Irving Fisher Committee on Central Bank Statistics

IFC Bulletin

No 55

New developments in central bank statistics around the world

November 2021

BANK FOR INTERNATIONAL SETTLEMENTS

Contributions in this volume were prepared of the proceedings of selected IFC-sponsored sessions at the 63rd World Statistics Congress of the International Statistical Institute (ISI), The Hague, Netherlands, July 2021 (virtual format).

This publication is available on the BIS website (www.bis.org).

ISSN 1991-7511 (online)

ISBN 978-92-9259-518-0 (online)

New developments in central bank statistics around the world

IFC Bulletin No 55
November 2021

Proceedings of selected IFC-sponsored sessions at the 63rd World Statistics Congress of the International Statistical Institute (ISI)

The Hague, Netherlands, July 2021 (virtual format)

3. Implications of the Digital Economy for Official Statistics

4. Central Banks as producers of official statistics

5. Addressing globalisation challenges

6. Cooperation issues between NSOs and Central Banks

New developments in official statistics – A central banking perspective after Covid-19

Alfonso Rosolia, Silke Stapel-Weber and Bruno Tissot[1]

Executive summary[2]

The experience of central banks has underlined the potential of alternative data sets to deliver statistics that are higher-frequency as well as more timely, flexible and granular than traditional ones. These are urgently needed to help policymakers follow macroeconomic developments and support policy decisions. In particular, the new, unconventional sources of information that have emerged with the digital transformation of our societies show a lot of promise (Hammer et al (2017)). They can cover many realms of the economic and financial sphere that are still difficult to capture through more traditional data collections. And they are potentially available in near real time, facilitating the conduct of economic policy especially in the face of unexpected shocks.

Yet these new data sources can come with huge numbers, multiple formats and high noise-to-signal ratios, **making them difficult to use systematically in policymaking and statistical production**. Some of these challenges might be addressed with appropriate engagement rules between public agencies and private data providers; others require further adequate improvement in our statistical and analytical methodological work.

Meeting all these challenges will make life easier for the statistical and policymaking communities. It's worth noting here that what may at first sight look like an information gap does not necessarily reflect a lack of relevant data, but rather a failure to transform existing indicators into useful knowledge (Drozdova (2017)). This is even more the case in today's evolving information society: torrents of data are constantly generated, collected and stored by both public and private agents. This means that perceived information gaps do not necessarily require new reporting exercises, as they may arguably be filled if statisticians and policymakers can quickly tap into existing data that could be turned into useful information, for instance to get timelier or higher-frequency measures of common phenomena or to cover new, unexplored statistical domains.

[1] Respectively, Deputy Head of Statistical Analysis Directorate, Bank of Italy (alfonso.rosolia@bancaditalia.it); Director-General Statistics, European Central Bank (ECB) (silke.stapel-Weber@ecb.europa.eu); and Head of Statistics and Research Support at the Bank for International Settlements (BIS) & Head of the Secretariat of the Irving Fisher Committee on Central Bank Statistics (IFC) (Bruno.Tissot@bis.org).

[2] This overview draws on the presentations made on the occasion of the various Invited Paper Sessions (IPSs) organised by the IFC at the 63rd biennial World Statistics Congress (WSC) of the International Statistical Institute (ISI) organised in The Hague, Netherlands, on 11–15 July 2021 on a virtual basis.

The views expressed here are those of the authors and do not necessarily reflect those of the Bank of Italy, the BIS, the ECB, the IFC or any of those institutions represented at the WSC. We thank Pieter Everaers for support and helpful comments.

1. Introduction

Central banks have an almost unique perspective on official statistics, being at the forefront of both the production and the application of economic and financial data. On the one hand, they produce statistics on a wide variety of domains, especially the financial system, that are of key relevance for a broad range of economic policymakers. On the other hand, central banks make extensive use of diverse data sources in pursuing their objectives, especially their monetary policy and financial stability goals. Both roles demand constant attention to the economic and financial environment and the fitness-for-purpose of statistics and analytical tools and products.

A key challenge is that **this environment is constantly changing, which requires the official statistical framework to evolve continuously**. In Japan, for instance, digitalisation has brought new types of service (eg internet advertising) that need to be considered when measuring inflation; this has also called for the development of new types of statistical method at the Bank of Japan, eg to adjust for quality changes. Moreover, while available statistical products and methods are designed to describe what is known to be relevant to decision-makers, this knowledge is not fixed in time, since new policy issues constantly emerge. These discontinuities in both the supply of statistics and the demand for them can be substantial, especially when large and unusual shocks occur that expose gaps in economic and financial information.

The vulnerabilities underlying the 2007–09 Great Financial Crisis (GFC), for example, went almost unnoticed by policymakers at first because of the lack of suitable statistics. However, through swift and globally coordinated action, the most critical data gaps were singled out and action plans designed to address them, especially via the Data Gaps Initiative (DGI) endorsed by the G20 (FSB and IMF (2009)). In the decade or so since the GFC, **extensive work has been done to close the most pressing data gaps and strengthen the ability to monitor global economic financial developments**. These improvements proved their worth when the pandemic struck: policymakers had at their disposal statistics of a quality and variety that would have been barely possible a few years ago (IFC (2021b)). The potential of this new information for monitoring risks in the financial and non-financial sector as well as for the analysis of interconnectedness and cross-border spillovers was underlined during the Covid-induced financial markets turmoil in March 2020 (FSB (2020)).

New lessons have emerged from the pandemic. One is the sheer speed of developments during a crisis, underlining the importance of high-frequency, well documented and timely indicators to support evidence-based policy. This calls for statistical frameworks to become more flexible and granular with the aim of addressing the evolving needs of users and help them monitor fragilities (De Beer and Tissot (2020)). Another lesson is that the (unexpected) nature of the shock has clearly expanded the range of statistics that central banks must look at. The unpredictability of the data needs that arise when a shock hits the economy means that instruments and arrangements are needed for the key phenomena to be measured as soon as they become relevant. A third lesson is that the disruptions caused to the traditional statistical production process, for example, due to the suspension of key surveys, have highlighted the need to look at less conventional and still untapped sources of alternative information (Biancotti et al (2021)). These sources can be essential when assessing the resilience of today's economies, for instance, if they help to measure phenomena that are not well captured by standard statistics.

Reflecting the importance of these issues for central banks, the Irving Fisher Committee on Central Bank Statistics (IFC), an affiliated member of the International Statistical Institute (ISI), organised specific sessions at the 63rd ISI World Statistics Congress (WSC) in July 2021 that focused on **the contributions of central bank statisticians around the world and the challenges they face**. The focus was relatively broad, covering first the new developments observed in official statistics, including the changing role of central banks as data producers and cooperation issues with national statistical organisations (NSOs). Attention was also paid to the impact of innovation, particularly as regards the relevance of data integration and advanced analytics in decision-making, the implications of the digital economy for official statistics, and ways of addressing the measurement challenges raised by globalisation. Lastly, this proved a useful opportunity to review the main statistical and methodological challenges posed by the pandemic and to reflect on how the lessons learned could be generalised and turned into permanent solutions.

From this perspective, a key message is the **need to broaden the ability of central banks to face future shocks that, like Covid-19, can test the resilience of our economies in unexpected ways**. This could be achieved by developing higher-frequency, more granular and timelier indicators, taking advantage of the growing availability of alternative data sources. In particular, the increased digitalisation of today's societies is bringing new types of information that can complement and expand traditional analysis and statistical measurements. Besides, a wealth of granular "financial big data" sets derived from traditional registers could be more effectively used, for instance loan-by-loan credit registers (Schubert (2016)).

Artman shows that **valuable information can be extracted from micro data sets** on FX market transactions or derivatives to develop an early warning system supporting the analysis of corporate cash flow and export performance. Similarly, Radke et al underline the merit of using highly granular (security-by-security) information to enhance European measurement of cross-border portfolio investment and external debt in international investment positions. Turning to Japan, the greater use of financial reports disclosed by financial and non-financial institutions has been instrumental in improving the accuracy of the flow of funds accounts. But reaping the full benefits of such alternative data sources (eg the internet of things, administrative-type registers, textual messages) can raise several important challenges.

2. Lessons to be learned from the Covid-19 pandemic

A first important lesson for producers of official statistics is the need for more timely information. The official measurement of real economic activity offered by the usual GDP statistics is produced only on a quarterly frequency (in advanced economies, at best, while a large number of less developed countries still rely on annual figures) and often with a substantial delay with respect to the period of interest. Policymakers thus have to rely on tracking other types of qualitative and quantitative indicator to gather real-time signals. Fortunately, a number of statistical techniques have been developed over time to extract timely and reliable signals about economic activity in advance of GDP releases. Such "nowcasting methods" have become all the more relevant during the pandemic, as the economic situation evolved at an unprecedented speed for quite some time and along dimensions unseen before. For instance, Ginker and Suhoy apply this kind of method to the Israeli economy to develop a monthly index of economic activity. They use a so-called collapsed dynamic factor model that first synthesises the main signals embedded in the available monthly series, extracts a limited number of summary factors and then jointly models these factors to obtain a nowcast estimate of quarterly GDP growth.

For reliability, **these techniques require a relatively large number of high-frequency series**. This can be a problem for small economies, where the supply of such indicators is often hampered by the resources available. In Albania, for instance, recent crises have underscored the need to collect micro-level household data to better assess the importance and impact of external remittances. Yet even large economies may not have a sufficient number of suitable high-frequency indicators, for instance, because of their limited time span. Moreover, these indicators can also be subject to large disruptions, as was seen in the early stages of the pandemic: there was a pressing need to monitor economic developments on a real-time basis but the collection of traditional high-frequency indicators such as economic surveys was hindered by lockdown restrictions (Bidarbakhtnia (2020)).

A telling example of these difficulties was related to the measurement of inflation. The compilation of consumer price indices (CPIs) during the pandemic suffered from the disruption of the data collection process (reflecting eg the closure of bricks-and-mortar stores) as well as from large swings in consumer behaviour, caused both by the shutdown of entire sectors (eg restaurants) and by dramatic changes in spending preferences (eg less travelling). These factors posed important challenges to the measurement of inflation dynamics, and hence to the design of adequate policy measures. A key reason is that traditional inflation measures rely on an annual updating of consumer basket weights, which arguably became quickly outdated as the pandemic struck (see Cavallo (2020) and Surico et al (2020)).

To **address these challenges**, Kouvavas et al have developed an experimental index to measure inflation during the 2020 pandemic. Using retail and services turnover data, they were able to calculate CPIs based on monthly updated weights to take into account high-frequency pandemic-related shifts in consumption patterns. Their estimates show that measured inflation for the euro area would have been slightly higher in 2020, as compared with the headline indicator (by around 0.2 pp), and lower in 2021 (reflecting the reversal of pandemic-related spending disruptions following the gradual normalisation of the situation and the lifting of lockdowns). However, and as with the above-mentioned challenges with GDP nowcasting exercises, one difficulty was finding adequate and timely data sources to track rapid changes in consumption weights; this difficulty was exacerbated by the disruption to several data collection processes at the height of the pandemic.

The examples above underline **the vulnerability of existing statistical production and policy design processes to shocks such as Covid-19, precisely when the smooth functioning of these processes is most needed**. One silver lining is that ample room exists to mitigate these difficulties by tapping into alternative data sources, especially those that are less subject to pandemic-related disruption. For example, the data from online activities were not disrupted by lockdowns and could still provide a realistic and timely picture of what was going on, especially in comparison with official statistics that arrived on a less timely or punctual basis. For example, data from online retail trade platforms as well as from providers of payment services continued to be available, allowing for real-time monitoring of spending patterns and prices. Similarly, a number of alternative sources such as smart meters (eg electronic devices recording electric consumption), mobility trends derived from smartphone location data, or even air pollution data were used during the pandemic to complement other sources of high-frequency measurements of real economic activity (see Deutsche Bundesbank (2020) and Lewis et al (2020)).

Moreover, **in addition to providing "hard" alternative data on relevant economic phenomena, digitalisation has also expanded the scope for considering other types of indicator**. This can be the case for "soft" factors, such as confidence indicators, which can play an important role in shaping and predicting economic dynamics, even though they may not be on the traditional radar screen of statisticians (Aguilar et al (2020)). For instance, Armas and Tuazon have adopted this kind of approach to use freely available data on internet searches to assess investor sentiment amid the pandemic and study the response of financial market prices to changes in risk attitudes. They find that this "soft" information could be statistically significant when monitoring daily stock market developments in Asian markets, thus potentially enhancing the design of policymaking processes.

More generally, **social media have become important sources of information** providing real-time insights on public behaviour and sentiment. This information can increasingly be extracted with the development of powerful big data analytics (eg text-based analysis or machine learning tools) that allow the signals collected to be deciphered and turned into statistical inputs complementing more traditional indicators to support policy. For instance, Jensen et al show that the combination of multiple data sources using innovative techniques might pave the way to using granular transaction data to support anti-money laundering policies. Similarly, Carboni et al show how ML learning algorithms have been effectively used to improve the compilation of balance of payments statistics at the Bank of Italy.

3. Challenges looking forward

Crises are learning experiences. The pandemic, just like the GFC a decade earlier, unveiled deficiencies and weaknesses in the traditional statistical apparatus. It is therefore an opportunity to reflect on how to address such shortcomings, in particular by identifying and filling relevant data gaps and reorganising processes so that the infrastructure underpinning official statistics can be better prepared for future emergencies.

As analysed above, one major lesson from the current crisis is that the disruptions in data collection exercises and the need to better monitor the swift changes that occurred in agents' preferences and behaviours require **innovative strategies to make up for the unavailability (or limited informativeness) of a number of traditional statistical sources**. These often called for the use of new and/or unconventional data sources, reflecting several developments: the large data sets produced as an organic by-product of business operations (Groves (2011)), the wealth of administrative registers maintained by public agencies that, up to now, have rarely been exploited for statistical purposes (Bean (2016)), the footprints of increased digitalisation that have emerged in many parts of modern life, and the improved techniques for processing unstructured data sets such as text.

These varied alternative sources have proved particularly helpful to statisticians and policymakers during the pandemic, by complementing conventional data sources (or substituting for them) in the face of compilation disruptions, providing more timely and/or frequent signals when needed, and offering new insights on phenomena that were not well captured by traditional indicators. For instance, the pandemic has underlined the need to enhance the measurement of environmental topics (eg climate change) and socioeconomic factors (eg distributional aspects and inequalities as well as financial inclusion issues), and which could be addressed in the next phase of the DGI, as envisaged by the G20 after 2021 (G20 Italian Presidency (2021)).

At the same time, a **number of challenges did arise in accessing alternative data sources, as recognised by most central banks** (IFC (2021a)).

First, **the systematic use of these data sources for statistical and policy purposes requires an adequate degree of stability,** although they are pervasive and provide an increasing amount of information on various aspects of economic and financial activities. They need to be both available and continuously accessible to justify the methodological and technical investments needed to exploit them. However, the continuity and consistency over time of the output generated based on new alternative sources is not always guaranteed. For instance, methods developed in stressed times may not work well under more normal conditions (INSEE (2020)). Moreover, a certain amount of experience is needed to judge the true quality of new indicators. As an example, Google Flu Trends was initially intended to provide estimates of influenza activity based on Google Search queries but was discontinued in the mid-2010s (Lazer et al (2014)). Furthermore, newly developed data sets may not pass the test of time if economic agents change their habits and hence their digital footprints. For instance, how far should policymakers rely on analysing messages collected by social media, given that the public use of these media may change or even fade away in the future?

Second, **the apparent breadth of new alternative data hides at least two drawbacks that need to be addressed from a statistical methodological perspective**. On the one hand, digital data are often generated by online or digitally savvy agents and activities. This can lead to substantial hard-to-assess composition biases that may well increase over time. For example, social media content is generated by people who actively participate in these forums. Similarly, web searches are generated only by those interested in the specific topic. As such, these data are unrepresentative of the whole population of policy interest (not everybody is on Twitter). Hence they can embed significant selection bias which must be properly understood, if not addressed, so that they can be reliably used (Mehrhoff (2019)). On the other hand, the sheer novelty of new alternative data sets often means that the significance of the information is unclear and requires additional efforts to be fully understood. For example, measuring the number of clicks made for specific web searches does not provide information on why these searches were undertaken. These difficulties are reinforced by the velocity and high frequency of alternative sources of information, with data users confronted with often unfavourable signal-to-noise ratios (Lane (2021)).

Third, **the information content of the data sources ultimately depends on their intended use**. Alternative statistics can be used as benchmarks to forecast official statistics, for instance in the case of GDP nowcasts. Yet one may also wish to use observed underlying correlations to make inferences that support policy recommendations. This puts a premium on ensuring transparency in the sources used for such purposes, given the risk of reaching false conclusions due to unobserved confounding factors. Hence a key public policy issue is how alternative information sources (ie private commercial data sets or public registers that were not initially set up for a statistical purpose) and the data producers located outside the national statistical systems feature vis-à-vis the Fundamental Principles underlying the quality of official statistics (UN (2013)). Given that many of the new data sets have a global nature, this would require their governance to be strengthened at the international level, with a broad focus so as to cover the entire production and use of statistics, including alternative sources (IFC (2021c)).

Fourth, **important issues are raised when new types of data are integrated into the infrastructure for the production official statistics**. Coping with an avalanche of data in various formats requires adequate IT, skills, and budget (IFC (2020)). It also calls for adequate registers, identifiers and aggregation rules so as to transform granular data points into meaningful macroeconomic aggregates. Last but not least, clear data-sharing agreements, standards (eg SDMX (IFC (2016)) and processes are necessary to mobilise various data sources in a coherent way. For instance, and as argued by Muench et al, the crisis has underscored the limitations of the current regulatory reporting process especially in times of intense stress, calling for its increased digitalisation to enhance banking regulation efficiency.

One way to go, as advocated by Colangelo et al, is to **accelerate statistical standardisation** through for instance, the establishment of a single data dictionary (see the European Banks' Integrated Reporting Dictionary (BIRD)). Another is to **enhance international data-sharing to make use of mirror data**, whether published or otherwise, for instance between banks and counterparty sectors, when dealing for example with incomplete statistical coverage, as highlighted by Pradhan et al, or when addressing the important asset/liability discrepancies that continue to exist at the global level, as done by Schmitz in Europe.

A final recommendation, put forward by de Beer and Tissot, is to use the new phase of the DGI to **enhance the global statistical infrastructure to improve existing core statistics and address new data needs**. As examples of the potential benefits, better information could be obtained on foreign control relationships, as argued by Vieira and Ferreira Lemos, or an enhanced understanding of intragroup operations of multinational enterprises and the role of global financial centres such as Luxembourg, in turn supporting the analysis of the effects of economic and financial globalisation. At the same time, improved standardisation and sharing of data between trusted institutions already in the statistical production phase can also help to reduce the reporting burden for respondents, since every data point is collected only once.

References

Aguilar, P, C Ghirelli, M Pacce and A Urtasun (2020): "Can news help measure economic sentiment? An application in Covid-19 times", Bank of Spain, *Documentos de Trabajo*, no 2027.

Bean, C (2016): *Independent review of UK economic statistics*, March.

Biancotti, C, A Rosolia, G Veronese, R Kirchner and F Mouriaux (2021): "Covid-19 and official statistics: a wakeup call?", *Bank of Italy Occasional Papers*, No 605, April.

Bidarbakhtnia, A (2020): "Surveys under Lockdown; a pandemic lesson", United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), *Stats Brief*, no 23, April.

Cavallo, A (2020): "Inflation with Covid consumption baskets", *NBER Working Papers*, no 27352.

De Beer, B and B Tissot (2020): "Implications of Covid-19 for official statistics: a central banking perspective", *IFC Working Papers*, no 20, November.

Deutsche Bundesbank (2020): "A weekly activity index for the German economy", *Monthly Report*, May, pp 68–70.

Drozdova, A (2017): "Modern informational technologies for data analysis: from business analytics to data visualisation", *IFC Bulletin*, no 43, March.

Financial Stability Board (2020): *Holistic Review of the March Market Turmoil and COVID-19 pandemic: Financial stability impact and policy responses*, November.

Financial Stability Board and International Monetary Fund (2009): *The financial crisis and information gaps*.

G20 Italian Presidency (2021): *Communiqué of the Second G20 Finance Ministers and Central Bank Governors meeting*, 7 April.

Groves, R (2011): "Designed data and organic data", in the Director's Blog of the US Census Bureau.

Hammer, C, D Kostroch, G Quirós and staff of the IMF Statistics Department (STA) Internal Group (2017): "Big data: potential, challenges, and statistical implications", *IMF Staff Discussion Notes*, no 17/06, September.

Irving Fisher Committee on Central Bank Statistics (IFC) (2016): "Central banks' use of the SDMX standard", *IFC Report*, no 4.

——— (2020): "Computing platforms for big data analytics and artificial intelligence", *IFC Report*, no 11, April.

——— (2021a): "Use of big data sources and applications at central banks", *IFC Report*, no 13.

——— (2021b): "Micro data for the macro world", *IFC Bulletin*, no 53.

——— (2021c): "Issues in data governance", *IFC Bulletin*, no 54.

Institut national de la statistique et des études économiques (INSEE) (2020): "High-frequency" data are especially useful for economic forecasting in periods of devastating crisis", *Point de Conjoncture*, June, pp 29–34.

Lane, P (2021): "Data analysis and monetary policy during the pandemic", presentation at the Central Bank of Ireland webinar, 7 October.

Lazer, D, R Kennedy, G King and A Vespignani (2014): "The parable of Google Flu: traps in big data analysis", *Science*, vol 343, no 6176, pp 1203–05, 14 March.

Lewis, D, K Mertens and J Stock (2020): "Monitoring real activity in real time: the weekly economic index", *Federal Reserve Bank of New York Liberty Street Economics*, 30 March.

Mehrhoff, J (2019): "Demystifying big data in official statistics – it's not rocket science!", *IFC Bulletin*, no 49.

Schubert, A (2016): "AnaCredit: banking with (pretty) big data", *Central Banking Focus Report*.

Surico, P, H Hacioglu and D Känzig (2020): "Consumption in the time of Covid-19: evidence from UK transaction data", *CEPR Discussion Papers*, no 14733.

United Nations (UN) (2013): "Fundamental Principles of Official Statistics", resolution adopted by the Economic and Social Council, E/RES/2013/21, 28 October.

Irving Fisher Committee on
Central Bank Statistics
BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics
July 2021, The Hague, Netherlands, virtual format

Introductory remarks: New developments in central bank statistics around the world[1]

Alfonso Rosolia,
Bank of Italy

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

Discussion of papers in Session

New developments in central bank statistics around the world

Alfonso Rosolia

Bank of Italy

ISI World Statistics Congress 2021

Nowcasting and monitoring Israeli real economic activity

Ginker & Suhoy

- Nowcast of quarterly GDP growth and monthly index of economic activity
- Usual problems from lack of hard data for end points.
- Overcome PCA limitations from small number of monthly indicators with use of appropriate instrument

- Not clear to me what is an «instrument» in this context.

  If you have «monthly» proxy of GDP why need monthly nowcast?

  What properties is it supposed to have? How do you choose/verify?

- Any room for «big data»?

  Small economy has same number of phenomena as large economy;

  limited number of high frequency indicators does not mean limited number of high frequency informative developments.

An Experimental Index to Measure Inflation in the Pandemic

Kouvavas, Trezzi & Rollo

- Use monthly retail and services turnover monthly data to develop monthly weights for CPI
- Accounting for pandemic-related shifts in consumption increases 2020 inflation by 0.2pp.

- Basic but fundamental question for central banks.
- Reliability of results is crucial, hence so is that of underlying data sources

- Turnover data, its granularity and reference population have issues but hardly any «hard data» alternative.
- How about «complementary» sources? Can social networks/media help? Construct complementary info on perceived inflation pressures and/or consumption habits during pandemic.

Revealing investors' sentiment amid COVID-19: the Big Data evidence based on internet searches

Armas & Tuazon

- Study response of Asian stock markets to pandemic (risk attitudes and gov't response)
- Δlog(sp) = F(Covid Risk Attitude (CRA) index, Gov't SI, Covid cases, fundamentals).
- ΔCRA (vol. Google searches for Covid-related words) and GSI attract positive signs.

- Does CRA capture risk attitudes or simply «interest»?
  Daily «Interest» may increase both in bad and good times.
- What about dynamic structure? Interactions of «interest» with Δ# of cases?

- Experiment with «sentiment» indexes based on semantic analysis of social media content (Twitter, Facebook) to capture «meaning» and «reason» of Covid-related Google searches.

Sum up and a consideration

- 3 extremely useful statistical works on «traditionally» relevant issues for central banks based on «consolidated» empirical tools.

- Are there no «new developments» then?

Not really (and one is COVID, that put us all on the same boat asking the same questions). Clear examples of the possibilities and/or potential of addressing traditional issues and/or complementing traditional data sources by exploiting unconventional data sources.

Unconventional sources pose problems.

Access can be complicated and unstable, tough for policy use

Require conceptual reflections on how to

extract «meaning»

address selection -> «digital» data only generated by «digitalised» agents.

Thank you!

Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Nowcasting and monitoring Israeli real economic activity[1]

Tim Ginker and Tanya Suhoy,

Bank of Israel

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

Nowcasting and monitoring Israeli real economic activity

T. Ginker[1] T. Suhoy[2]

[1]Bank of Israel
Statistical Methods and Data Science Unit

[2]Bank of Israel
Research Department

15/07/2021

Overview

Objectives and challenges

Objectives

- Real time GDP nowcasting
- Measuring monthly real economic activity

Challenges

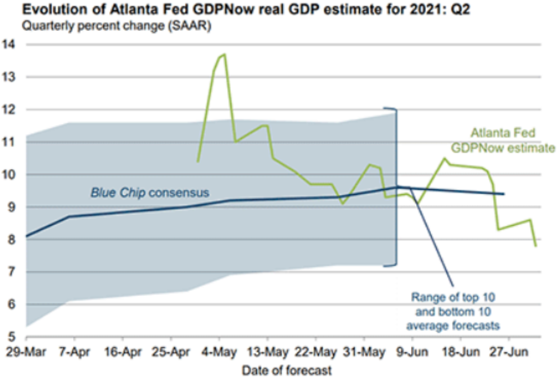
- Mixed frequency inputs
- "Large" number of monthly indicators: 40 macro-economic monthly series (hard data) and 12 survey-based series used for endpoints imputation
- Missing observations (non-synchronous monthly data releases - “jagged edges” link; varying historical length link)

Atlanta FED Nowcasting Report

FEDERAL RESERVE BANK of ATLANTA | GDPNow™

GDPNow is not an official forecast of the Atlanta Fed. Rather, it is best viewed as a running estimate of real GDP growth based on available economic data for the current measured quarter. There are no subjective adjustments made to GDPNow—the estimate is based solely on the mathematical results of the model.

In particular, **it does not capture the impact of COVID-19 and social mobility** beyond their impact on GDP source data and relevant economic reports that have already been released. It does not anticipate their impact on forthcoming economic reports beyond the standard internal dynamics of the model.



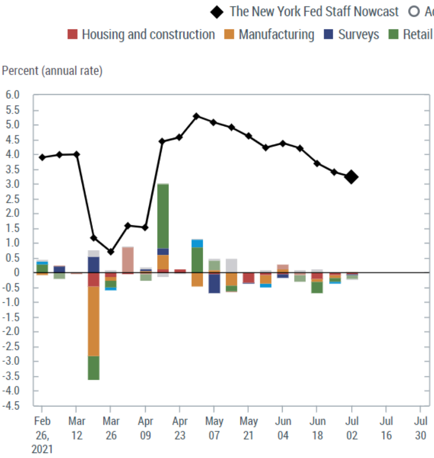
Sources: *Blue Chip Economic Indicators* and *Blue Chip Financial Forecasts*
Note: The top (bottom) 10 average forecast is an average of the highest (lowest) 10 forecasts in the *Blue Chip* survey.

NY FED Nowcasting Report

2021:Q3 | **2021:Q2** | 2021:Q1 | 2020:Q4 Reset to latest nowcast

Last Release 11:15am EST Jul 02, 2021

ARCHIVE DOWNLOADS LAYOUT

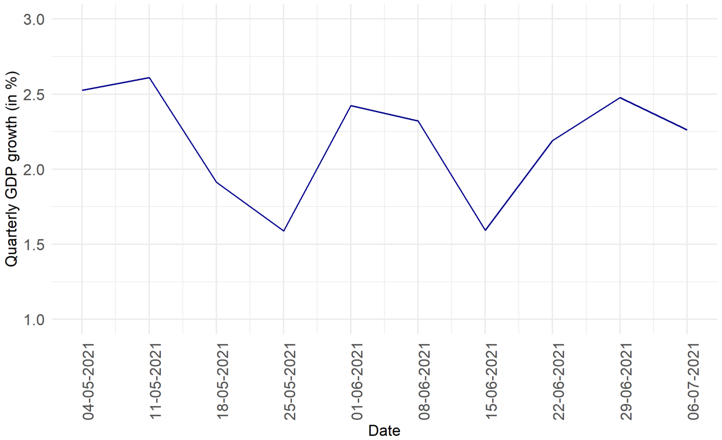


Expand

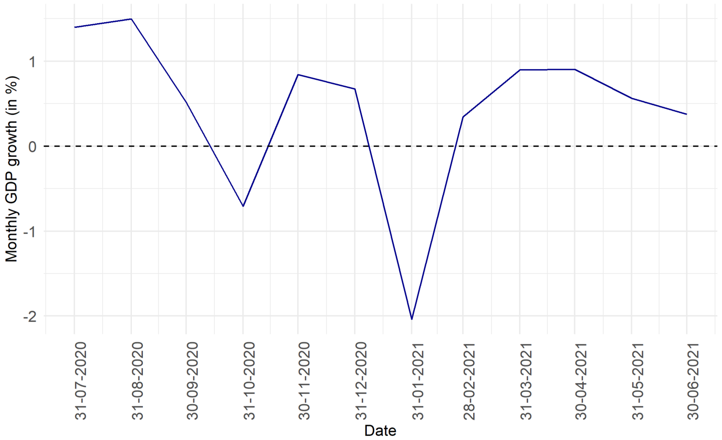
Data Flow (Jul 02, 2021)

Model Update	Release Date	Data Series	Actual	Impact	Nowcast GDP Growth
Jul 02					**3.23**
	10:00AM Jul 02	Total business inventories	0.47	0.03	
	8:30AM Jul 02	Civilian unemployment rate	0.10	-0.02	
	8:30AM Jul 02	Imports: Goods and services	1.27	-0.07	
	8:30AM Jul 02	Exports: Goods and services	0.64	-0.04	
	8:30AM Jul 02	All Employees: Total nonfarm	850.00	0.01	
	10:00AM Jul 01	ISM mfg.: Employment index	49.90	-0.07	
	10:00AM Jul 01	Value of construction put in place	-0.27	-0.01	
	10:00AM Jul 01	ISM mfg.: Prices index	92.10	0.02	
	10:00AM Jul 01	ISM mfg.: PMI composite index	60.60	0.00	
	8:10AM Jun 30	ADP nonfarm private payroll employment	692.00	0.00	
		Data revisions		-0.03	
Jun 25					**3.39**

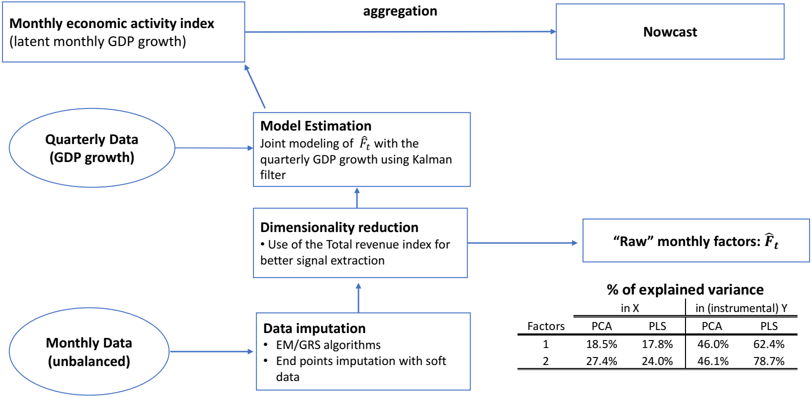
Nowcasts for 2021:Q2



Monthly real economic activity index



Nowcasting flow chart

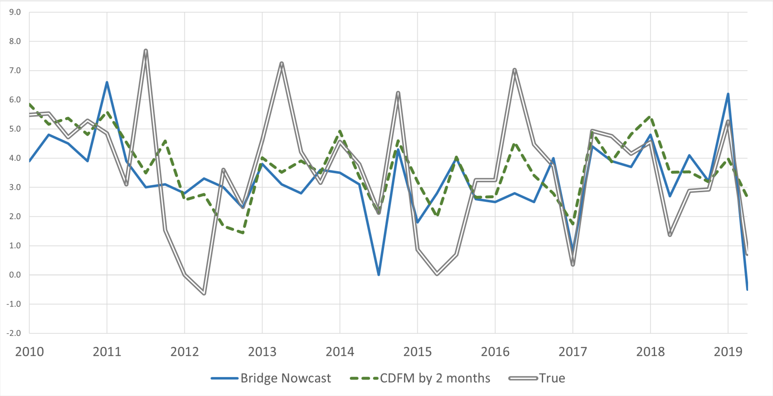


% of explained variance

	in X		in (instrumental) Y	
Factors	PCA	PLS	PCA	PLS
1	18.5%	17.8%	46.0%	62.4%
2	27.4%	24.0%	46.1%	78.7%

Model performance before COVID-19

Quarterly GDP growth (annualized) nowcasts, 2010:Q1-2019:Q2



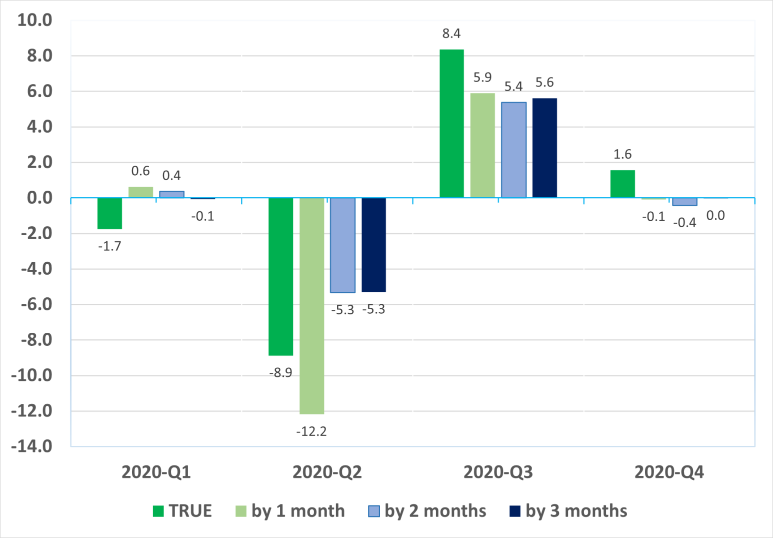
Model performance before COVID-19

Four models nowasting error summary, 2010:Q1-2019:Q2

Model	RMSE	MAE
$CDFM^{PLS}$ by 1 month	1.84	1.38
$CDFM^{PLS}$ by 2 months	1.75	1.34
$CDFM^{PLS}$ by 3 months	1.73	1.34
$CDFM^{PC}$ by 1 month	1.92	1.53
$CDFM^{PC}$ by 2 months	1.82	1.43
$CDFM^{PC}$ by 3 months	1.78	1.40
DFM by 1 month	1.92	1.47
DFM by 2 months	1.90	1.45
DFM by 3 months	1.98	1.43
Bridge	1.89	1.45

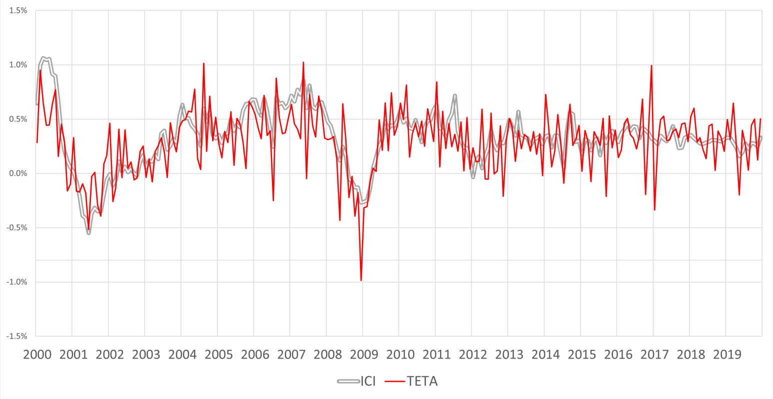
Model performance during COVID-19

Quarterly GDP growth nowcasts, 2020:Q1-2020:Q4



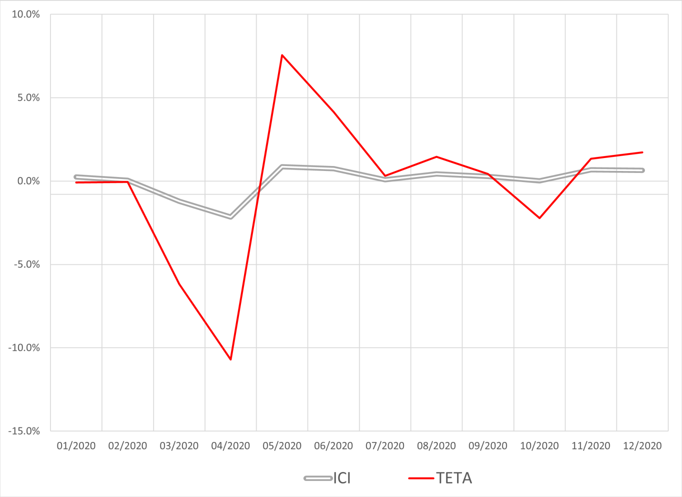
Monthly index before COVID-19

Monthly Economic Activity Indices: TETA alongside ICI (2000/1-2019/6)



Monthly index during COVID-19

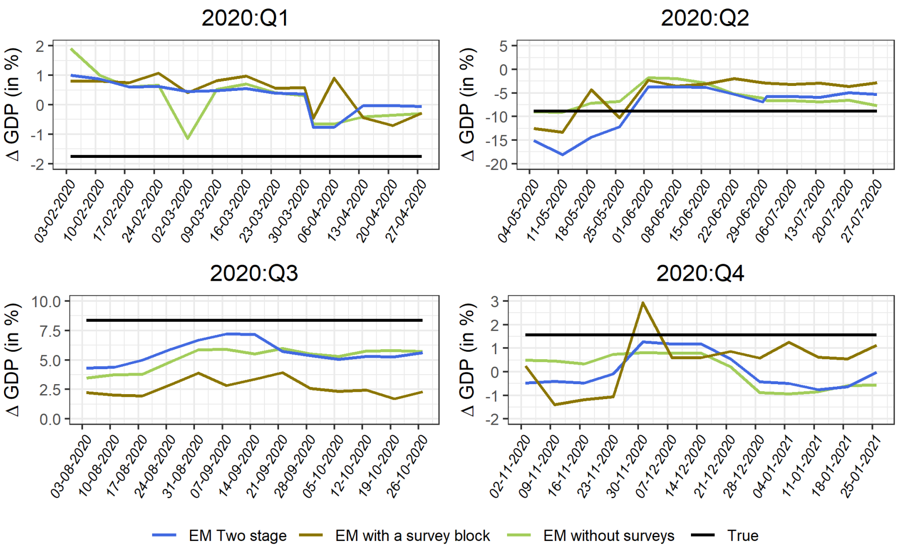
Monthly Economic Activity Indices: TETA alongside ICI (2020/1-2020/12)



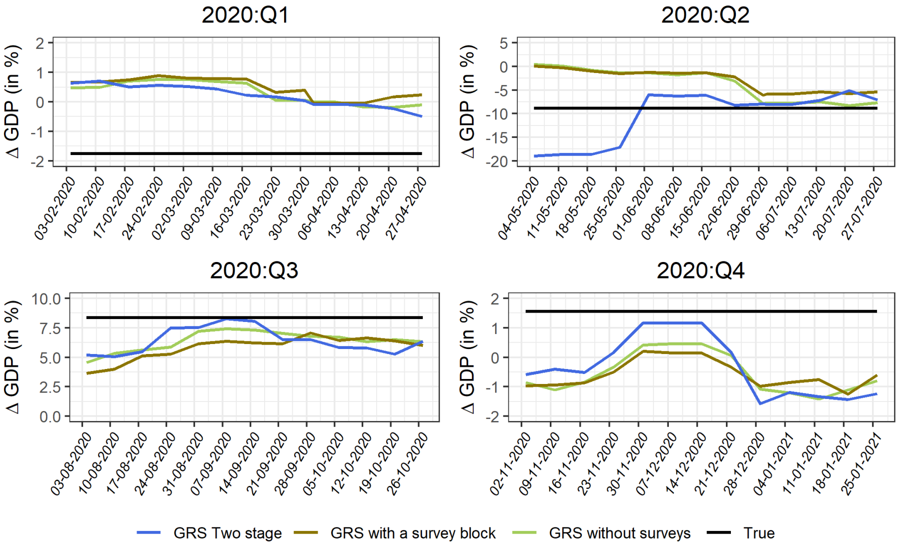
Missing data treatment

- EM algorithm (Stock and Watson, 2002)
- Kalman Filter (Giannone et al., 2008)
- Survey-based endpoints imputation

Real-time nowcasts in 2020 (EM)



Real-time nowcasts in 2020 (GRS)



2020 nowcast error summary by survey data inclusion method

Model	Q1	Q2	Q3	Q4	RMSE	MAE
EM without a survey	-1.94	-2.85	3.19	1.50	2.37	2.47
EM two-stage	-2.01	-0.95	2.75	1.53	**1.81**	**1.93**
EM with a survey block	-2.16	-3.89	5.70	1.12	3.22	3.66
GRS without a survey	-2.05	-4.85	1.97	2.13	2.75	3.01
GRS two-stage	-1.95	1.36	1.95	1.91	**1.79**	**1.81**
GRS with a survey block	-2.20	-5.78	2.55	2.14	3.17	3.51

Data release timeline

Explanatory Variable \ Day of month	< 7	7 – 14	15 – 22	> 22
Total Revenue	-2	E (2)	E (2)	E (1)
Industrial Production - total	-2	E (2)	E (2)	E (1)
Revenue in Trade	-2	E (2)	E (2)	E (1)
Revenue in Services	-2	E (2)	E (2)	E (1)
Revenue in business and private services (a)	-2	E (2)	E (2)	E (1)
Revenue in food and accommodation services	-2	E (2)	E (2)	E (1)
Sales Value in Chain Stores	-1	E (1)	E (1)	E (1)
Credit cards purchases value (b)	✓	✓	✓	✓
Building starts	-5	E (4)	E (4)	E (4)
Benzin consumption	-1	-1	-1	-1
Imports of consumer goods	-1	-1	-1	✓
Imports of production inputs	-1	-1	✓	✓
Imports of capital goods	-1	-1	✓	✓
Exports of goods	-1	-1	✓	✓
Exports of business and tourist services	-2	-2	-2	E (2)
Exports of services	-1	-1	-1	✓
Imports of services	-1	-1	-1	✓
Employees adjusted for absent workers	-1	E (1)	E (1)	E (1)
Employment posts in the private sector	-2	E (2)	E (2)	E (2)
Total (real) wages of employees	-2	E (2)	E (2)	E (2)
Job openings	-1	-1	-1	✓
PMI of Israel	-1	-1	-1	✓
PMI of USA	-1	-1	✓	✓
Electricity consumption (06:00-11:00), adjusted for weather conditions	✓	✓	✓	✓
Taxes: VAT, net (d, e)	✓	✓	✓	✓
Taxes: indirect (e)	-1	✓	✓	✓
Consumer confidence	-1	-1	✓	✓
Taxes: health (b)	-1	✓	✓	✓
Cushing oil price	✓	✓	✓	✓
TA General shares index	✓	✓	✓	✓
NASDAQ	✓	✓	✓	✓
Total Balance of Present evaluation (f)	-1	✓	✓	✓
Capital utilization (f)	-1	✓	✓	✓

back

Monthly variables list

Explanatory Variable	Data Source	Data start	Seas. adj.	Fixed price	Transformation
Total Revenue	Index, CBS	1996-01	✓	NIS	log-dif
Industrial Production - total	Index, CBS	1996-01	✓	NIS	log-dif
Revenue in Trade	Index, CBS	1996-01	✓	NIS	log-dif
Revenue in Services	Index, CBS	1996-01	✓	NIS	log-dif
Revenue in business and private services (a)	Index, CBS	1996-01	✓	NIS	log-dif
Revenue in food and accomodation services	Index, CBS	1996-01	✓	NIS	log-dif
Sales Value in Chain Stores	Index, CBS	1996-01	✓	NIS	log-dif
Credit cards purchasses value b)	CBS/Shva	2002-01 /2016-01	✓	NIS	log-dif
Building starts	CBS	1996-01	✓		log-dif
Benzin consumption	Ministry of Energy, Fuel Dep.	1996-01	✓	NIS	log-dif
Imports of consumer goods	CBS	1996-01	✓	$	log-dif
Imports of production inputs	CBS	1996-01	✓	$	log-dif
Imports of capital goods	CBS	1996-01	✓	$	log-dif
Exports of goods	CBS	1996-01	✓	$	log-dif
Exports of business and tourist services	CBS	2009-01	✓	$	log-dif
Exports of services	BOI system	1996-01	✓	$	log-dif
Imports of services	BOI system	1996-01	✓	$	log-dif
Employees adjusted for absent workeres	CBS	2012-01	✓		log-dif
Employement posts in the private sector	CBS	1996-01	✓		log-dif
Total (real) wages of employee jobs c)	CBS	1998-01	✓	NIS	log-dif
Job oppenings	CBS	2009-09	✓		log-dif
PMI of Israel	Bank-Apoalim	1996-01	✓		
PMI of USA	Bloomberg	1996-01			
Electricity consumption (06:00-11:00), adjusted for weather conditions (d)	BOI model	2002-01	✓		log-dif
Taxes: VAT net (e, f)	Ministry of Finance	1996-01	✓		log-dif
Taxes: indirect (f)	Ministry of Finance	1996-01	✓		log-dif
Taxes: health (b)	National Insurance	1996-01	✓		log-dif
Consumer confidence	CBS	2011-03			
Cushing oil price	Bloomberg	1996-01			log-dif
TA General shares index	TASE	1996-01			log-dif
NASDAQ	Bloomberg	1996-01			
Total Balance of Present evaluation g)	CBS	2011-01			
Capital utilization (g)	CBS	2011-01			

back

Dynamic factor model

Let $x_t = (x_{1,t}, x_{2,t}, ..., x_{n,t})'$ with $t = 1, 2, ..., T$ be a vector of n monthly series which have been transformed to stationary and standardized.

$$x_t = \Lambda F_t + \varepsilon_t, \ \varepsilon_t \sim N(0, R) \tag{1}$$

where F_t is an $(r \times 1)$ vector of unobserved common factors which, Λ is an $(n \times r)$ matrix of their loadings, and ε_t is an $(n \times 1)$ vector of the idiosyncratic components. The factors are assumed to have the following stationary VAR(p) representation:

$$F_t = \sum_{s=1}^{p} \Phi_s F_{t-s} + u_t, \ u_t \sim N(0, Q) \tag{2}$$

where Φ_s are $(r \times r)$ matrices of autoregressive coefficients.

Monthly growth dynamics

We could start from a benchmark assuming that the logarithm of the GDP follows a drifting random walk giving the following dynamics of y_t:

$$y_t = \mu + \varepsilon_{y,t}, \tag{3}$$

where $\varepsilon_{y,t} \sim N(0, \sigma^2_{\varepsilon y})$, μ represents the trend component, and $\varepsilon_{y,t}$ is the error term.

Monthly growth dynamics cont.

The performance of (3) can be further improved by augmenting the model with a set of factors derived from x_t, giving the following representation:

$$y_t = \mu + \Lambda_{yx} F_t + \varepsilon_{y,t}.$$

In the state space form the measurement equation can be written as

$$\begin{pmatrix} y_t \\ x_t \end{pmatrix} = \begin{bmatrix} \mu \\ 0 \end{bmatrix} + \begin{bmatrix} \Lambda_{yx} \\ \Lambda \end{bmatrix} F_t + \begin{pmatrix} \varepsilon_{y,t} \\ \varepsilon_t \end{pmatrix} \tag{4}$$

Collapsing

The idea is to use a transformed version of the measurement equation (4) pre-multiplied by the transformation matrix

$$P = \begin{bmatrix} 1 & 0 \\ 0 & A \end{bmatrix},$$

where A is an $(r \times n)$ matrix. The adjusted measurement equation therefore becomes

$$\begin{pmatrix} y_t \\ Ax_t \end{pmatrix} = \begin{bmatrix} \mu \\ 0 \end{bmatrix} + \begin{bmatrix} \Lambda_{yx} \\ A\Lambda \end{bmatrix} F_t + \begin{pmatrix} \varepsilon_{y,t} \\ A\varepsilon_t \end{pmatrix},$$

while the state equation remains unchanged.

Collapsing cont.

To reduce the incurred information loss, Bräuning and Koopman (2014) and Brave et al. (2019) construct A using the principal component weights. Denote by $\hat{F}_t = A_{pc}x_t$ the r principal components associated with the largest eigenvalues of the data matrix $(x_1, \ldots, x_T)'$. By writing $\hat{F}_t \approx F_t + error$, pre-multiplying (4) by $P = \begin{bmatrix} 1 & 0 \\ 0 & A_{pc} \end{bmatrix}$ gives the collapsed dynamic factor model

$$\begin{pmatrix} y_t \\ \hat{F}_t \end{pmatrix} = \begin{bmatrix} \mu \\ 0 \end{bmatrix} + \begin{bmatrix} \Lambda_{yx} \\ I_r \end{bmatrix} F_t + \begin{pmatrix} \varepsilon_{y,t} \\ \varepsilon_t^{pc} \end{pmatrix}. \tag{5}$$

Mixing frequencies

Let GDP_t^Q denote the observed quarterly level of GDP and GDP_t^M be its unobservable monthly counterpart. Thus, if GDP_t^Q is observed at the end of each quarter, we obtain that

$$\begin{cases} GDP_t^Q = GDP_t^M + GDP_{t-1}^M + GDP_{t-2}^M & t = 3, 6, 9, \dots \\ NA & o.w. \end{cases}$$

Mixing frequencies

Let us further define $Y_t^Q = \log(GDP_t^Q)$ and $Y_t^M = \log(GDP_t^M)$. Then, the unobserved monthly logarithmic growth rate y_t is equal to ΔY_t^M. To bridge between the observed quarterly data and the monthly series, we also define the GDP growth as a partially observed monthly variable

$$\begin{cases} y_t^Q = Y_t^Q - Y_{t-3}^Q & t = 3, 6, 9, \ldots \\ \quad\quad NA & o.w. \end{cases}$$

and apply the approximation of Mariano and Murasawa (2003):

$$y_t^Q = \frac{1}{3}y_t + \frac{2}{3}y_{t-1} + y_{t-2} + \frac{2}{3}y_{t-3} + \frac{1}{3}y_{t-4} \quad t = 3, 6, 9, \ldots$$

Mixing frequencies cont.

$$\begin{pmatrix} y_t^Q \\ \hat{F}_t \end{pmatrix} = \begin{bmatrix} \frac{1}{3} & \frac{2}{3} & 1 & \frac{2}{3} & \frac{1}{3} & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{pmatrix} y_t \\ y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ y_{t-4} \\ F_t \end{pmatrix} + \begin{pmatrix} 0 \\ \varepsilon_t^{pc} \end{pmatrix}$$

$$\begin{pmatrix} y_t \\ y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ y_{t-4} \\ F_t \end{pmatrix} = \begin{bmatrix} \mu \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & \Lambda_{yx}\Phi_1 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \Phi_1 \end{bmatrix} \begin{pmatrix} y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ y_{t-4} \\ y_{t-5} \\ F_{t-1} \end{pmatrix} + \begin{bmatrix} 1 & \Lambda_{yx} \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} \begin{pmatrix} \varepsilon_{y,t} \\ u_t \end{pmatrix}$$

REFERENCES

Brave, S. A., R. A. Butters, , and D. Kelley (2019). A new" big data" index of US economic activity. *Economic Perspectives, Federal Reserve Bank of Chicago 43*, 1–30.

Bräuning, F. and S. J. Koopman (2014). Forecasting macroeconomic variables using collapsed dynamic factor analysis. *International Journal of Forecasting 30*, 572–584.

Giannone, D., L. Reichlin, and D. Small (2008). Nowcasting: The real-time informational content of macroeconomic data. *Journal of Monetary Economics 55*(4), 665–676.

Mariano, R. S. and Y. Murasawa (2003). A new coincident index of business cycles based on monthly and quarterly series. *Journal of Applied Econometrics 18*, 427–443.

Stock, J. and M. Watson (2002). Macroeconomic forecasting using diffusion indexes. *Journal of Business and Economic Statistics 20*, 147–162.

Nowcasting and monitoring Israeli real economic activity*

Tim Ginker Tanya Suhoy

Bank of Israel

Abstract

We employ an extension of the collapsed dynamic factor model introduced by Bräuning and Koopman (2014) for GDP nowcasting. Compared with other popular benchmarks, our model is able to improve on the timelines and accuracy of the quarterly forecasts. Our real-time experiment during the COVID-19 crisis underlines the importance of using more timely released survey-based indicators for endpoints imputation of the "hard" data. The same framework allows the construction of a monthly index of real economic activity which is consistent with the nowcast. In contrast with the currently published by the Bank of Israel Composite State of the Economy Index, it utilizes a much broader data set and thus is likely to provide a more timely and precise picture of the course of economic activity.

Keywords: Nowcasting; Dynamic factor model; Partial Least Squares; COVID-19.

1 Introduction

In this paper, we present a nowcasting model for tracking Israeli real activity in terms of GDP growth. Using the mixed-frequency dynamic factor model, we address a number of important practical issues. Namely, the modeling framework allows us to combine monthly series with different historical lengths. In addition, it accommodates data with "jagged-edges" that arise from asynchronous data releases which lead to missing observations at the end of the sample. Along with traditional macroeconomic series with long history, such as the industrial production index, we incorporate some newly launched data sources, such as the Business Tendency Survey (hereafter - BTS) or daily volumes of credit cards purchases. In real-time applications, BTS based indices can be used as a timely proxy for important macroeconomic series that are released with significant delay. Our findings suggest that surveys can significantly reduce the nowcasting error when they are used for end points imputation.

Since the seminal research led by Stock and Watson (1989, 1991, 1993) showing that the co-movement across many macroeconomic indicators can be summarized in a few latent factors that can be used for tracking the course of economic activity, dynamic factor models have become popular in the analysis of large macroeconomic data sets and as a nowcasting tool at central banks and other institutions. Despite the existence of appropriate estimation routines (Banbura and Modugno, 2014) direct joint modeling of the quarterly GDP growth with a large panel of the available monthly indicators still leaves a model with a high number of parameters and hence higher forecast variance. To address this issue, Bräuning and Koopman (2014) introduced a collapsed dynamic factor model (hereinafter - CDFM) which allows the combination of a large number of monthly series in a relatively parsimonious model. This is a two-step procedure, where in the first step, the information contained in the monthly variables is summarized in a small number of factors using the principal component analysis (PCA). In the second step, the factors are modeled jointly with the GDP growth in a dynamic factor model.

We employ an alternative extension of the CDFM, aiming to increase the amount of relevant variation extracted in the first step. The idea is to adjust the collapsing scheme in such a way that it would put more weight on the variables that are more strongly related to economic growth. This can be achieved by finding a suitable monthly instrument that has a close relationship with the unobserved monthly growth and then using the partial least squares (PLS) scores instead of the principal components.

*We are grateful to Sercan Eraslan for his review and advice. We thank Ariel Mansura and Eyal Argov for valuable suggestions and discussions. This paper presents our preliminary findings and is being published exclusively to facilitate discussion on the topic. The authors are solely responsible for any error or omission present in the paper. The views expressed here are solely those of the authors.

From the theoretical perspective, in the CDFM framework quarterly forecasts are constructed from the filtered values of the unobserved monthly GDP growth, dynamics of which is derived mostly from the factors. Stock and Watson (2002) showed that it is possible to produce consistent estimates of the latent factors using principal components when both the number of observations and the number of monthly indicators tend to infinity. This feature was utilized by Brave et al. (2019) which constructed a new "big data" index of U.S. economic activity using a large panel of monthly indicators. However, these amounts of data are unattainable in small economies like Israel. Consequently, applying principal components to a small monthly dataset may result in low accuracy of the factors which would be passed to the implied monthly growth levels, and hence introduce a systematic error in the quarterly nowcasts. More recently, Groen and Kapetanios (2016) showed that PLS factors have similar properties to those found by Stock and Watson (2002) for PCA. Moreover, PLS retains the optimality characteristics even in the weak factor case for which it is known that PCA becomes inconsistent. Thus, if it is possible to find another monthly (instrument) variable which depends on the same factors as the unobserved monthly GDP growth, using PLS can provide a valuable alternative to PCA in small economies like Israel the number of monthly indicators is limited.

The paper is organized as follows. Section 2 presents the econometric methodology. Section 3 discusses our out-of-sample forecasting experiment and other practical issues related to the use of "soft" leading indicators and imputation methods in real-time applications, and Section 4 concludes.

2 Methodology

Let $x_t = (x_{1,t}, x_{2,t}, ..., x_{n,t})'$ with $t = 1, 2, ..., T$ be a vector of n monthly series which have been transformed to stationary and standardized. A dynamic factor model (DFM) assumes that it is possible to decompose x_t in terms of two unobserved orthogonal components representing common and idiosyncratic factors. The model is specified as follows:

$$x_t = \Lambda F_t + \varepsilon_t,\ \varepsilon_t \sim N(0, R) \tag{1}$$

where F_t is an $(r \times 1)$ vector of unobserved common factors which, Λ is an $(n \times r)$ matrix of their loadings, and ε_t is an $(n \times 1)$ vector of the idiosyncratic components. The factors are assumed to have the following stationary VAR(p) representation:

$$F_t = \sum_{s=1}^{p} \Phi_s F_{t-s} + u_t,\ u_t \sim N(0, Q) \tag{2}$$

where Φ_s are $(r \times r)$ matrices of autoregressive coefficients. The related inference and forecast procedures can be carried out using the standard Kalman filter techniques (see, for instance, Hamilton, 1994, Ch. 13).

Following Bräuning and Koopman (2014), we start from specifying the dynamics of the unobserved monthly GDP growth – y_t. Consider a benchmark model assuming that the logarithm of the GDP follows a drifting random walk giving the following dynamics of y_t:

$$y_t = \mu + \varepsilon_{y,t}, \tag{3}$$

where $\varepsilon_{y,t} \sim N(0, \sigma^2_{\varepsilon y})$, μ represents the trend component, and $\varepsilon_{y,t}$ is the error term. Its performance can be further improved by augmenting the model with a set of factors derived from x_t, giving the following representation:

$$y_t = \mu + \Lambda_{yx} F_t + \varepsilon_{y,t}.$$

In the state space form the measurement equation can be written as

$$\begin{pmatrix} y_t \\ x_t \end{pmatrix} = \begin{bmatrix} \mu \\ 0 \end{bmatrix} + \begin{bmatrix} \Lambda_{yx} \\ \Lambda \end{bmatrix} F_t + \begin{pmatrix} \varepsilon_{y,t} \\ \varepsilon_t \end{pmatrix} \tag{4}$$

In macroeconomic applications, the number of monthly indicators can be high relative to the number of observations, which can significantly complicate the estimation routine and introduce additional variance to the model. To overcome this difficulty, Bräuning and Koopman (2014) introduced a collapsed dynamic factor model that applies the dimension reduction transformation on the measurement equation. The idea is to use a transformed version of the measurement equation (4) pre-multiplied by the transformation matrix

$$P = \begin{bmatrix} 1 & 0 \\ 0 & A \end{bmatrix},$$

where A is an $(r \times n)$ matrix. The adjusted measurement equation therefore becomes

$$\begin{pmatrix} y_t \\ Ax_t \end{pmatrix} = \begin{bmatrix} \mu \\ 0 \end{bmatrix} + \begin{bmatrix} \Lambda_{yx} \\ A\Lambda \end{bmatrix} F_t + \begin{pmatrix} \varepsilon_{y,t} \\ A\varepsilon_t \end{pmatrix},$$

while the state equation remains unchanged. To reduce the incurred information loss, Bräuning and Koopman (2014) construct A using the principal component weights. Denote by $\hat{F}_t = A_{pc}x_t$ the r principal components associated with the largest eigenvalues of the data matrix $(x_1, \ldots, x_T)'$. By writing $\hat{F}_t \approx F_t + error$, pre-multiplying (4) by $P = \begin{bmatrix} 1 & 0 \\ 0 & A_{pc} \end{bmatrix}$ gives the collapsed dynamic factor model

$$\begin{pmatrix} y_t \\ \hat{F}_t \end{pmatrix} = \begin{bmatrix} \mu \\ 0 \end{bmatrix} + \begin{bmatrix} \Lambda_{yx} \\ I_r \end{bmatrix} F_t + \begin{pmatrix} \varepsilon_{y,t} \\ \varepsilon_t^{pc} \end{pmatrix}. \tag{5}$$

Since GDP growth is observed quarterly, to incorporate it with the monthly indicators within the same dynamic factor system, the state space representation needs to be further adjusted. To do so we adopt the framework proposed by Mariano and Murasawa (2003). Let GDP_t^Q denote the observed quarterly level of GDP and GDP_t^M be its unobservable monthly counterpart. We further define $Y_t^Q = \log(GDP_t^Q)$ and $Y_t^M = \log(GDP_t^M)$. Then, the unobserved monthly logarithmic growth rate y_t is equal to ΔY_t^M. To bridge between the observed quarterly data and the monthly series, we also define the GDP growth as a partially observed monthly variable

$$\begin{cases} y_t^Q = Y_t^Q - Y_{t-3}^Q & t = 3, 6, 9, ... \\ NA & o.w. \end{cases}$$

and apply the approximation of Mariano and Murasawa (2003):

$$y_t^Q = \frac{1}{3}y_t + \frac{2}{3}y_{t-1} + y_{t-2} + \frac{2}{3}y_{t-3} + \frac{1}{3}y_{t-4} \quad t = 3, 6, 9, ...$$

Finally, the series are modeled jointly using the suitable expansion of the state equation.

To summarize, the estimation of the CDFM consists of two steps. First, the information contained in the monthly variables is summarized in a small number of factors using the principal component analysis (PCA). If some of the observations are missing, imputation is performed using the iterative PCA technique proposed by Stock and Watson (2002). In the second step, the monthly factors are modeled jointly with the quarterly GDP growth in a properly adjusted dynamic factor model. In the current work, due to the aforementioned limitations of the PCA procedure in small markets like Israel where the number of monthly variables is limited, to construct the factors we opt to using the partial least squares (PLS) method with the Total revenue index as an instrument.

3 Result

Here we discuss a variety of aspects of our empirical results. First, we illustrate the advantages of the CDFM in nowcasting GDP growth. Then, we demonstrate its usefulness in monitoring the monthly changes in economic activity. Finally, we study various challenges of forecasting in real-time and imputation using survey data.

Our monthly data set consists of 40 economic and financial indicators. An overview of the series, their sources and transformations can be found in Table 1 in the online supplement. All monthly indicators are adjusted for price changes, seasonality, and are transformed to be stationary. All foreign series are presented in fixed USD prices.

Following the discussion in Sections 1 and 2, we estimate CDFM (hereafter - $CDFM^{PLS}$) using the PLS scores with the Total Revenue index being used as an instrument. Its predictive performance is then compared with the CDFM using PC scores (hereafter - $CDFM^{PC}$), dynamic factor model (DFM) and the current Bank of Israel staff forecast (hereafter - Bridge) built as a combination of an econometric model (for more technical details see see Krief, 2011) and a judgmental forecast. To make the nowcasts in the CDFM and DFM, for each quarter in the test sample we re-estimate the model using the monthly and quarterly data from January 2000 up to one of our three variants of the information set. For compatibility with the last Bridge validation report which separates the judgments effect, our forecast evaluation period is taken from the first quarter of 2010 to the second quarter of 2019. For the CDFM, the imputation of missing data at the beginning of the sample is done using the methodology of Stock and Watson (2002).

As was noted in Section 2, collapsing significantly reduces the number of parameters and hence the forecast variance. However, at the same time, it incurs the loss of information (Bräuning and Koopman, 2014). Consequently, it would be interesting to compare the predictive performance of the CDFM aginst the ordinary DFM to see whether the benefits from dimensionality reduction overweight the information loss. Our DFM specification is based on the same set of variables as CDFM with the block structure proposed by Bok et al. (2017), and is fitted using the Expectation Maximization algorithm as described in Bańbura and Modugno (2014). The models' out of sample prediction root mean squared error (RMSE) and the mean absolute error (MAE) are reported in Table 1. In all three setups, $CDFM^{PLS}$ gives the lowest prediction error. It should be noted that the initial nowcast is made one month before the Bridge. Thus, it improves not only on the accuracy but also on the timeliness of the forecast. It is worth nothing that judgements reduce the Bridge RMSE by 0.5. Thus, without a judgmental part, depending on the available data, $CDFM^{PLS}$ gives a reduction in the RMSE of 30% to 38%.

Table 1: Nowcasting error summary

	CDFM^{PLS}		CDFM^{PC}		DFM		Bridge	
	RMSE	MAE	RMSE	MAE	RMSE	MAE	RMSE	MAE
by 1 month	1.84	1.38	1.92	1.53	1.92	1.47		
by 2 months	1.75	1.34	1.82	1.43	1.90	1.45	1.89	1.45
by 3 months	1.73	1.34	1.78	1.40	1.98	1.43		

Following Brave et al. (2019) we construct a new activity index from the filtered values of the state corresponding to the current unobserved monthly GDP growth. As can be seen from Figures 1 and 2, the new indicator (hereafter - TETA) broadly coheres with the Israeli Composite State of the Economy Index (hereafter - ICI) during various stages of the cycle. However, it has a much higher variability which partly follows from the use of a broader information set and a binding restriction on the monthly growth rates to sum up exactly to the predicted quarterly growth (or to the actual, when available).

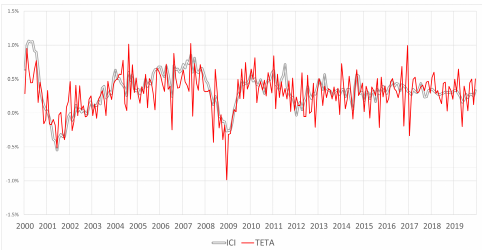


Figure 1: Monthly Economic Activity Indices: TETA alongside ICI (2010/1-2019/6).

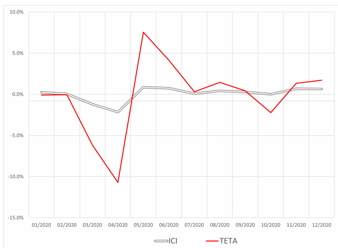


Figure 2: Monthly Economic Activity Indices: TETA alongside ICI (2020/1-2020/12).

The advantages of this higher sensitivity became apparent during 2020. As can be seen from Figure 2, during the whole period ICI continues to hover around zero and shows almost no indication of the crisis. In contrast, we observe a sharp drop in the new index coinciding with the emergency measures enacted in March which plunges even deeper in April. The marked improvement in May also corresponds to the easing of the lockdown restrictions followed by the decline in July during the second lockdown. Finally, the negative values in October coincide with the third wave of restrictions. This is in stark contrast with the ICI which remained at almost the same level since May. This demonstrates the ability of our new index to draw a more precise picture regarding the current state of the economy and to indicate earlier turning points.

Producing accurate nowcasts is most ambitious yet also most important at the periods of rapid changes and distress as was during the COVID-19 crisis in 2020. We conduct a real-time nowcasting experiment for the period from January 2020 to January 2021. For this purpose, we reconstructed the true data vintages at the weekly frequency and produced a sequence of forecasts for each quarter based on the expanding set of information.

Before, we dealt with the patterns of missing data arising solely from the differences in the historical length of the series. In practical applications it is highly common that due to non-synchronous data releases and publication delays there is an irregular pattern of missing observations at the end of the sample as well (it is frequently named as a "jagged edge" problem). As before, this issue could be treated routinely with the EM algorithm (Stock and Watson, 2002). In this method, the imputation of missing observations is done through the recursive procedure of computing the scores and filling the missing values using projection. However, many of the important leading indicators, such as production and revenue indices, are available with a significant delay (see Table 2 in the online supplement for more details on the release timeline) and the imputation accuracy based on the limited number of more timely released series may be insufficient.

Another interesting approach of dealing with missing data, which is currently applied in the Federeal Reserve Bank of Atlanta (see Higgins, 2014), was proposed by Giannone et al. (2008). In this method the initial factors are computed using the Kalman smoother. Here, the factor extraction process is designed in a way that it will simply put no weight on the missing observations rather than trying fill them using the available data. The method was less suitable for the pseudo real time forecasting experiment in the previous section because the constructed balanced monthly panel would be too short.

Many important series, such as industrial production, revenue, and labor indices have more timely released "soft" proxies. For instance, since 2011 Israeli Central Bureau of Statistics conducts a monthly compulsory survey (named a Business Tendency Survey, hereafter -BTS) among firm managers in the Manufacturing, Construction, Trade, Hotels, and Services industries, in which they provide an assessment (on a five-point scale, from "marked decrease" to "marked increase") of the current situation of their business and the outlook for the near future. The questionnaires are related to the companies' main parameters such as output, domestic and export sales, employment, and prices. Balances of opinion from such surveys is proven useful in forecasting GDP growth (see for instance Pichette and Rennison, 2011; Chernis and Sekkel, 2017). In the CDFM framework, these variables can be added directly to the monthly panel or to be used for external imputation of the series they are aimed to proxy outside the model (hereafter - two stage extraction). To test which extraction method is better, we evaluate the average precision of the nowcasts for the two alternatives with the model without the survey proxies serving as a benchmark.

Table 2 provides a breakdown of the average nowcasting error by survey inclusion method for each quarter. Several observations are in order. Prior research has emphasized the usefulness of "soft" indicators for nowcasting, and of the BTS in particular. Based on our analysis, for both factor extraction methods, BTS-based indices can significantly improve the timeliness and accuracy of the nowcasts when these are used for the end points imputation. Compared to the benchmark model without surveys, it reduces the RMSE by approximately 21.9% and 39.8% for the EM and GRS methods respectively. In contrast, while the CDFM framework is designed to deal with any number of indicators, it appears that we still should be careful with introducing unnecessary noise to the system. Expanding the monthly panel with the survey proxies of some of the already included variables leads to inferior forecasting performance. In our experiment, compared with the benchmark, the RMSE of the models with a survey block is higher by 48.5% and 16.7% for the EM and GRS methods respectively. For the two stage method both factor extraction methods shown similar MAE, and GRS had an RMSE lower by 6%.

Table 2: 2020 nowcast error summary by survey data inclusion method

	Q1	Q2	Q3	Q4	RMSE	MAE
EM without a survey	-1.94	-2.85	3.19	1.50	2.37	2.47
EM two-stage	-2.01	-0.95	2.75	1.53	1.81	1.93
EM with a survey block	-2.16	-3.89	5.70	1.12	3.22	3.66
GRS without a survey	-2.05	-4.85	1.97	2.13	2.75	3.01
GRS two-stage	-1.95	1.36	1.95	1.91	1.79	1.81
GRS with a survey block	-2.20	-5.78	2.55	2.14	3.17	3.51

4 Discussion and Conclusion

In this paper, we applied an extension of the CDFM to produce the nowcasts for Israeli quarterly GDP growth. Our pseudo-real-time forecasting experiment shows that the model is able to produce nowcasts as accurately as the judgmental ones. In addition, we have shown that using instruments can reduce the information loss from the dimension reduction and thus improve the accuracy of the forecasts. Our real-time nowcasting experiment during the COVID-19 crisis underlines the importance of using more timely released survey-based indicators for end points imputation of the "hard" data. Moreover, similarly to Brave et al. (2019) we applied the same framework to produce a new monthly index of economic activity. The index is shown to be able to give a more precise picture regarding the current state of the economy and to indicate earlier turning points.

References

Banbura, M. and M. Modugno (2014). Maximum likelihood estimation of factor models on datasets with arbitrary pattern of missing data. *Journal of Applied Econometrics 29*(1), 133–160.

Bańbura, M. and M. Modugno (2014). Maximum likelihood estimation of factor models on datasets with arbitrary pattern of missing data. *Journal of Applied Econometrics 29*(1), 133–160.

Bok, B., D. Caratelli, D. Giannone, A. Sbordone, and A. Tambalotti (2017). Macroeconomic nowcasting and forecasting with big data. Staff Report 830, New York, NY.

Brave, S. A., R. A. Butters, , and D. Kelley (2019). A new" big data" index of US economic activity. *Economic Perspectives, Federal Reserve Bank of Chicago 43*, 1–30.

Bräuning, F. and S. J. Koopman (2014). Forecasting macroeconomic variables using collapsed dynamic factor analysis. *International Journal of Forecasting 30*, 572–584.

Chernis, T. and R. Sekkel (2017, August). A dynamic factor model for nowcasting Canadian GDP growth. *Empirical Economics 53*(1), 217–234.

Giannone, D., L. Reichlin, and D. Small (2008). Nowcasting: The real-time informational content of macroeconomic data. *Journal of Monetary Economics 55*, 665–676.

Groen, J. J. and G. Kapetanios (2016). Revisiting useful approaches to data-rich macroeconomic forecasting. *Computational Statistics Data Analysis 100*, 221–239.

Hamilton, J. (1994). *Time series analysis.* Princeton university press.

Higgins, P. (2014). Gdpnow: A model for gdp ñowcasting". FRB Atlanta Working Paper 2014-7, Federal Reserve Bank of Atlanta.

Krief, T. (2011). Nowcasting model for GDP and its components. Technical Report 2011.01, Bank of Israel.

Mariano, R. S. and Y. Murasawa (2003). A new coincident index of business cycles based on monthly and quarterly series. *Journal of Applied Econometrics 18*, 427–443.

Pichette, L. and L. Rennison (2011). Extracting information from the business outlook survey: A principal-component approach. *Bank of Canada Review 2011*(Autumn), 21–28.

Stock, J. and M. Watson (1989). New indexes of coincident and leading economic indicators. *NBER macroeconomics annual*, 351–394.

Stock, J. and M. Watson (1991). A probability model of the coincident economic indicators. *Leading Economic indicators: new approaches and forecasting records 66.*

Stock, J. and M. Watson (1993). *Business cycles, indicators and forecasting*, Chapter A procedure for predicting recessions with leading indicators: econometric issues and recent experience. University of Chicago Press.

Stock, J. and M. Watson (2002). Macroeconomic forecasting using diffusion indexes. *Journal of Business and Economic Statistics 20*, 147–162.

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics
July 2021, The Hague, Netherlands, virtual format

An experimental index to measuring inflation in the Covid-19 pandemic[1]

Omiros Kouvavas, Riccardo Trezzi, Eduardo Gonçalves and Christian Rollo,
European Central Bank

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

An Experimental Index to Measuring Inflation in the COVID-19 Pandemic

July 2021

Omiros Kouvavas
DG Statistics
Joined work with: Riccardo Trezzi, Eduardo Gonçalves and Christian Rollo

15/07/2021

IFC participation - 63rd ISI World Statistics Congress

Overview

Main questions:

1. **What is the magnitude of the pandemic triggered consumption changes?**
   - Could this be approximated in a timely manner?
   - How do they compare to HICP yearly weights?
2. **How does a time-varying weights price index for the EA look like?**
   - What are the challenges?
3. **And how does such an index compare to the HICP?**
   - Pre-COVID-19 and after?
4. **What are the take-away point with respect to availability of data?**

Results:

1. **We have estimated timely consumption weights using publicly available data.**
    - This data reasonably match the official HICP weights of the year after.
2. **We have constructed a time-varying weights price index for the EA.**
    - This index captures substitution only to some extent, given data limitations. Monthly re-weighting could lead to chain-drift.
3. **The index is running higher than HICP but converging.**
4. **Granularity of input data matters, the formula choice matters less.**

Overview

Our contribution is closely related to recent papers:

1. **Literature on (Covid-induced) changes in spending composition:**
   - Cavallo (2020) for the US, Hood and Driessen (2020) for the US, Surico et al. (2020) for the UK, Carvalho et al. (2020) for Spain.
2. **Literature on time-varying weights price indexes:**
   - Cavallo (2020) for several countries, INSEE & BdF (2020) for France, Jaravel and O'Connell (2020) for the UK, Alvarez and Lein (2020) for Switzerland, Huynh et al. (2020) for Canada, ONS (2020) experimental index for the UK.

Overview

Methodology: the steps

Stylized steps to construct a timely monthly index:

Service and retail trade turnover data → Mapping to HICP components → Calculation of the monthly weights → Monthly weights consumer price index and HICP comparison

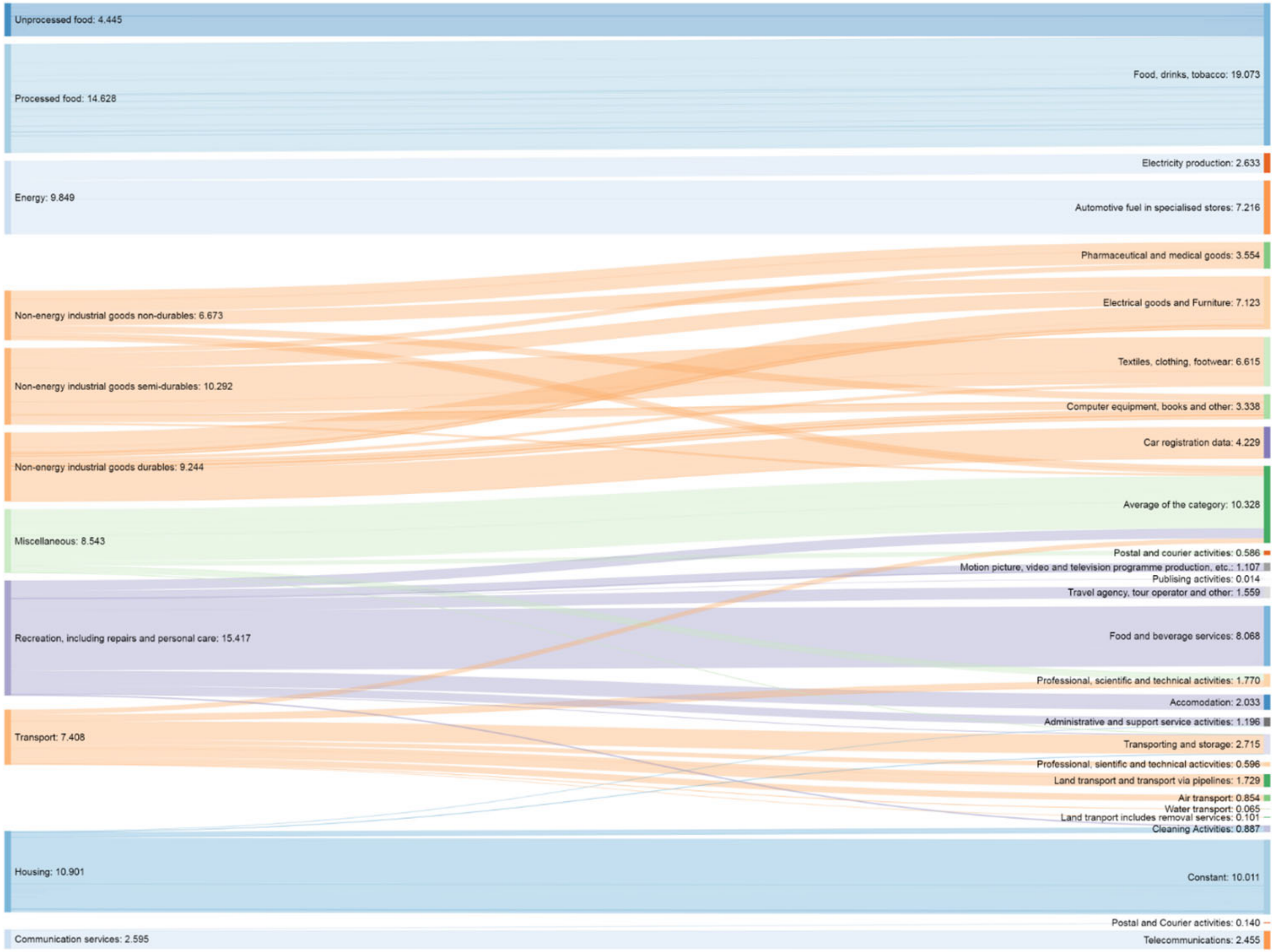
In order to construct a time-varying weights price index, 4 main steps are necessary:

1. **Identify (publicly available) data sources for consumption weights.**
   - Price data are the <u>same</u> of HICP (we assume same scope and coverage).
2. **Match the (publicly available) consumption data to the existing COICOP categories.**
3. **Choose the frequency of the weights update of the index (monthly?).**
4. **Choose the formula of the index (Fisher?).**

Methodology: Step 2 – Matching source data with COICOP categories

ECB-CONFIDENTIAL

COICOP categories



Input data match
(NACE Rev 2)

Summary:

Categories with granular matching: durables, semi-durables, non-durables, recreation, transport, and communication.

Categories with some detailed matching: part of miscellaneous services. The rest is assumed to grow at the same rate of the aggregate of the category.

Categories with only aggregate matching: unprocessed food, processed food, and energy.

- **Other:** nominal spending on housing services are random walked.
- **Scope and coverage:** for simplicity we have assumed the same scope and coverage of the HICP. In principle, this can be changed but non-trivial work would be required if, say, non-market prices have to be included.

Different formula options:

– Laspeyres index (Etienne Laspeyres (1871)). Used in HICP.

$$P_L = \frac{\sum(p_t \cdot q_{t-1})}{\sum(p_{t-1} \cdot q_{t-1})}$$

– Paasche index (Hermann Passche (1874)).

$$P_P = \frac{\sum(p_t \cdot q_t)}{\sum(p_{t-1} \cdot q_t)}$$

– Fisher index

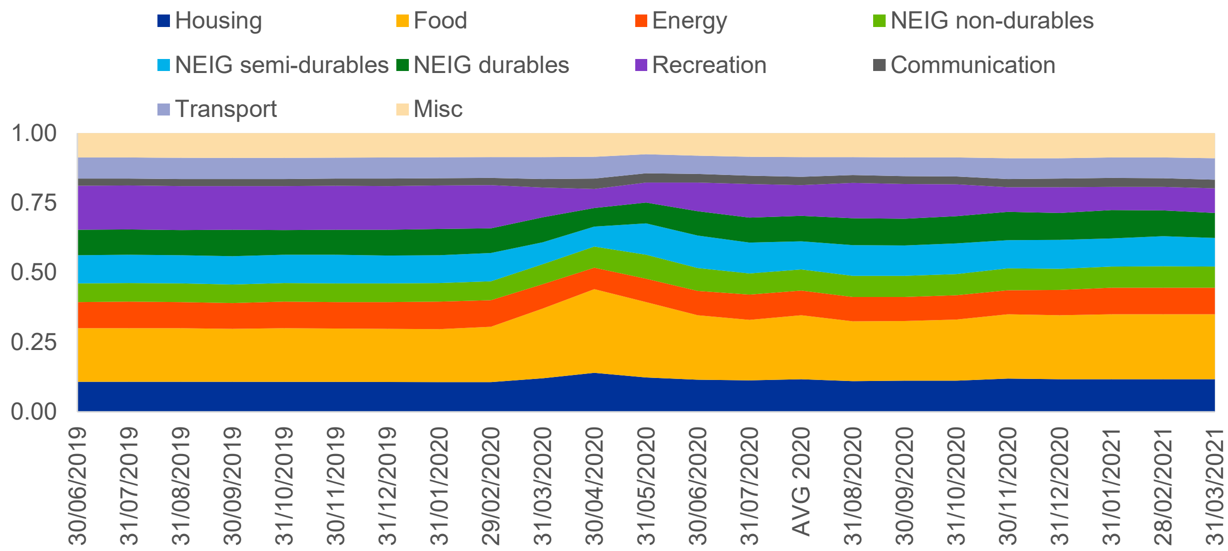
$$P_F = \sqrt{P_L \cdot P_P} = \sqrt{\frac{\sum(p_t \cdot q_{t-1})}{\sum(p_{t-1} \cdot q_{t-1})} \cdot \frac{\sum(p_t \cdot q_t)}{\sum(p_{t-1} \cdot q_t)}}$$

Note: the more frequent the weights update, the less important the choice of the formula. If weights are monthly, the difference becomes (almost) trivial.

Overview

Consumption changes during COVID-19 in the EA

Relative consumption weights
(relative percentage)

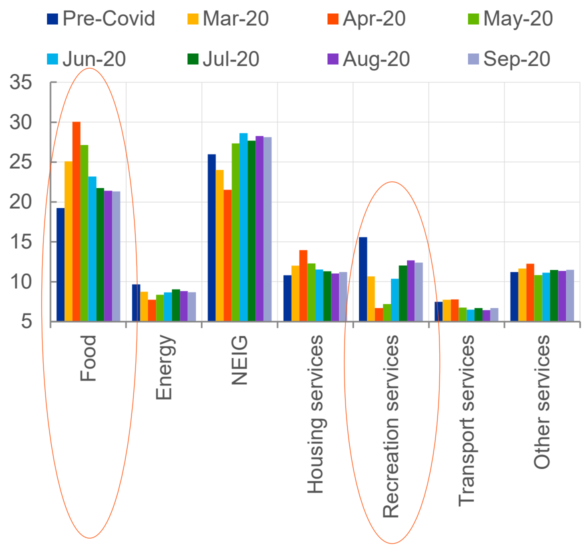


Sources: Eurostat and Author’s calculations.

Note: The chart shows the weights for each category at different points in time. For each category, the weight presented is the relative weight.

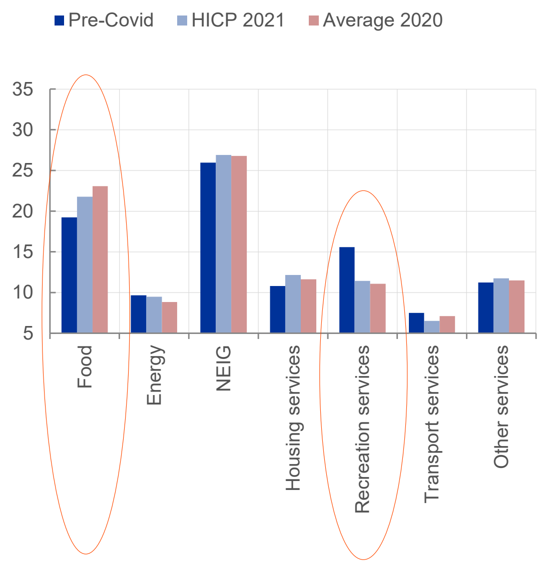
Effects of current changes in consumption patterns on inflation

Consumption weights compared to pre and post COVID – in 2020
(relative percentage)



Sources: Eurostat and ECB staff calculations.
Notes: Bar show the weight relative percent.

Consumption weights compared to pre and post COVID and HICP 2021 weights
(relative percentage)

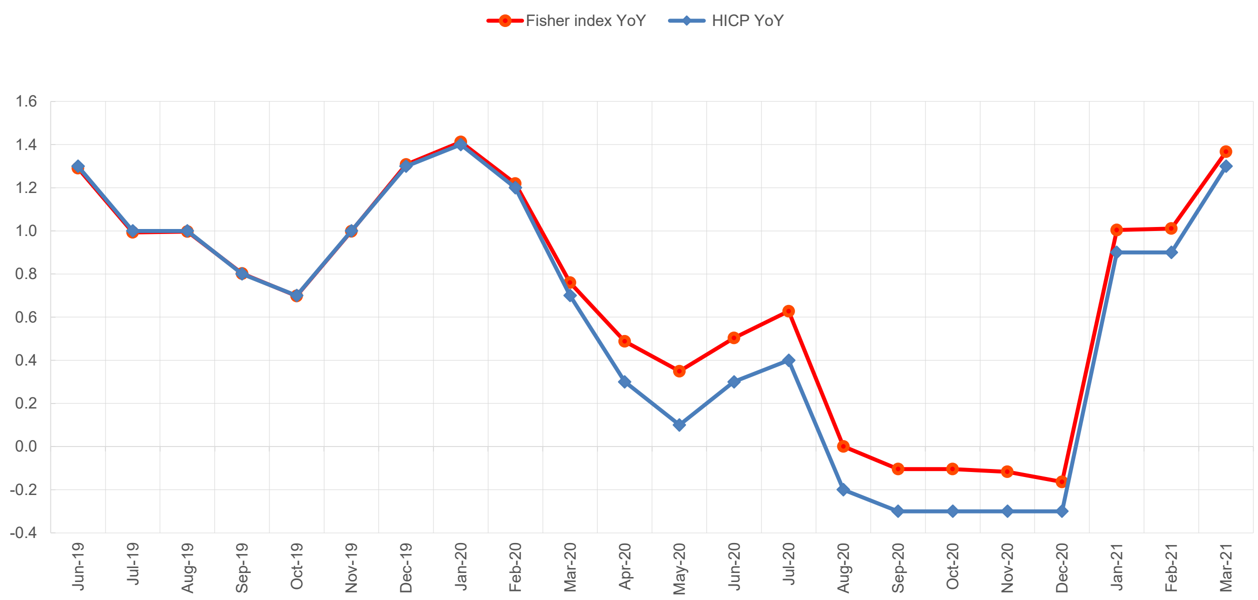


Sources: Eurostat and ECB staff calculations.
Notes: Bar show the weight relative percent.

Monthly experimental index

ECB-CONFIDENTIAL

HICP vs Monthly weights index
(year on year changes)

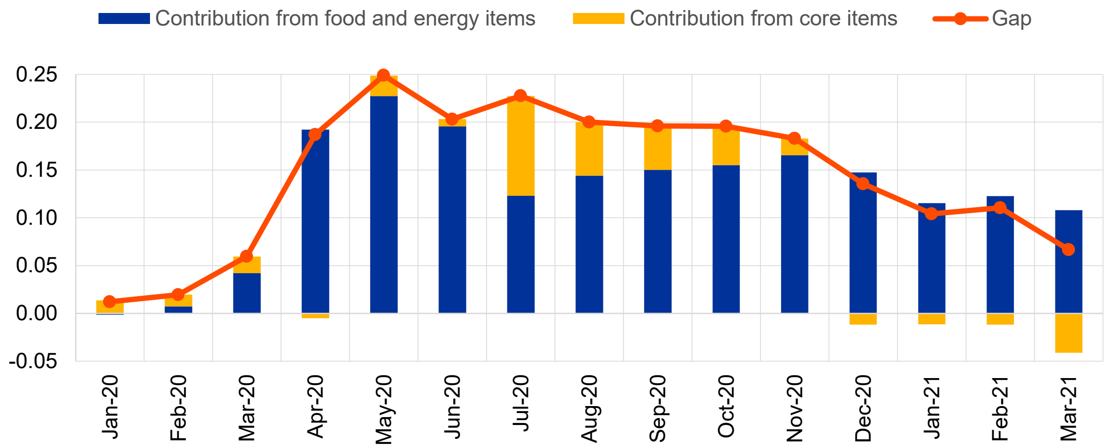


Sources: Eurostat and Author’s calculations.

Monthly experimental index

ECB-CONFIDENTIAL

Gap between HICP and the monthly weights index
(year on year changes)



Sources: Eurostat and ECB staff calculations.

Note: The line is calculated as the difference between a monthly index and published y-o-y HICP figures.

Overview

On the consumption side:

- Consumption patterns have significantly deviated post Covid-19 shock from their pre Covid-19 trend.
- Consumption patters are slowly returning to pre-COVID levels (at the aggregate categories), although spending on food remains a bit higher and spending on recreation remains low.

On the inflation side:

- The “structural” gap was about 20-25bps on YoY rates.
- Post Covid-19 shock, the gap has widened as consumption dropped for relatively higher inflation items (such as recreation services).
- The gap across food and energy remains positive but less pronounced. Overall, the gap for total inflation is currently almost zero.

Lessons learned:

- A time-varying weight (consumer) price index can be constructed (and possibly improved in the future) for the EA, despite data limitations.
- Monthly weights update can lead to chain drift.
- The formula choice for the index matters less if weights are updated frequently (monthly). However, it does play a role when weights changes are big (i.e. COVID case).
- There is a direct relationship between the granularity of input data and the magnitude of the substitution bias that can be captured.

Thank You!

Background Slides

Step 1: identify data sources for consumption weights.

In general, we can think of a (consumer) price index as divided in 2 categories (in terms of input data sources):

Goods	Services
Food	Services excluding housing
Energy	Housing services
Non-energy industrial goods	Miscellaneous services

General on data sources: a summary

- **Available data sources:**
  - **Direct measures:**
    - National accounts
      - Quarterly and COICOP 3 level
      - T+9 month reporting deadline since the last month of each year
    - Consumer survey
      - In principal every 5 years (countries could run it annually)
      - When not run annually, yearly updates using national accounts aggregates
  - **Indirect measures:**
    - Short term business statistics (STS) and other sources
      - Monthly frequency
      - 1-3 months delay

Food and Energy

**Input data based on the short term business statistics (STS) from Eurostat.
No detailed matching.**

- Retail trade turnover:
  - Monthly frequency.
  - Seasonally and calendar adjusted.
  - Compiled according to classification of economic activity (NACE Rev. 2, Eurostat).
  - Fixed base year Laspeyres type volume-index.

Non-durable / Semi-durable / Durable goods

Input data based on the short term business statistics (STS) from Eurostat. Detailed matching.

- Retail trade turnover
    - Monthly frequency.
    - Seasonally and calendar adjusted.
    - Compiled according to classification of economic activity (NACE Rev. 2, Eurostat).
    - Fixed base year Laspeyres type volume-index.

Services excluding housing

Input data based on the short term business statistics (STS) from Eurostat. Detailed matching (except for "miscellaneous services").

- Services turnover
  - Monthly frequency.
  - Seasonally and calendar adjusted.
  - Compiled according to classification of economic activity (NACE Rev. 2, Eurostat).
  - Fixed base year Laspeyres type volume-index.

Housing services

No available information for the EA on quantities of housing services at a monthly frequency.

However, there are workarounds (also used by the BEA in the US) to deal with this data limitation.

- Solutions:
  - Develop a model (typically based on demographic trends) to forecast housing services at medium-term (near-term can be then interpolated).
  - Random walk nominal spending (pretty reasonable assumption in the short-term, given the persistency of the series).

Conceptual issues: Granularity of input data

The more granular the source data, the more substitution an index can capture. Total vs Core inflation in our exercise.

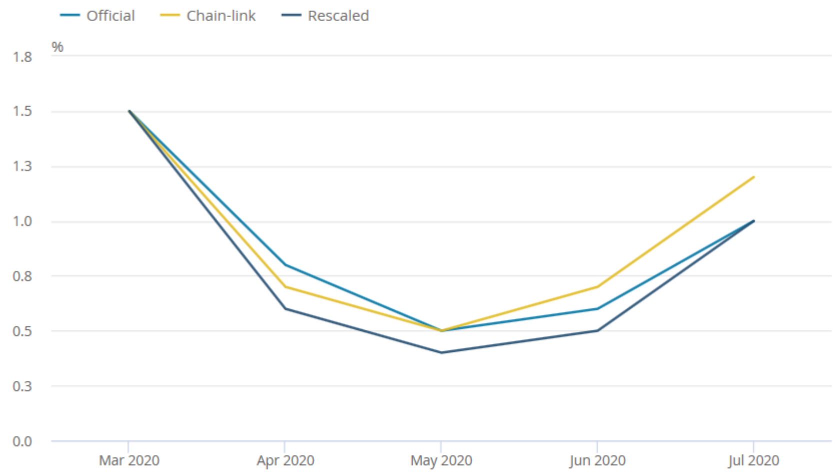
- **For total inflation:** we work at COICOP 2 level (aggregate 11 categories)
  - **Reason:** there are no granular data for food and energy. HICP weights are effectively used until that level.
  - **Implication:** Only very large swifts between aggregate categories can be captured by the index.

- **For core inflation:** we **could** work at COICOP 5 level
  - **Reason:** we do have more granular data (plus some reasonable assumptions for the missing COICOP 5 level categories for which we do not have a 1:1 match).
  - **Implication:** The index runs lower than HICP (similar to PCE for the US) because we capture more substitution.

ONS showed that both, a chained-linked and a re-scaled index were/are running lower than official CPI for the UK.

Figure 1: 12-month growth rates of the rescaled basket of CPIH have consistently been lower than the chain-linked official rate

12-month growth rates of CPIH official, chain-linked and rescaled, UK, March 2020 to July 2020

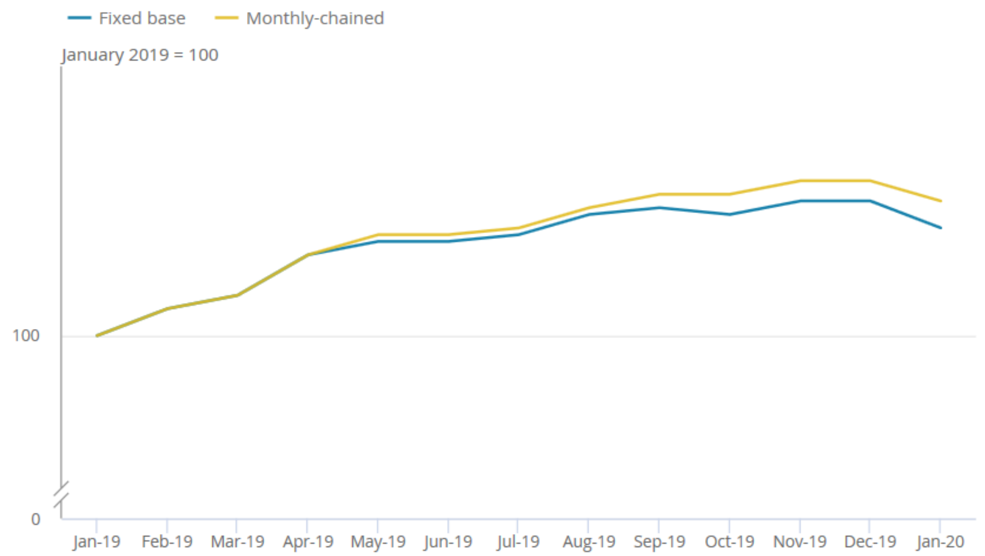


Source: Office for National Statistics – Consumer Prices Index including owner occupiers' housing costs

Chain drift bias.

Figure 4: Over time, the difference between the fixed base and monthly-chained index grows because of chain drift

Comparison of a fixed base index and a monthly chained index, UK, January 2019 to January 2020



Cavallo (2020) – (Paasche?)-type CPI index

Cavallo (2020) estimates a “Covid CPI” for several countries

(includ

Country	Monthly Inflation CPI	Monthly Inflation Covid CPI	Annual Inflation CPI	Annual Inflation Covid CPI
Argentina	1.74	1.91	44.67	45.10
Brazil	-0.28	0.20	2.10	2.76
Canada	-0.63	-0.36	0.08	0.54
Chile	-0.14	0.06	3.32	3.66
France	-0.01	0.23	0.53	0.87
Japan	-0.07	0.08	0.08	0.21
Korea	-0.63	-0.44	-0.02	0.33
Spain	0.39	0.48	0.00	0.01
Turkey	0.78	1.08	11.02	11.59
Uruguay	2.06	2.72	10.80	11.56
US	-0.69	-0.09	0.35	1.06
Germany	0.55	0.46	0.89	0.80
Greece	-0.14	-0.11	0.02	-0.26
Ireland	-0.42	-0.50	-0.35	-0.59
Italy	0.42	0.22	1.25	0.76
Netherlands	0.93	0.51	1.11	0.77
UK	-0.19	-0.28	0.87	0.81

Table 5: CPI and Covid Inflation Rates in April 2020

Notes: The top panel shows countries where the Covid inflation is higher than the fixed-basket CPI. The bottom panel shows countries where the Covid inflation is lower than the fixed-basket CPI. Covid inflation rates are constructed using official CPI weights in each country updated by the relative changes across categories observed in US data. Details on the incidence of CPI categories on the monthly inflation rate in each country are shown in the Appendix.

Cavallo (2020)

Cavallo (2020) argues that “Covid CPI” is running higher (in US) because household have been spending proportionally more

inflati

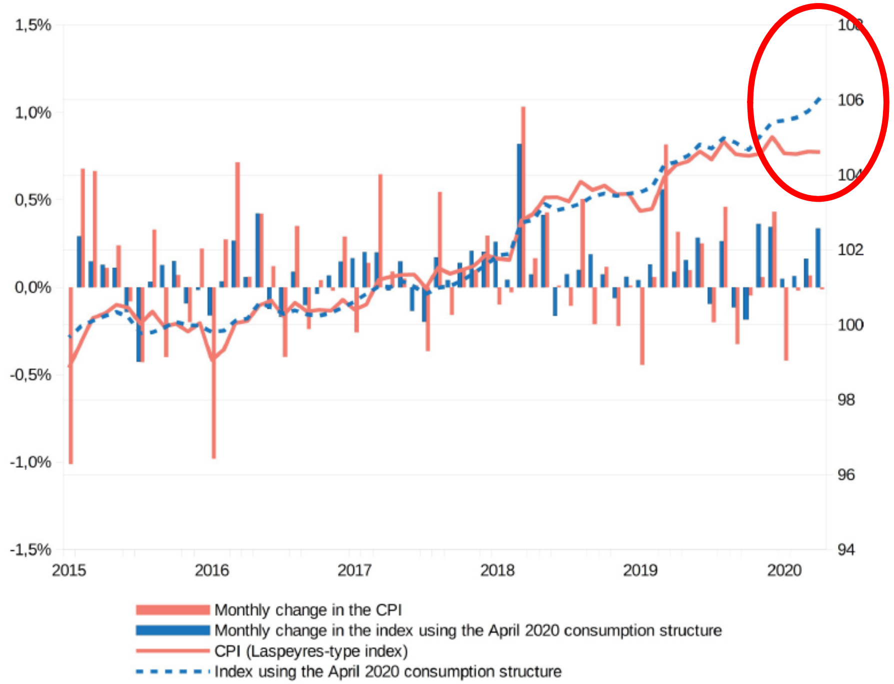
CPI Category	Monthly CPI Inflation	Weight CPI	Weight Covid CPI	Incidence CPI	Incidence Covid CPI
Food at Home	2.67	7.58	11.28	0.20	0.30
Alcoholic Beverages	0.30	1.02	1.52	0.00	0.00
Apparel	-4.38	2.81	2.20	-0.12	-0.10
Housing	-0.03	42.11	55.80	-0.01	-0.02
Medical Care	0.28	8.83	5.60	0.02	0.02
Transportation	-4.97	15.74	6.25	-0.78	-0.31
Recreation	-0.27	5.82	2.23	-0.02	-0.01
Education and Communication	0.13	6.77	8.97	0.01	0.01
Food Away from Home	0.15	6.19	3.13	0.01	0.00
Other Goods and Services	-0.04	3.13	3.03	0.00	0.00

Table 3: US CPI Weights and Incidence - April 2020

Notes: The CPI weight is the share of expenditure in a given category over total expenditures. Note that categories that experience no change in spending over time can have higher Covid weights as a share of the decreasing total expenditure basket. The incidence is the monthly inflation rate multiplied by the weight. The sum of all the category incidence numbers is equal to the monthly inflation rate.

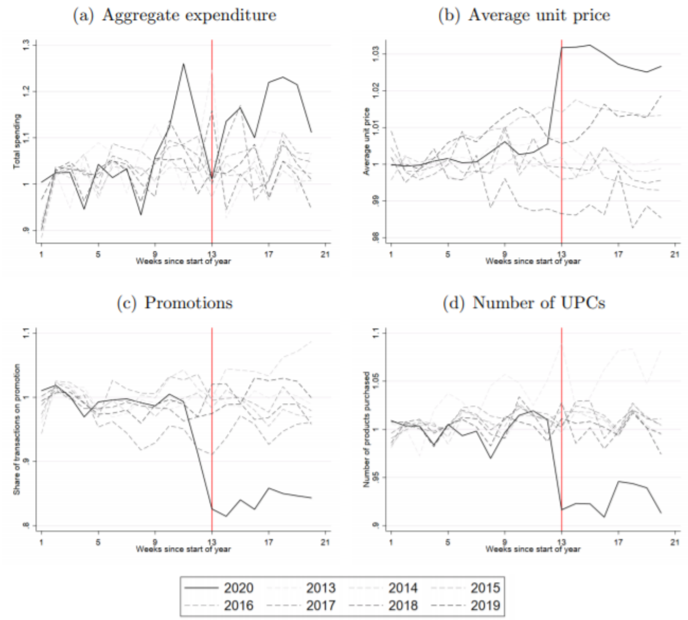
INSEE: “Paasche-type CPI” using the April 2020 consumption structure.

Figure 1 : The Consumer Price Index and an alternative index using the consumption structure observend in April 2020



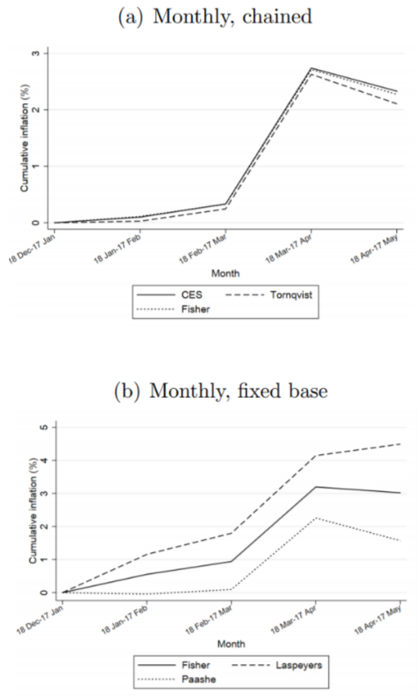
Jaravel and O'Connell (2020)

Figure 1: *Stylized Facts*



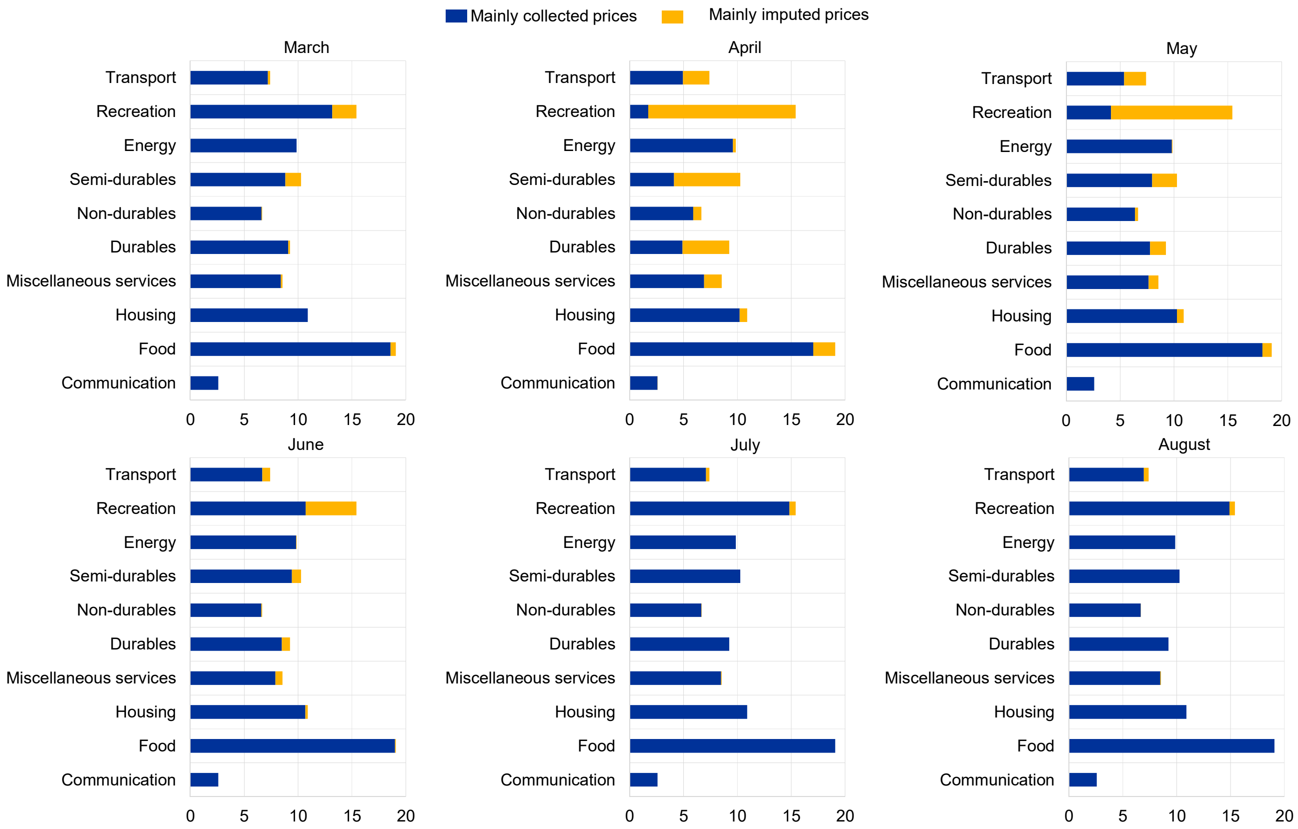
Notes: Panel (a) shows total expenditure, panel (b) average unit price, panel (c) shows the share of transactions that involve a price or quantity promotion and panel (d) shows the number of unique UPCs purchased, in each of the first 20 weeks of the year. Panel (b) conditions on UPCs purchased in all weeks (which account for around 77% of total expenditure). In each case the line is normalized by the mean value in the first four weeks. The red vertical line denotes the first week of lockdown.

Figure A2: *Aggregate Inflation in 2020, different indices*



Imputation: larger need for imputation during pandemic

ECB-CONFIDENTIAL



Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Revealing investors' sentiment amid Covid-19: the Big Data evidence based on internet searches[1]

Jean Christine A Armas and Pamela Kaye A Tuazon,
Bangko Sentral ng Pilipinas

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

Revealing investors' sentiment amid COVID-19: the Big Data evidence based on internet searches

Jean Christine A. Armas and Pamela Kaye A. Tuazon

The views expressed in this paper are those of the authors and do not necessarily reflect those of the BSP. Any errors and omissions are the sole responsibility of the authors.

Outline

- Research Objectives
- Review of Related Literature
- Variables and Data Characteristics
- Government Response Stringency Index (GRSI)
- Construction of the Covid-19 Risk Attitude (CRA) Index
- Model Specification
- Robustness of the Model
- Estimation Methodology
- Research Findings
- Conclusion

Research Objectives

To test whether or not the claim of Amstad, et al. (2020) that movements in some Asian stock markets not significantly correlated to the CRA index holds true.

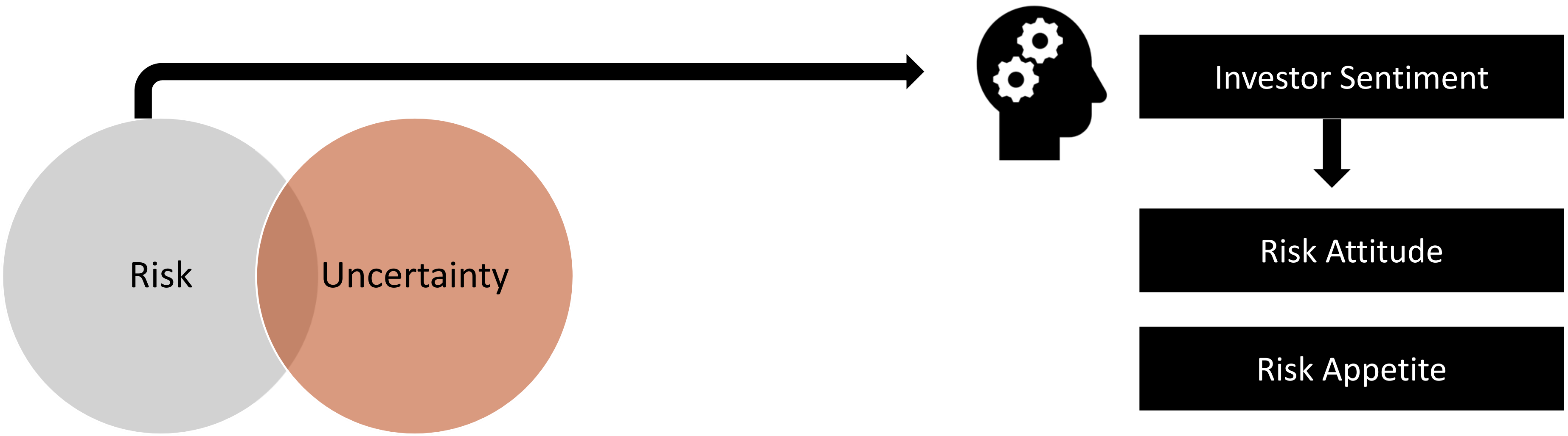
To construct the Covid-19 Risk Attitude (CRA) index for the Philippines and select Asian countries using daily internet-based search queries from 31 December 2019 to 03 July 2020.

To understand the differential responses of select Asian stock markets, categorized according to the country's income classification, to the pandemic.

Related Literature

How are stock markets behaving amidst COVID-19?

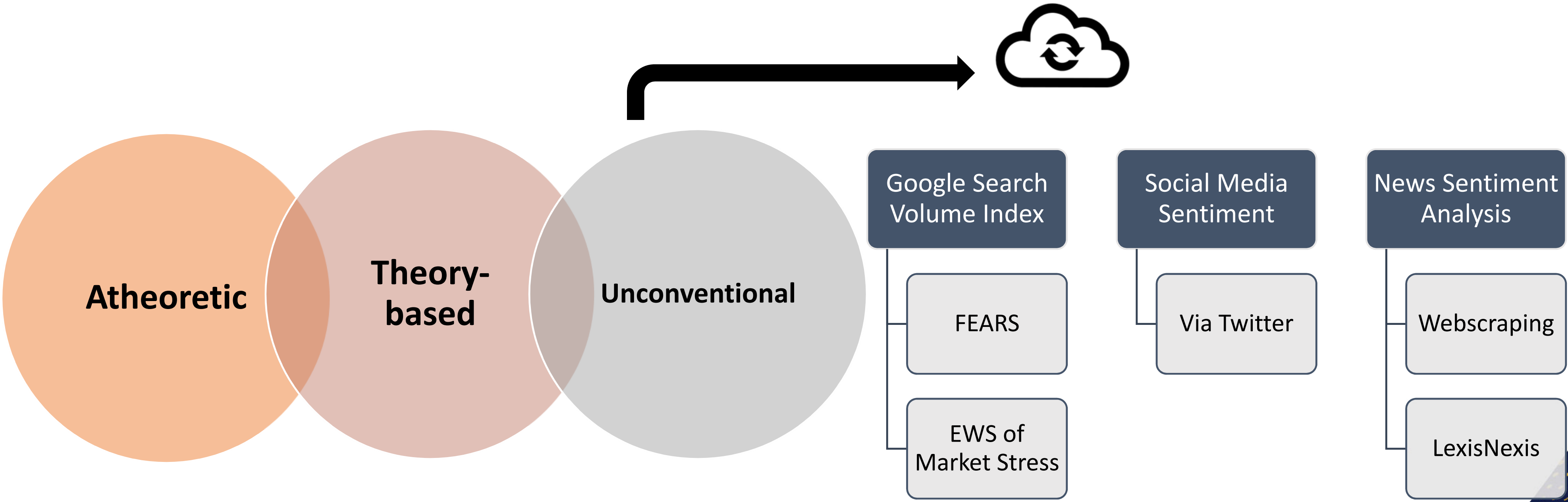
Are investors indifferent, over or under reacting towards this seemingly no-end-in-sight-epidemic?



Related Literature

Measuring Investor Risk Appetite

What if times are extraordinarily pessimistic?



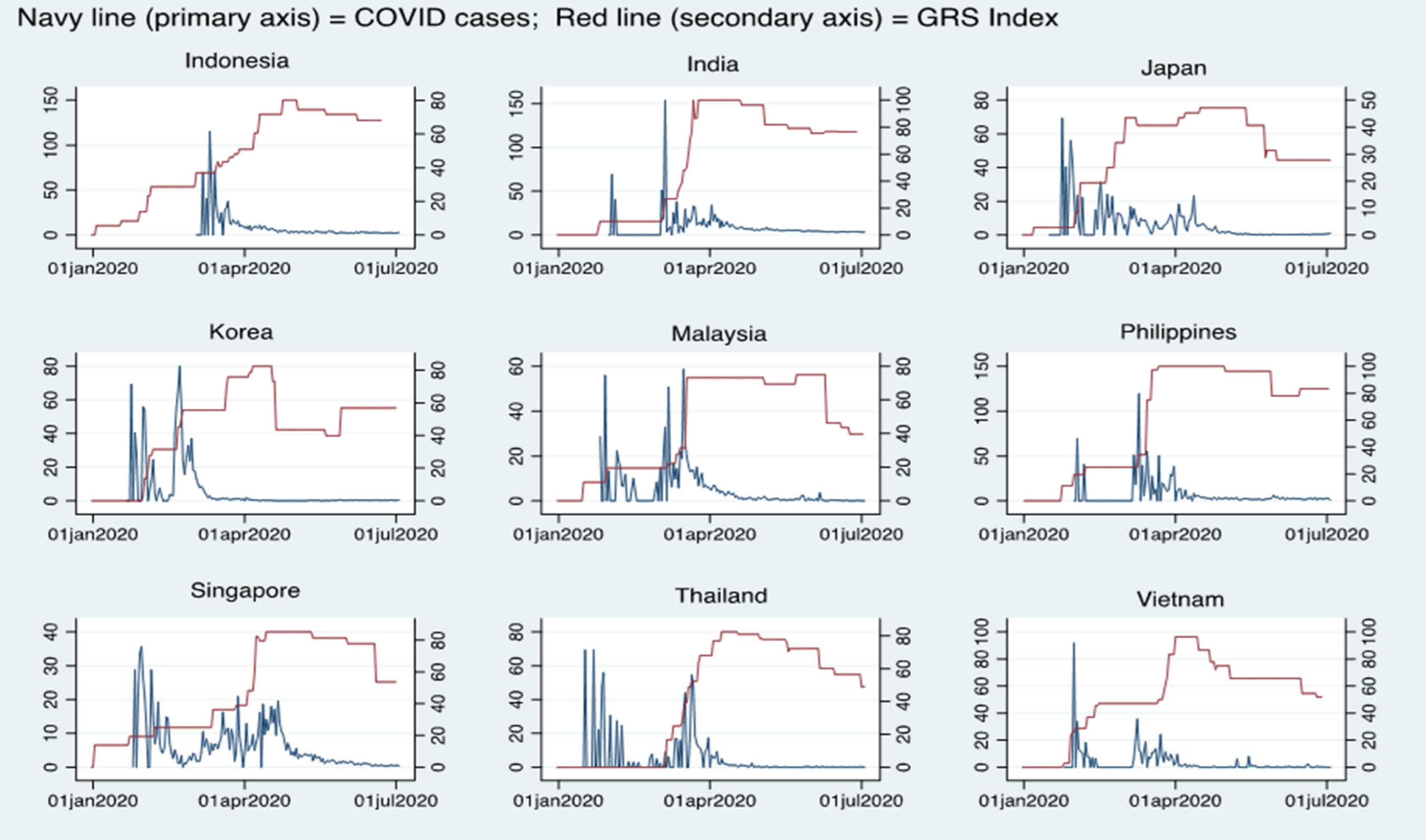
Variables and Data Characteristics

Variables	Description	Source
Stock price index	Derived as percentage change in the closing prices of major stock index in country i at time t.	Thomson Reuters Eikon
Oil price	Calculated as percentage change in Brent crude oil prices at time t.	Federal Reserve Economic Data (FRED)
Number of COVID-19 positive cases	Measured as percentage change in the number of COVID-19 cumulative cases in country i at time t.	European Centre for Disease Prevention and Control (ECDC)
Volatility of stock price index (VIX)	Computed as change in the market's expectation of 30-day implied volatility in the US stock market at time t, which is constructed from S&P 500 option prices.	FRED

Variables and Data Characteristics

Variables	Description	Source
COVID-19 Risk Attitude (CRA) index	Measured as change in the CRA index in country i at time t.	Google Trends; authors' calculations
Government response stringency index	Computed as the simple average of the number of measures that each government in country i adopted at time t.	Hale, T., Webster, S., Petherick, A., Phillips, T., and Kira, B. (2020), **Oxford COVID-19 Government Response Tracker,** Blavatnik School of Government
Trade-weighted US dollar index (broad)	Calculated as percentage change in trade-weighted US dollar index at time t.	FRED

Government Response Stringency Index (GRSI)



Source: Oxford Covid-19 Gov't. Response Tracker; Authors' calculations

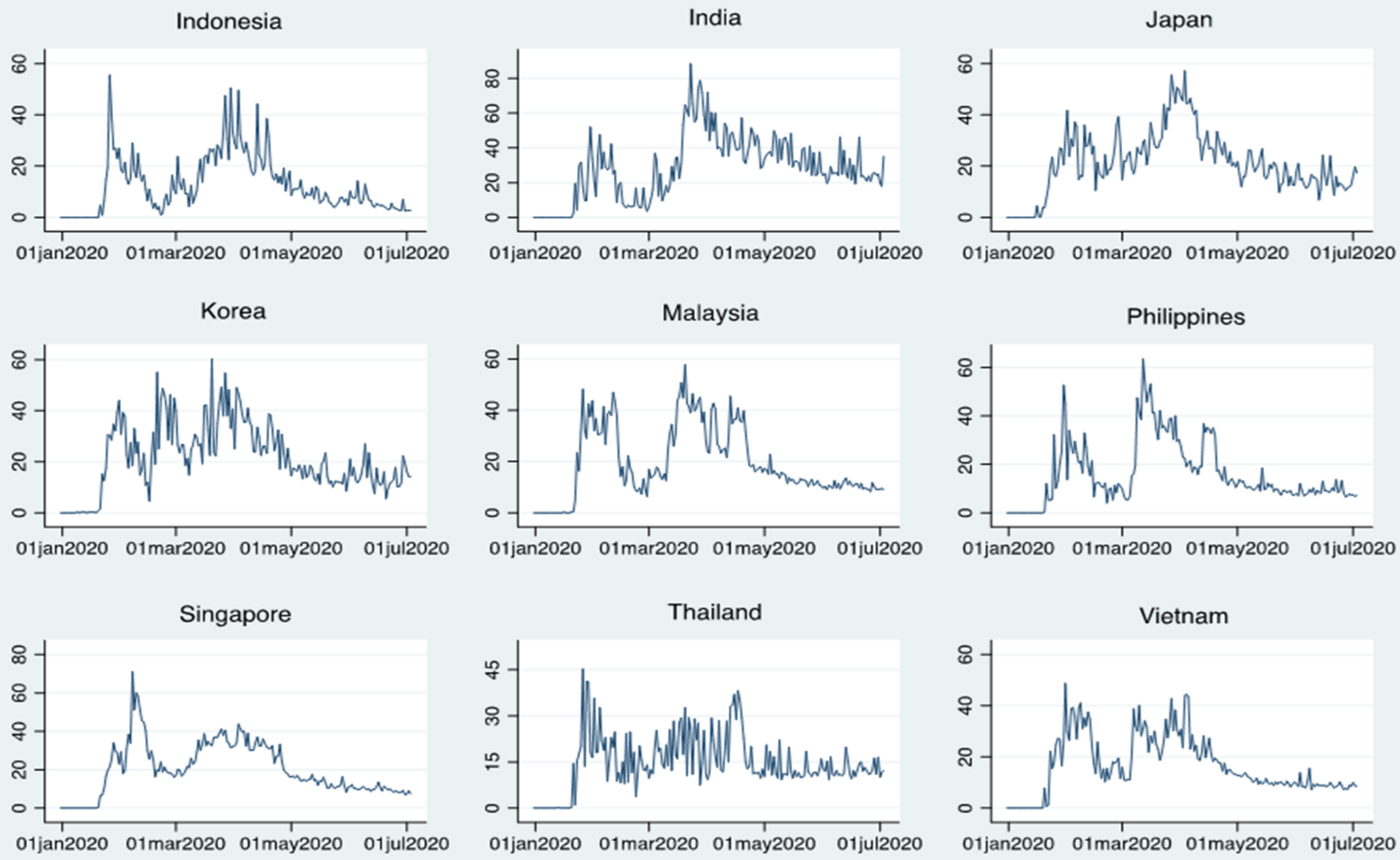
Construction of the COVID-19 Risk Attitude (CRA) Index

$$CRA_{i,t} = \frac{1}{K}\sum_{k=1}^{4} SVI_{k,i,t} \qquad eq.(1)$$

Where:

K is the total number of search terms
(i.e., coronavirus, COVID-19, 2019-nCoV, nCov)
$i = 1,2,\ldots N$, N is the total number of countries under study
T is the total number of time series observations
SVI is the search volume index, where each query inputted into Google Trends is normalized to 100 for the highest search volume in country i at time t.

Country-Level COVID-19 Risk Attitude (CRA) Index



Source: Authors' calculations; Google Trends

Model Specifications

A. Baseline Model

$$\Delta ln(sp_{it}) = \alpha_0 + \beta_1 \Delta ln(op_t) + \gamma_2 \Delta ln(twusd_t) + \varphi_3 \Delta vix_t + \omega_4 \Delta ln(cases_{it}) + \tau_5 \Delta CRA_{it} + \vartheta_i + \mu_{it} \qquad eq.(2)$$

Where:

$\Delta \ln(sp_{it})$ = log difference of stock price index in country i at time t – an approximation to the growth rate of daily stock price index

$\Delta ln(op_t)$ = log difference of Brent crude oil price at time t

$\Delta ln(twusd_t)$ = log difference of trade-weighted US dollar index at time t

Δvix_t = change in the volatility of stock price index

$\Delta ln(cases_{it})$ = log difference of COVID-19 cumulative cases in country i at time t

ΔCRA_{it} = change in CRA index in country i at time t

ϑ_i = captures the unobserved country-specific fixed effects

μ_{it} = observation specific errors (time varying unobservables

Model Specifications

B. Cross-country Classifications by Income Group

$$\Delta ln(sp_{it}) = \alpha_0 + \beta_1 \Delta ln(op_t) + \gamma_2 \Delta ln(twusd_t) + \varphi_3 \Delta vix_t + \omega_4 \Delta ln(cases_{it}) + \delta_5 \Delta CRA_{it} * income\ class + \vartheta_i + \mu_{it} \qquad eq.(3)$$

Where:

$\Delta CRA_{it} * income\ class$ = interaction term between the level of CRA index and country groupings by income

$income\ class$ = dummy variable that is categorized into three (3) clusters:

(i) higher income economies – Japan, Korea and Singapore

(ii) upper-middle income – Indonesia, Malaysia and Thailand

(iii) lower-middle income – India, Philippines, and Vietnam

Robustness of the Model

$$\Delta\ln(sp_{it}) = \alpha_0 + \beta_1\Delta\ln(op_t) + \gamma_2\Delta ln(twusd_t) + \varphi_3\Delta vix_t + \omega_4\Delta ln(cases_{it}) + \tau_5\Delta CRA_{it} + \psi_6 GRSI_{it} + \vartheta_i + \mu_{it} \qquad eq.(4)$$

Inclusion of the variable GRSI

- To check the consistency of the impact of investors' sentiment towards the pandemic-related risks

Limiting the period to Outbreak & Fever Phases

- *Outbreak* period spans from 20 January to 21 February
- *Fever* phase ranges from 22 February to 31 March

Estimation Methodology

Random Effects Panel Regression (using Driscoll-Kraay standard errors)		
Selected model by Hausman specification test	Takes into account the possibility that cross-country specific differences might have some influence on the dependent variable	Driscoll-Kraay standard errors corrects for the cross-sectional autocorrelation in the residuals

Research Findings

Impact of the COVID-19 Risk Attitude Index to Asian Stock Markets

Predictor Variables	Baseline Model (eq. 2)	Model for country groupings, by income (eq. 3)
Impact of investors' sentiment to Asian stock markets		
$\Delta ln\ (cases_{it})$	-0.003 (0.004)	-0.003 (0.005)
ΔCRA_{it}	0.023* (0.012)	
Impact of fundamentals to Asian stock markets		
$\Delta ln\ (op_t)$	0.008** (0.003)	0.008** (0.004)
$\Delta ln(twusd_t)$	-1.507*** (0.185)	-1.493*** (0.179)
Δvix_t	0.003 (0.020)	0.001 (0.020)
No. of observations	784	784
No. of countries	9	9

*Note: Driscoll-Kraay standard errors are in parentheses; ***, **,* denotes p-value less than the 1%, 5% and 10% levels of significance, respectively.*

Differential Effects of the Pandemic to Stock Markets, by Income Group

Predictor Variables	Baseline Model (eq. 2)	Model for country groupings, by income (eq. 3)
Impact of investors' sentiment to Asian stock markets		
$\Delta ln\ (cases_{it})$	-0.003 (0.004)	-0.003 (0.005)
ΔCRA_{it}	0.023* (0.012)	
Impact of COVID-19 to Asian stock markets, by income category		
$\Delta CRA_{it} * high$		0.050* (0.027)
$\Delta CRA_{it} * uppermid$		0.024* (0.013)
$\Delta CRA_{it} * lowermid$ *(benchmark/reference)*		
No. of observations	784	784
No. of countries	9	9

*Note: Driscoll-Kraay standard errors are in parentheses; ***, **,* denotes p-value less than the 1%, 5% and 10% levels of significance, respectively.*

Research Findings

Robustness of the Model

Predictor Variables	Controlling for GRSI (eq. 4)	Outbreak & Fever Phases (20 Jan – 31 Mar 2020)
Impact of investors' sentiment to Asian stock markets		
$\Delta ln\ (cases_{it})$	-0.002 (0.004)	-0.002 (0.004)
ΔCRA_{it}	0.023* (0.012)	0.029* (0.016)
Robustness checks		
$GRSI_{it}$	0.004* (0.002)	0.011 (0.009)
No. of observations	780	319
No. of countries	9	9

*Note: Driscoll-Kraay standard errors are in parentheses; ***, **,* denotes p-value less than the 1%, 5% and 10% levels of significance, respectively.*

Conclusions

Key Takeaways

The CRA index is a significant predictor variable for stock price movements. Across all model specifications Asian stock markets, in general, do not exhibit absolute pessimism towards the pandemic.	As governments pull out all the stops to soften, if not to totally eradicate, the impact of the pandemic, Asian stock investors appear to relatively gain market confidence.	The effect of the variable CRA index in high-income and upper-middle income countries to stock prices is positive and statistically significant while the opposite is observed in lower-middle income countries.

Revealing investors' sentiment amid COVID-19: the Big Data evidence based on internet searches

Jean Christine A. Armas and Pamela Kaye A. Tuazon

Revealing investors' sentiment amid COVID-19: the Big Data evidence based on internet searches

Jean Christine A. Armas[1] and Pamela Kaye A. Tuazon[2]

[1.] *Department of Economic Research, Bangko Sentral ng Pilipinas*
[2.] *Department of Economic Statistics, Bangko Sentral ng Pilipinas*

Abstract:

As the global economy grounded to a screeching halt during the wake of the coronavirus outbreak, the seemingly odd response of stock markets has raised both concerns and questions. Whether the dynamics in the behaviour of stock market is driven by the oscillation between the market fundamentals and investors' attitude in the face of pandemic is an open question that needs to be answered and tested.

Using random effects panel regression model and pandemic-related daily internet search keywords to construct the Covid-19 Risk Attitude (CRA) index, this study finds that select Asian stock markets are not sensitive to the (negative) impact of the epidemic as most of these countries were prompt in containing the spread of the virus. This claim is supported by the positive effect of government response stringency index to Asian stock prices. Taking into account the heterogeneity in the responses of the markets under study, this paper argues that stock markets in high and upper-middle income Asian countries are not negatively affected by investors' sentiment towards pandemic-related risks.

Keywords:
government policy regulation and public health; stock market; panel data models; investor attitude; big data

1. Introduction:

A number of research studies related to measuring investors' risk attitude and quantifying its effects amid COVID-19 have been proposed and published. The first set of this growing research study was discussed in the context of the US – (Baker et al., 2020; Giglio et al., 2020). And, while there have been some papers that included Asian economies, the discussion was not as extensive as that of Western and European countries (Amstad et al., 2020). In the Philippine setting, measuring investors' sentiment using big data or based on internet search keywords has not been addressed thus far. This is the research gap that this paper aims to contribute into the literature.

The specific research objectives below spin-off from the paper's main objective, which is to measure investors' risk attitude towards the pandemic and quantify its impact to select Asian stock markets:

(i) To construct the Covid-19 Risk Attitude (CRA) index for the Philippines and select Asian countries using daily internet-based search queries from 31 December 2019 to 03 July 2020;

(ii) To test whether or not the claim of Amstad, et al. (2020) on some Asian stock markets not significantly correlated to the CRA index holds true;[1] and

(iii) To understand the heterogeneous investors' sentiment in select Asian stock markets, categorized according to the country's income classification, to the pandemic.

2. Methodology:

Capitalizing on the optimal use of Google, which is the world's largest search engine, this study follows the general approach adopted by Amstad et al (2020) to construct the CRA index. More formally, the CRA index is estimated by aggregating the daily search volume terms (i.e., coronavirus, COVID-19, nCoV, 2019-nCoV) via Google Trends from 31 December 2019 to 03 July 2020 for the nine (9) select Asian countries (equation 1):

$$CRA_{i,t} = \frac{1}{K}\sum_{k=1}^{4} SVI_{k,i,t} \tag{1}$$

where K is the total number of search terms used in this study, $i = 1,2, \ldots N$, $t = 1,2, \ldots T$, N is the total number of countries under study while T is the total number of time series observations. The SVI is the search volume index where each query inputted into Google Trends is normalized to 100 for the highest search volume in country i at time t. Following the underlying assumptions of Amstad et al (2020), the frequency of searches related to the Covid-19 pandemic is a proxy for the public's or an individual's level of concern on the pandemic and its economic consequences.

Baseline Model:

This study, which is applied and focused in the context of Asian economies, follows the general approach of the recent works of Amstad et al (2020) and Capelle-Blanchard & Desroziers (2020). To test the paper's research objectives empirically, the baseline model will be estimated as:

$$\begin{gathered}\Delta ln(sp_{it}) = \alpha_0 + \beta_1 \Delta ln(op_t) + \gamma_2 \Delta ln(twusd_t) + \varphi_3 \Delta vix_t + \\ \omega_4 \Delta ln\ (cases_{it}) + \tau_5 \Delta CRA_{it} + \vartheta_i + \mu_{it}\end{gathered} \tag{2}$$

where the dependent variable $\Delta \ln\ (sp_{it})$ is the log difference of stock price index in country i at time t – an approximation to the growth rate of daily stock price index. The independent variables that represent the market fundamentals are op_t and $twusd_t$, which represents the Brent crude oil price and trade-weighted US dollar index at time t, respectively.

To measure and quantify investors' sentiment towards the risk associated with the pandemic, the variables COVID-19 cumulative cases and CRA index were added to the model estimation. As these two variables are likely to introduce collinearity, these indicators were concurrently estimated instead of regressing the variables separately in the model.

The total error term, e_{it}, is categorised into: (i) ϑ_i captures the unobserved country-specific fixed effects; and (ii) μ_{it}, which is the observation specific errors (time varying unobservables). Both ϑ_i and μ_{it} follows an independent, identical distribution (IID) with zero mean and constant variance $\sim IID\ (0, \sigma^2)$.

[1] The Asian stock markets included in the study made by Amstad, et al (2020) are China, Japan, South Korea, Singapore and Indonesia.

Cross-country classifications by income group model:

Rather than evaluating investors' behaviour towards the COVID-19 across economies in absolute terms, this study compares the stock price movements in select Asian countries and attribute the heterogeneous reactions of stock markets to country differences (e.g., pre-existing macroeconomic and financial conditions, level of financial development, institutional characteristics, among others). The third research objective of this paper will be examined by extending the benchmark model, equation (2), as follows:

$$\Delta ln(sp_{it}) = \alpha_0 + \beta_1 \Delta ln(op_t) + \gamma_2 \Delta ln(twusd_t) + \varphi_3 \Delta vix_t + \omega_4 \Delta ln\,(cases_{it}) + \delta_5 \Delta CRA_{it} * income\ class + \vartheta_i + \mu_{it} \quad (3)$$

where $\Delta CRA_{it} * income\ class$ is the interaction term between the level of CRA index and country groupings by income. The dummy variable, $income\ class$, is categorized into three (3) clusters: (i) higher income economies – Japan, Korea and Singapore; (ii) upper-middle income – Indonesia, Malaysia and Thailand; and (iii) lower-middle income (reference group) – India, Philippines, and Vietnam.[2]

Robustness of the Model:

To ensure the robustness of the model and ascertain that the empirical results are not provisional on the authors' data selection, sample coverage and time period, some modifications were considered in the regression. First, the authors incorporated the GRSI as control variable to check the consistency of the impact of investors' sentiment towards the pandemic-related risks. This is represented in the extended equation below:

$$\Delta \ln\,(sp_{it}) = \alpha_0 + \beta_1 \Delta \ln\,(op_t) + \gamma_2 \Delta ln(twusd_t) + \varphi_3 \Delta vix_t + \omega_4 \Delta ln\,(cases_{it}) + \tau_5 \Delta CRA_{it} + \psi_6 GRSI_{it} + \vartheta_i + \mu_{it} \quad eq.(4)$$

Second, we checked the robustness of the model by limiting the time period to *Outbreak* and *Fever* phases and excluding the *Incubation* stage as in Capelle-Blanchard & Desroziers (2020). The *Incubation* phase ranges from 02 January to 17 January while the *Outbreak* period spans from 20 January to 21 February. This paper, however, extends the *Fever* phase from 20 March to 31 March to fully consider the impact of the virus to stock price index for the entire period of March 2020.

Estimation Methodology:

The econometric approach that this paper will employ is panel regression, particularly the random effects (RE) model to test empirically the objectives of this research. The conventional way to choose which between the fixed effects (FE) and RE models to use best is through the Hausman test.[3] Under the RE model, the estimates are based on the identifying assumption that the error terms follow an IID with zero mean and constant variance $\sim IID\ (0, \sigma^2)$. The advantage of using the RE estimator is that the variation across countries is assumed to be random and uncorrelated with the explanatory variables in the model (Torres-Reyna, 2007).

---

2 The income groupings are: (i) low income class ≤ \$1,035; (ii) lower-middle income = \$1,036-\$4,045; (iii) upper middle income = \$4,046-\$12,535; and (iv) high income > \$12,536.
Source: The World Bank

3 Hausman test suggests the use of RE model.

3. Result:

Impact of the COVID-19 Risk Attitude Index to Asian Stock Markets:

In addition to market fundamentals, this paper finds that CRA index is important in predicting stock price movements in Asian countries. Contrary to the findings of Amstad et al (2020) that Asian stock markets are not significantly correlated with CRA index, this study shows that CRA index enters positively and statistically significant in equation 2.

Table 1: Models for Predictors of Stock Price Index

Predictor Variables	Baseline Model (eq. 2)	Model for country groupings, by income (eq. 3)
Impact of investors' sentiment to Asian stock markets		
$\Delta ln\ (cases_{it})$	-0.003	-0.003
	(0.004)	(0.005)
ΔCRA_{it}	0.023*	
	(0.012)	
Impact of fundamentals to Asian stock markets		
$\Delta ln\ (op_t)$	0.008**	0.008**
	(0.003)	(0.004)
$\Delta ln(twusd_t)$	-1.507***	-1.493***
	(0.185)	(0.179)
Δvix_t	0.003	0.001
	(0.020)	(0.020)
Impact of COVID-19 to Asian stock markets, by income category		
$\Delta CRA_{it} * high$		0.050*
		(0.027)
$\Delta CRA_{it} * uppermid$		0.024*
		(0.013)
$\Delta CRA_{it} * lowermid$ *(benchmark/reference)*		
No. of observations	784	784
No. of countries	9	9

*Note: Driscoll-Kraay standard errors are in parentheses; ***, **,* denotes p-value less than the 1%, 5% and 10% levels of significance, respectively.*

The findings suggest that the perceived negative effect of the pandemic to stock markets is non-evident in the context of Asian markets under study. Looking at Table 1, column 2, the coefficient associated with the investors' risk attitude index is estimated to be at 0.023. This implies that despite the increase in the investors' sentiment-revealing daily internet search volume index, Asian stock price indices is expected to increase by 2.3 percent on the average.

The empirical findings of this study reveal a myriad of plausible reasons. One is the claim of Amstad et al (2020) that Asian stock markets, unlike Western and European countries, are less sensitive to the negative impact of COVID-19 since most of the Asian countries entered the pandemic relatively earlier and therefore, were able to introduce prompt policy adjustments to combat the further spread of the virus. Second is the prudent use of technological applications to curb the virus outbreak like contact tracing and location tracking that started first in Asia, especially in countries with better digital infrastructures (Cantu et al, 2020). Third is the assumption that the experiences of most of the Asian countries included in this study during the 2002-2004 SARS outbreak have better equipped them in terms of dealing with the current pandemic.

Different Asian Investors' Sentiment to the Pandemic, by Income Group:

Seen on the whole, the stock investors' risk perception and general fear towards the negative impact of the pandemic is not as intense and pronounced as that in the European or American markets (Amstad et al, 2020). As compared to the lower-middle income countries – India, Philippines and Vietnam – the impact of CRA index to stock price index is positive and statistically significant for both high (Japan, Korea, Singapore) and upper-middle income countries (Indonesia, Thailand, Malaysia). Singapore, Japan, Korea were the first to press digital infrastructures into use in Asia to stem the virus outbreak (Chandran, 2020). Such prompt responses by these countries might have given stock investors a boost and confidence in the market.

Impact of Pandemic-related Government Responses to Stock Markets:

The inclusion of GRSI as a control variable in the model specification (eq.4) confirms the consistency of the direction of sign (i.e., positive) of the estimated coefficients for CRA index in all equations. The variable GRSI is positive and statistically significant, which means that as governments intensified their wide range of strict measures to stem the spread of the virus, Asian stock markets seem to gain market confidence.

Table 2: Models for Robustness Checks

Predictor Variables	Controlling for GRSI (eq. 4)	Outbreak & Fever Phases (20 Jan – 31 Mar 2020)
Impact of investors' sentiment to Asian stock markets		
$\Delta ln\ (cases_{it})$	-0.002	-0.002
	(0.004)	(0.004)
ΔCRA_{it}	0.023*	0.029*
	(0.012)	(0.016)
Impact of fundamentals to Asian stock markets		
$\Delta ln\ (op_t)$	0.008**	0.034
	(0.004)	(0.032)
$\Delta ln(twusd_t)$	-1.488***	-1.608***
	(0.185)	(0.277)
Δvix_t	0.004	0.004
	(0.020)	(0.020)
Robustness checks		
$GRSI_{it}$	0.004*	0.011
	(0.002)	(0.009)
No. of observations	780	319
No. of countries	9	9

*Note: Driscoll-Kraay standard errors are in parentheses; ***, **,* denotes p-value less than the 1%, 5% and 10% levels of significance, respectively.*

Asian Stock Markets' Response over the *'Outbreak'* and '*Fever'* Phases:

Overall, the impact of CRA index to Asian stock prices remains consistent regardless of the model specifications even if the model was estimated by limiting the time period to *Outbreak* and *Fever* phases only. To some degree, this result is supported by the claim of Amstad et al (2020) that the negative effect of the CRA index is less pronounced in a number of Asian equity markets than in America and Europe since the former went through the epidemic earlier and policy re-adjustments were effected accordingly.

4. Discussion and Conclusion:

The dynamics of the stock markets' behavior towards the global pandemic brought the public, not only the economists, to ask the question – *Is the glass half-empty or half-full?* In this paper, we tried to provide answers to some questions and/or issues with regard to stock price movements. In particular, the main objective of this research is to measure investor risk attitude towards COVID-19 and quantify its impact to select Asian stock prices by leveraging on the use of big data – internet search volume index.

In addition to market fundamentals, the CRA index is a significant predictor variable for variations in Asian stock prices. Across all model specifications, this study finds out that Asian stock markets, in general, do not exhibit absolute pessimism towards the pandemic. This paper argues that as governments pull out all the stops to soften, if not to totally eradicate, the impact of the dreaded coronavirus, Asian stock investors appear to relatively gain market confidence. This claim is corroborated by the positive effect of GRSI to equity prices where a suite of government responses – ranging from containment measures to economic relief operations and health facilities investments – have been enacted relatively prompt. Further, the main story holds true even when the time series observations were limited to *'Outbreak'* and *'Fever'* phases only.

Finally, since different countries have different pre-existing institutional characteristics or macroeconomic conditions, this research tested for the heterogenous response of select Asian countries by grouping these countries according to their income classification. The effect of the variable CRA index in high-income and upper-middle income countries to stock prices is positive and statistically significant while the opposite is observed in lower-middle income countries.

References:

1. Amstad, M., Cornelli, G., Gambacorta, L., and Xia, D. (2020). 'Investors' risk attitude in the pandemic and the stock market: new evidence based on internet searches', BIS Bulletin No. 25.
2. Baker, S.R., Bloom, N., Davis, S.J., Kost, K., Sammon, M., and Viratyosin, T. (2020). 'The unprecedented stock market reaction to COVID-19', NBER Working Paper No. 26945.
3. Cantu, C., Cheng, G., Doerr, S., Frost, J., and Gambacaorta, L. (2020). 'On health and privacy: technology to combat the pandemic', BIS Bulletin No. 17.
4. Capelle-Blanchard, G., and Desroziers, A. (2020). 'The stock market is not the economy? Insights from the COVID-19 crisis', Centre for Economic Policy Research Issue No. 28.
5. Chandran, R. (2020). 'Here's how Asia is using tech to tackle COVID-19', World Economic Forum. https://www.weforum.org/agenda/2020/03/asia-technology-coronavirus-covid19-solutions
6. Giglio, S., Maggiori, M., Stroebel, J., and Utkus, S. (2020). Inside the Mind of a Stock Market Crash, NBER Working Paper No. 27272.
7. Torres-Reyna, O. (2007), 'Panel data analysis: fixed and random effects using Stata', Princeton University. Retrieved from https://dss.princeton.edu/training/.

Revealing investors' sentiment amid COVID-19: the Big Data evidence based on internet searches

Jean Christine A. Armas and Pamela Kaye A. Tuazon[1]

Abstract

As the global economy grounded to a screeching halt during the wake of the coronavirus outbreak, the seemingly odd response of stock markets has raised both concerns and questions. Whether the dynamics in the behaviour of stock market is driven by the oscillation between the market fundamentals and investors' attitude in the face of pandemic is an open question that needs to be answered and tested.

Using random effects panel regression model and pandemic-related daily internet search keywords to construct the Covid-19 Risk Attitude (CRA) index, this study finds that select Asian stock markets are not sensitive to the (negative) impact of the epidemic as most of these countries were prompt in containing the spread of the virus. This claim is supported by the positive effect of government response stringency index to Asian stock prices. Taking into account the heterogeneity in the responses of the markets under study, this paper argues that stock markets in high and upper-middle income Asian countries are not negatively affected by investors' sentiment towards pandemic-related risks.

JEL Classification: I18, G10, C33

Keywords: government policy, regulation and public health, stock market, panel data models, investor attitude, big data

Corresponding authors: Jean Christine A. Armas (armasja@bsp.gov.ph)
Pamela Kaye A. Tuazon (tuazonpka@bsp.gov.ph)

[1] Ms. Armas and Ms. Tuazon are Senior Economists from the Monetary Policy Sub-Sector (MPSS) under the Monetary and Economics Sector (MES) of the Bangko Sentral ng Pilipinas (BSP). The usual institutional disclaimer applies.

Revealing investors' sentiment amid COVID-19: the Big Data evidence based on internet searches

1. Background

Through the decades, the world's economic system has flourished and eroded in a seemingly natural cycle of markets' booms and busts. However, notable historic events continue to challenge established economic theories and assumptions, as more granular information attempt to provide novel perspectives in trying to explain various conventional and unconventional economic phenomena.

In the past months, the world has witnessed the unravelling of an unprecedented event — a global pandemic that grounded the economy to a near standstill and paved the way towards the birth of the *"new normal"*. A virus strain, which allegedly started from Wuhan and fastidiously spread around the world in a matter of months (WHO, 2020), is set to change the economic, social, and political landscapes in the coming years.

1.1. The COVID-19 Timeline.[2]

The Wuhan Municipal Health Commission reported a cluster of pneumonia cases with "unknown aetiology" last 31 December 2019, citing the city's seafood market as the possible source (ECDC, 2020). Hubei's capital is one of the prominent commercial and industrial centres in China (Torsello & Winkler, 2020), thus could have contributed to its rapid and unforeseen spread. A study conducted by the Harvard Medical School later revealed that the virus must have started spreading as early as Fall *(August)* 2019 (Nsoesie et.al, 2020).

At the beginning of the year, the WHO tagged the emerging novel virus as the *"2019-nCov"* and later on declared a global health emergency due to its rate of spread. In February 2020, the WHO formally announced the change of the virus' official name from *"2019-nCov"* to *"COVID-19"*. Subsequently, in March 2020, the WHO announced the COVID-19 outbreak as a "global pandemic", which led to stringent lockdowns across countries. By middle to late March 2020, the epicenters of the virus have shifted from China to Europe[3] and the United States (US). At the end of March, the United Nations' (U.N.) Secretary-General heralded COVID-19 pandemic as the *"world's worst crisis"* since the World War II, asserting that this economic and health crisis will lead to a recession *"that probably has no parallel in the recent past"* (Lederer, 2020).

In April 2020, Wuhan announced its steady recovery and publicized that it has treated all of its COVID-19 patients. However, by May 2020, the WHO made a grim projection that the virus could infect millions[4], if swift measures will not be instituted. In the Asian region, India has already surpassed China's reported numbers of infections. By the end of May, Brazil, Russia

[2] Source: World Health Organization (WHO). Timeline of WHO's response to COVID-19. (Updated as of 30 July 2020).
[3] Italy and Spain were the hardest hit countries in Europe.
[4] With Africa as the most probable largest hit.

and the US recorded the highest number of infections in the world, while UK began emerging as one of the virus epicentres.

In early June 2020, Russia, UK and some EU countries gradually eased their stringent lockdown measures. On the contrary, the US recur to "near-peak" numbers of infections and fatalities, which coincided with the WHO's announcement that the pandemic was "getting worse globally". Most recently, in July 2020, the WHO reported a marked rise of cases in India, Brazil, UAE, Hong Kong, Australia, Saudi Arabia, including the Philippines. In response, the WHO holds virtual summits for COVID-19 research and innovation to fast track the development of its cure. By end July 2020, cases have breached 17 million and continues to rise as of writing.

1.2. The Economic Fallout of COVID-19

Governments worldwide are likewise racing against time to mitigate the atrocities of the global pandemic. The stern policies of lockdowns, temporary business closures, border controls and limited global trade led some experts to believe that we are *"nearing the point of de-globalization"* (Barua, 2020).

In April 2020, the International Monetary Fund (IMF) announced that global growth will contract by three (3) percent in 2020, the highest decrease since the Great Depression in the 1930s. This figure is a downgrade of 6.3 percentage points from the January 2020 projection, a major revision within a short span of time (WEO, 2020). In May 2020, the United Nations (UN) made a similar pronouncement wherein it predicted that the world economy would shrink by 3.2 percent, which offsets the global economic gains for the last four years (Economic Times, 2020). By June 2020, the Organization for Economic Co-operation and Development (OECD) made a bold declaration that "the pandemic had triggered the worst global recession in nearly a century even without a second wave of infections" with global economic outlook highly uncertain (OECD, 2020).

The *"Great Lockdown"* could be far more detrimental than the most recent Global Financial Crisis (GFC), hence, its adverse economic effects will surely spill over until 2021. More critically, no economic territory is spared. All countries are in recession, with growth projection of -6.1 percent for advanced economies, and -1.0 percent (in 2020) and -2.2 percent (in 2021) for the developing economies (Gopinath, 2020).

The dismal yet absolute pronouncements about the pandemic plus the high level of economic interconnectedness among countries meant heightened exposure to economic risks. While the extent and severity of the epidemic's impact to the global economy are still indeterminate, the financial markets have already reacted peculiarly. In particular, stock markets around the world cratered following WHO's declaration of global pandemic (Zhang et al, 2020). As economic risks associated with the pandemic build-up, countries introduced various fiscal relief packages to prop up the economy. Similarly, central banks worldwide responded with monetary easing and reserve reductions (including the Philippine central bank),[5] with Emerging Markets (EM) and Asian markets (AM) having more room to cut rates further, relative to its counterparts in the advanced economies.

Undoubtedly, the global pandemic has put financial markets and economists in an unchartered territory that whatever novel insights or developments this pandemic may bring forth will be of invaluable worth. Economic agents continue to grapple and adjust to the "new" market conditions of limited physical operations, restricted mobility, and bankruptcies. With these "new" market conditions, we ask the questions: *How are stock markets behaving amidst COVID-19? Are investors indifferent, over or under reacting towards this seemingly no end in sight epidemic?*

A number of research studies related to measuring investors' risk attitude and quantifying its effects amid COVID-19 have been proposed and published. The first set of this growing research study was discussed in the context of the US – (Baker et al., 2020; Giglio et al., 2020). And, while there have been some papers that included Asian economies, the discussion was not as extensive as that of Western and European countries (Amstad et al., 2020). In the Philippine setting, measuring investors' sentiment using big data or based on internet search keywords has not been addressed thus far. This is the research gap that this paper aims to contribute into the literature.

1.3. Research Objectives

The specific research objectives below spin-off from the paper's main objective, which is to measure investors' risk attitude towards the pandemic and quantify its impact to select Asian stock markets:

(i) To construct the Covid-19 Risk Attitude (CRA) index for the Philippines and select Asian countries using daily internet-based search queries from 31 December 2019 to 03 July 2020;

(ii) To test whether or not the claim of Amstad, et al. (2020) on some Asian stock markets not significantly correlated to the CRA index holds true;[6] and

(iii) To understand the heterogeneous investors' sentiment in select Asian stock markets, categorized according to the country's income classification, to the pandemic.[7]

The paper is outlined as follows: Section 2 reviews the theoretical and empirical literature. Section 3 elaborates on the data, model specification and methodology used in this study. Section 4 presents and analyzes the results. Section 5 concludes with policy implications.

---

[5] As of August 2020, policy rate reductions aggregated to 175 basis points.
Source: www.bsp.gov.ph/monetary/monetary.asp

[6] The Asian stock markets included in the study made by Amstad, et al (2020) are China, Japan, South Korea, Singapore and Indonesia.

[7] The select Asian countries are classified according to their income clusters using the World Bank's *Country Classification by Income Group* as of June 2020.

2. Review of Related Literature

In the midst of pandemics, economic risks and uncertainties elevate. Market players adjust their behaviour in congruence with the stringent policies and measures undertaken by the governments to ensure the health and safety of the public. Economic outlooks blur as border controls are tightened, trading activities are limited, and business closures become imminent.

Risk and uncertainty are closely related concepts, but the stark difference lie in the postulation that risk is measurable since it is "expected with varying degrees of probabilities", while uncertainty is often subjective and difficult to quantify (Alpers, 2019). Hence, measuring and managing risks and uncertainties are postulated to be distinct yet worthwhile activities.

In this paper, we will zero in on quantifying risk, specifically the investors' risk attitude, with the end-goal of aiding strategic policy decisions to be more agile during periods of uncertainty.

2.1. Theoretical Framework

On Terminologies: Investor Sentiment, Risk Attitude, and Risk Appetite

Investor Sentiment. As per convention, asset pricing has been heavily based on the traditional factors of payoffs and expected returns. However, as sentiments became quantifiable and measurable, this psychological factor has gained traction in explaining price movements. Zhang (2008) presented the diverging methods of asset pricing in which the *traditional approach* rested upon the assumption that asset prices are determined through *"rational assessments of expected future payoffs"* which are only affected by information on interest rates and future cash flows. On the contrary, the *alternative approach* injects the concept of behavioural finance where investor sentiments significantly affect the pricing mechanism. Bandopadhyaya and Jones (2016) further postulated that on one hand, individual investor sentiments cancel out when they are differing; on the other hand, when there is a consensus in investor sentiments, such attitude could significantly affect price movements. Baek et.al (2005) specified that such effect and influence are magnified in the short-run, thereby, making investor sentiment a more critical explanatory factor for price movements rather than the traditional fundamentals.

Risk Attitude. In linking investor sentiment with risk attitude, we propose to define the latter simply as the *investors' sentiment towards risk*. More formally, Rohrmann (2005) defines risk attitude as the "generic orientation or mindset towards taking or avoiding risk when deciding how to proceed in situations with uncertain outcomes". Rohrmann further sub-divided risk attitude into *risk propensity* as the attitude towards taking risks and *risk aversion* as the attitude towards avoiding risks.

Risk Appetite. Gai and Vause (2004) forwarded the idea that "risk aversion" and "risk appetite" may be considered as synonymous terminologies. However, the slight distinction between "risk aversion" and "risk appetite" rests upon the observation that the former is subjective yet stable over time, while the latter is objective and varies with the perceived level of the current uncertainties in the market. More specifically, "risk aversion" is an investor's inherent attitude towards uncertainty, while "risk appetite" includes the reaction to the overall uncertainty on the current fundamental market factors affecting prices in the equation (ECB, 2007). Hence, it would be more worthwhile to track "risk appetite" in deciphering asset price movements.

For the purpose of this paper, the terminologies "risk appetite" and "risk attitude" will be utilized in the discussions of the index to be constructed. Moreover, we will define risk attitude as the inclination of a person to evaluate the adverse economic effects of the pandemic (Amstad et al., 2020).

On Measuring Risk Appetite and Risk Attitude. In order to capitalize on the observable shifts in risk attitude in crafting proactive policies, one must quantify this sentiment factor to accurately gauge its effects. Illing and Aaron (2012) categorizes the measurement approaches into (1) atheoretic and (2) theory-based.

Atheoretic measures build risk appetite indices by using statistical methods to aggregate information from market prices *(e.g. volatility, asset class spread, liquidity risk, credit risk, etc.)*. Meanwhile, theory-based measures employ economic or financial models to build the indices as applied to a single financial market.

The theory-based measures were likewise denoted as "market-based measures" (ECB, 2007) and generally follows three approaches: (a) structured market-based method, which investigates the correlation of volatility and returns; (b) method-based, which examines the implied probability density function of prices with investors' expectations and degree of uncertainty; and (c) traditional structure, which looks at the infamous Capital Asset Pricing Model (CAPM) and complements it with investors' perception. The different measures of investor sentiment towards risk are presented in Appendix 1.

How, then, do we determine the most suitable methodology in building a risk attitude index? What if times are extraordinarily pessimistic?

Measuring Risk Attitude During Extraordinary Times. Through the years, investors have weathered market crises and bounced back to more stable positions. In the past decade alone, the market reacted to the 2001 U.S. terror attack, the 2008 Global Financial Crisis and now (2020), the COVID-19 crisis. Due to these unforeseen events, the economic path is neither predictable nor may be tracked with absolute precision.

Interestingly, according to Illing and Aaron (2012), a number of marked economic events in the past emerged to be driven by investors' risk attitude. Among them are the Asian Financial Crisis (1997), Russian debt default (1998) and the bust of high-technology share prices or the dot-com burst (2000). This led to a movement in which researchers and institutions alike developed a *risk appetite index* to examine and predict market movements for policies; while the private sector utilized said index to optimize returns. Hence, extraordinary episodes (such as pandemics), warrant an investigation on whether or not investors' risk attitude indeed impact asset prices.

On the macro scale, we witnessed the public sector's response to manage the economic effects of the pandemic. The US federal funds rate has been cut last March by 0.5 percent to a target range of 1-1.25 percent in a first inter-meeting rate cut in more than 10 years,[8] due to the "evolving risks of economic activity" attributed to the pandemic. In an explanatory pronouncement, US Federal Reserve Chairman Jerome Powell emphasized that the rate cut was prompted by the view that COVID-19 was having a *"material impact on the economic outlook",* hence on business confidence (Cox, 2020). Meanwhile, China (one of the world's largest producers) has yet to resume full production capacity; thereby, adding on to Asia's downside risk. With border controls and trade restraints, supply chain disruptions are imminent, which could in turn cause an economic contagion.

On the micro scale, investors are poised to review their portfolios as risk aversion builds up. Such evaluation is heavily dependent on their levels of risk tolerance and their immediate versus long-term needs. *How then do we measure these micro movements to track macro movements?*

Given the mobility restrictions of a pandemic lockdown, conducting surveys to measure investors' risk attitude are non-viable and impractical at some level. Providentially, the world is replete with technological resource that could easily gather copious amounts of information in a single click. Such is the utility of big data – the widely available, high volume, high frequency, novel information source that triggers timely and proactive policies and decisions.

2.2. Empirical Studies

As formalized by De Long et al (1990), investor sentiment influences the behavior of financial markets. While there is an impression that markets react irrationally and randomly in times of unexpected crises, it is still far from being conclusive. It is against this premise that several empirical studies related to investigating the impact of investors' risk attitude to equity price movements were executed.[9]

In the recent years, innovative approaches that make the most of digital infrastructures such as the use of internet search-based data to measure investor sentiment and predict stock market behavior has gained traction because of its potential to reveal *attitudes* (Beer et al, 2013; Da et al, 2015; and Ho et al, 2017). Beer et al (2013) found that the French investor sentiment index are significant predictors of the behavior of mutual fund investors. In the same year, Preis et al (2013) utilized Google search volume index for finance-related keywords to identify early warning signs of possible stress in the stock market. They argued that the search volume index for terms relevant to financial markets shoots up prior to the collapse of the market.

In a similar yet unique approach, Mao et al (2015) leveraged on the availability of social media via Twitter updates to investigate the power of online investor "bullishness sentiment indicator" in predicting international stock market movements. They claimed that bullish sentiments expressed by investors in Twitter are strong explanatory variable for increases in

[8] Since 2008.

[9] Stocks and equity are interchangeably used in this paper.

stock returns. Meanwhile, Da et al (2015) constructed the Financial and Economic Attitudes Revealed by Search (FEARS) index by aggregating internet search volume queries related to concerns of American households such as "bankruptcy", "unemployment", "recession", among others. They also discovered that the sentiment-revealing index is able to predict: (i) short-term stock returns reversal; (ii) temporary increases in stock volatility; and (iii) mutual fund flows.

The investment horizon remains bleak as we are yet to see the light at the end of the tunnel for the COVID-19 pandemic. The peculiar role of investors' risk attitude in understanding stock price movements became more pronounced following the global epidemic. A risk-averse investor may react via examining the intrinsic value of assets and act conservatively, while a risk-taker may bet on the companies who might weather the tides of the pandemic (and either they will relish gains or suffer losses).

Distinguished economists John Kay and Mervyn King's *"Radical Uncertainty: Decision-Making Beyond the Numbers"* was published during the height of the pandemic in March this year (Sandbu, 2020). It postulates that during times of enormous or unprecedented uncertainty, market players can neither determine all possible outcomes nor assign probabilities to them. Hence, one must be aware of these limitations in order to decide aptly. They posited that in times of "radical uncertainty", a market player copes by using narrative and intuition. Likewise, Malkiel & Shiller (2020) argued that the COVID-19 crisis presented an exceptional illustration of how investors' unpredictable risk attitude towards the pandemic can subject the market to greater volatility.

Using the CRA index to analyze the behavior of 61 stock markets, Amstad et al (2020) found that stock markets react strongly and negatively to COVID-19 in more financially developed Western and American economies. Similarly, Ramelli and Wagner (2020) proved the significant influence of the pandemic risk attitude to stock market returns, arguing that real shocks from the global health pandemic amplified the feverish reaction of stock markets. In this paper, we will examine how an investor's risk attitude towards COVID-19 influence Asian stock markets, depending on their surrounding market context (e.g., developed vs. developing country, country's economic policies on the pandemic, and localized lockdown measures, among others).

3. Data and Methodology

This section provides details on the variables used, the construction of the CRA index[10], model specifications and estimation methodology employed in this paper.

3.1. Variables and Data Characteristics

The paper uses data on select Asian stock markets to test how these markets react to the pandemic. The period covered in this study starts from 31 December 2019 to capture the time when the novel coronavirus was first identified in Wuhan, China.[11] Since a number of

[10] The construction of this index will be discussed in the subsequent sections.

[11] Source: World Health Organization (WHO)

research studies in this field were conducted during the height of the outbreak and enhanced quarantine or lockdown, there is a greater likelihood that these studies fail to consider the possible rebound of the stock market. Hence, this study extends the period coverage up to 03 July 2020, when most of the countries have already lifted or relaxed their containment measures. The variables used in this study are shown in Table 1. The panel data summary statistics is presented in Appendix 2.

Table 1: Description of variables

Variables	Description	Source
Stock price index	Derived as percentage change in the closing prices of major stock index in country i at time t.	Thomson Reuters Eikon
Oil price	Calculated as percentage change in Brent crude oil prices at time t. [12]	Federal Reserve Economic Data (FRED)
Number of COVID-19 positive cases	Measured as percentage change in the number of COVID-19 cumulative cases in country i at time t.	European Centre for Disease Prevention and Control (ECDC)
Volatility of stock price index (VIX)	Computed as change in the market's expectation of 30-day implied volatility in the US stock market at time t, which is constructed from S&P 500 option prices.[13]	FRED
Trade-weighted US dollar index (broad)	Calculated as percentage change in trade-weighted US dollar index at time t.	FRED
COVID-19 Risk Attitude (CRA) index	Measured as change in the CRA index in country i at time t.	Google Trends; authors' calculations
Government response stringency index	Computed as the simple average of the number of measures that each government in country i adopted at time t. [14]	Hale, T., Webster, S., Petherick, A., Phillips, T., and Kira, B. (2020), Oxford COVID-19 Government Response Tracker, Blavatnik School of Government

3.2. Construction of the COVID-19 Risk Attitude (CRA) Index

The unanticipated outbreak of COVID-19 that immensely shocked the global markets brings into fore the question on *"how to measure investors' risk attitude and quantify its impact to stock market in a more direct and timely manner?"*. The unconventional approach that has gained traction in the recent years is the use of big data or internet search-based indices to quantify investors' sentiment.

Capitalizing on the optimal use of Google, which is the world's largest search engine, this study follows the general approach adopted by Amstad et al (2020) to construct the CRA index. It is important to note that the proper and objective identification of all pertinent

[12] The Brent crude oil is a blended crude stream produced in the North Sea region which serves as a reference for pricing a number of other crude streams.
Source: https://www.eia.gov/dnav/pet/TblDefs/pet_pri_spt_tbldef2.asp

[13] Source: http://www.cboe.com/vix.

[14] The details will be explained in the following sections.

sentiment-telling internet search terms is crucial to the construction of the CRA index. While the calculated CRA index in their research involves only two sentiment-revealing search keywords (i.e., COVID-19 and coronavirus), we extended the relevant search queries to include "2019-nCoV" and "nCoV" since it was only on 11 February 2020 that the WHO officially referred the virus as "COVID-19".

More formally, the CRA index is estimated by aggregating the daily search volume terms (i.e., coronavirus, COVID-19, nCoV, 2019-nCoV) via Google Trends from 31 December 2019 to 03 July 2020 for the nine (9) select Asian countries (equation 1):

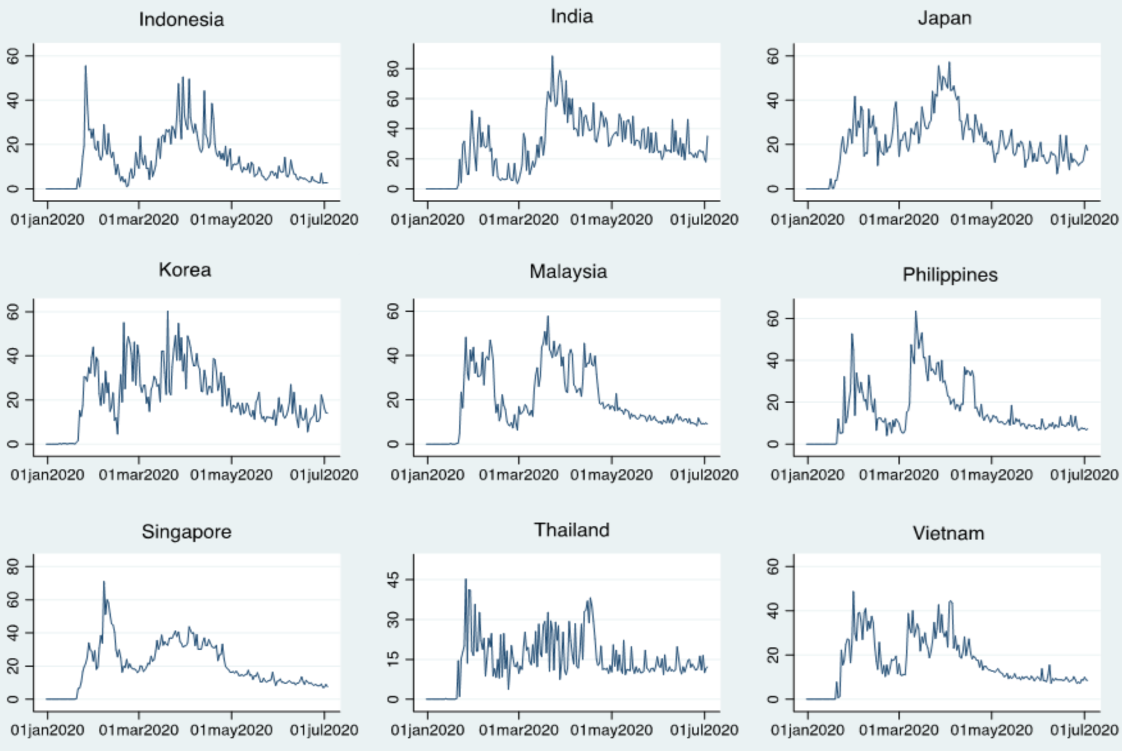
$$CRA_{i,t} = \frac{1}{K}\sum_{k=1}^{4} SVI_{k,i,t} \tag{1}$$

where K is the total number of search terms used in this study, $i = 1,2, \dots N$, $t = 1,2, \dots T$, N is the total number of countries under study while T is the total number of time series observations. The SVI is the search volume index where each query inputted into Google Trends is normalized to 100 for the highest search volume in country i at time t. Following the underlying assumptions of Amstad et al (2020), the frequency of searches related to the Covid-19 pandemic is a proxy for the public's or an individual's level of concern on the pandemic and its economic consequences.

To gauge the level of public attention towards the epidemic at the country-level, Figure 1 presents the CRA index for select Asian countries from 31 December 2019 to 03 July 2020. Similar patterns on CRA index can be observed across these countries where the peak is seen to be evident during the early stages of the pandemic. The number of sentiment-telling search queries started to pick up following the declaration of WHO on 30 January 2020 that the coronavirus outbreak is a global public health emergency.[15] The increasing trend in the index continues until April 2020 before it slowly wanes (Figure 1).

[15] Source: https://www.who.int/news-room/detail/29-06-2020-covidtimeline

Figure 1: Country-level CRA Index



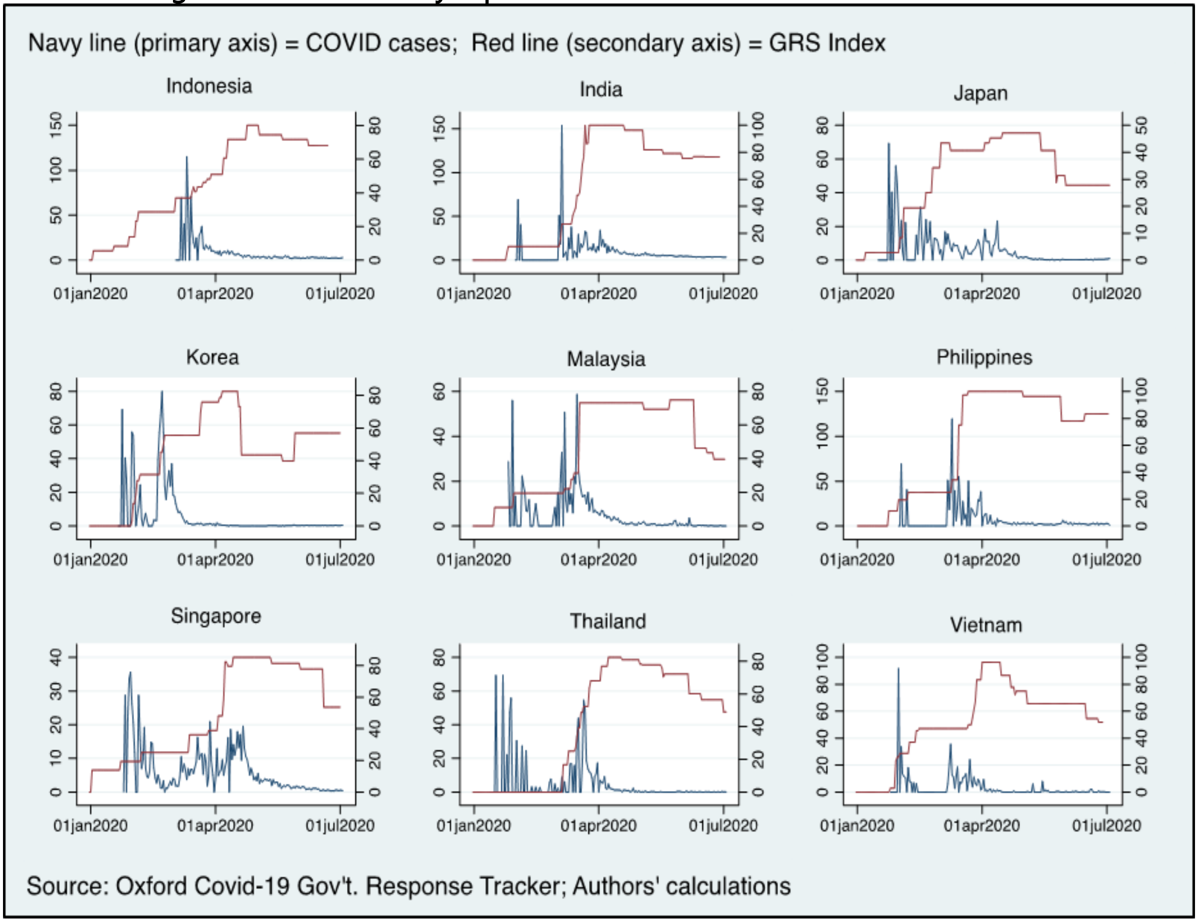
Source: Authors' calculations; Google Trends

3.3. Government Response Stringency Index (GRSI)

While the world faces the same public health conundrum, each nation has its distinct strategies and measures to contain the spread of the virus and thus, *'flatten the curve'*. To account for the different responses of government towards battling the pandemic, this study includes the variable Government Response Stringency Index (GRSI).

Hale et al (2020) calculated the index by simply taking the mean score of component indicators. The index has four (4) sub-indices, namely: (i) government response; (ii) containment and health; (iii) stringency; and (iv) economic support. The GRSI takes on a value between 0 to 100, with 100 being the strictest response. It should be noted, however, that the index does not necessarily entail the effectiveness or relevance of government's response to the epidemic. Figure 2 compares the daily percentage change in the number of COVID-19 cumulative cases with the government interventions adopted across Asian countries under research.

Figure 2: Cross-country reported COVID-19 cumulative cases and GRSI



The government responses strengthen throughout the virus outbreak and, for most of the Asian countries, the index started to ratchet up as the daily percentage change in the number of COVID-19 cumulative cases shoot up. However, there are still variations across these countries as to the degree at which the stringency of these responses was taken on board (Figure 2).

3.4. Model Specification

The specifications used in this study to estimate the model and test the robustness of this model will be discussed in this section.

3.4.1. Baseline Model

This study, which is applied and focused in the context of Asian economies, follows the general approach of the recent works of Amstad et al (2020) and Capelle-Blanchard & Desroziers (2020). To test the paper's research objectives empirically, the baseline model will be estimated as:

$$\Delta ln(sp_{it}) = \alpha_0 + \beta_1 \Delta ln(op_t) + \gamma_2 \Delta ln(twusd_t) + \varphi_3 \Delta vix_t + \omega_4 \Delta ln\,(cases_{it}) + \tau_5 \Delta CRA_{it} + \vartheta_i + \mu_{it} \quad (2)$$

where the dependent variable $\Delta\ln(sp_{it})$ is the log difference of stock price index in country i at time t – an approximation to the growth rate of daily stock price index. The independent variables that represent the market fundamentals are op_t and $twusd_t$, which represents the Brent crude oil price and trade-weighted US dollar index at time t, respectively. The variable oil price is incorporated to take into account impact of the discord between two of the world's major oil producers – Russia and Saudi Arabia during the 1st quarter of 2020.[16] Similarly, the inclusion of trade-weighted USD index captures the relative strength of US dollar against other foreign currencies. Meanwhile, the volatility of stock price index, vix_t, is a widely used and recognized international benchmark indicator of stock market volatility.

To measure and quantify investors' sentiment towards the risk associated with the pandemic, the variables COVID-19 cumulative cases and CRA index were added to the model estimation. As these two variables are likely to introduce collinearity, these indicators were concurrently estimated instead of regressing the variables separately in the model.

The total error term, e_{it}, is categorised into: (i) ϑ_i captures the unobserved country-specific fixed effects; and (ii) μ_{it}, which is the observation specific errors (time varying unobservables). Both ϑ_i and μ_{it} follows an independent, identical distribution (IID) with zero mean and constant variance $\sim IID\ (0, \sigma^2)$.

3.4.2. Cross-country Classifications by Income Group

Rather than evaluating investors' behaviour towards the COVID-19 across economies in absolute terms, this study compares the stock price movements in select Asian countries and attribute the heterogeneous reactions of stock markets to country differences (e.g., pre-existing macroeconomic and financial conditions, level of financial development, institutional characteristics, among others). One difference that this study considers looking at is the country's income classification.[17] The third research objective of this paper will be examined by extending the benchmark model, equation (2), as follows:

$$\begin{gathered}\Delta ln(sp_{it}) = \alpha_0 + \beta_1 \Delta ln(op_t) + \gamma_2 \Delta ln(twusd_t) + \varphi_3 \Delta vix_t + \\ \omega_4 \Delta ln\ (cases_{it}) + \delta_5 \Delta CRA_{it} * income\ class + \vartheta_i + \mu_{it}\end{gathered} \tag{3}$$

where $\Delta CRA_{it} * income\ class$ is the interaction term between the level of CRA index and country groupings by income. The dummy variable, $income\ class$, is categorized into three (3) clusters: (i) higher income economies – Japan, Korea and Singapore; (ii) upper-middle income – Indonesia, Malaysia and Thailand; and (iii) lower-middle income (reference group) – India, Philippines, and Vietnam. The country groupings were based on the World Bank's income classification according to 2019 Gross National Income (GNI) per capita of each economy.[18]

---

16 Source: https://www.spglobal.com/platts/en/market-insights/latest-news/oil/040420-opec-emergency-meeting-faces-_delay-as-russia-rift-with-saudi-grows.

17 Higher income Asian economies are assumed to be more financially developed.

18 The income groupings are: (i) low income class ≤ $1,035; (ii) lower-middle income = $1,036-$4,045; (iii) upper middle income = $4,046-$12,535; and (iv) high income > $12,536.
Source: The World Bank

3.4.3. Robustness of the Model

To ensure the robustness of the model and ascertain that the empirical results are not provisional on the authors' data selection, sample coverage and time period, some modifications were considered in the regression. First, the authors incorporated the GRSI as control variable to check the consistency of the impact of investors' sentiment towards the pandemic-related risks, as measured by CRA index, to stock price movements in country i at time t. This is represented in the extended equation below:

$$\begin{aligned}\Delta\ln(sp_{it}) = \alpha_0 + \beta_1\Delta\ln(op_t) + \gamma_2\Delta ln(twusd_t) + \varphi_3\Delta vix_t + \\ \omega_4\Delta ln(cases_{it}) + \tau_5\Delta CRA_{it} + \psi_6 GRSI_{it} + \vartheta_i + \mu_{it}\end{aligned} \qquad eq.(4)$$

Second, we checked the robustness of the model by limiting the time period to *Outbreak* and *Fever* phases and excluding the *Incubation* stage as in Capelle-Blanchard & Desroziers (2020). The *Incubation* phase ranges from 02 January to 17 January while the *Outbreak* period spans from 20 January to 21 February. This paper, however, deviates from their method to extend the *Fever* phase from 20 March to 31 March to fully consider the impact of the virus to S&P 500 index the entire period of March 2020.[19]

3.5. Estimation Methodology

The econometric approach that this paper will employ is panel regression, particularly the random effects (RE) model to test empirically the objectives of this research. The conventional way to choose which between the fixed effects (FE) and RE models to use best is through the Hausman test.[20] Under the RE model, the estimates are based on the identifying assumption that the error terms follow an IID with zero mean and constant variance $\sim IID\ (0, \sigma^2)$. The advantage of using the RE estimator is that the variation across countries is assumed to be random and uncorrelated with the explanatory variables in the model (Torres-Reyna, 2007). Since country-specific differences (e.g. level of financial development, macroeconomic and institutional characteristics of select Asian countries) might have some influence on the dependent variable (i.e., stock price index), the RE model would be the best option.

When using panel regression, typical econometric and specification problems arise such as within-group autocorrelation and cross-sectional dependence (Wooldridge, 2010). To make sure that the validity of statistical inference is not attenuated by these econometric issues, diagnostic tests were performed. The cross-sectional dependence (CSD) Pesaran test for serial correlation reveals that there is autocorrelation in the residuals. To correct for cross-sectional dependence, an auxiliary regression was employed in the main regression through the use of Driscoll-Kraay (1998) standard errors as proposed by Wooldridge.

[19] The S&P 500 index hit another lowest record-making in history at 12.5 percent for the month of March. Source: https://www.valuationresearch.com/pure-perspectives/covid-19-event-timeline/.

[20] Hausman test suggests the use of RE model.

4. Empirical Results

The research objectives of this paper as identified in Section 1 will be addressed in this section. An in-depth analysis will be provided on the following topics: (4.1.) impact of the COVID-19 Risk Attitude Index to Asian stock markets; (4.2.) different Asian investors' sentiment to the pandemic, by income group; (4.3) impact of pandemic-related government responses to stock markets; and (4.4) Asian stock markets' response over the *'outbreak'* and *'fever'* phases.

4.1. Impact of the COVID-19 Risk Attitude Index to Asian Stock Markets

In addition to market fundamentals, this paper finds that CRA index is important in predicting stock price movements in Asian countries. The parameter estimates for equations 2 and 3, which are specified in Sections 3.4.1 and 3.4.2, respectively, are presented in Table 2. Contrary to the findings of Amstad et al (2020) that Asian stock markets are not significantly correlated with CRA index, this study shows that CRA index enters positively and statistically significant in equation 2.

Table 2: Models for Predictors of Stock Price Index

Predictor Variables	Baseline Model (eq. 2)	Model for country groupings, by income (eq. 3)
Impact of investors' sentiment to Asian stock markets		
$\Delta ln\ (cases_{it})$	-0.003	-0.003
	(0.004)	(0.005)
ΔCRA_{it}	0.023*	
	(0.012)	
Impact of fundamentals to Asian stock markets		
$\Delta ln\ (op_t)$	0.008**	0.008**
	(0.003)	(0.004)
$\Delta ln(twusd_t)$	-1.507***	-1.493***
	(0.185)	(0.179)
Δvix_t	0.003	0.001
	(0.020)	(0.020)
Impact of COVID-19 to Asian stock markets, by income category		
$\Delta CRA_{it} * high$		0.050*
		(0.027)
$\Delta CRA_{it} * uppermid$		0.024*
		(0.013)
$\Delta CRA_{it} * lowermid$ *(benchmark/reference)*		
No. of observations	784	784
No. of countries	9	9

*Note: Driscoll-Kraay standard errors are in parentheses; ***, **,* denotes p-value less than the 1%, 5% and 10% levels of significance, respectively.*

The findings suggest that the perceived negative effect of the pandemic to stock markets is non-evident in the context of Asian markets under study. Looking at Table 2, column 2, the coefficient associated with the investors' risk attitude index is estimated to be at 0.023.

This implies that despite the increase in the investors' sentiment-revealing daily internet search volume index, Asian stock price indices is expected to increase by 2.3 percent on the average.

The empirical findings of this study reveal a myriad of plausible reasons. One is the claim of Amstad et al (2020) that Asian stock markets, unlike Western and European countries, are less sensitive to the negative impact of COVID-19 since most of the Asian countries entered the pandemic relatively earlier and therefore, was able to introduce prompt policy adjustments to combat the further spread of the virus. Second is the prudent use of technological applications to curb the virus outbreak like contact tracing and location tracking that started first in Asia, especially in countries with better digital infrastructures (Cantu et al, 2020). Third is the assumption that the experiences of most of the Asian countries included in this study during the 2002-2004 SARS outbreak have better equipped them in terms of dealing with the current pandemic.

Moreover, Table 2 shows that the daily rate of spread of virus $\Delta\ln(cases_{it})$ is not a significant predictor of stock price movements. What was not predicted by the growth in the number of daily COVID-19 cumulative cases have been explained by the CRA index, making the index a good measure of capturing investors' general sentiment amid the pandemic.

With reference to the traditional drivers of stock price, oil price and trade-weighted US dollar index are significant predictor variables of stock market. The signs of the estimated coefficients are consistent and significant in all model specifications (equations 2 and 3). On the average, a one percent increase in Brent crude oil prices is expected to positively affect Asian stock price indices by 0.01 percent. As apprehensions over the coronavirus impact to the world economy intensified, the US dollar index strengthened against a basket of other foreign currencies. Consequently, investors were impelled to offload riskier assets such as stocks in exchange for holding safer ones, especially the US dollar despite the fact that the US economy is also at risk (Miller, 2020; The Straits Times, 2020). Hence, bringing stock prices to fall and are estimated to drop to negative territory by approximately 1.5 percent (Table 2, columns 2 and 3). Miller (2020) further argued that whenever the world economy enters into unprecedented and unpredicted crisis, the demand for US dollar by investors around the globe tend to ratchet up.

4.2. Different Asian Investors' Sentiment to the Pandemic, by Income Group

Seen on the whole, the stock investors' risk perception and general fear towards the negative impact of the pandemic is not as intense and pronounced as that in the European or American markets (Amstad et al, 2020). However, since the Asian countries considered in this study are diverse and distinct in terms of the stage of economic and financial development, this section will provide further validation on the consistency of the estimated coefficient for CRA index in equation 2. The empirical results are reported in Table 2, column 3.

As compared to the lower-middle income countries – India, Philippines and Vietnam – the impact of CRA index to stock price index is positive and statistically significant for both high (Japan, Korea, Singapore) and upper-middle income countries (Indonesia, Thailand, Malaysia). Singapore, Japan, Korea were the first to press digital infrastructures into use in Asia to stem the virus outbreak (Chandran, 2020). Such prompt responses by these countries might have given stock investors a boost and confidence in the market. Meanwhile, the estimated coefficient of CRA index in lower-middle income countries is negative. While inference is invalid since it is statistically insignificant, the results could possibly hint of the countries' relatively underdeveloped financial system. Furthermore, following the extrapolations of Amstad et al (2020) on advanced versus developing economies, lower-middle income Asian economies have less integrated and less efficient markets, with a slimmer investor base relative to the high and upper-middle income countries in comparison.

4.3. Impact of Pandemic-related Government Responses to Stock Markets

The inclusion of GRSI as a control variable in the model specification (eq.4) confirms the consistency of the direction of sign (i.e., positive) of the estimated coefficients for CRA index in all equations. The variable GRSI is positive and statistically significant, which means that as governments intensified their wide range of strict measures to stem the spread of the virus, Asian stock markets seem to gain market confidence.

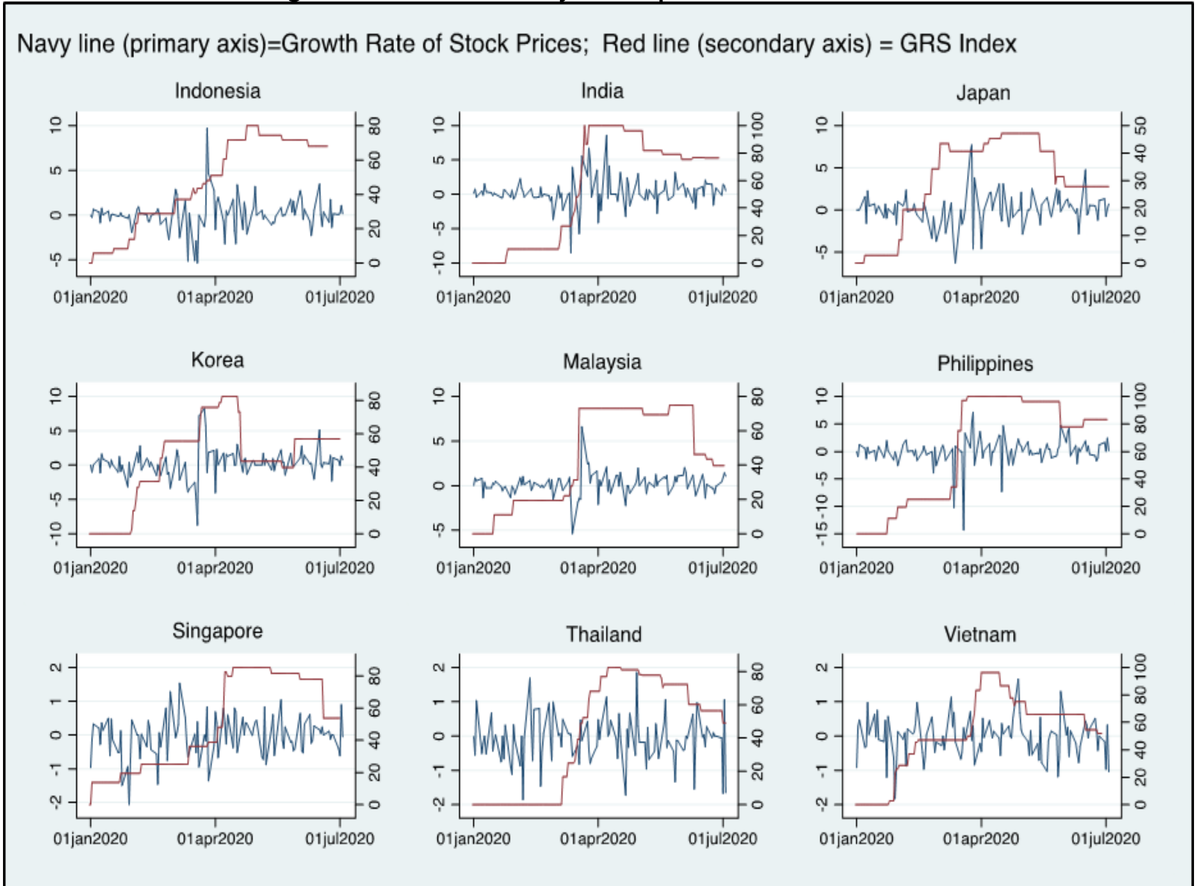
Table 3: Models for Robustness Checks

Predictor Variables	Controlling for GRSI (eq. 4)	Outbreak & Fever Phases (20 Jan – 31 Mar 2020)
Impact of investors' sentiment to Asian stock markets		
$\Delta ln\ (cases_{it})$	-0.002	-0.002
	(0.004)	(0.004)
ΔCRA_{it}	0.023*	0.029*
	(0.012)	(0.016)
Impact of fundamentals to Asian stock markets		
$\Delta ln\ (op_t)$	0.008**	0.034
	(0.004)	(0.032)
$\Delta ln(twusd_t)$	-1.488***	-1.608***
	(0.185)	(0.277)
Δvix_t	0.004	0.004
	(0.020)	(0.020)
Robustness checks		
$GRSI_{it}$	0.004*	0.011
	(0.002)	(0.009)
No. of observations	780	319
No. of countries	9	9

*Note: Driscoll-Kraay standard errors are in parentheses; ***, **,* denotes p-value less than the 1%, 5% and 10% levels of significance, respectively.*

The figure below distinctly shows that as the level of government's response measures gets stricter, stock prices tend to bounce back (Figure 3), signalling market's confidence amid the pandemic. Intuitively, this suggests that investors respond to the government's cue – that is, more stringent measures signalling a more active fight against the pandemic that shortens the waiting time for recovery, both in public health and in the economy. Broadly, the graph shows that the highest peak in the stock prices in most of the select Asian countries is seen around the month of April where majority of these countries have already implemented containment measures, economic relief operations, healthcare investments and other pandemic-related responses.

Figure 3: Cross-country stock price indices and GRSI



Source: Eikon; Oxford Covid-19 Gov't Response Tracker; Authors' calculations

4.4. Asian Stock Markets' Response over the *'Outbreak'* and '*Fever'* Phases

Overall, the impact of CRA index to Asian stock prices remains consistent regardless of the model specifications even if the model was estimated by limiting the time period to *Outbreak* and *Fever* phases only. In fact, the estimated coefficient for the impact of CRA index to stock prices is a little bit higher (Table 3, column 3) vis-à-vis the specification in equation 4 (Table 3, column 2). To some degree, this result is supported by the claim of Amstad et al (2020) that the negative effect of the CRA index is less pronounced in a number of Asian equity markets than in America and Europe since the former went through the epidemic earlier and policy re-adjustments were effected accordingly.

5. Conclusion

The dynamics of the stock markets' behavior towards the global pandemic brought the public, not only the economists, to ask the question – *Is the glass half-empty or half-full?* In this paper, we tried to provide answers to some questions and/or issues with regard to stock price movements. In particular, the main objective of this research is to measure investor risk attitude towards COVID-19 and quantify its impact to select Asian stock prices by leveraging on the use of big data – internet search volume index.

In addition to market fundamentals, the CRA index is a significant predictor variable for variations in Asian stock prices. Across all model specifications, this study finds out that Asian stock markets, in general, do not exhibit absolute pessimism towards the pandemic. This paper argues that as governments pull out all the stops to soften, if not to totally eradicate, the impact of the dreaded coronavirus, Asian stock investors appear to relatively gain market confidence. This claim is corroborated by the positive effect of GRSI to equity prices where a suite of government responses – ranging from containment measures to economic relief operations and health facilities investments – have been enacted relatively prompt. Further, the main story holds true even when the time series observations were limited to *'Outbreak'* and *'Fever'* phases only.

Finally, since different countries have different pre-existing institutional characteristics or macroeconomic conditions, this research tested for the heterogenous response of select Asian countries by grouping these countries according to their income classification. The effect of the variable CRA index in high-income and upper-middle income countries to stock prices is positive and statistically significant while the opposite is observed in lower-middle income countries.

References

Ahir, H., Bloom, N., and Furceri, D. (2020). 60 Years of Uncertainty. International Monetary Fund – Finance and Development, March 2020. Retrieved August 4, 2020, from https://www.imf.org/external/pubs/ft/fandd/2020/03/pdf/imf-launches-world-uncertainty-index-wui-furceri.pdf.

Alpers, I. (2019). Managing the "Unknowns": Exploring the nature of uncertainty and its effects on strategic decisions (Doctoral dissertation, University of St. Gallen). Retrieved June 28, 2020, from https://www1.unisg.ch/www/edis.nsf/SysLkpByIdentifier/4866/$FILE/dis4866.pdf

Amstad, M., Cornelli, G., Gambacorta, L., and Xia, D. (2020). 'Investors' risk attitude in the pandemic and the stock market: new evidence based on internet searches', BIS Bulletin No. 25.

Baek, I.-M., Bandopadhyaya, A. and Du, C. (2005), 'Determinants of Market Assessed Sovereign Risk: Economic Fundamentals or Market Risk Appetite?' Journal of International Money and Finance, 24(4), 533–48. Retrieved June 26, 2020, from https://www.sciencedirect.com/science/article/pii/S0261560605000306

Baker, S.R., Bloom, N., Davis, S.J., Kost, K., Sammon, M., and Viratyosin, T. (2020). 'The unprecedented stock market reaction to COVID-19', NBER Working Paper No. 26945.

Bandopadhyaya A., Jones A.L. (2016) Measuring Investor Sentiment in Equity Markets. In: Satchell S. (eds) Asset Management. Palgrave Macmillan, Cham. Retrieved June 26, 2020, from https://link.springer.com/chapter/10.1007/978-3-319-30794-7_11.

Barua, S. (2020). Understanding Coronanomics: The economic implications of the coronavirus (COVID-19) pandemic. SSRN Electronic Journal. Retrieved July 5, 2020, from https://www.ssrn.com/abstract=3566477.

Beer, F., Herve, F., and Zouaoui, M. (2013). 'Is big brother watching us? Google, investor sentiment and the stock market', *Economics Bulletin*, 33 (1), pp. 454-466.

Cantu, C., Cheng, G., Doerr, S., Frost, J., and Gambacaorta, L. (2020). 'On health and privacy: technology to combat the pandemic', BIS Bulletin No. 17.

Capelle-Blanchard, G., and Desroziers, A. (2020). 'The stock market is not the economy? Insights from the COVID-19 crisis', Centre for Economic Policy Research Issue No. 28.

Chandran, R. (2020). 'Here's how Asia is using tech to tackle COVID-19', World Economic Forum. https://www.weforum.org/agenda/2020/03/asia-technology-coronavirus-covid19-solutions.

Cox, J. 2020. CNBC News. Fed cuts rates by half a percentage point to combat coronavirus slowdown. 3 March 2020. Retrieved June 6, 2020, from https://www.cnbc.com/

2020/03/03/fed-cuts-rates-by-half-a-percentage-point-to-combat-coronavirus-slowdown.html.

Da, Z., Engelberg, J., and Gao, P. (2015). 'The sum of all FEARS investor sentiment and asset prices', *The Review of Financial Studies*, vol. 28, no.1.

De Long, J., Shleifer, A., Summers, L., Waldman, R. (1990). 'Noise trader risk in financial markets', *Journal of Political Economy*, Vol, 98, No. 4, pp. 703-738.

Ding, Z., Hartog, J., Sun, Y. (2010). Can We Measure Individual Risk Attitudes in a Survey? IZA Institute of Labor Economics Discussion Paper No. 4807. Bonn, Germany. Retrieved June 5 2020, from http://ftp.iza.org/dp4807.pdf.

Driscoll, J.C. & Kraay, A.C. (1998). 'Consistent covariance matrix estimation with spatially dependent panel data', *The Review of Economics and Statistics*, Vol. 80, No. 4, pp. 549-560.

Economic Times. 13 May 2020. UN forecasts pandemic to shrink world economy by 3.2 percent. Retrieved June 6, 2020, from https://economictimes.indiatimes.com /news/international/world-news/un-forecasts-pandemic-to-shrink-world-economy-by-3-2-percent/articleshow/75724301.cms?from=mdr.

European Central Bank (ECB) Financial Stability Review. June 2007. Retrieved June 2, 2020, from https://www.ecb.europa.eu/pub/pdf/fsr/art/ecb.fsrart200706_04.en.pdf.

European Centre for Disease Prevention and Control (ECDC). Event Background COVID 19. [Updated July 2020] Retrieved July 19, 2020, from https://www.ecdc.europa.eu/en /novel-coronavirus/event-background-2019.

Gai, P. and Vause, N. (2004). "Risk Appetite: Concept and Measurement." Bank of England Financial Stability Review (December): 127-136. Retrieved June 13, 2020, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=872695.

Gandel, S. (2020). 'Stock markets reeling after Fed's emergency coronavirus cuts', *CBS News*, 16 March.

Giglio, S., Maggiori, M., Stroebel, J., and Utkus, S. (2020). Inside the Mind of a Stock Market Crash, NBER Working Paper No. 27272.

Gopinath, G. 14 April 2020. The Great Lockdown: Worst Economic Downturn Since the Great Depression. IMF Blogs. Retrieved July 17, 2020, from https://blogs.imf.org/2020/04/14/the-great-lockdown-worst-economic-downturn-since-the-great-depression/.

Hale, T., Webster, S., Petherick, A., Phillips, T., and Kira, B. (2020). Oxford COVID-19 Government Response Tracker, Blavatnik School of Government. www.bsg.ox.ac.uk/covidtracker.

Ho, C-S., Damien, P., Gu, B., and Konana, P. (2017). 'The time-varying nature of social media sentiments in modelling stock returns', *Elsevier Decision Support Systems*, Vol. 101, No. 3, pp. 69-81.

Illing, M. and Aaron M. (2012). A Brief Survey of Risk-Appetite Indexes. Financial System Review. Bank of Canada. Retrieved June 3, 2020, from https://www.bankofcanada.ca/wp-content/uploads/2012/01/fsr-0605-illing.pdf.

Kay, J. and King, M. (2020), 'Radical Uncertainty: Decision-Making Beyond the Numbers', Financial Times, March. Retrieved from https://www.ft.com/content/0b2dcf46-6538-11ea-a6cd-df28cc3c6a68.

Lederer, E. (2020 March 31). Coronavirus outbreak is the world's worst crisis since Second World War: UN chief. Retrieved July 15, 2020, from https://globalnews.ca/news/6759978/coronavirus-world-war-2-un-chief-crisis/.

Malkiel, B. and Shiller, R. (2020). 'Does COVID-19 prove the stock market is inefficient?, *Pairagraph*, 4 May 2020.

Mao, H., Counts, S., and Bollen, J. (2015). 'Quantifying the effects of online bullishness on international financial markets', *Statistics Papers* No. 9, European Central Bank (ECB).

Miller, C. (2020). 'The dominance of the US dollar during the COVID-19 pandemic', *Foreign Policy Research Institute*, 06 May.

Nsoesie, Elaine Okanyene, Benjamin Rader, Yiyao L. Barnoon, Lauren Goodwin, and John S. Brownstein. Analysis of hospital traffic and search engine data in Wuhan China indicates early disease activity in the Fall of 2019 (2020). Retrieved July 15, 2020, from https://dash.harvard.edu/handle/1/42669767.

OECD Economic Outlook. June 2020. Organisation for Economic Co-operation and Development. Retrieved July 3, 2020, from http://www.oecd.org/economic-outlook/june-2020/.

Preis, T., Moat, H.S., Stanley, H.E. (2013). 'Quantifying trading behavior in financial markets using Google Trends,' *Scientific Reports*, Vol. 3, No. 1684.

Ramelli, S., and Wagner, A.F. (2020). 'Feverish stock price reactions to COVID-19', Swiss Finance Institute, Working Paper.

Rohrmann, B. (2005). Risk Attitude Scales: Concepts, Questionnaires, Utilizations. University of Melbourne: Department of Psychology. Australia. Retrieved July 5, 2020 from http://www.rohrmannresearch.net/pdfs/rohrmann-racreport.pdf.

Sandbu, M. (2020). Radical Uncertainty: Decision-Making Beyond the Numbers, by John Kay and Mervyn King. 16 March 2020. Financial Times. Retrieved June 5, 2020, from https://www.ft.com/content/0b2dcf46-6538-11ea-a6cd-df28cc3c6a68

The Straits Times (2020). 'US dollar is still king, even as coronavirus slams country', 07April.

Tarashev, N., Tsatsaronis, K. & Karampatos, D., (2003)."Investors' attitude towards risk: what can we learn from options?," BIS Quarterly Review, Bank for International Settlements, June 2003. Retrieved June 4, 2020, from https://ideas.repec.org/a/bis/bisqtr/0306f.html.

Torres-Reyna, O. (2007), 'Panel data analysis: fixed and random effects using Stata', Princeton University. Retrieved from https://dss.princeton.edu/training/.

Torsello, M., & Winkler, M. M. (2020). Coronavirus-infected international business transactions: A preliminary diagnosis. European Journal of Risk Regulation. Retrieved July 20, 2020, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7160163/

World Economic Outlook (WEO) (April 2020). International Monetary Fund. Retrieved on June 18, 2020, from https://www.imf.org/en/Publications/WEO/Issues/2020/04/14/weo-april-2020.

Wooldridge, J.M. (2010). 'Econometric analysis of cross section and panel data', 2nd edition, MIT Press, Cambridge, MA.

World Health Organization (WHO). Timeline of WHO's response to COVID-19. (2020, July 29). Retrieved August 04, 2020, from https://www.who.int/news-room/detail/29-06-2020-covidtimeline.

Zhang, C. (2008). Defining, modelling, and measuring investor sentiment (Doctoral thesis). University of California, Berkeley, USA. Retrieved June 28, 2020, from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.169.9209&rep=rep1&type=pdf.

Zhang, D., Hu, M., & Ji, Q. (2020). Financial markets under the global pandemic of COVID-19. Finance Research Letters, 101528. Advance online publication. https://doi.org/10.1016/j.frl.2020.101528.

Appendix 1: Different Measures of Investor Sentiment Towards Risk

Index	Brief Description
Chicago Board Options Exchange Volatility Index (VIX)	The CBOE's VIX is measured via the investors' buying and selling of the S&P 500 options to mitigate their risk exposure based on the market's expectation of the 30-day implied volatility in the US stock market at a specified time (t). *VIX, which measures the implied volatility of the S&P 500 options, will be used as one of the variables in the proposed model of this paper.
JP Morgan's Risk Tolerance Indices a. Global (JPM G-10 RTI) b. Emerging Markets the (JPM EM RTI)	The JPM G-10 RTI uses the US swap spread for liquidity risk, the aforementioned VIX for equity market risk, EMBI+ for credit risk in Emerging Markets and the Trade-weighted Swiss France for the "risk appetite" in the currency markets. Meanwhile, the JPM EM RTI uses only the VIX and EMBI+ with a 30-70 weight.
Dresdner Kleinwort's Aggregate Risk Perception Index (ARPI)	The ARPI uses high-frequency data on the spreads and volatilities from the fixed income basket to measure global and political risk, the equity basket for equity investment risk, the liquidity basket for liquidity risk, the commodity basket for energy risk and the credit basket for credit risk.[21]
Goldman Sachs Risk Aversion Index (GS)	The GS uses the real US per-capita consumption growth, returns on real rate on three-month US T-bills and returns on inflation-adjusted S&P 500 Index.
State Street Investor Confidence Index (ICI)	The ICI measures the changes in the international holdings of large institutional investors,[22] by comparing the dollar flow of the day versus the dollar holdings in the previous day (given the country and the day).[23]
Tarashev, Tsatsaronis and Karampatos Risk-Appetite Index (from the Bank of International Settlement or BIS)	The BIS index compares the probability of future asset returns (based on spot prices' historical patter) vis-à-vis the probability of the returns through the effective risk preferences of the investors largely driven by options prices.[24]
Gai and Vause from the Bank of England (FSI)	The FSI follows that of the BIS, with difference emanating from calculating the ration of the whole probability distributions rather than just the tails.
Credit Suisse Global Risk Appetite Index (CS)	The CS uses a pool of safe and risky assets (via 7-10 year government bonds and equities & EM bonds, respectively).[25]
Kumar and Persuad's (2002): Global Risk Appetite Index (GRAI)	The GRAI is measured by ranking assets in terms of their level of "riskiness"[26] and their level of "excess returns".[27]

[21] The method used a 2-step Principal Component Analysis (PCA) (e.g., within baskets and among the principal components of the baskets).

[22] Those with 22 million security transactions annually across 45 countries.

[23] Thus, simply the market capitalization in each country over time.

[24] The index is calculated as the ratio of the left tails of the probability distributions.

[25] The index is calculated through a cross-sectional linear regression of excess returns and volatilities of the assets, with the slope of the regression line as the risk appetite index.

[26] Based on past returns.

[27] Based on the difference between future and spot prices at time (t). The principle being that the correlation between the ranking of risk and return should be close to 0 for changes in "riskiness". The correlation should be positive for increasing risk appetite (RA) and negative for decreasing RA.

Ding et al (2010): Surveys-based risk attitude measure	Using a survey among Peking University students which inquires on an individual's reservation price for a "hypothetical lottery" and a self-scale assessment of risk attitude (0-10 scale, with 0 as the most risk averse).

Appendix 2: Panel Data Summary Statistics

Variables		Mean	Standard Deviation	Min	Max	Observations
$\Delta ln\ (sp_{it})$	overall	0.07	1.71	-14.32	9.70	N = 963
	between		0.14	-0.10	0.34	n = 9
	within		1.70	-14.32	9.77	T = 107
$\Delta ln\ (op_t)$	overall	0.18	10.25	-64.37	41.20	N = 927
	between		0.00	0.18	0.18	n = 9
	within		10.25	-64.37	41.20	T = 103
$\Delta ln(twusd_t)$	overall	0.03	0.48	-1.94	1.92	N = 927
	between		0.00	0.03	0.03	n = 9
	within		0.48	-1.94	1.92	T = 103
Δvix_t	overall	-0.04	4.11	-17.64	21.57	N = 954
	between		0.00	-0.04	-0.04	n = 9
	within		4.11	-17.64	21.57	T = 106
$\Delta ln\ (cases_{it})$	overall	5.93	12.21	0.00	154.04	N = 1422
	between		1.72	3.22	8.61	n = 9
	within		12.10	-2.68	151.37	T-bar = 158
ΔCRA_{it}	overall	0.07	7.36	-36.50	37.75	N = 1665
	between		0.05	0.01	0.19	n = 9
	within		7.36	-36.51	37.74	T = 185
$GRSI_{it}$	overall	46.95	31.00	0.00	100.00	N = 1646
	between		8.77	29.82	61.51	n = 9
	within		29.86	-14.56	93.38	T = 182.89

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Introductory remarks:

Relevance of data integration and advanced analytics in central bank decision-making[1]

Maayan Kellerman,
Bank of Israel

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

IPS 212 - Relevance of data integration and advanced analytics in central bank decision-making

Discussant session, July 2021

Maayan Kellerman
Head of the Data Integration and Coordination Unit
Information and Statistics Department
Bank of Israel

The future of data collection & data management: Agile RegOps for digitalizing the regulatory value chain

- We should all move toward the use of advanced technology and access to granular data
- In order to pull the data, each figure must be defined very clearly and uniformly across the reporting entities
- The preparations of the regulator

A data-driven, risk-based approach to strengthen the fight against money laundering

- Connection to other granular databases
- Uniform methodology among all reporting entities
- Legal and information management challenge
- Customers need to know that their information is being shared

Thank you

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

The future of data collection & data management: Agile RegOps for digitalising the regulatory value chain[1]

Daniel Muench, Maciej Piechocki and Eric Stiegeler, BearingPoint RegTech,
Johannes Turner, Central Bank of the Republic of Austria,
and Martina Drvar, Croatian National Bank

1 This presentation was prepared for the WSC. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

BearingPoint RegTech

Future of data collection & data management: Agile RegOps for digitizing the regulatory value chain

ISI Virtual 2021, 63rd World Statistics Congress

July 2021

Martina Drvar, Johannes Turner, Maciej Piechocki, Eric Stiegeler, Daniel Muench

BearingPoint®

Something is rotten in the state of regulatory reporting…

Despite major efforts of industry participants and regulators, problems in regulatory reporting are increasing and new answers must be found

Symptoms

"Lack of analysis capabilities for regulators"

"High implementation cost of regulatory reporting"

"Industry cooperation in RegTech is proclaimed, but does not materialize"

"Data models and processing standardization is not gaining traction from industry or regulator"

"Does the current template-based regulatory reporting regime make sense at all nowadays?"

"Difficult implementation of regulatory content on complex data silo structures"

"Received data flood cannot be analyzed"

"Application of emerging technologies impeded due to missing standards"

Problems

01.

Lack of data insight for supervisors

- The regulator's get only a fraction of the insight the financial institutions generate for reporting

02.

High cost

- High and increasing costs of banking supervision and regulatory reporting hurt the financial market participants

03.

Does banking regulation work?

- Recent developments hint at the fact that the current regulatory regime is hard to operate during times of stress

Root causes

No granular data

No common data & logic standards

Non-integrated data flow

What is missing is not the proper rationale or technology, but a new design of regulatory content & data flow

BearingPoint®

“What more might be feasible? I have a dream. It is futuristic, but realistic. It involves a Star Trek chair and a bank of monitors. It would involve tracking the global flow of funds in close to real time (from a Star Trek chair using a bank of monitors), in much the same way as happens with global weather systems and global internet traffic […]). Its centerpiece would be a global map of financial flows, charting spill-overs and correlations.”

Andrew G Haldane (October 29th 2014)

Bank of England

“[…] Imagine a world where big data architecture is built with technology stacks that support data of higher granularity, diversity and frequency than could be accommodated previously. Data loading and consolidation are fully automated using, for instance, application programming interfaces (APIs). Larger data pools, ample data storage and greater computing power enable continuous data interrogation and more advanced statistical modelling, including predictive analytics. […]”

Benoît Coeuré (August 19th 2020)

Head of the BIS Innovation Hub

RegOps makes dreams and visions come true

Our RegOps approach is paradigm change to the way how regulation is being developed, deployed and how data is being exchanged between regulators and regulated using push and pull approaches.

With the use of standardization and industrialization RegOps provides a framework and state-of-the-art tech infrastructure to regulators worldwide to collect data efficiently and flexibly from the regulated markets.

With RegOps regulators get data from regulated without burden within a time of a single sprint.

Three building blocks of RegOps

These three core elements enable a completely novel way for regulatory reporting

01.

Digital twins of contracts in common granular, standardized data dictionary & processing logic

- Deal data needs to be delivered on granular level, i.e. contract, partner or cashflow level
- The granular dataset is standardized in a common data model to establish a universal “language” for regulatory data
- A standardized common processing logic to calculate regulatory results based on the common data model

02.

End-to-end decentralized integration via API

- A federated, integrated, end-to-end flow of granular regulatory data via an API system
- The flexibility of designing the data flow fitting to requirements to the specific regulatory environment (existing IT landscape, legal frameworks etc.)
- The option to store regulatory logic needs as standardized, common regulatory code repository

03.

Big data-enabled tech backbone

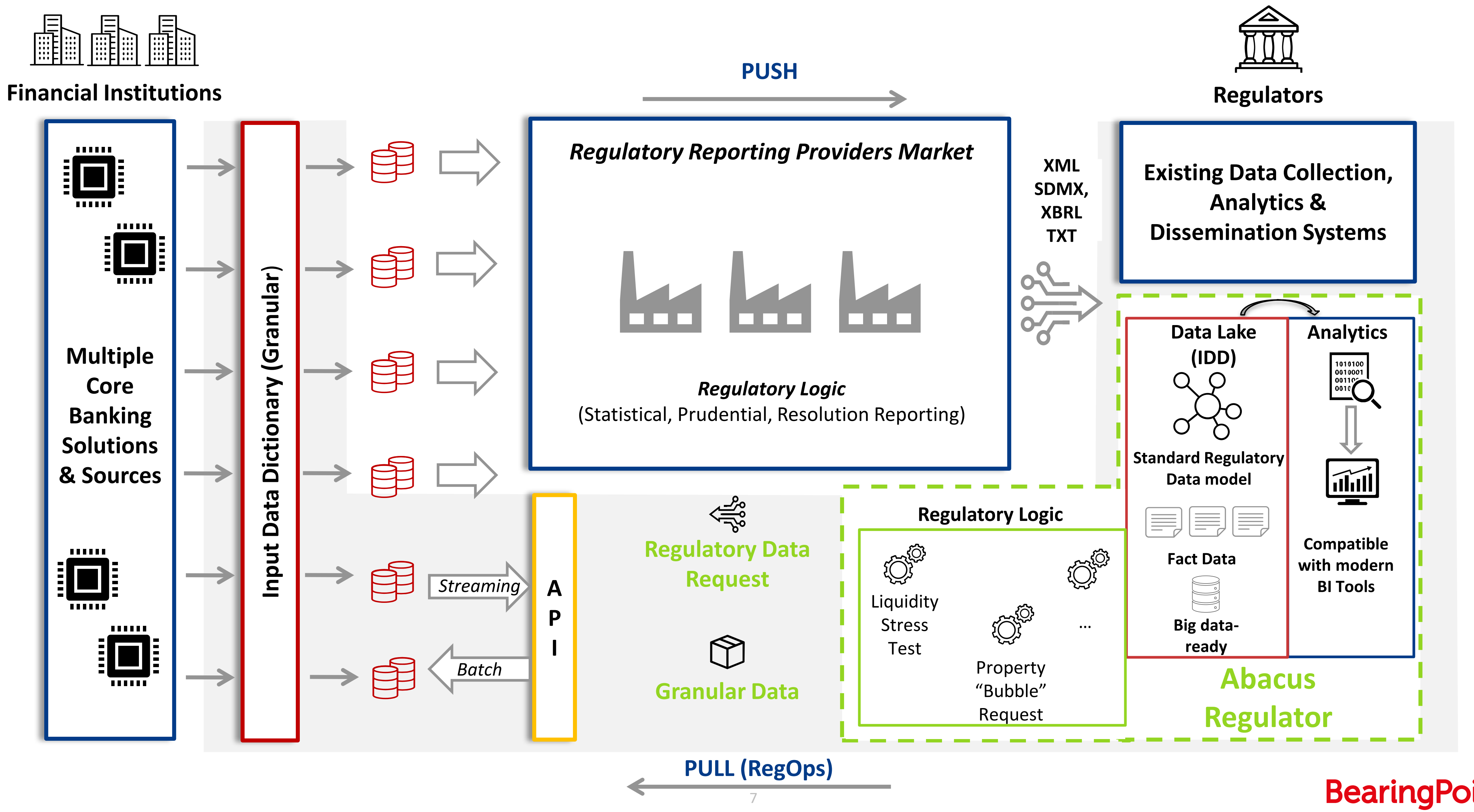
- A big-data enabled data platform which enables regulators to receive, store, and access large amount of granular regulatory datasets
- A platform which enables the regulator to work with the existing regulatory frameworks currently in use while also being future-proof for the application of new technologies
- A platform which enables the regulator to access large datasets via market-leading Business Intelligence solutions for analytical purposes

RegOps approach – The future of regulatory reporting

BearingPoint®

The RegOps concept – A vision for regulatory reporting (1.0)

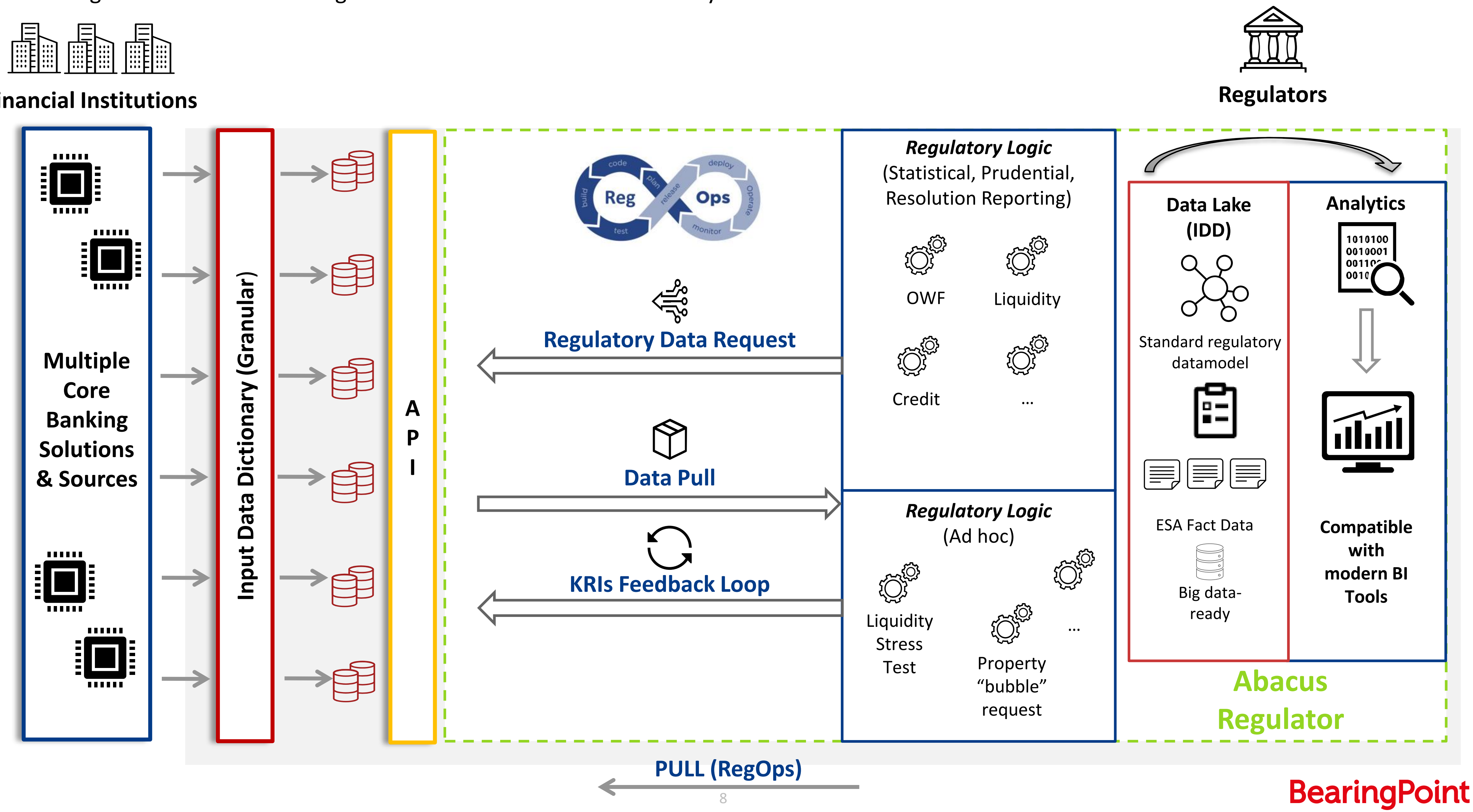
With BearingPoint IDD on Abacus Regulator. Hybrid of Push & Pull approaches



BearingPoint

The RegOps concept – A vision for regulatory reporting (2.0)

With BearingPoint IDD on Abacus Regulator. Push elimination and Pull only



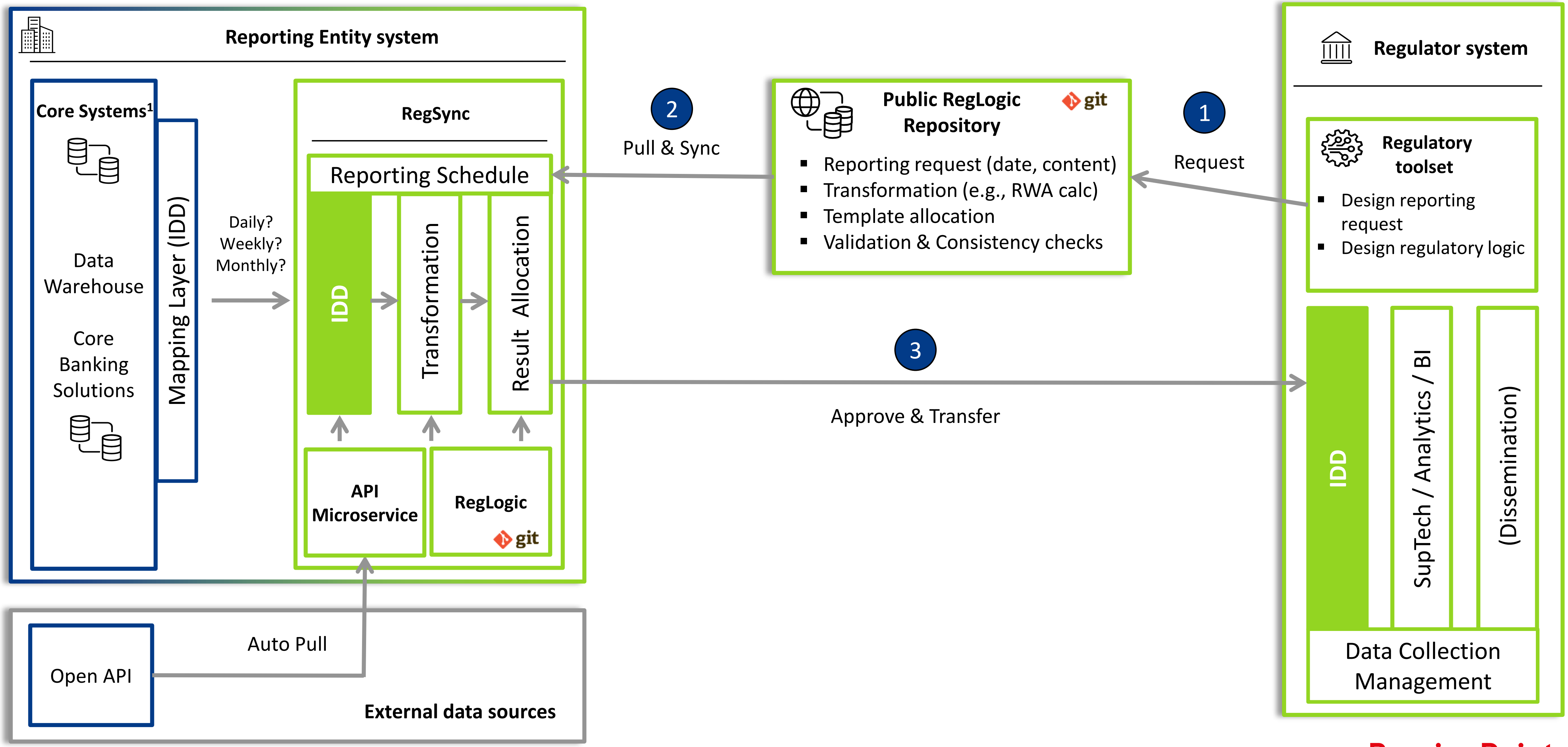
BearingPoint

G20 TechSprint Solution implementation

BearingPoint®

Our solution architecture for RegOps

Reporting Entities and the regulator are talking the same language and are “in sync”

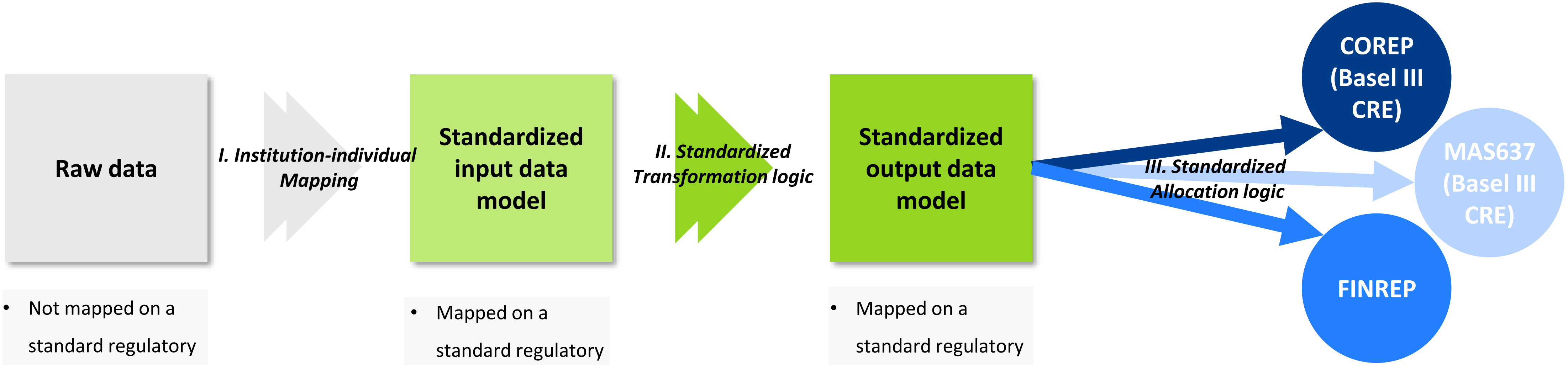


BearingPoint®

Our data processing flow

In order to topple today's regulatory reporting issues, aligned data requirements must be defined

Scope of Solution Build for G20 Techsprint



- Not mapped on a standard regulatory data model
- No processed regulatory results
- No position within the template is given

- Mapped on a standard regulatory data model
- No processed regulatory results
- No position within the template is given

- Mapped on a standard regulatory data model
- Contains processed regulatory results
- No position within the template is given

- Mapped on a standard regulatory data model
- Contains processed regulatory results
- Specifies all template positions for multiple jurisdictions per granular dataset

Key benefits & features of RegOps

RegOps in a nutshell and why it should be deployed

01.

Improving transparency and stability of financial markets

- High-quality, granular regulatory data in a standardized data-model for deep data insights
- Standardized regulatory processing, allocation & validation logic strongly improves reporting quality and comparability
- Automatic, timely data routing and processing via an API enabled network

02.

High efficiency & robustness

- All components of RegOps are generally available and initial deployment can begin within a short timeframe
- New regulatory code can be deployed rapidly by the regulators
- The RegOps model is highly cost-efficient for the financial institutions due the strong reduction in regulatory change costs
- Due to the high degree of automation this system is operationally highly robust

03.

Open for extension & innovative tech

- The RegOps framework is highly flexible and adaptable to all scenarios of regulatory reporting globally
- It is also is compatible with modern & upcoming technologies such as Cloud computing, AI, DLT etc.

Further publications

If you are interested, feel free to check our other publications or get in touch!

1. E-Mail

   Daniel.muench@bearingpoint.com

2. SUERF Policy Note

   https://www.suerf.org/policynotes/20123/the-future-of-data-collection-data-management-agile-regops-for-digitalizing-the-regulatory-value-chain

3. Extended Whitepaper

   https://www.reg.tech/en/knowledge-hub/insights/regops-innovative-approach-towards-regulatory-reporting/

BearingPoint®

DISCLAIMER

This document is issued by BearingPoint Software Solutions GmbH, part of the BearingPoint RegTech group of companies which is not affiliated with and independent from BearingPoint Holding B.V. and its affiliates.

The future of data collection & data management: Agile RegOps for digitalizing the regulatory value chain

Daniel Münch[1]; Maciej Piechocki[1]; Johannes Turner[2]; Martina Drvar[3]; Eric Stiegeler[1]

[1] BearingPoint RegTech
[2] Oesterreichische Nationalbank (Austrian National Bank)
[3] Hrvatska Narodna banka (Croatian National Bank)

Abstract:

Since the 2007-2008 financial crisis, global regulatory regimes and reporting have improved significantly, and the Basel reforms were broadly deemed sufficient.

Coupled with the high costs for financial institutions (FI), the widespread easing of regulatory requirements and additional ad hoc requests due to the COVID-19 crisis highlight that the current regulatory reporting model is not sustainable enough, especially in times of intense stress.

The paper sets out to identify the root causes of current issues in banking regulation and regulatory reporting, to find best practice use cases, and to give conclusions on how to improve the status quo.

The authors of this paper first identify the main root problems in regulator reporting. Then, case studies on how selected jurisdictions have attempted to improve data collection and reporting are being analysed to identify best practice solutions to overcome these issues. Based on these best practice scenarios, this paper outlines an agile, wholesome concept, called RegOps, which synthesises the best practice lessons from the case studies to overcome the previously identified root issues by addressing processes, technology, and governance.

The paper shows that not the underlying rationale of banking regulation and regulatory reporting is deficient but rather the way how the system is organized and operationalized. With a concept like RegOps a complete digitalization of regulatory reporting is possible and has the potential to strongly increase effectivity and efficiency of banking regulation and regulatory reporting. Furthermore, the concept shows a sensible transformation scenario on how to shift to this novel model.

Keywords:
Regulatory Reporting; Big Data; Granular data; Financial Data Standards; RegTech

The future of data collection & data management: Agile RegOps for digitalizing the regulatory value chain

Daniel Münch[1]; Maciej Piechocki[1]; Johannes Turner[2]; Martina Drvar[3]; Eric Stiegeler[1]

[1] BearingPoint RegTech
[2] Oesterreichische Nationalbank (Austrian National Bank)
[3] Hrvatska Narodna banka (Croatian National Bank)

Abstract:

Since the 2007-2008 financial crisis, global regulatory regimes and reporting have improved significantly, and the Basel reforms were broadly deemed sufficient.
Coupled with the high costs for financial institutions (FI), the widespread easing of regulatory requirements and additional ad hoc requests due to the COVID-19 crisis highlight that the current regulatory reporting model is not sustainable enough, especially in times of intense stress.

The authors of this paper present case studies on how selected jurisdictions have attempted to improve granular data collection and reporting. Furthermore, this paper outlines an agile concept, called RegOps, for the complete digitalization of regulatory reporting, which maximizes operational efficiency and presents a transformation scenario on how to shift to this novel model.

Keywords:
Regulatory Reporting; Big Data; Granular data; Financial Data Standards; RegTech

1. Introduction:

The decade of the 2010s saw the implementation of Basel III reforms to cope with fallout of the 2007/2008 financial crisis. With the official end of the post-2007 crisis agenda (BIS 2020c) and the Covid-19 pandemic as well as the ensuing economic crisis, we are at a perfect point to evaluate banking regulation and the corresponding banking regulatory reporting system.

When looking at the results of the Basel III reform (BIS 2019) regarding its performance, one can observe a mixed picture. For one, many of the ideas manifested in the Basel reforms and its national and supranational implementations were highly successful.

On the other hand, several major deficiencies of banking regulation became visible or are now prominently in the focus of all involved stakeholders in the financial market. Most remaining shortcomings are interestingly found not in the principal ideas and concepts of the regulatory reforms but their functional, technical, and organizational implementation. To find approaches to overcome these shortcomings, the authors propose the "RegOps" approach, a regulatory reporting framework that combines an integrated data flow, a common processing of standardized, granular datasets based on a big data-enabled platform for computation and analysis. This model was also successfully implemented in a Proof-of-Concept and proved to deliver all requirements conceptually.

Please note that this paper is a short version of our full RegOps paper which was previously published on SUERF and as an individual publication by BearingPoint.

2. Methodology:

This paper is based on a longer paper which used mainly qualitative analysis to identifying current issues of regulatory reporting, and best practice approaches which are used globally by leveraging relevant scientific and official publications by central banks and regulators. The authors also drew from their joint experience in the field of banking regulation and especially regulatory reporting, and comprises many years of exchange with relevant stakeholders from the banking, regulatory and scientific community.

3. Result:

a. Problems

The first major deficiency is the generally low application of innovative technology in the fields of digitization and modern computing in the banking regulatory reporting regime. In most regulatory frameworks in global jurisdictions, regulatory data flow still happens in a quasi-manual, template-based fashion. This means that the mere automatization of manual, printed, or handwritten reporting processes of aggregated data, which was the main activity in the past years, is not enough. The digitalization of regulatory reporting does not only mean changing technology but also requires rethinking the whole process, from the beginning of data generation within banks throughout the entire processing chain to the regulators and analysts. Only a few jurisdictions have started the journey thinking regulation anew and leveraging the possibilities of new technologies such as artificial intelligence (AI), application programming interfaces (API), big data, the cloud, high-performance computing, and blockchain/distributed ledger technologies (DLT).

These technologies could also help to topple the second point, the high cost of regulation and regulatory reporting. Estimations of the cost of regulatory reporting vary wildly, yet all indicate very high costs for financial institutions. McKinsey estimates that the annual cost for regulatory reporting of UK banks is 2bn – 4.5bn GBP (Van Steenis, 2019). A commission staff working document estimated 4bn EUR for the European Union (European Commission, 2020), while a study by Chartis & BearingPoint estimated the cost of compliance in the EU and the USA for the full scope of risk data aggregation and regulatory reporting to be approximately 70bn USD (Chartis and BearingPoint, 2018).

While banking regulation has become more effective over the last decade, the marginal use of an ever-increasing set of template-based regulatory requirements is strongly decreasing; the main impediments being the limited insight and flexibility of the aggregated data reported. Also, it becomes clear that while technology could significantly reduce costs, it currently cannot be deployed efficiently because of a lack of common standards in data models and processing. The financial markets would need a common standard to describe regulatory data requirements and the corresponding regulatory logic processing before leveraging large amounts of data with modern technology. To a large extent, the current high costs in regulatory data generation for institutions are rooted in the necessity to leverage the same information artefacts repeatedly for different non-aligned regulatory reporting regimes with myriads of templates (prudential, national, statistical, granular, resolution reporting) with often very similar, but slightly differing definitions. However, common standards require finding governance models between the stakeholders within the financial markets on the one hand, and the financial market stakeholders and the regulatory authorities, on the other hand.

The third shortcoming of the current regulatory regimes is the lack of operational excellence, which became apparent via several high-profile failures in recent years, such as the hidden derivative losses at Banca Monte dei Paschi di Siena and the Wirecard scandal. For one, offsite supervisory overview is still limited due to the nature of the collected data. Aggregated and template-based reporting is conceptually more prone to data correction or even manipulation. Fully granular, automatically pushed, end-to-end integrated data delivery could strongly improve trust and operational stability for data reporting and could make data manipulation virtually impossible or prohibitively expensive.

b. Stock-taking exercise & case studies

A stock-taking exercise was conducted to find notable solutions to the issues above, identify the key elements of solutions, and to explain why they were successful to introduce them. Based in this exercise, we conclude that the following features are missing in current regulatory reporting regimes:

- *Standardized input data model and processing logic*: standard of data and data processing used for regulatory reporting, which is either defined by the regulator or the market participants
- *Pull mechanism*: the bank does not submit data to the regulator (push of data); instead, the regulator accesses the required data (pull of data)
- *Integrated data transfer*: end-to-end data flow, which is fully integrated and automatable via modern interfacing, e.g., API
- *Granular data delivery*: banks submit contract-granular data instead of aggregated regulatory reporting templates to fulfill the regulatory requirements
- *Big data-enabled platform*: employing a big data-capable regulatory platform which can collect, store, and analyze large amounts of granular data to generate insights for authorities

Please refer to the long version of the paper for insights into currently productive notable case studies of modernized regulatory reporting regimes:

- Switzerland/Liechtenstein (Standardization of source systems)
- Oesterreichische Nationalbank (AuRep: a standardization of regulatory data model)
- Croatian National Bank (CNB BIRD)
- Bangko Sentral Ng Pilipinas (API-based Prudential Reporting System)

c. Proposed approach “RegOps”

In the previous section, it has been shown that there are several innovative concepts to regulatory reporting in production, which partly deliver the necessary features for future-proof regulatory reporting. However, it can be concluded that none of these innovative approaches fully cover all the mentioned features yet. To combine all these features, the authors propose the RegOps model for regulatory reporting.

RegOps is closely connected to the term DevOps (a portmanteau of development and operation), known from software development and seen as the answer to the shortcomings of the waterfall model. The waterfall model, as a traditional plan-driven approach to software development, has been around for decades. To improve software development, individuals have adopted methodologies that focus on customer collaboration, continuous delivery, constant feedback and communication between developers, customers, and users while delivering software incrementally in small releases. These methodologies have led many individuals to become advocates of an agile way of thinking.
RegOps is defined as an approach to systematically change how regulation is developed and deployed and how data is exchanged between regulators and regulated using push and pull

approaches. With standardization and industrialization, RegOps provides a framework and infrastructure to regulators worldwide to collect data efficiently and flexibly from the regulated markets. With the use of modern technology and proven standardization artefacts, RegOps allows regulators to arrive closer to the dream of RegTech from Andy Haldane (Bank of England) in 2014: “I have a dream. It is futuristic, but realistic. It involves a Star Trek chair and a bank of monitors. It would involve tracking the global flow of funds in close to real time (from a Star Trek chair using a bank of monitors), in much the same way as happens with global weather systems and global internet traffic. Its centerpiece would be a global map of financial flows, charting spill-overs and correlations.” (Haldane, 2014). With RegOps, regulation and reporting are not a top-down process based on macroeconomic risk considerations, which are transformed into standardized regulatory approaches, definitions, and later implemented in fixed, low insight-giving regulatory templates. Instead, the proposition is to start regulation as a bottom-up process focusing on regulatory micro definitions of standardized data fields and models on the granular dataset and data information level, which can then be flexibly used for any macro-regulatory requirement.

In the author’s opinion such regulatory reporting model would have to be built on these elements:

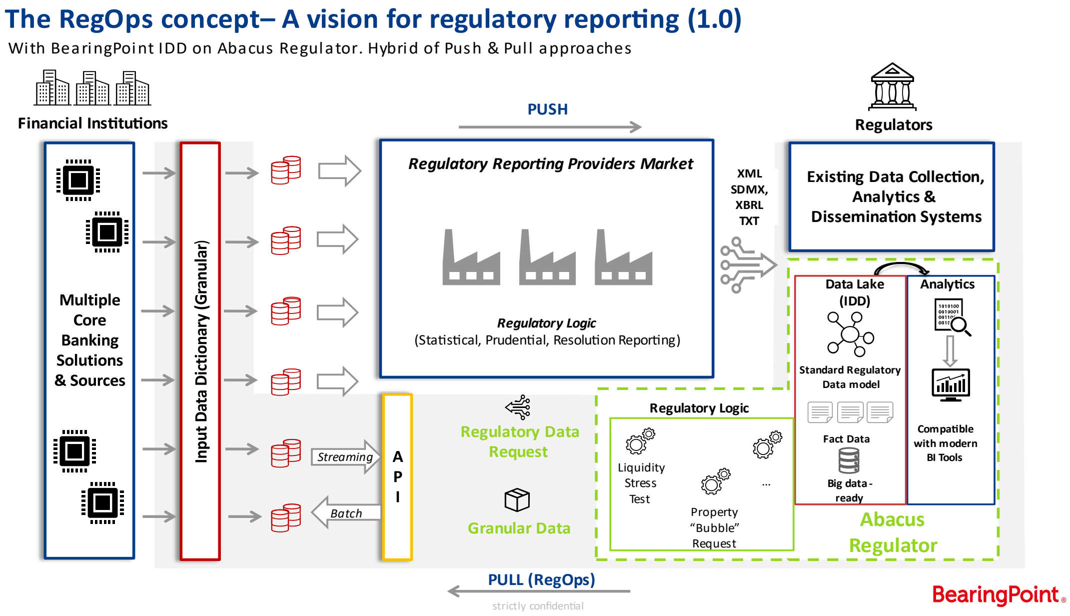
- A unified, normalized, universal data model and standardized, common regulatory logic for prudential, statistical, financial, and resolution regulatory reporting purposes
- A fully integrated, bi-directional data delivery stream including a toolset to export, transform, and load data to deliver functionally valid results
- A big data-enabled platform to collect, store, and analyze data to gain insights for regulators

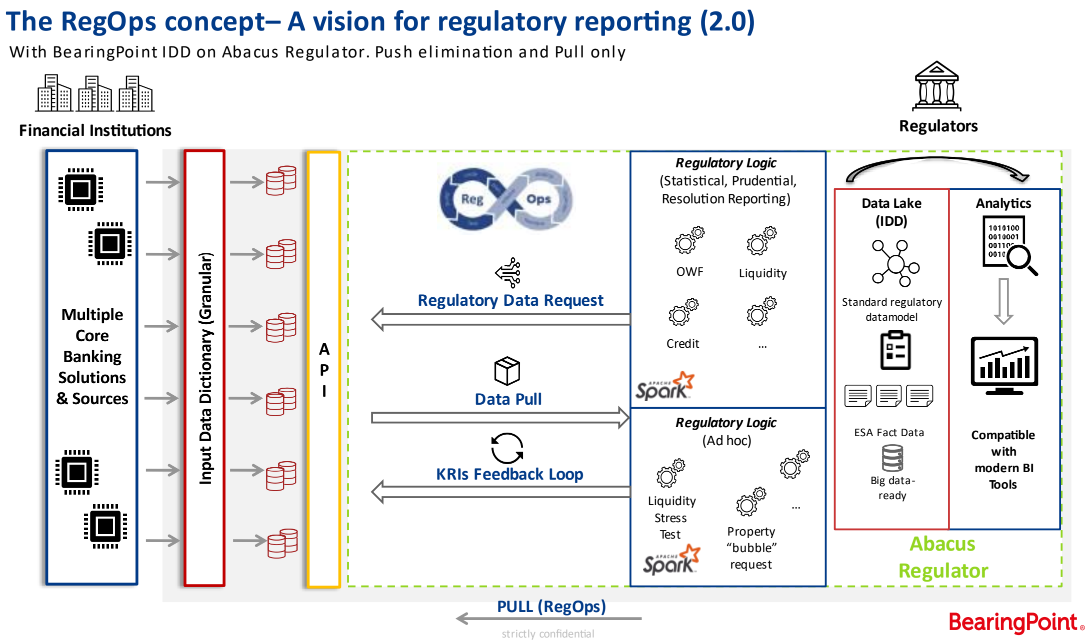
d. The RegOps Model

When we combine these elements, we can see a system where regulatory data is directly sourced from a highly detailed, complete, and fully granular standardized data model from every single institution. This data can then be accessed by a standardized logic to be imported, processed, and returned in standardized and ad-hoc formats for the regulator.

An interesting side effect is that this model will virtually end the need for regulatory change on the side of financial institutions after a few iterations, as there is only a finite number of sensible information artefacts and data fields to be added to such a granular data model. The regulator can then flexibly build new regulatory templates without action required by the financial market. This is also confirmed by the authors' experience of operating granular data model-based regulatory reporting approaches.

The pull-based model could be gradually phased in to gain experience with granular data and give time to adopt regulation and legislation towards the new architecture while keeping the existing regulatory reporting infrastructure (push approach) in place to enable a smooth transition for all involved parties. If the model yields the envisaged benefits, the legacy push-based infrastructure could be migrated gradually to the new pull model.





Thus, we would see a natural shift of regulatory development from "waterfall supervision" to "agile supervision." This model would not only strongly increase the quality, timeliness, completeness, and transparency of regulatory reporting but also concurrently greatly reduce the cost and efforts for regulatory reporting for the affected financial institutions.

BearingPoint RegTech participated in the G20 / BIS Techsprint 2020 with the RegOps model and developed a fully functional prototype. The PoC was deployed by reusing existing software stacks and regulatory contents in a completely new manner. BearingPoint RegTech built a fully working demo version within a five-week time frame. The solution was shortlisted by the G20 / BIS Techsprint 2020 judges panel for the finalist round in September 2020 (BIS 2020c).

4. Discussion and Conclusion:

This paper identified core prerequisite features that a new regulatory reporting system needs to overcome the current issues. These are:Integrated data transfer

- Granular data delivery
- Pull-mechanism
- Standardized data model
- Big data-enabled analysis tool

The paper has demonstrated that many of these problems and features were already partially addressed via various approaches and initiatives by regulators, financial institutions, and solution providers worldwide and have shown that they are able to deliver positive results not only in theory but also in practice.

The authors argue that the first iteration of the proposed model is feasible with today's technology, available data standards, and current governance setups. For financial jurisdictions with common data standards, implementation could start instantly for a relatively low cost. It is realistic for other jurisdictions to envision an implementation effort of about 1-2 years for initial results if a common data model based on existing standards can be quickly agreed upon which could be extended via the transformation scenarios as outlined above (RegOps V1.0 → RegOps V2.0).

The shift from a regulation-driven to data-driven regulatory reporting is also a perfect base layer for the application of emerging technologies like blockchain (Münch and Bellon, 2020) (Regulation execution, data collection, and transmission), artificial intelligence (data validation, processing, and analysis), cloud computing (storing, processing) or quantum computing (calculations). The authors urge regulatory authorities and supervisors to test new approaches to regulatory reporting and recommend conducting trials and proof-of-concept studies to validate approaches such as RegOps further.

References:

Bank for International Settlements, (2020c). *Saudi G20 Presidency and BIS Innovation Hub update on the progress made in the G20 TechSprint initiative.* https://www.bis.org/press/p200810.htm [Accessed 23th September 2020]

Chartis and BearingPoint, (2018). *Counting and Cutting the Cost of Compliance- How to accurately assess the cost of Risk Data Aggregation and Regulatory Reporting*. https://www.reg.tech/files/Chartis_COC_Position-Paper.pdf?download=0&item=7197 [Accessed 24th September 2020]

Haldane, A., G., (2014). *Managing global finance as a system. Speech at Maxwell Fry Annual Global Finance Lecture, Birmingham University*. https://www.bankofengland.co.uk/-/media/boe/files/speech/2014/managing-global-finance-as-a-system.pdf?la=en&hash=93BF6D650AAE5D055618D2D2DBC5870DC0580FA7 [Accessed 22nd July 2020]

Münch, D. and Bellon, N., (2020). *DLT-Based Regulatory Reporting – A game changer for the regulatory regime? SUERF Policy Issue, No 123.* https://www.suerf.org/policynotes/9393/dlt-based-regulatory-reporting-a-game-changer-for-the-regulatory-regime/ [Accessed 22nd July 2020]
Van Steenis, H., (2019). Future of Finance Review on the Outlook for the UK Financial System: What It Means for the Bank of England. *Future of Finance Report, Bank of England,* https://www.bankofengland.co.uk/report/2019/future-of-finance [Accessed 15th July 2020

Irving Fisher Committee on
Central Bank Statistics
BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics
July 2021, The Hague, Netherlands, virtual format

Real time data platform as a monitoring tool for Central Bank of Turkey[1]

Merve Artman,
Central Bank of the Republic of Turkey

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

TÜRKİYE CUMHURİYET
MERKEZ BANKASI

Real Time Data Platform as a Monitoring Tool for Central Bank of Turkey

ISI 63rd World Statistical Congress

July 2021

- Central Bank of Turkey build real time data platform as a monitoring tool with a well-established data streaming process.

- This process contains all necessary components to enable CBRT to integrate data for advanced analysis.

- High frequency raw data collected in real time from multiple data providers, cleaned, processed, matched and stored safely with other financial and non-financial CBRT data thanks to the data highway established on big data platform.

- Decision makers in CBRT can benefit from this enhanced data by visualization tools. These visualization tools link all the necessary information to overview market conditions via customized dashboards.

- The most prominent motivation is to prove more complete, timely and granular information as a complement to traditional macroeconomic indicators.

- It is important to strengthen analysis for decision-making and data is valuable only if we can manage to extract value from it.

- To make this possible, CBRT creates data highway on big data platform and this make easier to combine different data sets and extract necessary information for decision making.

Real Time Data Platform

Motivation	Providing **more complete, timely and granular** information as a complement to traditional macroeconomic indicators is important to strengthen analysis for decision-making and data is valuable **only if we can manage to extract value from it**
Data System	Data Highway on Big Data Platform
Usage Area	Real time alerts

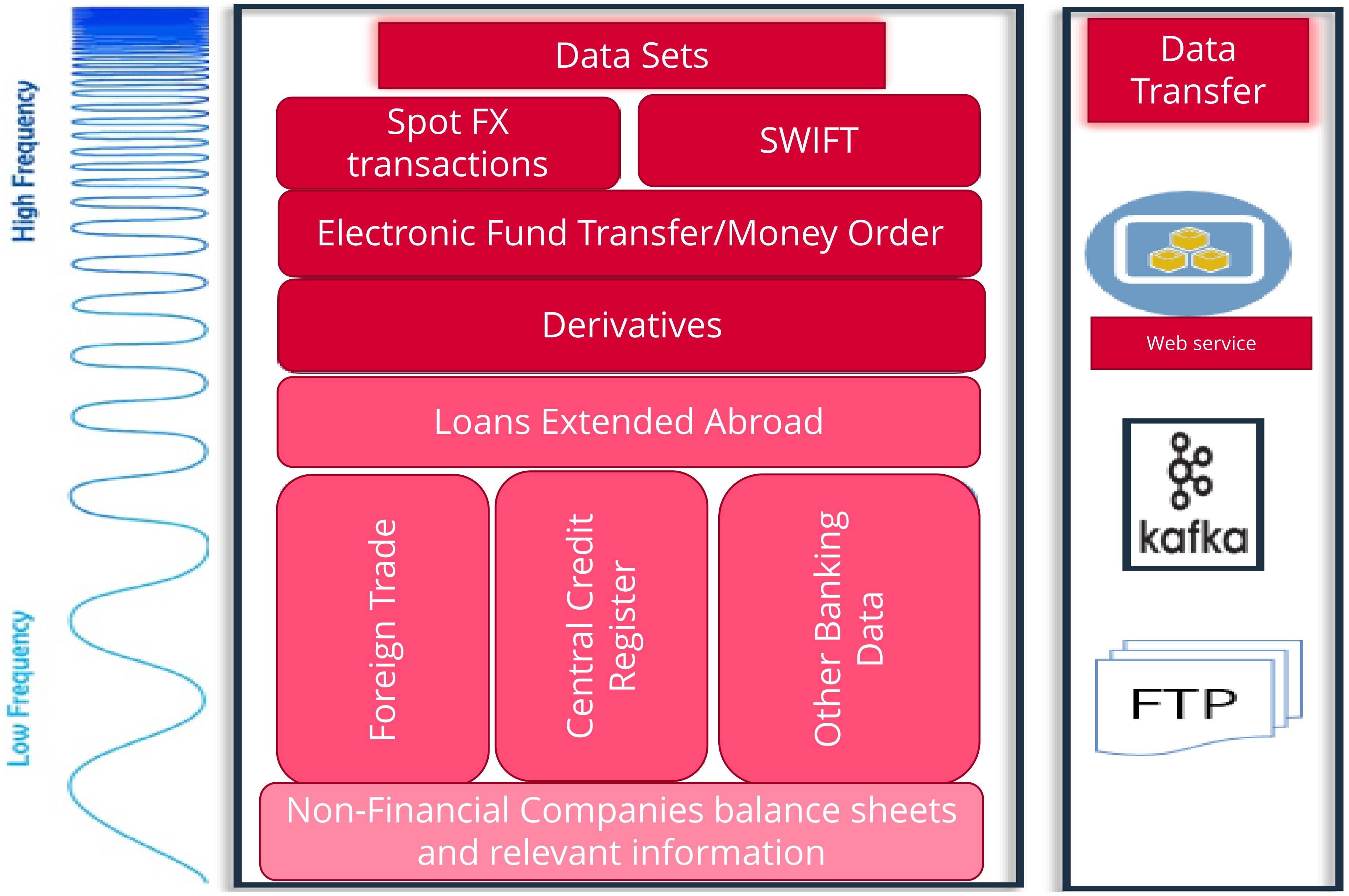
- The different datasets range from high frequent to low frequent ones. The most important contribution of the new system is to integrate daily spot FX transactions, electronic fund transfers, and money orders, swift and derivative transactions to our database.

- In the new system CBRT increases the frequency of loan information from credit institutions from monthly to daily to make it possible to match with other high frequent data sets. Specific to non-financial companies, we integrate foreign trade and B2B invoice data to the system monthly from administrative records.

- CBRT starts collecting financial statements of companies monthly directly from the companies that have FX loans above the determined thresholds.

- Data is transferred from different data sources from financial institutions, ministries, other governmental bodies or from directly non-financial institutions through web service, ftp or using apache kafka for handling real time data feeds.

Data Highway on Big Data Platform



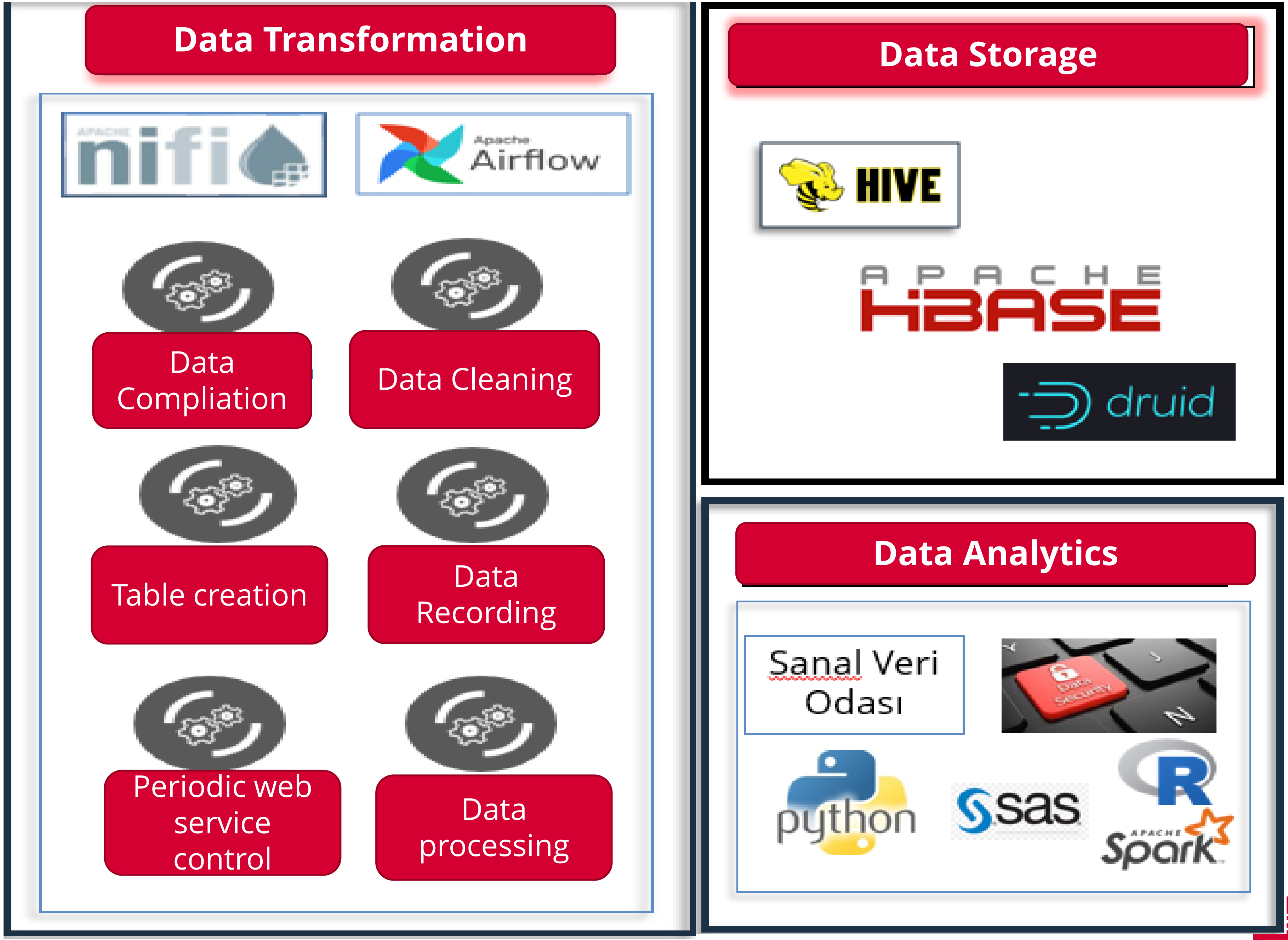
TÜRKİYE CUMHURİYET MERKEZ BANKASI

- Once the real data is taken into our system, it is transformed, cleaned and standardized to make it possible matching different datasets. The new system make it possible to make network analysis inside non-financial companies and NFCs to financial institutions.

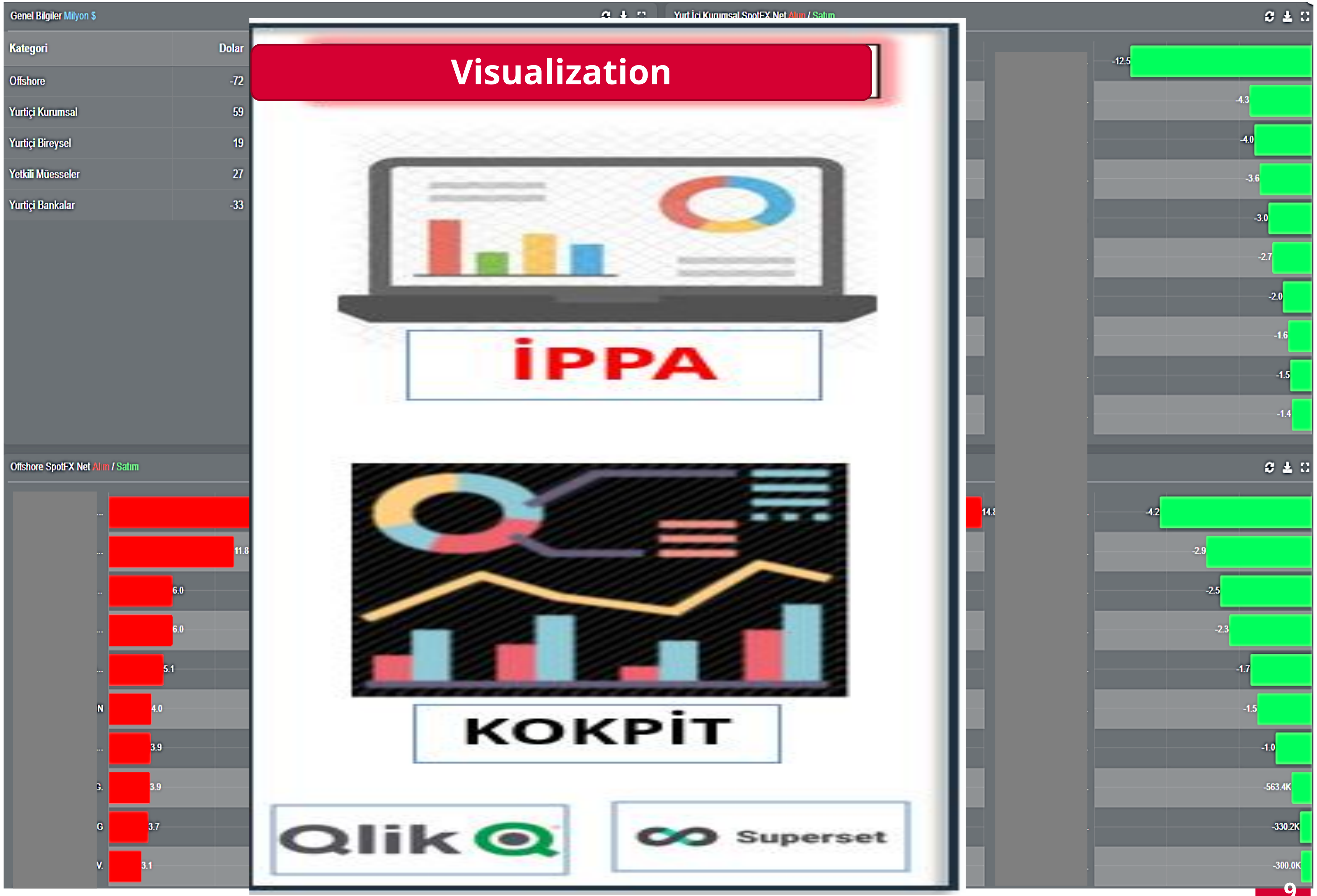
- To provide data query and analysis, data are stored in the big data platform and analyst can use interface to query data using different program options through virtual data rooms.

- This real time data platform and related analysis are visualized through customized dashboards.

Data Highway on Big Data Platform



Data Highway on Big Data Platform



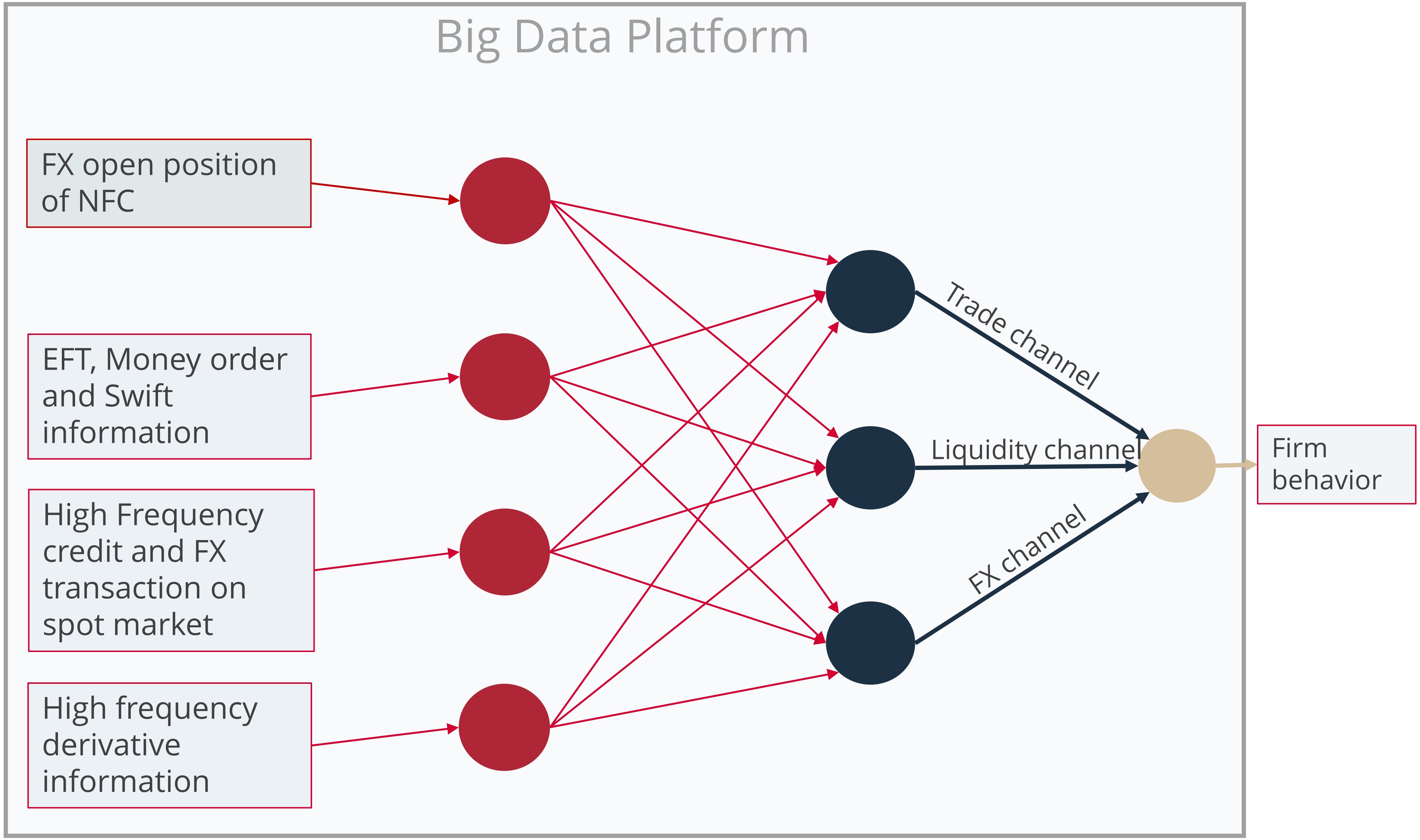
TÜRKİYE CUMHURİYET
MERKEZ BANKASI

- The early warning system starting from the FX spot market transaction of the firm. This system connects the FX spot market transaction of the firm to the other data sets daily such as EFT, money order, swift, derivatives, credit and balance sheet information. This enables us to understand the firm behavior in the market through trade, liquidity and FX channel.

- In this early warning system firms’ behaviors are scored through 1 to 20 and higher the score the more irrelevant the firm behavior in the spot market with its expected credit and other payments, export-import relations, firms’ business model or size or net sales.

- Not only detecting irrelevant transactions, this system also enable us to understand the timing of the FX transaction for some sectors and their business model. For example, what time of the year the sector will need FX to buy raw materials for production.

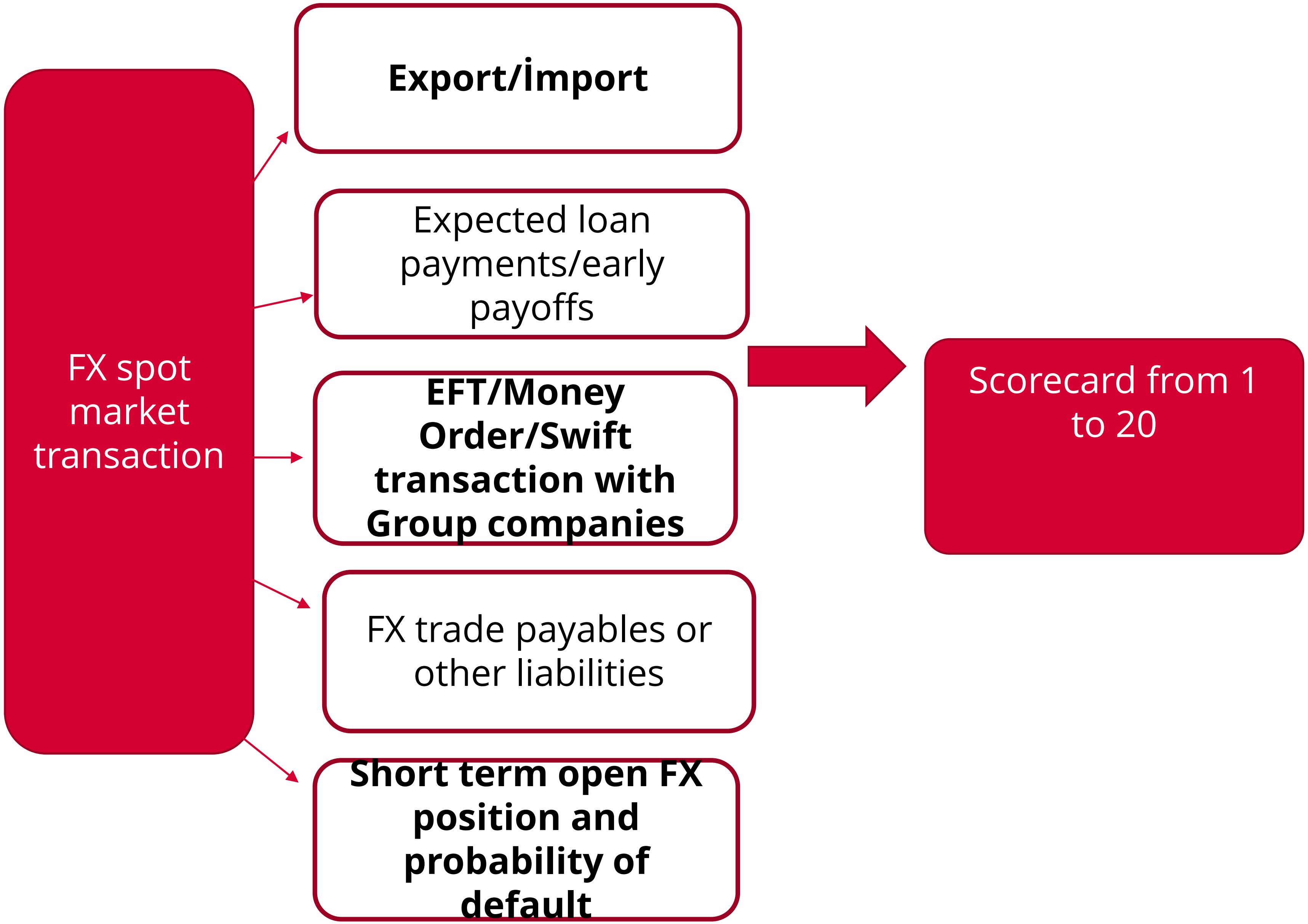
Early warning system on Big Data Platform



TÜRKİYE CUMHURİYET MERKEZ BANKASI

Early Warning System

Scorecard for Foreign Exchange Spot Market Transactions



TÜRKİYE CUMHURİYET MERKEZ BANKASI

Early Warning System Daily Report

Daily FX spot market transactions (USD Dollar)

Company	FX tarnsaction	C1	C2	C3	C4	C5	Total Score
Company 1	17,273,388.66	4	0	0	0	0	4
Company 2	10,900,000.00	2	1	0	0	5	8
Company 3	10,133,955.59	0	0	0	0	0	0
Company 4	8,761,938.72	3	5	0	0	0	8
Company 5	7,089,510.72	1	0	0	0	5	6
Company 6	7,000,000.00	1	0	0	0	0	1
Company 7	6,534,000.00	5	0	5	5	5	20
Company 8	5,950,765.66	3	0	0	0	0	3
Company 9	5,842,740.16	1	5	0	0	0	6
Company 10	5,749,608.59	5	0	0	0	5	10
Company 11	106,956.00	0	5	5	5	5	20

Kaynak: TCMB SRTVS

Son gözlem:03.21

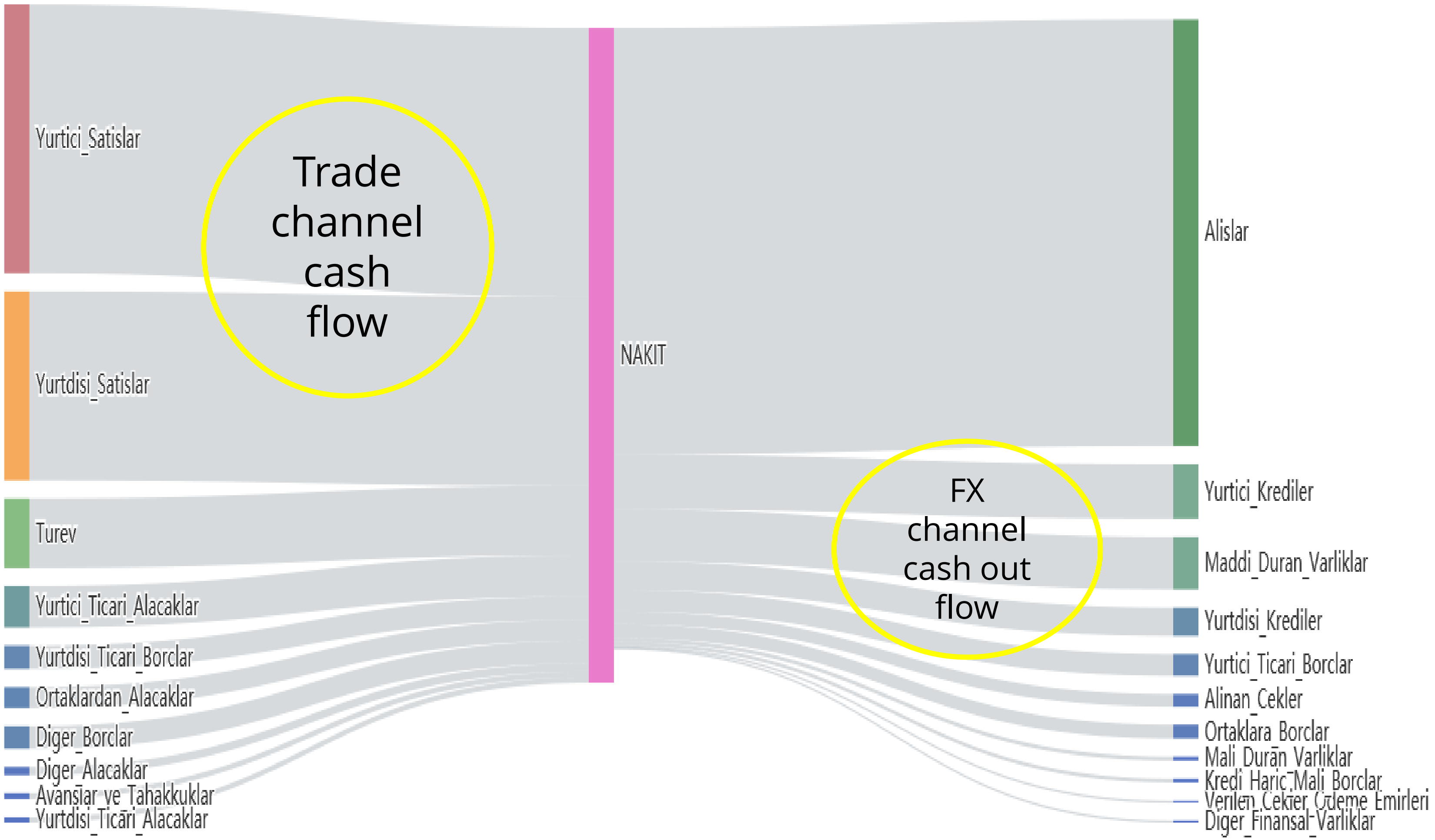
- Thanks to the combined real time data set, CBRT can analyze the cash flow for both company and sector level. We visualize the cash flow sources in dashboards and try to understand which channel affects the cash flow of the sector in that month. This help us to understand which sectors are in need of cash at that time of the year. If the sector is not fed from regular trade channels but mostly from credit channel, then this can be the signal for that sector's business become deteriorated.

- This combined real time data also make it possible to make anomaly detection on daily and monthly loan data. Loan data is matched with monthly balance sheet of the companies and through machine learning techniques, we try to figure out the level of the credit the company should use given balance sheet information. This study is also important to forecast expected loan level of the company for the next time and so the loan demand on financial sector.

Cash Flow Analysis

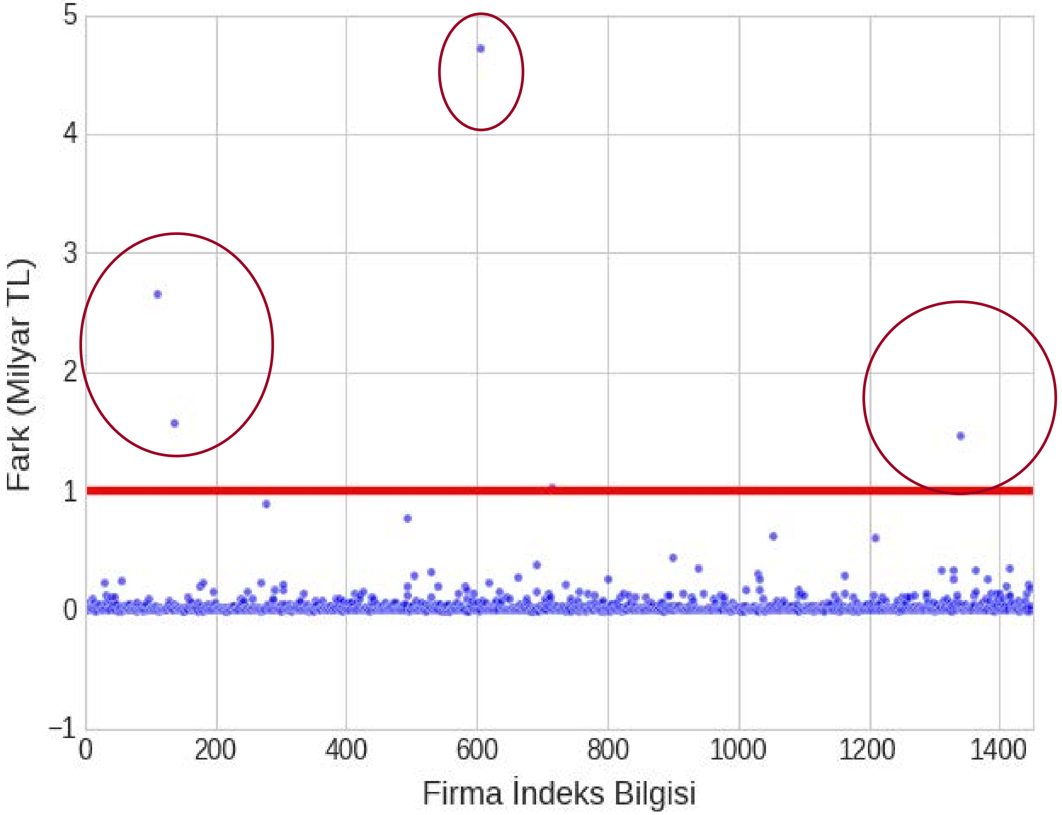
Firm and sector level cash flow analysis

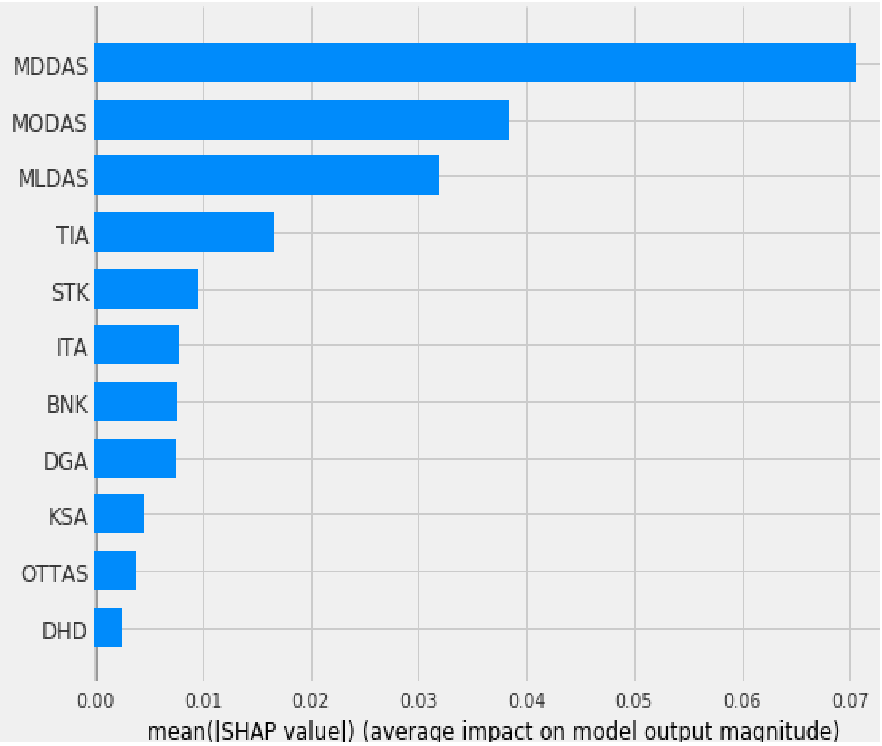
Cash flow analysis for an sector examle



TÜRKİYE CUMHURİYET MERKEZ BANKASI

Anomaly detection for loan data with machine learning techniques





Importance of variables

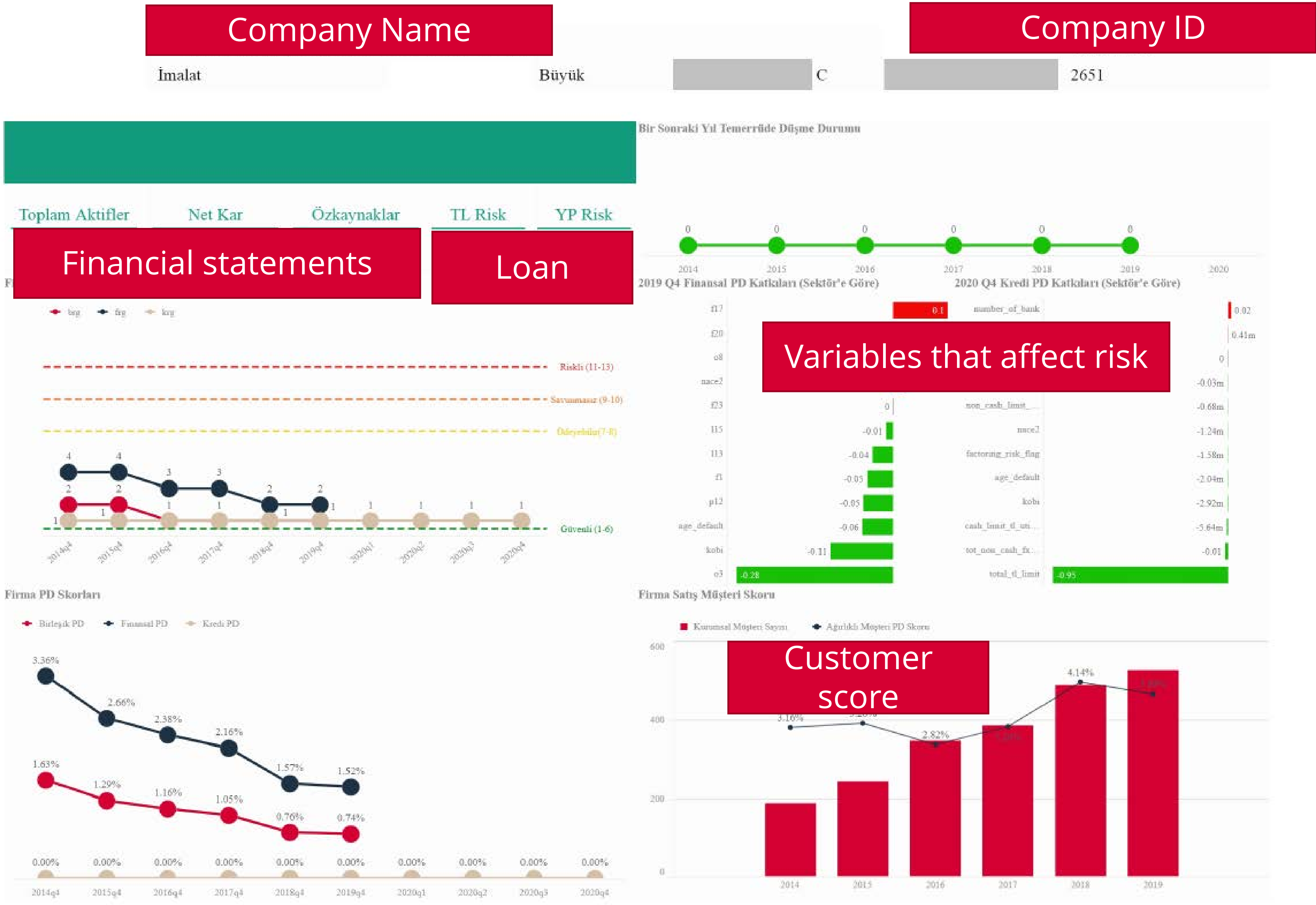
TÜRKİYE CUMHURİYET MERKEZ BANKASI

- Another areas that CBRT use this real time data system is to monitor risk analysis and export performance to help efficient allocation of credits. We can see all relevant information of the companies on the same screen from their own probability of default to their customers' weighted probability of default. One can also see asset size, profitability, own funds, current loans, default situation and the variables that affect the probability of default for this specific company from both financial statements and credit usage side. From micro level to macro, we can also aggregate the figures to the sector level. .

- Export performance surveillance system has all relevant information for the single exporter company on the same screen; the credit risk level, risk group, current credit, spot FX transaction, current balance sheet information, current export and import information.

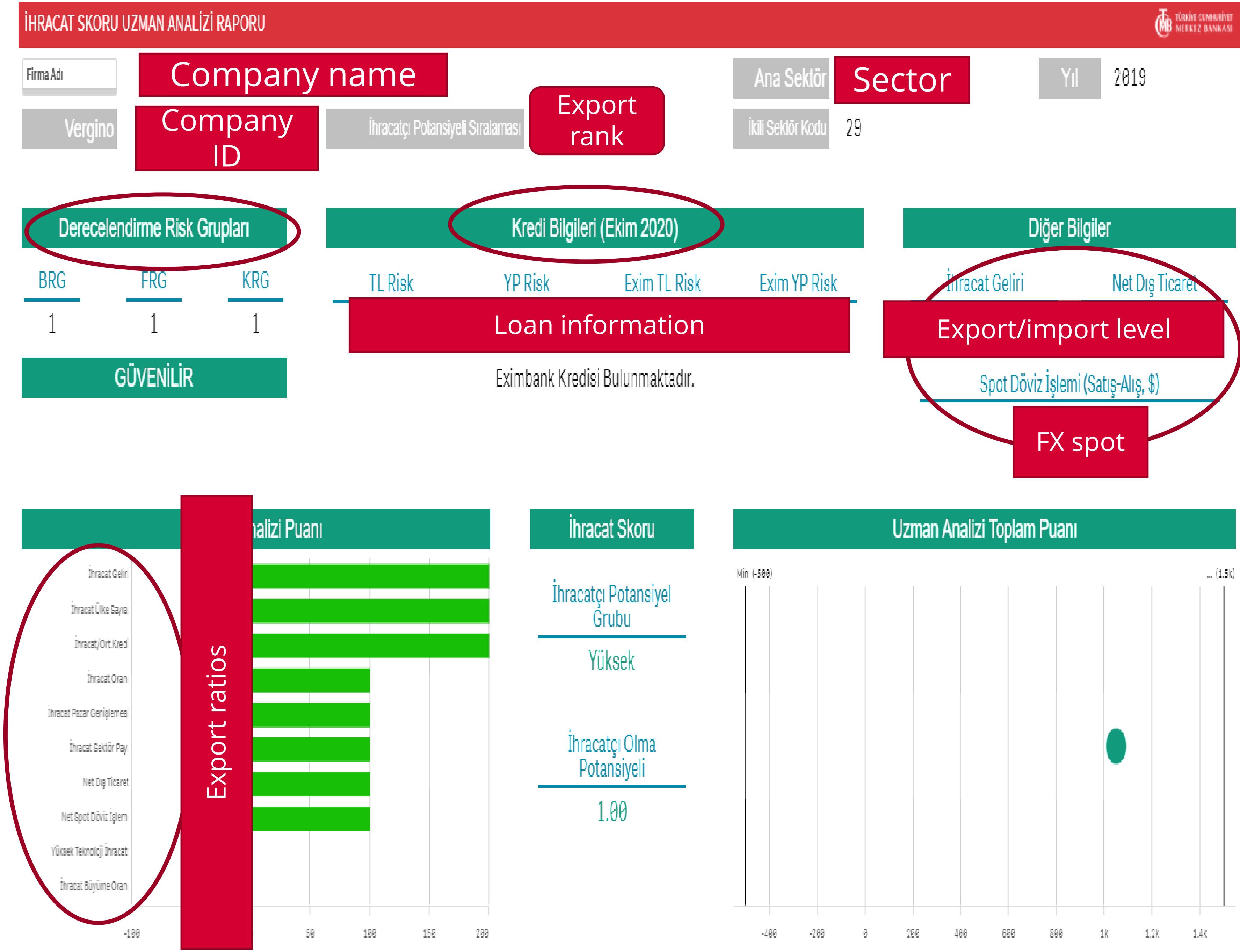
- The companies can be scored related to the export performances with real time integrated data. Each ratios and calculations are updated with the updating data in the big data platform. This system is very useful particularly for surveillance of efficient credit allocation to exporter companies having better performance.

Visualization of Risk Assessment



TÜRKİYE CUMHURİYET MERKEZ BANKASI

Export performance surveillance system and effective loan allocation



TÜRKİYE CUMHURİYET MERKEZ BANKASI

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

A data-driven, risk-based approach to strengthen the fight against money laundering[1]

Thais Lærkholm Jensen, Alessandro Tang-Andersen Martinello and Bjarke Mørch Mønsted,
Danmarks Nationalbank

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

A data-driven, risk-based approach to strengthen the fight against money laundering

Alessandro Tang-Andersen Martinello, Danmarks Nationalbanken

Granular transaction data can strengthen efforts against money laundering

Implementation of Proof of Concept (POC) in the first half of 2020

3
data sets from SØIK, the participating bank and the Danish Business Authority were combined

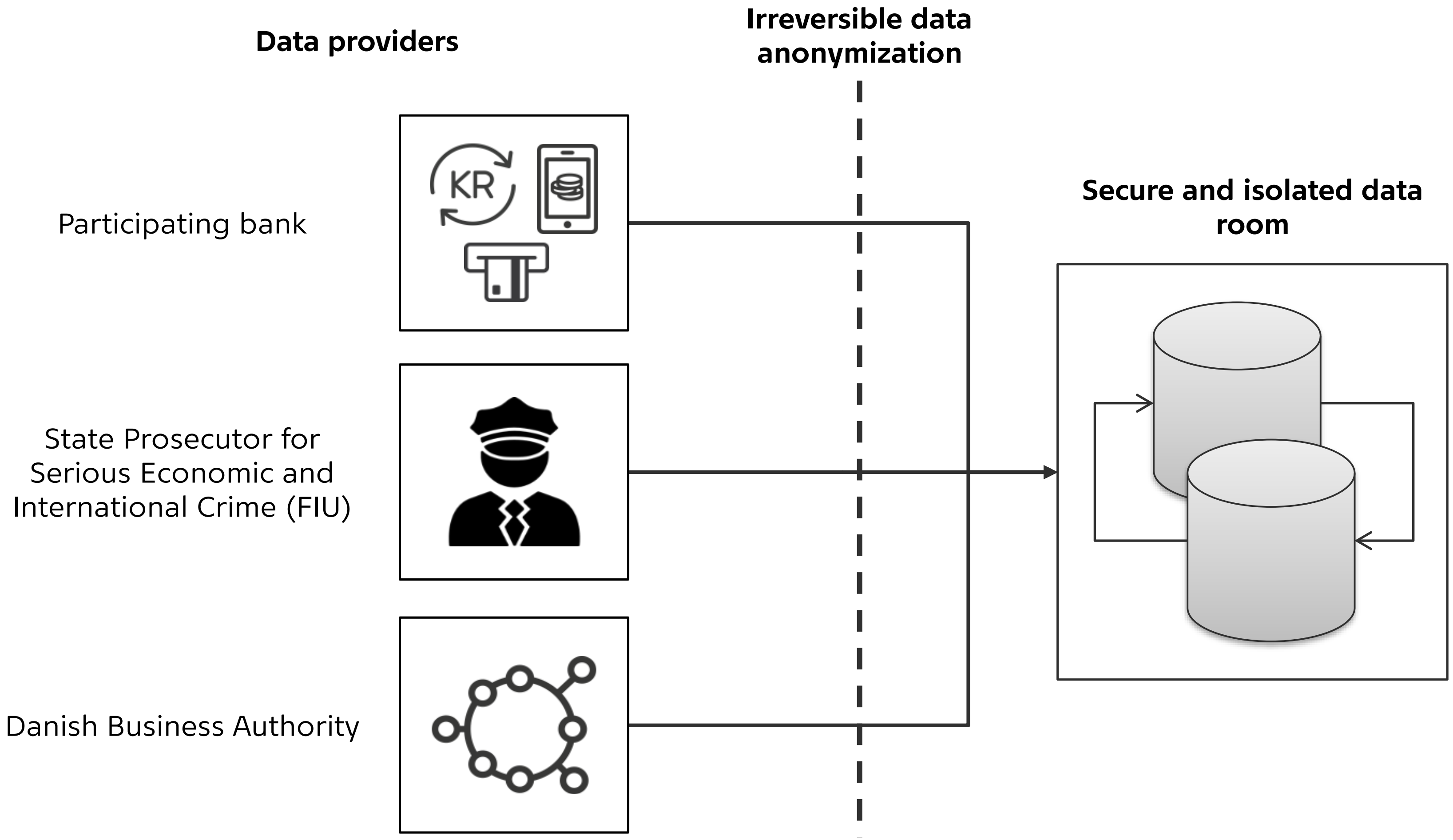
400.000
companies and individuals in the data set

2B
transactions analyzed as part of the database

10
data scientists and experts were involved and worked from the "war room"

18.000
lines programming code written during the PoC

The project required special dispensation from payment law and security clearance of project participants



Combining data across the financial sector allows better, faster, and more effective countering of money laundering

Results of the Proof of Concept

Bottom of the iceberg
Identifying suspicious patterns that are not investigated in the current system

An innovative data-driven approach can identify types of money laundering that are not caught by the current system

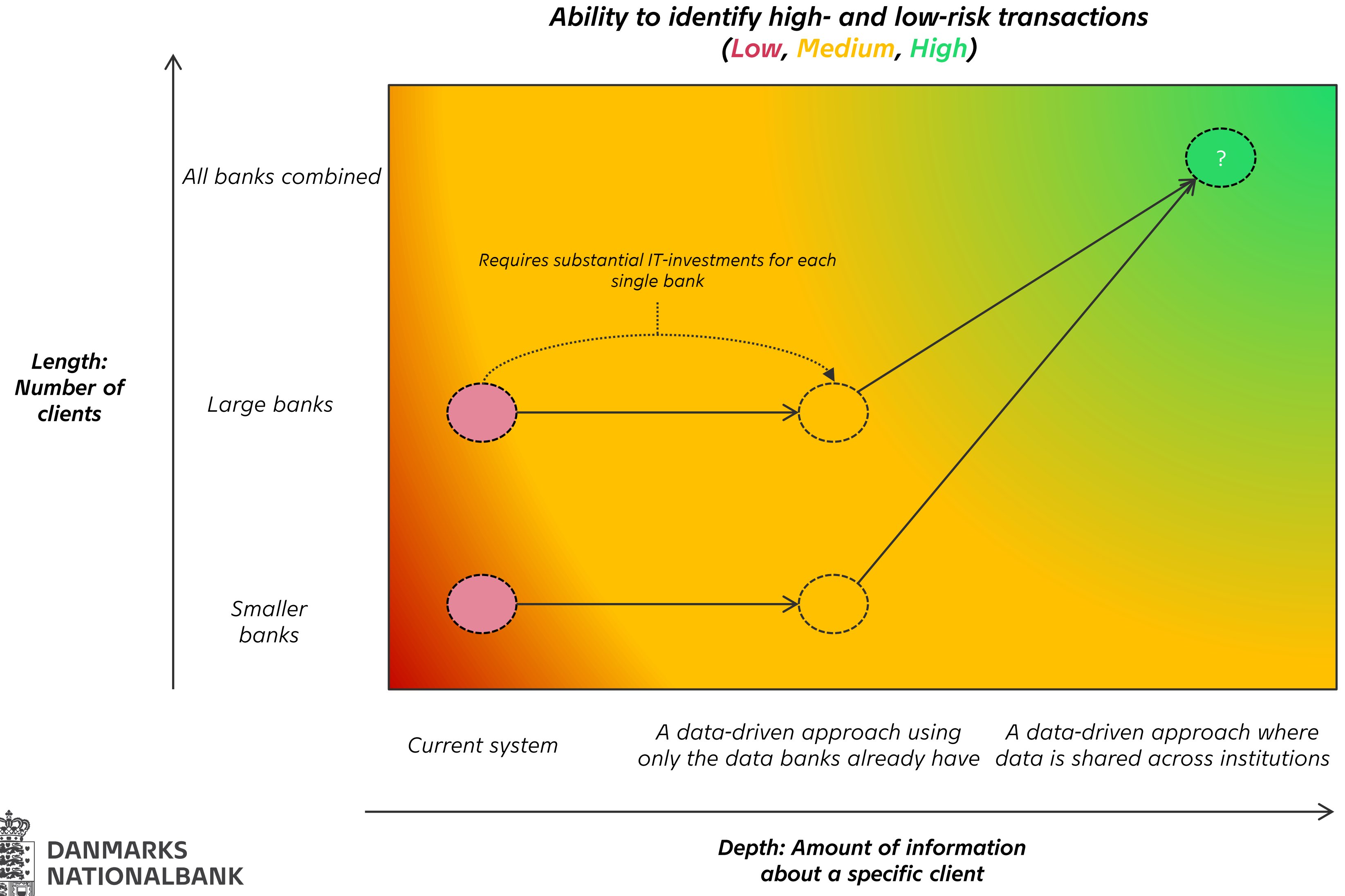
Earlier identification
Flagging suspicious behavior earlier

The same suspicious transactions can be identified earlier

Better value-chain
Streamlining the processing of suspicious transactions

As low-risk cases can be automatically discarded, resources can be redirected towards high-risk cases

The more data are available, the better economic crime can be identified



A data-driven, risk-based approach to strengthen the fight against money laundering

Thais Lærkholm Jensen[1]; Alessandro Tang-Andersen Martinello[1]; Bjarke Mørch Mønsted[1]

[1] Danmarks Nationalbank, Langelinje Allè 47, Copenhagen

Abstract:
The paper assesses the potential of intensifying the usage of granular transaction data to strengthen the fight against economic crime. We show that an innovative risk-based approach based on multiple data sources not only improves the identification of suspicious activities, but also identifies them faster and more efficiently. The realisation of the full potential of a risk-based approach however requires combining data across banks and public institutions. This combination would require a revised legal framework.

Keywords:
Money laundering; Transaction data; AML; Machine learning; Network

1. Introduction:

Economic crime and money laundering have serious economic and social consequences, threaten the integrity of the legal system and erode trust in the financial sector.

To counteract economic crime, the Danish financial sector currently employs more than 4,300 workers for compliance and anti-money laundering (AML) purposes. Their efforts result in more than 50,000 annual reports of suspected money-laundering practices to the authorities, a number that has been steadily increasing over the years. While significant resources are being invested in the fight against money laundering, the system has weaknesses that are not solvable in the current setup.

Danmarks Nationalbank, in cooperation with the Danish Business Authority, the State Prosecutor for Serious Economic and International Crime (SØIK), a major Danish bank and other government agencies, has assessed the potential of applying a data-driven approach to countering economic crime, specifically money laundering and VAT fraud, on the basis of transaction-level data

2. Methodology:

The analysis was based on detailed transaction data from a major bank, which contained detailed information on more than 1 billion transactions over a period of approximately four years. The transaction data were combined with information from the following institutions.

- The participating bank: Information on all alarms triggered by the current system.
- State Prosecutor for Serious Economic and International Crime: Information on the reports from banks included in reports sent for further investigation.
- Danish Business Authority: Information on all firms established in Denmark organised in a graph database, which includes both information on the connection across firms and major stakeholders, and information on VAT fraud investigations by the Danish Tax Agency.

The data were anonymised and analysed in a secure data room by analysts with security clearance. Data and hard drives were destroyed after completion of the analytical work.
The analysis employed a combination of two approaches:

•	A model-based approach, which consists in applying advanced analytical tools and machine learning to predict the likelihood of a bank client to be eventually reported for further investigation by the FIU. This estimation is based on recent and past transaction history coupled with background information on the bank's clients, mapped against what has earlier been considered suspicious by the authorities.[1]
•	A scenario-based approach consists in combining transaction data from a single bank with other data sources to construct scenarios, designed in collaboration with AML experts, flagging suspicious behaviour that ought to be investigated.
The two approaches complement each other. A model-based approach employs data to recognise transaction patterns and detects high-risk cases, triggering an alarm that AML investigators should then investigate manually. However, a model is dependent on past history and can only learn patterns of behaviour that have been detected and processed in the past. Therefore, a model will be unable to discover new patterns of money laundering by itself.

A scenario-based approach allows new scenarios to be developed to detect money-laundering patterns in collaboration with AML experts. While it can be refined by patterns detected through a model-based approach, it allows AML experts to actively contribute to the investigation. The scenario-based approach is very similar to the current automated flagging system: The additional value added is provided by the innovative combination of multiple data sources (banks and public institutions) and, in particular, by developing scenarios that utilise data sources across organisations, e.g. when investigating chains of money-laundering networks.

3. Result:
Based on multiple independent approaches, the analysis estimates that twice as many cases that would have eventually been sent for further investigation by the FIU could be detected.

The project also shows that a data-driven approach can optimise the current manual investigation process. Currently, the automated system triggers a large number of false alarms, which need to be manually discarded by AML investigators. An innovative risk-based and data-driven approach allows a risk score to be estimated for each generated alarm. Equipped with these estimates, a risk-based system could automatically discard low-risk cases that are routinely not included in reports sent to SØIK, and as such considered false alarms.

When sorting alarms triggered by the current system according to their estimated risk score, only 1 per cent of all cases being sent for further investigation originated from the bottom 27 per cent of alarms with the lowest imputed risk score. In other words, one could discard 27 per cent of all alarms that are currently manually investigated, and still retain 99 per cent of cases that are sent for further investigation.

This result shows that both banks and authorities are using a lot of resources to examine low-risk alarms which ultimately prove to have no relation to or little risk of economic crime. These resources could instead be redirected to the investigation of transactions with a high estimated risk score that do not trigger an alarm in the current system, improving the efficiency of manual investigations.

[1] Machine learning models are ideal for recognising suspicious behaviour. These models do not need to be overly complex and uninterpretable. While model performance increased with model complexity, at least initially, simple regression scoring models also worked satisfactorily. A combined approach would be to let the complex model inform an analysis of which variables and patterns the model is using to formulate predictions. The analyst can then incorporate these insights into a simple and more interpretable model.

The innovative data-driven approach can detect 84 per cent of the alarms that were reported to the FIU earlier than the current system. More than half of these clients would be detected more than ten weeks before they trigger an alarm in the current system.

4. Discussion and Conclusion:

The analysis has shown that considerable resources are spent on false alarms, that many suspicious transactions fly under the radar, and that those detected are often detected with a delay. A common system can improve the joint efforts against economic crime, but it requires combining data across multiple banks and public institutions for three reasons.

First, in most cases banks do not have detailed information about the counterpart of a transaction and are therefore unable to properly evaluate its riskiness. This limitation constitutes a large obstacle in the detection of complex networks spanning multiple banks. Moreover, information is not shared across banks, and criminals can therefore erase their history of suspicious behaviour simply by changing bank. More than half of the reports submitted by the participating bank involve one or more players that are known to the authorities from other reporting sources. In contrast, a single platform for collecting and processing data from multiple banks would allow the financial sector to share information in order to more effectively counteract criminal behaviour.

Second, joining data across banks creates synergies that are impossible to achieve for a single bank. The project shows that the potential gains from a data-driven approach increase with the volumes of data available. Specifically, the gains improve both in terms of client numbers in the database and in terms of the amount of information available about a single client. Combining data across banks will increase both the number of clients in the database and the amount of information available about each client, and their relations with other clients across banks. This type of information is particularly useful for identifying criminal networks.

Third, small banks have a considerable disadvantage since they do not have enough internal bank data to learn to recognise suspicious patterns in their transactions. The discrepancy between small and large banks risks amplifying structural weaknesses in the fight against economic crime, as a disparity of resources risks creating safer havens for criminals where the probability of detection is smaller.

Transaction data can also support the fight against VAT fraud. The International Monetary Fund estimates that VAT fraud results in a revenue loss of over DKK 10 billion for the Danish state budget every year. The project shows that granular transaction data can also improve the detection of VAT fraud by imputing the amount of VAT that firms should pay given their transaction history. By comparing firms' reported VAT with the VAT imputed on the basis of their transaction history, tax authorities would be able to better target their controls at firms with large discrepancies, or at firms that are not registered for VAT, but ought to be given their income flow.

The project has shown that an innovative data-driven approach based on granular transaction data can greatly improve the fight against economic crime. Nonetheless, realising the full potential of such an approach requires collaboration between public institutions and the financial sector to collect and process data from multiple institutions in a single platform.

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Introductory remarks / The impact of digitalisation on inflation measurement[1]

Jens Mehrhoff,
International Monetary Fund

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

isi 63rd WORLD STATISTICS CONGRESS

VIRTUAL 2021

INTERNATIONAL MONETARY FUND | STATISTICS

The Impact of Digitalization on Inflation Measurement

JULY 15, 2021

Jens Mehrhoff
Real Sector Division

Digitalization and Measurement of Inflation

- Some longstanding challenges for price statistics of keeping up with a changing economy and capturing quality change have been amplified by digitalization.
- Whether estimates of CPIs still provide a good measure of inflation in a digitalized economy has become a topic of debate.
- The claims that prices of household consumption are being mis-measured largely revolve around incomplete adjustment for quality change in products or distribution channels, i.e.,
  - the treatment of new, and often improved, varieties of existing digital products (e.g., computers);
  - the treatment of new digital products that replace existing non-digital products (e.g., streaming services replacing CDs); and
  - improved variety selection of digital and non-digital products (e.g., clothing, books).

Quality Change in Existing Product Lines

- Reinsdorf and Schreyer (2019) calculate upper-bound impacts on the deflator (price index) for household consumption in OECD countries.
- In terms of the simulated effects of possible measurement errors based on 2015 weights,
  - the upper bound correction to the index's growth rate for overlooked quality change is –0.41 percentage point, largely driven by the 0.24 percentage point overestimation of the deflator for telecommunication services;
  - the potentially unmeasured savings from digital replacements is –0.11 percentage point; and
  - the upper bound correction for improved variety selection is –0.05 percentage point.
- Combining all the effects, Reinsdorf and Schreyer end up with an upper bound for the potential mismeasurement of digital products of –0.57 percentage point.

New Varieties of Digital Products

- Using price changes of continuing products (matched-model approach) to approximate price changes of new varieties typically leads to an over-estimation of inflation for digital products.
- Sample refreshments help to keep the sample representative and are also occasions for bringing in *new products and product varieties*. In a sample refreshment, a newly selected sample is ‘linked in’, and the old sample is ‘linked out’. The first period the new sample comes in is also the last period for which the old sample is used.
- First, in the case of a product undergoing significant quality improvement, the failure to adjust for the higher average quality of the items in the sample being linked in may cause the index to overstate the product’s price change.
- Second, late introduction can lead to price declines early in the life cycle being missed, a problem that is particularly relevant for digital products.

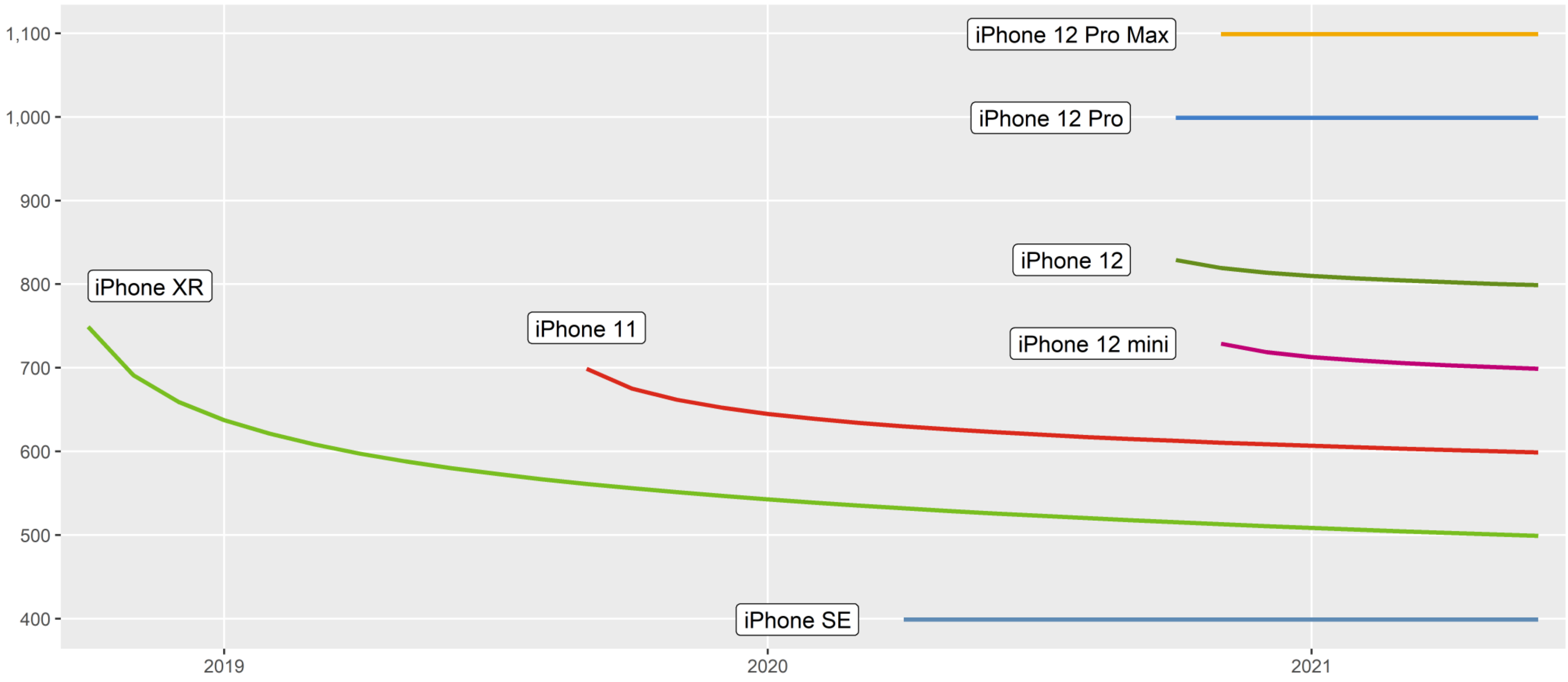
Simultaneous Price and Quality Changes

- However, often quality increases are higher than price differences between old and new varieties.
- Much less investigated, but not to be overlooked, is whether quality change of some digital products may systematically be *overstated*. Examples of quality declines that are not captured in price measures include the requirement to purchase new models of cell phones and computers in the absence of backwards compatibility of new software with older hardware.
- To summarize, quality adjustment of replacements for existing products within a sample, and of new products coming in during sample refreshments, may miss some quality change. The overlooked quality change and cost of living effects could be in either direction, but for digital products benefitting from new technology, insufficient capture of quality improvements is more likely.

Do Higher Prices Reflect Quality Growth or Inflation?

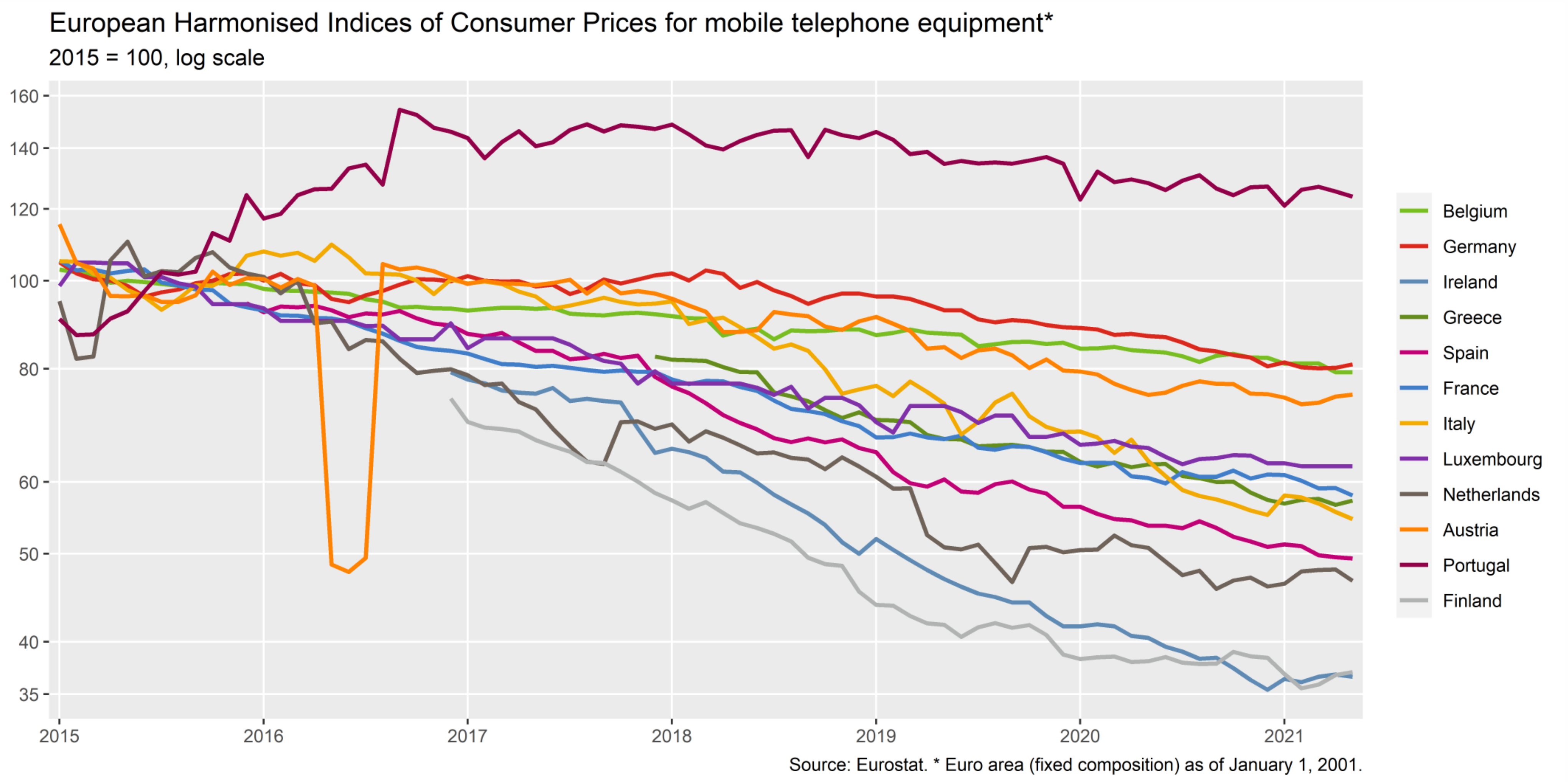
Stylized price paths of different iPhone models

$



Sources: Apple; and IMF staff calculations.

Quality Adjustment is as Much an Art as a Science…



…and a Matter of Debate and Personal Perception

- Have prices for smart phones in six years (from 2015 to 2021 May) risen by 24% (Portugal), or fallen by 63% (Ireland and Finland)?
  - If we assume today's average smart phone would have cost €1,000 in 2015, it will now cost €370 in Ireland and Finland, or €1,240 in Portugal; a trade margin of €870 – per smart phone!
- Several academic and business economists have suggested that digital products are conceptually relevant for understanding consumer inflation as measured by the CPI.
  - Using matched models or implicit methods that fail to adjust for the higher average quality of new varieties (comparable replacement, overlap pricing, etc.) may cause the index to overstate the product's price change.
  - Errors in capturing digital products in the price measures for household consumption could potentially play a role in mismeasurement of real GDP.

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Effective measurement of the economy in the emerging digital age[1]

Antonio Colangelo, Francis Gross and Florian Schuster,
European Central Bank

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

Effective measurement of the economy in the emerging digital age[1]

Antonio Colangelo, Francis Gross and Florian Schuster

Abstract

Since the Crisis, banks' internal data have massively expanded to meet regulators' growing demands. Banks and public institutions are changing profoundly as digitalisation and technological change affect their internal processes and their interaction with other market participants. The financial sector's new mass data is messy, rarely enabling straight-through processing. Many legacy practices, fragmented across countries, companies and generations of systems, are obsolete. Control functions have fallen way behind the speed, scale and complexity of market action and progress is too slow to catch up as technology keeps accelerating. A necessary condition for improvement is a radical acceleration of standardisation activities across countries. Effective standardisation demands strict discipline that only law and infrastructure can provide. Central banks, at the centre of the new data world, could catalyse standardisation by devising a vision and designing conceptual solutions. Integrating banks' external reporting requirements through a single dictionary and organising reporting in a single data architecture are immediately feasible steps.

Keywords: Digitalisation, identifiers, standards, central bank statistics, Integrated Reporting Framework (IReF), Banks' Integrated Reporting Dictionary (BIRD)

JEL classification: G21, E50, C81, C82, L15

Contents

[1] The views expressed are solely those of the authors and do not necessarily reflect the opinion of the European Central Bank.

1. Introduction

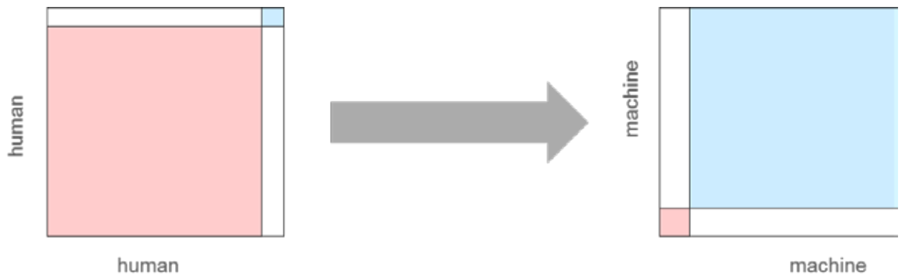
This paper provides a conceptual framework for the rising Data Problem and makes the case for a radical acceleration of standardisation activities on a systemic scale, from identifiers to, ultimately, standards for the representation of contracts and their states along their lifetime. As a health warning, it should be noted that the authors take a holistic, conceptual approach, which is somewhat unusual for this type of paper. Sections 2 and 3 are written combining the perspectives of the scientist and the designer. The scientist accepts the facts observed and thinks from there. The designer explores conceptual solutions, which would remain out of reach if exploration was conducted within the narrow bounds of immediate feasibility constraints. Section 4 reviews two Eurosystem initiatives relevant to the topic, BIRD and IReF, while Section 5 concludes proposing a way forward towards sustainable and effective measurement of the economy in the digital age.

2. The Data Problem

What is data? Data are symbols generated independently by millions of sources across the world. The Data Problem arises when data is separated from their source and there is no more guarantee that they mean to a reader what they were created to represent by their author and no way to clarify the meaning by asking. The Data Problem grows when data from ever more sources is collected, pooled and processed by machines and people.

The digital age sees rapidly increasing connectivity, globally. Machines and applications exchange data, in principle without requiring human-to-human or human-to-computer interaction. Networks see speed and capacity explode, next with 5G; billions of connected objects form the emerging ‘internet-of-things’. Artificial Intelligence, though immature, is adopted on a grand scale, driven by competition.

Figure 1. The interface has shifted



The Data Problem is not new, but statisticians have always considered that human intervention could control it – e.g. by providing definitions and manuals for reporting agents explaining how to link source data to reporting requirements, or by adjusting and reconciling the input received to ensure harmonised output. Likewise, users in all sectors relied on “fixes”, “data wrangling”, to cope. In a simple, slow, human-to-human world, the paradigm may have worked. However, the complexity of the world we are living in keeps increasing and technology has shifted the human-machine interface quite radically. Automation, data volumes, global scale and speed now overwhelm human capacity for good.

Technology changes the financial industry in myriads of ways, as new business models are tested all over the world and FinTechs develop digital ways of providing banking services. For example, digitalising the lending application process using "big data"[2] can accelerate to nearly real-time the 'time-to-decision' of a loan, currently between three and five weeks.[3] Technology is also changing the very structure of the financial industry, with the emergence of new service providers (e.g. Ant in China), large cloud providers, "open banking", etc. and the emergence of entirely new concepts such as digital currencies.

Alongside those shifts, technology has also driven the specifications for effective measurement in the system, the job of Statisticians, to a whole new level. Indeed, if effective measurement means to provide timely information at the scale of the event measured, and if the most dangerous events can be global, real-time, at least some measurement needs to work global, real-time. Given that such events can arise suddenly and unfold in unforeseeable ways, the measurement system must always stand ready and be nimble adjusting to surprising events.

Global, real-time, nimble, always on: those specifications leave little choice but to build a measurement chain connecting operations to analytical systems, straight-through, fully automated, on a global scale. As one consequence, operational data must serve such measurement directly, as there will be no time for transformation and reporting other than fully automated. In other terms, the future of at least some reporting is "no-reporting": regulators will access the data they need, online and in real time. To that end, operational data must ultimately be subjected to "hard" [4] standardisation, globally.

Whereas these broad specifications can seem extreme, they espouse quite well the trends to cloud and to the large-scale operational systems of internet companies, which makes them less outlandish, especially considering the magnitude and speed of change we witness. The financial services industry of tomorrow will be very different from today's indeed – many industries have gone the same way and improved.

Issues related to data protection are left out of this consideration. The digital age will see evolutions in the societal, legal and technical fields. Some of these can be guided by policy for the purpose of systemic stability. This paper examines the technical constraints and specifications of effective measurement in the context of technology and the use made of it. Societal processes will then discover a hopefully coherent balance between technical progress, systemic stability and privacy. For instance, one could imagine a conceptual architecture with operational systems and their data running on a "global cloud" – single or federated – where all parties would have access to their own contractual footprint whereas authorities could interrogate the entire system, with regulated access only to specific data.

[2] See, for instance, Daley (2020).

[3] See, for instance, Chappel et al (2018).

[4] A standard is defined here as "hard" when the implementation leaves room for only one interpretation. The LEI is an example of a "hard" standard as the unique valid data set is stored in an infrastructure that all users can access. As opposed to a "soft" standard, which is essentially a publication by ISO, open for interpretation by any user, potentially leading to diverse implementations across the population.

The specifications for effective regulation will change as well. Effective regulation will have to work at the scale of the system that is relevant for the events that could endanger stability. For many events, that relevant system is now global, so that regulation restricted to the national level miss the relevant system by an increasingly wider margin. The global financial system is becoming ever more complex and tightly coupled, the hallmarks of a vulnerable system.[5] That raises another deep challenge: the need to reconcile the local nature of human political organisation that carries regulatory institutions with the global nature of technology-fuelled markets.

That reconciliation must be designed to accommodate the full diversity of sovereign choices and rules in the global, standardised technical data infrastructures, public goods that serve all parties in all sectors. An example of such design can be found in the Global LEI System where the identity of any legal entity is given a globally standardised representation without prejudice to the local identifiers and legal form, the latter being identified in the Entity Legal Form (ELF) Standard[6].

A solution to that challenge might be easier to discover and start in the more technical functions supporting market regulation, for instance measurement. It could begin with the technical data interface between markets (global) and authorities (local). Building global data standards and the related data infrastructures that make them into "hard" standards – as the LEI – could offer a good initial laboratory for designing technical, organisational and legal solutions at the requisite scale.

Ultimately, regulation will need to adjust to the speed (real-time) and scale (global) of the system relevant to regulation and to emerging industry structures that blur once solid sectoral boundaries. That might require designing new, digital-age-worthy mandates and building institutions to serve them. A start has been made in the EU with the creation after the Crisis of several pan-European institutions.

If statisticians were to embrace the specifications for measurement presented above and take up the challenge of reforming the legacy of the statistical world, a shift in strategic outlook would serve them well in achieving success. Better measuring the financial system will require intervention to make the financial system more measurable under the conditions of the digital age as it will be. Such an undertaking requires a strategic horizon of thirty, forty years – the time to conceive and build infrastructure plus a decent span of useful life – and a global scale. To achieve that statisticians would need to design a grand project and durably mobilise society's leaders. A project plan would have to include designing (i) a conceptual "endgame"-architecture based on broad "Tech-2050" scenarios and on invariants (e.g. sovereign law, legal entities, contracts), (ii) migration paths exploiting current trends and market forces, as well as (iii) feasible initial steps with transformational power (easy to do, benefits to all, inspiration for more). A few starts are underway, such as the Global LEI System, dictionaries (BIRD), new data collection strategies (the ECB's IReF, BoE's strategy), large scale, near-time granular data collections (EMIR, IReF) and large new granular databases (the ECB's Centralised Securities Database). These, for some of them large, investments are laudable, but they are insufficient, and their progress

5 See Perrow (1999) – a system is said to be "tightly coupled" when it has components offering little slack, i.e. allowing a shock to propagate instantly throughout the system. Complexity makes for unpredictability of the system-wide impact of a shock.

6 ISO 20275.

remains too slow and they could benefit from a comprehensive systemic target architecture.

Statisticians find themselves caught in a double pincer: (i) whereas digital-age specifications for good measurement seem unavoidable and put extreme new demands on data quality, the Data Problem keeps growing, taking data quality further away from those demands and (ii) whereas the speed of tech-driven change keeps increasing, making change more urgent, statistics, already slow to move within its old paradigm, will slow down further as it needs to accept and move to a new paradigm and to align globally. That double pincer makes the Data Problem central to sustaining Statistics' effectiveness in the digital age. It also makes action an urgent necessity.

Action might best begin with broad dialogue among all parties, across all sectors, exploring the Data Problem, and starting the conceptual design of solutions, migration paths and initial steps. Ideas developed through such a dialogue would both be better and strengthen acceptance of the resulting public goods and their legal mandating. Dialogue could also help in unsettling conservatism by shifting the perception from regulation as a growing burden to regulation as a way of designing together a frame of rules that will make the game sustainable for all in the digital age. Finally, that could contribute to shifting the financial impact from a perception of "cost" to one of "investment", business decisions to improve one's competitive position and generate superior returns. This has been done in many areas of the economy that have improved as a result.

Finally, the Data Problem has similarity with Climate Change: it affects all parties globally, a solution is conceivable yet demands cooperation, and both hold potential for catastrophic failure if left unaddressed. However, the Data Problem is the smaller one; solving it depends on changing behaviour in a smaller community of professionals: the financial industry, regulators and lawmakers. Also, the now strengthening dynamic on Climate Change could be used to solve the Data Problem, if we can show that Climate solutions require better data, for instance on tracking supply chains.

3. A conceptual framework

The specifications for measurement of finance and the economy in the digital age raise extreme demands that seem impossible to reach with traditional methods. A different concept of the substance we measure could generate new ideas. Other sciences have demonstrated the breakthrough power of new concepts, new ways of seeing reality, e.g. the periodic table gave us a different view on matter and enabled modern chemistry and materials science.

Contrary to matter, the economy and finance are immaterial substances, inaccessible to our natural senses. Whereas it is easy to agree about fact with material objects, this is less evident with immaterial objects. However, some immaterial objects can be treated as facts, namely objects defined by law, such as the identity of a person or a legal entity.

A basic challenge of measurement lies in the representation of objects. It is easier with objects that are facts that, by definition, give the possibility of a unique representation, accepted by all, globally. For instance, in the immaterial world, the name of a person or a legal entity will be recognised by all citizens of all sovereigns who recognise the sovereign that gave that person or that entity her identity. Therefore, the name of a person or an entity, once enacted by a single sovereign, becomes a fact for all citizens, globally. The same logic applies very largely to other categories of immaterial objects made facts by law, as for instance to contract terms.

This opens the possibility of a simple concept for the substance of economy. If we consider contracts and parties as basic factual elements of the economy, the substance of the economy could be conceived as a network of contracts that connect a global population of parties. There is much more to the economy, of course, but that network could be used as the skeleton that helps to organise all the rest of it.

For one, that concept reconciles the divide between a global economy and local societal systems; indeed, each contract and each party of that global system is anchored in at least one local, legal system. A national economy is a sub-system of the entire system.

Measurement would look at that network of contracts as a graph, a notion close to large-scale computing and with strong underlying mathematical theory. Identifying the nodes and edges of that graph then becomes the evident starting point of any measurement.

Many concepts known to economists, statisticians and regulators (including those referenced in BIRD) can be built from that graph: the contractual footprint of a legal entity (resp. group) represents the entire business of that entity (resp. group). The contractual footprint of all parties attached to a sovereign, e.g. by a passport, a legal form, a residency, represents that country's economy with contracts within the population of parties providing national accounts and contracts to the outside throwing up balance of payment. A party's exposure to an event can be represented as a set of contract chains or contract networks connecting the event to the party, along which a shock can propagate. A relationship among entities (e.g. "control") can be defined as a constellation of contracts (direct or chains). A group structure is determined by the choice of relationships (majority ownership or else) used to define it, hence it can vary with the observer as we know it today. That approach suggests the possibility of deriving macro concepts from micro-data organised around the contracts and parties that form the graph.

Proper organisation of the data and of the analytical systems could enable large-scale, real-time measurement, nimble to adjust to new demands and new situations. Adding data elements to the skeleton of factual data could be organised quickly and cheaply through online input by all relevant parties on elements pertaining to them, a gain over current ad hoc data collections. Stress tests could be envisaged as frequent, quasi-automated exercises flexible enough to address many questions and test diverse scenarios.

Ultimately one could see measurement as permanent "live video" of the system, playing the role of artificial senses for a reality our natural senses do not perceive.

Different users would be able to shape their own measurement as they wish, knowing that their results would be consistent with others' measurement, as they come from the same representations of facts.

Reassuringly, as in engineering, the legacy techniques would perform very well for most applications. In engineering, for instance, only cutting-edge designs require the use of quantum physics (e.g. chip design), whereas Newtonian physics is largely sufficient for most machines and building tasks. In Statistics, cutting-edge measurement would be needed for serving financial stability, especially in technology-intensive fields, whereas most other statistics could continue as so far. However, also classical statistics would benefit from new infrastructure to become more efficient and see quality improve, for instance through easier provision of breakdowns and shorter frequency. Creativity of statisticians would be given new spaces and potentially new resources, freed through efficiency gains.

Implementing that concept would demand as a first step the creation of a global, public-good data infrastructure that would hold globally standardised identification of all parties and contracts, real-time accurate. For legal entities, that could be achieved quite simply by connecting official registers to the Global Legal Entity Identifier System, which could be the kernel of such an infrastructure. That, however, would require relevant authorities, usually outside the remit of central banks and statistical offices, to move in support.

A next step would be to represent all contracts in a standardised, mathematically rigorous algorithmic language, whereby such a language would represent contracts in all their diversity stemming from local legislation and practices. Whereas a more distant goal, this is conceptually possible, as all contracts can be represented as algorithms (who does what for whom, when and under what circumstances). A start could be imagined in applying that principle to simpler contracts (e.g. loans) in a single jurisdiction (e.g. the EU), serving measurement (e.g. a future AnaCredit 2.0) as well as business operations. The Algorithmic Contract Type Unified Standard (ACTUS) standard could offer a starting point here[7].

As ulterior conceptual steps, the data infrastructure could be enriched with a ledger of assets (identifiers and representations) referenced in contracts as well as events driving contracts (e.g. instalment dates in a loan contract).

Ultimately, a powerful new analytical tool might emerge. Contemplating the real world, the analyst would develop scenarios of events around a theme (e.g. drop in house prices –> loan failures –> impact on securities, derivatives –> etc.). Feeding such scenarios of events into the population of contracts, the graph would rapidly reveal the potential "mechanical" impact of the events. This would guide policy makers who could then also test and calibrate policy ideas using the same system.

There is a long way to go, of course. Progress will require bold thinking, overcoming the high hurdle of our current paradigm and constraints, but the facts we can observe are telling us that there might be no alternative and that time is pressing. We face a fundamental choice: either stumbling into the future, step by step as budgets allow, or designing our steps to form an organised migration path, guided by a conceptual design frame that fulfils the specifications of effective measurement, fit for the digital age.

Several promising initiatives are under way, also in the Eurosystem. Two of them, BIRD and IReF are presented here.

7 ACTUS offers algorithmic representation of so far over 30 contract types that cover most known financial contracts.

4. The Eurosystem initiatives

Over time, and especially after the Crisis of 2007-2008, regulators all over the world have vastly expanded their data demands, without investing in solutions that would minimise the impact on reporting agents. Datasets collected for regulatory purposes have traditionally been defined in isolation, without coordination across the institutions. Europe was no exception, and legacy systems played a vicious role. For instance, the ECB has traditionally set out statistical regulations for banks in silos and leaving discretion to NCBs to collect the required data as part of the statistical reporting framework they have established under their own responsibility. De facto, a cross-border bank, in order to fulfil the same set of statistical requirements, must deal with heterogeneous national systems that feature different models and dictionaries, complex transmission schedules and processes, etc.[8]

Against this background, the Eurosystem has developed a vision which primarily aims at reducing reporting burden by standardising and integrating statistical data reporting through two strictly connected initiatives.[9] The Integrated Reporting Framework (IReF) integrates banks' statistical reporting requirements into a unique framework that would be directly applicable to euro area banks, without any translation into national collection frameworks. In order to effectively integrate the existing requirements, the IReF will encompass a set of requirements with different levels of granularity that will consolidate the existing reporting lines across countries into a unique framework and avoid any duplication of the requirements. The reporting will be defined through a standardised data model and the same reporting schedules will apply across the euro area.[10] The Banks' Integrated Reporting Dictionary (BIRD) is a joint initiative with the banking industry aimed to help reporting agents efficiently organise information stored in their internal systems and fulfil their reporting requirements, going beyond statistical requirements covered in the IReF and also including prudential and resolution requirements of banks. The BIRD defines the transformation rules to be applied to banks' input data in order to transmit data to the authorities. Figure 2 shows how BIRD and IReF will affect the reporting of banks. By applying BIRD, banks are in the position to generate reporting requirements from a single redundancy-free defined input layer.

The IReF and the BIRD are being developed closely to each other and will rely on a common data dictionary that will ideally be developed in cooperation with the European Banking Authority following the feasibility study[11]. The common dictionary will ensure the standardisation of the definitions (also with resolution and prudential data), reducing the effort banks would otherwise make interpreting and reconciling instructions formulated in different frameworks. While the BIRD is expected to remain voluntary for the banking industry (at least for the time being), the use of a common

8 See also European Banking Federation (2019).

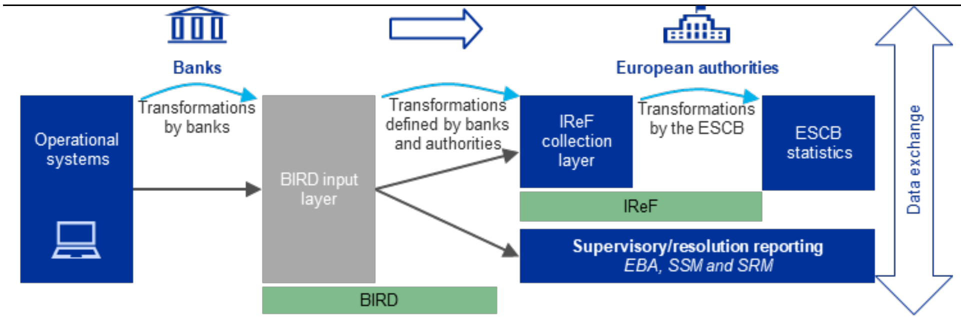
9 These initiatives are part of a broader data integration strategy requested by the European Parliament and Council as well as by the European banking industry; see European Central Bank (2020a).

10 See European Central Bank (2020b).

11 See Article 430c of Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019 amending Regulation (EU) No 575/2013 as regards the leverage ratio, the net stable funding ratio, requirements for own funds and eligible liabilities, counterparty credit risk, market risk, exposures to central counterparties, exposures to collective investment undertakings, large exposures, reporting and disclosure requirements (OJ L 150, 7.06.2019, p. 1).

dictionary will represent an important incentive for adopting it. At the same time, it should be noted that the existing BIRD modules that have been developed for supporting statistical reporting (e.g. in the context of AnaCredit) only serve as a methodological reference, but cannot be directly applied by reporting agents due to the heterogeneous national implementation of these requirements. With the IReF this circumstance will be rectified and with a homogenous implementation across the euro area the banking industry is expected to benefit significantly.

Figure 2. Eurosystem strategy for collecting data from banks



Notes: EBA stands for European Banking Authority, SSM for Single Supervisory Mechanism and SRM for Single Resolution Mechanism.

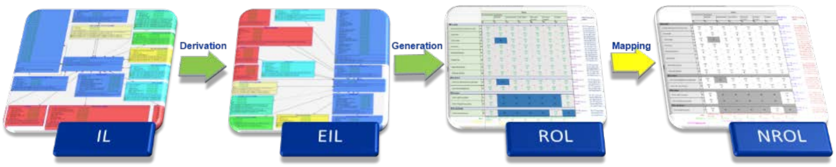
One of the critical success factors for the Eurosystem strategy relates to the way it will address the requirements covered in the national (statistical) collection frameworks of NCBs that do not arise from the existing ECB statistical regulations. The objective is that under the IReF country-specific requirements should be kept to a minimum. However, it is clear that (some) country-specific requirements will continue to exist under the IReF. As explained in the cost-benefit assessment on the IReF[12], the Eurosystem is expecting to develop an extended IReF layer which would model and describe these residual country-specific requirements from a technical perspective. Such an approach would support reporting agents, e.g. by ensuring that overlapping requirements across countries are described in the same way. The common requirements will be covered in the ECB Regulation on the IReF, whereas the country-specific requirements will be legislated for at national level tough technically part of the extended layer.

The IReF and its foreseen extensions will cross-fertilise with the BIRD and result in further advantages for reporting agents. Before exploring these changes, it is necessary however to describe the current BIRD process in more detail, as shown in Figure 3.[13] For the sake of simplicity, the individual components are explained in the order of how they are logically established.

[12] See European Central Bank (2020c).

[13] Please notice that some BIRD components like the very normalised Logical Data Model (LDM) are not shown in this depiction for the sake of simplification.

Figure 3. BIRD process



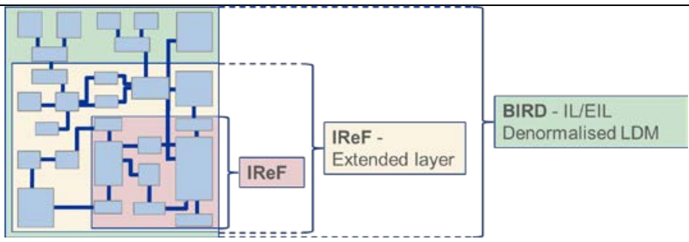
The non-reference output layer (NROL) is the description of reporting requirements based on the original codification system (e.g. EBA DPM). Via (Meta data) Mappings the original codification is translated into the reference codification. The reference output layer (ROL) therefore describes all reporting requirements in one standardised language. This is already advantageous, but the next step is to describe all the various reporting requirements within a redundancy-free data model. These are the input layer (IL) which acts as interface to the banks source system and the enriched input layer (EIL) which comprises the same information as the IL but also concepts (e.g. classification of small and medium-sized enterprises) that can be derived from the input. Formal transformation rules bridge the gap between IL, EIL and the ROL.

Two issues are relevant to explain how the IReF fits into the BIRD process.

- Firstly, the IReF is using the same reference codification system as the BIRD. As a result, the NROL and mappings are irrelevant in this case.
- Secondly, in order to achieve integration via a relational model and be redundancy-free, the IReF features a high degree of granularity and detail.

The IReF is thus moving much closer to the IL/EIL structure in terms of modelling and content than other reporting requirements. For this reason, it makes sense to very much align in terms of the data models both the IReF and the BIRD.

Figure 4. BIRD, IReF and the extended layer



Notes: This depiction provides a conceptual representation, not a physical one.

As shown in Figure 4, the data model of the IReF and its extended layer can be conceptualised as a slice of the BIRD enriched input layer or, depending on the view, the BIRD EIL an extension of the IReF. It is important to emphasise that this alignment is at the level of the data model, meaning that the actual content of the IReF can diverge, for example in terms of level of aggregation.

An alignment has the potential to utilize many synergies. The familiarity with the BIRD model will grow significantly considering that the IReF and its extended layer will form a primary reporting required across the euro area. This can be considered an important step towards a more automated and on-demand reporting, which will easier materialise through two intermediate phases.

Phase 1: BIRD and IReF in their first configuration do not change the overall fabric of reporting but rather prepare the foundations for future bigger steps. The IReF will require largely 1:1 transformations from the IL/EIL. Other frameworks not included in the IReF (e.g. FINREP) would continue to require more complex transformations from the BIRD IL/EIL. With this solution the banking industry can fulfil all reporting requirements in a consistent way and enabling a reconciliation at the level of the authorities. Based on such positive results, authorities might be more inclined and willing to abandon aggregated (e.g. template) reporting in favour of a more structured and redundancy-free granular reporting.

Phase 2: Aggregated reporting can be phased out over time through an extension of the IReF. It is important to stress that the authors do not imagine a big bang solution but rather a stepwise approach, although guided by an "endgame design concept". Eventually this process could lead to the BIRD input layer becoming the required reporting with only limited aggregated requirements remaining (e.g. for the purpose of requiring reporting agents to remain liable for certain values).

The standardisation envisaged within phase 1 and 2 in conjunction to the development of international standards and infrastructures (e.g. LEI) can lay the foundation of reporting via the digitalisation of contracts and an on-demand reporting or direct access to data from the side of authorities.

5. Conclusions

The Eurosystem initiatives described above represent important steps towards reducing reporting burden while improving its outcomes. Their benefit will increase however if they are integrated into a more comprehensive vision and strategy to accompany ongoing digitalisation. In Figure 2, for instance, reporting agents still need to bridge the BIRD input layer with their operational systems where contracts, parties and other facts remain represented in diverse ways. Hence, standardisation in the representation of the operations underlying financial markets is a necessary condition for fulfilling the digital-age specification of effective measurement.

To achieve true digitalisation, standardisation must first refer to the foundational level of identifying and representing financial contracts, parties and other facts. This will have to take place involving market participants, and possibly leveraging on on-going initiatives. Standardisation will need to be radical to work sustainably; compromises will be counterproductive and voluntary adoption too slow when time is now of the essence. Where rigorous discipline among millions of parties is required, that will likely require legislating the use of standards and public data infrastructures. As noted by Ramsey (2021), standards are the typical example of a public good, that market participants by themselves will not realise although the benefits will outweigh costs for society. Public authorities then need to intervene and catalyse change to achieve the common good. Efforts should first focus on building strong and global identification infrastructure for contracts and parties.

The digitalisation of financial services also opens new possibilities towards the standardisation of the technical representation of financial and other contracts. Many initiatives are on-going to develop standards for specific financial instruments (see also Bank of England (2021) and BIS (2020)). However, whereas these ongoing initiatives are mostly local, an effective solution, accepted in markets, would need to be far wider, being ideally global and to cover all contract types, as proposed by the ACTUS initiative. Continuing with local, siloed and underfunded initiatives will deliver yet another wave of heterogenous solutions, forming the next generation of messy legacy that will cost more and this time perhaps lead to failure. Coordination across jurisdictions is thus key. The digital transformation that affects all of us offers a unique opportunity to authorities to strengthen their catalytic role by leading the development of a comprehensive vision and the design of a conceptual architecture that would provide a frame in which local initiatives could flourish while forming a coherent system, sustainable in the digital age.

References

Bank of England (2021): "Transforming data collection from the UK financial sector: a plan for 2021 and beyond": London, February.

Chappell, G., Harreis, H., Havas, A., Nuzzo, A., Pepanides, T. and K. Rowshankish (2018): "The lending revolution: How digital credit is changing banks from the inside", McKinsey & Company.

Crisanto, J.C., Kienecker, K., Prenio, J. and E. Tan (2020): "From data reporting to data-sharing: how far can suptech and other innovations challenge the status quo of regulatory reporting?", FSI Insights on policy implementation, no 29, December.

Daley, S. (2020): "13 fintech lending companies upending the credit card, mortgage and loan industries".

European Banking Federation (2019): "Boosting Europe: Building Trust and Supporting Growth in Europe. EBF recommendations for the EU 2019-2024 legislative cycle and beyond", May.

European Central Bank (2020a): "The ESCB input into the EBA feasibility report under article 430c of the Capital Requirements Regulation (CRR 2)", September.

European Central Bank (2020b): "The Eurosystem Integrated Reporting Framework: an overview", November.

European Central Bank (2020c): "Cost-benefit assessment on the Integrated Reporting Framework", November.

Gross, F. (2019): "Digital-Age Finance: Staying in Control as Technology transforms the World - a Systemic View"

Gross, F. (2020): "Preliminary Considerations on the Future Business Model of the Global LEI System"

Perrow, C. (1999). Normal Accidents – Living with High-Risk Technologies (Updated Edition), Princeton University Press

Ramsay, G. (2021): "From master masons to information architects: how standards can transform reporting (and bring benefits well beyond it)": London, April.

United Nations (2014), Fundamental principles of national official statistics, United Nations: New York, see https://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx.

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

New hedonic quality adjustment method using sparse estimation[1]

Sahoko Furuta and Yoshiyuki Kurachi,
Bank of Japan

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

BANK OF JAPAN

New Hedonic Quality Adjustment Method using Sparse Estimation

Sahoko Furuta
Bank of Japan
Research and Statistics Department

Introduction

- ✓ The hedonic estimation generally has issues with multicollinearity and the omitted variable bias. This leads to a low estimation accuracy and a large estimation burden in practice.

- ✓ To overcome these problems, we introduce new estimation method using "sparse estimation" as a way to automatically select the meaningful variables from a large number of candidates.

- ✓ The new method brings three benefits;
  1. A significant increase in the number of variables in the model
  2. An improvement in fit of the model to actual prices
  3. A reduction of the over-estimation in quality improvements due to the omitted variable bias

1. Motivations

What is Hedonic Quality Adjustment?

- ✓ The Bank of Japan applies **the hedonic quality adjust method** in the compilation of the Price Indexes to eliminate the effect of products' quality changes.
- ✓ When a product turnover occurs, the observed price difference between new and old products is decomposed into (a) the difference due to a quality change and (b) the difference due to a pure price fluctuation, which is called **quality adjustment**.

The observed price difference between new and old products = (a) The price difference due to a quality change + (b) The price difference due to a pure price fluctuation

(a): Estimated by the hedonic regression model

(b): Only this part is reflected in the Price Indexes.

- ✓ In the hedonic method, the relationship between **product quality** and **price** is statistically regressed with a large amount of data. This method is not only highly objective, but also applicable to various changes in characteristics of products.

Overview of Conventional method

✓ Given the non-linear relationship between the price and characteristic of a product, the hedonic regression model often has both of linear parts and non-linear parts by the Box-Cox transformed term.

$$y_i^{(\lambda_0)} = \beta_0 + \sum_{k=1}^{p_d} \beta_{dk} x_{dk,i} + \sum_{j=1}^{p_c} \beta_{cj} x_{cj,i}^{(\lambda_j)}$$

y_i: theoretical price, $x_{cj,i}$: continuous variable, $x_{dk,i}$: dummy variable,
β_0: constant term, β_{cj}: coefficient on a continuous variable,
β_{dk}: coefficient on a dummy variable,
λ_0: Box-Cox parameter for theoretical price,
λ_j: Box-Cox parameter for a continuous variable,
p_c: number of continuous variables, p_d: number of dummy variables

Issues of Conventional method

Accuracy of estimation

- Multicollinearity
- The omitted variables bias

These problems are likely to arise when the characteristics of the products are highly correlated. They disturb accurate estimation of the parameters.

Burden of estimation

Repeating estimation while changing the set of the variables (excluding variable that cause multicollinearity and including the meaningful variables) to obtain good results.

Accuracy of estimation (1)

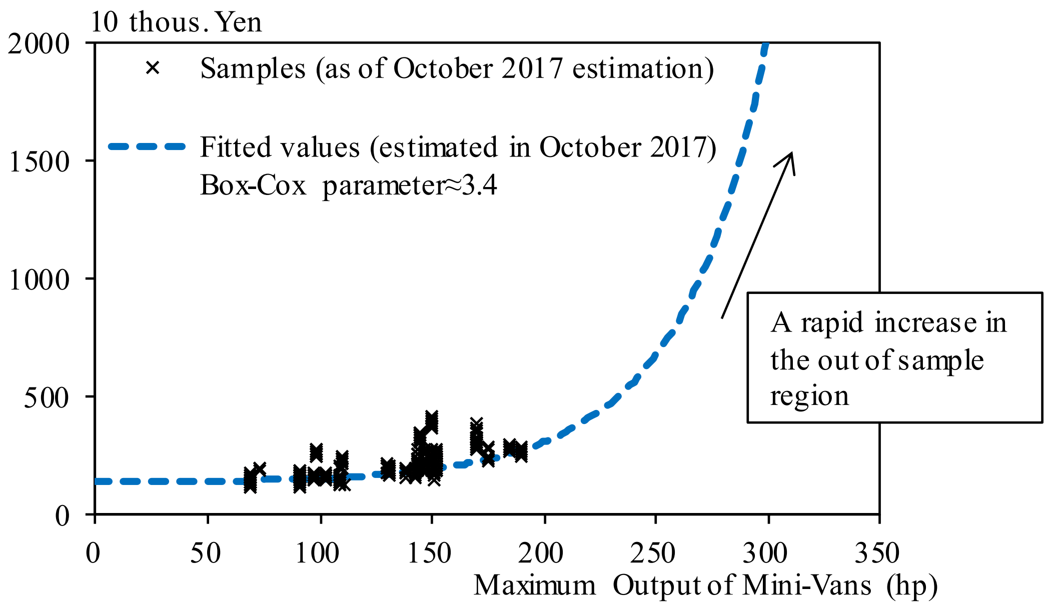
日本銀行 BANK OF JAPAN

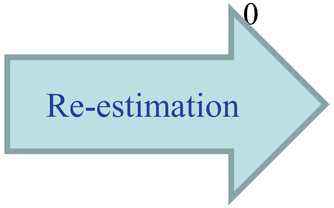
- ✓ Estimated parameters on variables may become unstable due to the problem of multicollinearity and the omitted variables bias.
- ✓ Multicollinearity refers to a state in which there is a high inter-connection among the variables. Multicollinearity makes it difficult to identify price effects of variables, and it may also cause the omitted variables bias through the variable selection based on the statistical significance.
  As a result, the parameters are not estimated accurately.
- ✓ It is known that these problems can be more serious as the model has more complex functional form to deal with the non-linear effects of price determining characteristics.

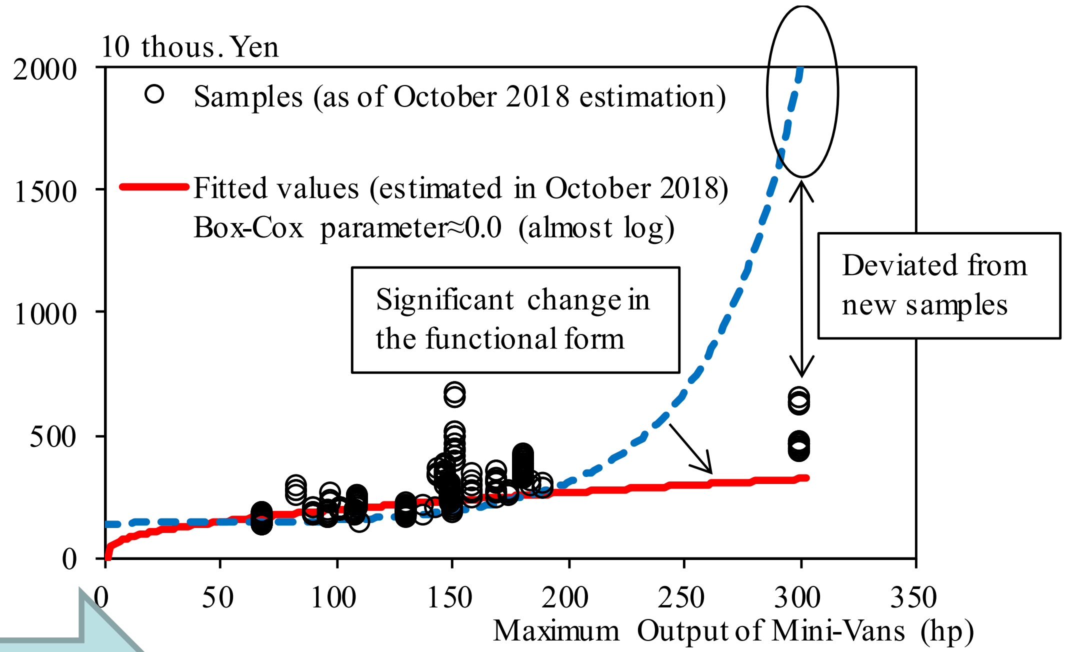
Accuracy of estimation (2)

日本銀行 BANK OF JAPAN

- ✓ A distorted functional form has a problem, called "overfitting."
- ✓ The model may give quite poor estimates for the new products (i.e. out-of-sample).







Burden of estimation

- ✓ As mentioned, the model with complex functional form may be suffered by the problem of multicollinearity and the omitted variables bias.
- ✓ Then, a slight change in sample and regressors often leads to a quite different estimation result in each re-estimation. Discontinuity in the estimates is highly problematic in practice.

  ⇒We have to repeat estimation with changing the set of the variables each time until obtaining a better and acceptable result.
- ✓ This problem is serious in the estimation of "passenger car", where there are many candidate variables and they are highly correlated.

2. New Method using Sparse Estimation

Sparse Estimation (1)

- ✓ Sparse estimation has a property that select the meaningful variables from a large number of candidates and gives zero coefficients to the rest of the variables ("Sparsity"). It can perform "variable selection" and "coefficient estimation" at the same time and can automatically derive a stable and well fitted model.

- ✓ The new estimation method proposed in this study employs an Adaptive Elastic Net (AEN), which enjoys two desirable properties;

  1. "Group Effect" that gives robustness for multicollinearity
  2. "Oracle Property" that ensures the adequacy of variable selection and estimated coefficients.

Sparse Estimation (2)

- ✓ For example, Lasso, a typical sparse estimation, estimates $\boldsymbol{\beta}$, by minimizing loss function: the sum of the squared errors and the regularization term ($\boldsymbol{L_1}$norm of $\boldsymbol{\beta}$).
- ✓ Lasso has similar loss function with Ridge, but differs in that it has sparsity.

Lasso

$$\underset{\boldsymbol{\beta}}{\operatorname{argmin}}\left(|\boldsymbol{Y}-\boldsymbol{X\beta}|^2+\lambda\sum_{j=1}^{p}|\beta_j|\right)$$

Ridge

$$\underset{\boldsymbol{\beta}}{\operatorname{argmin}}\left(|\boldsymbol{Y}-\boldsymbol{X\beta}|^2+\lambda\sum_{i=1}^{p}{\beta_j}^2\right)$$

$\lambda > 0$: regularization parameter (It selects relatively smaller number of variables if λ is large)

Sparse Estimation (3)

- ✓ In the bivariate model, $\boldsymbol{\beta}$ is derived from the intersection of the contour line of the sum of squared error and the constraint.
- ✓ Lasso gives $\boldsymbol{\beta}$ at the corners of rhombus of the constraint, and then one coefficient is estimated to be exactly zero.

Lasso

$$\underset{\beta_1,\beta_2}{\operatorname{argmin}} \sum_{i=1}^{n} \left(Y_i - \beta_1 X_{1,i} - \beta_2 X_{2,i}\right)^2$$

$$\text{s.t. } |\beta_1| + |\beta_2| \leq s$$

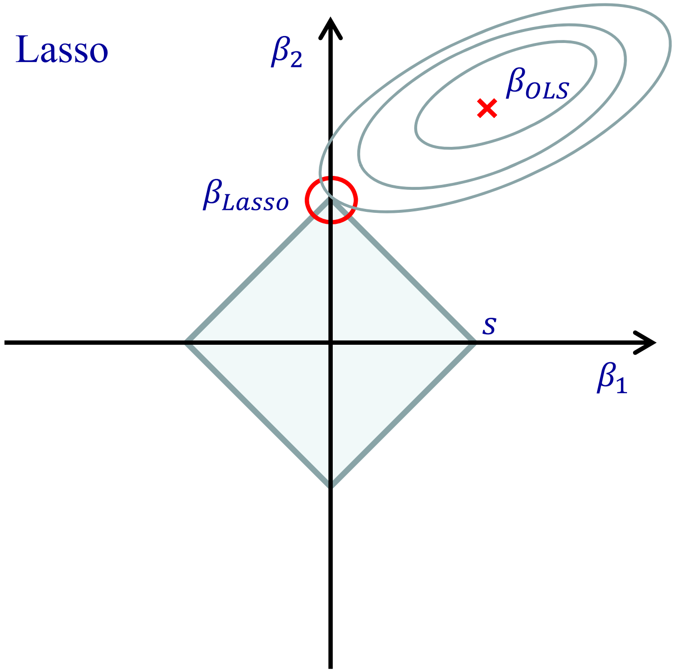
$s > 0$: 1−1 corresponding to λ

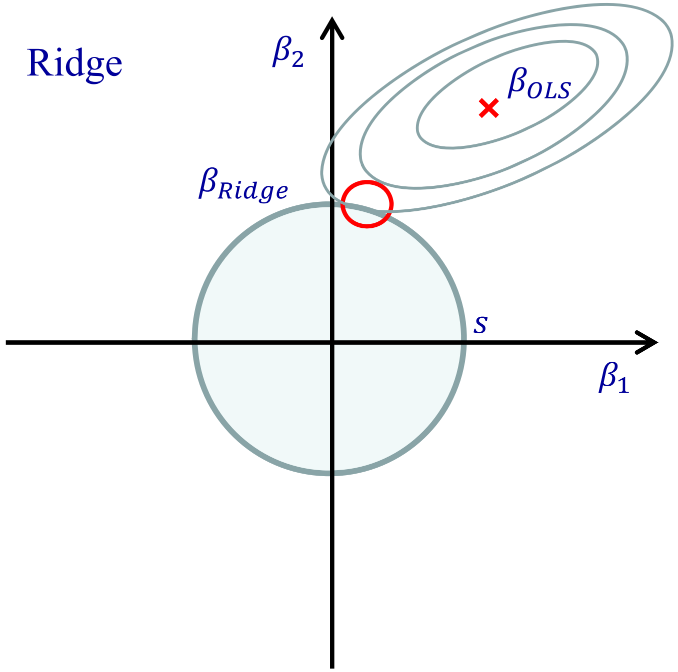
Ridge

$$\underset{\beta_1,\beta_2}{\operatorname{argmin}} \sum_{i=1}^{n} \left(Y_i - \beta_1 X_{1,i} - \beta_2 X_{2,i}\right)^2$$

$$\text{s.t. } {\beta_1}^2 + {\beta_2}^2 \leq s^2$$

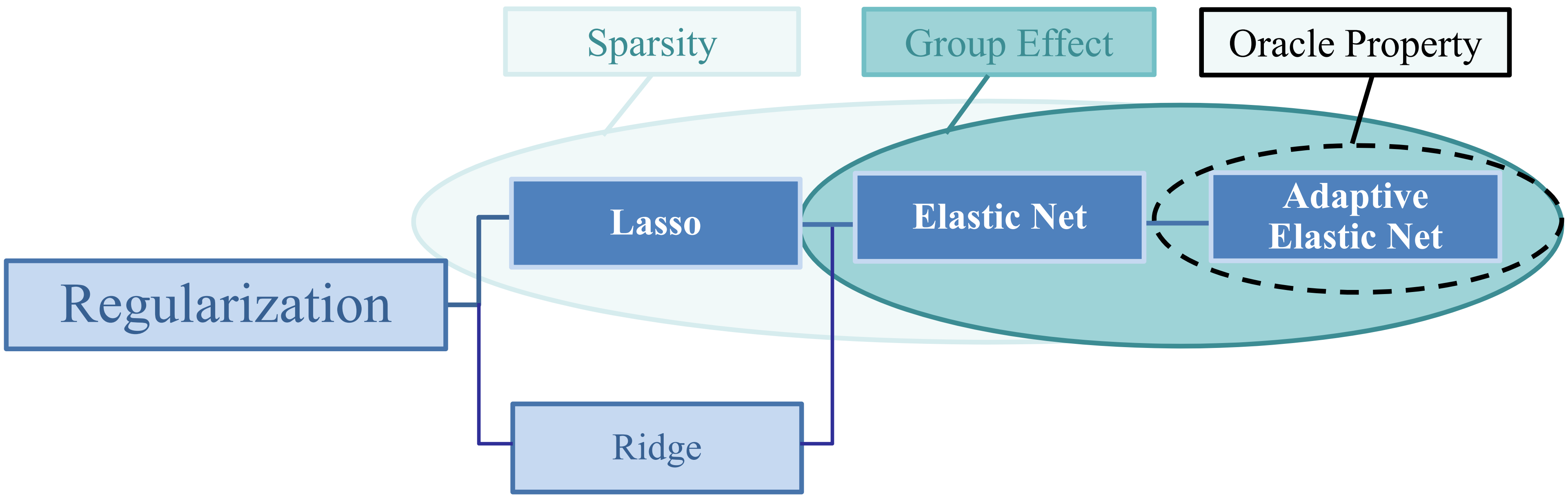
$s > 0$: 1-1 corresponding to λ





Adaptive Elastic Net (1)

- ✓ AEN can be interpreted as the combination of the Lasso and the Ridge.
- ✓ It has "group effect" and "oracle property."



Adaptive Elastic Net (2): Group Effect

日本銀行 BANK OF JAPAN

- ✓ For Lasso, the results of variable selection are known to be unstable in data has strong multicollinearity.
- ✓ A typical method to overcome this problem is the "Elastic Net (EN)."
- ✓ The robustness of EN for multicollinearity is called "group effect". It is a property that gives similar coefficients on variables when the correlation between them is high.

$$\widehat{\boldsymbol{\beta}}(EN) = \left(1 + \frac{\lambda_2}{n}\right)\left\{\underset{\boldsymbol{\beta}}{\operatorname{argmin}} |\boldsymbol{Y} - \boldsymbol{X}\boldsymbol{\beta}|^2 + \lambda_2 \sum_{j=1}^{p} \beta_j^{\ 2} + \lambda_1 \sum_{j=1}^{p} |\beta_j|\right\}$$

$\lambda_2 > 0$: L_2 norm regularization parameters
$\lambda_1 > 0$: L_1 norm regularization parameters
n: number of observations

Adaptive Elastic Net (3): Oracle Property

- ✓ The "oracle property" is known as a property that asymptotically guarantees the appropriateness of both the "variable selection" and the "coefficient estimation".

When $\boldsymbol{\beta}^*$ is the true coefficient, the estimator $\hat{\boldsymbol{\beta}}$ satisfies the following;

(1) Variable Selection Consistency

$$\lim_{n\to\infty} P\left(\hat{\beta}_j = 0\right) = 1 \qquad with\ \beta_j{}^* = 0$$

(2) Asymptotic Normality of the Non-zero Coefficients

$$\lim_{n\to\infty} \frac{\left(\hat{\beta}_j - \beta_j{}^*\right)}{\sigma\left(\hat{\beta}_j\right)} \sim \mathrm{N}(0,1) \quad with\ \beta_j{}^* \neq 0$$

$\sigma^2\left(\hat{\beta}_j\right)$: asymptotic variance of estimator

Adaptive Elastic Net (4)

日本銀行 BANK OF JAPAN

- ✓ We employ AEN as a new estimation method for hedonic regression model.
- ✓ The AEN estimation is performed in two stages. At the first stage, we estimate the coefficients with EN. Then, EN is performed again to impose greater penalties for variables with small absolute values of the coefficients.

$$\widehat{\boldsymbol{\beta}}(AEN) = \left(1 + \frac{\lambda_2}{n}\right)\left\{\underset{\boldsymbol{\beta}}{\operatorname{argmin}}\left(|\boldsymbol{Y} - \boldsymbol{X}\boldsymbol{\beta}|^2 + \lambda_2 \sum_{j=1}^{p} {\beta_j}^2 + {\lambda_1}^* \sum_{j=1}^{p} \widehat{w}_j |\beta_j|\right)\right\}$$

$$\widehat{w}_j = \left(|\hat{\beta}_j(EN)|\right)^{-\gamma}$$

${\lambda_1}^* > 0$: L_1 norm regularization parameters (2nd stage)

$\widehat{w}_j > 0$: adaptive weight, $\gamma > 0$: adaptive parameter

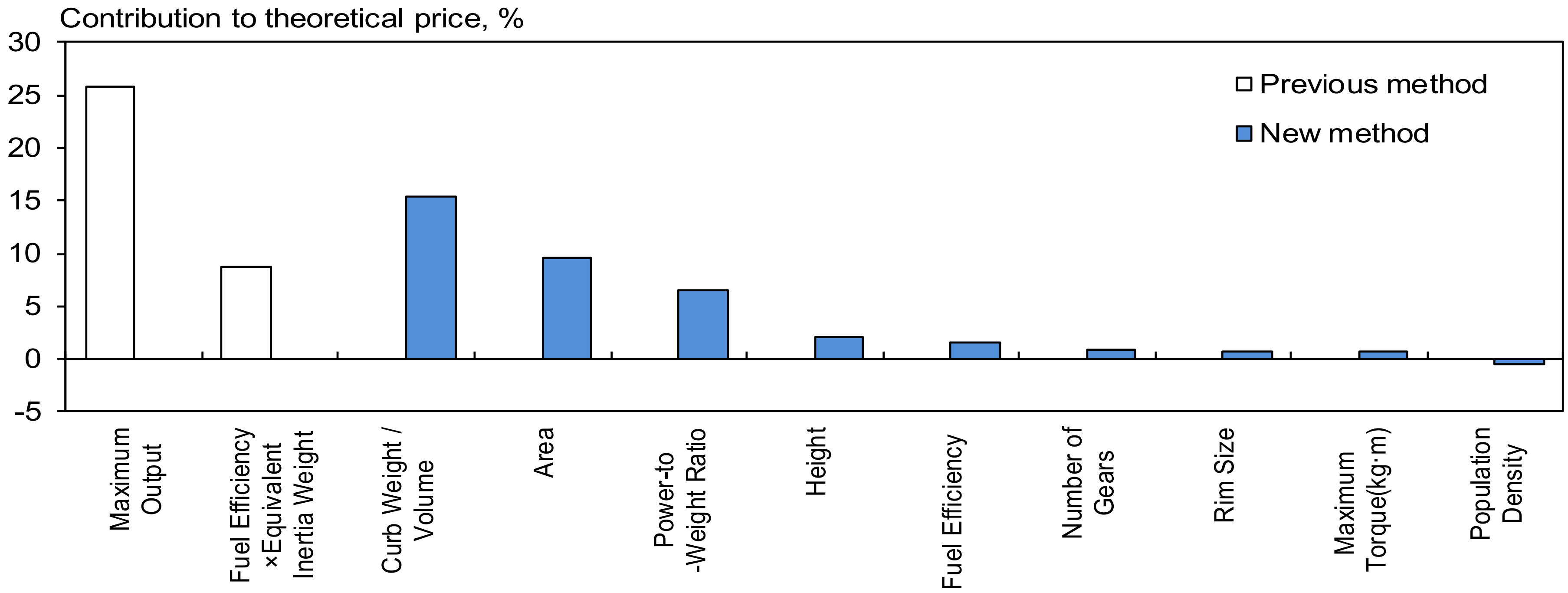
(Larger γ imposes larger penalties corresponding to the absolute value of the coefficient)

3. Estimation Results

Continuous variables in the model

日本銀行 BANK OF JAPAN

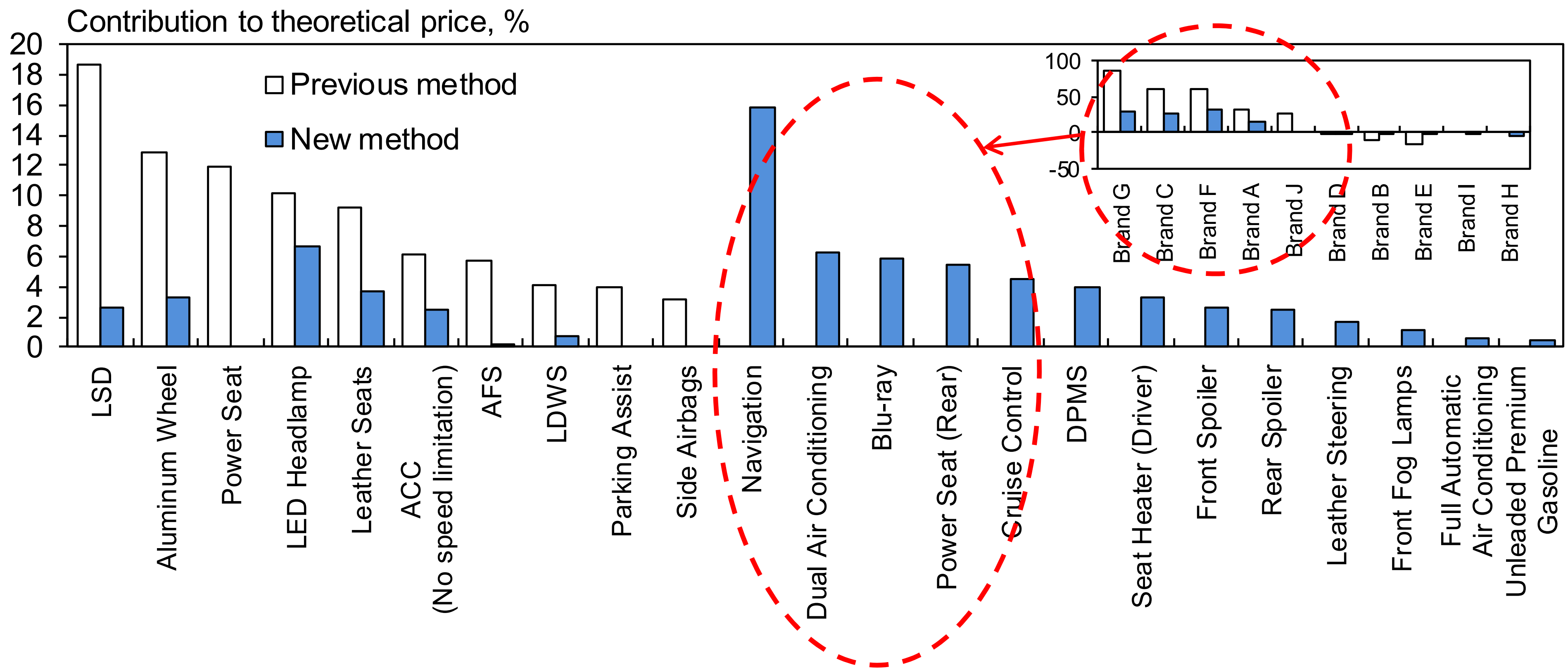
- ✓ We apply new and previous hedonic regression models to passenger cars in Japan and compare those results.
- ✓ The number of continuous variables in the regression models increases and this is accompanied by a reduction in dependence on just a few specific variables.



Note: Bar charts indicate the rates of change in theoretical price due to one unit increase in variables where all variables of a product are set at sample means.

Dummy variables in the model

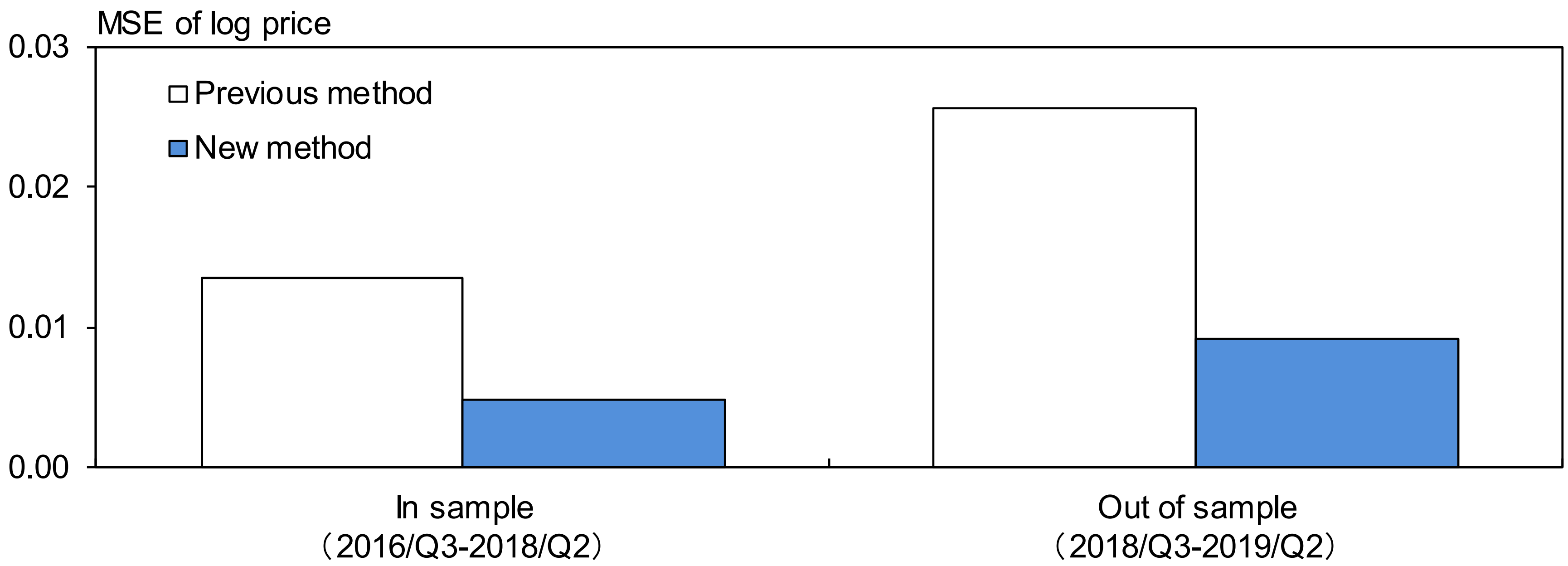
✓ As a result of the increased number of characteristics, the new regression model reduces its reliance on manufacturer dummies (control variables).



Note: Bar charts indicate the rates of change in theoretical price due to one unit increase in variables where all variables of a product are set at sample means.

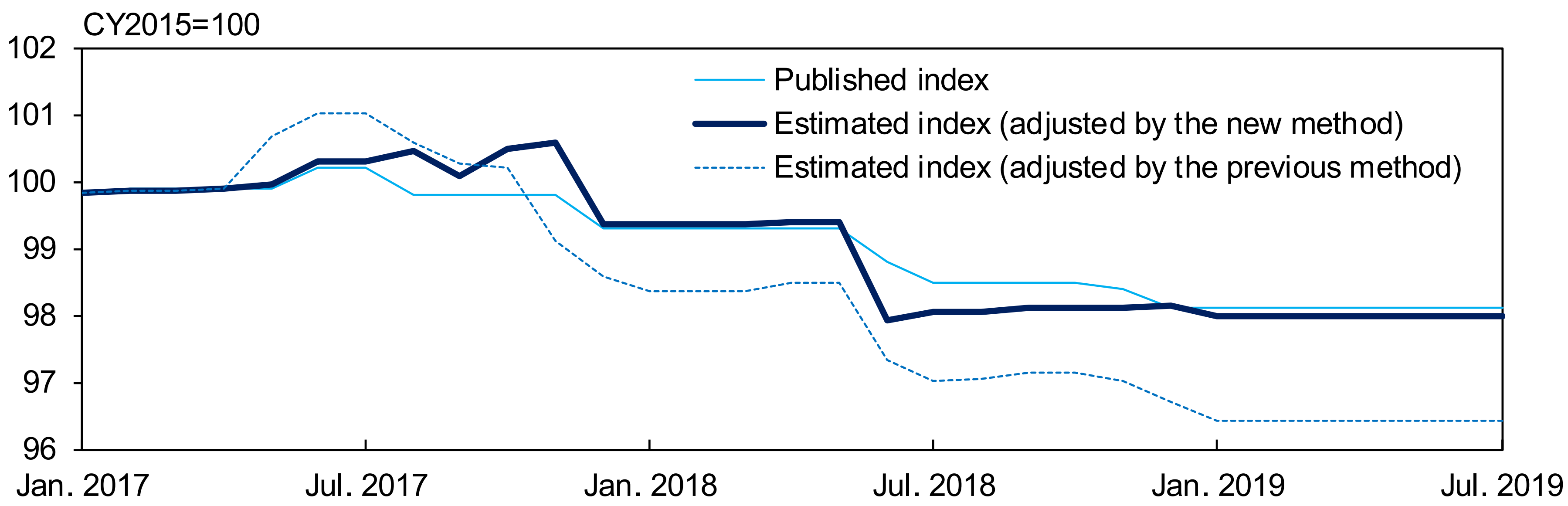
Fit of the model

- ✓ The fit (mean squared errors) of regression models to actual price improves in the new estimation method for both in-sample and out-of-sample period.
- ✓ Since the quality adjustment is generally applied to products, released after the estimation, the improvement in the out-of-sample fit implies an increase in the usefulness of the hedonic quality adjustment method in practice.



Estimated Price Index

- ✓ The estimated price index of "standard passenger cars (gasoline cars)" in the PPI, which is retrospectively calculated by applying the new hedonic estimation method to all quality adjustments, shows similar developments to the published price index.
- ✓ On the other hand, the previous method highlights the risk of over-estimating the rate of quality improvement as it shows an excessive decline in the price.



4. Conclusion

Conclusion

日本銀行 BANK OF JAPAN

- ✓ The new estimation method using "sparse estimation"
  1. mitigates the problems of omitted variables and multicollinearity significantly.
  2. improves estimation accuracy and reduces estimation burden.
  3. possibly improves the accuracy of the price index.
- ✓ The proposed method can supports effective use of big data for price statistics as it can automatically build a good performance model by extracting all necessary information even with the large dataset.

New Hedonic Quality Adjustment Method using Sparse Estimation

Sahoko Furuta[1]*, Yoshiyuki Kurachi[2]

[1] Bank of Japan, Tokyo, JAPAN, sahoko.furuta@boj.or.jp
[2] Bank of Japan, Tokyo, JAPAN, yoshiyuki.kurachi@boj.or.jp

Abstract:
In the application of the hedonic quality adjustment method to the price index, multicollinearity and omitted variable bias arise as practical issues. This paper proposes the new hedonic quality adjustment method using "sparse estimation" in order to overcome these problems. The new method deals with the problems by ensuring two properties: the "Grouped Effect" that gives robustness for multicollinearity and the "Oracle Property" that provides the appropriate variable selection and the asymptotically unbiased estimators. We perform an empirical analysis applying the new method to the producer price index of passenger cars in Japan. The result shows that, compared with the conventional standard estimation method, the new method brings the following three benefits; 1) a significant increase in the number of variables in the regression model, 2) an improvement in fit of the model to actual prices, and 3) the reduction of the overestimation in quality improvements due to the omitted variable bias. These points suggest that the proposed method is likely to improve the accuracy of the price index while enhancing the usefulness of the hedonic quality adjustment method. We expect that this method supports effective use of big data for price statistics through automatically building a good performance model by extracting all necessary information even with the large dataset.

Keywords:
Price index; Quality adjustment; Hedonic regression model; Sparse estimation; Adaptive Elastic Net

1. Introduction:

Given the price index indicates "pure" price changes of the product over time, it is essential to adjust the price difference attributable to quality differences between old and new products in response to the renewal of products in the market. The hedonic quality adjustment method is one of the quality adjustment methods for the price index. It extracts a quality change by using the regression model which estimates the relationship between characteristics and prices while assuming the quality of a product can be represented by the accumulation of individual characteristics.

The hedonic quality adjustment method has two main advantages; 1) it can objectively evaluate the quality changes of products based on data and statistical methods rather than on the subjective judgement, and 2) even if there are various changes in characteristics of products, it can comprehensively evaluate the effects of these changes on the product prices. Therefore, the hedonic approach has been applied in the compilation of the consumer price index (CPI) and the producer price index (PPI) in many countries.

However, there are some issues for applying the hedonic quality adjustment method in practice. First, if the characteristics of the products are highly correlated, the problem of multicollinearity on the explanatory variables is likely to arise, and it may cause the omitted variables bias through the variable selection based on the statistical significance.

Furthermore, it is known that the problems of multicollinearity and omitted variable bias can be more serious as the model has more complex functional form to deal with the non-linear effects of price determining characteristics.

In this paper, we attempt to overcome these problems by introducing the new estimation method employing "sparse estimation" in the estimation of the hedonic regression model.

2. Methodology:

Taking into account the non-linear relationship between the price and characteristics of a product, the Bank of Japan (BOJ) previously employed the following hedonic regression model with the Box-Cox transformed term[1], and it was estimated by using the ordinary least squares (OLS) method, in the compilation of the PPI and export/import price index.

$$y_i^{(\lambda_0)} = \beta_0 + \sum_{j=1}^{p_c} \beta_{cj} x_{cj,i}^{(\lambda_j)} + \sum_{k=1}^{p_d} \beta_{dk} x_{dk,i}\,, \tag{1}$$

where y_i: theoretical price, $x_{cj,i}$: continuous variable, $x_{dk,i}$: dummy variable,
β_0: constant term, β_{cj}: coefficient on a continuous variable,
β_{dk}: coefficient on a dummy variable,
λ_0: Box-Cox parameter for theoretical price,
λ_j: Box-Cox parameter for a continuous variable,
p_c: number of continuous variables, p_d: number of dummy variables.

However, there are some issues with this method in that the parameters are not stable due to multicollinearity and omitted variables, which can cause bias in the parameters when the explanatory variables (characteristics in the hedonic regression model) are highly correlated. In particular, it is known that the omitted variable bias becomes more severe on complex functional forms, and it poses a risk of generating downward bias in the price index because of an overestimation of the rate of quality improvement.

To deal with the aforementioned issues, we introduced the new estimation method with "adaptive elastic net: AEN", a type of sparse estimation proposed in Zou and Zhang (2009). Sparse estimation performs variable selection and coefficient estimation at the same time under the property called "sparsity". This method has an advantage over the previous one (equation (1)) in that it can automatically derive a more stable and fitted model. In addition, the AEN incorporates the L_1 norm (sum of absolute values) and the L_2 norm (sum of squares) of coefficients as regularization terms in the two-stage estimation of coefficients (see equations (3)-(5) below). Then it enjoys two desirable properties: the "Grouped Effect" that gives robustness for multicollinearity and the "Oracle Property" that ensures the adequacy of variable selection and coefficients (Zou, 2006).

Given these properties, the new estimation method selects variables and a functional form simultaneously by extracting variables from the quadratic multivariate regression model with interaction terms, shown as equation (2), in the AEN estimation. Note that this regression model is to incorporate interaction effects among characteristics of a product while maintaining the non-linear relationship between price and characteristic in the regression model.

$$Y_i \equiv \log y_i\,,$$

[1] The Box-Cox transformation of a variable x with the Box-Cox parameter (λ) is as follows (Box and Cox, 1964).

$$x^{(\lambda)} = \begin{cases} \dfrac{x^\lambda - 1}{\lambda} & (\lambda \neq 0) \\ \log x & (\lambda = 0) \end{cases}$$

$$Y_i = \hat{\beta}_{00} + \sum_{j=1}^{p} \hat{\beta}_{0j} x_{j,i} + \sum_{j=1}^{p} \hat{\beta}_{jj} {x_{j,i}}^2 + \sum_{k>j\geq 1} \hat{\beta}_{jk} x_{j,i} x_{k,i}\,, \qquad (2)$$

where

$$\widehat{\boldsymbol{\beta}} = \left(1 + \frac{\lambda_2}{n}\right) \left\{ \underset{\boldsymbol{\beta}}{\operatorname{argmin}} \left(|\boldsymbol{Y} - \boldsymbol{X\beta}|^2 + \lambda_2 \sum_{k\geq j\geq 0} {\beta_{jk}}^2 + {\lambda_1}^* \sum_{k\geq j\geq 0} \widehat{w}_{jk} |\beta_{jk}| \right) \right\}, \qquad (3)$$

$$\widehat{w}_{jk} = \left(\left| {\hat{\beta}_{jk}}^{1st} \right| \right)^{-\gamma}, \qquad (4)$$

$$\widehat{\boldsymbol{\beta}}^{1st} = \left(1 + \frac{\lambda_2}{n}\right) \left\{ \underset{\boldsymbol{\beta}}{\operatorname{argmin}} \left(|\boldsymbol{Y} - \boldsymbol{X\beta}|^2 + \lambda_2 \sum_{k\geq j\geq 0} {\beta_{jk}}^2 + \lambda_1 \sum_{k\geq j\geq 0} |\beta_{jk}| \right) \right\}, \qquad (5)$$

y_i: theoretical price, $x_{j,i}$: explanatory variable, $\widehat{\beta}_{jk}$: coefficient on $x_{j,i}x_{k,i}$,
p: number of candidate explanatory variables, n: number of samples in dataset,
$\lambda_1 > 0$: L_1 norm regularization parameter (1st stage),
${\lambda_1}^* > 0$: L_1 norm regularization parameter (2nd stage),
$\lambda_2 > 0$: L_2 norm regularization parameter,
$\gamma > 0$: adaptive parameter, $\widehat{w}_{jk} > 0$: adaptive weight.

3. Result:

In this section, we apply new and previous hedonic regression models to passenger cars in Japan and compare those results.

Chart 1 shows the rate of change in theoretical price due to one standard deviation increase in continuous variables where a hypothetical data with all variables are set at the mean value over the sample period. It is clear that the number of explanatory variables in the regression models increases and this is accompanied by a reduction in dependence on just a few specific variables. For instance, regarding the driving performance of passenger cars, in addition to the maximum output, which is solely selected in the previous model, the new estimation method enables the incorporation of characteristics related to the acceleration performance into the model, such as number of gears and maximum torque.

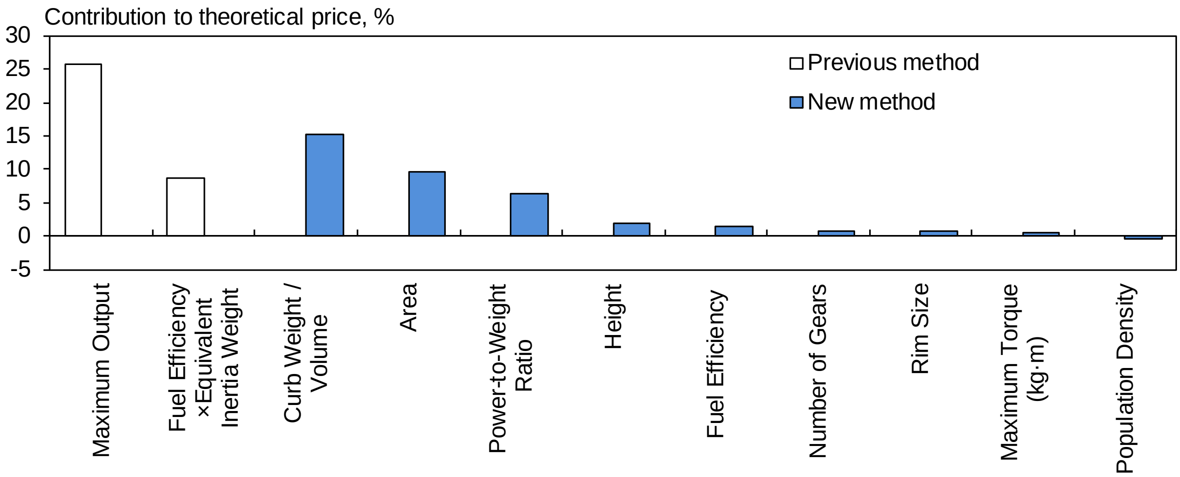


Chart 1: Estimated Effects of Characteristics on Price of Passenger Cars

As for the estimation accuracy of these models, we calculate the mean squared errors for both in-sample and out-of-sample period (Chart 2). We can find that the fit of regression models to actual price generally improves in the new estimation method for both in-sample and out-of-sample data. Since the quality adjustment is generally applied to products that is released after the estimation, the improvement in the out-of-sample fit implies an increase in the usefulness of the hedonic quality adjustment method in practice.

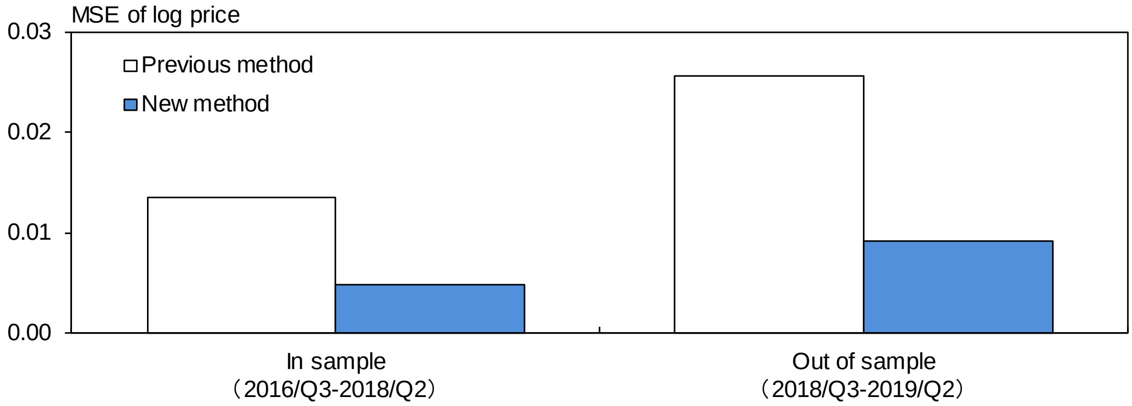


Chart 2: Fit of Hedonic Regression Models by Estimation Method

In fact, looking at the price index of "standard passenger cars (gasoline cars)" in the PPI, it can be seen that the estimated index, which is retrospectively calculated by applying the new hedonic estimation method to all quality adjustments, shows similar developments to the published price index[2] (Chart 3). On the other hand, the estimated index by the previous method highlights the risk of over-estimating the rate of quality improvement as it shows an excessive decline in the price. These observations suggest that an increase in the number of explanatory variables under the new method contributes to the accurate estimation of quality improvement rates in practice.

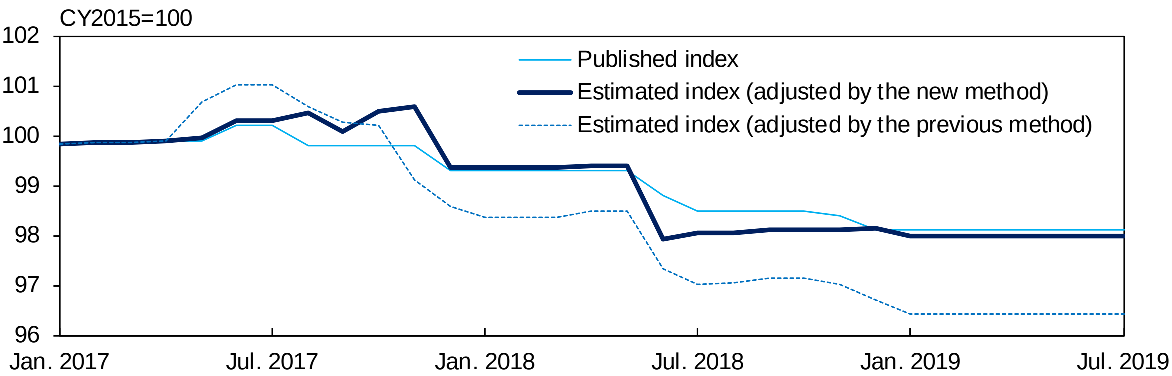


Chart 3: Estimated Price Index by New and Previous Methods

4. Discussion and Conclusion:

This paper introduces the new estimation method for the hedonic quality adjustment to overcome the problems due to multicollinearity and omitted variables. The AEN, which is employed in the new method, provides two desirable properties: the "Grouped Effect" that gives robustness for multicollinearity and the "Oracle Property" that ensures the adequacy of variable selection and asymptotic unbiasedness of coefficients.

[2] In the compilation of the PPI, the BOJ choose the most appropriate one among various quality adjustment methods including the hedonic quality adjustment method based mainly on review of an estimated quality improvement with a respondent firm. If the estimates by the hedonic quality adjustment method cannot pass this review, the BOJ applies other quality adjustment methods such as the production cost method.

The empirical analysis for passenger car prices in Japan suggests that the new method using the AEN potentially offers following benefits: 1) a significant increase in the number of variables incorporated in the model, 2) an improvement in fit especially for the out-of-sample period, and 3) less omitted variable bias which reduces the risk of over-estimation of the quality improvement rate. Therefore, the new method is expected to make the hedonic quality adjustment more accurate and more applicable for various sample replacements.

As mentioned above, since the hedonic method is based on data and statistical methods, it has strength in its objectiveness and applicability for a quality change accompanied by developments in a wide range of product's characteristics. The increased usability of the hedonic regression model will lead to the more accurate price index. Moreover, the proposed estimation method is a highly efficient as it can automatically build a good performance model by extracting all necessary information even with the large dataset. We expect that this method supports effective use of big data for price statistics.

References:

1. Box, G. E. P. & Cox, D. R. (1964). An Analysis of Transformations, *Journal of the Royal Statistics Society Series B*, **26**, 211-252.
2. Furuta, S., Hatayama, Y., Kawakami, A., & Oh, Y. (2021). New Hedonic Quality Adjustment Method using Sparse Estimation, Bank of Japan Working Paper Series, Forthcoming.
3. Triplett, J. E. (2006). *Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products*, OECD Publishing.
4. Zou, H. (2006). The Adaptive Lasso and Its Oracle Properties, *Journal of the American Statistical Association*, **101**, 1418-1429.
5. Zou, H. & Zhang, H. H. (2009). On the Adaptive Elastic-Net with a Diverging Number of Parameters, *The Annals of Statistics*, **37**(4), 1733-1751.

Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Digital advertising activities in Japan's services producer price index[1]

Moegi Inoue,
Bank of Japan

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

BANK OF JAPAN

Digital Advertising Activities in Japan's SPPI

Moegi Inoue

Bank of Japan

Research and Statistics Department

Introduction

Basic Information of Japan's SPPI

BANK OF JAPAN 日本銀行

Scope

- Services provided by businesses to other businesses and governments (excluding services provided to households).

Purpose

- Capture developments in supply-demand conditions for service products provided to business and government.
- Used as a deflator of GDP (mainly used in corporate sector).

Index structure

- Compiled and published only on commodity basis (not industry basis).

Basic Information of Japan's SPPI

日本銀行 BANK OF JAPAN

Time of release

- Monthly
- Preliminary indexes are released on the 18th business day of the month following the reference month.

Sources for weights

- "2015 Updated Input-Output Tables"
- Other various statistics are also employed as source data (including "Economic Census for Business Activity").

Rebasing

- Every five years (base year and weights are updated).
- At the time of rebasing, we incorporate new services and reconsider the pricing and quality adjustment methods

Rebasing

- ✓ Japan has rebased SPPI this June from 2010 base to 2015 base.
- ✓ We have expanded the coverage of two digital services; "Web portals", "Internet advertising" (as shown in yellow).

2010base	
Items	Weights
Internet related services	9.2
Internet advertising	6.8

Split & Expand

Expand

2015base	
Items	Weights
Web portals	14.3
Internet support services	4.1
Internet data centers	1.2
Internet advertising	10.9

Web Portals

Web Portals

✓ "Web portals" offers searching function by intermediating companies and customers online.

(Ex.) Hotel Reservation

Commission rate 10%
Profit $10

Survey this commission rate or profit per a transaction

Note: The above commission rate and profit are fictitious.

Web Portals

(Ex.) Restaurant Information

Survey posting & booking fee

Note: The above commission rate and profit are fictitious.

Web Portals

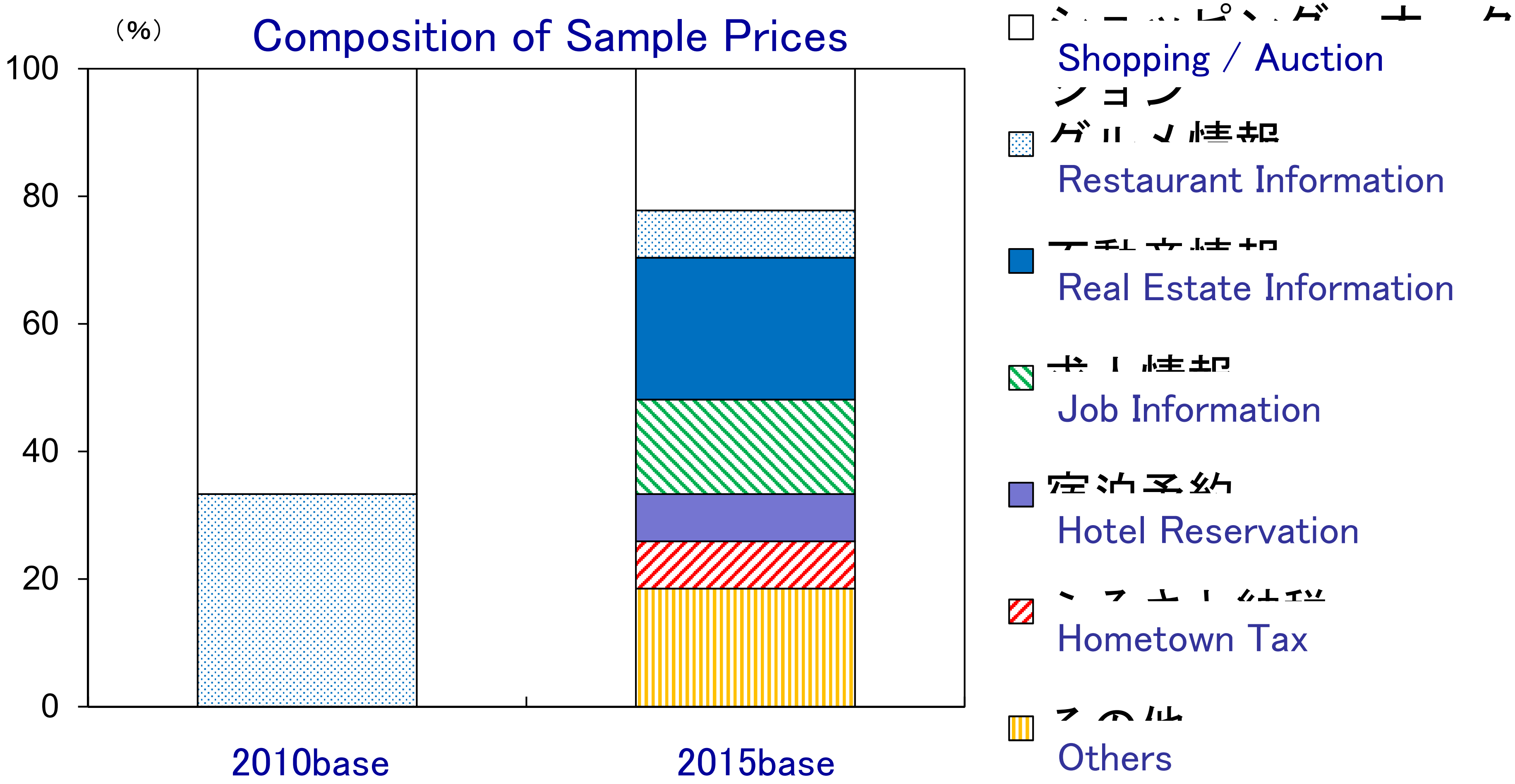
✓ Each web portal has a different business model, even though they deal with the same products or services.

Web Portal Categories	Fixed Fee		Fee according to the Volume of the Purchase		Mixed Fee
	Per Shop	Per transaction	Fixed Unit Price	Percentage Fee	
Shopping / Auction				✓	✓
Restaurant Information					✓
Real Estate Information	✓	✓			
Job Information		✓			
Hotel Reservation				✓	
Hometown Tax	✓			✓	
Others	✓		✓		✓

Note: Not all the web portals are included to the above table.

Web Portals

✓ Many kinds of web portals are newly incorporated to our new index (2015 base).



Internet Advertising

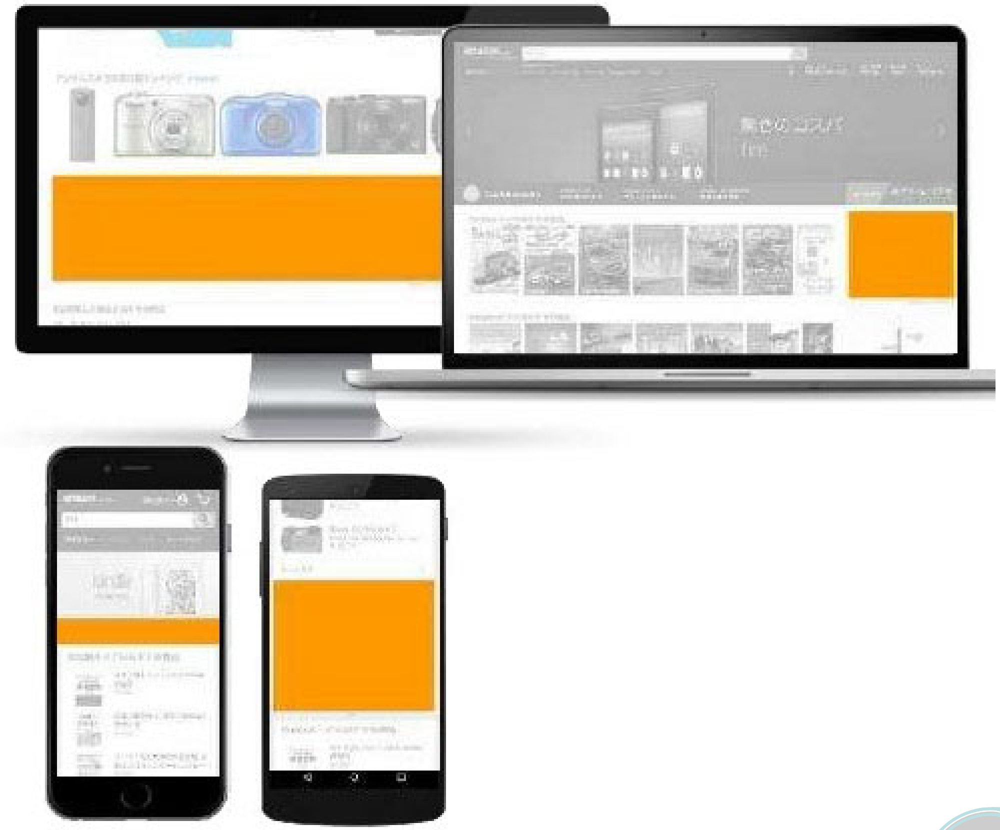
Internet Advertising

✓ "Internet advertising" provides advertising space via ad network operated by web portals.

Advertising Categories		Definition
Reservation Advertising		Advertisement transacted with fixed price using a non-auction method.
Programmatic Advertising	Listing Ad	Advertisement on the search screen linked to the keyword searched by the consumer using auction method.
	Display Ad	Advertisement whose effect is assumed to be high based on the content of website and the consumer's browsing history, etc. using auction method.
	Video Ad	
Affiliate Advertising		Advertisement whereby if a consumer views an Internet advertisement and then performs some predetermined action, the media or consumer is paid some remuneration.

Internet Advertising

(Ex.) Reservation advertising

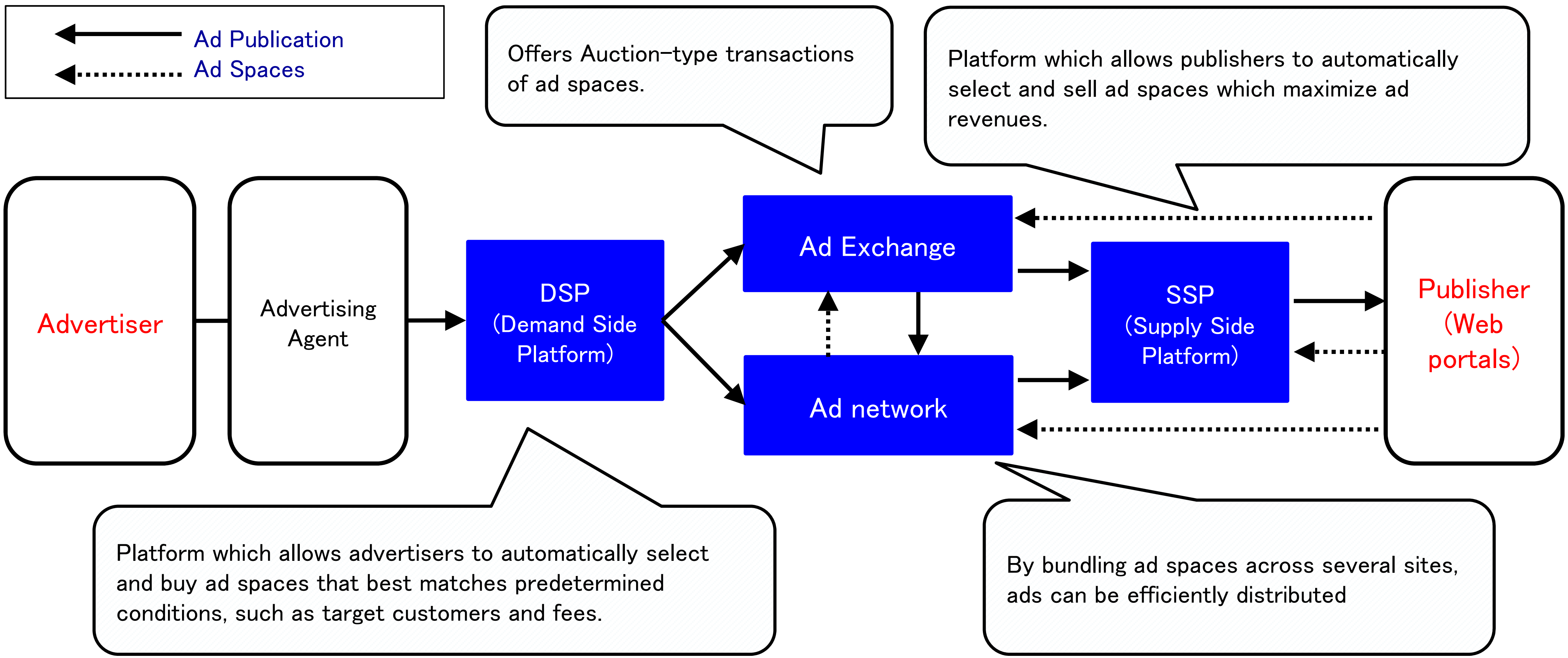


Media Sheet

Listing fee	$15,000
CPM(Cost Per Miles)	$0.8
Guaranteed impressions	1,875,000
Assumed CTR (Click Through Rate)	0.29%
Listing Period	1 week
Listing page	Top Page

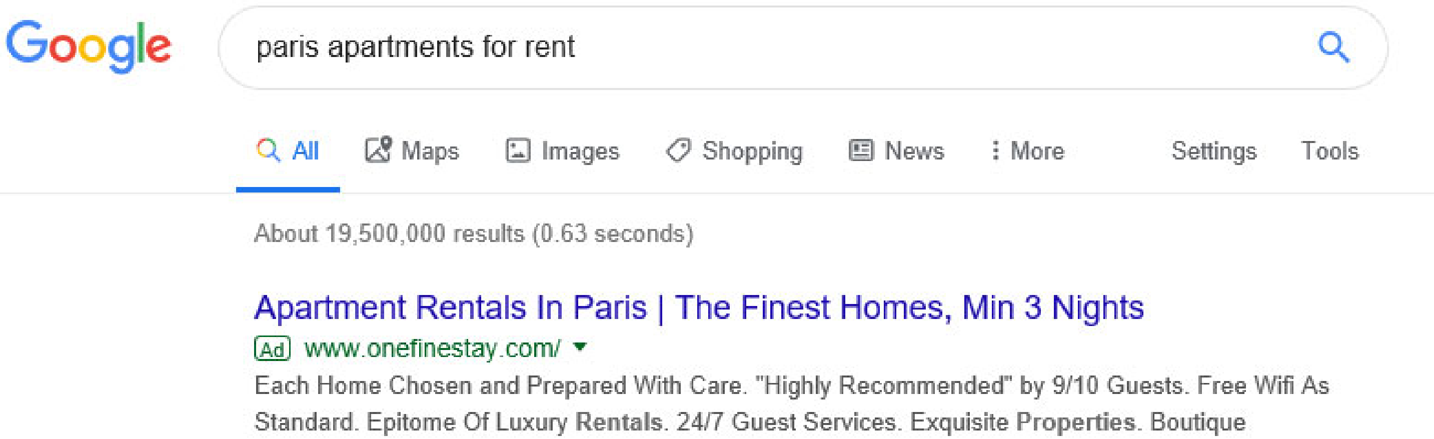
Internet Advertising

(Ex.) Programmatic advertising

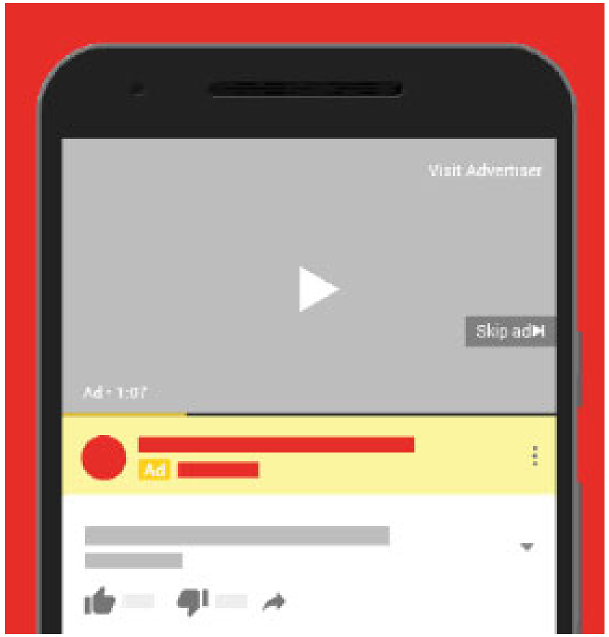


Internet Advertising

(Ex.) Listing ads



(Ex.) Video ads

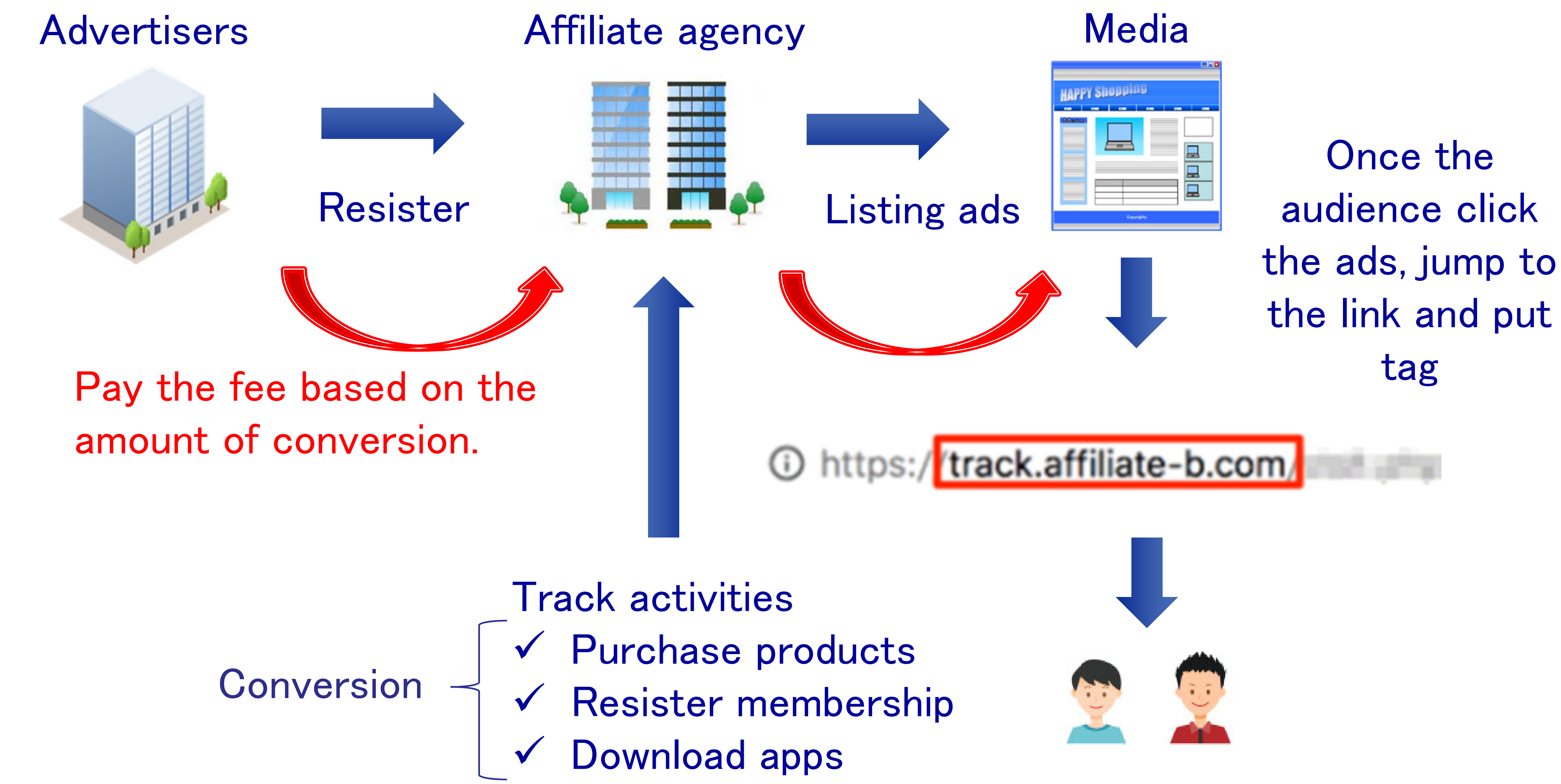


(Ex.) Display ads

If you click,
“Ads by Google” is displayed

Internet Advertising

(Ex.) Affiliate advertising



Internet Advertising

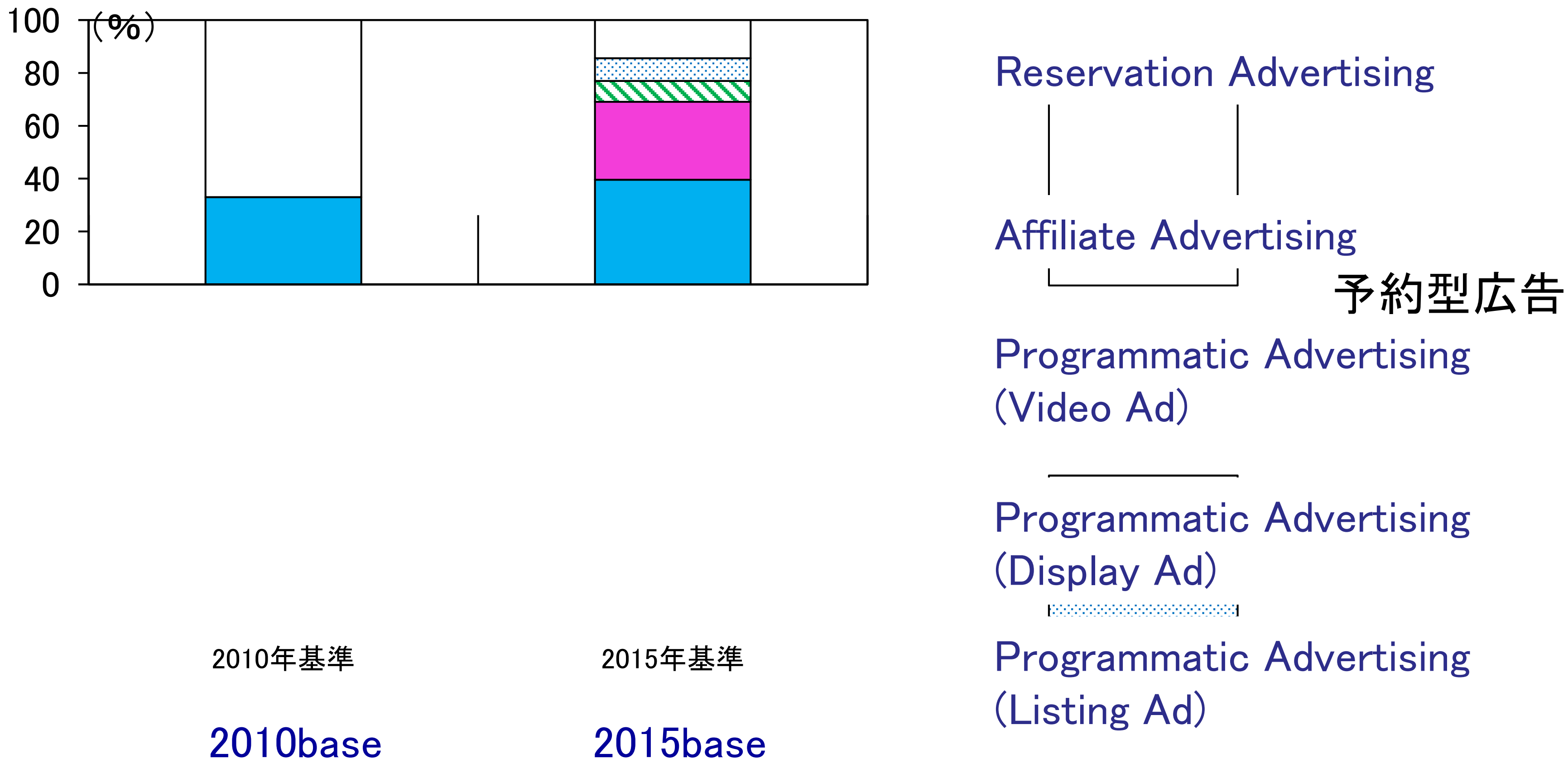
✓ Our pricing method is as below.

Advertising Categories		Pricing Method	Unit
Reservation Advertising		List Price – Specify the media and ad space	Impression
Programmatic Advertising	Listing Ad	Unit Value Method – Specify the search engine and advertiser's industry	Click
	Display Ad	Unit Value Method – Specify the ad network and advertiser's industry	Click
	Video Ad	Unit Value Method – Specify the ad network and advertiser's industry	View
Affiliate Advertising		Unit Value Method – Specify the advertiser's industry	Conversion

Internet Advertising

- ✓ We designed the composition of sample prices based on the amount of real transaction value, which is published by one of the biggest agencies in Japan.
- ✓ Programmatic and affiliate ads are expanded in 2015 base index.

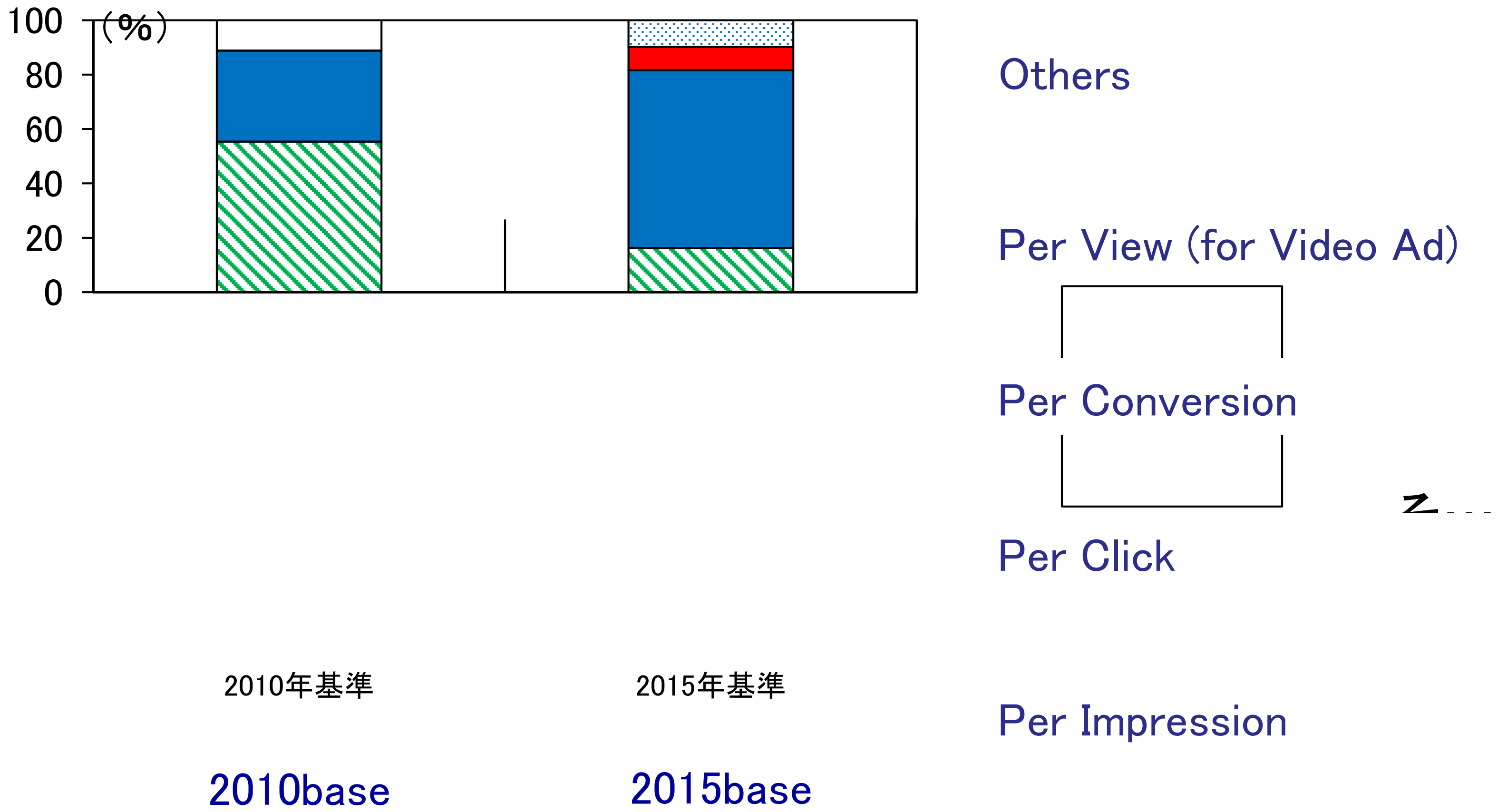
Composition of Sample Prices by Type of Advertising



Internet Advertising

- ✓ The Cost per click is expanded in2015 base index.
- ✓ The Cost per conversion and cost per view are newly incorporated.

Composition of Sample Prices by Unit of Sample Prices

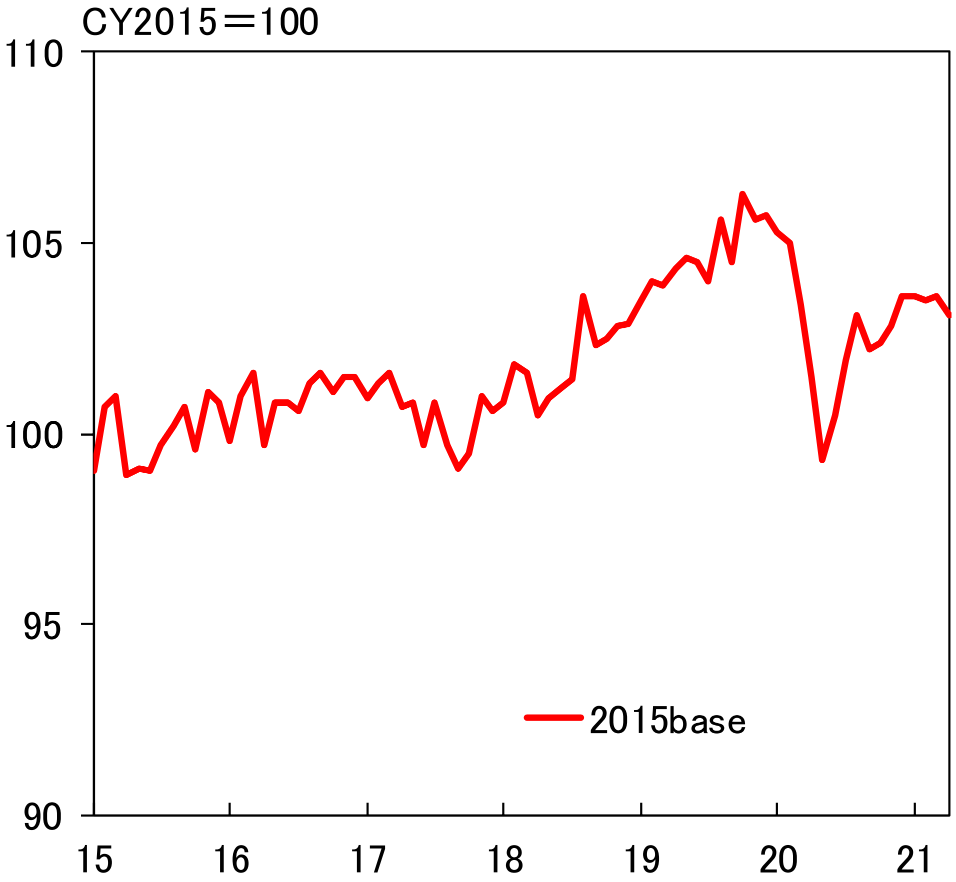


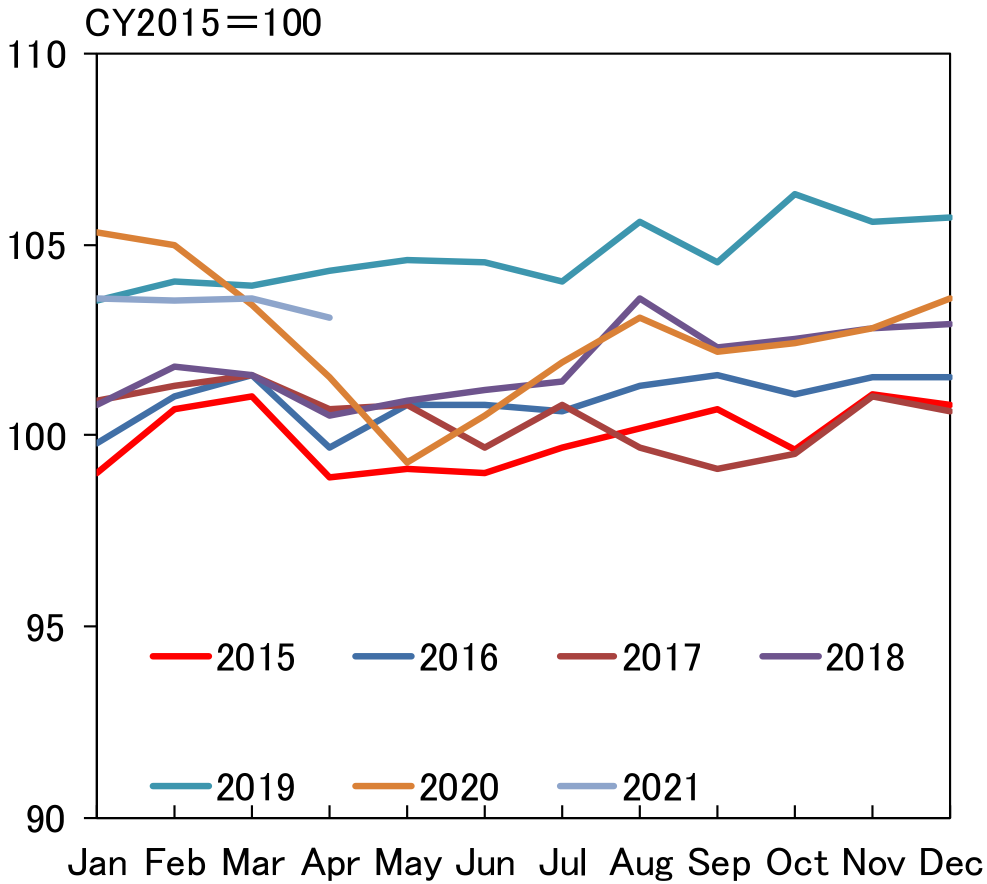
Price Trends in Digital Activities

Price trend of Web Portals

- ✓ The index of "Web portals" is rising especially these days reflecting increase in listing fees at real estate and job search web portals.
- ✓ Gradual seasonal trends can be observed.

Price Index of "Web portals"

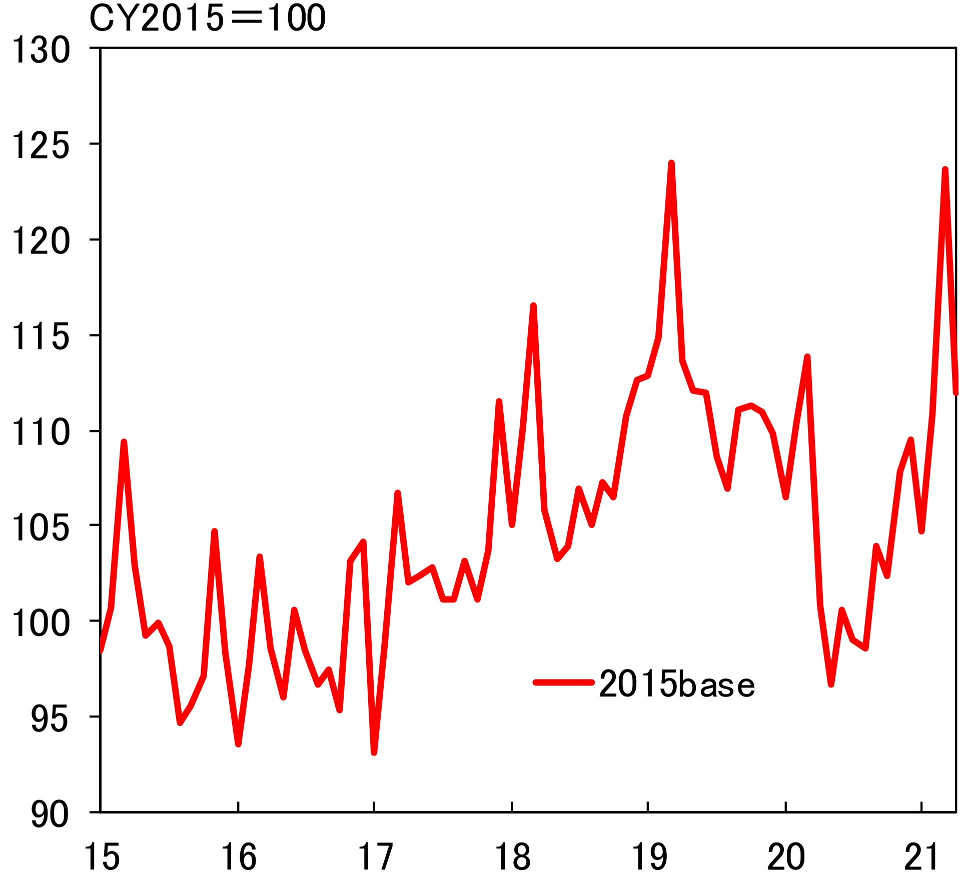


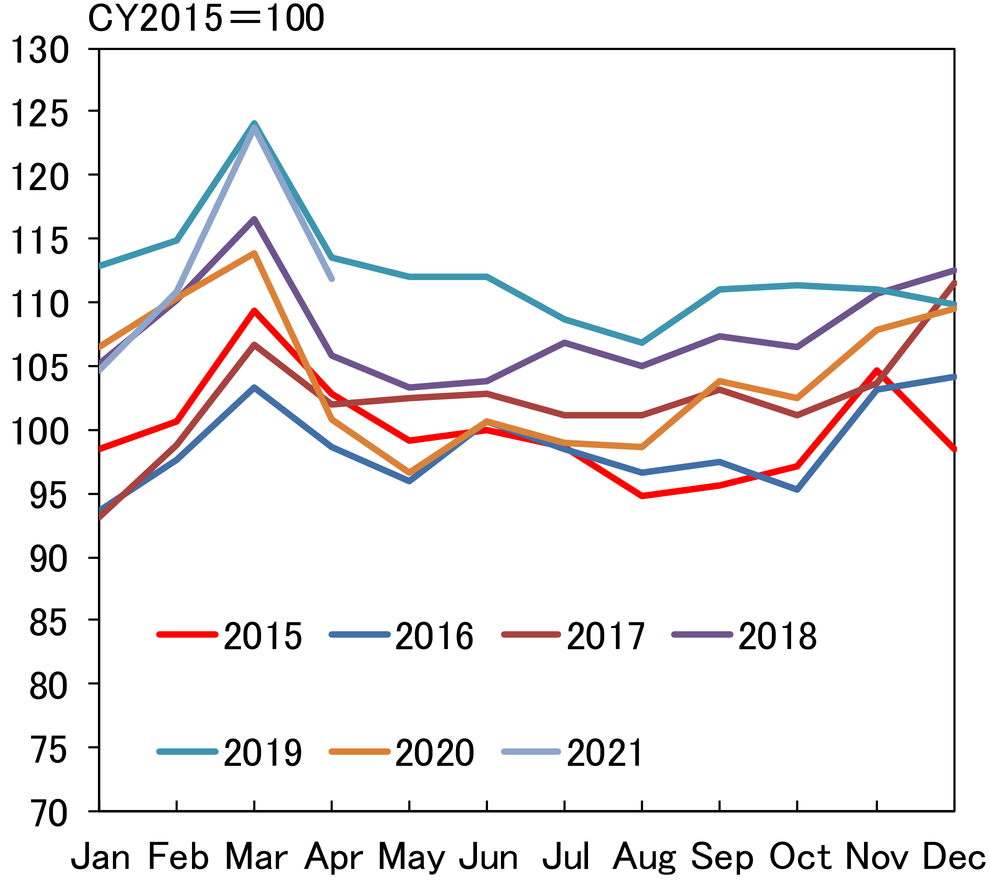


Price trend of Internet Advertising

- ✓ The index of "Internet advertising" is rising reflecting increase in demand.
- ✓ Seasonal trend is clear like TV and newspaper advertising.

Price Index of "Internet advertising"

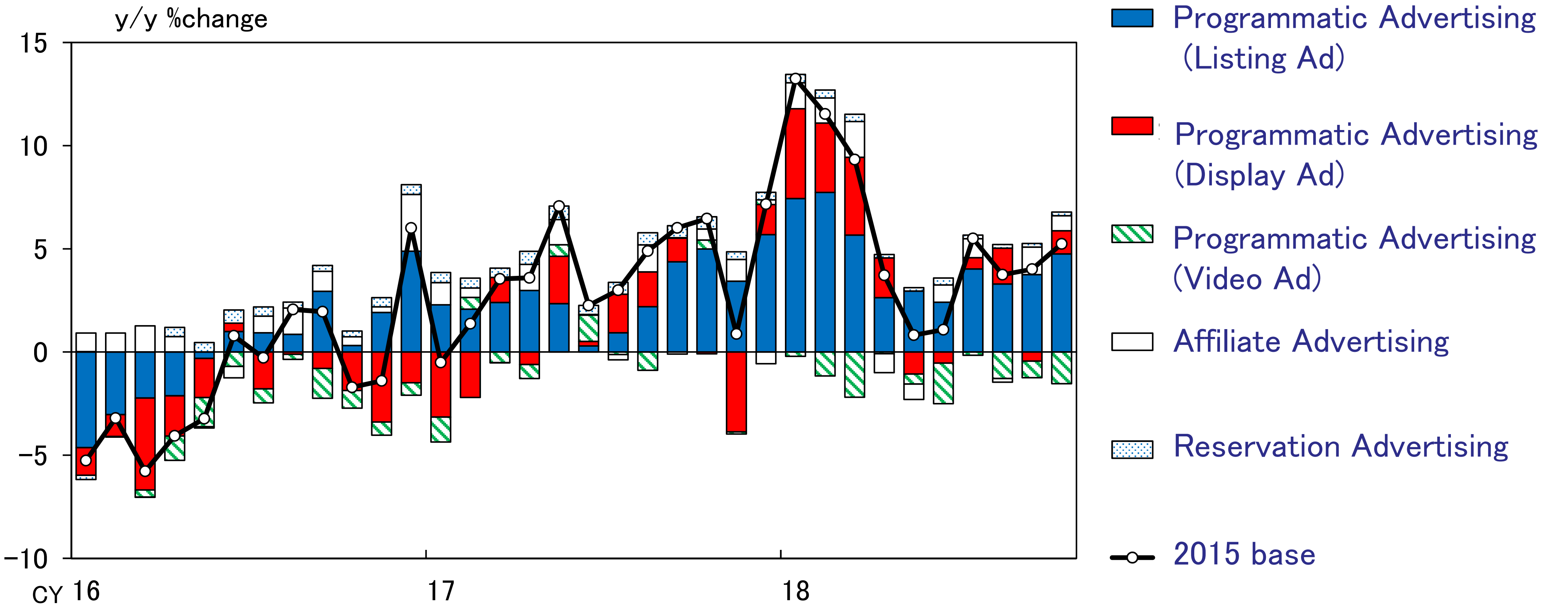




Price trend of Internet Advertising

✓ Looking at the Decomposition of Year-on-Year Change, the price of listing ads has been rising due to increase in demand under the situation that the ads space are comparably limited.

Decomposition of Year-on-Year Change : Internet Advertising in 2015 base

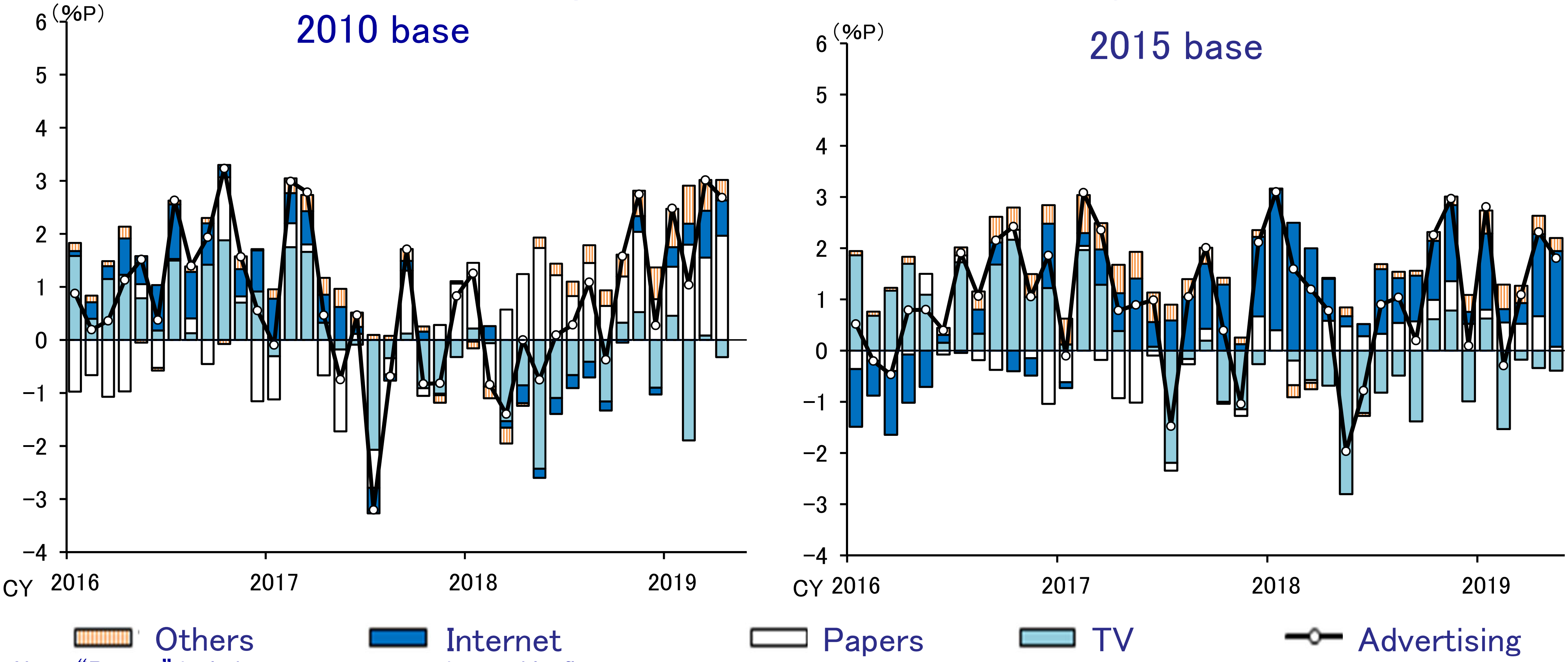


Price trend of Internet Advertising

日本銀行 BANK OF JAPAN

✓ Comparing the decomposition of Y/Y change in 2015 base and that in 2010, the impact of the Internet is greater and that of papers is smaller.

Decomposition of Year-on-Year Change

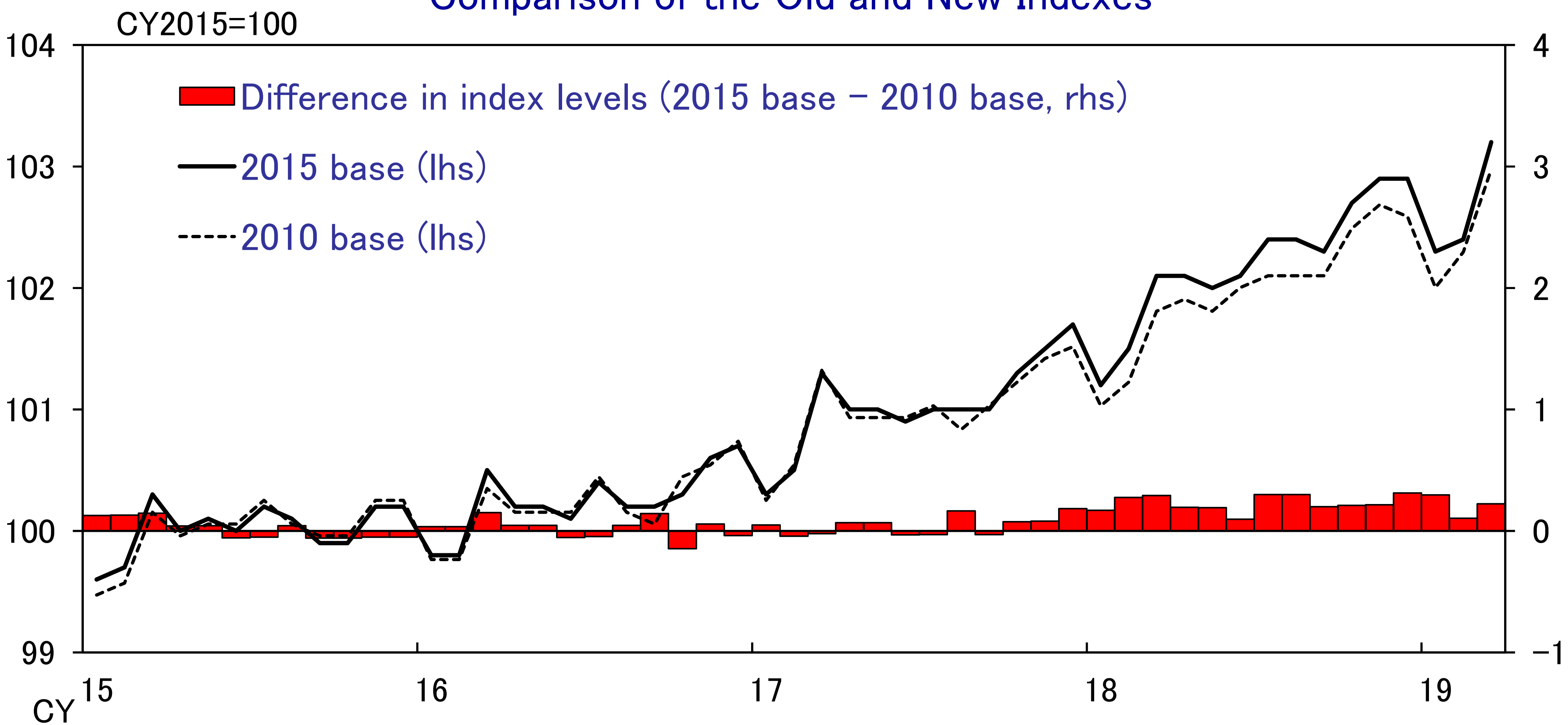


Note: "Papers" include newspaper, magazine, and leaflet.

Impact to all item index

- ✓ The all item index shifted upward after late 2017 because of the price increase in "Web portals" and "Internet advertising".

Comparison of the Old and New Indexes



Impact to all item index

New Findings

✓ This index implies that the price has been rising at least B to B transaction as opposed to the discussions that the price tends to decrease under digitalization.

✓ As these digital services only charge the fee on businesses, not on consumers, these price trends can be observed only in SPPI, not in CPI. It is important to capture the price trend of digital services in SPPI.

Thank you for your attention

Moegi Inoue
Price Statistics Division
Research and Statistics Department
BANK OF JAPAN
Email:moegi.inoue@boj.or.jp

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Introductory remarks:
Central Banks as producers of official statistics[1]

Gülbin Sahinbeyoglu,
The Economic Policy Research Institute of Turkey (TEPAV)

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

Central Banks as Producers of Official Statistics (IPS174)

ISI- 63rd World Statistics Congress, 2021 (Virtual)

Gülbin Şahinbeyoğlu (Discussant)
Director, Data Analysis and Monitoring Center at TEPAV

Plan of the discussion

- Central banks are conventional producers of official statistics
- The scope of their statistical function is beyond the financial area
  - “Remittances and their impact on poverty in Albania”
- Revisit of the statistical function with the outbreak of Covid 19
  - Reveal of the richer sets of information
  - *“The more the merrier: enhancing traditional cross-border portfolio investment statistics using security-by-security information”*
  - New data and new technologies are in place
  - *“Unbundling Package Tours: a Machine Learning Application with the LASSO”*
- How will the central banks adopt to the new statistical ecosystem?

“Remittances and their impact on poverty in Albania”

Argita Frasheri and Elona Dushku (Bank of Albania)

- More than 40% of the population live outside the country, remittances amount to almost 12% of GDP. What is the impact on households?
- The analysis based on HFCS 2019 concludes that:
  - Almost ¼ of the households receive remittances, ratios differ by regions
  - The average annual amount per beneficiary household reaches above 2 thousands euro, indicating the second important source of income
- Any insights on BoP coverage? Does HFCS 2019 survey data differ from BoP reportings?

Plan of the discussion

“The more the merrier: enhancing traditional cross-border portfolio investment statistics using security-by-security information”

Thorsten Radke, Antonio Rodríguez Caloca and Martin Schmitz (ECB)

- Proposes a “bottom-up” approach to compile euro area i.i.p. based on SHSS data
- Estimates conclude that:
  - SHSS price indicators offer useful information on additional details in i.i.p. such as currency, maturity and counterpart issuer geographic location and sectoral breakdowns
  - The data also propose the possibility to derive nominal indicators of gross and net external debt, enriching the debt sustainability analysis
- Could it be possible to give further explanation on the differing consistency levels by maturity and coverage?

“The more the merrier: enhancing traditional cross-border portfolio investment statistics using security-by-security information”

Thorsten Radke, Antonio Rodríguez Caloca and Martin Schmitz (ECB)

Plan of the discussion

Table 1. Coverage and correlation between i.i.p. and SHSS stocks at market value

Period 2014Q1 - 2020Q3	Average coverage		Correlation coefficient		Average coverage		Correlation coefficient	
	Intra euro area	Extra euro area	Intra euro area	Extra euro area	Intra euro area	Extra euro area	Intra euro area	Extra euro area
Short-term debt securities excl. Eurosystem	**94%**	**76%**	**98%**	**91%**				
	By resident sector				By counterpart issuer sector. Eurosystem holdings included in i.i.p.			
Eurosystem	-	-	-	-	-	364%	-	61%
Deposit taking corporations except Eurosystem	98%	82%	98%	93%	89%	79%	95%	84%
Money market funds	92%	82%	95%	93%	-	5987%	-	12%
General government	71%	95%	89%	99%	85%	72%	96%	98%
Financial corporations other than MFIs	97%	65%	75%	68%	85%	66%	55%	68%
NFC, HHs and NPISHs	78%	64%	58%	99%	123%	29%	80%	1%
Long-term debt securities excl. Eurosystem	**94%**	**95%**	**97%**	**98%**				
	By resident sector				By counterpart issuer sector. Eurosystem holdings included in i.i.p.			
Eurosystem	-	-	-	-	-	410%	-	52%
Deposit taking corporations except Eurosystem	98%	98%	98%	95%	86%	98%	89%	80%
Money market funds	104%	129%	84%	82%	-	366%	-	16%
General government	57%	50%	31%	48%	80%	93%	94%	98%
Financial corporations other than MFIs	94%	95%	95%	99%	84%	88%	53%	82%
NFC, HHs and NPISHs	85%	89%	30%	39%	88%	95%	94%	99%

Sources: ECB (i.i.p. statistics and SHSS) and author’s calculations.

“Unbundling Package Tours: a Machine Learning Application with the LASSO”

Andrea Carboni, Claudio Doria and Alessandro Moro (Bank of Italy)

- International transport is a separate item. Unbundling of the package tours is needed to correct the compilation of the BoP data
- Employs a ML algorithm to impute the components of package tour, convincing results for BoP compilers
- Would it be an option to complement the research with other available sources of information?
  - Credit card transactions provide timely and detailed information on foreigners spending.
  - Airline companies and travel agencies could be other data providers on the number of passengers and the destinations as well as on the details of package tours

Plan of the discussion

Central Banks as Producers of Official Statistics (IPS174)

ISI- 63rd World Statistics Congress, 2021 (Virtual)

Gülbin Şahinbeyoğlu (Discussant)

Director, Data Analysis and Monitoring Center at TEPAV

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Remittances and their impact of poverty: the case of Albania[1]

Argita Frasheri and Elona Dushku,

Bank of Albania

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

63rd World Statistics Congress

IPS Non-Live 174 - Central Banks as producers of official statistics 12 July 2021

Remittances and their impact on poverty: the case of Albania

Elona Dushku

Research Department

edushku@bankofalbania.org

Argita Frasheri

Statistics Department

afrasheri@bankofalbania.org

Outline

I. Introduction

II. Methodology &Data

III. Preliminary Results

IV. Conclusions

I. Introduction

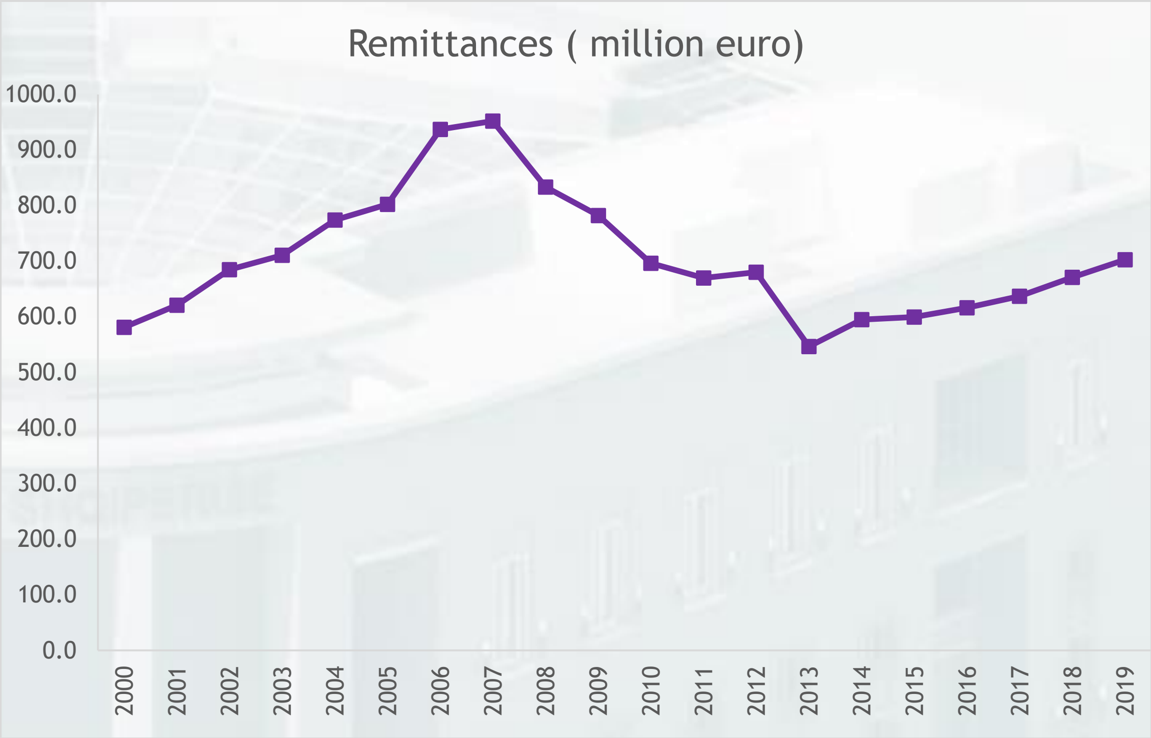
- At the beginning of this century, UN estimated that 2.8% of the world's population or about 174 million people live and work outside their country of birth (UN, 2019).

- In 2019, the number of international migrants is estimated 272 million people or 3.5 % of world population (UN, 2019).

- India continued to be the largest country of origin of international migrants
  - India had the largest number of migrants living abroad (17.5 million), followed by Mexico and China (11.8 million and 10.7 million respectively).
  - The top destination country remained the United States (50.7 million international migrants).

- International remittances increased to USD 689 billion in 2018.
  - The top 3 remittance recipients were India (USD 78.6 billion), China (USD 67.4 billion) and Mexico (USD 35.7 billion).
  - The United States remained the top remittance-sending country (USD 68.0 billion) followed by the United Arab Emirates (USD 44.4 billion) and Saudi Arabia (USD 36.1 billion).

I. Introduction



Source: Bank of Albania

- Albania is a country in South-Eastern Europe, with 2.83 million people, where migration is a very widespread and well-known phenomenon, especially after the ex-post communism.
- 1.21 million people or 42.7 % of total Albanian population live outside Albania (UN, 2019).
- Remittances in Albania constitute at one of the largest foreign exchange inflows coming from abroad and are an important source of financing the balance of payments.
- On average during the period 2008-2019, remittances are estimated at 11.7% of GDP (Bank of Albania, 2019).

I. Introduction

- After the recent financial crisis household surveys are becoming an important and predominant source of micro-level data on household wealth for:
  - Collecting detailed information on households such as: demographic, socio-economic information on income, employment, consumption, assets, liabilities etc.
  - Analyzing different aspect of hhouseholds patterns based on different group of households
- The aim of this article is to asses the importance of the remittances on Albanian households based on the micro data:
  - 2006, Migration Survey (Frashëri, 2007)
  - 2019, Albanian Household Wealth Survey (Dushku, 2019)

II. Methodology

- Albanian Household Wealth Survey (AHWS), introduced in 2019 by the Bank of Albania, was based on the methodology proposed by HFCS (Household Finance and Consumption Survey).
- The main purpose of Albanian Household Wealth Survey is to obtain detailed information on Albanian households, in terms of income, expenditures, real and financial assets of households, employment status and education level of all household members, etc.
- The relevance of micro data from AHWS :
  - Analyzing and evaluating various aspects of the transmission mechanism of monetary policy and financial stability.
  - Detailed assessment of the behavior of the household and its members.
  - Assessing and analyzing various macroeconomic policies as well as macroeconomic shocks.
  - Designing appropriate policies for monetary policy, financial stability, financial inclusion and financial education.

II. Methodology

Sample design of AHWS	Two-stage stratified sample (random selection)
Sampling frame	National population register
Stratification criteria	Region, population size
Primary sampling unit	312 (8+4 household)
Region	12
Panel component	No/in future
Excluded groups	Population in institutions, homeless
Oversampling of wealthy	No
Weighting procedure	the unit’s probability of selection; coverage issues; unit non-response

II. Methodology

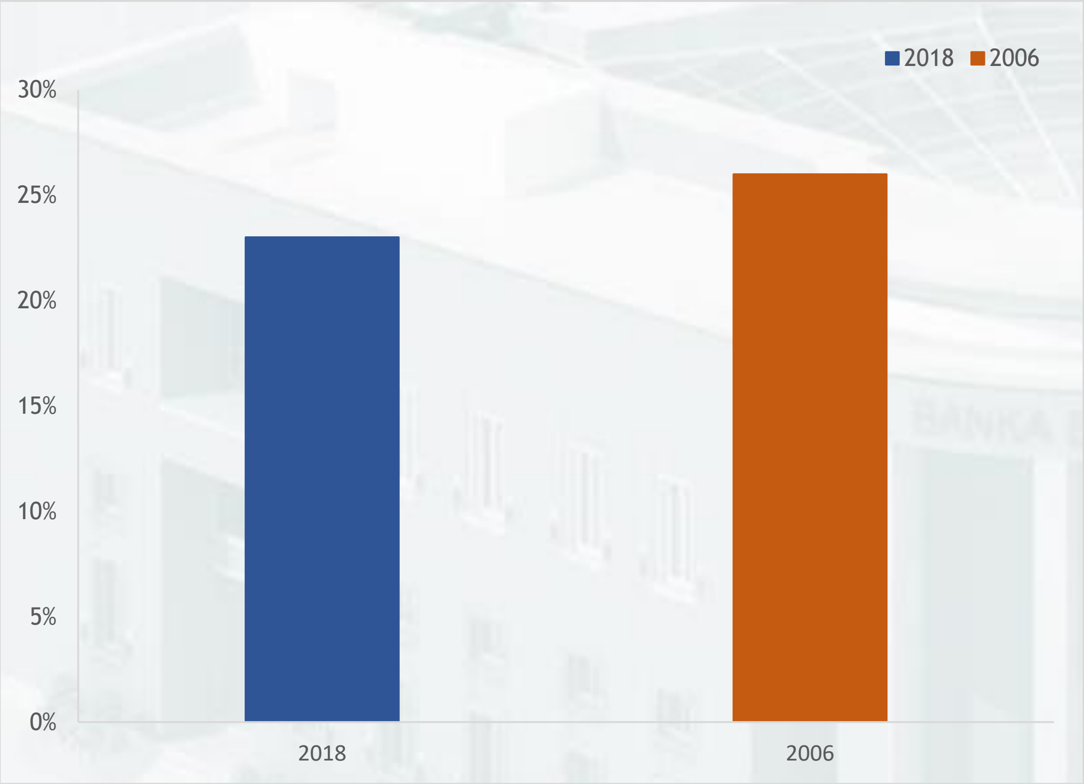
Main questions in AHWS:

- Have you or any households member received remittances during 2018?

- How much (annual) remittances did you or your family receive during 2018?

III. Data

Graph 1: Percentage of households receiving remittances



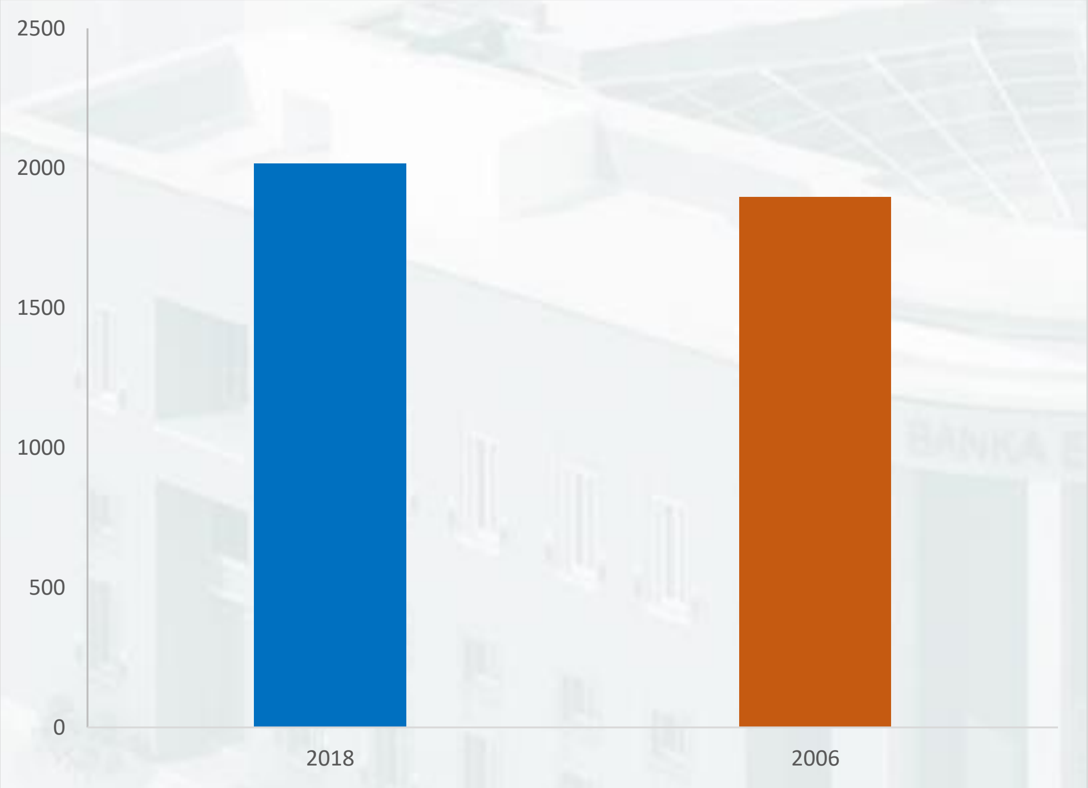
Source: Frashëri, (2007), Dushku (2019)

Graph 2: Geographical distribution of remittances-receiving households as % of total

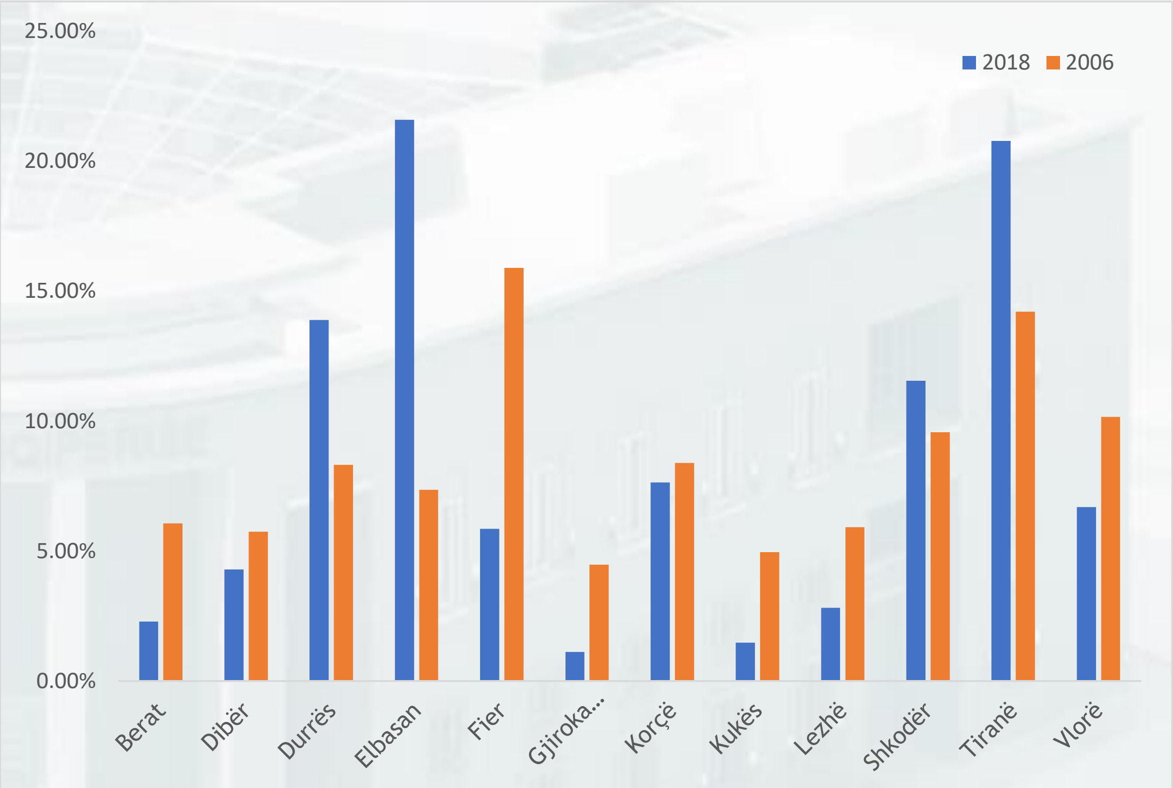
- 23%-26% of households in Albania received remittances.
- Geographical distribution of remittances-receiving households is almost the same during two periods for the majority of the regions. In 2018, the regions of Elbasan and Tirana, showed double increase of households receiving remittances, while reverse path showed the region of Fieri.

III. Data

Graph 3: Annual average flow of remittances per household in euro



Graph 4: Geographically distribution of amount remittances as % of total remittances

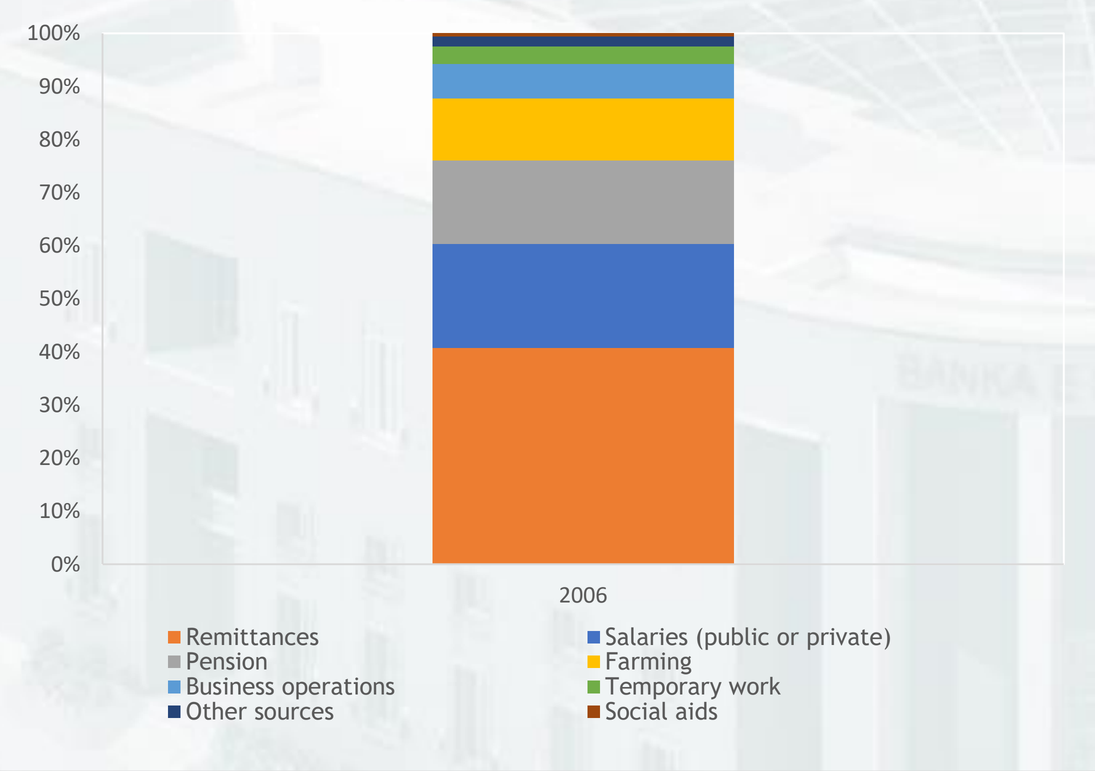


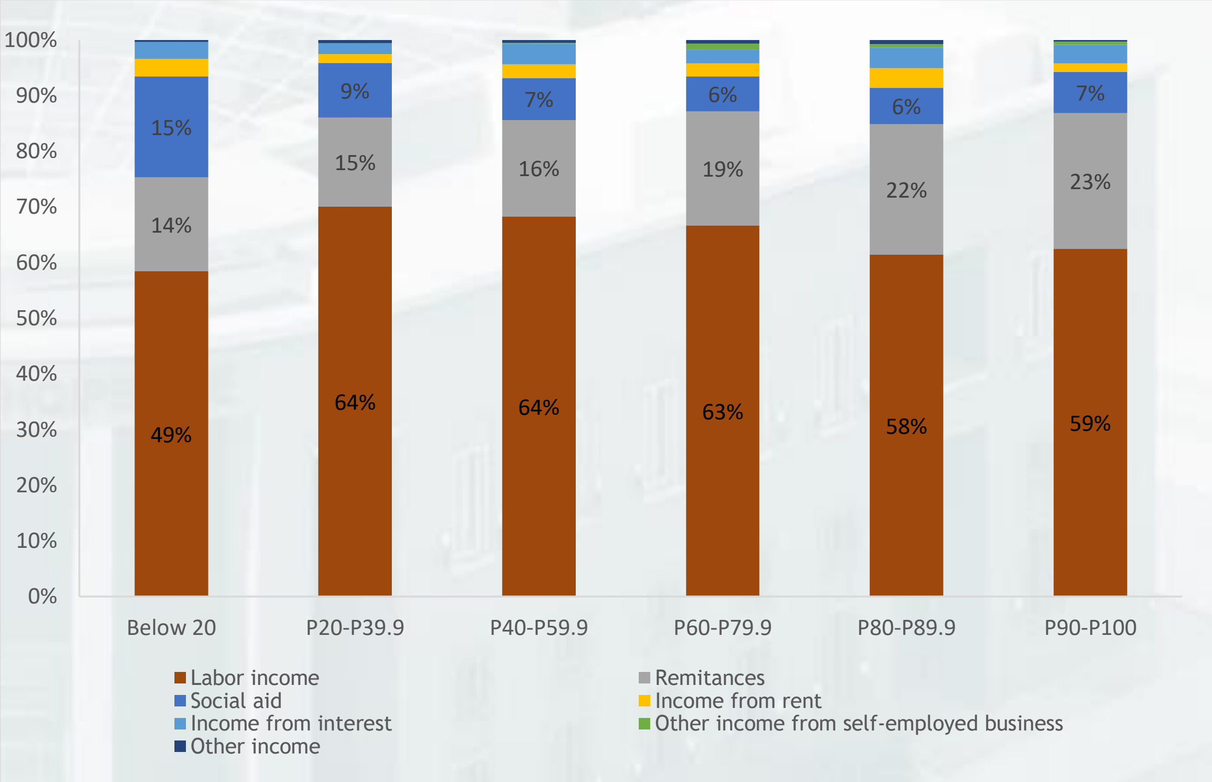
Source: Frashëri, (2007), Dushku (2019)

- On average, annual flow of remittances per household is estimated around 1,897 to 2,018 euro.
- In 2006 the most beneficiaries households are those located in the region of Fieri, Tirana, Vlora and Shkodra, while in 2018, are those located at the region of Elbasani, Tirana, Durresi and Shkodra.

III. Data

Graph 5: Source of household income in 2006 and 2018





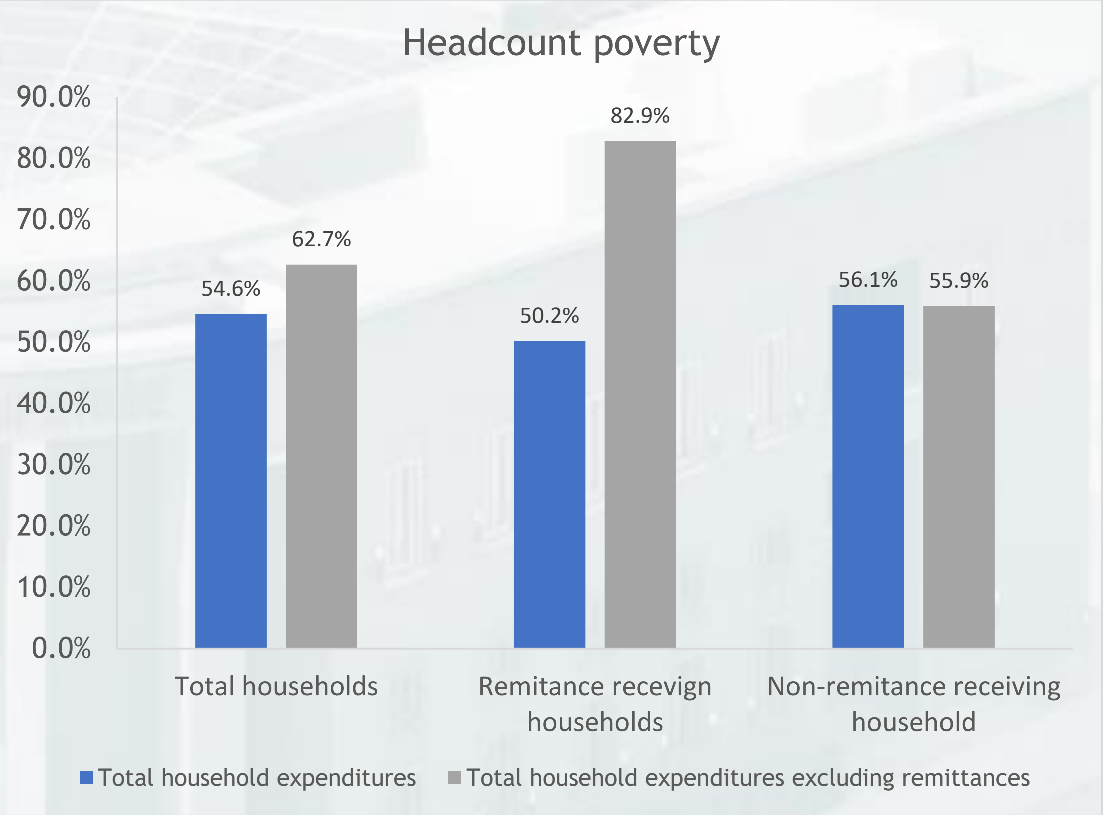
Source: Frashëri, (2007), Dushku (2019)

- Remittances are the second most important source of household income, they accounted from 14 % to 23 % of households income.
- The households survey data in 2019, showed that for 24.4% of remittances-receiving households, remittances are the only source of household income.

III. Data

Graph 6: The impact of remittances on household poverty

Source: Frashëri, (2007)



Source: Dushku (2019)

- In 2007, Frashëri showed that excluding remittances, 40 % of households would fall under poverty level.
- The estimated results for 2019, showed that excluding remittances will increase the percentage of poor households, especially for the remittances-receiving household by 30 pp (Dushku, 2019).

IV. Estimation strategy

We aim to model the impact of receiving remittances on household poverty based on probit models.

$$\boldsymbol{P\_H^*}_{\boldsymbol{i}} = \boldsymbol{x}_{\boldsymbol{i}}^{`}\boldsymbol{\beta} + \boldsymbol{\mu}_{\boldsymbol{i}}$$

$$\boldsymbol{P\_H_i} = \begin{cases} \mathbf{1}\ \boldsymbol{if}\ Poverty\_line^* - H\_income_i > \mathbf{0} \\ \mathbf{0}\ \boldsymbol{if}\ Poverty\_line^* - H\_income_i \leq \mathbf{0} \end{cases}$$

$\boldsymbol{P\_H_i}$ is a dummy variable, which is used to define whenever the households is consider poor or not. A households is consider poor if the gap between poverty line and household income is positive, otherwise non-poor.

The probability of a household being poor is:

$$\Pr(y_i = 1 \middle| x_i\beta) = \Pr\left(\boldsymbol{Poverty^*}_{\boldsymbol{i}} > \mathbf{0}\right) = \Pr\left(\boldsymbol{x}_{\boldsymbol{i}}^{`}\boldsymbol{\beta} + \boldsymbol{\mu}_{\boldsymbol{i}} > \mathbf{0}\right) = \mathbf{1} - \boldsymbol{F}_{\boldsymbol{u}_{\boldsymbol{i}}}\left(-\boldsymbol{x}_{\boldsymbol{i}}^{`}\boldsymbol{\beta}\right)$$

$\boldsymbol{F_{ui}}$ is the cumulative distribution function of ui,

IV.Regression results

	I-WB poverty line	II-60 % of the median of expenditure per capita	III-60 % of the median of equalized expenditure
Head: Male	0.248	0.352	0.226
p-value	(0.009)	(0.002)	(0.040)
Head: Age	0.016	-0.031	0.007
p-value	(0.053)	(0.001)	(0.458)
Head:Age2(/100)	-0.020	0.013	-0.012
p-value	(0.024)	(0.205)	(0.228)
Head: Married	0.072	-0.075	-0.239
p-value	(0.496)	(0.554)	(0.047)
Head: Year of education	0.059	0.030	0.042
p-value	(0.085)	(0.461)	(0.302)
Head: Year of education2/(100)	-0.774	-0.685	-0.709
p-value	(0.000)	(0.003)	(0.0032)
Head: unemployment	0.300	0.316	0.271
p-value	(0.003)	(0.001)	(0.0066)
Number of persons in the households	0.251	0.215	-0.031
p-value	(0.000)	(0.000)	(0.227)
Number of children under 5 years old	0.115	0.188	0.136
p-value	(0.125)	(0.010)	(0.075)
Household expenditure per capita (excluding remittances)	-0.088	-0.013	-0.061
p-value	(0.000)	(0.000)	(0.000)
Receipt of remittances	**-0.701**	**-0.405**	**-0.712**
p-value	(0.000)	(0.000)	(0.000)
Observations	2106	2106	2106

V. Conclusions

- Household level data confirm that remittances continued to be an important source of household income in Albania during the last decade.

- 23-26 % of Albanian households received remittances, with an annual average flow of remittances per household that range from 1827-2018 euro.

- Tirana, Elbasan and Fier are the most beneficiaries region in terms of amount and receiving-remittance households .

- Estimated results show that remittances reduces the probability of household being poor.

Thank you for your attention !

Elona Dushku
Research Department
edushku@bankofalbania.org

Argita Frasheri
Statistics Department
afrasheri@bankofalbania.org

Remittances and their impact of poverty: the case of Albania

Elona Dushku[1][1]; Argita Frasheri[2]

1 Head of Microeconomic Research Unit, Research Department, Bank of Albania, Albania.
edushku@bankofalbania.org

2 Director of Statistic Department, Bank of Albania, Albania.
afrasheri@bankofalbania.org

Abstract:

The purpose of this article is to assess the impact of remittances on poverty in Albania, based on household level data obtained from the first wave of Household Wealth Survey in Albania, conducted by the Bank of Albania in collaboration with Instat during 2019. Survey data show that 23% of Albanian households receive remittances, which an average annual inflow of remittance per household around 2,000 euros, which varies according to different groups of households and region. The data show that remittances are the second most important source of household income, after income from work. Estimations based on probit regressions show that remittances have a positive and significant impact on the reduction of household poverty in Albania.

Keywords: Remittances; Household Behavior, Poverty
JEL Classification F24, D10, I32

1. Introduction:

Migration has been identified as one of the most important factors of the 21st century affecting economic relations between developed and developing countries (Adams and Page, 2003). The United Nations, at the beginning of this century have estimated that 2.8% of the world's population or about 174 million people live and work outside their country of birth. In addition the latest figures show that migration is a growing phenomenon and that the world in this period is facing the deepest migration crisis it has seen in its entire history (WB, 2019). Estimates for 2017 done by United Nations, show that total number of migrants is 274 million people, increased by 98 million (or 56%) compared to the data of year 2000. Migrants in 2019 make up 3.5% of total world population, where Europe and North America represent the countries with the largest stock of migrants in the world, at 82.3 million and 58.6 million, respectively.

Migration is a multidimensional phenomenon that affects both the economies of sending and receiving countries in many ways. In addition to the economic, social and cultural impact that migration has mainly on countries that export migrants, the income they send to their country of birth is probably the most direct link between migration and the economic development of

[1] The views expressed are those of the authors and do not necessarily reflect the views of Bank of Albania.

their country (Ratha 2007). Globally, in 2019 remittance reached the level of $689 billion (WB, 2019) and represent the largest source of income for many developing countries. Remittance flows tend to be more stable and more countercyclical than capital flow and during the latest financial crisis remittances proved to be more resilient (Ratha, 2011). The main data source of recorded international migrant remittances are based on balance of payment data. However the estimation of the exact size of remittances is challenging because mostly of remittances have sent through unofficial channels. However empirical literature based on cross-country and country-level analysis have showed that remittances have reduced the share of poor people in the population (Adams and Page 2003, 2005; Gupta, Pattillo, and Wagh 2009) and are an important source of household income. Remittances are used to increase the level of consumption, saving, investments, financial intermediation of household, by contributing in reducing poverty and improving the overall economic growth perspective (Ratha et al, (2011)).

Albania, represent an interesting case where migration is a very widespread and well-known phenomenon. Many Albanians have relatives or friends, who work or live abroad. In 2017, it was estimated that 1.21 million Albanians or 42.7% of the Albanian population live outside the borders of Albania (UN DESA 2017, 2019, World Bank 2017) and 98 % of Albanian migrants have moved to the top five destination countries (World Bank, 2019). At the macroeconomic level, remittances in Albania constitute at one of the largest foreign exchange inflows coming from abroad and are an important source of financing the balance of payments. On average during the period 2008-2018, remittances estimated at 11.7% of GDP (Bank of Albania, 2019). Aggregate remittance data, although indicate their importance at macro level, show less about their importance at the household level. Most of the paper that discussed the phenomenon of remittances in Albania are focused mainly on the characteristics of migrants and their motives for remit (Gëdeshi (2000), Frashëri, (2007), Zanger-Siegel, (2007), (Abazaj (2011), Gëdeshi-Jorgoni (2012)), without analyzing the impact of remittances on poverty.

This article based on household level data from the first wave of the Albanian Household Wealth Survey, developed by the Bank of Albania in early 2019 analyzes the impact that remittances have on poverty in Albania. The data obtained from this survey show that 23% of Albanian households received income from migrants during 2018, and it is estimated that remittances are the second most important source of income. In addition empirical results based on probit model show that remittances negatively affect the probability of Albanian households being poor.

The article is organized into three parts. The first part makes a summary on the data collected from the Albanian Household Wealth Survey. The second part continues with the presentation of the empirical model, while in the third and fourth part are discussed the results and the main findings of this article.

2. Methodology:

In this article, the main source of data are households level data obtained from the first wave of the Albanian Household Wealth Survey (Dushku, 2019), conducted by Bank of Albania in 2019. This survey was based on the HFCS (Household Finance and Consumption Survey) methodology, applied by all national central banks in European Union and was adapted based on the features of Albanian households. The main purpose of this survey is to obtain detailed information on Albanian households, in terms of income, expenditures, real and financial assets of households, employment status and education level of all household members, etc. Albanian Household Wealth Survey was conducted in cooperation with Instat (Institute of Statistics), which collected the data through face-to face interviews methods, during the period March-April 2019 and provided the household sample. The sample design was based on the use of probability sampling, in order to have a full representation of all households and the population size on twelve region in Albania were used as stratification criteria. Despite different data on balance sheet of Albanian households we have collected data whether households have received remittances and to what amount. So, the two main questions from the survey that we have taken in consideration related to migration and remittances are as following:

- Have you or any households member received remittances during 2018?
- How much (annual) remittances did you or your family receive during 2018?

We have to highlight that AHWS is not a migration or remittance survey, so we have shortage of information about the reasons condition Albanian to migrate, why they remit or the utilization of remittances. However, taking into account the advantages of disaggregate data on household level, our aim is to assess the impact of remittance on household poverty.

Dushku, (2019) by using the data of AHWS found that 23% of the total households received remittances in 2018. On average, households received around 2,000 euro annual inflow remittances, which varies on different household groups and regions. The data showed that remittance-receiving households were mostly located in the region of Tirana, Elbasani and Vlora. While based on the inflow of remittances, the most beneficiaries households were those located in the region of Elbasani, Durrësi and Tirana.

In addition we have estimated the importance of remittances for household income. Based on the detailed information that we have for all sources of household income we have found that remittance are the second most important source of income, accounting for 14 % -23 % of total income, after labor income which accounts for 49% to 64% of the total income. While other sources of income such as social contribution, rent or interest income comprise 20 % or less of total labor income.

Since we attempt to explain the impact that remittances have on household poverty first we will describe some characteristics of households taking into consideration the differences among the remittance-receiving households and no-remittance-receiving households. The data show that remittance-receiving households have on average fewer household members, fewer children under the age of 5 and low number of male over the age of 15 comparing to the no-remittance-receiving households. In addition the no-remittance-receiving households have on average more female over the age of 15 and older household head. The data reveal minor differences on the number of household members over age 15 with primary and secondary education but show that remittance-receiving households have less household members with tertiary education. Both groups differentiate in terms of average monthly household per capita expenditure (excluding remittances), which show that remittances are very crucial for the remittance-receiving households group.

Table 1: Features of No-Remittance-Receiving Household and Remittance-Receiving Household

	No-Remittance-Receiving Household	Remittance-Receiving Household
Human capital		
Mean number of member over age 15 with primary education	1.77	1.76
Mean number of member over age 15 with secondary education	1.14	1.12
Mean number of member over age 15 with university	0.42	0.38
Households characteristics		
Mean age of household head (years)	55	60
Mean education of household head (years of education)	10.3	9.7
Mean household size	3.8	3.2
Mean number of males in households over age 15	1.68	1.58
Mean number of females in household over age 15	1.64	1.69
Mean number of children in household under age 5	0.16	0.13

Wealth		
Mean value of house (in million ALL)	5.98	5.73
Median monthly household per capita expenditure (excluding remittances) in ALL	10,851.25	3,388.34
Median monthly household per capita expenditure (including remittances) in ALL	10,905.08	11,525.51
area (1=Nord, 2=Centre, 3=South-East, 4=South)	2.22	2.26
Number of households	1,569	537

In our econometric analysis, we aim to model the impact of receiving remittances on household poverty. Based on the work of Raihan et al. (2009), Wurku and Marangu (2015) and Abbas et al. (2014), we have estimated a probit regression model as follows:

$$\boldsymbol{P\_H^*}_{\boldsymbol{i}} = \boldsymbol{x}_{\boldsymbol{i}}^{\grave{}}\boldsymbol{\beta} + \boldsymbol{\mu_i}$$

Where $\boldsymbol{P\_H_i}$ is a dummy variable, which is used to define whenever the households is consider poor or not, $\boldsymbol{x}_{\boldsymbol{i}}^{\grave{}}$ are exogenous variables and $\boldsymbol{\mu_i}$ is a random disturbance. A households is consider poor if the gap between poverty threshold line[2] and household income ($\boldsymbol{H\_income^*}_{\boldsymbol{i}}$) is positive, otherwise non-poor. Poverty threshold line is determine as the minimum of income needed to cover basic needs (WB, 2019) based on Foster-Greer-Thorbecke index[3]

$$\boldsymbol{P\_H_i} = \begin{cases} \boldsymbol{1}\ \boldsymbol{if}\ Poverty\_line^* - H\_income_i > \boldsymbol{0} \\ \boldsymbol{0}\ \boldsymbol{if}\ Poverty\_line^* - H\_income_i \leq \boldsymbol{0} \end{cases}$$

While the probability of a household being poor is determined as follows:

$$\Pr(y_i = 1|x_i\beta) = \Pr(\boldsymbol{Poverty^*}_{\boldsymbol{i}} > \boldsymbol{0}) = \Pr(\boldsymbol{x}_{\boldsymbol{i}}^{\grave{}}\boldsymbol{\beta} + \boldsymbol{\mu_i} > \boldsymbol{0}) = \boldsymbol{1} - \boldsymbol{F_u}(-\boldsymbol{x}_{\boldsymbol{i}}^{\grave{}}\boldsymbol{\beta})$$

Where $\boldsymbol{F_u}$ is the cumulative distribution function of u,

Both income and consumption observations are available from the AWHS data, however our measure of poverty indicator is based on consumption data. One reason for this preference is that consumption is less subject to short term economics shock and usually income are underestimated. As exogenous variables we have include those variables, which tend to capture the characteristic of households head and those of the households. We have added dummies variables for the gender, marital and occupation status of the household head and also the years of education for him. We have entered the numbers of people in the households and the number of children under 5 years old to take to account the difference between households. In addition we have included a dummy variable equal to one when household had received remittances during the past year to investigate the impact that remittances had on poverty. We have added household expenditure per capita (excluding remittance) for estimating the effect of income on the probability of households on being poor.

3. Result:

[2] Determine as the minimum of income needed to cover basic needs (World Bank, 2019)

[3] The index is calculated as follows: $Poverty_\alpha = \frac{1}{N}\sum_{i=1}^{H}\left(\frac{z-y_i}{z}\right)^\alpha$

Where, H is the total number of poor households, whose income lie below the poverty line, y_i is the expenditure (or income) of the i^{th} individual households, N is the total number of households and z is the poverty line. We have used as a measure of the poverty line the daily per capita income proposed by World Bank in 2019 which is 3 $ per day for developing countries. α is a parameters index, which takes the value of 0, 1 and 2 and is used to calculate different measures of poverty..

Since our aim is to investigate the impact of remittances on poverty, the estimated results are revealed in the table 2. In the column 1 we have presented the impact that remittances have on household poverty, whereas as poverty line we have used the World Bank definition. As robustness check in the column 2 and 3 we have presented the results, where household poverty is based on the OECD definition[4].

Table 2: Estimated results based on probit model regressions

	I-wb poverty line	II-60 % of the median of expenditure per capita	III-60 % of the median of equalized expenditure
Head: Male	**0.248*** **	**0.352*** **	**0.226*** **
p-value	*(0.009)*	*(0.002)*	*(0.040)*
Head: Age	**0.016** **	**-0.031*** **	0.007
p-value	*(0.053)*	*(0.001)*	*(0.458)*
Head:Age^2/100	**-0.020** **	0.013	-0.012
p-value	*(0.024)*	*(0.205)*	*(0.228)*
Head: Married	0.072	-0.075	**-0.239** **
p-value	*(0.496)*	*(0.554)*	*(0.047)*
Head: Year of education	**0.059* **	0.030	0.042
p-value	*(0.085)*	*(0.461)*	*(0.302)*
Head: Year of education^2/100	**-0.774*** **	**-0.685*** **	**-0.709*** **
p-value	*(0.000)*	*(0.003)*	*(0.003)*
Head: unemployment	**0.300*** **	**0.316*** **	**0.271*** **
p-value	*(0.003)*	*(0.001)*	*(0.006)*
Number of persons in the households	**0.251*** **	**0.215*** **	-0.031
p-value	*(0.000)*	*(0.000)*	*(0.227)*
Number of children under 5 years old	0.115	0.188*	0.136*
p-value	*(0.125)*	*(0.010)*	*(0.075)*
Household expenditure per capita (excluding remittances)	**-0.088*** **	**-0.013*** **	**-0.061*** **
p-value	(0.000)	(0.000)	(0.000)
Receipt of remittances	**-0.701**	**-0.405**	**-0.712**
p-value	*(0.000)****	*(0.000)****	*(0.000)****
N	2102	2102	2102

*Note: ***, **, * denote significance at the 1%, 5% and 10% level, respectively*

The estimated results show a negative and significant results of remittance on poverty, which is in line with literature that remittances increase the level of income of households receiving remittances, as result increase the level of consumption and savings. Then this rise of income diminish household vulnerability as result reduce household poverty. We have found that larger households are more likely to be poor. Also our results show that occupation status of household head affect positively the probability of household being poor. Education level of the household head has a u-shaped effect on the probability of being poor, which confirm that higher level of education is associated with lower probability of household being poor. We have found that household expenditure per capita effect negatively the probability of

[4] The at-risk-of-poverty rate is the share of people with an equalized disposable income (after social transfer) below the at-risk-of-poverty threshold, which is set at 60 % of the national median equalized disposable income after social transfers. The equalized disposable income is the total income of a household, after tax and other deductions, that is available for spending or saving, divided by the number of household members converted into equalized adults; household members are equalized based on two scale, the number of households and their square.

household being poor, while about the impact of household head age we have found mixed results.

4. Discussion and Conclusion:

Generally households are characterized by a considerable level of heterogeneity, not only in terms of their finances, but also in terms of the behavior towards them. This has led to greater attention to micro-level data analysis in order to better illustrate the heterogeneity that exists in households data. Following the latest financial crisis, household's data are used to assess the financial vulnerability of the household based on different socio-economic factors. Furthermore, these data are used to identify those groups that are most vulnerable to various risk factors and how they may impair financial stability.

The results of the first wave of Albanian Household Survey data confirm that remittances continued to be an important source of Albanian household income during the last decade. In Albania 23% of households have received remittances, with an annual average flow of remittances per household at 2,000 euro. Tirana, Elbasan and Vlora were the most beneficiaries regions in terms of amount and percentage of households, which received remittances. The empirical results confirm that remittances have reduced the probability of household on being poor, which is in line with literature that remittances increase the level of income of households receiving remittances, as result increase the level of consumption and savings and reduce poverty. In addition, we have found a u-shaped relationship between education and poverty and that household size and occupation status of household head being unemployed affect positively the probability of households being poor.

References:

1. Abazaj, E, (2011), "Ecuria e remitancave në Shqipëri për periudhën 1996-2010 dhe faktorët përcaktues të tyre", Banka e Shqipërisë, Buletini Ekonomik, 6M-2011.
2. Adams, R.H., & J. Page. (2003), "International Migration, Remittances and Poverty in Developing Countries." World Bank Policy Research Working Paper, No. 3179, World Bank.
3. Adams, R.H., & J. Page. (2005), "Do International Migration and Remittances Reduce Poverty in Developing Countries?"‖ World Development, Vol. 33, No. 10, pp. 1645-1669.
4. Adams, R.H., & J. Page. (2005), "Do International Migration and Remittances Reduce Poverty in Developing Countries?"‖ World Development, Vol. 33, No. 10, pp. 1645-1669.
5. Dushku, E "Households and remittances: Evidence based on Household finance and consumption survey", Remittances and Payments, Bank of Albania, 2019,p 34-43
6. Frashëri, A (2007), "Informacion mbi rezultatet e vrojtimit pranë familjeve", Banka e Shqipërisë, Buletini Ekonomik, Vëllimi 10, nr. 3.
7. Gëdeshi, I (2000), "Role of Remittances from Albanian Emigrants and Their Influence in the Country's Economy" Eastern European Economics, vol. 40, no. 5.
8. Gësheshi, I & Jorgoni, E., (2012), "Social impact of emigration and rural-urban migration in Central and Eastern Europe"; Final country report, European Commision.
9. Ratha, D., Mohapatra, S., Scheja, E., (2011), "Impact of Migration on Economic and Social Development", World Bank Policy Research Working Paper, WP5558.United Nation (2019)
10. World Bank, (2019), "Migration and Brain Drain"; Europe and Central Asia Economic Update, Fall, 2019.
11. Zanker, J. H. and Siegel, M. (2007). "The determinants of remittances: A review of the literature". USA: Maastricht University, Working Paper.

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

The more the merrier: enhancing traditional cross-border portfolio investment statistics using security-by-security information[1]

Thorsten Radke, Antonio Rodríguez Caloca and Martin Schmitz,
European Central Bank

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

EUROPEAN CENTRAL BANK

EUROSYSTEM

The more the merrier: enhancing traditional cross-border portfolio investment statistics using security-by-security information

63rd World Statistics Conference

11 July 2021

Thorsten Radke, Antonio Rodríguez Caloca and Martin Schmitz
European Central Bank

Introduction

- Enhancing **b.o.p./i.i.p statistics: estimating debt securities at nominal value (stocks)**
- Developed using the available **ESCB security-by-security databases: SHSDB and CSDB** (and ratings)
- Initial focus on **debt securities**
- **Additional enhancements:** by currency, risk type, …

The i.i.p. – SHSS consistency: pre-condition

- **I.i.p. – SHSS comparison for debt securities:** 2014Q1-2020Q3 coverage and correlation coefficient between i.i.p. and SHSS stocks (1st difference) at *market values*

- **Pre-conditions to compile i.i.p. stocks at *nominal values*:** high coverage ratios and correlation coefficients → SHSS prices **fit to “deflate”** i.i.p. stocks at market values → SHSS stocks at nominal values are a **good benchmark** to compile i.i.p. stocks at NV

- **Positive outcome!**

Conceptual and compilation frameworks

- **Conceptual framework:** BPM6 §7.27 and HSS Annex 1
- **Compilation framework:** SHSS price indexes following a "*bottom-up*" approach

$$Price\ index_t^{SHSS} = Debt\ securities_t^{MV,SHSS} / Debt\ securities_t^{NV,SHSS\ enhanced}$$

$$Debt\ securities_t^{NV,i.i.p.} = Debt\ securities_t^{MV,i.i.p.} / Price\ index_t^{SHSS}$$

i.i.p. stocks assets in nominal terms

$$GED\ debt\ securities_t^{NV} = Debt\ securities_t^{MV,i.i.p.extra\ liabilities} / Price\ index_t^{SHSS,intra\ assets}$$

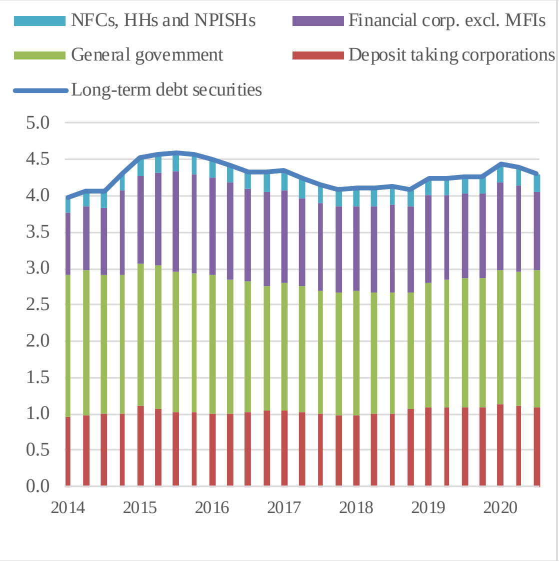
$$NED\ debt\ securities_t^{NV} = GED\ debt\ securities_t^{NV} - Debt\ securities_t^{NV,i.i.p.extra\ assets}$$

GED/NED in nominal terms

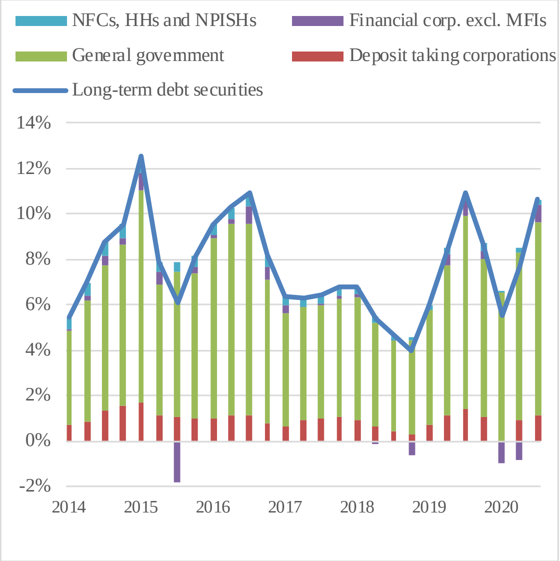
Main results: GED at nominal values

Results for GED and NED estimates as well as those for portfolio investment assets provide high value added for users

Gross External Debt. EUR trillions



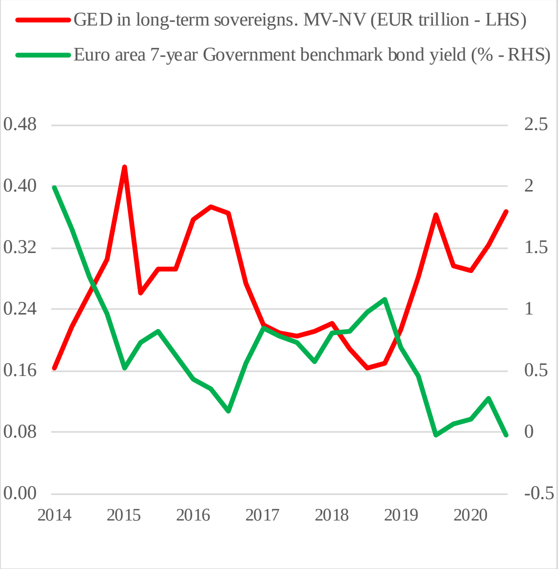
Gross External Debt. % MV stocks



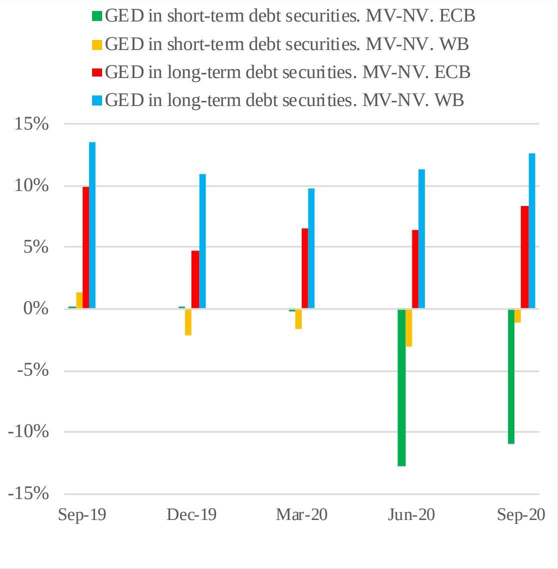
Robustness checks

Robustness checks carried out confirm estimates are of high quality!

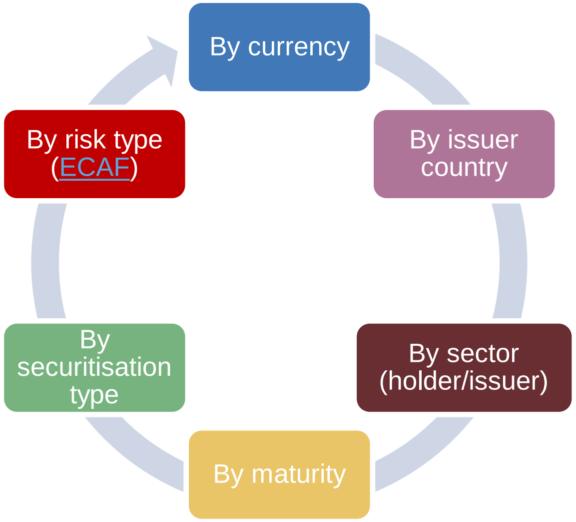
GED vs yields



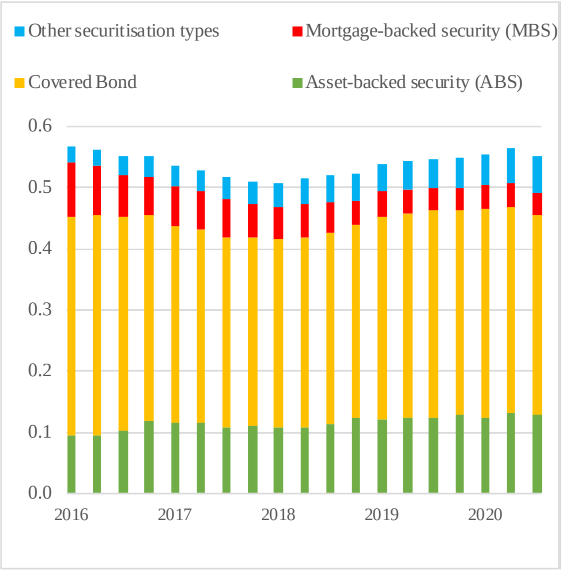
GED estimates vs WB/Bundesbank



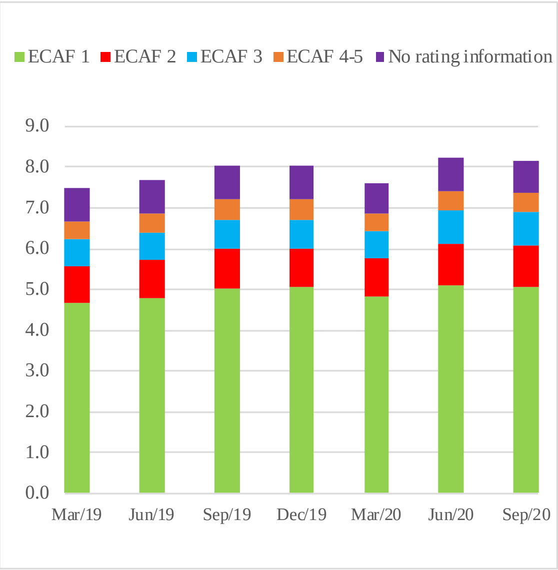
Other enhancements: SBS rich granularity



Securitisation types. EUR trillions



Risk types. EUR trillions



The more the merrier: enhancing traditional cross-border portfolio investment statistics using security-by-security information

Thorsten Radke[Ŧ]; Antonio Rodríguez Caloca[Ŧ*]; Martin Schmitz[Ŧ]
[Ŧ] European Central Bank (ECB), Frankfurt am Main, Germany

Abstract
This paper presents a proposal to enhance the current information available on euro area cross-border portfolio investment and external debt in international investment position (i.i.p.) statistics by using granular (security-by-security) information. This project benefits from the high consistency between the euro area i.i.p. statistics and European System of Central Banks' (ESCB) securities holdings statistics by sector (SHSS). First, nominal stock values for debt securities are compiled using the available SHSS information on securities prices. Information on debt at nominal values is useful for the analysis of debt sustainability. Second, additional details are proposed to be included in i.i.p. statistics drawing on the rich granularity of the SHSS and the ESCB's centralised securities database (CSDB). This paper suggests new i.i.p. details for debt securities by currency, maturity and counterpart issuer geographic area and sectors as well as by riskiness based on ratings. These enhancements are highly demanded by users and the suggested centralised approach at the euro area level provides an optimal cost-benefit solution from the reporting agents' perspective.

Keywords: balance of payments, securities holdings statistics, micro-data, security-by-security, portfolio investment.

1. Introduction[1]

The ECB's External Statistics Guideline describes the different collection models available to compile statistics on portfolio investment.[2] The common denominator of these methods is that stocks of securities reported to national compilers on an aggregated basis, i.e. not relying on security-by-security (SBS) information, should not exceed 15% of value of total portfolio investment stocks of assets or liabilities. This requirement is supported by the CSDB which covers reference and price information on all relevant securities. Therefore, *ex-ante* a good consistency between euro area b.o.p./i.i.p. statistics and SHSS is expected. As shown in this paper, the results for euro area i.i.p. indeed show a high consistency, making the SHSS dataset appropriate to enhance the data available in euro area portfolio investment and external debt.

This paper presents a proposal for selected enhancements to euro area i.i.p. and external debt statistics using SHSS(/CSDB) data, with an initial focus on debt securities. Section 2 briefly describes the main results of the comparison between i.i.p. and SHSS data and further identifies the items for which enhancements are deemed feasible. Section 3 explains the proposed methodology to compile debt securities at nominal value, while Section 4 shows the main results. Section 5 introduces additional enhancements. Finally, Section 6 concludes.

2. Consistency between i.i.p. statistics and SHSS data

The comparison between i.i.p. and SHSS data highlights the high consistency between both domains for debt securities in the period from 2014Q1 to 2020Q3 (**Table 1**). The average coverage ratio of SHSS to i.i.p. data on euro area holdings of debt securities issued by non-

---

[1] We acknowledge the research assistance provided by Carles Gómez Llabrés and Matteo Paolo Pirone as well as the comments received from Jorge Diz Dias and members of the ESCB Working Group on External Statistics.
[2] Refer to the European Central Bank (ECB) Guideline ECB/2011/23 in the field of external statistics as amended, particularly by Guideline ECB/2018/19 ("external statistics Guideline" hereinafter) Annex VI.

euro area residents was within the expected range for long-term debt securities (at 95%), while it was lower for short-term debt securities (76%), but still providing a consistent picture between both domains. In the context of this exercise, it is also relevant to assess to what extent the evolution over time observed in SHSS data is consistent with that of i.i.p. data. Hence information on the correlation between holdings at market values is considered in terms of first differences. The high correlation coefficients suggest that the implicit prices derived from SHSS data can be used to "deflate" i.i.p. data at market prices. For the resident and counterpart sectors, a general positive assessment is obtained for both the extra- and intra-euro area perspectives. [3] The cases recording either relatively low correlations and/or coverage refer to details with relatively low amounts that in the most recent reference periods recorded substantial improvements.[4] Summing up, the presence of both a high coverage ratio and correlation coefficient between both domains shows that the pre-conditions for compiling i.i.p. portfolio investment data in nominal terms based on SHSS data are fulfilled.

Table 1. Coverage and correlation between i.i.p. and SHSS stocks at market value

Period 2014Q1 - 2020Q3	Average coverage		Correlation coefficient		Average coverage		Correlation coefficient	
	Intra euro area	Extra euro area	Intra euro area	Extra euro area	Intra euro area	Extra euro area	Intra euro area	Extra euro area
Short-term debt securities excl. Eurosystem	**94%**	**76%**	**98%**	**91%**				
	By resident sector				By counterpart issuer sector. Eurosystem holdings included in i.i.p.			
Eurosystem	-	-	-	-	-	364%	-	61%
Deposit taking corporations except Eurosystem	98%	82%	98%	93%	89%	79%	95%	84%
Money market funds	92%	82%	95%	93%	-	5987%	-	12%
General government	71%	95%	89%	99%	85%	72%	96%	98%
Financial corporations other than MFIs	97%	65%	75%	68%	85%	66%	55%	68%
NFC, HHs and NPISHs	78%	64%	58%	99%	123%	29%	80%	1%
Long-term debt securities excl. Eurosystem	**94%**	**95%**	**97%**	**98%**				
	By resident sector				By counterpart issuer sector. Eurosystem holdings included in i.i.p.			
Eurosystem	-	-	-	-	-	410%	-	52%
Deposit taking corporations except Eurosystem	98%	98%	98%	95%	86%	98%	89%	80%
Money market funds	104%	129%	84%	82%	-	366%	-	16%
General government	57%	50%	31%	48%	80%	93%	94%	98%
Financial corporations other than MFIs	94%	95%	95%	99%	84%	88%	53%	82%
NFC, HHs and NPISHs	85%	89%	30%	39%	88%	95%	94%	99%

Sources: ECB (i.i.p. statistics and SHSS) and author's calculations.

3. Compilation of debt securities at nominal values: proposed methodology

Market valuation (MV) is the standard to follow when compiling debt securities according to BPM6 (IMF, 2009): stocks should be valued at the end of period market value. In particular, the so-called "dirty" price applies (BPM6 §7.27). This means that for debt securities, the accrued interest not yet paid is included in the price. The default face value (FV) stocks available in the SHSS dataset do not contain the accrued income component. They are defined in BPM6 §3.88 (d) as the "*undiscounted amount to be paid to the holder at maturity*". Therefore, the following adjustment is implemented at the SBS level in this exercise to obtain nominal values (NV):

$$[1]\ Accrued\ income_t^{SHSS} = Debt\ securities_t^{FV,SHSS} * Accrued\ income\ factor_t^{SHSS}$$

$$[2]\ Debt\ securities_t^{NV,SHSS\ enhanced} = Debt\ securities_t^{FV,SHSS} + Accrued\ income_t^{SHSS}$$

where $Accrued\ income\ factor_t^{SHSS}$ refers to the annualised accrued income, i.e. interest accrued for not yet paid coupons and the discount factor due to the difference in issue and redemption price. The Handbook on Securities Statistics (HSS) provides in its Annex 1 a detailed explanation of how to reconcile market and nominal valuations for debt securities. Nominal valuation is defined in HSS §A1.3 as follows: "…*the sum of funds originally advanced, plus any subsequent advances, less any repayments, plus any accrued interest*" and considering also the revaluations owing to exchange rates fluctuations. Therefore, and as mentioned in paragraph HSS §A1.5, the only difference between market (MV) and nominal valuations (NV)

[3] One of the main concerns given the magnitude of the underlying stocks concerns the low ratio for holdings of long-term debt securities held by the general government. This mainly reflects the non-inclusion of the holdings of the nationalised German bank Hypo Real Estate in the SHSS dataset.

[4] Neither the Eurosystem nor money market funds (MMFs) issue debt securities as such instrument types are out of the scope of their regular activities. Hence debt securities issued either by the Eurosystem or MMFs are set to zero by default in the compilation process as not being plausible.

for debt securities stocks in a specific moment of time T and as available in the SHSS dataset concerns the impact of the cumulative revaluations arising from (market) price changes:

$$[3]\ Debt\ securities_t^{MV,SHSS} = Debt\ securities_t^{NV,SHSS\ enhanced} + \sum_{t=1}^{T} Price\ changes\ revaluations_t^{SHSS}$$

It is proposed that i.i.p. asset stocks in nominal terms are derived as follows:

$$[4]\ Price\ index_t^{SHSS} = Debt\ securities_t^{MV,SHSS} / Debt\ securities_t^{NV,SHSS\ enhanced}$$

$$[5]\ Debt\ securities_t^{NV,i.i.p.} = Debt\ securities_t^{MV,i.i.p.} / Price\ index_t^{SHSS}$$

In a first step, the $Price\ index_t^{SHSS}$ indicator is calculated as shown in Equation [4] using the available information in the SHSS dataset, i.e. the ratio between the stocks at market and (enhanced) nominal values. Such index, as mentioned in the HSS §A1.4, reflects the changes in stocks at market values vis-à-vis nominal amounts owing to (accrued) changes of the market price. In a second step, the $Price\ index_t^{SHSS}$ is applied as in Equation [5] to derive the corresponding i.i.p. stocks in nominal amounts following a "bottom-up" approach: the lower items (e.g. short-term debt securities assets by resident sector) are aggregated to obtain the corresponding upper item (e.g. total short-term debt securities assets).

The final step of this compilation process is to derive euro area external debt in nominal terms. This paper includes a proposal based on the use of $Price\ index_t^{SHSS}$ obtained for intra euro area debt securities holdings. We assume that non-euro area investors follow the same investment patterns as euro area-based investors with regard to securities issued by euro area residents: they invest in similar instruments/securities and in similar proportions.[5] Hence equation [6] is used to derive euro area gross external debt (GED) for debt securities in nominal terms:

$$[6]\ GED\ debt\ securities\ _t^{NV} = Debt\ securities_t^{MV,i.i.p.extra\ liabilities} / Price\ index_t^{SHSS,intra\ assets}$$

where $Debt\ securities_t^{MV,i.i.p.extra\ liabilities}$ refers to euro area debt securities held by non-euro area investors at market values in i.i.p. statistics, and $Price\ index_t^{SHSS,intra\ assets}$ to the corresponding price indicator of the same instruments held by euro area investors as available in the SHSS dataset. Finally, the last step is to derive the corresponding euro area net external debt (NED):

$$[7]\ NED\ debt\ securities\ _t^{NV} = GED\ debt\ securities\ _t^{NV} - Debt\ securities_t^{NV,i.i.p.extra\ assets}$$

where $Debt\ securities_t^{NV,i.i.p.extra\ assets}$ are the extra euro debt securities i.i.p. stocks obtained in Equation [5], including also those being held as reserve assets by the Eurosystem.

4. Main results of the compilation of debt securities at nominal values

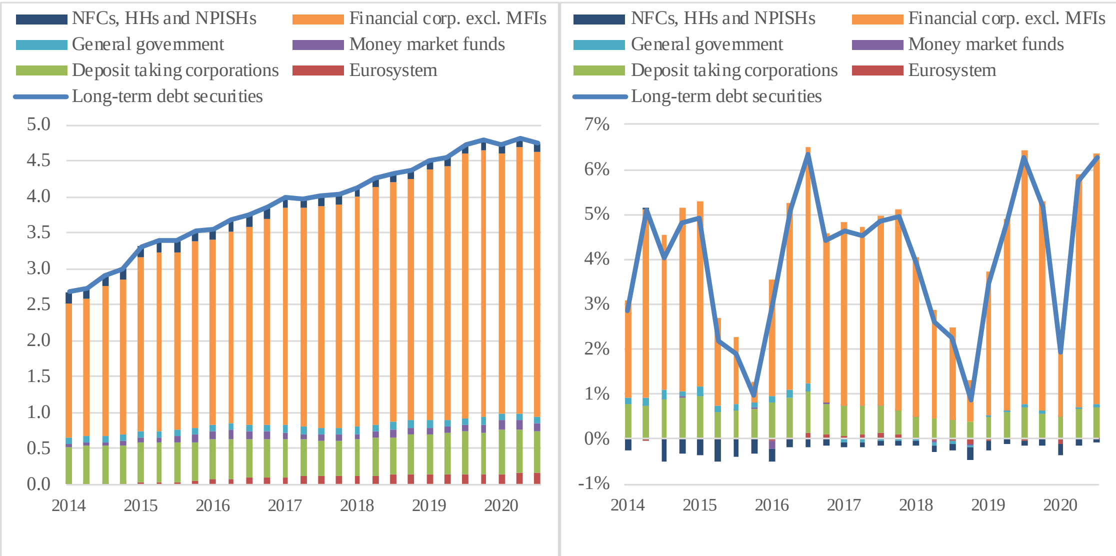
As expected, the estimates for long-term debt securities at nominal value follow a similar pattern to the corresponding stocks at market values as shown in **Chart 1**. The main differences are found in the financial corporations excluding MFIs subsector (the major resident sector) and reflecting significant economic developments or shocks (e.g. the COVID-19 impact in 2020Q1). The differences between market values and nominal estimates is explained by the price changes "premium" (defined as the difference between the $Price\ index_t^{SHSS}$ and 1) in the context of low interest rates: for the period from 2014Q1 to 2020Q3 it was below 10% in absolute terms with very few exceptions. This price changes "premium" may be triggered by specific circumstances such as changes in the perceived creditworthiness of the issuer (reflected in the rating information), changes in the market liquidity of the specific instrument or in the key ECB reference rates. A similar assessment also applies to short-term debt securities and intra euro area cross-border holdings as well as the other additional categories considered in this exercise.

[5] This assumption is debatable especially when considering the impact of the Eurosystem's holdings in the euro area portfolio rebalancing in the context of the Eurosystem's purchase programmes (PSPP), see Bergant and Schmitz (2019). However, the robustness checks implemented in Section 4 validate our assumption.

Chart 1. Extra euro area long-term debt securities assets (stocks) by resident sectors

A. Nominal values (EUR trillions)

B. Market minus nominal stocks (% of MV total stocks)



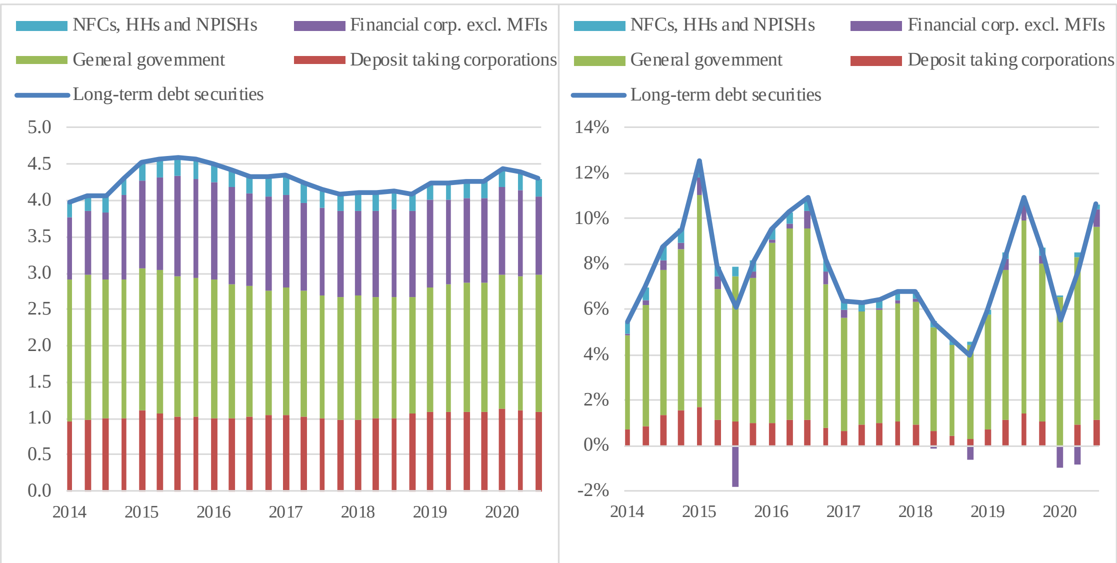
Sources: ECB (i.i.p. statistics and SHSS) and author's calculations.

The GED debt securities estimates in nominal terms are also generally in line with the stocks at market values as shown for long-term debt securities in **Chart 2**, with the main differences arising for debt securities issued by the government. A similar picture also holds true regarding the NED indicator for debt securities.

Chart 2. GED in long-term debt securities

A. Nominal values (EUR trillions)

B. Market minus nominal stocks (% of MV total stocks)



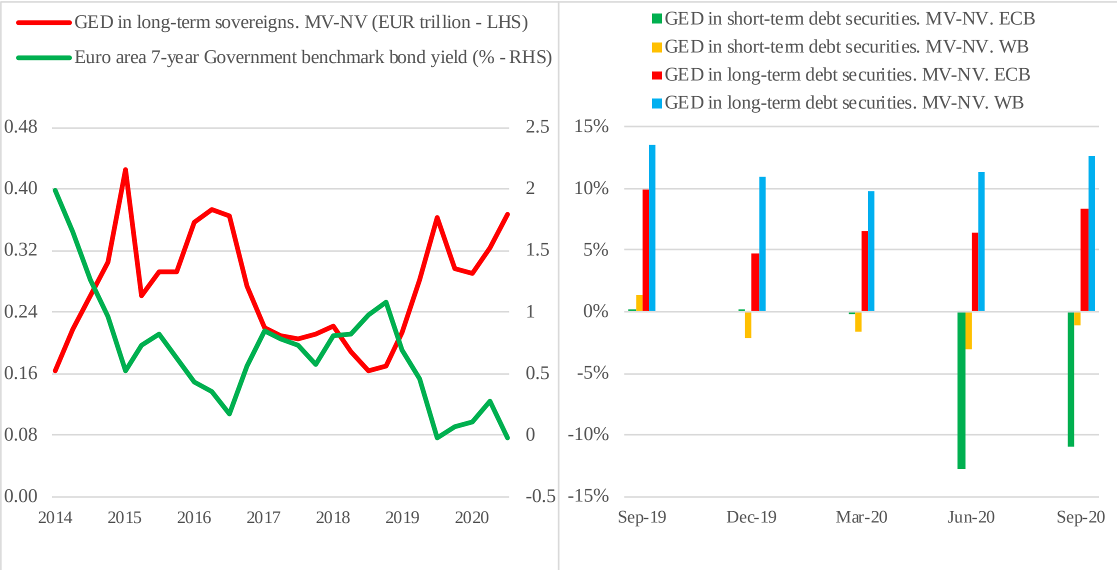
Sources: ECB (i.i.p. statistics and SHSS) and author's calculations.

Two sets of robustness checks were carried out with a focus on the GED indicators. First, the evolution of GED in long-term debt securities issued by the general government was compared with the underlying yields, namely the euro area 7-year sovereign benchmark bond yield. Panel A in **Chart 3** shows the comparison is in line with expectations as there is a consistent negative correlation between interest rates and the implicit impact on bond prices (-67%). Second, the GED nominal stocks data available in the World Bank website and referring to Germany were compared with the estimates obtained following the compilation approach of this document. As shown in Panel B in **Chart 3**, the results are consistent especially for long-term debt securities as showing a similar MV-NV gap and trend, while differences are more pronounced for short-term debt securities, although being based on lower underlying stocks. Hence, the overall outcome of the robustness check is very encouraging, confirming the high quality of the euro area nominal stocks estimates and validating the assumptions of the compilation model.

Chart 3. Robustness checks for GED nominal stocks

A. GED long term sovereigns and yields evolution

B. GED estimates vs World Bank data for Germany (% of MV stocks)



Sources: ECB (i.i.p. statistics and SHSS), World Bank and author's calculations.

5. Additional enhancements using SBS data

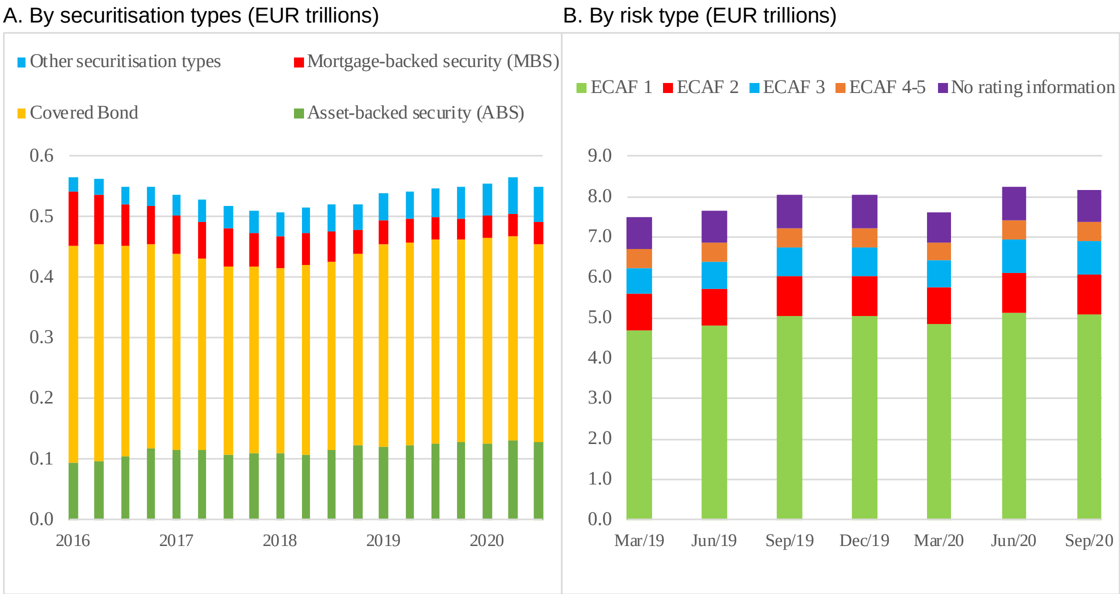
Additional details for debt securities stocks at market values can be included in i.i.p. statistics drawing on the rich granularity of the SHSS (/CSDB) datasets, namely:

- By currency: seven additional currencies (on top of the already available euro, US dollar and Japanese yen) are covered with an original maturity breakdown.[6]
- By issuer country: new aggregate counterparties relevant for analytical purposes (i.e. OECD, OPEC, ASEAN and Latin America), and Cayman Island and Jersey enriching the "of which" detail of offshore financial centres with an original maturity breakdown.
- By resident and counterpart issuer sectors: they are enriched with the split between insurance corporations and pension funds, and additional granularity for the other financial institutions sector with an original maturity breakdown.
- By maturity: six maturity brackets are included both for the original and residual maturity perspectives and broken down by resident sectors.[7]
- By securitisation type: the CSDB provides rich reference information on the securitised debt securities traded by the euro area investors distinguishing four categories – asset backed securities, mortgage backed securities, covered bonds and other securitisation types. This information is available only since 2016Q1 (see **Chart 4**A).

[6] The Australian dollar, Brazilian real, Swiss franc, British Pound, Danish Krone, Mexican peso and Swedish krona are included, representing around 10% of the total.
[7] Below three months, above three months and below 1 year, between 1 and 2 years, between 2 and 5 years, between 5 and 10 years, and above 10 years.

- By risk type: an additional dataset of the CSDB, i.e. the ratings data, is used to classify the euro area cross-border debt securities stocks according to the Eurosystem Credit Assessment Framework (ECAF) [8] broken down by original maturity (see **Chart 4**B).

Chart 4. Selected additional enhancements in non-euro area long-term debt securities



Sources: ECB (i.i.p. statistics, SHSS, CSDB and ratings database), and author's calculations.

6. Conclusions

This paper provides an overview of the proposed approach ("bottom-up" and based on SHSS price indicators) to compile euro area portfolio investment debt securities i.i.p. stocks at nominal values which also offers the possibility to derive GED (and NED) in nominal amounts. The estimates included in this document provide high quality results not only for the portfolio investment assets component, but also for GED (and NED) indicators.

Moreover, additional details are suggested to be compiled and drawing on the rich granularity of the SHSS and CSDB datasets. The enhanced set of portfolio investment debt securities series can cover detailed information, e.g. by currency or risk type. This information provides high value added for users in terms of economic, monetary policy and financial stability analysis purposes (Lane, 2015).

Bibliography

1. Bank for International Settlements, International Monetary Fund, and European Central Bank (2015). "Handbook on Securities Statistics".
2. Bergant, K. and Schmitz, M. (2019). International financial flows and the Eurosystem's asset purchase programme: evidence from b.o.p and security by security data. BIS IFC Bulletin No. 49.
3. International Monetary Fund (2009). Balance of Payments and International Investment Position Manual (BPM6). IMF.
4. Lane, P. R. (2015). Risk Exposures in International and Sectoral Balance Sheet Data. World Economics, 16, 55–76.

[8] The ECAF framework provides a harmonised rating scale classifying ratings into 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.

Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Unbundling package tours: a Machine Learning application with the LASSO[1]

Andrea Carboni, Claudio Doria and Alessandro Moro,
Bank of Italy

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

BANCA D'ITALIA
EUROSISTEMA

63rd ISI WORLD STATISTIC CONGRESS – 2021

63 IPS – Central Bank as producer of official statistics

Unbundling Package Tours: a Machine Learning Application with the LASSO

Andrea Carboni – Claudio Doria – Alessandro Moro
(Banca d'Italia)

Outline

Definition of package tours for BOP compilers

The EU Regulation 2015/2302 about the package tours
The BOP prospective and the importance of unbundling a package tour

The Bank of Italy frontier survey

The frontier survey main features
The package tours in the survey

An application with ML techniques

The old procedure donor method
A new ML approach: LASSO Regression
Main Results

Definition of package tours for BOP compilers

The Directive EU 2015/2302 gives an official definition of package tours for the consumer protection as a combination of at least two different types of travel services for the purpose of the same trip (or holiday).

*a) **carriage of passengers**;*
b) accommodation;
c) rental of cars, other motor vehicles;
d) any other tourist service (not included in a, b, or c).

In an international travel, at least one element of a package tour (b, c or d) is included in BOP travel item

AN OPERATIVE DEFINITION FOR BOP COMPILERS

The purchase of **two or more services**, of which at least one to be recorded under the Bop travel item, when it is known the total value of the services, but not the value of the single components.

Definition of package tours for BOP compilers

Regulation 2015/2302	BOP ITEM
a) carriage of passengers	No record in balance of payments (if it is a domestic transaction)
a) carriage of passengers	International Transport (if it is an international transaction)
b) accommodation	Travel
c) rental of cars	Travel
d) other tourist service	Travel

Effect of a possible misallocation in the unbundling procedure

Incorrect estimation of the travel item and of the current account (GDP)

The Bank of Italy frontier survey

The Italian Survey on International Tourism was conducted from by the Bank of Italy since 1995. Two distinct operations are carried out at each border point:

1. **COUNTING (1.0 million per year):** The counting aims at assessing the number and the nationality of the travellers, entering or exiting from Italy. As of October 2020, we are using also mobile phone data in the estimation process.

Seaports

Road crossings

Rail passages

International airports

2. **INTERVIEWING (110,000 per year):** The interviewing (face-to-face) consists in questioning a sample of the travellers, after having approached and stopped them, in order to assess a number of basic classification characteristics of the traveller, the trip, the expenditures, and so on (answer are recorded in real time via tablet).

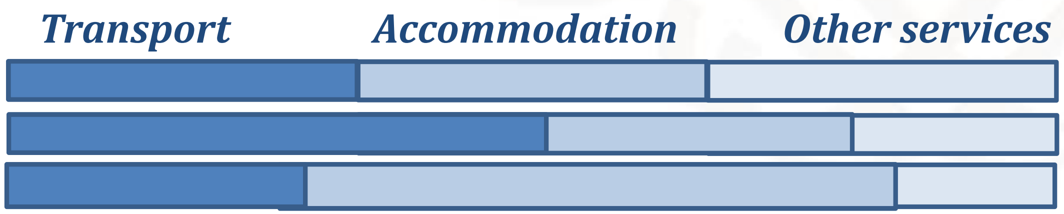
The Bank of Italy frontier survey

The Packages Tour in the survey

In the questionnaire is collected the **total value** of the package and the **services purchased**: international transportation, accommodations, restaurants, other transports, other services (museum, tours, shows, rented vehicles) .

The Practical Issue

Allocating the total package value to the single services components (in math terms, estimating the percentage shares of each package component).



V. "ALL INCLUSIVE" TRIPS

12a. Can you tell us if your trip was "all inclusive", that is an organized tour or tour package which included expenses for two or more types of the following services: transportation, overnight accommodations, meals, other services?

- Yes 1
- No..2 → Question 13a.

12b. Which services were included in the tour package you bought?

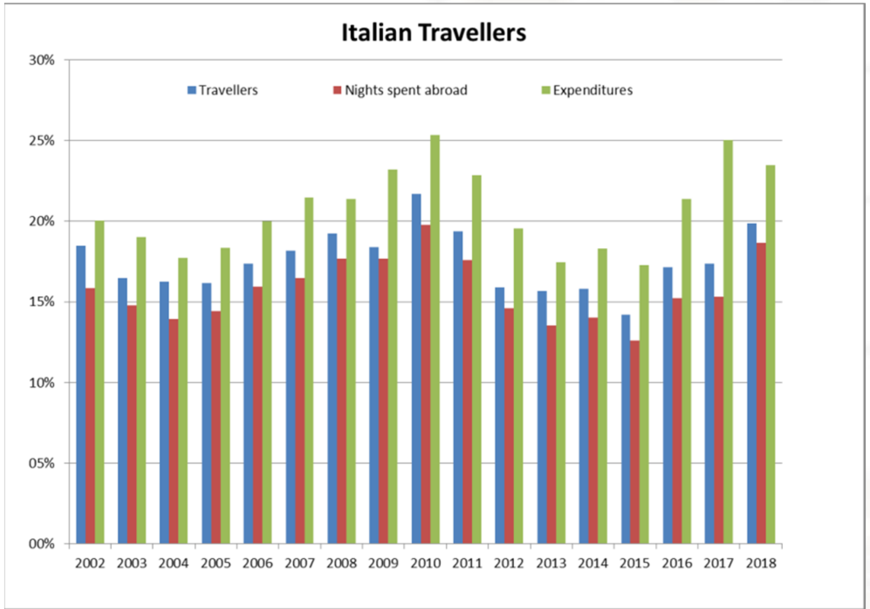
- Transportation between Italy and abroad 1
- Transportation within your own country, between foreign countries or within foreign countries 2
- Transportation within Italy 3
- Accommodations, with or without meals included 4
- Restaurants, cafés (and other meals taken outside your own accommodations 5
- Other services (museums, shows, entertainment, tours, rented vehicles, etc.) 6

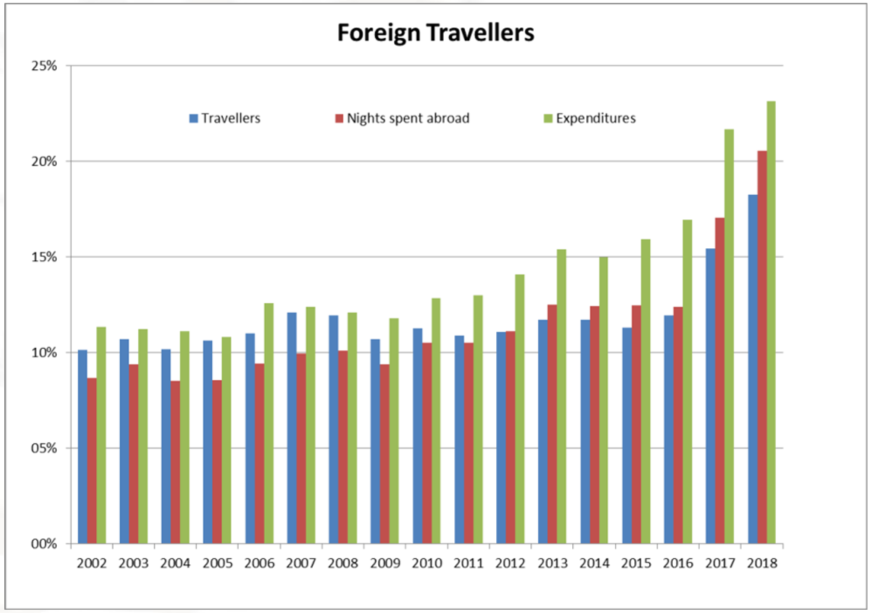
12c. How did you buy your travel package?

- with a tour operator/travel agent from your own town or your company's Recreational Association, other associations, social groups.. 1
- with an online travel agency or using a hotel booking portal.. 2
- using the destination's tourism portal 3
- other (please, specify)_______________________________4

The Bank of Italy frontier survey

The Packages Tour in the survey - (share of the packages tour)





About 20 per cent of the travelers has bought a tour package in an international travel in 2018

The old procedure: the donor method

The package is broken down in the different components, using the proportion of the *"twins" travelers*, that have not purchased a package in their travelers.
The traveler and his twins should have the **same characteristics**: country of residence, mean of transport, length of the stay, type of accommodation, and reason of the trip.

EXAMPLE
Suppose that an international traveller has purchased, for 1.200 Euro, a tour package with three components: an international air ticket, an hotel abroad, and a car rent (always abroad). The proportion (mean) of the three twins is used to split the total amount in the single components.

	International Transport	Accommodation	Car Rent	Total
Twin 1	500	350	150	1,000
Twin 2	400	550	50	1,000
Twin 3	600	1,200	200	2,000
Mean (%)	*0.4*	*0.5*	*0.1*	
Package	***480***	***600***	***120***	**1,200**

The old procedure: the donor method

The package is broken down in the different components, using the proportion of the *"twins" travelers*, that have not purchased a package in their travelers.
The traveler and his twins should have the **same characteristics**: <u>country of residence</u>, mean of transport, <u>length of the stay</u>, type of accommodation, and reason of the trip.

A TRADE-OFF
It is not always possible find an enough number of "twins" for realizing robust estimations, because of the high number of the constrains (characteristics).

Number of twins vs Similarity

A new ML approach

The basic idea is to find a *predictive model* relating the *shares of expenditure for transportation, accommodation and other services* to the other variables collected in the survey, such as the travellers' socio-demographic characteristics, the country of origin/destination, the type of transportation and accommodation, the number of nights, and so on.

The predictive models are estimated separately for the *resident* (Italian travellers) and *non resident* (foreign travellers): in total 6 models.

Since these shares are unobservable for package tours, this model must be estimated using the travellers who have not purchased a tourist package

A new ML approach

THE SAMPLE

Italian and Foreign travelers, that have bought at least two kind of services (international transport, accommodation, other services) without a package tour in the period 2010 – 2018.

More than 500.000 interviews.

The 80% of the sample is used for the training of the algorithm, and the remaining 20% for its validation.

A new ML approach

The share Q of expenditure (Exp) for international transports, accommodation and other services, for the traveller i at time t is given by

$$Q^j_{i,t} = \frac{Exp^j_{i,t}}{TOT_{i,t}}$$

Where TOT is the sum of the three services considered

J=1,2,3 (International transport, Accommodation, Other Services)

The share can be estimated considering many features (characteristic of the traveller)

$$Q^j_{i,t} = \beta^j_0 + \beta^j_{TD} TD_t + \beta^j_{CO} CO_{i,t} + \beta^j_{SD} SD_{i,t} + \beta^j_{TC} TC_{i,t} + \beta^j_{AC} AC_{i,t} + \varepsilon^j_{i,t}$$

TD_t is a set of time dummies;
$CO_{i,t}$ is the country of origin (destination) of the foreign (Italian) traveller;
$SD_{i,t}$ is a vector of socio-demographic characteristics (number of travellers, gender and age, the job of the interviewed, the reason of the journey);
$TC_{i,t}$ are the transportation features (mode of transport: car, train, boat and plane, the transportation company, the class of the flight/boat);
$AC_{i,t}$ indicates a vector of accommodation variables (number of nights distinguished by the type of accommodation)

A new ML approach

Since the right-hand side variables of the equation includes many variables, it is useful to employ a regularisation method to automatically select the relevant features. One of the most common methods used in the machine learning literature is the Least Absolute Shrinkage and Selection Operator (LASSO)

$$\min_{\beta_0^j,\beta_{TD}^j,\beta_{CO}^j,\beta_{SD}^j,\beta_{TC}^j,\beta_{AC}^j} \sum\nolimits_{i,t} \left(Q_{i,t}^j - \beta_0^j - \beta_{TD}^j TD_t - \beta_{CO}^j CO_{i,t} - \beta_{SD}^j SD_{i,t} - \beta_{TC}^j TC_{i,t} - \beta_{AC}^j AC_{i,t}\right)^2 - \lambda^j \left(\left\|\beta_0^j\right\|_1 + \left\|\beta_{TD}^j\right\|_1 + \left\|\beta_{CO}^j\right\|_1 + \left\|\beta_{SD}^j\right\|_1 + \left\|\beta_{TC}^j\right\|_1 + \left\|\beta_{AC}^j\right\|_1\right)$$

The coefficients are put equal to zero if in the preliminary estimation (without the regularization) they are quite small.

A new ML approach: main results

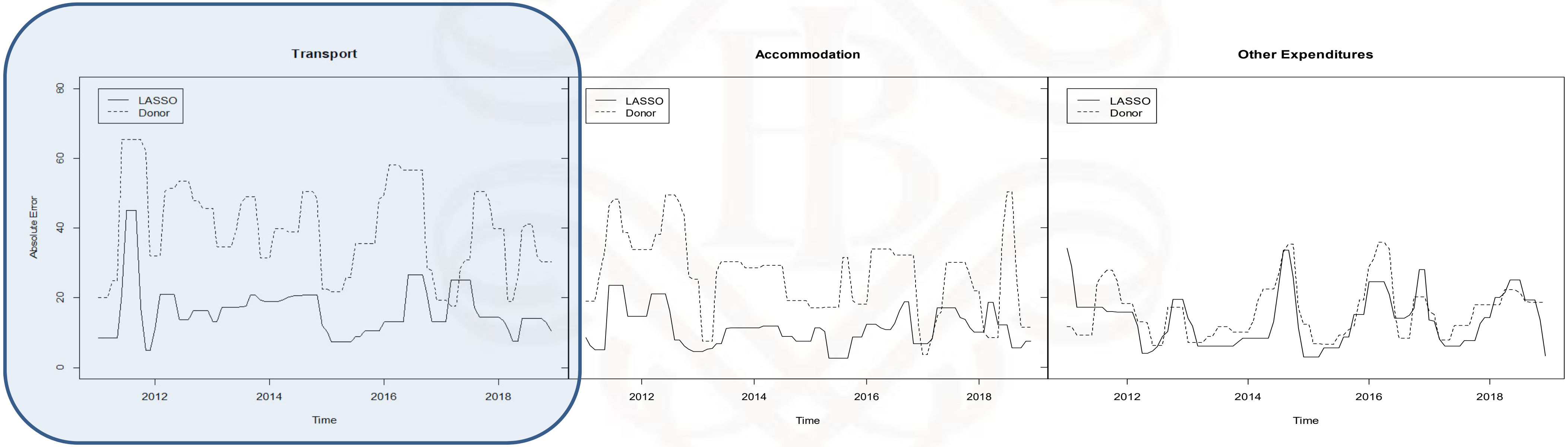
Comparison of the out-of-sample predictive performance of the Donor and LASSO methods

The LASSO regression improves the results of the Donor Method (unbiased estimation, and smaller Variance and Mean Square Error).

		Italian Travellers			Foreign Travellers		
		Donor	LASSO	Diff(%)	Donor	LASSO	Diff(%)
Transport							
	Bias	0.154	0.033	-79%	0.130	-0.066	-49%
	Variance	246.739	173.666	-30%	293.427	209.334	-29%
	MSE	246.757	173.663	-30%	293.439	209.335	-29%
Accommodation							
	Bias	-0.143	-0.034	-76%	-0.115	0.070	-39%
	Variance	219.617	180.528	-18%	225.143	178.931	-21%
	MSE	219.632	180.525	-18%	225.153	178.933	-21%
Other Expenditures							
	Bias	-0.011	0.001	-91%	-0.015	-0.004	-72%
	Variance	196.096	175.134	-11%	224.595	196.066	-13%
	MSE	196.092	175.130	-11%	224.592	196.063	-13%

A new ML approach: main results

The absolute value is significantly below using the LASSO method in comparison to the Donor Method



63rd ISI WORLD STATISTIC CONGRESS – 2021

63 IPS – Central Bank as producer of official statistics

Thank you for your attention !!!

andrea.carboni@bancaditalia.it

Unbundling Package Tours: a Machine Learning Application with the LASSO

Andrea Carboni* [1]; Claudio Doria[2]; Alessandro Moro[3]

[1] Banca d'Italia – Rome, Italy – andrea.carboni@bancaditalia.it
[2] Banca d'Italia – Rome, Italy – claudio.doria@bancaditalia.it
[3] Banca d'Italia – Rome, Italy – alessandro.moro2@bancaditalia.it

Abstract:
In order to estimate the travel item of the Italian Balance of Payments (BoP), the Bank of Italy carries out an extensive border survey, collecting information about travel expenditures from a sample of resident and foreign travellers. The travel item covers an assortment of goods and services: in particular, according to the international standards, it includes local transport, i.e. transport within the economy being visited, but excludes international transport, reported in a separate BoP item. In the questionnaire of the survey a detailed breakdown of expenditures is asked, allowing the correct split between the travel and international passenger transport components. However, this breakdown is not available if these two items are purchased in a package tour with a single transaction. The unbundling of package tours is therefore needed for the correct compilation of the BoP. The present paper proposes a machine learning algorithm based on LASSO techniques to impute the components of package tours, improving the performance of the current procedure employed by the Bank of Italy.

Keywords:
Balance of payments; Travel; International transport; Linear regression; Donor method.

1. Introduction[1]:

The Bank of Italy carries out an extensive border survey on International Tourism, designed to elicit the travel expenditures of a sample of resident travellers coming back to Italy from a trip abroad and of foreign travellers leaving Italy after a visit in the country.[2] The main purpose of the survey is the estimation of the travel item of the current account of the Italian Balance of Payments (BoP). Travel is a relevant component of Italian economy: in 2018, foreign travellers' expenditures in Italy were 41.7 billion (2.4 per cent of Italian GDP), while Italian expenditures abroad amounted to 25.5 billion (1.5 per cent relative to GDP).
Unlike most of the other service categories of the BoP, travel is a transactor-based component that covers an assortment of goods and services. On the one hand, as reported in the IMF Balance of Payments and International Investment Position Manual (2009), goods and services provided to visitors during their trips, that would otherwise be classified under another item (such as postal services, telecommunications, local transport, hire of equipment, or gambling), are included under travel. On the other hand, travel excludes goods for resale, which are included in general merchandise and the acquisition of valuables (such as jewellery), consumer durable goods (such as cars and electric goods) that are included in customs data when in excess of custom thresholds.

[1] We thank Matteo Piazza, Alfonso Rosolia and Simonetta Zappa for helpful comments and suggestions. The views expressed in the paper are those of the authors and do not involve the responsibility of the Bank of Italy.
[2] For the sake of brevity, in the rest of the paper, we might refer to resident travellers using the adjective Italian and we might use the term foreign for non-resident ones.

Moreover, according to international standards, travel includes local transport (i.e., transport within the economy being visited and provided by a resident of that economy), but excludes international transport, which is included in a specific BoP item. International passenger transport covers all services provided in international transports to non-residents by resident carriers, as a credit, and those provided to residents by non-resident carriers, as a debit.
In the questionnaire of the survey a detailed breakdown is adopted, making a distinction between international and local transport, accommodation, meals, other services (museums, courses, concerts, etc.), and goods (shopping). However, this breakdown is not available for package tours, when two or more items of an international travel are purchased with a single transaction. In fact, with regard to this kind of trips, it is possible to know only the total value of the package and which services are included but the value of each service bought with the package is unknown. The unbundling of package tours, which account for more than 20% of the travel credits and debts in 2018, is therefore needed for the correct compilation of the BoP.
Currently, the donor method is used to unbundle package tours: in fact, the package of a given traveller is broken down in its different components using the proportion of an average "twin" traveller, who has not purchased a package in his travel. In principle, the traveller and his twin should have the same characteristics: country of residence, mean of transport, length of the stay, type of accommodation and reason of the trip. However, it is difficult to find enough twins to have stable estimates according to all these features and, consequently, some constraints must be relaxed with the risk of introducing bias in the estimates.
In order to overcome the limitations of the current procedure, it is necessary to model the relationship between the most important components of a package tour (transportation, accommodation, and other included services) and the characteristics of travellers and those of their trip. Moreover, it is worth to select the relevant features to be included in the model as explanatory variables in an efficient way.
This paper proposes a Machine Learning (ML) approach to solve these two issues. Firstly, a linear relationship is supposed between the shares of expenditure in the three major components of a package tour and a huge set of explanatory variables derived from the border survey. Then, the relevant features are selected using a popular regularisation method in the ML literature, i.e. the Least Absolute Shrinkage and Selection Operator (LASSO) proposed by Tibshirani (1996).
A number of authors have studied the ability of the LASSO and related procedures to select the relevant features and recover the correct model. Examples of this kind of literature include Knight and Fu (2000), Friedman et al. (2001), Donoho (2006), Meinshausen and Bühlmann (2006), Zhao and Yu (2006), Bunea et al. (2007), Meinshausen (2007) and, more recently, Lee et al. (2016), Plan and Vershynin (2016), Dalalyan et al. (2017).
Our proposed algorithm is trained using the interviews of the travellers without a package tour: in fact, for these travellers we know both their characteristics (and the features of their travel) and the expenditures in the different items. Then, the algorithm is applied to travellers with a package tour in order to impute the value of the unknown components. The comparison of the LASSO and donor method shows that the LASSO approach clearly outperforms the latter method in terms of prediction accuracy. In fact, the LASSO exhibits a lower variance of the forecast error term and eliminates completely the systematic bias that affects the current procedure.
Moreover, the strength of the approach described in this paper is also in its ability to incorporate the potential effects of exogenous variables that may alter the expenditure behaviours of international travellers. This flexibility will allow to take into account the impacts of the recent COVID-19 pandemic in the unbundling procedure applied to the next waves of the tourism survey.

2. Methodology:

According to the descriptive evidence of the Bank of Italy's border survey, the main issue related to the unbundling of package tours is the estimation of the value of three components: the carriage of international transport, the expenditures for accommodation, and the residual

component.[3] A bias in the estimation of the first component has also an effect in the correct allocation of the monetary flows between two BoP components, i.e. travel and international transport: from the compiler perspective, the priority in unbundling package tours is therefore the correct estimation of the international carriage of passengers. According to the results of the border survey, the second important aspect is the correct estimation of accommodation in package tours, as almost all packages contain this component.
The current procedure adopted in the Bank of Italy is the donor method (or nearest neighbour approach). The value of the package of a traveller is split in its components using the shares of "similar" travellers, the so-called twins, who have purchased the same services without buying a package (for details see Introduction).
In order to overcome the limitations of the donor method, a ML algorithm is proposed which should be able to improve the results of the unbundling procedure by exploiting in a more effective way all the information contained in the international tourism survey. In fact, on one side, a parametric structure is imposed to the relationship between the shares of expenditure in the different package components and the characteristics of travellers and their trips; on the other, the most useful features for the estimation of these shares are automatically selected using regularisation techniques.
The basic idea is to find a predictive model relating the shares of expenditure for international transport, accommodation and remaining services to the other variables collected in the survey, such as the travellers' socio-demographic characteristics, the country of origin/destination, the type of transportation and accommodation, the number of nights, and so on. Since these shares of expenditure are unobservable for package tours, this model must be estimated using the travellers who have not purchased a package tour: in fact, for this kind of travellers we can observe both the target variables (international transport, accommodation and other services) and the input variables (i.e., the characteristics of the travel and of the travellers). Then, the model can be applied to the travellers with a package tour in order to infer from their features the value of the different components of the package.
More precisely, it is possible to estimate the following relationship in which the share of expenditure of traveller *i* in item *j* (international transport, accommodation, other services) is explained by a set of features:[4]

$$(1)\ Q_{i,t}^{j} = \beta_0^j + \beta_{TD}^j TD_t + \beta_{CO}^j CO_{i,t} + \beta_{SD}^j SD_{i,t} + \beta_{TC}^j TC_{i,t} + \beta_{AC}^j AC_{i,t} + \varepsilon_{i,t}^j$$

where TD_t are time dummies; $CO_{i,t}$ is the country of origin (destination) of the foreign (Italian) traveller; $SD_{i,t}$ is a vector of socio-demographic characteristics, such as the number of travellers, distinguished by sex and age, the job of the interviewed, the reason of the journey (work, pleasure, other); $TC_{i,t}$ are the transportation features, like the mode of transport (car, train, boat and plane), the transportation company, the class of the flight/boat; finally, $AC_{i,t}$ indicates a vector of accommodation variables, such as the number of nights distinguished by type of accommodation. Equation (1) can be estimated separately for Italian and foreign travellers without a package tour.
Then, the model can be applied to travellers that have bought a package tour in order to impute the unknown expenditure shares from their characteristics. In fact, for this latter kind of travellers, we know the input variables and the total value of the package, but we ignore the expenditures for the different items. The imputed expenditure shares $\hat{Q}_{i,t}^{j}$ are calculated as the predicted values of equation (1), rescaled in order to guarantee that $\sum_{j=1}^{3} \hat{Q}_{i,t}^{j} = 1$ (ruling out the few cases of negative predicted values).

[3] In the rest of the analysis, we decide to aggregate in this residual component the other services different from international transport and accommodation (i.e., food-serving services, local transport, other services not included elsewhere).
[4] We have also tested a model in which the logit of the expenditure shares are regressed on the explanatory variables. However, this specification exhibits worse forecasting performance than the linear model presented in this section.

The underlying assumption of the procedure is that there are no systematic differences in the expenditure shares between travellers with a package tour and travellers without a package, once controlling for the observed characteristics included in equation (1). Unfortunately, this hypothesis cannot be tested directly with the available data. However, it is important to stress that this assumption does not impose the equality between the total value of a package and the sum of the values of the different components if purchased separately: in fact, these two values are likely to be different due to agency costs or discount strategies. The assumption is violated only if the expenditure shares in the different items are different between package and standard tours, which is a far less restrictive hypothesis.
For the training and validation of the proposed algorithm, the Bank of Italy's data of the International Tourism Survey are employed. In particular, it is worth to consider the interviews of the Italian and foreign travellers without a package tour that have sustained all the three types of expenditures (international transport, accommodation and the residual component) during their journey. The interviews carried out in the 2011-2018 period are used ending up with a repeated cross-section database: the total number of observations are 216,974 for Italian and 294,636 for foreign travellers. The 80% of the sample is used for the training of the algorithm, i.e. for the estimation of the model (hyper-)parameters, and the remaining 20% for its validation, comparing the observed expenditures with the ones predicted by the model.
Since the right-hand side of equation (1) includes many variables, especially dummies (e.g., one dummy variable for each month and year of the interview, country of origin/destination, transportation company, etc.), it is useful to employ a regularisation method to automatically select the relevant features. One of the most common methods used in the ML literature is the Least Absolute Shrinkage and Selection Operator (LASSO). This approach adds the sum of the absolute values of the model coefficients to the sum of squared residuals to be minimised, forcing the coefficients of the irrelevant variables to zero. In formula, the coefficients are estimated in this way:

$$(2)\quad \min_{\beta_0^j,\beta_{TD}^j,\beta_{CO}^j,\beta_{SD}^j,\beta_{TC}^j,\beta_{AC}^j} \sum\nolimits_{i,t}\left(Q_{i,t}^j-\beta_0^j-\beta_{TD}^j TD_t-\beta_{CO}^j CO_{i,t}-\beta_{SD}^j SD_{i,t}-\beta_{TC}^j TC_{i,t}-\beta_{AC}^j AC_{i,t}\right)^2 + \lambda^j\left(\left\|\beta_0^j\right\|_1+\left\|\beta_{TD}^j\right\|_1+\left\|\beta_{CO}^j\right\|_1+\left\|\beta_{SD}^j\right\|_1+\left\|\beta_{TC}^j\right\|_1+\left\|\beta_{AC}^j\right\|_1\right)$$

For larger values of λ more coefficients are forced to zero: the choice of the value for this hyper-parameter becomes therefore crucial. Following the literature, λ is chosen by minimising the out-of-sample Mean Squared Error (MSE) in a cross-validation exercise in which the training sample is divided in five subsets. With the data considered, the optimal λ is very small: this implies that many variables are relevant.

3. Result:

It is worth to compare the predictive performance of the proposed approach with the current donor method in order to understand if and how the new methodology can improve the unbundling of package tours.
Both methods are trained using the 80% of the sample and the remaining 20% is employed to compare the accuracy of predictions measured in terms of forecast bias, variance of the prediction errors and, combining these two dimensions, with the MSE. In particular, the out-of-sample forecast errors with method *m* (donor or LASSO) are defined as:

$$(3)\quad e_{i,t}^{j,m}=\left(Exp_{i,t}^j-TOT_{i,t}\hat{Q}_{i,t}^{j,m}\right)\cdot w_{i,t}$$

where $w_{i,t}$ are the survey grossing-up factors. The bias, standard deviation (STD) and the Root Mean Squared Error (RMSE) of the forecasts are calculated using the error terms in expression (3). Table 1 shows the results of this comparison, distinguishing between Italian and foreign travellers, as well as different package components. The analysis is conducted on the overall time period, i.e., the years from 2011 to 2018, and by focusing on the more recent four-year period 2015-2018, when there has been a significant growth of package tours, especially among foreign travellers.

Table 1: Comparison of the out-of-sample forecasting performance of the LASSO and donor methods

		Italian Travellers			Foreign Travellers		
		Donor	LASSO	Diff (%)	Donor	LASSO	Diff (%)
Overall validation set (2011-2018)							
International Transport							
	Bias	-20,468	-12,490	-39%	-11,261	-5,452	-52%
	STD	262,110	203,690	-22%	270,976	222,304	-18%
	RMSE	262,905	204,070	-22%	271,207	222,369	-18%
Accommodation							
	Bias	14,921	6,389	-57%	9,189	2,248	-76%
	STD	233,524	207,552	-11%	230,049	210,824	-8%
	RMSE	233,998	207,648	-11%	230,231	210,835	-8%
Other Expenditures							
	Bias	5,547	6,100	10%	2,072	3,204	55%
	STD	192,472	177,094	-8%	236,475	228,858	-3%
	RMSE	192,550	177,197	-8%	236,482	228,879	-3%
Sub-sample (2015-2018)							
International Transport							
	Bias	-18,591	-13,978	-25%	-15,031	-6,640	-56%
	STD	290,378	221,787	-24%	323,495	263,541	-19%
	RMSE	290,966	222,222	-24%	323,838	263,619	-19%
Accommodation							
	Bias	13,513	5,198	-62%	12,841	3,832	-70%
	STD	261,990	226,663	-13%	279,434	272,820	-2%
	RMSE	262,332	226,717	-14%	279,724	272,842	-2%
Other Expenditures							
	Bias	5,078	8,780	73%	2,190	2,808	28%
	STD	219,074	206,611	-6%	276,205	272,130	-1%
	RMSE	219,127	206,792	-6%	276,209	272,139	-1%

Notes: Bias, STD and RMSE are in euro.

It is possible to observe that the proposed approach clearly outperforms the donor method in the forecast of the most relevant components of package tours, i.e., international transport and accommodation. In fact, the LASSO method exhibits systematically lower values of bias and standard deviation, both for Italian and foreign travellers: considering the RMSE, the reduction in percentage terms is around 20 per cent for international transport and 10 per cent for accommodation. Looking at the residual component, the new method shows an increase of the bias with respect the donor approach; however, this increase is more than compensated by the reduction of the forecast error variability: in fact, the RMSE of the LASSO approach is still lower than the one obtained with the donor method.

The reduction of the bias for the international transport and accommodation components means that the model imposed to the data by the LASSO approach seems quite reasonable. Moreover, the variability of the imputation errors is lower in the case of LASSO given that in this method we need to estimate a vector of parameters, while the donor approach is fully non-parametric. These considerations explain the reason why our proposed approach outperforms the existing one.

The comparison of the forecasts for the 2015-2018 period proves the robustness of the analysis: in fact, the improvements gained with the new algorithm, in terms of bias and variance reduction, are confirmed. It also suggests that the new approach will probably be capable to learn quickly possible changes in the structure of travellers' expenditures, which might have happened after the COVID-19 pandemic. On the contrary, the donor method, using only partially the information in the interviews, might require a longer time and many waves to identify enough twins to produce unbiased estimates after the pandemic outbreak.

4. Discussion and Conclusion:

In this paper, a ML approach is proposed with the aim of overcoming the limitations of the current donor method. The new approach improves the existing one in two directions: firstly, it models explicitly the relationship between the different components of a package and the characteristics of travellers and their trips in a parametric framework; secondly, it adopts a regularisation method, i.e. the LASSO, to automatically select the relevant features for the estimation of the package components.

The comparison of the out-of-sample forecasting performance of the two methods reveals that the ML algorithm generally outperforms the donor method in terms of more precise and, above all, less biased predictions. The robustness of the ML approach, tested with a more recent sub-sample, is a further advantage in the production of reliable estimations in the presence of behavioural changes in travellers' expenditures, which might have occurred after the COVID-19 pandemic.

It is important to stress that in the analysis carried out in this paper we have made some minor simplifications, such as considering the interviews with strictly positive expenditure shares in all the three components, i.e., international transport, accommodation, and other expenditures. In the (few) cases in which a package does not include all the three items, but only two of them, the observed expenditure will be used for the service excluded from the package, while the model equations for the other two components will be employed to obtain the predicted shares in order to impute the unobserved expenditures. Moreover, the residual component called "other services" in this paper includes different services, like local transport, food-serving services, other services not included elsewhere, that will require ad-hoc models in the practical implementation of the proposed approach.

Despite these minor considerations, the evidence produced in this work should be enough to convince BoP compilers on the usefulness of ML methods to improve the unbundling of package tours.

References:

1. Bunea, F., Tsybakov, A., and Wegkamp, M. (2007). Sparsity oracle inequalities for the Lasso. *Electronic Journal of Statistics*, 1, 169-194.
2. Dalalyan, A. S., Hebiri, M., and Lederer, J. (2017). On the prediction performance of the lasso. *Bernoulli*, 23(1), 552-581.
3. Donoho, D. L. (2006). For most large underdetermined systems of linear equations the minimal $\ell 1$-norm solution is also the sparsest solution. *Communications on Pure and Applied Mathematics: A Journal Issued by the Courant Institute of Mathematical Sciences*, 59(6), 797-829.
4. Friedman, J., Hastie, T., and Tibshirani, R. (2001). *The Elements of Statistical Learning* (Vol. 1, pp. 337-387). New York: Springer Series in Statistics.
5. IMF (2009), *Balance of Payments and International Investment Position Manual*, Sixth Edition (BPM6), Washington, D.C.: IMF
6. Knight, K., and Fu, W. (2000). Asymptotics for lasso-type estimators. *The Annals of Statistics*, 28(5), 1356-1378.
7. Lee, J. D., Sun, D. L., Sun, Y., and Taylor, J. E. (2016). Exact post-selection inference, with application to the lasso. *The Annals of Statistics*, 44(3), 907-927.
8. Meinshausen, N. (2007). Relaxed lasso. *Computational Statistics and Data Analysis*, 52(1), 374-393.
9. Meinshausen, N., and Bühlmann, P. (2006). High-dimensional graphs and variable selection with the lasso. *The Annals of Statistics*, 34(3), 1436-1462.
10. Plan, Y., and Vershynin, R. (2016). The generalized lasso with non-linear observations. *IEEE Transactions on Information Theory*, 62(3), 1528-1537.
11. Tibshirani, R. (1996). Regression Shrinkage and Selection via the Lasso. *Journal of the Royal Statistical Society. Series B (methodological),* 58 (1), 267–88.
12. Zhao, P., and Yu, B. (2006). On model selection consistency of Lasso. *Journal of Machine Learning Research*, 7(Nov), 2541-2563.

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Introductory remarks / Statistical challenges posed by globalisation – some remarks from Basel[1]

Bruno Tissot,
Bank for International Settlements (BIS)

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

BIS

Statistical challenges posed by globalisation some remarks from Basel

Bruno Tissot

Head of Statistics and Research Support, BIS & Head of the Secretariat of the Irving Fisher Committee on Central Bank Statistics

63rd ISI World Statistics Congress - IPS 113 - Addressing globalisation challenges – 14 July 2021 (virtual)

The views expressed are those of the author and do not necessarily reflect those of the BIS or the IFC.

Main remarks

- **Globalisation challenges**
- **A roadmap**
- **Focus 1: Nationality-based statistics**
- **Focus 2: Cross-border activities**
- **Focus 3: Granular view of financial corporations sector**
- **Questions**

Globalisation challenges

- **Important challenges to official statistics, reinforced by**
  - Rapid digital innovation (eg dematerialisation of economic activities)
  - Complexity / limited transparency of multinational corporate structures
  - Increased importance of global financial centres
- **Examples of such challenges**
  - Fragmentation of global production chains across borders
  - Changing nature of foreign direct investment (FDI): increased financial role
  - Difficulties to measure / assess impact of cross-border positions and flows
  - Assessing global exposures (off- and on-balance sheet)
  - Large effect on macro indicators: cf intragroup transfers of intangible assets (eg intellectual property products (IPPs)) in Ireland
  - …

A roadmap looking forward? Lessons from recent IFC work

- **Enhancing the global statistical infrastructure**

→ eg legal entity identifier (LEI)

- **Improving the exchange of confidential statistical data**

→ eg international data sharing

- **Organising a comprehensive data collection for large corporates**

→ cf exercise conducted for global banks at the BIS

- **Enhancing the granularity of SNA aggregates**

→ eg identification of special purpose entities (SPEs), foreign-controlled corporations, non-bank financial sub-sectors

- **Complementing the residency-based framework of the SNA**

→ eg use information derived from consolidated accounting frameworks

Contributions of the session presentations

- *"A Roadmap to the Concept of "Nationality" in the External Sector Statistics Revision" (Vieira & Ferreira Lemos, Banco Central do Brasil)*
  - Unique opportunity provided by **ongoing SNA/BPM revisions**
  - **Improved information** on foreign controls, ultimate investors, MNEs, SPEs
- *"An assessment of euro area households' missing foreign assets" (Martin Schmitz, ECB)*
  - Importance of **asset / liability global discrepancies** ("unrecorded assets")
  - **Useful new initiatives** (global tax transparency, voluntary disclosures, "mirror" counterparty-country information in BIS banking statistics)
- *"A Typology of Captive Financial Institutions and Money Lenders in Luxembourg" (Di Filippo & Pierret), Central Bank of Luxembourg)*
  - More **granular measurement / typology** of the non-bank financial sector
  - Understanding **intragroup operations & role of global financial centres**

Focus 1: Nationality-based statistics

- **The residency-based SNA approach relies on a "triple coincidence"**
  - national territory
  - decision-making unit
  - currency area

- **Nationality-based statistics**
  - **Nationality defined** as the country of residence of a firm's controlling entity
  - Facilitates the monitoring of global, **"borderless" MNEs indicators**
  - Allow balance sheets to be considered on a **consolidated basis**
  - Independently of the location of **controlled affiliates**
  - Help to assess **global exposures**
  - **BIS nationality-based statistics (consolidated or not)** show how this can be done
  - **Complementary** information: parent relationships complex and unstable

Focus 2: Cross-border activities

- **Measurement issues**
  - **Firms**: cross-border impact of complex intra-group operations
  - **Households**: foreign holdings difficult to capture due to tax evasion / role of foreign custodians
  - Issues masking the **true geography of investors' exposures**
  - Can have sizeable **impact on BoP and IIP indicators**
- **Developing a global view**
  - BIS statistics provide **country counterparty breakdowns**
  - Cross-border information **linking issuers and ultimate investors**
  - Use of **global sources**: mirror data; data sharing; global registers

Focus 3: Granular view of financial corporations sector

- **Growing importance of financial globalisation**
  - **FDI transactions**: financial purpose instead of “real investment”
  - Impact of regulatory/tax optimisation strategies on **MNEs relocation**
  - **Complex structures**: network of affiliates with little presence
  - **SPEs** treated as institutional units if they are not in the parent economy (even though they may not act independently)

- **Role of financial centres in international capital allocation**
  - Main countries involved in FDI operations today are frequently **small open economies and financial and offshore centres**
  - Trend reinforced by the **shift in global credit intermediation** from banking to offshore debt issuance (often classified as FDI)
  - Need to **better identify** SPEs, foreign firms, and control relationships

Thank you!!

Selected references

- IFC Bulletin, no 52 (2020): "Bridging measurement challenges and analytical needs of external statistics: evolution or revolution?"
- Reporting guidelines for the BIS international banking statistics (2019)
- BIS 87th Annual Report (2017): "Understanding globalisation", Chapter VI
- BIS Working Papers no 587 (2016): "Globalisation and financial stability risks: is the residency-based approach of the national accounts old-fashioned?"
- IFC Report no 2 - An IAG reference document (2015): "Consolidation and corporate groups: an overview of methodological and practical issues"

Questions?

bruno.tissot@bis.org

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

A roadmap to the concept of "nationality" in the external sector statistics revision[1]

Thiago Said Vieira and Fernando Augusto Ferreira Lemos,
Central Bank of Brazil

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

A Roadmap to the Concept of "Nationality" in the External Sector Statistics Revision

IPS 214 - Addressing globalisation challenges

Author: Thiago Vieira and Fernando Lemos
Affiliation: Banco Central do Brasil
Email: thiago.vieira@bcb.gov.br and fernando.lemos@bcb.gov.br

BANCO CENTRAL DO BRASIL

Introduction

- National accounts and external sector statistics (ESS) frameworks are based on the concept of **residence**

  "the economic territory with which it has the strongest connection … its centre of predominant economic interest" (SNA 2008, par. 4.10, and BPM6, par. 4.113)

- At the same time, several statistical datasets address the concept of **nationality** (BIS International Debt Security Statistics (IDS), BIS International Banking Statistics (IBS), OECD databases for Activity of MNE (AMNE), OECD Trade by Enterprise Characteristics (TEC) and Trade in Value Added (TiVA), Eurostat-OECD database on services TEC (STEC))

- Globalization - related topics, such as multinational enterprises (MNEs), address **nationality** as a complement to **residence**

SNA 2008 and BPM6 revision processes

SNA 2008 and BPM6 revision processes (2020-25) are addressing several issues of research, related to **nationality.** The IMF's Committee on Balance of Payments Statistics clearly addressed this in a 2019 strategy note:

" (…) extending the traditional residency-based cross-border positions with supplementary information based on nationality and/or of expanding the institutional sector breakdown of the accounts to record separately transactions/positions corresponding to resident units belonging to multinational groups."

A Backbone Strategy for Updating BPM6 (IMF, 2019)

The Task Teams (TTS) established for the revision of the BPM6 are addressing the concept of nationality in several Guidance Notes (GN)

Guidance Notes (1/4)

Current Account Task Team (CATT)
"C.2 Goods, Services, and Investment Income Accounts by Enterprise Characteristics"

- The GN proposes a breakdown by enterprise characteristics, <u>including nationality (foreign-owned/domestically-owned)</u>, for exports and imports of goods and services, and for income

- Aims to <u>support a better analysis of globalization</u>, identifying the role of MNEs in current account transactions

Guidance Notes (2/4)

Direct Investment Task Team (DITT)
"D.6 Ultimate Investing Economy/Ultimate Host Economy and Pass-through Funds"

- Concepts of Ultimate Investing Economy (UIE) and Ultimate Host Economy (UHE) are closely linked to **<u>nationality</u>**
- Statistics using UIE and UHE are useful to Global Value Chain (GVC) initiative and to measure pass-through funds
- Financial linkages and interdependencies between economies are more evident knowing the ultimate investors
- MNE corporate structures are complex, and direct investment is frequently channeled through many economies, with several steps between the headquarters and the final destination

Guidance Notes (3/4)

Direct Investment Task Team (DITT)
"D.9 Reconciling BPM-Based Direct Investment (DI) and Activities of MNEs (AMNE) Statistics"

- AMNE statistics use the nationality approach, focusing on the location of the entity that ultimately controls the DI enterprise

- The GN recommends developing a framework for the reconciliation of DI statistics (residence approach) with AMNE:

"*identifying additional breakdowns of either sets of statistics, new supplemental presentations, and perhaps additional variables to enable the two sets of statistics to be used together*"

Guidance Notes (4/4)

Joint Globalization Task Team (GZTT)
“G.4 Treatment of Special Purpose Entities and Residency”

- Special Purpose Entities (SPE) have gained relevance
- The concept of residence should remain central following revisions
- Focus on resident SPEs with nonresident controller, implying no methodological change to the nationality concept
- However, the GN proposal is to increase the disaggregation and granularity of published data, separately identifying SPEs as “of which” items, and thus allowing to users to derive nationality information

Conclusions

- Residence will remain the central concept in in the revised manuals
- More supplementary and encouraged items addressing nationality are expected
- More detailed guidance regarding nationality and coordination among the revision bodies is required to assure consistency across the different statistical domains
- A significant increase in reporting and compiling burdens should be expected from compiling statistics following the concept of nationality

A Roadmap to the Concept of "Nationality" in the External Sector Statistics Revision

Thiago Said Vieira[1]; Fernando Augusto Ferreira Lemos[2]

[1] Banco Central do Brasil, Department of Statistics (DSTAT), Head of the Balance of Payments Division.
[2] Banco Central do Brasil, Department of Statistics (DSTAT), Deputy Head of Department.

Abstract:
The System of National Accounts (SNA 2008) has only two incidental mentions to the concept of « nationality » (to discart it). The Balance of Payments and International Investment Position Manual (BPM6) has none. Nonetheless, this concept would likely play an important role in the current revision process of both manuals, as the main economic reasons for this revision are globalization and digitalization. While maintaining the concept of residence as pivotal to structuring macroeconomic statistics and recording transactions and positions, both SNA and BPM framework are likely to consider nationality as supplemental and explore the duality of both concepts. This paper focus on the revision process of the BPM framework and the role nationality concept is likely to play in it both in the current and the financial account, specially relating to direct investment.

Keywords:
Residence; Nationality; External Sector Statistics.

1. Introduction

Residence is one of the pivotal concepts for compiling macroeconomic statistics, both for transactions and positions. In this aspect, national accounts and external sector statistics (ESS) frameworks are fully consistent. In the two manuals, the residence concept is defined, for each institutional unit, as "*the economic territory with which it has the strongest connection … its centre of predominant economic interest*" (SNA 2008, par. 4.10, and BPM6, par. 4.113)[1].

On the other hand, SNA 2008 has only two incidental mentions to the word "nationality". The most relevant to this paper intends to explicitly differentiate residence from it: "*The concept of residence in the SNA is not based on nationality or legal criteria*" (SNA 2008, par. 2.19)[2]. BPM6 does not use the word.

Nonetheless the explicit rejection of the nationality concept, it in a way enters the national accounts actual framework through the identification of "foreign controlled" institutional units. When sectorizing corporations, both SNA 2008 and ESA 2010 create a subsector for foreign controlled financial, non-financial and non-profit institutions serving households units. Foreign control is simply defined as "*corporations controlled by non-resident units*" (SNA 2008, par. 4.96), "*all … corporations and quasi-corporations that are controlled by non-resident institutional units*" (ESA 2010, par. 2.54). Control is generally viewed as implying at least 50% of voting power by the investor. As such, these foreign controlled corporations are the multinational enterprises (MNE), established by direct investment (DI) transactions. MNEs, as

[1] For further details regarding to the residence concept refer to SNA 2008 par. 4.10 to 4.15 and 26.36 to 26.48 and to BPM6 par. 4.113 to 4.144.
[2] ESA 2010 has a similar paragraph: "*… Such units are known as resident units, irrespective of nationality, legal form or presence on the economic territory at the time they carry out a transaction*".

a matter of fact, are a subgroup of DI enterprises, which could be separately identified in DI transactions as well as positions.

Some statistics already deal with the nationality concept, such as the Bank for International Settlements (BIS) International Debt Security Statistics (IDS) – with separate datasets by residence and by nationality – and International Banking Statistics (IBS) – which identifies foreign banks in the reporting country in the Locational Banking Statistics (LBS) and consolidates domestic banks' with its non-resident subsidiaries in the Consolidated Banking Statistics (CBS). In a sense, the United Nations Conference for Trade and Development (Unctad) statistics on foreign direct investment (FDI) debt instruments, using the directional principle, refers to the nationality principle when considering the parent company to classify the transactions as inward or outward FDI. The Organization for Economic Cooperation and Development (OECD) databases for Activity of MNE (AMNE), Trade by Enterprise Characteristics (TEC) and Trade in Value Added (TiVA) and Eurostat-OECD database on services TEC (STEC), all consider the duality of domestic and foreign institutional units.

The developments of globalization since the publication of SNA 2008 and BPM6, specially the broader scope of MNEs activities across countries, raised the case for methodological discussions on the residence/nationality complementarity within these statistical frameworks. As MNE play a key role in the internationalization and integration of trade, production and finance – such as in production chains, research and development, intellectual property rights, services, capital flows, etc. including by creating complex corporate structures in many countries – methodological guidance, data collection and data templates for statistical presentations are viewed as important steps forward.

The remaining of the paper is structured as follows: item 2 presents SNA and BPM6 revision processes and highlights the role of nationality, item 3 discusses the guidance notes (GN) already approved or circulated for public consultation, and item 4 summarizes the main findings and concludes.

2. SNA and BPM revision process and the role of "nationality"

SNA 2008 and BPM6 revision processes both started in the beginning of 2020 and target the release of the new manuals by March 2025. Phase 1 of the BPM6 revision process, from March 2020 to March 2022, is expected to deal with the research issues listed in IMF (2020a) by the creation of dedicated Task Teams (TT). When issues overlap, SNA/BPM joint TT are created. On phase 1, the International Monetary Fund's (IMF) Committee on Balance of Payments Statistics (Bopcom) should take the methodological decisions whether to maintain status quo or to change the guidance regarding specific methodological concepts, disaggregation of information and standard or supplementary/encouraged presentations. Phase 2, then, is planned to prepare an Annotated Outline, make consultations and seminars worldwide and draft chapters and appendixes of the BPM7 (IMF, 2020b).

While a decision is already taken to sustain residence as the main concept and the criteria for all standard statistical presentations, the revision processes of both SNA 2008 and BPM6 are dealing with nationality issues.

The Intersecretariat Working Group on National Accounts (ISWGNA) included on the SNA update list of issues a specific topic on "Nationality concept / Extension of IIP on a nationality basis". The distinction among domestic and foreign companies, according to the ISWGNA, is likely to achieve users' needs, contribute to financial stability analysis and to the better understanding of GDP/GNI relationship (ISWGNA, 2020). Bopcom likewise included the issue of extending the residence concept. The aim seems to be adding, on supplementary basis, nationality information by creating non-mandatory additional breakdowns to the standard presentations or perhaps even consolidating cross-border positions of resident and non-resident MNEs according to the nationality of the parent company (IMF, 2019a).

Bopcom's compendium of research issues for the updating of the BPM6 (IMF, 2020a) includes a specific GN on the nationality concept, but the issue also touches upon several specific topics treated in individual GN. The planned list of GN include discussions on residence/nationality impacting the current and the financial accounts as, although mainly an DI issue, the impacts of separating domestic and foreign companies potentially reach trade in goods and services and primary income, as well as financial flows. For the current account, one issue in how to include TEC in the BPM framework. Regarding DI, one main topic is more detailed guidance for compiling DI statistics for the Ultimate Investing Economy (UIE) and Ultimate Host Economy (UHE), trying to go further than the immediate balance of payments transaction counterparts to identify the foreign controller or the chain of control from the domestic investor. Also, for DI relationships there are issues related to reconcile DI and AMNE statistics and to disentangle the connections of Special Purpose Entities (SPE) between the domestic unit and its foreign controller. In this latter case, consideration is also taken from the previous Bopcom work on SPEs and the separate SPEs data collection to start this year.

3. Guidance Notes (GN) proposals

The BPM6 updating process includes detailed research on the issues identified in IMF (2020a) and discuss how they would impact the new manual. This paper highlights the approved or in public consultation GNs, produced by the Current Account Task Team (CATT), the Direct Investment Task Team (DITT) and the Joint (ISWGNA and Bopcom) Globalization Task Team (GZTT), proposing to create supplementary tables and "of which" lines related to the nationality concept, broadening the scope of ESS.

CATT – GN C.2 Goods, Services, and Investment Income Accounts by Enterprise Characteristics

This GN proposes the development of an encouraged data collection template that introduces further disaggregation of exports and imports of goods and services, as well as investment income, specifically the breakdown of these balance of payments accounts by enterprise characteristics, including nationality (foreign-owned/domestically-owned). These statistics would support a better analysis of globalization – better identifying the role of MNEs in current account transactions – including the OECD-IMF Working Group on Balance of Payments Statistics Relevant to Global Value Chains, OECD TEC and Eurostat-OECD STEC statistics.

The GN proposes separate templates for international trade in goods and in services. At the first level of the proposed breakdown, there is a distinction between enterprises domestically controlled and those controlled from abroad. In a second level, within the domestic controlled enterprises, the template disaggregates enterprises belonging to a multinational group. All the lines are associated with the main products/services, industry and partners countries. This data collection would allow to start to build a map of importers and exporters considering the nationality criteria and thus going beyond the residence concept.

According to the GN, the ownership of enterprises engaged in international trade, foreign or domestically owned, have recently been added to TEC statistics by many countries. Nevertheless, precise definitions of MNE and control (UIE versus Immediate Investor Economy), and more guidance on the identification of partner country are yet to be elaborated.

From the description above, it is clear the need for much more disaggregated data collection processes and databases. The users' needs, in this case, will probably represent a significant additional burden both to compilers and data providers. Legal provisions and regulations would have to be enacted or amended, closer contact to data providers should be stablished, compilers units budget are likely to increase or to represent a risk to the data collection and an enterprise-by-enterprise business register would probably have to be developed to include the necessary information on foreign control.

DITT – GN D.6 Ultimate Investing Economy/Ultimate Host Economy and Pass-through Funds

Standard bilateral DI statistics are based on the first known counterpart, i. e., on an immediate partner basis and are the ones more frequently compiled by reporting countries and are useful to know where financial claims and liabilities are created. However, a simple ownership structure, with the direct investor resident on one economy and the direct investment enterprise resident in another economy, very often does not resume the complexity of MNEs corporate arrangement. The DI is frequently channelled through many economies, with several steps between the headquarters and the final destination. In this sense, DI by UIE and UHE also have analytical value identifying who makes the investment decisions, who has the benefits and holds the risks. The financial linkages and interdependencies between economies are more evident knowing the ultimate investors, information which is also useful to treat the country allocation of income in the Global Value Chains (GVCs) framework.

This GN recommends the development of supplementary presentations of DI statistics by ultimate partner economy and identifying pass-through funds to greatly enhance the interpretability and usefulness of these statistics to users. Addressing one issue raised by the previous GNs, including IMF (2021a), the text discusses different definitions of the UIE and UHE, and proposes a presentation by residency of the ultimate investor as an indication of funds and income passing through an economy.

While residency concept is related to DI statistics on an immediate partner basis, statistics based on UIE and UHE are closely linked to the nationality concept. From the point of view of the reporting economy, UIE/UHE statistics means going beyond the immediate partner economy by identifying the control chain of the UIE, i.e., by considering the nationality of the unit at the end of the control chain.

As mentioned in analysing the first GN, there are likely significant additional costs to revising survey forms and interacting with respondents to clarify the needed information on the full controlling chain of its investors or of its investments abroad.

DITT – GN D.9 Reconciling BPM-Based Direct Investment (DI) and Activities of MNEs (AMNE) Statistics

Geographical diversification for reasons such as trade barriers, proximity to markets and reduction of costs and taxes is a characteristic of MNEs activities. As already pointed out in the previous GN (IMF, 2021b), the ultimate source and destination of DI could be “masked” in ESS by investment passing through various intermediate enterprises and economies. Providing a better understanding of the location and nature of MNE operations is an objective of the AMNE statistics.

AMNE statistics uses the nationality approach, focusing on the location of the entity that ultimately controls the DI enterprise. AMNE statistics are nationality-based and statistics by immediate partner are out of its scope. But some variables can include links between affiliates in the same country (transactions between residents, not included in the BPM framework), and also between fellows in different economies, that share a common parent (transactions between non-residents, not included in the BPM framework). Nevertheless, the framework of DI statistics is based on the residency concept, which excludes such transactions.

There is currently no agreed framework for reconciling AMNE with DI statistics, including the residency/nationality approach. The GN recommends developing a framework for this reconciliation within the current revision process, "*identifying additional breakdowns of either sets of statistics, new supplemental presentations, and perhaps additional variables to enable the two sets of statistics to be used together*".

Regarding the challenge for compilers and the burden for respondents, the reconciliation will probably need additional detailed and granular information on the transactions of each affiliated with other, as well as the ultimate controller. As mentioned in a previous paragraph, not all such transactions are included in the resident/non-resident framework of ESS, making this data collection specially challenging for balance of payments compilers. Necessary granular data sharing with other agencies is also far from granted.

GZTT – GN G.4 Treatment of Special Purpose Entities and Residency.

Special Purpose Entities (SPE) acquired growing importance in global financial flows and MNE corporate structure, being used as financial conduits, channels to pass-through investments, holding companies, intragroup lending, captive financial activities etc. Besides that, SPEs have also broadened their scope to nonfinancial activities (see the SPEs typology in IMF, 2018). As such, SPEs activities not only cannot be disregarded in the analysis of capital flows but there is a growing users' demand for separately identifying SPEs activities and flows.

From a compiler's point of view, it is necessary to have a clear and unique definition of SPEs, consistent across statistical domains, to avoid national definitions influenced by legal or institutional frameworks and achieve international comparability. The GN adopts the Bopcom's Task Force on SPE (IMF, 2018) definition of SPEs as an institutional unit, resident in an economy, direct or indirectly controlled by non-residents, transacting almost entirely with non-residents, with little or no physical presence or production nor employees. The discussion in the SNA and BPM revision processes highlighted the need to maintain the residence concept, focus on resident SPEs with non-resident controller, and consider SPEs as institutional units, not consolidating them with the non-resident parent.

The maintenance of the residence concept aims at keeping SPEs as institutional units, i.e., not consolidating with the non-resident parent company – which would be the case if a methodological change to the nationality concept were proposed to be implemented. The GN proposal is to increase the disaggregation and granularity of data published, on a supplementary/encouraged basis, to separately identify SPEs as "of which" items to the ESS standard presentation. These separate lines are to be provided by institutional sector (financial and nonfinancial), by current account items (goods – merchanting, services – transport, financial services, charges for the use of intellectual property, and other business services, and income) and financial accounts functional categories (DI, portfolio investment, financial derivatives and other investment).

The GN proposal allows users to derive nationality information from the statistical frameworks, via more disaggregated data. A more disruptive proposal, disregarded on practical grounds (costs involved and practical feasibility), was to prepare a supplementary presentation completely disregarding the residence concept and consolidating resident SPEs with the non-resident parent on a nationality basis. It is equivalent to a global consolidation of the domestic MNE in its reporting country statistics, i. e., the resident unit and all its non-resident-controlled entities. Although dismissed on practical grounds as a recommendation in the forthcoming manuals, the GN recognizes users' interest in such presentation, provided that careful explanations are given, to avoid confusion of both datasets.

To achieve the objective of separately identifying SPEs, there is an obvious need for more disaggregated data. Following the Task Force on SPE report, the IMF decided to launch a data collection initiative (IMF, 2019b) to separately identify SPE's transactions as "of which" lines to the ESS standard presentation on supplemental/encouraged basis. This annual exercise will begin with end-2020 position, to be reported to the IMF this year and be publicly disseminated by early 2022.

4. Conclusion:

This paper provided an overview of the current discussions within the revision process of SNA and BPM regarding the duality of the residence and nationality concepts. While a decision was already taken to maintain the residence criteria as the structuring one for compiling and presenting macroeconomic statistics, there is likely to be as increasing role to supplementary and encouraged, non-mandatory, presentations using the nationality concept.

The reasons for the growing role of nationality-based statistics are the increased globalization, the central role of more and more complex MNE structures involving many countries, the blurring definitions of its activities at each economic territories boundaries, and users' needs for additional presentations to provide a broader and more complete picture of economic and financial flows, activity and production. In this sense, several topics in the research agenda of both SNA and BPM deal with methodological guidance (concepts and definitions), collection of additional and granular data, new templates with more disaggregated presentations, all related to complementing residence-based statistics with information by nationality.

This paper analysed the main nationality related GN already made public and reached three main conclusions:

1. It is a necessity that the new SNA and BPM framework present more detailed guidance regarding nationality, as well as supplementary/encouraged templates to disclosure additional information needed by users.
2. While this is still a work in process, higher-level coordination among the main SNA and BPM bodies are crucially needed to consolidate the different proposals and make them consistent within the framework of each statistical domain and among them.
3. If all proposals are accepted there will likely be a significant increase in respondent's cost of observation and in the compilers' burden, which have to be carefully evaluated.

References:

1. European Commission (EC) – Eurostat. (2013). European System of Accounts (ESA 2010).
2. IMF and ISWGNA. (2021). Treatment of Special Purpose Entities and Residency.
3. IMF. (2009). Balance of Payments and International Investment Position Manual, Sixth Edition (BPM6).
4. IMF. (2018). Final Report of the Task Force on Special Purpose Entities (TFSPEs).
5. IMF. (2019a). A Backbone Strategy for Updating BPM6.
6. IMF. (2019b). Implementation Plan for Launching Data Collection Template on Special Purpose Entities.
7. IMF. (2020a). BPM Update. Compendium of Research Issues Version 1.1.
8. IMF. (2020b). Process and Timeline for Updating BPM6.
9. IMF. (2021a). Goods, Services, and Investment Income Accounts by Enterprise Characteristics.
10. IMF. (2021b). Ultimate Investing Economy/Ultimate Host Economy and Pass-through Funds.
11. IMF. (2021c). Reconciling BPM-Based Direct Investment (DI) and Activities of MNEs (AMNE) Statistics.
12. ISWGNA. (2020). 2008 SNA update issues.
13. United Nations, IMF, World Bank, OECD and EC. (2009). System of National Accounts 2008 (SNA 2008).

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

An assessment of euro area households' missing foreign assets[1]

Martin Schmitz,
European Central Bank

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

EUROPEAN CENTRAL BANK

EUROSYSTEM

An assessment of euro area households' missing foreign assets

63rd World Statistics Conference

11 July 2021

Martin Schmitz
European Central Bank

Introduction

How large are euro area households' missing foreign assets?

- **Research** methods and results
- **Assessment** of research studies in a euro area context
- **Implications** for estimates of euro area households' assets

Research methods

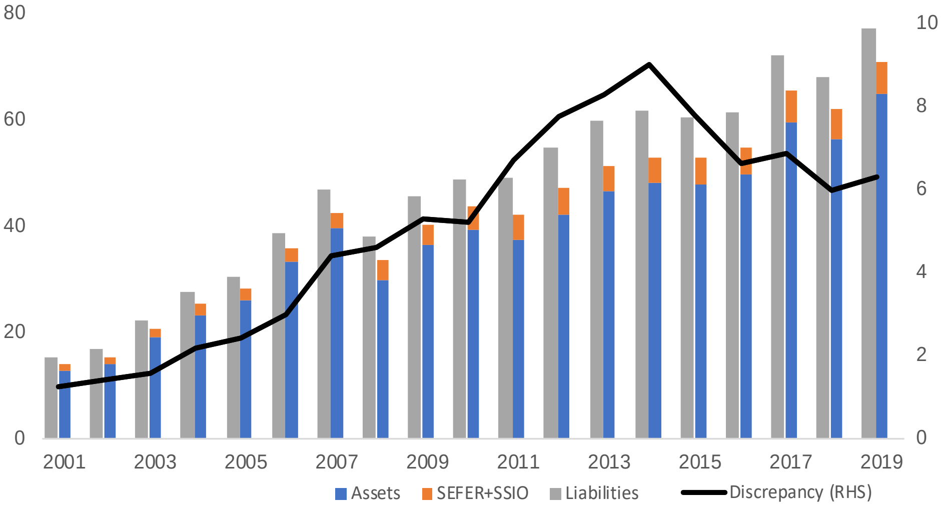
Estimates of households' unrecorded foreign assets based on:

1. The global discrepancy between **portfolio investment liabilities and assets** (including securities held as foreign exchange reserves)
2. Data on **external deposits** (obtained e.g. from the Swiss National Bank and the BIS)
3. Net **errors and omissions**
4. Voluntary **disclosure/reporting** schemes

Excess global portfolio investment liabilities

Global discrepancy between assets and liabilities in international security holdings, attributed to households' assets

(Zucman, 2013; Alstadsæter, Johannesen and Zucman, 2018) (AJZ))



Source: Lane and Milesi-Ferretti (2018), IMF Securities Held as Foreign Exchange Reserves (SEFER) and Securities Held by International Organizations (SSIO).

Data on external deposits

- **Swiss National Bank** data
  - Foreign households’ assets held in Switzerland consisted to 25% of (fiduciary) deposits and 75% of securities (Zucman, 2013)
  - Ratio applied globally
- **BIS locational banking statistics** (LBS)
  - Data on bank deposits by non-banks banks (other financial and non-financial corporations, households and NPISH)
  - AJZ allocate offshore assets held outside Switzerland by country

Assessment of research studies (1)

Discrepancy between global asset and (portfolio) liability positions in securities (6 tn US dollar in 2019)…

1. …only due to **households'** unrecorded assets?
   - Incomplete **country coverage** (mainly in reserve assets)
   - Coverage gaps also for **non-financial corporations (NFCs)** and institutional investors
   - France: **1/3** of missing assets belong to NFCs (Bui Quang and Gervais, 2019)
2. …may reflect **misclassifications** between portfolio equity and FDI equity
   - **Excess global FDI equity assets** over liabilities of around 2 tn US dollar in 2017
   - Potentially problems for inward FDI to identify 10% threshold and incomplete coverage

Assessment of research studies (2)

Estimates of households' offshore assets in **Switzerland**…only due to **households**?

	Method	Securities	Deposits	Total	*of which EA*
(1)	Alstadsæter, Johannesen and Zucman (2017)	2,174	167	2,342	822
(2)	Reported by SNB and BIS	539	184	724	254
(3)	Securities (55% HH share), Deposits (as reported)	1,087	184	1,271	446
(4)	Sec. (55% HH share), Dep. (non-bank, 55% HH share)	1,087	198	1,285	479
(5)	Sec. (100% HH share), Dep. (non-bank, 100% HH share)	1,976	361	2,337	791

Outside Switzerland:

- Falling deposits in offshore financial centres (partly) driven by international initiatives to tackle tax evasion
- **Euro area households' assets** (including securities)
  ~390 bn US dollar, if same ratio as for Switzerland is used (5.5)
  ~120 bn US dollar (if ratio of 1 is used)

Euro area households' foreign assets

Total extra-euro area: **~540 to 800 bn euro** in 2017

- In Switzerland: ~500 bn US dollar
- In other countries: range from 120 to 390 bn US dollar

Of which 20% may be recorded in official statistics (Zucman, 2013):

Total **unrecorded** assets: **~430 to 640 bn** euro in 2017

- 1.7% to 2.5% of euro area external assets recorded in the i.i.p.
- **3.5% to 5% of euro area annual GDP**

*AJZ estimated **7%-8% of euro area GDP for 2007***

Euro area households' foreign assets:

Why are the estimates smaller?

- **Measurement issues** and **assumptions** made in research studies
  - Better **coverage** of securities holdings
  - Estimates may partly reflect assets of **corporations** rather than households
  - Potential **misclassifications** between FDI and portfolio investment

- **Global developments**
  - Falling offshore deposits, at least partly due to **global tax transparency** initiatives
  - Incorporation of (previously) unrecorded offshore assets in official statistics (e.g. following **voluntary disclosure schemes**)

- **Looking ahead**
  - Pursue initiatives to improve official statistics on foreign assets of households
  - Maintain dialogue with researchers

An assessment of euro area households' missing foreign assets[1]

Martin Schmitz
European Central Bank (ECB), Frankfurt am Main, Germany

Abstract

This paper reviews the methodologies behind estimates of households' "missing" foreign assets contained in key research studies, with a particular focus on the euro area. Recent research studies estimate euro area households' offshore financial assets at 7% to 8% of GDP, while this paper suggests them to be lower at around 3.5% to 5% of GDP. These lower estimates reflect measurement issues and strong assumptions made in research studies, for example due to allocating unrecorded assets entirely to households rather than corporations as well as potential misclassifications between direct investment and portfolio investment. Moreover, there is evidence that households' unrecorded foreign assets have declined in recent years due to global tax transparency initiatives and the incorporation of previously unrecorded offshore assets in official statistics, for instance following voluntary disclosure schemes.

Keywords:
Balance of payments, international investment position, households, offshore wealth

1. Introduction

This paper reviews the methodologies behind estimates of households' "missing" foreign assets contained in key research studies, with a particular focus on the euro area. It presents various methods to estimate households' foreign assets in Section 2, while Section 3 critically these approaches. Section 4 derives implications for the estimation of euro area aggregates and concludes.

2. Research methods and results

2.1 Discrepancies between global assets and liabilities

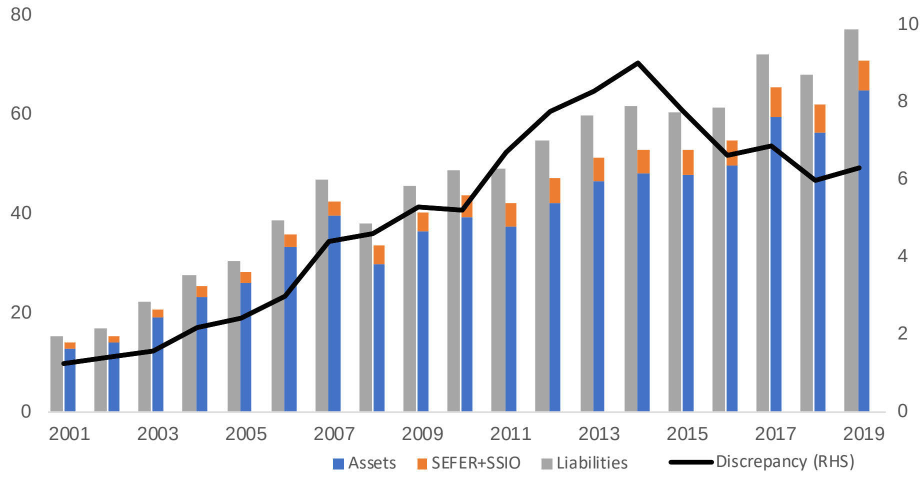
The pioneering study of Zucman (2013) on households' unrecorded assets in international investment position (i.i.p.) statistics attributed the excess in global portfolio investment liabilities over assets entirely to households' 'hidden' foreign assets. This rests on the assumption that portfolio investment liabilities, all securities held by direct reporters and those held by households outside offshore financial centres are captured perfectly in official statistics. Under this assumption, the global discrepancy between portfolio liabilities and assets (including securities held as foreign exchange reserves and held by international organisations) corresponds 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 a discrepancy of 6.3 trillion (tn) US dollar between global portfolio investment liabilities and assets in 2019 is found (Figure 1).[2] The global discrepancy has significantly declined from its peak of 9 tn US dollar 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 (see Section 3.3).

---

[1] Email: Martin.Schmitz@ecb.int. The views expressed in this paper are those of the author and do not necessarily reflect those of the European Central Bank. I am grateful for comments to H. Ahnert, M. Anacki, S. Bösenberg, C. Giron, I. Kavonius, O. Monteiro, F. Pastoris, C. Picon-Aguilar, N. Silva, P. Sola, C. Willeke as well as members of the ESCB Statistics Committee and Working Group on External Statistics.

[2] The results presented in Figure 1 are consistent with Zucman (2013) who estimated the discrepancy at 4.5 tn in 2008 and also in line with Alstadsæter, Johannesen and Zucman (2018), Pellegrini, Sanelli and Tosti (2016) and Gervais and Bui Quang (2019).

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).

2.2 Using data published by the Swiss National Bank and the BIS

Key data sources in the estimation of households' foreign assets are the datasets on *Securities holdings in bank custody accounts* and *Fiduciary deposits* published by the Swiss National Bank (SNB). Based on these datasets, Zucman (2013) estimated for 2008 that households' offshore wealth held in Switzerland consisted to 25% of (fiduciary) deposits and 75% of securities. He applied these proportions to the global discrepancy in security holdings to compute households' total offshore assets (including deposits).[3]

In order to compute the offshore assets of households resident in a given country Alstadsæter, Johannesen and Zucman (2018) (AJZ) allocate the estimated global amount of offshore wealth using counterpart country information provided by the SNB and the Bank for International Settlements (BIS). First, they estimate on a country-by-country basis the assets held by foreign households in Switzerland. To this end, AJZ focus on holdings of fiduciary deposits which according to Zucman (2013) are likely to "entirely belong to foreign [..] households[4] Including security holdings, AJZ estimate that offshore assets held in Switzerland peaked in 2007 at 2.9 tn US dollar, but have declined to 2.2 tn US dollar in 2015. In 2006-2007, 35% of offshore assets intermediated via Switzerland are attributed by AJZ to the euro area. Second, to estimate the offshore wealth held by households outside Switzerland AJZ use data on bank deposits by non-banks (other financial and non-financial corporations as well as households and NPISH) in a number of offshore financial centres as reported in the locational banking statistics (LBS) of the BIS.[5]

AJZ make several important assumptions: first, the authors derive holdings of securities in custody in a particular offshore centre by applying the same ratio of deposits to securities to all offshore centres. Second, they assume that a country's share in deposits by non-banks in a given offshore centre also applies to the total assets (consisting of deposits plus securities) in this offshore centre. Third, the authors could only access the BIS breakdown which distinguishes banks' deposit liabilities vis-a-vis other banks and non-banks. In an effort to exclude all deposits of non-bank corporations, the authors "estimate" for each offshore centre

[3] By using an equivalent approach at annual frequency, Alstadsæter, Johannesen and Zucman (2018) (AJZ) find global offshore financial assets of 8.6 tn US dollar in 2015, 7.0 tn US dollar of which in securities and 1.6 tn US dollar in deposits.

[4] AJZ use the counterparty country breakdown recorded for 2003 and 2004, i.e. just before the EU Saving Tax Directive entered into force. The underlying rationale is that there was no evidence of EU residents channelling their deposits in Switzerland via intermediary "shell companies" (trusts, foundations and holding companies) resident in tax havens in those years, while this phenomenon increased substantially afterwards. Thus, to 'look-through' shell companies, AJZ assume that the 'true' country distribution of deposits held in Switzerland was observed in 2003-04 and has remained constant afterwards.

[5] Notably, the list of "offshore countries" employed also includes a number of euro area countries and other advanced economies such as the United Kingdom and the United States. AJZ's full list of offshore financial centres that report to the BIS are Austria, Belgium, Bahamas, Bahrain, Bermuda, the Cayman Islands, Curacao, Cyprus, Guernsey, Hong Kong, the Isle of Man, Jersey, Luxembourg, Macao, Malaysia, Panama, Singapore, Switzerland, United Kingdom and United States.

the fraction of deposits that belong to households; these estimates range from 10% in the United Kingdom and United States to 100% in Switzerland. Fourth, AJZ also adjust on an ad-hoc basis the deposits by residents of countries with a high concentration of multinational enterprises (such as the Netherlands and Ireland) to avoid an overestimation of households' foreign assets for these countries.

AJZ estimate that households' assets held in offshore centres outside Switzerland amounted to 3.4 tn US dollar in 2007 and increased to 6.4 tn US dollar in 2015. For 2006-07, 26% of offshore assets intermediated outside Switzerland are attributed to euro area households (83% of which are held in so-called European havens, including a number of euro area countries). Overall, AJZ conclude that out of the global offshore assets (including Switzerland) in 2006-07 (5.6 tn US dollar), 1.8 tn US dollar (i.e. 31%) belong to euro area households.

Bui Quang and Gervais (2019) also use BIS LBS data on cross-border deposits of French non-banks and the SNB dataset on securities in custody. The latter data are employed to apply the aggregate ratio of foreign securities held in custody in Switzerland to foreign deposits in Switzerland to French households' deposits in non-euro area countries. In case the BIS LBS breakdown is only available vis-à-vis non-banks a household share of 1/3 is assumed. Notably, Bui Quang and Gervais (2019) estimate French households' offshore security holdings at around 60 bn US dollar in 2015, compared to 300 bn US dollar by AJZ in 2006-07.

2.3 Net errors and omissions

Another method to gauge households' unrecorded foreign assets is to consider net errors and omission (n.e.o.) in a country's balance of payments (b.o.p.). In line with the b.o.p. identity, negative n.e.o. can be associated with an underestimation of net acquisitions of foreign assets (or an overestimation of the incurrence of foreign liabilities). Pellegrini, Sanelli and Tosti (2016) (PST) show negative n.e.o. at the global level in the period 2008 to 2013 and Bui Quang and Gervais (2019) find the same phenomenon in the French b.o.p. data. Both studies point out that an under-estimation of net acquisitions of foreign assets is more likely the driver and probably due to non-financial corporations and households.[6] As n.e.o. capture transactions, they need to be cumulated over a certain time frame to deliver an estimate of households' unrecorded offshore assets.

2.4 Evidence from voluntary disclosure schemes

An additional approach to estimate unrecorded offshore financial assets is to use information obtained from (ad-hoc) voluntary disclosure/reporting schemes. PST focus on the Italian 2009-2010 voluntary scheme that allowed Italian taxpayers to disclose previously undeclared financial assets and real estate held abroad by repatriating or declaring them. This scheme led to the disclosure of undeclared foreign assets of about €100 billion, triggering statistical revisions in the Italian b.o.p. and i.i.p., mainly for portfolio investment (approximately €60 billion) and bank deposits (€13 billion), in particular held in Switzerland (69%). Comparing these figures to AJZ's estimates, it emerges that between 30% to 50% of Italian households' offshore assets were disclosed in this scheme.

3. Assessment of research studies in a euro area context

In this section, the soundness of the assumptions used in the studies described above is assessed, mainly focusing on the approaches of Zucman (2013) and AJZ.[7]

3.1 Global estimates of offshore assets

As reported in Figure 1 there is a substantial, albeit declining, discrepancy between global asset and (portfolio) liability positions in securities. While the phenomenon of unrecorded external assets is widely established, its full attribution to households is less straightforward:

[6] An overestimation of liabilities on the other hand may arise due to the residual approach of compiling portfolio investment liabilities in which case unrecorded holdings of domestic securities by resident investors would be wrongly attributed to holdings of foreign investors.

[7] AJZ are confident on their global estimate of offshore holdings, but acknowledge the margin of error associated with allocating these to households of specific countries.

first, part of the global asset-liability discrepancy may be accounted for by missing reserve assets due to the still incomplete coverage in the IMF's SEFER.[8] Indeed, the recent decline in the global discrepancy is partly driven by larger security holdings recorded in reserves. Second, securities held in custody abroad may reflect assets of non-financial corporations (NFCs) or even of institutional investors. Bui Quang and Gervais (2019) show – using metadata for the IMF's Coordinated Portfolio Investment Survey (CPIS) – that households are indeed the sector with the largest identified coverage gaps, but coverage issues are also present for NFCs and insurance companies and pension funds. Bui Quang and Gervais (2019) further compute the security holdings of French NFCs held in custody abroad, both inside the euro area (using security holdings data on third-party holdings) and outside the euro area (using adjusted NFC balance sheet information collected by Banque de France) and arrive at a total of 30 bn US dollar of assets not covered by French custodians (equivalent to 5% of NFC's total securities holdings), while they estimate French households' offshore security holdings at around 60 bn US dollar in 2015. Applying these proportions globally would suggest that – out of total unrecorded assets of 6 tn US dollar in 2016 – 2 tn US dollar may be attributed to NFCs rather than households.[9]
Moreover, misclassifications between portfolio equity investment and foreign direct investment (FDI) equity may account for part of the observed discrepancy between global asset and (portfolio) liability positions. The IMF's Coordinated Direct Investment Survey shows a persistent excess of global FDI equity assets over liabilities, amounting to around 2 tn US dollar in 2017. Angulo and Hierro (2017) suggest that this discrepancy may be partly driven by differences in the valuation applied by statistical compilers, as inward FDI valuations tend to be more accurate due to the better information set on these entities available to statisticians.[10] A complementary explanation may however be that some of the globally unrecorded portfolio equity assets are in fact recorded in FDI equity, reflecting a misclassification of the functional category. It is conceivable that a company investing in foreign equity can identify clearly if such an investment exceeds the 10% threshold to be considered as FDI. An entity receiving such an investment may however experience difficulties in identifying if a foreign equity investor exceeds the 10% threshold – in particular if there is a chain of FDI relationships – and hence may misclassify it as portfolio investment. Given the substantial discrepancy between global FDI equity assets and liabilities of around 2 tn US dollar in 2017, such misclassifications may at least partly explain the observed discrepancy.

3.2 Estimates of households' offshore assets in Switzerland

Zucman (2013) and AJZ assume that all foreign securities held in custody in Switzerland by non-residents belong to households. Since 2016 however, the SNB publishes a sector breakdown of these holdings which reveals that at its peak in 1999 63% of the securities in custody could be attributed directly to foreign private customers (i.e. households). Since then, the household share declined substantially to around 24% in 2017, while the share of institutional investors increased from 26% to 72%. Even though it appears convincing that some of the institutional custody account holders are ultimately private customers (e.g. via asset management institutions set up in offshore financial centres), a household share of 100% as assumed by AJZ seems disproportionate, in particular as global banks' business models may well include the use of Swiss banks as intermediate custodians.[11] Using the approach applied by AJZ for the attribution of household deposits to countries (i.e. keeping it at 2003-04 levels before the adoption of the EU Savings Directive which triggered the move from household owners to offshore shell companies) may suggest that households account for around 55% of the securities held in custody, if ownership via shell companies is included.

[8] A (likely minor) part of the gap between global portfolio investment liabilities and asset may be accounted for by countries that do not report any i.i.p. data.
[9] Similarly, estimates relying on cumulating net errors and omissions may reflect unrecorded net acquisitions of foreign assets by other sectors than households or compilation problems associated with other functional categories apart from portfolio investment.
[10] An additional factor is that in some jurisdiction it might be easier to ensure that an investing entity is covered in the reporting population than is the case for an entity receiving inward direct investment.
[11] For global banks it is very likely that the bulk of their security holdings are recorded in official statistics.

Similarly, as described in Section 2.2, AJZ make ad-hoc assumptions on the household share in non-bank deposits, which may not be accurate in some cases. For example for non-bank deposits in Switzerland AJZ assume a household ownership share of 100%, while according to BIS LBS data it amounts to around 50% in recent years.

Table 1: Estimates of foreign households' assets held in Switzerland
Billion of US dollars for 2014

	Method	Securities	Deposits	Total	*of which EA*
(1)	Alstadsæter, Johannesen and Zucman (2017)	2,174	167	2,342	822
(2)	Reported by SNB and BIS	539	184	724	254
(3)	Securities (55% HH share), Deposits (as reported)	1,087	184	1,271	446
(4)	Sec. (55% HH share), Dep. (non-bank, 55% HH share)	1,087	198	1,285	479
(5)	Sec. (100% HH share), Dep. (non-bank, 100% HH share)	1,976	361	2,337	791

Notes: HH stands for households.
Source: AJZ, Swiss National Bank, BIS and own computations.

Table 1 computes the amount of offshore financial assets held in Switzerland under different assumptions and benchmarks them with those estimated by AJZ (2.3 tn US dollar, row 1) for 2014. Using exclusively reported data on household counterparts gives an estimate of 0.7 tn US dollar (i.e. around 30% of AJZ's estimate, row 2). In the third row a household share of 55% for securities is imputed providing estimated households' offshore assets in Switzerland of 1.3 tn US dollar. A similar estimate is also obtained with the assumption of a 55% share by households applied to deposits by non-banks (fourth row). In the fifth row it is assumed that all custody accounts and deposits by non-banks in Switzerland belong to households, which is in line with AJZ's assumption and yields the same headline estimate (2.3 tn US dollar) as in AJZ, however with a slightly larger share for deposits.

Table 1 also provides estimates of euro area households' assets held in Switzerland. AJZ estimate the euro area share at 35% (for 2007) and the same percentage is found in reported data. If applied to AJZ's estimate of total offshore assets in Switzerland this suggests around 800 bn US dollar of euro area households' assets in Switzerland (row 1). Applying it to the estimates in rows 2 to 4 gives a range for euro area households' assets held in Switzerland from 254 to 479 bn US dollar. The assumption of households accounting for 100% of securities in custody and deposits by non-banks is rather heroic, while on the lower end a full reliance on reported data likely misses the impact of pass-through holdings via shell companies based in offshore centres. Thus, a conservative estimate for euro area households' offshore assets in Switzerland in 2014 may be around 500 bn US dollar. Extrapolating 2014 values using the dynamics observed for securities in custody and deposits suggest that they have hovered around this level since then.[12]

3.3 Estimates of households' offshore assets outside Switzerland

The analysis by AJZ – in particular the country allocation of offshore assets – is based on 2007 estimates and thus misses important global and country-specific developments. Global deposits by households fell by around 25% since their peak in 2008 which however masks substantial heterogeneity across offshore centre.[13] Several studies have identified international initiatives to tackle households' tax evasion – including the OECD's automatic exchange of information (AEOI) – as major drivers of falling deposits in offshore financial centres (e.g. Johannesen and Zucman, 2014; Benetrix, Emter and Schmitz, 2021).

Euro area households' offshore deposits outside Switzerland are estimated to have fallen by more than 25% since 2008 and have hovered around 60 bn US dollar since 2014. Using Zucman's (2013) and Bui Quang's and Gervais' (2019) method of extrapolating from deposits

[12] This paper does not make an attempt to quantify the amount of unrecorded foreign assets held by other euro area resident sectors, in particular non-financial corporations.

[13] The decrease was particularly pronounced for deposits held in Switzerland and in a number of offshore centres (by around 50%), while households' deposits increased in Hong Kong and Macao. The increase observed for Hong Kong and Macao is however due to factors other than tax evasion and almost exclusively driven by residents of mainland China.

to securities held in custody by applying the ratio between the two statistics recorded for Switzerland (around 5.5) would suggest that euro area households' securities held in offshore custody accounts amount to around 330 bn US dollar and total assets (including deposits) to around 390 bn US dollar in 2014. Having said this, applying Switzerland's ratio to all offshore centres might be misleading, as custody services may be an idiosyncratic specialisation of Swiss banks rather than being provided in all offshore centres. To illustrate the importance of this assumption, a ratio of 1 –which is based on the premise that households use offshore centres to the same extent to place deposits as for holding securities in custody – would imply euro area households' offshore assets (outside Switzerland) of 120 bn US dollar.

4. Implications for estimates of euro area households' offshore assets

Using the estimate for euro area households' assets held in Switzerland of 500 bn US dollar and adding an estimated 390 bn US dollar held in other offshore centres leads to a total estimate of extra-euro area household assets of around 900 bn US dollar or 800 bn euro in 2017 (which would decline to 540 bn euro if a security to deposit ratio of 1 is applied for assets outside Switzerland). In addition, assuming the ad-hoc assumption of Zucman (2013) that 20% of these assets are recorded in official statistics, the estimate is in a range of 430 to 640 bn euro for 2017 (i.e. 3.5% to 5% of GDP; 1.7% to 2.5% of euro area external assets recorded in the i.i.p.; and, 1.8% to 2.7% of households' total financial assets recorded in the euro area sector accounts), compared with AJZ's estimate of 7% to 8% of GDP in 2006-2007.

Having said this, available estimates of households' offshore financial assets only capture financial assets in the form of securities and deposits, disregarding other potentially unrecorded financial assets such as insurance and pension schemes, as well as non-financial assets – in particular real estate abroad (which is recorded as FDI in the i.i.p.).

Overall, this paper suggest that euro area households' unrecorded offshore financial assets are likely smaller than estimated in previous studies and thus within a statistically reasonable level of error with no major negative impact on the analytical value of the existing statistics. Nevertheless it is important to continue working to improve b.o.p./i.i.p. statistics for the household sector, e.g. by making use of the sector breakdown reported in the BIS LBS and by seeking access to the data national tax authorities receive via the AEOI. Moreover, a close dialogue with academic researchers is needed to benchmark the information available in official statistics vis-à-vis those obtained from more experimental approaches.

5. References

1. Angulo, E. and Hierro, A. (2017), Asymmetries in the Coordinated Direct Investment Survey: What Lies Behind? *IMF Working Paper* No. 17/261.
2. Alstadsæter, A., Johannesen, N., & Zucman, G. (2018). Who owns the wealth in tax havens? Macro evidence and implications for global inequality. *Journal of Public Economics*, 162: 89-100.
3. Benetrix, A., Emter, L. & Schmitz, M. (2021), Automatic for the (tax) people: information sharing and households' cross-border deposits in tax havens. *mimeo*.
4. Bui Quang, P. & Gervais, E. (2019), How to identify "hidden securities assets" in the Balance of Payments: methods of Bank of France, *BIS IFC Bulletin* No. 49.
5. Johannesen, N., & Zucman, G. (2014). The end of bank secrecy? An evaluation of the G20 tax haven crackdown. *American Economic Journal: Economic Policy*, 6(1), 65-91.
6. Lane, Philip R. and Gian Maria Milesi-Ferretti, 2018, "The External Wealth of Nations Revisited: International Financial Integration in the Aftermath of the Global Financial Crisis," *IMF Economic Review* 66, 189-222.
7. Pellegrini, V., Sanelli, A., Tosti, E., 2016. What do external statistics tell us about undeclared assets held abroad and tax evasion? *Bank of Italy Occasional Paper* 367.
8. 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.

Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

A typology of captive financial institutions and money lenders (sector S127) in Luxembourg[1]

Gabriele Di Filippo and Frédéric Pierret,
Central Bank of Luxembourg

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

BANQUE CENTRALE DU LUXEMBOURG
EUROSYSTÈME

Virtual 63rd ISI World Statistics Congress 2021

A Typology of Captive Financial Institutions and Money Lenders (sector S127) in Luxembourg

Gabriele di Filippo & Frédéric Pierret

Statistics Department, External Statistics Section

Banque Centrale du Luxembourg

Definition of Captive Financial Institutions (CFIs)

Captive financial institutions and money lenders
Classified in sector S127 (financial sector)

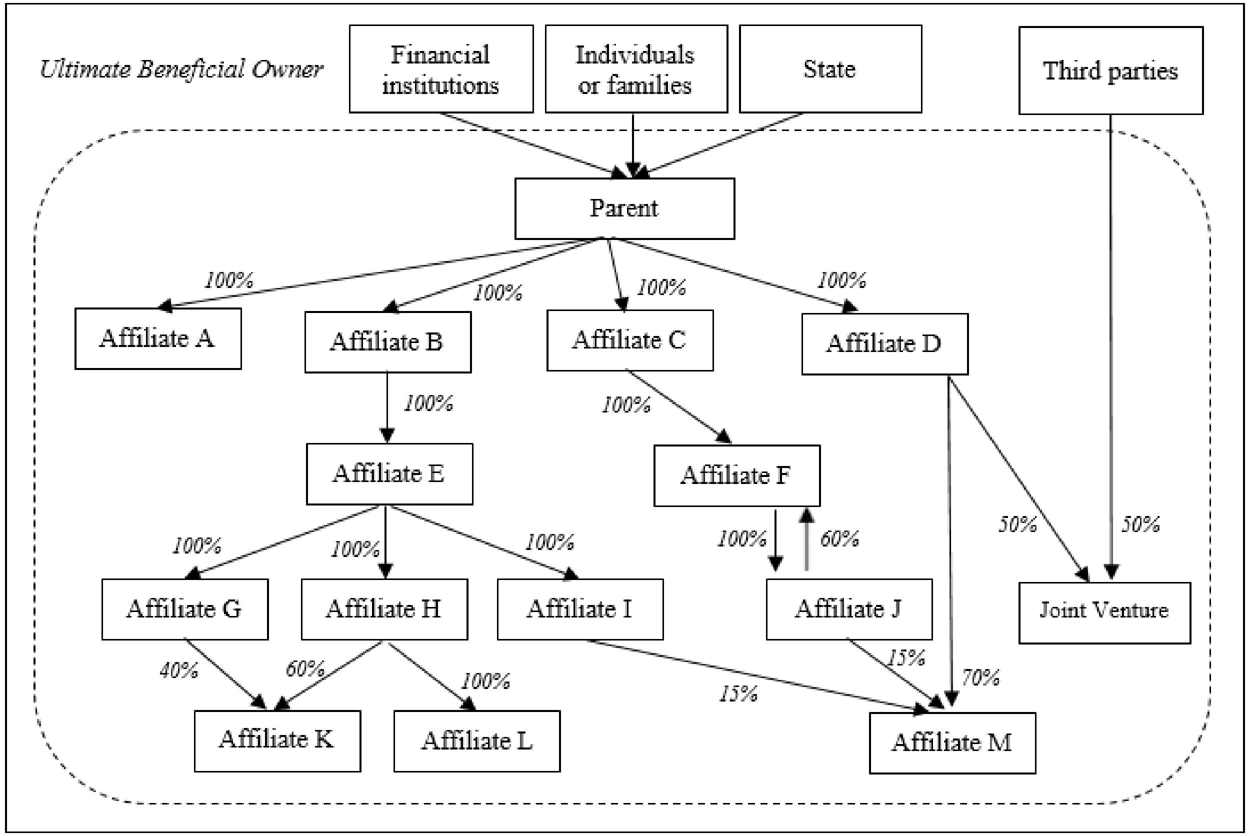
Can be found in MNEs' structures and located
btw the headquarters and the operational affiliates

Meaning of term « captive »
« Captive » as owned and controlled by and typically for the sole use of an organisation: the parent

Main purpose
Holding and finance activities
(e.g. holding of participations, treasury management, cash pooling, intragroup lending, carbon trading, etc.)

Geographical location
Financial centers
(access to various financing means, infrastructure, tax, regulatory and institutional advantages)

Diagram 1: Example of a hypothetical complex structure of MNE



Source: Adapted from UNCTAD (2016)

Literature Review


eurostat

OECD

Final Report by the Task Force on Head Offices, Holding Companies and Special Purpose Entities (SPEs)

ECB-Eurostat-OECD (2013) "Final Report by the Task Force on Head Offices, Holding Companies and Special Purpose Entities (SPEs) "

Innovations: Definition for several types of CFIs (including ISIC-codes)

Types: holdings, shell company, unit for holding and managing wealth of individuals and families, securitization vehicle, conduit, captive leasing company, factoring and invoicing company, SPE carrying out other financial functions


Thirty-First Meeting of the IMF Committee on Balance of Payments Statistics

Washington, D.C.
October 24–26, 2018

BOPCOM—18/03
For discussion

Final Report of the Task Force on Special Purpose Entities

Prepared by the Statistics Department
INTERNATIONAL MONETARY FUND

IMF (2018) "Final Report of the Task Force on Special Purpose Entities"

Innovations: Definition for several types of CFIs (including potential prototype balance sheets, ISIC-codes, schematic representation of the position of CFIs in the structures of MNEs across countries)

Types: holding, intragroup lending, conduit, captive factoring and invoicing, captive financial leasing, loan origination, securitization vehicle

Examples of Prototype Balance Sheets by IMF (2018)

Table 1.1: Holding corporations

Prototype balance sheet (IMF (2018))		Assets	Liabilities
Non-Financial Assets		No	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: IMF (2018)

Table 3.1: Intragroup lending corporations

Prototype balance sheet (IMF (2018))		Assets	Liabilities
Non-Financial Assets		No	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: IMF (2018)

Table 2.1: Conduit corporations

Prototype balance sheet (IMF (2018))		Assets	Liabilities
Non-Financial Assets		No	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: IMF (2018)

Table 4.1: Captive factoring and invoicing corporations

Prototype balance sheet (IMF (2018))		Assets	Liabilities
Non-Financial Assets		Yes	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: IMF (2018)

=> Possible ways of improvement:

Fine-tune the definitions of CFIs

Empirical application

Discover potential new types of CFIs

Data on Captive Financial Institutions

Data collection

- The **BCL** collects balance sheet items data for CFIs with **total assets ≥ EUR 500 million**
- => The analysis relies on a **sub-sample** of the whole population of CFIs in Luxembourg

Sample representativeness (as of Q4 2018)

- ≈ **5%** of the total **number** of CFIs
- ≈ **90%** of the total **assets** held by CFIs

Data content

- Balance sheet items (cf. Table 9)

Period of analysis

- Q4 2014 to Q4 2019

Table 9: Balance sheet items available in the BCL database

Item	Definition		Affiliation link	Freq.	Item	Definition		Affiliation link	Freq.
1-LA2001	Intragroup loans: loans to shareholders		Yes	Q	2-LA2001	Intragroup loans: loans from shareholders		Yes	Q
1-LA2002	Intragroup loans: loans to companies where the company holds at least 10% of the social capital		Yes	Q	2-LA2002	Intragroup loans: loans from companies where the company holds at least 10% of the social capital		Yes	Q
1-LA2003	Intragroup loans: loans to sister companies		Yes	Q	2-LA2003	Intragroup loans: loans from sister companies		Yes	Q
1-N02000	Extra-group loans		Yes	Q	2-N02000	Extra-group loans		Yes	Q
1-003000	Debt securities	ISIN	No	M	2-003000	Debt securities	ISIN	No	M
		non-ISIN	Yes				non-ISIN	Yes	
1-005000	Equity securities	ISIN	No	M	2-C05000	Capital	ISIN	No	M
		non-ISIN	Yes				non-ISIN	Yes	
1-006000	Non-financial assets		Yes	M	2-002050	Short sales		Yes	M
1-007000	Financial derivatives		Yes	M	2-011000	Financial derivatives		Yes	M
1-090000	Other assets		Yes	Q	2-090000	Other liabilities		Yes	Q
1-000000	TOTAL Assets		Yes	Q	2-000000	TOTAL Liabilities		Yes	Q

Source: BCL

Matching BCL Balance Sheet Data with IMF (2018)'s Prototype Balance Sheets

Unconditional treatment of specific items

- NFA, L_OI, CD_OI_A, Deriv, SS_L, Other_L

Conditional treatment of specific items

- Equity: E_DI *versus* E_PI
- Debt: D_DI *versus* D_PI

=> Equity: E_DI *versus* E_PI

- Equity as direct investment (E_DI) *versus* equity as portfolio investment (E_PI)
  - Decision variable: **Affiliation link**
  - Equity share ≥ 10% as E_DI
  - Equity share < 10% as E_PI

Table 10: Matching BCL balance sheet data with IMF (2018)'s prototype balance sheets

		Assets (A)		Liabilities (L)	
		IMF (2018) prototype BS items	BS items available in the BCL database	IMF (2018) prototype BS items	BS items available in the BCL database
Non-Financial Assets		*NFA*	1-006000		
Direct investment	Equity	*E_DI_A*	1-005000 with *dumAL_A*=1	*E_DI_L*	2-C05000 with *dumAL_L*=1
	Debt	*D_DI_A*	1-LA2001+1-LA2002+ 1-LA2003+(1-003000 with *dumh_A*=1)	*D_DI_L*	2-LA2001+2-LA2002+ 2-LA2003+(2-003000 with *dumh_L*=1)
Portfolio investment	Equity	*E_PI_A*	1-005000 with *dumAL_A*=0	*E_PI_L*	2-C05000 with *dumAL_L*=0
	Debt	*D_PI_A*	1-003000 with *dumh_A*=0	*D_PI_L*	2-003000 with *dumh_L*=0
Other investment	Loans	*L_OI_A*	1-N02000	*L_OI_L*	2-N02000
	Curr. & Deposits	*CD_OI_A*	1-090000		
Financial derivatives		*Deriv_A*	1-007000	*Deriv_L*	2-011000
Short sales				*SS_L*	2-002050
Other liabilities				*Other_L*	2-090000

Source: IMF (2018) and BCL. NB: The term "BS items" stands for balance sheet items.

=> Debt: D_DI *versus* D_PI

- Debt as direct investment (D_DI) *versus* debt as portfolio investment (D_PI)
- Debt securities include non-hybrid and hybrid instruments
  - Decision variable: **Instrument negotiability**
  - Hybrid instruments (non-negotiable) as D_DI, adding to intragroup loans
  - Non-hybrid instruments (negotiable) as D_PI

Methodology to Identify the Prototype Balance Sheets

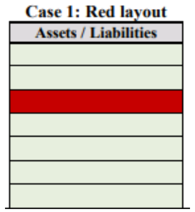
Objective

- Screen the balance sheet of each CFIs
- Match with the pre-determined prototype balance sheet

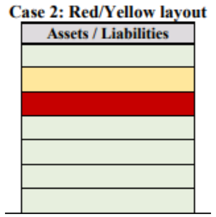
Criteria

- Qualitative criteria: Predominance of balance sheet items
- Advantage: Avoid arbitrary quantitative thresholds

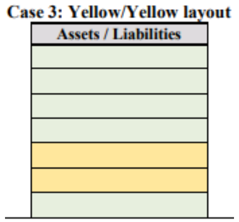
Schematic representation



Red layout ⇔
- *Existence criterion*: $s_1 > 0$
- *Predominance criterion*: $s_1 > (1 - s_1)$
- *Strong predominance over the second largest item*: $(s_1 - s_2) > \sigma^2/\mu$



Red / Yellow layout ⇔
- *Existence criterion*: $s_1 > 0$ and $s_2 > 0$
- *Predominance criterion*: $s_1 > (1 - s_1)$
- *Weak predominance over the second largest item*: $(s_1 - s_2) \leq \sigma^2/\mu$



Yellow / Yellow layout ⇔
- *Existence criterion*: $s_1 > 0$ and $s_2 > 0$
- *Non-predominance criterion*: $s_1 \leq (1 - s_1)$
- *Non-predominance criterion*: $s_2 \leq (1 - s_2)$

Empirical Results: Identified Prototype Balance Sheets

Chart 1.1: Holding corporation as defined in IMF (2018)

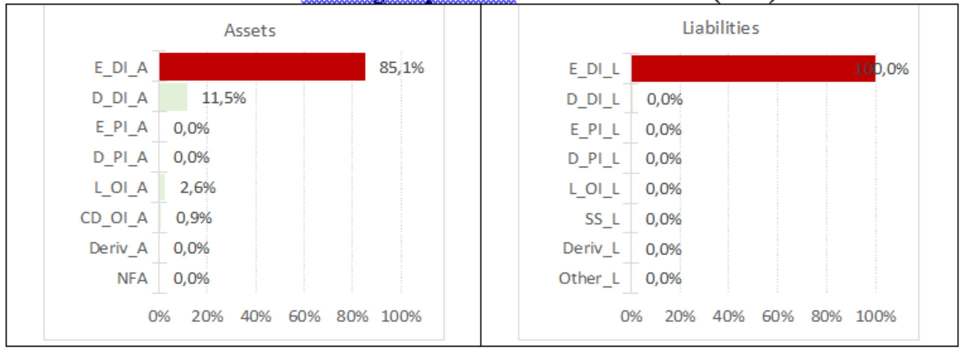


Chart 1.2: Conduit corporation as defined in IMF (2018)

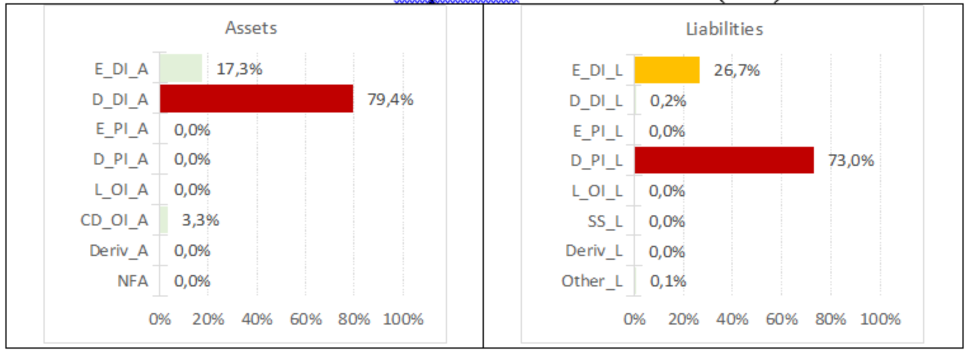


Chart 1.3: Intragroup lending corporation as defined in IMF (2018)

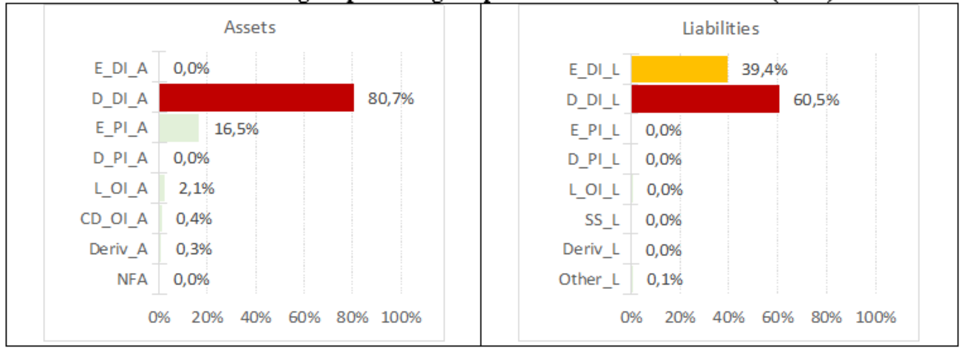


Chart 1.4: Captive factoring and invoicing corporation as defined in IMF (2018)

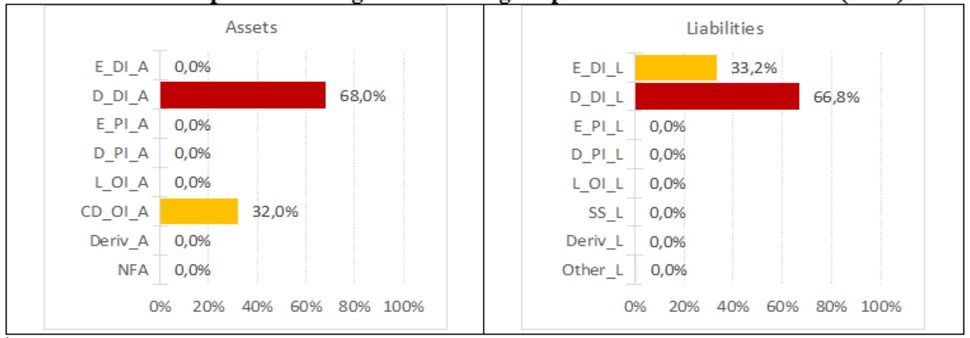


Chart 1.5: Loan origination corporation as defined in IMF (2018)

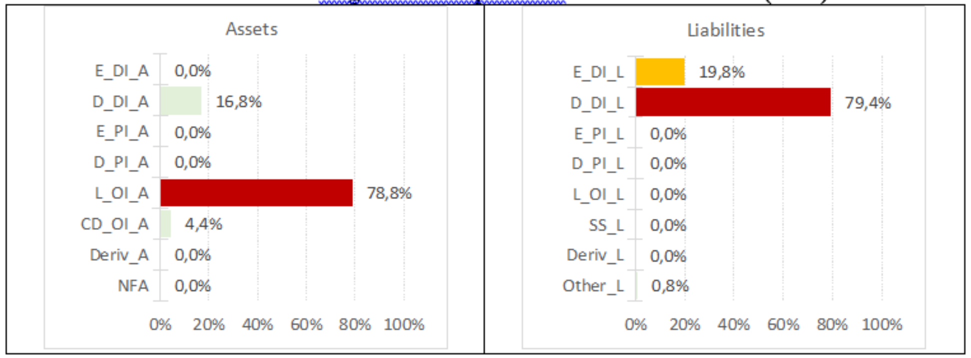
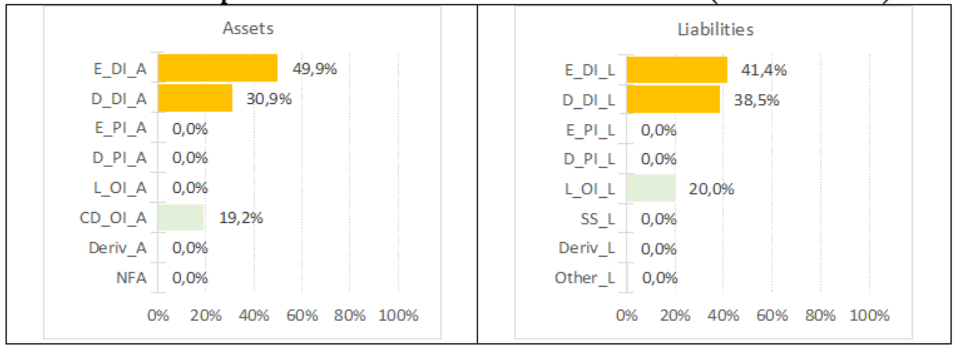


Chart 1.6: Corporations with a mixed balance sheet structure (mixed structure)



Empirical Results: Typology by Total Number of CFIs

Types of entities

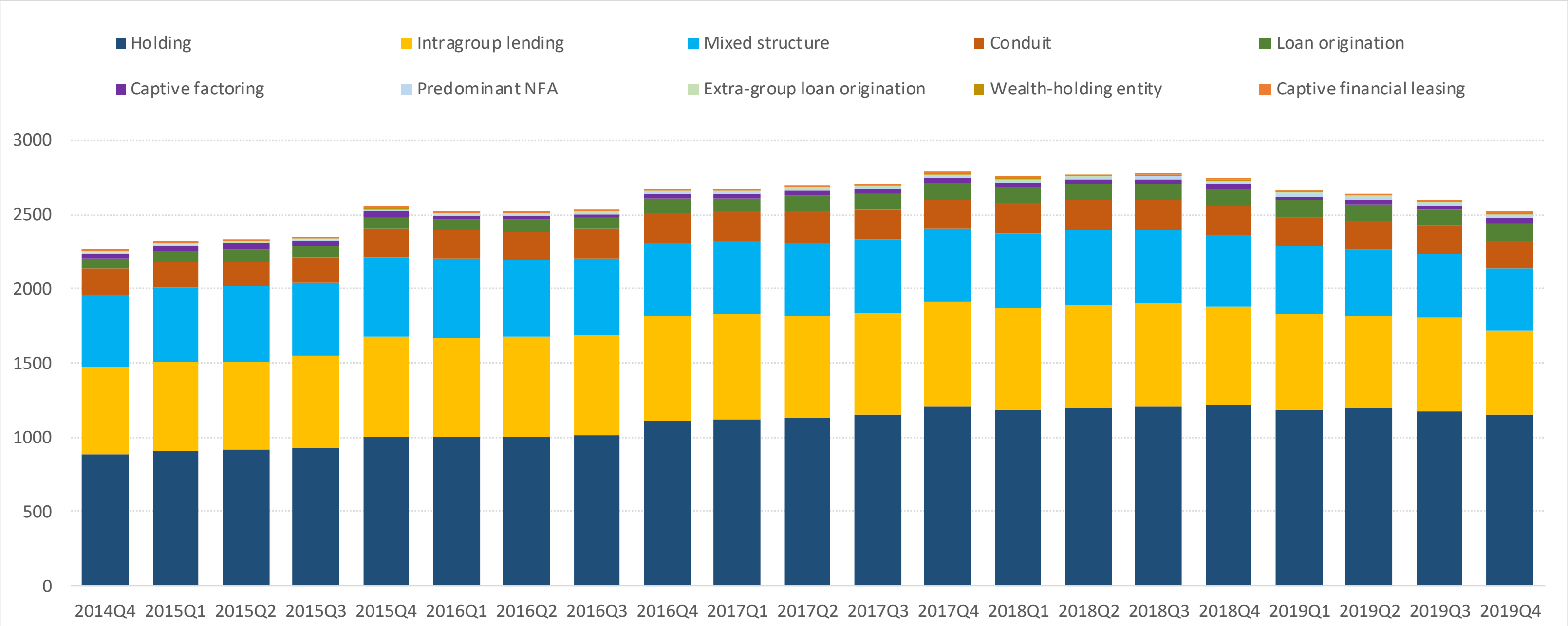
- **Traditional types listed in the literature:** holding, intragroup lending, conduit, loan origination, captive factoring, wealth-holding entity, captive financial leasing
- **New types:** mixed structures, predominant NFA, extra-group loan origination

Main types

- Holding corporations (42%)
- Intragroup lending companies (25%)
- Mixed structures (19%)
- Conduits (7%)
- Loan origination companies (4%)

- => These corporations represent about 98% of the total number of CFIs with at least EUR 500 million in total assets

Chart 2: Typology of CFIs (by number)



Evolution over time

- The relative proportion of the different types of CFIs remains stable over time (Q4 2014 – Q4 2019)

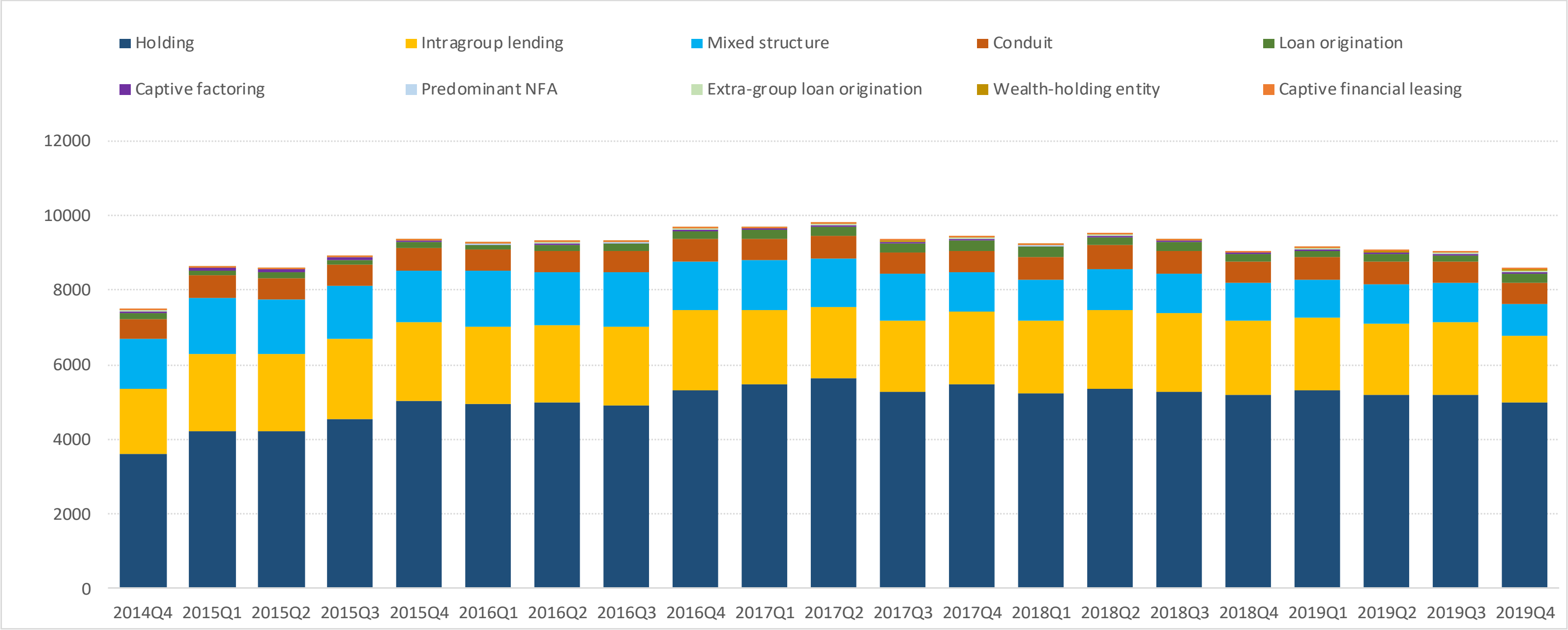
Empirical Results: Typology by Total Assets held by CFIs

Main asset holders

- Holding (55%)
- Intragroup lending companies (22%)
- Mixed structures (14%)
- Conduits (6%)
- Loan origination companies (2%)

- => These corporations represent about 99% of the total assets held by CFIs with at least EUR 500 million in total assets

Chart 3: Typology of CFIs (by total assets held)



Evolution over time

- The relative proportion of the different types of CFIs remains stable over time (Q4 2014 – Q4 2019)

Remaining types

- Captive factoring and invoicing corporations, companies with predominant non-financial assets, extra-group loan origination firms, wealth-holding entities and captive financial leasing corporations

Thanks for your attention!

Reserve Slides

Caution about Type Duplicates for a given S127 Entity

Caution

- Limits of the identification based on prototype balance sheets: Types with Similar Prototype Balance Sheet
- => Avoid **type duplicates** for a given S127 entity
- => Example: **intragroup lending** *versus* **captive financial leasing**

Table 3.1: Intragroup lending corporations

Prototype balance sheet (IMF (2018))		Assets	Liabilities
Non-Financial Assets		No	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: IMF (2018)

Table 5: Captive financial leasing corporations

Prototype balance sheet (IMF (2018))		Assets	Liabilities
Non-Financial Assets		No	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: IMF (2018)

Question

- How to distinguish btw intragroup lending and captive financial leasing?

Potential solution

- Identification of captive financial leasing corporations based on the **NACE code:** K6491 “Financial leasing” (UN (2008))
- Identification of intragroup lending corporations based on the prototype balance sheet (Table 3.1) and with NACE code ≠ K6491 “Financial leasing”

Fine-Tuned Definitions of the Types of S127 Entities

Definitions of the type of S127 entities

- For each type, reflection about its definition => fine-tuned definition
- **Advantages**
  - Improve the classification to better suit empirical facts
  - Avoid the exclusion of any S127 entity from the typology or the creation of a large “miscellaneous category”

- **Example**: Conduit corporations
- **Definition by IMF (2018):** “*Conduits raise or borrow funds from unrelated enterprises or the open market and remit those funds to its parent or to other affiliated enterprises. Conduits typically do not transact on the open markets on the assets side. A synonym for conduit is external financing.*”

Table 2.1: Conduit corporations

Prototype balance sheet (IMF (2018))		Assets	Liabilities
Non-Financial Assets		No	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: IMF (2018)

Remits funds to parent or to other related enterprises (E_DI_A, D_DI_A) based on …

Table 2.2: Variants of conduit corporations

Variants of prototype balance sheet		Assets	Liabilities
Non-Financial Assets		Yes	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: Adapted from IMF (2018)

…funds raised or borrowed from unrelated enterprises (L_OI_L) or open market (E_PI_L, D_PI_L)

Limits

- The prototype balance sheet by IMF (2018) does not cover all the possible external financing means (only debt securities as PI)

Solution

- Consider variants of the prototype balance sheet of conduits (with equity as PI and loans granted by unrelated enterprises)

Fine-Tuned Definitions of the Types of S127 Entities

- **Example**: Holding corporations
- **Definition by IMF (2018):** "*A holding corporation mainly owns a controlling-level amount of equity in one or more subsidiaries in a passive manner, i.e. without providing any other service to its subsidiaries. Thus, holdings do not administer or manage other units or undertake any management activities.*"

Table 1.1: Holding corporations

Prototype balance sheet (IMF (2018))		Assets	Liabilities
Non-Financial Assets		No	
Direct investment	Equity		
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: IMF (2018)

Holding the assets (owning controlling level of equity, *E_DI_A*) of subsidiary corporations…

Table 1.2: Variants of holding corporations

Variants of prototype balance sheet		Assets	Liabilities
Non-Financial Assets		Yes	
Direct investment	Equity	*E_DI_A*	*E_DI_L*
	Debt		
Portfolio investment	Equity		
	Debt		
Other investment	Loans		
	Currency & Deposits		

Source: Adapted from IMF (2018)

…on behalf of its parents (*E_DI_L*) or its direct shareholder affiliated to the same parent

Limits

- The prototype balance sheet by IMF (2018) considers the definition of a **pure holding**. Should we classify **holdings with ancillary activities** within this category?

Solution

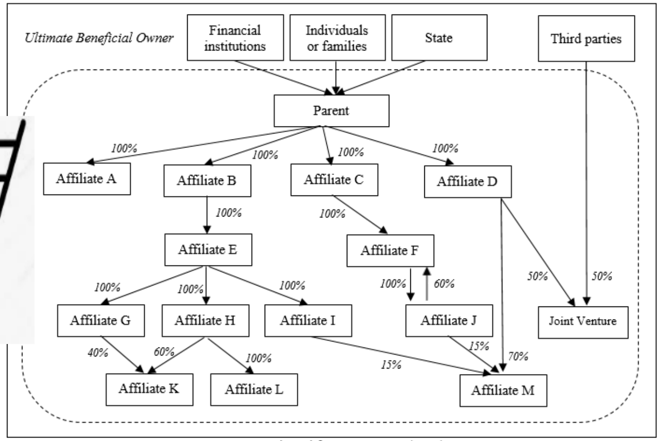
- Consider variants of the prototype balance sheet of holdings => distinction btw **pure holdings** and **mixed holdings**

Going forward: Climbing the Ownership Chains

Going forward: Climbing the ownership chains
- S127 entities take part of a more or less complex MNE structure
- Need to understand this structure and notably the head of the structure (parent, decision centre)

Objectives
- Identify the **name of the group** owning the S127 entities
- Highlight the **main economic activity** undertaken by the group
- Determine the **geographical location of the operational headquarters** (parent) owning the S127 entities
- **Alternative map of FDI** according to the parent owning the S127 entity rather than the balance sheet counterpart of the S127 entity

Diagram 1: Example of a hypothetical complex structure of MNE



Source: Adapted from UNCTAD (2016)

Sources
- Annual accounts of S127 entities (Business Register), Annual accounts released by the group (website of the group)
- Specific websites: US Securities and Exchange Commission, Bloomberg
- Alternative datasets: GLEIF, EGR, RIAD

Challenges
- Investigations can be time-consuming, nobably for specific groups featuring complex structures
- Quantitative dimension (≈ 2500 CFIs to affiliate to a group) & Qualitative dimension (complexity of the structure of a group)

Main Economic Activity of Groups owning S127 entities

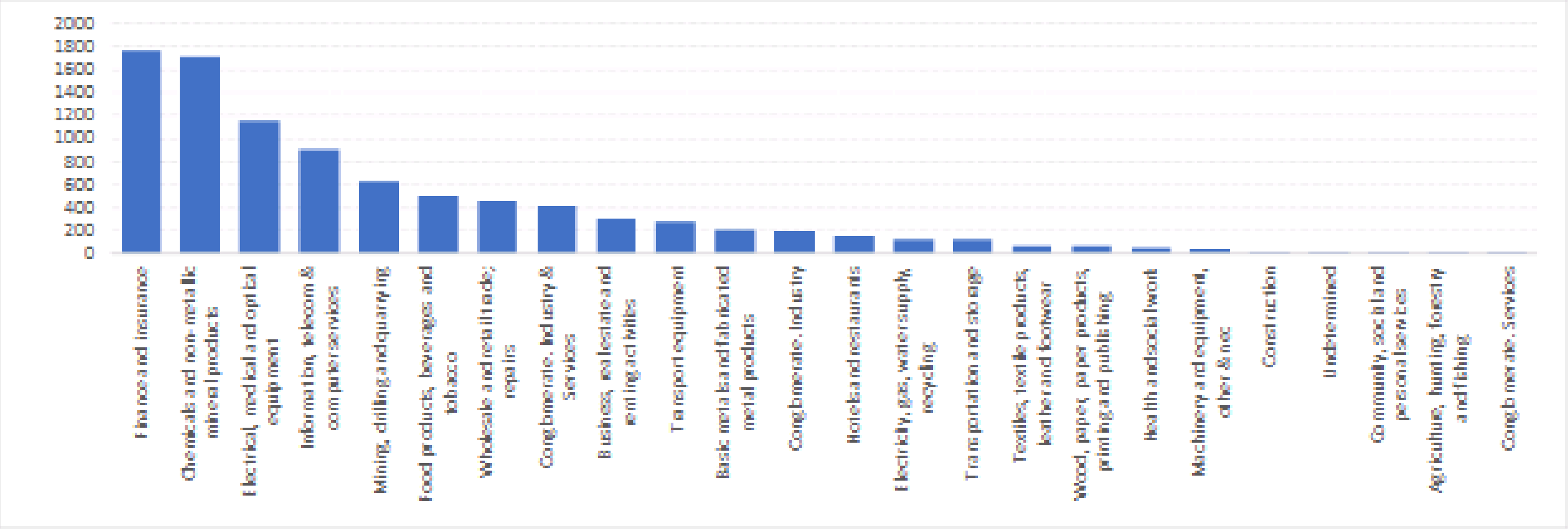
Financial activities
(20%)

Non-financial activities
(80%)

44% relate to investment funds (private equity, real estate, renewable energy)

78% relate to pharmaceutical groups

Chart 1.1: Total assets of S127 entities by main economic activity of their affiliated group



Source: Authors' calculations. Units: EUR billion. Average Dec. 2014 - Dec. 2019

57% relate to beverage industry and 43% to food industry

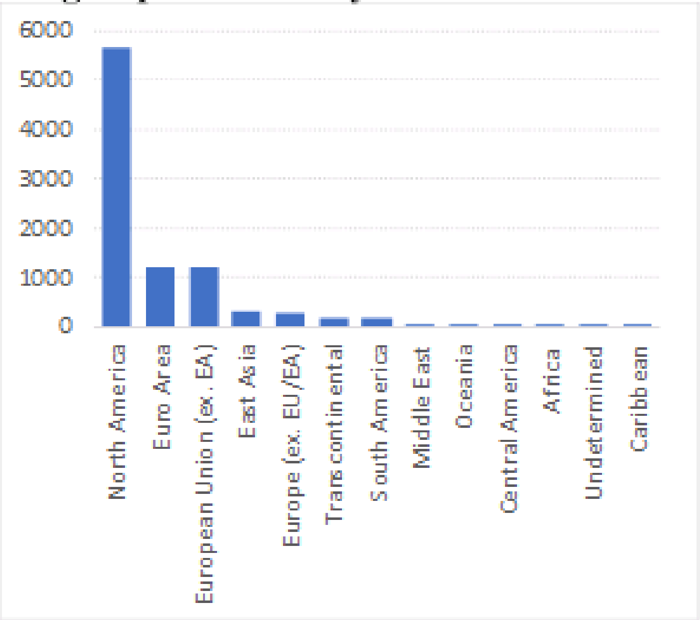
49% relate to groups manufacturing electrical equipment and 49% to medical equipment

55% relate to telecommunications

48% relate to petrochemical groups

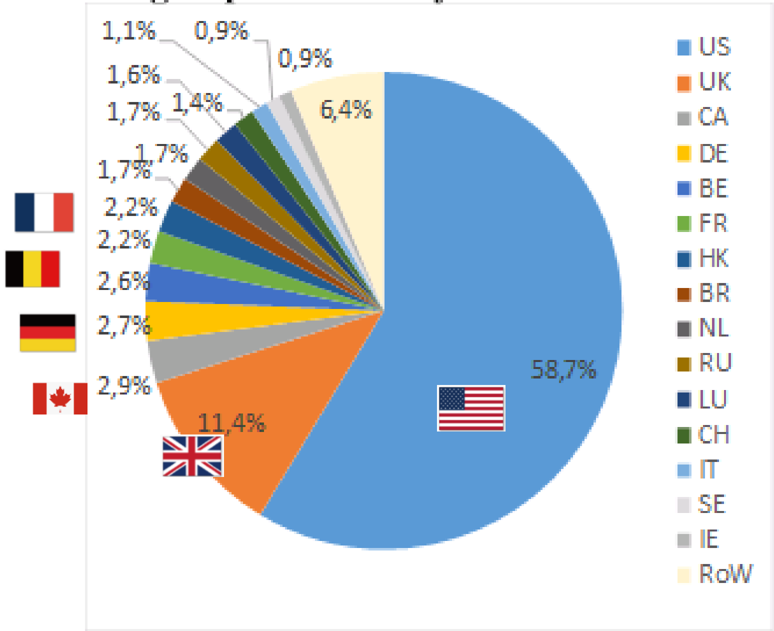
Headquarters of Groups resorting to S127 entities

Chart 2.1: Total assets of S127 entities by groups' nationality: economic zones



Source: Authors' calculations. Units: EUR billion. Average Dec. 2014 - Dec. 2019

Chart 2.2: Total assets of S127 entities by groups' nationality: main countries



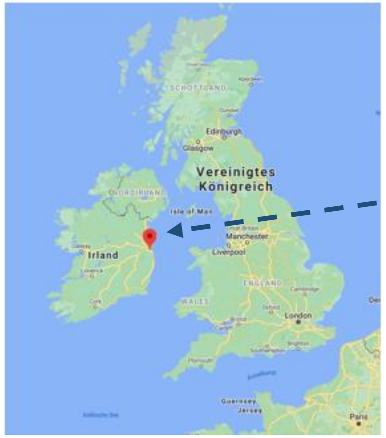
Source: Authors' calculations. Units: Percent. Average Dec. 2014 - Dec. 2019

Robustness checks

- Comparison with alternative datasets: GLEIF, EGR, RIAD
- Results match for a large majority of the groups
- Still, existence of differences (for a minority of the groups)
- **Potential causes**: methodological differences (lack of clear distinction between the operational and legal headquarters, consideration of intermediary entities along the ownership chains) and data limitations (data unavailability)

Geographical location of Group Headquarters
Difficulty Encountered: Operational *versus* Legal

Group manufacturing electrical equipment
IE Headquarter

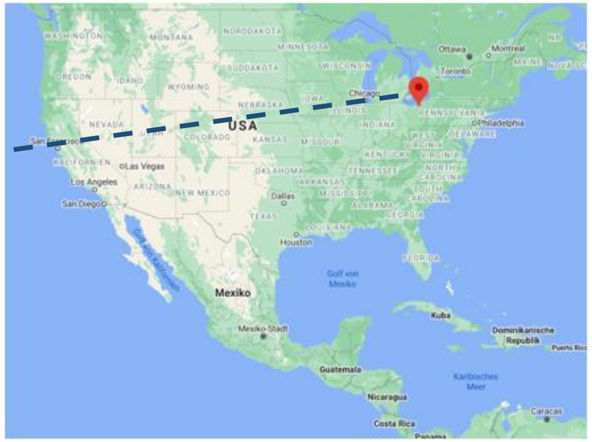


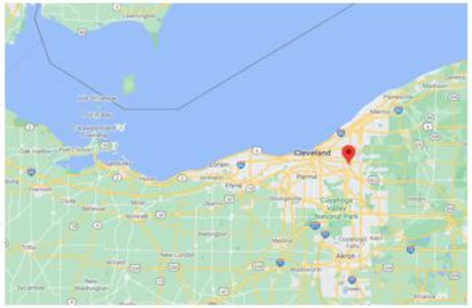
Source: Google maps

The current parent is replaced by a foreign parent, and the original parent company becomes a subsidiary of the foreign parent

Group manufacturing electrical equipment
US Headquarter

Executives and operational headquarters stay in the original country



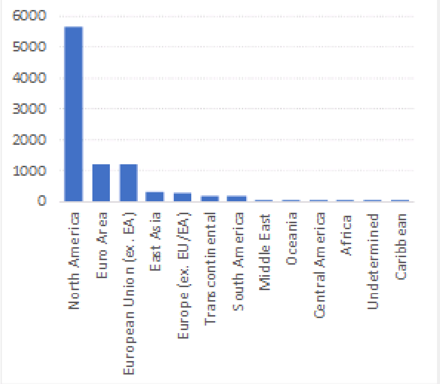


Source: Google maps

Geographical Location:
Headquarters *versus* Balance Sheet Counterparts

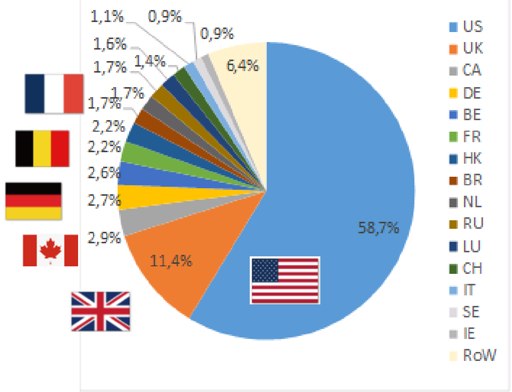
Headquarters counterparts

Chart 2.1: Total assets of S127 entities by groups' nationality: economic zones



Source: Authors' calculations. Units: EUR billion. Average Dec. 2014 - Dec. 2019

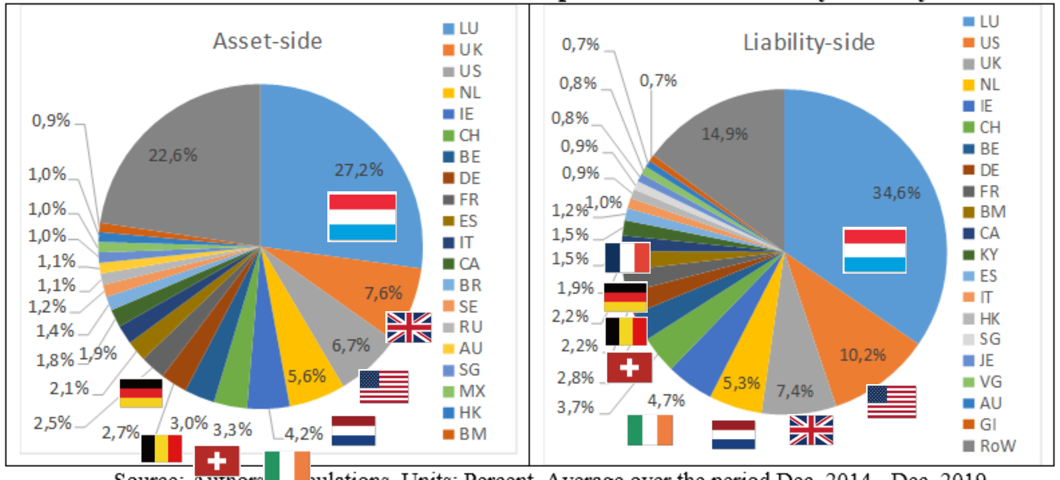
Chart 2.2: Total assets of S127 entities by groups' nationality: main countries



Source: Authors' calculations. Units: Percent. Average Dec. 2014 - Dec. 2019

Balance sheet counterparts

Chart 3.2: Balance sheet counterpart of S127 entities by country



Source: Authors' calculations. Units: Percent. Average over the period Dec. 2014 - Dec. 2019

Balance Sheet Counterpart

- Relative importance of the domestic (LU) counterpart
- => Most MNEs own more than one S127 entity in Luxembourg
- => MNEs own a network of captive financial institutions - potentially of different types and of different sizes - to finance their business activities and structure their strategic corporate investments

Concluding remarks

Work accomplished so far

- **Typology** of S127 entities
- Identification of the **parent (operational headquarters)**
- **Geographical location** of the parent
- **Main economic activity** of the affiliated group

Implications

- Clearer picture of sector S127
- Better understanding of sector S127

A Typology of Captive Financial Institutions and Money Lenders (sector S127) in Luxembourg

Gabriele Di Filippo[1]; Frédéric Pierret[2]

[1] Banque Centrale du Luxembourg, Department of Statistics, External Statistics
[2] Banque Centrale du Luxembourg, Department of Statistics, External Statistics

Abstract:

The paper presents a typology of captive financial institutions and money lenders (CFIs, sector S127) in Luxembourg. Given data availability, the analysis relies on a sub-sample of the whole population of CFIs. This sub-sample features CFIs whose total assets are at least equal to EUR 500 million. As of Q4 2018, this sub-sample represents about 5% of the total number of CFIs in Luxembourg, and about 85% of the total assets held by CFIs in Luxembourg. The period of analysis spans Q4 2014 to Q4 2019. In terms of number and on average over the period Q4 2014 – Q4 2019, the sample of CFIs regroups holding corporations (42%), intragroup lending companies (25%), mixed structures (19%), conduits (7%) and loan origination companies (4%). These corporations represent about 98% of the total number of CFIs whose total assets of at least EUR 500 million. The remaining types that complete the sample of CFIs consist of captive factoring and invoicing corporations, companies with predominant non-financial assets, extra-group loan origination firms, wealth-holding entities and captive financial leasing corporations. In addition, on average over the period Q4 2014 – Q4 2019, holding corporations own the largest share of total assets (55%) followed by intragroup lending companies (22%), mixed structures (14%), conduits (6%) and loan origination companies (2%). These corporations account for about 99% of the total assets held by CFIs whose total assets are at least equal to EUR 500 million. The relative importance of holding corporations, intragroup lending companies, mixed structures, conduits and loan origination companies suggests that Luxembourg plays the role of a global financial centre for MNEs. The latter benefit from Luxembourg as a financial platform to manage their business activities and structure their corporate investments.

Keywords:

Captive financial institutions and money lenders, Sector S127, Typology

1. Introduction:

The manuals of statistics published by the main international bodies define captive financial institutions and money lenders (CFIs) as “institutional units providing financial services other than insurance, where most of either their assets or liabilities are not transacted on open financial markets. It includes entities transacting only within a limited group of units, such as with subsidiaries or subsidiaries of the same holding corporation, or entities that provide loans from own funds provided by only one sponsor” (OECD (2008), UN (2009), IMF (2009), EC (2013), IMF (2017))[1].

The adjective “captive” means that the financial company is here *owned and controlled by* and typically for the sole use of an organisation: the parent. Within a MNE’s structure, captive financial entities generally lie between the decision body (i.e. the headquarters) and the operational affiliates (i.e. those relating to the production activities).

Thereby, captive financial entities can serve different investment and financial purposes by the means of different types of corporations. Whether directly or indirectly, they usually own the share capital of one or several operational entities of the group and can manage the decisions of its subsidiaries. They are often used to optimise the management of liquidities and the financing of a group’s entities. Such activities cover the pooling of cash proceeds from the operational affiliates, the granting of intragroup loans, the raising of funds on external markets for lending on behalf of its parent, the centralised management of treasury activities and accounts receivables, etc.

Owing to their role of financial intermediary within the group, captive financial institutions and money lenders are often located in jurisdictions that act as global financial centres and share the following structural characteristics: openness to trade and financial flows, political and economic stability, international tax treaty network, access to different forms of finance, reliable communication and financial infrastructures, skilled and multilingual workforce, etc.

When settled in these jurisdictions, captive financial institutions and money lenders often contribute to an increase, sometimes substantially so, in the flows of foreign direct investment at national level. In this context, there is a need to understand these influential players on the scene of international capital flows. This topic is of importance for Luxembourg

[1] For more information, the reader can refer to OECD (2008)’s Benchmark Definition of Foreign Direct Investment p. 162-163, p. 77-78, UN (2009)’s SNA2008 framework Para 4.113 to 4.114 p. 77-78, IMF (2009)’s BPM6 Para. 4.82 to 4.87 p. 65-66, EC (2013)’s European System of Accounts ESA 2010 Para 2.98 to 2.99 p. 42, IMF (2017)’s Monetary and Financial Statistics Manual and Compilation Guide Para. 3.181 to 3.188, p. 46-47.

since this global financial centre features a large amount of foreign direct investments whose flows are predominantly initiated by captive financial institutions and money lenders.

A potential way to understand captive financial institutions and money lenders is to establish a typology of these entities. To our best knowledge, two pioneering papers in the literature came up with elements of a typology for the sector S127: ECB-Eurostat-OECD (2013) and IMF (2018). The ECB-Eurostat-OECD (2013)'s typology relies essentially on qualitative criteria pertaining to institutional sectors and economic activity[2]. In addition to the latter criteria, the IMF (2018)'s typology includes qualitative criteria regarding the resident parent, the production and the FDI pass-through investment. More importantly, the IMF (2018)'s typology puts forward prototype balance sheets assigned to specific types of corporations. Despite the advances made, neither of these papers attempted to test a typology of sector S127 empirically.

Against this background, the paper presents an empirical typology of the sector of captive financial institutions and money lenders (S127) in Luxembourg.

2. Methodology:

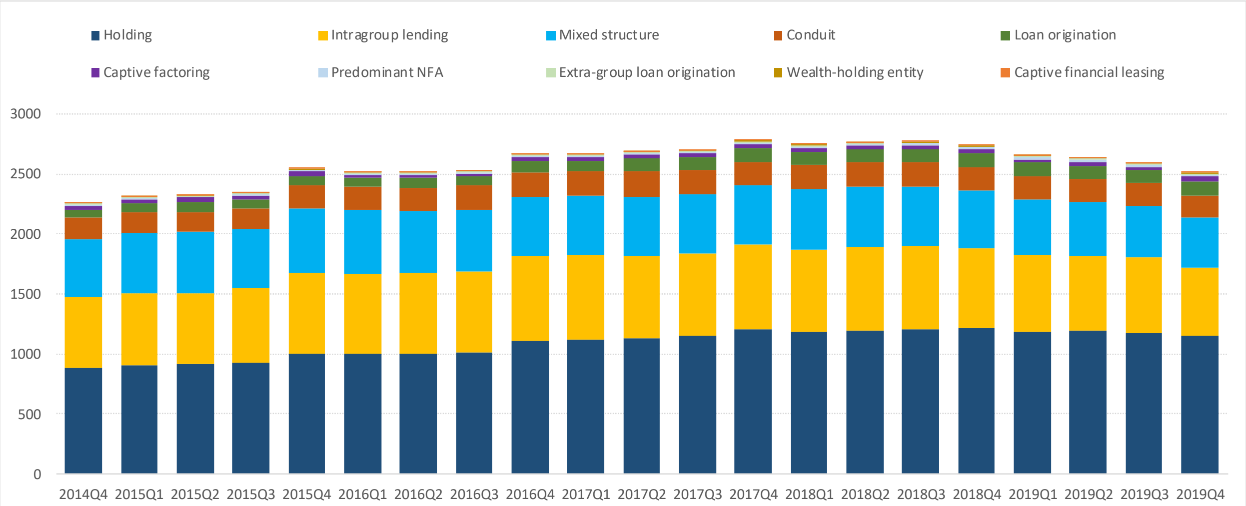
This paper contributes to the literature in various aspects. It fine-tunes definitions of the potential types of CFIs along with their respective prototype balance sheets. In addition, the paper presents a simple and robust qualitative method to identify all the potential types of CFIs, based on the relative predominance of a given balance sheet item over the others. This method highlights not only the prototype balance sheet of CFIs put forward in the literature (ECB-Eurostat-OECD (2013), IMF (2018)), but also variants of the prototype balance sheets defined in this paper as well as new prototype balance sheets of CFIs which may be peculiar to the case of Luxembourg. Thanks to this method, it becomes possible to draft an initial empirical typology of CFIs in Luxembourg, a global financial centre where the sector S127 is of notable importance, particularly in terms of FDI stocks.

[2] Institutional sectors rely on the UN (2009)'s System of National Accounts 2008 (SNA2008) and EC (2013)'s European System of Accounts 2010 (ESA2010) classifications while economic activity is based on the UN (2008)'s International Standard Industrial Classification of All Economic Activities (ISIC), Revision 4.

3. Result:

Chart 1 presents the typology of CFIs in Luxembourg, by number of firms. On average over the period Q4 2014 – Q4 2019, the sample of CFIs regroups holding corporations (42%), intragroup lending companies (25%), mixed structures (19%), conduits (7%) and loan origination companies (4%). These corporations represent about 98% of the total number of CFIs with at least EUR 500 million in total assets. The remaining types that complete the sample of CFIs consist of captive factoring and invoicing corporations, companies with predominant non-financial assets, extra-group loan origination firms, wealth-holding entities and captive financial leasing corporations.

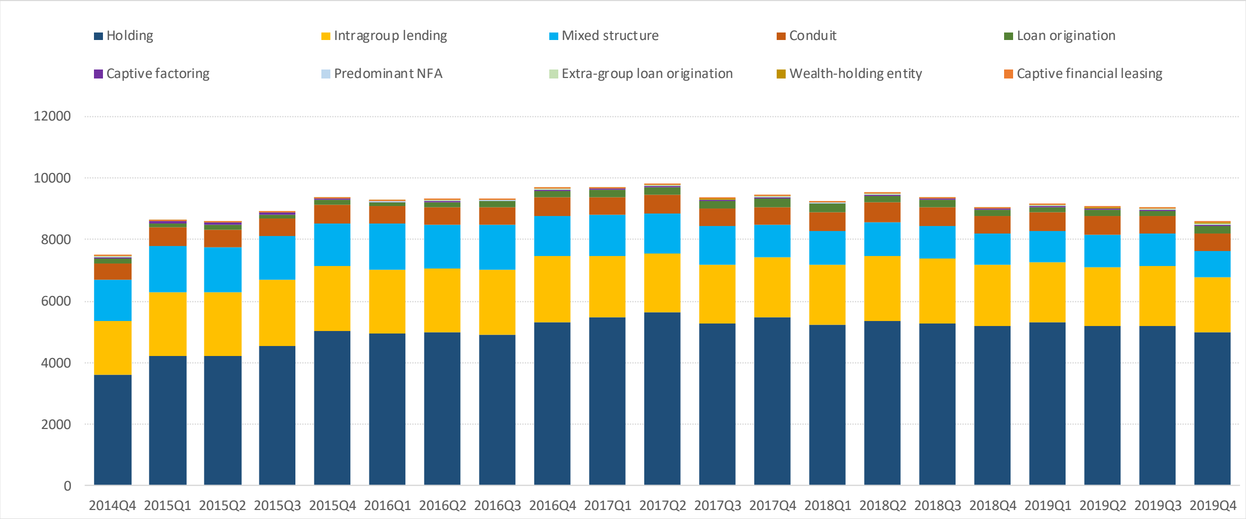
Chart 1: Typology of CFIs (by number)



Source: Authors' calculations. Units: Number of CFIs

Chart 2 presents the typology of CFIs in Luxembourg, by total assets held. On average over the period Q4 2014 – Q4 2019, the most important asset holders are holding corporations (55%), followed by intragroup lending companies (22%), mixed structures (14%), conduits (6%) and loan origination companies (2%). These corporations represent about 99% of the total assets held by CFIs with at least EUR 500 million in total assets. The remaining types that complete the sample of CFIs consist of captive factoring and invoicing corporations, companies with predominant non-financial assets, extra-group loan origination firms, wealth-holding entities and captive financial leasing corporations.

Chart 2: Typology of CFIs (by total assets held)



Source: Authors' calculations. Units: EUR billion

4. Discussion and Conclusion:

Altogether, the relative proportion of the different types of CFIs remains stable over time, whether in terms of number or in terms of total assets. The most important types of CFIs are holding corporations, followed by intragroup lending companies, mixed structures, conduits and loan origination corporations.

The relative importance of holding corporations, intragroup lending companies, mixed structures, conduits and loan origination companies suggests that Luxembourg acts as a global financial centre for multinational enterprises (MNEs), which benefit from Luxembourg as a financial platform for managing their business activities and structuring their corporate investments.

According to the literature (Moyse et al. (2014), Hoor (2018)), several factors can explain the attractiveness of Luxembourg as a platform for MNEs to structure their investment and financing activities. These factors include an open economy, an international tax treaty network and a stable legal and regulatory environment. Moreover, Luxembourg also boasts a qualified, experienced and multilingual workforce and financial infrastructures (e.g. access to the Eurobond market via the Luxembourg stock exchange, clearing entities to settle transactions with Clearstream, large number of foreign banks) that contribute to its integration within the network of financial centres worldwide.

References:

1. **Di Filippo Gabriele, Pierret Frédéric, 2020,** "**A Typology of Captive Financial Institutions and Money Lenders (sector S127) in Luxembourg**", Banque Centrale du Luxembourg, Working Paper No. 146, July 2020
https://www.bcl.lu/fr/Recherche/publications/cahiers_etudes/146/BCLWP146.pdf

2. **ECB-Eurostat-OECD, 2013,** "Final Report by the Task Force on Head Offices, Holding Companies and Special Purpose Entities (SPEs)", June 2013
https://ec.europa.eu/eurostat/documents/737960/738007/Final_Report_Task_Force_SPEs.pdf/9390b392-62d3-45b4-a4ee-fd9ed7a78da2

3. **European Commission (EC), 2013,** "European System of Accounts ESA 2010", Theme: Economy and Finance Collection: Manual and Guidelines, Luxembourg: Publications Office of the European Union, 2013
https://ec.europa.eu/eurostat/documents/3859598/5925693/KS-02-13-269-EN.PDF/44cd9d01-bc64-40e5-bd40-d17df0c69334

4. **Hoor Oliver R., 2018,** "Transfer Pricing in Luxembourg", Legitech, Editions Juridiques et Fiscales, Edition 2018

5. **International Monetary Fund (IMF), 2018,** "Final Report of the Task Force on Special Purpose Entities", IMF Statistics Department, BOPCOM—18/03 For discussion, Thirty-First Meeting of the IMF Committee on Balance of Payments Statistics, Washington, D.C. October 24–26, 2018
https://www.imf.org/external/pubs/ft/bop/2018/pdf/18-03.pdf

6. **International Monetary Fund (IMF), 2017,** "Monetary and Financial Statistics Manual and Compilation Guide", IMF, Washington, D.C., 2017

7. **International Monetary Fund (IMF), 2009,** "Balance of Payments and International Investment Position Manual", Sixth Edition (BPM6), Washington D.C. https://www.imf.org/external/pubs/ft/bop/2007/pdf/bpm6.pdf

8. **Moyse Laurent, Meiers Claude, Maquil Michel, 2014,** "Les Artisans de l'Industrie Financière: Témoignages sur l'Origine et le Développement de la Place Financière de Luxembourg", Editions Saint Paul (French version)

9. **Organisation for Economic Co-operation and Development (OECD), 2008,** "Benchmark Definition of Foreign Direct Investment", Fourth Edition
https://www.oecd.org/daf/inv/investmentstatisticsandanalysis/40193734.pdf

10. **United Nations (UN), 2009,** "System of National Accounts 2008", New York 2009
https://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Introductory remarks:
Cooperation issues between NSOs and Central Banks[1]

Luís Morais Sarmento,
Bank of Portugal

[1] This presentation was prepared for the WSC. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

Cooperation issues between NSOs and Central Banks

Luís Morais Sarmento – Deputy Director
Statistics Department

BANCO DE PORTUGAL
EUROSYSTEM

General remarks

- Cooperation issues between NSOc and Central Banks
- Todays' presentations:
  - *Recent Developments in the Use of Disclosed Detailed Financial Information in the Estimation of Japan's Flow of Funds Accounts*
  - *Uses of Mirror Data: Estimation of Foreign Assets and Liabilities of Households*
  - *Implications of Covid-19 for official statistics*
- At a first glance, these papers represent interesting cases but that do not directly relate to the subject.
- A closer reading let us identify a common aspect:

The three papers emphasize the importance of cooperation for better statistics!

- Not only between NSOs and Central Banks but at a cross-sector and cross-border cooperation:

Among national statistical authorities

With third entities

International cooperation

Recent Developments in the Use of Disclosed Detailed Financial Information in the Estimation of Japan's Flow of Funds Accounts

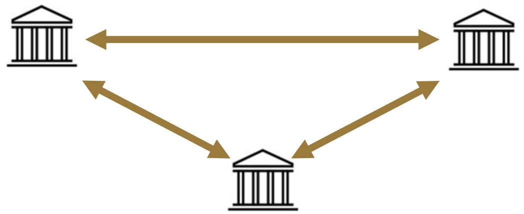
- Lack of cooperation between national statistical authorities
- The use of disclosed financial information as a second or third best solution
- It represents improvements but not without a cost, this approach has some limitations:

\+ It allowed to mitigate the limited access to information on non-banks and non-financial sector.

− How to ensure:
- coverage and representativity of the corporations considered?
- consistency and coherence with other indicators on non-financial sector/real accounts?

- **Portuguese case:** The Simplified Corporate Information (IES) and the Central Balance-sheet database
  - ✓Cooperation between Central Bank, NSO, Fiscal authority and Ministry of Justice
  - ✓Use of administrative data, reducing reporting burden and ensuring (almost) census approach

Uses of Mirror Data: Estimation of Foreign Assets and Liabilities of Households



- Case of cross-border cooperation
- Highlights the importance of share information among Central Banks
- Methodology used allows to mitigate the lack of structured information on the Households assets and liabilities
- Quality control of cross-border information and reconciliation of assets/liabilities
  - Assets of country A vis-a-vis country B = Liabiliaties of country B vis-a-vis country A

Implications of Covid-19 for official statistics

- More conceptual and comprehensive paper that points several issues that were raised and/or particularly exacerbated by the pandemic context- *food for thought*

- It stresses many challenges that call for increased and deeper cooperation among statistical authorities and between statistical authorities and other entities at national and international levels

- Core macro statistics (namely national accounts) may be complemented with other new indicators/datasources – improve timeliness and measurement of new phenomena
  - Use of administrative data: very useful and powerfull but not without a cost
  - Use of big data: the exemple of mobility data
  - Challenges of a more digital and global world: exemple of measurement of prices

Final remarks

- I would recall my initial message:

The three papers emphasize the importance of cooperation for better statistics!

- From this session we must take a call for action
- Cooperation is more necessary than ever
- It is a (the) way to improve results and quality of statistics produced

Thank you for your attention

BANCO DE
PORTUGAL
EUROSYSTEM

Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Recent developments in the use of disclosed detailed financial information in the estimation of Japan's flow of funds accounts[1]

Yukiho Ishigami, Ayaka Sekita and Hiroyuki Fujiwara,
Bank of Japan

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

BANK OF JAPAN

63rd World Statistics Congress
Virtual July 2021

Recent Developments in Use of Disclosed Financial Information in Estimation of Japan's Flow of Funds

Yukiho Ishigami　Ayaka Sekita
Bank of Japan

Outline/Contents

1. Introduction

1. Introduction

The FFA	• The Flow of Funds Accounts (FFA) covers wide range of sectors and financial items - 50 sectors and 57 items
Challenge	• Limited access to source data for non-banks and non-financial sectors
Solution	• Incorporated newly disclosed financial reports to improve accuracy of estimated figures for non-banks and non-financial sectors and reflect changes in market activities

2. Use of Disclosed Financial Reports

2. Use of Disclosed Financial Reports

Two FFA's revised estimation methods of figures for the non-bank financial institutions using disclosed reports:

Case 1

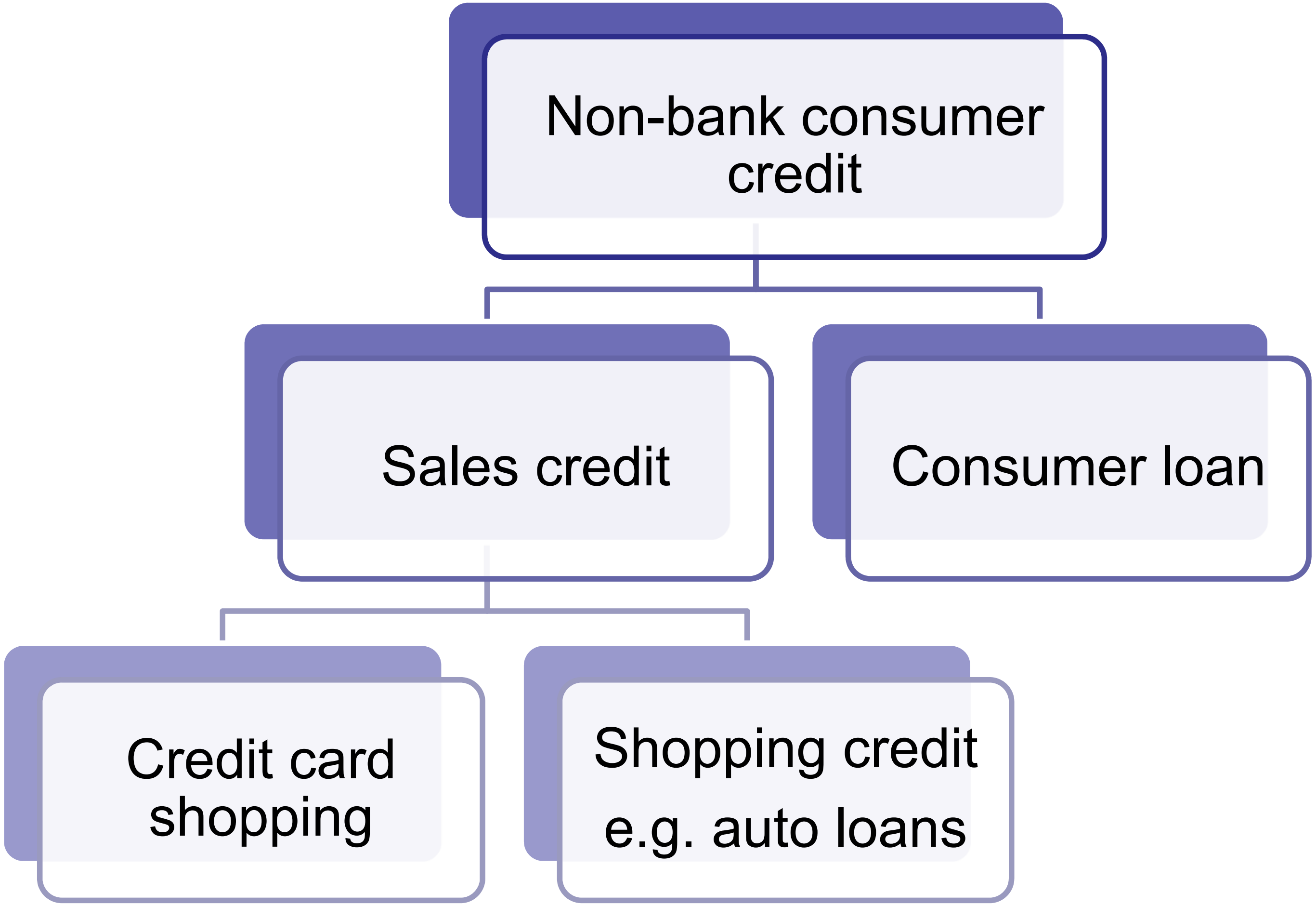
- Non-Bank Consumer Credit

Case 2

- Investments by public pension funds

2.-Case 1: Non-Bank Consumer Credit

Definition



2.-Case 1: Non-Bank Consumer Credit

Previous Methodology

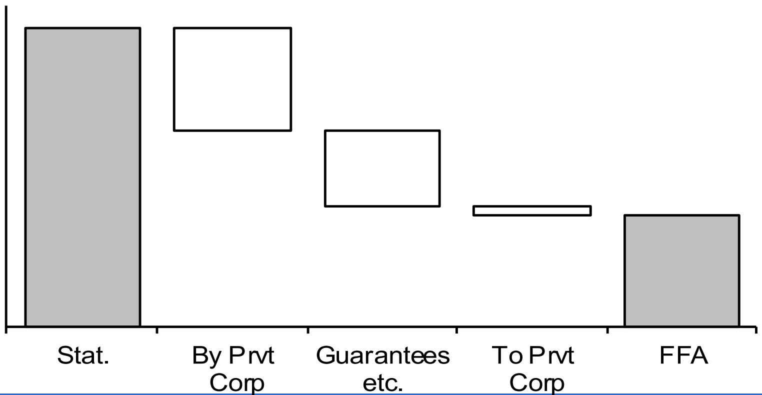
Used ratio of total lending to multiply sample data.

$$\text{Sample data: consumer credit} \times \frac{\text{JFSA's Statistics: Total lending}}{\text{Sample data: Total lending}}$$

Main Challenge

Definition of statistics does not match that of the FFA.

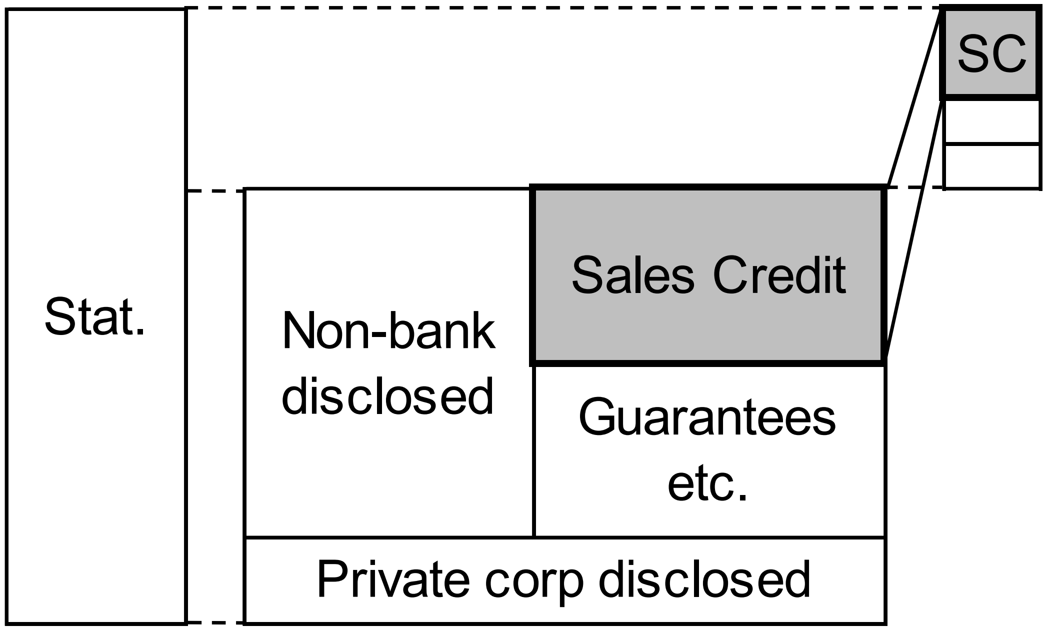
Adjustment of Shopping Credit Statistics to Definition of Non-bank Consumer Credit in FFA



2.-Case 1: Non-Bank Consumer Credit

New Methodology
Use disclosed reports to estimate breakdown ratio of statistics to adjust it to definition in the FFA.

Estimation of Breakdown of Statistics Using Disclosed Financial Data

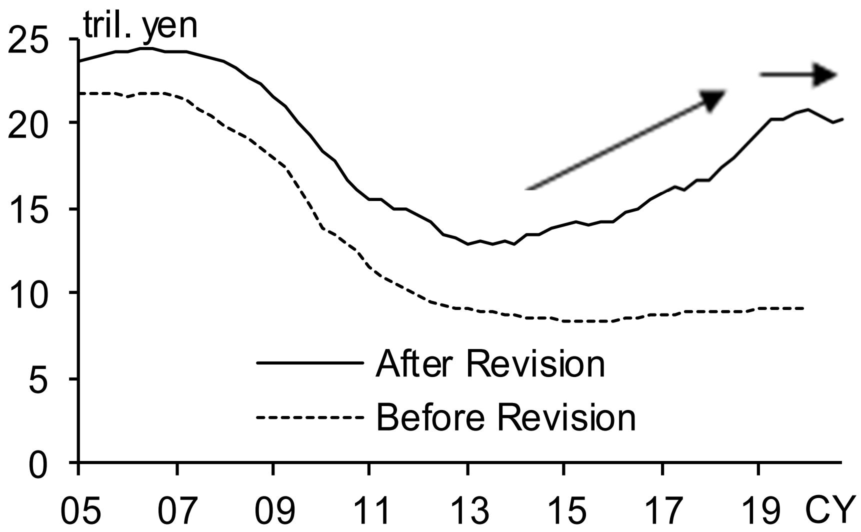


2.-Case 1: Non-Bank Consumer Credit

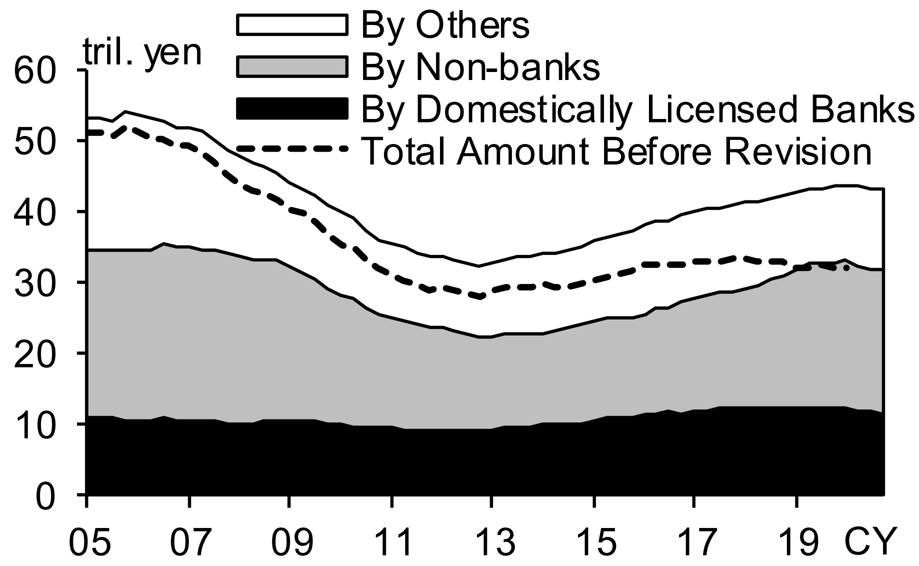
Results

- ✓ Revealed increasing trend until 2019 led by sales credit, and stagnation during pandemic in 2020.
- ✓ Amount outstanding doubled from 9 trillion to 21 trillion yen as of March-end 2020.
- ✓ Revealed increasing trend of non-bank consumer credit as a whole.

The Amount Outstanding of Non-bank Consumer Credit until Dec-end 2020



The Total Amount Outstanding of Consumer Credit by Sectors until Dec-end 2020



2.-Case 2: Investments by public pension funds

Definition

- ✓ Public pension funds: the Government Pension Investment Fund (GPIF), Mutual Aid Associations for public workers, etc.
- ✓ They invest in securities mainly through money trust, which should be divided into securities it owns.

Money trust →
- Domestic debt securities
- Domestic equities
- ⋮
- Foreign equities

Previous Methodology

Investment through money trust by public pension funds (Mutual Aid Associations for public workers, etc.) × Average ratio of all sectors

2.-Case 2: Investments by public pension funds

Main Challenge

No access to breakdown data of investments made by the pension funds through money trust.

New Methodology

Use two disclosed breakdown data sets

Annual reports

List of all securities owned by the public pension funds

+

Quarterly reports

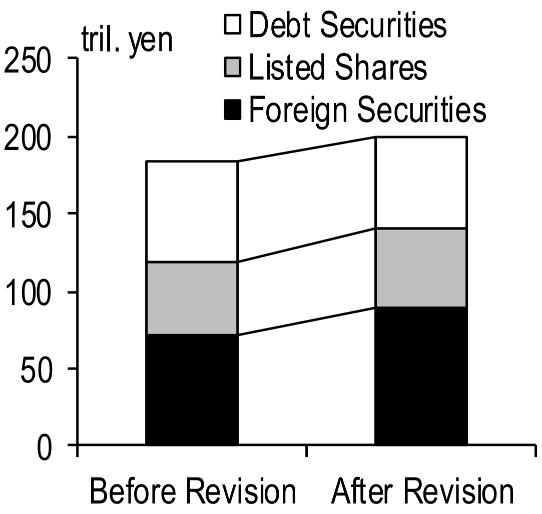
Breakdown of money trust in five types of securities invested

2.-Case 2: Investments by public pension funds

Results

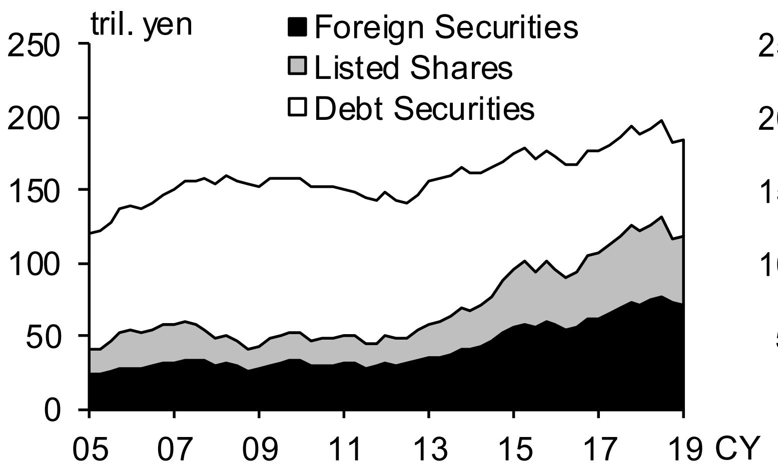
- ✓ Revealed shift from domestic debt securities to foreign securities
- ✓ Increased recent amount reflecting the change in market values

Figures of Public Pension Fund Assets as of Mar-end 2019

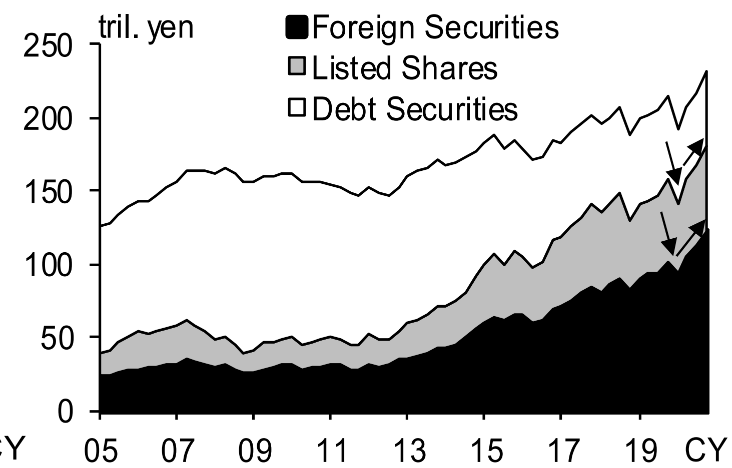


Figures for Public Pension Fund Assets before/after Revision

Before Revison until Mar-end 2019



After Revison until Dec-end 2020



3. Combination with Collected Data

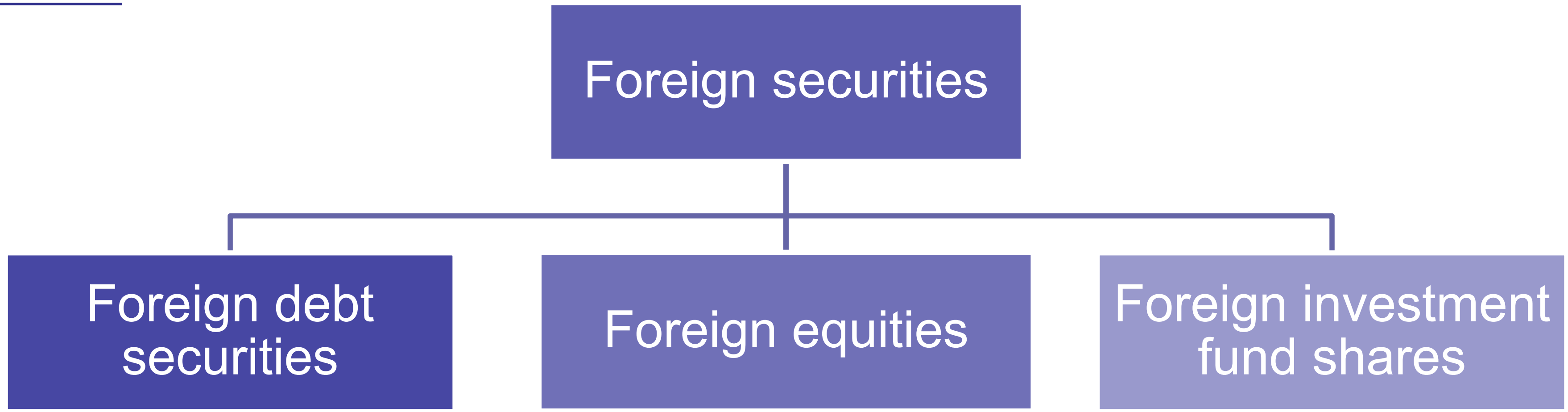
3. Combination with Collected Data

Two FFA's revised estimation methods combining disclosed materials and data submitted from financial institutions:

Case	
Case 3	• Household Investment in Foreign Securities
Case 4	• Private Loans to Solo-Proprietors

3.-Case 3: Household Investment in Foreign Securities

Definition



Previous Methodology

Applied ratio of investment in domestic securities by households and private non-financial corporations to investment in foreign securities.

Main Challenge

No access to data for subcategories of non-financial sector: households and private non-financial institutions.

3.-Case 3: Household Investment in Foreign Securities

New Methodology for Foreign Debt Securities and Foreign Equities

- ✓ Accumulates the data for households submitted from major securities companies.
- ✓ Uses total amounts of foreign securities in custody in their annually disclosed financial reports to estimate total amount.

Submitted data of major securities companies : Household investment

×

Disclosed data of all securities companies : Total investment in custody

―――――――――――――――

Disclosed data of major securities companies : Total investment in custody

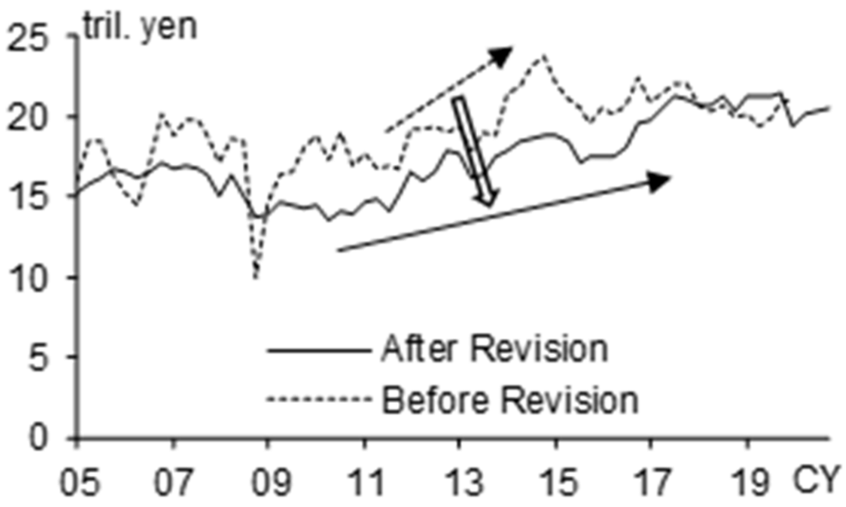
Bank of Japan

3.-Case 3: Household Investment in Foreign Securities

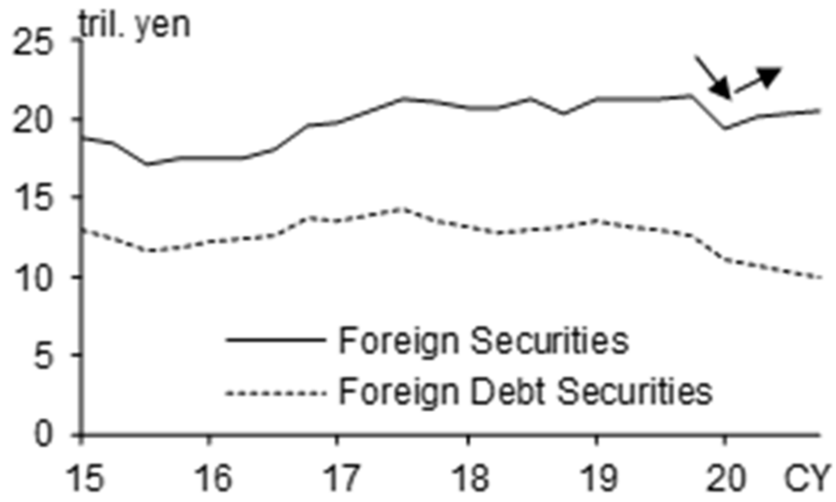
Results

- ✓ Revealed moderate increasing trend throughout the 2010's
- ✓ Figure fluctuated due to change in stock prices during pandemic in 2020
- ✓ Enabled breakdown into subcategories required in the Data Gaps Initiative (DGI-2): debt securities, equities and investment fund shares.

Amount Outstanding of Household Investment in Foreign Securities until Dec-end 2020



Revised Amount Outstading of Household Investment in Foreign Securities until Dec-end 2020



3.-Case 4: Private Loans to Solo-Proprietors

Definition and Main Challenge

Loans to solo-proprietors

- Apartment loans
  - By Banks etc. : Statistics available
  - By Others : Statistics unavailable
- Non-apartment loans :Statistics unavailable

Previous Methodology

Average amount of borrowings per small enterprise × Number of solo-proprietors

3.-Case 4: Private Loans to Solo-Proprietors

Planned New Methodology

- ✓ Use statistics for apartment loans by banks.
- ✓ Introduce various disclosed financial reports, statistics and data provided from related institutions.

Provisional Results*

- ✓ Increase from 44 trillion to 54 trillion yen as of March-end 2020, of which 27 trillion yen represents the apartment loans by banks

  * Official data sets are released on June 25, 2021

Provisional Figure of Loans to Solo Proprietors as of March-end 2020 after Revision in June 2021

Amount Outstanding before Revision	Amount Outstanding after Revision	Change in Amount Outstanding
43.8 tril. yen	54.0 tril. yen	+10.2 tril. yen

4. Conclusion

4. Conclusion

Methodology	• Use of disclosed financial reports is effective especially for non-banks and non-financial sectors. • Disclosed information can be combined with submitted data where it is insufficient.
Results	• Accuracy of estimation has improved remarkably and the FFA reflected changes in market activities. • Figures become more accurate especially for households.
Additional Implication	• New methods realized an appropriate balance between accuracy of estimation and efficiency of data collection.

Thank you

Yukiho Ishigami, Ayaka Sekita
Research and Statistics Department
Bank of Japan
Email: yukiho.ishigami@boj.or.jp
ayaka.sekita@boj.or.jp

Recent Developments in the Use of Disclosed Detailed Financial Information in the Estimation of Japan's Flow of Funds Accounts

Yukiho Ishigami[1]; Ayaka Sekita[2]; Hiroyuki Fujiwara[3]

[1] Bank of Japan, Tokyo, Japan – yukiho.ishigami@boj.or.jp
[2] Bank of Japan, Tokyo, Japan – ayaka.sekita@boj.or.jp
[3] Bank of Japan, Tokyo, Japan – hiroyuki.fujiwara@boj.or.jp

Abstract:
Recently, the financial information disclosed by both financial and non-financial institutions has become increasingly detailed in Japan, reflecting a growing sense of the importance of accountability in corporations. The Bank of Japan has been improving the accuracy of Japan's Flow of Funds Accounts (FFA) to reflect the changes in the financial activities by absorbing these newly disclosed materials.

The use of the disclosed financial reports is especially effective in estimating the data sets for non-banks and non-financial sectors because the Bank has relatively limited access to source data for these sectors compared to that of private banks. For example, the revised estimation method of non-bank consumer credit refers to reports disclosed by non-banks in order to adjust the available source data to meet the definition in the FFA. This revision revealed the increasing trend of non-bank consumer credit, which reflects the growing use of credit cards and other sales credits to consumers. Also, the investment portfolio by public pension funds is measured more accurately, since its new estimation method introduces the disclosed list of securities owned by the funds.

Although the disclosed materials have contributed to the improvement of the FFA as mentioned above, the newly available data does not necessarily reach a sufficient level for the full estimate of the FFA or to keep pace with the progress of global statistical standards. Thus, the Bank needs to combine the disclosed information with the data received from various institutions. The renewed estimation method of the household investment in foreign securities utilizes the data of household assets in custody obtained from securities companies in addition to their disclosed materials. This revision would even enable breaking down the household investment in foreign securities into subcategories of debt securities, equities and investment fund shares as required in the Data Gaps Initiative (DGI-2).

Consequently, the compilation method of the FFA has achieved an appropriate balance between the efficiency of data collection and accuracy of estimation. The efficiency of data collection is particularly important during the pandemic in order not to impose excessive burdens on institutions to submit all necessary information to the Bank. The Bank will continue to enhance the quality of the FFA by incorporating available source data.

Keywords:
Newly disclosed materials; Efficiency of data collection; Reflection of change in financial activities; Non-banks; Households

1. Introduction:

This paper describes recent developments in the estimation methods of Japan's Flow of Funds Accounts (FFA) where the Bank of Japan has utilized information available in newly disclosed financial reports. The developments comprise the following two parts: the revisions in the non-bank consumer credit and the investment by the public pension funds that adopted disclosed materials, as well as those in the household investment in foreign securities and the loans to solo-proprietors that combined disclosed information with submitted data.

This paper consists of four parts, starting with this introduction. Then, section 2 introduces the revisions in the non-bank consumer credit and the investment by the public pension funds, and section 3 explains the improvements in the household investment in foreign securities and the loans to solo-proprietors. Finally, the conclusion summarizes the paper.

2. Use of Disclosed Financial Reports

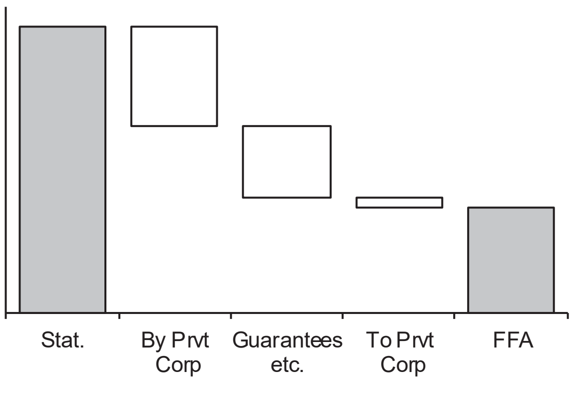
2.1 Non-Bank Consumer Credit

2.1.1 Methodology

In the FFA, non-bank[1] consumer credit consists of two elements—consumer loans and sales credit. Sales credit is credit that is related to a purchase contract and is the sum of credit card shopping and other shopping credit such as auto loans. Sales credit has grown for several years and has increased its share in consumer credit, while consumer loans have decreased their share.

Before the revision, the Bank estimated non-bank consumer credit by multiplying the amount of consumer credit from major traditional consumer credit companies by the ratio of their total lending to the total amount of non-bank lending as extracted from the statistics released by the Financial Services Agency. This original method used to be effective because the consumer loans represented a large part of the consumer credit by around 2010. However, the method has not necessarily grasped the recent increase of the sales credit.

(Chart 1) Adjustment of Shopping Credit Statistics to Definition of Non-bank Consumer Credit in FFA



The main challenge in estimating non-bank sales credit for the FFA was that, although there have been several statistics released by industrial associations, their definitions do not match the definition of the FFA (Chart 1). First, several lending companies are classified as private non-financial corporations in the FFA, and thus their amount of outstanding consumer credit needs to be eliminated from the non-bank consumer credit[2]. In addition, while the statistics include the credit, such as credit guarantees[3], that is not recorded on the balance sheets of non-banks, it should be excluded from the non-bank consumer credit in the FFA. Furthermore, consumer credit should be distinguished from non-bank lending to corporations, whereas statistics often combine both of them.

---

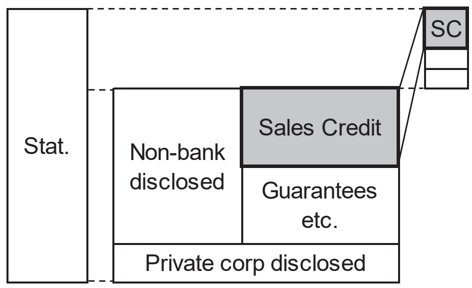
[1] In this paper, "non-bank" indicates the sector "finance companies" in the FFA.

[2] For example, car dealers belong to private non-financial corporations, as no single entity should represent more than one sector and the main business of car dealers is car sales, not lending. Therefore, their auto loans should not be included in non-bank consumer credit.

In order to both expand use of the available statistics and meet the definition of the FFA, the Bank investigated the area and found that financial reports disclosed by non-banks would help improve the accuracy of the data series[4].

In the new estimation method[5], the Bank accumulates non-bank disclosed financial reports to estimate the breakdown of the statistics and adjust the data to the definition of the FFA. The Bank divides the consumer credit into consumer loans and sales credit and estimates them separately. As for sales credit, the Bank uses disclosed data to estimate the ratio of the elements, such as credit guarantees and sales credit by and/or to private corporations, that should be eliminated from the non-bank consumer credit in the FFA in its total amount outstanding extracted from the statistics (Chart 2).

(Chart 2) Estimation of Breakdown of Statistics Using Disclosed Financial Data

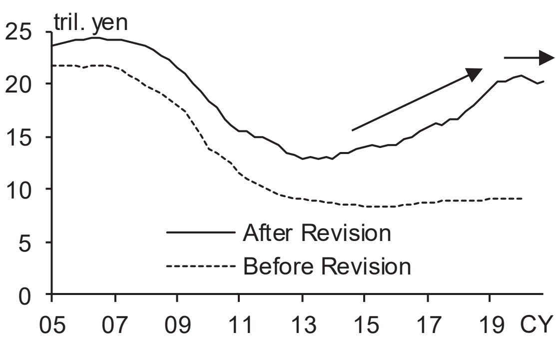


2.1.2 Results

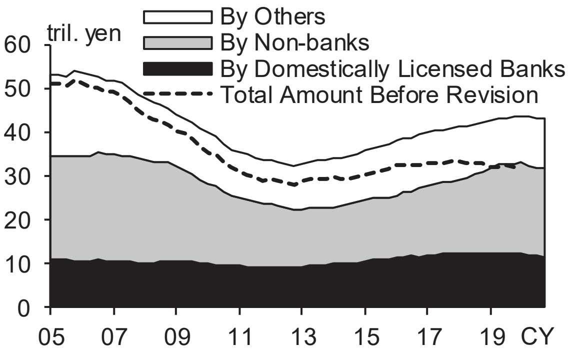
As seen in the chart 3, the revision revealed the increasing trend of non-bank consumer credit until 2019, which was led by sales credit, and the stagnation during the pandemic in 2020. Due to the revision, its amount outstanding also doubled from 9 trillion to 21 trillion yen as of March-end 2020.

Furthermore, the revised figures enable an overview of consumer credit. This shows that non-bank consumer credit has led the increasing trend as a whole (Chart 4).

(Chart 3) The Amount Outstanding of Non-bank Consumer Credit until Dec-end 2020



(Chart 4) The Total Amount Outstanding of Consumer Credit by Sectors until Dec-end 2020



2.2. Investments by public pension funds

2.2.1 Methodology

In the FFA, the sector "public pensions" consists of institutions such as the Government Pension Investment Fund (GPIF) and Mutual Aid Associations for public workers, which mainly invest in securities through money trust. Previously, the Bank assumed that the Mutual Aid Associations had the same breakdown ratio of the investment through money trust as its average ratio of all sectors. While they changed their portfolios significantly in 2015, the Bank had difficulties in reflecting the change to the FFA because the Bank did not have access to the breakdown data of investments made by the pension funds through money trust[6].

[4] For example, the accumulation of the disclosed financial reports turned out to be effective especially in estimating the breakdown of shopping credit. The Bank succeeded in adding disclosed data of around 10 companies to occupy most of the total amount outstanding of shopping credit.

[5] See Bank of Japan (2020, 2021b, c) for details.

[6] In the FFA, the investments made through money trusts are not stated simply as money trust, but must be divided into the actual types of securities that the money trust owns.

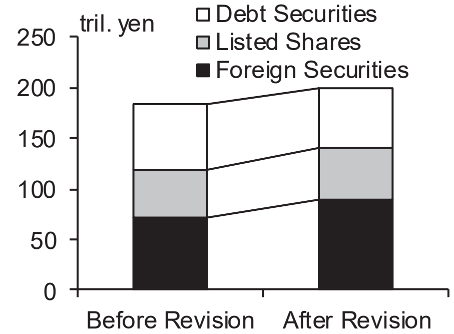
In estimating the breakdown of money trust owned by public pension funds[7], the Bank incorporated the detailed data that have been disclosed recently by each institution. More specifically, the Bank uses two types of disclosed financial materials. First, the Bank introduced annual reports that list all securities owned by the public pension funds. Second, it adopted quarterly reports that classify money trust into five types of securities invested: domestic debt securities, domestic equities, foreign debt securities, foreign equities and short term assets.

2.2.2 Results

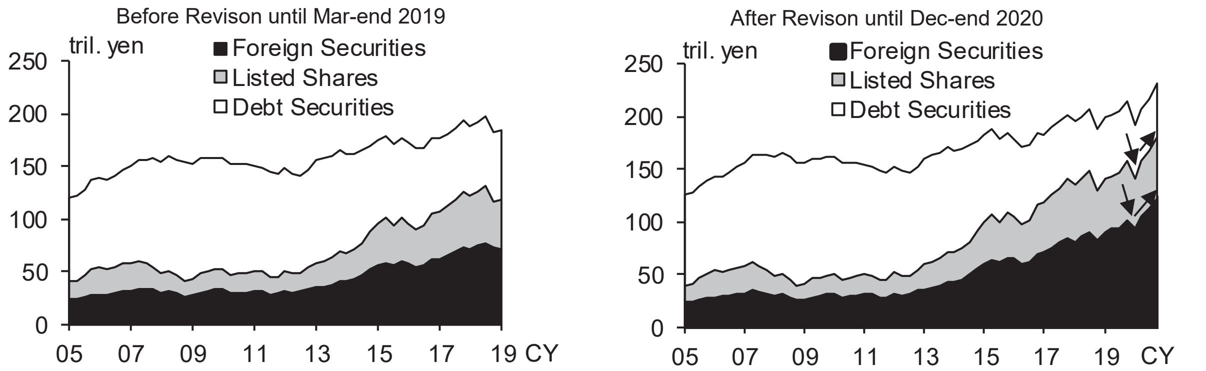
The revision revealed the shift in public pension investments from domestic debt securities to foreign securities (Chart 5), and the increased recent amount reflecting the change in their market values. It was also revealed that the figure dropped instantly at March-end 2020 due to the decrease in stock prices at the outbreak of the Covid-19 pandemic and has recovered afterwards (Chart 6).

Consequently, the revised figures reflected the aforementioned change in the portfolio of the investment by public pension funds.

(Chart 5) Major Changes in Figures of Public Pension Fund Assets as of Mar-end 2019



(Chart 6) Figures for Public Pension Fund Assets before/after Revision



3. Combination with Collected Data

While section 2 describes the revised methods using the disclosed reports for estimating the figures for the non-bank financial institutions in the FFA, this section explains those that combine the disclosed materials and the data submitted from financial institutions to the Bank.

3.1 Household Investment in Foreign Securities

3.1.1 Methodology

In the FFA, the transaction item "outward investment in securities" means the investment in foreign securities that are foreign debt securities, foreign equities and foreign investment fund shares.

Although the "Balance of Payment" and the "International Investment Position" released by the Bank provide the flow and amount of the investment in foreign securities by the non-financial sector, no data sets are available for investments by its subcategories such as households and private non-financial corporations. Thus, the major challenge in estimating investment in foreign securities by households is how to distinguish its amount from the investment by private non-financial corporations. Before the revision, the Bank applied the

[7] See Bank of Japan (2019, 2021b, c) for details.

ratio of the investment in domestic securities by households and private non-financial corporations to the investment in foreign securities.

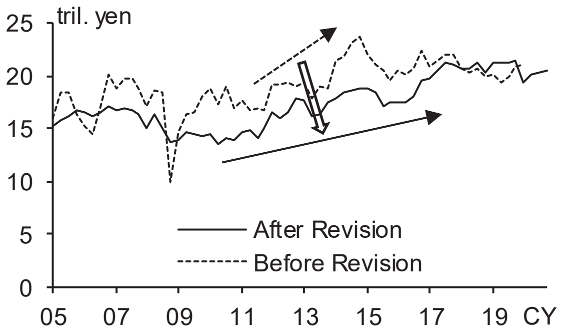
Securities companies disclose their total amounts of foreign debt securities and foreign equities in custody in their annually disclosed financial reports. In order to estimate the breakdown data for households[8], which are undisclosed, the Bank first accumulates the data for households submitted from major securities companies, and uses the aforementioned data extracted from the disclosed reports to estimate the total amount. As for the foreign investment fund shares, since the data of the respective companies are not available, the Bank combines several statistics and estimates the bond-type and the equity-type investment fund shares separately.

3.1.2 Results

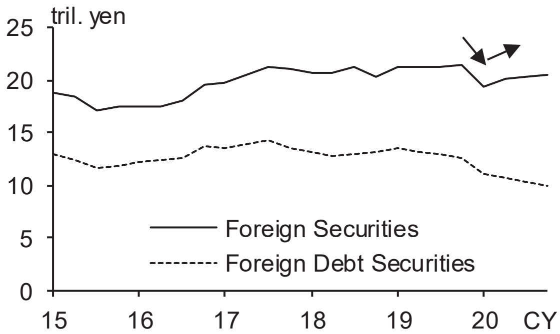
As a result of the revision, the moderate increasing trend throughout the 2010's has become clearer than before (Chart 7). Also, in 2020, the figure fluctuated in accordance with the change in stock prices during the pandemic (Chart 8).

In addition, the revision enabled the household investment in foreign securities to be broken down into subcategories required in the Data Gaps Initiative (DGI-2): debt securities, equities and investment fund shares. Consequently, the improvement has contributed to the progress of standardized global financial statistics (Chart 8).

(Chart 7) Amount Outstanding of Household Investment in Foreign Securities until Dec-end 2020



(Chart 8) Revised Amount Outstading of Household Investment in Foreign Securities until Dec-end 2020



3.2 Private Loans to Solo-Proprietors

3.2.1 Methodology

Although the "Loans and Bills Discounted by Sector" released by the Bank reveals the amount of apartment loans by domestically licensed banks and *shinkin banks*, there is no measure to capture the amount of other sorts of loans to solo-proprietors[9] or to separate them from loans to corporations, and accordingly the Bank can only estimate their amounts. Before the revision, the Bank calculated the average amount of borrowings per small enterprise and multiplied it by the number of solo-proprietors to estimate the amount of loans to solo-proprietors.

In the planned revision[10] in June 2021, the Bank will divide the loans to solo-proprietors into apartment loans and the remaining, non-apartment loans. While using the aforementioned "Loans and Bills Discounted by Sector" to capture the apartment loans by domestically licensed banks and *shinkin banks*, the Bank will introduce various disclosed financial reports,

[8] See Bank of Japan (2020, 2021b, c) for details.
[9] In this paper, "loans to solo-proprietors" indicates the transaction item "loans to companies and governments" on the liability of the sector "households" in the FFA.
[10] See Bank of Japan (2021a) for details.

statistics and data provided from related institutions such as CRD (Credit Risk Database) Association to estimate loans to solo-proprietors.

3.2.2 Results
The revised time series data are yet to be compiled and will be released on June 25 2021. However, on May 28 2021, the Bank disclosed its plan to revise the FFA's estimation method and the provisional figures as of March-end 2020.

According to the plan, the amount outstanding of the loans to solo-proprietors will be increased from 44 trillion to 54 trillion yen, of which 27 trillion yen represents the apartment loans directly extracted from the "Loans and Bills Discounted by Sector" (Chart 9).

(Chart 9) Provisional Figure of Loans to Solo Proprietors as of March-end 2020 after Revision in June 2021

Amount Outstanding before Revision	Amount Outstanding after Revision	Change in Amount Outstanding
43.8 tril. yen	54.0 tril. yen	+10.2 tril. yen

4. Discussion and Conclusion:
In conclusion, the Bank has been revising the estimation methods of the FFA to reflect changes in the financial activities by absorbing newly disclosed financial reports and improving the quality of the FFA. The use of disclosed financial reports has turned out to be effective especially in estimating data sets for non-bank financial institutions and non-financial sectors, of which the data accuracy remains to be improved. Although there are statistics available on non-bank financial institutions, their definitions often differ from those of the FFA. Thus, the Bank incorporated disclosed data to adjust the available data to meet the definitions in the FFA. In the areas on which the data availability of disclosed materials does not reach the sufficient level to estimate the FFA thoroughly, the Bank combined the disclosed information with data submitted from financial institutions to improve the FFA's estimation methods. As a result, the figures have become more accurate especially for households in the transaction items that used to rely largely on estimations.

The new estimation methods have realized an appropriate balance between the accuracy of estimation and efficiency of data collection. This balance is particularly important during the pandemic, in order not to impose excessive burdens on institutions to submit all necessary information to the Bank. The Bank will continue to enhance the quality of the FFA by incorporating disclosed source data.

References:
1. Research and Statistics Department, Bank of Japan (2019) "Retroactive Revision to the Flow of Funds Accounts"
2. Research and Statistics Department, Bank of Japan (2020) "Retroactive Revision to the Flow of Funds Accounts"
3. Research and Statistics Department, Bank of Japan (2021a) "Planned Retroactive Revision to the Flow of Funds Accounts"
4. Research and Statistics Department, Bank of Japan (2021b) "Guide to Japan's Flow of Funds Accounts"
5. Research and Statistics Department, Bank of Japan (2021c) "Compilation Method of Japan's Flow of Funds Accounts"
— The above references are available at https://www.boj.or.jp/en/statistics/sj/index.htm/.

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics
July 2021, The Hague, Netherlands, virtual format

Uses of mirror data: estimation of foreign assets and liabilities of households[1]

Swapan-Kumar Pradhan, BIS, João Falcao Silva, Bank of Portugal,
and Stefan Wiesinger, Central Bank of the Republic of Austria

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

USES OF MIRROR DATA
estimation of Foreign Assets and Liabilities of Households*

Swapan-Kumar PRADHAN
João Falcão SILVA
Stefan WIESINGER

63rd ISI World Statistics Congress “IPS 134 - Cooperation issues between NSOs and Central Banks ”
11-16 July 2021

BANCO DE PORTUGAL
EUROSYSTEM

BANK FOR INTERNATIONAL SETTLEMENTS

OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

* The views expressed in this presentation are those of the authors and not necessarily of the BIS, BdP or OENB.

3 TOP motivations

1. Delimitation, complexity and importance of the household sector

Group of persons…

- ✓ Who share the same living accommodation
- ✓ Who pool some, or all, of their income and wealth and consume certain goods and services collectively

[SNA §4.147]

[1] At mid-year. [2] Per capital outstanding amounts; As of end-December. [3] GDP at current price.

3 TOP motivations

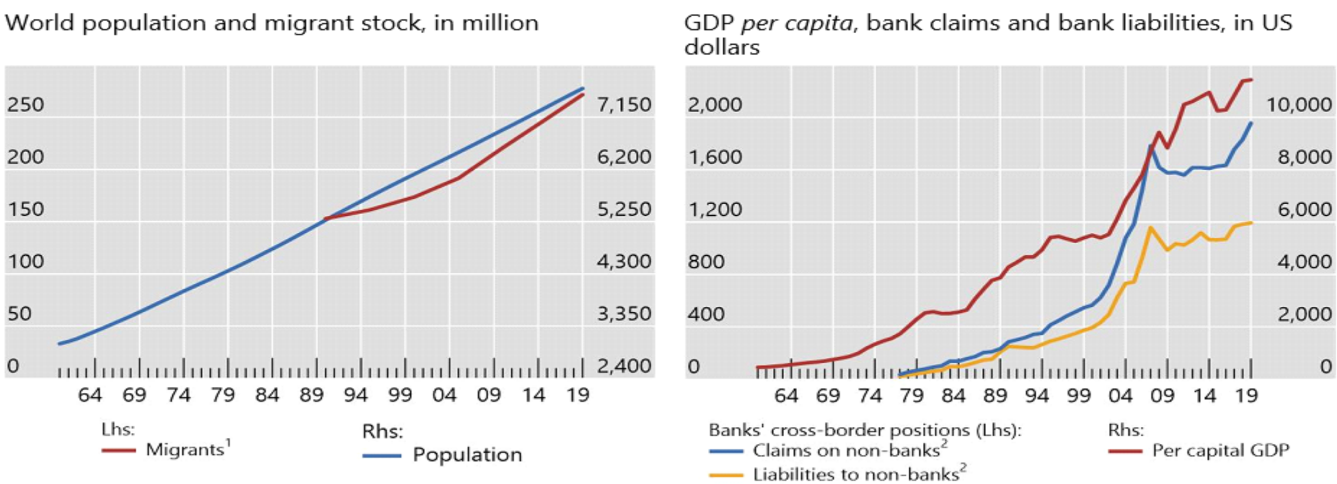
1. Delimitation, complexity and importance of the household sector

Group of persons…

- ✓ Who share the same living accommodation
- ✓ Who pool some, or all, of their income and wealth and consume certain goods and services collectively

[SNA §4.147]

World population, stock of migrants, GDP *per capita* and cross-border claims/liabilities [1990-2019]



[1] At mid-year. [2] Per capital outstanding amounts; As of end-December. [3] GDP at current price.

1. Delimitation, complexity and importance of the household sector

Group of persons…

- ✓ Who share the same living accommodation
- ✓ Who pool some, or all, of their income and wealth and consume certain goods and services collectively

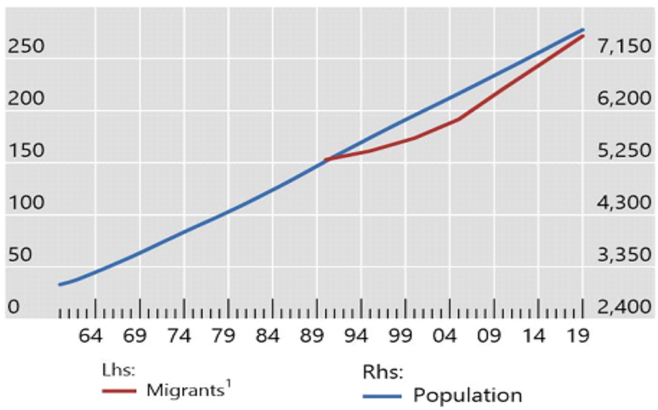
[SNA §4.147]

The measurement of the households' sector implies the consistency between:

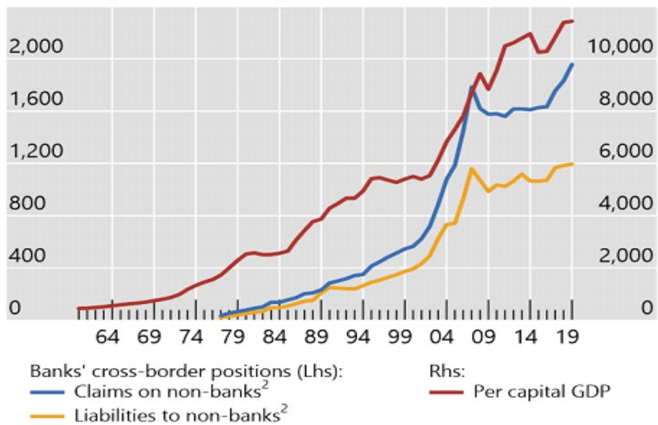
FINANCIAL ACCOUNT ⟲ **NON-FINANCIAL ACCOUNT**

World population, stock of migrants, GDP *per capita* and cross-border claims/liabilities [1990-2019]

World population and migrant stock, in million



GDP *per capita*, bank claims and bank liabilities, in US dollars



[1] At mid-year. [2] Per capital outstanding amounts; As of end-December. [3] GDP at current price.

2. Mirror data can be used to measure this sector

Incomplete information/scarce data sources

↓

DATA GAPS

MIRROR DATA - different sources that capture similar concepts

Statistical tools - allow validity of common data items across statistical domains

2. Mirror data can be used to measure this sector

Incomplete information/scarce data sources

DATA GAPS

MIRROR DATA: different sources that capture similar concepts

Important statistical tools that allow common data items to be validated across statistical domains

PROMOTES:

CONSISTENCY

ACCURACY

RAISE STATISTICAL QUALITY STANDARDS

OESTERREICHISCHE NATIONALBANK EUROSYSTEM

3. Relevance to other domains of Households' foreign assets and liabilities

Correspond to an **important portion** of many **external operations** both **on the non-financial** and **financial items**

BIS
IBS/IDS

External statistics

BoP/IIP

National accounts

WHY THIS PAPER?

1. **Estimate stocks** that can **improve the coverage** of other statistical domains: **International Investment Position** and **Rest of the World Sector** – National accounts

2. **Provide guidance on derivation of households' assets/liabilities** (loans & deposits) on a country basis for more than 200 countries

3. Exploit **mirror relationship between bank & counterparty sector,** using aggregated data (published) or granular data (unpublished)

WHY BIS - Locational Banking Statistics?

1. Estimation of stocks

- **Consistency** with the International Investment Position
- **Granular** data with country location of both reporting banks and counterpart
- Breakdown available by **counterparty sector, instrument and currency**

WHY BIS - Locational Banking Statistics?

1. Estimation of stocks

- **Consistency** with the International Investment Position
- **Granular** data with country location of both reporting banks and counterpart
- Breakdown available by **counterparty sector, instrument and currency**

2. Derivation of households' Loans and deposits

- 3 **methods to estimate cross-border assets/liabilities** depending on the available data
- **Mirror data:**

Banks' deposit liabilities to households = Assets of households with banks

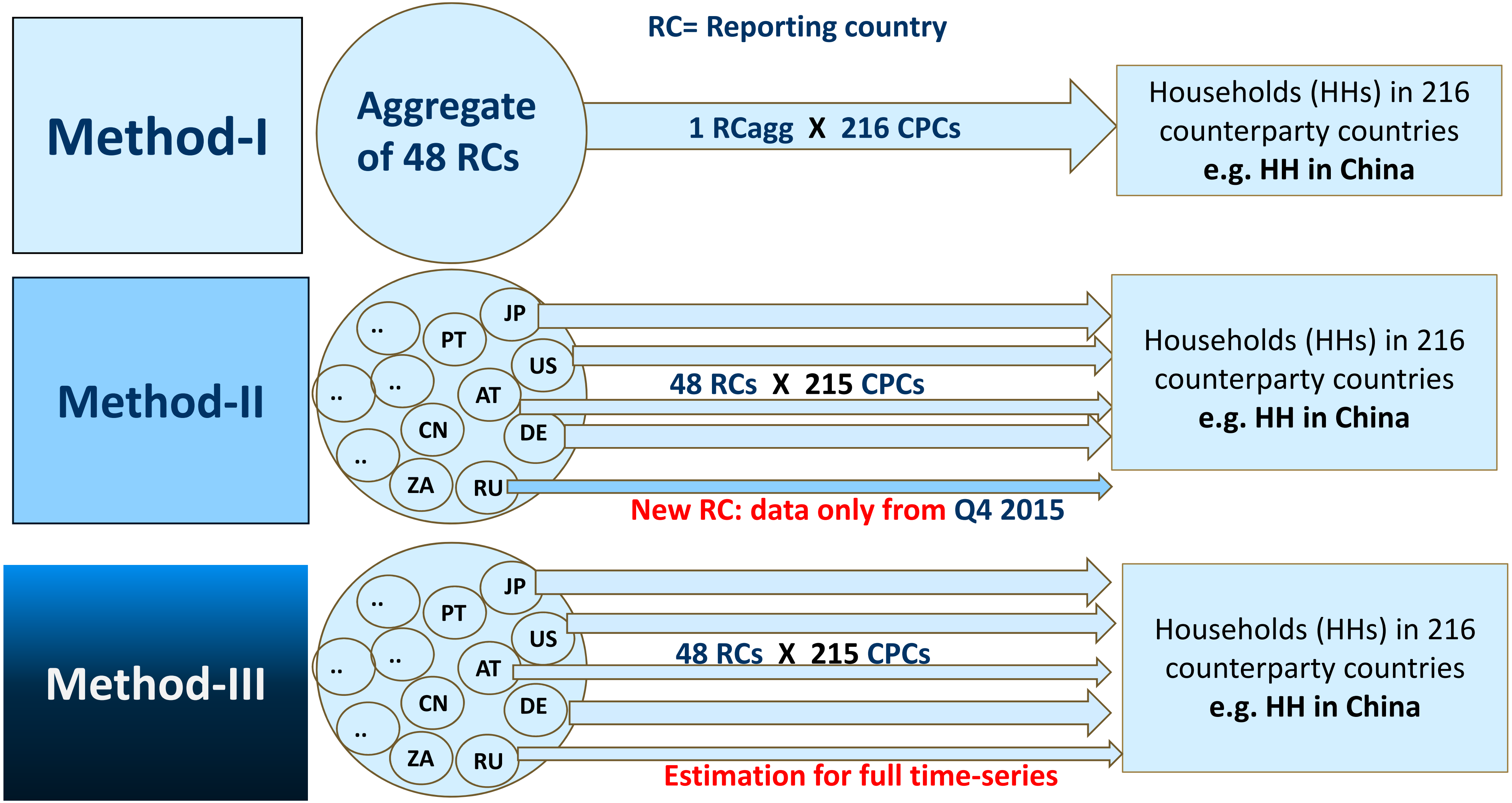
Bank's loan claims on households = Borrowing/liabilities of households to banks

Methodology

We will present 3 alternative estimation methods

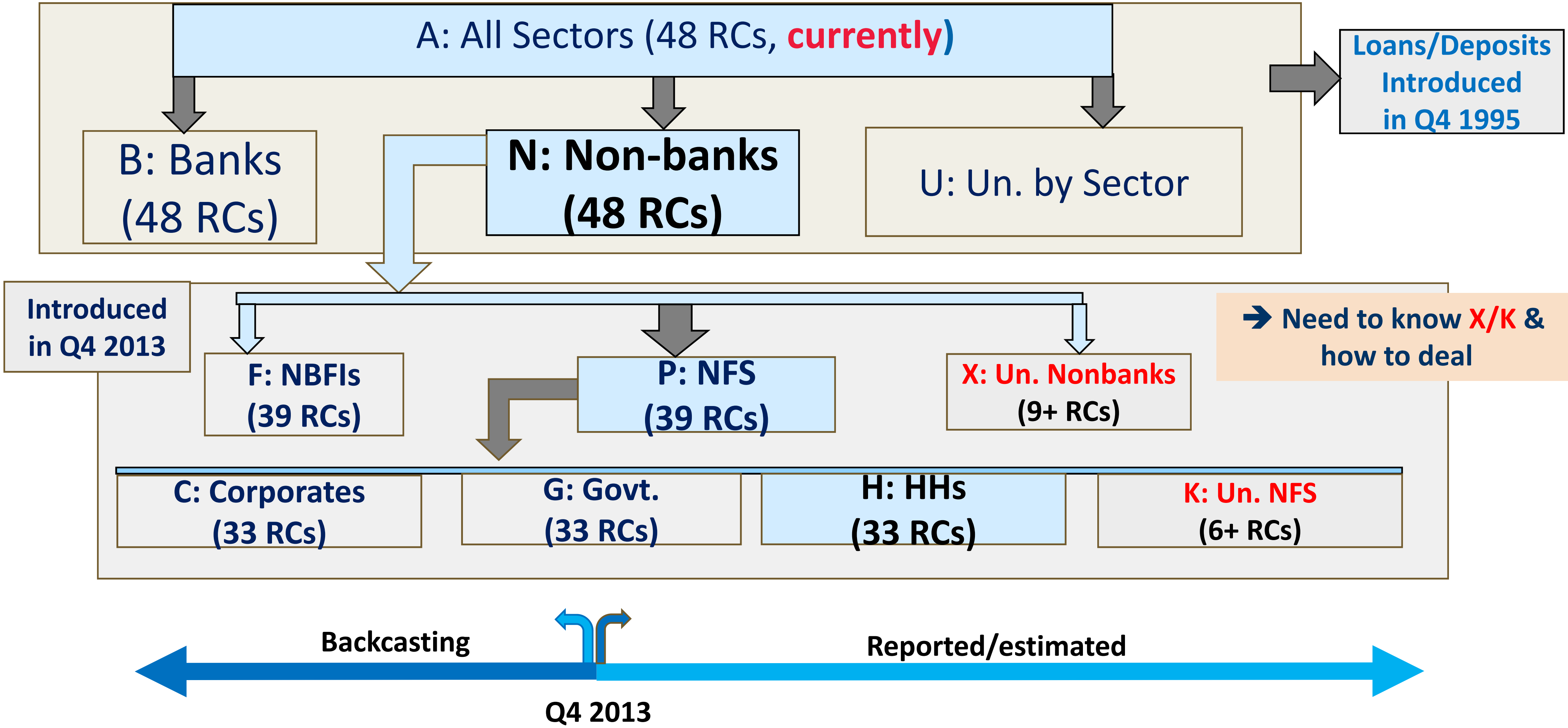
Method-I	**Method-II**	**Method-III**

Methodology: 3 Estimation Methods – What and Why?



Method-II PLUS Estimated data of RCs for periods prior to their joining

Estimation based on Data Knowledge Level 1 (➔Method-I)



Source: Guidelines to the BIS Locational Banking Statistics (LBS)

Estimation based on Data Knowledge Level 2 (➔Method-II)

OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

Breakdown of N: Non-banks
(N = F + P +X, P = C + G + H + K)

Introduced/available from Q4 2013

1. Of 48 RCs, who provides which breakdowns and from when? **Backcasting depends**
2. What is their profile vis-à-vis HHs or other sectors in other country?

Backcasting

Reported/estimated

Sub-sectors	Q4 2006	…	…	Q3 2013	Q4 2013	Q1 2014	….	….	Q4 2015	…	…	Q4 2017	..	..	Q4 2020
N: Non-bank, total	40 RCs			44	44	44			46 (CN/RU)			48			48
F and P (+X)					18	20 (=18+2)			31(=20+11)			38 (=31+7)			39
C,G and H (+K)					15	16 (=15+1)			26(=16+10)			32 (=26+6)			33

Note: 8 reporting countries joined the reporting system between Q4 2006 and Q4 2017

Estimation based on Data Knowledge Level 3 (➔Method-III)

Breakdown of N: Non-banks
(N = F + P +X, P = C + G + H + K)

Issue raised by Patrick McGuire during BIS internal presentation: **Number of reporting countries changed over time** and some of them have large positions and may not be representative for period before they joined. For example, CN/RU vis-à-vis HK before they joined in Q4 2015.

Question: Is it possible to have estimates, even if not perfect, for all 48 countries since Q4 2006?

We estimate N: Non-bank (total) of 8 countries for periods before they joined and apply Method-II. Estimates comprising values for all 48 countries

Method-III = Method-II + Estimated non-reported data of **8 newly joined countries** since Q4 2006

Method – I: Published data on the BIS Website (Table A.6)

- The Table shows aggregated data of all reporting countries vis-à-vis non-bank subsectors in China

Sectors	Q4 2020, Amount oustanding in USD bn	
	Loan claims	Deposit liabilities
N: Non-banks, total (48)	**265.8**	**291.1**
F: NBFIs	30.3	33.0
P: NFS	193.0	241.0
X: Non-banks, unallocated	**42.5**	**17.1**
C: NFCs	46.6	25.2
G: GG	5.8	13.8
H: Households	**15.3**	**18.2**
K: Unallocated NFS	**125.2**	**183.8**

- Large unallocated amounts in X and K are more than 50% of non-bank total BUT most users don't pay attention to these!
- Share (%) of unallocated is larger in earlier quarters. Published data would be misleading unless users take proper care of gradual increase in coverage and related issues.

Method – I: Estimation – Step 1

- We proportionally allocated X to sectors F(NBFIs) & P (Non-Financials), using reported share.
- This gives estimated values for F(NBFIs) & P (Non-Financials)

STEP 1

As of end-2020 — Amount outstanding, in USD billion

Sectors	Loan claims		Deposit liabilities	
	Published	Estimated	Published	Estimated
N: Non-banks, total (48)	**265.8**	**265.8**	**291.1**	**291.1**
F: NBFIs	30.3	36.1	33.0	35.0
P: NFS	193.0	229.8	241.0	256.0
X: Non-banks, unallocated	**42.5**	**-**	**17.1**	**-**

Method – I: Estimation - Step 2

- Unallocated K derived = difference between estimated P and sum of its reported subsectors C, G & H
- Proportionally allocate derived-K to C, G and H, using reported share, to get estimated C, G and H

Sectors	Loan claims		Deposit liabilities	
	Published	Estimated	Published	Estimated
N: Non-banks, total (48)	**265.8**	**265.8**	**291.1**	**291.1**
F: NBFIs	30.3	36.1	33.0	35.0
P: NFS	193.0	229.8	241.0	256.0
X: Non-banks, unallocated	42.5	-	17.1	-
C: NFCs	46.6	158.0	25.2	112.9
G: GG	5.8	19.8	13.8	61.8
H: Households	**15.3**	**52.0**	**18.2**	**81.4**
K: Unallocated NFS	125.2		183.8	
K^{est}: derived from estimated P	**161.9**		**198.8**	

STEP 2

Method – I: Estimation – Step 3

Loan claims: All reporting countries vis-à-vis China ($bn)

Quarter	N: NBk	F: NBFI	P: NFS	X: Nbk, U	C: NFCs	G: GOV	H: HHs	K: NFS, Un
2006-Q4	23.0							
...	...							
...	...							
...	...							
...	...							
2012-Q4	154.3							
2013-Q1	156.7							
2013-Q2	188.0							
2013-Q3	207.3							
2013-Q4	242.7	15.7	226.9	0.0	205.9	18.3	2.7	0.0
2014-Q1	272.5	15.0	257.5	0.0	233.6	20.8	3.0	0.0
2014-Q2	301.2	18.2	283.0	0.0	261.8	17.6	3.6	0.0
2014-Q3	296.6	20.3	276.3	0.0	248.3	24.4	3.7	0.0
...	...	..	..	0.0	...	...	...	0.0
...				.0				
...	...	..	..	0.0	...	...	...	0.0
2019-Q3	270.6	31.1	239.5	0.0	185.0	10.5	44.1	0.0
2019-Q4	276.0	31.8	244.2	0.0	185.1	11.6	47.6	0.0
2020-Q1	266.4	30.3	236.1	0.0	179.1	13.6	43.5	0.0
2020-Q2	272.4	31.5	240.8	0.0	183.0	12.6	45.2	0.0
2020-Q3	272.9	30.3	242.6	0.0	179.3	15.1	48.2	0.0
2020-Q4	265.8	36.1	229.8	0.0	158.0	19.8	52.0	0.0

Step 3:
Backward estimation

Step 1: For each quarter

Step 2: For each quarter

- **Repeat Step 1 and 2 for each quarter until the first reported quarter Q4 2013.**
- **For quarters prior to Q4 2013, we estimate using weighted average of subsectors to Sector N**

We not only get estimates for HH but also for other subsectors

Method –II/-III: Basis assumption ..in Estimation

OESTERREICHISCHE NATIONALBANK EUROSYSTEM

BASIC ASSUMPTION

➔ Exposure of banks in a reporting country, say **RC1,** vis-à-vis Households in country **XX** follows a pattern ***that is different*** from the banks in reporting country **RC2**

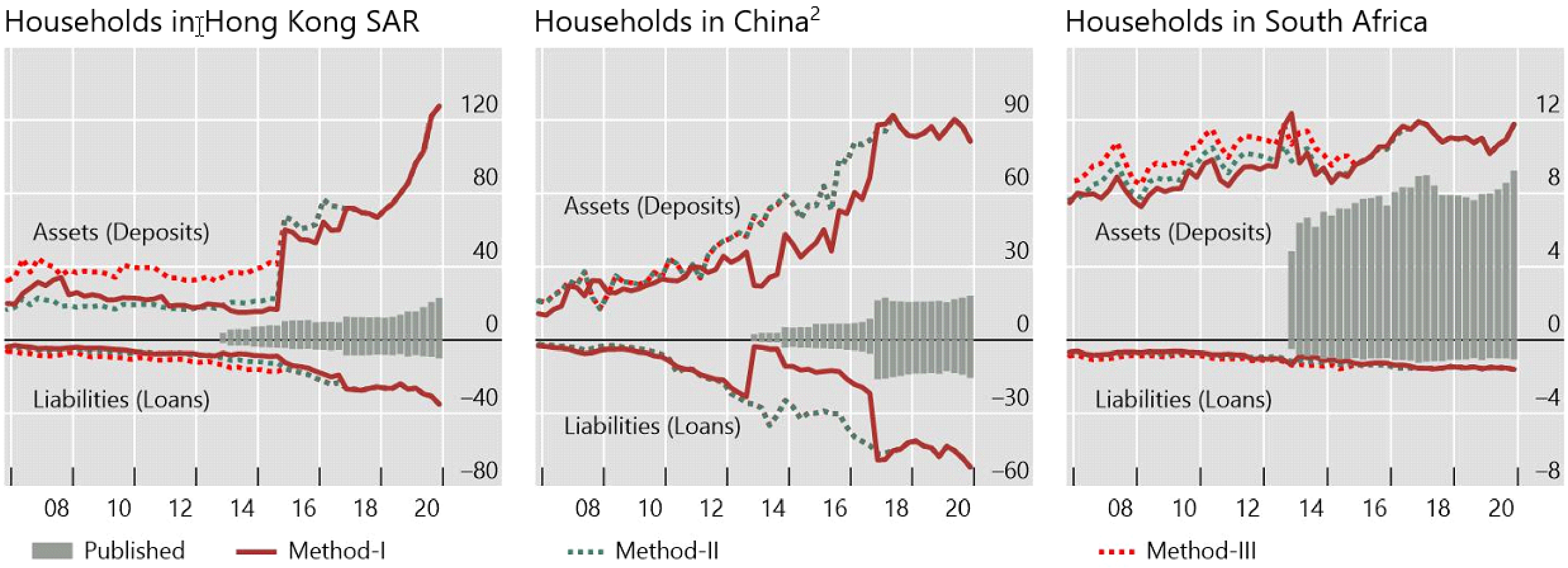
For example:

Claims and liabilities of banks in the *Japan vis-à-vis Households in Germany has a specific profile different from that of banks in Austria or Portugal.*

Published and 3 estimates for households: Sample of countries

Households' foreign assets and liabilities[1]

Amounts outstanding, in billions of US dollars | Graph 6



[1] Method-I estimates using published aggregates; Method-II uses non-published bilateral data; Method-III=Figures from Method-II plus estimated amounts for new reporting countries prior to their joining. [2] Visibly no impact due to new reporting countries (Method-III).

Sources: BIS locational banking statistics (by residence); Authors' estimate.

Main conclusions

SIMPLE BUT ROBUST METHODOLOGY – fill in data gaps/backward estimation

- The effectiveness of these exercises depends on the availability of granular information

[Public data]

Method-I - exploits published data from the BIS website

[Non-public data]

Method-II – estimates using bilateral data

Method–III - exploratory in nature providing estimated figures for the complete reporting population of banks in 48 countries, since Q4 2006

Main conclusions

SIMPLE BUT ROBUST METHODOLOGY – fill in data gaps/backward estimation

- The effectiveness of these exercises depends on the availability of granular information

[Public data]

Method-I - exploits published data from the BIS website

[Non-public data]

Method-II – estimates using bilateral data

Method–III - exploratory in nature providing estimated figures for the complete reporting population of banks in 48 countries, since Q4 2006

SOME ISSUES

- Availability of the data **only from Q4 2013 and time lag**
- **Reporting is voluntary** - coverage but not yet complete
- **Analysis/interpretation** of published data needs proper care (of gaps/metadata)

Main conclusions

THE RESULTS ARE RELEVANT

- Mirror data analysis ensures **consistency** and enhances **statistical coverage and quality standards**
- **Back data estimations** to a **more comprehensive and complete time-series** information

Main conclusions

THE RESULTS ARE RELEVANT

- Mirror data analysis ensures **consistency** and enhances **statistical coverage and quality standards**
- **Back data estimations** to a **more comprehensive and complete time-series** information

CAN BE APPLIED TO OTHER STATISTICAL DOMAINS

- These **methods are also applicable for other non-bank sectors**
- And **can be used for the compilation of external statistics** and **rest of world sector accounts**, and **may be possible to extend for other flows**

Main conclusions and Recommendation

THE RESULTS ARE RELEVANT

- Mirror data analysis ensures **consistency** and enhances **statistical coverage and quality standards**
- **Back data estimations** to a **more comprehensive and complete time-series** information

CAN BE APPLIED TO OTHER STATISTICAL DOMAINS

- These **methods are also applicable for other non-bank sectors**
- And **can be used for the compilation of external statistics** and **rest of world sector accounts**, and **may be possible to extend for other flows**

Similar to the BIS estimated data for "Credit to the non-financial sector" on the BIS website…

We recommend the BIS to adopt this method to disseminated estimated data not only for households' sector but also for other non-financial sectors (NBFIs, NFCs and GG).

USES OF MIRROR DATA
Examples from the BIS international banking statistics and other external statistics

THANK YOU

Contacts

Swapan-Kumar PRADHAN • swapan-kumar.Pradhan@bis.org

João Falcão SILVA • jmfsilva@bportugal.pt

Stefan WIESINGER • stefan.wiesinger@oenb.at

BANCO DE PORTUGAL
EUROSYSTEM

BANK FOR INTERNATIONAL SETTLEMENTS

OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

4 June 2021

Uses of Mirror Data: Estimation of Foreign Assets and Liabilities of Households[1]

Swapan-Kumar PRADHAN[1], João Falcão SILVA[2], and Stefan WIESINGER[3]

[1] Principal Statistical Analyst, Monetary & Economic Department, Bank for International Settlements (swapan-kumar.pradhan@bis.org).
[2] Head of Unit Financial accounts, BoP and IIP Statistics, Statistics Department, Bank of Portugal (jmfsilva@bportugal.pt)
[3] Economist Statistician External Statistics, Financial Accounts & MFS, Oesterreichische Nationalbank (Stefan.Wiesinger@oenb.at).

Abstract

This paper estimates cross-border assets and liabilities of households in the form of bank deposits and bank loans and provides methodological guidance for users.[2] While banks' exposure to the households' sector are available in the BIS locational banking statistics, they are reported only on an encouraged basis from end-2013. The lack of information on household sector represents challenging issues to the compilers in particular. Moreover, analysis and interpretation of publicly available data are often misleading without taking care of gradual increase in coverage and data gaps.

First, we apply three alternative mirror data methods to deal with incomplete coverage and to provide estimate outstanding cross-border assets and liabilities of households in more than 200 countries around the world. Second, we demonstrate that the methods are suitable to improve estimates for other non-bank subsectors as well. Third, we apply the proposed methods to provide estimate data back to end-2006. Method-I can be applied to the publicly available data, while methods-II and –III use non-public data. These methods are also useful for compiling external statistics and national accounts.

Keywords

Data gaps; cross-border assets/liabilities; households; international banking; mirror data.

1. Introduction

In a more globalized world of continuing economic and financial integration, policy makers, market participants and other users have an increasing demand for reliable and comparable data on economic developments. For the particular case of the household sector, there are statistical challenges in accurate measurement of exposures to this institutional sector. Due to the development in globalization, domestic entities, especially households use the global financial market for their financial investments as well as financing. The delimitation of the household sector is complex and very challenging to compile. In addition, the measurement of the households' sector implies the consistency between multiple dimensions – financial and non-financial perspective; counterparty countries and sectors, flows and stocks. Households' foreign assets and liabilities correspond to an important portion of many external operations both on the non-financial and financial part of the external statistics (Balance of Payments and International Investment Position) and rest of the world sector of the National Accounts.

Incomplete information and scarce data sources on the non-financial and financial cross-border operations may lead to the existence of data gaps. In this context, the BIS locational banking statistics (LBS) are very useful, because they provide information about the geographic and currency composition of banks' assets and liabilities (outstanding amounts) broken down by counterpart sector and instruments. The LBS data are consistent with the International Investment Position methodology, as they correspond to claims/liabilities of residents in one country vis-à-vis those of other countries. In the case of households' assets and liabilities, the LBS offer country location of counterparties and thus a full country coverage.

[1] The authors thank Bryan Hardy, Patrick McGuire, Bruno Tissot and Goetz von Peter (BIS); Luís Teles Dias, and Paula Menezes (Bank of Portugal) for their useful comments, continued encouragement and support on mirror data exercise to enhance the quality and coverage of data. The views expressed are those of the authors and do not necessarily reflect those of the Bank for International Settlements or the Oesterreichische Nationalbank or the Bank of Portugal.

[2] The household sector consists of private households as well as non-profit organisations serving households.

In this article, we focus on the outstanding amounts (stocks) to fill-in the data gaps, applying mirror-data methods to the LBS. The aim is to provide guidance on how to exploit available partial data and apply statistical methodology under reasonable assumptions to obtain consistent, comparable and reliable data for better analysis. This also provides more comprehensive and complete information of the external accounts – International Investment Position and, consequently, of the rest of the world counterparty in National Accounts.

2. Methodology

Although there are different data sources on the households' foreign assets and liabilities, the sources of this information are scarce in terms of granularity, and do not permit a full breakdown by counterparty country.

We address the challenges by focusing on the LBS data as this is the main source to perform this empirical exercise. We apply the mirror data approach which refers to complementary sources that capture similar concepts (ie use the data reported from one side of the transaction to fill in missing observations for the other side of the transaction). This is a crucial statistical tool that helps complete the picture when data is sparse. Pradhan and Silva (2020) demonstrated the importance of mirror data to enhance statistical quality as well as coverage of data across comparable statistical domains. There are challenges when using the LBS data for this exercise. First, data on banks' claims on and liabilities to households are collected only on an encouraged basis, which does not ensure full data coverage. Second, the coverage varies over time - only 15 out of 48 countries started reporting these data from end-2013, with another 18 countries starting to report in subsequent quarters. Third, confidentiality concerns mean that not all of the data are publicly available (though some are shared among reporting countries for internal analysis).

We propose three alternative methodologies to estimate bank assets and liabilities of the household sector in more than 200 countries. The first method uses published pooled (aggregated) data of banks in all reporting countries, the second method exploits unpublished bilateral data of banks in individual reporting countries, and the third method amends the second method by adding estimated bilateral data of 8 countries prior to start of their reporting LBS data to the BIS (we use their reported with incremental effect vis-à-vis individual countries to back cast data). We also demonstrate that depending on type of users to access the data (e.g. reporting countries have access to the unpublished bilateral data), these methods provide reasonably sound estimates for historical data, even for quarters prior Q4 2013. In addition, our proposed methods allow improved estimates for exposure of other non-bank subsectors, namely Non-Bank Financial Institutions (NBFI), Non-Financial Corporations (NFC) and General Government (GG) sectors. To clarify the linkages on the sector code/name between the LBS and the System of National Accounts (SNA), Table 1 shows the mapping of sector hierarchy between the SNA and BIS LBS.

Table 1: Sector hierarchy between the SNA and BIS LBS

LBS sector codes/names		SNA codes
A: All sectors		**S1**
B: Banks, total (sub-sectors reported)		S121+S122
N: Non-banks, total		(S123+S124+S125+S126+S127+S128+S129) + (S11+S13+S14+S15)
F: Non-bank financial institutions-NBFIs		S123+S124+S125+S126+S127+S128+S129
P: Non-financial sectors-NFS		S11+S13+(S14+S15)
C: Non-financial Corporations-NFCs		S11
G: General Government-GG		S13
H: Households incl. NPISHs-HH		**S14+S15**
K: NFS, unallocated		
X: Non-banks, unallocated		
U: Unallocated by sector		

The coverage of reported data differs across counterparty countries and sector. Estimation of positions for non-bank subsectors, especially for households is important because even after

8 years since Q4 2013, the coverage is still partial. Table 2 shows that more than 25% cross-border loan claims on non-bank aggregate remain unallocated by subsector for 108 of 217 counterparty countries and 56 counterparty countries for deposit liabilities.

Table 2: **Breakdown of non-bank subsectors incomplete**[1]

Unallocated non-bank (in % of total)	Q4 2013				Q4 2020			
	Loan claims		Deposit liabilities		Loan claims		Deposit liabilities	
	CPC count[2]	Cum. share of non-bank[2]	CPC count[2]	Cum. share of non-bank[2]	CPC count[2]	Cum. share of non-bank[2]	CPC count[2]	Cum. share of non-bank[2]
>=90%	13	0.04	11	22.81	15	0.6	0	-
>=70%	42	26.90	40	32.50	33	2.0	3	1.40
>=50%	108	60.92	101	53.94	68	17.0	17	9.74
>=25%	*166*	*98.04*	*172*	*98.43*	*108*	*23.9*	*56*	*21.14*
>=15%	183	99.80	190	98.71	126	27.7	87	25.14
>=5%	199	99.90	211	99.99	151	69.8	143	44.13
>=0%	216	100	216	100	217	100	216	100
Amount ($bn)								
Non-bank, total[3]	-	**6,792.5**	**-**	**7,496.2**	**-**	**9,153.9**	**-**	**9,057.9**
o/w: Unallocated (% of non-bank)	-	3,941.4 (58.0%)	-	4,345.3 (58.0%)	-	1,520.6 (16.6%)	-	1,339.2 (14.8%)

[1] Excluding regional residuals, international organisations and unallocated by non-residents; CPC = Counterparty country. [2] Share in total non-bank amount; for example, 166 counterparty countries in Q4 2013 had at least 25% unallocated by non-bank subsectors and these 166 counterparty countries comprise 98.04% of total cross-border non-bank (aggregate). [3] The non-bank totals as published on the BIS website and include regional residents, international organisations and unallocated by non-residents.
Source: BIS locational banking statistics (BIS Quarterly Review, June 2020 release); authors' calculations.

Method-I: Estimates using aggregated published data

External users with access to public data only can run a mirror exercise on aggregated LBS data. Using aggregated published data the LBS allows, for example, each counterparty country to estimate bank deposits abroad by its resident sectors **F, P** and subsectors of **P** and in particular the household sector **H** (see Table 1 for codes). This method involves three sequential steps[3] to obtain the estimation for each counterparty country: 1) the aggregate sectors (**F** and **P**); 2) the sub-sectors (**C/G/H**); 3) non-reported (historical) data.

Step 1: F, **P** and **K** are estimated by assuming that the allocation of the reported amounts are representative for the unreported amounts (letter without "est" are the data as reported):

1. Estimated F: $\mathrm{F^{est}} = \mathrm{F} + \mathrm{X}\left[\frac{\mathrm{F}}{(\mathrm{F+P})}\right]$
2. Estimated P: $\mathrm{P^{est}} = \mathrm{P} + \mathrm{X}\left[\frac{\mathrm{P}}{(\mathrm{F+P})}\right]$
3. Derived K: $\mathrm{K^{est}} = \mathrm{P^{est}} - (\mathrm{C} + \mathrm{G} + \mathrm{H})$

Step 2: Estimation for the sub-sectors: **C**, **G** and **H**, with a similar assumption as in step 1:

1. Estimated C: $\mathrm{C^{est}} = \mathrm{C} + \mathrm{K^{est}}\left[\frac{\mathrm{C}}{(\mathrm{C+G+H})}\right]$
2. Estimated G: $\mathrm{G^{est}} = \mathrm{G} + \mathrm{K^{est}}\left[\frac{\mathrm{G}}{(\mathrm{C+G+H})}\right]$
3. Estimated H: $\mathrm{H^{est}} = \mathrm{H} + \mathrm{K^{est}}\left[\frac{\mathrm{H}}{(\mathrm{C+G+H})}\right]$

[3] *We propose proportional allocation of residual amounts to reportable subsectors. An improved alternative is to use moving average or average from the latest 4 or 8 quarters and apply the share to reported sector **N** amounts.*

Step 3: To obtain estimates in periods before any data for these sector splits are available, compute a weighted average of the ratio of positions on sector **S** (ie **F**,**C**, **G**, **H**) relative to positions on the non-bank total over the reported quarters **(S/N)$_w$** and apply that ratio to the reported non-bank position (**N$_q$**) in each of the previous quarters: $N_q\left(\frac{F}{N}\right)_w, N_q\left(\frac{C}{N}\right)_w, N_q\left(\frac{H}{N}\right)_w$.

Method-II: Estimates using bilateral data

This estimation in Method-I can be made more precise by using the available bilateral data, including mirror data, to produce the estimate. In this process, we identify three different groups of reporting countries. The estimation for each reporting country vis-à-vis an individual counterparty country is done in multiple sequential steps. This set-up allows us to relax the assumption that claims/liabilities of banks in a reporting country vis-à-vis the counterparty sector in another country to follow a pattern that is different from the banks in another reporting country[4]. Over time, the share of NBFI to the non-bank total remains stable for banks in respective countries. We exploit this trend in estimating data for non-reported quarters. The estimation is first carried for 33 countries (group 1) that report both required subsectors (**F** and **P**), and encouraged subsectors (**C**, **G** and **H**). We use complementary information from group 1 countries to estimate non-reported encouraged subsectors for 6 additional countries (group 2) that report the required subsectors (**F** and **P**). In the same way, we use complementary information from the combined 39 countries for 9 countries (group 3) that neither report required nor encouraged subsectors. For each group of countries vis-à-vis non-bank subsectors in individual counterparty countries, we apply backward estimation up to Q4 2006[5]. Once estimation is done for the 3 groups of countries, we aggregate quarterly bilateral data by sector to arrive at the estimated amount.

Group 1: For each of the 33 countries, unallocated amounts, if any, in **X** and **K** are reallocated to derive estimate amounts, following the first two steps of Method-I, but applying them country by country. In the third step, again along the lines of Method-I, we derive a weighted average of $\frac{F}{N}$ and $\frac{P}{N}$ from all reported quarters (only when sector **N** is reported) and derive estimated **F** and **P** for all prior quarters. In the fourth step, we similarly derive a weighted average of $\frac{C}{P}$, $\frac{G}{P}$, and $\frac{H}{P}$, from all reported quarters and derive estimated **C**, **G** and **H** for all prior quarters, using estimated sector **P** values from the third step.

Group 2: The estimation for each of 6 additional reporting countries is carried out again in 4 similar steps. Unallocated amount, if any, in **X** are reallocated to derive estimated **F** and **P** (step1 mentioned above). In the second step, weighted average of $\frac{F}{N}$ and $\frac{P}{N}$ from all reported quarters are used to estimate **F** and **P** for all prior quarters (only sector **N** reported). In the third step, we derive quarterly weighted average of $\frac{C}{P}$, $\frac{G}{P}$, and $\frac{H}{P}$ from the 33 countries in group 1 and derive estimated **C**, **G** and **H** for all prior quarters, using estimated sector **P** values in the step 2.

Group 3: Nine additional countries in this group report only Sector **N** (total non-bank) and no subsectors. In this case, we derive quarterly weighted average of $\frac{F}{N}$, $\frac{P}{N}$, $\frac{C}{N}$, $\frac{G}{N}$ and $\frac{H}{N}$ from 39 countries in group 1 and group 2. In the second step, we apply quarterly weighted average ratios to reported **N** and derive estimated values for **F**, **P**, **C**, **G** and **H**.

[4] *For example, claims on NBFIs in KY by banks in the US follow a specific profile than those by banks in Portugal.*

[5] *The estimated amounts for quarters prior to Q4 2013 could be improved using moving average or another alternative algorithm. However, we find that the estimated amounts are reasonable within acceptable limit (about 10%) of variation.*

Method-III: Complementing Method II with estimated data for new reporting countries prior their joining the LBS

The estimated amounts mentioned above are based on reported bilateral data, with availability of sector **N** and full or partial availability of its subsectors. However, the previous two methods did not take into account the impact of 8 new reporting countries prior to their joining the LBS reporting system. These 8 countries joined in different years during the period from Q4 2006 to Q4 2017[6]. While analysing bilateral reported and estimated data, we noticed strong impact on certain counterparty countries due to addition of new reporting countries over time. The additional reporting countries, by contributing more data, increases the accuracy of the estimated shares. Hence, using the most recent data where everything is well reported can help improve the shares constructed[7].

Cerutti, Casanova and Pradhan (2020) highlighted a significant increase in bilateral positions of Chinese banks, mainly after China joined reporting system in Q4 2015. Taking into consideration of such worldwide and regional influence of new 8 reporting countries since Q4 2006, we estimated these countries' bilateral positions vis-à-vis non-bank sector (aggregate) for all periods prior to their joining the BIS LBS reporting system. We treated quarterly estimates in the same way as in group 3 (method-II) but only for quarters prior to start period of their LBS reporting[8]. It is recognised that the estimation of data for these 8 countries is exploratory and could be improved but we are the first ever to attempt in such bilateral estimates and resulted in better estimates.

3. Results

Table 3 illustrates the results of method-I from published data for each of the non-bank subsectors **F**, **P**, **C**, **G** and **H** and the published data. Step 1 and Step 2 of Method-I are used. It evidences how the unallocated amounts are distributed to the sectors/subsectors.

Table 3: Banks' cross-border claims/liabilities: published vs estimated

As of end-2020, Amount outstanding, in USD billion

Sectors (# of reporting countries)	Loan claims		Deposit liabilities	
	Published	Estimated	Published	Estimated
N: Non-banks, total (48)	**9,153.9**	**9,153.9**	**9,057.9**	**9,057.9**
F: NBFIs (39)	4,526.9	4,900.0	4,930.0	5,184.6
P: NFS (39)	3,929.9	4,253.8	3,683.1	3,873.3
X: Non-banks, unallocated	697.1	-	444.8	-
C: NFCs (33)	2,554.7	3,498.2	1,886.2	2,619.8
G: GG (32)	242.3	331.9	107.3	149.0
H: Households (32)	**309.5**	**423.8**	**795.1**	**1,104.4**
K: Unallocated NFS	823.5		894.5	
K^{est}: derived after allocating X to F &P	1,147.4		1,084.6	

Sources: BIS locational banking statistics (Quarterly Review, June 2020 release); authors' calculations.

In addition, Graph 1 shows reported/published amounts by non-bank subsector including unallocated amounts (left panel) and estimated amounts derived in three steps of Method-I (right panel) since Q4 2006. The reported figures do not identify the breakdown between sectors/subsectors, whereas the estimated figures show the amounts by sector/subsector and its evolution over time. Thus, this estimation can be incorporated on both

[6] *Malaysia in Q4 2007, Cyprus in Q4 2009, South Africa in Q3 2009, Indonesia in Q4 2010, China and Russia in Q4 2015, Philippines in Q4 2016 and Saudi Arabia in Q4 2017.*

[7] It is true that these shares can change over time, especially for growing banking sectors like CN.

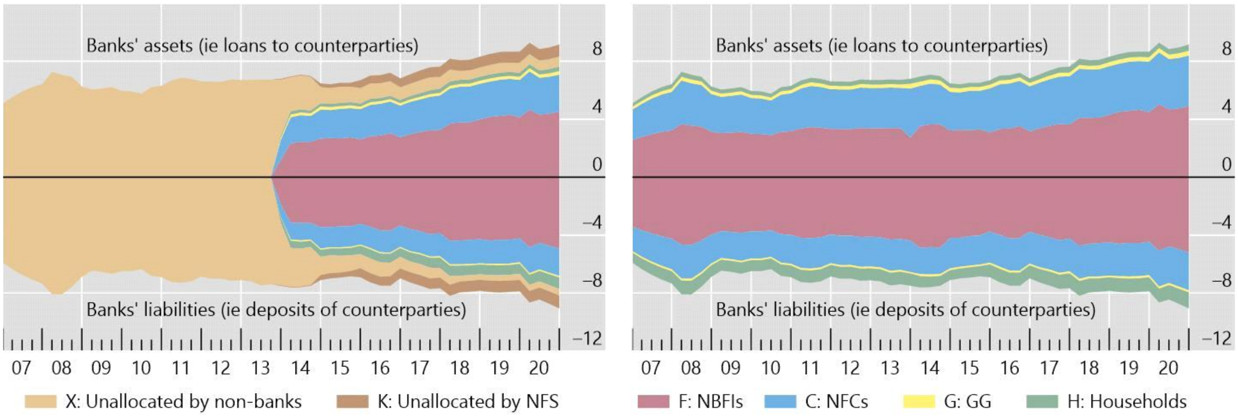
[8] *While details of this estimation method is out of scope of this paper, we made use of incremental contribution (share) by each of their countries since their joining and global trends to estimate their bilateral data backwards.*

external statistics and rest-of-the-world accounts to complement the existing national data sources, on an aggregate basis.

Banks' cross-border loans and deposits by non-bank subsectors[1]

Amounts outstanding, in USD trillion | Graph 1

Reported/Published | Estimated (Method-I)



[1] Positive amounts relate to claims and negative to liabilities; Claims of banks on a counterparty sector are the liabilities of counterparty sector to the reporting banks.

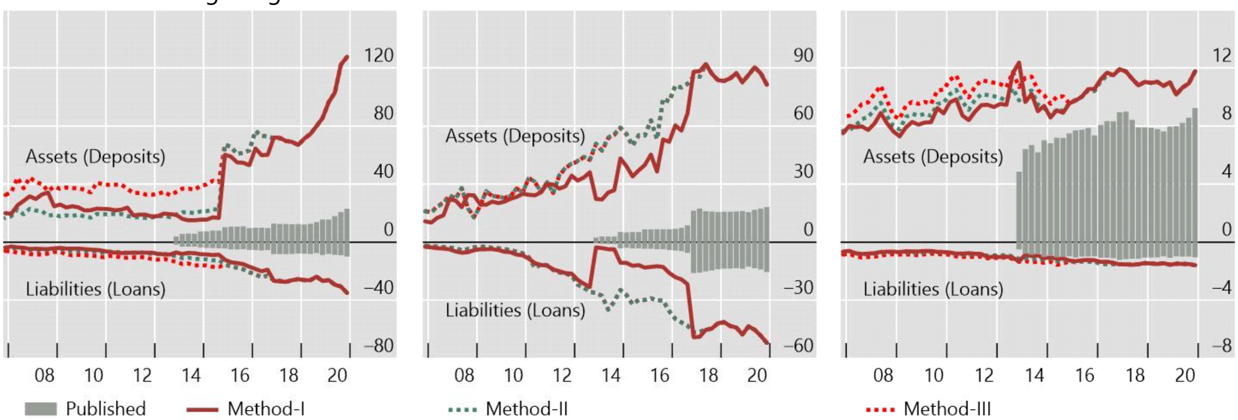
Sources: BIS locational banking statistics (by residence), authors' calculations.

Moreover, the results of the three methodologies for households' foreign bank claims and liabilities are obtained for all counterparty countries. In Graph 2 below, we show results for three selected jurisdictions. Reported/published figures are shown in bars and estimated figures from all three methods are in lines. The difference between the reported (published) and estimated amounts during the period from Q4 2013 is due to reallocation of unallocated amounts (Method-I and -II), and estimated positions for new reporting countries (Method-III).

Households' foreign assets and liabilities[1]

Amounts outstanding, in billions of US dollars | Graph 2

Households in Hong Kong SAR | Households in China[2] | Households in South Africa



[1] Method-I estimates using published aggregates; Method-II uses non-published bilateral data; Method-III=Figures from Method-II plus estimated amounts for new reporting countries prior to their joining. [2] Visibly no impact due to new reporting countries (Method-III).

Sources: BIS locational banking statistics (by residence); Authors' estimate.

The rationale for selection of three jurisdictions are: (a) Hong Kong SAR is representative of offshore centre, with relatively largest gap between published and estimated figures (mainly due to non-reporting of household sector by China and Japan); (b) China and South Africa, are representatives of EMDEs, China with largest gap between published and estimated figures, whereas South Africa with lesser gaps; and (c) gap for advanced economies is smaller and not considered for this shorter version of the paper.

4. Conclusions

Mirror data analysis ensures consistency and enhances statistical coverage and quality standards, which is crucial for economists, analysts and policy makers. The effectiveness of these exercises depends on the availability of granular information. We apply mirror data concepts to develop the methodological framework on uses of reported data, and to provide estimates for non-reported data with an aim to provide users with more complete information. We discuss methodological aspects and offer guidance on derivation of household assets/liabilities abroad in the form of bank deposits/loans, for more than 200 individual countries around the world.

Any user can easily adopt Method-I exploiting published data from the BIS website. We recommend the BIS to consider adopting Method-II to publish estimated data not only for households' sector but also for other non-financial sectors (NBFIs, NFCs and GG). This would be similar to the new database for total credit to the private non-financial sector following method proposed by Dembiermont and Mukusakunratna (2013). Method-III is exploratory in nature providing estimated figures for the complete reporting population of banks in 48 countries. Our results for three specific jurisdictions show the importance of back data estimations to a more consistent comprehensive and complete time-series information. These methods are also applicable for the compilation of external statistics and rest of world sector accounts, and may be possible to extend for other flows (exchange rate, price and volume changes and other adjustments). Furthermore, this short version of the paper for the conference does not include additional details due to limitation of length.

References:

Avdjiev, S, P McGuire and P Wooldridge (2015): "Enhanced data to analyse international banking", *BIS Quarterly Review*, September, pp 53–68.

Bank for International Settlements (2016): "Recent enhancements to the BIS statistics", *BIS Quarterly Review*, September, pp 35–44.

Casanova, C, E Cerutti and S K Pradhan (2020): Banking across borders – Are Chinese banks different?, BIS Working Papers, No. 892.

Committee on the Global Financial System (2012): "Improving the BIS international banking statistics", *CGFS Papers*, no 47, November.

Dembiermont, C, M Drehmann and S Muksakunratna (2013): "How much does the private sector really borrow - a new database for total credit to the private non-financial sector", *BIS Quarterly Review*, March, pp 65–81.

Garcia, P and B Hardy (2019): Non-bank counterparties in international banking, *BIS Quarterly Review*, September, pp 15–31.

International Monetary Fund (2013): *Balance of Payments and International Investment Position Manual*, 6th edition.

Pradhan, S and J Falcão Silva (2019): "Using mirror data to track international banking", IFC Working Papers, No 19, December 2019.

Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

63rd ISI World Statistics Congress (WSC) / IFC-sponsored Invited Paper Sessions (IPS) related to new developments in central bank statistics

July 2021, The Hague, Netherlands, virtual format

Enhancing the global architecture supporting economic and financial statistics: a post Covid-19 perspective[1]

Barend de Beer, South African Reserve Bank, and
Bruno Tissot, Bank for International Settlements (BIS)

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

Enhancing the global architecture supporting economic and financial statistics: a post Covid-19 perspective

Barend De Beer (SARB) & Bruno Tissot (BIS / IFC)

The views expressed are those of the authors and do not necessarily reflect those of the BIS, the IFC or the SARB

BIS

South African Reserve Bank

SARB 100 YEARS 1921–2021

A purposeful journey

Overview

1. **Covid-19 (CV19) impact on central banks as producers & users of official statistics**

2. **Implications for central banks' statistical function**

3. **A new global framework for official statistics?**
   - Enhancing existing core official statistics
   - Addressing newly-emerging data needs
   - Strengthening the global statistical infrastructure

1. CV19 impact on central banks as producers & users of statistics

- **Proactive response of central bank statisticians**
  - Facing production disruptions
  - Dealing with distorted economic indicators
  - Addressing a key CV19 dilemma:
  - → *need for more data / relaxation in compilation obligations*
- **Challenges for central banks' data users**
  - Limited accuracy/availability of indicators
  - Compilation difficulties & delays
  - Larger uncertainty and data revisions

2. Implications for central banks' statistical function

- **General review triggered by CV19**
  - ➢ More, not less information: timeliness, frequency, new needs
  - ➢ Alternative data sources as a complement
- **Reorganise the statistical production chain to**
  - ➢ Get a comprehensive overview of the economy
  - ➢ Have flexible frameworks to address evolving users' needs
  - ➢ Incorporate complementary sources in main frameworks
- **A wake up call for official statistics**
  - ➢ Make better use of existing data
  - ➢ Revamp statistical frameworks by leveraging on innovation
  - ➢ Enhance users' experience with statistics

3. A new global framework for official statistics?

- **Build on the G-20 DGI & its 3 success factors**
  - ➢ Structured collaboration IOs / statistical systems
  - ➢ Connection/reporting to policymakers
  - ➢ Effective peer pressure mechanism
- **Way forward after the DGI (post 2021)**
  - ➢ Support global production and use of official statistics
  - ➢ Focus on the actual reporting of relevant data
  - ➢ Parallel to other international statistical work streams (eg revision of SNA/BPM standards)
  - ➢ Non-G20 outreach
- **3 main focus:** existing statistics / new needs / global statistical infrastructure

3(i) Enhancing existing core official statistics

- **Pursuing post-GFC statistical exercises**
  - ➢Urgency underscored by the pandemic
  - ➢To compile better economic aggregates eg FA, debt
  - ➢To collect more granular financial information
  - ➢International progress monitoring (by the IAG?)
- **4 main financial areas for central banks, as highlighted by CV19 market turmoil in 2020**
  - ➢Credit flows
  - ➢Repos / Securities Financing Transactions (SFT)
  - ➢FX funding needs
  - ➢Derivatives

3(ii) Addressing newly-emerging data needs

- **Alternative data**
  - ➢Private data sources, administrative registers
  - ➢Complement to improve official statistics
  - ➢Information buffer in crisis times
  - ➢Leveraging on IT innovation / AI techniques
- **New topics not covered by traditional statistics**
  - ➢Environmental, social & governance (ESG) issues
  - ➢Key factors supporting economic resilience/sustainability
  - ➢Flexible review of policy needs
  - ➢Close related (and certainly global!) data gaps

3(iii) Stronger global statistical infrastructure

- **Further the work undertaken after the GFC**
  - ➢Global identifiers eg LEI
  - ➢Data standards eg SDMX 3.0
  - ➢Data sharing / access / cooperation
  - ➢Macro / micro integration eg Regtech, distributional issues
- **International cooperation is essential**
  - ➢Address economic & financial globalisation
  - ➢Knowledge sharing and pilot projects eg AI tools
  - ➢Best practices eg data access principles
  - ➢Prioritisation of data needs for policy
  - ➢Outreach to non-G20

THANK YOU

barend.debeer@resbank.co.za

bruno.tissot@bis.org

IFC.secretariat@bis.org

See also

De Beer, B and B Tissot (2020): "Implications of Covid-19 for official statistics: a central banking perspective", IFC WP no 20

IAG website

South African Reserve Bank

SARB 100 YEARS 1921–2021 A purposeful journey

Enhancing the global architecture supporting economic and financial statistics: a post Covid-19 perspective

Bruno Tissot[1]; Barend de Beer[2]

[1] Head, of Statistics & Research Support, Bank for International Settlements (BIS) and Head of the Secretariat of the Irving Fisher Committee on Central Bank Statistics (IFC) (bruno.tissot@bis.org)

[2] Lead economist and head of methodology and special projects, Economic Statistics Department, South African Reserve Bank (barend.debeer@resbank.co.za)

Abstract:

The impact of the Covid-19 pandemic (CV19) on official statistics has been large and multiform. As regards central banks, their statisticians responded proactively to the related data disruptions, and new ways were found to address policy information needs. But the pandemic also triggered a general review of their statistical functions with the view of reorganising statistical production chains. In that sense, the pandemic proved to be a wakeup call for official statistics, underscoring the need for a new, enhanced global framework to improve existing core statistics and address new data needs. The completion of the G20 Data Gaps Initiative at the end of 2021 will provide a key opportunity to enhance the global statistical infrastructure.

Keywords:
Covid19; official statistics; pandemic; global statistical infrastructure

The views expressed here are those of the authors and do not necessarily reflect those of the BIS, the IFC or the SARB.

I. Introduction

As argued in De Beer and Tissot (2020), the impact of the Covid-19 pandemic (CV19) on official statistics has been a particularly relevant issue for central banks. These have been confronted with significant data gaps and methodological challenges as producers of official statistics, while at the same time they needed information themselves to pursue their policy objectives. Their experience has highlighted three main lessons. First is the importance of efforts made since the Great Financial Crisis (GFC) to develop higher-quality statistics, especially under the G-20 Data Gaps Initiative (DGI) (FSB and IMF (2009)). Second, official statistics still present significant shortcomings and gaps, as was particularly evident in 2020 with the CV19-induced stress in the financial markets (FSB (2020)). Third, the pandemic underscored the need to go beyond the "standard" statistical offering and cover broader environmental, social and governance (ESG) issues.

These lessons call for further enhancing the international cooperative framework to both enhance existing core official statistics and address emerging data needs. This paper is organised in three parts. It first briefly recalls the impact of CV19 on the compilation and use of official statistics in the light of the experience of central banks. Second, it reviews the main implications of these developments for the design of their statistical functions. Third, it concludes with some thoughts on new global framework to support official statistics looking forward.

II. The impact of Covid-19 on central banks as producers and users of statistics

A. Proactive response of central bank statisticians to CV19-related data disruptions

The occurrence of the pandemic highlighted the need for reliable and relevant information. Yet producers of official statistics were confronted with a sudden disruption in the data available as CV19 escalated. This is because many activities just stopped, or because the statistical apparatus was unable to measure adequately the new activities that had quickly replaced others. Moreover, a number of key economic indicators became more difficult to assemble properly, for instance because of the discontinuation of normal statistical exercises like surveys or face-to-face interviews, esp. due to social distancing rules and office closures (cf ISWGNA (2020)). Furthermore, the measurement of certain economic variables proved more difficult because of the impact of the outright policy response to the crisis. All these disruptions have led to an important dilemma for authorities in charge of public policy like central banks. On the one hand, the speed and specificity of the crisis called for having more, and more varied types of, data at hand to monitor what was going on. On the other hand, compilation difficulties and other priorities reflecting the intensity of the crisis (including new ad hoc data requests) warranted some relaxation in compilation practices and postponing non-urgent data obligations in a pragmatic way. As highlighted in Box 1 (refer to Bruno and de Beer ***"Enhancing the global architecture supporting economic and financial statistics: a post Covid-19 perspective***"[1], central banks' statisticians around the world worked actively on finding concrete solutions to address this dilemma.

B. Challenges for data users

The pandemic also led to important challenges for central bank users of official statistics, with three key issues. First, there were increased concerns about the disposal and/or accuracy of the indicators being generated by statisticians. Cases in point were consumer price inflation indices in the face of the sudden closure of shops and restaurants (BLS 2020)). Second, significant delays emerged in the availability of official statistics, caused by the pandemic and related compilation difficulties. To try to avoid making "decisions in the dark", users had therefore been leading the call to generate alternative statistics in response to the pandemic (Ducharme et al (2020)). But one challenge was the high volatility of such sources, with the difficulty to get informative but not too noisy data and their potential estimation bias. Thirdly, by impacting both the quality and the timeliness of statistics, the pandemic further complicated users' life because of increased data revisions. CV19 brought a high level of uncertainty to the statistical world, and an important consequence of this uncertainty has been that official statistics have become more likely to be revised significantly as time evolves.

III. Implications for the statistical function in central banks

A. General review triggered by the pandemic

By making statistical compilation work more difficult and bringing various challenges to data users, the pandemic triggered a general review of the statistical function in central banks. Two areas of interest were, first, the identification of the new data needs brought about by the crisis and, second, the adaptation of existing statistical frameworks to ensure the continuous provision of reliable statistics to support policy-making. First, in view of the impact of CV19 on official statistics, most central banks felt the need to have more, not less information. Compared to the situation prevailing before the crisis, attention focused on three major points: timeliness, frequency, and the need to address new topics highlighted by the pandemic. Firstly, the need for timely data reflected the fact that the speed of the pandemic and the size of the economic disruptions had called for having more rapid statistics at hand to quickly assess the economic situation. Another and related focus point was frequency: the dynamics of the crisis put a premium on having data on what was going on more frequently, say on a weekly or even daily basis. A further

[1] ECE/CES/GE.20/2021/11

focus point was to get information on the new topics raised by the crisis that were not properly covered by the "traditional" statistical apparatus. The second key consequence was to spur interest in alternative data sources to complement official statistics. This had been already on the radar screen of statisticians for many years (Tissot (2019)), but the pandemic reinforced two main points. One was to take benefit from the new digital information provided by the "data revolution", namely web-ased indicators and other "organic" available as a by-product of the services provided by the wide range of sensors, devices, satellites etc.– in particular by enhancing the access to and use of (non-official) private data sources for national statistics and public policy (G20 Italian Presidency (2021a)). A second focus area was to make better use of the information contained in large administrative datasets that have been collected by authorities for many years without being duly exploited for statistical purposes. While there had been already a gradual recognition of the value of such administrative data since the GFC (Bean (2016)), the pandemic clearly reinforced this trend.

B. Need to reorganise the statistical production chain

Faced with increased uncertainty, central banks as producers of statistics had to reassess their production functions and reorganise themselves where needed and appropriate. In general terms, they focussed on three areas. First, the importance of the economic shock and its uncertain repercussions throughout the economy reinforced the need for developing a comprehensive overview of the entire economy, its components and the way they interact. In particular, the CV19-related disruptions in financial markets clearly highlighted the importance of having an encompassing view of the financial system, e.g. by types of market segments, financial instruments, and investors[2]. They were also a stark reminder of the important data gaps that remain despite the progress achieved under the DGI, in particular as regards the functioning of the repo market, the balance sheets of non-bank financial entities such as hedge funds, and the interconnections between the various players in terms of liquidity provision. Second, there was general recognition that statistical frameworks have to become more flexible to address evolving users' needs and the sheer uncertainty created by the crisis. This called statisticians to re-assess the relevance and agility of their tools and methods to deliver required statistics. It also put a premium on developing new and more sophisticated techniques to extract useful information from data. Third, statisticians had to figure out how complementary data sources and information could be brought into their mainstream statistical frameworks. One way was to integrate alternative input sources within the conventional methodological process to generate official statistics. Another was to use these additional sources to get supporting and benchmarking data that can act as an "information buffer" in times when conventional official statistics dry up or are lagged significantly. In any case, a key concern is that the new data sources being considered – such as private web-based data, additional regulatory input data, etc – do not present the same guarantees as official statistics in terms of uniform definition consistency, time consistency, etc.

C. A wakeup call for official statistics?

The effects of the CV19 pandemic on economic statistics have been far-reaching and necessitated statistical agencies including central banks to adapt to these challenges in an effort to continue to best inform policy makers under difficult circumstances. But it was also a wakeup call to deal with issues that had been neglected for too long. A first one was to make better use of existing data. From this perspective, the outbreak of CV19 shed light on the existence of various datasets that may not be known widely, partly reflecting the fact that significant and rapid progress had been made by numerous economies in developing their statistical frameworks since the GFC. Case in point is the micro-level information already collected by public authorities, financial institutions etc, which would facilitate the identification of vulnerabilities to potential shocks and support the calibration of policy tools to mitigate these risks (IFC (2021b)). Another example was the wealth of information that international organisations were quickly able to publish as the pandemic occurred (CCSA (2020)). A second lesson was to revamp macroeconomic statistical frameworks by leveraging in particular on technology innovation and realise the full benefit of supplementary data to support official statistics. However, such a fundamental review may take time and energy. One solution would be to start by enriching the financial accounts (FA) framework that is already available in several jurisdictions. Another way is to build on recent technological developments to develop datasets that reflect the entire target population or at least a much larger sample thereof. Lastly, digital innovation could more generally help to accelerate the production of official statistics. Third, the crisis has forced statisticians to revisit the services they provide to their stakeholders, for instance to increase the frequency and/or timelines of their estimates to better support policy decision. It was also an opportunity to revisit general user experience with official statistics. The starting point is that thinking the unthinkable has become a key priority, not least because of the structural shifts in the economy triggered by CV19 (e.g. destabilisation of existing relationships and unprecedented policy decisions). One of the foundational pillars in the quest to address this revolves around cooperation and data sharing. The pandemic highlighted the importance of ex ante coordination among public authorities so that adequate processes were already in place to allow for an effective exchange of information when the crisis occurred. This also requires the development of data sharing within and between agencies producing statistics so that databases can be linked in a coherent way, also helping to limit the reporting burden for the economy (IFC (2015)). At the international level, the sudden data needs highlighted by CV19 underlined the merit of having a good exchange of economic information between countries. Another avenue is to develop a "central marketplace" to increase accessibility to official statistics.

---

[2] A number of these issues are indeed being actively considered in the context of the ongoing international process of updating the System of National Accounts

IV. A new global framework for official statistics?

Obviously, a key question posed by the pandemic looking forward is how to best address policy needs, specifically in the monetary and financial sectors. One solution is to build upon the infrastructure already put in place by the G-20 DGI so as to take advantage of its three key success factors. First, its approach of structured collaboration between international organisations and national statistical systems, which ensures effective coordination and helps avoid the risk of duplicating other global statistical initiatives such as those related to updating international statistical standards. Second, its close connection to current authorities' priorities, with effective reporting to policymakers (as was the case with the G20 Finance Ministers and Central Bank Governors under the DGI). And third, an effective peer pressure mechanism for spurring the active involvement of national jurisdictions, comparable to the regular national self-commitments reporting organised by G20 and FSB jurisdictions under the DGI and complemented by the active participation of other interested economies, depending on the relevant recommendations (e.g. for those BIS member central banks involved in the DGI-related compilation of international banking and financial statistics). The way forward would thus be to enhance and expand the current DGI initiative that is due to be completed at end 2021 so as to set up a more permanent and comprehensive framework to support the global production and use of official statistics. The focus should be on the actual reporting of relevant data, complementing other existing international statistical work streams that are more devoted to methodological issues, such as the updates of the 2008 System of National Accounts (2008 SNA) and the Balance of Payments and International Investment Position Manual, sixth edition (BPM6), both launched in 2020. Such a revised international framework for cooperation could be instrumental to both (i) enhancing existing core official statistics, especially as regards timeliness, frequency and international comparability, (ii) addressing newly emerging data needs, and (iii) strengthening the global statistical infrastructure needs, and (iii) strengthening the global statistical infrastructure.

A. Enhancing existing core official statistics

The Covid-19 pandemic has highlighted the urgency of pursuing the statistical exercises started after the GFC to compile better macroeconomic statistical aggregates – for instance, the DGI recommendation of publishing general government data consistent with the SNA (an issue that has clearly gained importance in view of the surge in public spending that reflects authorities' response to the pandemic) or of furthering the development of FA (including detailed breakdowns of securities issues and holdings; (Çakmak et al (2020)) as well as of fintech statistics (IFC (2020a)), as argued above. It also underlines the need for collecting more granular financial information, especially on firms' financing needs, securities financing transactions (repos), forex funding and derivatives in order to better understand episodes of stress in financial markets. From this perspective, important financial data collections initiated since the GFC, especially in the context of the DGI, should be finalised, especially for the following four main areas that are closely inter-related and of key interest for central banks. One relates to the measurement of credit flows. The economic disruptions caused by CV19 highlighted the need for having more granular information on firms' funding needs, especially on the size of their cash shortfalls, the ability to finance them, and the way to do so e.g. through credit lines (Banerjee et al (2020)). Certainly, a limited number of countries have set up large micro data collections exercises that can be of help, in particular in the context of their efforts to compile comprehensive FA. However, there is no global infrastructure to address these issues in a comprehensive and global way, esp. in real time. As a result, many analytical needs were addressed during CV19 by working on the information collected by commercial vendors (cf Goel and Serena (2020)).

A second area should cover Securities financing transactions (SFTs). SFTs such as securities lending and repurchase agreements (repos) are instrumental in supporting price discovery and secondary market liquidity for various market segments and can contribute importantly to an increase in leverage and maturity / liquidity mismatches (FSB (2013)). Third, more data should be collected to assess FX funding needs. The structural demand for dollar funding appears to have grown in the recent past, reflecting the currency hedging needs of corporates and portfolio investors outside the United States and reduced capacity among commercial banks to address this demand. This has led to a widening in the (negative) FX swap basis, which should be close to zero assuming perfect arbitrage (Borio et al (2016)). Yet, with the start of the CV19 pandemic, it widened again vis-à-vis the US dollar across major currencies, and central banks had to expand their operations in terms of swap lines and temporary US dollar liquidity arrangements to mitigate market stress (Avdjiev, Eren and McGuire (2020)). These developments clearly underscored the need to improve the measurement of financial balance sheets' currency composition for important sectors. A last and related area of key interest is derivatives. Certainly, many initiatives have been in train since the GFC to address the information gaps related to derivatives, not least the decision to collect granular transaction data through trade repositories (TRs). Yet challenges remain, especially for smaller jurisdictions where data are scarcer and access for central banks is more difficult. There is therefore a clear need for greater coordination at both the domestic and international levels to enhance the quality of TR data, develop their global aggregation, and foster their use for policymaking (IFC (2018)). Moreover, particular attention should be paid to FX derivatives, which generally require the actual payment of the notional amount at maturity – which make them a form of debt, unlike many other derivatives; cf Borio et al (2017). One issue is that the amounts involved are recorded off balance sheet, while they can have significant implications for on-balance sheet cash positions. Moreover, they can be used as hedging tools to close on-balance sheet currency mismatches (see Aldasoro et al (2020) for an analysis of these issues and related dollar funding needs from commercial banks). Hence, more data should be collected to be able to monitor conditions in global funding markets, in particular data to assess the direction and amounts of FX trades crossed by currency, maturity, instrument type and counterparty sector/region[3]. This would greatly complement existing information on countries' total (ie on- and off-) balance sheets, and would significantly enhance existing measures of both external debt and foreign currency debt (Avdjiev, McGuire and von Peter (2020)).

B. Addressing newly emerging data needs

A new framework for global statistical statistics should also address the lessons underlined by the pandemic. A first one relates to how to better tap into big data, eg private data sources as well as administrative registers, so that they can be brought into mainstream statistical frameworks and used to deliver more timely, frequent and comprehensive information to policymakers. In particular, better cooperation among the different operators of administrative, statistical and commercial business registers would help to have a more agile statistical system (Lane (2021)). Another important issue is to understand better the potential of emerging trends in data science, data engineering and information technologies. Central banks are in particular increasingly interested in adopting data analytics and business intelligence techniques along with data transformation and big data ecosystems in their organisations − especially in finding appropriate sources, developing new methodological concepts and techniques, compiling policy-relevant indicators and making use of them, and taking advantage of rapid improvements in technology (the "big data revolution") (IFC (2020b, 2021a)). Progress looking forward will depend on the fostering of exchange, collaboration and understanding on the related interdisciplinary practices, use cases, and technologies, including to cover important issues such as data governance and data protection. Regional specificities, especially between advanced and developing economies, are also important factors to be carefully considered[4].

A second focus area is to better measure the new topics underscored by CV19 that are not properly covered by the "traditional" statistical apparatus, especially on environmental topics and socioeconomic factors (e.g. distributional aspects, inequalities). In particular, financial authorities have an increasing interest in developing proper statistics on sustainable finance and address the related analytical needs. Key is to draw the relevant lessons from the impact of the pandemic as regards future developments in greenhouse gas emissions, investments in sustainable technologies, and ways to strengthen the sustainability and resilience of today's economies[5]. This requires taking stock of the related statistical data needs of users in policy-making financial institutions, especially as regards the use of sustainable finance data in areas such as microprudential supervision, financial stability and macroeconomic analysis, risk and reserve management etc. Another objective is to review existing indicators, ad-hoc surveys, and analytical datasets developed or under development at national, regional, or industry levels, as well as the operational ways for bringing together data supply and demand (e.g. development of statistical hubs). Lastly, ways should be found to close potential data gaps, both in the official and the private sector.

C. Enhancing the global statistical infrastructure

At the global level, the underlying financial statistical infrastructure is still incomplete, reflecting the slow development of global identifiers, standards for exchanging information, and data sharing arrangements. Certainly, there has been notable progress since the GFC as regards the Legal Entity Identifier (LEI; see LEIROC (2016)), the Statistical Data and Metadata eXchange standard (SDMX; see IFC (2016)), and the actual nternational sharing of granular information on global financial institutions (see Bese Goksu and Tissot (2018)). Moreover, public authorities and the private industry[6] have been working to promote a "regtech approach" to the reporting of financial data, which basically refers to the provision of methodology, technology and processes to financial institutions to support regulatory monitoring, reporting and compliance (IFC (2021b)). More progress is in particular needed as regards more effective data-sharing possibilities and increased use of the global identifiers being developed. Promoting global initiatives and the international exchange of national experiences could be also instrumental to enhance the timely production of official statistics, by leveraging information technology to support data collection, compilation and dissemination processes It would also provide an opportunity to highlight existing best practices and potential opportunities, especially to support policymaking, as well as to take stock of the challenges to be addressed as a priority. Addressing these issues could help to significantly enhance statistical systems' preparedness in the face of unexpected events and their role as providers of timely and reliable information to

---

[3] These elements are not currently captured by the global derivatives statistics published by the BIS that encompass the trading of foreign exchange instruments in spot and OTC derivatives markets as well as of OTC interest rate derivatives (cf Wooldridge (2019) as well as BIS data on https://www.bis.org/statistics/about_derivatives_stats.htm?m=6%7C32). They are under consideration not least in the context of the recommendations of the second phase of the DGI related to cross-border exposures (FSB and IMF (2015)).

[4] As regards the challenges for accessing alternative private data in developing countries, a key one is that these jurisdictions often have particularly tight resources and rarely possess the expertise to extract information from raw unofficial data (Robin et al (2015)). Yet, on the other hand, the big data revolution offers an opportunity to avoid the organisation of costly data collection exercises for underdeveloped official statistical systems. For instance, quick inflation estimates can be made by directly scraping prices displayed on the web, instead of setting up specific surveys that can be quite time- and resource-intensive – see for instance the Billion Prices Project (Cavallo and Rigobon (2016)).

[5] Policy makers have indeed underlined the importance of these issues to address the challenges associated with the Covid-19 pandemic. In particular, the G20 Finance Ministers and Central Bank Governors have stressed "that improving data availability and provision, including on environmental issues, and harnessing the wealth of data produced by digitalisation, while ensuring compliance with legal frameworks on data protection and privacy, will be critical to better inform our decisions" and invited the main international financial organisations to reflect on a possible new Data Gaps Initiative (G20 Italian Presidency (2021b)).

[6] See the activities supported by the Business Reporting Advisory Group (BRAG), a consulting organisation collaborating with a number of European regulatory and supervisory authorities, or the Eurofiling Foundation, a forum initiative started in 2005 to improve collaboration on and awareness of European regulatory reporting among regulators, supervisors and entities from both the public and private sectors.

central banks as well as to other authorities and the public in general. This will, however, require careful and effective prioritisation of related implications for official statistics, tailored to actual policy needs.

References

Aldasoro, I, T Ehlers, P McGuire and G von Peter (2020): “Global banks’ dollar funding needs and central bank swap lines”, BIS Bulletin, no 27, July.

Avdjiev, S, E Eren and P McGuire (2020): “Dollar funding costs during the Covid-19 crisis through the lens of the FX swap market”, BIS Bulletin, no 1, April.

Avdjiev, S, P McGuire and G von Peter (2020): “International dimensions of EME corporate debt”, BIS Quarterly Review, June, pp 1–13.

Banerjee, R, A Illes, E Kharroubi and J Serena (2020): “Covid-19 and corporate sector liquidity”, BIS Bulletin, no 10, April.

Bean, C (2016): Independent review of UK economic statistics, March.

Bese Goksu, E and B Tissot (2018): “Monitoring systemic institutions for the analysis of micro-macro linkages and network effects”, Journal of Mathematics and Statistical Science, vol 4, April.

Borio, C, R Mc Cauley and P McGuire (2017): “FX swaps and forwards: missing global debt?”, BIS Quarterly Review, September, pp 37–54.

Borio, C, R McCauley, P McGuire and V Sushko (2016): “Covered interest parity lost: understanding the cross-currency basis”, BIS Quarterly Review, September, pp 45−64.

Bureau of Labor Statistics (BLS) (2020): “The impact of the COVID-19 pandemic on food price indexes and data collection”, Monthly Labor Review, August.

Çakmak, B, C Gökçe Zeybek, B Tissot and B Tunç (2020): “Using financial accounts: A central banking perspective”, Statistical Journal of the IAOS, 1 – 15, June.

Cavallo, A and R Rigobon (2016): “The Billion Prices Project: Using online prices for measurement and research”, Journal of Economic Perspectives, Spring 2016, vol 30, no 2, pp 151–78.

Committee for the Coordination of Statistical Activities (CCSA) (2020): How COVID-19 is changing the world: a statistical perspective, May.

De Beer, B and B Tissot (2020): “Implications of Covid-19 for official statistics: a central banking perspective”, IFC Working Papers, no 20, November.

Ducharme, LM, J Tebrake and Z Zhan (2020): “Keeping Economic Data Flowing During COVID-19”, IMF Blog, 26 May.

Financial Stability Board (FSB) (2013): “Policy Framework for Addressing Shadow Banking Risks in Securities Lending and Repos”, FSB Report, August.

——— (2020): Holistic Review of the March Market Turmoil and COVID-19 pandemic: Financial stability impact and policy responses, November.

Financial Stability Board and International Monetary Fund (2009): The financial crisis and information gaps.

——— (2015): The financial crisis and information gaps – Sixth Implementation Progress Report of the G20 Data Gaps Initiative.

G20 Italian Presidency (2021a): “Principled Data Access − Building Public-Private Data Partnerships for Better Official Statistics”, mimeo.

——— (2021b): Communiqué of the Second G20 Finance Ministers and Central Bank Governors meeting, 7 April.

Goel, T and J Serena (2020): “Bonds and syndicated loans during the Covid-19 crisis: decoupled again?”, BIS Bulletin, no 29, August.

Inter secretariat Working Group on National Accounts (ISWGNA) (2020): National Accounts Statistics Continuity.

Irving Fisher Committee (2015): “Data-sharing: issues and good practices”, IFC Report, no 1, January.
——— (2016): “Central banks’ use of the SDMX standard”, IFC Report, no 4, March.
——— (2018): “Central banks and trade repositories derivatives data”, IFC Report, no 7, October.
——— (2020a): “Central banks and fintech data issues”, IFC Report, no 10, February.
——— (2020b): “Computing platforms for big data analytics and artificial intelligence”, IFC Report, no 11, April.
——— (2021a): “Use of big data sources and applications at central banks”, IFC Report, no 13, February.
——— (2021b): “Micro data for the macro world”, IFC Bulletin, no 53, April.

Lane P (2021): “Maximising the user value of statistics: lessons from globalisation and the pandemic”, speech at the European Statistical Forum (virtual), 26 April.

Legal Entity Identifier Regulatory Oversight Committee (LEIROC) (2016): Collecting data on direct and ultimate parents of legal entities in the Global LEI System – Phase 1, March.

Robin, N, T Klein and J Jüttin (2015): "Public-Private Partnerships for Statistics − Lessons Learned, Future Steps, PARIS21 Discussion Paper, no 8, December.

Tissot, B (2019): "Financial big data and policy work: opportunities and challenges", Statistical Working Papers, Eurostat, KS-TC-19-001-EN-N.

Wooldridge, P (2019): "FX and OTC derivatives markets through the lens of the Triennial Survey", BIS Quarterly Review, December.