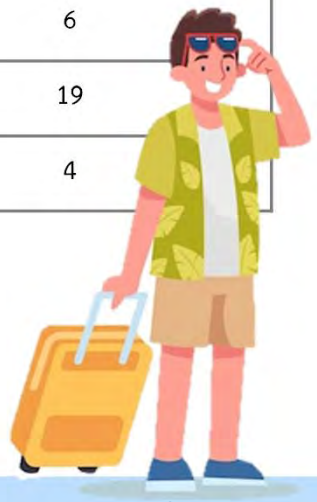


Top 5 : Inbound By Nationality

Nationality	Visitors (persons)	Length of stay (days)
Chinese	3,447,557	8
Korean	1,621,799	6
Indian	1,605,372	6
Russian	1,286,589	19
Malaysian	1,126,890	4

As of 23 December 2023, there are roughly around

1.8M foreigners in Thailand



Souce : Immigration Bureau, calculated by Bank of Thailand

Note : Data as of 23 December 2023

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Conclusion

- Travel receipt as Thailand's major income source
  → accurate measurement is vital for external sector surveillance
- "Arrival Basis" understates travel receipt during the pandemic
- "Stock Basis" developed to better derive travel receipts (for inbound travel) and payments (for outbound travel)
  (1) Daily stock of travelers
  (2) Spending per day
- "Stock Basis" yields a more realistic estimation
  (attributes travel income to period when spending was incurred)

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Conclusion

- BOT explored granular data from IB to enhance computation of stock of travelers.
- Shared data were based on “masked ID” to comply with the PDPA
- BOT can now fully utilize individual / entry-level data and all supplementary details without identifying the person itself.
- Potential cases of expats and some informal workers can be inferred from available data fields and exclude from tourist stock.

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Way Forward

- BOT to further develop a common dataset where granular inputs are clustered and mapped to provide additional data dimensions; e.g.,
  - Regional block
  - Airlines used
  - Provincial breakdown of border checkpoints
  - Frequency of visit
  - etc.
- Additional information would be of interest to non-ESS users as well.
- IB plans to design “e-immigration” system, which should enable collection of more details of cross-border travels.

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Thank You

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Capturing e-commerce transactions from the travel group of BPM6: an Indian experience[1]

Arjya Misra, Savita Pareek and Seema Saggar,
Reserve Bank of India

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Capturing eCommerce transactions from the Travel Group of BPM6

An Indian Experience

Arjya Misra, Savita Pareek and Seema Saggar[1]

Abstract

The rise in eCommerce transactions received an impetus globally during the social restrictions induced by the COVID-19 pandemic, when consumers, businesses, and governments placed higher reliance on digital solutions for continuity of economic and social activities. During this period, physical retail sales moderated in many geographies but online B2C sales and global eCommerce surged substantially. In India, volume and reach of eCommerce have since strengthened further and the share of businesses and consumers shifting to online shopping has been ever rising. This marked shift necessitated the designing of suitable systems to capture such transactions. For external sector statistics, capturing cross-border eCommerce transactions as per economic purpose classification is more challenging, especially when past data collection has been on a more consolidated basis. Cross-border card-based eCommerce transactions, witnessed a rise since the onset of the pandemic, and their classification under travel/non-travel economic activities needed special attention in India. The paper documents the motivation, the challenges of addressing multilateral net card settlement mechanism and multiple settlement structures, a detailed approach for ensuring uniform reporting on a gross basis, the processes adopted for capturing merchant category code (MCC) for transactions, differences between card present/not-present transactions and the consequent refinement undertaken in compilation of BOP statistics. The paper inter-alia also analysed the behavioural differences in card usage for international trade in various types of goods and services. These insights from the Indian experience would be useful to some compilers dealing with similar issues.

Keywords: Covid-19, balance of payments, cross-border eCommerce, international digital card payments.

[1] The authors work in the Department of Statistics and Information Management, Reserve Bank of India. This paper was prepared for the Second External Sector Statistics Conference on "External statistics after the pandemic: addressing novel analytical challenges", co-organised with the European Central Bank and the Bank of Spain, in Madrid, Spain, on 12-13 February 2024.

Disclaimer: The views expressed here are those of the authors and do not represent those of Reserve Bank of India.

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1. Introduction

The revolution in online payment systems worldwide, including in India has been one of the important drivers facilitating the surge in eCommerce business processes. The state-of- the-art digital public infrastructure (DPI) in India is boosting connectivity through its integrated payment systems and data exchange[2]. With availability of instant and convenient modes of payments that provided ease in transactions, the volume and reach of eCommerce have also strengthened concomitantly.

International trade administration, U.S. department of commerce projects global eCommerce sales to soar to $28.1 trillion in 2023 and further to $41.3 trillion by 2026. It also expects India to lead retail eCommerce development globally with 14.1 per cent compound annual growth rate between 2023 and 2027 (Bledsoe J.). The report by UNCTAD (2021)[3] places India at 9th place among 20 top economies engaging in B2C eCommerce sales and documents online shoppers in India to be around 20 per cent of all internet users. The DPI has been the big enabler and contributor to the rising share of business and consumers shifting to online shopping in India.

This marked shift necessitates the designing of suitable systems to identify and capture such cross-border eCommerce transactions. However, capturing them as per economic purpose classification under the balance of payments (BOP) framework tends to be more challenging due to lack of details on the economic activity of the transactions ordered/delivered online[4] and also partly due to data collection that are done on a more consolidated basis, for instance for the transactions that involve card payments.

In India, the development in secure online payment gateways and networks has resulted in ease and greater card use as a mode of payment, as reflected in rapid growth in the volume of outstanding credit/debit cards. The credit and debit card volume as proportion to India's population increased to 0.76 as on March 2023 from 0.66 as on March 2020, signalling a notable post-COVID rise (Figure 1.1).

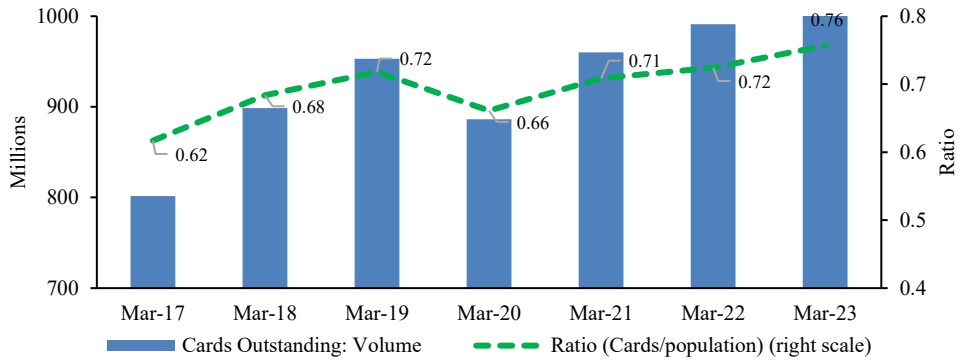
In this context, the paper documents the innovative approach to capture and measure that part of the cross-border eCommerce that are enabled by credit and debit card payments (mostly B2C or retail online) with a special attention to their classification under travel/non-travel economic activities. It then integrates and substitutes such transactions in BOP framework. To that extent, the approach refines the BOP estimates for India at sub-component level. The measure of cross-border eCommerce facilitated through electronic fund transfers/EDI (largely B2B) is however, an agenda for future work.

[2] Different digital payment modes include BHIM-UPI, IMPS, NACH, AePS, NETC, debit cards, credit cards, NEFT, RTGS, PPI and others.

[3] UNCTAD, estimates of global eCommerce 2019 and preliminary assessment of COVID-19 impact on online retail 2020.

[4] There could be links between postal/courier shipments and eCommerce (UNCTAD (2016)). However, due to the lack of details on the economic activity of the transactions ordered online, a transaction can be allocated to multiple BOP classifications.

Figure 1.1: Credit/Debit Cards Outstanding to Population Ratio: India



Sources: CEIC and RBI.

The approach paper is structured in 5 sections. Section 2 provides the concept and the overview of the digital trade and eCommerce. It describes the extant practice of classifying card payment related transactions in transactor-based travel category of BOP. Section 3 explains the approach adopted and steps involved to identify and reclassify card-enabled eCommerce transactions that should result in some refinement in India's BOP statistics at the sub-component level. Section 4 documents the preliminary findings on eCommerce reflected in card transaction data and looks at the supplementary data collected for card consumption patterns. Section 5 concludes with key observations on the approach for improving and enhancing the statistical measurement of card based B2C eCommerce for its integration with BOP at the component level.

2. The Overview and the Issue

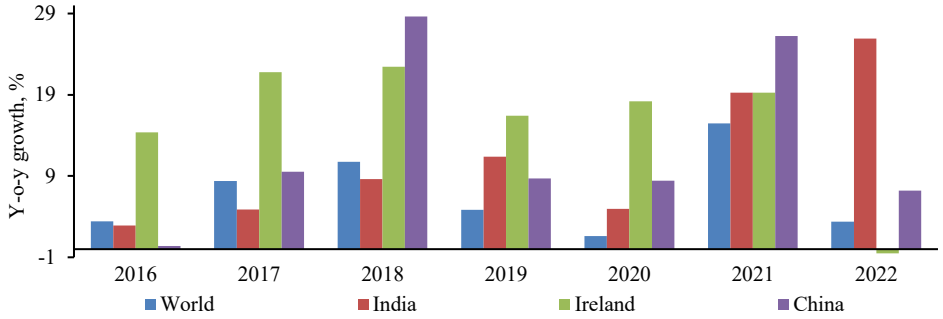
Digitally related transactions have become significant over the years with rapid progress in digitalisation and globalisation. Digital trade involves a trade in a good or a service or in information/data. The partners involved could be B2B, B2C, B2G, C2C etc. Digital trade is premised on how it is ordered or delivered.

While digital commerce encompasses digital technologies, digital marketplaces, and platforms, eCommerce primarily indicates buying and selling products online. While the World Trade Organisation (WTO) defines eCommerce as "the production, distribution, marketing, sale or delivery of goods and services by electronic means" (WTO (1998a)), the Organisation for Economic Cooperation and Development (OECD) focuses on ordering process in defining eCommerce and defines it as "...the sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders.....to be included are orders made over the web, extranet or electronic data interchange" (OECD (2011)). The type is defined by the method of placing the order. India Foreign

Trade Policy 2023[5] defines eCommerce exports of goods and services as, "where selling is through the internet on an eCommerce platform[6], the payment for which shall be done through international credit or debit cards, or other authorised electronic payment channels and as specified by the RBI from time to time".

Notwithstanding the flexibility in definition, cross-border digital trade, whether in the nature of data flows or eCommerce, appears as a good or a service in the current account in exchange of monetary payment. For instance, rapidly growing internet penetration is resulting in understating the magnitude and growth of online cross-border data flows (Mandal (2014)). These flows being intangible, do not pass through the customs. Digitally ordered/deliverable services are not compiled as a separate category in trade statistics but are generally related to the BPM6/EBOPS 2010 service cluster comprising the categories that relate to insurance and pension services, financial services, charges for the use of intellectual property n.i.e., telecommunications, computer and information services, other business services, and audio-visual and related services (IMF *et al.* (2023)). India's exports in this service cluster have been recording a marked growth (Figure 2.1).

Figure 2.1: Digitally Delivered (Exports) Services Growth



Notes: digitally deliverable services are an aggregation of the insurance and pension services, financial services, charges for the use of intellectual property n.i.e., telecommunications, computer and information services, other business services, and audio-visual and related services.
Sources: WTO and authors' calculations.

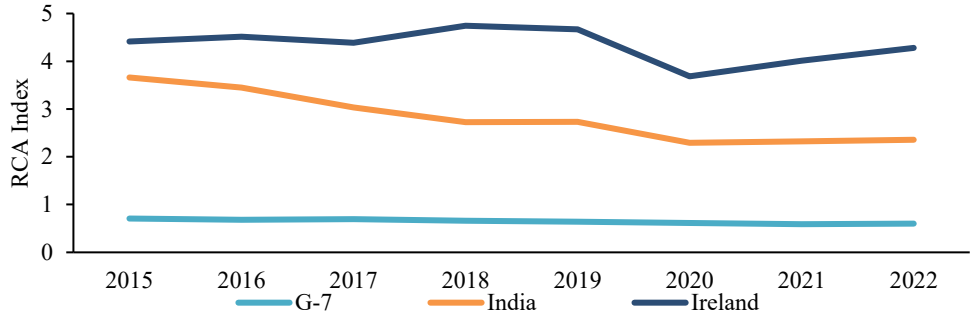
Within this cluster of digitally delivered services, India's exports under 'telecommunication, computer, and information services' and 'other business services' lead with almost 95 percent share in 2022. Overall, in total service exports, these two groups dominate forming more than 70 percent. The prominence of the digitally delivered data sector for India is also reflected in strong revealed

[5] India Foreign Trade Policy 2023, Promoting Cross Border Trade in Digital Economy.

[6] eCommerce platform is an electronic platform, including a web-portal, that enables the commercial process of buying and selling through the internet.

comparative advantage (RCA)[7] which India enjoys in the telecommunication, computer and information export service group, second only to Ireland[8] (Figure 2.2).

Figure 2.2: Telecommunication, Computer and Information Services Exports Revealed Comparative Advantage (RCA): Major Economies



Notes: G-7 includes USA, UK, Canada, Germany, Italy, France and Japan.
Sources: WTO and authors' calculations.

Though the digital/eCommerce trades are compiled and are part of BOP statistics, the distinct identification, and the measurement of cross-border eCommerce under various economic classes for the countries following international transaction reporting system (ITRS), have remained the challenges given the lack of granular information with the reporting banks, contrasted with enterprise reporting on the same through surveys, where direct information on ecommerce activity can be compiled.

BPM6 as early as 2010 has recognised an increased use of credit and debit cards and other similar payment means in settling international eCommerce transactions[9]. Such card-based eCommerce generally involves small-value B2C transactions, in contrast to large-size B2B transactions that may use electronic data interchange (EDI)/payment systems. In this context, several economies are looking at increases in card usage as one of the many approaches for measuring the rise in B2C eCommerce in their countries. Cross-country practices in the collection of cross-border eCommerce transactions are provided in the Annex. For instance, Portugal which follows ITRS for the BOP compilation, collects monthly card payment data at a gross level, and classifies all under travel. However, the approach adopted lacks differentiation in non-travel-related eCommerce sales/purchases of valuables, consumer durables, and non-tourist goods and services made by individuals in their home country (Miguel C.J. *et al.* (2011)).

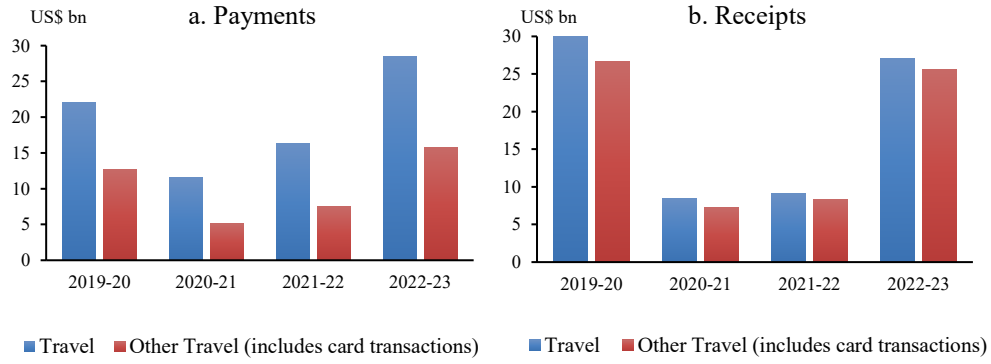
[7] A country is said to have a revealed comparative advantage in a given service i when its ratio of exports of service i to its total service exports exceeds the same ratio for the world as a whole. In terms of comparative advantage (RCA >1), a country is a competitive producer/exporter in comparison to a country producing/exporting goods at or below the world average.

[8] Ireland has a presence of several large multinational firms in the ICT space, contributing significantly to its exports.

[9] IMF, BPM6 compilation guide Chapter 12. Services; para 12.158, 2014.

Likewise, in the production of India's BOP statistics, all transactions other than card-based are being captured at the gross level in relevant economic categories correctly. Given the limited cross-border eCommerce activity that was in the nascent stage of growth and with the view that card spending is generally in-store (card present[10]) during foreign travels, the Working Group (WG) on India's BOP in 2010[11] also recommended card-based transactions to be classified in the travel group[12] . As per the global guidelines, the travel purpose group covers the traveller's purchase of all goods and services abroad[13] (provided that, there is no change in residence status of the traveller). It is a transactor-based category of BOP covering an assortment of goods and services. In India, the receipts, and the payments in this component of travel group have clearly risen post-covid, reflecting the notable use of cards for overseas payments (Figure 2.3).

Figure 2.3: Travel Payments and Receipts in India BOP



Notes: Travel includes business, education, health related and other travel.
Sources: RBI and authors' calculations.

With the associated strong growth in eCommerce business crossing borders, the proposition that card enabled cross-border transactions take place only while on travel appears restrictive. The significant and rapidly increasing gross credit/debit entries with card-not-present (CNP)[14] status are found to be majorly related to non-travel economic activities, bunching them all under travel overstate the travel services and by contra, induces underestimation elsewhere. This requires re-categorisation of such non-travel eCommerce transactions even as the overall size of BOP remains unaltered.

[10] The term "card present" refers to transactions that are made when the card is used in PoS or ATM.

[11] RBI, Report of the Working Group on India BOP para 4.21, 2010.

[12] Here, the other travel service category inter-alia captures transactions related to credit card, debit card and prepaid cards along with other tour operator related transactions.

[13] According to IMF, BPM6, 2009, the travel purpose group includes transactions related to visiting another economy and incurring expenses related to that visit. For example, not only accommodation and site-seeing expenses are captured in travel, but goods or services acquired by persons undertaking study or medical care while outside their country of residence are also included.

[14] The card-not-present refers to transactions that are made when the card is used through internet.

3. India's Stepwise Approach to Address the Challenge

The primary source of BOP compilation in India is the gross forex receipts and payment transactional settlement data reported by authorised dealer banks under FEMA to the Reserve Bank of India (RBI (2012)). These transactions are settled through Nostro/Vostro accounts of the reporting entities. However, for the card transactions, the reporting could be on a net basis as international card transactions are settled through a multilateral net settlement mechanism at end-of-the-day (EOD) that involve card payment networks such as Visa, Mastercard, Amex etc. These networks which have the long pipeline of transactional details at gross level for all card-based transactions undertaken by their member banks, play a significant and distinct role given their different settlement structures[15] . The related economic activity for all card-based transactions as mentioned under section 2 is recorded as 'travel'.

The multilateral net settlement recording in BOP results in an underestimation of the value of card transactions. Also, as multiple card transactions settle on an EOD basis at the bank level, the volume of such transactions also gets underestimated. Therefore, the first step is to ensure the uniform reporting of the value of card transactions at the gross level by the reporting banks. For this purpose, RBI as a regulator for foreign exchange transactions and payment systems, instructed card networks to provide proprietary gross-level international card settlement data to its respective member banks for them in turn, to report the same at gross level to RBI for BOP compilation. This was the first refinement of India's BOP in compliance with BPM6 gross reporting.

With the rising recognition of card usage for eCommerce activity, the approach needed to segregate online card transactions by the banks. It underscores the need for more details such as card-present/card-not-present concerning card transactions, which can be used to broadly identify the eCommerce trade, *vis-à-vis* in-store card-present purchases. Also, information on merchant category code (MCC) embedded in the card transaction data pipeline, can be used to identify the economic activity pertaining to the transaction.

However, the banks' gross reporting on cross-border card transactions under India's ITRS in the travel group of BOP does not include such details. This is because the transactor-based travel group for BOP reporting does not require information on the underlying goods and services and whether the purchase is with a card-present (in-store) or a card not present (eCommerce). In other words, the banks' reporting on card payments under travel fails to provide details for any further disaggregation. As such, the approach needed to find an alternative source for obtaining the relevant details on card transactions to supplement the gross settled aggregates reported by banks under BOP framework.

In India, card transactions are settled either by transaction issuing/acquiring banks or by designated banks of the card networks. These designated settlement

[15] For instance, Mastercard transactions in India are settled directly with overseas banks by the AD banks, but majority of international Visa transactions are settled with overseas banks by a designated bank which holds current accounts of member banks in India. India also has its own Rupay network which has arrangements with foreign networks to facilitate the Rupay-based transactions abroad where it lacks presence.

banks which hold current accounts of member banks in India, collect net settled card amounts from resident banks and channel the same to overseas bank (and vice versa) and as such, have neither visibility of the economic nature of card transactions nor their card present status. In other words, the visibility on economic nature of card transactions through MCCs resides with either the card payment network or with the transaction issuing or acquiring bank.

In view of above, the detailed MCC-wise aggregates at gross card transaction data were collected from transaction issuing/acquiring banks. This formed the second source of information on card transactions data, which included the value and volume of transactions across both credit and debit cards. Alongside, the gaps in information from the first source, namely, data on card present (in-store payment (Point of Sale)/ATM withdrawal) and card not present (card not used over PoS or ATM/Online) status and MCC of a transaction are also collected.

The above satellite information on card payments is collected in a fixed format[16] and at the aggregate so as to keep the reporting burden minimum. The fixed format ensured the comprehensibility, comparability and ease of reporting. The data on amounts and transaction currency are collected at MCC X country X currency X amount (payment/refund) X card present/not present status at credit and debit card levels to RBI. Since the information sought from the secondary source is not at transaction level, no beneficiary/remitter details are collected. Likewise, aggregates for UPI cross border transactions[17] are collected on MCC X country X currency X Amount (Payment/refund) X QR scan status levels (RBI (2021)).

The next step in the approach involves the integration of the data compiled from two different sources in order to identify and filter out the non-travel eCommerce transactions from travel group. This could be challenging as integration may not be straightforward as the gross reporting on card transactions by the settlement banks (the first and the primary source) was found to be at variance with the gross reporting of the same by transaction issuing/acquiring banks (secondary source). As such, the identification of the sources of the difference and reconciliation thereafter of the data compiled from two sources became the next step in the approach before the integration.

The primary source of gross card payment data for BOP is Nostro/Vostro credits and debits of the settlement banks. The data revealed that the settled amount for a cross-border card transactions not only includes the price of the purchased merchandise/services (transaction amount), but also the various fees namely, interchange fee, member-to-member fee, service assessment fee, network fee etc. These fees are different kinds of financial service charges clubbed with the value of the product/service in settlement amount. The presence of such charges in the settled amounts, though relatively small in magnitude, made the reconciliation between the two sources providing information on card transactions very challenging. BPM6 recommends classifying the various kinds of services associated with the cost of a

[16] RBI, A.P. (DIR Series) Circular No.13 dated March 25, 2021.

[17] According to NPCI "Unified Payments Interface (UPI) is a system that powers multiple bank accounts into a single mobile application (of any participating bank), merging several banking features, seamless fund routing & merchant payments into one hood. It also caters to the "Peer to Peer" collect request which can be scheduled and paid as per requirement and convenience". Currently, P2M UPI payments are live in Singapore, UAE, Bhutan, Nepal, and Mauritius, Maldives.

particular goods/ services ordered through eCommerce as per their respective economic nature[18]. Moreover, financial charges are treated differently by the card networks which added another layer of difficulty in uniformly extracting and classifying them in financial services group under BOP.

For the purpose of reconciliation, card networks were instructed to provide details of various explicit financial service fee (such as member to member fee, network charges etc.) associated with the settlement amount on card transactions separately to their member banks to enable them in turn, to eliminate from gross settlement values and bundled these charges correctly under financial services for BOP reporting to RBI[19]. This was the second refinement.

To reconcile the data received from the two sources, AD banks were instructed to provide card network-wise break-up of the settlement amounts reported by them in the payments data (primary data). Alongside, designated settlement banks were instructed to provide bank-wise gross settlement amounts reported in payments data. Reconciliation table was prepared and cross-verified. The approach assumes the reconciliation complete if on the quarterly basis, the variation between the said data sources is below 5 per cent.

Post successful reconciliation between the two data sources, i.e., when the gross aggregates match, the details on card transactions compiled from the secondary source could safely be integrated in the BOP framework to identify and filter out the non-travel eCommerce card transactions reported and distribute them as per the economic activity the card is used in. As a next step, therefore, MCCs were mapped to the economic activity classification as per BPM6[20] .

For the purpose, the card aggregates (at MCC X card-status) for card present status were mapped to travel, ignoring the economic activity reflected in MCC. On the other hand, MCC level card aggregates having the status 'card not present' were mapped in the respective BOP purpose category (including travel) based on mapped MCC, as these were linked to eCommerce.

This approach targets such international card transactions and correctly classifies them into relevant economic BOP activity. This is the third improvement that the approach brings to India's BOP estimates at component-level.

In short, the approach does not affect the overall BOP aggregates, but at disaggregate or compositional level, it redistributes the card-based overseas transactions over the relevant economic activities.

[18] As per IMF, BPM6, 2009 "In general, charges for electronically delivered products are usually included in services, whereas products supplied across the border are usually classified as goods (see Table 10.4 for further details). Shipping charges associated with eCommerce are allocated in line with the FOB valuation principle. Financial services associated with eCommerce are included in financial services."

[19] Other than these explicit financial charges which could be separately provided by networks, there was an implicit part that remained in the transaction amount. This inherent charge in card transaction data provided by the secondary source is imputed based on suitable proportions for each network and added to the implicit financial charges under financial services of BOP.

[20] In India, economic activity of forex transaction is captured through purpose codes as per the recommendation of Working group committee on BOP. MCCs captured through card transactions data are mapped with the existing purpose code list.

As a case study for India, the present paper analyses the detailed international card transactions during April 2022-September 2023 obtained from transaction issuing/ acquiring banks, that were reconciled with data reported by settlement banks under BOP framework. It then integrates the two data sources as per the adopted approach, to identify the eCommerce transactions with the underlying economic activity. In addition, the detailed card transaction data were broken down into various key goods/services groups based on only MCC, independent of BOP classification. Next section presents the findings.

4. Integration of Card-based eCommerce Transactions into BOP Framework

The internal pilot exercise on the integration of information compiled from the two sources on card payment data for the period April 2023 to September 2023 reveals more than half of total payments and receipt pertained to card-not-present transactions, volume-wise. Following the literature, this part of reporting in travel can be assumed to belong to eCommerce transactions which, as per the suggested approach outlined in the previous section, needed to be filtered out and reclassified away from transactor-based classification. The rest, where the card was presented for making cross-border payments will stay in travel component of BOP.

Within the segment identified as eCommerce, a small component as per the approach will pertain to eCommerce in travel, for instance for hotel booking, car rental etc. Remaining eCommerce transactions not pertaining to travel category would get appropriately distributed, for instance into transport, goods trade, personal, cultural and recreational services and other business services.

In other words, the approach does not expect any change in aggregate BOP outflow or inflow as no new transactions from a new source are added, but at disaggregate or compositional level, it refines the underlying economic activity-wise aggregates. In nutshell, the steps in the approach ensure the gross reporting of card transactions for BOP, segregate the eCommerce non-transactor-based transactions and lastly filter out and classify card-enabled eCommerce transactions into appropriate BPM6 based economic classes.

Additionally, card details captured separately under this approach, could also be used to analyse the behaviour of resident Indians and non-residents in India in terms of respective card usage. For this, merchant categories were clubbed for making classifications, differently from the classifications recommended by BPM6. This provided classification of card transactions into homogeneous types of goods and services based on MCC descriptions, enough to be made into groups. In other words, a meaningful grouping can be done to homogenise the activities strictly based on merchant categories. The groups so formed can provide interesting observations, for instance, the behavioural differences between Indian residents and non-residents in their comfort in using cash (using cards for withdrawing cash from ATMs and then paying cash for the activity) in contrast to, using cards to directly paying for the activities, sidestepping the cash withdrawal.

Large use of cards for cash withdrawal means the comfort in holding cash in their hand for spending in stores and making remittances abroad. Also, the additional data on cards can be used to analyse the differential behaviour between residents and foreigners travelling from different countries on their respective preference of merchandise/services that use card payments.

Such analytical insights are the potential inputs for the policy makers on international eCommerce in different economic activities that add to the importance of the additional data collected.

5. Conclusions

In view of the rapid rise in digital payments and associated increase in cross-border eCommerce transactions, their measurement is becoming increasingly more important with the rising demand for such statistics for policy making and monitoring. At the same time, compilers face the challenge of identifying and capturing details of such transactions, where data collection efforts have been on a more consolidated basis so far.

The paper discussed an approach for capturing details of cross-border eCommerce statistics, based on credit and debit card payments (mostly B2C), which can be extended to measure such transactions facilitated through other modes of payments. To address the challenges of multilateral net card settlement mechanism and multiple settlement structures, detailed approach is presented for ensuring uniform reporting on a gross basis, the processes adopted for capturing MCC for transactions, and the consequent refinement undertaken in compilation of BOP statistics.

At present elsewhere, card payment data are largely used to estimate travel debits or issuing transactions, and therefore, some information gap exists on the treatment of identified card-based eCommerce in the BOP network. The paper discusses the Indian effort to compile auxiliary information on international card transactions for identification of non-travel eCommerce card transactions, which presently remain small in size. Integration of MCC mapping with the BOP classification indicates sizeable redistribution of transactions into different BOP classifications, away from travel group at present, including into merchandise.

A study of the distinct behavioural aspects on card-usage for international trade across different goods and services and across countries, also provides important inputs towards policy making for measuring and promoting eCommerce, enhancing the value and usability of the data collected under the suggested approach.

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Annex: Cross-country Practices in Collection of Cross-border eCommerce Transactions

The growing digital economy is throwing up significant measurement challenges within existing national and international frameworks, including BOP statistics. Literature highlights various sources for capturing digital trade, majorly through business surveys, household surveys and surveys of government units or NPISHs. Countries such as the UK, Spain, Canada, Malaysia, France, and Poland publish business cross-border eCommerce sales, while some collect web sales data, excluding electronic data interchange (EDI) type sales (UNCTAD (2023)). Alternative approaches for aggregating tourism spending data include mobile data, big data analytics, artificial intelligence tools, payments, credit card records, and social media (Dubreuil M. (2017)). Ribarsky J. and Ahmad N. (2018) explore the creation of a macroeconomic satellite account for the digital economy, adhering to international accounting standards.

Specifically, Canada enterprise survey of digital technology and internet use[21] measures international eCommerce sales by trading partner. It provides data on the proportion of overseas B2B and B2C internet sales of all Canadian enterprises, broken down by sales to the United States and to the rest of the world. UK digital economy survey[22] collects trading partners involved, the sales channels used, including online marketplaces (DIPs), and the types of products sold and purchased for both international eCommerce sales (exports) and purchases (imports) by businesses. In Japan, the Ministry of Economy, Trade and Industry (METI) is the official source that collects data on the value of bilateral B2C trade for selected destinations[23]. Malaysia Survey on Usage of ICT and eCommerce by Establishment[24] includes questions about Malaysia's eCommerce sales income, including an apportionment between domestic and international eCommerce sales.

Akin to India, Philippines under ITRS captures forex transactions, encompassing credit card settlements between banks and major credit card networks (VISA, Mastercard, American Express, etc.). Credit card details are sourced from the credit card business activity report (CCBAR), that offers insights into card-present and card-

[21] Canada Survey of Digital Technology and Internet Use – 2021 questionnaire.

[22] 2022 UK Digital Economy Survey questions.

[23] Results of FY2022 Japan eCommerce Market Survey Compiled.

[24] Borang-ICTEC-2020.pdf (dosm.gov.my).

not-present status, usage profiles, active cards, limits, billing, and fees[25]. However, debit card details are not captured in the report.

In Portugal, which follows ITRS for the BOP compilation, card payments are used for the estimation of travel items of BOP. A monthly report is collected from the card processing companies detailing transaction volume and value from ATMs and POS, both domestically and abroad. This data also includes card characteristics and channels used. The approach adopted in Portugal lacks differentiation in non-travel-related eCommerce sales/purchases of valuables, consumer durables, and non-tourist goods and services made by individuals in their home country (Miguel C.J. *et al.* (2011)).

Armenia's BOP compilation relies on surveys conducted by its central bank, extensively explores B2C imports in goods and services and provide insights by country, POS terminal types, and transaction classification, with a focus on import transactions related to issuing rather than acquiring transactions. Utilising the Armenia card database (ArCA), the research filters online transactions based on the card-not-present status and categorises them using MCC. The study addresses travel debits transactions, leaving travel credit or the non-resident ecommerce transactions. Also, how the information captured as such is used into BOP framework is unclear (Yezekyan L. (2018)).

In Italy, where BOP compilation relies primarily on surveys, a significant technology advancement that involved integration of mobile phone data, Google trends data, and electronic payments data contributed to enhancement in collection of tourism statistics. Carboni A. *et al.* (2023) proposed a model that leveraged payment card data to enhance the timely estimation of travel-related items within the BOP framework. The study employs predictive modeling techniques such as ridge, lasso, and decision tree algorithms. However, despite the availability of payment databases at the MCC level, an information gap on travel whether business or personal limited the use of information into the BOP framework.

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Capturing eCommerce Transactions from the Travel Group of BPM6 - An Indian Experience

Arjya Misra, Savita Pareek and Seema Saggar

Reserve Bank of India

Feb 12-13, 2024

Second External Statistics Conference organized by IFC, BIS jointly with ECB and Banco de España

The views expressed are those of the authors and do not represent the views of the Reserve Bank of India (RBI).

Objective

Capture and measure part of the cross-border eCommerce - that are enabled by credit and debit card payments (mostly B2C or retail online).

-With a special attention to their classification under travel/non-travel economic activities.

-With a purpose to improve India's BOP estimates.

Contents

The Concept and the Issue

The Challenges and the Approach

BOP Refinements

Conclusion

Growth in cross-border digital trade in India - Pull factors

A world-class digital public infrastructure (DPI) – served India well during the pandemic

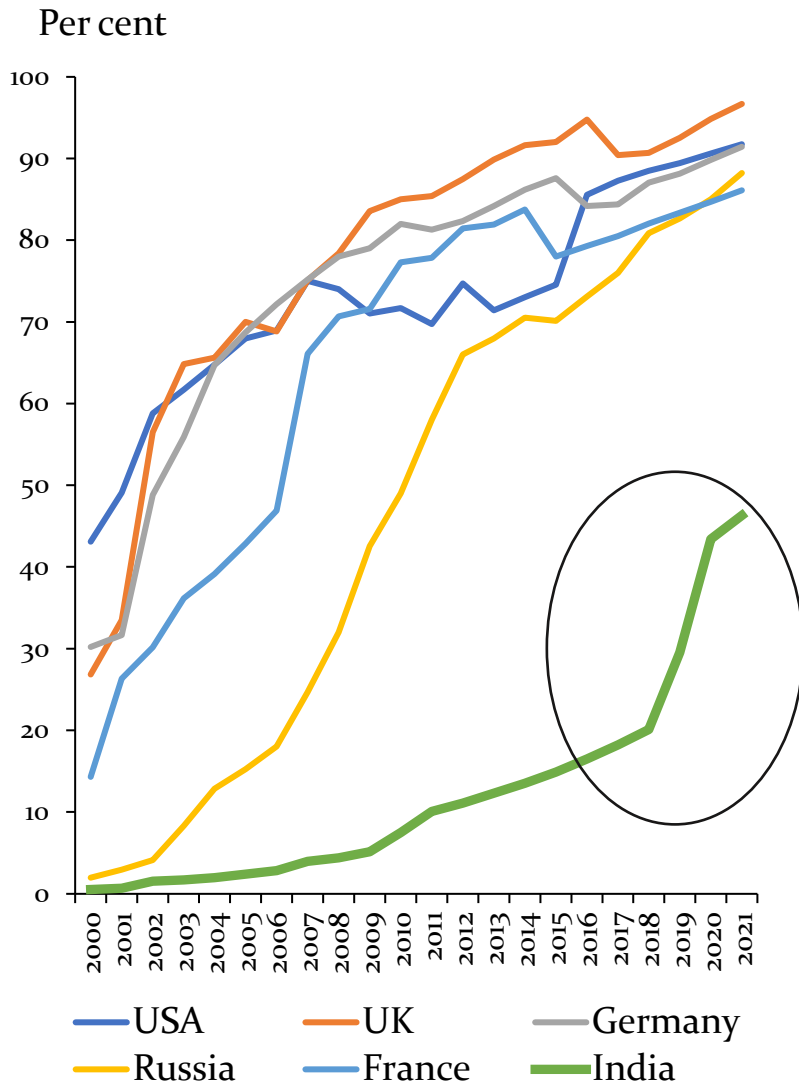
- Prominence of international transactions in services – majorly software and IT enabled services

(Revealed Comparative Advantage (RCA) in Exports = 2.36 in 2022)

- 'Digital India' programme - Internet & smartphone penetration.

- 100% FDI in B2B eCommerce and 100% FDI within the marketplace

Internet Penetration- Major Countries



Data Source: Bloomberg.

eCommerce

The Definition

"the production, distribution, marketing, sale or delivery of goods and services by electronic means" (WTO, 1998a) -- focuses on sale and delivery

"the sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders.....to be included are orders made over the web, extranet or electronic data interchange"(OECD, 2011) ---- *focuses on the mode of the order*

"where selling is through the internet on an eCommerce platform, the payment for which shall be done through international credit or debit cards, or other authorised electronic payment channels and as specified by the RBI from time to time" (India Foreign Trade Policy, 2023) -- *focuses on the mode of order and payment channel*

Concept

Measure and Economic Classification of Digital Trade in BOP – IMF *et al.* (2023) *

Digitally ordered/deliverable services

Generally, relates to the BPM6/EBOPS 2010 categories -

(a) insurance and pension services,

(b) financial services,

(c) charges for the use of IP *n.i.e.*,

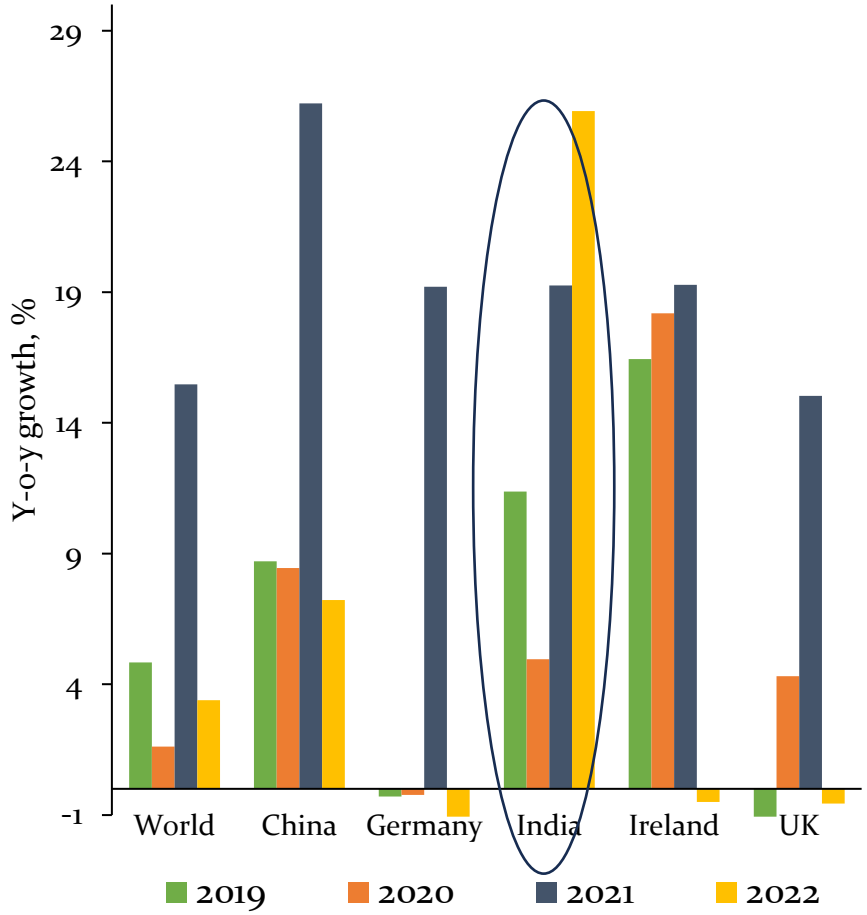
(d) telecommunications, computer and information services,

(e) audio-visual and related services

(f) other business services

Global shares of digitally delivered (exports) services for UK, Ireland, Germany, India and China in 2022 are 9, 8, 6, 6 & 5 per cent, respectively.

Digitally Delivered (Exports) Services Growth



Data Source: WTO and authors' calculations.

*: IMF, OECD, UNCTAD and WTO (2023), Handbook on Measuring Digital Trade, Second edition.

Measure and Economic Classification of eCommerce in BOP

Under international transaction reporting system (ITRS) framework

– A Case of India

- Identification and estimate of digital trade is a challenge given the limited information with the reporting authorised dealers for BOP under ITRS.

- Each sale/purchase forex transaction at gross level is classified as per the purpose, including digital trade transactions.

  Except for card transactions, which generally get reported at a net multilateral flow (on end-of-day basis) under travel.

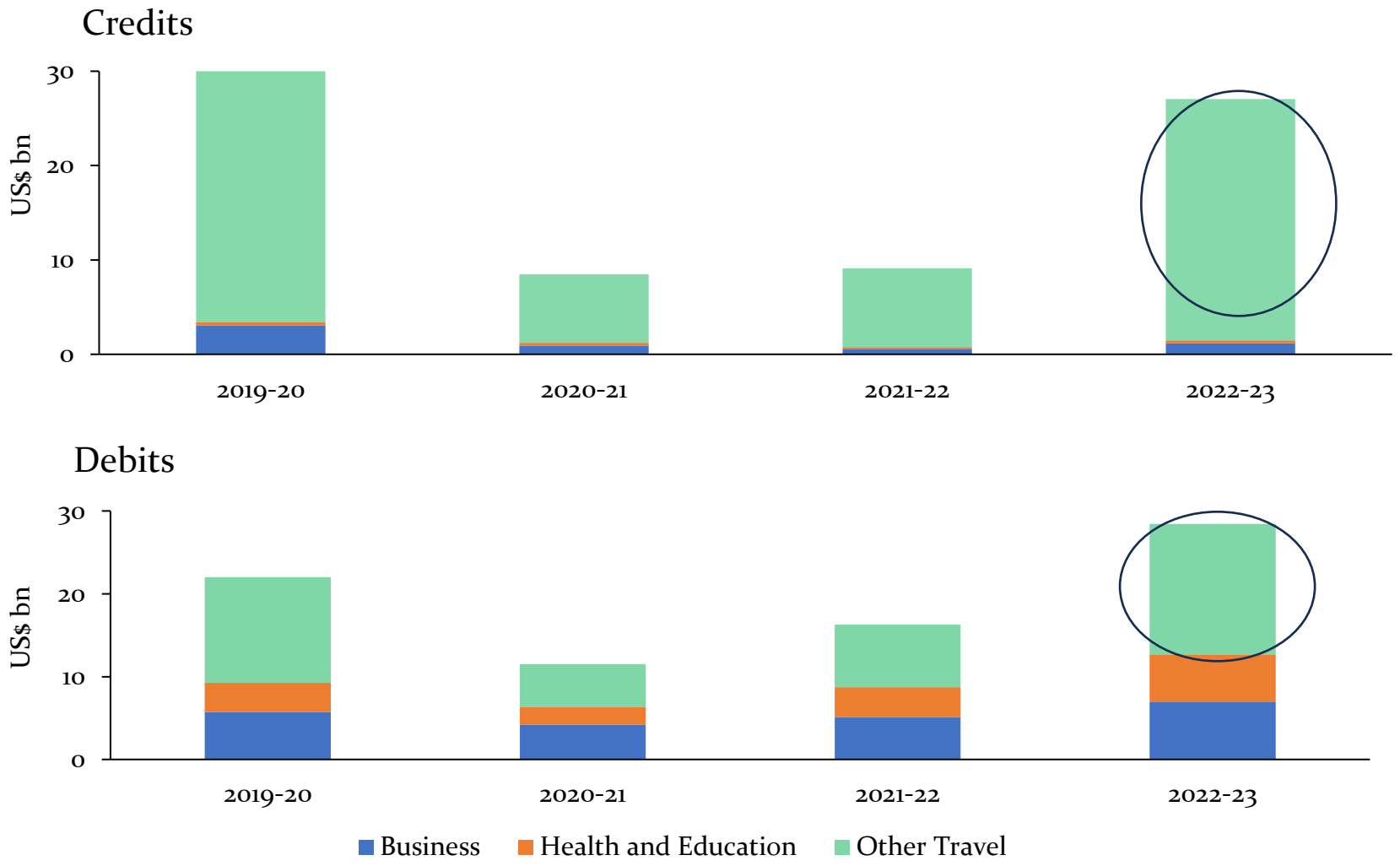
Multilateral net settlement flow

Measure and Economic Classification of Card-based eComm in BOP

Global BPM6 guidelines - travel purpose group covers traveller's purchase of all goods and services abroad (provided that, there is no change in residence status of the traveller). It is a transactor-based category of BOP covering an assortment of goods and services.

- Travel purpose group includes transactions related to visiting another economy and incurring expenses related to that visit (assortment of goods and services).
- For instance, accommodation, site-seeing expenses, goods and services acquired by persons undertaking study or medical care outside their country of residence etc. are all captured in travel group.
- Also with limited eComm activity, all cross-border card spending could safely be assumed to be card present purchase/cash withdrawal in store/ATM.
- Accordingly, the card transactions are classified in travel group, besides travel for medical, education, business etc.

Travel Service Debits and Credits: India



Note: Other travel *inter alia* includes payments for settling international cards transactions.

Data Source: RBI.

The Issue

The card transactions are classified under transactor-based travel group of BOP given,

(a) lack of purpose details with the reporting banks on card transactions

(b) limited international card-not-present transactions until till very recently

- Globally, rapid recent growth of credit/debit with card-not-present (CNP) transactions.
- The present classification may be overstating the travel service and by contra, inducing underestimation elsewhere.
- Need to segregate transactions with card-not-present (CNP) (eCommerce) related to non-travel economic activities from the travel group.
- This is the timely and appropriate refinement towards the development of India's BOP statistics at component level, even as the overall size of BOP remains unaltered.

Card-based Cross-border eCommerce - India's Stepwise Approach to capture and measure

Step 1

- Gross Reporting of Card–based International Transactions

Step 2

- Identifying the non-travel transactions

Step 3

- Allocating the non-travel transactions to relevant BPM6 purpose groups

Conceptual issues and compilation challenges

Identification of the new data elements and processes to report at a gross level.
Need for a secondary source
Reconciliation of gross amounts obtained from two sources to enable integration
Filtering out the financial service fees in card settlement amounts
Additional data required for reconciliation
Mapping for economic purpose across sources

Challenge 1:

Correcting for Net-Multilateral Reporting of Card–based International Transactions

Multilateral net settlement mechanism results in understated reporting of the value of card transactions.

Need to identify the new data elements and processes and advise banks accordingly to report at gross level.

Challenge 2:

Banks' reporting for BOP on card transactions -

Does not provide comprehensive data for purpose/ eCommerce identification

Banks reporting for BOP under ITRS in India do not report information on:

(i) card present(CP) to identify eCommerce activity

(ii) economic nature of the card transactions

(designated settlement bank does not have visibility on the issued /acquired card transactions by its member banks).

Need for a secondary source.

Challenge 3:

Need for Reconciliation of Primary and Secondary Data Sources

Primary Data Source : All card transactions (at gross without required details) are reported for BOP under the travel group

Secondary Data Source : All card transactions (at gross with details) were compiled in a fixed format.

Need reconciliation of gross amounts obtained from two sources to enable integration of information.

Challenge 4:

Different settlement structures of different networks and inclusion of financial services in settlement amount

Different card networks have different settlement structures and different financial service fee structures.

For instance, MasterCard international transactions are settled by domestic banks directly with overseas banks, but Visa transactions are generally settled through a designated bank that holds current accounts of member banks in India.

Financial service fees explicitly include member-to-member fee, network fee etc. Also include implicit fees like service assessment fee and interchange fees.

The presence of various kinds of financial charges in the settled amounts, *albeit* relatively small in magnitude, made the reconciliation between the two sources very challenging.

Need to filter out the financial service fees.

Challenge 5:

Data Sources Providing Data Differently

Reporting for card transactions under ITRS is either by

an individual settlement bank OR

designated bank for a specific network for its member banks

Compilation of detailed card transaction data are from respective issuing and acquiring banks, collectively under all networks.

Reconciliation needs additional data

Challenge 6:

Integration of Data from Two Sources

The gross data on card payment transactions (primary source) reported under BOP

Disaggregated granular gross data on card transactions (secondary source)

Needs mapping for economic purpose between two sources

Challenge 7:

Allocating non-travel transactions to relevant BPM6 purpose groups

Redistribution of the cross-border card-enabled debits and credits over the relevant economic activities, resulting in component-level changes.

The shift may bring-in sudden large variations across BOP components over time

The Approach…..
Steps Taken to Address the Challenges

Challenge 1

1: Correcting for Gross vis-à-vis Net Multilateral Reporting

Multilateral net settlement of card transactions

SOLUTIONS IMPLEMENTED

- Card networks were instructed to provide proprietary gross-level international card settlement data to its respective member banks.
- ADs (including the designated bank for member banks' transactions) in turn, reports the same at gross level to RBI for BOP compilation (first refinement).

Challenge 2

2: Identifying the Non-travel Transactions

Banks reporting for BOP under ITRS in India do not report information on CP status and economic activity

SOLUTIONS IMPLEMENTED

Secondary source identified - MCC-wise aggregates at gross card transaction data with CP status indicator from transaction issuing/ acquiring banks

Secondary data source format - amounts and transaction counts - collected at

(MCC X country X currency X Amount (payment/refund) X (card present/not present) separately for credit and debit cards

Challenge 3

Challenge 4

3 & 4: Reconciliation of data collected from primary and secondary sources

The settled amount includes the price of the purchased merchandise/services (transaction amount) along with service charges

Different card networks have different settlement structures in India

SOLUTIONS IMPLEMENTED

Instructed card networks to support the banks in extracting the explicit financial service fees associated with settlement amounts

Started classifying the financial charges on card payments in financial services group of BOP (second refinement).

Challenge 5

5: Reconciliation process of data collected from primary and secondary sources

Reporting banks (Primary source) instructed to provide card network-wise breakdown of settlement amounts in payment data.

Designated settlement banks directed to provide bank-wise gross settlement amounts.

Reconciliation table prepared based on network-wise breakdown.

Reconciliation is deemed complete if quarterly variations in the two sources stay below 5%.

Challenge 6

6: Integration of Secondary source data into BOP framework

After matching the gross aggregates from two sources, secondary source data is used to identify and filter out non-travel eCommerce card transactions. Therefore, MCCs were mapped to the economic activity classification as per BPM6.

Card aggregates (at MCC X card present) were mapped to travel, ignoring economic activity.

Card aggregates with the status 'card not present' were mapped to the respective BOP purpose category (including travel) based on mapped MCC.

Challenge 7

7: Allocating non-travel transactions to relevant BPM6 purpose groups

Data granularity allows redistribution of the cross-border card-enabled debits and credits over the relevant economic activities, resulting in component-level changes (third refinement, though very small for India).

Card not present transactions

(a) are taken out from travel.

(b) mapped in the respective BOP purpose category, including travel.

The integration does not increase the size of overall BOP outflow or inflow.

The Refinements

The Impact

- BOP estimates at the component level could be refined.
- With the gross reporting, identification, reconciliation and redistribution of card-enabled cross-border eComm transactions, hitherto under a transactor-based Travel,
- The magnitude of card-based credit/debits has been small and therefore the refinements might not get visibility.

BUT the conceptual approach to deal correctly with such transactions is highlighted.

Conclusion

- The approach entails capturing details of card-based cross-border eCommerce statistics (mostly B2C).

- Does not affect the overall BOP aggregates, but at a disaggregate level, it redistributes the card-based overseas transactions based on economic activities, and hence refines India's component-level BOP.

- The proposed approach can be extended to measure such transactions facilitated through other modes of payments.

- Since the approach captures credits and debits both, card details captured could also be used to analyse the behavior of resident Indians and non-residents in India in terms of respective card usage.

Thank You!

Q & A

Cross- country Practices

- USA, UK, Canada, Malaysia, and Spain - Business surveys, household surveys, and surveys on government units of NPISHs are the major sources of capturing e-commerce, including card transactions
- In Portugal which follows ITRS for the BOP compilation, monthly card payment data are leveraged at a gross level and are classified under travel (Miguel C.J. et al. (2011)).
- Armenia's BOP compilation relies on surveys, explores B2C imports in goods and services, and provides insights by country, POS terminal types, and transaction classification (Yezekyan L. (2018)).
- Italy - Carboni A. et al. (2023) proposed predictive modeling techniques that used payment card data at MCC level to enhance the timely estimation of travel-related items within the BOP framework.
- Philippines under ITRS captures forex transactions, encompassing aggregate level credit card settlements between banks and major credit card networks.

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Challenges and opportunities presented by generative AI in official statistics[1]

Giannakouris Konstantinos and Jean-Marc Museux,
Eurostat;

and Cimpermann Miha,
Jozef Stefan Institute

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Challenges and opportunities of generative AI in official statistics

Museux Jean-Marc[1], Giannakouris Konstantinos[2] , Cimpermann Miha[3][4]

Abstract

The paper illustrates the challenge and opportunities of embracing Generative AI, particularly Large Language Models (LLMs), in the broad context of the imperative for innovation in the European Statistical System (ESS) to meet evolving demands for timelier, detailed statistics amidst a rapidly changing data and technology landscape (ref Eurostat-Cros). Building on the HLG-MOS collaborative white paper on LLM for Official Statistics (ref UNECE) and on Eurostat own exploration of LLM technologies for easing access to EU statistics and metadata, the paper explores their potential applications and associated challenges. The authors delve into key concepts of Generative AI, detailing LLM capabilities, promising use cases, and recent advancements.

Recognizing the need for a cautious approach, the paper discusses risks and challenges related to ethics, transparency, accuracy, bias, and privacy in LLM adoption. It introduces the concept of In-Context Learning (ICL) as a mechanism to balance the flexibility of LLMs with the need for integrating verified, up-to-date information, addressing challenges associated with fine-tuning and controlled usage.

In the Eurostat case, the paper explores the potential of LLMs to enhance user access to official statistics by providing a natural language - based interface, enabling richer interaction e.g., through chatbot, and offering advanced and semantically powered search for data based on human language. The authors share initial learnings and recommendations based the preliminary experience, emphasizing the role of prompt engineering techniques, the importance of non-standard metrics for validation, the value of open-source alternatives, and the importance of a user-centric approach.

Concluding with broader recommendations for exploring and deploying generative AI solutions in official statistics, the paper advocates for continued assessment, user-centric design, and a staged approach in the dynamic LLM ecosystem. Overall, the paper contributes to the discourse on leveraging Generative AI to transform official statistics, recognizing its potential while addressing the intricacies of implementation and other considerations.

[1] Eurostat, Unit A.5 Methodology and Innovation for Official Statistics

[2] Eurostat, Unit A.5 Methodology and Innovation for Official Statistics

[3] Jozef Stefan Institute, Department for Artificial Intelligence

[4] The views expressed in this paper are those of the authors and do not necessarily represent the official position of the European Commission.

The paper concludes with the promotion of several collaborative initiatives that should contribute to deepen our understanding of LLMs and realising proof of concepts of most promising use cases in the future.

Keywords: Generative AI; Large Language Models (LLMs); European Statistical System (ESS); Official Statistics

JEL classification: C81, O30

1. Introduction - The need for innovation in official statistics

Innovation is not an option for the European Statistical System (ESS). It is a necessity. Today's business environment — defined by competition from a large number of private data providers, an ever faster changing data ecosystem, and a rapid rise in increasingly urgent demands for new, timelier and more detailed statistics — makes innovation an even higher priority for ESS partners. In recent years, the producers of official statistics have been faced with increased demands from their users to be more responsive and agile especially in times of crises, to expand the range of statistics, improve timeliness and level of detail. The current situation calls for ESS members to expand their use of digital technologies, widen the use of data sources like new digital sources, and apply new technologies, such as artificial intelligence. The ESS members are also pursing more innovative practices and create conditions for successful innovation so that they can more quickly anticipate and respond to the challenges ahead. Novel digital technologies provide opportunities to address these challenges. Taking advantage of new technological and methodological developments — such as artificial intelligence and machine learning, privacy enhancing techniques, smart devices, methods for data integration, geospatial capabilities, and data analytics are crucial for the Official Statistics to maintain its key role of provider of Trusted Smart Statistics to citizen (Ricciato, 2020) in this new realm. These strategic considerations and other related issues have been addressed in the ESS Innovation Agenda (Eurostat, 2023) adopted but the 27 heads of Statistical Organisations of the EU in February 2023. The ESS Innovation Agenda proposes a strategic approach to innovation as well as a series of activities that aim at enabling and accelerating innovation, conducting and supporting innovative projects leading to concrete outcomes meeting user demands. The implementation of the ESS Innovation Agenda requires a constant horizon scanning to identify new trends and on-going activities within and outside official statistics and streamlined processes to turn them into the production of new and experimental statistics and the improvement of statistical processes.

Artificial intelligence (AI) is an area of strategic importance and is recognised a key driver of social and economic development. It is transforming every walk of life. The magnitude of this socioeconomic change is coming rapidly. In this context, Generative AI is undoubtably one of the recent and striking markers of the evolution of Artificial Intelligence. Materialised with the outspring and never precedent adoption by a broad public, the large language models-based technologies are on the way to revolutionise many industries by enabling the harnessing of the power of new emerging AI technologies.

In the following sections we will develop the generative AI case illustrating the challenge and opportunities it could raise for official statistics and the ESS in particular in incorporating these new feature in statistical production It is not meant to provide a technical review on the topic but next sections will provide the essential elements to understand what LLMs are and explore the risks associated with their use in the context of official statistics and the certain options to mitigate these risks.

Many of the concepts and challenges exposed here are borrowed from the recent work carried out at the UNECE level under the HLG MOS initiative, in particular the release in December 2023 of the white paper on LLM (UNECE, 2023) to which some

of the authors of the current paper contributed. It also builds on a very first explorative study carried by Eurostat in the domain with the purpose of launching of a proof of concept to demonstrate the potential of LLM and generative AI in the context of dissemination of EU statistics and metadata. Notions and definitions also come from Eurostat effort to provide a comprehensive review of LLM features in the context of Official Statistics – this document, still unpublished, is referenced as a forthcoming paper.

Despite its rapid evolution and deployment, Generative AI is still in its infancy and its adoption by statistical organisation will require a pace wise approach addressing the challenge it creates for their integration in quality framework which proved and will remain a critical asset of official statistics while recognizing the need to adapt it to the new data ecosystem context. The views expressed by the authors of this paper do not represent the official views of Eurostat. It is an attempt to present in a coherent manner few of the key issues opportunities raised by generative AI in the context of official statistics.

2. Generative AI – key concepts and standard use cases

Generative AI is a general umbrella term used to refer collectively to a range of emerging techniques and tools having in common to generate new content or data that is not explicitly derived from existing examples and data. This can include generating text, images, music, and more.

A key representant of Generative AI family is the wide language model, also known as a Large Language Model (LLM). LLMs are an advanced type of artificial intelligence technology, that has been trained on vast amounts of text to "understand" and generate human language in a sophisticated way. These models are designed to capture natural language structures, patterns, and relationships, allowing them to perform a variety of tasks related to automatic natural language processing (NLP).

LLM uses techniques from machine learning, deep learning, natural language processing (NLP) and computational linguistics. In a narrow view, the LLM models can be seen as stochastic parrots: that is highly efficient at stitching together words according to probability and generating convincing language, without any fundamental understanding of its meaning. Compared to more traditional NLP framework, LLM models a have significantly improved their efficiency by providing additional features such as:

- Attention Mechanism: It allows the model to focus on different parts of the input text differently, enabling it to capture contextual elements.
- Transformer Architecture: Introduces self-attention mechanism where it weighs input tokens based on their relevance.
- Training: LLMs are trained on vast datasets, sometimes encompassing parts of the internet. They learn patterns, structures, and facts from this data.
- Fine-tuning: After being pre-trained on large datasets, LLMs can be additionally trained (fine-tuned) on specific datasets. This enables models to be optimized for specific use cases and /or to perform specific tasks extremely well.

The standard use cases of Natural Language Processing in general and LLM are to enable machines to understand and work with human language in a variety of ways, such as:

- Text Analysis: Extract useful information from textual documents, such as identifying named entities (names of people, organisations, places), detecting relationships between entities, etc.
- Automatic translation: Automatically translate text from one language to another, for example, translate text from English to French.
- Summarization: Create concise, informative summaries of longer documents or articles.
- Speech Recognition: Converting human speech into written text, which allows machines to process and understand voice commands.
- Text generation: Create text automatically, whether for content writing, dialog generation, or even computer code creation.
- Sentiment analysis: Determine the emotion or opinion expressed in a text, such as detecting the positivity, negativity or neutrality of a comment.
- Chatbots and virtual assistants: Create computer programs that can interact with users in a natural way, answering their questions and providing information.
- Discourse analysis: Analysing language in a larger social or cultural context to understand intentions, implications and hidden meanings.
- Information Extraction: Identifying and extracting specific information, such as dates, locations, amounts, etc., from unstructured text.

In the last two years, the field of LLMs has witnessed a meteoric rise, revolutionising natural language processing and understanding. The rapid evolution of this subject in this time is evident in the myriad of breakthroughs and innovations.

LLM services and capabilities are widely available on the "market". Beyond, ChatGPT suite developed by Open AI, many solutions and framework exist. While the pace of evolution is very much driven by the commercial players (Google, Amazon, Microsoft), a broad range of open-source solution are developed and maintained by active and open communities.

The recent advancements and the sheer capabilities of these models see for instance. "Sparks of Artificial General Intelligence'' paper on GPT-4 [v2] have demonstrated the potential of LLMs, highlighting their ability to perform tasks that were once thought to be exclusive to human cognition. In this era, where data is abundant and the need for accurate interpretation is paramount, LLMs offer a promising avenue to transform the way official statistics are understood and utilised.

LLM have already proven value in the context of Official statistics. The HLG MOS white paper on Generative AI provides a few illustrative examples:

LLM have a great potential for assisting, improving the efficiency and the quality of regular workplace tasks. Beyond the sheer use of ChatGPT web apps and locally deployed specific instances for day-to-day task, it is expected that these features will be integrated in standard desktop suite soon.

More specifically LLM have already revealed high potential for boosting some of the supporting capabilities to produce official statistics. In particular:

- Statistics Canada is using LLMs to generate textual descriptions from a table or a series of numbers which can be tailored to different audience segments, including policymakers, journalists, and the general public. This could greatly simplify the work of analysts and communication experts by providing initial drafts that human experts could work on. LLMs can also assist in automating the creation of charts and graphs, although this area is still under exploration.
- The Bank of International Settlements is exploring the use of LLM to produce metadata to document their open data.
- The Irish Central Statistics Office has built up a prototype based on chat GPT to assist coding and translating between programming languages (SAS & R).: LLMs have shown to significantly enhance the efficiency and effectiveness of programmers and analysts by helping streamlining and optimising code development, providing code snippets and translating them.
- The Australian Bureau of Statistics is using LLM to update and maintain statistical standard and generate draft text descriptions to assist human experts in updating statistical classification systems.
- Eurostat has developed algorithms to automatic classify occupations (ISCO) extracted from On Line Job Advertisement and build thesaurus and description ESCO digital skills taxonomy in the context of ESS Web Intelligence HUB .i.e. a set of methodological and technological capabilities for harvesting (web scrapping) and processing data obtained from the web.

3. Taking benefit from LLM while addressing risks and challenges.

Navigating the expansive landscape of LLMs presents a myriad of challenges and risks that demand careful consideration. Therefore, along the developments for maximising the output of LLM, it is necessary to consider these risks. The HLG-MOS white paper on generative AI described a series of risks that need to be taken into consideration when implementing LLMs in statistics. The key elements are summarised below providing some highlights on the practical way to mitigate them. Readers would refer to the original paper (ref UNECE) for a more thorough presentation.

Ethics and Legal aspects

LLMs pertain to the large family of AI solutions. The use of AI solution raises general issues regarding public trust and social licence to operate. Use of LLMs may lead to reputational damage and infringement is in case mistakes or generated content closed to copyrighted material are propagate to the public.

Governmental organisations have above all to abide to their respective regulatory environment that are being issued (see for instance the proposal for the EU Artificial

Intelligence Act (https://data.consilium.europa.eu/doc/document/ST-5662-2024-INIT/en/pdf). There is thus an urgent need to develop specific policies at the level of organisation for the development and use of AI solutions expanding privacy and statistical confidentiality provisions.

There are multiple relevant ethical frameworks for the use of AI, all of which cover similar principles. It is worth referring the attempt of UNECE – HLG-MOS task team to release draft guidelines for Responsible AI relevant at the level of the industry (ref UNECE 2). This framework needs to be adapted and instantiated in the context of LLM. Broadly, when using LLMs, the major considerations therein are the protection of human rights and the need for human-centred oversight and authority. It requires that a suitably qualified human should always be in the loop, and have a final say on any LLM generated output.

Transparency and explainability

Algorithms used in commercially available LLMs are rarely shared as open source, leading to considering them as black boxes. In addition, as data used for training the foundational model is not controlled; the number of parameters involved is gigantic; the objective function cannot be made explicit as they are convoluted in the depth of the deep neural network layers and many steps and ad hoc intervention are involved prior to the release, make these models not directly explainable. Transparency and explainability mostly revolve in exposing and sharing the script and the pipelines that are used to prompt the LLM foundational model. Therefore, their use should be supported by clear communication on the impact on users and the rationale and benefit for using them. In particular, metadata should contain information as to how that material was produced and any limitations it has, including potential for bias, hallucinations, etc.

Accuracy and bias

One of the major issues in LLMs use is "hallucinations", which stands for model generating inaccurate or completely not true information. It presents one of the key issues in using LLM in chatbots for example. LLMs have a documented tendency to make up facts and propagate biases inherited from their generic training on a massive dataset, usually containing billions of words from diverse sources such as internet.

Although recent model developments are focused on integrating back loop with fact checking capabilities to minimize the effects of hallucination, care should be taken to evaluate them and address biases in LLM outputs. Beyond the involvement of expert to validate and correct outputs as frequently encountered, new measures of accuracy based on semantic closeness need to be generalised and implemented to assess global performance in generating coherent outputs. Few examples of accuracy measures are described in the white paper.

The second main drawback of LLM is their inability to handle adequately numerical information. In the current settings, LLM are not mean to handle numerical data in the way that specialised algorithms and statistical/mathematical models do. Automated and reproducible data analysis and mathematical tasks are out of reach of LLMs. As a work around, numerical data can be transformed in text that can be

further embedded as an input to the model. Basic mathematical operations are emulated by using patterns expressed in textual examples on which the models have been trained but without the accuracy and the reproducibility of for instance R and Python scripts. Despite recent evolution of generic models to handle logical operation, LLMs do not have an internal framework of logical computation rendering them suboptimal (for instance in terms of technical resources and data governance) to undertake complex mathematical operations nor to understand complex mathematical prompts.

However, LLMs have proved to be quite efficient in translating of text to code, from semantic description into underlying programming concepts. This enables creating SQL or like SMDX queries (see IMF) to query the data repository directly from text taking benefit of the semantic content of the related metadata. With accurate implementation and suing a combination of text-to-text and text-to-SQL LLM representation, numerical values can therefore be retrieved automatically and the LLM can deliver a textual interpretation of the data [UNECE] as response to the user.

Privacy, data protection and data governance

Rights to privacy, data protection apply to both LLM training data and the information supplied as prompts. It requires to uplift the data governance in place to identify wide variety of sources that are activated and enable audits when errors and bias are detected. In addition, the wide availability of LLMs has proved to increase the risk of disclosure of protected information. As in most cases LMMs data sources provenance and accuracy are not under the control of the statistical offices, they must engage with the service provider to get minimal metadata and assurance the training sources uphold these rights. In the same line, inputting LLM models with sensitive information should be prohibited if safeguard measure (technical, organisational …) regarding their use by the LLM system are not put in place.

Generative AI and In-Context Learning

On one side, it is now recognised that the direct fine tuning of model can hardly be achieved by a single organisation. The main reasons are the difficulty to compile of vast amounts of "corporate" labelled data, the constant change and the flow of new information that will make the model already outdated when released, the lack of accessibility and openness of foundation LLMs available through API's only, the prohibitive processing costs and the restrictive licenses accompanying most powerful commercial solutions. In many cases, adjusting the model is not sustainable and effective and might not ensure the adequate quality.

On the other side, the need to limit and constraint the answers of the model to verified, fresher and cooperate information while benefiting of the flexibility of LLM is a key requirement. For instance, for chatbot assisting user to access official statistics indicators, a key requirement is to provide answer that use only open data and metadata from the dissemination systems.

The In-Context Learning (ICL) has been introduced as a practical framework to achieve a good trade-off between large scale fine tuning of LLM using corporate data and uncontrolled use of LLM exposing the user to hallucination and structural bias. In-

context learning is a mechanism to constraint LLMs towards specific results. It consists of providing the model with context when sending a request. First, ICL framework is trained on a limited set of examples to form a demonstration context. These examples are usually written in natural language templates. Then, ICL concatenates a query question and a piece of demonstration context together to form a prompt, which is then fed into the language model for prediction. A practical approach to leveraging ICL involves constructing a vector database that archives the embeddings of corporate documents. When a user submits a prompt, pertinent document vectors are swiftly retrieved from the database, supplying them as context to the model. The framework incentivises the model to respond with the answers obtained from the knowledge corpus that fed as contextual information together with the query of the model.

ICL has become the main method of applying the LLM technology for specific use cases. It is an efficient mechanism to feed specialised external knowledge to the models, to be able to provide answers in the specific domain. Research has shown that through ICL, LLMs capabilities can be expanded to execute more complex tasks, such as basic mathematical reasoning. All these functionalities rely on prompt engineering techniques, i.e., the careful and assisted design of input prompts to guide the model's output in desired directions, to make functions that work well for the specific use case.

For official statistics, leveraging LLMs in combination with ICL can be determinant in the processing the vast amounts of textual data, extraction meaningful insights, and support data-driven decisions using already available assets (Website, Publications Dissemination database, metadata systems) while at the same time providing the necessary safeguards to steer the response of LLM and control the drift of the model.

4. Improving access to Official Statistics: the Eurostat use case

Despite the significant modernisation effort National and International Statistical Offices have put transitioning their dissemination system taking benefit of state-of-the-art digital solutions, users who seek to extract insight from statistical data and related statistical information today, face several challenges. First, searching for the 'needle' of relevant data in the huge 'haystack' of Eurostat's dissemination environment (i.e., dissemination databases, statistics explained articles, statistical publications, press releases, etc.) can be time-consuming and burdensome, also due to the limitations of existing search interfaces and the need to process a great amount of context information along the process. Second, when dashboard interfaces are available, the analytics and visualisation functionalities may be limited to a small set of pre-defined ones that not always match the one required by the user. Third, even basic data analysis and visualisation tasks that do not fall into the set of pre-defined dashboard options require the users to program queries and scripts in some formal language (SQL, R, python etc.) Limitations include the complexity of 'search interfaces', limited search options, lack of prior knowledge of the structure of the dissemination environment, data overload or lack of user support for troubleshooting, or general guidance on how to use the database effectively and

interpret the results of searches. Moreover, for the analytics and visualisation, users would need to develop/use SQL/R/Python/ or other software to get insights of the data. accessing the latest, most relevant information available, integrating them with other sources required some effort (navigating through data and metadata system) and skills (statistical literacy) from users.

The development of metadata management systems accompanying dissemination databases provide to a certain degree data insights but their activation for automated analysis and visualisation possibilities are still very much unused. Advanced metadata system could link the metadata with the data they described and provide a rich semantic context to be used to search for across data silos. Effort to organise them as knowledge graph have proved of little impact on user experience.

LLMs can largely improve this situation and help improve the quality of data provision to users – through, for example,

- Providing a semantic aware interface to search statistical data using natural (human) language: questions in natural language are translated in the database query and returned in the form of graphs or table with statistical annotation and storytelling. There is no need to formulate complex queries in formal languages (e.g., SQL, R, Python, etc.) or program scripts in analytics tools.
- Enabling a richer interaction: LLMs can be used to engage in a dialogue with users to clarify their information needs and refine queries can result in more accurate and relevant responses.
- Providing different options for reply: users can choose how they receive statistical information from LLMs, for instance, summarised reports, in-depth analyses or raw data.
- Data interpretation assistance: LLMs can help users interpret complex statistical data by providing explanations, visualisations, and context and the scripts for retrieving data and carry out detailed analysis in the own environment.

It is hoped that in the long term, specialised generative application combining the many capabilities of the LLM ecosystem can contribute to the analysis the content of the data and provide deeper insights into the content combining structured and unstructured information, such as identifying relationships between concepts or detecting patterns in the data in multiple languages.

First learnings and recommendations for exploring and deploying generative AI solution.

The integration of LLMs into existing workflow systems unveils a significant transformative potential. The integration of LLMs into workflow systems not only optimises efficiency but also opens avenues for innovative applications across diverse domains. By seamlessly incorporating LLMs into established workflows or developing new ones, NSIs will automate repetitive tasks, leading to significant efficiency gains and streamlined processes. Their integration through their Application Programming Interface (API) enhances the adaptability of the application by allowing taking benefit on the development and innovations. This also facilitates a more stepwise and coherent approach, enabling to build generic capabilities serving a broad spectrum of applications.

The Eurostat experience collected so far through the landscaping and exploration of LMMs in the context access and dissemination of EU statistics indicates furthermore:

- The importance of prompt engineering techniques. The careful and programmatic design of input prompts to guide the model's output in the desired directions is at the core of any solution that works in real-life scenarios. This new discipline requires new skills and need to be developed at scale in the organisation prior to any development LLMs based solutions.
- It is necessary to design non-standard process including pre-validation of outputs by user and integrating in design domain expert for validation and finetuning of prompt system to achieve the desired output and quality. For instance, system can ensure that the data match end users request, by prompting the to validate the query parameters on the output prior to submitting the final query results. System should be able to segregate the numerical aspects of the query and the semantic and contextual aspects and to trat them separately but coherently. To gain in efficiency and confidence new quality metrics based on semantic similarity and factual correctness need to be developed enabling systematic benchmark of the different solutions and allowing gaining confidence of the level of uncertainty and mistakes generated by the system.
- Many valuable alternatives to commercial LLM exist and have been tested. Several open source and free alternatives are available and proved to be functionally equivalent to large models offering decent performance at a lower cost and enabling transparency and reproducibility. Commercial solutions still tend to have better performance and can be used as benchmark without prohibitive costs. Open-source alternative available can be deployed locally so to facilitate compliance to security policies. The open source models are available on open access platforms (such as replicate.com), provided as a service for the public user, while the models can also be deployed locally (on-premisse) with appropriate infrastructure to run them (GPU).
- In Context Learning is an effective way to constraint and integrate external information considering the need for constant adaptation to new information and the relatively high cost of fine-tuning foundational model. This should lead to a significant reduction of errors in practical applications.
- Adopting a user centric approach when designing solution does not only contribute probing the social expectance but also assessing actual benefit of the solution and helping in fine tuning the trade-off between uncertainty and usefulness of the system.
- Continue to assess and value the possibility to gradually develop industry model that are trained and finetuned with the core semantic assets and values of official statistics.
- Integrating and deploying LLM capabilities requires a careful and stagewise approach. The LLM ecosystem is fast-changing where new LLMs are being listed basically on weekly basic. Therefore, when experimenting and realising LLM applications, a layered and modular architecture is fundamental, to enable model-agnostic architecture. This important aspect enables to potentially change the LLM model used I application or use multiple models for different functionalities.

5. Generative AI – the way forward

Generative AI and ESS innovation: The One stop shop on AI/ML (AIML4OS)

The use of Artificial Intelligence/Machine Learning to produce official statistics is one of the strategic domains that need to be developed further and where coordinated ESS actions could be beneficial. It plays an important role in developing innovative solutions with respect to statistical products and processes, allowing for more timely production of official statistics and better response to user needs.

The ESS Innovation Agenda endorsed by ESSC in February 2023, has clearly recognised AI/ML as a key domain for cross cutting developments for processing new data sources and supporting complex processes. It involves the development and deployment of AI/ML to extract information for unstructured data, to assist in labour intensive activities, to improve data integration and users' experience. It requires pooling expertise to provide support to business initiatives exploring, for example, the use of data from sensors, satellite images, and web scraping to enhance statistics portfolio Several NSIs have already embarked on various pilot projects testing and implementing AI/ML methods and tools in various domains leading to new or improved statistical products. Therefore, collaboration and co-creation is likely to boost development in this domain for creating the conditions for bringing these approaches into statistical production across the ESS.

The goal of the one-stop-shop for AI/ML is to guide and support ESS organisations, towards experimentation and eventually the use of AI/ML solutions for official statistics production (products and processes). On the one hand, to realise added value by aiming at providing effective and tailored guidance and assistance to the ESS organisation. On the other hand, to continue developing knowledge and provide mock up and standard for implementing use cases to produce official statistics -based on AI/ML solutions.

The One Stop Shop on AI/ML will be single entry point for ESS staff involved in innovation to identify concrete opportunities and to be guided and supported in deploying AI/ML solutions within adequate methodological and implementation frameworks in view of developing new statistical products and processes taking advantage of AI/ML state of the art research and developments. The scope of AI/ML applications is broad and includes existing applications in production pipelines as well as experimental and testing applications. Guidance should be adequate for basic, intermediate and advanced AI/ML implementation levels.

In addition, the One Stop Shop on AI/ML will continuously develop, maintain, and evolve a coherent set of relevant capabilities (including methodologies, guidelines, sandboxes, labelled data, processes, methodological, implementation and quality frameworks for implementing AI/ML-based solutions in official statistics across the ESS. It will provide a platform/hub providing a single gateway for ESS staff to access the relevant capabilities. It will provide support and guidance for the integration and maintenance of relevant AI/ML-based solutions in ESS organisations through training and active and efficient support. Fostering reuse of new solution, the consortium should build on open-source solutions and their active communities to provide a range of tools that can be leverage. The AIML4OS will implement new form of agile

cooperation allowing sharing ideas, experiences, success stories and lessons learned to stimulate innovation. Special attention will be given to facilitate the transition from development and experimentation of AI/ML-based solutions to industrialisation and production.

Beyond the already well-established use cases such as automatic classification editing and imputation and satellite image processing, LLM in the context of NLP will certainly receive much attention and the project should contribute to mature solutions than can be scale up at the level of the industry.

The case for international cooperation

As already stated, LLMs are still in their infancy and remain an uncharted field for Official Statistics. The skills and knowledge are scattered. No one fits all solution is expected and the pipelines to be designed will be realised by the combination of specialised modules to adapt to real life situation.

Customisation and fine-tuning of LLMs are pivotal activities for ensuring quality and performance of LLMs in statistical applications. Tailoring the LLM for statistics involves customising its parameters and compiling rich information corpus to be embedded in models and queries to ensure its relevance and accuracy within specific context of statistics.

In this context, the importance of data curation, metadata descriptions and semantic enrichment (providing more verbose descriptions of tables and columns), has a very significant impact on performance of models and ability to understand the data represented in the tables. Using rich descriptions of the tables enables for models to build a cohesive representation of Official Statistics dissemination system. Work is needed to prepare and optimise the way contextual data descriptions and definitions, together with vocabularies, to enable more advanced AI functionalities.

Part of these activities can more efficiently be performed at the level of Official Statistics industry leveraging common standards and assets such SDMX. It should also involve the active engagement of the community of users as social license and output validation are essential. By activating a community around the LLM, official statistics organisations and developers can create an environment conducive to knowledge sharing and collaboration. This collaborative approach not only enhances the model's capabilities but also ensures that it remains attuned to the evolving needs and challenges within the statistical community.

An important aspect is collaboration with statistical domain subject matter experts. It is instrumental in enhancing the effectiveness of LLMs for specific use cases. By actively engaging with experts in specific fields, LLMs can be improved with respect to accuracy and relevance. Seeking input from these experts also serves as a crucial validation mechanism, ensuring that the LLMs' output aligns (e.g., concerning quality) with the requirements and of specialised fields.

In the area of scalability and performance optimisation, despite the current trend is to development of much smaller model, very often provided with open-source license delivering core LLM capabilities, the requirements for a technical infrastructure remain significant. Bearing the cost of managed solutions provided by standard cloud providers may not be sustainable in the long run. It is crucial to achieve economies of

scale, effectively sharing resources and infrastructure. This collaborative approach would also help to moderate the environmental impact of LLMs, addressing concerns related to computational resources, energy consumption, e-waste, hardware production, carbon footprint of data centres, and the need for more sustainable practices.

In this context, international cooperation based on voluntary participation as initiated at UNECE level is essential waiting for more sustainable and structured approaches. In particular, the HLG MOS is launching in 2024 a project on generative AI. It capitalises on the momentum generated by the work conducted for white paper on generative AI. Participation is not limited to statistical organisations; it includes government agencies and research/academia. It should involve the sharing of use cases to share experiences and insights, not only for text based LLM output but also other types of multi-modal generative AI use (e.g., image generation). It will encourage co-development of solution(s) on common targeted use cases: that are of common interest for statistical organisations (e.g., chatbot), The project should contribute to accumulating and sharing experience in the community possibly addressing concrete recommendations on the use of generative AI for official statistics.

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The Potential of Generative AI in Official Statistics

External statistics after the pandemic: addressing novel analytical challenges
Madrid, 12-13 February 2024

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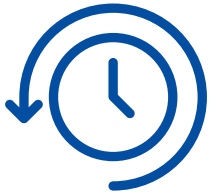
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Outline

- Acknowledgements
- Innovation of official statistics
- Generative AI – Large Language Model
- Risks and challenges
- Eurostat use cases (In Context Learning)
- Future perspectives:
  - International Collaboration
  - ESS One-Stop-Shop on AI/ML

European Commission

The Need for Innovation



Timelier, more detailed statistics needed to meet user demands

Rapid societal and technological changes require more frequent and more granular statistics



European Statistical System must be more responsive and agile and resilient to crises

ESS needs to expand use of digital technologies and new data sources

Innovation is vital for ESS to meet evolving user needs in a rapidly evolving data ecosystem



ESS Innovation Agenda

Goals

- **Strengthen the ESS ability to respond rapidly to new and urgent user needs**
- **Augment products and service portfolio for meeting policy needs**
- **Realize efficiency gains to free up resources**
- **Strengthen resilience to shocks and adapt to societal change**

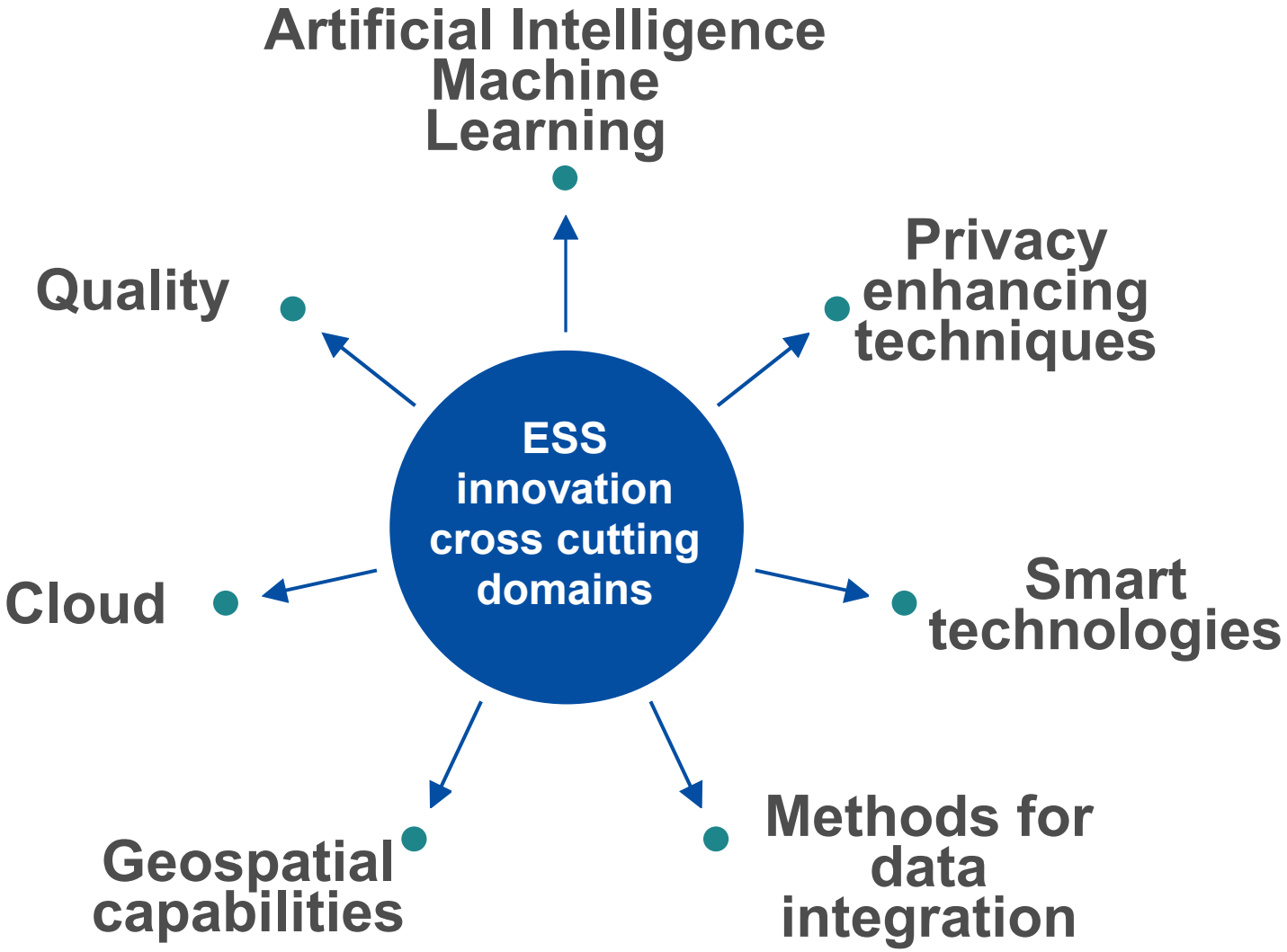
Means

- Leverage key innovation **drivers and enablers**, offered by the recent technological developments
- Promote internal and external **cooperation**
- '**Cross-domain**' thinking and working
- Focus on implementing in statistical production

European Commission

Methodological and Technological innovations

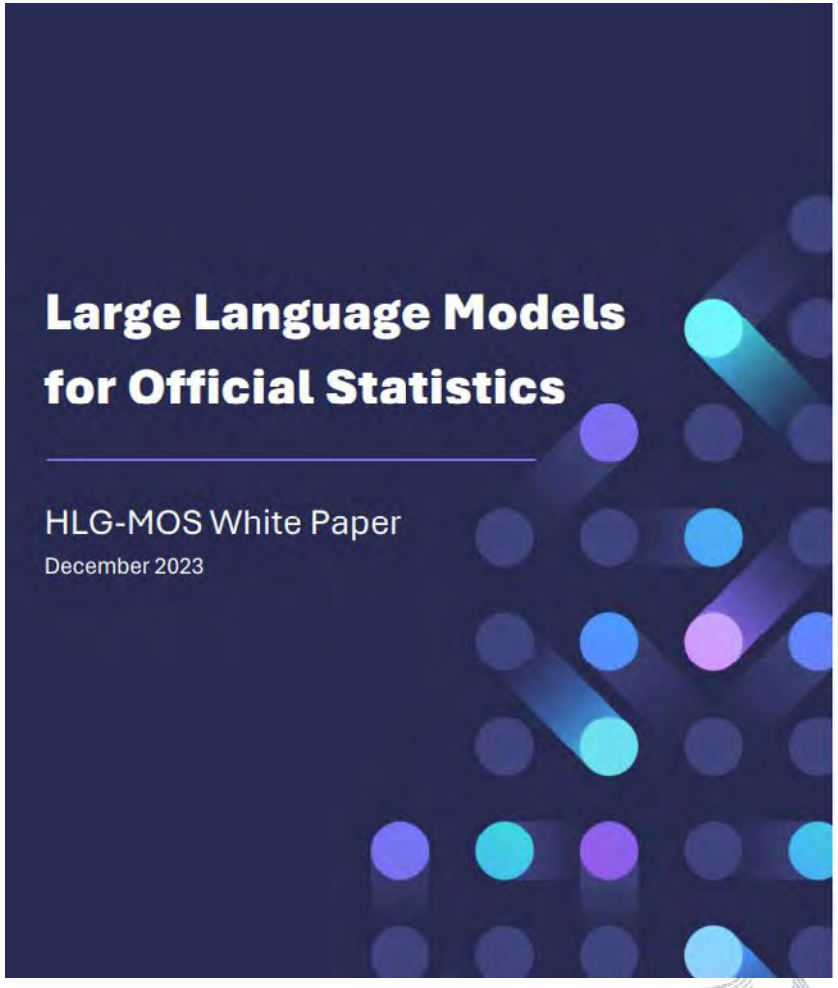
TOP priorities



European Commission

AI & Official Statistics
Improving efficiency and statistical services

- Data collection
- Data processing and cleaning
- Quantitative data analysis (imagery, web)
- Qualitative data analysis and extraction of findings
- Data and knowledge discovery
- Improving data user experience (Chatbots)
- Operational efficiency of the supporting services: translation, memos, emails, summarization



White paper on generative AI for official statistics (unece.org)

AI disruption: Generative Pretrained Transformer

GPT-1: 2018

117 million parameters

GPT-2: 2019

1.5 Billion parameters

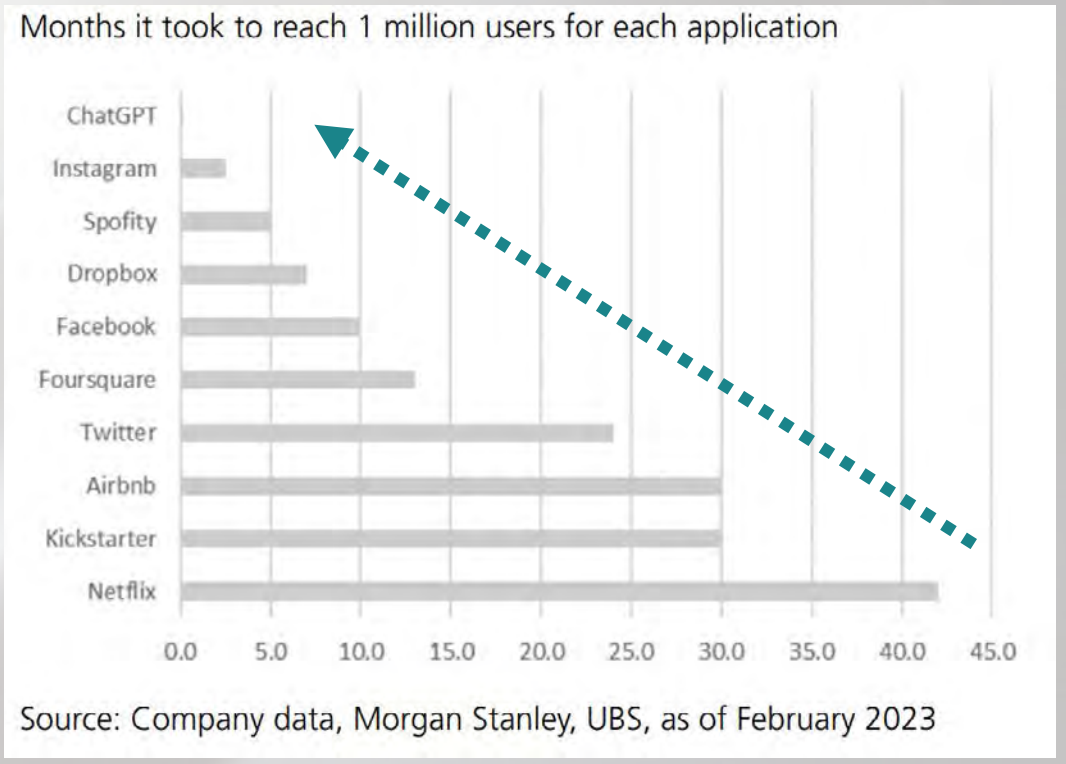
GPT-3: June 2020

175 billion parameters

ChatGPT

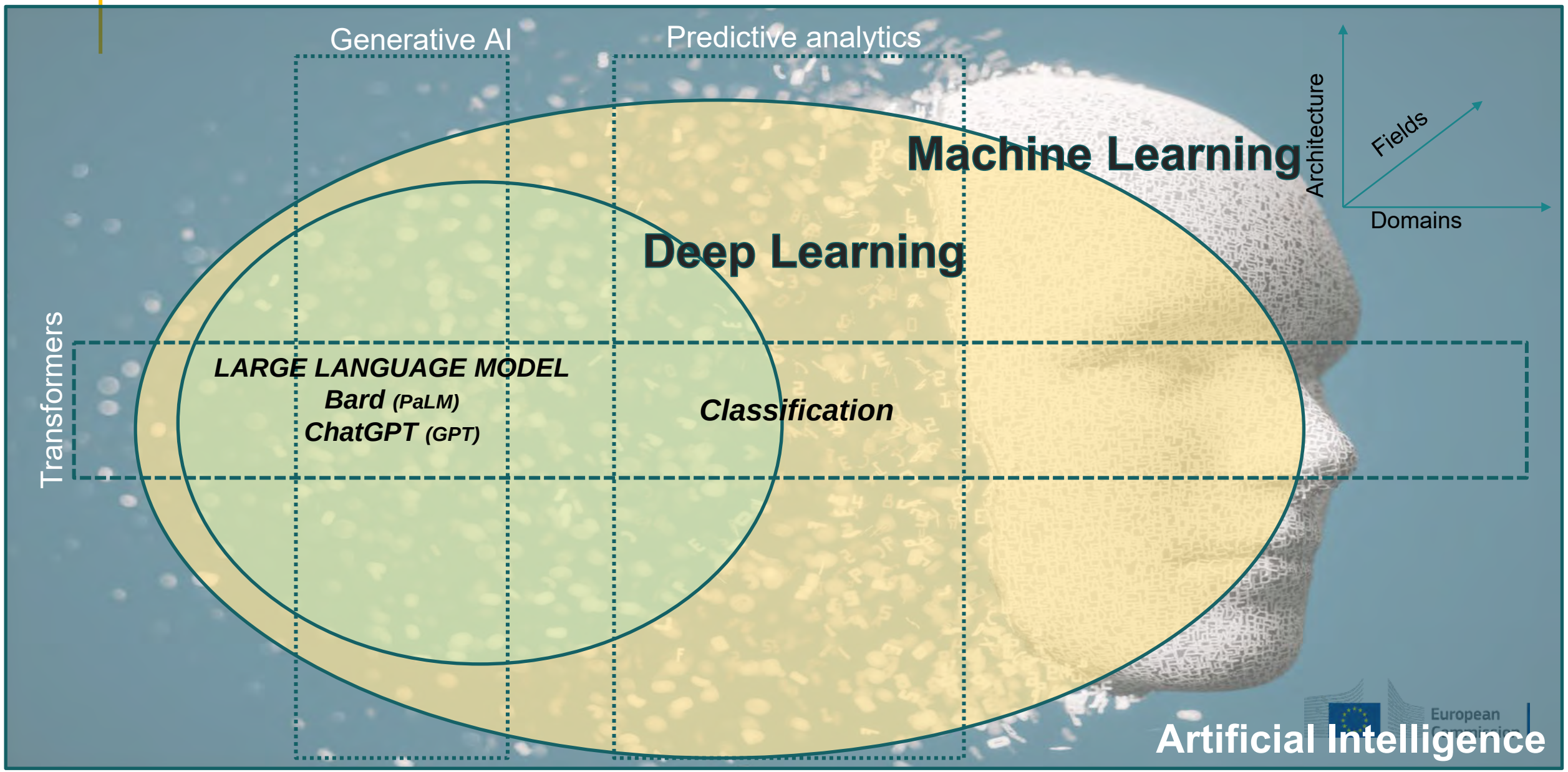
GPT4: Early 2023

100 trillion parameters



European Commission

AI landscape



Large Language Models

What are they ? Advanced AI systems trained on vast amounts of text data to generate human-like text.

How they works

Models predict the next word in the output sentence

Content is generated by a deep neural network. Parameters are adjusted during the training

Strengths

Efficient at text-related tasks, can understand nuance and generate human-quality text.

Foundational model can be fined tuned for specific tasks

Standard tasks

Analyze text, answer questions, summarize, translate and generate new text.

Limitations

Prone to hallucinations, inaccuracies, and perpetuating biases in training data.

Costs of finetuning

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Risks and Challenges

- Ethics

LLMs raise issues regarding ethics and social acceptability.

Ethical frameworks need adapting to LLMs:

human oversight and user feedback.

- Accuracy and Bias

'Hallucinations' and propagating biases from training data are key issues.

New semantic closeness measures are needed to assess LLMs.

- Privacy, Data Protection & IPR

Rights to privacy, data protection, IPR apply to LLM training data and derived user output.

Data governance needs strengthening for audit trails.

- Transparency

LLMs are 'black boxes': limited access to algorithms, input data and parameters.

Use should be supported by documentation and communication on limitations and bias potential.

Eurostat use cases (exploration)

UC Level 1: Statistical advisor

The application enables users to search for the relevant Eurostat data, based on simple text description and recommends the relevant data sources to be used.
A chat session assistant.

UC Level 2: Statistical assistant

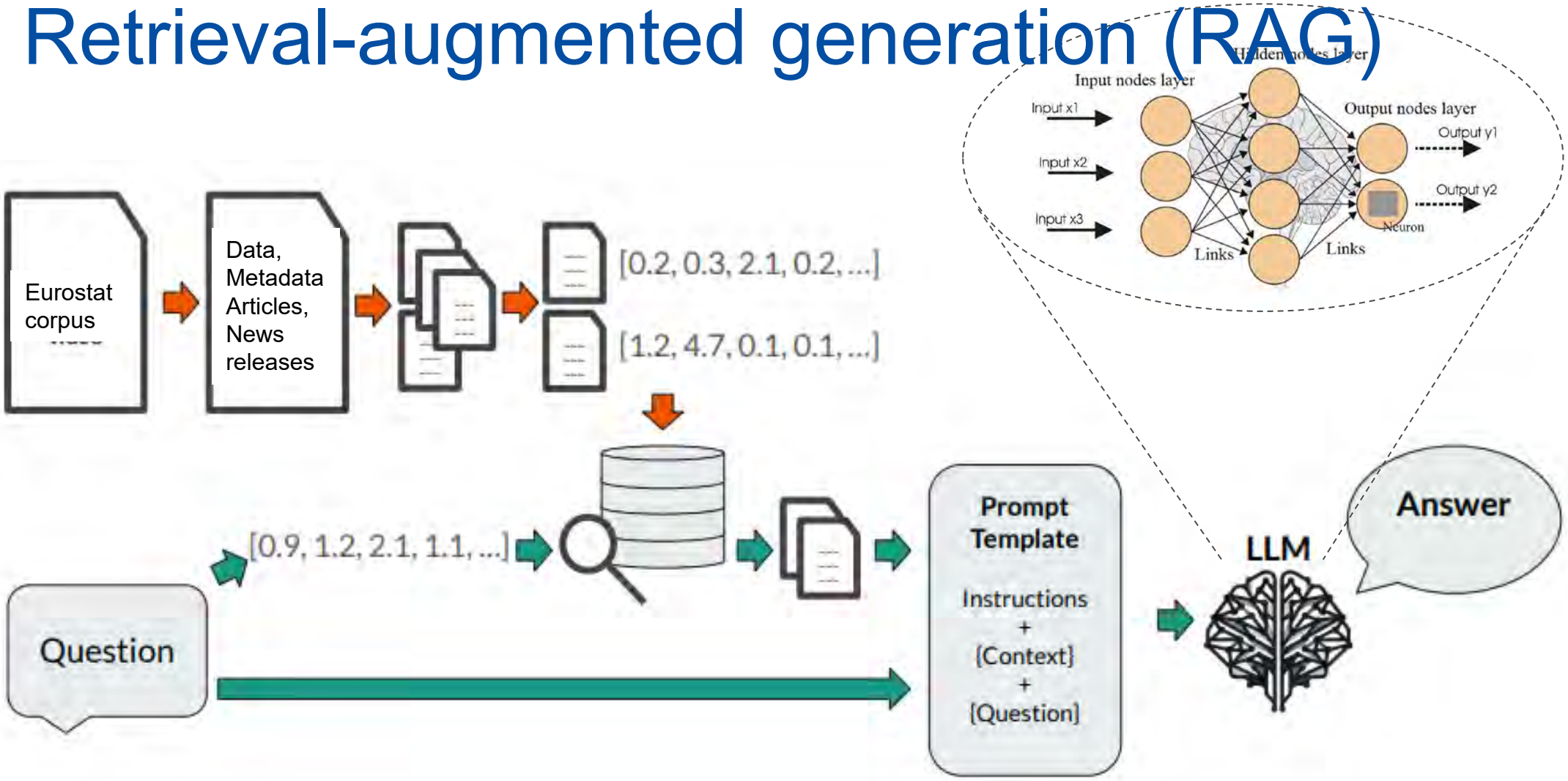
The application enables searching and retrieving relevant Eurostat data, based on problem description.
The data would be available in different formats (graphs, tables, extraction scripts) accompanied with relevant description.
Chat session + numerical data retrieval

UC Level 3: Analytical assistant

Performing analysis on top of Eurostat's data corpora, based on problem description.
Chat sessions + complex analytical data processing
.

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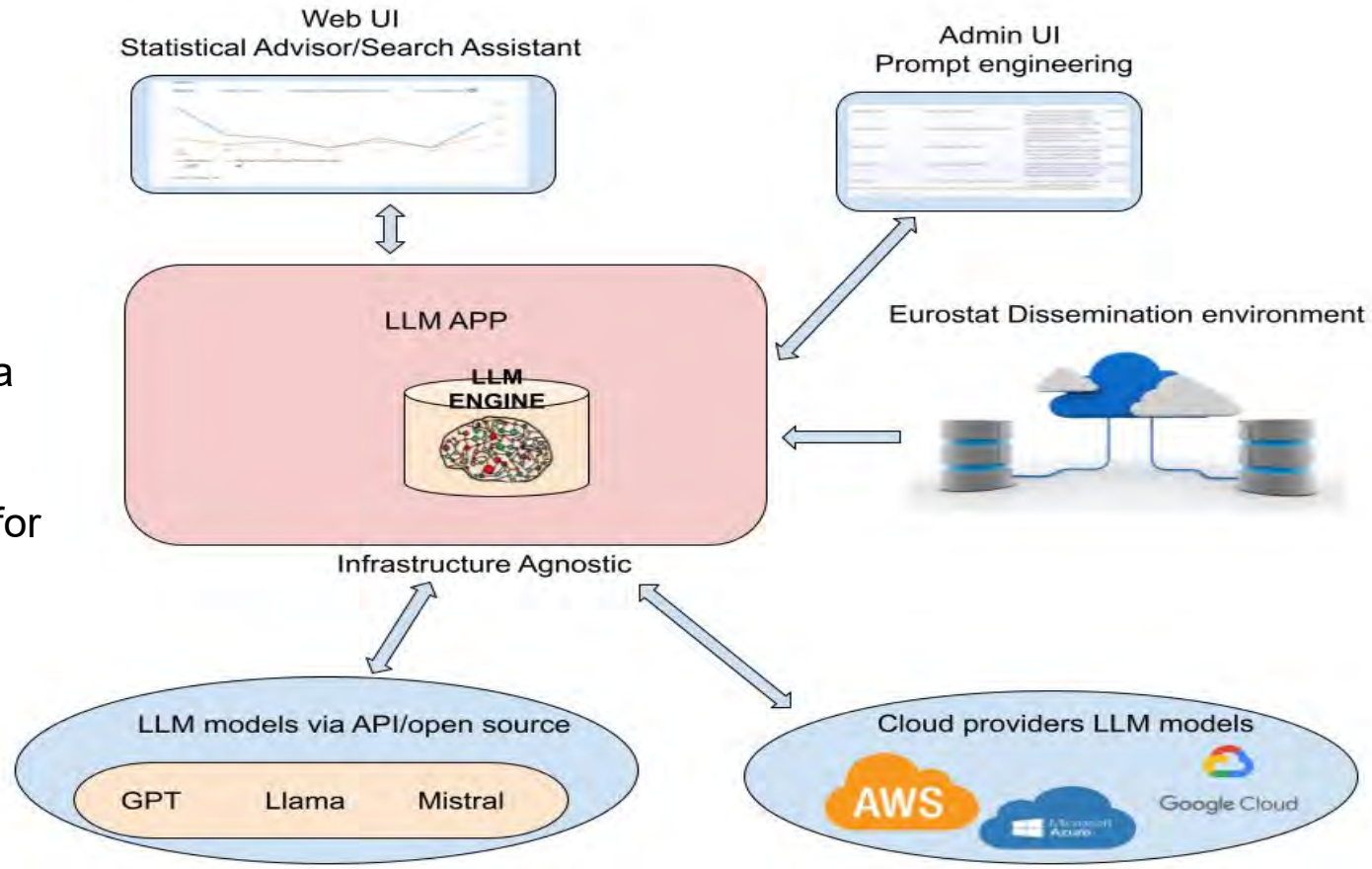
In-Context Learning (ICL)
Retrieval-augmented generation (RAG)



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Eurostat experimentation evolvable workbench

- LLM models: able to use open source models on premise and dedicated cloud-based proprietary instances such as MS Azure or AI studio
- Eurostat's assets (metadata description, catalogues, articles) embedded in the vector data base
- Web UI for the users of the Statistical assistant, for information search and retrieval accessible from Eurostat's dissemination environment
- Admin Web UI for Administrator of the system to do prompt engineering or other configurations



Eurostat aims to cautiously evaluate LLMs capabilities benchmarking the different models available

Case for international cooperation

Model Customization

Collaboration needed for model finetuning which requires data and domain expertise.

Data Curation

International cooperation to curate Official Statistics data corpus and datasets for training generative AI models.

Pooling skills

Sharing knowledge across countries will aid in customizing models for specific statistical use cases.

Infrastructure Sharing

Pooling computational resources through infrastructure sharing can help reduce the environmental impact of large AI models.

Accumulating Experience

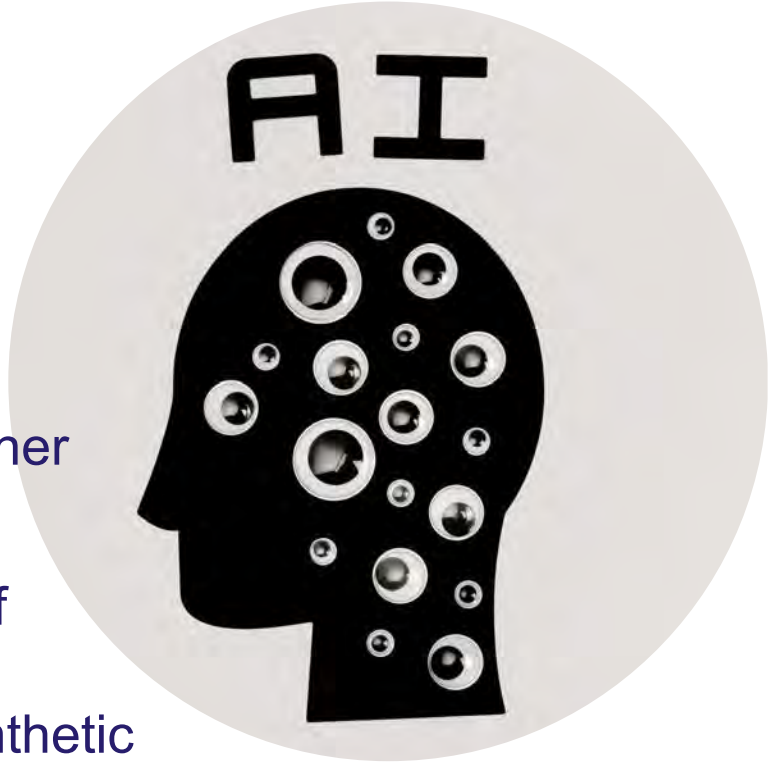
Cooperative initiatives allow accumulating experience in applying generative AI to official statistics.

Developing Use Cases

International collaboration enables exploring and developing new use cases for generative AI in statistics.

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AI/ML One-Stop-Shop



A single-entry point for NSIs staff

- Sandbox infrastructure to test and pilot AI/ML approaches together with training and coaching
- Reference implementation of AI approaches in the production of official statistics (e.g. information extraction, data editing and imputation, automatic coding, use of LLM, network analysis, synthetic data / predictive analytics)
- Communities to share ideas, experiences, success stories and lessons learned to stimulate innovation based on the use of AI/ML.
- Best practices to facilitate the transition from development and experimentation of AI/ML-based solutions to industrialisation and production

Thank you

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IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Exploring the evolving determinants of foreign direct investment and the investing country preferences in developing Asian economies using machine learning[1]

Carmelita G Esclanda-Lo, Gabriel A Masangkay,
Chelsea Anne S Ong and Rossvern S Reyes,
Bangko Sentral ng Pilipinas

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Exploring the evolving determinants of foreign direct investment and the investing country preferences in developing Asian economies using machine learning

Carmelita G. Esclanda-Lo, Gabriel A. Masangkay, Chelsea Anne S. Ong, Rossvern S. Reyes[1]

Abstract

Foreign Direct Investment (FDI) has the potential to stimulate and sustain economic growth in both the recipient and investing countries, especially during the economic recovery following the pandemic. Recipient countries have been able to finance new infrastructure projects and create local jobs through FDI, while foreign direct investors have been able to enlarge their global presence. According to the UNCTAD World Investment Report 2023, Asia received 51% of global inflows but remained steady at USD 662 billion in 2021. Singapore, the largest receiver in Southeast Asia, set another record, increasing by 8% to $141 billion. Flows to Malaysia increased by 39% to $17 billion, setting a new high for the country. FDI to Vietnam and Indonesia increased by 14% and 4%, respectively, to $18 billion and $22 billion, while FDI to the Philippines decreased by 23% due to many divestments. There have been many studies done on the factors that influence FDI. However, more research is still needed to determine the factors that contribute to the increasing foreign capital transported and the preference of investing countries to Asia's developing markets. With the advent of automated machine learning (ML), we utilize panel data from several open-source international databases and run various ML techniques (e.g., Decision Trees, Random Forest Classifier, Gradient Boosting Machines) in examining the economic, institutional, political, and environmental determinants of FDI inflow from 2008 to 2022 in developing Asian Economies as well as uncover investing country preferences through time via unsupervised similarity calculations.

Keywords: foreign direct investment, developing Asia, machine learning, panel data analysis

JEL classification: F21, B17, G11, C33, O53

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1. Introduction

In the fast-evolving global economic landscape, it has been important to understand the drivers behind Foreign Direct Investment (FDI), especially for politicians, investors, and researchers. FDI significantly shapes the nations' economic future, impacting economic growth, employment, and technological progress (Alfaro et al., 2017). Conventional economic models and statistical research have been used to identify FDI determinants.

ML has been effective in finding patterns and connections within vast and complicated datasets, which is essential given the complexity and non-linearity of factors influencing FDI. As such, for this study, we used ML techniques to find new determinants, uncover hidden insights, and improve the predictive power of FDI models. The main objective of this research is to utilize ML techniques to bridge the gap between conventional econometric methodologies and the complex nature of FDI.

The ML methods used were decision trees, random forests, and gradient boosting to find non-linear correlations between FDI and its determinants. These models and algorithms can often achieve higher accuracy and generalization than linear models and algorithms, but they may also require more data, tuning, and interpretation. ML methods were also used to identify the relevance of various factors affecting FDI so as to provide insights into the variables most significantly influencing investment decisions.

Finally, we used unsupervised similarity calculations to uncover the similarity between country investors based on their interactions or preferences without relying on explicit labels or training data. To uncover mutual economic interests, geopolitical factors, or geographical preferences, we examined which countries invest together regularly or have comparable investment destinations.

We utilized an extensive dataset covering trade flows, institutional variables, macroeconomic indicators, and other pertinent variables of developing Asian nations over a predetermined period. We then compared the different ML algorithms with conventional econometric models in capturing the intricate dynamics of FDI.

2. FDI in developing Asia

It is crucial to investigate the factors influencing FDI in developing Asia and provide information to investors, researchers, and governments. This knowledge is essential for developing successful policies, attracting investments, fostering economic expansion, and ensuring long-term development.

Before the 1980s, developing countries viewed FDI adversely. This was fuelled by colonial experiences and the widespread belief that multinational corporations (MNCs) would wield significant economic and political power over the host country (Brooks et al., 2003). That perspective on FDIs has long been abandoned, with FDIs now viewed as a crucial driver of economic progress. China's Open Door Policy in 1978 was a pivotal event that transformed the global FDI landscape, marking China's transition towards an open-market economy by allowing foreign investments. Special Economic Zones (SEZ), free of bureaucratic restrictions and regulations, were quickly established in Shenzhen, Shantou, Zhuhai, and Xiamen, making China an attractive foreign investment destination. Since their inception, these SEZs have welcomed significant FDIs, paving the way for China's rapid industrialization and propelling the country to become the second largest economy in the world.

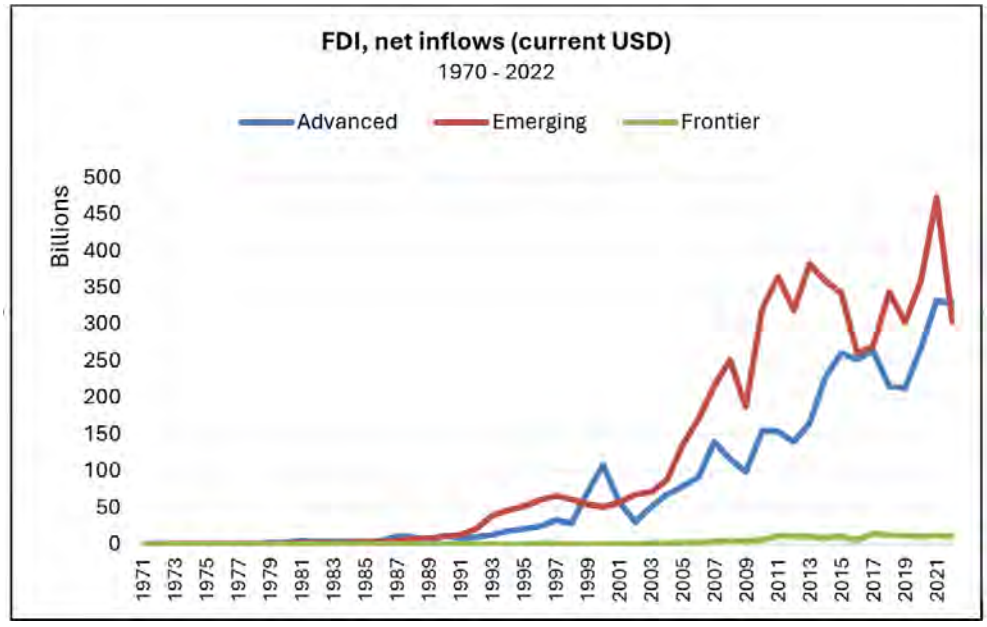


Figure 1. Sum of FDI net inflows (BoP, current USD)
Source: Authors' computation based on the World Development Indicators.

FDIs are regarded as critical in driving economic growth in China and the rest of Asia. Figure 1 demonstrates that net FDI inflows into Advanced and Emerging Asian countries have considerably increased since the 1970s.[2] For all of Asia, FDI inflows

[2] Per the IMF's Regional Economic Outlook, Advanced Asian countries include Australia, Hong Kong SAR, Japan, Korea, New Zealand, Singapore, and Taiwan Province of China; Emerging Asian countries are China, India, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam; while, Frontier Asian countries are Bangladesh, Cambodia, Lao People's Democratic Republic, Mongolia, Myanmar, Nepal, and Sri Lanka.

began to climb in the late 1980s and have continued to increase since then, suggesting the region's positive disposition towards FDIs.

There are several reasons why a host country accepts FDIs. FDIs contribute to capital formation by injecting much-needed funds into domestic economies (Blomström & Kokko, 2003). This influx of capital encourages investment in various sectors and stimulates economic growth. FDIs are also crucial for technology transfer since multinational corporations bring innovative technologies and managerial expertise to the host country, thereby increasing the productivity and efficiency of local industries (Blalock & Gertler, 2008). The positive impact also extends to job generation since foreign investors often establish or expand businesses (Lipsey & Sjöholm, 2005).

Furthermore, FDIs improve market access and global competitiveness by allowing local industries to compete in foreign markets and increase exports (UNCTAD, 2020). FDI inflows also lead to the construction of critical infrastructure, such as transportation and energy, which improves the overall economic landscape of host nations (Asiedu, 2002). While the literature recognizes the varied nature of FDI effects, there is widespread consensus that well-managed and targeted foreign investments can significantly propel economic development.

Asian nations have adopted several reforms to create an inviting environment for foreign investors as the benefits of FDIs have become widely recognized. For instance, countries like Singapore and Hong Kong have demonstrated proficiency in liberalizing investment policies, offering minimum bureaucratic obstacles and expediting approval procedures for foreign investors. China and India have established SEZs that provide tax incentives and simplified regulations. Malaysia and Thailand leveraged tax incentives to attract FDI and reduced tax rates for a specified period to encourage foreign investments. At the same time, South Korea focused on infrastructure development, while Vietnam established Investment Promotion Agencies (IPAs) to encourage a well-connected business environment. Meanwhile, the Philippines amended the Public Service Act to liberalize various industries to attract more foreign investment. Indonesia updated its Negative Investment List to open up more sectors, particularly in e-commerce, logistics, and tourism.

3. Determinants of FDI

Based on the literature, FDI is an important economic driver for a host country. As such, it is critical to understand the drivers of FDI flows, which host countries may use as basis to develop strategies that encourage or foster foreign direct investments into a host country. It is critical for policymakers, economists, and businesses to understand FDI flows as they study international investment trends, assess the impact on host and home nations, and develop strategies to encourage or engage in FDI.

Diverse factors influence FDI attraction in host countries, varying across regions, countries, and sectors. Per existing literature, economic variables play a crucial role in influencing FDI. Countries with larger populations would have higher potential

demand and lower costs due to economies of scale (Resmini, 2000; Bevan and Eastrin, 2000; and Bhavan et al., 2010), while openness to trade and investments, and higher levels of trade indicate a country's positive disposition towards foreign trade. Zaman et al. (2018) found that higher openness to trade, defined as the sum of a country's exports and imports as a share of GDP, positively impacts FDI inflows in India, Iran, and Pakistan, while Resmini (2000) found that manufacturing sectors in Central and Eastern European countries benefit from increased trade openness.

Additionally, weaker exchange rates resulted in an increase in FDIs as relatively lower prices in host countries incentivized foreign firms. Froot and Stein (1991) found that countries with weak currencies tend to have more significant FDI inflows. Contrarily, a stronger real exchange rate increases costs, incentivizing foreign firms to produce domestically.

Institutional and political stability are important factors that investors consider when entering foreign markets. Uddin et al. (2019) found that institutional factors, such as the size of the government, legal structure, strong property rights, freedom to trade, and civil liberty significantly affect FDI inflows in Pakistan, while Schneider and Frey (1985) found that political instability significantly reduces the FDI inflows.

4. Machine learning approaches in analyzing FDI

The increasing volume and complexity of FDI datasets made extracting useful information using traditional analytical processes more challenging. To address this, analysts and researchers are actively exploring ML approaches to uncover hidden correlations and non-linear relationships among various factors influencing investment decisions. For instance, Singh (2023) developed an interpretable machine learning (IML) framework to examine FDI inflow in Europe using the data from the World Bank from 1995 to 2018. In this study, we explored supervised and unsupervised learning methodologies to understand FDI dynamics using data from investing and recipient economies.

4.1 Supervised learning

Supervised learning involves training ML models on historical FDI data where the outcomes are known. The trained models can then generalize patterns from the historical data to make predictions and generate a feature importance list to identify the top determinants of FDI in a given timeframe.

Random Forest

Random Forest (RF) is an ensemble learning method known for building multiple decision trees with random subsets of data and features. It builds multiple decision-making models and then combines their outputs to make more accurate predictions, as shown in Figure 2. RF is robust to overfitting and can handle large datasets with high dimensionality. Several studies used RF, such as Jiménez and Herrero (2019), which explored feature selection for FDI in Spain, and Horobet et al. (2021), which investigated driving factors of business profitability in European high-tech vs. low-

tech companies. The former revealed that urbanization, GDP growth rate, and unemployment significantly influence country-level FDI, while the latter indicated that the impact of FDI is more substantial for profitability in higher technologically intensive industries.

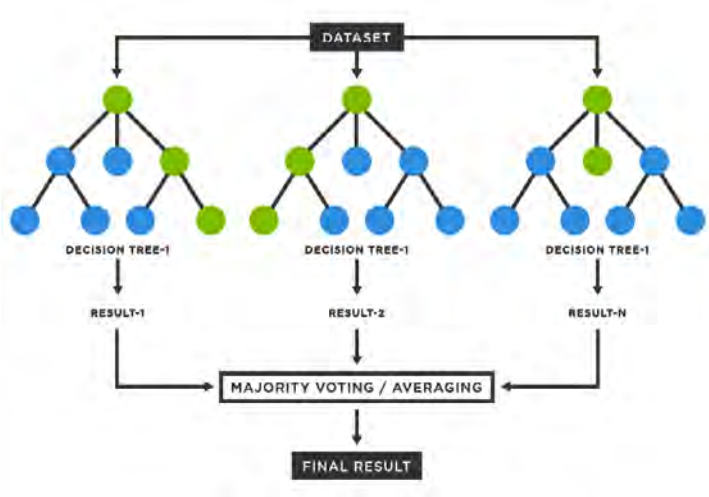


Figure 2. Random Forest

Source: Spotfire.com

Extra Trees Regression

Extra Trees Regression extends the RF algorithm by elevating the randomness further in building the decision trees. Each tree is trained on a random subset of features, and at each split, a random subset of potential splits is considered. This randomness helps reduce overfitting and can result in a more robust and accurate regression model, especially when the dataset has noisy or complex patterns.

Support Vector Regression

Support Vector Regression (SVR) is a regression algorithm based on the concept of Support Vector Machines where the objective is to find a hyperplane that fits the training data within a specified margin called the epsilon-tube (ε-tube), as shown in Figure 3. This minimizes the error of points outside this tube. SVR's performance can be sensitive to the choice of hyperparameters, such as the kernel and regularization parameters. SVR can handle noisy data and outliers, providing more robust predictions and avoiding undue influence from irregularities in the dataset.

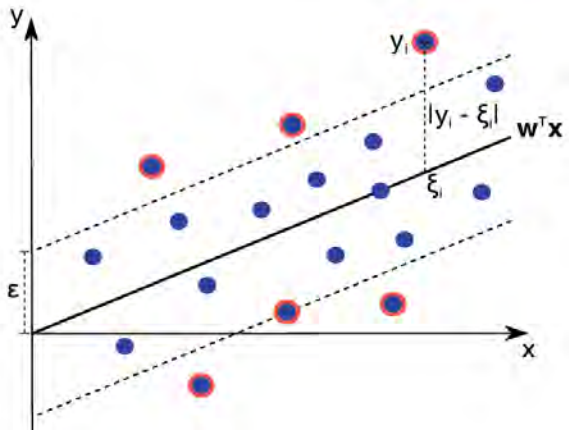


Figure 3. Support Vector Regression

Source: Rosenbaum et al. (2013)

Gradient Boosting Machines

Gradient Boosting Machines build an ensemble of weak learners, refining predictions by minimizing residuals at each step. It excels in capturing complex relationships, providing high predictive accuracy, and is robust to outliers and missing data. Giraldo et al. (2023) utilized extreme gradient boosting (XGBoost) and SHAP Additive Explanations to investigate sovereign risk determinants across countries from 2002 to 2021, while Zhou et al. (2023) identified several macroeconomic factors affecting FDI inflow to China during the pandemic using XGBoost tree regression model – including correlation between the actual monthly data of FDI and the economic variables.

CatBoost Regression

CatBoost is an intelligent algorithm that combines decision trees and gradient boosting to make accurate predictions. Boosting involves combining weaker models to create a robust predictive model. CatBoost grows "oblivious trees," where nodes at the same level test the exact predictor with the same condition. This unique tree-growing approach simplifies the process, thus making it efficient for computation while also preventing overfitting for better predictions.

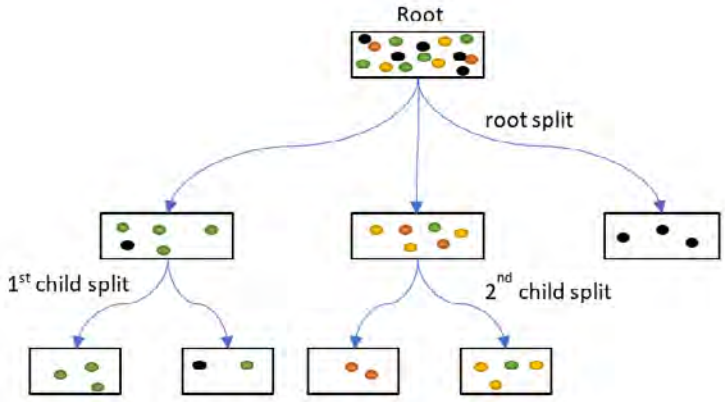


Figure 4. CatBoost Regression

Source: Prokhorenkova et al. (2018)

4.2 Unsupervised learning

As countries integrate into the global economy, the interactions between investing and receiving nations have become increasingly complex. Unsupervised learning techniques, such as association analysis and collaborative filtering, provide a novel lens through which we can discern hidden patterns, correlations, and clusters in the complex FDI dataset.

Association Rule Mining

Association rule mining is a technique used to discover hidden relationships between variables in large datasets. It is a popular method in data mining and machine learning. It has various applications in various fields, such as market basket analysis, customer segmentation, and fraud detection.

Concept	Formula
Support	$\sup(X) = \frac{(X \cup Y)}{N}$
Confidence	$\text{conf}(X \rightarrow Y) = \frac{(X \cup Y)}{X}$
Lift	$\text{lift}(X \rightarrow Y) = \frac{sup(X \cup Y)}{sup(X) * sup(Y)}$

Sources: Kim et al. (2017), Yaman et al. (2020)

Support pertains to the fraction of investment instances that flow to a specific set of countries. Confidence refers to how often items in country Y are invested in with country X. Lift shows how many more times than expected X and Y were invested together if they were statistically independent. A lift value must be greater than one to indicate independence between X and Y. The greater the values of support, confidence, and lift, the more associated the countries are.

Cluster Analysis using Collaborative Filtering

Collaborative filtering is employed to unravel shared investment strategies among countries focusing on developing Asian economies. Collaborative filtering is a technique that gathers preferences from numerous users to predict the interests of a particular user automatically. By examining the investment patterns of different nations, this analysis aims to identify countries that exhibit similar strategies in their investments within the Asian region. Mathematically, this can be shown as:

$$sim(a,b) = \frac{\sum_{p \in P}(r_{a,p} - \bar{r_a})(r_{b,p} - \bar{r_b})}{\sqrt{\sum_{p \in P}(r_{a,p} - \bar{r_a})^2}\sqrt{\sum_{p \in P}(r_{b,p} - \bar{r_b})^2}}$$

where a and b are investing countries, $r_{a,p}$ is the inflow of an investing country to a recipient country, and P is the set of countries invested in by both countries a and b.

This method analyzes historical investment data in the context of FDI without requiring pre-existing labels or training sets. By utilizing the inherent connections between investors and their investment decisions, collaborative filtering sheds light on obscure trends and provides a sophisticated comprehension of the complex preferences influencing FDI decisions.

5. The Variables and Data

According to Bretas et al. (2021), companies prioritize host markets offering good market conditions (e.g., market growth, size, trade flows, open trade regimes and regional integration), good access and entry conditions, good production conditions (e.g., low cost of production and labor, availability of natural resources), good institutional framework (governance and acceptable risk) and suitable structure for FDI (e.g., financial development, political stability, inflation, exchange and interest rates, taxes and capital regulation).

To study the FDI determinants, we analyzed yearly observations from 2008 to 2022 (15 years) for 20 developing Asian countries. The datasets are obtained from four databases (i.e., the United Nations Conference on Trade and Development's Bilateral FDI Statistics, the International Monetary Fund (IMF) DataMapper Datasets, Word Development Indicators DataBank, and ADB Key Indicators Database). Initially, we gathered 38 economic, institutional, political, and environmental indicators, as listed in Appendix A. However, upon checking the completeness and fit for analysis, these were trimmed down to 18 variables listed in Appendix B.

FDI inflow data per country is presented in Figure 5, which shows that most of the country samples received FDI inflows below 10% of GDP over time, while there are exemptions like Hong Kong, Singapore, and Mongolia that have relatively higher inflows in certain periods. Notably, inflows in Mongolia are distinct in some periods like 2011, when it had its highest inflow at 43% of GDP and its lowest in 2016 at -37%.

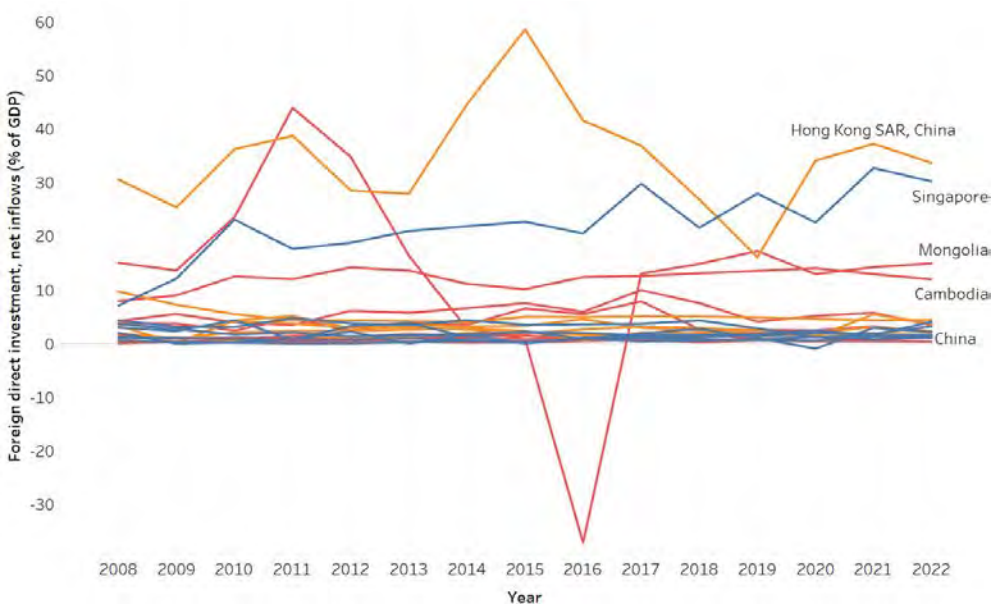


Figure 5. FDI Time Series per Country

Source: World Development Indicators Databank

As shown in Figure 6, the relationship among variables is explored using correlation coefficient analysis. We note that some variables, like GDP per capita and government efficiency, correlate highly with other institutional/political variables. To avoid multicollinearity, 'GDP_CAP_CURR', 'GOVT_EFF', 'RULE_LAW', 'CORRUPT_CONTROL', and 'REG_QUAL' were disregarded in the analysis.

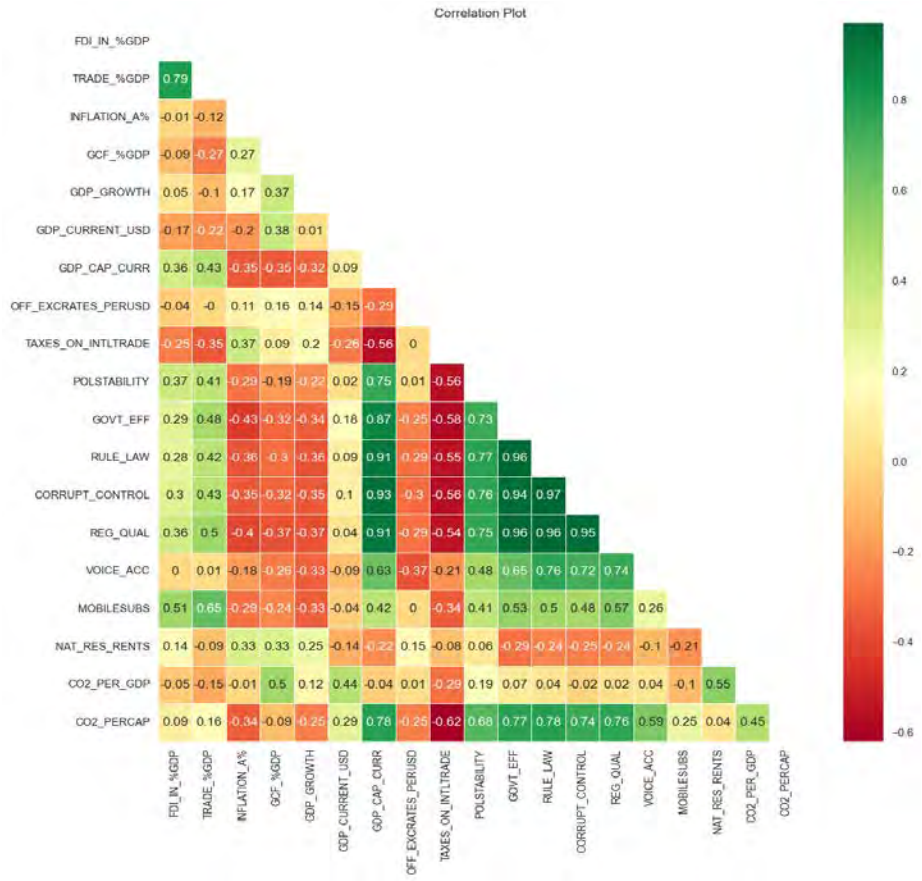


Figure 6. Correlation Heatmap of Variables

Source: Authors' computation

For the unsupervised learning methods, the FDI data was gathered from the IMF's Coordinated Direct Investment Survey (CDIS). This voluntary data collection exercise assembles data on countries' direct investment positions to build a database on from-whom-to-who cross-border direct investment positions and advance knowledge of financial interconnection.

6. Key Observations/Results

This section presents and discusses results from applying ML techniques to answer the questions formulated in the previous sections.

6.1 Supervised learning

As seen in Figure 7, trade openness is highly correlated with the FDI net inflows. The positive relationship between trade openness and FDI underscores the importance of a conducive trade environment. Non-resident investors are more likely to establish operations in a host country when they can easily sell and move their goods and services around the world. This necessitates fewer import and export restrictions, such as tariffs, quotas, and licensing requirements, which enhance market access and reduce trade barriers. As a result, a more open trade policy fosters an environment

that attracts FDI by providing opportunities for international trade and investment. This agrees with the majority of empirical studies that found a positive relationship between trade openness and FDI inflows, such as Makoni (2018), Sahoo (2006), Janick and Wunnava (2004), and Zaman et al. (2018). The positive relationship between trade openness and FDI indicates that fewer import and export restrictions better attract FDI.

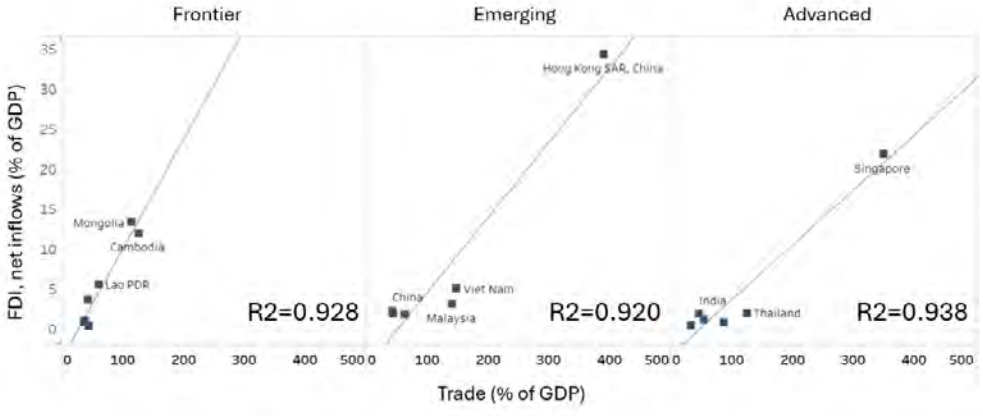


Figure 7. Trade openness vs. Average FDI net inflows

Source: Authors' computation

Apart from trade openness, the importance of other factors was explored using different ML approaches. Unlike cross-country studies by Sattarov (2012), O'Meara (2015), Jahan and Paul (2021), and Bénétrix et al. (2023) that examined relationships between FDI and other macroeconomic factors using econometric models that have an R-squared ranging from 0.40 to 0.61, the models created for this study resulted in R-squared of 0.54 to 0.81 by using various ML models to analyze all country sample. Table 2 summarizes the model performances of five ML models. Different models worked best for different samples: Extra Trees Regressor is effective in generalizing the overall trends of FDI inflows, while Random Forest, Support Vector, and CatBoost regressions are best for specific country groups, suggesting that the fit of ML models depends on the datasets used.

Evaluation Metrics

Table 2

	All Samples	Frontier	Emerging	Advanced
Extra Trees Regression				
R squared	**0.807****	0.207	0.386	0.839
Normalized RMSE*	**4.257**	4.068	0.967	4.310
MAPE	**0.618**	1.395	0.791	1.785
Random Forest				
R squared	0.736	**0.724****	0.319	0.878
Normalized RMSE*	4.818	**3.513**	1.057	3.965
MAPE	1.173	**1.695**	0.863	0.837

Evaluation Metrics

Table 2

	All Samples	Frontier	Emerging	Advanced
Gradient Boosting Method				
R squared	0.752	0.543	0.361	0.842
Normalized RMSE*	4.453	4.050	0.995	4.617
MAPE	0.933	1.602	0.667	1.695
Support Vector Regression				
R squared	0.541	0.286	**0.513****	0.679
Normalized RMSE*	6.594	5.119	**1.033**	6.192
MAPE	1.341	3.477	**0.801**	1.289
CatBoost Regression (Decision Tree + Gradient Boosting)				
R squared	0.767	0.614	0.436	**0.910****
Normalized RMSE*	4.570	3.805	0.955	**3.784**
MAPE	0.635	1.917	0.8035	**0.821**

* normalized by the standard deviation.
** best model (tuned)

Sources: Alon et al. (2022), Faruq (2023), Kurul (2017), Phung (2017)

The best-performing model, i.e., Extra Trees Regressor, was used to get the top features. Table 3 provides the importance or weights of the top variables used to predict FDI inflows. The most important determinant is trade openness for all samples, which can explain 47% of the variance in the dataset. However, this is not the case in emerging countries as this may suggest the data sparsity in this country group.

Other variables deemed crucial in predicting the FDI inflows include carbon intensity, total natural resource rents, gross capital formation (GCF), exchange rate, and institutional factors like political stability, and voice and accountability.[3] The exchange rates and GCF prove to be crucial determinants. The results support the findings of Alba et al. (2010), Suliman et al. (2015), and Tan et al. (2021) that exchange rates and FDIs are inversely related. This phenomenon stems from the notion that weaker exchange rates attract FDIs because input prices are comparatively more affordable. Likewise, a high GCF, representing the total value of capital goods produced in an economy, reflects the country's commitment to infrastructure development and capacity building, signaling a favorable environment for foreign investors.

[3] Refer to Appendix B for the complete definition of these variables.

Feature Importance

Table 3

Variable	All Samples	Frontier	Emerging	Advanced
Economic				
Trade openness	**0.469**	**0.297**	0.080	**0.560**
Inflation/macroeconomic factors		0.060	0.059	
Gross capital formation	0.056	**0.142**	0.059	
GDP growth rate			0.075	
Exchange rate	0.063	0.074	**0.270**	
Institutional/Political				
Political stability		0.050	**0.111**	
Voice and accountability			**0.083**	**0.096**
Infrastructure				
Infrastructure capability	0.059		0.062	
Environmental				
Total natural resource rents	**0.086**	**0.084**	0.052	
Carbon Intensity	**0.070**	0.052		**0.117**

Note: The top 3 features are highlighted.

Consistent with Rashid et al. (2017), Sabir et al. (2019), and Kinuthia and Murshed (2015), the results show that institutional factors, such as political stability and voice and accountability, especially in emerging economies, are crucial in attracting FDI due to the confidence they instill in investors regarding the protection of their investments and the conducive business environment. Political stability reduces the risk associated with abrupt policy changes, government upheavals, and social unrest, which creates a more predictable and secure atmosphere for foreign investments. Further, voice and accountability, which captures perceptions of citizens' freedom to select their government, freedom of expression and association, and free press, is associated with better protection of property rights, lower corruption levels, and stronger institutions, which are factors that appeal to international investors seeking a stable and reliable investment environment.

While few studies accounted for carbon intensity and total natural resource rents as FDI inflow determinants, the results show that these factors highly contribute to the attractiveness of a host country to foreign investors. Natural resource rents are the surplus profits from utilizing natural resources. This act as an incentive for FDI as they represent an opportunity for investors to tap into exclusive resources available in recipient countries. Additionally, the significance of carbon intensity in determining FDI inflows shows how investors are becoming more attuned to the environmental impacts of their operations, and regions with lower carbon intensity are perceived as more sustainable and less exposed to future regulatory risks associated with climate

change. This aligns with global movements towards achieving carbon neutrality and mitigating climate change, as highlighted in international environmental agreements.

6.2 Unsupervised learning

Using exploratory data analysis and unsupervised techniques, we uncovered the similarities between investing countries. Figure 8 shows that most of the investments flowing to developing Asian countries come from either the Hong Kong Special Administrative Region (SAR) or the United States. However, looking further into each country group, different investing nations are observed to lead the investment patterns: Thailand and South Korea in the frontier (Figure 9), Hong Kong SAR in emerging (Figure 10), and the United States in the advanced ones (Figure 11). This shows the differing investment preferences of top investing countries in the region.

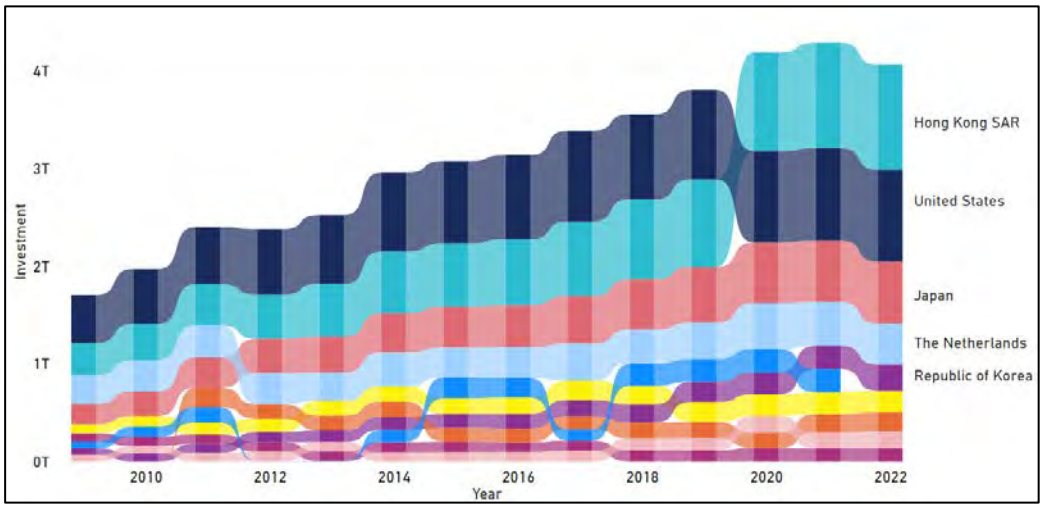


Figure 8. Outward Position of Investing Countries in Developing Asia, 2009 to 2022 (US Dollars)

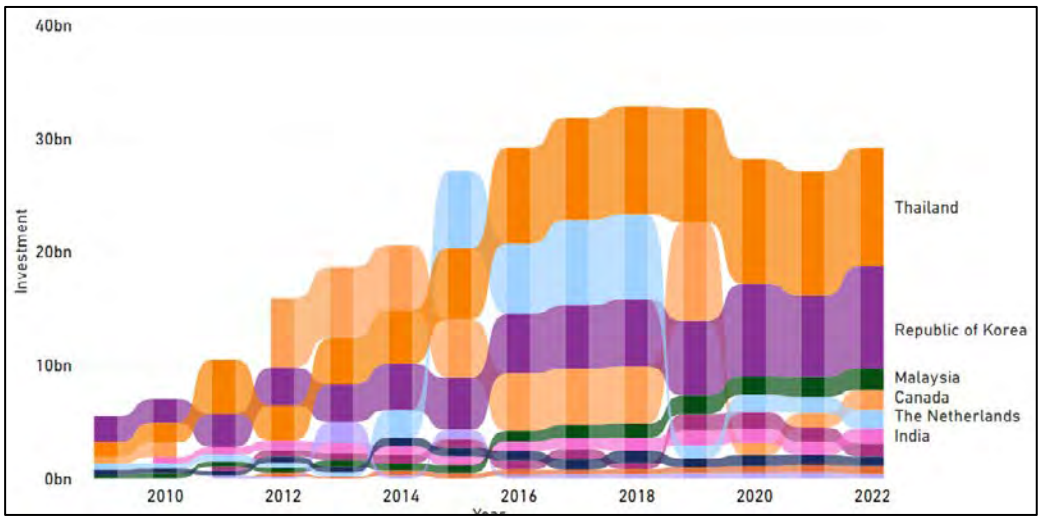


Figure 9. Outward Position of Investing Countries in Frontier Countries, 2009 to 2022 (US Dollars)

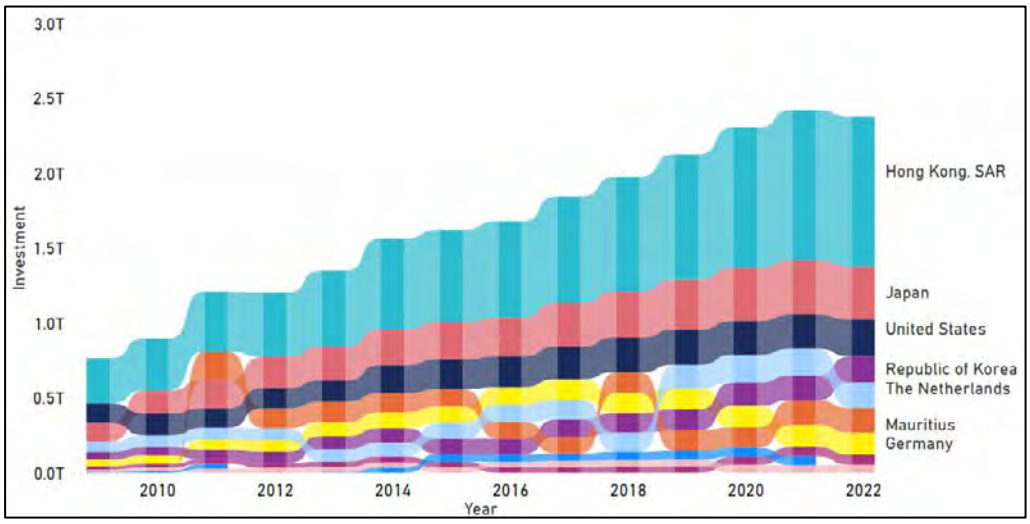


Figure 10. Outward Position of Investing Countries in Emerging Countries, 2009 to 2022 (US Dollars)

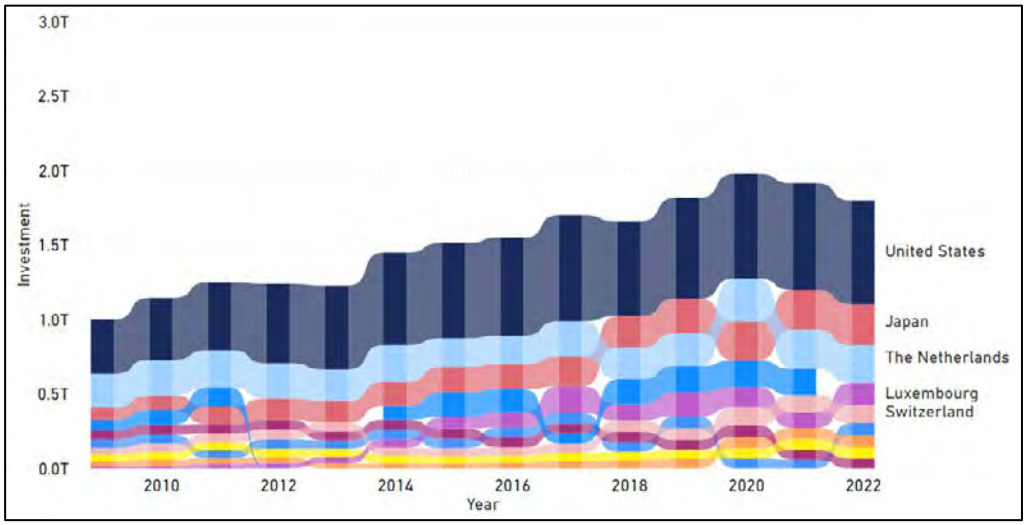


Figure 11. Outward Position of Investing Countries in Advanced Countries, 2009 to 2022 (US Dollars)

In Table 4, the results from association mining show the frequently invested pairs or clusters that are often chosen together as FDI recipients. Investing nations are observed to be co-investing in Hong Kong SAR, Singapore, India, and China. Because of their strategic locations, Hong Kong SAR and Singapore are major worldwide financial and trade hubs. They act as entry points to Asia and allow trade between the East and West. Meanwhile, China and India have diverse economies and large domestic markets. China is recognized as the "World's Factory" by housing 28% of the world's manufacturing, while India is a significant participant in IT services, pharmaceuticals, and other industries.

Regarding trade volume, China is a major worldwide exporter and importer. It maintains extensive trading links with countries all around the world. Hong Kong SAR and Singapore are known for their high trade volumes. They serve as major trading hubs with extensive shipping and logistics networks. The identified most co-invested

recipient countries are highly open economies with minimal trade barriers, low taxation, and well-developed infrastructure. They also actively participate in various multilateral trade agreements (e.g., the South Asian Free Trade Area and the Regional Comprehensive Economic Partnership).

Furthermore, this is In line with the observations of Le Leslé et al. (2014) that Hong Kong SAR's and Singapore's economy and trade will become more interconnected in the future and that financial system stability will be enhanced if both countries act in a complementary fashion. This further suggests that both countries are stepping up outreach efforts to raise their profile among the international community.

Results of Association Analysis

Table 4

Antecedents	Consequents	Support	Confidence	Lift
Hong Kong SAR	Singapore	0.4619	0.8729	1.6075
Singapore	Hong Kong SAR	0.4619	0.8506	1.6075
India	Singapore	0.4570	0.8416	1.5500
Singapore	India	0.4570	0.8416	1.5500
Hong Kong SAR	China	0.4910	0.9279	1.5257
China	Hong Kong SAR	0.4910	0.8073	1.5257
Singapore	China	0.5000	0.9208	1.5140
China	Singapore	0.5000	0.8221	1.5140
China	India	0.4695	0.7959	1.4657

Source: Authors' computation

The results from collaborative filtering suggest that Switzerland, France, Canada, Japan, Denmark, Australia, and the Netherlands share common investment patterns in Asian economies, as illustrated in Figure 12 and detailed in Annex C. To understand the investor preferences of firms in these countries, we examined the specific countries within Asia where these firms choose to expand their business operations.

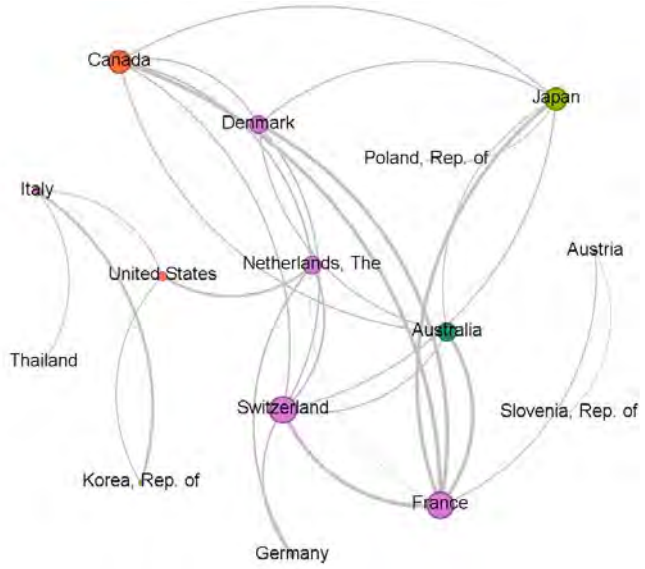


Figure 12. Collaborative Filtering Results

Note: The edges or links are based on the similarity scores, while the nodes or vertices denote the degree or the number of similar countries.

These investing countries are at the forefront of technological advancements and innovations. Their investment in host countries like Hong Kong SAR, Singapore, India, and China, as detailed in Table 5, may include technology, research, infrastructure development, manufacturing, and even renewable energy. Similar economic strategies, common investment interests, political and regulatory alignment, and even cultural and historical factors may also play a role. Further research into these areas of interest will be worthwhile in the future.

Top Five Asian Investment Destinations from Switzerland, France, Canada, Japan, Denmark, Australia, and the Netherlands in 2022

Table 5

Country	FDI Inflows
Singapore	351,834.28
Mainland China	277,415.98
India	107,488.01
Hong Kong SAR, China	95,143.74
Thailand	93,962.27

Source: Authors' computation based on the CDIS

We noted that the specific sectors and industries targeted for investment can vary depending on the investing and receiving countries' economic strengths and requirements. Furthermore, geopolitical issues, regulatory frameworks, and cultural variables are essential in defining investment strategy.

7. Conclusion and Recommendations

This study explored different ML techniques to examine the FDI determinants in developing Asian nations using the latest economic, political, institutional, and environmental indicators from several open-source platforms of international organizations. Extra Trees Regressor has the highest coefficient of determination at 0.807 in identifying the top features of all developing Asian nations. In contrast, CatBoost Regression has an R-squared of 0.910 for data on advanced Asian countries. These numbers mean that the features selected by the Extra Trees and CatBoost Regressors collectively account for a significant portion (i.e., 80.7% and 91%) of the variability observed in the development-related metric for the developing Asian nations and Advanced ones, respectively. These supervised ML models perform better than previous relevant studies using econometric models with R-squared ranging from 0.40 to 0.61. This indicates that ML models can effectively identify and analyze the key determinants of FDI and, hence, can be further leveraged to improve and supplement current traditional models to explore complex datasets like those of international trade.

The analysis of FDI determinants in developing Asia reveals several key factors influencing FDI inflows, including trade openness, GCF, exchange rate dynamics, political stability, voice and accountability metrics, total natural resource rents, and carbon intensity. Notably, the significance of these determinants varies across country classifications. In frontier countries, FDI is closely associated with trade openness, GCF, and natural resource rents. These economies often prioritize policies that facilitate international trade and investment while requiring substantial investments in infrastructure, technology, and human capital to support economic development. Total natural resource rents represent a valuable asset for many frontier countries. Rich endowments of natural resources, such as minerals, oil, or agricultural land, can attract significant FDI inflows from multinational corporations seeking to extract these resources. In emerging countries, Governments often implement policies to maintain exchange rate stability, such as adopting flexible exchange rate regimes or intervening in currency markets when necessary, to instill confidence among foreign investors. Also, emerging countries with stable political environments are perceived as safer and more conducive to long-term investment, as they offer predictability and security for businesses.

Conversely, advanced countries exhibit a pronounced relationship between FDI and trade openness, voice and accountability measures, and carbon intensity considerations. Advanced countries often prioritize trade agreements and integration initiatives to enhance their attractiveness to foreign investors further. These countries are found to have transparent and accountable governance structures, as they provide assurance of stability, predictability, and legal protection for investments. Also, with growing awareness of environmental sustainability and climate change concerns, advanced countries are transitioning towards low-carbon and sustainable

development pathways. These findings underscore the nuanced nature of FDI determinants, contingent upon the respective countries' developmental stage and economic characteristics. These findings on economic and institutional determinants are consistent with the literature, such as the studies of Rashid et al. (2017), Sabir et al. (2019), and Tan et al. (2021).

Interestingly, the ML model identified environmental variables like the total natural resource rents and carbon intensity as significant FDI determinants. To date, few studies have accounted for these environmental variables. This may be a call for policymakers in developing Asian nations to undertake reforms such as promoting the adoption of green technology and practices, shifting towards cleaner and renewable energy resources, establishing clear and consistent carbon pricing policies, and establishing financial mechanisms, like green bonds, to support the transition of industries heavily reliant on natural resources.

Using association analysis, we found that investing nations mostly co-invest in Hong Kong SAR and Singapore. This is in line with the observations of an IMF study done by Le Leslé et al. (2014), identifying these countries as Asia's preeminent international finance centers. Hong Kong SAR and Singapore are found to have complementary evolution paths, each tending to specialize in different asset markets and financial services, focusing on different parts of Asia. Given the consistent concentration of co-investment in these countries, competition within Hong Kong SAR and Singapore might intensify. While this could pose challenges, it could also drive increased market efficiency and innovation in each country, and other developing Asian countries can learn from their experience.

Results from collaborative filtering suggest shared investment patterns among Switzerland, France, Canada, Japan, Denmark, Australia, and the Netherlands. The algorithm identified the commonalities in their investment behaviors, particularly in Asian economies. Given this, recipient countries can analyze the sectors and types of projects that attract investments from the identified countries. This insight can help them align their economic development plans with the preferences of these investors. The innovation and technology-related opportunities driving these collaborative investments may be explored to guide efforts in fostering innovation ecosystems to attract FDIs from multiple countries. Recipient countries can further assess whether the collaborative investments are concentrated in specific regions or span different parts of the world. This information can guide regional economic development strategies and partnership initiatives.

This study highlights the potential for leveraging ML techniques to enhance our understanding of FDI dynamics. While supervised ML models show promise in predicting FDI levels accurately, there is a notable gap in utilizing unsupervised ML techniques. Exploring clustering algorithms like K-means can illuminate patterns in FDI behavior across countries or sectors, informing targeted policy interventions. Additionally, employing association rule mining techniques can reveal co-investment patterns, aiding policymakers in optimizing resource allocation. Furthermore, incorporating labor data into the analysis can provide valuable insights into the labor market's role in shaping FDI decisions, thereby improving predictive accuracy and informing evidence-based policymaking.

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Appendix A

Original Set of Variables

Type	Variable
Economic	Business extent of disclosure index (0=less disclosure to 10=more disclosure)
Economic	CPIA business regulatory environment rating (1=low to 6=high)
Economic	Cost to export, border compliance (US$)
Economic	Cost to export, documentary compliance (US$)
Economic	Cost to import, border compliance (US$)
Economic	Cost to import, documentary compliance (US$)
Economic	Exports of goods and services (% of GDP)
Economic	Foreign direct investment, net (BoP, current US$)
Economic	Foreign direct investment, net inflows (% of GDP)
Economic	Foreign direct investment, net outflows (% of GDP)
Economic	GDP (current US$)
Economic	GDP growth (annual %)
Economic	GDP per capita (current US$)
Economic	Government Effectiveness: Estimate
Economic	Gross capital formation (% of GDP)
Economic	Imports of goods and services (% of GDP)
Economic	Inflation, consumer prices (annual %)
Economic	Lending interest rate (%)
Economic	Logistics performance index: Quality of trade and transport-related infrastructure (1=ow to 5=high)
Economic	Real effective exchange rate index (2010 = 100
Economic	Real interest rate (%)
Economic	Taxes on international trade (% of revenue)
Economic	Trade (% of GDP)
Economic	Official Exchange Rates (local currency units per $, period averages), National Currency Unit per US Dollar
Environmental	Total natural resources rents (% of GDP)
Environmental	PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total)
Environmental	Carbon Intensity (kg of CO2, equivalent per constant 2017 $)
Environmental	CO2 emissions (metric tons per capita)
Environmental	Adjusted savings: carbon dioxide damage (% of GNI)
Environmental	Adjusted savings: carbon dioxide damage (current US$)
Environmental	Natural gas rents (% of GDP)
Infrastructure	Electricity production from oil, gas, and coal sources (% of total)
Infrastructure	Mobile cellular subscriptions (per 100 people)
Institutional/Political	Control of Corruption: Estimate

Institutional/Political	Political Stability and Absence of Violence/Terrorism: Estimate
Institutional/Political	Regulatory Quality: Estimate
Institutional/Political	Rule of Law: Estimate
Institutional/Political	Voice and Accountability: Estimate

Sources: TableNote

Appendix B

List of variables used in the ML models

Variable	Description	VarName
Dependent/Target		
Foreign Direct Investment	FDI, net inflows (% of GDP)	FDI_IN_%GDP
Independent		
Economic		
Trade openness	The sum of imports and exports (% of GDP)	TRADE_%GDP
Inflation/macroeconomic factors	Inflation, consumer prices (annual %)	INFLATION_A%
Gross capital formation	Indicates the savings of the country (% of GDP)	GCF_%GDP
GDP growth rate	The annual average rate of change of the GDP at market prices based on constant local currency, for a given national economy, during a specified period. (%)	GDP_GROWTH
Nominal GDP	The total value of all goods and services produced in a given year. (USD)	GDP_CURRENT_USD
GDP per capita	GDP per capita in current terms. (USD)	GDP_CAP_CURR
Exchange rate	The real effective exchange rate, base 2010 (%)	OFF_EXCRATES_PER USD
Taxes on international trade	Taxes on international trade include import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes. (% of revenue)	TAXES_ON_INTLTRADE
Institutional/Political		
Political stability (-2.5=Low to 2.5=High)	Measure perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism.	POLSTABILITY
Government effectiveness (-2.5=Low to 2.5=High)	Capture perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	GOVT_EFF
Rule of Law (-2.5=Low to 2.5=High)	Captures perceptions on rules of society, quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	RULE_LAW
Control of corruption (-2.5=Low to 2.5=High)	Captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as “capture” of the state by elites and private interests.	CORRUPT_CONTROL
Regulatory quality (-2.5=Low to 2.5=High)	Captures perceptions of the ability of the government to formulate and implement sound	REG_QUAL

		policies and regulations that permit and promote private sector development.	
	Voice and accountability (-2.5=Low to 2.5=High)	Captures perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free press.	VOICE_ACC
Infrastructure			
	Infrastructure capability[1]	Mobile cellular subscriptions (per 100 people)	MOBILESUBS
Environmental			
	Total natural resource rents	The sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. (% of GDP)	NAT_RES_RENTS
	Carbon Intensity	Captures the amount of carbon dioxide (CO2) emissions produced per unit of GDP. (kg of CO_2 equivalent per constant USD 2017)	CO2_PER_GDP
	CO2 emissions per capita	Captures the contribution of the average citizen of each country by dividing its total emissions by its population. (current USD)	CO2_PERCAP

[1] Proxy variable given the lack of data.

Sources: Alon et. al. (2022), Faruq (2023), Kurul (2017), Phung (2017)

Appendix C

Collaborative Filtering Results

Investor 1	Investor 2	Similarities
Canada	France	0.9661
Denmark	France	0.9661
France	Switzerland	0.9661
France	Japan	0.9636
Australia	France	0.9636
Italy	Republic of Korea	0.9500
The Netherlands	United States	0.9459
The Netherlands	Switzerland	0.9393
Germany	The Netherlands	0.9393
Canada	The Netherlands	0.9393
Germany	Switzerland	0.9333
Canada	Denmark	0.9333
Canada	Switzerland	0.9333
Denmark	Switzerland	0.9333
Japan	Switzerland	0.9309
Australia	Canada	0.9309
Australia	Denmark	0.9309
Canada	Japan	0.9309
Australia	Switzerland	0.9309
Denmark	Japan	0.9309
Australia	France	0.9258
Italy	United States	0.9234
Republic of Korea	Unites States	0.9234

Sources: Authors' computation

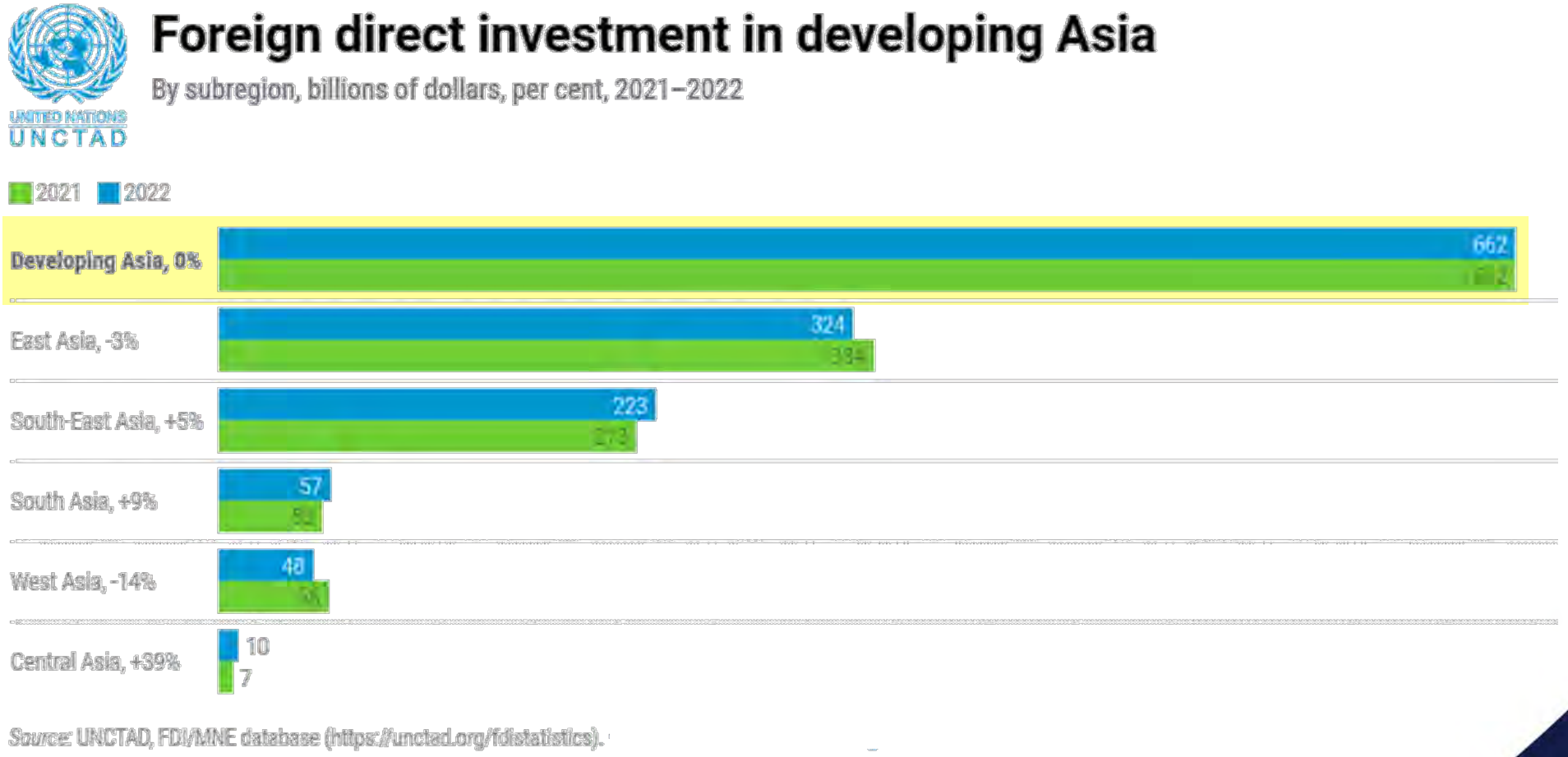
Exploring the Evolving Determinants of Foreign Direct Investment and the Investing Country Preferences in Developing Asian Economies using Machine Learning

Carmelita G. Esclanda-Lo
Gabriel A. Masangkay
Chelsea Anne S. Ong
Rossvern S. Reyes



BACKGROUND

Asia received 51% of global inflows but remained steady at USD 662 billion



Classification: GENERAL

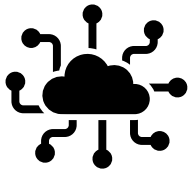
BACKGROUND

Foreign Direct Investment (FDI) plays a crucial role in the economic development of countries, especially in developing nations.

Benefits of FDI includes:



Capital Inflow and Economic Growth



Technology Transfer



Access to Global Markets



Infrastructure Development

Classification: GENERAL

BACKGROUND

FDI inflows into developing Asian Economies have increased since 1970s

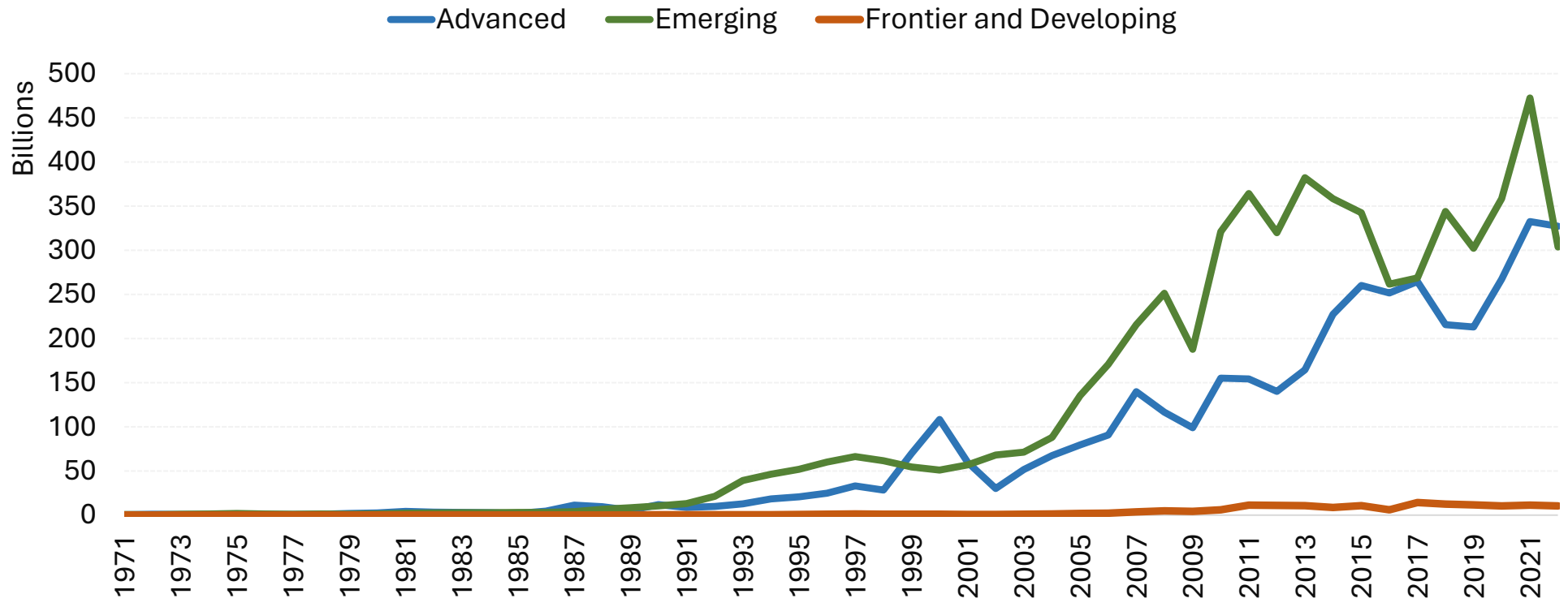


Figure 1. Sum of FDI net inflows (BoP, current USD)
Source: Authors' computation based on the World Development Indicators.

Classification: GENERAL

RELATED LITERATURE



Africa:

- Asiedu (2002), Sattarov (2012), Makoni (2018)

Europe:

- Resmini (2000), Bevan and Estrin (2000)

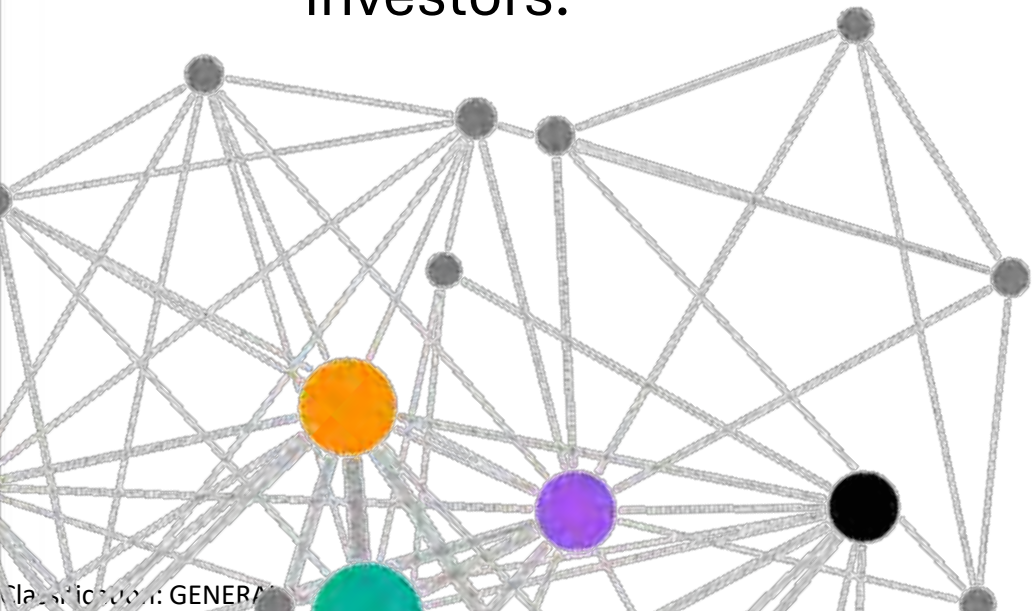
Asia:

- Brooks et al. (2003), Sahoo (2006), Zaman et al. (2018), Bhavan et al. (2010)

Classification: GENERAL

OBJECTIVES

1. Utilize ML methods to find non-linear correlations between FDI and its determinants.
2. Use ML methods to analyze feature importance of FDI determinants.
3. Use unsupervised similarity calculations to uncover similarities of comparable investment destinations and investment patterns of foreign investors.

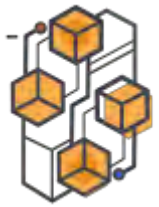


METHODOLOGY



Supervised ML

- Random Forest Regression
- Extra Trees Regression
- Gradient Boosting Machines
- CatBoost Regression
- Support Vector Regression



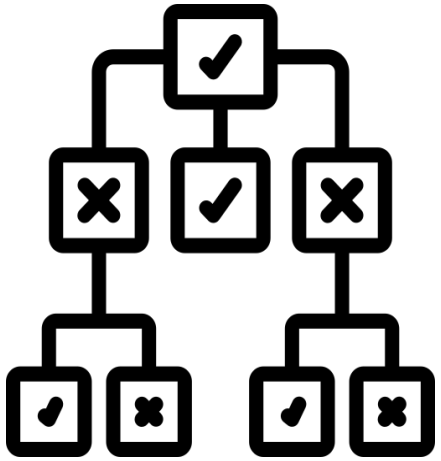
Unsupervised ML

- Association Rule Mining
- Collaborative Filtering

Classification: GENERAL

METHODOLOGY

SUPERVISED LEARNING



Random Forest, ExtraTrees, GBM, and CatBoost are variations of a non-linear model that partition the feature space into regions, making decisions based on the values of the features.



SVM handles non-linear decision boundaries by using kernel functions that implicitly map the input features into a higher-dimensional space where the data may be more separable, allowing for more complex decision boundaries.

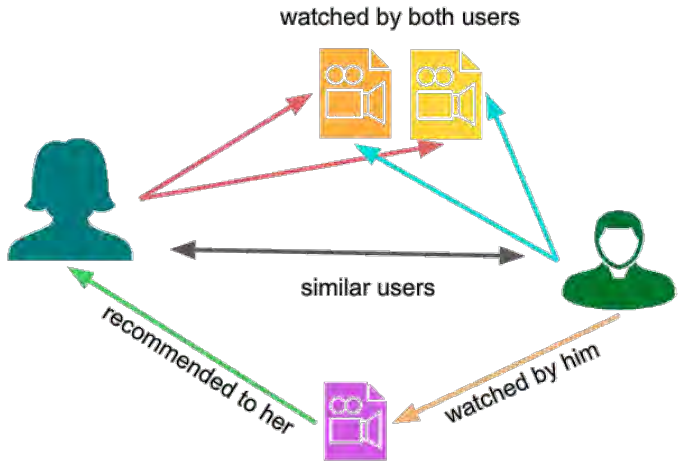
Classification: GENERAL

METHODOLOGY

UNSUPERVISED LEARNING



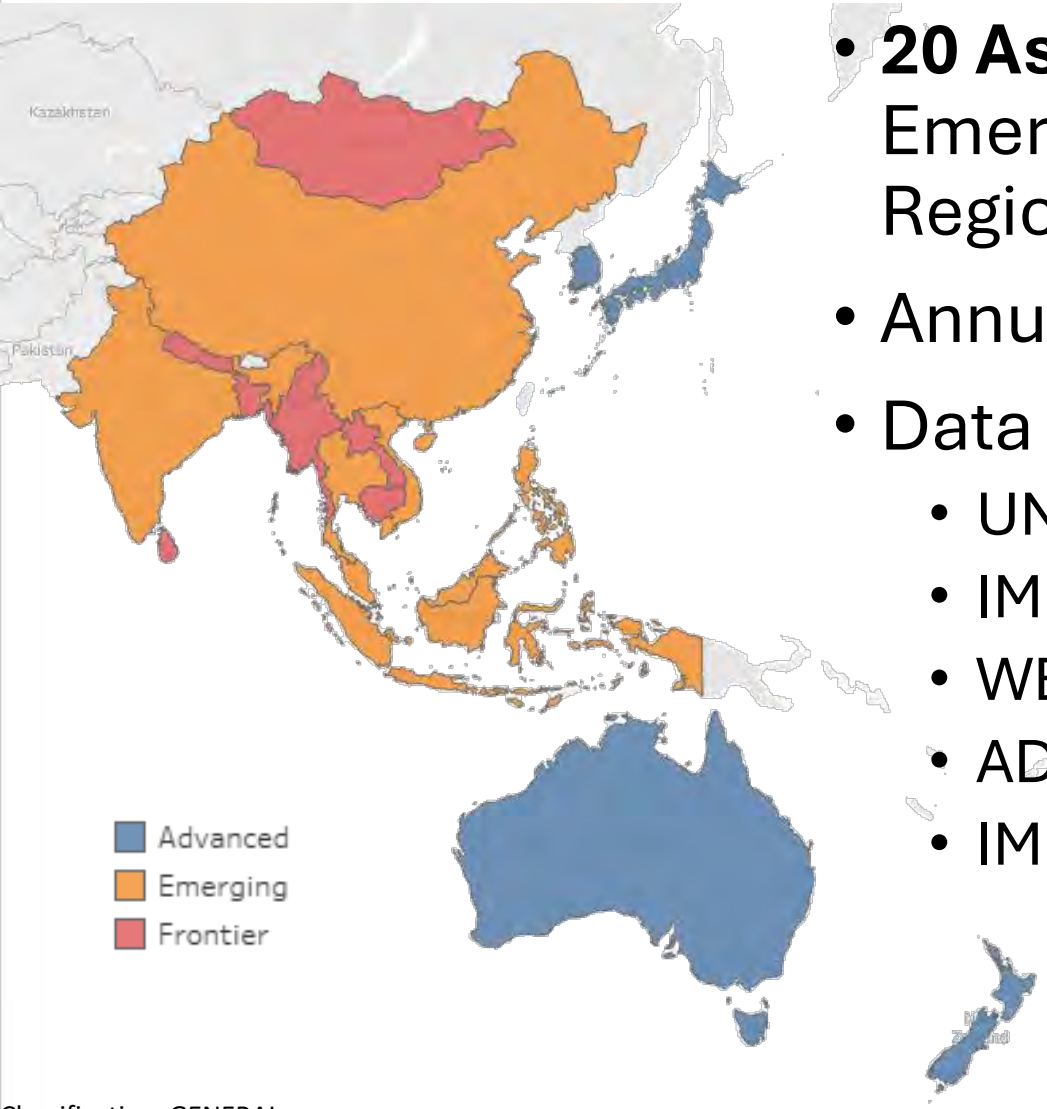
Association rule mining is a data mining technique used to discover interesting relationships or patterns within large datasets. It is commonly applied in market basket analysis to identify frequently co-occurring items in transactions.



Collaborative filtering is a recommendation technique commonly used to identify similarities between users based on their interactions or preferences.

Classification: GENERAL

DATA



- **20 Asian countries**, categorized into Advanced, Emerging, and Frontier, as classified in the IMF's Regional Economic Outlook.
- Annual observations from **2008 to 2022**.
- Data sources:
  - UNCTAD Bilateral FDI Statistics,
  - IMF DataMapper Datasets,
  - WB World Development Indicators,
  - ADB Key Indicators Database
  - IMF's Coordinated Direct Investment Survey (CDIS)

Classification: GENERAL

DATA

Type	Variable
Dependent/Target	Foreign Direct Investment
Economic	Trade openness
	Inflation/macroeconomic factors
	Gross capital formation
	GDP growth rate
	Nominal GDP
	GDP per Capita
	Exchange rate
	Taxes on international trade
Political	Political stability
	Government effectiveness
	Rule of Law

Type	Variable
Political	Control of corruption
	Regulatory quality
	Voice and accountability
	Political stability
Infrastructural	Infrastructure capability
	(Mobile cellular subscriptions (per 100 people))
	Total natural resource rents
Environmental	Carbon Intensity
	CO2 emissions per capita
	Total natural resource rents

Classification: GENERAL

RESULTS

Evaluation Metrics

Method	All Samples	Frontier	Emerging	Advanced
Extra Trees Regression				
R squared	**0.807****	0.207	0.386	0.839
Normalized RMSE*	**4.257**	4.068	0.967	4.310
MAPE	**0.618**	1.395	0.791	1.785
Random Forest				
R squared	0.736	**0.724****	0.319	0.878
Normalized RMSE*	4.818	**3.513**	1.057	3.965
MAPE	1.173	**1.695**	0.863	0.837
Gradient Boosting Method				
R squared	0.752	0.543	0.361	0.842
Normalized RMSE*	4.453	4.050	0.995	4.617
MAPE	0.933	1.602	0.667	1.695
Support Vector Regression				
R squared	0.541	0.286	**0.513****	0.679
Normalized RMSE*	6.594	5.119	**1.033**	6.192
MAPE	1.341	3.477	**0.801**	1.289
CatBoost Regression (Decision Tree + Gradient Boosting)				
R squared	0.767	0.614	0.436	**0.910****
Normalized RMSE*	4.570	3.805	0.955	**3.784**
MAPE	0.635	1.917	0.8035	**0.821**

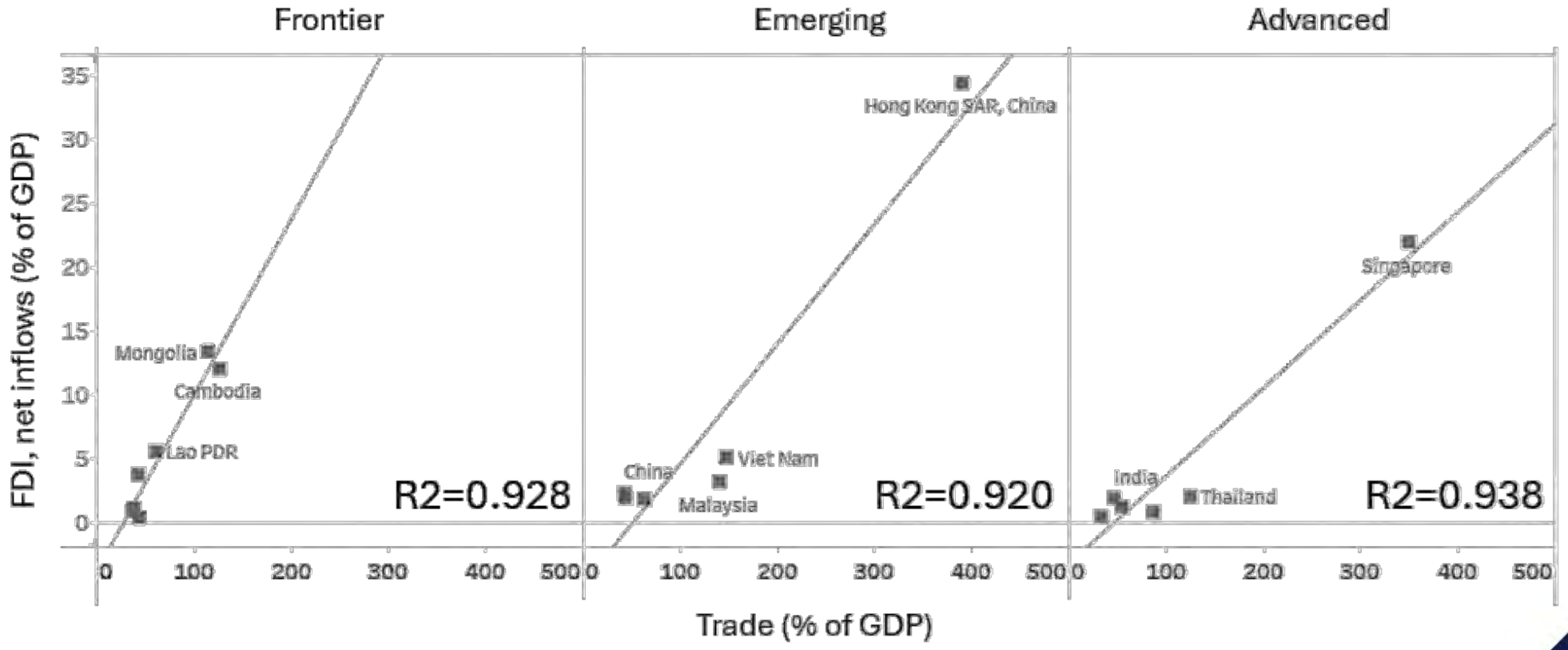
* normalized by the standard deviation.
** best model (tuned)

Classification: GENERAL

RESULTS

Trade openness is highly correlated with FDI net inflows.

Figure 7. Trade openness vs. Average FDI net inflows



Classification: GENERAL

RESULTS

The study aligns with prior research and establishes Carbon Intensity as a significant predictor of FDI.

Feature Importance

Variable	All Samples	Frontier	Emerging	Advanced
Economic				
Trade openness (++)	**0.469**	**0.297**	0.080	**0.560**
Inflation/macroeconomic factors (+)		0.060	0.059	
Gross capital formation (+)	0.056	**0.142**	0.059	
GDP growth rate (+)			0.075	
Exchange rate	0.063	0.074	**0.270**	
Institutional/Political				
Political stability (+)		0.050	**0.111**	
Voice and accountability (+)			**0.083**	**0.096**
Infrastructure				
Infrastructure capability (++)	0.059		0.062	
Environmental				
Total natural resource rents (+)	**0.086**	**0.084**	0.052	
Carbon Intensity (-)	**0.070**	0.052		**0.117**

Classification: GENERAL

RESULTS

The ultimate investors in developing Asia are Hong Kong SAR and the United States, along with Japan and the Netherlands.

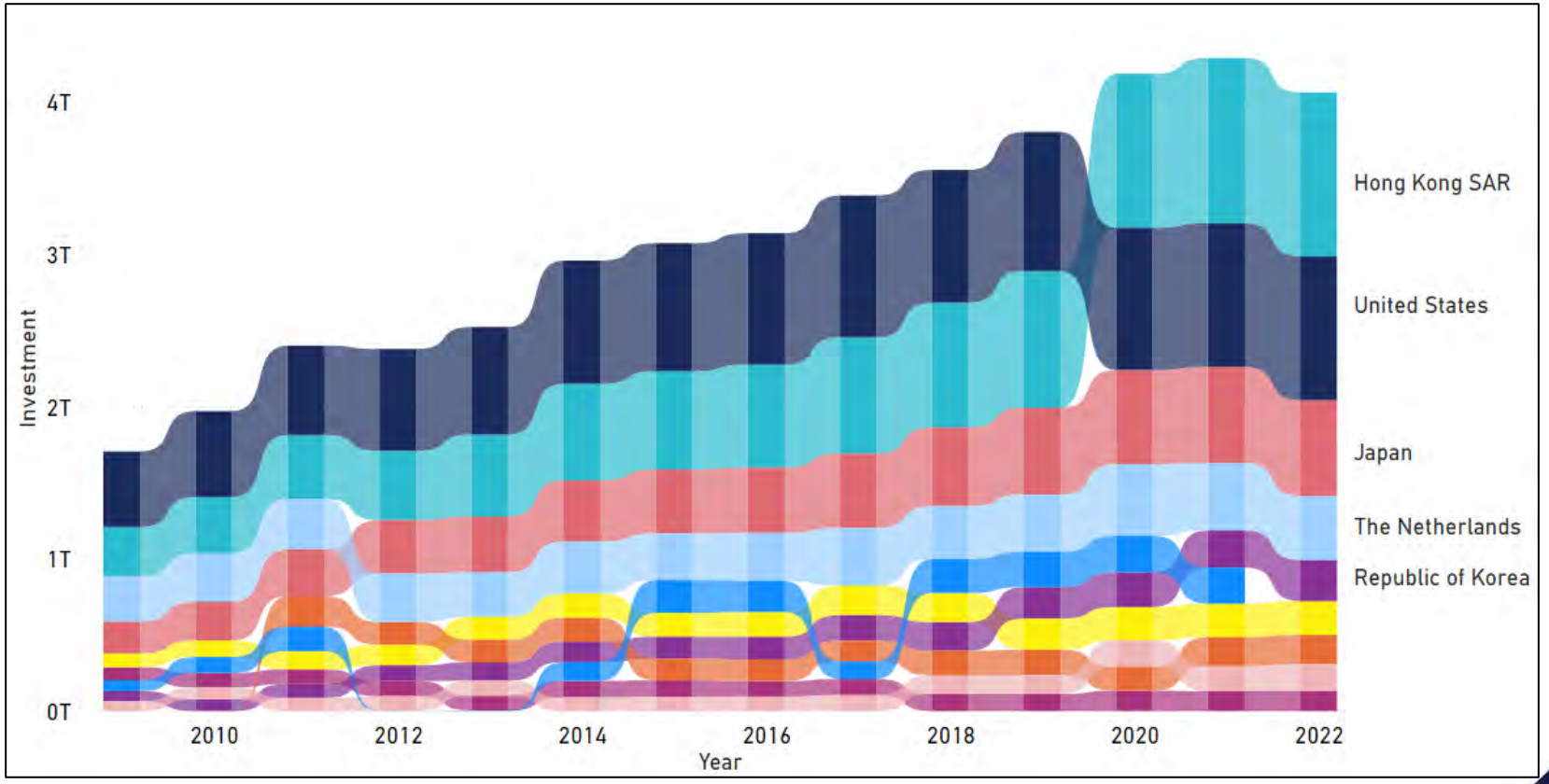


Figure 8. Outward Position of Investing Countries in Developing Asia, 2009 to 2022 (US Dollars)

Classification: GENERAL

RESULTS

Nevertheless, we can observe a different trend looking into the different country groups in Developing Asia.

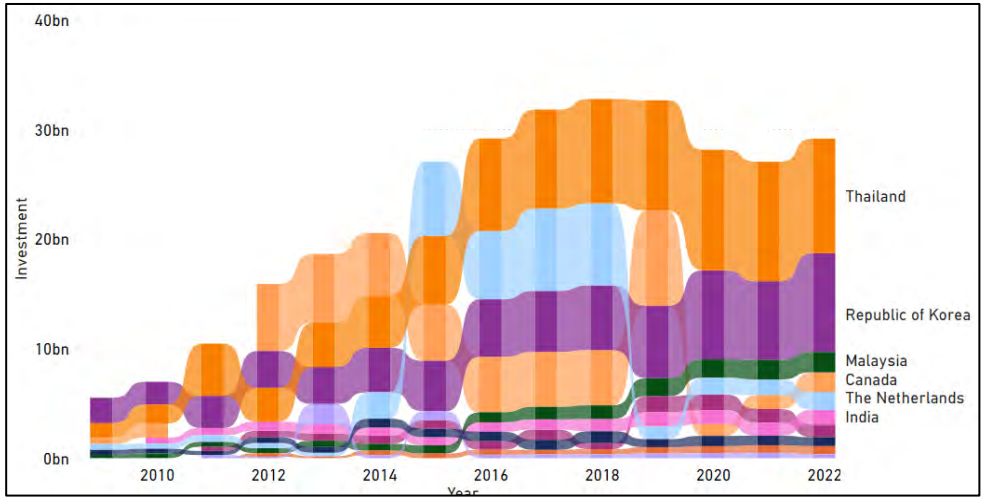


Figure 9. Outward Position of Investing Countries in Frontier Countries, 2009 to 2022 (US Dollars)

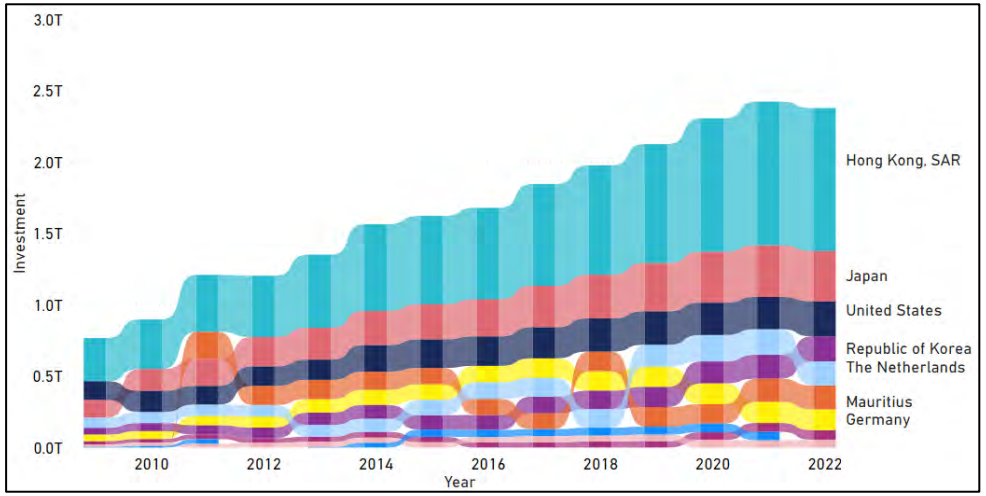


Figure 10. Outward Position of Investing Countries in Emerging Countries, 2009 to 2022 (US Dollars)

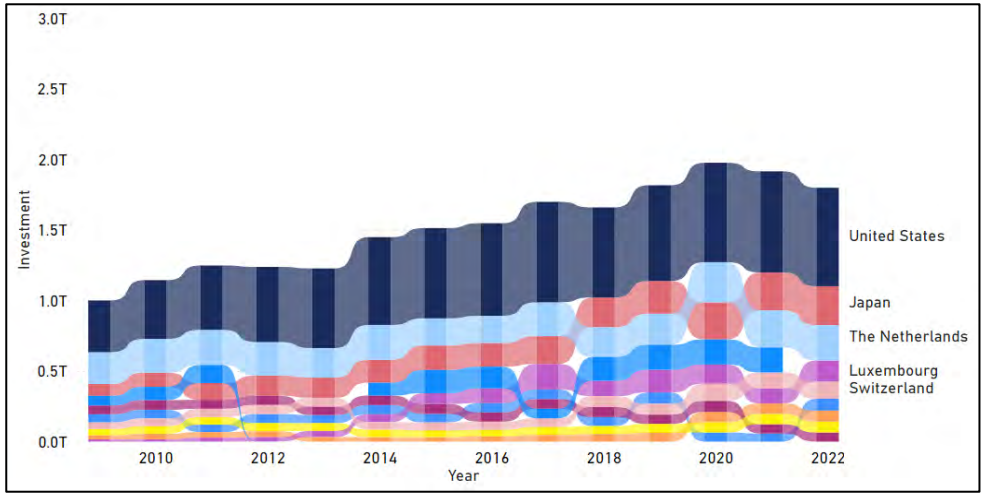


Figure 11. Outward Position of Investing Countries in Advanced Countries, 2009 to 2022 (US Dollars)

Classification: GENERAL

RESULTS

Foreign Investors (the same countries) tend to invest in Hong Kong SAR, Singapore, India and China (the investees) at the same time.

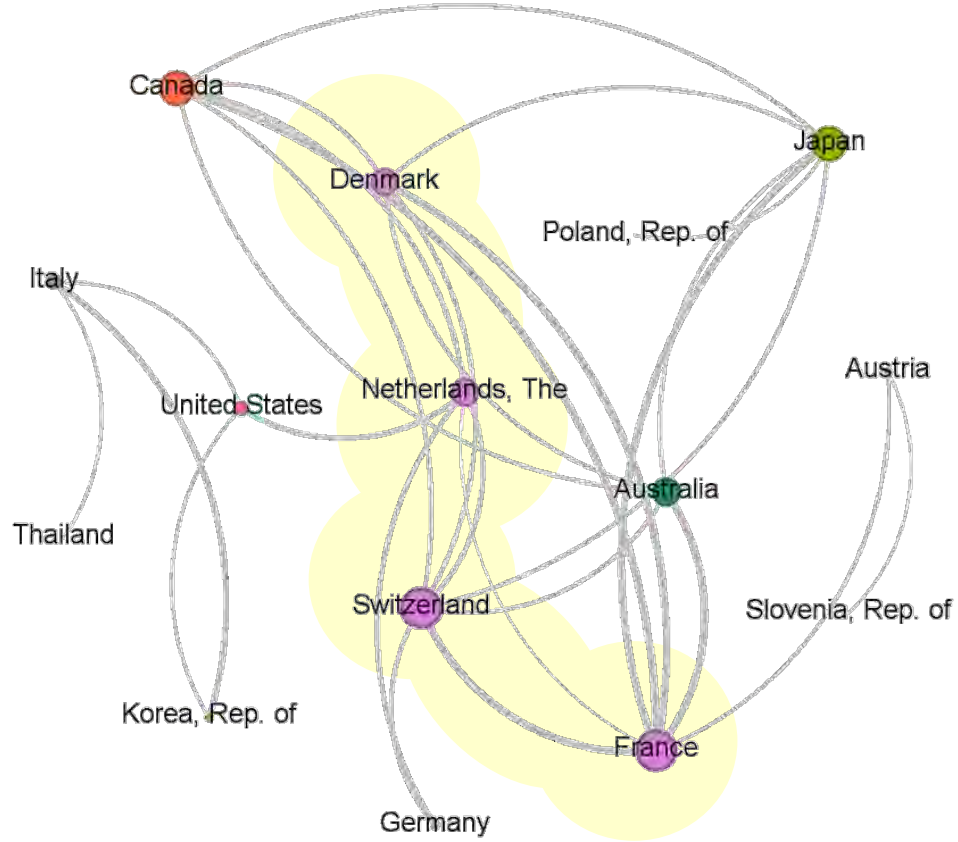
Association Analysis Results

Antecedents	Consequents	Support	Confidence	Lift
Hong Kong SAR	Singapore	0.4619	0.8729	1.6075
Singapore	Hong Kong SAR	0.4619	0.8506	1.6075
India	Singapore	0.4570	0.8416	1.5500
Singapore	India	0.4570	0.8416	1.5500
Hong Kong SAR	China	0.4910	0.9279	1.5257
China	Hong Kong SAR	0.4910	0.8073	1.5257
Singapore	China	0.5000	0.9208	1.5140
China	Singapore	0.5000	0.8221	1.5140
China	India	0.4695	0.7959	1.4657

Classification: GENERAL

RESULTS

Switzerland, France, Canada, Japan, Denmark, Australia, and the Netherlands exhibit the same investment behavior towards Asian economies.



Top Five Asian Investment Destinations from Switzerland, France, Canada, Japan, Denmark, Australia, and the Netherlands in 2022

Country	FDI Inflows
Singapore	351,834.28
Mainland China	277,415.98
India	107,488.01
Hong Kong SAR	95,143.74
Thailand	93,962.27

Figure 12. Collaborative Filtering Results
Note: The edges or links are based on the similarity scores, while the nodes or vertices denote the degree or the number of similar countries.

Classification: GENERAL

KEY TAKEAWAYS

- Supervised non-linear ML methodologies are effective in identifying the primary features contributing to FDI.
- Extra Trees Regression yielded better R-square of 0.81 compared to conventional econometric models employed in prior research.
- The performance of ML algorithms varies across different subsets of the developing Asian nations.

Classification: GENERAL

KEY TAKEAWAYS

Preferred countries (Investees)	Potential Reasons
• Hong Kong SAR • Singapore • India • China	• Trade openness • Favorable tax regimes • Robust infrastructure development • Multilateral trade agreements

Classification: GENERAL

KEY TAKEAWAYS

Countries with similar investment behavior (Investors)	Focus
• Switzerland • France • Canada • Japan • Denmark • Australia • The Netherlands	• Technological innovation • Research and development • Infrastructure enhancement • Manufacturing capabilities • Renewable energy

Classification: GENERAL

RECOMMENDATIONS

- ML should be further explored to generate new insights, especially in the FDI literature.
- Clustering algorithms can be explored to group countries or sectors with similar FDI behavior.
- Association rule mining can be utilized to identify co-investment or sequential investment patterns in different sectors.

Classification: GENERAL

Exploring the Evolving Determinants of Foreign Direct Investment and the Investing Country Preferences in Developing Asian Economies using Machine Learning

Thank you!



IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Web scraping as a detection tool in identifying Indonesian cross-border digital trade actors[1]

Aditya Wisnugraha Sugiyarto, Marlina Novita Uligoma, Hasudungan Paulanka Siburian, Dwi Cahyo Ardianto, Novi Ajeng Salehah and Detasya Avri Magfira,
Bank Indonesia

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the events.

Web scraping as a detection tool in identifying Indonesian cross-border digital trade actors

Aditya Wisnugraha Sugiyarto[1], Marlina Novita Uligoma[2], Hasudungan Paulanka Siburian[3], Dwi Cahyo Ardianto[4], Novi Ajeng Salehah[5], Detasya Avri Magfira[6]

Abstract

Massive technological advances have enabled the shift of the trade conducts, enabling the rise of digital trade that gradually replacing the physical exchange of products. Accordingly, tracking the digital trade activities through a robust statistic is becoming more important, including the cross-border trade. A good cross-border digital trade statistics will help in understanding how such trade evolves and how it impacts the economy. However, there are challenges in compiling the statistics, especially in collecting the data. To identify whether a cross-border trade can be classified as digital, the products exchanged should be either ordered or delivered digitally. One approach for such identification is to identify whether the actors involved are digital trade players or not. If the actors are digital trade players, then transactions involving their products could be assumed to be digital trades. This study proposes such identification by leveraging web scraping techniques to identify and compile the cross-border digital trade actors in Indonesia. Web scraping provides the ability to efficiently collect digital trade actors from various online sources, including e-commerce websites. In this paper, we will explore how the techniques can be used to overcome data limitations in digital trade analysis, enlarging the breadth of data coverage analysed. We also discuss aspects of legality, scalability, data security and data quality of such techniques, as well as the importance of complying with international statistical standards. By using the proposed method, we find that advanced analytics (including web scraping) in cross-border digital trade statistics significantly boosts exporter scope, improves efficiency, and ensures data quality by minimizing human errors.

Keywords: digital trade, web scraping, data engineering, statistics

JEL classification: C82, E58, F14, O19

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1. Background

In the era of globalization and economic digitalization, developments in information technology have brought major changes in the way trade is conducted. Technological advances are facilitating changes in trading behaviour, with digital commerce gradually replacing physical exchange of products (Ezel & Koester, 2023). Indonesia, as a country with rapid economic growth, is also experiencing the same significant transformation in its economic structure, especially with more transactions are carried out online and more products are delivered digitally. Digital Commerce has become a critical component of the modern global economy, enabling broader access to international markets, speeding up business processes, and giving consumers more choice (Kraus et al., 2021).

The rapid growth of the digital economy also brings a number of challenges in recording the Balance of Payments. As an important tool in measuring a country's economic transactions with the outside world, the recording of the Balance of Payments must be able to reflect changes in transaction patterns due to developments in the digital economy. This concern is reflected in the growing literature of digitalization inside the IMF's Balance of Payments Manual (BPM). The currently developing BPM7 has a dedicated section that discuss the framework of cross border digital trade, which would address the importance of the impact of such issue.

Some of the specific challenges faced in recording the Balance of Payments in the digital economy era and particularly in digital trade are: i) measuring digital transactions, ii) definition and classification of transactions, iii) uncertainty in transaction values, iv) identification of the parties involved (actors), and iv) adjustment to rapid changes (OECD, WTO & IMF, 2023). To address those challenges, a good methodology is needed in the process of recording digital trade, especially those involving cross-border transactions.

Indonesian digital economy potential is also huge. Statistically, Indonesia's digital economy is the largest among member countries of the Association of Southeast Asian Nations (ASEAN). In 2021, the size of the digital economy in Indonesia is around 42% of the ASEAN digital economy. Indonesia is also one of the most attractive digital investment destinations. Total investment inflows into the digital sector were $4.5 billion in 2020 and $9.1 billion in 2021 (Google, Temasek, dan Bain & Company, 2022).

The strength of Indonesia's digital economy comes from the high level of internet penetration and the large population of the younger generation (dominated by the younger generations Y and Z), which will become more dominant in the coming years (Alisjahbana et al, 2020). Both the government and the private sector have launched various initiatives to support the growth of Indonesia's digital economy. These initiatives mainly come in the form of physical and digital telecommunications infrastructure, investments in start-ups (including micro, small and medium enterprises) and general initiatives to improve the ease of doing business (East Ventures, 2022).

Indonesia's digital economy showed extraordinary growth of 414% in 2017 to 2021. In addition, it is estimated that it will grow around 62% in 2021 to 2025. In just less than 10 years, Indonesia's digital economy will grow eightfold. This is different

from the economic slowdown (shown by GDP) that occurred during the Covid-19 pandemic and the possibility of gloomy prospects for the global economy in the coming years (IMF, 2023; Sapulette & Santoso, 2021).

Sectors related to mobility and technology show higher growth than other sectors. Sectors related to technology support sectors related to mobility, such as transportation and tourism. Additionally, digital technology has enabled less popular tourism destinations to reach new consumers. Digital technology also allows small businesses to reach new consumers through online platforms, even if resources are limited. The digital economy has played an important role in supporting Indonesia's economic growth and will continue to do so (Sapulette & Muchtar, 2023).

According to the Central Agency of Statistics (BPS) in 2023, Indonesia has reached a population of around 275 million people in 2022, with 52% of the population dominated by generations Y and Z. This growth in the number of young people is in line with the rapid adoption of digital technology in Indonesia. The digital payment sector has also experienced significant progress, including the emergence of Electronic Money (e-money), card payments, QRIS, and mobile banking. Apart from that, e-commerce and digital financial services are also key sectors in Indonesia's digital economic ecosystem.

In the context of cross-border trade, identification of digital trade actors becomes increasingly complex. Available information is often limited to company names, and with the high volume of transactions, it is difficult to ascertain whether a company is truly engaging in cross-border digital trade (OECD & IMF, 2017). This challenge is further exacerbated by the lack of structured data and the variety of information spread across various sources.

The importance of data in supporting policy and decision making has encouraged the development of big data analysis (Suominen & Hajikhani, 2021). The use of big data analytics provides the ability to analyze and interpret large and complex amounts of data. However, in the context of identifying digital traffickers, it is necessary to look for more innovative and specific solutions.

Web scraping, as part of advanced analytics, is emerging as a potential solution to overcome the challenges of identifying digital traffickers. This technique allows collecting data from various sources automatically and efficiently. As technology develops, web scraping can become a very effective tool for accessing information about digital traffickers, including their activities and characteristics (Rundel & Dogucu, 2020).

Web scraping has experienced rapid development along with the need to efficiently gather information from an increasingly complex web. This technique involves the use of algorithms and software to extract data automatically, allowing for more in-depth analysis (Rundel & Dogucu, 2020).

Web scraping can be used to gather information from various digital trading platforms, company directories, and other related sources (Rundel & Dogucu, 2020). Its potential in accessing and collecting relevant data can provide a better understanding of digital trading actors.

By understanding the growth of the digital economy, the challenges of identifying digital traffickers, and the role of big data analytics, the use of web scraping becomes increasingly relevant as an innovative solution. This is what

underlies the author to apply this technique to provide a more accurate and in-depth understanding of digital trade actors, helping to develop policies that are adaptive to the dynamics of cross-border trade in the era of the digital economy in Indonesia.

Thus, this article contributes in terms of providing additional digital trade literature amid limited literature related to cross-border digital trade assessments particularly in Indonesia. In addition to that, the authors provide overview and framework of how to use advanced analytics to improve the quality of digital trade statistics compilations.

2. Literature Review

2.1. Digital Trade Concept

Digitalization affects international trade on multiple levels, by changing the way goods and services are traded and by creating completely new, internationally traded digital products. Equally important, digitalization also has a significant transformative impact on many existing industries: by "shrinking the distance" between consumers and producers, and between producers, digitalization provides previously unimaginable access to new markets, especially for micro, small, and intermediate business entities (MSMEs).

One of the main concerns driving the demand for better evidence on digital trade is the perception that large parts of the economy and international trade are going unaccounted for due to digitalization (Ahmad and Schreyer, 2016; Corrado et al., 2021). Even if it is generally accepted that the current statistical framework is still appropriate for measuring international trade, the fact that digital trade is not visible in existing statistics hinders the ability to assess the impact of trade policies and may lead to the misperception that digitalization in the trade economy is not being accurately measured.

The statistical definition of digital trade is based on the nature of the transaction, not on the characteristics of the products traded or on the characteristics of the actors involved in the transaction. Based on an international standard statistical manual, namely the Handbook of Measurement Digital Trade, released by the OECD, WTO and IMF (2023), digital trade is defined as: "All international trade that is ordered digitally and/or submitted digitally". Based on the guidebook, the explanation of the digital trade concept is explained in the following conceptual framework (Figure 1):

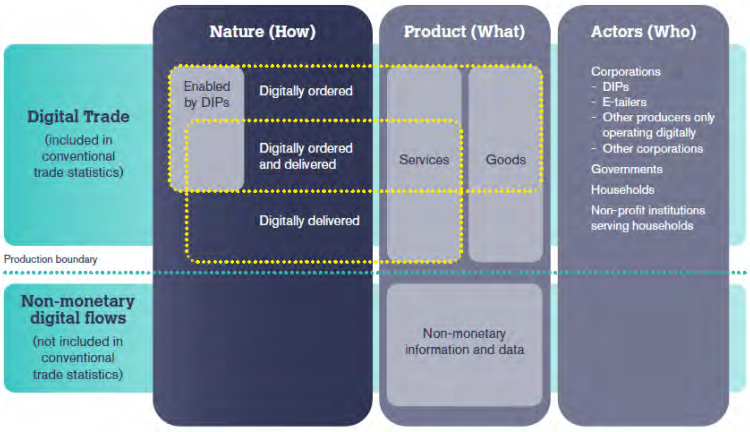


Figure 1. Conceptual Framework of Digital Trade (source: OECD, WTO & IMF, 2023)

Based on (see Figure 1), digital trade is divided into two types of transactions (how), namely:

a) Transactions for goods/services ordered digitally (digitally ordered)

Cross-border digital transactions ordered digitally are the international sale or purchase of a good or service, conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders. The following supporting clarifications are provided to help identify digitally ordered transactions in international trade (OECD, WTO & IMF, 2023):

- For digitally ordered transactions, the payment and ultimate delivery of the goods or services do not have to also be conducted online.
- Digitally ordered transactions can involve participants from all institutional sectors.
- Digitally ordered transactions cover orders made over the web, 6 extranet or via electronic data interchange.
- Digitally ordered trade includes purchases of applications (apps) and in-app online purchases.
- Digitally ordered trade includes transactions via online bidding platforms
- Orders made by phone, fax or manually typed email are excluded from digitally ordered trade
- Offline transactions formalized using digital signatures are excluded from digitally ordered trade
- Each trade transaction should be treated separately. When a transaction is established via offline ordering processes, but subsequent transactions (or follow up orders) are made via digital ordering systems, the follow-up orders should be considered as e-commerce
- Trade transactions do not necessarily coincide with contracts. For a contract spanning several statistical periods and potentially involving multiple transactions, each transaction should be classified as

digitally ordered or not digitally ordered, reflecting the mode(s) of ordering initiated in the current period

b) Transactions for goods/services sent digitally (digitally delivered)

The second criterion for identifying digital trade is transactions which are "digitally delivered" and only cover services. Referring to the handbook, digitally delivered trade is defined as all international trade transactions that are delivered remotely over computer networks. The following supporting clarifications are provided to identify digitally delivered transactions in international trade (OECD, WTO & IMF, 2023):

- Only services can be digitally delivered
- Digitally delivered transactions can involve participants from all institutional sectors
- For digitally delivered transactions, the payment for and ordering of the services do not have to be conducted online
- Services delivered by phone, fax, video call or email are included in digitally delivered trade
- Digitally delivered trade includes services provided through apps
- Each trade transaction should be treated separately. When a trade transaction is delivered via offline processes, but subsequent follow-up transactions are delivered digitally, the follow-up transactions should be considered as digitally delivered
- A trade transaction can be delivered via multiple (digital and non-digital) modes

Online platforms play an increasingly important role in the digital economy. They facilitate economic transactions (e.g. trade in goods and services), or non-economic interactions (e.g., social media and discussion sites). In 2019, the OECD, after extensive consultations, set out a broad definition of online platforms as "a digital service that facilitates interactions between two or more distinct but interdependent sets of users (whether firms or individuals) who interact through the service via the internet" (OECD, 2019).

Digital intermediary platform (DIP) is online interfaces that facilitate, for a fee, the direct interaction between multiple buyers and multiple sellers, without the platform taking economic ownership of the goods or rendering the services that are being sold (intermediated). The assumption in this Handbook is that all transactions undertaken via a DIP are digitally ordered (OECD, WTO & IMF, 2023).

Since 2019, Bank Indonesia has begun studying the concept of digital trade in Indonesia. This is what Bank Indonesia analyse of digital economic activities in Indonesia. In its development, Bank Indonesia has formulated a concept model for digital trade transactions that occur in Indonesia (see Figure 2) which is presented as follows:

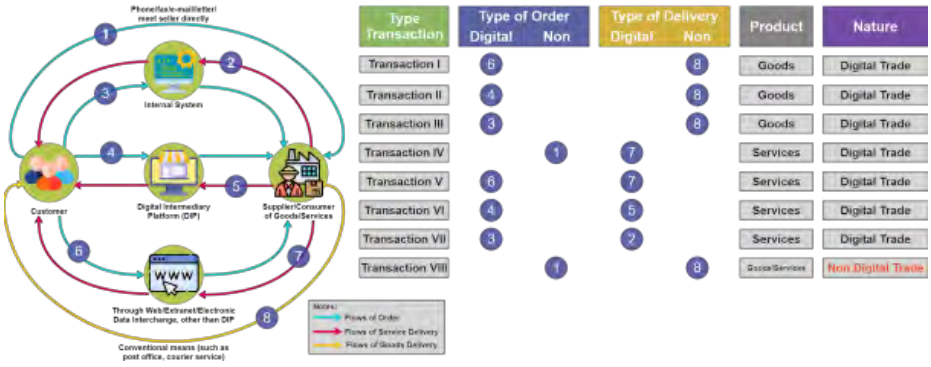


Figure 2. Digital Trade Transaction Model in Indonesia

In this scheme (see Figure 2) it is described into 8 (eight) digital goods and services trade transaction models. Meanwhile, transactions that use non-digital trading facilities for ordering and delivery (type 8 transactions) are not digital trading schemes.

This transaction model is the basis for forming cross-border digital trade statistics in Indonesia for both goods and services. For exports of both services and goods, it means that the customer comes from abroad (non-resident) while the supplier comes from within the country (resident). Then, for imports of both services and goods, it means that the customer comes from within the country (resident) while the supplier comes from abroad (non-resident).

2.2. Goods Export Processing

In compiling digital trade statistics on exports and imports of goods and services, Bank Indonesia, especially the Department of Statistics, has made extraordinary efforts in exploring potential data sources, data collection and data processing. The data sources that form the basis for compiling cross-border digital trade statistics are the International Transaction Reporting System (ITRS), Customs Documents, domestic e-commerce, websites/internet, and Credit and Debit Cards (LBUT). In the process of identifying digital trade actors in goods exports, the data sources used are ITRS, export platforms, as well as export transaction data from the e-commerce companies that have collaborated with Bank Indonesia. ITRS and export platforms are used as sources to obtain the names of companies indicated to be carrying out digital trade exports, which are then obtained from the transaction value of special export customs documents (export declaration). Next, selected actors will be invited to a Focus Group Discussion (FGD).

Specifically, digital trade export players are grouped into 3 (three) categories based on the ordering media, namely through DIP, internal systems and websites. Specifically, orders made via the internal system and website are obtained from ITRS. Meanwhile, orders via DIP are obtained from websites/internet, export platforms, as well as the e-commerce sites that have collaborated with Bank Indonesia.

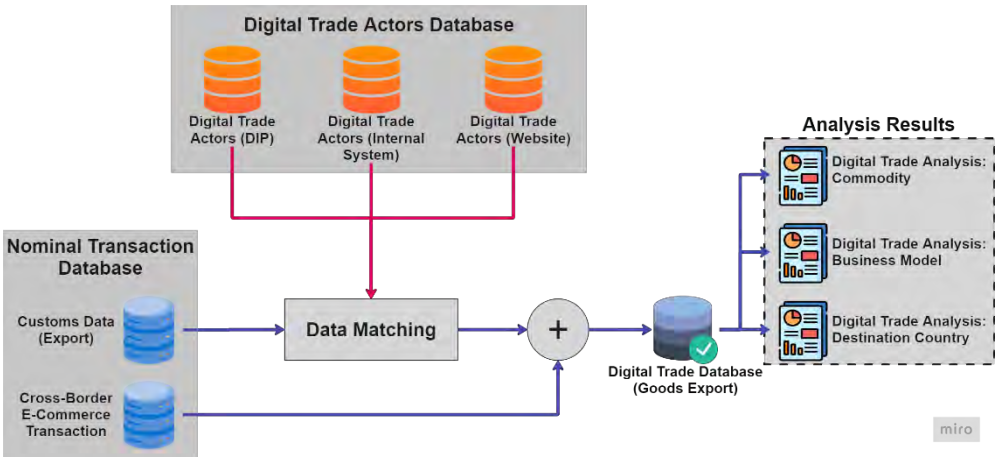


Figure 3. General Description of Goods Export Data Processing in Indonesia

Even though there are 5 (five) data sources used in compiling digital trade statistics on exports and imports of goods and services, this research only focuses on the process of identifying digital actors who export goods sourced from export platforms using the web scraping method.

2.3. Web Scraping

Web scraping is the process of extracting data off the web programmatically and transforming it into a structured dataset. Web scraping allows for larger amounts of data to be collected in a shorter span of time and in an automated fashion that minimizes errors. There are two types of web scraping. The first is screen scraping, where you extract data from source code of a website, with an HTML parser or regular expression matching. The second is using application programming interfaces, commonly referred to as APIs. This is where a website offers a set of structured HTTP requests that return JSON or XML files (Rundel & Dogucu, 2020).

Many national statistical agencies started relying on web scraping as a form of data collection, including the Italian National Institute of Statistics, ISTAT (Polidoro et al., 2015), the Federal Statistical Office of Germany, Destatis (Destatis, 2018), and Statistics Netherlands (Ten Bosch et al., 2018). One widespread way such agencies use web scraping is in automating the collection of prices of specific consumer products (e.g., electronics, housing, and medicine) to calculate some form of index of consumer prices. Uses of web scraping for data collection for other purposes have also been considered. The United States Census Bureau is building a tool that automatically scrapes tax revenue collections from websites of state and local governments as opposed to collecting this information with a traditional questionnaire (Dumbacher and Capps, 2016). Similarly, Statistics Canada (2019) is looking into ways how they can incorporate web scraping to reduce the burden on survey responders.

In industry, perhaps the best-known scraper is Googlebot (Google, 2019) which scrapes data from many web pages for Google's search engine. Web scraping is also often used in e-commerce. For instance, flight comparison websites scrape data from multiple airlines (Poggi et al., 2007). Many e-commerce websites scrape pricing information from their competitors' websites (Stiving, 2017).

Web scraping comprises three primary and intertwined phases: 1) website analysis, 2) website crawling, and 3) data organization (see Figure 4) (Krotov & Silva, 2018; Krotov & Tennyson, 2018). Each phase requires one to understand several Web technologies and at least one popular programming language, such as R or Python. However, these three phases often require at least some human involvement and, thus, one cannot fully automate them.

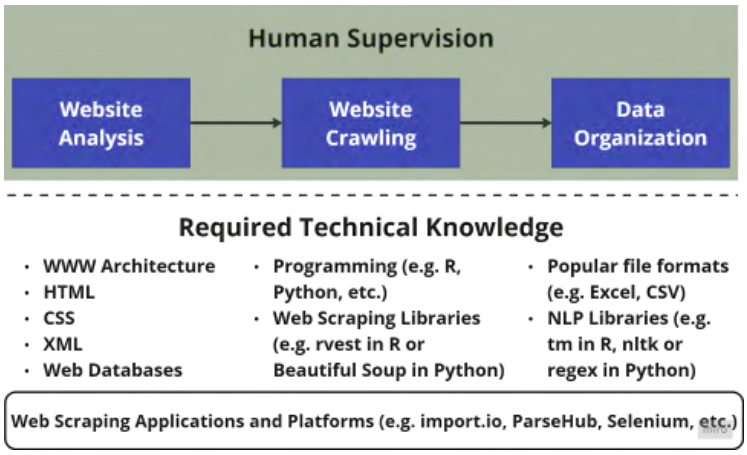


Figure 4. Web Scraping (source: Krotov & Silva, 2018; Krotov & Tennyson, 2018)

From a legal perspective, if an organization or person wants to use web scraping, they need to answer the question, namely whether their scraping action is detrimental to the website being scraped. If the scraping activity is so intense that it interferes with the services of the scraped website or the scraped data is used to duplicate the website's activities or services, then even if there is no regulation, the website has an excuse. to file a lawsuit against the scrapper. Meanwhile, from an ethical point of view, considering that web scraping already has many use cases and professional providers in the market, we can claim that there is no harm in using web scraping for business purposes. (Krotov et al., 2020).

In terms of using web scraping to identify digital trade actors, we do this to retrieve the names of exporters who are suppliers on the export platforms. The data provided from this platform is open to the public and the period used for scraping is once a month so that it does not cause problems in terms of legality or in other words the process carried out is an act that does not violate the law.

3. Methodology

3.1. Data Source

In compiling cross-border digital trade statistics, especially exports of goods, 5 (five) data sources are used as a basis, namely:

1. International Transaction Reporting System (ITRS)

ITRS is data obtained from bank reporting to the Central Bank regarding transactions in the context of international trade. This database is designed to track

and report international trade activities including exports and imports. ITRS data is the basis for identifying actors who export goods and services.

2. Export Platforms

In order to develop the potential of the export business sector in Indonesia, there are digital export platforms that can be used to help domestic export business actors to gain access and information regarding the needs of prospective buyers abroad. Two of these export platforms are used as web scraping objects to identify digital trade actors in exporting goods. These platforms provide information about export opportunities as well as connect Indonesian suppliers with buyers around the world and promote Indonesian companies and products online to reach a wider range of potential buyers.

3. Export Declaration (Customs Data in Export)

Export data includes all goods brought outside Indonesian territory. This data was obtained from the Directorate General of Customs and Excise (under the Indonesian Ministry of Finance) which has collaborated with Bank Indonesia. Export data is the basis for obtaining transaction values from actors identified in points 1 and 2 as digital trade actors.

4. Focus Group Discussion (FGD)

FGD with the company was carried out to deepen the company's business processes, especially the practice of ordering digitally and delivering digitally. Representative actors are selected and sorted based on their transaction value and then a bilateral structured discussion is held with Bank Indonesia. Open questions were asked to collect information regarding the extent to which the company has implemented digital technology in the process of selling the goods it markets, because the process of ordering and sending goods is the main key in identifying digital trading actors. The results of the FGD were used as the basis for analysis carried out by Bank Indonesia to determine whether the company was a digital trading actor or not. If the company does not carry out digital trade practices, export transactions will be excluded from the digital trade statistics for exports of goods (filtering process).

5. Cross Border E-commerce Transaction Data

Goods export data used as an additional data source besides customs data is export transaction data originating from domestic e-commerce companies that have collaborated with Bank Indonesia.

In general, the description of the mapping of the data universe used in the process of compiling digital trade statistics on exports of goods is as follows (see Figure 5):

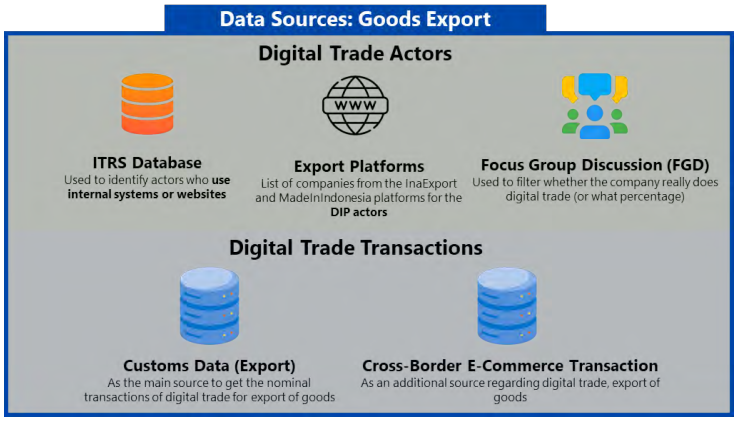


Figure 5. Data source mapping for Goods Export

3.2. Data Processing

In compiling cross-border digital trade statistics, there are 2 (two) major processes, namely (i) identification of cross-border digital trade actors and (ii) matching of actors with the nominal transactions. These two things are done sequentially, starting from the first process (identifying the digital trade actors) then matching the transaction nominal. For more details, each process is as follows:

1) Identify cross-border digital trade actors

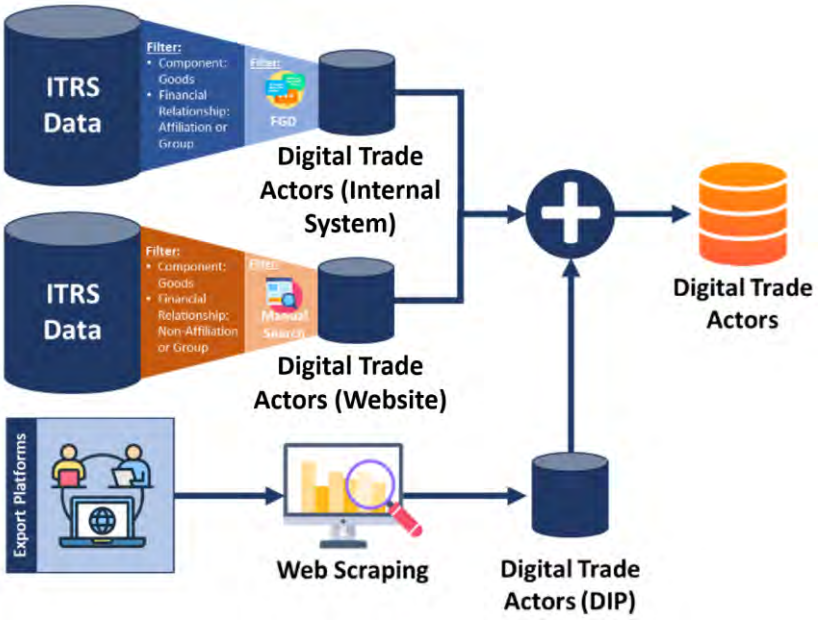


Figure 6. Digital Trade Actor Identification Process (Export of Goods)

Based on (Figure 6), after obtaining various companies exporting goods from ITRS data, the process of identifying these companies one by one via the internet was carried out regarding the ordering media used both through internal systems, websites and DIP. A company is categorized as ordering goods through an internal system if the transaction is carried out between the parent company and a subsidiary (having a group/affiliate financial relationship) and has

been confirmed through an FGD. Meanwhile, a company is categorized as ordering goods via a website if the company has a website that is used to market and order products. In addition, the actors through the Digital Intermediary Platform (DIP) were identified using a web scraping process by extracting the names of supplier/seller companies from existing export platforms in Indonesia.

2) Identify the nominal value of cross-border digital trade transactions

After the process of identifying the digital trade actors and the ordering media used, the next step is to match the name of the digital trade actors with special customs data for Exported Goods (export declaration) (see Figure 7). The data matching process uses a gestalt pattern matching algorithm (one of the algorithms in the entity resolution family that is part of advanced analytics).

If the export transaction value has been obtained from export declaration, it is necessary to carry out special screening of transaction actors via the website. Conformity between products marketed on the website and export commodities recorded in the PEB database is very important to be checked to increase data accuracy.

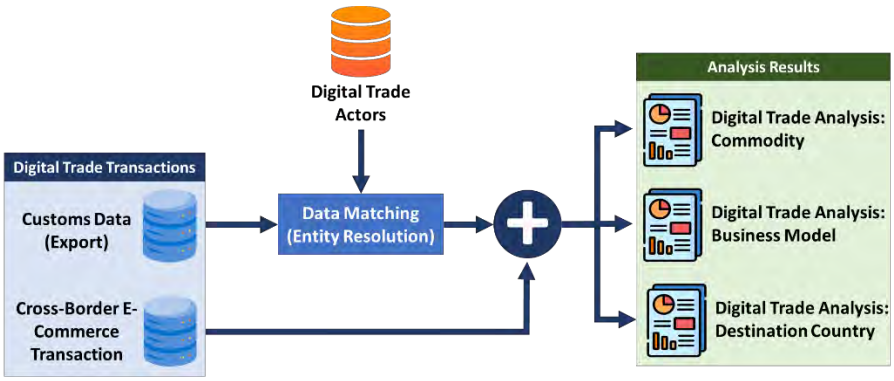


Figure 7. Cross-Border Digital Trade Transaction Nominal Identification Process

In the end, the value of goods export transactions resulting from data matching and the value of goods export transactions originating from 2 (two) e-commerce sites are used to compile digital trade statistics for goods exports.

4. Result and Discussion

In compiling digital goods export trade statistics, the first thing to do is carry out web scraping to obtain a list of digital trade actors through DIP channels, while the website and internal systems come from a list of actors collected manually. Web scraping is done to retrieve data from a table or list on the export platforms. The steps taken in web scraping are (Figure 8):

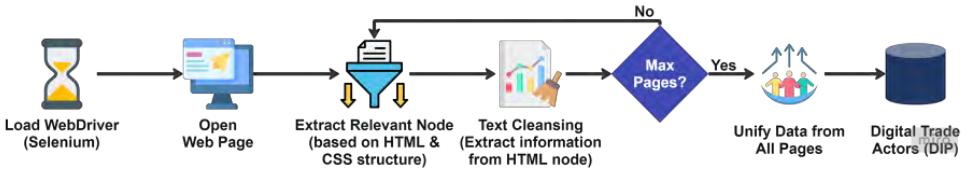


Figure 8. Web scraping steps

In the web scraping process, the information we want to obtain from the export platforms is the name of the company that are determined to be a supplier of the platform.

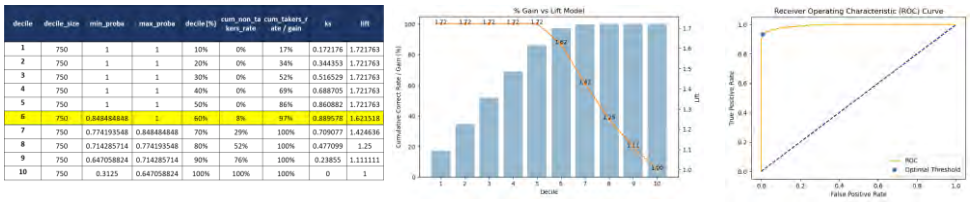
After obtaining the names of suppliers from all export platforms, the list of actors will be combined with other channels. The next process carried out is to match the name of the digital trade actor who exports goods for all routes with the name of the export actor in the transaction database (export declaration) so that the nominal export transaction carried out by that actor is obtained. This matching process uses advanced analytical techniques, namely entity resolution using a gestalt pattern matching algorithm which is formulated as follows:

$$D = \frac{2K_m}{|S_1| + |S_2|}$$

Notes:

- K_m is the number of matching characters
- S_1 is the first string
- S_2 is the second string

Using this algorithm, an analysis of the best threshold is carried out that provides the highest accuracy using decile analysis and receiver operating characteristic (ROC) curve analysis as shown in (Figure 9):



(a) (b)

Figure 9. Threshold analysis using (a) Decile analysis (b) ROC curve

Based on the analysis results in (Figure 9) it is known that: the best decile used is the 6th decile which has a true positive rate of 97% with a lift showing 1.62 or in other words this algorithm has a reliability of 1.62 times compared to using the similarity threshold. of 0.5, by using the ROC curve the optimal threshold was also obtained, namely 0.9268 with an accuracy of 96% by utilizing 7500 data as testing.

By using advanced analytics, namely web scraping and entity resolution as method development, several benefits are obtained, namely:

a) The scope of digital trade actors

The application of advanced analytics in terms of compiling statistics, especially in terms of data collection, has had a major impact in increasing the scope of identified digital trade actors, especially those using DIP

channels. The additional actor coverage is 294 actors (before the use of web scraping there were only 153 actors, but after there are 447 actors that use DIP as a transaction intermediary). This shows that there has been an increase in actors by 292% with the implementation of web scraping in identifying actors of cross-border exports of digital trade goods. Subsequently, the expansion of identified actors will lead to a greater transaction value.

b) The efficiency of the work process

The utilization of advanced analytics contributes to enhancing the efficiency of work processes at Bank Indonesia, where statistical compilation results become available more quickly, even with limited resources. The efficiency impact of implementing advanced analytics is presented as follows (see Figure 10):

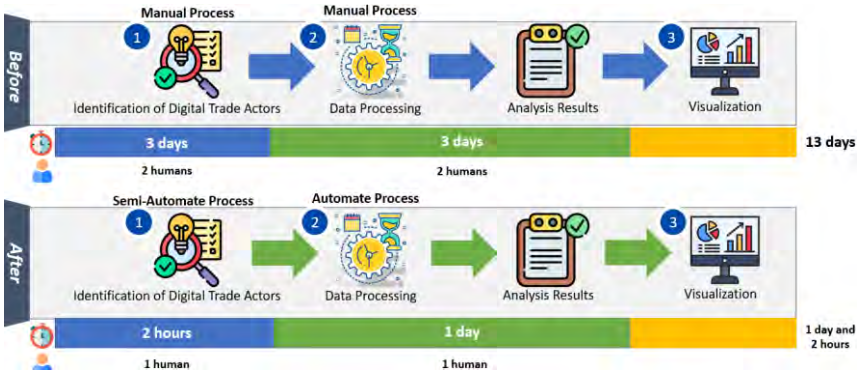


Figure 10. Business Process Improvement (effect of Advanced Analytics)

Based on (Figure 10), there is efficiency in the work process so that there is a reduction in the time required for a work process (13 days to 1 day 2 hours) thereby reducing the work process to around 12 days. In addition, in terms of human resource requirements, it is found that there is a reduction in resources. What is needed is from 2 people to 1 person. This is due to the use of programming in it so that it no longer requires human touch starting from the identification and data processing process.

c) The quality of the data obtained

Based on improvements in terms of work processes and the web scraping process itself, apart from being able to increase the scope of actors, it also increases the effectiveness and efficiency of the work process. The quality of data obtained from web scraping results is also increasing, this is because the web scraping process uses a programming method so that there is no human touch in it, thereby minimizing errors caused in data processing (Rundel & Dogucu, 2020).

5. Conclusion and Future Works

Based on this discussion, several conclusions were obtained, namely:

a) By implementing advanced analytics in the process of compiling cross-border digital trade statistics, especially the use of web scraping, it can increase the scope of exporters of goods by 294 actors (an increase of 292%).

b) By implementing advanced analytics (a combination of web scraping and entity resolution) work process efficiency can be achieved, namely by reducing the work process by around 12 days, in terms of human resources required can be reduced from initially requiring 2 people to only 1 person.

c) By using web scraping in the process of compiling statistics, the quality of the data used can be guaranteed, or in other words, without human touch, human error can be minimized.

In addition, the web scraping process is currently limited to DIP-mediated transactions only. In the future, Bank Indonesia will develop this web scraping technique to identify actors who use website intermediaries (based on whether the website can be used for transactions or not) and develop web scraping to extract the profile of a company so that it can be tracked (used as a reference for knowledge, whether the company is a digital trading actor that uses an internal system or not). This is done considering that the initial data known as the basis for identifying digital trade actors is only based on the name of the company, so it is necessary to extract new basic data sources to identify digital trade actors.

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Bank Indonesia

Web Scraping as a Detection Tool in Identifying Indonesian Cross-Border Digital Trade Actors

Aditya Wisnugraha Sugiyarto, Hasudungan Paulanka Siburian, Marlina Novita Uligoma, Dwi Cahyo Ardianto, Novi Ajeng Salehah, Detasya Avri Magfira





Department of Statistics, 13th February 2024

BANK INDONESIA
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Motivation and Introduction

Indonesia: Rising Digital Frontier

Volume
42% of the ASEAN Digital Economy

Investment Inflows
100% Growth from 2021 to 2022
from $4.5 bio to $9.1 bio

Internet User
66% Of whole population in Indonesia

Population
52% Of whole population dominated by gen Y and Z

Digital Economy Growth
8x In just less than 10 years

Source: Google, World Bank, NSO, IMF, Sapulette & Santoso, etc. (2022)

Current State

- Identification of digital trade actors process becomes increasingly complex and time consuming
- Available information is often limited to company names
- The current database has incomplete transaction coverage due to the manual data processing

Opportunity

- The importance of data in supporting policy and decision making has encouraged the development of big data analysis (Suominen & Hajikhani, 2021)
- The use of big data analytics provides the ability to analyze and interpret large and complex amounts of data
- Web scraping can become a very effective tool for accessing information about digital trade actors, including their activities and characteristics (Rundel & Dogucu, 2020)
- Web scraping can be used to gather information from various digital trading platforms, company directories, and other related sources (Rundel & Dogucu, 2020)

Desired State

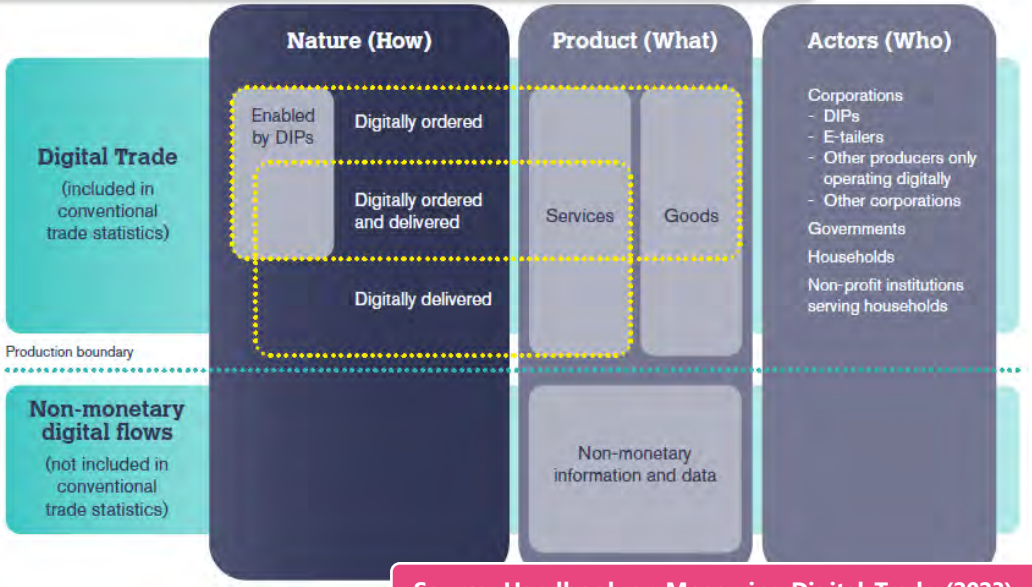
- The identification process of digital trade actors is clear and efficient
- The information available from digital trade actors is complete
- A new database that has very good quality with complete transaction coverage

Paper Contribution

- This paper contributes in terms of providing one of the first work/paper related to cross-border digital trade in Indonesia.
- In addition, the authors provide overview and framework of how to use advanced analytics to improve the quality of digital trade statistics compilations

Digital Trade Concept

Conceptual Framework of Digital Trade



Source: Handbook on Measuring Digital Trade (2023)

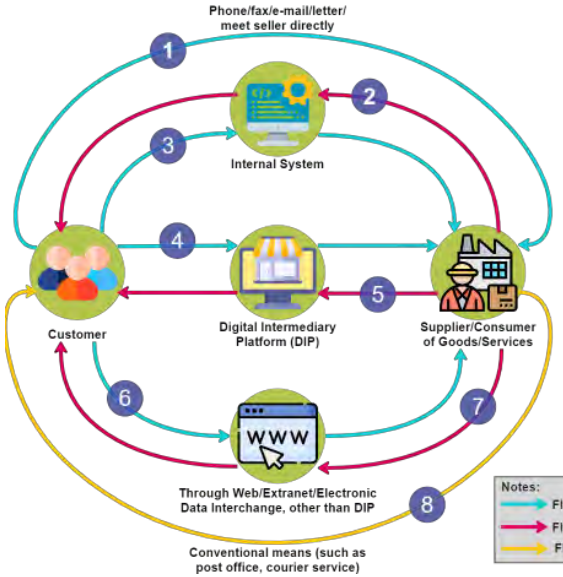
Based on Conceptual Framework of Digital Trade, digital trade is divided into two types of transactions (how), namely:

- **Transactions for goods/services ordered digitally (digitally ordered)**
  Cross-border digital transactions ordered digitally are the international sale or purchase of a good or service, conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders.
- **Transactions for goods/services sent digitally (digitally delivered)**
  Digitally delivered trade is defined as all international trade transactions that are delivered remotely over computer networks

Since 2019, Bank Indonesia has begun studying the concept of digital trade in Indonesia.

In its development, **Bank Indonesia has formulated a concept model for digital trade transactions that occur in Indonesia** (see Digital Trade Transaction Model in Indonesia).

Digital Trade Transaction Model in Indonesia

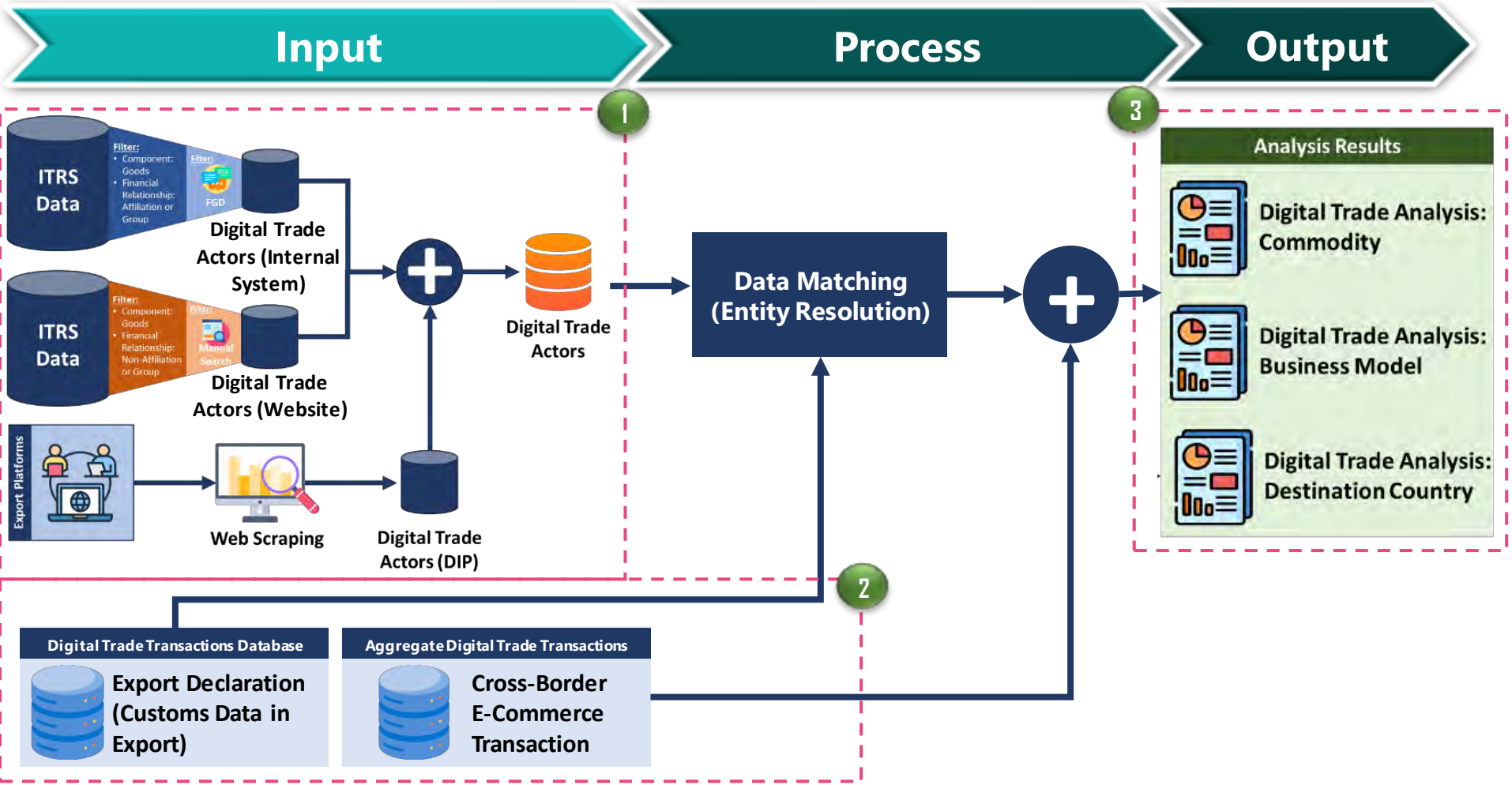


Type Transaction	Type of Order		Type of Delivery		Product	Nature
	Digital	Non	Digital	Non		
Transaction I	6			8	Goods	Digital Trade
Transaction II	4			8	Goods	Digital Trade
Transaction III	3			8	Goods	Digital Trade
Transaction IV		1	7		Services	Digital Trade
Transaction V	6		7		Services	Digital Trade
Transaction VI	4		5		Services	Digital Trade
Transaction VII	3		2		Services	Digital Trade
Transaction VIII		1		8	Goods/Services	Non Digital Trade

This transaction model is the basis for forming cross-border digital trade statistics in Indonesia for both goods and services.

Methodology

Compiling cross-border digital trade statistics on goods exports involves 3 main processes: profiling of digital trade actors, identification of transactions, and extracting analysis results of the statistics...



1. Identification (profiling) of cross-border digital trade actors on goods export using Digital Intermediary Platform (DIP), websites, internal systems channels by utilizing data sources such as ITRS and export platforms.

2. Based on data from digital trade actors, goods export transactions are identified based on export declarations (customs data on exports) and supplemented with aggregate data on cross-border e-commerce transactions. This matching process uses the entity resolution method.

3. After obtaining information related to transactions from digital trade actors, statistical results and details of cross-border digital trade are obtained.

Results

1 Identification of Digital Trade Actors



- The coverage of actors has increased by 292%.
- The use of web scraping improve work process efficiency.
- The expansion of identified actors will lead to a greater transaction coverage.

2 Data Processing



- The entity resolution method (gestalt pattern matching) with 96% accuracy can increase the efficiency of work process in terms of processing time and human resources.

3 Analysis Results of The Statistics



- **A more detailed database of cross-border digital trade statistics is acquired**, such as names of actors, transaction values, commodities, destination countries, where these information can be interlinked to obtain a more in-depth analysis.
- **The new database has better quality compared to the manual process, featuring more accurate actor names and broader transaction coverage**.

The Efficiency of the work process

	Before	After
Identification of Digital Trade Actors	3 days, 2 persons	2 hours, 1 person
Data Processing	10 days, 2 persons	1 day, 1 person
TOTAL	13 days, 2 persons	1 day and 2 hours, 1 person

Conclusion & Way Forward

Conclusion

- Advanced analytics (web scraping and entity resolution) can increase the scope of exporters of goods by 294 actors (an increase of 292%).
- Efficiency in the work process has increased as reflected in faster data processing (13 days to 1 day) and fewer human resources (2 humans to 1 human).
- The quality of data can be enhanced through advanced analytics as it can minimize the human error.

Way Forward

- Utilize web scraping to identify actors that use website intermediaries (based on whether the website can be used for transactions or not), as one of the data sources for measuring cross-border digital trade in Indonesia.
- Develop web scraping to extract the profile of companies so that it can be tracked (as a reference in getting information whether the company is a digital trade actor that use an internal system or not).

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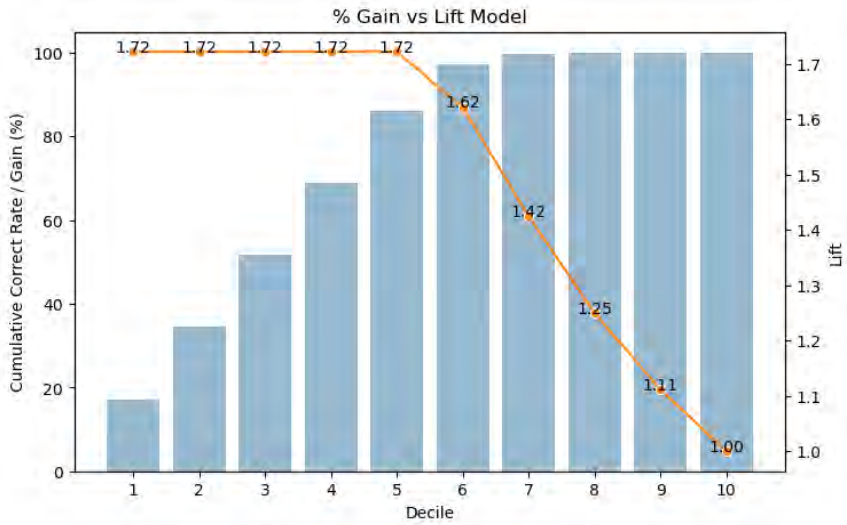
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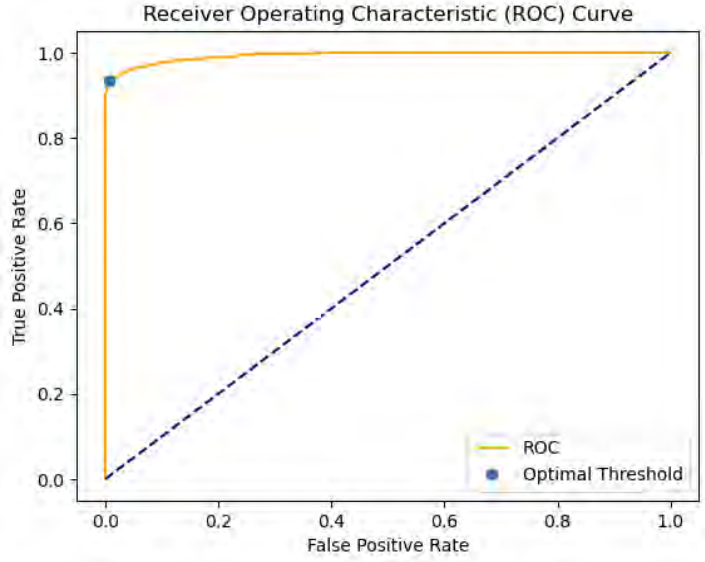


Entity Resolution: Accuracy

Decile Analysis

decile	decile_size	min_proba	max_proba	decile (%)	cum_non_takers_rate	cum_takers_rate / gain	ks	lift
1	750	1	1	10%	0%	17%	0.172176	1.721763
2	750	1	1	20%	0%	34%	0.344353	1.721763
3	750	1	1	30%	0%	52%	0.516529	1.721763
4	750	1	1	40%	0%	69%	0.688705	1.721763
5	750	1	1	50%	0%	86%	0.860882	1.721763
6	750	0.848484848	1	60%	8%	97%	0.889578	1.621518
7	750	0.774193548	0.848484848	70%	29%	100%	0.709077	1.424636
8	750	0.714285714	0.774193548	80%	52%	100%	0.477099	1.25
9	750	0.647058824	0.714285714	90%	76%	100%	0.23855	1.111111
10	750	0.3125	0.647058824	100%	100%	100%	0	1





Based on the results of the analysis using Decile Analysis and ROC-AUC to obtain the best threshold results, it was found that::

- **The best decile obtained was the 6th decile, which obtained an improvement of 97%** (a true positive rate of around 97% was obtained in that decile) and the improvement still showed 1.62 (this model is 1.62x better than using the default threshold, 0.5).
- By using the AUC-ROC curve**, the optimal threshold value was obtained is 0.9268 with an accuracy of 96%** based on a dataset of 7500.

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

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Malaysia's experience in using mirror data to complement external sector statistics[1]

Choo Ching Yii, Zima Mazfahani Mazlan
and Nurina Nasaruddin,
Central Bank of Malaysia

[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Malaysia's experience in using mirror data to complement external sector statistics[1]

Nurina Nasaruddin, Zima Mazfahani Mazlan and Choo Ching Yii

Abstract

Comprehensive and reliable external sector statistics are essential for policy-making, surveillance and research, especially in this challenging era of globalisation and digitalisation. Apart from the traditional statistical methodology for compilation and analysis, adoption of additional measures such as exploring complementary data published by international agencies and counterparts can provide new insights to analysis, especially to address evolving needs for statistics, e.g. sectoral and country breakdown as well as to navigate around the complexity of analysing data under the new economy landscape. By leveraging on mirror data, countries can detect data gaps and asymmetries as well as gain valuable insights on their economic transactions with the rest of the world and external position.

This paper presents Malaysia's experience in applying mirror data analysis specifically by comparing the country's deposit abroad with deposit accepted by the rest of the world, particularly for non-bank entities, as well as country's foreign direct investment with direct investment abroad by counterpart economy. While the data sourced from Bank for International Settlements' International Banking Statistics and International Monetary Fund's Coordinated Direct Investment Survey were found to be useful for the assessment, the paper also aims to discuss challenges and limitations in integrating the mirror data into national statistics frameworks, thus, create an avenue for refinement and expanded usage of such technique.

Keywords: mirror data, non-bank deposits, foreign direct investment, international investment position

JEL classification: C800, C820, F300

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Abbreviation

BIS	Bank for International Settlements
BOP	Balance of Payments
BPM6	Balance of Payments and International Investment Position Manual – sixth edition
CDIS	Coordinated Direct Investment Survey
CPIS	Coordinated Portfolio Investment Survey
DIA	Direct Investment Abroad
DTC	Deposit Taking Corporations
ESS	External Sector Statistics
FDI	Foreign Direct Investment
IBS	International Banking Statistics
IIP	International Investment Position
ISS-ESS	Integrated Statistical System - External Sector Statistics
ITRS	International Transactions Reporting System
IMF	International Monetary Fund
LBS	Locational Banking Statistics

1. Introduction

The external sector statistics (ESS) presents an overview and detailed information on the size and composition of Malaysia's external trade in goods and services, as well as the country's financial transactions with other countries and its international investment position, which includes external liquidity and national debt obligation. Hence, the statistics play a major role as key economic indicators and determinants for policy-making, surveillance and research, especially in this challenging era of globalisation and digitalisation.

Mirror data analysis is a data analysis method which compares data captured from different sources based on similar concepts for the same period. By leveraging on mirror data, countries can validate its own data compiled against its partner countries, detect data gaps and asymmetries as well as gain valuable insights on their economic transactions with the rest of the world.

This paper focuses on Malaysia's experience in mirror data analysis by comparing – the country's deposit placed abroad with deposit accepted by counterpart countries, particularly for non-bank entities, as well as – the country's foreign direct investment (FDI) with direct investment abroad (DIA) by counterpart economies. The comparisons were made by using data published by Bank for International Settlements (BIS) and International Monetary Fund (IMF) on their respective data sharing platforms. It aims to demonstrate the application of this data analysis technique to measure the comprehensiveness of current ESS compilation in Malaysia, as well as to explore new insights for internal economic surveillance, analysis and research.

There are five sections in this paper. Following the introduction, Section 2 presents data sources used for the mirror data analysis. Section 3 and 4 explain the linkages between the pairs of comparable data, findings from the analysis and plausible arguments for the discrepancies and asymmetries. Lastly, Section 5 describes the challenges and limitations encountered while performing the mirror data analysis.

2. Data Sources

Direct reporting system and statistical imputation

The compilation of Malaysia's ESS is managed by both Bank Negara Malaysia (BNM) and the national statistics office, Department of Statistics Malaysia (DOSM) through the Memorandum of Understanding (MOU) instituted since 2008 that led to the establishment of BNM-DOSM Joint IIP Survey. The Survey collects quarterly data on cross-border flows and stocks, directly from all banks, selected non-bank enterprises, custodians managing funds on behalf of foreign investors in Malaysia as well as residents' portfolio investments overseas and relevant government agencies. The data comprises all financial instruments, such as equity capital, retained earnings, loans, deposits, etc. and augmented with further details on respective non-resident counterparty, country, institutional sector, industry and currency denomination of

such exposure. Additional attributes such as name, relationship, percentage shareholdings of investors and affiliated companies are collected to facilitate more in-depth analysis of external flows and positions.

Given the fact that the Survey does not cover all non-bank enterprises and individuals in Malaysia, the compilation of deposits and real estates of these non-surveyed entities is further complemented with data imputation based on cross-border transactions reported by the domestic banks via International Transactions Reporting System (ITRS), inclusive of the estimation for informal economies. These data are compiled via Integrated Statistical System - External Sector Statistics (ISS-ESS) – a single repository to produce Balance of Payments (BOP) and other related statistics including International Investment Positions (IIP), External Debt Statistics, Coordinated Portfolio Investment Survey (CPIS), Coordinated Direct Investment Survey (CDIS) and International Banking Statistics (IBS). The aggregated data are published on quarterly basis from as early as 1Q 2008 by 7th week after the end of reference period on DOSM and BNM's websites.

IMF Coordinated Direct Investment Survey (CDIS)

The IMF collects annual data on direct investment position by immediate counterpart economy via CDIS. It is collected to improve the quality and availability of direct investment position in the IIP statistics. The survey comprises data on inward direct investment position (FDI in the reporting economy) and outward direct investment position (DIA by the reporting economy). Both datasets are cross-classified by economy of immediate investors and direct investment enterprises respectively and components of direct investment, namely equity and investment fund shares and debt instruments. All reporting economies provide data on their inward direct investment, while a subset of them contributed data on their outward direct investment. In principle, CDIS data concept and methodology are consistent with the sixth edition of the Balance of Payments and International Investment Position Manual (BPM6). The participation in the survey is voluntary and its accessible outputs date back to year 2009. Data is published 12 months after the end of reference year.

BIS Locational Banking Statistics (LBS)

The BIS collects quarterly data on locational banking statistics (LBS) from reporting countries, with focus on internationally active banks. It is collected to observe the change in the financial landscape and identify emerging vulnerabilities within the banking sector (BIS, 2019). It captures the outstanding financial assets and liabilities of banks with breakdown by instruments (loans and deposits, debt securities, derivatives and other instruments), currencies, bank nationalities, counterparty sectors and geographical location. The LBS comprises two data subsets, the LBS by residence (LBS/R) and the LBS by nationality (LBS/N), where the latter provide the same information as LBS/R on on-balance sheet claims and liabilities but aggregated by reporting banks' nationality. In principle, LBS data concept and methodology are consistent with the BPM6, as they correspond to claims/liabilities of one country vis-à-vis those of non-resident countries. Currently, the LBS data is submitted by 48 countries and the earliest data available is from 2007 onwards. Data is published about 4 months after the end of reference quarter.

3. Linkages of Malaysia's foreign direct investment between IMF CDIS and direct reporting system

This mirror data analysis focuses on FDI into Malaysia due to the significant presence of multinational enterprises in the country and increasing complexity of ownership structure and offshoring business operations worldwide. Therefore, the motivation of the study is to validate the current compilation practices with other relevant data sources to detect data gaps to further improve the data coverage, quality as well as exploring potential leverage for data estimation purposes.

In principle, the inward direct investment (i.e. FDI) reported by Malaysia to the IMF for CDIS and IIP publications is comparable with the outward direct investment (i.e. DIA) reported by counterpart reporting economies (i) to the IMF CDIS, as illustrated below:

$$IMF\ CDIS\ inward\ direct\ investment_{Malaysia} \approx IMF\ CDIS\ outward\ direct\ investment_i$$

or

$$IIP\ FDI_{Malaysia} \approx IMF\ CDIS\ DIA_i$$

On average, from year 2010 – 2021, 37 out of 246 reporting economies reported outward direct investment to Malaysia in the IMF CDIS database while Malaysia disseminated data on inward direct investment for 14 out of these 37 reporting economies, mainly due to confidentiality restriction. In addition, due to its significant exposure with Malaysia, the analysis against Singapore is included using data directly sourced from the publication channel of Singapore's national statistical office as the information is not available in the IMF CDIS database.

Chart 1 and Table 1 shows the bilateral comparison at aggregated level between inward direct investment reported by Malaysia and outward direct investment reported by 12 – 15 counterpart reporting economies from 2010 to 2021. The total FDI in Malaysia for the same period is included as reference.

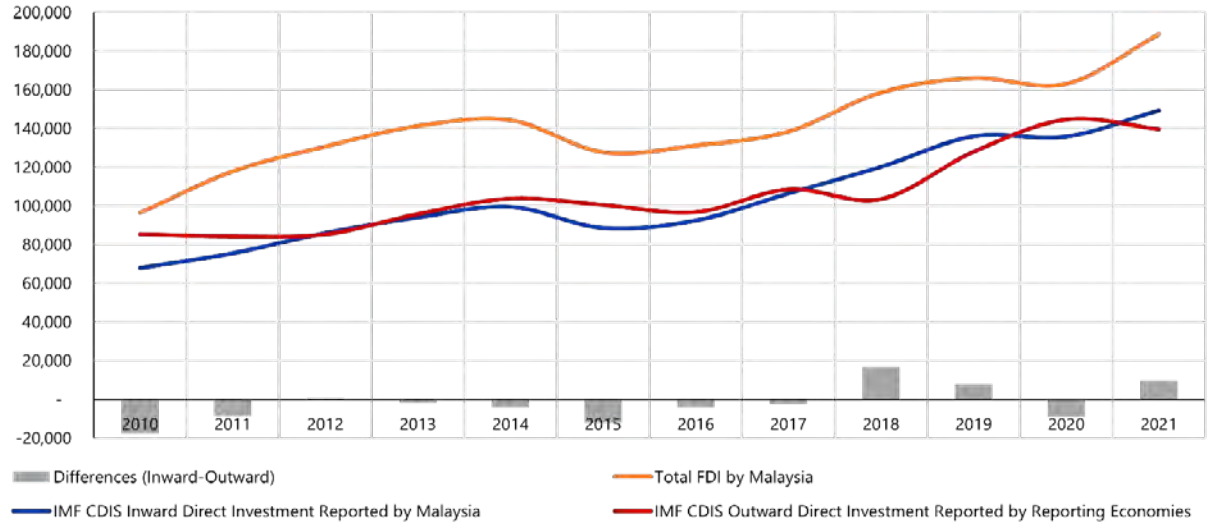
On average, the outward direct investment for these reporting economies accounted for 75% of the total FDI compiled by Malaysia, suggested that the comparison for these economies is sufficient for this study. The observation on the bilateral comparison can be segregated into two main phases as below:

1. **Year 2010 – Year 2016:** The inward direct investment reported by Malaysia is mostly lower than the corresponding mirror data, suggesting an under coverage of surveyed entities and lack of reliable benchmark for data quality assurance.
2. **Year 2017 – Year 2021:** Starting from 2018, the values of inward direct investment by Malaysia are higher, indicating an improvement in Malaysia's ESS compilation due to implementation of ISS-ESS in 3Q 2017. The new integrated system enables an expansion of data collection scope with higher levels of granularity whilst ensuring efficiency, accuracy and consistencies of ESS.

Comparison between Malaysia's foreign direct investment and IMF CDIS inward direct investment vis-à-vis IMF CDIS outward direct investment positions[1]

In millions of US dollars

Chart 1



[1] The comparable reporting economies varies from 2010 to 2021 due to confidentiality restrictions by reporting economies i.e. 2010 (12 reporting economies), 2011 (11 reporting economies), 2012 (12 reporting economies), 2013 (13 reporting economies), 2014-2017 (14 reporting economies) and 2018-2021 (15 reporting economies).

Sources: IMF CDIS, Bank Negara Malaysia, Department of Statistics Malaysia and author's calculation.

Chart 2 shows the relationship between inward direct investment reported by Malaysia and outward direct investment reported by counterpart reporting economies to IMF CDIS for two periods, i.e. 2010 and 2021. In 2010, the total exposure reflected in both data sets are consistent except for 4 reporting economies - Japan and the United Kingdom reported lower exposure, while Singapore and the Netherlands reported higher outward direct investment to Malaysia. Comparison for these bilateral asymmetries after a decade in 2021 shows a significant improvement in Malaysia's FDI compilation particularly for the Netherlands, Singapore, Japan and the United Kingdom, where the discrepancies are smaller. Hence data points are concentrated along the benchmark line in the chart. On the other hand, the bilateral asymmetries grew larger for Hong Kong and Switzerland, potentially due to the following:

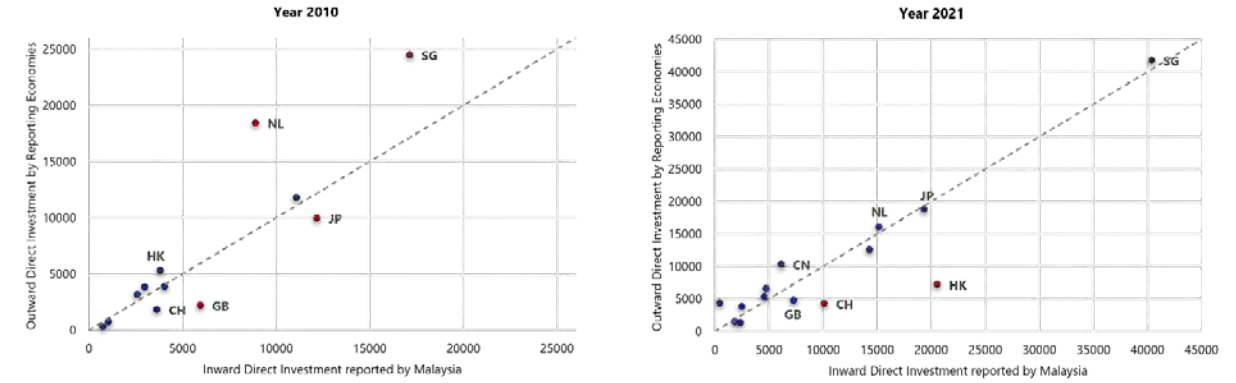
1. **Different reporting of country of investment based on immediate or ultimate counterpart:** As an international financial centre, Hong Kong serves as an important gateway for investment and financing between Mainland China with the rest of the world. Various data sources indicate that roughly two-thirds of China's outward and inward direct investments originate in and pass through the economy (Hong Kong Is China's Financial Gateway to the World, 2021). Hence, the outward direct investment may be classified under the ultimate investor, China, while inward direct investment reported by Malaysia is based on the immediate country of investor, Hong Kong.

2. **Different valuation methods, data sources and estimation techniques**: Malaysia collects direct investment position based on book value (except where the direct investment enterprise is listed on local bourse) while other reporting economies may have adopted estimation approach constructed using annual data (Angulo & Hierro, 2017).

The exchange of data and metadata between reporting economies could enhance the understanding on the asymmetries and subsequently facilitating its resolution.

Malaysia's inward direct investment vis-à-vis outward direct investment positions for 14 economies reported to IMF CDIS for Year 2010[1] and Year 2021[2]

In millions of US dollars Chart 2[3]



[1] The IMF CDIS data for outward direct investment are available for 11 reporting economies as per Table 2. Singapore data is sourced directly from Singapore Department of Statistics (DOS).

[2] The IMF CDIS data for outward direct investment are available for 15 reporting economies as per Table 2. Singapore data is sourced directly from DOS.

[3]The dotted lines indicate the meeting points where inward direct investment compiled by Malaysia equals to the outward direct investment reported by reporting economies to IMF CDIS. Data points below the lines reflects inward direct investment compilation by Malaysia is higher and vice versa.

Sources: IMF CDIS, Singapore Department of Statistics and author's calculation.

4. Linkages of Malaysian non-bank deposits between BIS LBS/R and direct reporting system

The motivation of this study is to validate the comprehensiveness of current compilation by leveraging other relevant data sources and understand the reasons of the divergence. This analysis focuses on Malaysian non-bank deposits abroad as conducting a survey on all households' and non-bank enterprises' financial assets abroad is impractical and unfeasible. Furthermore, cross-border transactions have become increasingly complex especially for households due to the rapid revolution of digital banking services as well as enhancement to cross-border payments connectivity.

In principle, the claims of non-banks entities in Malaysia on deposit taking corporations (DTC) abroad, in the forms of deposits, which is classified under the

functional category of 'Other Investment' in IIP for Malaysia, is comparable with the liabilities of reporting countries (i) reported in the LBS/R under loan and deposits item vis-à-vis Malaysia, as illustrated below:

$$IIP\ assets_{Malaysia}^{Currency\ and\ deposits} \approx LBS/R\ liabilities_{i}^{Loans\ and\ deposits}$$

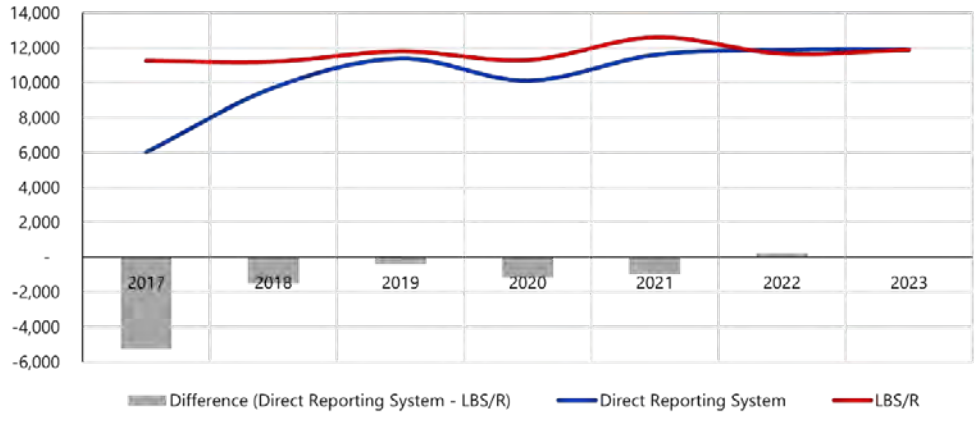
Chart 3 and Table 3 (Annex) show the high-level comparison of Malaysian non-bank outstanding deposits between its direct reporting system and LBS/R from 2017 to 1Q 2023, where 38 out of the 48 reporting countries in the LBS/R reported their exposure vis-à-vis Malaysia. The comparison is performed from 2017 onwards due to unavailability of the detailed breakdown prior to 2017.

Upon the implementation of new data collection system via ISS-ESS, which was implemented in 3Q 2017, the data compilation has been improved to support the expansion of data scope and granularity to ensure comprehensiveness, accuracy and efficiency. The expansion of data granularity for deposits amongst others, covers individual counterparty and counterparty sector that need to be reported item-by-item by direct reporting entities.

While during its inception in 2017, there was a discrepancy amounting to USD5,225mil, the divergence has progressively improved throughout the years and narrowed in the recent 2 years of 2022 and 2023. It was identified that the discrepancies during the early implementation of ISS-ESS was due to familiarisation with the new reporting requirements as more granular items are required to be reported. On the other hand, the convergence implying a continuous improvement in the data compilation in terms of survey coverage, data scope as well as data quality assurance mechanism. In addition, Malaysia has also developed a methodology to estimate the exposure of households and non-survey non-bank enterprises.

Cross-border Malaysian non-bank deposits between BIS LBS/R and direct reporting system[1]

In millions of US dollars — Chart 3



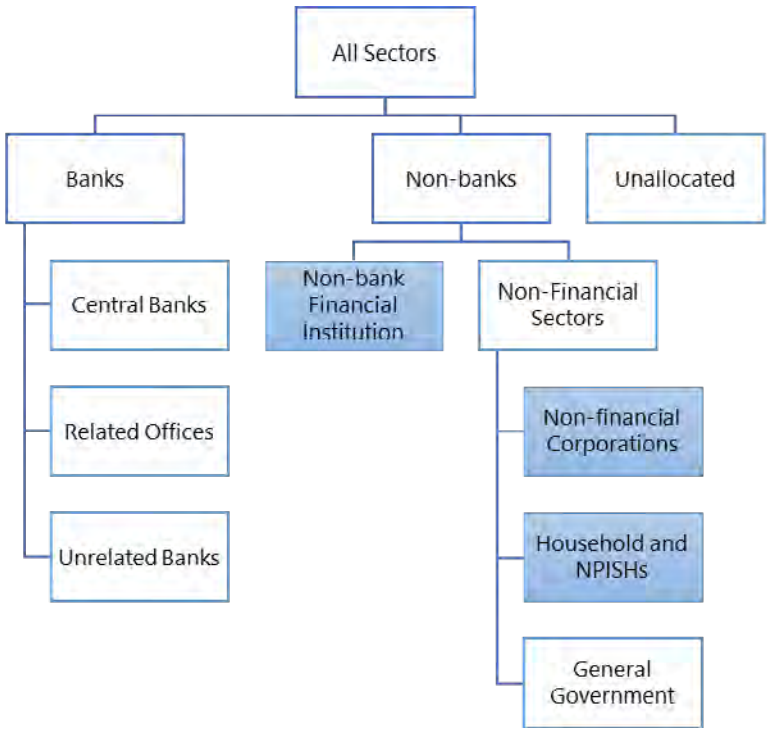
[1]Data as of 1Q 2023.

Sources: BIS locational banking statistics (LBS), Bank Negara Malaysia, Department of Statistics Malaysia and author's calculation.

In addition to the high-level data comparison, further analysis is carried out on the total exposure by depositors' institutional sector and incorporation country of DTCs who accepted the deposits from Malaysian non-bank entities. The reporting countries are required to report their banks' financial assets and liabilities by sector of their counterparty, at a minimum of five sectors: central banks, intragroup, non-bank financial institutions, non-financial sector and unallocated. The detailed breakdown of non-financial sector, which comprises government, non-financial corporations and households, is encouraged items. For this study, the comparable institutional sectors are non-bank financial institutions[2], non-financial corporations[3] and households[4] as shown in Diagram 1.

Sectoral breakdown of LBS

Diagram 1



Source: Author's own illustration.

In general, the divergence observed for households' deposit placed abroad was narrowed down in the recent 3 years from 2021 to 2023, while the discrepancies for non-bank financial institutions and non-financial corporations remain the same throughout the years. Since the access to the details is restricted for the internal use of reporting authorities and eligible data receivers, the graphical data comparison by depositors' institutional sector and counterparty country is not shown in this paper.

[2] Include insurance corporations and pension funds.

[3] Include corporations other than financial corporations.

[4] Include non-profit institutions serving households (NPISHs) such as charities, religious institutions, trade unions and consumer associations.

The potential reasons for the discrepancies are listed below:

1. **Different reporting treatment for purpose of investment, either immediate or ultimate**: Malaysian non-bank entities' deposits in offshore financial centres may not be reported by the counterparty reporting countries as it is potentially further transferred to or subsequently invested in another financial instrument in the rest of the world. Based on detailed assessment at entity level, there is an instance where the deposits are reported by the ultimate reporting countries instead. This is due to the presence of Malaysia's direct investment enterprises in the reporting countries.
2. **Different treatment of residency status**: deposits placement abroad by Malaysian households due to emigration may be treated as deposits by resident in the counterpart countries.

Such granular data comparison provides better insight and understanding on the ultimate destination of deposits placed by Malaysia non-bank entities as well as the purpose of deposit placement abroad.

5. Challenges and limitations

The key challenges and limitations are attributed to (a) periodicity, frequency and timeliness of mirror data publication, (b) unavailability of data from major counterparty economies, (c) reconciliation between flows and positions and (d) metadata comprehensiveness for official statistics.

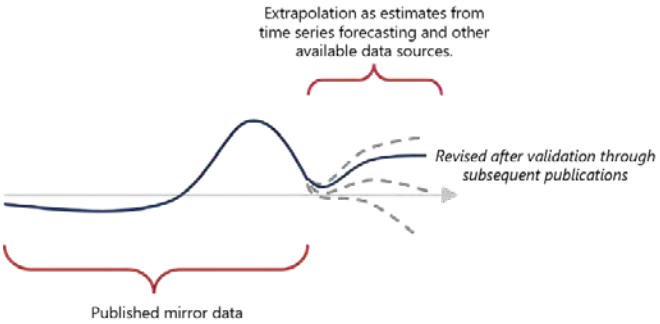
Periodicity, frequency and timeliness of mirror data publication

The annual CDIS data and quarterly IBS data are released on 12-month and 4-month after the end of reference period respectively. In this respect, any identification of data discrepancies identified from the comparison for further analysis and improvement can only be considered in the annual data revision. While this process allows overall improvements to the data accuracy, it is not as useful to perform timely analysis and surveillance on prevailing economic conditions.

Despite delayed availability, back series data could be leveraged alongside other indicators available such as administrative data from central counterparty clearing houses and national registrars, etc. for extrapolation to derive a credible estimate of the total economic transactions with the rest of the world. Having an estimate compensates for missing data points, as it enables the analysts to form preliminary views until the complete dataset becomes available for validation through subsequent publications.

Using extrapolation as estimates

Diagram 2



Source: Author's own illustration.

The discussed time lag does not pose a significant constraint for data from major economies as comparable datasets are likely accessible with higher frequency and within a shorter time frame through their respective national statistics portals. In addition, some countries have further eased the data accessibility by providing data extraction APIs or other techniques allowing public to extract relevant datasets for own analysis in a seamless manner.

Unavailability of data from major counterparty economies

Detailed data at the country, sector and instrument levels of some major counterparty economies are not available for analysis given that participation in CDIS and CPIS are voluntary. For instance, mirror data in year 2021 for major counterparty economies of Malaysia's direct investment which collectively contributed 38.1% and 42.9% for assets and liabilities, respectively, is not available in the IMF CDIS database. Fortunately, these limitations where partially mitigated as the necessary details could be accessed from the national platform.

Although CPIS is not discussed in this paper, it is worth to highlight that the granular details of these major counterparty economies are important for mirror data analysis given their significant exposure of Malaysia, namely the United States (25.4%), Singapore (7.6%), the United Kingdom (5.4%), Hong Kong (5.3%) and Luxembourg (4.3%), which collectively accounted for 48% of the total portfolio investment abroad as of 3Q 2023 as depicted in Diagram 4. However, only Singapore submitted the mirror data for these financial assets to IMF in CPIS Table 4: Reported Portfolio Investment Liabilities by Economy of Non-resident Holder. The granular details were absent in respective national statistics portal too.

Data availability from major counterparty economies

Diagram 3

	Mirror data from	
Top 5 Countries *(as of September 2023)*	IMF/ BIS	Counterparty Country's National Statistics Portal
Inward CDIS (59.0%)		
Singapore (21.1%)	X	✓
Hong Kong* (11.2%)	✓	X
United States^ (11.2%)	✓	✓
Japan^ (9.9%)	✓	✓
Netherlands* (5.5%)	✓	X
Outward CDIS (48.6%)		
Singapore (21.6%)	✓	✓
Indonesia^,# (10.9%)	✓	✓
Netherlands* (6.1%)	✓	X
Cayman Islands (5.7%)	X	X
United Kingdom* (4.4%)	X	X
CPIS Assets (48.1%)		
United States*,# (25.4%)	X	X
Singapore (7.6%)	✓	✓
United Kingdom (5.4%)	X	X
Hong Kong* (5.3%)	X	X
Luxembourg (4.3%)	X	X

Notes:
* Data available by selected counterparty countries only, Malaysia not included.
^ Data available on country by sector.
Higher periodicity

Source: IMF CDIS, IMF CPIS, author's own illustration.

The absence of data has posed a predicament in the mirror data study, particularly in assessing exposure with major counterparty economies. These may stem from difficulties in data collection within the reporting economies or confidentiality constraints imposed by national statistics authorities, preventing data sharing. In such circumstances and when peculiarities observed in the data needs to be addressed, bilateral engagement with official compilers for potential data exchange becomes crucial to advance the study and yield meaningful outcomes.

Reconciliation between flows and positions

The supplementary data presented for the mirror data analysis comprises stock positions, enabling for comparison with the published international investment position (IIP), where both refers to the value of financial assets of residents of an economy that are claims on non-residents and the liabilities of resident of an economy to non-residents, at a point in time. In BPM6, IMF has strongly recommended an integrated approach that reconciles the opening and closing values of the IIP through the financial account (flows arising from transactions) and the other changes in financial assets and liabilities account (other volume changes and revaluation). To incorporate the supplementary data into the BOP statistics publication, it is imperative to separately calculate the foreign exchange (fx) -adjusted flows, price changes for securities as well as other changes in volume where applicable. The first component was calculated and published by BIS in the international banking statistics for country reference.

Integrated approach recommended in BPM6 Diagram 4



Source: Author's own illustration.

To calculate the segregation of flows between two reference periods, data compilers may consider the nature of economic transactions, whether in the form of merchandise trades or remittances and the major settlement currency (and hence the average exchange rate) between the countries for the foreign exchange gain/ loss. Other considerations include major world stock market indices for the price changes of listed securities and global events that affect the volume changes for financial assets and liabilities.

Metadata comprehensiveness for official statistics

Relevant metadata from the compilers and list of the main methodological differences are critical for mirror data analysis in addressing different compilation practices among countries. Some examples include treatment for residency status of short-term and long-term migrants, geographic allocation of direct investment positions (especially where the chain of ownership includes a resident SPE), treatments of instruments, etc.

This information where it is made available through metadata responses from respective economies published by the IMF is heavily relied upon to ascertain the insights obtained from detailed analysis on discrepancies reflected in the mirror data analysis. However, where this information is lacking, a comprehensive understanding on businesses nature through engagement with the direct reporting entities as primary data provider enabled deliberation and hence reconciliation on accuracy of sectoral and country breakdowns recorded in BOP/IIP, particularly on immediate and ultimate destination for the flow of funds. Another instance is, for the analysis on deposits placement abroad by households, descriptors on treatment of residency status of migrants based on their centre of predominant economic interest is important to be known, given the increasing prevalence of digital nomads and evolving emigration dynamics in developing country.

6. Conclusion

Mirror data analysis can complement traditional data analysis by providing a more objective and comprehensive view of external exposures between countries. It provides additional data points in assessing the comprehensiveness of Malaysia's ESS compilation, deriving additional valuable insights on the economic transactions with major counterparty countries. While the comparison on an aggregated basis might suffice to examine the data comprehensiveness, quality and adequate reporting entities, the comparative analysis with focus in more granular level, specifically by counterparty countries resulted in a more profound insight. Notably, the methodological differences in reporting practices may cause the divergence between datasets that can be resolved by introduction of metadata.

Despite the satisfactory results obtained from the study, it is crucial to emphasise that the effectiveness of this approach relies on the availability of granular data published by respective reporting countries through the international organisations or own national statistics platform. Though the participation of reporting countries in providing detailed breakdown are increasing over time, further application of this data assessment method is still limited for Malaysia given the absence of the mirror data from major counterparty countries. Nonetheless, the observed asymmetries could be further analysed via bilateral data exchange with the counterparty countries. In addition, the studies could be extended to observe the relationship of selected major counterparty with other economies similar to Malaysia, to ascertain the potential reason of the discrepancies.

Moving forward, given the evolving financial and economic landscape, such analysis shall not be episodic but assimilated into the operational framework as part of the continuous effort and commitment to ensure a credible national statistic for policy-making, surveillance and research.

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Annex

Malaysia's foreign direct investment and inward direct investment vis-à-vis IMF CDIS's outward direct investment positions[1]

In USD millions — Table 1

Year	Total FDI by Malaysia [1]	IMF CDIS Inward Direct Investment Reported by Malaysia [2]	IMF CDIS Outward Direct Investment Reported by Reporting Economies [3]	Differences (amount) (Inward DI – Outward DI) [4] = [2] - [3]	Differences (percentage) [5] = [4] *100 / [2]
2010	96,400	67,838	85,323	-17,485	-25.8
2011	117,822	75,472	84,225	-8,753	-11.6
2012	130,637	85,902	85,249	653	0.8
2013	141,263	94,012	95,677	-1,666	-1.8
2014	144,243	99,427	103,775	-4,348	-4.4
2015	127,712	88,511	100,441	-11,930	-13.5
2016	131,168	92,399	96,704	-4,305	-4.7
2017	138,396	106,376	108,448	-2,071	-1.9
2018	158,543	120,110	103,473	16,637	13.9
2019	166,006	135,866	127,946	7,920	5.8
2020	162,982	135,738	144,620	-8,882	-6.5
2021	188,612	149,259	139,689	9,570	6.4

[1] The comparable reporting economies are varying from 2010 until 2021 due to confidentiality restrictions by reporting economies i.e. 2010 (12 reporting economies), 2011 (11 reporting economies), 2012 (12 reporting economies), 2013 (13 reporting economies), 2014-2017 (14 reporting economies) and 2018-2021 (15 reporting economies).

Sources: IMF CDIS, Bank Negara Malaysia, Department of Statistics Malaysia and author's calculation.

IMF CDIS: Malaysia's inward direct investment vis-à-vis outward direct investment positions for 14 economies for Year 2010 and Year 2021[1]

In USD millions

Table 2

Year	2020			2021		
Country	Inward Direct Investment Reported by Malaysia [1]	Outward Direct Investment Reported by Reporting Economies [2]	Differences (amount) (Inward DI – Outward DI) [3] = [1] – [2]	Inward Direct Investment Reported by Malaysia [5]	Outward Direct Investment Reported by Reporting Economies [6]	Differences (amount) (Inward DI – Outward DI) [7] = [5] – [6]
AU	2,970	3,843	-874	2,473	3,900	-1,427
CH	3,623	1,836	1,787	10,098	4,337	5,761
CN	…	…	…	6,099	10,355	-4,256
DE	4,021	3,883	138	4,552	5,336	-784
DK	1,026	766	260	2,332	1,371	961
FR	743	319	424	1,828	1,524	304
GB	5,943	2,221	3,722	7,274	4,793	2,481
HK	3,791	5,309	-1,518	20,530	7,280	13,250
JP	12,162	9,979	2,183	19,321	18,839	482
KR	2,576	3,185	-609	4,721	6,612	-1,891
LU	…	…	…	-169	477	-645
NL	8,899	18,436	-9,538	15,143	16,118	-975
SG[2]	17,127	24,528	-7,401	40,358	41,780	-1,421
TH	-172	1,446	-1,618	431	4,376	-3,945
US	11,072	11,791	-719	14,266	12,591	1,675

[1] Three dots ("…") stand for restricted or confidential.

[2] No outward direct investment reported by SG to IMF CDIS. Data is sourced from Singapore Department of Statistics website.

Sources: IMF CDIS, Singapore Department of Statistics and author's calculation.

Malaysian non-bank deposits: liabilities BIS LBS/R vis-à-vis assets direct reporting system

In USD millions

Table 3

Year	Direct Reporting System [1]	LBS/R [2]	Differences (amount) (Direct Reporting System – LBS/R) [3] = [1] - [2]	Differences (percentage) [4] = [3] *100/ [1]
2017	6,030	11,255	-5,225	-86.7
2018	9,706	11,205	-1,499	-15.4
2019	11,388	11,791	-403	-3.5
2020	10,110	11,295	-1,185	-11.7
2021	11,598	12,590	-992	-8.6
2022	11,887	11,661	226	1.9
2023[1]	11,916	11,886	30	0.3

[1] Data as of 1Q 2023.

Sources: BIS locational banking statistics (LBS), Bank Negara Malaysia, Department of Statistics Malaysia and author's calculation.

Malaysia's Experience in using Mirror Data to Complement External Sector Statistics

Nurina Nasaruddin, Zima Mazfahani Mazlan and Choo Ching Yii
Bank Negara Malaysia

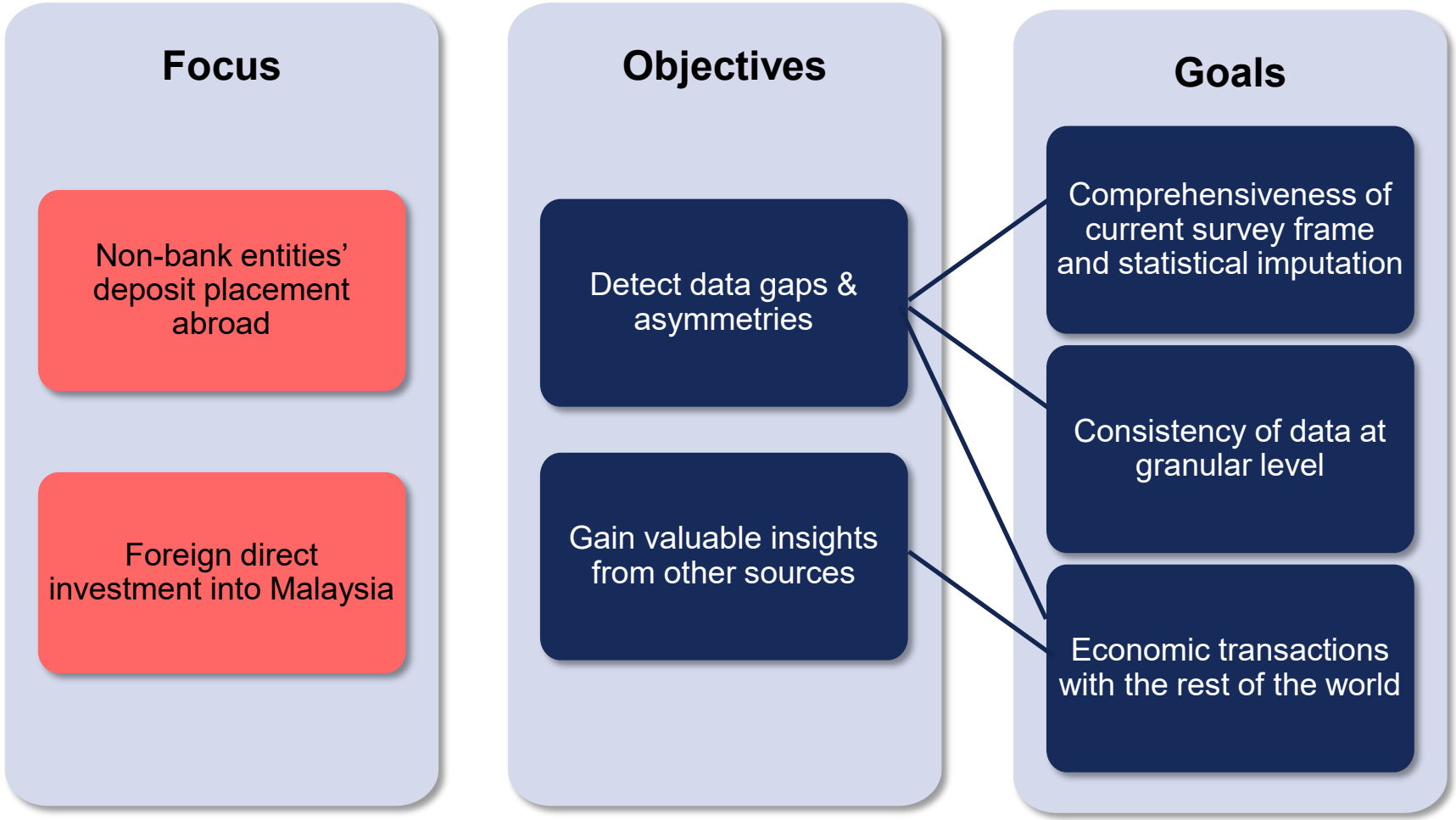
External Sector Statistics (ESS) Conference
Madrid, Spain
12 – 13 February 2024

The views expressed in this presentation are those of the authors and not necessarily those of Bank Negara Malaysia.

Presentation Outline

1. Background
2. Linkages of Malaysia's FDI between IMF CDIS and direct reporting system
3. Linkages of Malaysian non-bank deposits between BIS LBS/R and direct reporting system
4. Challenges and limitations
5. Conclusion

Background


Focus
Non-bank entities' deposit placement abroad
Foreign direct investment into Malaysia
Objectives
Detect data gaps & asymmetries
Gain valuable insights from other sources
Goals
Comprehensiveness of current survey frame and statistical imputation
Consistency of data at granular level
Economic transactions with the rest of the world

Linkages of Malaysia's FDI between IMF CDIS and direct reporting system

Focus

Foreign Direct Investment (FDI) into Malaysia

Significant presence of multinational enterprises in the country and increasing complexity of ownership structure and offshoring business operations worldwide.

Data linkages

$$IMF\ CDIS\ inward\ direct\ investment_{Malaysia} \approx IMF\ CDIS\ outward\ direct\ investment_{i}$$

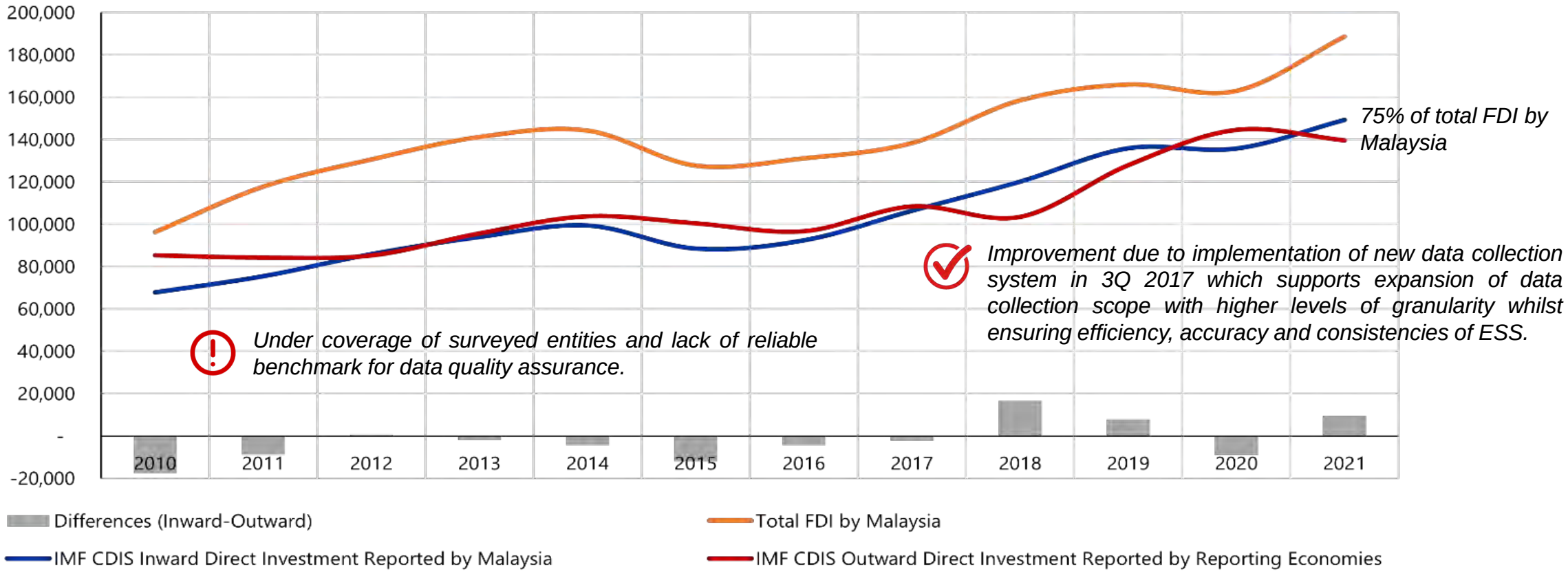
or

$$IIP\ FDI_{Malaysia} \approx IMF\ CDIS\ DIA_{i}$$

Inward direct investment (i.e. FDI) reported by Malaysia to the IMF for CDIS and IIP publications is comparable with the outward direct investment (i.e. DIA) reported by counterpart reporting economies (i) to the IMF CDIS.

Linkages of Malaysia's FDI between IMF CDIS and direct reporting system

Comparison between Malaysia's FDI and IMF CDIS inward direct investment vis-à-vis IMF CDIS outward direct investment positions (in USD mil)



75% of total FDI by Malaysia

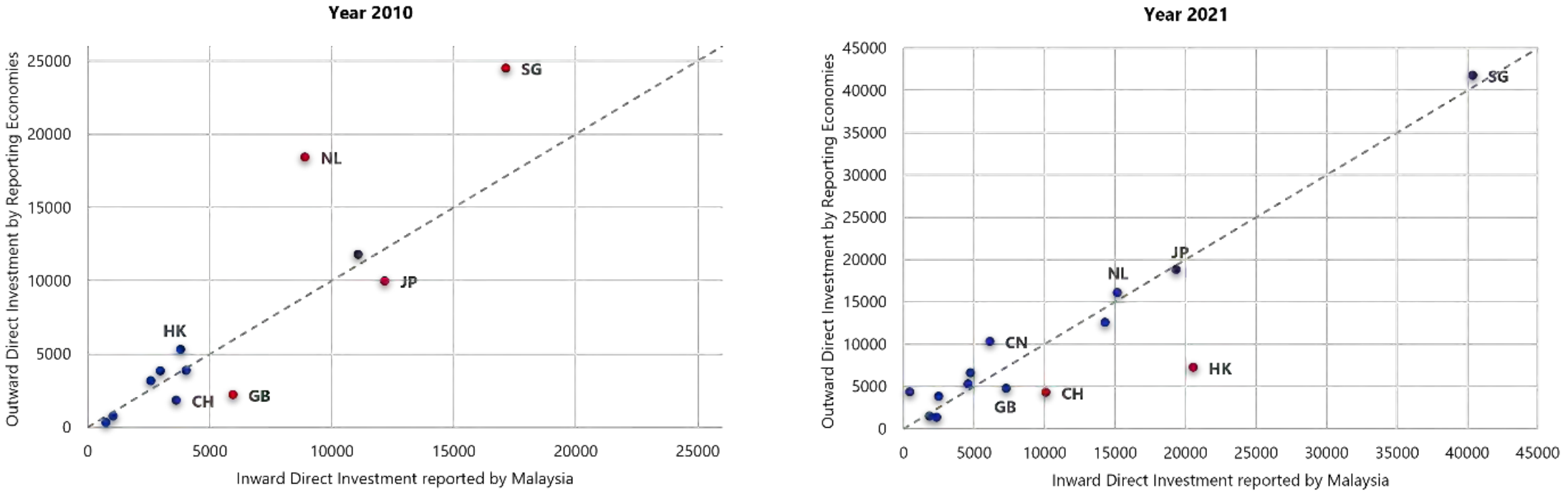
Improvement due to implementation of new data collection system in 3Q 2017 which supports expansion of data collection scope with higher levels of granularity whilst ensuring efficiency, accuracy and consistencies of ESS.

Under coverage of surveyed entities and lack of reliable benchmark for data quality assurance.

Sources: IMF CDIS, Bank Negara Malaysia, Department of Statistics Malaysia and author's calculation.

Linkages of Malaysia's FDI between IMF CDIS and direct reporting system

Malaysia's inward direct investment vis-à-vis outward direct investment positions for 14 economies reported to IMF CDIS for Year 2010 and Year 2021 (in USD mil)



Potential reasons for asymmetries with Hong Kong and Switzerland:

i. Different reporting of country of investment based on immediate or ultimate counterpart

ii. Different valuation methods, data sources and estimation techniques

Sources: IMF CDIS, Singapore Department of Statistics and author's calculation.

Linkages of Malaysian non-bank deposits between BIS LBS/R and direct reporting system

Focus

Malaysian non-bank deposits abroad

(a) Impractical and unfeasible to survey all households' and non-bank enterprises' financial assets abroad, and

(b) complexity of cross-border transactions for households due to digitalisation of banking services.

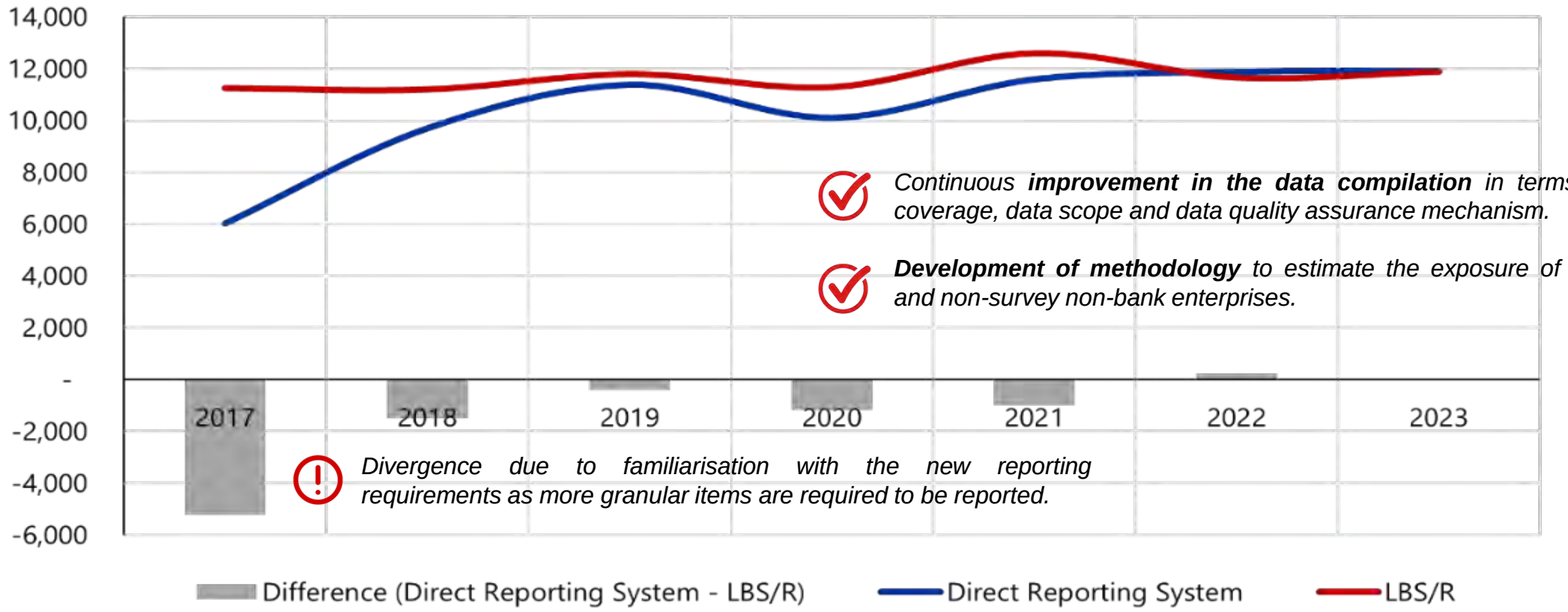
Data linkages

$$IIP\ assets^{Currency\ and\ deposits}_{Malaysia} \approx LB\,S/R\ liabilities^{Loans\ and\ deposits}_{i}$$

Claims of non-banks entities in Malaysia on deposit taking corporations abroad, in the forms of deposits, which is classified under the functional category of 'Other Investment' in IIP for Malaysia, is comparable with the liabilities of reporting countries (i) reported in the LBS/R under loan and deposits item vis-à-vis Malaysia.

Linkages of Malaysian non-bank deposits between BIS LBS/R and direct reporting system

Comparison between direct reporting system and LBS/R reported by 38 reporting countries to BIS (in USD mil)



*Continuous **improvement in the data compilation** in terms of survey coverage, data scope and data quality assurance mechanism.*

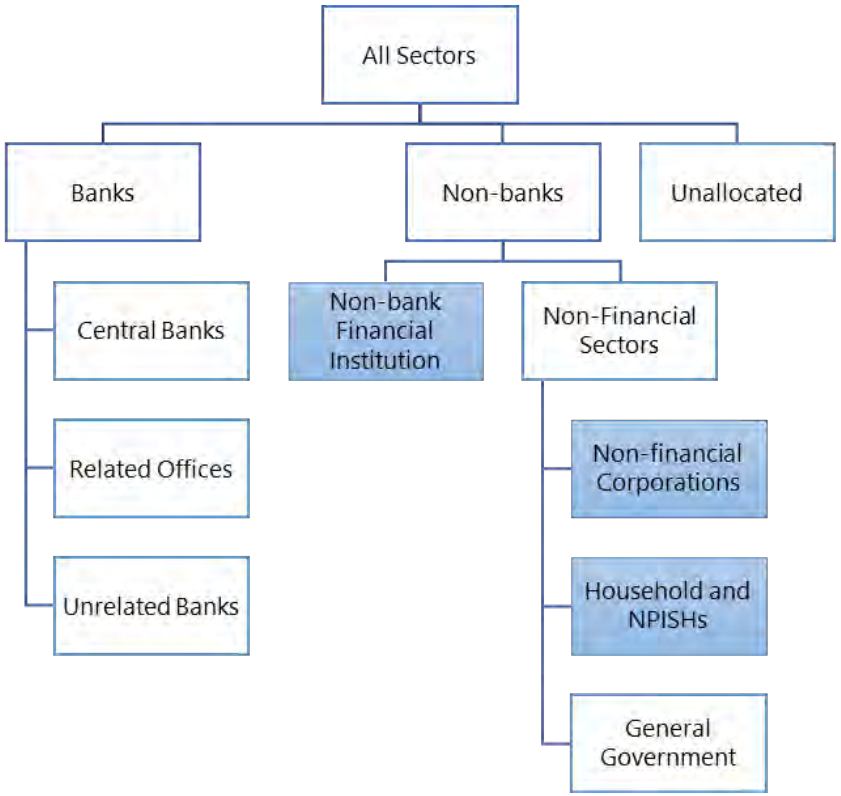
***Development of methodology** to estimate the exposure of households and non-survey non-bank enterprises.*

Divergence due to familiarisation with the new reporting requirements as more granular items are required to be reported.

Sources: BIS locational banking statistics (LBS), Bank Negara Malaysia, Department of Statistics Malaysia and author's calculation.

Linkages of Malaysian non-bank deposits between BIS LBS/R and direct reporting system

Sectoral breakdown of LBS



Sources: Author's own illustration.

Observation on comparison by institutional sector and country of deposit taking corporations that accepted the deposits from Malaysian non-bank entities[1]

1. Divergence observed for **households' deposit placed abroad was narrowed down** in the recent 3 years from 2021 to 2023.

2. Discrepancies for **non-bank financial institutions and non-financial corporations remain the same** throughout the years.

Potential reasons for the discrepancies:

1. Different **reporting treatment for purpose of investment, either immediate or ultimate,** particularly for deposits into offshore financial centres. This transaction may not be reported as deposits into the counterparty reporting countries as it is potentially further transferred to or subsequently invested in another financial instrument in the rest of the world.

2. Different **treatment of residency status** particularly for emigrant that may be treated as deposits by resident in the counterpart countries.

[1] Since access to granular details by institutional sector and country is restricted for the internal use of reporting authorities and eligible data receivers, the graphical data comparison is not shown in this paper.

Challenges and Limitations

	Limitations	Mitigation actions to minimise the limitations
A	**Periodicity, frequency and timeliness of mirror data publication.**	Leverage on back series data alongside other indicators available to derive a credible estimate of the total economic transactions with the ROW until complete dataset becomes available for validation through subsequent publications.
B	**Unavailability of data from major counterparty economies.**	Obtain data from reporting country's national platform or bilateral engagement with official compilers for potential data exchange.
C	**Reconciliation between flows and positions.**	Consider nature of economic transactions i.e. in the form of merchandise trades or remittances and major settlement currency for foreign exchange gain/ loss, major world stock market indices for price changes of listed securities and global events that affect the volume changes for financial assets and liabilities.
D	**Metadata comprehensiveness for official statistic.**	Comprehensive understanding on businesses nature through engagement with the direct reporting entities enabled deliberation and reconciliation on accuracy of sectoral and country, particularly on immediate and ultimate destination for the flow of funds.

Conclusion

1. Mirror data analysis provides a **more objective and comprehensive view of external exposures between countries.**

2. While aggregated basis comparison may suffice to address the objectives, **comparative analysis at more granular level, specifically by counterparty countries resulted in a more profound insight.**

3. Hence, **effectiveness of this approach relies on the availability of granular data** published by respective reporting countries.

4. The observed asymmetries could be further analysed:

   - **via bilateral data exchange with the counterparty countries.**
   - **by observing relationship of selected major counterparty with other economies similar to Malaysia, to ascertain the potential reason of the discrepancies.**

Thank you!

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IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

Spanish experience in the use of data generated by the private sector with an application to estimation of tourism data[1]

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[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Spanish experience in the use of data generated by the private sector with an application to estimation of tourism data

Javier Alvarez, Maria Velasco (Bank of Spain / Spanish National Statistical Institute)

Abstract

In Spain, Tourism basic statistics (responsibility of the National Statistical Institute _NSI_ and traditionally based on surveys) are an important input for the compilation of the Travel item of the Balance of Payments (BOP) (responsibility of the Bank of Spain _BoS_). In recent years, due to the challenges associated with the collection of data from persons, especially during the COVID-19 pandemic, both statistics/agencies have explored the access to data generated by private sector using two different approaches: based on either a specific arrangement or taking advantage of a regulatory framework. In this article, we describe the Spanish experience in the use of two of these new data: mobile phones positioning and payment card data.

NSI Spain uses mobile phone positioning data and bank card transactions as auxiliary information to tourism surveys with the objective of improving the geographical breakdown of tourism expenditure (both inbound and outbound). The use of these sources of information allows obtaining new products with a granularity in terms of origin/destination of tourists that would be impossible to achieve using traditional techniques, without increasing the cost of the statistics and the burden on the informant. Nonetheless, it poses some challenges in terms of quality assurance and sustainable access. The results are published as experimental statistics, but the ultimate aim is to integrate them with traditional tourism surveys.

Connecting with the use of bank card transactions, at present, BoS (as well as other National Central Banks in the euro area), is exploring the use of the information on card payments collected in virtue of the European Central Bank Regulation on Payments statistics 2020/2011. This regulation is addressed to Payment Service Providers (PSPs) and introduces new requirements with the aim of improving the quality of the data used for compilation of the trade in goods and services in BOP. An essential feature of the new card data is the information on Merchant Category Codes (MCC), which classify a business by the type of goods or services produced. Moreover, the regulation provides an extensive geographical breakdown by country of terminal of the transaction. In the article, we will also describe the main results of the analysis carried out so far paying attention to its potentialities and limitations specifically focused on the estimation of Travel debits.

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1. Introduction

External statistics have always been crucial to monitor the health of open economies. In the current globalised system, boosted by digitalisation and by the high speed and huge magnitude and complexity of financial flows, good and timely external statistics are even more crucial.

In this context, in order to fulfil the user's requirements of information (in terms of timeliness and granularity) it is increasing relevant to make use of new data sources and to promote the sharing of information among statistical agencies at national level and among countries. As the recent COVID pandemic has shown, this has been especially relevant in the estimation of Tourism data.

In Spain, Tourism basic statistics are responsibility of the National Statistical Institute _NSI_ while the Travel item of the Balance of Payments (BOP) is responsibility of the Bank of Spain _BoS_. Tourism basic statistics are traditionally based on surveys and at the same time consist of the main input for the compilation of the credits of the Travel item of the BOP. Travel BOP debits mainly rely in credit card data in combination with NSI operations. The aim of this article is to describe NSI and BoS experience in the use of two new data sources for the estimation of Tourism data: mobile phones data and card payments data.

As concerns NSI, it is making a considerable effort to produce some experimental statistics in the field of tourism that rely on data of different nature: obtained through web scraping techniques, bank card data and mobile phone data, among others. In the first part of the article, we present the main features of the experimental statistics elaborated by NSI for measuring trips made by foreign tourists in Spain using data from mobile phone networks. The main goal of this project has been to produce and publish data about movements of non-resident visitors with a more detailed level of geographical granularity than the inbound border survey (FRONTUR) and to improve its timeliness. The article presents the methodology followed to adapt mobile phone data into concepts in the field of tourism statistics, and the dissemination in the NSI web page.

In relation to BoS, in the second part of the article we present the main features of the card payments data collected by this institution, both in virtue of a national agreement with a card scheme and also of the European Central Bank Regulation on Payments statistics 2020/2011. This regulation is addressed to Payment Service Providers (PSPs) and collects information on card payments with cards issued by resident PSPs. The main strengths and limitations of card data for the estimation of BOP Travel debits are highlighted, and a project of experimental statistics that BoS plans to publish based on the data from the regulation is described. In spite of certain limitations, the information included in the regulation on the Merchant category codes (MCCs) represents an important progress to improve the quality of the estimation of Travel in BOP. A conclusion from our analysis is that the cooperation among statistical institutions (at national and international level) and the contact with declarants will be essential to achieve a better use of this data.

2. Measuring tourism flows using data from mobile phone networks

2.1 Information available at NSI

According to the Spanish Tourism Satellite Account of Spain in 2019, before the pandemic, tourism accounted for 12.6% of GDP and generated 12.7% of total employment. Given the importance of this sector, not only as a generator of wealth, but also as an element favouring the economic and social development of regions, it is essential to have a tourism statistics system that provides quality, disaggregated and timely information.

NSI Spain disseminates information for the knowledge of this area, based on traditional surveys:

- From the supply side: Tourist Accommodation Occupancy Surveys[1].
- From the demand side: to measure inbound tourism and its expenditure (FRONTUR and EGATUR[2]), and domestic tourism (both internal and outbound) with the Resident Tourism Survey[3].
- General business and employment surveys, both short-term and structural.
- To synthesise all this information, the Tourism Satellite Account is compiled.

For the compilation of all these statistics, the manuals, and recommendations of the UNWTO[4] and Eurostat[5] are followed.

In the current context of an increasingly digitalised society, and with a growing number of public and private organisations that have new data sources, NSIs are working to be able to use them in the production of official statistics. The general objective is to improve the granularity and timeliness of the statistics, without losing quality and preserving the confidentiality of the data used.

[1] As an example, Hotel Occupancy Survey:

https://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736177015&menu=ultiDatos&idp=1254735576863

[2] FRONTUR:

https://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736176996&menu=metodologia&idp=1254735576863

EGATUR:

https://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736177002&menu=metodologia&idp=1254735576863

[3] Resident Travel Survey:

https://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736176990&menu=ultiDatos&idp=1254735576863

[4] https://www.unwto.org/tourism-statistics/on-basic-tourism-statistics-irts-2008

https://www.unwto.org/tourism-statistics/on-economic-contribution-of-tourism-tsa-2008

[5] https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/ks-gq-14-013

In the field of tourism, several experimental statistics are being carried out at NSI Spain[6]:

- Measurement of the number of tourist dwellings in Spain and their capacity: information obtained with webscraping techniques.
- Estimation of occupancy in tourist accommodation using data from digital platforms: in collaboration with Eurostat, which in turn has an agreement with the main accommodation platforms in Europe.
- Foreign visitor expenditure on their visits to Spain: using information on transactions made in Spain with foreign bank cards.
- Distribution of resident expenditure on their visits abroad by country of destination: using information on transactions made abroad with bank cards issued by Spanish banks.
- Measurement of tourism flows based on the position of mobile phones: estimation of outbound, inbound and domestic tourism flows.

  It is this last experimental statistic that will be explained in greater detail below.

The complexity of the positioning data captured by a mobile phone antenna, their transformation to adapt them to the definitions of the field of tourism and the processing necessary to obtain a set of aggregated data that allows statistical processes to be applied, has involved the development of a series of algorithms. These algorithms have been developed by each of the mobile telephone operators participating in this project, with continuous interaction on the part of NSI Spain. Since the beginning of this project at the end of 2020, NSI Spain and each operator have worked together, analysing the results, detecting systematic differences and obtaining conclusions, until a set of algorithms has been constructed that convert the positioning data into variables that follow international definitions for measuring tourist flows.

2.1.1 Mobile network information available at NSI

All the data used in this project are generated by the mobile networks of the mobile telephone operators. These networks consist mainly of mobile devices with SIM cards and the antennas with which they communicate.

The location of mobile phones is estimated from the mobile phone antennas. This implies that the location of a mobile phone is not established with complete accuracy, and the error depends on the concentration of mobile antennas (more accurate the higher the concentration of antennas).

The information on the location of the phones is anonymised and processed by each company, with the NSI receiving only aggregated and tabulated data, and not having access at any time to individual records of any element of the mobile network.

[6] The methodologies and figures can be found here:

https://www.ine.es/en/experimental/experimental_en.htm

The basis of this project is formed by the network events generated by the communication between mobile devices and antennas:

- Mobile devices (switched on and in coverage) communicate continuously with the antennas to which they are connected.
- Each antenna is assigned a theoretical geographical coverage area or cell. All mobile devices physically located in a cell connect to that antenna. The coverage area of a cell varies widely (from a few hundred metres to several kilometres), depending on the density of the network in an area. Thus the density is higher in urban areas than in rural or sparsely populated areas.

Network events are classified into the following two types:

- Active events: when a call is made or received, a text message, an email is received, an app is used or updated, web pages are browsed, or the device is turned on or off. In addition, when the device is active and moves, it generates records in the antennas to which it is connected, leaving a record of its new location.
- Passive events: these are generated when the device is switched on and moving but no action is being performed.

For the global project to measure both domestic and inbound tourism flows, the following will be considered:

- Domestic tourism: events generated by mobile devices that are customers of an operator and their connections to the operator's network.
- Outbound tourism: mobile devices that are customers of an operator and connect to mobile networks outside the country.
- Inbound tourism: mobile devices of international operators that connect to the network of Spanish companies.

As the methodologies are similar and in order not to make this document repetitive and extensive mentioning similar concepts or processes, we are going to focus on inbound tourism, i.e., the measurement of trips made by foreign tourists in Spain.

2.2 The use of mobile phone data at NSI: experimental statistics complementary to tourism basic statistics

2.2.1 Main objective

The main objective of this project is to produce and publish data about movements of non-resident visitors with a more detailed level of geographical granularity than FRONTUR and to improve its timeliness.

The improvements achieved by using this source of information in the field of inbound tourism include the following:

- The set of individuals on which the operators have information is much larger than the FRONTUR sample. Considering that most of the population has a mobile phone and that the main operators have around a 25% market each, the

coverage of each of them exceeds by far the FRONTUR sample size by far, and therefore the estimate of trips that they can make through their algorithms is much more accurate.

- By having a much larger number of individuals for whom information on their journeys is available, the geographical disaggregation that can be provided is much broader. Currently, the information provided in FRONTUR is at Autonomous Community level. With this project, it is extended to the municipal level.
- In terms of timeliness, the NSI Spain publishes the results of FRONTUR for a reference month, some 30-35 days after the end of it. It is under analysis whether in the medium term an advance estimate could be given using this source of information.
- On the other hand, FRONTUR provides monthly information for a reduced list of source countries. With this experimental statistic monthly information can be provided for the complete list of countries (if there are data for a minimum number of trips, to keep confidentiality).
- A frequent problem with this survey is a large variability when disaggregated geographically. This is due to the small sample sizes at certain levels of disaggregation. Using the information from mobile phones, more accurate and robust rates of variation are obtained when disaggregated by either trip destination or country of origin.

The objective of this operation, in the short term, is to provide a rapid and highly detailed estimate of the number of foreign tourists visiting Spain based on innovative sources and processes, which can be used to complement the estimates provided by FRONTUR.

In the medium term, an integration of both operations will be pursued, thus combining the speed and granularity of the former with the detail of the characteristics of tourists' trips (purpose of the trip, type of accommodation, etc.) provided by the second.

Before explaining the methodology of this statistical operation, a summary of strengths and limitations of this new source of information is presented:

Table 1. Strengths and limitations of using positioning mobile phone data

Strengths	Limitations
High granularity	Access to information conditional on contracts
Improved timeliness and punctuality (specially for internal and outbound tourism)	Adaptation of network information to statistical definitions
Large coverage on population	Lack of information on other important variables
No respondent burden	Changes in technology affect data

2.2.2 Methodology

Main characteristics

These are the main characteristic of this statistic:

- POPULATION SCOPE: The target population consists of mobile telephony users from other countries using the networks of the operators participating in this project. And the target population includes non-residents visiting Spain.
- SCOPE OF THE STUDY: The scope of the study is non-resident tourists travelling to Spain.
- GEOGRAPHICAL SCOPE: Trips made by non-resident tourists in Spain are analysed.
- TIME SCOPE: The study period for which results will be obtained is the month. Information is available from July 2019.
- STUDY VARIABLES AND CLASSIFICATION: The study variables are the number of tourists, overnight stays and average duration of the trip. The classification variables are: Autonomous Community, province and municipality, for the main destination of the trips, and country of origin.

Basic concepts

For the development of this project, FRONTUR's definitions and concepts, which follow international methodologies and standards, have been adjusted and adapted to the information available to mobile telephone operators and their networks.

Definitions of the most relevant concepts within the scope of tourism statistics and mobile networks are included in the table below.

Table 2. Definitions in tourism statistic and mobile network fields

Concept	Tourism Statistics	Mobile Networks
Tourism trip and tourist	All journeys with a main destination outside the person's place of usual residence, involving an overnight stay away from the place of usual residence and lasting less than one year, considering that the main purpose of the trip, including business, leisure or other personal reasons, other than employment in an enterprise established in the place visited. In the case of inbound tourism, the persons reside abroad, and the destination of their trip is in Spain.	A mobile phone non-resident in Spain is considered to have crossed the entry border to a geographical location in Spain, when the mobile has been detected in Spain between 22:00 and 6:00 on a given day D of the month under observation, and furthermore the mobile has continued to be detected in Spain after 6:00. The journey ends the day on which the mobile is not detected in Spain between 22:00 and 6:00, having been detected in Spain in the hours before 22:00.

	They are round trips and end when the person leaves our country. A tourist is any person who makes a tourism trip. In the field of inbound tourism, a person who travels several times to Spain in the same month will be counted as many times as he/she travels. In other words, if a French person comes to Spain three times in the month of April, he/she will count as three French tourists.	
Overnight stay	Generically, it corresponds to the number of consecutive nights that a person overnight stay in Spain as part of a trip.	In inbound tourism, a mobile phone resident in country B, other than Spain, is considered to have stayed overnight in Spain when a day D has been detected in Spain continuously between 22:00 and 6:00. The number of overnight stays during the journey of a non-resident shall be determined as the number of consecutive nights that the mobile has been detected in Spain continuously between 22:00 and 6:00.
Main trip destination	The destination where the most time has been spent, measured in number of overnight stays.	The main destination of a trip for a non-resident mobile phone in Spain is that geographical location within the national territory where the most time was spent, measured in number of overnight stays, i.e. the place where the mobile has spent the highest number of overnight stays. Given that a given day is considered to have been spent in a given place when the mobile phone has been detected continuously at that location between 22:00 and 6:00, the main destination is the place where the mobile phone has

	been detected in that time slot for the most days.

Although these definitions could be found simple, there are a list of situations which the mobile phones are not detected by antennas for a while. For all those situations NSI Spain and each operator work together to find solutions and design the correct algorithm to calculate an accurate estimation.

Data collection

NSI Spain receives tabulated and aggregated data prepared by each operator. It is important to stress the fact that NSI Spain does not have individual device information at any time. It only receives the aggregated information provided by the mobile telephone operators.

For each month, operators send files including number of tourist and overnight stays, by country of origin, and by Autonomous Community, province and municipality of destination.

We always work on the premise that the data on the breakdowns requested are provided for those that have enough observations associated with them. Otherwise, they are aggregated into 'rest' categories.

Data processing

PROCESSING DATA FROM OPERATORS

The files that mobile telephone operators send monthly to the NSI detail the number of tourists and overnight stays by Autonomous Community, province and municipality of destination made by non-resident tourists in Spain, including the country of origin.

The NSI carries out a prior filtering of the same, to adapt their format before processing the information they contain.

ESTIMATION OF TOTALS BY PROVINCE-COUNTRY

For the estimation of tourists, the information supplied by the three operators is integrated, at provincial and country of origin level, to take into account all roaming agreements and coverage provided by the three operators to mobile telephony users of foreign companies in Spain.

The information from the three operators is cross-checked internally to ensure that the results obtained are congruent and consistent.

The criteria adopted for the final estimate of the number of trips by province and country are also applied to the estimate of overnight stays.

ESTIMATES BY REGION AND MUNICIPALITY

Once the trips and overnight stays by province-country have been calculated, the results by Autonomous Community-country, national total-country are calculated by adding the corresponding province-country data.

For the calculation of the estimates by municipality, a percentage distribution of the data by province-country is carried out.

1. For each operator and for each province-country crossing, the percentage of trips made in each municipality is calculated.
2. For each province-country junction, the average of the three percentage structures obtained in the previous point is calculated.
3. Adjustments are made so that the total sum of the percentage structure is 100.
4. The percentages obtained are applied to the trip estimates for that province-country crossing.

The same apportionment method is used for overnight stays.

The final estimates obtained are checked against auxiliary sources which are used to validate and refine the results.

Data publication

The variables to be published are:

- Number of tourists
- Number of overnight stays.
- Average duration of trips.

The classification variables are:

- Geographical - Destination of the trip: national, Autonomous Communities, provinces and municipalities.
- Geographical - Origin of the trip: continent, countries.

The following tables are published monthly:

- No. of tourists, overnight stays and average duration per month by continent and country of residence.
- No. of tourists, overnight stays and average duration per month by Autonomous Community of main destination, broken down by continent and country of residence.
- No. of tourists, overnight stays and average duration per month by province of main destination, broken down by continent and country of residence.
- Monthly Excel file with the data of tourists by municipality of main destination, broken down by continent and country of residence.

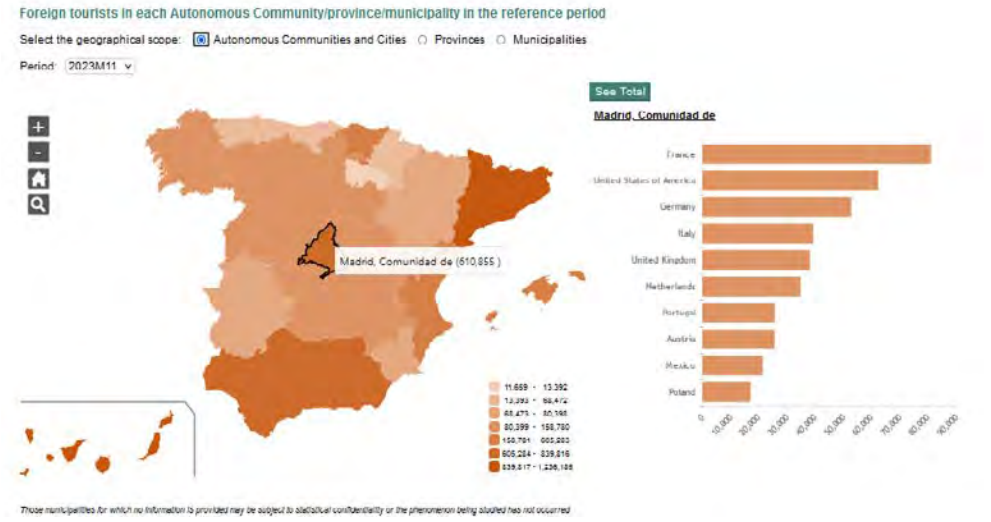
The publication is completed by the following infographics:

- World map, marking by colours according to value ranges, the number of tourists by country of residence.



A similar map, putting the focus at continent level is also available. Moreover, placing the cursor on a country, the data for the last month is displayed and on one side you can see a graph with the available monthly series.

– Maps by Autonomous Community: marking by colour according to the range of values, the number of tourists whose main destination of their trips has been each autonomous community. Selecting a specific community, a graph is displayed with the number of tourists broken down by country of residence in the selected community.



Similar maps at province and municipal level are also available.

It is important to underline, again, that confidentiality is one of the important pillars of this project. Those crossings origin-destination with less than 30 tourists are hidden.

All those maps, the data series, and methodological documents for inbound tourism, but also for outbound and domestic tourism can be consulted here:

https://www.ine.es/experimental/turismo_moviles/experimental_turismo_moviles.htm?L=1

2.2.3 Description of the results

The results of the official statistics are now published and these experimental statistics on the number of tourists and trips provide different results. This is done to point out the differences in the data using different sources. These differences do not follow a constant pattern. There are months in which FRONTUR provides a higher number of tourists, and in others a lower number of tourists than that provided by the mobile phones. These differences will disappear when both sources are integrated.

The level of detail provided by the mobiles, at the level of countries of origin and municipality of destination (in the case of inbound tourism) was what prompted the publication of the results of the experimental statistics, although at an aggregate level the results were different.

2.2.4 Next steps

So far, the actions carried out with the data provided by the mobile phone operators have been explained. But there are still many steps to be taken to achieve the integration of this source of information with traditional surveys, which are necessary to obtain the variables that characterise trips.

- Estimation of excursions using this new source of information.
- Estimation of trip stages and not only the main destination of trips.
- To be able to estimate the number of tourist trips made by residents within their province of residence.

The use of new information sources in the field of official statistics is already a reality, but their use must be guided by the principles of the European Statistics Code of Practice.

3 Card payments data for BOP Purposes

3.1 Information available at BoS

As it was mentioned above, NSI is currently using card payments data for the elaboration of an experimental statistics on the distribution of the expenditure made by foreign visitors on visits to Spain. In this section we describe the experience in the use of card data by BoS oriented to the estimation of BOP Travel debits.

3.1.1 Data provided on the basis of a national agreement

At present, the Payment Systems Department of BoS (PAY) provides data to the Statistics Department (STAT) referred to transactions settled with bank cards issued against accounts in Spain. These data are reported by the society Sistema de Tarjetas y Medios de Pago S.A (STMP) on a voluntary basis in virtue of a national agreement. STMP shareholding consists of banks and other payment services providers (PSPs) to

whom STMP offers regulatory compliance, business intelligence and fraud prevention. More specifically, STMP reports monthly and quarterly payments data broken down by the channel of the transaction: Automated Teller Machines (ATMs), Point of Sale Terminals (PSTs) (non-remote) and e-commerce (remote[7]). In addition, quarterly data inform about the counterpart area of the transactions specifying: Euro Zone, European Union, European Free Trade Area and Rest of the world. For non-remote transactions (withdrawals and payments in PST) the geographical information refers to the area where the ATM or PST is located. For remoted transactions, the geographical breakdown refers to the area where the business center is located (with independence of the location of the terminal). The timeliness of the data is approximately 30 days after the reference period for monthly data and 75 days in the case of quarterly data.

3.1.2 Data provided in virtue of EU-ECB Regulation

Since April 2022, STAT has started to directly collect data[8] referred to the EU Regulation 2020/2011 of the European Central Bank (ECB regulation from now on) that amends Regulation (EU) No 1409/2013 on payments statistics. In particular, the information included in Table 9[9] of the Regulation, "Quarterly reporting of payment transactions involving non-MFIs", which is reported by the resident issuing PSPs. It covers domestic and cross-border payments transactions[10] specifying: bank transfers, direct debits, card based payments transactions, e-money payments and cheques. As concerns card payments, the data include transactions with cards issued by resident PSPs (except cards with an e-money function only)[11] regardless of the location of the payment brand under which the payment transaction has been made[12]. The Table details those payments initiated electronically[13], which are further broken down into

7 In addition to transactions carried out through internet they also include transactions carried out through mail or phone.

8 In the Spanish case, the Balance of Payments Divisions is also responsible of the delivery of the data to ECB.

9 In addition, there is some information that can be exploited for BOP compilation collected in semiannual frequency in Table 6 Payment transactions per type of terminal involving non-MFIs.

10 It follows Article 2(8) of Regulation (EU) 2015/751 in virtue of which a cross-border payment transaction means a card-based payment transaction where the issuer and the acquirer are located in different Member States or where the card-based payment instrument is issued by an issuer located in a Member State different from that of the point of sale. In addition, Article 2(9) of the same regulation establishes that a domestic payment transaction means any card-based payment transaction which is not a cross-border payment transaction.

11 It doesn't cover payments carried out using other methods of payment as PayPal, N26 or Revolut. In the case of Revolute transactions, the code 6012 - Financial Institutions – Merchandise, Services, and Debt Repayment includes the recharge of the Revolut card that may refer to Travel related payments, but also to payments of other nature carried out in the home country or in the country of visit.

12 The PSP acquirer of the transaction may be resident or non-resident while in the data reported nationally the acquirer is a non-resident PSP.

13 Card-based payment transactions which are initiated at an EFTPOS, ATM or other physical terminal that allows electronic payment initiation or remotely by electronic means of information transmission

initiated remotely[14] and initiated non-remotely. In both cases (remote and non-remote), the merchant category code (MCC)[15] is reported when available. Moreover, cross-border card payments initiated remotely are reported to identify the country in which the point of sale is located, while cross-border card payments initiated non-remotely are reported to identify the country in which the physical terminal is located[16]. The timeliness of data is 30 days after the end of the quarter of reference. In table 3 we specify the main differences between the data provided on the basis of a national agreement and this dataset.

Table 3. Comparison national vs EU-ECB Regulation card payments data

	Data collected on the basis of a national agreement	Data collected in virtue of ECB regulation
Mandatory	NO	YES
Internationally harmonized	NO	YES
Data provider	Central scheme STMP (to PAY Department)	Resident issuing PSPs (to STAT Department)
Frequency	Monthly Quarterly	Quarterly
Timeliness	M+30d Q+75d	Q+30d
Geographical breakdown	Euro area, EU, EFTA, Rest of the world	Individual country (Geo 6)
Breakdown available:		
-ATM withdrawals	YES	NO
-PSTs non-remote	YES	YES
-PSTs remote	YES	YES
-Merchant category code	NO	YES

[14] It applies Article 4(6) of Directive (EU) 2015/2366 that establishes that remote payment transactions are those initiated via internet or through a device that can be used for distance communication.

[15] A four-digit number (listed in ISO 18245) for retail financial services that is used to classify the business by the type of goods or services it provides. The list covers 339 MCC codes specified in the technical application of BoS Circular 2/2022 available at the site https://www.bde.es/webbe/en/estadisticas/temas/sistemas-pago.html.

[16] It corresponds to a list Geo 6 of 239 geographical codes available in the auxiliary tables of the technical application of BoS Circular 2/2022.

3.2 The use of card payments data in BoS

3.2.1 The estimation of BOP Travel debits

Since the year 2002, when the euro was physically introduced, as a result of the consequent loss of information on the exchange of banknotes (a key feature of the procedure used until then), the procedure for estimating the BOP Travel debits[17] has used, to a lesser or greater extent, information on card payments. At the beginning, year on year evolution rates of bank cards and transfers were used in combination with the information still available on the weight of each mean of payment in the total of Travel related transactions. At present, in the absence of updated information on the importance of each mean of payment, card payments year on year evolution rates are still used in combination with other data sources.

More specifically, we use the monthly and quarterly data provided by PAY to calculate a Travel related aggregate vis a vis the rest of the world (with no geo breakdown) as the sum of: a) ATM withdrawals, b) non-remote payments and; c) part of the remote ones. In order to estimate the part of the remote payments that corresponds to Travel transactions, we use data published by the National Commission of Markets and Competition on the breakdown of e-commerce by activity sector (in particular, we select as touristic the following activities: Travel agencies and tour operators, Hotel and similar accommodation establishments-hotels, motels and resorts, automobile rental agencies and artistical, sport and recreational shows). The yearly evolution of that Travel related aggregate is used to estimate Travel BOP debits in levels extrapolating historical BOP data. In addition, the results of the NSI's Residents' travel survey (ETR)[18] and "mirror" data (travel credits published by the main counterpart countries) are used to estimate the geographical breakdown of BOP Travel debits. Finally, in accordance with international methodological guidelines, imputed consumption of rental services during the length of the stay are also recorded for Spanish resident owners of real estate located abroad[19].

A very important limitation of the Spanish method is that the year on year evolution rates of BOP debits could be distorted due to differences over the time in the prevalence of cards as mean of payment. In addition, the geographical breakdown

[17] As it is indicated in the sixth edition of IMF BOP manual (par 10.86), travel debits cover goods and services for own use or to give away acquired from other economies by residents during visits to these other economies. This heading doesn't include the expenses in international transportation that are registered in the heading of passenger transport services.

[18] The ETR is a continuous survey designed principally to provide monthly, quarterly and annual estimates of travel by the population of residents in Spain and its main features (destination, duration, reason, accommodation, means of transport, expenditure, sociodemographic characteristics of travellers, etc.). This survey gives continuity to the statistic of Spanish Residents' Domestic and Foreign Travel (FAMILITUR), with results from February 2015 onwards.

[19] The estimates of such imputed payments are made by the NSI in relation to the National Accounts and combine information on overnight stays of travellers in their own home, average size of homes and average rental expenses in secondary homes. The information sources for payments are the ETR and the Household budget survey (EPF, by its Spanish abbreviation) corrected against the purchasing power parity index of the main counterpart countries and the consumer price index, and data obtained from the population and housing census and the Continuous household survey (ECH).

of the ETR doesn't allow to publish a detail breakdown due to insufficient sample size in the survey.

3.2.2 Potential use of the new data collected on the basis of EU-ECB Regulation

Besides the current use of card payments for the estimation of BOP Travel debits, at present we are exploring how to take advantage of the new information collected in virtue of ECB Regulation 2020/2011. The objective is to disseminate new experimental statistics complementary to BOP Travel debits.

The most relevant feature of the new data is the information on the merchant category code (MCC) both for remote and non-remote transactions. As it is mentioned above, the MCCs describe the economic activity of the merchant. Initially MCCs were formed following ISIC[20] - the UN classification on economic activity[21].

Though the MCC may not provide an accurate description of the products acquired, it enables obtaining a breakdown into goods and services very useful for identifying those in principle typically related to trips abroad. Furthermore, MCC is also helpful for isolating goods and services that can be digitally delivered[22] and therefore can provide a powerful basis for estimating households imports related to digital trade (goods and services _touristic and non-touristic). Besides that, the new card payments data offer a very detailed geographical information by individual country difficult to cover with other type of data collection systems such as surveys.

In section 3.3 below detailed information is provided on the method that we plan to follow in order to produce these new statistics.

3.2.3 Strengths and limitations of using card payments data for BOP Travel purposes

Both as regards the current use and the plans for the future, before entering into next section, it is worth highlighting the strengths and limitations of using card payments data for BOP purposes. The main strengths of using card payments data in comparison to other data sources used for BOP purposes are: a) low cost of compilation, b) adequate frequency and timeliness and c) high sustainability (especially relevant in the Covid period). In spite of these strengths, the use of card transactions also presents strong limitations. Among others, three can be noted. The first one, is that it only covers transactions paid for by card; purchases by other means are excluded. The second one is that it requires assuming that the country of residence of the cardholder coincides with the one of residence of the card issuer.

[20] The International Standard Industrial Classification of All Economic Activities (ISIC).

[21] The MCCs are maintained by ISO 18245 and are used by payment card institutions, for example, MasterCard and Visa, in order to classify the transactions carried out. MCCs are assigned, by the bank or financial institution processing the debit/credit card payments on behalf of the merchant, although it is not mandatory for them to follow and in some cases the list is not enough updated.

[22] According to the Handbook on Measuring Digital Trade (2023), digitally delivered trade is defined as: "all international trade transactions that are delivered remotely over computer networks".

The third one, is that there may be a difference between the period in which the payment is carried out and the period in which the consumption takes place. Finally, additional distortions can be mentioned due to: a) the merchant location of corporate groups (for example, a multinational merchant could use its principal place of business) and b) due to the presence of transactions routed through Digital intermediation platforms (DIPs), some assumptions are needed to separate the intermediation fee from the good or service intermediated and furthermore, the intermediated good or service may or may not be imported.

Table 4. Strengths and limitations of using card payments data

Strengths	Limitations
Low cost of compilation	Only covers transactions paid for by card
Adequate frequency and timeliness	The country of residence of the cardholder may be different from the country of issuance
High granularity	The period in which the payment is carried out may be different from the period in which the consumption takes place
High sustainability	The location information can reflect corporate structures and other distorting factors rather than geographical reality
Breakdown into goods and services may be possible based on MCCs	Transactions routed through DIPs require valuation and geographical adjustments
Homogeneous dataset across countries	The product breakdown based on MCCs likely to be inexact

3.3 New experimental statistics complementary to BOP Travel debits

Taking advantage of the new information available collected on the basis of the EU Regulation 2020/2011 of the ECB, we plan to disseminate data on card payments abroad that could be in principle related to the consumption of travellers broken-down by MCC (groupings) and country (individual). In the next sections we describe the main features of the methodology applied to the data and the results that we have obtained.

3.3.1. Methodology

Selection of MCC codes

For the purpose of the estimation of those purchases that in principle could be related to the Travel item of the BOP a selection of MCC is necessary.

In this sense, the Travel Workshop group (TWS)[23] has carried out an analysis of the MCC that according to their definition[24] should be considered Travel related. The objective of the group is to define a selection of codes Travel related that may serve as reference for compilers[25]. For the analysis described in this article we base on a first selection of MCC carried out in the framework of TWS[26]. In general, most of the MCC in non-remote payments are considered related to Travel but in the case of remote payments the inclusion of some categories is more doubtful, and a discussion based on theoretical/practical aspects was necessary.

More specifically, the following adjustments can be mentioned:

a. MCCs to be excluded always:

– Likely to be business to business services (B2B): Management, consulting and public relations services, advertising services, stenographic and secretarial support services, etc. To be recorded under Other non-touristic services headings in BOP

– Corresponding to goods and services that can be digitally delivered: digital goods media books, movies, music, games, applications, betting and gambling, etc. To be recorded under the BOP headings of Goods or Other non-touristic services.

– Referred to high value and durable goods: precious stones and metals, watches and jewelry, durable goods — not elsewhere classified, etc. In theory only transactions below the customs thresholds should be included under the Travel heading (under Goods if above the threshold). From a practical point of view, given the difficulty to isolate that amounts, the recommendation is to exclude these codes in all cases.

– Related to contracted services that could be linked to second residencies: general contractors — residential and commercial, carpentry and electrical contractors, etc. To be recorded under Other non-touristic services or in Direct investment depending on the amounts.

– Transportation services likely to be international: airlines and air carriers (not elsewhere classified), motor freight carriers and trucking — local and long distance, etc. To be recorded under Transport services.

– Referred to transfers and remittances: wire transfers and money orders, money send intra and inter country, etc. To be recoded under Secondary income, Capital account or Financial account.

[23] The WS Travel brings together a set of compilers from European countries together with international organizations and has investigated different issues related to the question of the integration of the ECB regulation data in BOP compilation. Several subgroups have worked with the objective of elaborating guidance notes to analyze different aspects related to the integration of the ECB regulation data in the estimation of Travel in BOP. In particular, five guidance notes were elaborated covering the topics: Merchant Category Codes, Integration of Payment Statistics and other sources, Accrual Principle, Travel Agencies Intermediation and Residence Issues (case of use approach).

[24] As a reference we consider the document Visa Merchant Data Standard Manual (2023).

[25] Every country can adapt the list taking into account their own specific features.

[26] The work of the WS in relation to the suggested list of Travel related MCCs is still in progress.

b. MCCs to be excluded only for remote transactions:

– Clothing and shoes stores: men's and women's clothing shops, furriers and fur shops, children's and infants' wear shops, etc. To be recoded under Goods.

– Health and education codes: doctors and physicians, nursing and personal care facilities, hospitals, correspondence schools, etc. To be recorded under Other non-touristic services.

– Referred to miscellaneous stores: groceries and supermarket, department stores, etc. To be recorded under Goods.

– Transportation services likely to be local/domestic: bus Lines, railways, etc.

Travel agencies and tour operator's specific adjustments

In the case of Travel agencies and tour operators (4722), apart from accommodation, the payments may include international transportation and fees. In order to filter out the amounts not corresponding to travel, we use information obtained from the ETR and from a specific module on Tour operators (TTOO). More specifically the weight of transport in the total expenditure of Spanish residents in domestic and international trips[27] and the weight of fees in touristic packages total expenditure are supposed to be booked with a Travel agency.

Digital intermediation (DIPs) geographical re-allocation

For transactions channelled through DIPs (like Booking or Airbnb), the geographical allocation corresponds to the country where the business of the platform is sited. This means that, on the one hand, the payments could be including transactions linked to trips carried out in Spain, and on the other hand, that the geographical allocation of the "genuine" cross-border transactions could be distorted. This is especially relevant (although not exclusively) in the case of the MCCs: Lodging, hotels, motels and resorts (MCC 7011), Travel agencies and tour operators (MCC 4722) and Theatrical producers (except motion pictures) (MCC 7922). These codes mainly concentrate their amounts in countries of terminals Netherlands, United Kingdom and Luxembourg (where the online operators that provide these services internationally are located).

With the objective of correcting the amounts registered in those codes, we adopt the following approach. We estimate the part corresponding to transactions related to trips carried out in Spain booked by Spanish residents through online platforms using information from the Tourist Resident Survey (ETR) on the percentage that represent the tourist expenditure by those visitors in domestic trips in Spain in the total tourist expenditure in domestic and cross-border trips. Once deducted that amount, we distribute the rest of the payments ("genuine" cross-border) by country using the geographical breakdown of the amounts registered in the code Lodging, hotels, motels and resorts (MCC 7011) for non-remote payments[28]. This geographical

[27] We consider the total expenditure for the adjustment since the code includes trips to domestic and international destinations booked using DIPs.

[28] Other alternatives explored were the geographical breakdown of guest nights spent at short-stay accommodation offered via collaborative economy platforms from the experimental statistics

breakdown reflects the location of the physical terminal of the hotel where payments are carried out. The assumption is that the geographical distribution of the services booked via DIPs should not differ greatly from that for accommodation services paid in presence.

Other adjustments

Finally, we adopt a more conservative approach excluding some MCCs that not of a clear touristic nature and that in the case of remote payments seems to be more related to services consumed by residents in Spain (Cable services for instance).3.3.2 Description of the results

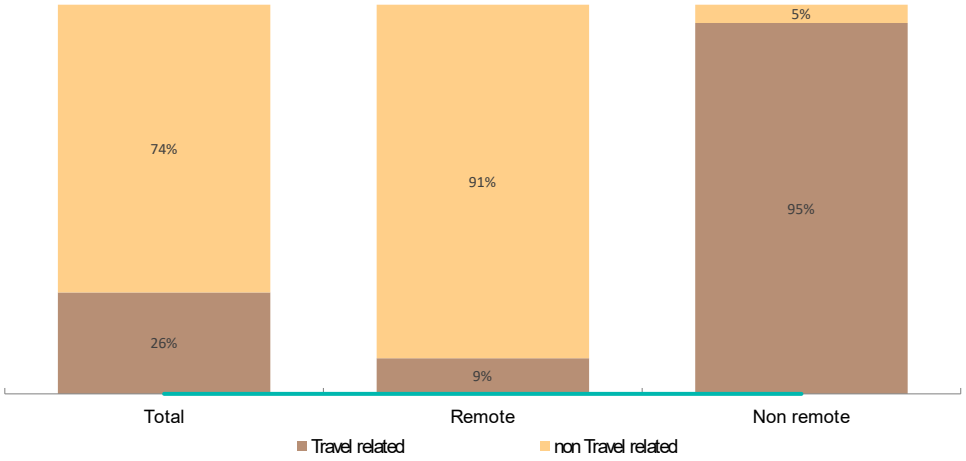
In the next graph we compare for 2022 the total card payments collected in Table 9 of the Regulation (travel related and not travel related), to the results that we have obtained applying the methodology previously explained (travel related) and to the Travel BOP debits. As it can be seen, the Travel related payments represent approximately a 26% out of the total card payments. Most of non-remote payments (95%) are considered Travel related. Nonetheless, for remote payments only 9% of total card payments are considered Travel related. Main MCCs excluded are related to digital goods and services, betting and gambling and wire transfers (see section 3.3.1 above)[29]. In terms of BOP Travel debits, the Travel related card payments estimate represents a 58% approximately[30].

published by Eurostat (it has the limitation that it doesn't include data on night stays in hotels), the geographical breakdown of the tourist expenditure by country of residence booked using accommodation platforms from ETR (the main limitation is that the geographical breakdown is limited), and the geographical breakdown of night stays estimated using mobile phone positioning data from the experimental statistics published by NSI.

29 In particular, the three main MCCs not related to Travel (representing approximately a 30% of total remote transactions) are: Miscellaneous and specialty retail outlets, Betting, including Lottery Tickets, Casino Gaming Chips and Wire transfers and money orders.

30 Another component that is relevant for estimation of Travel debits is that of ATM withdrawals that are reported nationally. If we add that component to the aggregate calculated for card payments the percentage would be a 64% of Travel debits.

GRAPH 1. TRAVEL RELATED PAYMENTS IN CARD DATA (%)



With respect to the main MCCs Travel related, in the following table we group the codes selected in ten categories[31] representing a percentage of approximately a 70% of total Travel related payments. The main three categories correspond to accommodation services (lodging, hotels and others), expenses in bars, restaurants and eating places, and Travel agencies and tour operators. The ranking is different in the case of remote and non-remote payments. In the case of remote payments, the main categories are related to travel agencies and tour operators, accommodation services and theatrical producers. In the case of non-remote payments, the main categories are bars, restaurants and eating places, accommodation services and food shops and supermarkets.

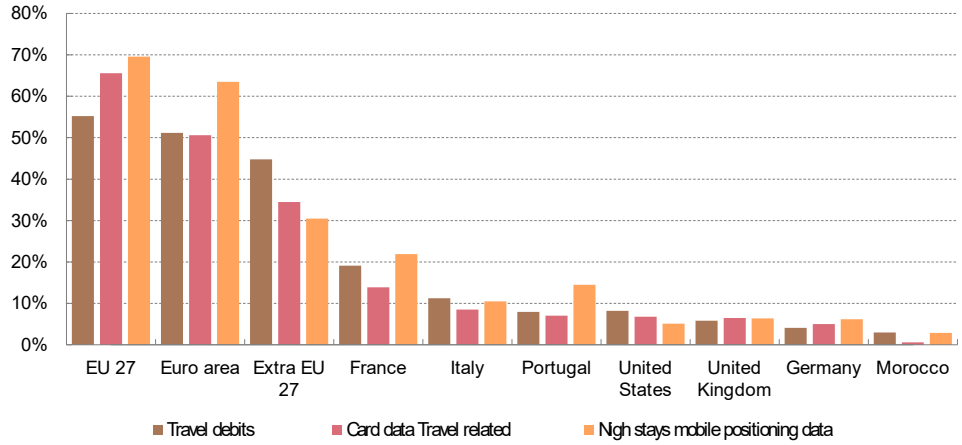
Table 5. Main categories of MCC Travel related 2022

Category	Total	Remote	Non remote
Lodging - hotels, motels and resorts	20%	30%	16%
Bars, restaurants and eating places	14%	0%	20%
Travel agencies and tour operators	11%	39%	1%
Food shops and supermarkets	10%	0%	13%
Family clothing shops	4%	0%	6%
Service stations	4%	0%	5%
Automobile Rental Agency	3%	5%	3%
Theatrical producers	2%	8%	0%
Electronic, video and photograph shops	1%	0%	2%
Department stores	1%	0%	2%

In the next graph we show the geographical breakdown of Travel debits, card related payments and night stays estimated from mobile positioning data (experimental statistics published by NSI).

[31] In order to group MCCs we have used the information published in the Visa Standards Manuals.

GRAPH 2. GEOGRAPHICAL BREAKDOWN OF TRAVEL DEBITS, CARD DATA AND MOBILE POSITIONING DATA 2022



The weight of payments to EU countries is lower in BOP Travel debits than in card payments, and both are smaller than the weight in mobile positioning data[32]. The weight of the payments to euro area countries is similar in card data than in Travel debits, and lower to that in mobile positioning data[33]. For France, Italy and Portugal, the weight in Travel debits is higher than in card data[34]. The weights of card payments to United Kingdom and Germany are a bit higher to the corresponding weights in Travel debits, while for the United States and Morocco the weight in Travel debits is higher than in card data. The mobile phone positioning data show a higher weight than for Travel debits for France, Portugal and Germany and a smaller weight for Italy, the United Sates and Morocco than those registered in Travel debits.

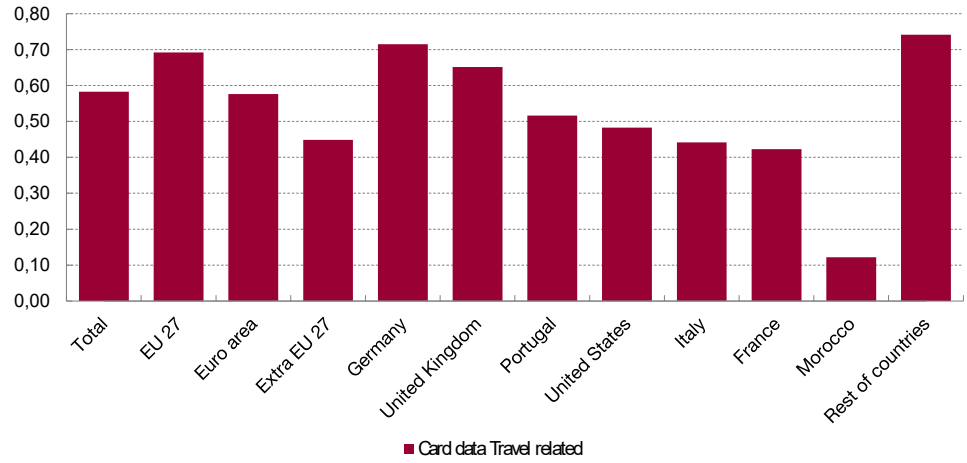
Finally, in the next graph we represent the ratio of card payments to Travel debits. It can be seen that the values of the ratio differ across areas and within areas, across countries. The ratio is higher for EU countries than for non EU countries. Among countries, the ratio for card data is higher for Germany and United Kingdom than for Portugal, Italy and France.

[32] It may be reflecting the higher prevalence in the use of mobile phone with SIM cards of national phone operators in trips to EU destinations than to non EU destinations.

[33] The weight of EU countries not belonging to the euro area is much higher in card data than in Travel debits due to mainly the higher weight of Nordic EU countries in card data than in Travel debits. Although deeper research involving declarants of transactions with those countries is required, a first analysis concluded that this would be partly reflecting transactions declared by PSPs that provide payments services from Spain to Nordic countries and that would correspond to transactions among non-Spanish residents.

[34] In the case of France and Portugal, a possible explanation it is that payments of Spanish cross-border workers using cards issued in those countries may be relevant and are not captured in card data.

GRAPH 3. RATIO CARD DATA ON TRAVEL DEBITS 2022



For Morocco the ratio is quite low which may indicate that cards issued by resident PSPs are less used as a mean of payments for those trips, for example due to a greater importance of trips related to visits to family and friends, or trips of cross-border workers (they would be using cash or cards issued in Morocco for payments in a higher extent). This is also the case of other countries with a high weight in the immigration population resident in Spain (as Dominican Republic or Colombia) for which we observe relatively low values of the ratio of card payments to Travel debits.

As it is mentioned before for Portugal and France, the difference between residency of the traveller and the residency of the card issuer (for example for Spanish cross-border workers using cards issued in that countries) may be an issue to explain their lower weight of card data than for other countries.

The opposite holds for cases of large ratios for Germany and United Kingdom (and others with ratios larger than one such as Ireland, Netherlands or Andorra), that may be reflecting the importance of the card payments carried out by residents in those countries with cards issued by Spanish PSPs (not to be included in Travel).

These are examples that illustrate some of the limitations in the use of card data for estimation of BOP Travel debits.

3.3.3 Way forward

In the future, improving the method previously explained will require: a) to continue participating in the Travel WS discussions, b) to intensify the contacts with Payment services providers reporting card payments data in order to clarify the nature and geographical allocation of some transactions, c) to cooperate with NSI in investigating how to combine card payments data with other sources and d) to be active in data sharing with counterpart countries. Apart from this, the use of card payments data for the estimation of Digital commerce in general should be explored.

4 Conclusions

In this article, we show that the use of data sources generated by the private sector is very relevant to improve the quality of the external statistics in the field of Tourism.

Firstly, the use of mobile phone data is a great challenge for NSI Spain. The potential of this source of information is indisputable, as it makes it possible to know the number of tourists at a level of detail that would be unthinkable if a traditional survey were used. The NSIs must be committed to its incorporation into the official statistics collection systems, bearing in mind the following aspects (applicable not only to the use of mobile phone data):

- Integration with traditional statistics: in general, mass databases do not cover all information needs. In the specific case of mobile and tourism, the number of tourists can be estimated, but not the characteristics of their trips or expenditure, so it will be necessary to integrate them with the results of traditional surveys and/or card transaction data in order to have complete information.
- Continuity and sustainability of access to information sources:
- Collaboration with the providers of the information: as we are not working directly with the microdata, but with processed and aggregated results, it is necessary to work collaboratively with the providers to ensure that their processing complies with the definitions of the study. There needs to be constant communication to ensure that the processes that are developed are working properly.

Secondly, despite their limitations, card payments data provide a powerful basis for measuring households imports of goods and services (in general) and of travel expenditures (in particular). Compared to other data sources, they have great advantages in terms of timeliness and granularity. In this sense, the new information available on MCCs represents an important progress. Nonetheless, it is still a challenge to solve some geographical issues (both related to residency and to counterpart countries). Besides that, it will be essential to capture its precise weight in the total of cross border transactions. To this aim, it will be necessary to continue sharing experiences across countries and to intensify the cooperation with NSI especially as regards how to combine card data with other data sources (mainly household surveys and mobile phones positioning data).

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BANCO DE ESPAÑA
Eurosistema

INE
Instituto Nacional de Estadística

SPANISH EXPERIENCE IN THE USE OF DATA FROM MOBILE PHONE NETWORKS AND CREDIT CARD DATA

Javier Álvarez (Banco de España) and Maria Velasco (NSI)

INTERNATIONAL STATISTICAL CONFERENCE

Banco de España, Madrid

12-13 February 2024

PRESENTATION BLOCKS

I. MEASURING TOURIST FLOWS USING DATA FROM MOBILE PHONE NETWORKS – INSTITUTO NACIONAL DE ESTADÍSTICA

II. USE OF CARD PAYMENTS DATA FOR BOP PURPOSES - BANCO DE ESPAÑA

I. MEASURING TOURIST FLOWS USING DATA FROM MOBILE PHONE NETWORKS

1. NEW SOURCES OF INFORMATION IN TOURISM STATISTICS FIELD

2. EXPERIMENTAL STATISTIC: MEASUREMENT OF INBOUND TOURISM FROM THE POSITION OF CELL PHONES

A. NEW SOURCES OF INFORMATION IN TOURISM STATISTICS FIELD

Experimental

A. Banking transaction with credit cards

- Distribution of the expenditure made by foreign visitors on visits to Spain.
- Distribution of expenditure by residents on their visits abroad by country of destination.





B. Web scraping data

Measurement of the number of tourism dwellings in Spain and their capacity.

C. Privately held data

Estimation of tourist accommodation occupancy using data from digital platforms.

D. MNO data

Measurement of national and inbound tourism from the position of cell phones.



A. NEW SOURCES OF INFORMATION IN TOURISM STATISTICS FIELD

https://www.ine.es/en/experimental/experimental_en.htm

Available experimental statistics



Company Demographic Profile



Distribution of expenditure by residents on their visits abroad by country of destination



Estimation of tourist accommodation occupancy using data from digital platforms



Studies on mobility based on mobile phone



Distribution of the expenditure made by foreign visitors on Visits to Spain



Multidimensional Quality of Life Indicator (MQLI)



Rental Housing Price Index (RHPI)



Measurement of Large Company Daily Retail Trade



Measurement of the Number of Tourist Dwellings in Spain and their Capacity



Measurement of National and Inbound Tourism from the position of cell phones

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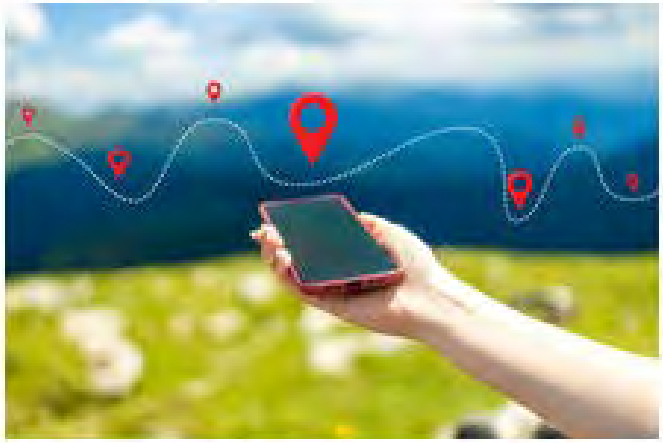
Measurement of National and Inbound Tourism from the position of cell phones

B. MEASUREMENT OF NATIONAL AND INBOUND TOURISM FROM THE POSITION OF CELL PHONES

- *Agreement with 3 MNOs:*
  - *Telefónica*
  - *Vodafone*
  - *Orange*

- *Monthly data provided:*
  - *July 2019 – december 2019*
  - *2020*
  - *2021*

- *Extension for 3 years: 2022, 2023 and 2024*



Main objective: Measure No. of tourist (resident and non-resident), brokendown by origin and destination of trips.

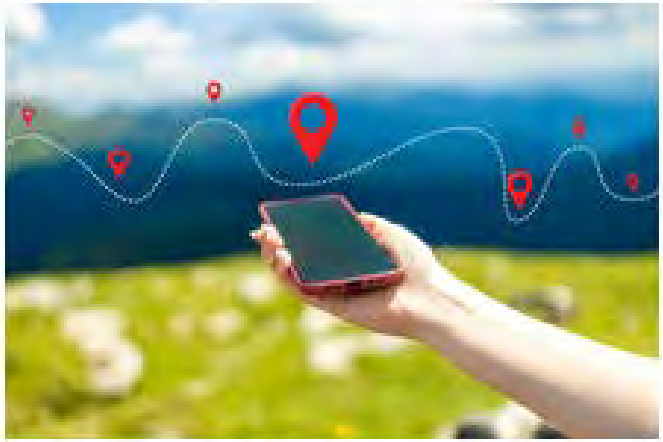




GRANULARITY
PUNCTUALITY
BURDEN REDUCTION

B. MEASUREMENT OF NATIONAL AND INBOUND TOURISM FROM THE POSITION OF CELL PHONES

- Work in cooperation with MNOs to adapt the information recorded in their databases to tourism concepts and definitions.
- NSI Spain integrates the information sent by the three companies.
- Great results for trips and overnightstays for inbound, outbound and domestic(*) tourism.
- Work in progress: sameday-trips and domestic tourism in the same province of residences.







B. MEASUREMENT OF NATIONAL AND INBOUND TOURISM FROM THE POSITION OF CELL PHONES

INBOUND TOURISM

- Variables:
  - Tourists
  - Overnightstays
  - Average stay
- Monthy
- Country of origin (200)
- Destination at NUTS2, NUTS3 and municipality level.

OUTBOUND TOURISM

- Variables:
  - Tourists
  - Overnightstays
  - Average stay
- Monthy
- Country of destination (200)
- Origin at NUTS2, NUTS3 and municipality level.

DOMESTIC TOURISM

- Variables:
  - Tourists
  - Overnightstays
  - Average stay
- Monthy
- Only inter-province trips
- Origin and destination at NUTS2, NUTS3 and municipality level.

Confidentiality: INE only receives files with aggregated data

(we don't have access to individual records nor can identify individuals).

Only cells with 30 tourists or more are published

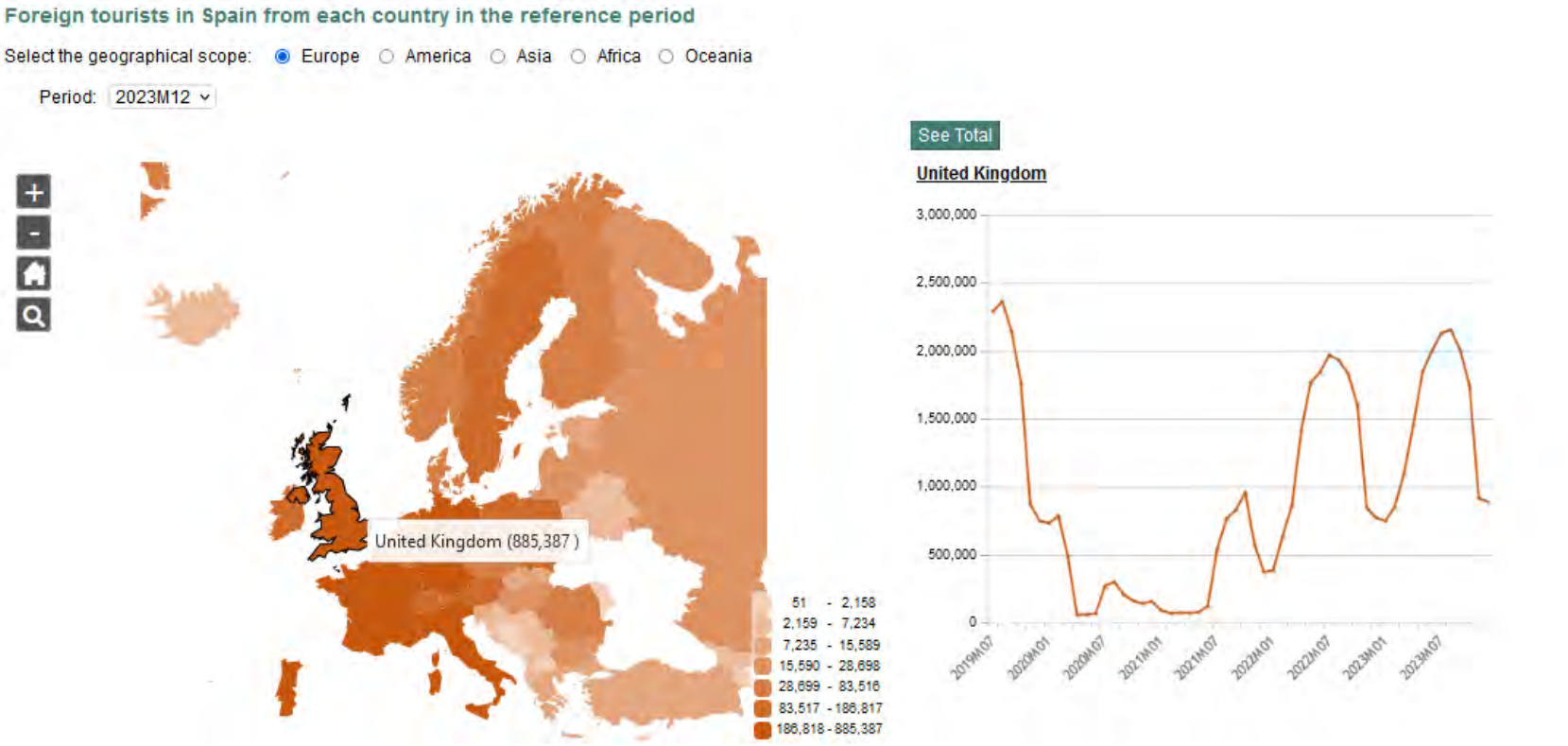
INBOUND TOURISM FROM THE POSITION OF CELL PHONES



World map: painting with colour intensity the countries of origin of tourists to Spain

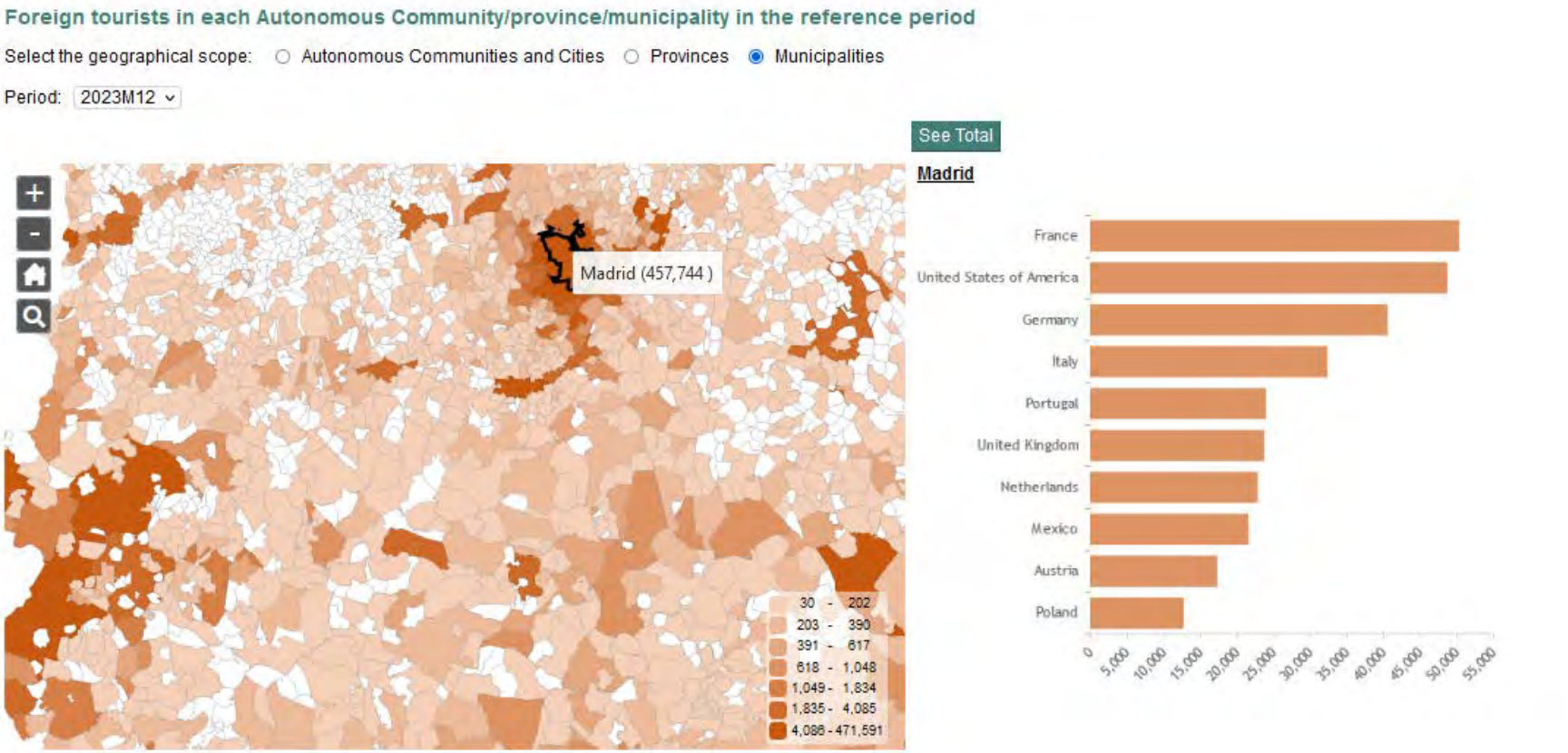
Link to INE website

INBOUND TOURISM FROM THE POSITION OF CELL PHONES



Map for each continent, painting with colour intensity the countries of origin of tourists to Spain

INBOUND TOURISM FROM THE POSITION OF CELL PHONES



Maps for municipalities, painting with colour intensity according the number of tourists and a graph for the main countries of origin.

INBOUND TOURISM FROM THE POSITION OF CELL PHONES

Municipalities with the highest number of foreign tourists for the main outbound countries

United Kingdom	Germany	France	The Netherlands	Italy
Calvià	Palma	Barcelona	Barcelona	Barcelona
Benidorm	Calvià	Madrid	Madrid	Madrid
Barcelona	Capdepera	Roses	València	Sant Josep de sa Talaia
Adeje	Barcelona	Jonquera, La	San Bartolomé de Tirajana	Formentera
Arona	Pájara	Palma	Sant Josep de sa Talaia	València
Sant Josep de sa Talaia	San Bartolomé de Tirajana	Lloret de Mar	Palma	Eivissa
Palma	Sant Llorenç des Cardassar	Donostia/San Sebastián	Málaga	Palma
Tías	Muro	Irun	Santa Eulària des Riu	Calvià
Marbella	Madrid	Castelló d'Empúries	Marbella	Ciutadella de Menorca
Yaiza	Alcúdia	Sevilla	Torremolinos	Arona

PROS & CONS



- Granularity
- Punctuality
- No burden (no interviews required)
- Large coverage



- Original MNO database not adapted to tourism definitions
- More variables required (main trips charactaristics or expenditure)
- Changes in technology affect data
- Access to information by contracts

FINAL REMARKS

- ✓ The new sources of information are a great opportunity for the producers of statistics since they will allow us to provide much more **frequently, timely and detailed information**.
- ✓ It is important to reach **agreements** with the owners of the information to access the databases.
- ✓ It will be necessary to work together with the owners of the information to develop **new methodologies to integrate the new sources into the traditional statistics**.
- ✓ The **definitions used in tourism surveys should be reviewed** to see if new sources of information can capture the same concepts.
- ✓ Reputational impact of data transfers. **Data confidentiality.**

II. CARD PAYMENTS DATA FOR BOP PURPOSES

1. INFORMATION AVAILABLE AT BANCO DE ESPAÑA
2. USE OF CARD DATA FOR BOP PURPOSES
3. PROS AND CONS
4. NEW EXPERIMENTAL STATISTICS
5. CONCLUSIONS

CARD PAYMENTS DATA (I): INFORMATION AVAILABLE AT BANCO DE ESPAÑA

NATIONAL AGREEMENT AND EU-ECB REGULATION (PAYMENTS ABROAD FROM 2022 DATA ONWARDS)

At present, two different types of data sets:

DATA COLLECTION:	ON THE BASIS OF A NATIONAL AGREEMENT	IN VIRTUE OF EU-ECB REGULATION ON PAYMENT STATISTICS (2020/2011)
Mandatory	NO	YES
Internationally harmonized	NO	YES
Data provider	Central scheme	Resident issuing PSPs
Frequency	Monthly and Quarterly	Quarterly
Timeliness	M+30d and Q+75d	Q+30d
Geographical breakdown	Areas (euro, EU, EFTA, rest)	Individual countries (Geo 6)
ATM withdrawals	YES	NO
PSTs remote	YES	YES
PSTs non-remote	YES	YES
Merchant category code	NO	YES

Similar coverage ratio national/EU-ECB reg=0.94 for 2022

CARD PAYMENTS DATA (II): THE USE OF THESE DATA

Since 2002, BOP Travel debits are estimated on the basis of card data collected on the basis of national agreement

- Provided by the Payments Systems Department of Banco de España
- We consider growth of rates instead of levels (no information on the weight of card payments)
- Complementary data sources: National Commission of Markets and Competition (e-commerce by activity), Residents travel survey (geo details), mirror data (geo details)

At present, studying how to use the new EU-ECB 2020/2011 Regulation data

- For the estimation of BOP Travel debits, international cooperation in the framework of the Travel Workshop
- In the short run, working in the dissemination of a new experimental statistics

CARD PAYMENTS DATA (III): PROS AND CONS

STRENGHTS

- Low cost of compilation
- Adequate frequency and timeliness
- High granularity
- High sustainability
- Beakdown into goods and services may be possible based on MCC

LIMITATIONS

- Partial (and unknown) coverage
- Assumption on residency: card holder=card issuer
- Cash principle vs accrual
- Distortions in geo data (due to digital intermediation platforms (DIPs) among others)

More tan 300 MCC

Miscellaneous and specialty retail outlets
Lodging - hotels, motels and resorts
Travel agencies and tour operators
Betting, including Lottery Tickets, Casino Gaming Chips
Wire transfers and money orders
Eating places and restaurants
…

CARD PAYMENTS DATA (IV): NEW EXPERIMENTAL STATISTICS

WORK IN PROGRESS – TRAVEL RELATED CARD PAYMENTS

SELECTION OF MCCs

Starting point = work carried out in the Travel WS = 200 aprox. out of 340.

- **MCCs always excluded** goods or services digitally delivered (games), related to international transport, etc.
- **MCCs to be excluded for remote transactions**: clothing and shoes stores for instance.

SPECIAL ADJUSTMENTS

For corrections we use information from the Tourist Resident Survey (ETR)

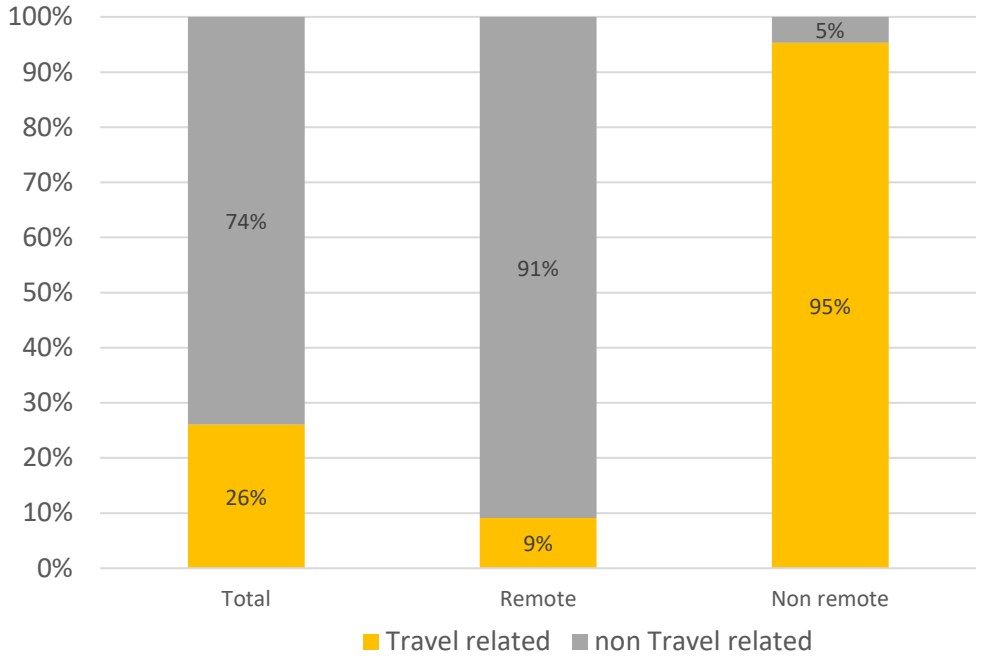
- **Travel agencies and TTOO**: deduction of international transportation and intermediation fees.
- **Lodging, hotels, motels and resorts; Travel agencies and TTOO and Theatrical producers:** geo reallocation and deduction of expenditure in domestic trips for transactions routed through Digital intermediation platforms (DIPs), concentrated in LU, NL and GB.

CARD PAYMENTS DATA (V): RESULTS (I)

WORK IN PROGRESS – TRAVEL RELATED CARD PAYMENTS

- A 26% of card payments are Travel related (95% of non remote payments, and 9% of remote payments), representing near a 60% of Travel debits

Graph 1. Card data breakdown Travel and non-Travel related 2022



Category MCC	Total
Lodging - hotels, motels and resorts	20%
Bars, restaurants and eating places	14%
Travel agencies and tour operators	11%
Food shops and supermarkets	10%
Family clothing shops	4%
Service stations	4%
Automobile Rental Agency	3%
Theatrical producers	2%
Electronic, video and photograph shops	1%
Department stores	1%

CARD PAYMENTS DATA (V): RESULTS (II)

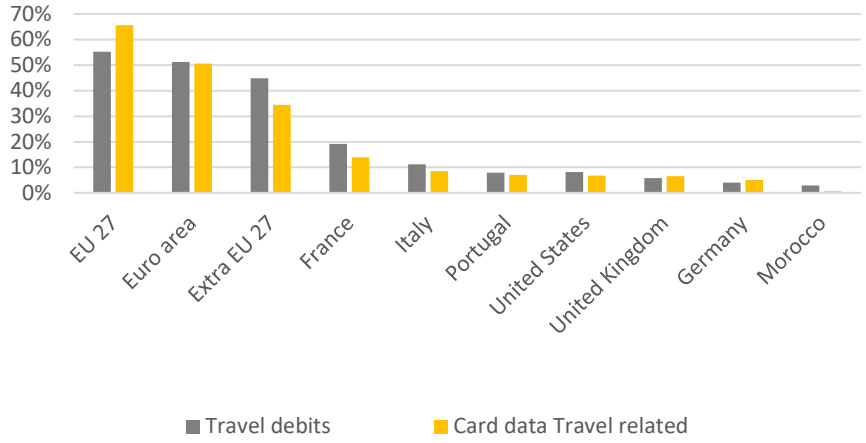
WORK IN PROGRESS – TRAVEL RELATED CARD PAYMENTS

- Differences in geographical breakdown:

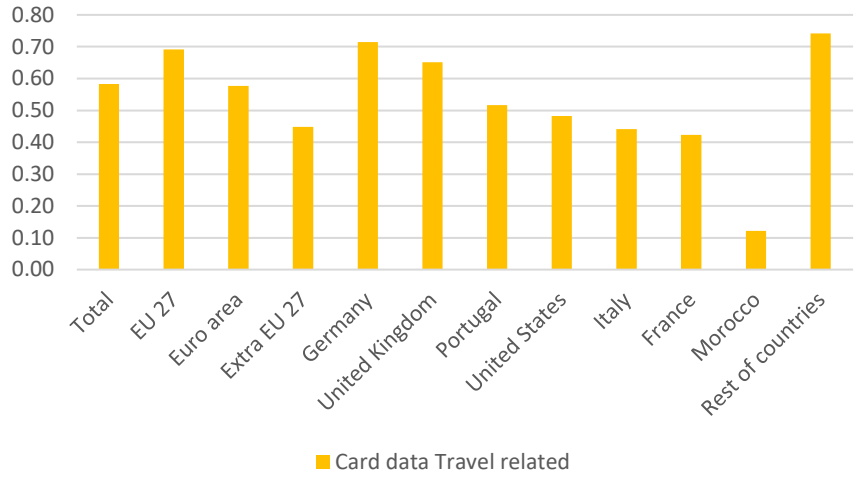
- Extra EU card payments < Travel debits: greater importance of other means of payments (cash payments in the case of LATAM migrants visiting their families in their countries of origin)

- Ratio card data / Travel debits higher for UK and Germany (residents abroad?) and lower for Morocco (again other means of payments when MO migrants visit their families)

Graph 2. Geographical breakdown of Travel debits and Card data 2022



Graph 3. Ratio card data on Travel debits



CONCLUSIONS

1. Despite their limitations, card payments data provide a powerful basis for measuring households imports of goods and services (in general) and of travel expenditures (in particular)

   - ***Great advantages in terms of timeliness and granularity***
   - ***The new information on MCCs represents an important progress***

2. Challenges to solve:

   - ***Geographical issues (both related to residency and to counterpart countries)***
   - ***Combination with other sources (capture of the weight of card data in total payments)***

3. Important to keep contacts with declarants to clarify the content of the information and necessary to continue sharing experiences across countries and to intensify the cooperation (especially with NSIs)

   - ***The access to mirror data (payments declared by counterpart countries in order to check our credits estimates) is foreseen***

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Where are the hidden securities in external statistics?[1]

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[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Where are the hidden securities in external statistics?

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Abstract

Several studies on the international investment position and balance of payments statistics (external statistics) suggest that holdings of foreign financial assets are greatly underestimated ("hidden" or "missing") in official data. This is evidenced by a significant global discrepancy between external assets and liabilities that reached $4.2 trillion at the end of 2022.

The literature relates the gap to an effort to hide wealth for tax evasion purposes ("hidden") coupled with the difficulties faced by external statistics compilers to collect information on cross-border financial investments of non-financial corporations and households, notably if intermediated via custody accounts in foreign countries ("missing").

We take a deeper look on the "missing" hypothesis, i.e. data on foreign assets missing from external statistics data collections due to foreign custody. We are interested in further testing the "missing" hypothesis and estimate its magnitude by using a novel method based on the mechanics of international finance and the practices in external statistics recording. To this end we considered the inverse relationship between securities and deposits using a particular sub-set of non-financial corporations' and households' external statistics data, namely transactions in "third-party securities holdings" held in custody in euro area financial centres and the deposits held with foreign banks (collected by the Bank of International Settlements).

The results obtained for the euro area financial centres are extrapolated to other financial centres worldwide to estimate the global "missing" securities broken down by holding country. For the year 2021, about 50% of the "missing" securities globally are statistically attributed to the United States, the United Kingdom, Germany, the Netherlands, Cayman Islands, and Ireland. The "missing" securities represented about 1.4% of GDP for these countries. The results may complement and improve the interpretation of international statistics, as this method keeps the methodological consistency of macroeconomic external statistics based on the residency framework.

Keywords: international investment position, portfolio investment, data gaps, household assets

JEL classification: TBC

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1 Introduction

Statisticians and economists have long puzzled over an abnormal global discrepancy in portfolio investments reported as foreign assets and liabilities in the international investment position and balance of payments statistics (external statistics) – that is, at the global level, cross-border liabilities are larger than cross-border holdings. The most recent estimates of this discrepancy, referred to as the global assets-liabilities gap, place this unaccounted figure at a level of $4.2 trillion as of end-2022, down from $6.1 trillion at end-2021. Such gap represents a substantial portion of overall global wealth and economists and statisticians are interested to ascertain the composition of the gap and how its spreads across countries.

Several authors suggest the assets-liabilities gap may be due to intentional actions to hide savings offshore and/or evade taxes, which constitutes the so-called "hidden" element of the gap. Gullo et al (2022) argue that money laundering takes advantage of less financially transparent countries, thereby increasing the probability of observing anomalous flows in global financial data. They also conclude that offshore secrecy is no longer a stronger determinant of anomalous flows than onshore secrecy.

We also support the offshore hypothesis as main driver for the assets-liabilities gap and we argue there is a sizable "missing" component attributable to limitations in cross-border data collection of official statistics. More recently, households and corporations increasingly allocate investments through globally active asset managers and online brokerages. This complicates the direct ties between investors in securities and (chains of) financial intermediaries, which effortlessly make use of the global financial infrastructure to manage their financial services in the most efficient manner.

International finance leverages on securities custodians dispersed worldwide. While this enhances the global capital mobility, the "fragmentation" of custody complicates the statistical data collection. Official external statistics are typically compiled only from resident custodians based on their legal mandate (Fache Rousová and Rodríguez Caloca, 2015). As households and non-financial corporations are not always required to directly report their portfolio investments, official statistics are pushed to collect indirect ownership information for the asset side. This creates the potential for underreporting of financial claims held in foreign custody – the so-called "third-party holdings" (TPH) – which is our analytical focus.

We propose that quantifying the scale of "missing" third-party holdings will help us understand the composition of the global assets-liabilities gap. To achieve this objective, we present an innovative methodological framework that estimates the dynamic link between third-party holdings and foreign-held deposits. This approach goes beyond previous level-based analyses (Zucman, 2013; Alstadsæter, Johannesen and Zucman, 2018).

We apply this flow-focused approach to granular and high-quality data on third-party holdings of euro area custodians (Fache Rousová and Rodríguez Caloca, 2015). We subset the data to investment fund shares as this segment is deemed to account for most of the assets-liabilities gap (Milesi-Ferretti, 2023). We then extrapolate the findings to gauge a global aggregate of "missing" securities that contribute to close the assets-liabilities gap. Furthermore, our results, when distributed by major holder

countries, shed light on global cross-border "missing" investment concentration. Our analysis reveals that among the top 20 countries in terms of portfolio asset holdings as of the end of 2021, 10 countries have missing assets amounting to more than 10% of their total assets. Notably, for countries like the Netherlands, Cayman Islands, Belgium, and the United Kingdom, this proportion reaches nearly 20%.

By maintaining consistency with the international statistical standards on external statistics, i.e. following the residency-based framework as opposed to the ultimate-owner or look-through approach, and further incorporating custody-based insights, our research design aims to improve the interpretation of global macroeconomic data and complement incrementally official statistics. Our contribution may help to advance our understanding of the assets-liabilities puzzle faced by policymakers and academics by examining its composition across borders through an enhanced approach.

Overall, our contribution provides valuable evidence for the ongoing efforts to understand unexplained movements in international portfolio investment positions, which are critical for economic performance and financial stability monitoring. In the following Sections, we further describe the motivation and theoretical context of cross-border investment intermediation structures that challenge conventional data collection frameworks for official statistics. We then detail our empirical approach (Section 3) and present key findings (Section 4). The conclusion reflects on implications, limitations, and avenues for future research.

2 Motivation and link to existing studies

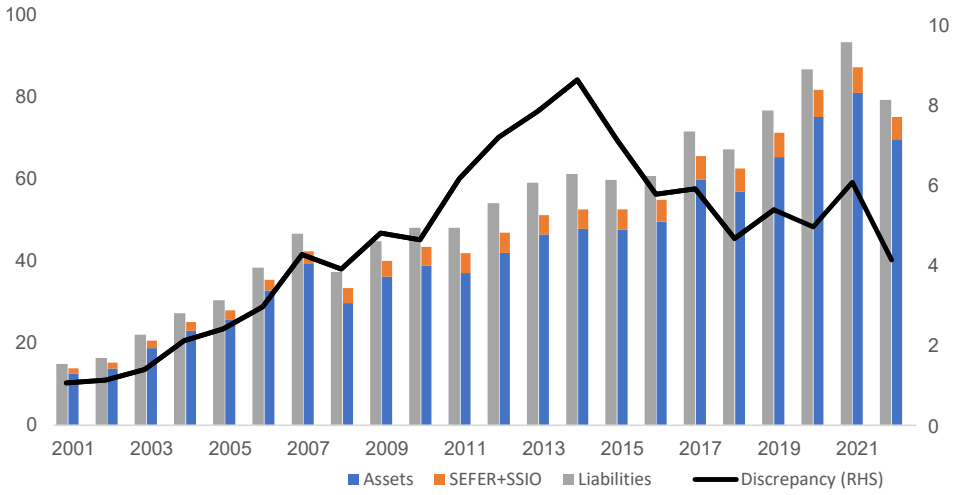
A key metric to measure the extent of global hidden/missing financial assets not fully captured in official statistics is the underestimate of net foreign asset positions of developed countries that Zucman (2013) mainly attributed to the portfolio investment assets held by households in offshore tax havens. In fact, there are several data collection challenges for statistics on securities, notably for securities held abroad, that lead to underreporting as indicated by Bui Quang & Gervais (2019). Several authors have advanced statistical methods that estimated higher levels of foreign assets compared to official figures, but also acknowledged limitations in the results (Pellegrini et al., 2016).

In the literature, it is widely assumed that official statistics capture to a considerable extent portfolio investment liabilities (issuances), portfolio investment assets held by direct reporters (legal entities with reporting obligations), and portfolio investment assets held by households in countries other than offshore financial centres. Under this assumption, the global discrepancy between portfolio liabilities and assets (including securities held as foreign exchange reserves and held by international organisations) corresponds broadly to the financial assets of households held via offshore financial centres.

Replicating this methodology and using the latest vintage of the External Wealth of Nations dataset by Lane and Milesi-Ferretti (2018) as well as IMF data shows a discrepancy of 4.2 trillion (tn) US dollar between global portfolio investment liabilities and assets in 2022 (see Figure 1). Notably, the global discrepancy has significantly declined from its peak of $8.7 tn in 2014, which may be attributed to better coverage

in the collection of securities, in particular for those held as reserve assets, but may also reflect more stringent efforts to combat tax evasion (Benetrix et al., 2021).

Figure 1: Global discrepancy between assets and liabilities in international security holdings



Source: Lane and Milesi-Ferretti (2018), IMF Securities Held as Foreign Exchange Reserves (SEFER) and Securities Held by International Organizations (SSIO).

While Zucman (2013) attributed the missing assets to the household sector, there may be additional factors at play: first, part of the global assets-liabilities discrepancy may be accounted for incomplete country coverage and under-reporting of assets by CPIS participants due to incomplete institutional coverage (i.e. missing reserve assets due to the still incomplete coverage in the IMF's SEFER.)[1] Second, misclassifications between portfolio equity investment and foreign direct investment (FDI) equity may account for part of the observed discrepancy between global assets and (portfolio) liabilities positions (Schmitz, 2021). Moreover, survey responses in some countries may be based on resident custodians and not directly reported by respondents making it difficult to account for securities held in custody abroad by non-financial corporations (NFCs) in addition to households, or even sometimes of institutional investors (Bui Quang and Gervais, 2019).

Milesi-Ferretti (2023) shows that the global discrepancy between portfolio investment assets and liabilities is mainly due to equity securities and in particular driven by investment fund shares issued in Ireland and Luxembourg for which information on the holders is missing to a great extent in the international financial statistics (Beck et al., 2023). Beck et al. (2023) use administrative data from the Central Bank of Ireland and the Commission de Surveillance du Secteur Financier (CSSF) for Luxembourg and find that the United Kingdom in particular plays a major role as an immediate counterpart to the investment fund shares issued in Ireland and Luxembourg. The

[1] A likely only minor part of the gap between global portfolio investment liabilities and assets may be accounted for by countries that do not report any international investment position data (Milesi-Ferretti, 2023).

authors provide evidence that this reflects both underreporting of holdings by UK residents and holdings by investors residing outside the euro area and the UK.

Zucman (2013) established that households' offshore wealth held in Switzerland in 2008 consisted to 25% of deposits and 75% of securities.[2] He applied these proportions to the global discrepancy in security holdings to compute households' total offshore assets (including deposits). By using an equivalent approach at annual frequency, Alstadsæter, Johannesen and Zucman (2018) find global offshore financial assets of $8.6 tn in 2015, $7.0 tn of which in securities and $1.6 tn in deposits. Bui Quang and Gervais (2019) also use the aggregate ratio of foreign securities held in custody in Switzerland to foreign deposits in Switzerland to estimate French missing securities assets.

In our work we focus on the securities held in custody abroad to capture underreporting. We make use of the link between cross-border deposits and security holdings abroad and take advantage from the fact that investors using a securities account abroad will typically have a deposit account in that country and/or transfer funds into that country as needed.

In this regard we establish a stronger connection between deposits and securities than other authors, refining previous approaches on the link between securities and deposits. We estimate the relationship between securities and deposits using a particular sub-set of non-financial corporations' and households' external statistics data, namely "third-party securities holdings" held in custody in euro area financial centres and the deposits held with foreign banks (collected by the Bank of International Settlements). The deposits provided by the BIS under the International Banking Statistics are consistent with international statistical standards for external statistics.

3 Empirical strategy

3.1 Hypotheses

One of the most relevant challenges faced in the compilation of the external statistics is to ensure the double-bookkeeping entry recording, and consequently a balanced recording of credits and debits (net acquisition of financial assets and/or net incurrence of liabilities) of the transactions. This principle is at the core of our approach to reconstruct hidden/missing assets, as developments in cross-border deposits can be indicative and used as a proxy to estimate the holdings of securities in portfolio investment that are missing from official data. To confirm this assumption, we test two hypotheses on the relationship of transactions in cross-border deposits with the assets-liabilities gap in securities and with third-party securities holdings.

We focus on the assets side of the portfolio investment (securities holdings), as the complete recording of securities liabilities is less of an issue for statistical compilers. Companies and sovereigns can easily report their securities issuances as well as the initial holders buying the issuances in the primary market or the domestic custodians

[2] Specifically Zucman (2013) used the *Securities holdings in bank custody accounts* and *fiduciary deposits* datasets published by the Swiss National Bank (SNB).

used in the primary market. The recording difficulties mostly arise with transactions in the secondary markets and/or if securities are held by foreign custodians. In these cases, missing information about the actual holders of securities can lead to mis-recordings in the balance of payments and in international investment position statistics. This may happen when the security is traded between a resident and a non-resident in the secondary market, and/or when it is held in a foreign custodian that is not required to report to the compilers located in the residency of the issuer.

Hypothesis 1: *Cross-border deposits (in/outflows) in country i (i.e. liabilities) are (negatively) correlated with the global assets-liabilities gap vis-à-vis country i.*

The first variable used is cross-border deposits (in/outflows) from the rest of the world vis-à-vis country *i*. The assets-liabilities gap is defined by the difference between the stocks of portfolio investment liabilities of country *i* in the form of equity and investment fund shares as reported in country *i*'s international investment position, and the total bilateral assets of portfolio investment in the form of equity and investment fund shares issued by residents of country *i* , as reported in the IMF's CPIS (i.e. derived from the creditor data).

The rationale for this hypothesis is the typical inverse relation between the flows of deposits and the holdings of securities as generally investors make use of deposit accounts to invest in securities. We anticipate a negative relation between the in/outflow of deposits and the flow of securities holdings. If changes in securities holdings are not accurately reflected in external statistics as signalled by the assets-liabilities gap, a reduction in deposits held by foreigners in country *i* may be associated with larger missing assets in terms of securities issued by country *i*.

Hypothesis 2: *Cross-border deposits (in/outflows) held in country i by country j are (negatively) correlated with the "third-party" holdings of securities held in country i by country j.*

Third-party holdings refer to the act of entrusting securities to a separate specialised entity (typically custodians) for safekeeping and management on behalf of another party. While various combinations of third-party holdings exist, our specific focus lies on the scenario where a custodian within a particular country offers custody services for securities issued within the same country to non-resident investors.

This hypothesis is a more granular version of hypothesis 1. We believe that foreign custodians have a significant impact on the assets-liabilities gap when they are not reporting the holdings (referred to as 'third-party holdings') to the external statistics compiler located in the country where the security holder resides. The underlying idea is that e.g. a household has a deposit account in a foreign country where the custodian is based and subsequently uses this deposit account to invest in securities.

3.2 Data sources

To test the hypotheses outlined in Section 3.1, we employ and combine different data sources, namely information on international banking statistics for deposits, third-party holdings of securities in European financial centres, Coordinated Portfolio Investment Survey (CPIS) and International Investment Position (IIP) for securities.

Data on third-party holdings are available in the Securities Holdings Statistics by Sector (SHSS) database maintained by the European System of Central Banks. We

focus on the investment fund shares held by non-financial investors (excluding general government) from all available countries that are reported by custodians located in Ireland, Luxembourg, and Belgium[3]. The data used include the following variables: (i) holder country, (ii) custodian country, (iii) total holdings and transactions of investment fund shares. We used quarterly data from 2013Q4 to 2022Q3.

The locational banking statistics (LBS) follow balance of payments concepts and tracks the claims and liabilities (including interoffice positions) of banks resident in a reporting country. It includes breakdowns by instrument (loans and deposits, debt securities, and "other"), currency, bank nationality, counterparty sector (e.g. intragroup, central banks, unrelated banks, and non-banks) and counterparty country. The LBS are divided into two data subsets, the LBS by residence (LBSR) and the LBS by nationality (LBSN). Broadly speaking, the datasets differ in that the LBSR are reported by bank located in a particular country and includes an instrument breakdown for banks' on-balance sheet claims/liabilities. The LBSN provide the same information based on a reporting bank's nationality regardless of where it is located.

In our analysis, we gathered data on LBSR by financial instrument and institutional sector across all countries, which were deposited with banks located in Ireland and Luxembourg. The data consists of (i) reporter country (i.e. where the bank is located), (ii) counterparty country (i.e. where investor is located), (iii) total value of deposits, (iv) counterparty sector. We considered three different sectors – households, non-financial corporations, non-bank financial institutions and quarterly data from 2013Q4 until 2022Q3.

The Coordinated Portfolio Investment Survey provides detailed bilateral cross-border portfolio investment holdings. The CPIS was first conducted as a pilot for 1997, but a more complete dataset is available annually from 2001 to 2012. From 2013 onwards, the CPIS was published semi-annually (end-June and end-December). According to the CPIS guidelines, a reporting economy provides data on its holdings of portfolio investment securities. Separate data are reported for equity, including investment fund shares. Both, the LBSR and CPIS data are consistent with the Balance of Payments methodology. We used semi-annual CPIS data between 2013Q4 to 2022Q2.

The data for balance of payments and international investment position are from the ECB database, available in link. It corresponds to the quarterly outstanding amounts of liabilities in the form of portfolio Investment equity and investment fund shares of Ireland and Luxembourg.

3.3 Testing Hypothesis 1

To test hypothesis 1, we examined the correlation between the assets-liabilities gap in equity, as defined previously and the changes in cross-border deposits (Table 1). Specifically, we analysed the data from 2014Q2 to 2021Q4 for Ireland and Luxembourg. The correlation was evaluated both contemporaneously and with a one-quarter lag (i.e. one period lag). At this stage, we want to capture the sign of the correlations between the asset-liabilities gap and the flows of the deposits, not necessarily to discuss the magnitude of its correlation. The results revealed a negative

[3] These countries account for a large share of the custody industry in the EU. Ireland and Luxembourg are the main countries of residence for investment funds in the EU.

relationship between the assets-liabilities gap and the amount of deposits in/outflows, which became more pronounced in the lagged specification, thereby providing evidence for hypothesis 1. For the contemporaneous specification there are negative correlations for Ireland (-0.358) and for Luxembourg (-0.259) (see Table 1). In addition, if we consider the one-period lag specification, the results show a stronger negative correlation: -0.511 for Ireland and -0.481 for Luxembourg.

Table 1: Correlations between the asset-liability gap in equity and in/outflows of cross-border deposits (2014Q1-2021Q4)

	Ireland	**Luxembourg**
Contemporaneous	-0.358	-0.259
One period lag	-0.511	-0.481

3.4 Testing Hypothesis 2

To test hypothesis 2, we estimated the correlation between changes in cross-border deposits (both current and lagged by one quarter) and developments in third-party holdings (either transactions or changes in positions). To do so, we run the following regression:

$$\Delta TPH_{ijt} = \alpha + \beta_1 \Delta LBS_{ijt} + \beta_2 \Delta LBS_{ijt-1} + \varepsilon_t \,, \qquad (1)$$

where ΔTPH_{ijt} refers to either transactions or changes in positions of third-party holdings by the non-financial sector (excluding general government) and ΔLBS_{ijt} refers to changes in the level of deposits by both households and non-financial corporations between t and $t-1$, α refers to relevant fixed effects (holder, custodian or period).

We expect, according to hypothesis 2, β_2 to be negative. β_1 may be either negative or null, depending on the time the deposits are used to invest. Specifically, if deposits are used in the same quarter to invest in securities, we expect β_1 to be negative. On the contrary, if deposits are used to invest in a different quarter, β_1 may not be statistically relevant.

We used bilateral data at the holder-country custodian-country pair, for which we have information on third-party-holdings (TPH) and deposits with no gaps in observations. This criterion results in 158 holder countries[4] and the three custodian countries Belgium, Ireland and Luxembourg. For each holder-custodian-quarter observation, we observe the positions in third-party holdings of investment fund shares (total euro area, or combined Ireland and Luxembourg issuances), the

[4] ISO-2 codes of included holders are: AD, AE, AM, AO, AR, AT, AU, AW, AZ, BA, BD, BF, BG, BH, BI, BJ, BM, BO, BQ, BR, BS, BW, BZ, CA, CD, CF, CG, CH, CI, CL, CM, CN, CO, CR, CV, CW, CY, CZ, DE, DK, DO, DZ, EC, EG, ET, FI, FR, GA, GB, GG, GH, GN, GR, GT, HK, HN, HR, HT, HU, ID, IL, IM, IN, IT, JE, JO, JP, KE, KH, KR, KW, LB, LI, LK, LR, LY, MA, MG, ML, MO, MU, MV, MW, MX, MY, MZ, NE, NG, NL, NO, NP, NZ, OM, PA, PE, PF, PH, PK, PL, PT, PY, QA, RO, RS, RU, RW, SC, SE, SG, SI, SK, SL, SN, SR, SX, TG, TH, TN, TR, TW, TZ, UA, UG, US, UY, VE, VN, VU, ZA, ZM, ZW, BE, FJ, KY, BB, BN, BY, DJ, EE, GI, IQ, IR, IS, JM, KZ, LC, LT, LV, NA, NC, NI, SA, SM, SV, TC, VA, VC, YE

transactions in third-party holdings (total euro area, or combined Ireland and Luxembourg issuances), as well as deposits of households and non-financial corporations of holding countries in banks in the three custodian countries.

We additionally excluded holdings by euro area countries to check whether results still hold for "worse quality" data, as data on third-party holdings are systematically collected and quality assured for euro area holder countries. The quality difference may arise from the fact that euro area custodians have better information on the actual holder of the securities held in custody if these are euro area residents.

Our main exercise is to estimate aggregate missing assets. In the baseline specifications we aggregate holdings of each country over all custodians, while controlling for holder and period fixed effects. In another specification, we also run regressions using bilateral data while controlling for holder, custodian and period fixed effects. Out method focus on flows and not levels.

Table 2 shows the results for the transactions in third-party holdings of investment fund shares issuances held by all (available) countries (and of which non-Euro Area countries) as a consequence of a change in foreign deposits. In addition, we also estimated the impact of a change in foreign deposits in the third-party holdings of investment fund issuances in Ireland and in Luxembourg and held by all (available) countries and non-Euro Area countries.

Table 2: In/outflows of deposits and transactions in third-party holdings - Regression results

	TPH: all issuances held by:		**THP: IE+LU issuances held by:**	
	all countries	**non-EA countries**	**all countries**	**non-EA countries**
change in deposits	0.58 *(1.84)*	1.30 *(3.46)*	0.54 *(1.90)*	1.30 *(3.60)*
change in deposits lagged	-2.54* *(1.36)*	-4.84** *(1.14)*	-2.49* *(1.34)*	-4.85** (1.07)
Holder FE	*yes*	*yes*	*yes*	*yes*
Period FE	*yes*	*yes*	*yes*	*yes*
Cluster S.E.	*Holder + Quarter*	*Holder + Quarter*	*Holder + Quarter*	*Holder + Quarter*
Observations	*5372*	*4862*	*5372*	*4862*
R^2	*0.05*	*0.05*	*0.09*	*0.10*

Significance levels * <0.01, ** <0.001

Note: Table shows results from regression model (1). Left-hand side contains aggregate quarterly transactions in third-party holdings of all available countries or non-euro area countries. Right-hand side contains quarterly changes in aggregate cross-border deposits of households and NFCs of the holding countries. In the specifications holder and period fixed effects are included. Standard errors are clustered over holder and quarter.

The estimations presented in Table 2 exhibit a statistically significant negative relationship between transactions in the TPH and changes in cross-border deposits lagged by one quarter, β_2. When we consider the impact for the same quarter, β_1, the estimations are not statistically significant.

The results indicate that a decrease in deposits in the previous period by $1 leads to positive transactions in third-party holdings of $2.5 (see results for all TPH issuances held by holders in all countries). We also check whether the effects hold if we consider only holders outside the euro area, for whom we assume worse data quality. Results in a column for all TPH issuances by non-EA countries also show a lagged negative correlation between TPH transactions and changes in deposits but of greater absolute value elasticity of -4.8. This can indicate that non-euro area households and NFCs place more frequently deposits in Belgian, Irish and Luxembourgish for their investment purposes. The results remain robust whether we include holdings of all investment fund shares or only those issued by funds in Ireland and Luxembourg. This is evident in the regression results for transactions in shares solely from investment funds in Ireland and Luxembourg.

As we aim estimating the missing holdings across all custodian destinations, we rely on baseline estimates derived from the regression results for all holders and all issuances. In our subsequent calculations, we use the results obtained from the specifications with all holdings. These results provide us with a multiplier of -2.5 and a standard error of 1.3, which we take to establish the lower and upper bounds of our estimates (2.5 ± 1.3).

4 Estimating missing portfolio investment assets by geography

4.1 Calculation approach

Using the results from Section 3.4, we provide an estimate of missing portfolio investment assets by holder country. The underlying idea is to make use of the existing relationship with in/outflows of deposits as a proxy to estimate the missing assets that we assume taking mostly the form of investment fund shares and via foreign custodians.

First, we establish a starting value for the initial period to estimate the missing assets. The starting value is chosen to be 2018Q4, motivated by the availability of deposits data. When determining the starting value, we consider the fact that the level of cross-border deposits represent a share of total wealth placed abroad. In line with existing studies (see e.g. Zucman, 2013, or Quang and Gervais, 2019), we multiply the deposits with this ratio to estimate the value of missing assets. However, we do this only for the initial period of 2018Q4. The following periods we use the multiplier obtained from the regression analysis and the changes in deposits, which is a novel approach in the literature.

The candidate for the starting value is calculated using a ratio between portfolio investment and other investment in the i.i.p of the euro area, assuming that we can extrapolate it to the rest of the world. The ratio in 2018Q4 as well as the average ratio in 2018 is equal to 2.8, which we use to calculate the starting value. This value is also quite close to what is reported in BIS LBS and in SNB data for Switzerland: specifically, the ratio between foreign equity securities held in custody by foreign private investors (i.e. households and NFCs) in banks in Switzerland to cross-border deposits by foreign households and NFCs held in Swiss bank equaled 2.3 in 2021. The reconstruction of

the missing assets stop in 2021Q4, which is the value we an estimate for missing assets.

In summary, we start by multiplying the position in cross-border deposits at end 2018Q4 by *γ=2.8*

$$\widehat{MA_{j0}} = \hat{\gamma} Deposits_{j0} \quad (2)$$

where $\widehat{MA_{j0}}$ corresponds to the estimated missing assets in the initial period (calculated for each country j). $Deposits_{j0}$ represent total cross-border deposits by households and NFCs of country j in the initial period, in all foreign banks. $\hat{\gamma} = 2.8$ stands for the ratio between the missing assets and deposits.

Secondly, using the starting value of missing assets and the in/outflows of cross-border deposits, we construct the series for missing assets for each holder country, using the following equation:

$$\widehat{MA_{jt}} = MA_{j0} + \sum_{\tau=0}^{\tau=t-1} \widehat{\beta_2} \Delta Deposits_{j\tau}, \quad (3)$$

where $\widehat{MA_{jt}}$ is the amount, for country j of the missing assets in period t, $\Delta Deposits_{j\tau}$ is the in/outflows of cross-border deposits between $t-2$ and $t-1$ (assuming that the lag between deposits and investment is one quarter)[5], and $\widehat{\beta_2} = -2.5$ according to the scenario considered from the regression results (Table 2). Equation (3) gives the aggregate value of the missing assets over time for each country.

Finally, the adjusted assets position is obtained by summing the CPIS position of country *j,* in period *t* with an estimate of missing assets:

$$\widehat{CPIS_{jt}} = CPIS_{jt} + \widehat{MA_{jt}} \quad (4)$$

Note that while we obtain the coefficient β_2 using investment fund share issuances only, we apply it later to adjust CPIS positions for equity and investment fund shares.

Lower and upper bounds are obtained in equation (3), while constructing 68% confidence bands, by modifying the multiplier as $\widehat{\beta_2} - \sigma = -2.5 - 1.3 = -3.8$ for a lower bound and as $\widehat{\beta_2} + \sigma = -2.5 + 1.3 = -1.2$ for an upper bound. When decomposing missing assets by destinations (e.g., intra-euro area vs. extra-euro area), we use the respective bilateral cross-border deposits and apply the procedure described in equations (2) and (3).

4.2 Estimates of missing assets

The results for the missing assets for end-2021, are presented in Table 3, at an aggregate level, for all the reporting CPIS countries and on an individual level for the top 20 holder countries in official CPIS data. It shows the reported CPIS assets, the results of our estimates for missing assets, and the CPIS assets plus the estimated missing assets that we call adjusted total assets. Moreover, it illustrates the relative value of missing assets as a percentage of the adjusted total assets and as a percentage of GDP.

The estimated aggregate value of the missing assets is $4.9 tn at end-2021, representing 9.7% of the adjusted total assets and 5.5% of aggregate GDP. For the

[5] Note, to avoid extreme changes in deposits, we calculate changes in deposits in percentage of positions, winsorize 10% tails of this distribution, and recover adjusted changes in deposits.

largest 20 CPIS holders the estimated amount of the missing assets is $3.9 tn at end-2021, 8.8% of the adjusted total assets and 5.6% of aggregate GDP.

According to the obtained results, the primary contributors to the aggregate amount of missing assets are : the United States ($662 billion (bn)), the United Kingdom ($548 bn), Germany ($391 bn), the Netherlands ($328 bn) and Cayman Islands ($316 bn).

These results are broadly consistent with Zucman (2013) that estimated around 8% of the global financial wealth of households is held in tax havens, three-quarters of which goes unrecorded. Available evidence suggests that offshore assets belong mainly to residents of richer countries, in particular to Europeans. Moreover, Pellegrini, V. and Tosti, E. (2012) show that the underestimate of global foreign portfolio assets remains steady at between 7 and 7.5 per cent of global GDP in the period from 2001 to 2010 (about $4.5 tn at the end of 2010).

The largest missing assets in proportion to the total adjusted assets, are estimated for the Netherlands (19.5%), Belgium (18.6%), Cayman Islands (18.3%) and United Kingdom (17.5%) and Switzerland (16.2%). Relevant proportion of missing assets (largest than 10%) are also estimated for Germany (15.4%), France (13.6%) and China (11.8%). Missing assets lower than 5% of the total adjusted assets are instead estimated for Norway (1.3%), South Korea (1.5%), Canada (3.3%), Japan (4%) and Honk Kong (4.7%) and Sweden (4.8%). Estimates for the United States, Luxembourg, and Ireland, which are among the largest CPIS holders, range between 5% and 10% of total assets.

The estimations of the missing assets as percentage of GDP show that Cayman Island and Luxembourg have the highest percentages. The results are highly influenced by the population and GDP amounts of these countries. Other countries with high missing assets as percent of GDP are: Ireland (51.0%), the Netherlands (31.8%), Switzerland (25.6%), Singapore (22.3%), Belgium (22.1%), Hong Kong (18.8%), and the United Kingdom 17.5%.

Our results are consistent with the literature. For example, according to Pellegrini, V. and Tosti, E. (2012) estimated for the period between 2001-2010, the share of the missing assets to be allocated to major euro area countries (France, Germany, Italy, the Netherlands, and Spain) on average around 9 per cent of national GDPs. According to our estimations the missing assets as percentage of GDP for these countries fiver countries we obtain a ratio of 9.1% of GDP.

Table 3. Reported, missing and adjusted total portfolio investment assets (equity and investment fund shares)

End-2021, USD bn

COUNTRY	REPORTED ASSETS	MISSING ASSETS	ADJUSTED TOTAL ASSETS	MISSING AS % OF TOTAL ASSETS	MISSING AS % OF GDP
UNITED STATES	12061	662	12724	5.2	2.8
LUXEMBOURG	3473	227	3700	6.1	264.6
UNITED KINGDOM	2575	548	3123	17.5	17.5
IRELAND	2306	262	2569	10.2	51.0
JAPAN	2215	92	2306	4.0	1.8
GERMANY	2153	391	2545	15.4	9.1
CANADA	2056	71	2127	3.3	3.5
HONG KONG	1416	69	1486	4.7	18.8
CAYMAN ISLANDS	1411	316	1726	18.3	5237.4
NETHERLANDS	1354	328	1682	19.5	31.8
ITALY	1343	105	1448	7.3	5.0
NORWAY	1208	16	1224	1.3	3.2
FRANCE	1176	186	1362	13.6	6.3
SWITZERLAND	1074	208	1282	16.2	25.6
SINGAPORE	968	95	1062	8.9	22.3
AUSTRALIA	878	30	908	3.3	1.8
SWEDEN	806	41	847	4.8	6.4
CHINA	648	87	735	11.8	0.5
SOUTH KOREA	592	9	601	1.5	0.5
BELGIUM	575	131	706	18.6	22.1
SUM OF TOP 20	*40290*	*3872*	*44162*	*8.8*	*5.6*
TOTAL CPIS	*45229*	*4885*	*50115*	*9.7*	*5.5*

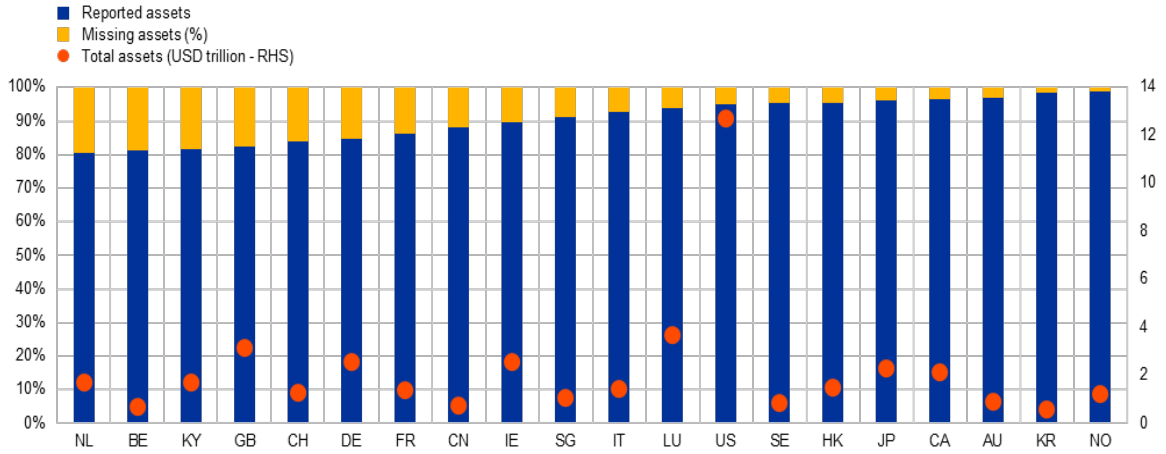
Sources: IMF CPIS, World Bank, authors' calculations.

Notes: Reported assets show the assets as reported by each country in the CPIS dataset. Missing assets show the missing assets as estimated in our model presented in Section 4.1. Adjusted total assets show the sum of reported and estimated missing assets.

We provide a graphical representation of the results (see Chart 1) to illustrate a ranking of the top-20 CPIS holders by the proportion of estimated missing assets in the total adjusted assets. The results are heterogeneous since there is no direct relationship between the total assets held by each country and the percentage of the missing assets.

Chart 1. Proportion of reported and estimated missing assets

End-2021, LHS: % in total assets; RHS: USD trillion



Sources: IMF CPIS, authors' calculations.

Notes: Reported assets show the assets as reported by each country in the CPIS dataset. Missing assets show the missing assets as estimated in our model presented in Section 4.1. Adjusted total assets show the sum of reported and estimated missing assets.

The heterogeneity across the top-20 countries with respect to the proportion of missing assets highlights the importance to assess other factors that explain the existence of the missing assets. This can include a variety of factors already advanced in the literature such as legislation, tax heavens regimes, financial transparency, among others.[6]

The results obtained in our study broadly align with the findings presented by Alstadsæter, Johannesen and Zucman (2018). These authors, using a different approach and methodology, focused on estimating the magnitude of missing household wealth kept off-shore in tax havens. In our study we do not restrict our estimates to holdings of the household's sector, but we focus only on estimating the missing gap for the portfolio securities most relevant in the global discrepancy, that is related to missing holding assets of equity and investment fund shares.

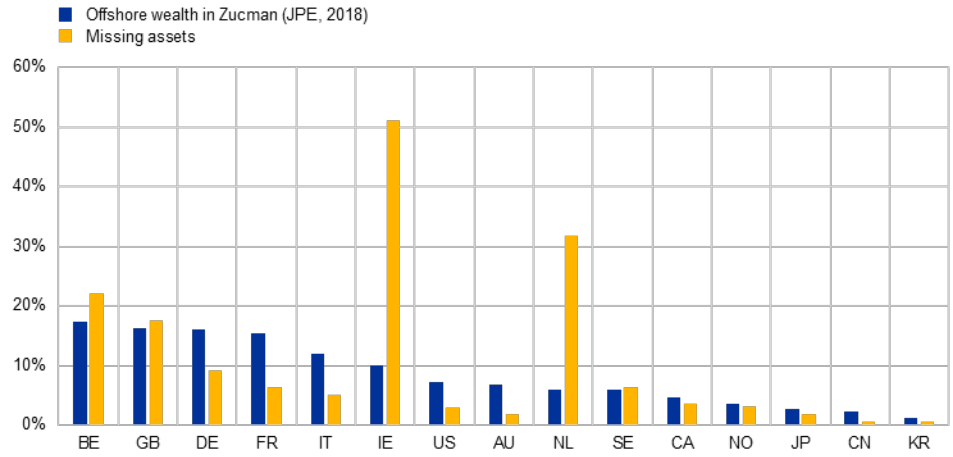
Our estimates also refer to missing assets held anywhere, while Zucman's work specifically focus on wealth held in offshore tax havens. Notwithstanding these differences in method, scope and reference period of the exercises, our results bring some similarities to Zucman (JPE, 2018).[7] Chart 2 shows the estimates of offshore wealth as in Zucman (JPE, 2018) compared to our estimates for missing assets, for the sample of countries presented in both studies.

[6] Between 2007 and 2021 overall size and composition of foreign holdings as percentage of GDP changed considerably for some countries (e.g. Ireland and Netherlands) and this needs to be taken into account in the comparative interpretation between the estimates of these two studies.

[7] Our estimates do not include, for example, holdings abroad of debt securities and deposits abroad.

Chart 2. Comparison of missing assets with results from Zucman (JPE, 2018)

% of GDP, 2017 and 2021



Sources: Zucman (JPE, 2018), authors' calculations.

Notes: Offshore wealth as % GDP refers to estimates of offshore household's wealth from Zucman (JPE, 2018) referring to end-2007. Missing assets as % of GDP refer to the estimates presented in this paper, referring to end-2021.

We associate this heterogeneity also to country economic size, competition in financial services, and the residency approach (and not ultimate owner) followed in statistics. In high developed countries, wealthy households and NFCs may seek innovative and fragmented financial services solutions for their investments, making use of global financial infrastructure to optimise returns. Some of their wealth will be placed with foreign custodian services (TPH) and may end up being underreported in official statistics. This explanation supports the fact that Zucman (JPE, 2018) estimates are higher than ours for Germany, France, Italy, United States, and Australia.

On the other extreme, the most striking differences are found for Ireland, the Netherlands, Belgium and, to a lesser extent, the United Kingdom, where our estimates have a larger share of GDP in missing assets. For countries where the missing assets as percentage of GDP is elevated there are additional factors to consider. Our methodology follows the residency approach as establish by the international statistical standards for external statistics and national accounts. Wealthy families or NFCs establish sometimes legal units abroad (e.g. family and other type of trusts, special purpose vehicles, conduits, etc) and transfer assets to them.

These legal units are generically called special purpose entities (SPEs) as they are just passive legal entities used as a tool (e.g. fiscal optimisation, confidentiality benefits, ring-fenced and protection of assets to certain events, etc) for their owners. However, following the statistical standards, these SPEs are resident in a country different from their owners.[8] The link between owner and SPEs is established by foreign direct investment and no longer by portfolio investment or other investment (deposits). In

[8] The residency of the SPEs was discussed in the ongoing review of the international statistical standards discussed (see https://unstats.un.org/unsd/nationalaccount/aeg/2022/M18/M18_8_G4.pdf). It was concluded to keep the current convention in the IMF's balance of payments manual sixth edition.

fact, statistics would report a global shift of wealth to countries where such SPEs are located and reside. This explains, following the residency approach, why countries such Cayman Island, Luxembourg, Ireland, the Netherlands, Switzerland, Singapore, Belgium, Hong Kong, and even the United Kingdom have high missing assets compared to their GDP.

Regarding the remaining countries, our findings could be interpreted as giving overall consistent results: a group of large foreign investors (South Korea, China, Japan, Norway and Canada) have a low share in GDP in missing foreign assets/wealth.

4.3 Official statistics and third-party holdings

Addressing the missing assets from third-party holdings in official statistics requires more than using the typical statistical data collection instruments at the disposal of country's statistical authorities. An enhanced CPIS report could be promising in improving transparency regarding cross-border security holdings. However, to fully unlock the potential of this valuable dataset, it is essential that regulatory and statistical measures promote comprehensive and detailed reporting of third-party holdings to the CPIS.

Without this statistical disaggregated dissemination of indirect holdings obtained from all foreign custodians a significant portion of countries' external assets will remain missing in official statistics. Implementing a mandate for global custodians to provide detailed third-party holdings would greatly contribute to reconciling global discrepancies with greater accuracy. It is crucial that global statistical compilation guides continue to evolve and require the inclusion of this custody-level data. A country granular third-party reporting, notably for households and NFCs, within the CPIS framework would be a vital step towards advancing our understanding of global investment portfolio investment.

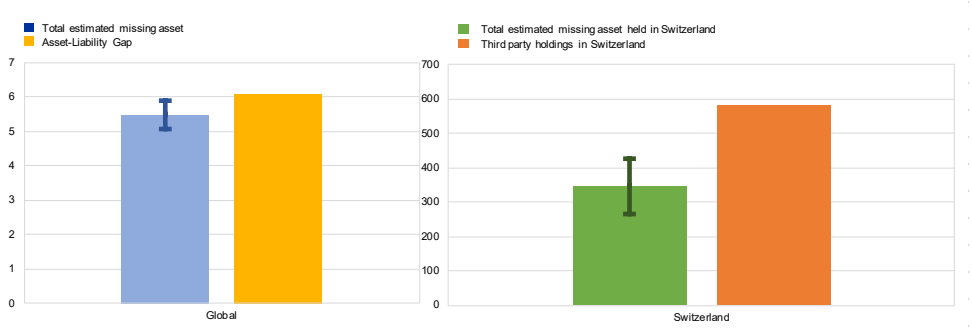
5 Robustness checks

To further benchmark our estimates of missing assets we compare the results for the total missing assets of all countries in the world to the global assets-liabilities gap as (presented in Figure 1). Notably, this comparison hinges on the assumption that the global discrepancy is mainly due to equity (and less driven by reserve assets and debt securities). Moreover, one has to consider that there are other sources that can potentially create discrepancies. Our main assumption underlying our estimates is that household and NFC missing assets are the main factor.

The results show that for end-2021 our estimates come quite close to the global-assets-liabilities gap (see Chart 3, left-hand-side panel). While the global assets-liabilities gap amounted to $6.1 tn, our mid-point estimate of missing assets reaches $5.5 tn. This is re-assuring for our methodological approach, as our global estimates do not take into account the global assets-liabilities gap itself but are based on the estimated link between deposits and securities held in custody.

Chart 3. Estimated missing equity securities, the global asset-liability gap and Swiss third-party holdings, 2021

USD trillion (lhs); USD billion (rhs)



Notes: Estimates of missing assets are obtained following equations (2) and (3) and shown with a 68% confidence band.

Secondly, we compare an estimate of the missing assets held in Switzerland, based on our methodology, with the data available on foreign equity securities held in custody by foreign private investors (i.e. households and NFCs) in banks in Switzerland.[9] Our results show that for end-2021 we estimate missing equity assets held in Switzerland which account for around 60% - if our mid-point estimate is considered – of the assets held in custody in Swiss banks as reported by the SNB (Figure 2, right-hand-side panel). As for globally missing assets, we take this result as supportive of our methodology, noting that we base our methodology in the residency approach. The fact that our estimates are somewhat lower than what is reported in SNB data, may be due to a larger ratio – between securities held in custody in Switzerland and deposits – for Switzerland than is observed in other countries.

6 Conclusion

This paper contributes to our comprehension of the global assets-liabilities gap in external statistics by estimating the extent of unreported third-party securities holdings in official data. We used reliable data on custody arrangements from financial centers in the euro area and implemented a dynamic flow-based model approach to cover globally missing asset. This method offers valuable insights that further refine the previous level-based model analyses.

Our estimates show that approximately $4.9 trillion (about 8% of total assets or 5.6% of world GDP) of portfolio equity and investment fund share securities held through third parties abroad are missing from official statistics as of the end-2021. This significant amount accounts for a significant portion of the $6.1 trillion of the global assets-liabilities gap and is primarily concentrated in a small number of major economies. The underestimation varies across countries but is particularly

[9] To calculate missing assets held in Switzerland, we perform the procedure described in equations (2) and (3) in section 4.2. but use bilateral cross-border deposits of all countries held in banks in Switzerland.

pronounced in key investment hubs like the Cayman Island, Luxembourg, Ireland, the Netherlands, Switzerland, Singapore, Belgium, Hong Kong, and the United Kingdom.

While this research makes progress in understanding discrepancies in cross-border portfolio positions, certain limitations persist. Data constraints hindered us from fully leveraging the potential of our methodological framework beyond the euro area. Greater granularity regarding custodial arrangements worldwide would enhance our understanding of the distribution of household and NFC wealth among advanced and emerging market economies.

Looking ahead, efforts to enhance transparency in reporting institutional investors' cross-border security holdings, as facilitated by ongoing enhancements to the IMF CPIS, are encouraging. But it would be ideal that regulatory and statistical initiatives would promote a comprehensive and granular reporting of third-party holdings to the CPIS, as this information would provide valuable insights and would complete countries' actual external assets and liabilities.

In conclusion, this study improves our understanding of the assets-liabilities gap in global portfolio investment positions. By quantifying a statistically significant portion of missing assets it contributes to economic and financial surveillance analyses. Ongoing methodological refinements coupled with expanding datasets will further enhance our ability to accurately account for international portfolio investment, which are crucial for policy assessment.

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Where are the missing securities in external statistics?

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2nd External Statistics Conference
Bank of Spain
12 February 2024

The views expressed in this paper are those of the authors and do not necessarily reflect those of the ECB, the Eurosystem, or the World Bank.

Introduction

- **Statistical Puzzle**: globally, external assets are smaller than external liabilities Figure
- Why?
  - difficult to capture in official statistics securities held via foreign custodians
  - hidden assets due to intentional actions to hide savings offshore and/or evade taxes
- What do we know?
  - HHs and NFCs hold securites in custody abroad (Zucman 13, Gervais/BuiQuang 19)
  - investment fund shares (IVFs) drive the global discrepancy in portfolio investment (Milesi-Ferretti 23, Beck et al. 23)
- **Research Question**: can securities held in custody abroad be considered the missing link to close the asset-liability gap in portfolio investment?
- **Our contribution**:
  - estimate a dynamic link between third-party holdings of investment fund shares and foreign-held deposits of HHs and NFCs
  - recover the missing securities using flow-focused approach

Hypothesis 1

- **Hypothesis 1**: *Cross-border deposits (in/outflows) in country **i** are (negatively) correlated with the global assets-liabilities gap vis-à-vis country **i**.*
- **Data**:
  - International Investment Position of the Euro Area
  - Coordinated Portfolio Investment Survey
  - Locational Business Statistics: bilateral cross-border deposits of HHs and NFCs
- Results:

Table: Correlation between asset-liability gap and flows of deposits

	Ireland	Luxembourg
Contemporaneous	-0.358	-0.259
One period lag	-0.511	-0.481

Hypothesis 2

- **Hypothesis 2**: *Cross-border deposits (in/outflows) held in country **i** by country **j** are (negatively) correlated with the "third-party" holdings of securities held in country **i** by country **j**.*
- **Data**:
  - Locational Business Statistics: bilateral cross-border deposits of HHs and NFCs
  - Third-party holdings of a private sector
- Run:

$$\Delta TPH_{ij,t} = \alpha + \beta_1 \Delta Deposits_{ij,t} + \beta_2 \Delta Deposits_{ij,t-1} + \varepsilon_{ij,t} \quad (1)$$

  - $\Delta TPH_{ij,t}$ - transactions in TPF by holders from ***j*** of issuances in ***i*** in ***t***
  - $\Delta Deposits_{ij,t}$ - deposits growth of HHs and NFCs from ***j*** in banks in ***i*** in ***t***
- We expect $\beta_2 < 0$

Hypothesis 2

- Aggregate results are:

	ΔTPH_t: all issuances, held by...		ΔTPH_t: IE+LU issuances, held by...	
	all countries	non-EA countries	all countries	non-EA countries
$\Delta Deposits_t$	0.58	1.30	0.54	1.30
	(1.84)	(3.46)	(1.90)	(3.60)
$\Delta Deposits_{t-1}$	-2.54*	-4.84**	-2.49*	-4.85**
	(1.36)	(1.14)	(1.34)	(1.07)
Holder FE	yes	yes	yes	yes
Period FE	yes	yes	yes	yes
Cluster S.E.	Holder + Quarter	Holder + Quarter	Holder + Quarter	Holder + Quarter
Observations	5372	4862	5372	4862
R2	0.05	0.05	0.09	0.10

Note: Results from regression model (1). LHS: aggregate quarterly transactions in TPH of (i) all available countries, or (ii) non-euro area countries. RHS: quarterly changes in aggregate cross-border deposits of households and NFCs of the holding countries. Holder and period fixed effects are included. Standard errors are clustered by holder and quarter.

- Correlation with lagged deposits is -2.5 with 68% confidence bands $(-3.8, -1.2)$.

Constructing Adjusted CPIS Position

- **Step 1**: set a starting value in 2018q4

$$\widehat{MA}_{j,0} = \hat{\gamma} \cdot Deposits_{j,0}$$

  $\hat{\gamma} = 2.8$ (ratio of portfolio assets to other investment liabilities in IIP of Euro Area)

- **Step 2**: construct a series of missing assets up to 2021q4:

$$\widehat{MA}_{j,t} = \widehat{MA}_{j,0} = \sum_{\tau=0}^{t-1} \hat{\beta}_2 \Delta Deposits_{j,\tau}$$

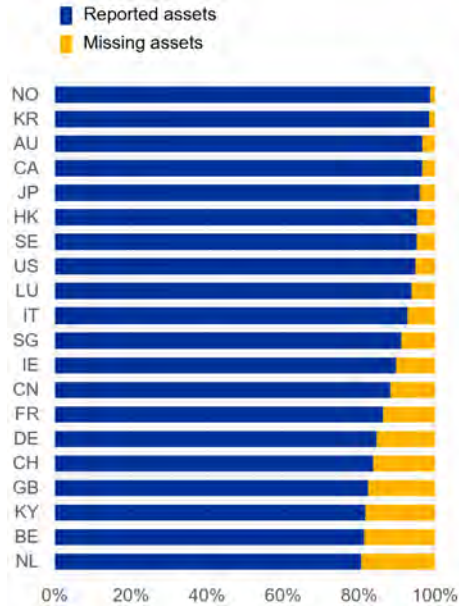
- **Step 3**: adjust CPIS position for 2021q4:

$$\widehat{CPIS}_{j,t} = CPIS_{j,t} + \widehat{MA}_{j,t}$$

- Bounds for estimates: 68% confidence bands $(\beta_2 - \sigma, \beta_2 + \sigma) = (-3.8, -1.2)$
- Bilateral estimates: the same procedure as for aggregate

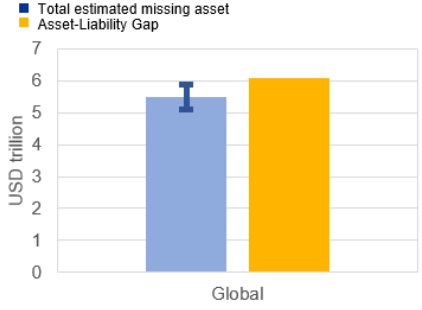
Estimates of Missing Assets

Country	Assets			Missing assets as % of	
	Reported	Missing	Adjusted	Adjusted	GDP
United States	12061	662	12724	5.2	2.8
Luxembourg	3473	227	3700	6.1	264.6
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Sum of top 20	**40290**	**3872**	**44162**	**8.8**	**5.6**
Total CPIS	**45229**	**4885**	**50115**	**9.7**	**5.5**



Robustness

- Global:
  - Global discrepancy in 2021 is $6.1 tn
  - Our estimate is $5.5 tn [5.1,5.9] $\sim$ 90%
- Switzerland:
  - Reported amount of foreign securities in custody is $582 bn
  - Our estimate is $347 bn [266,428] $\sim$ 60%





Conclusions

- Our paper contributes to understanding the causes of global assets-liabilities gap
- We estimate holdings of missing assets due to unreported foreign custody securities in official data
- We find global missing assets of around 5.5% of global GDP, with a key role of investment hubs countries
- Missing assets account for around 15-20% of aggregate holdings in the countries with the largest share of unaccounted securities.

A way forward for global statistics on portfolio holdings?

- Statistical recording of residents' HH and NFC assets held via foreign custodians is challenging due to difficulty of obtaining direct reporting
- Possible solution is global sharing of data on third-party holdings (TPH) collected from resident custodians
  - Resident custodians to provide statistical compilers with granular information on holdings by foreign residents
  - Statistical compilers to publish aggregated data on these third-party holdings by holder country, sector, counterpart country and assets classes
- Within ESCB, granular TPH information is available (SHS), covering only euro area custodians
  - Enhancing IMF CPIS data collection to country-by-country information on TPH to cover custodial holdings at global level

Appendix

Global asset-liability discrepancy

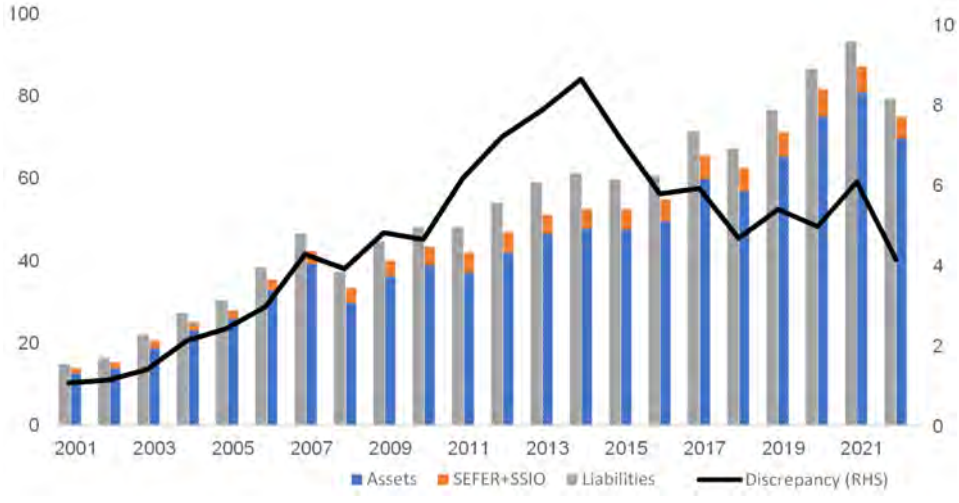


Figure: Global asset-liability discrepancy in international security holdings, $ trillion

Back

IFC-ECB-Bank of Spain Conference: "External statistics in a fragmented and uncertain world"

12-13 February 2024

EMIR data to compile external statistics[1]

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[1] This contribution was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the European Central Bank, the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

EMIR Data for external statistics

An analysis of the Austrian financial derivatives market using experimental data derived from EMIR

Kujtim Avdiu[1], Eva Ubl[2] and Stephan Unger[3]

Abstract

After the economic and financial crisis in 2008, it was identified that good and granular data on financial derivatives (especially OTC-derivatives) was needed for a better understanding of economic linkages and contagion risks. In the aftermath of the crisis the European Market Infrastructure Regulation (EMIR) was established and very granular data for financial derivatives are now available. Primarily, these data are collected for financial stability issues, but the experimental data derived from it could be used for other purposes e.g. statistical purposes in concrete external statistics. Especially for Austria a small and open economy, most derivatives contracts are concluded with foreign countries, therefore data of financial derivatives are of high interest for Balance of Payment compiler. In 2022, as the war in Ukraine began and energy prices rose, financial derivatives gained renewed importance, and data from all sectors of the economy, not only banks but also non-financial companies, were urgently needed.

The big advantage of EMIR data is, that it is granular data and therefore contains a lot of information that is lost in aggregated data reports. It is almost a complete survey without any thresholds and if the aggregation for the compilation of macroeconomic statistics is successful, a direct macro-micro linkage is available. The disadvantage of EMIR data is, that they are not collected for statistical purposes, the data are relatively unstructured, and the quality controls are different from those of a direct national collection for statistical purpose.

In this paper, we will first briefly describe the EMIR data source and then highlight its potential usefulness for the compilation of the financial account. We will provide a first analysis of the experimental data set of financial derivatives stocks for Austria derived from EMIR.

Keywords: financial account, financial derivatives, EMIR Data

JEL classification: C55, F40, G15

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1. Introduction

The role of financial derivatives in the 2008 financial and economic crisis is undisputed; they were the key factor in the rapid contagion effects within the financial sector. One of the most important lessons from the crisis was that the risk of the system might be much higher as the sum of individual agent's risk: As the case in 2007 the contagion risk through derivatives was underestimated for the financial sector as a whole. Furthermore, the financial derivative market was unregulated, and few information was available for OTC traded derivatives.

Therefore, in the aftermath of the crisis increased attention was paid in regulation and data availability of financial derivatives. It became apparent that derivatives are important in many contexts: for the analysis of economic and financial markets, for monetary policy, for financial stability analysis as well as for prudential and macroprudential supervision and regulation. In order to cover all these issues reliable and complete data of financial derivatives are crucial.

Already in 2009 at the G20 summit in Pittsburgh it was decided that standardized OTC derivatives shall be centrally cleared, and OTC derivatives reported to the trade repositories.

In 2012 this G20 decision was implemented in the EU with the adoption of the European market infrastructure regulation (EMIR) which refers to the regulation on OTC derivatives, central counterparties and trade repositories. The aim of this regulation is to improve the stability and transparency of the financial system in the European Union. EMIR was introduced to reduce the risks associated with over the counter (OTC) derivatives and to increase transparency in the financial markets. One of the main requirements of EMIR is the reporting of derivatives transactions to a trade repository. This register collects and stores information on derivatives transactions to provide regulators with a better overview of the derivatives market. The report includes information such as the type and nature of the derivative, the value and notional, the maturity date, margin, and the counterparties involved.

The collected data provide the supervisory authorities with a comprehensive overview of the derivatives market in order to identify, monitor and control risks. By reporting derivatives transactions, the supervisory authorities may identify potential risks at an early stage and take appropriate measures to ensure the stability of the financial system. EMIR also aims at promoting the use of central counterparties (CCPs) to reduce the risk of derivatives transactions. CCPs act as intermediaries between trading parties and assume the risk of a transaction if one party becomes insolvent. The introduction of EMIR and the associated reporting obligations have increased transparency in the derivatives markets, leading to a better understanding of the risks and improved monitoring.

A new step in regulation was that, in addition to financial counterparties, non-financial counterparties are also affected by the reporting obligation under EMIR. Even though the introduction of EMIR Reporting primarily serves the purpose of monitoring derivative transactions it represents much more than a mere regulatory requirement. The data collected through EMIR on micro data base might be used also to compile macroeconomic statistics.

In Balance of Payments and Financial Accounts all financial transaction and non-transactions- related changes have to be compiled with splits regarding country, counterpart sector and type of transaction. A good coverage of derivative data is necessary for the complete presentation within the macroeconomic statistics.

The EMIR data source on micro-data level may significantly contribute to the improvement of the representation of financial derivatives in macroeconomic statistics. A direct macro to micro link can be established.

A restriction is that the data is not collected for statistical purpose and therefore it is a challenge to derive the required data, especially for transactions, which we are still working on. In addition, EMIR data can be classified as big data, which means that structuring and cleansing the data requires a relatively large amount of effort. The main critical issue is the data quality; the data do not pass through the standard data checks as implemented for reported data for external statistic purpose and especially queries to the reporting companies are not integrated in the quality process.

Thus, EMIR reporting appears not only as a regulatory obligation but as a comprehensive instrument that promotes transparency, improves the quality of data on financial derivatives, and could make a significant contribution to the compilation of macroeconomic statistics such as balance of payments.

In this paper we introduce the EMIR data source, we show how experimental data for balance of payment and financial account might be derived, we present and describe the data for Austria, and give an outlook for further potential use especially in evaluating the risk of the exposure.

2. Financial derivatives in macroeconomic statistics

Financial derivatives play an important role in all macroeconomic statistics such as in the quarterly financial accounts (QFA), the balance of payment (BoP), the international investment position (IIP) and the Banking Balance Sheet Item (BSI) and other monetary statistics. For a complete presentation stocks, transactions, price effects, currency effects and other changes of financial derivatives are needed. Furthermore, information about counterpart country and counterpart sector is required. The statistic definition of financial derivatives within external statistics is set in the IMF's Balance of Payment and International Investment Position Manual 6 (BPM6) in paragraph 5.8:

"A financial *derivative contract is a financial instrument that is linked to another specific financial instrument or indicator or commodity and through which specific financial risks (such as interest rate risk, foreign exchange risk, equity and commodity price risks, credit risk, and so on) can be traded in their own right in financial markets. Transactions and positions in financial derivatives are treated separately from the values of any underlying items to which they are linked*." The definition in the European System of Accounts 2010 (ESA 2010) paragraph 5.199 is consistent with the definition in the BPM6.

Thus, under financial derivatives very different form of contracts such as option, forwards, futures, swaps with different properties and different contractual arrangements are summarized.

3. Literature

In the following section we situate this article in the context of the recent literature. In ESMA 2023 provides a comprehensive overview of the European derivatives market. While they present a very detailed statistical overview of the development of the derivatives sector in the European Union, this article focuses on the identification of Austrian derivatives exposure with its counterparties as well as the measurement of the riskiness of these exposures. The contribution of this article is the application of a unique data set in terms of size and importance to the descriptive statistics of a financial network as well as identification of leverage risks associated with certain exposures. %, which could undermine the stability of the financial system.

Moreover, since this data is not utilized yet due to its recent introduction and limited access to the financial world, we show the potential by highlighting some important use cases. Pelkmans and Simoncini (2014) stressed already the importance of the ESMA data since it has the potential to end a remaining fragmentation of the single European financial market and to ensure a proper functioning of this market. Also, Tridimas (2012) analyzed the introduction of the ESMA framework. He focused on the powers and the accountability mechanisms of ESMA and examined its quasi-regulatory, decision-making and administrative powers and assesses and its likely impact on financial supervision in the EU.

In more recent studies, such as by Vuarlot-Dignac and Siracusa (2019), it is discussed how the introduction of the EMIR fills the gap of divergences in data collection for establishing a common supervisory culture across Europe. Payne (2017) and Berg (2015) stress the necessity of common institutional design of the EU economic and monetary union and the need of financial supervision and financial stability as a response to the financial crisis and the sovereign debt crisis.

In our study we show concrete applications of the unified data collection standard and the potential of data extraction for measuring derivatives exposure risk to bolster financial stability and to improve financial supervision on a cross-country level.

Flotynski (2015) provides a case study analysis by analyzing the impact of EMIR on the financial stability by looking at the derivative market crises in Poland and Brazil. He stresses the potential of regulations such as EMIR in preventing firms from huge losses on options settlement or alerting them from signing contracts for toxic derivatives. Pennesi (2021) discusses potential EU regulatory mechanisms to manage cross-border trade in financial services with third countries, as he argues that safeguards are ineffective in protecting the internal market from external risk. We show that by proper utilization of the EMIR data base, internal market structure can be reinforced to a degree to withstand greater external risk.

Hsiao (2018) puts EMIR into the context of tackling the shadow banking system through an enhanced market transparency and regulation of over-the-counter (OTC) derivatives. His analysis focuses on the reporting obligation to the trade repository and the clearance obligation of designated OTC derivatives through the central counterparty. He argues that while these two obligations can functionally transform shadow banking into a resilient market-based finance, the regulatory framework also creates an exchange platform that transforms the OTC derivative contracts into

fungible securities. Balmer (2018) analyzes the post-crisis derivatives regulation reform by comparing the EU regulation in EMIR with that of Dodd-Frank in the United States and discusses the lack of an existing recovery and resolution framework. Another comparative analysis is done by Grossule (2020) who weighs risks and benefits of the increasing role of ESMA.

While most existing literature discusses mainly the framework and impact of EMIR, this article deals with the actual utilization and application of the data in derivative risk exposure identification.

In the field of application EMIR data to macroeconomic statistics the following two articles should be mentioned Boneva et alii (2019) and Keith Lai (2019). In Boneva et alii (2019) the authors give use cases for the data in the field of central banking and analysed in detail how to identify counterparty sector within EMIR. In Keith Lai (2019). a paper of the UK office for National Statistics the author did a comprehensive study of comparing the different UK data reports of financial derivatives with EMIR data and achieves similar results in the sense that EMIR data should be used additional to other data sources.

Our research aims at exploring the potential use of EMIR data as a source of a wide range of macroeconomic statistics, including balance of payments, financial accounts, and monetary statistics. In order to achieve this objective, we conduct an analysis to determine which EMIR reports are most suitable for this purpose. Subsequently, we extract the stocks and notionals of the financial derivatives from the EMIR data, including other important statistical information's. Additionally, we incorporate exchange rate adjustments and confidentiality checks to ensure the accuracy and reliability of the derived statistics.

This newly generated data set serves as a basis to perform descriptive statistics about country, sector, contract type, and asset class, as well as to perform corresponding risk assessment through calculation of derivative leverage risk.

4. EMIR reporting and data extraction

The EMIR data set contains the complete description of a derivative security which is necessary for identification. The conversion of EMIR Data into macroeconomic statistical data can be done through selection of the corresponding sections and extraction of the subset of interest. The Oesterreichische Nationalbank is currently working on achieving experimental data for financial derivatives in BoP and QFA based on EMIR data.

This study delves into the December 2022 reporting period, focusing on the macroeconomic statistics landscape. The analysis leverages data derived from all valid and non-terminated contracts reported within the EMIR framework with relevance to Austria (involving at least one Austrian counterparty), spanning the timeframe from January 1, 2021, to December 31, 2022. The comprehensive examination of this dataset forms the basis for our insights and conclusions.

4.1 Trade Activity Reports vs Trade State Reports

The EMIR data includes two types of reports, namely the Trade Activity Reports (TAR) and the Trade State Reports (TSR). The Activity reports contain detailed information on various contracts in the derivatives market and provide comprehensive information on specific trades, individual transactions, and other valuable information. They provide information about the counterparties, contracts, and trade specifications. In contrast, the State reports produced by trade repositories (TRs) summarize the daily intraday reports in a final version. They only contain the last action type, if reported on that day, and do not include all open contracts. The Activity reports contain the complete data of all derivative transactions, while the State reports reflect only the latest status of derivative contracts.

To determine which of the two reports is more suitable for statistical purposes, we calculate the stock of financial derivatives from the perspective of macroeconomic statistics (see chapter 4.3), such as balance of payments, financial accounts, and monetary statistics, from these two reports and compare it with the MFI financial derivatives data collected by the Oesterreichische Nationalbank (OeNB) as part of the balance of payments and monetary statistics. Contracts of the same type, asset class, and underlying can be compressed by market participants and central clearing counterparties at any time, significantly altering the ratio between assets and liabilities, hence we use the net stock of financial derivatives (assets - liabilities) for this comparison. For this purpose, we calculate the Root Mean Squared Error (RMSE) for all reported MFIs and all Austrian counterpart countries as follows:

$$RMSE_{Activity,State} = \frac{1}{n}\sqrt{\sum_{m \in MFI}\sum_{c \in Country}\left(S_{m,c}(BoP) - S_{m,c}\left(EMIR_{Activity,State}\right)\right)^2}$$

where *n* is the number of countries multiplied by the number of MFIs, and $S_{m,c}$ is the net stock of financial derivatives (balance of payments or calculated from EMIR data) for the corresponding MFI, *m* and country, *c*.

Our results indicate that the *RMSE* for the trade activity data is EUR 16.7 mln., which is significantly lower than the *RMSE* for the trade state data (EUR 52.3 mln). Therefore, we utilize in this study the data from the trade activity reports.

4.2 Time interval of the used historical data

Depending on the reporting type (EMIR action type), the Emir reports are sometimes missing information which is required for the collection of various macroeconomic statistics. This missing information can comprise data on the counterparties such as LEI, country, sector, as well as on traded contracts such as contract value, notional, strike price, multiplier, quantity, contract type, asset class, currencies, and position (long or short). To improve the accuracy of the results we rely on a more comprehensive historical time series of EMIR data. Given the large volume of EMIR data, we aim to establish a historical timeframe that allows for efficient data processing and significant results.

Our statistical analyses show that a historical time frame of 6 months, comprising the contract value and notional amount, is sufficient to obtain significant results. For all other relevant information, we use a time series of EMIR data over a period of 2 years. This extended time perspective ensures that the chosen data time frame for our macroeconomic analyses is sufficient and reliable.

4.3 Calculation of stocks and notional value from EMIR Data

To determine the stocks of financial derivatives from the EMIR data, we take the last reported contract value for all valid and unexpired contracts. If both counterparties report on the same day, the Austrian reporters have priority.

If no reported contract value is available for a contract within this 6-month period, we calculate the price of this contract using Monte Carlo simulations based on the fair value principle and the assumption of risk neutrality. This calculation assumes that all required data, such as underlying asset time series, risk-free interest rate, strike price, and maturity, are accessible. We proceed as follows:

First, we simulate the price of the underlying asset at a point in time *t* for interest rate contracts using a Cox-Ingersoll-Ross model (CIR).

$$S_t = E_t^* \left[exp\left(- \int_t^{t+T} r_u du \right) \right]$$

with interest rate *r*

$$dr_t = \alpha(\mu - r_t)dt + \sigma\sqrt{r_t}\, dW_t, \alpha, \mu, \sigma > 0, r \geq 0$$

where W_t is a standard Brownian motion at time *t*, α is the speed of adjustment, μ is the long-term average rate (the mean-reverting level) and $\sigma\sqrt{r_t}$ is the implied volatility at time *t*, *T* is the maturity of the contract and E_t^* denotes expectation under the risk-neutral probability measure at time *t*.

Next, we simulate the price of the underlying at time *t* for other contracts with other asset classes, such as indices or commodities, using a Geometric Brownian Motion.

$$\frac{dS_t}{S_t} = \mu dt + \sqrt{\sigma} dW_t$$

Where σ is the volatility of the underlying and μ is the average inflation rate of the seller's country over the last 5 years for commodity contracts and the risk-free interest rate of the currency in which the contract is quoted for other contracts.

Avdiu and Unger (2014) showed that the long-term risk-neutral measure of commodities, especially fuels can be replaced by the inflation rate since option valuation reflects more accurate expected price developments than when using interest rates.

Finally, we obtain the share price at time *t* with maturity T from the discounted expected value of the payoff:

$$Unconditional\ contracts: Stock(t) = E[S_T - K] * e^{-r_t*(T-t)}$$

$$Call\ options: Stock(t) = E[max(S_T - K)] * e^{-r_t*(T-t)}$$

$$Put\ options: Stock(t) = E[max(K - S_T)] * e^{-r_t*(T-t)}$$

where E is the risk-neutral expected value, K denotes the strike price of the contract, and S_T the price of the underlying at maturity T.

To avoid negative stocks, we categorize all contracts with a positive contract value from the perspective of the Austrian counterparties as assets, while all contracts with a negative contract value are classified as liabilities. This classification method clearly distinguishes the breakdown of financial derivatives from other functional categories of the balance of payments.

To derive the notional values from the EMIR data we take the last reported notional value for all valid and unexpired contracts, where Austrian reporters are prioritized. For unspecified notional values we multiply the strike price, the multiplier and the quantity of the contract.

4.4 Incorporation of additional data relevant for macroeconomic statistics

All additional relevant contract information such as counterparty, country, sector, buyer, seller, contract type, asset class, underlying, currencies, price, strike, multiplier, quantity, etc. is retrieved systematically from the OeNB's comprehensive EMIR and master database and stored separately. This data is then combined with contract values and nominal values for each contract and subjected to the necessary adjustments.

4.5 Exchange rate adjustment

All contract and notional values which are not denominated in EUR are converted with the exchange rates as of December 31, 2022, taken from the OENB's database. We observed that interest rate contracts in different currencies and currency contracts were partially incorrectly reported. This caused obvious outliers which we detected with an ARIMA outlier test.

4.6 Confidentiality

EMIR and other statistical regulations explicitly require strict confidentiality for EMIR data. To comply with these regulations, we conduct a thorough review of all data based on two main criteria: Firstly, evaluating the dominance of each specific aggregate and secondly, evaluating the number of counterparties involved in the aggregate's composition. We define a counterparty as dominant if the total value of the aggregate stock composition, reported by this counterparty, exceeds 85\%. The number of counterparties to be evaluated has to be at least three. If these two criteria are satisfied, we classify the aggregate as free, otherwise as confidential.

4.7 Summary statistics

In this study, we utilized around 190 million reports from EMIR data. As of December 31, 2022, a total of 2.469 Austrian counterparties were involved in financial derivative transactions with 3,658 foreign counterparts across 54 countries. Together, they held 13,809 open financial derivatives contracts, spanning 63 different currencies.

Out of the 13,809 open contracts, roughly 5% of the contract value were determined through the application of a financial mathematical model, while around 2% of the notional value were calculated using multiplication. For approximately 8% of the contracts, we couldn't ascertain the contract value, and for about 4% of the contracts we couldn't obtain a notional value.

The assets on financial derivatives held by Austrian market participants in relation to other countries, as determined from the EMIR data, reached at the end of 2022 a total of EUR 41.7 bln, while their corresponding liabilities amounted to EUR 42.5 bln. By the end of 2022, Austrian market participants themselves had a cumulative total of EUR 8.5 bln in outstanding assets and liabilities in financial derivatives.

Austrian market participants were most significantly engaged in financial derivatives contracts with Germany, holding 1,864 contracts, followed by France and the UK, with 1,015 and 594 open contracts, respectively. Within their domestic network, Austrian market participants collectively held 8,162 contracts. Overall, 209 contracts could not be allocated to a specific country, which accounts for around 0.9% of total volume of assets and 0.5% of total volume of liabilities.

At the end of 2022, Austrian market participants were most actively trading swaps, totaling 3,675 contracts, followed by forwards at 3,483, and options at 2,065. The primary asset classes in their trades with financial derivatives were currencies, accounting for 5,637 open contracts, and interest rates with 4,574 contracts. We couldn't determine the specific contract type for 3,067 contracts, which constitutes approximately 17% of the total volume of the portfolio. Similarly, 2,298 contracts within various asset classes could not be identified, representing around 9% of the total volume of the portfolio.

5. Methodology

We extract relevant data to provide a descriptive statistic about the financial derivatives exposure from the Austrian perspective. This includes the name and information of the counterparts involved in the transaction, ID number, contract type, asset class, value of the contract, notional, and settlement type and date of every derivative security as of December 31, 2022.

To provide a descriptive statistic of Austrian sector exposures with other countries, we compare Austria's Monetary Financial Institutions (MFIs), Non-MFIs, Non-financial corporations, Households and Government derivative exposure with the countries which exhibit the biggest Austrian derivative exposure. We identify seven countries: Germany, France, Netherlands, Great Britain, Ireland, Hungary, and Czech Republic.

In a second step we analyze the riskiness associated with the different derivatives exposures. We utilize the stock and notional data to measure the riskiness of the exposure, caused by volatility in the generated profit and loss data to measure the riskiness of the exposure, caused by volatility in the generated profit and loss.

6. Results

First, we provide an overview of the distribution of each sector's assets and liabilities between Austria and the corresponding country. We start by providing the results for the descriptive statistics on the sectoral derivatives exposure towards each country.

Figure 1

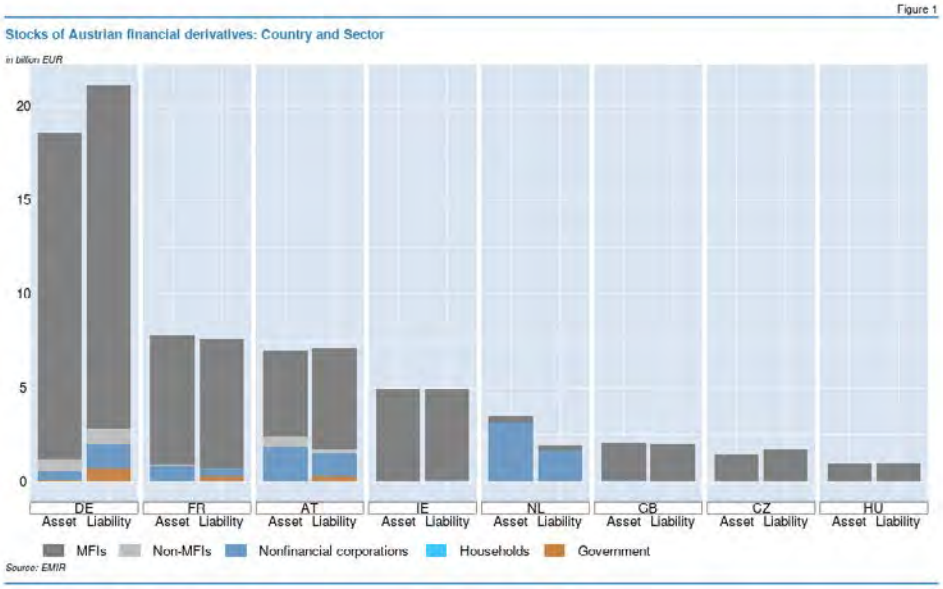
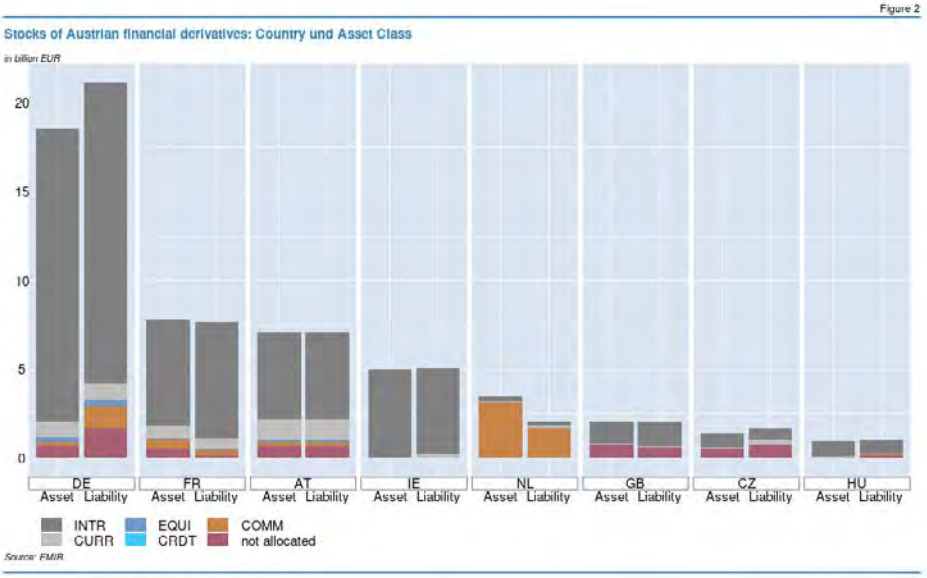


Figure 1 shows that Austria's main derivative exposure is towards Germany, followed by France and Ireland. The balance of stocks between assets and liabilities displays the profit or loss generated across all derivative instruments as of Dec 31, 2022. In case of the Austria's exposure towards Germany we can see that the liabilities exceed the assets while the net stocks with the other counterparts are more balanced. Further, we can see that the main contributor towards the assets and liabilities are for most countries Monetary Financial Institutions (MFI), except the Netherlands where we can see that the predominant exposure is held by non-financial corporations. Thus, banks and other financial institutions exhibit the highest exposure while the exposure of the Government and the Household sector is neglectable.

Figure 2

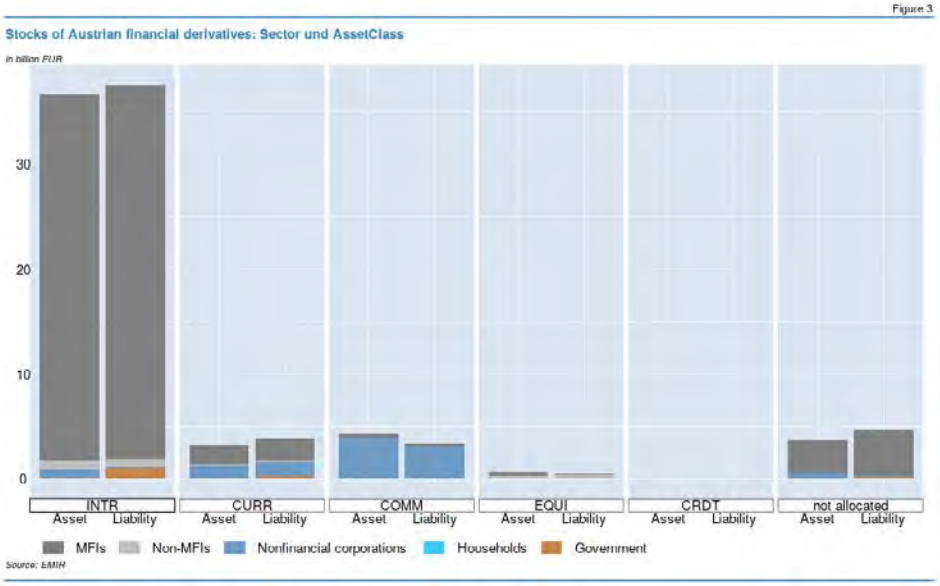


The distribution of financial derivative types across the eight countries is shown in figure 2. We can see that the main types of financial derivatives with an open balance are interest rate derivatives (INTR), followed by currency derivatives (CURR). The main exposure in interest rate derivatives is towards Germany, where the liabilities in size of EUR 22 billion exceed the assets of EUR 18 billion. Thus, it can be concluded that the total MFI liability against Germany stems from the negative balance in interest rate derivatives. The second interesting observation is that the main asset class which is being traded between Austria and Netherlands is commodity (COMM). In general commodity involves derivatives such as electricity, oil, natural gas, precious and non-precious metals, carbon emissions, no reason exotic derivatives, inter energy, grains and oil seeds and soft agricultural products.

In relation to the other countries, commodity derivative assets of size EUR 4 billion exceed the liabilities of EUR 3 billion by most, while all other derivative exposures per asset class are rather balanced.

Taking into account the insights gained from figure 1 we can see in combination with figure 2 that the main exposure of MFIs and Non-MFIs is mostly held in interest rate and currency derivatives, while non-financials hold their exposure mostly in commodity derivatives. Equity derivatives (EQUI) and credit derivatives (CRDT) are of minor importance.

Figure 3



We can see in figure 3 how Austria's global sector exposure is distributed across all the different asset classes. On a global level we can further see that the financial derivatives exposure is still dominated by interest rate derivatives, where the liabilities of EUR 37 billion exceed the assets of EUR 36 billion. These interest rate derivatives positions are mostly held by MFIs. The other notable finding is that the commodity exposure is mostly held by non-financial corporations, such as commodity exploration and trading firms. The exposure of the commodities is of the same size as the currency exposure, where MFIs and Non-financial corporations have slightly higher liabilities than assets.

Figure 4

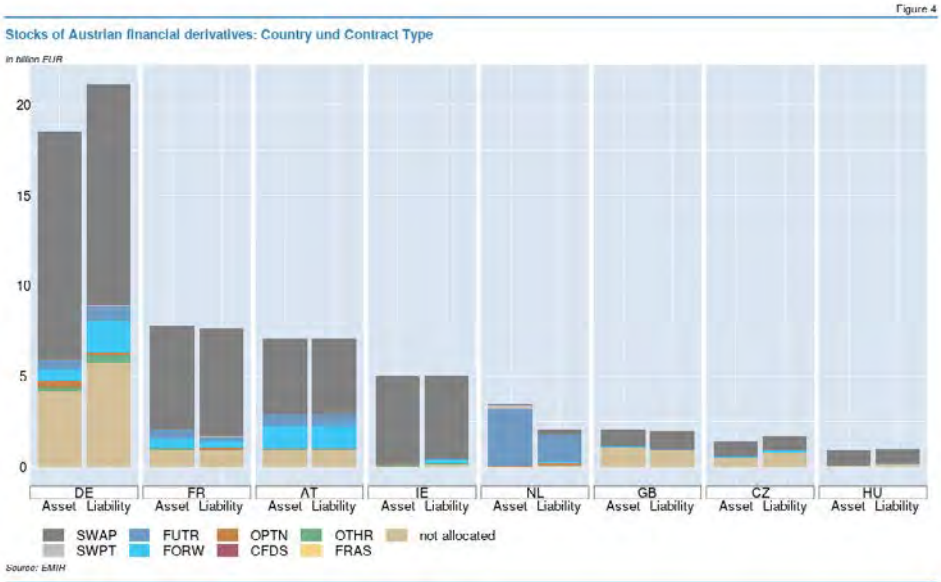


Figure 4 reports the regional breakdown of contract types. Given Germany as the main trading partner, the most traded contract type are swaps (SWAP) (EUR 12 billion EUR in assets vs. EUR 13 billion in liabilities), followed by options (OPTN) (EUR 4 billion in assets vs. EUR 5 billion in liabilities) and forwards (FORW) (EUR 1 billion in assets vs. EUR 3 billion in liabilities). The total assets across all derivative contract types are EUR 17 billion vs. EUR 22 billion in liabilities. Swaps are also the main derivative

contract types traded with France, Ireland, and Hungary. However, the main derivative contract types traded with the Netherlands are Futures. The difference can be explained by the fact that most trading in swaps relates to interest rate derivatives, and trading in commodities is mostly done through futures (FUTR). The remaining contract types as swaptions (SWPT), forward rate agreements (FRAS) and contracts for difference (CFDS) do not substantially contribute to the Austrian exposure.

In combination with figure 1 and 2 we can see that in countries where MFIs and Non-MFIs dominate the market, interest rate and currency swaps are the most traded contract types, while in countries where non-financials dominate the market, commodity futures exhibit the highest derivative exposure.

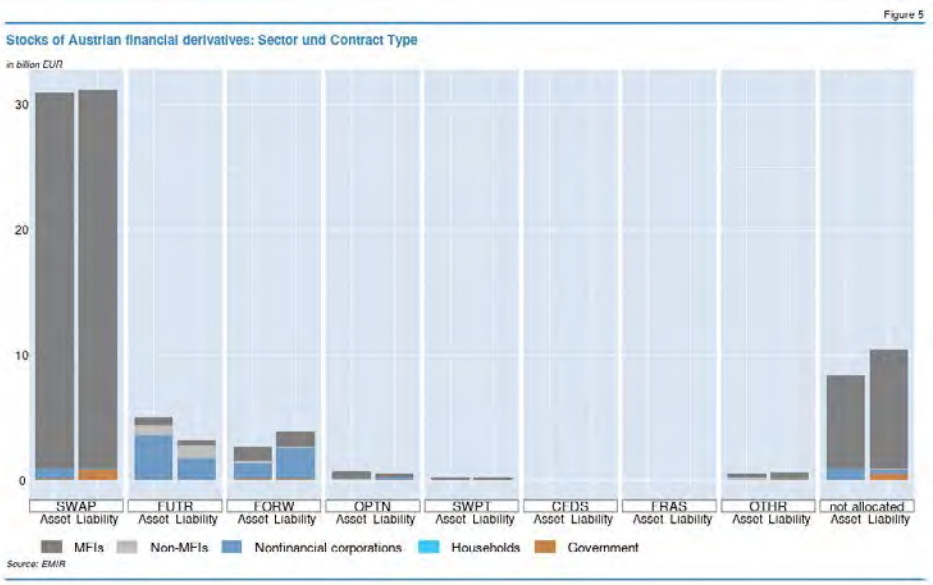


Figure 5 depicts the distribution of which contract types are traded with which sector. We can see that an overwhelming majority of more than EUR 31 billion in assets are held in swaps by Austrian MFIs vs. EUR 32 billion in liabilities. The second largest contract types are futures, which are mainly held by Non-financial corporations (EUR 4 billion in assets vs EUR 2 billion in liabilities), followed by forwards, which are also mainly held by Non-financial corporations (EUR 2 billion in assets vs EUR 3 billion in liabilities). Government don't hold any considerable contract sizes of any derivative type.

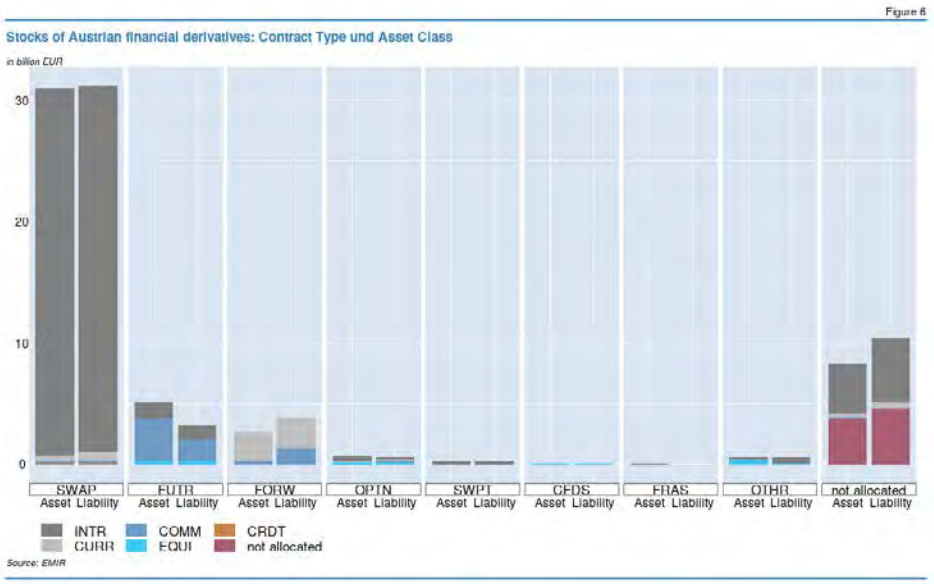


Figure 6 shows the breakdown of asset class according to its contract type. Again, one can see that an overwhelming majority of the derivative exposure is held in interest rate swaps. The assets amount up to EUR 31 billion vs. EUR billion in liabilities. The second most traded assets classes are commodity futures (EUR 3 billion in assets vs EUR 2 billion in liabilities), followed by currency forwards (EUR 2 billion in assets vs EUR 3 billion in liabilities).

7. Risk assessment of derivatives exposure

The previous chapter presented an overview of the major derivatives exposures according to their country, sector, contract type, and asset class. The contract values showed a stand-alone risk in certain areas. Therefore, this section deals with the quantification of this associated risk. For this purpose, we introduce a risk measure which quantifies the derivative exposure as a measure of leverage, measured through the ratio between contract value, CV, and notional, N. Thus, the leverage ratio, LR, of country i, sector j, and asset class k, can be written as

$$LR_{i,j,k} = \frac{CV_{i,j,k}}{N_{i,j,k}}$$

where

$$CV_{i,j,k} = \frac{Asset_{i,j,k} + Liability_{i,j,k}}{2}$$

measures the average profit or loss, and

$$N_{i,j,k} = \frac{Long_{i,j,k} + Short_{i,j,k}}{2}$$

measures the average notional from long and short positions. Thus, the leverage ratio measures the leverage of the average contract value vs. the underlying average notional. The larger this ratio, the riskier the exposure.

We provide next the results of the leverage ratios for each derivatives exposure analysis.

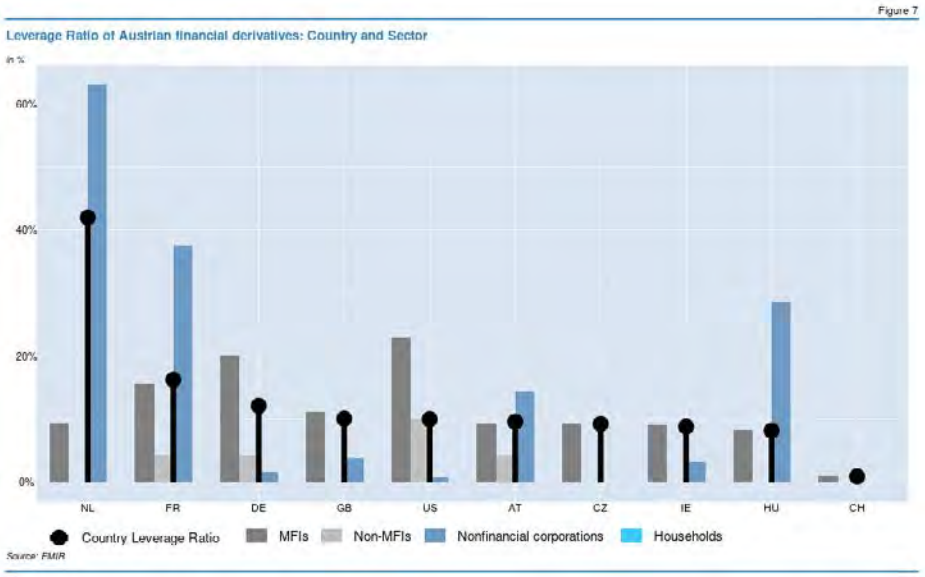


Figure 7 exhibits the leverage ratio of each Austrian sector to each country on an aggregate global basis, including the breakdown into each sector's derivative exposure to each country. We can see the riskiest exposure of non-financial corporations towards the Netherlands, followed by France and Hungary. Austrian MFIs have a moderate risk exposure towards the US, Germany, and France. Government don't exhibit any considerable risk exposure concerning the leverage.

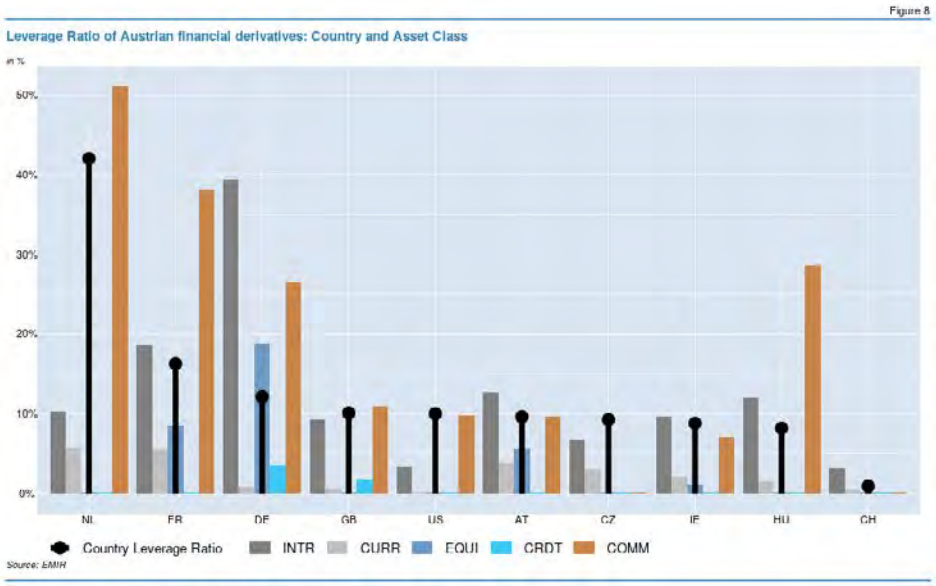


Figure 8 shows the leverage ratio for each country with respect to their asset class. We can see again that the riskiest derivatives exposure is towards the Netherlands with 51%, reflected in commodities, followed by France with 38%, and Hungary with 28%. However, the second riskiest asset class exposure is the interest rate derivative exposure towards Germany with 38%, France with 18% and Hungary with 12%. In general, one can see that commodities bear the highest leverage risk for Austria.

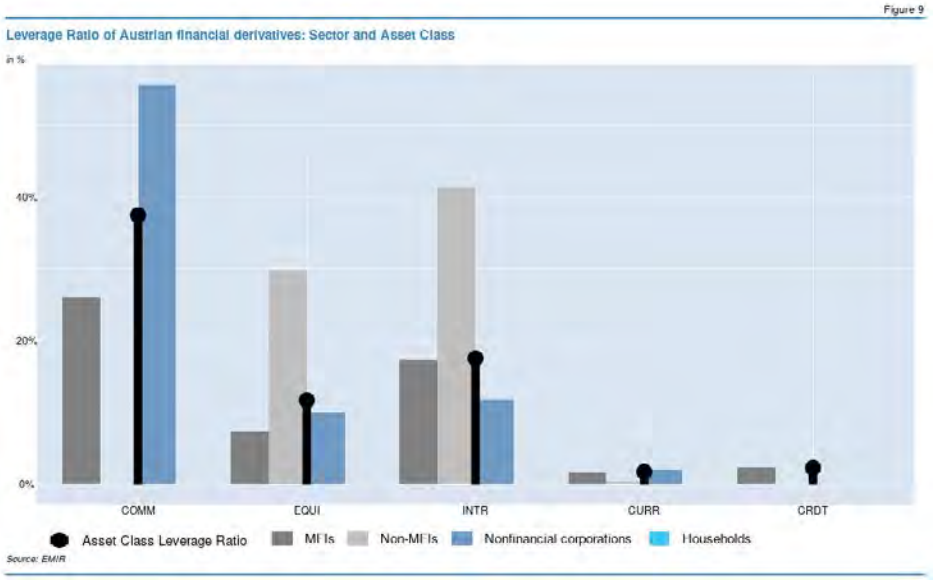


Figure 9 depicts the leverage ratio of all asset classes for all sectors. The highest risk is born by non-financial corporations through commodity exposure with 55%, while the second largest risk is born by non-MFIs which are also very exposed to interest rate exposure. The third largest risk can be found to be borne by non-MFIs in equity derivatives with 30%, followed by MFIs in commodity exposure with 25%.

The riskiness of the leverage ratio in commodities can be explained by an increased volatility due to macroeconomic events such as the war in Ukraine. This caused market risk premiums to skyrocket and hedging costs to increase. The resulting incorporated riskiness was reflected in the deterioration of the leverage ratio in commodities.

The riskiness of interest rate swap exposures can mainly be attributed to the heterogeneous timing of interest rate increases by the Central Banks with Austrian interest rate derivative exposure. Interest rate derivatives suffered higher volatility during this phase, causing the leverage ratio to increase.

7. Conclusion

This article demonstrates that achieving experimental macroeconomic statistical data of financial derivatives from EMIR data is very promising and the resulting macro-micro link enables a variety of analysis.

This article shows the power of the EMIR database and the capabilities for conducting a descriptive statistical analysis of a country-wide, sectoral, and asset type derivative risk analysis. By analyzing the assets and liabilities of each country, MFI, Non-MFI, Non-Financial corporation, Household, and Government it is possible to reveal cluster risk, stand-alone risk, and leverage risk for each type of derivative or asset type. We also calculate the leverage ratio to measure the leverage of each country and sector towards each asset class.

For this purpose, we derive the stocks and nominal values of the financial derivatives from the EMIR data and adjust the exchange rates during this process. We

also check the confidentiality of the data to ensure that this data is adequately protected. In addition, we expand the data set by integrating further relevant information such as country, sector, contract type and asset class. We hereby create a comprehensive data set for our analysis which provides a broad perspective on the relevant financial information.

The main findings are an overwhelming interest rate swap exposure of MFIs towards Germany and a significant commodity future exposure of Non-financial corporations towards the Netherlands. Some heightened MFI interest rate exposure can also be measured towards France and Ireland.

Regarding the associated leverage risk, we find a significant Non-financial corporate leverage risk towards the Netherlands, followed by France and Hungary. The risk is born mainly through commodity and interest rate derivatives.

The results show the importance of financial derivatives database analysis since it enables Central Banks to identify sources of derivatives risk and thus, to intervene and preemptively contain potential spillover effects towards other sectors of the economy.

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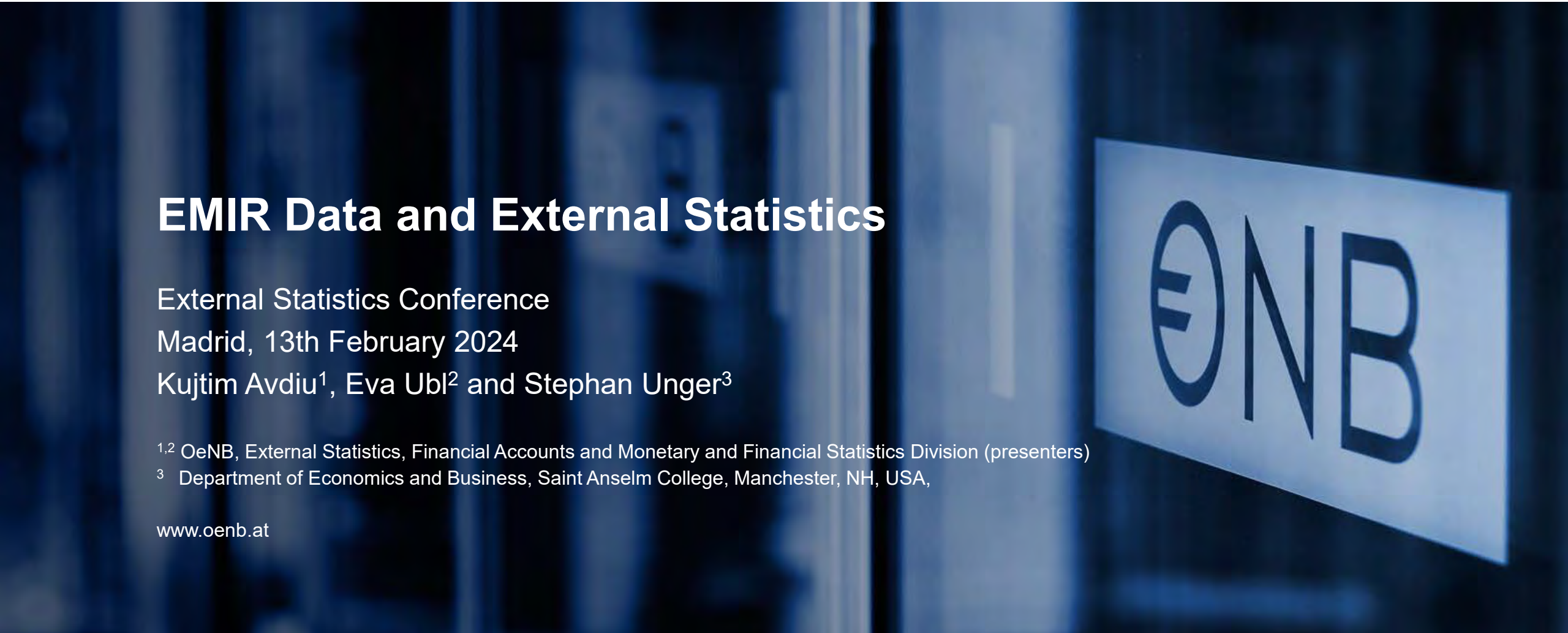
EMIR Data and External Statistics

External Statistics Conference
Madrid, 13th February 2024

Kujtim Avdiu[1], Eva Ubl[2] and Stephan Unger[3]

[1,2] OeNB, External Statistics, Financial Accounts and Monetary and Financial Statistics Division (presenters)
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- Why using EMIR Data?
- How to use EMIR Data?
- Which first results can be derived?

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Why using EMIR Data?



Pros

- Granular Data
- Almost complete
- Data are available

Cons

- Unstructured big data
- Not collected for statistical purpose
- Quality issues

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How to use EMIR Data?

EMIR reporting and data extraction



EMIR Reporting for macroeconomic statistics

Emir is a comprehensive database

- Contains detailed information that is relevant for macroeconomic purposes:
  - Contract and notional value, counterparty information, derivative type
  - and many other important details

Conversion to macroeconomic statistics

- By selecting relevant indicators, EMIR data can be converted into macroeconomic statistics
- An in-depth analysis of the data set provides the basis for our findings

Research of the Oesterreichische Nationalbank

- Development of experimental data for financial derivatives in BoP and QFA based on EMIR data
- Focus: Reporting period December 2022
- Analysis includes all valid reported EMIR contracts with Austrian context (at least one Austrian counterparty) from January 2021 to December 2022.

Trade Activity vs Trade State Reports

Trade Activity Reports (TAR)

- Detailed information on derivative contracts
- Comprehensive data on specific trades and individual transactions

Trade State Reports (TSR)

- Summarizes daily intraday reports from TAR in a final version
- Only includes the last action type reported on that day

Objective

- Deriving the financial derivatives stocks from TAR and TSR
- Comparison with the OeNB's MFI financial derivatives data in BoP and BSI

Comparison Outcome via Root Mean Squared Error (RMSE)

- RMSE for Trade Activity Data: EUR 16.7 million vs. RMSE for Trade State Data: EUR 52.3 million
- Decision to use Trade Activity Reports for the study based on superior accuracy

Data Extraction

Time Interval for Historical Data

- Challenges in missing information in EMIR reports
- Establishment of historical timeframe for efficient data processing
- 6 months for contract value and notional amount, 2 years for other relevant information

Calculation of Stocks and Notional Value

- Methodology for determining stocks of financial derivatives
  - Mainly derived from the reports of the counterparties
  - Preference to more up-to-date reports and Austrian counterparties
  - Use of Monte Carlo simulations for missing contract values
- Derivation of notional values from EMIR data
- Categorization of contracts into assets and liabilities or long and short

Data Extraction

Incorporation of Additional Data for Macroeconomic Statistics

- Derivation of other relevant contract information from EMIR and the OeNB master database
  - Contract type, asset class, strike price, currency, maturity, country, sector, etc.
  - Merging with contract values and notional values
- Necessary adjustments for a comprehensive analysis

Exchange Rate Adjustment and outlier test

- Conversion of non-EUR denominated values using December 31, 2022, exchange rates
- Detection and correction of outliers with ARIMA outlier test

Confidentiality

- Strict confidentiality measures for EMIR data
- Review criteria based on dominance and number of counterparties

Summary statistics

Overview of EMIR Data

- Total Reports Utilized: 190 million
- Participants: 2,469 Austrian counterparties, 3,658 foreign counterparts (54 countries)
- Open Contracts: 13,809 spanning 63 currencies

Contract Value and Notional Value

- Derived mostly directly from the EMIR reports
- 5% of open contracts valued using financial mathematical models
- 2% of notional value calculated using multiplication
- For 8% of the contracts no contract value could be derived
- For around 4% of the contracts, no notional value could be determined

Summary statistics

Assets vs. liabilities from the Austrian perspective

- Assets: EUR 41.7 billion
- Liabilities: EUR 42.5 billion
- Austrian market: EUR 8.5 billion in outstanding assets and liabilities

Geographic Engagement

- Top Engagements: Germany (1,864 contracts), France (1,015 contracts), UK (594 contracts)
- Domestic Network: 8,162 contracts
- Unallocated Contracts: 209 (0.9% of total assets, 0.5% of total liabilities)

Summary statistics

Contract Type and Asset Class Distribution

- Most Traded Contracts: Swaps (3,675), Forwards (3,483), Options (2,065)
- Primary Asset Classes: Currencies (5,637 contracts), Interest Rates (4,574 contracts)
- Unidentified Contract Types: 3,067 contracts (17% of total portfolio)
- Unidentified Asset Classes: 2,298 contracts (9% of total portfolio)

Summary and Key Takeaways

- EMIR data are distinguished by their exceptional level of detail and richness in information
- Despite their complexity and potential errors, EMIR data remain a valuable resource
- The EMIR database serves as a meaningful source for deriving experimental macroeconomic statistics
- The depth of information provided by EMIR improves the ability to provide comprehensive insights into economic trends

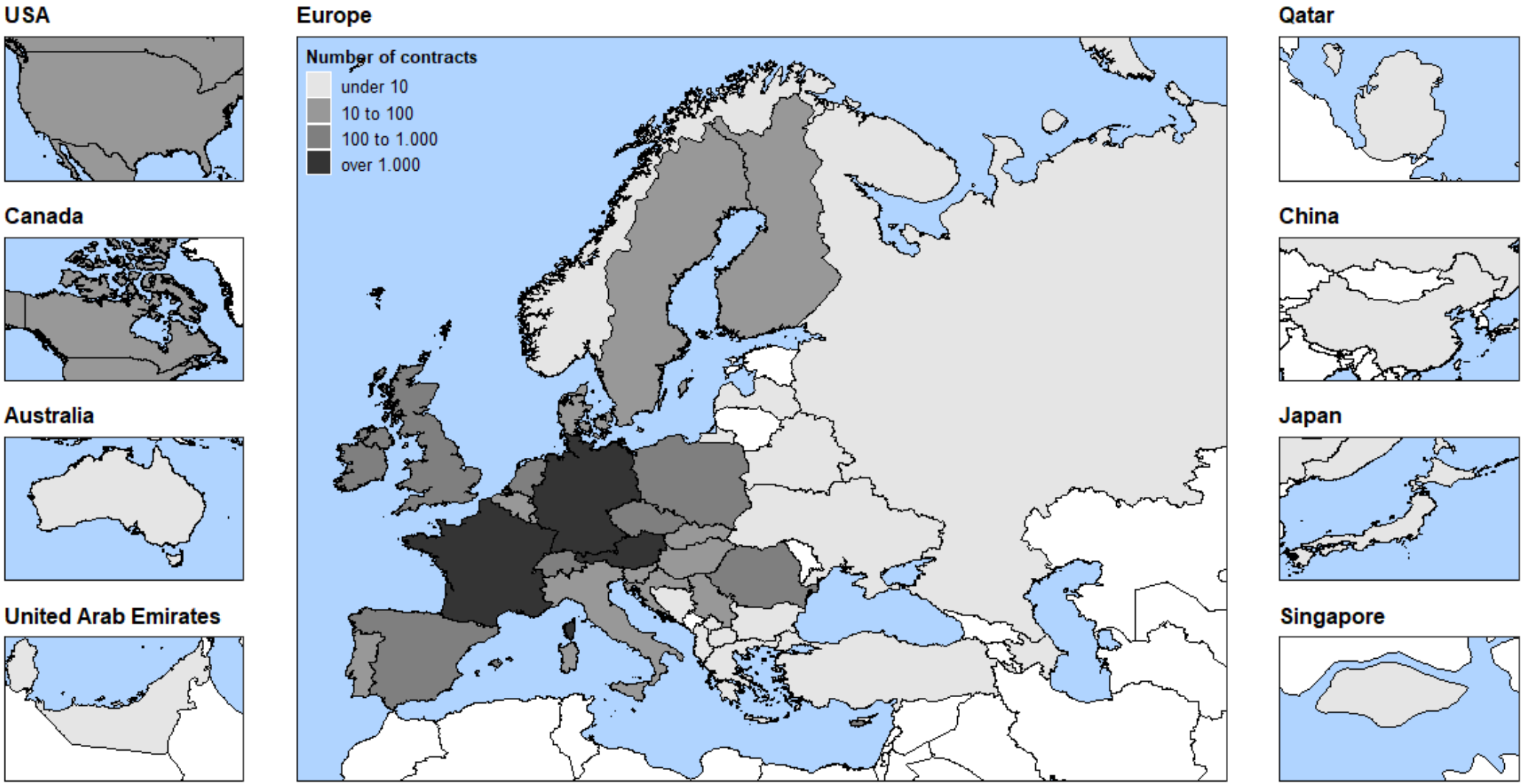
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Which first results can be derived?

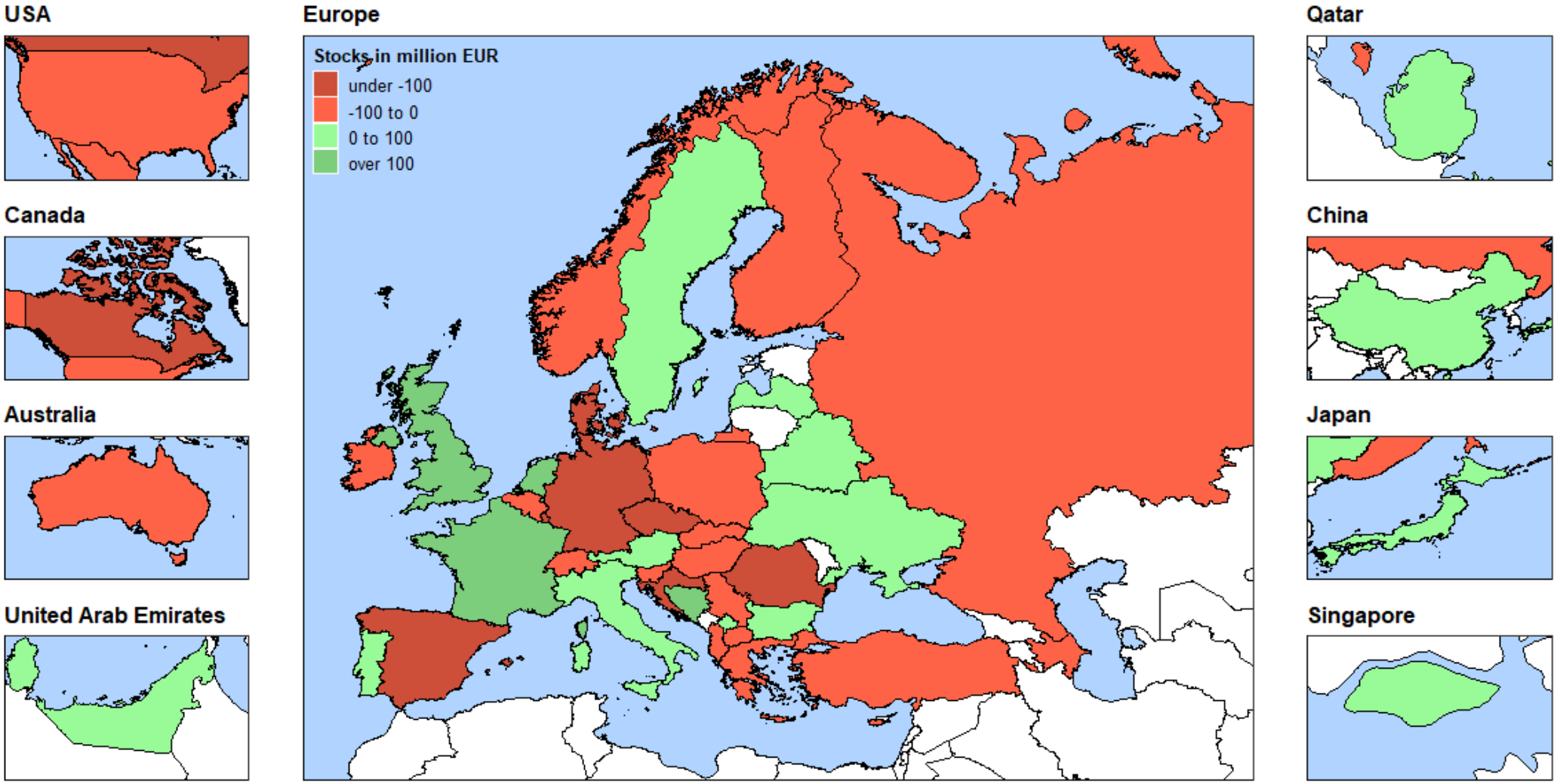
Results & Conclusion

Contracts of Austrian financial derivatives



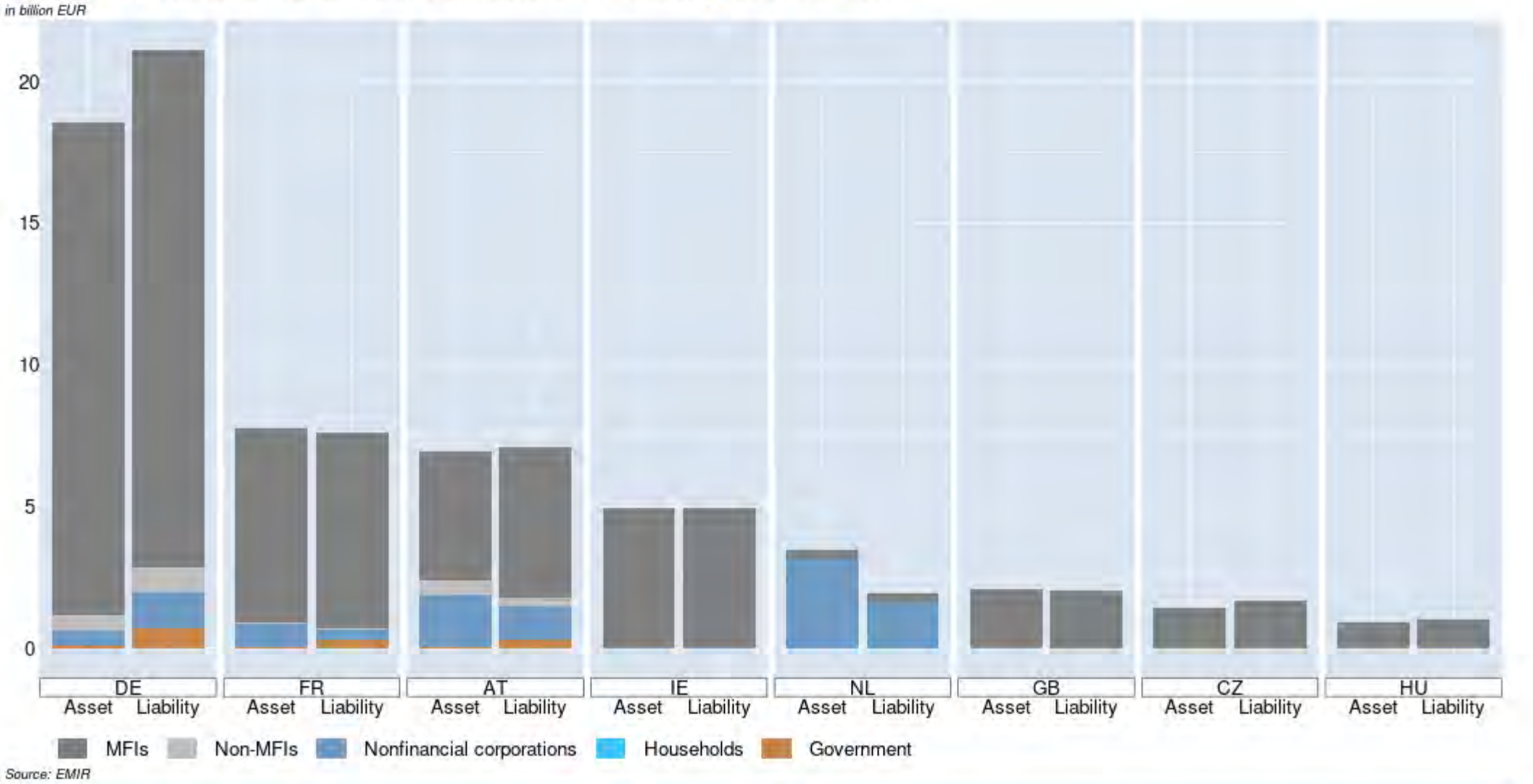
Source: EMIR

Net stocks of Austrian financial derivatives



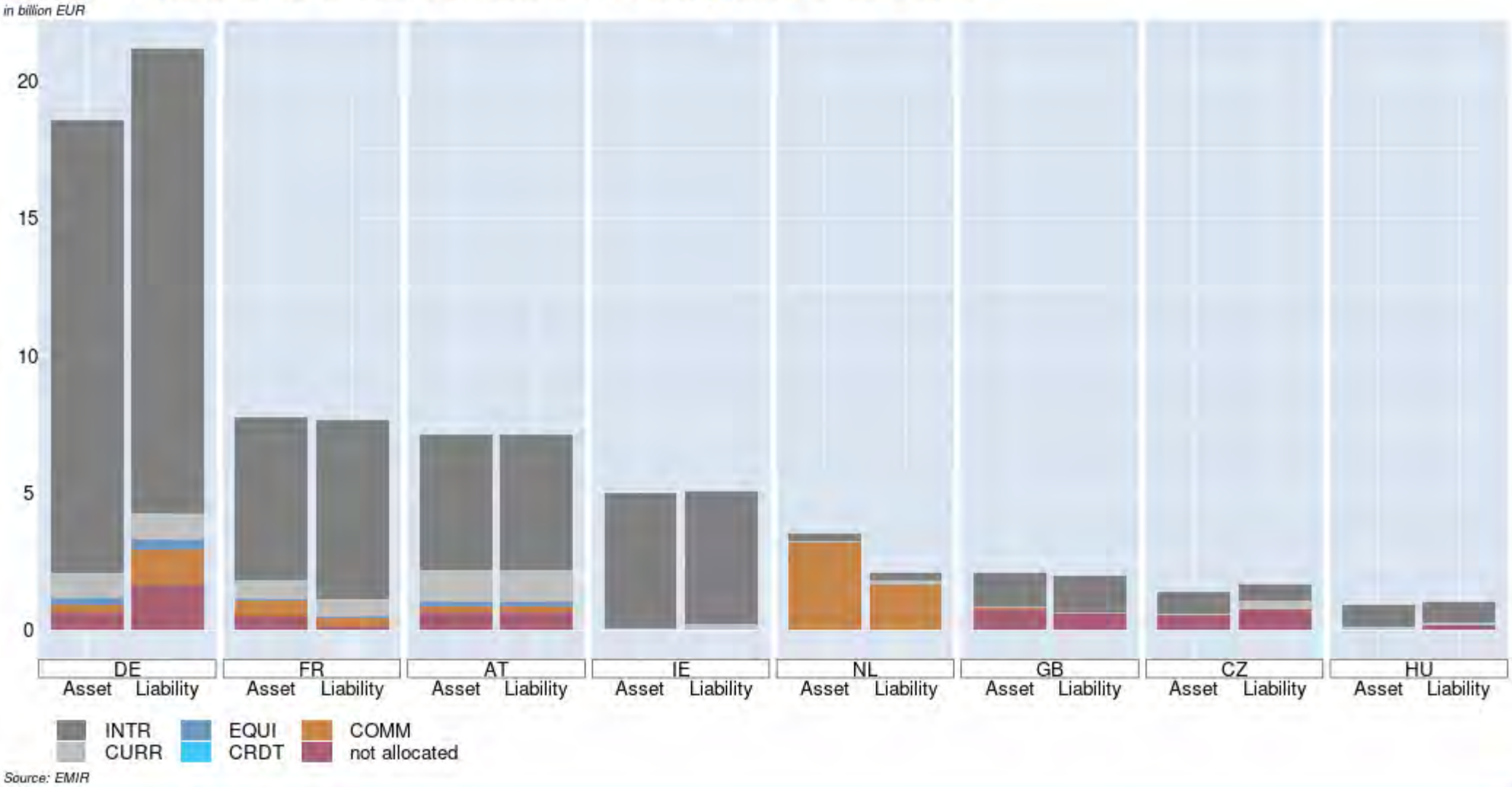
Source: EMIR

Stocks of Austrian financial derivatives: Country and Sector



Source: EMIR

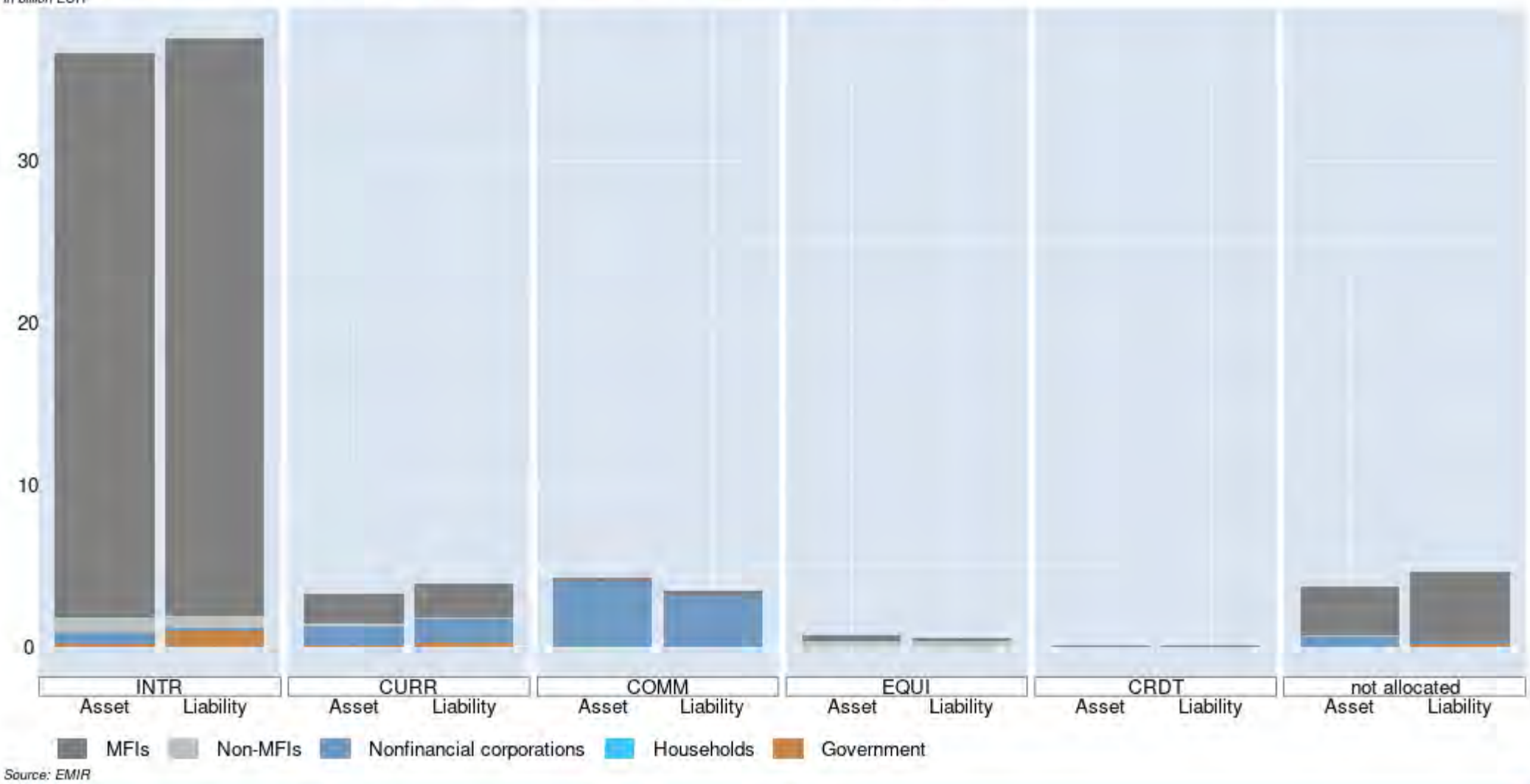
Stocks of Austrian financial derivatives: Country und Asset Class



Source: EMIR

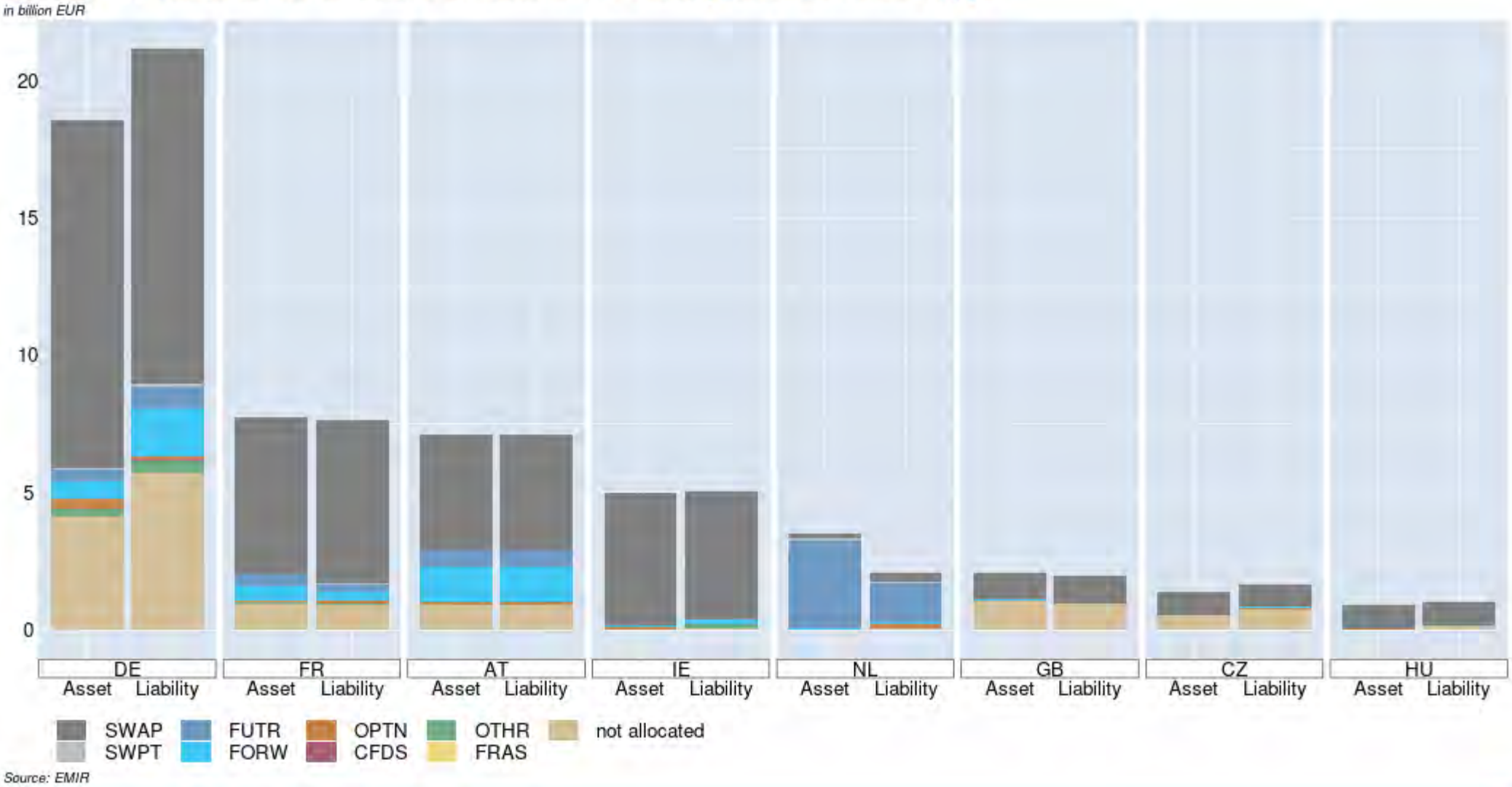
Stocks of Austrian financial derivatives: Sector und AssetClass

in billion EUR



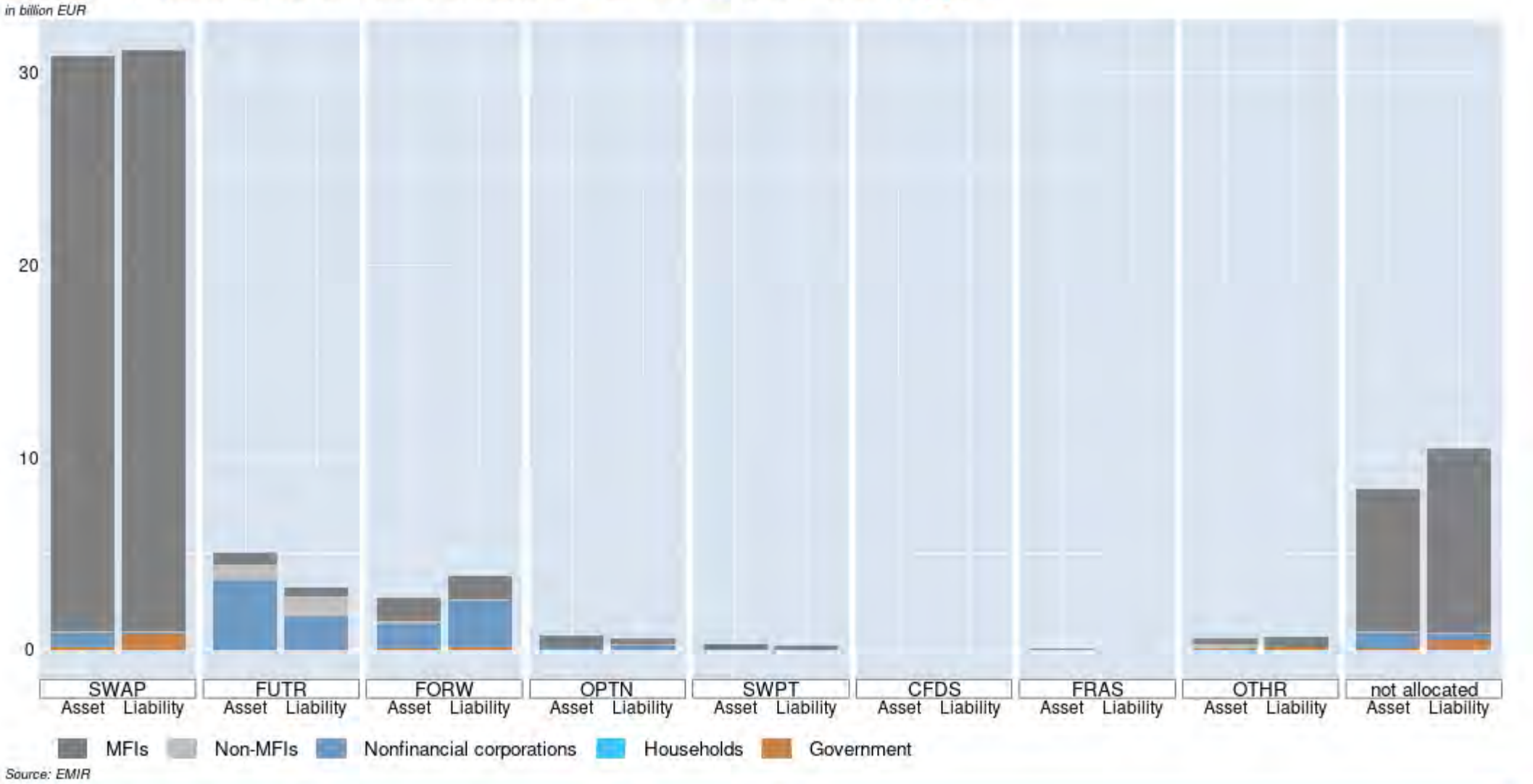
Source: EMIR

Stocks of Austrian financial derivatives: Country und Contract Type



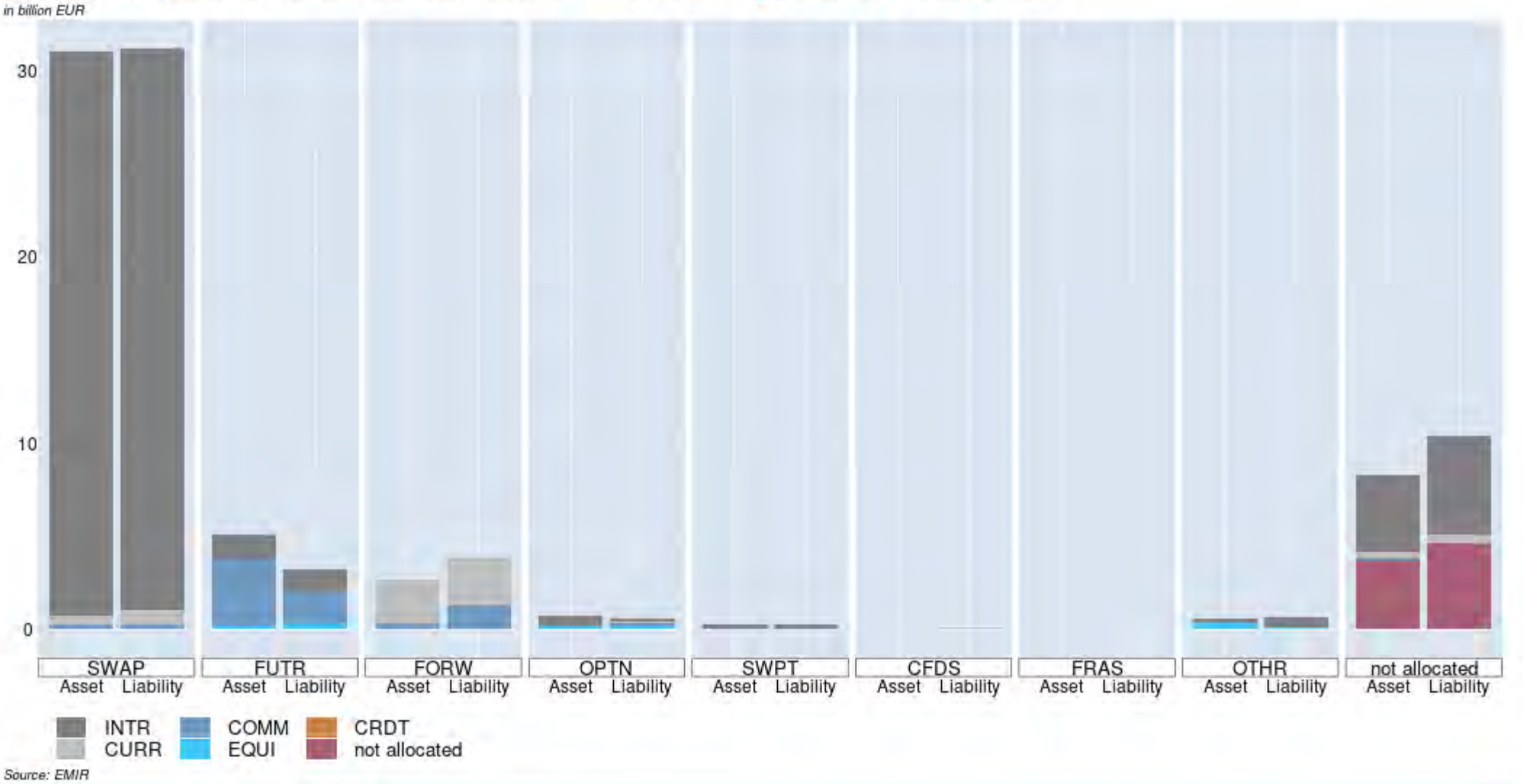
Source: EMIR

Stocks of Austrian financial derivatives: Sector und Contract Type



Source: EMIR

Stocks of Austrian financial derivatives: Contract Type und Asset Class



Source: EMIR

Aggregated Risk Indicator: ratio of Contract value and Notional

The Leverage Ratio *LR* of each country *i*, sector *j* and asset class *k* can be written as mean of

$$LR_{i,j,k} = \frac{CV_{i,j,k}}{N_{i,j,k}}$$

where

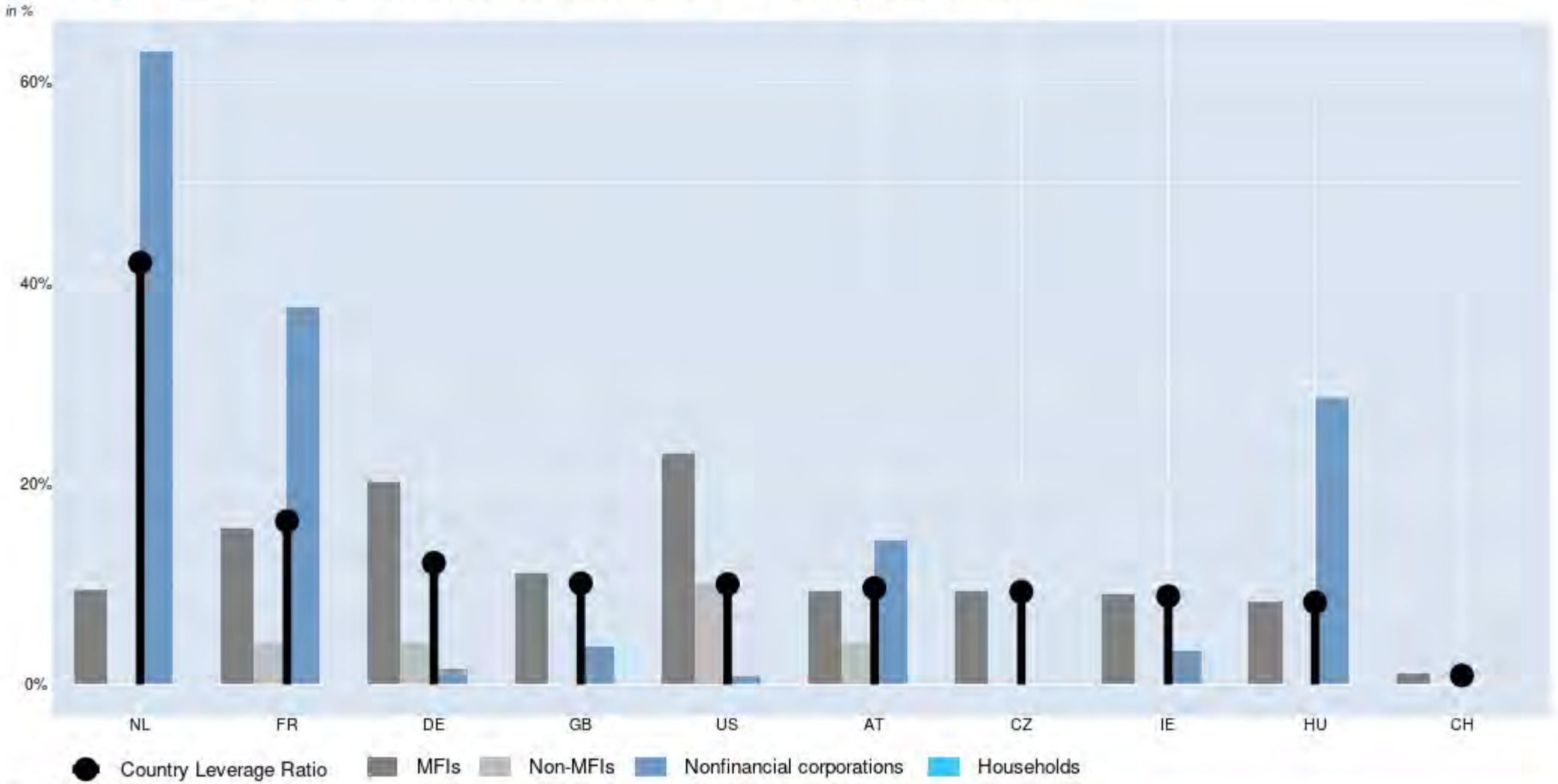
$$CV_{i,j,k} = \frac{Asset_{i,j,k} + Liability_{i,j,k}}{2}$$

CV is the respective average contract value (=market value), and

$$N_{i,j,k} = \frac{Long_{i,j,k} + Short_{i,j,k}}{2}$$

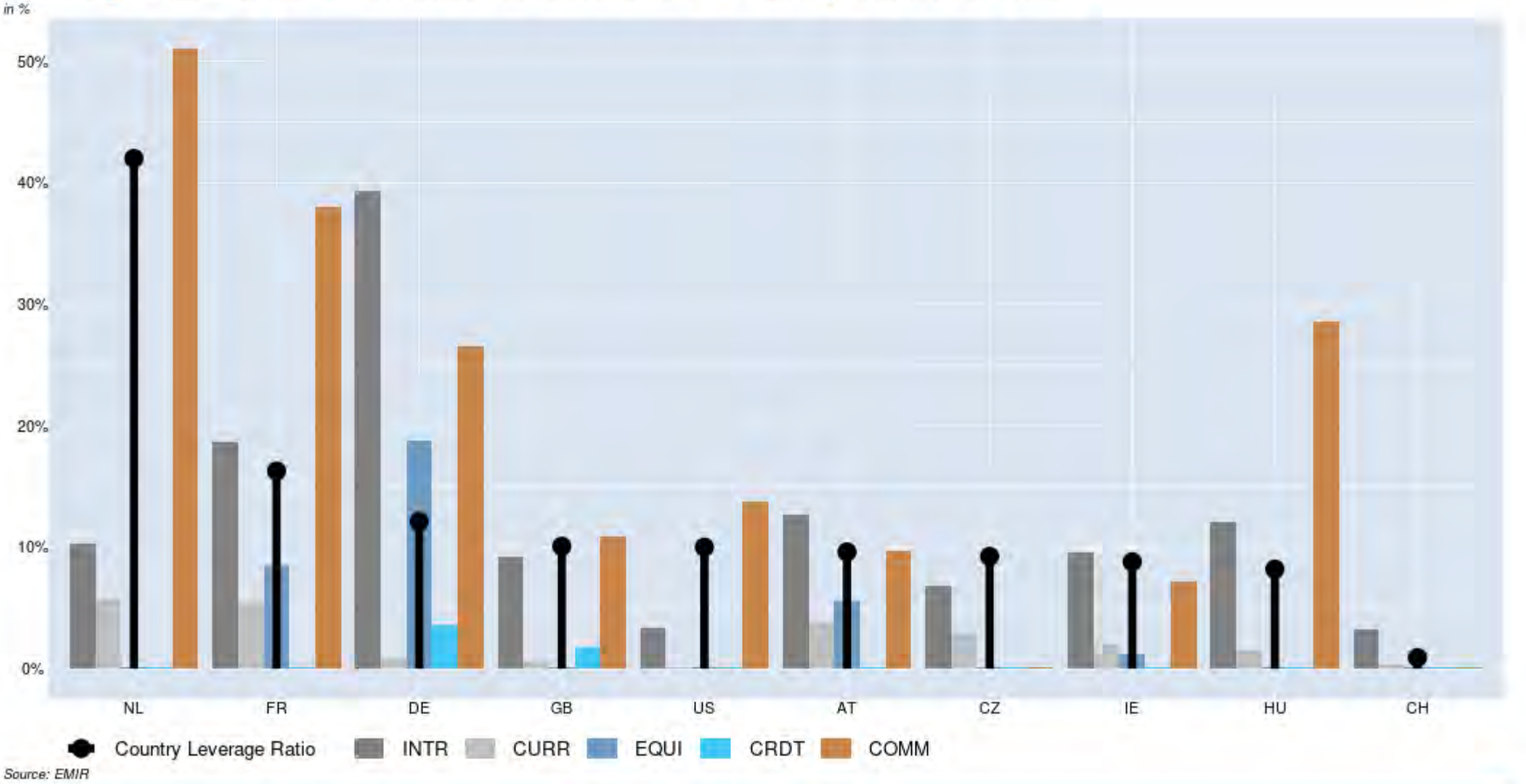
N measures the average notional from long and short postions

Leverage Ratio of Austrian financial derivatives: Country and Sector



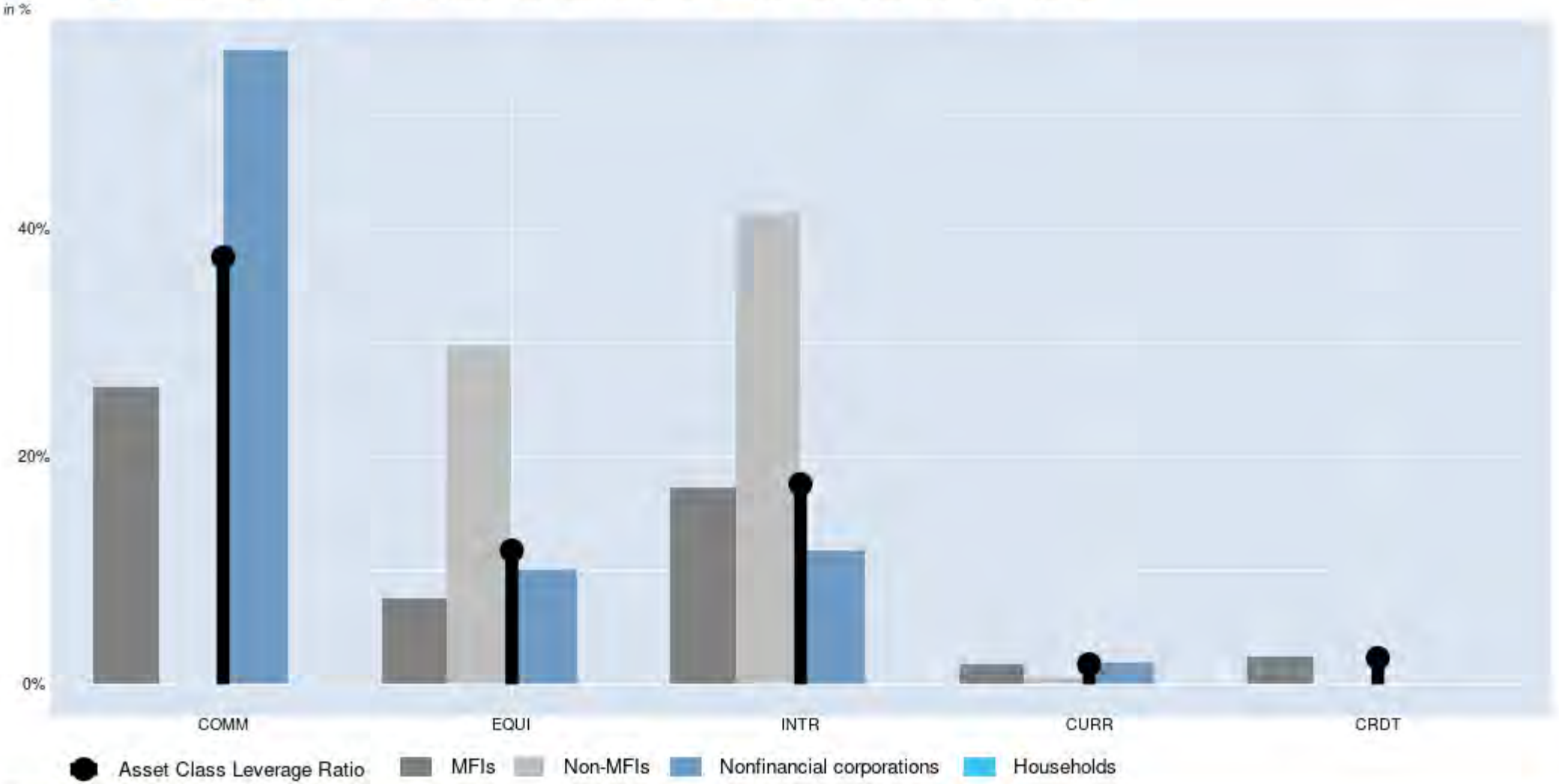
Source: EMIR

Leverage Ratio of Austrian financial derivatives: Country and Asset Class



Source: EMIR

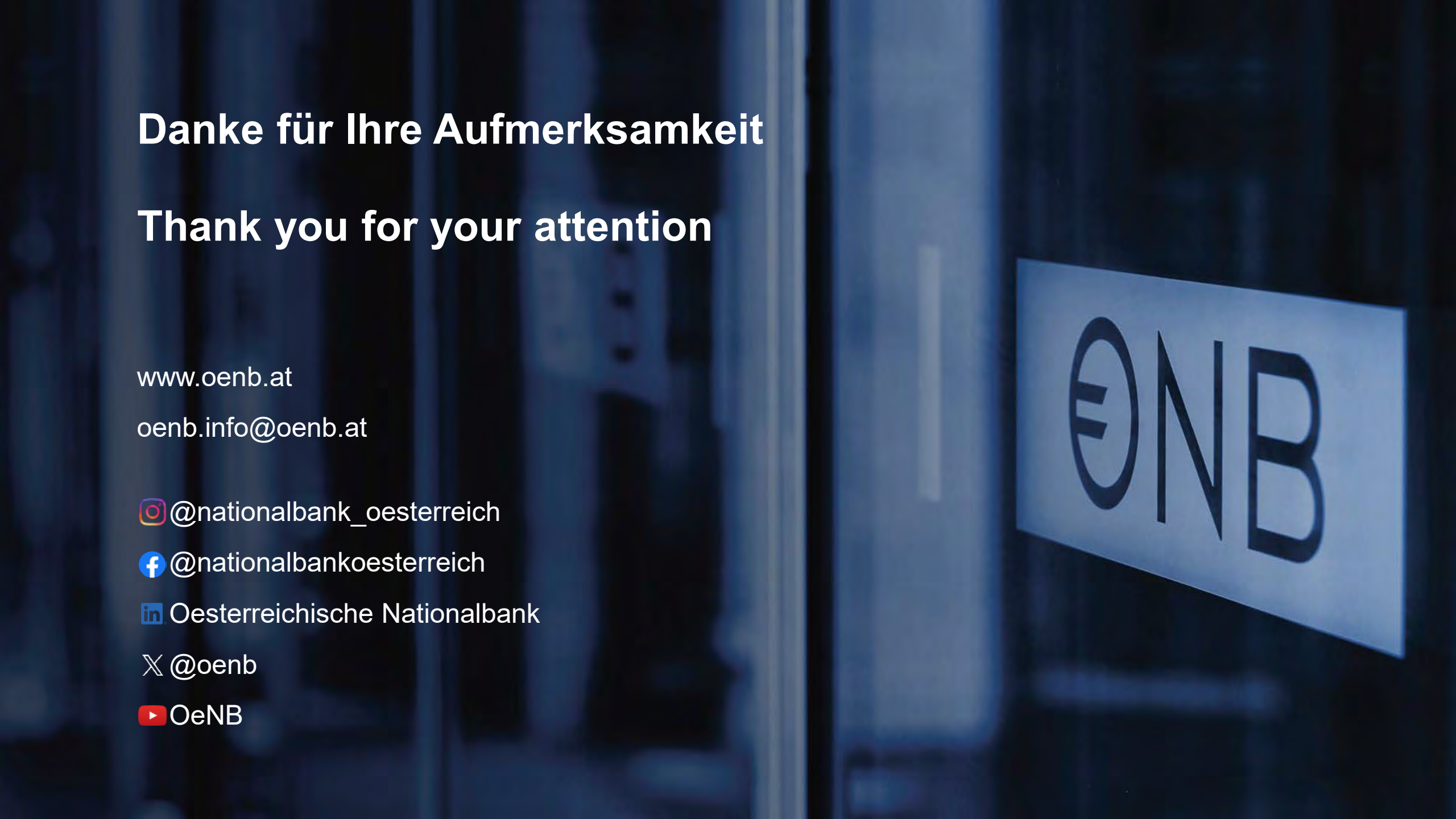
Leverage Ratio of Austrian financial derivatives: Sector and Asset Class



Source: EMIR

Conclusion

- Experimental data for financial derivatives stocks and notional values were sucessfuly derived from EMIR data
- Data can be used for statistical analysis broken down by country, sector, asset type and contract type
- Austrian MFIs are highly exposed to interest rate swaps with Germany
- Austrian non-financial corporations are significantly exposed to commodity futures vis-à-vis the Netherlands



Danke für Ihre Aufmerksamkeit

Thank you for your attention

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