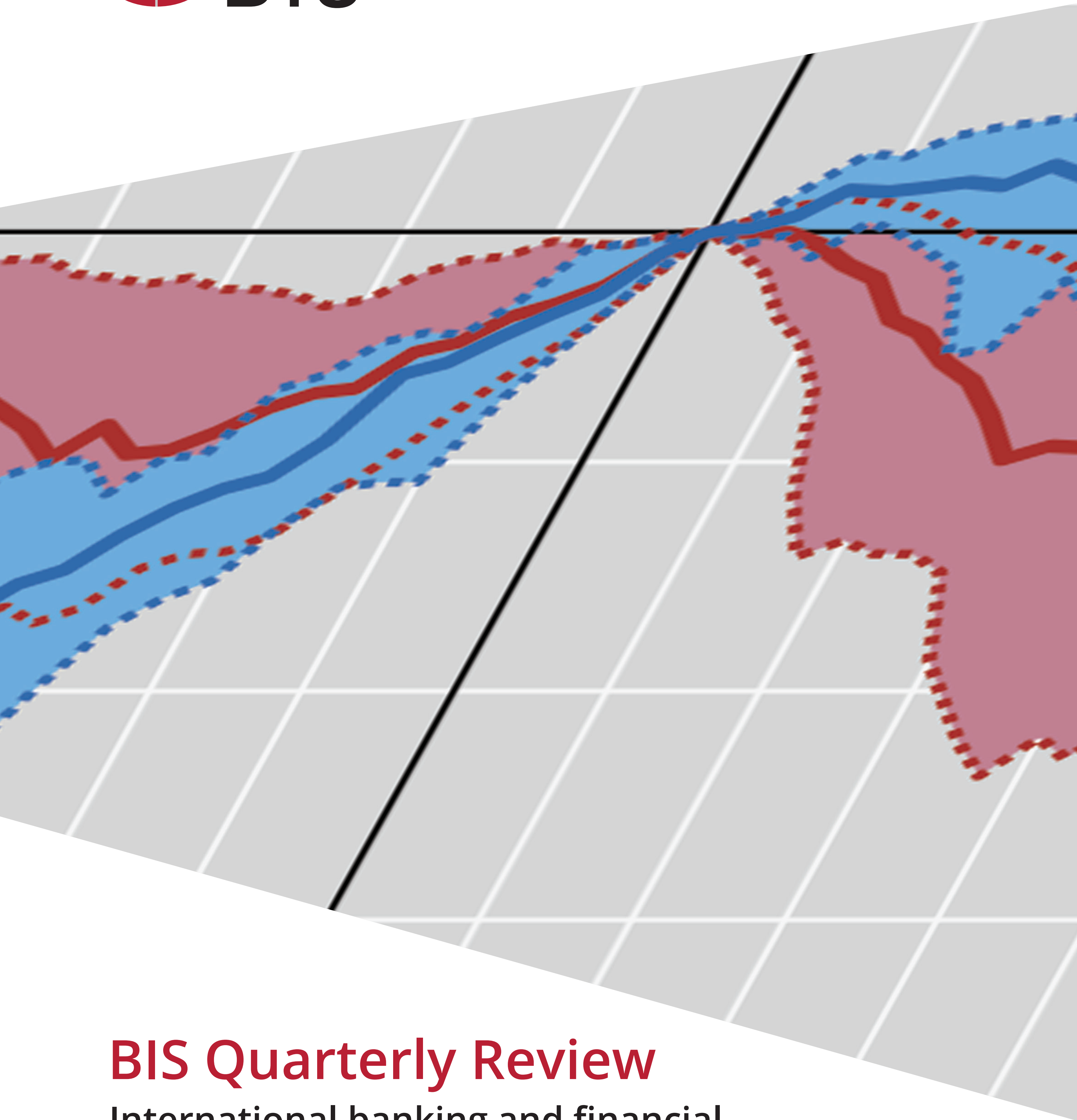

# BIS Quarterly Review

## International banking and financial market developments

March 2024

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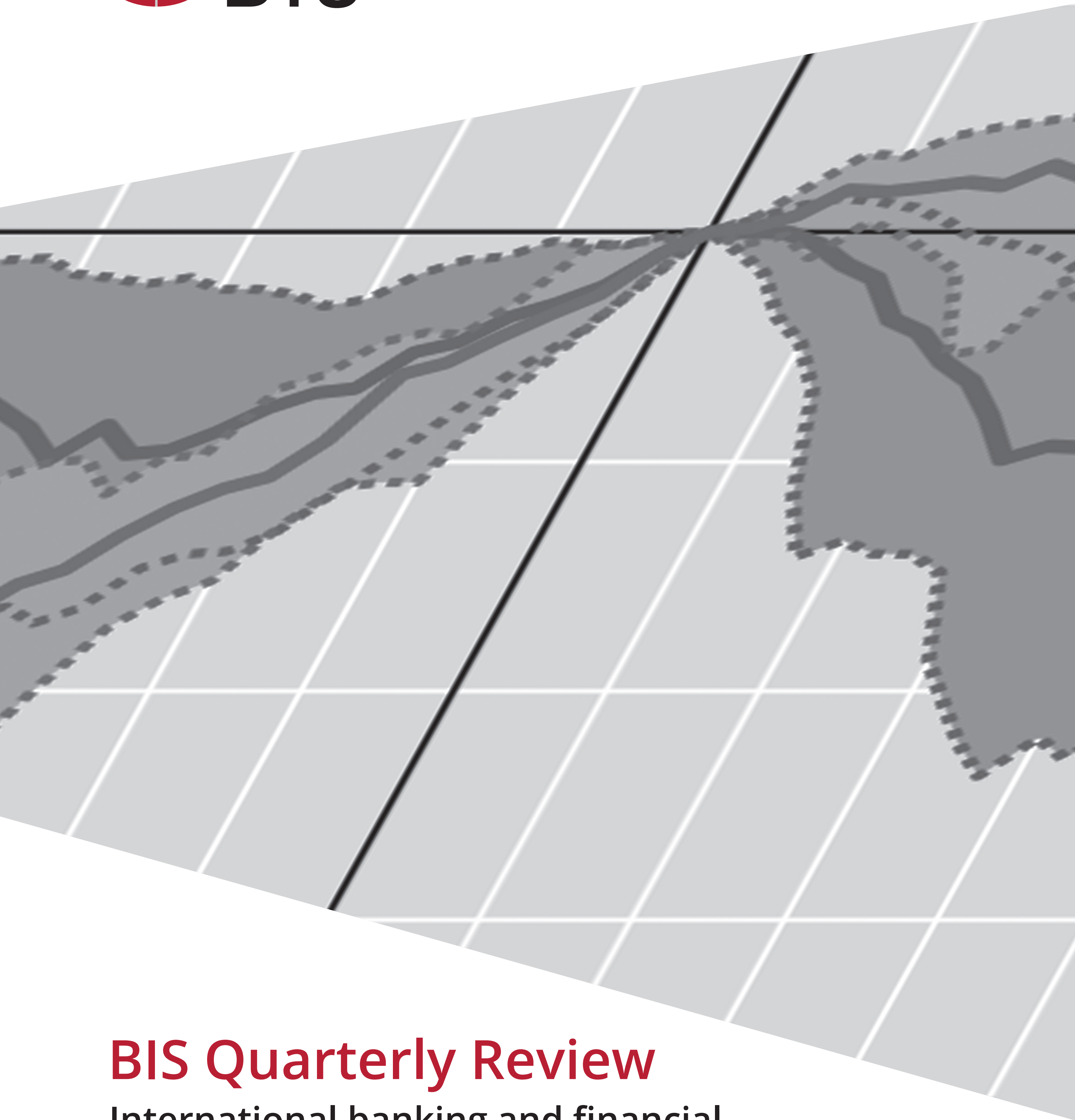

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March 2024

BIS Quarterly Review
Monetary and Economic Department



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# BIS Quarterly Review

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Notations used in this Review

| | |
|---|---|
| billion | thousand million |
| e | estimated |
| lhs, rhs | left-hand scale, right-hand scale |
| $ | US dollar unless specified otherwise |
| … | not available |
| . | not applicable |
| – | nil or negligible |

Differences in totals are due to rounding.
The term "country" as used in this publication also covers territorial entities that are not states as understood by international law and practice but for which data are separately and independently maintained.

# Abbreviations

## Currencies

| | | | |
|---|---|---|---|
| AED | United Arab Emirates dirham | MXN | Mexican peso |
| ALL | Albanian lek | MXV | Mexican unidad de inversión (UDI) |
| ARS | Argentine peso | MYR | Malaysian ringgit |
| AUD | Australian dollar | NAD | Namibian dollar |
| BGN | Bulgarian lev | NGN | Nigerian naira |
| BHD | Bahraini dinar | NOK | Norwegian krone |
| BRL | Brazilian real | NZD | New Zealand dollar |
| CAD | Canadian dollar | OTH | All other currencies |
| CHF | Swiss franc | PEN | Peruvian sol |
| CLP | Chilean peso | PHP | Philippine peso |
| CNY (RMB) | Chinese yuan (renminbi) | PLN | Polish zloty |
| COP | Colombian peso | RON | Romanian leu |
| CZK | Czech koruna | RUB | Russian rouble |
| DKK | Danish krone | SAR | Saudi riyal |
| EUR | euro | SEK | Swedish krona |
| GBP | pound sterling | SGD | Singapore dollar |
| HKD | Hong Kong dollar | THB | Thai baht |
| HUF | Hungarian forint | TRY | Turkish lira |
| IDR | Indonesian rupiah | TWD | New Taiwan dollar |
| ILS | Israeli new shekel | USD | US dollar |
| INR | Indian rupee | VES | bolívar soberano |
| ISK | Icelandic króna | VND | Vietnamese dong |
| JPY | Japanese yen | XOF | CFA franc (BCEAO) |
| KRW | Korean won | ZAR | South African rand |
| MAD | Moroccan dirham | | |

## Countries

| | | | |
|---|---|---|---|
| AE | United Arab Emirates | CZ | Czechia |
| AF | Afghanistan | DE | Germany |
| AL | Albania | DJ | Djibouti |
| AM | Armenia | DK | Denmark |
| AO | Angola | DM | Dominica |
| AR | Argentina | DO | Dominican Republic |
| AT | Austria | DZ | Algeria |
| AU | Australia | EA | euro area |
| AZ | Azerbaijan | EC | Ecuador |
| BA | Bosnia and Herzegovina | EE | Estonia |
| BD | Bangladesh | EG | Egypt |
| BE | Belgium | ER | Eritrea |
| BF | Burkina Faso | ES | Spain |
| BG | Bulgaria | ET | Ethiopia |
| BH | Bahrain | FI | Finland |
| BI | Burundi | FJ | Fiji |
| BJ | Benin | FO | Faeroe Islands |
| BM | Bermuda | FR | France |
| BN | Brunei | GA | Gabon |
| BO | Bolivia | GB | United Kingdom |
| BR | Brazil | GD | Grenada |
| BS | The Bahamas | GE | Georgia |
| BT | Bhutan | GG | Guernsey |
| BW | British West Indies | GH | Ghana |
| BY | Belarus | GI | Gibraltar |
| BZ | Belize | GN | Guinea |
| CA | Canada | GQ | Equatorial Guinea |
| CD | Democratic Republic of the Congo | GR | Greece |
| CF | Central African Republic | GT | Guatemala |
| CG | Republic of Congo | GW | Guinea-Bissau |
| CH | Switzerland | GY | Guyana |
| CI | Côte d'Ivoire | HN | Honduras |
| CL | Chile | HK | Hong Kong SAR |
| CM | Cameroon | HR | Croatia |
| CN | China | HT | Haiti |
| CO | Colombia | HU | Hungary |
| CR | Costa Rica | ID | Indonesia |
| CV | Cabo Verde | IE | Ireland |
| CW | Curaçao | IL | Israel |
| CY | Cyprus | IM | Isle of Man |

## Countries (cont)

| | | | |
|---|---|---|---|
| IN | India | MX | Mexico |
| IO | International organisations | MY | Malaysia |
| IQ | Iraq | MZ | Mozambique |
| IR | Iran | NA | Namibia |
| IS | Iceland | NC | New Caledonia |
| IT | Italy | NG | Nigeria |
| JE | Jersey | NL | Netherlands |
| JM | Jamaica | NO | Norway |
| JO | Jordan | NR | Nauru |
| JP | Japan | NZ | New Zealand |
| KE | Kenya | OM | Oman |
| KG | Kyrgyz Republic | PA | Panama |
| KH | Cambodia | PE | Peru |
| KR | Korea | PG | Papua New Guinea |
| KW | Kuwait | PH | Philippines |
| KY | Cayman Islands | PK | Pakistan |
| KZ | Kazakhstan | PL | Poland |
| LA | Laos | PT | Portugal |
| LB | Lebanon | PY | Paraguay |
| LC | St Lucia | QA | Qatar |
| LK | Sri Lanka | RO | Romania |
| LR | Liberia | RS | Serbia |
| LS | Lesotho | RU | Russia |
| LT | Lithuania | RW | Rwanda |
| LU | Luxembourg | SA | Saudi Arabia |
| LV | Latvia | SC | Seychelles |
| LY | Libya | SD | Sudan |
| MA | Morocco | SE | Sweden |
| MD | Moldova | SG | Singapore |
| ME | Montenegro | SK | Slovakia |
| MH | Marshall Islands | SI | Slovenia |
| MK | North Macedonia | SM | San Marino |
| ML | Mali | SR | Suriname |
| MM | Myanmar | SS | South Sudan |
| MN | Mongolia | ST | São Tomé and Príncipe |
| MO | Macao SAR | SV | El Salvador |
| MR | Mauritania | SZ | Eswatini |
| MT | Malta | TD | Chad |
| MU | Mauritius | TG | Togo |
| MV | Maldives | TH | Thailand |
| MW | Malawi | TJ | Tajikistan |

## Countries (cont)

| | | | |
|---|---|---|---|
| TL | East Timor | UY | Uruguay |
| TM | Turkmenistan | UZ | Uzbekistan |
| TO | Tonga | VC | St Vincent and the Grenadines |
| TR | Türkiye | VE | Venezuela |
| TT | Trinidad and Tobago | VG | British Virgin Islands |
| TW | Chinese Taipei | VN | Vietnam |
| TZ | Tanzania | ZA | South Africa |
| UA | Ukraine | ZM | Zambia |
| US | United States | | |

# Markets count on a smooth landing

The central theme of the review period was the waxing and waning of financial markets' optimistic expectations over the policy outlook.[1] Until late December, financial conditions continued to ease, driven by investors anticipating looser policy in the near term. Since January, financial conditions firmed and tightened, as central bank communication pushed back against such expectations and data releases pointed at more stubborn inflation pressures. Sovereign bond yields declined on balance during the period, while valuations of risky assets generally rose. Supported by resilient risk sentiment, emerging market economies (EMEs) experienced bond inflows, and (except China) their stock markets extended gains.

Expectations of policy rate trajectories set the tone for global fixed income markets. Against a benign backdrop of declining inflation and surprisingly resilient economic activity, market participants' expectations initially drifted away from central bankers' projections, so they started pricing in early rate cuts. But then central bank officials repeatedly intervened to dispel excessive optimism, reaffirming that the fight to bring inflation back to target could not be declared won yet. Their efforts to herd market expectations back in line with their projections succeeded and narrowed the daylight between markets' and central banks' expectations. These reassessments left an imprint in elevated bond volatility, which even surpassed that of equities. Government bond yields in major economies broadly reflected these developments: they first continued to decline in December, and then they edged up again after central bank communications pushed back in January and a less benign inflation release in the United States came out in February.

The overall optimistic mood also had a bearing on risky assets. Global stock indices rallied and credit spreads narrowed. While still relatively tight, global financial conditions eased, reflecting expectations of a soft landing. That said, bond issuance and bank credit supply terms painted a less rosy picture. Issuance remained rather subdued, as firms seemed less willing to tap the market at higher rates while banks' lending standards were still tight. The foreign exchange market sent mixed signals: the dollar initially depreciated but then appreciated markedly from January onwards, in response to signs of later-than-expected rate cuts. This pattern reflects exchange rate movements being associated mostly with revisions to the monetary policy outlook rather than being driven by risk sentiment.

EMEs broadly followed the developments in AEs. Bond yields fell, driven by the outlook for policy easing, and equity markets rose across the board. In China, however, equity markets plunged in response to persistent woes about the real estate sector, despite several support measures. EME bond funds saw sustained inflows in Asia and Latin America, in contrast to equity funds, which differed across jurisdictions. EME currencies depreciated across the board, with those in Latin America depreciating more than those in Asia, on the back of a larger compression in yield spreads vis-à-vis the United States.

[1] The review period covers 25 November 2023 to 26 February 2024.

*Key takeaways*

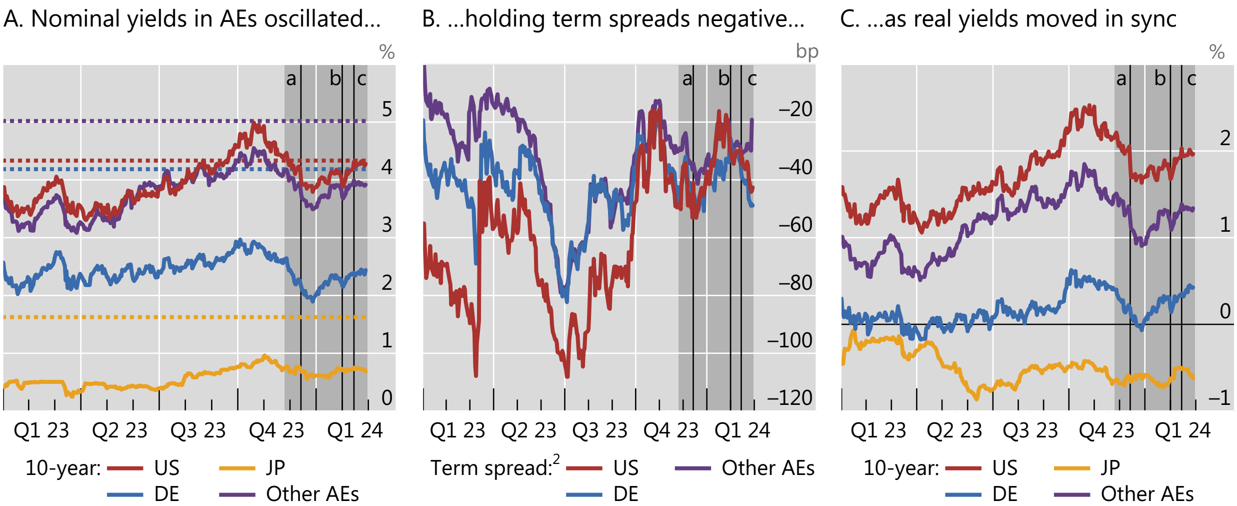
- *Bond markets moved with the waxing and waning of expectations of early policy rate cuts as central bankers intervened to dispel excessive optimism.*
- *Risky assets rallied, with still tight financial conditions easing substantially from their late-October peak.*
- *EMEs broadly followed the developments in AEs as yields fell and equity markets rallied; in China, by contrast, the stock market slumped.*

## Global bond markets stay attuned to monetary policy

A "tug of war" between markets and central banks characterised developments over the review period. In early December, market pricing indicated greater investor conviction in earlier and deeper rate cuts, largely in response to macroeconomic data releases. Yet, from early January onwards, central bank communication increasingly pushed back to dispel excessive market optimism.

Government bond yields declined, on balance, even though they underwent substantial gyrations. In December, long-term government bond yields in major AEs continued their descent from the late-October peaks. In January, yields firmed and then increased, in part supported by central bank communication pushing back

US yields set the tone for global bond markets[1] Graph 1




The shaded area indicates 25 November 2023–26 February 2024 (period under review). The dotted horizontal lines indicate January 2007–June 2008 average.

[a] FOMC press conference (13 December 2023). [b] FOMC press conference (31 January 2024). [c] US CPI release (13 February 2024).

[1] Other AEs based on simple average of AU, CA and GB. [2] 10-year minus 2-year.

Sources: Bloomberg; Datastream; BIS.

expectations of early rate cuts (Graph 1.A).[2] Evolving expectations over the timing and extent of policy rate cuts also drove changes in the overall shape of the yield curve: term spreads fluctuated, but overall the curve remained negatively sloped in most AEs (Graph 1.B).

As long-term inflation expectations remained roughly stable, changes in inflation-adjusted (real) yields matched most of the movement in nominal yields (Graph 1.C). Japan was an exception: real yields remained mostly flat, and the bulk of the movement in nominal yields reflected changing long-run inflation expectations.

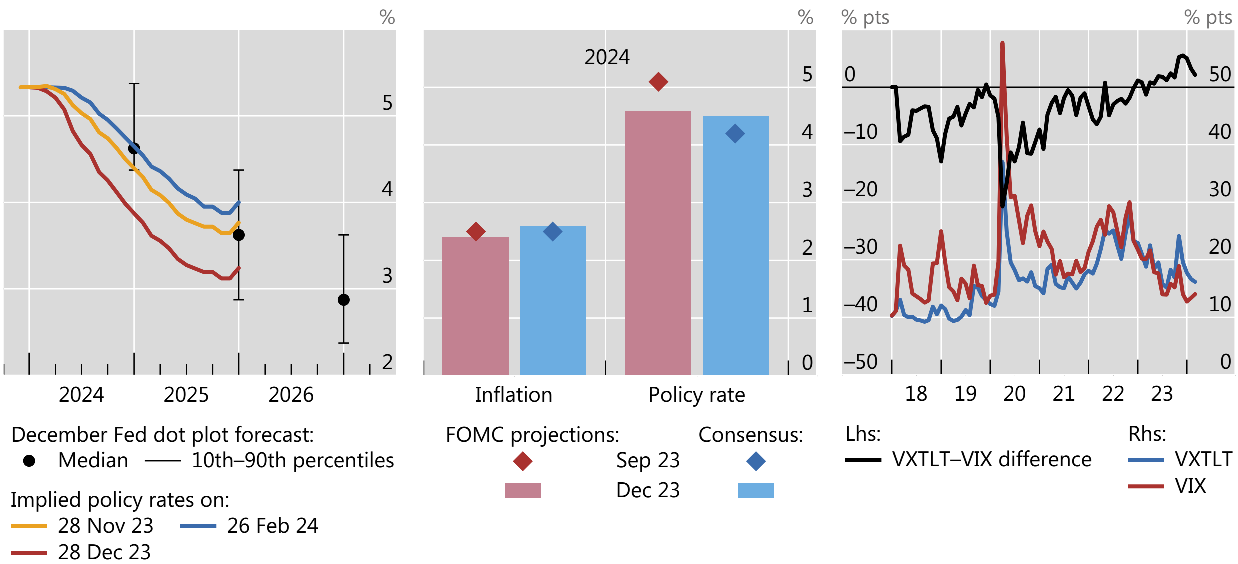
Central bank communication conveyed a sense of patience and caution, but financial market participants eyed a much easier stance ahead. Market participants revised their policy expectations repeatedly, navigating between macroeconomic releases and central bank communication. Eventually though their views converged towards central bankers' projections. Market-based measures of expected US policy rates for end-2024 declined substantially in December, moving well out of line with the Federal Open Market Committee (FOMC) members' projections (Graph 2.A, red line), but reverted by February. Similarly, while professional forecasters' prospects on US inflation were aligned with FOMC projections, they also reflected more dovish expectations on the policy rate trajectory (Graph 2.B). That said, the disagreement

Yields remain volatile amid changing expectations of monetary policy — Graph 2

A. Investors anticipated steep rate cuts in 2024

B. Professional forecasters expected lower policy rates than the FOMC

C. Gap between bond and equity volatility is historically high[1]




[1] See technical annex for details.

Sources: Federal Reserve Bank of St Louis; Bloomberg; Consensus Economics; BIS.

[2] The minutes of the December FOMC meeting, released on 3 January, while acknowledging the risks of high policy rates, reaffirmed the need to see more progress on inflation before cutting rates. This was then reinforced in a speech by Governor Waller on 17 January and in Chair Powell's press conference following the 31 January FOMC meeting. ECB President Lagarde was also cautious and stressed in the press conference following the 25 January ECB governing council meeting that rate cuts were yet not discussed.

among different forecasters on the future course of monetary policy rose substantially, both in the United States and the euro area (Box A).

Reassessments of policy rate paths and the associated portfolio shifts kept bond yield volatility elevated. Gauges of government bond volatility declined somewhat from the peak in October last year, but they remained high and, more unusually, well above those for equities (Graph 2.C). Historically, such a pattern tends to occur around turning points in the policy cycle. For instance, the lift-off of policy rates at end-2015 also coincided with higher volatility in bonds than equities. That said, the recent gap has been larger and longer-lived. Part of the gap may reflect a stronger compression of equity volatility due to dealers selling volatility via yield-enhancing structured products (Box B).

Box A

## The return of monetary policy uncertainty

*Matteo Aquilina, Marco Lombardi and Sonya Zhu*①

Uncertainty about policy rates is a key factor that influences financial markets. Market participants therefore keep their eyes firmly on central banks' deliberations. Broadly speaking, policy rate uncertainty fuels the volatility of all financial assets – not only bonds – and hence has significant implications for asset prices and economic decisions. Uncertainty and, more generally, the distribution of policy expectations, may also impact the transmission of monetary policy.②

The yields on short-term government paper closely track policy rates. This is why policy rate uncertainty, which is not directly observable, can be proxied by looking at the disagreement (ie dispersion) among individual forecasters about three-month yields.③ Based on forecasts by respondents to the Consensus Economics survey, this box documents how such disagreement has evolved over time. By further examining forecasters' disagreement at different horizons (three or 12 months ahead), it also highlights a recent upward trend and dissects its drivers.

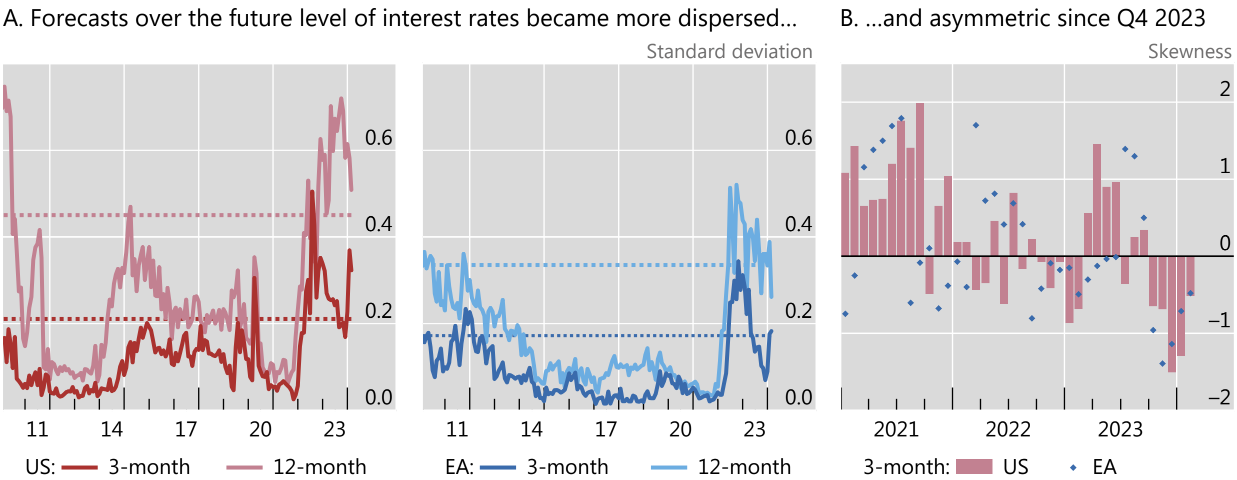
Disagreement over interest rates evolved in line with the monetary policy cycle. In major advanced economies, disagreement was exceptionally low following the Great Financial Crisis (GFC), echoing the low policy rate uncertainty at that time (Graph A1.A, dark coloured line). Before 2013, several central banks deliberately sought to compress policy uncertainty by signalling that rates would be kept extraordinarily low for extended periods – the so-called forward guidance. Afterwards, disagreement briefly resurfaced in the United States during the tightening phase preceding the pandemic as well as at its outbreak. But it then abated swiftly when central banks underscored their commitment to keep policy rates low to support lockdown-stricken economies.

Disagreement over short-term bond yields at the 12-month-ahead horizon (Graph A1.A, light coloured lines) started to grow in 2021, as inflation surged and the economic outlook became more uncertain. Yet this disagreement remained high and failed to subside④ even when inflation and macroeconomic uncertainty receded last year. This has fuelled exceptionally high volatility in bond markets, even exceeding than that of equities, as described in the main text.

Since mid-2022, the dynamics of disagreement over future interest rates at different forecast horizons diverged substantially. At first, disagreement over the level of interest rates that would prevail in three months dwindled as tightening progressed and forecasters anticipated rates nearing their peaks; disagreement 12 months ahead kept rising instead. However, these dynamics have reversed since late-2023. As the debate focused on the timing of the first cut, disagreement at the three-month horizon surged but that at the 12-month horizon declined in the United States and remained stable in Europe. This highlighted that forecasters had different views over when the easing cycle would start.

## Disagreement about short-term interest rates is high

Graph A1




Dotted horizontal lines indicate 2005–09 averages.

Sources: Consensus Economics; authors' calculations.

Looking at the asymmetry of individual forecasts reveals that interest rate uncertainty is unevenly balanced. In 2021, before the tightening cycle even started, a greater proportion of forecasters were more hawkish than the average. Such positive skewness characterised the distribution of forecasts for most of the last three years (Graph A1.B). It reflected that survey participants anticipated a large upside risk to interest rates; that is, central banks might have tightened more aggressively than expected in the short run. Skewness became negative in the last few months: forecasters were anticipating a higher likelihood of deep rate cuts in the next quarter.

Looking beyond the three- and 12-month horizons, there is also wide disagreement on terminal rates – the level of policy rates that will eventually prevail once inflation is again at the desired level.⑤ This is what in macroeconomic jargon is called r* (see G Benigno, B Hoffman, G Nuño and D. Sandri, "Quo vadis, r*? The natural rate of interest after the pandemic," in this issue for a comprehensive discussion).

① The views expressed are those of the authors and do not necessarily reflect the views of the BIS. ② See, for example, M De Pooter, G Favara, M Modugno and J Wu, "Monetary policy uncertainty and monetary policy surprises", *Journal of International Money and Finance*, vol 112, April 2021, 102323. ③ As the projections of the Consensus survey participants do not cover the policy rate, we proxy it by looking at the three-month rate projections. ④ On the contrary, the standard deviation of the one-year inflation forecast of the same Consensus Economics survey increased substantially in 2022, but it then declined and remained low. ⑤ Note that this will be reflected only partly in disagreement at the 12-month horizon, unless one believes inflation would have already reverted to target within the next year.

Box B

## What could explain the recent drop in VIX?

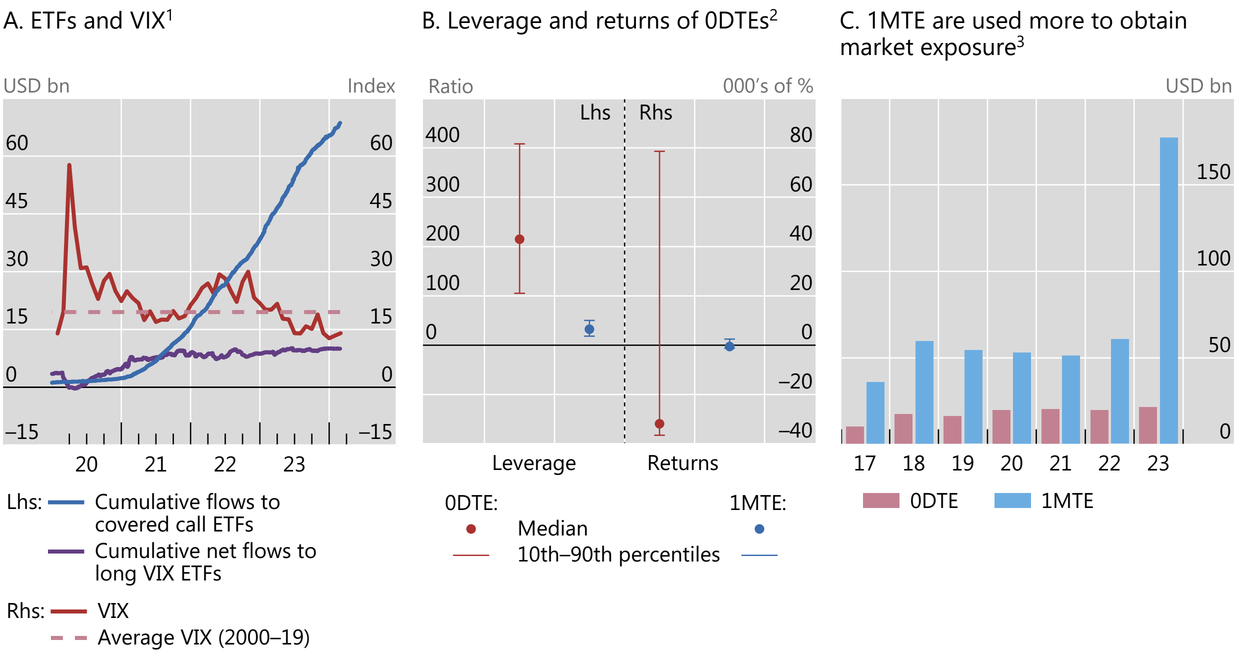
*Karamfil Todorov and Grigory Vilkov*[1]

The compression of equity market volatility (VIX) throughout most of 2023 seems puzzling. Despite the prevailing uncertainty stemming from interest rate paths (Box A) and geopolitical tensions, the VIX remained below its long-term average of around 20 for most of 2023 (Graph B1.A, red line). Some observers relate the drop in VIX to the recent rise of trading in short-term options on the S&P 500 index that expire on the day of trading (zero-days-to-expiry or 0DTE). The rise of these short-term options, so the argument goes, has drawn trading activity away from the one-month-to-expiry (1MTE) options that underlie VIX. This drop in activity, in turn, has decreased demand for one-month options, thereby depressing VIX.[2] In this box, we show that the increased trading in 0DTEs in the past few years did not, on net, lure activity away from one-month options and thus is unlikely to be the main explanation behind the drop in VIX. We then propose an alternative explanation: option dealers effectively dampen volatility when they hedge structured products, which have become more popular recently.

Trading volume in 0DTEs has risen in recent years because these options are relatively cheap and provide a lottery-like payoff with extremely high, if very unlikely, returns, which appeals to certain investors.[3] These 0DTE options on the S&P 500 index (SPX) accounted for more than 50% of the SPX options' trading volume in August 2023, up from just 5% in 2016.[4] Low premiums on 0DTEs allow investors to build in very high leverage, hence the lottery-like payoff profile. In fact, leverage ratios of 0DTEs are several orders of magnitude higher than those of one-month options and can reach levels above 400 (Graph B1.B, left-hand scale). Investing in 0DTE options loses money on average, with annualised returns of -32,000%, but on rare occasions generates extremely high returns of up to 79,000% (Graph B1.B, right-hand scale). These returns are much more volatile than the returns on one-month options, which have an average return of -550% annualised and a maximum of 2,500%.

### VIX dropped as popularity of structured products surged

Graph B1




0DTE = zero-days-to-expiration options; 1MTE = one-month-to-expiration options.

[1] Covered call exchange-traded funds (ETFs) implement a strategy that buys the index and sells a call option on the index every month. The flows are based on the following ETFs: QYLD, BUFR, XYLD, KNG, RYLD, PJUL, JEPI, QYLG, JEPQ, FEPI, KLIP and DIVO. VIX ETFs trade VIX futures. Net flows to long VIX ETFs are computed as flows into long VIX ETFs minus flows into short VIX ETFs, weighted by their corresponding leverage. The flows are based on the following ETFs: SVIX, SVXY, SVOL, VXX, VIXY, UVXY and UVIX. [2] Leverage and returns are computed across moneyness levels for calls and puts. [3] Computed as open interest times option's absolute delta.

Sources: Bloomberg; CBOE; BIS.

While the trading in 0DTEs soared in the past few years, this surge is unlikely to explain the drop in VIX for two reasons. First, even though both instruments have grown in past years, one-month options are still used disproportionally more than 0DTEs to get actual exposure to the market index itself (Graph B1.C, blue bars vs red bars).⑤ Second, 0DTE trading activity does not directly affect the pricing of one-month options and thus the VIX. This is because the latter is based on one-month maturity, whereas 0DTEs expire on the day of trading.

The sale of VIX futures by short VIX exchange-traded funds (ETFs), which was presumably one of the factors behind the drop in VIX in 2017–18, is also unlikely to explain the recent decrease in VIX. These ETFs could put downward pressure on VIX as they sell futures on the volatility index. Such a mechanism was potentially at play in the years before the "Volmageddon" of February 2018, when VIX spiked more than 100% on a single day.⑥ Recent years though have seen a net positive demand for VIX futures by VIX ETFs (Graph B1.A, purple line). This is inconsistent with pressure from VIX futures sales by ETFs as being a key driver of the drop in VIX.

An alternative and presumably more likely reason behind the compression of volatility is the surge in issuance of yield-enhancing structured products. These types of structured products provide a yield enhancement by offering higher returns to investors thanks to the sale of options. A classic example of a yield-enhancing structured product is a so-called "covered call": a purchase of the S&P 500 index and a simultaneous sale of a one-month call option on the index. The product gives an exposure to the index and generates a yield enhancement with the sale of the call option (the premium income), but it gives up part of the upside if the index rises above a threshold, say 5% over the next month. In other words, an investor in this covered call effectively takes the view that the market will not rise more than 5% over the next month and monetises this view by selling the call option. A covered call is just a simple illustration of a yield-enhancing structured product, but there are many more-complicated types.⑦ These structured products are frequently offered to retail investors by banks, which are often dealers.

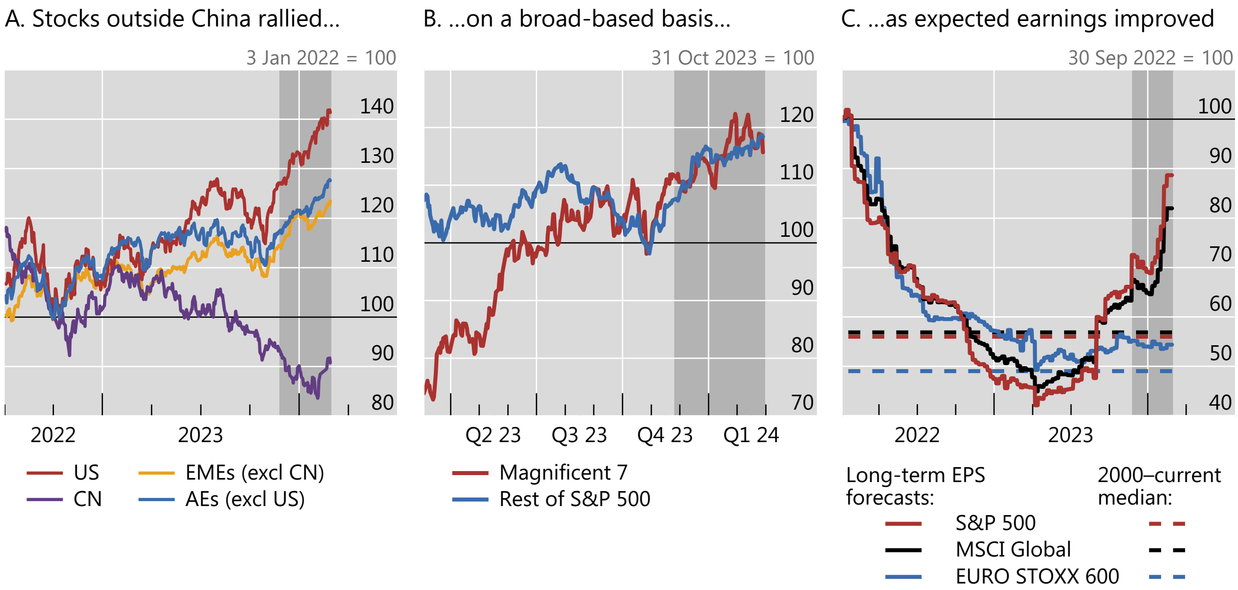
The rise of yield-enhancing structured products may dampen volatility due to the mechanics of how dealers hedge option exposures. When dealers sell such structured products, they effectively buy an option from their clients. To hedge the option exposure, dealers trade in the underlying asset (the equity index) as a function of its price.⑧ Specifically, they need to buy when the index goes down and sell when it goes up – a practice known as "dynamic hedging".⑨ By doing so, dealers act in a contrarian way, effectively dampening the price movements of the underlying asset. As volatility declines, so does the cost of ensuring against it, as reflected in option prices. Such market dynamics could explain why the VIX can be depressed even in an environment of heightened uncertainty. Suggestive of this mechanism at play, the meteoric rise of yield-enhancing structured products linked to the S&P 500 over the last two years has gone hand in hand with the drop of VIX over the same period (Graph B1.A, blue line).

① The views expressed are those of the authors and do not necessarily reflect the views of the BIS. ② R. Wigglesworth, "The 'broken' Vix", *Financial Times*, 30 January 2023, ft.com. ③ G. Vilkov, "0DTE trading rules", December 2023, available at SSRN: https://ssrn.com/abstract=4641356. ④ M. Xu, "Volatility Insights: Much Ado About 0DTEs - Evaluating the Market Impact of SPX 0DTE Options", CBOE, 8 September 2023, cboe.com. ⑤As each option is equivalent to certain number of market shares (delta), the absolute exposure of all one-month options to the market is obtained by multiplying the total amount of option contracts traded with their absolute market share equivalent (absolute delta). ⑥ K. Todorov, "When passive funds affect prices: evidence from volatility and commodity ETFs", *Review of Finance*, forthcoming. ⑦ Other examples include equity-linked notes or barrier options. Structured products might also involve selling a put option, or a simultaneous purchase and sale of calls and puts. However, as long as the product is yield-enhancing and generates higher coupons than the risk-free rate, which is achieved by the sale of options, the mechanism is similar to a covered call: the client is net short an option and thus sells volatility. ⑧ The dealer can also offload the resulting exposure by matching it against opposing exposure due to transactions in other instruments or other clients; alternatively, the dealer can sell the option on the market, which would also decrease VIX because it depresses option prices. ⑨ H S Shin, *Risk and Liquidity*, Oxford University Press, 2019.

## Risky assets pull ahead amid a buoyant mood

Equity markets posted substantial gains in the review period, as market participants anticipated rate cuts and earnings surprises on the upside supported risk sentiment. The rally was common to most AEs and EMEs, with the notable exception of China (Graph 3.A). This time around, it encompassed most stocks (Graph 3.B), rather than overwhelmingly the "magnificent 7" big tech companies, whose valuations nonetheless reached ever loftier levels. In addition to lower discount rates, positive earnings surprises buoyed prices (Graph 3.C). Japanese stocks, which underperformed in December, subsequently rallied, reaching all-time highs.

Global equity markets are buoyed by declining interest rates and strong earnings[1] Graph 3




The shaded area indicates 25 November 2023–26 February 2024 (period under review).

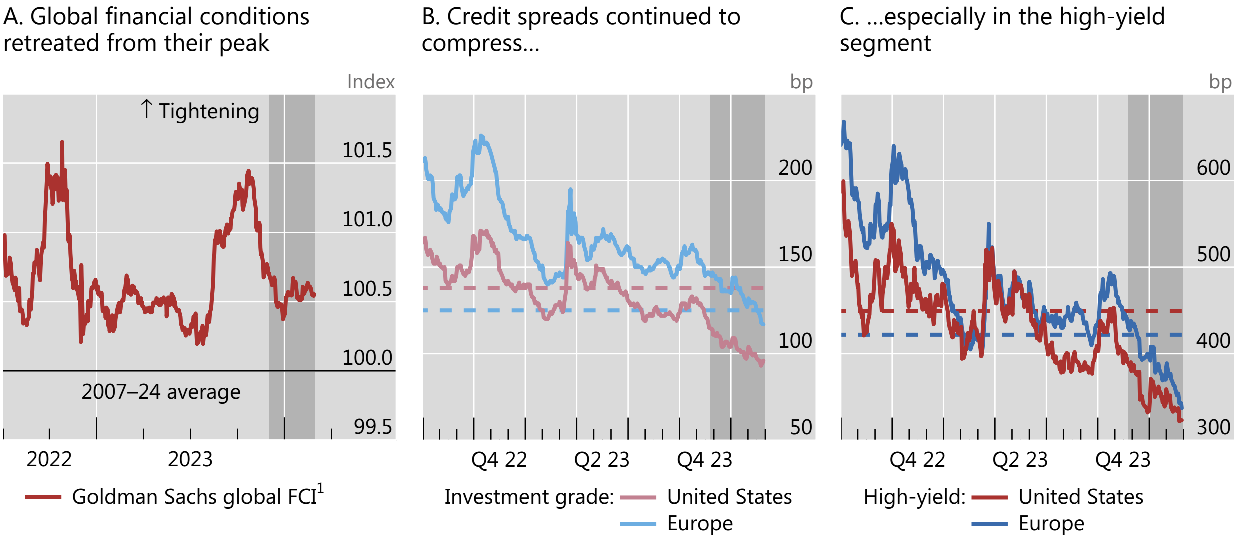
[1] See technical annex for details.

Sources: IMF; Bloomberg; Datastream; Refinitiv; BIS.

The dynamics of financial conditions reflected the waxing and waning of market participants' expectations of early rate cuts. While remaining, on balance, tight relative to historical averages, global financial conditions eased substantially from their late-October peak (Graph 4.A). Corporate bond yields fell considerably until the end of December and then recovered somewhat as participants continuously re-evaluated how central bank actions would evolve. Credit spreads, by contrast, mostly followed the declining trajectory embarked on in mid-2022. They declined both in the investment grade and high-yield segments of the market and are now substantially below historical norms in the United States and Europe (Graphs 4.B and 4.C).

Credit markets pulled ahead

Graph 4




The shaded area indicates 25 November 2023–26 February 2024 (period under review). The horizontal dotted lines indicate 2005–current medians.

[1] See technical annex for details.

Sources: Goldman Sachs Global Investment Research; ICE BoAML indices; BIS.

The buoyant pricing in equity and credit markets stood in contrast with banks' cautious approach to lending, subdued bond issuance and rising corporate defaults.[3] Survey responses showed that – on net – banks were still tightening standards, albeit less than in the previous quarter (Graph 5.A). Furthermore, while bond issuance rose slightly, it remained substantially below pre-pandemic levels. This probably reflected firms' overall limited refinancing needs, given the bulge in issuance in 2020 and 2021. Another factor could be timing decisions, as firms waited for rates to decline further. That said, the continued increase in defaults suggests that at least some firms may have been experiencing funding difficulties (Graph 5.B).

Different factors drove changes in the foreign exchange market over the review period. Until late December, the US dollar depreciated while risk assets rallied, in line with the dollar functioning as a key barometer of risk-taking. However, from January onwards, the dollar appreciated markedly, even as equity and credit markets continued to rally. This pattern is at odds with typical risk-on phases of the period following the Great Financial Crisis (GFC), but it aligns with a more traditional channel of exchange rates reacting to interest rate differentials. Indeed, the behaviour of the dollar was closely linked with changing expectations of future policy rates. When markets' views on the prospects of early rate cuts waned and expectations realigned with central banks' projections, the dollar strengthened materially (Graph 5.C).

[3] The resolution of this tension between central banks, financial markets and lending volumes may produce some turbulence, especially in markets with pockets of leverage; see Box C for a discussion of risks among prime brokers.

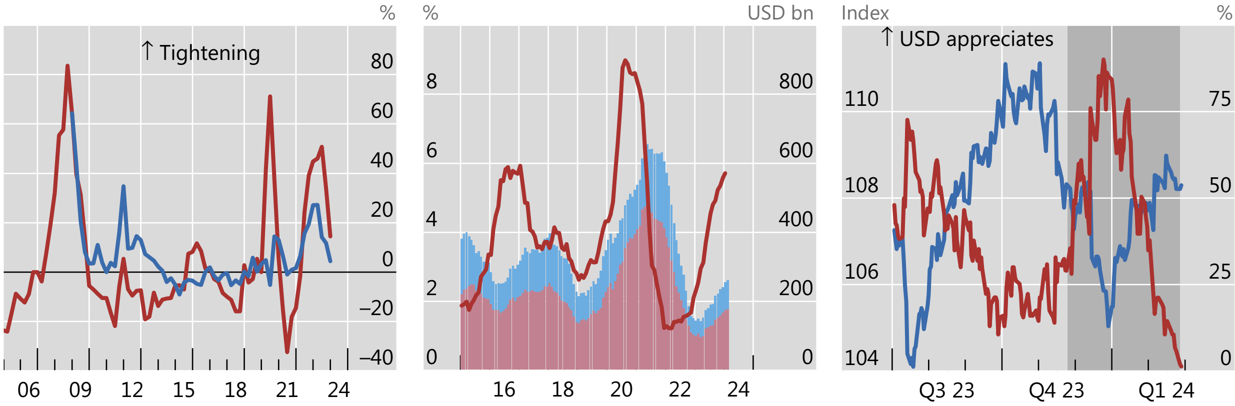
Lending standards are still restrained, and issuance subdued

Graph 5

A. Lending standards stayed tight…

B. …amid subdued corporate issuance, increasing defaults…[1]

C. …and a strengthening US dollar




Net percentage of respondents reporting credit tightening standards:
United States — Euro area

US high-yield debt default rate (lhs)

High-yield issuance (rhs):
United States — Europe

US nominal effective exchange rate (lhs)
Probability of cut for March 2024 meeting (rhs)

[1] See technical annex for details.

Sources: Board of Governors of the Federal Reserve System; Bloomberg; Datastream; Dealogic; Moody's; BIS.

Box C

## The prime broker–hedge fund nexus: recent evolution and implications for bank risks

*Douglas Araujo, Benjamin Cohen and Kevin Tracol*[1]

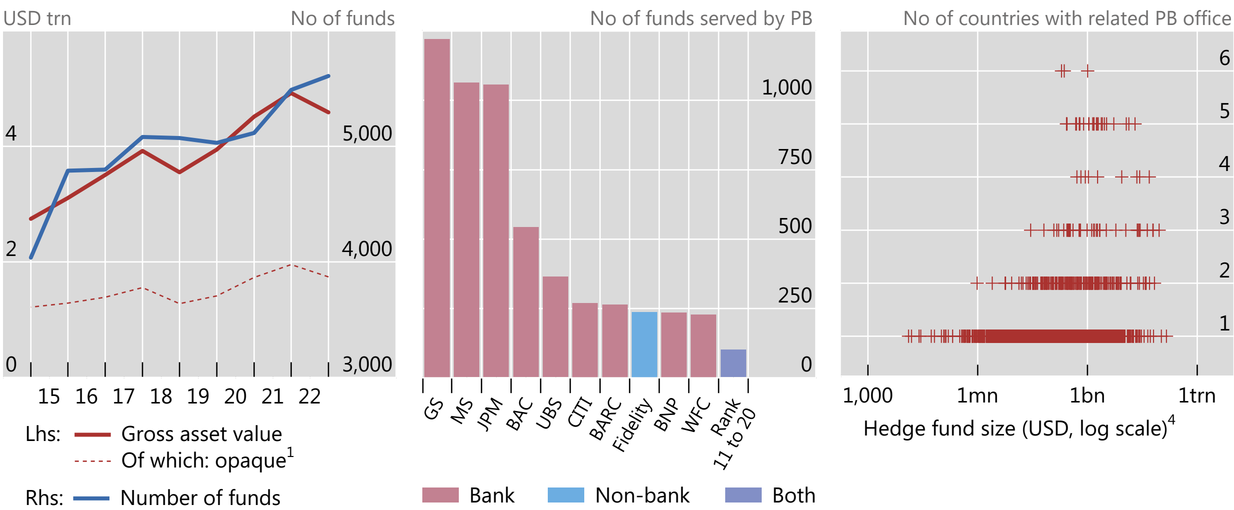
Prime brokerage is a set of services offered to hedge funds and other non-bank financial institutions by broker-dealers, most of which are part of large banking groups. It centres around the provision of leverage via both derivatives and securities financing transactions, such as margin loans, and of the necessary infrastructure related to market access, custody, clearing and related support. Past research has studied how liquidity and funding shocks at prime brokers (PBs) can spill over to hedge funds,[2] but contagion can run in both directions. This box uses several relatively underexplored data sets to look at how hedge funds might contribute to the risks of their PB counterparties.

As of end-2022, US-registered hedge funds held over $4.5 trillion of gross assets (Graph C1.A). This sum refers to those funds not associated with any bank, broker-dealer or insurance company. Their gross assets are small relative to the global assets of non-bank financial institutions, estimated at between $63 trillion and $218 trillion.[3] But hedge funds attract particular attention because of their ability to ramp up leverage, which can create financial stability risks.

Hedge funds rely mostly on a few PBs, who tend to be global systemically important banks, with the largest ones each serving more than 1,000 funds (Graph C1.B). Larger hedge funds tend to have relationships with PB offices located in various jurisdictions (Graph C1.C), helping them to broaden their trading reach across markets.

### Hedge funds are directly connected to large banks and non-banks across borders — Graph C1

A. Independent hedge funds are significant players… | B. …that rely mostly on a few large banks for prime brokerage…[2] | C. …in multiple financial markets[3]




[1] Assets not independently valued. [2] Ranked by number of funds serviced by prime broker in 2022. Count of prime broker linkages ranked 11 to 20 represent the average number of funds serviced by each prime broker (PB) in the sample as of end-2022. [3] 2022 data. Each plus sign represents a hedge fund. [4] Hedge fund's gross asset value.

Sources: US Securities and Exchange Commission (SEC) Form ADV; authors' calculations.

Prime brokerage is designed to be a low-risk activity, but wrong-way risk (WWR), the opaqueness of funds' positions and poor risk management can create vulnerabilities for PBs. WWR refers to the risk that a PB's credit exposure to a hedge fund counterparty increases at the same time as the likelihood of the counterparty's default. Opaqueness is present when the PB does not have the necessary visibility into the funds' positions, eg because they are booked in different entities, the assets are complex or the assets do not have readily verifiable market values. The resulting risk exposures often become apparent only when the fund is facing severe difficulties.

These factors played out, for example, in the Archegos Capital Management episode. The fund had large and concentrated positions in a small number of shares. When these stocks suddenly plummeted, the fund's financial strength suffered a blow, while PBs' exposure to the fund surged, exacerbated by leverage – a case of WWR. Illustrating opaqueness, Archegos' PBs were not fully aware of the size of the fund's positions with other banks, thereby underestimating its overall leverage and impact on the markets in which it was active. Compounding these risks, Credit Suisse, the PB most affected by Archegos' failure, had not set sufficiently conservative terms for the leverage it had provided. This resulted in both an excessive credit exposure for the bank and excessive leverage of the fund.④

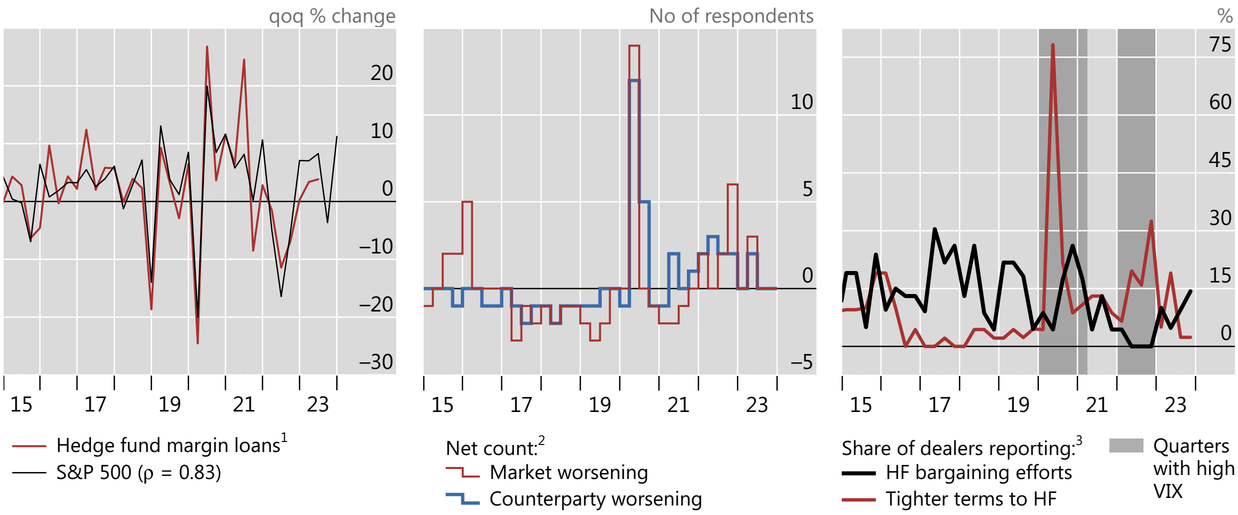
The hedge fund sector as a whole also demonstrates signs of procyclical leverage, WWR and opaqueness. PBs tend to provide more margin loans to hedge funds when markets are buoyant: secured borrowing by hedge funds correlates closely with stock market valuations (Graph C2.A), just as leverage in dealer balance sheets is procyclical.⑤ Hedge fund credit quality as perceived by dealers (Graph C2.B, blue line) deteriorates during weak market conditions (red line), when the value of assets the banks hold as collateral vis-à-vis the funds falls. This positive correlation between default probability and *net* credit exposure constitutes WWR. As for opaqueness, the assets of a quarter of hedge funds are not fully independently valued,⑥ comprising 38% of hedge fund assets (Graph C1.A), making it more difficult for PBs to trust the fund's stated asset values, especially in adverse market conditions.

PBs accommodate hedge fund requests for better conditions on margin loans during calmer market periods, only to tighten these conditions during stress episodes (Graph C2.C). The Archegos episode is an extreme example: well in advance of the fund's troubles, those in Credit Suisse who wanted to maintain a relationship with Archegos reportedly resisted efforts by risk management to demand more margin. Evidence suggests that such efforts to accommodate customers occur in the market in aggregate, reinforcing procyclicality. When hedge funds seek looser trade conditions with their PBs, such as better pricing or lower margin requirements (Graph C2.C, black line), fewer dealers report margin loan tightening (Graph C2.C, red line). Dealers tighten such terms when markets turn volatile (quarters with darker shading).

These vulnerabilities call for sound risk management by PBs, overseen by risk-based, proactive supervision. Further, the global nature of prime brokerage illustrates the value of international supervisory collaboration.

Vulnerabilities from hedge funds also play out in aggregate — Graph C2

A. Leveraged trades that co-move with the market… | B. …lead to wrong-way risk… | C. …while dealers avoid tightening trade conditions in calmer periods




[1] Hedge funds' total secured borrowing via prime brokerages (margin accounts). [2] Net count of dealers reporting reason for tightening vs easing price or non-price terms to hedge funds over the past quarter due to either market or counterparty worsening. [3] Net per cent of dealers reporting reason for tightening vs easing price or non-price terms to hedge funds over the past quarter.

Sources: Federal Reserve Bank of St Louis, FRED; US Securities and Exchange Commission (SEC) Form ADV; authors' calculations.

① The views expressed are those of the authors and do not necessarily reflect the views of the BIS. ② M S Kruttli, P J Monin and S W Watugala, "The life of the counterparty: shock propagation in hedge fund-prime broker credit networks", *Journal of Financial Economics*, vol 146, no 3, December 2022, pp 965–88. ③ Financial Stability Board, *Global monitoring report on non-bank financial intermediation: 2023*, 18 December 2023. ④ Paul, Weiss, Rifkind, Wharton & Garrison LLP, *Credit Suisse Group Special Committee of the Board of Directors report on Archegos Capital Management*, 29 July 2021. ⑤ S Aramonte, A Schrimpf and H S Shin, "Non-bank financial intermediaries and financial stability", *BIS Working Papers*, no 972, October 2021. ⑥ Data from US Securities and Exchange Commission Form ADV.

## EMEs, with the exception of China, followed AEs

With the exception of China, developments in EME fixed income markets were broadly in line with those in AEs. Disinflation also remained well on track in EMEs (Graph 6.A), and most central banks were expected to either continue or begin cutting policy rates (Graph 6.B). As a result, nominal government bond yields fell in the early part of the review period. In contrast to AEs, however, and somewhat surprisingly given the appreciation of the dollar, they did not increase substantially afterwards (Graph 6.C).

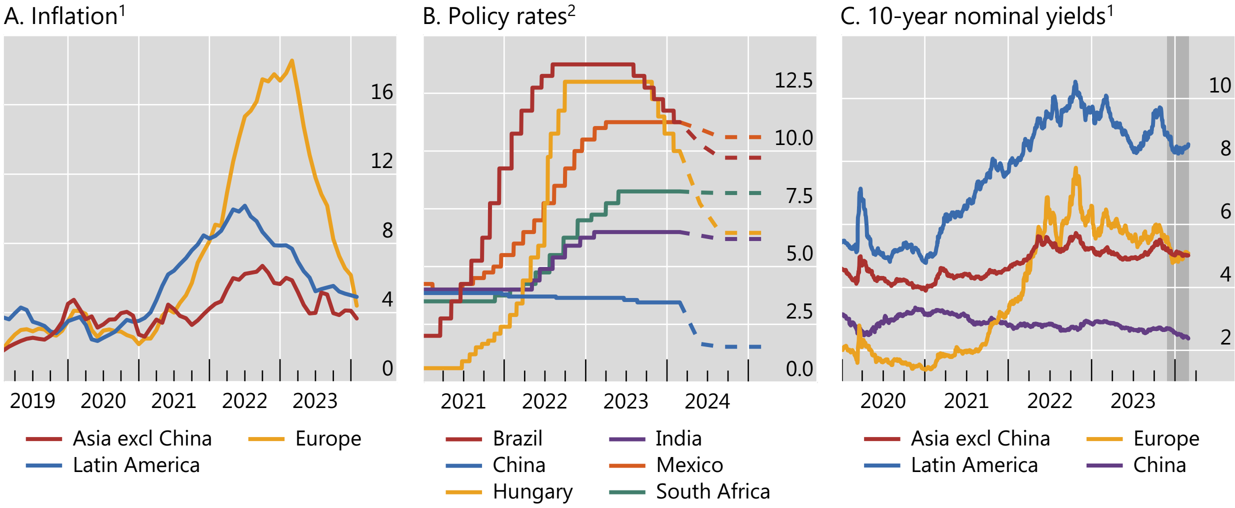
In line with the general risk-on sentiment, equity markets in most EMEs rose, even though they broadly underperformed those in AEs. Latin American markets increased slightly more than Asian ones (Graph 7.A). Despite the recent rally, EME stock prices still entailed a heavy valuation discount, rendering their valuations more attractive on a forward-looking basis compared with those of AEs (Graph 7.B).

In contrast to those of most other EMEs, Chinese stocks continued to slump. And this took place despite signs that the Chinese economy was stabilising, as official data showed it had met the government's 5% growth target. Market participants shrugged off the support offered by the central bank and fiscal authorities in December. Instead, they seemingly focused on inflation indicators and the persistent problems in the real estate sector. Property sales and new home starts contracted, and property prices continued to decline. In addition, inflation gauges pointed to prices declining at their fastest pace since the GFC. Reflecting this negative sentiment, Chinese equities extended losses: at one point the CSI 300 Index was 45% below its previous peak. In parallel, the Hang Seng Index fell in January, even reaching July 1997 levels. The tide seemed to turn in February, when Chinese authorities unveiled a number of measures to ease financial conditions and stimulate credit.

EME yields went down

In per cent

Graph 6



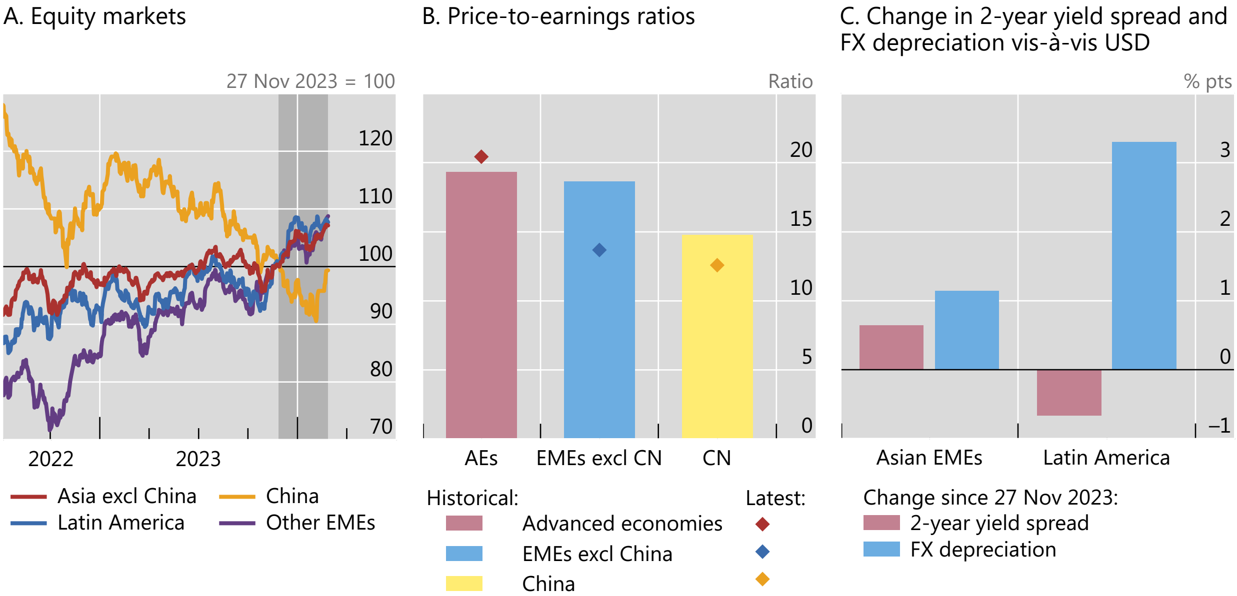

The shaded area indicates 25 November 2023–26 February 2024 (period under review).

[1] See technical annex for details. [2] Dashed lines represent futures-implied market expectations of policy rates.

Sources: Bloomberg; Datastream; BIS.

EME equities went up with the exception of China[1]

Graph 7




The shaded area indicates 25 November 2023–26 February 2024 (period under review).

[1] See technical annex for details.

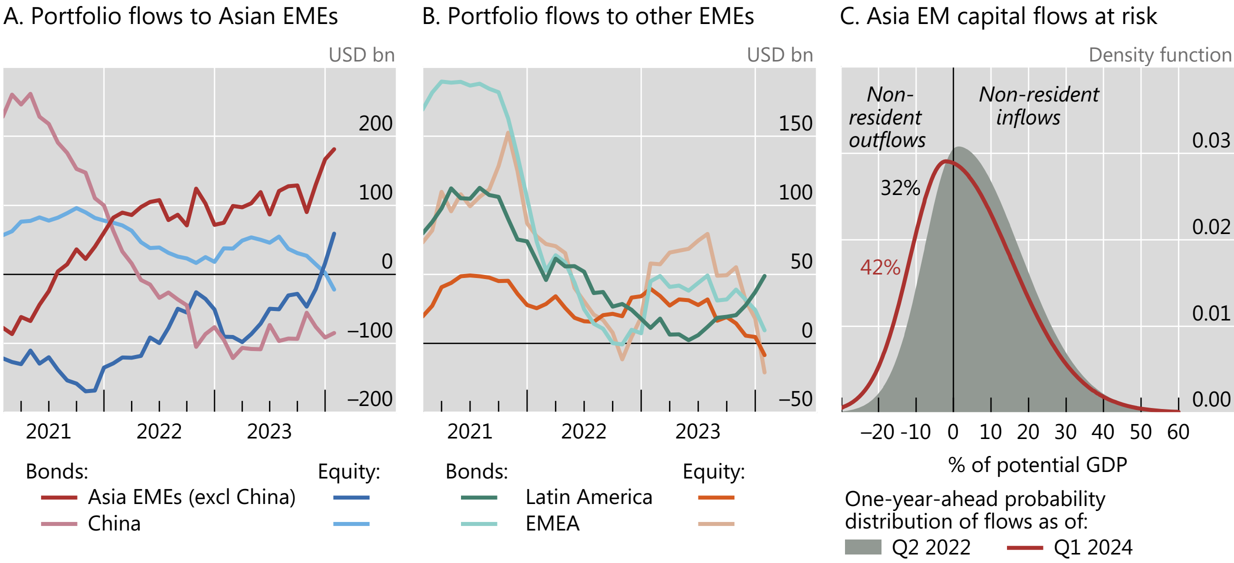
Sources: Bloomberg; Datastream; BIS.

EME currencies depreciated mildly, with foreign exchange (FX) markets hinting at some localised pressure. Asian currencies depreciated less than Latin American ones on the back of improving interest rate differentials vis-à-vis the US dollar (Graph 7.C). While EME spot markets remained orderly, FX derivative segments for the Chinese renminbi showed signs of tension. Against the backdrop of sustained capital outflows, the cross-currency basis for the Chinese renminbi remained substantially large, indicating an elevated premium for Chinese borrowers to obtain dollar funding. This contrasted with the dynamics of the basis for major currencies, which continued to narrow despite the appreciation of the US dollar.

Prospects for yield differentials and equity valuations influenced capital flows to EMEs. Bond flows picked up in Latin America and Asia, given the mostly positive interest rate differentials with the United States (Graphs 8.A and 8.B). Equity flows diverged across jurisdictions: Latin American and EMEs in Europe, the Middle East and Africa saw pronounced outflows (Graph 8.B), whereas Asian EMEs experienced inflows (Graph 8.A). China was a notable exception, as equity funds saw sustained outflows.

There are indications that the risk of moderate-to-large EME capital outflows has increased, which could bring vulnerabilities to the fore. Specifically, compared with mid-2022, the estimated probability distribution of non-resident capital flows one year ahead shifted to the left, indicating a higher probability of outflows (Graph 8.C).

EME portfolio flows have been subdued for some time and risk deteriorating[1] Graph 8




EMEA = Europe, Middle East and Africa.

[1] See technical annex for details.

Sources: Aguilar et al (2024); IIF; BIS.

## Technical annex

Graph 2.C: VIX = CBOE Volatility Index. The VIX Index is a financial benchmark designed to be an up-to-the-minute market estimate of the expected volatility of the S&P 500R Index. It is calculated by using the midpoint of real-time S&P 500 Index (SPX) option bid/ask quotes. VXTLT = CBOE 20+ Year Treasury Bond ETF Volatility Index.

Graph 3.A: US = S&P 500; CN = CSI 300 Index. Country group aggregates based on gross domestic product (GDP)-weighted averages.

Graph 3.B: Magnificent 7 = Apple, Alphabet, Amazon, Meta, Microsoft, Nvidia and Tesla.

Graph 3.C: EPS = earnings per share.

Graph 4.A: Goldman Sachs Financial Conditions Index (FCI): a weighted average of country-specific risk-free interest rates (both long and short term), exchange rates, equity valuations and credit spreads, with weights that correspond to the estimated impact of each variable on GDP. A value of 100 indicates average conditions. A higher (lower) value indicates tighter (looser) conditions.

Graph 5.B: US high-yield default rate based on Moody's 12-month rolling US speculative grade default rates. High-yield issuance based on a 12-month rolling sum.

Graph 6.A: Purchasing power parity (PPP)-weighted averages. Asia excl China = IN, ID, KR, MY, PH, SG and TH. Latin America = BR, CL, CO, MX and PE. Europe = BG, CZ, HU, PL and RO.

Graph 6.C: Asia excl China = IN, ID, MY and TH. Latin America = CL, CO, MX, PE and BR. Europe = CZ, HU, PL, SK and RO.

Graph 7.A: Asia excl China = HK, IN, ID, KR, MY, PH, SG and TH. Latin America = BR, CL, CO, MX and PE. Other EMEs = CZ, HU, PL and ZA.

Graph 7.B: Historical = average GDP-weighted price-to-earnings ratios from 2 January 2010 until 26 February 2024. Latest = 26 February 2024. Advanced economies = US, JP, EA, AU, CA, NZ, CH and GB. EMEs excl China = HK, ID, KR, MY, PH, SG, TH, BR, CL, CO, MX, PE, CZ, HU, PL and ZA.

Graph 7.C: Asian EMEs = CN, ID, IN, KR, MY, TH and SG. Latin America = BR, CL, CO, MX and PE. Yield spread is the average spread of the two-year yield over the two-year US Treasury yield.

Graphs 8.A and 8.–B: Cumulative net non-resident purchases of equity and debt flows for the past 12 months, serving as proxy for portfolio flows as measured in the balance of payments.

Graph 8.C: Average figures for Emerging Asia considering ID, IN, KR, MY, PH and TH. Probability distribution of non-resident flows based on model estimation of A Aguilar, R Guerra and F Zampolli, "Assessing capital flows' risk to emerging market economies: the role of domestic factors", *BIS Working Papers*, forthcoming.

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# Quo vadis, r*? The natural rate of interest after the pandemic[1]

*Where is the natural rate of interest? How has it evolved? And where is it heading? In core advanced economies, several estimates of the natural rate have edged up. Shifts in the saving-investment balance and a more inflationary environment, which elicited a strong monetary policy response, may have been factors raising r* and perceptions thereof. The measurement of r* is, however, surrounded by very high uncertainty, making it a blurry guidepost for monetary policy.*

*JEL classification: E40, E43, E52, E58.*

The sharpest and most synchronised monetary tightening in decades has lifted policy rates from their decade-long historical lows (Graph 1.A). Against this background, there is an increasingly lively debate on whether policy rates adjusted for inflation ("real rates") will converge back to their pre-pandemic lows or to a higher level.

Views differ widely. Some contributions posit that real rates will most likely return to low levels as unchanged powerful structural forces, including low potential growth, continue to hold them down (eg IMF (2023); Obstfeld (2023)). On the other hand, higher long-term real bond yields, reflecting in part higher distant forward real rates, suggest that at least investors expect higher real interest rates in the future (Graph 1.B). Likewise, the surprising resilience of economic activity to tighter monetary policy in the current cycle could be seen as an indication that the level of real policy rates that dampens demand is higher than previously thought.

This special feature contributes to this debate by assessing the natural rate of interest, commonly known as r*, in the post-pandemic era. The natural rate refers to the short-term real interest rate that would prevail in the absence of business cycle shocks, with output at potential, saving equating investment and stable inflation. Hence, the natural rate serves as a yardstick for where real policy interest rates are headed. It is also a benchmark for assessing the monetary policy stance "looking through" business cycle fluctuations. It can be conceived of as representing the

1 The views expressed are not necessarily those of the BIS. We thank Claudio Borio, Sebastian Doerr, Jon Frost, Gaston Gelos, Peter Hördahl, Enisse Kharroubi, Marco Lombardi, Cristina Manea, Benoît Mojon, Dan Rees, Phurichai Rungcharoenkitkul, Hyun Song Shin, Andreas Schrimpf and Fabrizio Zampolli for helpful comments and Burcu Erik and Nicolas Lemercier for excellent research assistance. We are also grateful to Claus Brand, Ambrogio Cesa-Bianchi, Marco Del Negro, Richard Harrison, Peter Hördahl, Zehao Li, Noemie Lisack, Thomas Lubik, Christian Matthes, Elmar Mertens, Stefano Neri, Rana Sajedi, and Steve Wu for sharing data and for helpful discussions. All remaining errors are ours.

*Key takeaways*

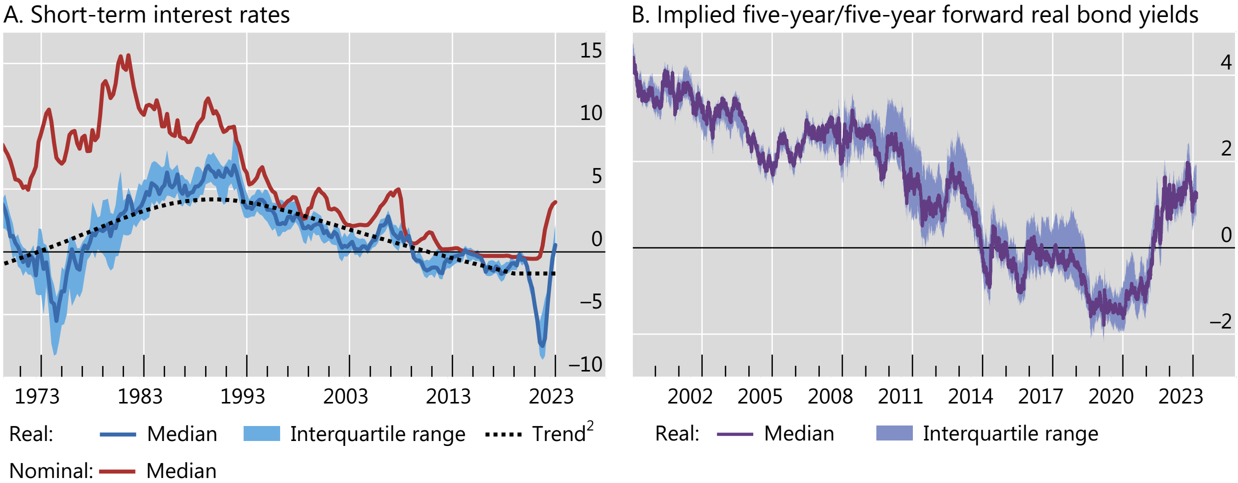
- *Several estimates of the natural rate of interest (r*) suggest that it may have increased relative to pre-pandemic levels.*
- *Potential shifts in the saving-investment balance and a more inflationary environment, which elicited a strong monetary policy response, may have raised r* and perceptions thereof.*
- *Assessments of the level and direction of r* are surrounded by very high uncertainty, making it a blurry guidepost for monetary policy, especially in the current context.*

intercept in a monetary policy rule, as in a "Taylor rule" (Taylor (1993)). Together with the long-run inflation rate, defined by the central bank inflation target, it pins down the long-run level of the nominal policy rate.

We assess the post-pandemic natural rate from different perspectives. A review of various established measures of r* in core advanced economies suggests that it may indeed have increased. That said, there is considerable dispersion across estimates and high statistical uncertainty around individual estimates. The recent behaviour of the structural drivers of r* does not paint a clear-cut picture either. Low expected potential growth and rising longevity may continue to weigh on r*. Several other factors may exert upward pressure though, including persistently large fiscal deficits due to rising age-related spending as well as higher public investment needs for infrastructure, defence and the green transition. Moreover, and less often appreciated, monetary policy itself could have a non-negligible effect on natural rates and perceptions thereof, through debt accumulation and beliefs about r*. As such, the recent reemergence of upside inflation risks inducing a tighter monetary policy stance going forward may have pushed at least perceptions of r* higher.

Rising short- and long-term real interest rates in advanced economies[1]

In per cent — Graph 1




[1] See technical annex for details. [2] Hodrick Prescott-filtered trend of the median with a smoothing parameter λ = 400,000 estimated up to Q4 2019 (constant afterwards).

Sources: IMF; OECD; Consensus Economics; Datastream; Refinitiv; national data; authors' calculations.

The article proceeds as follows. The first section discusses the concept of the natural rate. In Section 2, we assess and compare different estimates of r* for the United States and the euro area. Section 3 looks at the long-run determinants of saving and investment as drivers of the natural rate, while Section 4 discusses the role of monetary policy. We end with a discussion of policy implications.

## The natural rate: conceptual considerations

The concept of the natural rate of interest traces back at least to Wicksell (1898), who described it as the rate of interest that would equate saving and investment and be consistent with stable prices. In this vein, the natural rate is generally defined as the level of the short-term real interest rate that would prevail in the absence of business cycle fluctuations, with output at potential, saving equating investment and stable inflation (Borio (2021)).[2]

The natural rate is commonly thought to be determined by real forces that structurally affect the balance between actual and potential output, or equivalently between saving and investment. Specifically, factors that increase saving or decrease investment lower the natural rate. These include potential growth, demographic trends, inequality, shifts in savers' and investors' risk aversion and fiscal policy. Lower potential growth lowers investment by reducing the marginal return on capital and increases saving by lowering expected income. Longer life expectancy raises saving as households need to support a longer retirement. A lower dependency ratio – reflecting a higher share of working age people in the population – increases saving as those in the workforce typically save more than the young and the elderly. Higher inequality raises saving as richer households save a larger share of their income. Higher risk aversion induces higher saving, in particular in safe assets, and at the same time lowers investment. Finally, persistent fiscal deficits reduce aggregate saving.

In a globalised world economy, with free capital flows, the same considerations apply but at the global level. At the country level, saving-investment differences can be accommodated through current account deficits or surpluses. However, natural rates would still need to adjust to equate actual and potential output and saving and investment at the world level.

The natural rate is generally assumed to be independent of monetary policy. This reflects the principle that monetary policy is neutral in the long run and can affect real variables only in a transitory fashion. Instead, the natural rate should be seen as a guidepost for monetary policy as it encapsulates where real policy rates would be headed once the effects of business cycle shocks have petered out. The central bank sets the nominal short-term riskless rate directly and, given that prices are relatively "sticky", also the corresponding real rate at any and hence all points in time. This establishes a direct link to policy: to the extent that the natural rate defines good macroeconomic outcomes, if the central bank does its job, over time it will take the short-term rate towards r*.

2 The natural rate definition followed in this special feature should not be confused with alternative concepts of equilibrium interest rates that depend on business cycle fluctuations. For example, in Woodford (2003) the natural rate corresponds to the short-term real rate in a counterfactual economy without nominal rigidities but subject to business cycle fluctuations. See also the discussion in Obstfeld (2023), who distinguishes between the natural rate and the neutral rate, the latter being the interest rate consistent with no inflationary or disinflationary pressure.

## Natural rate estimates

The natural rate is an analytical concept. Since it is by nature unobservable, it can only be inferred through estimation, making any measurement of it a model-dependent exercise. Furthermore, operationalising the concept requires taking a stand on what the analytical long run without shocks corresponds to in calendar time. It is often assumed to refer to a horizon of five to 10 years.

In this vein, we consider a number of established estimates of r*, focusing on the United States and the euro area for reasons of data availability.[3] The estimates considered are the following (see Box A for more details):

(i) a semi-structural model-based measure from Holston et al (2023) (HLW)

(ii) a time series model-based measure from Lubik and Matthes (2015) (LM)

(iii) a dynamic stochastic general equilibrium (DSGE) model-based measure from Del Negro et al (2017) (only for the US)

(iv) a term structure model-based measure from Hördahl and Tristani (2014)

(v) a survey-based measure from central-bank surveys of market participants

While these estimates are often referred to as gauges of the natural rate, they may still reflect cyclical factors to some extent. Therefore, the focus should be on the trend movements of the measures, not on their short-term blips. Moreover, by their very nature, they mix to varying degrees signals about r* and perceptions of it, making it very hard to disentangle the two.

A number of key observations emerge from the estimates (Graph 2). First, different approaches yield at times very different estimates of r*. The difference between the highest and lowest estimates is over 2 percentage points in several instances. Second, we observe a downward trend in natural rate estimates over the pre-pandemic decades, with estimates falling by several percentage points. Third, this downward trend shows signs of reversing post-pandemic: most measures display a significant increase over the past few years, in some cases to levels similar to those before the Great Financial Crisis (GFC). The HLW measure is the notable exception, falling back to pre-pandemic lows recently after an initial increase.

The uncertainty around r* estimates at the current juncture is very high. The latest difference between the highest and lowest estimates is about 1–2 percentage points (Graph 3.A). At the same time, there is also a high degree of uncertainty around the individual estimates. This is evident from the often large statistical confidence bands surrounding, for instance, the latest HLW and LM measures (Graph 3.B).

[3] Since real interest rates and estimates of r* tend to be closely correlated across countries (Del Negro et al (2019); Cesa-Bianchi et al (2023)), the developments in the two major global economies should be broadly representative. See Brand et al (2024) for a comparison of a broader range of r* measures for the euro area.

Box A

## Natural rate estimates: the different approaches

*Semi-structural model*

Holston et al (2023), building on Laubach and Williams (2003) and Holston et al (2017), measure the natural rate of interest based on a semi-structural model, incorporating time-varying volatility and persistent supply shocks to take into account the pandemic shocks. The model is a linearised New Keynesian model with a link between the output gap and real interest rates (an IS curve) and between the output gap and inflation (a Phillips curve). The key intuition is that rising inflation generally signals that current interest rates are below the natural rate. The model removes short-run business cycle fluctuations through a trend/cycle decomposition and attributes changes in the natural rate to trend output growth and a residual that captures other potential drivers. According to Laubach and Williams (2016), the HLW natural rate estimate can be interpreted as the short-term real interest rate likely to prevail five to 10 years into the future, when current business cycle disturbances have dissipated.

*Time series model*

Lubik and Matthes (2015) derive a measure of the natural rate based on a three-variable time-varying parameter vector autoregressive model (TVP-VAR). The model comprises inflation, real output growth and the short-term real interest rate. The natural rate is then estimated as the model's five-year-ahead forecast of the real interest rate. Lubik and Matthes (2023) update the original version of the model, changing the specification to one that restricts the variability of the model parameters as a way to address the effects of the pandemic shock.①

*Dynamic stochastic general equilibrium (DSGE) model*

Del Negro et al (2017) develop a New Keynesian DSGE model and derive the natural rate as the real short-term interest rate that would prevail in a counterfactual economy with flexible prices. It is the rate that would coexist with output at its flexible price (natural) level. A key feature of the model is the existence of a convenience yield on liquid and safe short-term assets. If risk aversion rises, this convenience yield increases and lowers the natural rate. The model yields estimates of the natural rate that would be expected to prevail at different points in time in the future. We use the 10-year-ahead expected level of the natural rate.

*Term structure model*

Hördahl and Tristani (2014) develop a term structure model using information across the maturity spectrum of bonds to infer the path of expected future interest rates and the term premium that compensates for the risk of holding longer-term bonds. The model estimate of the expected short-term real interest rate is informed by a vector autoregressive model (VAR) comprising inflation, the output gap and policy rates to construct long-horizon forecasts of inflation and policy rates. We use the term structure model to estimate a five-year/five-year forward expected real short-term interest rate.

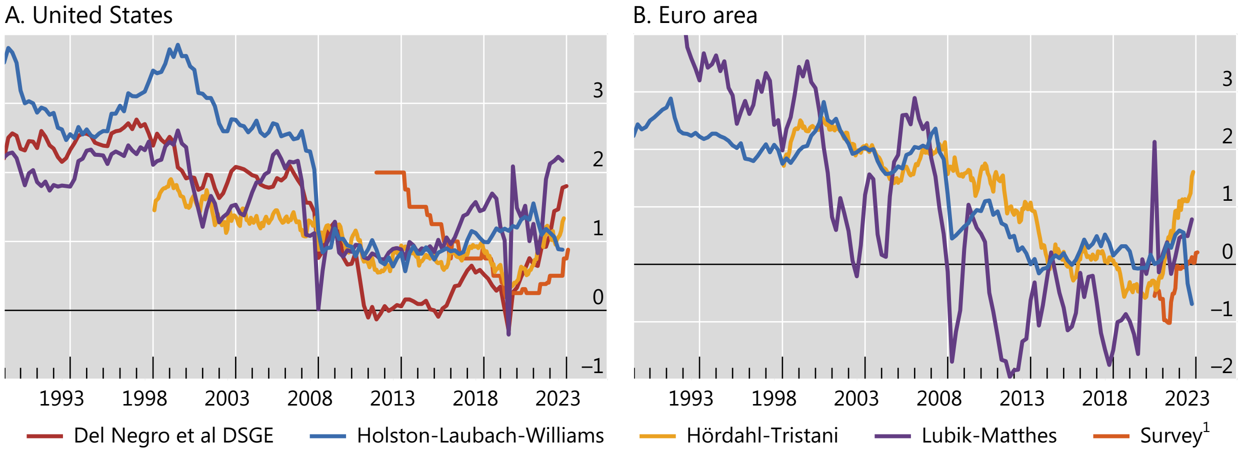
*Surveys*

Surveys of market participants are a direct way of assessing perceptions of the natural rate. We derive a survey-based measure of the natural rate as the difference between the "long-run" expected level of the policy rate and the "long-run" expected level of inflation based on the median responses in the Federal Reserve Bank of New York's Survey of Primary Dealers (SPD) in the United States and the ECB's Survey of Monetary Analysts (SMA) in the euro area. The definition of "long run" is a bit vague in both surveys, but in the SPD it seems to refer to a period of five to 10 years ahead, while in the SMA it refers to a period longer than five years.

① Our analysis does not cover times series approaches which estimate r* based on low-frequency trends in realised real interest rates (eg Del Negro et al (2019); Cesa-Bianchi et al (2023)).

## Natural rate estimates

In per cent | Graph 2

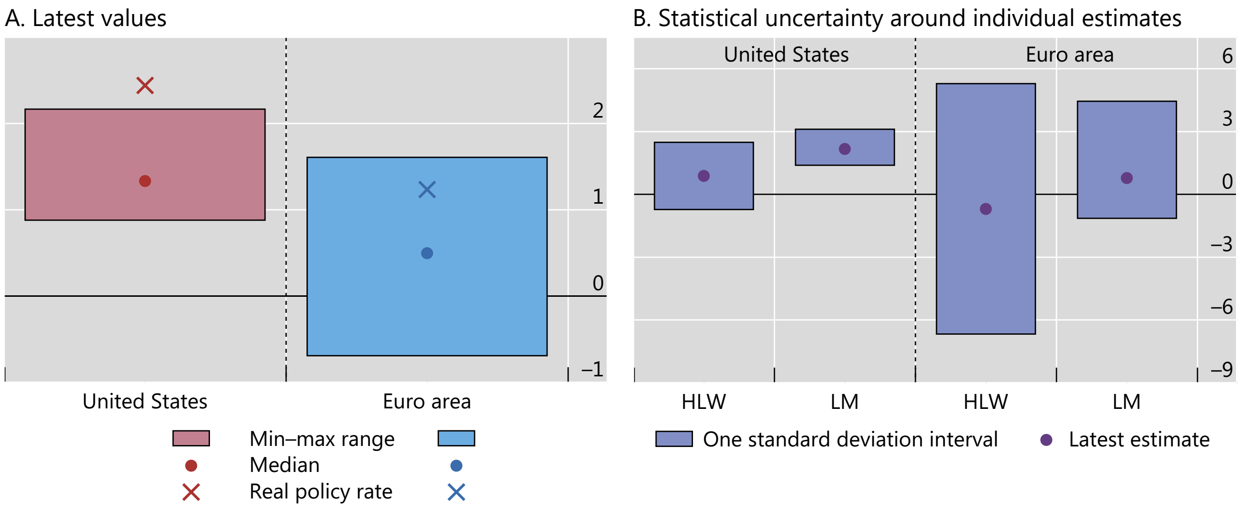



[1] Survey of primary dealers for the US; survey of monetary analysts for the euro area.

Sources: Del Negro et al (2017); Holston et al (2023); Hördahl and Tristani (2014); Lubik and Matthes (2015); ECB; Federal Reserve Bank of Richmond; Federal Reserve Bank of New York.

## Current natural rate estimates[1]

In per cent | Graph 3




HLW = Holston et al (2023); LM = Lubik and Matthes (2015).

[1] See technical annex for details.

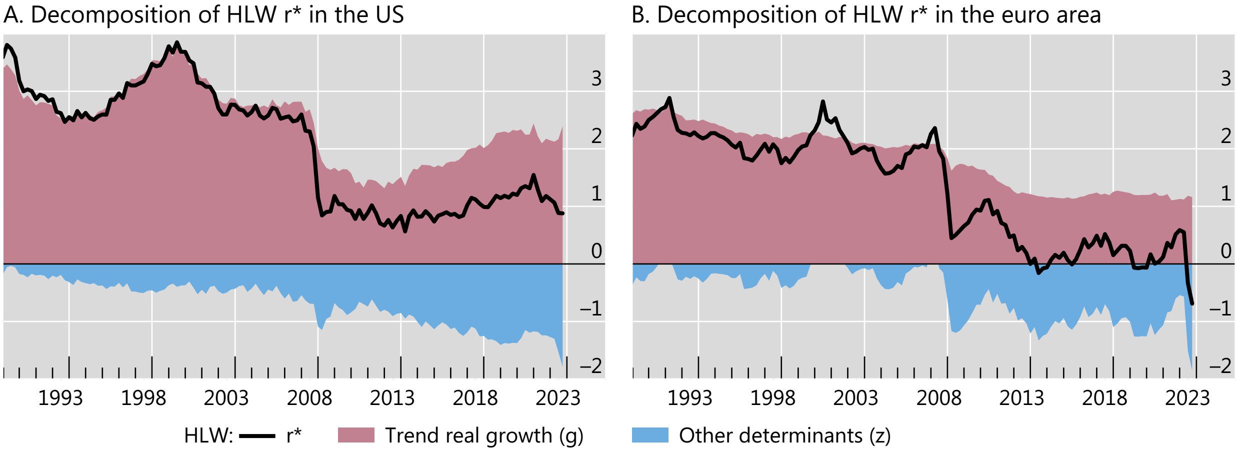
Sources: Del Negro et al (2017); Holston et al (2023); Hördahl and Tristani (2014); Lubik and Matthes (2015); ECB; Federal Reserve Bank of Richmond; Federal Reserve Bank of New York; Datastream; national data; authors' calculations.

Looking behind the estimates sheds some light on the reasons for the differences across approaches. For instance, the semi-structural HLW r* estimate is geared to an estimate of trend output growth. Estimated potential growth is therefore the key driver, although other factors not explicitly modelled have played an increasing role in the decline of the measure since the GFC, and also most recently (Graph 4). In the fully structural model of Del Negro et al (2017), shifts in risk aversion are a key driver of r*. The recent increase in this estimate reflects a pickup in risk appetite associated with lower risk spreads in financial markets (Baker et al (2023)). The time series estimates of LM are in part driven by current and past dynamics of growth, inflation and real interest rates. The same applies to the term structure model-based estimate as it depends in part on long-horizon forecasts of the policy rate and inflation. Current macroeconomic developments may obviously also affect the survey-based estimates.

What drives the natural rate estimates?

In per cent

Graph 4




Source: Holston et al (2023) (HLW).

## Natural rate drivers

A complementary approach to assess the recent direction of the natural rate is to examine more broadly the evolution of the long-run drivers of saving and investment.

The secular decline in real interest rates in the four decades before the pandemic was linked to long-run forces that lifted saving and depressed investment. Among these, lower potential growth rates and population ageing pushing saving up and investment down were particularly important drivers according to a number of recent studies (Gagnon et al (2021); Cesa-Bianchi et al (2023); IMF (2023)). Another key factor was arguably high saving rates in rapidly growing emerging market economies (EMEs), the so called global "saving glut" (Bernanke (2005)). Greater demand for safe assets in the wake of greater risk aversion after the GFC was identified as yet another important factor putting downward pressure on r* in major advanced economies (Caballero et al (2017); Marx et al (2021); Del Negro et al (2017)). Finally, fiscal policy was probably a countervailing force, reducing aggregate saving and sustaining aggregate demand and thereby limiting the decline in natural rates (Rachel and Summers (2019)).

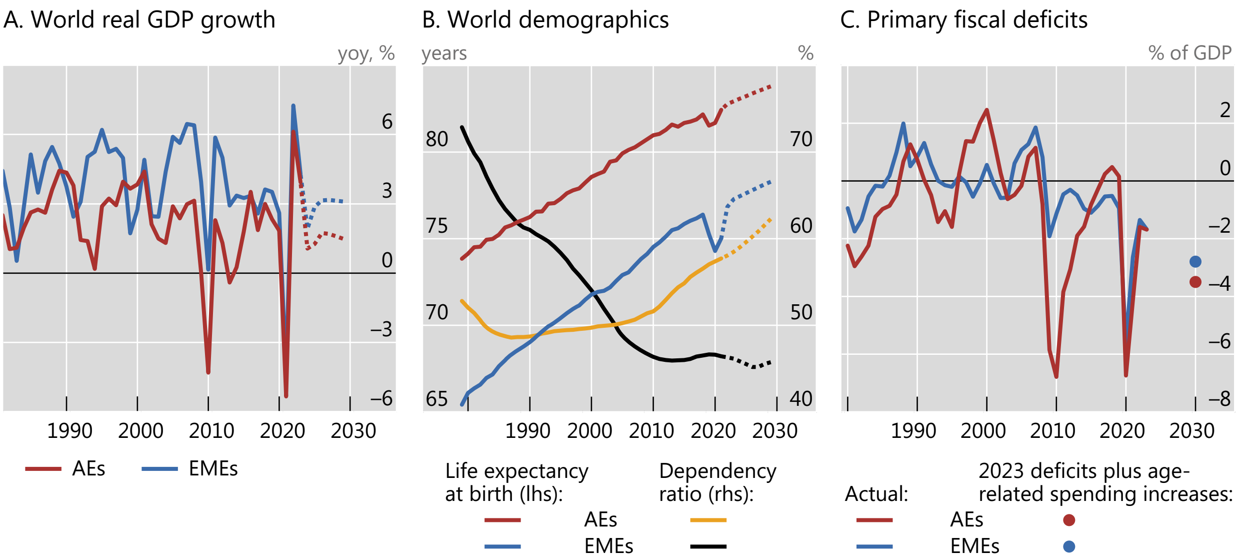
What are the implications of the recent evolution of key drivers? The picture is unclear. Some developments point to r* remaining at low pre-pandemic levels. Trend real growth has remained anaemic globally for two decades and does not show signs of acceleration (Graph 5.A). There is speculation that the widespread adoption of artificial intelligence may boost productivity growth, but it is too early to assess how realistic these hopes are. At the same time, after a brief dip during the Covid pandemic, life expectancy keeps increasing in both advanced and emerging market economies (Graph 5.B).

However, other developments point to a potential increase in natural rates. Dependency ratios are rising in advanced economies as the baby boomer generation enters retirement and are flattening out in EMEs (Graph 5.B). Fiscal deficits have ballooned in the wake of the pandemic and, absent fiscal consolidation, are poised to increase further on the back of higher age-related spending (Graph 5.C). Additional public spending needs will probably arise from the need to support the green transition and higher defence spending given geopolitical tensions.[4] The adoption of new technologies, green or digital, may also boost private investment. Furthermore, growing geopolitical fragmentation could roll back financial globalisation, thus mitigating the global saving glut effect on natural rates in core advanced economies.

In sum, a qualitative assessment of the evolution of saving-investment drivers suggests that few are pointing towards continued low r* and a number towards higher r*. On balance, a higher post-pandemic r* can therefore not be ruled out, but uncertainty again looms large.

An additional source of uncertainty of the assessment concerns the significance and stability of the linkages between r* and its potential drivers. Empirically, the relationships between real interest rates and the key saving-investment forces discussed so far are often not statistically significant and unstable over time (Hamilton

Evolution of possible drivers of r*[1] Graph 5




Dotted lines in panels A and B indicate forecasts.

[1] See technical annex for details.

Sources: IMF; OECD; United Nations; authors' calculations.

[4] However, if growing public debt on the back of rising deficits would at some point raise risks to fiscal sustainability, the result could be downward pressure on natural rates due to the required fiscal adjustments or the aftermath of sovereign crises.

et al (2016); Lunsford and West (2019); Borio et al (2022)). This cautions against drawing firm conclusions about the evolution of r* from developments in saving and investment drivers.

## Monetary policy and the natural rate

The assessment of r* is further complicated by the possibility that the natural rate, or at least perceptions of it, are influenced by monetary policy. To be sure, much standard macroeconomic theory rules this out based on models in which money is "neutral", ie it cannot have an impact on real variables in steady state. That said, regardless of the model specifics, it is possible that monetary policy has at least very long-lasting effects on real variables. These would be quite similar to, or hardly distinguishable from, changes in r*.

Some recent studies point to the possibility that expansionary monetary policy may raise r*. Long-lasting positive effects on aggregate demand, so-called "hysteresis effects", could boost innovation and growth (eg Benigno and Fornaro (2018); Jordà et al (2020)). Furthermore, a supportive monetary policy stance could yield improvements in resource allocation across firms, boosting productivity (Baqaee et al (2021); Gonzalez et al (2023)). That said, given prolonged monetary accommodation in the wake of the GFC, these channels do not seem to have materially affected the downward trend in r* according to essentially all estimates over this period, as documented above.

By contrast, through the interaction with the financial cycle, prolonged expansionary monetary policy could lower r* over long horizons. This is because monetary policy has a major impact on debt and asset price dynamics.[5] Prolonged monetary easing could therefore fuel debt accumulation and financial imbalances. This could push down r* because high debt burdens can weigh heavily on demand (Mian et al (2021)). At the same time, financial imbalances often usher in financial crises, which have very persistent, if not permanent, effects on economic activity (Borio and Disyatat (2014); Kashyap and Stein (2023)). The risk of such developments playing out is higher when inflation remains subdued and fails to signal unsustainable expansions, eg owing to structural forces that keep it down, such as globalisation. From this perspective, low pre-pandemic interest rates may have been – at least in part – the result of progressive monetary policy easing over sequential business cycles pushing real interest rates down and indebtedness up in a context of low inflation (Graph 6.A).[6]

A role for monetary policy in affecting r* could also be suggested by the apparent long-lasting influence of monetary policy on long-term real interest rates. The overall decline in US long-term real yields since the late 1990s appears to have been driven to a large extent by yield changes around monetary policy announcements

5 See eg Hofmann and Peersman (2017) for evidence for the United States.

6 See Borio et al (2019), Borio (2021) and BIS (2023) for more detailed discussions. A reinforcing effect could be the negative impact on potential output from the existence of persistently unprofitable firms ("zombie firms") supported by very low interest rates (Banerjee and Hofmann (2018)).

(Graph 6.B). This indicates that financial market participants take a cue from policy decisions when assessing where real rates will go over long horizons – implicitly, r* – and that, over time, those changes do not vanish.

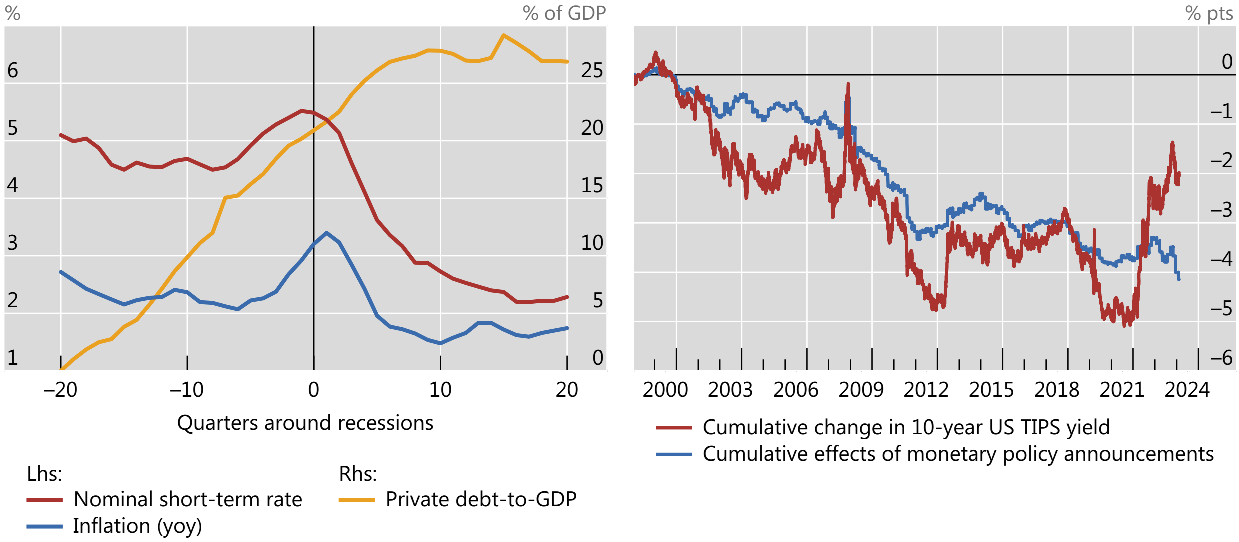
This finding can be interpreted in different ways. On the one hand, it may reflect fundamental news from the central bank guiding markets to the true r* (Hillenbrand (2023)). On the other hand, it could reflect information feedback loops with financial markets. They can occur whenever r* is hard to measure and both central banks and market participants need to learn about it from each other. Such loops can induce shifts in perceived r* despite no independent shifts in saving and investment (Rungcharoenkitkul and Winkler (2021)).[7] Shifts in perceived r*, in turn, could affect r* to the extent that they influence spending decisions. That said, monetary policy announcements do not seem to have played an important role in the surge in real yields over the past few years (Graph 6.B).

These considerations have two main implications. First, the possibility that r* may be influenced by monetary policy further complicates the operationalisation of the concept. Second, r*, or at least perceptions thereof embedded in market prices, may have risen relative to pre-pandemic years because of expectations of a prospectively tighter monetary policy in a structurally more inflationary environment. For instance, adverse supply side developments in the global economy (Carstens (2022)) could reduce monetary policy's leeway to remain as accommodative during economic

Monetary policy and the natural rate[1] Graph 6

A. Interest rates and debt over business cycles[2]

B. Monetary policy announcements and long-term real interest rates




[1] See technical annex for details. [2] The horizontal axis denotes quarters around recessions in the business cycles, with the peak date set at zero (vertical line). Lines show the mean evolution of the time series across 16 AEs and events from 1985 to 2019.

Sources: Gürkaynak et al (2008); Board of Governors of the Federal Reserve; IMF; OECD; National Bureau of Economic Research; Bloomberg; Datastream; Economic Cycle Research Institute; Global Financial Data; Refinitiv; national data; BIS; authors' calculations.

[7] For example, when the central bank cuts the policy rate sharply, market participants may attribute part of the reduction to a lower r* in the reaction function. The central bank, in turn, may misinterpret lower market yields as indicating a lower r*, and hence cut the rate further. This "hall of mirrors" interaction can lead to persistent shifts in r* itself.

expansions as in the past, reducing the risk of the build-up of financial imbalances and their downward pressure on r* over long horizons.

## Conclusion

The analysis in this special feature suggests that r*, or at least perceptions of it, may have risen post-pandemic, but that its assessment is surrounded by a very high degree of uncertainty. These findings caution against over-reliance on r* as a guide for monetary policy.

The uncertainty surrounding r* suggests that it is a blurry guidepost for assessing the monetary policy stance and hence the tightness of monetary policy, in particular at the current juncture. In this context, it appears advisable to guide policy decisions based more firmly on observed inflation rather than on highly uncertain estimates of the natural rate.

Uncertainty about r* also underscores the need for robust monetary policy frameworks. They need to be fit for purpose regardless of the broad economic environment and associated estimates of r*. The expectation of the persistence of a very low r*, and hence of a high incidence of the effective lower bound, was a key consideration behind the review of monetary policy frameworks pre-Covid. The last couple of years have highlighted how quickly the environment, and associated views of r*, can change.

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## Technical annex

Graph 1: The sample covers AT, AU, BE, CA, CH, DE, DK, ES, FI, FR, GB, IE, IT, JP, NL, NO, NZ, PT, SE and US. Statistics are computed using a smaller set of countries when data are not available.

Graph 1.A: Three-month interbank rates. Real rates are computed as nominal rates minus year-on-year inflation.

Graph 1.B: Based on nominal rates minus long-term Consensus forecasts.

Graph 3.A: Statistics are computed based on estimates for Q3 2023 (HLW, LM), October 2023 (Hördahl and Tristani (2014)), Q4 2023 (Del Negro et al (2017)) and Jan 2024 (survey of primary dealers) for the US. For the euro area, based on estimates for Q3 2023 (HLW and LM), October 2023 (Hördahl and Tristani (2014)) and Jan 2024 (survey of monetary analysts). Real policy rate is computed as federal funds rate minus year-on-year change in the price index of personal consumption expenditures less food and energy for the US. For the euro area, ECB main refinancing operations interest rate minus year-on-year change in the harmonised index of consumer prices excluding energy, food, alcohol and tobacco. Latest real policy rate for December 2023 for US; January 2024 for the euro area.

Graph 3.B: For HLW, the lower (upper) bound is calculated as the latest natural rate r* estimate minus (plus) one standard deviation. Latest estimate for Q3 2023.

Graph 5: The sample covers AT, BE, DE, ES, FI, FR, GB, IE, IT, JP, NL, PT and US (AEs); AR, BR, CL, CN, CO, CZ, HU, ID, IL, IN, KR, MX, PL and ZA (EMEs). Simple averages across economies.

Graph 5.C: Projections assume an interest rate-growth differential equal to –1%; constant primary deficits as a percentage of GDP as of 2023 (October 2023 IMF *World Economic Outlook* estimate) and an increase in age-related spending based on IMF projections for pension and healthcare spending for 2030. Historical deficit is computed using a smaller set of countries when data are not available.

Graph 6.A: Business cycle dates are from National Bureau of Economic Research for US; Economic Cycle Research Institute for AU, CA, CH, DE, ES, FR, GB, IT, JP and SE. For BE, FI, IE, NL and NO, business cycles are dated with a business cycle-dating algorithm. Episodes for which data for the previous and next 20 quarters are available are used in computing the statistics.

Graph 6.B: Cumulative effects of monetary policy announcements are computed as the cumulative changes in the 10-year US TIPS yield only over three-day window around Federal Open Market Committee meetings (the day prior to the meeting, the day of the meeting and the day after the meeting) where changes outside this window are set to zero.

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# Fast payments: design and adoption[1]

*The payments landscape is evolving rapidly, and fast payment systems (FPS) have emerged as a key innovation. Jurisdictions differ in their approach to designing FPS and in user adoption. In this article we lay out the main design features of FPS that may foster adoption. Cross-country regressions suggest that adoption of fast payments is greater when the public sector plays an active role in the FPS. Other design factors important for adoption are non-bank participation, more use cases and more cross-border connections.*

*JEL classification: H41, L10.*

Fast payments, the (near-) real-time transfer of funds between end users, are at the forefront of digitalisation in payments.[2] Concerted efforts by both the public and private sectors have transformed the payments landscape by offering faster, cheaper and more inclusive payments. Households and businesses in over 100 jurisdictions now have access to fast payments, with more to be launched in the coming years (CPMI (2021), World Bank (202)).

Fast payment systems (FPS) enable swift processing of retail transactions to ensure the immediate availability of funds for the recipient. FPS is an umbrella term that encompasses the infrastructure, participating payment service providers (PSPs), end user-facing services and underlying rules that govern the processing and delivery of fast payments.[3]

The growing importance of FPS warrants a closer examination of their design features and uptake. Countries have taken different approaches to designing FPS,

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[2] For the formal definition used in this article, see the glossary. The meaning of the term "fast payments" may vary slightly based on the context in which it is used. See CPMI (2016), Bech and Hancock (2020), World Bank (2021).

[3] Like fast payments, the use of the term "fast payment systems" can also vary. It sometimes refers to only the infrastructure underlying the delivery of fast payments, its governing rules and participants (see CPMI (2016, 2021)). Our interpretation is wider and includes the end user-facing services offered by multiple participants, such as the mobile payment app built on top of these infrastructures, and the rules governing these.

*Key takeaways*

- *Fast payments have achieved mass adoption in some jurisdictions but not in others – with adoption likely depending on the design characteristics of different fast payment systems (FPS).*
- *Adoption of fast payments tends to be more widespread when the central bank owns the FPS, when non-banks participate and when the number of use cases and cross-border connections is greater.*
- *These insights can help inform the design and development of FPS and other payment infrastructures.*

depending on central bank mandates, societal preferences and changing technological constraints. For example, in some jurisdictions, the public sector – typically led by central banks – plays a more active role by owning and operating FPS. In others, the private sector plays this role. In some FPS, non-bank PSPs offer fast payment services, but not in others. This heterogeneity is also present in the settlement infrastructure and number of (domestic and cross-border) use cases.

To understand how these differences in design relate to the adoption of fast payments, we conduct a cross-country quantitative analysis of fast payments adoption in 13 jurisdictions. We assess key design features of FPS under four headings: *user focus*, *infrastructure*, *rules* and *governance*. We include proxies for them in our quantitative analysis.

These design features can have important implications for FPS adoption. *User focus* captures whether the FPS has features that help meet end user needs, such as a wide scope of domestic and cross-border use cases. *Infrastructure* captures systems and technology that enable fast payments, which influence the incentives of PSPs to take part in the FPS. *Rules*, ie requirements and expectations for all stakeholders, define for example which types of institutions (eg banks, non-banks) participate in an FPS. More broadly, *governance* captures the ownership structure and decision-making process of FPS, which may affect the goals of an FPS and how these goals are achieved. While the uptake of fast payments is influenced by many country-specific characteristics beyond FPS design, the insights from this analysis are helpful for jurisdictions considering the design and development of an FPS.[4]

Our results suggest that adoption of fast payments indeed depends on design elements in our categorisation. FPS transactions per capita are higher when there is central bank ownership of an FPS (*governance*), participation by non-bank PSPs (*rules*) and a greater number of use cases and cross-border connections (*user focus*).

The rest of the article proceeds as follows. The first section provides an overview of the evolution and potential benefits of fast payments. The second presents our categorisation of key FPS design features. We then draw on these features to study – in a cross-country panel setting – which are most conducive to adoption. The fourth section concludes.

[4] Other factors that may influence the adoption of fast payments that are unrelated to the design of the FPS may include availability of other payment alternatives, internet and smartphone penetration, digital literacy, general legal frameworks (for example, legal provisions for non-bank participation) and societal preferences.

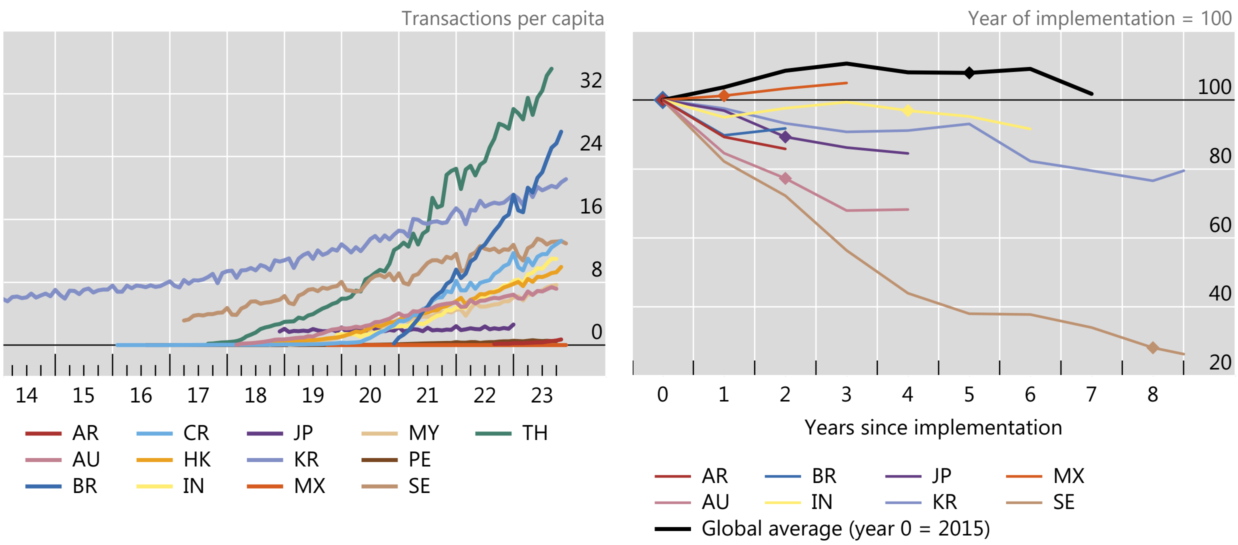
## Fast payments: an overview

In recent decades, the market for retail payments has undergone significant changes. Driven by technological advances and changing user preferences, digital payments have become increasingly popular.[5] The Covid-19 pandemic further accelerated the digitalisation of payments (Auer et al (2022), Glowka et al (2023), Di Iorio et al (2024)). In particular, the use of fast payments has soared (Graph 1.A), albeit to different extents in different jurisdictions.

In line with the trend towards payments digitalisation, the number of fast payments has grown rapidly in most jurisdictions. The biggest markets for fast payments in 2022 (by number of transactions) were India (79.7 billion), China (16.6 billion), Thailand (14.8 billion) and Brazil (24.1 billion).[6] In per capita terms,

Fast payments are rising rapidly, while cash in circulation is falling — Graph 1

A. The volume of fast payment transactions has grown rapidly[1] — B. Cash in circulation has declined in many jurisdictions[2]




[1] Monthly data. See technical annex for details. [2] Banknotes and coins in circulation are shown as a percentage of narrow money, except for KR for which currency in circulation/narrow money is shown. The markers indicate the year of the Covid-19 pandemic, 2020, except for KR, which shows only eight years after 2009.

Sources: Individual central banks; IMF; World Bank; National Payments Corporation of India; Hong Kong Interbank Clearing Limited; CPMI Red Book statistics; authors' calculations.

Thailand (35 transactions per person per month), Brazil (27) and South Korea (21) see the largest fast payments volumes. The rise in FPS use has coincided with a fall in cash use in many of these countries (Graph 1.B). This points to increasing digitalisation of payments.

[5] For a discussion on changing user preferences and the impact of technological developments in the financial sector, see Petralia et al (2019).

[6] Data for India (IMPS and UPI) and China (IMPS) are taken from Table 8 ("Volume of transactions processed by selected payment systems") of the financial market infrastructures and critical service providers data made available through the BIS Data Portal (https://data.bis.org/topics/CPMI_FMI). Data for Brazil (Pix) and Thailand (PromptPay) are sourced from the Central Bank of Brazil and the Bank of Thailand.

The popularity of fast payments stems from the variety of benefits they provide. Fast payments can offer individuals and businesses with a fast, reliable and secure digital alternative to cash. This is particularly useful in countries with low debit and credit card penetration. Yet even in countries with high card use, fast payments can offer faster and cheaper access to funds for businesses.[7] By generating digital footprints, they can provide a gateway to other retail financial services (like credit) for the financially excluded (Aguilar et al (2024), CPMI and World Bank (2020)). Moreover, when fast payments enable interoperability, they allow users to move money easily across PSPs, thus boosting competition (World Bank (2021)). For governments, which are also important end users of payment services, fast payments can help streamline direct benefit transfers or wage payments. For example, in some jurisdictions, governments relied on FPS to distribute Covid-19-related benefit payments to those in need (IMF (2021)). FPS can also trigger enhancements in the larger payment ecosystem and enable further innovations (CPMI (2016)).[8]

At the same time, FPS exhibit significant network effects that are inherent to payments (Bolt and Humphrey (2005)). As adoption expands, fast payments become more valuable to existing and new users. This may lead to a virtuous cycle where new users encourage further users to join and benefit. A larger user base also offers incentives for the private sector to innovate and develop new payment solutions.

Central banks and the private sector have both been actively involved in the provision of fast payments. In general, payment infrastructures like FPS require significant investment and coordination among many stakeholders. Central banks, often in collaboration with private sector PSPs, can help overcome coordination problems associated with a revamp of existing infrastructures or building new ones (CPMI (2016)). This collaboration can be important in reconciling competing goals in the provision of FPS, which exhibit characteristics of a public good.[9]

Around the world, FPS have been launched with diverse policy objectives. The most common motivations centre around enhancing financial inclusion, fostering competition between PSPs, driving digitalisation, developing payment infrastructures and enabling innovation (Aurazo et al (2024), CPMI (2016), CPMI (2021), World Bank (2021)). These varied motivations have resulted in a diverse range of FPS design choices. We delve into these design choices in the next section.

7 For example, for merchants, the cost of using Pix, the FPS in Brazil, is 0.22% of the transaction value (Duarte et al (2022)). This is much lower than the average fees for credit (2.2%) and debit cards (1.1%).

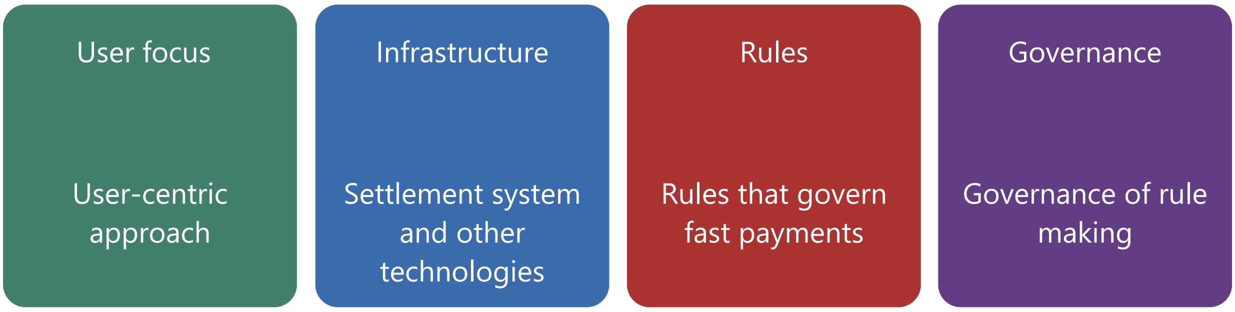
8 For example, some jurisdictions used the launch of an FPS as an opportunity to implement the ISO 20022 messaging standard for other payment systems as well. The use of fast payments may also help encourage the use of QR codes for other applications.

9 Public goods are defined as being non-rival (use by one party does not diminish the ability of another to use them) and non-excludable (no party can be excluded from using them). FPS can be provided as a public good, both when publicly owned or privately owned, and subject to public regulation and oversight. If there were no public regulation and oversight, a payment system operated solely by private parties may have inefficiencies. In particular, private providers may have an incentive to charge high fees for use and/or to restrict access to only certain participants in order to obtain monopoly rents. In the absence of public sector involvement, there could also be coordination failures in payment system provision. While the public sector may face better incentives to operate such a system, adoption may be low without sufficient buy-in by private PSPs. For further details, see BIS (2020).

## Key elements of fast payment system design

In this section, we identify and categorise key elements relevant to the design of FPS that can affect end user adoption of fast payments. We highlight four groups of design features of FPS: *user focus*, *infrastructure*, *rules* and *governance* (Graph 2).[10]

Key design features for the adoption of fast payments Graph 2




Source: Authors' elaboration.

### User focus

At the heart of FPS design and fast payments adoption is the end user. A user-centric design approach anticipates gaps in market offerings and adapts to changing user needs. An example of such an approach is to enable a wide scope of use cases that are valuable to the end user, eg payments to merchants, bill payments, person-to-person (P2P) payments and government-to-person (G2P) payments.

Aliases are another design feature that provide added value to end users. Aliases are alternatives to bank account numbers that can be used to initiate payments. For example, CoDi, in Mexico, offers the option to use mobile phone numbers to initiate and receive payments. In Thailand, PromptPay offers other aliases in addition to mobile phone numbers, such as the national ID number, e-wallet number and corporate identification number for businesses.

Cross-border functionalities can expand the utility of FPS beyond domestic transactions. These allow users to transact seamlessly across different jurisdictions, enhancing the convenience and efficiency of international transactions. Cheap and fast cross-border transactions can also broaden firms' access to global markets.

User focus can include provision of standardised mobile applications and open application programming interfaces (APIs). Standardised apps may foster ease of use. APIs can facilitate data exchange and make the end user experience smoother.

[10] This is not intended to be an exhaustive list, but rather it provides one approach to analysing important key design features of FPS.

## Infrastructure

Infrastructure refers to the underlying plumbing, ie the systems and technology that enable the provision of fast payments to end users. For fast payments, the key infrastructure is the wholesale settlement system, which settles payment obligations between the PSPs of the end users.

Fast payments are instant or "near-instant" for end users but do not necessarily require real-time settlement among PSPs. Final settlement of obligations among PSPs can occur on either a real-time or a deferred net basis. The use of real-time gross settlement (RTGS) versus deferred net settlement (DNS) models may affect PSPs' cost structure and incentives to participate in the FPS and offer fast payments to clients.[11]

The decision to introduce fast payments also comes with the choice of using or enhancing a pre-existing wholesale settlement system or building a new one.[12] Opting for a new dedicated wholesale system likely entails larger costs, which can translate into differences in end user pricing and may ultimately affect FPS adoption.

Apart from the settlement system, various other types of infrastructure are key to the functioning of an FPS. These may be additional systems like proxy databases, which are responsible for enabling aliases. Additionally, FPS may also rely on messaging standards like ISO 20022 or API standards for communication between PSPs. Auxiliary infrastructures such as cloud computing can also be important to provide scalability for the delivery of fast payments (see Brainard (2022)).

## Rules

Rules are key to the functioning of any FPS. They define the requirements and expectations for all stakeholders, including the end users. For example, rules define who is allowed or required to participate in the FPS (eg only banks or also non-bank PSPs). Rules can define other aspects, such as the pricing structure (eg fees charged by the system operator to the participants, fees that PSPs can set for end users), transaction limits and financial requirements (eg capital levels for participating banks and non-banks). The rules may also include the initiation methods (eg whether a user can initiate a payment with a smartphone, web interface or quick response (QR) code or from an automatic teller machine (ATM)).

There is substantial heterogeneity in the rulebooks of fast payments around the world. For example, in Brazil, the central bank mandates the participation of large banks in Pix (Duarte et al (2022)). This differs from other jurisdictions such as India, Thailand and Sweden, where participation is voluntary. Similarly, non-bank PSPs are allowed to participate in the FPS in some jurisdictions but not in others. For example, CoDi in Mexico, Swish/BiR in Sweden and FedNow in the United States are open only

[11] The use of RTGS versus DNS generally involves a trade-off between liquidity costs and settlement risks. This trade-off may vary depending on the size of the transactions. Given the retail nature of fast payments, the credit and liquidity risks may be limited. PSPs' incentives to participate in the FPS also depend on other system design features, such as operational arrangements, liquidity management features and risk management mechanisms. See CPMI (2021) for a discussion of different setups of RTGS and DNS systems.

[12] South Korea's Electronic Banking System (EBS) settles the payment obligations of PSPs on a deferred basis in the pre-existing BoK+ Wire system (RTGS). Brazil already had a functioning RTGS system prior to the launch of Pix and decided to develop a new RTGS system to guarantee service levels with a more modern technology. In India, an RTGS system also existed prior to the launch of the United Payments Interface (UPI), but UPI functions on a DNS system.

to banks (due to legislative requirements in some cases). This heterogeneity is also evident in other aspects of the rulebook, for example, the regulation of end user fees.

### Governance

Governance defines how rules (discussed above) and decisions are made for the FPS. Ownership and operation of the FPS are important aspects of governance. Because payment systems have characteristics of a public good, these aspects can reflect the ultimate objectives of an FPS and thus affect end user adoption. Such public goods can be offered by the public sector or by the private sector with public regulation and oversight.

The role of the public and private sector in FPS can vary substantially. An FPS may be owned and operated only by the public sector (central banks or other public institutions), as with CoDi in Mexico. Alternatively, both the public and private sector can sit at the decision-making table, irrespective of the ownership or operating model. For example, Brazil's Pix is publicly owned and operated, but hosts an official forum for discussion with the private sector and develops products and services through public consultations. In India, private banks and the central bank jointly govern the rule making for UPI through an organisation created for this specific purpose, the National Payments Corporation of India. Governance may also be only private. In Sweden, the Swish mobile app and underlying BiR settlement system are owned and operated entirely by private banks. Even if a central bank does not engage in the rule making and the FPS is governed only by the private sector, the central bank, as an overseer, still has an interest in the smooth functioning of the FPS.

## Cross-country analysis of fast payments adoption

With the key elements of FPS design features at hand, we now seek to provide a deeper understanding of design factors that foster FPS adoption across jurisdictions. The focus on end user adoption is relevant due to its importance in driving network effects. To measure adoption, we focus on the per capita number of FPS transactions.[13] We base our analysis on the FPS in 13 jurisdictions, at a monthly frequency, between April 2001 and December 2023. The choice of these jurisdictions is based on the availability of monthly numbers of FPS transactions. In total, we have 1,030 observations at the country-month level.[14]

[13] There are other ways to measure successful adoption of fast payments, especially given the diverse policy objectives of jurisdictions. Other relevant metrics may include private investment in payment markets (Cornelli, Gambacorta, Qiu and Shreeti (2024)) or downloads of digital finance apps (Cornelli, Frost, Velasquez, Warren and Yang (2024)).

[14] Note that not all jurisdictions have an FPS throughout the length of the sample. The countries in our sample are Argentina, Australia, Brazil, Costa Rica, Hong Kong SAR, India, Japan, Malaysia, Mexico, Peru, South Korea, Sweden and Thailand, each of which introduced an FPS at some point during this period.

To study the design factors conducive to FPS adoption, we specify a panel regression with fixed effects of the form:

$$\Delta FPS\ transactions_{it} = \alpha + \beta_1 Number\ of\ use\ cases_{it} + \beta_2 \#\ Crossborder\ connections_{it} + \beta_3 Settlement\ platform_{it} + \beta_4 NBFI\ participation_{it} + \beta_5 Public\ FPS_{it} + \beta_0 \Delta FPS\ transactions_{it-1} + FE + \epsilon_{it},$$

where the variable to be explained, $\Delta FPS\ transactions_{it}$, is the change (in levels) in the per capita number (or volume) of FPS transactions in country $i$ between month $t$ and the previous month.

As explanatory variables, we include some of the design features presented in the previous section. The selection of our explanatory variables is motivated by the elements of the design framework but are constrained by data availability. $Number\ of\ use\ cases_{it}$ represents the user focus element of our framework in the previous section. Potential uses include P2P payments, payments to merchants, bill payments, cross-border payments, scheduling future payments, bulk payments and request to pay functionality. Another important feature that matters for user-centric design is the cross-border integration of an FPS. $\#\ Crossborder\ connections_{it}$ is the number of other FPS that the users in country $i$ can transact with.

We also consider explanatory variables that capture the underlying infrastructure, participation of non-banks and public vs private ownership of the FPS. The variable S$ettlement\ platform_{it}$ takes the value of 1 if the underlying settlement platform of the FPS is based on RTGS and 0 if it is DNS; $NBFI\ participation_{it}$ is 1 if non-bank PSPs are allowed to participate; and $Public\ FPS_{it}$ captures the governance of an FPS – it is 1 if the FPS is owned by the public sector and 0 otherwise.

Characteristics of FPS included in the sample and regressions (in 2023)[1] Table 1

| | FPS name | Number of use cases | Cross-border connections | Settlement | Participation of NBFIs | Ownership |
|---|---|---|---|---|---|---|
| Argentina | Transferencias 3.0 | 4 | 0 | RTGS | Yes | Non-public |
| Australia | New Payments Platform (NPP) | 3 | 0 | RTGS | Yes | Non-public |
| Brazil | Pix | 5 | 0 | RTGS | Yes | Public |
| Costa Rica | SINPE Móvil | 7 | 0 | DNS | Yes | Public |
| Hong Kong SAR | Faster Payment System (FPS) | 4 | 1 | RTGS | Yes | Public |
| India | Unified Payments Interface (UPI) | 5 | 4 | DNS | Yes | Non-public |
| Japan | Zengin System | 5 | 0 | DNS | Yes | Non-public |
| Malaysia | DuitNow | 4 | 3 | DNS | Yes | Non-public |
| Mexico | CoDi | 4 | 0 | RTGS | No | Public |
| Peru | Transferencias Inmediatas | 2 | 0 | DNS | Yes | Non-public |
| South Korea | Electronic Banking System (EBS) | 4 | 0 | DNS | Yes | Non-public |
| Sweden | Swish | 2 | 0 | RTGS | No | Non-public |
| Thailand | PromptPay | 6 | 6 | DNS | Yes | Non-public |

[1] See technical annex for details.

Sources: Individual central banks; CPMI (2021); World Bank, *Project FASTT*, Global Tracker; National Payments Corporation of India; Hong Kong Interbank Clearing Limited.

Additionally, we control for various factors that may also affect adoption. $\Delta FPS\ transactions_{it-1}$ is the lagged change in per capita volume of FPS transactions (in levels) and controls for adoption dynamics and the size of the user base in the previous period.[15] We also include country fixed effects and year fixed effects. Country fixed effects control for institutional factors in each jurisdiction that do not change over time. Year fixed effects control for time-specific developments, such as the Covid-19 pandemic. Countries may differ along many dimensions outside of our framework – eg in terms of general legal frameworks, market conditions and social preferences. There may also be common elements across countries that change over time (eg due to the Covid-19 pandemic). Including both country and time fixed effects is therefore our preferred regression specification.

In Table 1, we summarise key characteristics of the FPS covered in our regression analysis. Note that some of these, eg number of use cases, number of cross-border connections and participation of non-bank PSPs, evolve over time. While our data set captures this time variation, the table reports just a snapshot of data for 2023.

Our regressions (Table 2) show that uptake of fast payments is indeed higher when certain design features are in place. In our preferred specification (column I), we find a larger growth in the monthly volumes of FPS transactions when there are more use cases and cross-border connections, when non-bank PSPs participate and when the FSP is publicly owned. In contrast, the type of settlement system is not significantly linked to changes in monthly volume of FPS transactions.[16]

These relationships are not only statistically significant but also have a sizeable magnitude. The average number of FPS transactions per capita is five per month in our sample. Non-bank PSP participation is associated with an increase of 3.5% in the number of FPS transactions per capita. An additional use case offered by the FPS is associated with a 2% increase and an additional cross-border connection with an increase of the same magnitude. Public ownership of FPS entails an increase of 1.8% in the number of FPS transactions.

The adoption of FPS may also be reflected beyond narrow metrics of transactions, notably in indicators of financial inclusion. In some jurisdictions, the introduction of FPS has indeed gone hand in hand with greater access to digital payments and other services. Box A shows that there is a robust relationship between FPS and access to transaction accounts, payments and credit in different jurisdictions.

Our results highlight the importance of collaboration between the public and private sectors as well as of user-centric design. FPS owned by the public sector (often central banks) may be operated in a way that allows for wider participation and lower fees. They may have explicit mandates to make the retail payments market more open, inclusive and competitive. Some FPS, like Pix in Brazil, also mandate participation by large private banks.[17] Meanwhile, participation of non-bank PSPs in the FPS may foster the uptake of fast payments when these non-bank PSPs offer new

15 Although using the lagged dependent variable in our regression may introduce Nickell bias, our primary focus is on the coefficients of design variables, not the lagged dependent variable per se.

16 Similar results hold when using only country fixed effects (column II) or no fixed effects (column III). Our results are robust to other specifications that consider the dependent variable and the lagged dependent variable in levels. We also include the age of the FPS as an additional control variable, and our results do not change. Finally, results are robust to using the lagged level of FPS transactions per capita as a control and to using the level of FPS transactions per capita as a dependent variable.

17 Ideally, mandatory participation by banks would be a further variable in our regressions. Yet unfortunately, data on this design feature are not readily available.

Correlations of FPS transactions with FPS design features[1] Table 2

| | Change in monthly per capita volume of transactions | | |
|---|---|---|---|
| | (I) | (II) | (III) |
| **User focus**: number of use cases | 0.10*** | 0.12*** | 0.03 |
| | (0.01) | (0.01) | (0.02) |
| **User focus**: number of cross-border connections | 0.10*** | 0.09**** | 0.13*** |
| | (0.01) | (0.02) | (0.02) |
| **Infrastructure**: RTGS | –0.09 | –0.01 | 0.11* |
| | (0.07) | (0.06) | (0.06) |
| **Rules:** non-bank PSP participation | 0.18*** | 0.06 | 0.06 |
| | (0.02) | (0.05) | (0.09) |
| **Governance:** public FPS | 0.09*** | 0.07*** | 0.12 |
| | (0.01) | (0.006) | (0.14) |
| Lagged change in per capita FPS volume | –0.39*** | –0.39*** | –0.3*** |
| | (0.04) | (0.04) | (0.005) |
| Country fixed effects | ✓ | ✓ | ✗ |
| Year fixed effects | ✓ | ✗ | ✗ |
| Observations | 1,017 | 1,017 | 1,017 |
| Pseudo R-squared | 0.26 | 0.25 | 0.15 |

[1] Standard errors in brackets; ***/**/* indicates statistical significance at the 1/5/10% level.

Sources: Authors' calculations.

payment methods or provide payment services to customers that are not served by banks. Simultaneously, a variety of uses for fast payments and cross-border connections makes the FPS more valuable for users.

Of course, the industrial organisation of the banking and payments market may also matter. In particular, public ownership by itself may not be enough to foster end user adoption. Given the oligopolistic market structure of many banking industries, large banks may still find ways to reinforce their competitive advantage by excluding or limiting participation of smaller competitors or non-bank PSPs. In some instances, large banks may have insufficient incentives to join a public FPS, and participation may need to be mandated. In other cases, there may be competing FPS initiatives. These considerations underscore the importance of broad buy in and of a collaborative approach between the public and private sector.

Box A

## Fast payment systems and financial inclusion

*Jose Aurazo and Cecilia Franco*①

Fast payment systems (FPS) could be a catalyst to expand access to and use of formal transaction accounts and related financial services (eg payment cards, loans and insurance). This is broadly defined as financial inclusion (CPMI and World Bank (2020)).

FPS and financial inclusion are linked in several ways. First, they are linked due to network effects. As more individuals and businesses adopt fast payments across the economy, the unbanked may start to do so too, as a way to address the challenges and costs associated with cash management and handling. Second, because fast payments offer low-cost and immediate access to funds, underbanked end users could switch from using cash or payment cards to fast payments. Third, subject to customer consent, financial institutions can offer personalised financial products such as credit cards and loans by using the data generated from the use of fast payments.

Using country-level data from 148 countries from the 2011–21 World Bank Global Findex, we assess how the presence of an FPS relates to three indicators of financial inclusion, namely access to an account at a financial institution, use of digital payments and access to a loan from a financial institution.② To formally assess the role of an FPS, we run the following two-way fixed effects regression:

$$y_{i,t} = \beta_0 + \beta_1 FP_{i,t} + \beta_2 X_{i,t} + \delta_i + \theta_t + \varepsilon_{i,t},$$

where $y_{i,t}$ are the three indicators of financial inclusion (access to a bank account, use of a digital payment and access to a loan from a financial institution) for country $i$ in period $t$. $FP_{i,t}$ is a dummy variable that takes a value of 1 if an FPS is available in country $i$ in period $t$. $X_{i,t}$ is a set of controls that vary across countries and over time, such as GDP per capita (in logs), automatic teller machines (ATMs) per 100,000 inhabitants, internet coverage and mobile phone subscriptions. $\delta_i$ and $\theta_t$ denote country and time fixed effects, respectively.

The regression results (Table A1) show that countries with an FPS have higher levels of access to credit from financial institutions. This is robust to different specifications and suggests that FPS may be associated with access to financial services beyond payments. Greater access to credit may relate to an individual building up a track record of formal payments. Regarding access to a financial account and the use of digital payments, the presence of an FPS becomes insignificant when we include country and time fixed effects.

Although we are trying to control for some omitted variables, this evidence is just suggestive because in some cases there could be reverse causality and co-dependence on omitted variables.

### Empirical results[1]

Table A1

| | Have an account at a financial institution | | | Make a digital payment | | | Borrowed from a financial institution | | |
|---|---|---|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (I) | (II) | (III) | (I) | (II) | (III) |
| Fast payment system | 0.18 | 1.13 | 2.17** | 0.91 | 4.08** | 6.47*** | 3.91*** | 6.63*** | 4.83*** |
| | (1.30) | (1.17) | (1.11) | (1.99) | (1.80) | (1.53) | (1.42) | (1.80) | (1.48) |
| Country fixed effects | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ |
| Year fixed effects | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ |
| Observations | 501 | 501 | 501 | 374 | 374 | 374 | 501 | 501 | 501 |
| R-squared | 0.576 | 0.553 | 0.547 | 0.595 | 0.556 | 0.537 | 0.457 | 0.168 | 0.150 |

[1] The regressions include control variables such as GDP per capita (in logs), ATMs per 100,000 inhabitants, internet coverage and mobile phone subscriptions. The coefficients of the fast payment system should be interpreted in percentage points. Standard errors in brackets; ***/**/* indicates statistical significance at the 1/5/10% level.

Sources: Authors' calculations.

① The views expressed are those of the authors and do not necessarily represent the views of the Bank for International Settlements ② The 2021 Global Findex database can be downloaded at www.worldbank.org/en/publication/globalfindex. The source for the year of implementation of an FPS is Cornelli, Frost, Velasquez, Warren and Yang (2024) and central banks' websites.

## Conclusions

Fast payments offer secure, low-cost and quick transactions and are becoming increasingly popular across many jurisdictions. They foster competition among PSPs and serve as a gateway to additional financial services. The public good characteristics of FPS make their design important for central banks and public policy.

We present key design features that are conducive to the adoption of fast payments. There are four groups: user focus, infrastructure, rules and governance. We find that the adoption of FPS is stronger with central bank ownership, more use cases, more cross-border connections and participation by non-bank PSPs.

The insights from our quantitative analysis may be relevant for other public infrastructures, such as central bank digital currency (CBDC) systems and unified ledgers. Publicly owned FPS may be designed to prioritise a public good perspective, aiming for open, inclusive and competitive payment markets. A user-centric approach, addressing diverse needs such as P2P transactions, merchant payments and cross-border transactions is also important. The inclusion of non-bank providers may improve access for underserved customers. Keeping these features in mind may help to build strong public infrastructures that are widely adopted and support policy goals.

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## Glossary

**Alias:** a single piece of information (eg mobile phone number, e-mail address, tax identification, a string of characters, etc) that represents the set of information required to identify a bank account (eg bank name, bank branch, bank account number).

**Application programming interface (API):** a set of rules and specifications followed by software programs to communicate with each other, and an interface between different software programs that facilitates their interaction.

**Deferred net settlement (DNS):** a net settlement model that settles on a net basis at the end of a predefined settlement cycle.

**Fast payments:** real-time or near real-time transfers of funds between accounts of end users as close to a 24 hour per day and seven days per week basis as possible. End users can be individuals, merchants, businesses or public institutions. Funds can be commercial bank money or e-money.

**Fast payment system (FPS):** the infrastructure, participating payment service providers (PSPs), end user-facing services, as well as the underlying rules that govern the processing and delivery of fast payments.

**Payment service provider (PSP)**: a financial institution that offers payment services. A PSP may be a bank or a non-bank financial institution.

**Proxy database:** a database system that connects aliases to bank account information.

**Real-time gross settlement (RTGS):** the real-time settlement of payments, transfer instructions or other obligations individually on a transaction-by-transaction basis.

## Technical annex

Graph 1.A: The relevant central banks that provided the data on the volume of transactions are: Central Bank of the Argentina, Reserve Bank of Australia, Central Bank of Brazil, Central Bank of Costa Rica, Bank of Japan, Bank of Korea, Central Bank of Malaysia, Bank of Mexico, Central Reserve Bank of Peru, Sveriges Riksbank and Bank of Thailand. The data on population are retrieved from the World Bank.

Table 1: The relevant central banks that provided the information are the same as in Graph 1.A. Some of these characteristics, like the number of use cases, cross-border connections and participation of non-bank PSPs, have evolved over time. We report data from the latest period available. For ownership, non-public refers to FPS that are either semi-public or private. Semi-public FPS are owned partly by private institutions and partly by public institutions. Examples of use cases are peer-to-peer payments, payments to merchants, bill payments and cross-border payments. Cross-border connections refer to the number of FPS that the users in the country can transact with internationally.

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# Sectoral price dynamics in the last mile of post-Covid-19 disinflation[1]

*The drivers of the Covid-19 inflation surge have evolved as demand has shifted, first from services to goods and then back from goods to services. We document the sectoral price growth patterns since the surge and discuss what the composition of inflation implies for the outlook. We find that the contribution of services has increased and has been slower to retreat than that of goods excluding food and energy ("core goods"). This could imply slower disinflation ahead, especially given the relative stickiness of services prices and past relative price trends. We then discuss the implications for monetary policy.*

*JEL classification: E31, E52.*

After reaching highs not seen in decades, inflation has receded while its drivers have evolved. In the earlier phases of the inflation surge associated with the Covid-19 pandemic, reports of rocketing prices for used cars and other durable goods dominated the news, along with eye-popping commodity prices. In the later phases, attention shifted to the increasing cost of shelter and restaurant meals.

The composition of inflation across goods and services can give indications about inflation dynamics. How have sectoral price growth patterns changed during the current episode? What do they imply for underlying inflationary pressures and the outlook? Answers to these questions matter for monetary policy as central banks navigate the last mile of the post-pandemic disinflation journey.

We document several noteworthy patterns. The initial surge in inflation in 2021 came largely from a spurt in the prices of food and energy and "core goods" (such as manufactured goods). Services prices picked up later, in 2022. The disinflation observed in 2023 largely resulted from a decline in the contributions of food and energy and, to a lesser extent, core goods. Services price growth proved more stubborn.

Going forward, this shift towards more services-driven inflation may imply slower disinflation. This is because of three factors. First, services prices are less sensitive to energy prices and, hence, may not respond strongly to their recent declines. Second, price growth in services tends to be more persistent than that in goods, in part

[1] We thank Claudio Borio, Gaston Gelos, Carlos Madeira, Aaron Mehrotra, Benoît Mojon, Andreas Schrimpf and Hyun Song Shin for comments and to Emanuel Kohlscheen and Galo Nuño for extensive discussions. Adam Cap, Emese Kuruc and Jose Maria Vidal Pastor provided excellent research assistance. The views expressed in this article are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

*Key takeaways*

- *Services price growth played a smaller role than core goods price growth in the initial phases of the inflation surge, but its importance has grown over time.*
- *On balance, a larger contribution from services may make inflationary pressures more stubborn in the near term, as services inflation is structurally more persistent. This is even more likely if services prices increase faster to catch up with pre-pandemic relative price trends.*
- *Monetary policy may need to remain tight for longer to achieve a given inflation objective than if inflation mainly reflected faster growth in core goods prices.*

because of the higher labour intensity of services. Third, the pandemic brought about substantial deviations in the relative price of services vis-à-vis core goods from its previously established trend; if this trend re-asserts itself, services prices could increase further to catch up. This possible slowdown of disinflation could prompt monetary policy to remain tighter for longer.

The remainder of this special feature proceeds as follows. The next section breaks down headline inflation to reveal the contributions from goods and services. It then discusses possible reasons behind the evolution of these contributions. The feature then lays out what the changes in the composition of inflation may imply for its dynamics going forward. It concludes with a discussion of challenges for monetary policy in this context.

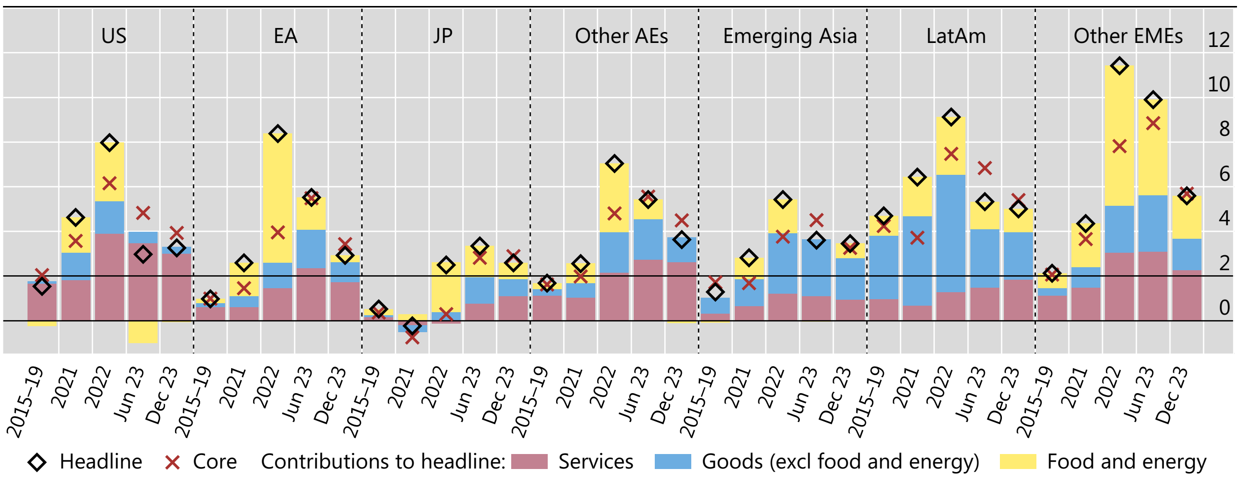
## Goods vs services prices in the current inflation episode

Services price growth played a smaller role than goods price growth in the initial phases of the inflation surge, but its imprint has grown over time. The relative

Goods price growth has retreated, but services price growth has not retreated as much[1]

Year-on-year changes, in per cent

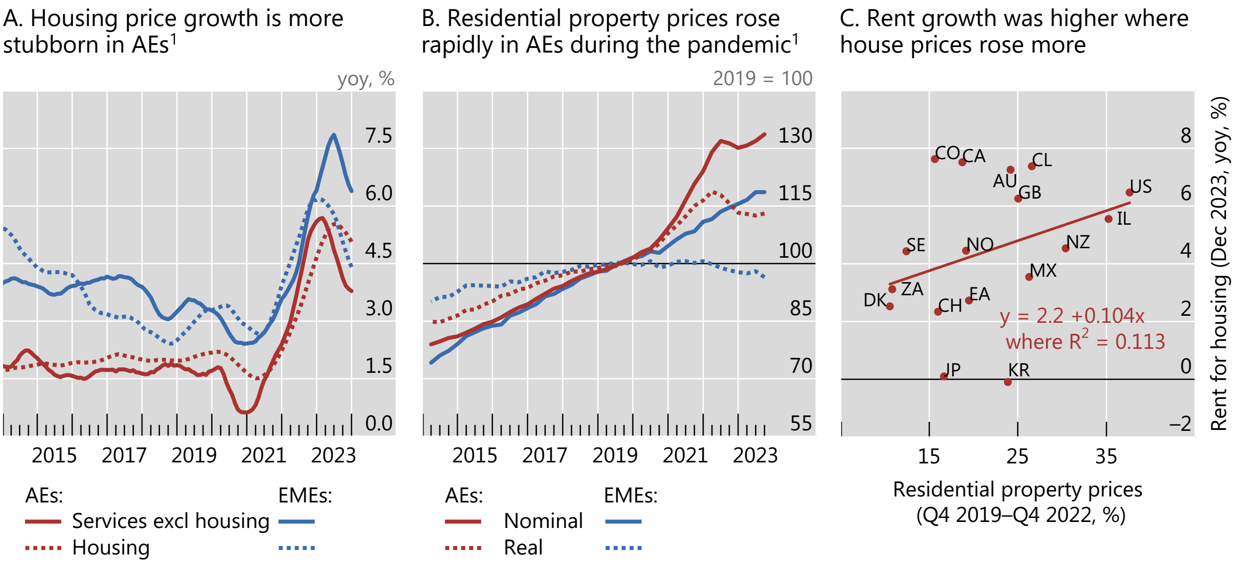
Graph 1




[1] See technical annex for details.

Sources: OECD; Datastream; national data; authors' calculations.

Housing pushes services price growth up in advanced economies — Graph 2




[1] See technical annex for details.

Sources: OECD; Datastream; national data; authors' calculations.

contribution to headline inflation of core goods as well as that of food and energy surged in 2021, while the marked increase in that of services came only later in 2022 (Graph 1; blue and yellow bars compared with red bars). These dynamics have played out in a similar way across countries and regions, but less so in Asian emerging market economies (EMEs) and Latin America.

The dynamics within services have differed between advanced economies (AEs) and EMEs. The housing component has held its ground in AEs while the non-housing component has moderated. In EMEs, by contrast, the prices of housing-related services have led the decrease in services price growth (Graph 2.A). One possible reason for this is that house prices picked up much more in AEs than in EMEs during the pandemic (Graph 2.B).[2] These increases percolate to the housing component of prices via their impact on new supply and rents, but only with a lag (Graph 2.C).[3, 4] In some countries, a combination of strong household formation rates and subdued supply of new and existing homes due to higher financing costs has boosted the growth in the housing component of prices.

Compared with past inflation episodes, services price growth has been more stubborn. While the current pace of deceleration in both headline inflation and the core goods component matches the previous cases quite closely (Graphs 3.A and 3.B),

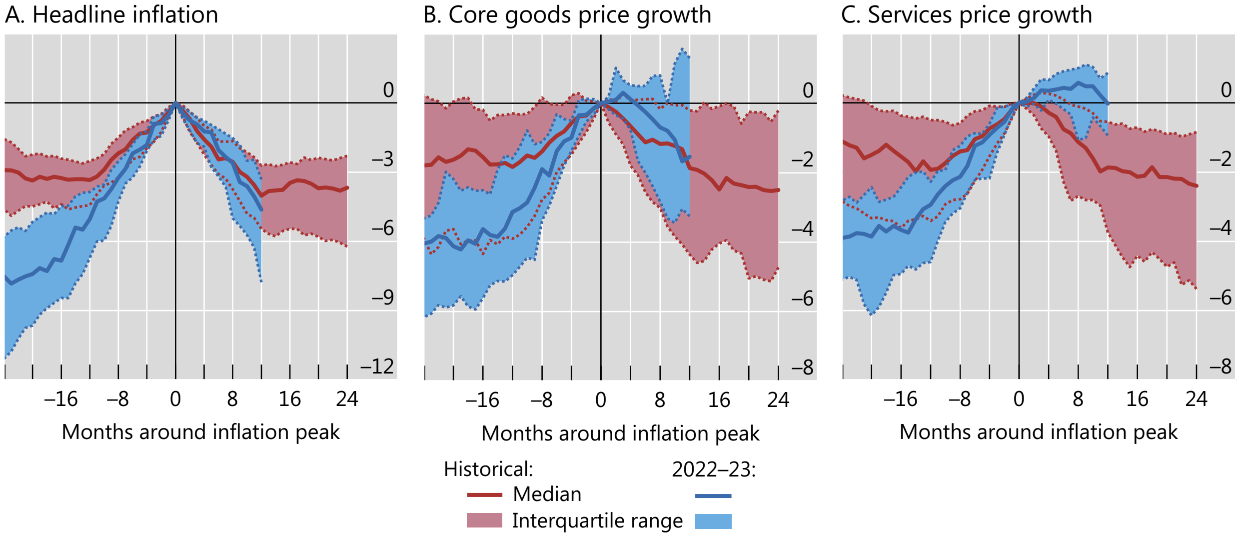
[2] See Igan et al (2022) for more discussion. Nominal house prices have seen some correction as monetary policy tightened, but they started rising again more recently in several countries (eg Australia, Denmark, Norway, Sweden, Switzerland and the United States).

[3] Consistent with this, in the United States, for instance, the housing-specific contribution to core trend inflation caught up with that from non-housing services only in mid-2022, even though house prices had already risen sharply in 2021. See Federal Reserve Bank of New York (2023).

[4] The methodology used to treat owner-occupied housing in consumer price indices as well as the weights applied to shelter vary widely across countries. See, for instance, Eiglsperger et al (2022) for a recent summary.

## Services inflation proves more stubborn this time[1]

Historical disinflation: difference relative to inflation peaks, in percentage points | Graph 3




[1] Each start of a disinflation episode is captured when the 13-month moving average is at its peak, under the conditions that: (i) there are no other peaks in the preceding and the following 12 months; (ii) the peak is between 3 and 25%; and (iii) the peak is at least 3 percentage points higher than the lowest troughs in the preceding and the following 12 months. Month = 0 is when the actual headline inflation value is at the highest during that particular episode. Panels include data from 21 AEs and 18 EMEs, where available. Data for historical episodes are from 34 countries. For 2022–23, data are from AU, BR, CA, CH, CL, CO, CZ, DK, EA, GB, HU, IL, JP, KR, MX, NO, NZ, PH, PL, SE, SG, US and ZA.

Sources: OECD; World Bank; Datastream; national data; authors' calculations.

services price growth has continued to rise even after headline inflation peaked (Graph 3.C).

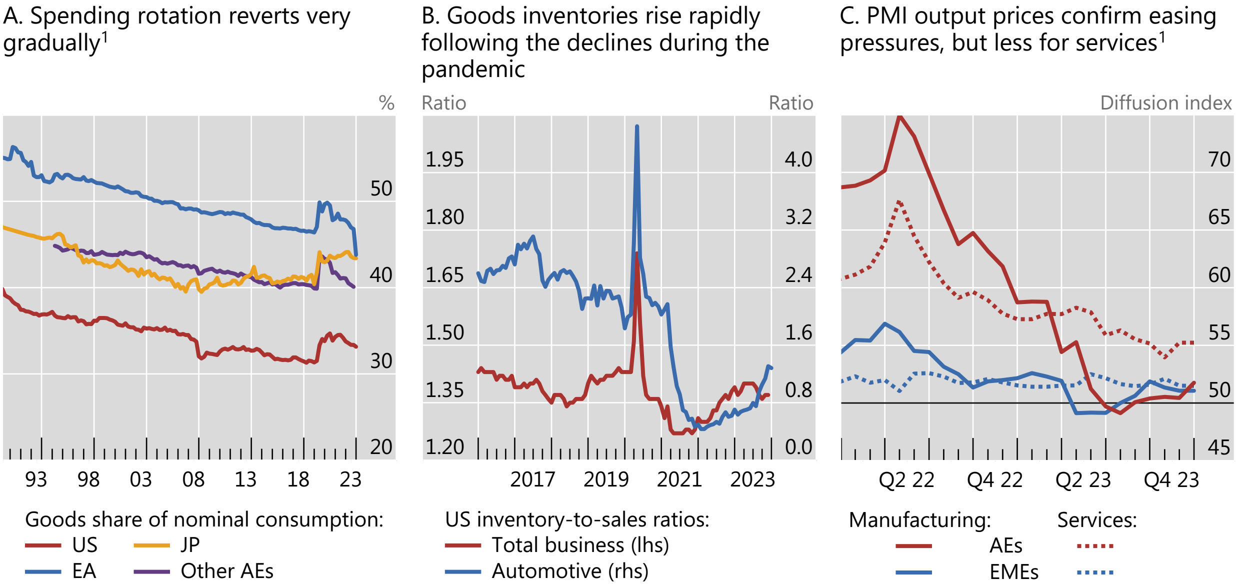
These patterns reflect two factors that ignited the inflation burst and then partially reversed it (BIS (2022, 2023)).

The first factor is the unusually sharp rotation of demand from services to goods and the associated unprecedented supply chain disruptions. As a result, the relative price of services vis-à-vis core goods initially declined, especially in AEs. However, as economies reopened, the rotation started to slowly revert (Graph 4.A). This back-and-forth shift alone can explain a considerable portion of the recent inflation dynamics.[5] Eventually, supply chains normalised, and much of the surge in core goods price growth reversed. Amplification mechanisms were also at work, as firms along the supply chain first hoarded inventories and then unloaded them onto the market, magnifying price moves – the so-called bullwhip effect (Rees and Rungcharoenkitkul (2021)). Indeed, total business inventories rose throughout 2022 and started to decline recently (Graph 4.B). Accordingly, upward price pressures for both inputs and outputs in manufacturing dissipated, and core goods prices even fell for a brief period (Graph 4.C).

The second factor behind the inflation burst is the surge in energy prices related to the war in Ukraine. While this shock was common to both core goods and services,

[5] For instance, in the United States, Ferrante et al (2023) attribute 3.5 percentage points of the 4.2 percentage point increase in inflation between end-2019 and end-2021 to the demand reallocation shock from services to goods. They find that a reversal of the shock raises inflation by around 1 percentage point.

Pandemic-related disruptions disappear — Graph 4




[1] See technical annex for details.

Sources: Federal Reserve Bank of New York; Federal Reserve Bank of St Louis; OECD; S&P Global; national data; authors' calculations.

it had a larger and more immediate impact on the prices of core goods.[6] The subsequent decline in energy prices set in motion the opposite process.

## Implications for the inflation outlook

What does the change in the composition of inflation towards services imply for the outlook? On balance, it may make inflationary pressures more stubborn, for three reasons. First, services price growth is less sensitive to energy prices and will not benefit much from their recent declines. Second, services price growth is structurally more persistent than growth of goods prices. Third, the relative price of services may not have fully adjusted yet. On balance, these implications may matter more for AEs, which have higher shares of services in their consumer price indices.

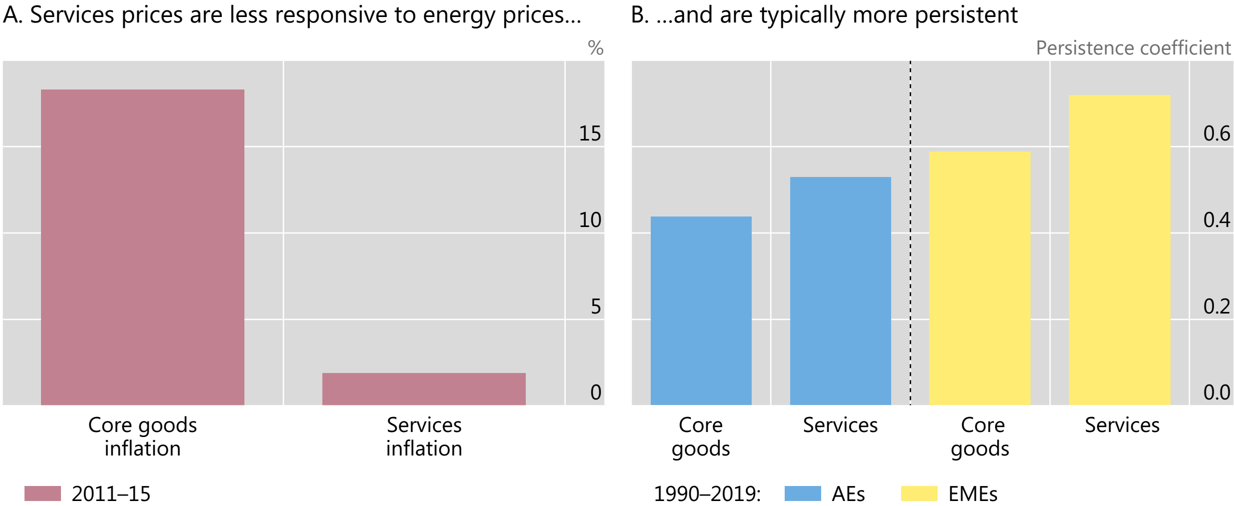
### Sensitivity to energy prices

Services prices are less sensitive to energy prices than core goods prices. Following an energy price shock, core goods prices are estimated to increase about 10 times higher than services prices (Graph 5.A). This reflects in part the higher energy intensity of core goods: the quantity of energy needed to produce one unit of economic output in services is roughly a tenth of that in goods.[7] As a result, the current disinflation in energy prices will have less impact on the overall inflation rate going forward.

[6] The heterogeneous propagation of a common shock – particularly its slow spread to services price growth – is a key part of the mechanism generating persistent inflation. See Altissimo et al (2009).

[7] World Bank, Sustainable Energy for All. Based on the statistics for upper and lower middle-income countries, manufacturing takes 4–5 megajoules per 2,011 purchasing power parity–adjusted US dollar

Inflationary pressures may be more stubborn when services are the main driver[1] Graph 5




[1] See technical annex for details.

Sources: OECD; Datastream; national data; authors' calculations.

## Persistence

Services price growth is typically more persistent than core goods price growth, and this could slow down the deceleration of overall inflation going forward.[8] The difference in persistence is noticeable across both AEs and EMEs (Graph 5.B). Of a given year's services price growth, roughly 50% in AEs and almost 70% in EMEs carry over to the next year, compared with 40% in AEs and 60% in EMEs for core goods price growth.[9]

Higher persistence is partly due to the much higher labour intensity of services. This makes services prices more sensitive to wage growth than core goods prices (Graph 6.A).[10] Wage growth is the most persistent type of cost. This reflects the length of contracts and other institutional labour market characteristics.

The higher labour intensity of services puts the spotlight on the labour market. Indicators of wage growth have pointed to a notable acceleration after the acute phase of the pandemic and a moderation more recently (Graph 6.B). Still, it is quite plausible that wages are rising at rates inconsistent with inflation targets given

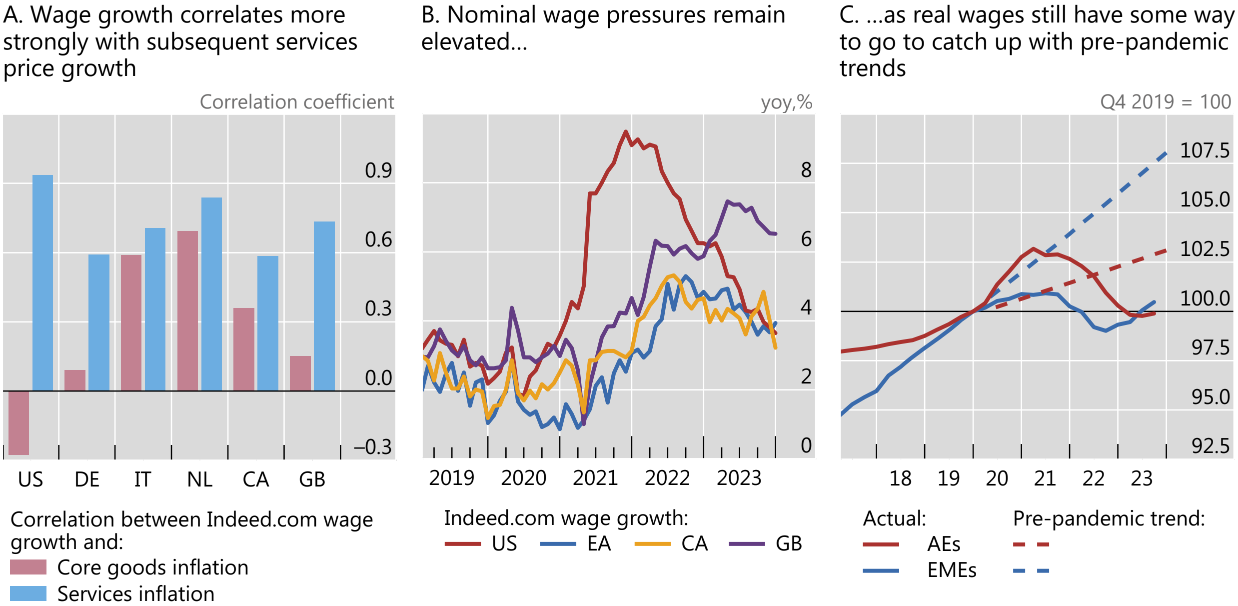
while services takes only 0.4–0.5 megajoules. This is, to a certain extent, a mirror image of the labour intensity of services: a large share of labour costs in total costs implies a smaller share of energy and other intermediate input costs.

[8] There are historical exceptions for some countries and time periods, for example, Babecký et al (2009) and Clark (2006).

[9] See Angeloni et al (2006) for evidence and theoretical implications of persistence and price stickiness.

[10] This is based on monthly wage data for new hires. The pattern holds for a larger set of countries, including EMEs, using quarterly wage data for all employees.

The behaviour of wages is more relevant for services inflation[1] Graph 6




[1] See technical annex for details.

Sources: OECD; Github.com, Indeed Hiring Lab; Datastream; national data; authors' calculations.

sluggish productivity growth. Labour market tightness and real wages falling well below trends from before the inflation burst add to the risks ahead (Graph 6.C).[11]

These risks increase the longer inflation remains above target, which could lead to an adjustment in wages.

## Relative price adjustment

In the decades leading up to the pandemic, services price growth was about 1 percentage point higher than core goods price growth on average, which gave rise to an upward trend in the price of services relative to core goods. This trend had been well established and steady in pre-pandemic data for many countries and mainly reflected the confluence of two factors. First, a higher income elasticity of services: as income per capita rises, so does the relative demand for services and hence their relative price. Second, in what is commonly known as the Baumol cost disease, rising wages in higher productivity sectors push the costs in labour-intensive services sectors up, while lower productivity growth in the services sector then leads to higher services prices.[12]

The pandemic disrupted this trend with core goods prices growing much faster than usual and, in some cases, even faster than services prices. This disruption may

[11] For a discussion of how wages catch up with prices to recover lost purchasing power, see Borio et al (2023).

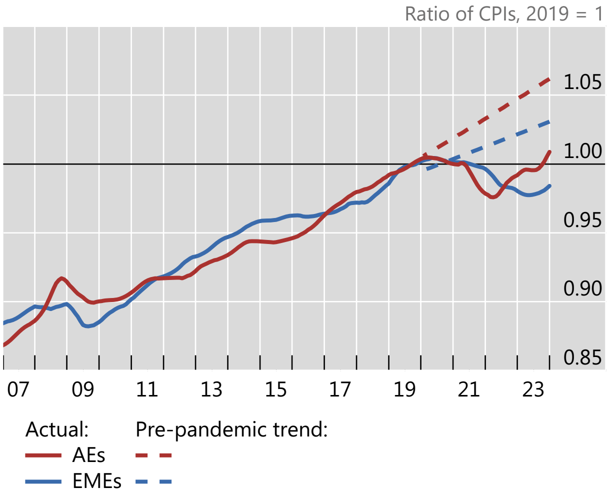
[12] See Cœuré (2019) for a detailed discussion. The effect of lower productivity growth is compounded by the lack of tradability: services are typically much less exposed to international competition, and therefore their price does not necessarily react to developments abroad. And even within a country, competition among providers of services in the domestic market tends to be less intense than that among providers of goods, reflecting the traditionally larger role of the government in some service sectors.

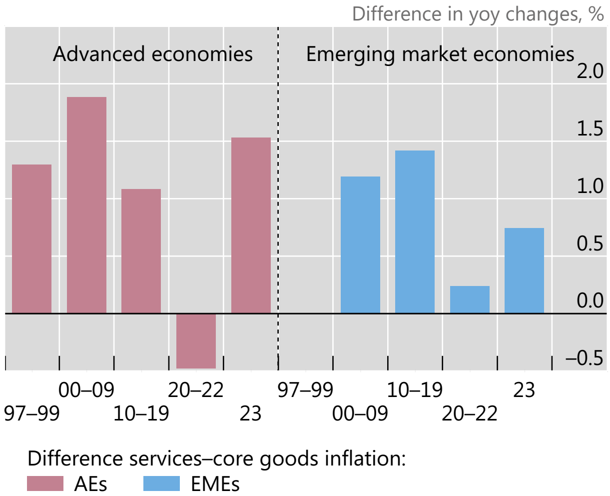
Services price growth may run high if pre-pandemic relative price trends are restored[1]

Graph 7

A. The relative price of services vs core goods recovers in AEs but not in EMEs

B. Services, especially in AEs, display higher rates of price growth than goods




[1] See technical annex for details.

Sources: OECD; Datastream; national data; authors' calculations.

have been only temporary, however, as the growth differential between core goods and services has reverted to the pre-pandemic pattern.

Services price growth may continue to be significantly higher than core goods price growth for some time if the pre-pandemic relative price trends are restored. The price of services vis-à-vis core goods in EMEs is still well below its 2019 pre-pandemic *level*, while it is just barely back there in AEs (Graph 7.A). In both cases, the relative price remains below the previous *trend*. As the pandemic shock is unlikely to have produced a *permanent* shift in preferences and productivity patterns, the pre-pandemic *trend* could re-establish itself.

Should the trend re-assert itself, overall inflation could remain above central bank targets for longer. This would be the case unless core goods price growth slows to a rate well below the pre-pandemic one, as a back-of-the-envelope calculation suggests. Assuming core goods price growth goes back to its pre-pandemic rate of about 0.6% for AEs and 2.7% for EMEs, services prices would have to grow at an annual rate of 4.7% for AEs and 6.1% for EMEs over the next two years[13] for the relative price of services to catch up with the pre-pandemic trend. To put these figures into perspective, average annual services price growth in the 2021–23 period was 3.8% for AEs and 5% for EMEs, compared with annual averages just below 2% for AEs and about 4% for EMEs in 2010–19 (Graph 7.B). Importantly, these scenario-based higher growth rates of services prices would imply overall inflation rates that are roughly 1 percentage point above inflation targets. However, the scenario embeds the implicit assumption that central banks will not react; this is not going to be the case if inflation remains above target.

[13] The choice of the adjustment window in this stylised exercise is informed by insights from the econometric analysis in Box A, where the trend convergence is around two years. The discussion in this box sheds further light on the mechanisms at work and confirms the thrust of the results.

Box A

## Short-run implications of long-run trends in the relative price of services

The presence of a secular trend in the relative price of goods and services can have implications for the dynamics of goods and services price growth in the shorter run. For example, a phase of faster growth in the price of core goods, such as the one experienced during the Covid-19 pandemic, brings the relative price below the long-run trend and may produce an acceleration in services prices to make up for the lost ground. Past deviations from the long-run trend may sustain services price growth in the shorter run.

To shed further light on the analysis in the text, we deploy econometric techniques to empirically assess the relationship between short-term price dynamics and the pre-2020 long-run trend in the relative price of goods and services. In particular, we examine the extent to and speed at which services prices tend to adjust to the trend in a sample of countries. This exercise allows us to shed light on three main aspects and thereby complements the analysis in the main text. We find evidence that a catch-up towards the long-run trend has been a statistically significant driver of short-term services price growth and that the catch-up process takes, on balance, around two years. On that basis, we confirm the finding that the catch-up would imply substantially higher services price growth in the near term.

The approach we deploy takes into account the short- and long-run dynamics of the two sectoral price levels. More specifically, we estimate a simple error correction model, in which deviations from the long-run relationship between the relative price level of core goods and that of services help drive the short-run dynamics of services price growth. Whenever the level of services prices falls behind that of core goods prices and the long-run trend that ties them together, an adjustment mechanism sets in and nudges services price growth higher to recover the lost ground.

To do so, we proceed in two steps. First, we specify an equation for the (log-)level of services prices that takes into account core goods prices as well as a long-run trend between the two.① We then add the deviations of services prices from the value implied by this equation as an explanatory variable in a regression for services price growth that also includes its own past value alongside that of core goods price growth.② More formally, we estimate the following equations using monthly time series:

$$s_t = \mu + \gamma \cdot g_t + \rho \cdot rp_t + u_t \qquad (1)$$

$$\Delta s_t = \kappa + \alpha \cdot u_{t-1} + \sum_j \beta_{s,j} \Delta s_{t-j} + \sum_j \beta_{g,j} \Delta g_{t-j} + \epsilon_t \qquad (2)$$

where $s_t$ and $g_t$ are, respectively, the log of services and core goods prices, and $rp_t$ is the trend in the relative price of core goods and services. Hence, the residuals $u_t$ from equation (1) represent the deviations of the (log-)level of services prices from the long-run relationship. These residuals are then used as an explanatory variable in equation (2) for services price growth (Δ being the first difference operator). The coefficient $\alpha$ represents the so-called error correction, that is the extent to which past deviations from the long-run relationship play a role in explaining the short-run dynamics of services price growth.

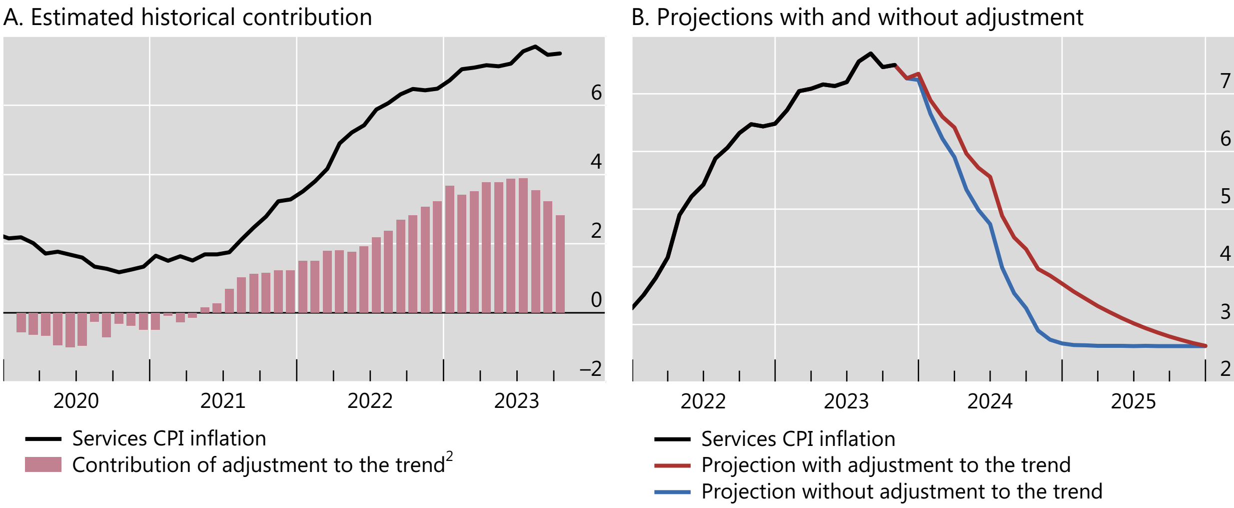
We estimate the model separately using US, euro area and UK data over a sample that runs from January 1996 (January 2001 for the euro area) to December 2019. Our estimates③ uncover a clear role for the trend while at the same time revealing a degree of cross-country heterogeneity. The error correction coefficient α is statistically significant in most countries, although its magnitude naturally varies alongside the idiosyncratic short-run persistence of sectoral price growth. While the speed of adjustment to the trend varies, on balance, it suggests that the catch-up process lasts about two years – the assumption underlying the back-of-the-envelope calculations in the main text.

To quantify the contribution of the error correction mechanism to the recent dynamics of services price growth, we assess the post-2020 developments of core goods and services prices through the prism of the econometric relationships. More precisely, we construct projections for services price growth $\Delta s_t$ over a sample ranging from January 2020 to December 2023 under two scenarios: one in which the error correction mechanism is active and drags services prices towards a relative price trend $rp_t$ extrapolated linearly from its evolution over the previous five years and one in which the error correction mechanism does not operate. As an illustration, we consider three jurisdictions – the United States, the euro area and the United Kingdom – and then take an average across them.

The exercise suggests that the contribution of the catch-up mechanism to services price growth over those three years can be sizeable. Over time, it fluctuates between 30 and 50% of the observed readings (Graph A1.A).

The contribution of an adjustment to the trend of services price inflation[1]

In per cent | Graph A1




[1] GDP-PPP weighted averages for the euro area, the United Kingdom and the United States. [2] Difference between the fitted values of services price inflation based on the estimated error correction model and those from a counterfactual in which the error correction mechanism does not operate, ie α = 0. Estimation samples are January 2001 to December 2019 for the euro area, and January 1996 to December 2019 for the United Kingdom and the United States.

Sources: OECD; Datastream; national data; authors' calculations.

Running the projections forward indicates that the catch-up process would keep providing momentum for services price growth (Graph A1.B). This growth would be substantially higher, as indicated by the comparison between the red and blue lines.④ At the end of the two years (end-2025), the catch-up would be complete and the projections would have converged to the historical average.

① This is close to estimating a co-integrating model for (log-)prices of goods and services with a deterministic trend in the cointegrating equation. However, to allow for the possibility of time variation in the trend itself, we construct the relative price trend $rp_t$ by applying the Hodrick-Prescott filter to the observed relative price series. ② In principle, one could estimate an equivalent equation for goods price growth; we do not do this for simplicity and to focus squarely on services prices. ③ Full estimation results are available from the authors upon request. ④ This is also conditional on core goods price growth evolving according to a simple autoregressive model with no error correction; in practice, this implies that the entire burden of the adjustment towards the long-run trend is borne by services prices.

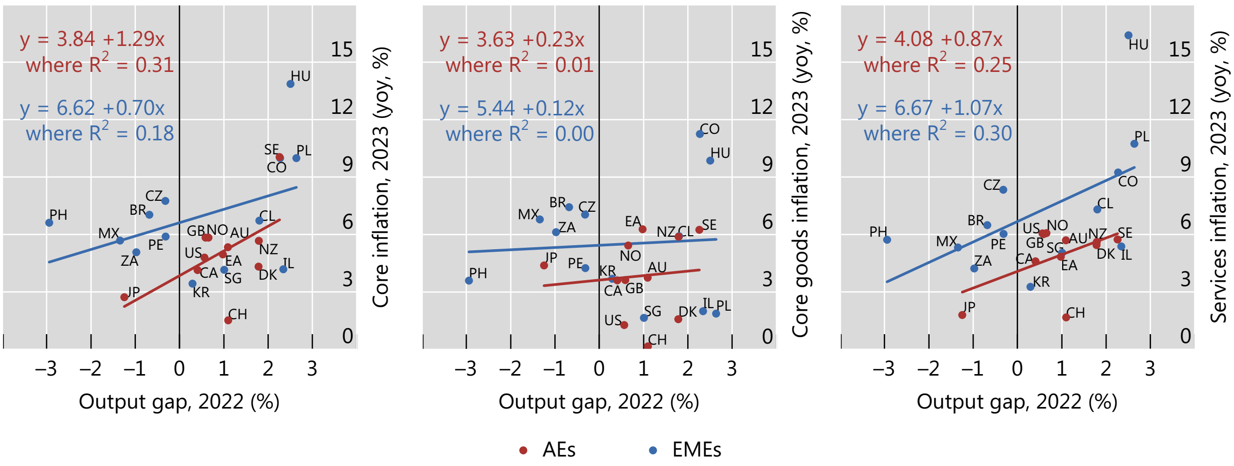
## Monetary policy challenges

Disinflation is in progress in 2024, but the job is not yet done. The analysis in this special feature suggests that the larger contribution of services to inflation could sustain underlying inflationary pressures in the short term. If so, monetary policy would have to stay tighter to achieve a given inflation objective than would be the case if inflation mainly reflected faster growth in goods prices.

Still, with services-driven inflation, some factors could reduce the extent of monetary policy restrictiveness. In particular, monetary policy may be more impactful at this stage, as services price growth is much more responsive to domestic economic

Inflation, especially for services, is higher where output gaps have closed[1] Graph 8

A. Core inflation B. Core goods price growth C. Services price growth




[1] See technical annex for details.

Sources: IMF; OECD; Datastream; national data; authors' calculations.

slack than core goods price growth; hence, the correlation of services price growth with domestic output gaps is higher in both AEs and EMEs (Graph 8).[14] Consistent with this observation, a global services factor explains roughly 18% of services price growth since 1990, while the corresponding share for core goods price growth is higher, at 25%. The main reasons for the greater responsiveness of services price growth to domestic slack are lower tradability and the stronger dependence on domestic labour markets. To be sure, manufacturing prices are more sensitive than services prices to the exchange rate – another key channel of monetary policy. But this channel tends to be less powerful when central banks tighten collectively, as they have done in the current episode, since this limits adjustments in exchange rates.

While goods prices in some jurisdictions in late 2023 and early 2024 are below previous trends, global forces can structurally alter the dynamics of inflation in the longer term. Climate change could create upward pressures on goods prices through more severe disruptive weather events or drought-induced restrictions on freight shipping in waterways. Geopolitical tensions could add to these pressures, including through a reorganisation of global value chains. This means that, all else equal, services price growth may have to be much lower than it was in the decades that preceded the pandemic if inflation targets are to be achieved.

Whether structural forces could support lower services price growth is not clear. On one hand, artificial intelligence and digitalisation could increase productivity and lower costs, perhaps disproportionately in the services sector. On the other hand,

[14] That said, the impact of higher interest rates on the housing component of inflation can be ambiguous. For instance, in the United States, Liu and Pepper (2023) report a negative response of rents to monetary policy tightening. In contrast, Dias and Duarte (2019) find a positive response, unlike the negative response of house prices. Corsetti et al (2022), Koeniger et al (2022) and Lazarowicz and Richard (2023) also report the response of rents and house prices going in opposite directions in the euro area, Switzerland and the United Kingdom, respectively. This highlights supply-side constraints, institutional arrangements (eg contractual links between interest rates and rents) and the treatment of owner-occupied housing in the price index.

ageing and labour scarcity could work in the opposite direction for this labour-intensive sector.

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## Technical annex

Graph 1: Simple averages for the years. GDP-purchasing power parity (PPP) weighted averages for: other AEs = CA, CH, DK, GB, NO and SE; emerging Asia = KR, PH and SG; Latin America = BR, CL, CO, MX and PE; other EMEs = CZ, HU, IL, PL and ZA. Core inflation does not add up to the sum of services (red bar) and goods (blue bar) because the latter includes the contributions to headline inflation.

Graph 2.A: GDP-PPP weighted averages for 11 AEs and 13 EMEs (not including CN). Six-month moving averages.

Graph 2.B: GDP-PPP weighted averages for 11 AEs and 21 EMEs (not including CN).

Graph 4.A: Other AEs = GDP-PPP weighted average of AU, CA, DK, GB, NO, NZ and SE.

Graph 4.C: Purchasing managers' indices: a value above (below) 50 indicates that the number of firms reporting increasing price pressures is higher (lower) than the number reporting decreasing price pressures. GDP-PPP weighted averages; for manufacturing, six AEs and 14 EMEs; for services, five AEs and three EMEs.

Graph 5.A: Result of a doubling of energy prices aggregated at the global level using OECD inter-country input-output tables, following the methodology of Di Giovanni et al (2022).

Graph 5.B: Based on a panel regression of year-on-year (yoy) inflation on its one-year lag, with country fixed effects. Unbalanced quarterly panel of 11 AEs and 13 EMEs (not including CN).

Graphs 6.A–B: The Indeed Wage Tracker measures growth in wages advertised in job postings. Correlations between yoy growth rates, since January 2020, where data are available. Wages lagged by 12 months.

Graph 6.C: Real wages are computed by deflating nominal wages with headline consumer price index (CPI) inflation. National definitions. GDP-PPP weighted four-quarter moving averages for four AEs and four EMEs. Pre-pandemic trend estimated based on Q1 2013–Q4 2019 data.

Graph 7.A: GDP-PPP weighted averages for 11 AEs and 12 EMEs (not including CN). Ratio of the services and core goods CPI to base year 2019. Six-month moving averages. Pre-pandemic trend estimated based on 2015–19 data.

Graph 7.B: GDP-PPP weighted averages for 11 AEs and 13 EMEs (not including CN), where data are available; simple averages for the time periods. "00–09" for EMEs is July 2007–December 2009.

Graphs 8.A–C: The output gap is estimated as the deviation of real GDP from its Hodrick-Prescott filtered trend.

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# Towards liquid and resilient government debt markets in EMEs[1]

*Over the last 20 years, government debt markets in emerging market economies (EMEs) have grown and matured. Not only has it become easier for foreign investors to participate in these markets, but also the local investor base has deepened. Our findings show that the investor base and size of hedging markets affect the liquidity and resilience of EME government debt markets. In times of stress, a greater presence of domestic banks helps stabilise liquidity conditions, while domestic and foreign non-banks could propagate external shocks. Countries with more developed hedging markets exhibit more resilient liquidity conditions after major shocks.*

*JEL classification: D53, E63, G15, G18, H63.*

Government debt markets play a crucial role in the financial system and economy at large. By providing a benchmark to price financial assets, well-functioning government debt markets in local currency ensure the transmission of monetary policy to the wider economy and facilitate the development of corporate bond and other markets. Deep and liquid debt markets are thus a cornerstone of the financial system, especially if they remain liquid in times of stress.[2] Less liquid markets, by contrast, tend to propagate adverse shocks more quickly (eg Boermans et al (2016)).

Over the last 20 years, debt markets in emerging market economies (EMEs) have grown and matured. It has become easier for foreign investors to participate, and the domestic investor base has grown. Overall, EMEs tend to have smaller government debt markets than advanced economies (AEs) (Graph 1.A), both in absolute terms and relative to gross domestic product (GDP). These smaller markets also generally tend to be less liquid (Graph 1.B). Yet as financial markets in EMEs grow bigger, broader and more liquid (BIS (2020)), this could alter liquidity conditions and how resilient these markets are to shocks.

1 The opinions expressed in this article are those of the authors and do not necessarily reflect those of the Bank for International Settlements. We would like to thank Ryan Banerjee, Claudio Borio, Gaston Gelos, Bryan Hardy, Peter Hördahl, Benoît Mojon, Gabor Pinter, Andreas Schrimpf, Ilhyock Shim, Hyun Song Shin, Vladyslav Sushko, Philip Wooldridge and seminar participants at the BIS Representative Office for the Americas for useful comments and suggestions, and Alison Arnot for editorial support.

2 Surges in risk premia play an important role in the transmission of stress to EMEs (Aguilar et al (2023)). To some extent, robust liquidity can help shield EME government bond markets from such surges during episodes when global financial conditions tighten.

*Key takeaways*

- *The presence of different investor types and the size of hedging markets affect the liquidity and resilience of government debt markets in EMEs.*
- *In times of stress, a deep domestic investor base protects EME debt market liquidity while non-bank investors exacerbate shocks.*
- *EMEs with deeper hedging markets weather shocks to liquidity conditions better than others during observed stress events.*

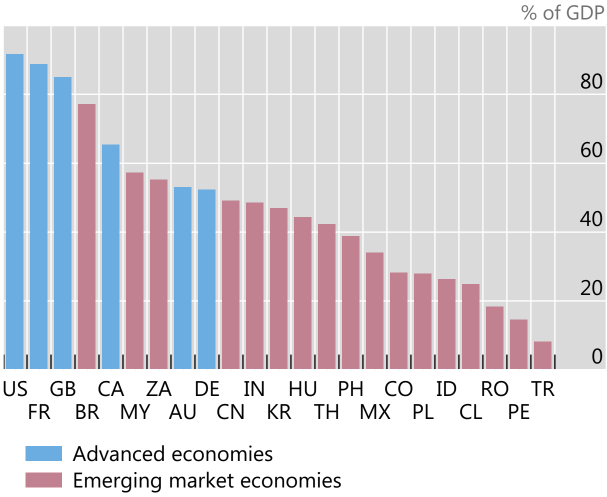
Against this background, this article shows that the composition of the investor base and the depth of hedging markets affect liquidity conditions and the resilience of local currency government bond markets in EMEs. This applies in both tranquil times and times of stress, although the role played by different investor groups changes. We focus on market liquidity, ie the ability to trade immediately at "market" prices and with minimum impact on prices.[3] We also look at the resilience of liquidity, ie how quickly liquidity measures return to long-run averages.

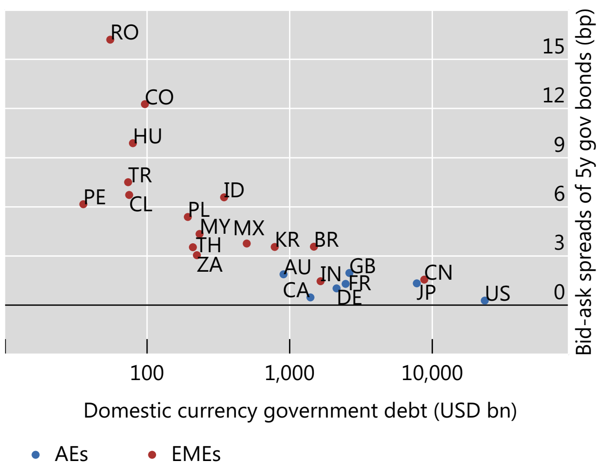
This article is organised as follows. First, we discuss how market liquidity and resilience are measured as well as trends in AEs and EMEs over time. Next, we consider the roles of the investor base and hedging markets in market liquidity. We then present evidence on market liquidity during normal and stress periods and during three specific shocks. The final section concludes.

Government debt markets in EMEs tend to be smaller and less liquid[1] Graph 1

A. Government debt in local currency is lower relative to GDP than in AEs

B. Smaller markets tend to be less liquid




[1] Data for 2022.

Sources: IMF; Bloomberg; authors' calculations.

[3] This is distinct from (but closely related to) funding liquidity, which refers to the ability to obtain funding at prices reflecting the underlying demand and supply.

## Measuring market liquidity and resilience

Market liquidity is a multi-faceted concept. At the most basic level, it refers to the ease with which securities can be traded. In practice, a market is liquid if securities can be bought and sold quickly in large amounts without affecting prices adversely.[4] We gauge liquidity using a measure that considers transaction costs – the difference between quoted bid and ask prices from Bloomberg, adjusted by their average price. While these quotes are only indicative, ie they do not commit market makers to trade at these prices, they are widely available and tend to proxy high-frequency measures reasonably well (Schestag et al (2016)).[5]

Liquidity is resilient if transaction costs quickly return to normal levels after being hit by a shock.[6] We proxy resilience with the speed at which bid-ask spreads return to long-term levels, ie their speed of mean reversion. We measure this over a one-year window since estimates over shorter windows are more unstable. In a resilient market, we expect the speed of mean reversion to be high.

Our measures confirm that bond markets in EMEs tend to have wider bid-ask spreads (Graph 2.A) and lower resilience than those in AEs (Graph 2.B). Bid-ask spreads on EME government debt have followed a cyclical pattern over the past decade but without any overall trend. They spiked during the 2013 Taper Tantrum and the March 2020 Covid-19 turmoil. Resilience is lower than in AEs, as indicated by the lower degree of mean reversion in spreads. The resilience of liquidity in EME debt markets rose from mid-2013 to the end of 2015 but fell in 2016 on the back of lower commodity prices. During the Covid-19 pandemic, resilience deteriorated less in EMEs than in AEs. Over the last three years, markets in both EMEs and AEs appear to have become more resilient again.

## Developing liquid and resilient government debt markets

Developing liquid and resilient markets for government debt is a key policy objective shared by governments (including their debt management offices) and central banks (Tombini (2023)). Even though financial markets in EMEs have developed substantially and have become more accessible to foreign investors over the past two decades,[7]

4 More technically, one can distinguish between *tightness* (how far transaction prices deviate from mid-market prices), *depth* (the volume that can be traded without affecting the prevailing market price) and *resilience* (the speed with which price fluctuations from trades dissipate). See CGFS (2000).

5 Alternative measures tend to require data that are not available for a broad range of countries. These include the Amihud (2002) illiquidity measure, which requires information on volumes, and the micro-founded measures used in the market microstructure literature, which tend to be based on order book data. Moreover, measures based on daily prices do not significantly outperform quoted spreads. Schestag et al (2016) show that the correlation between Bloomberg bid-ask spreads and liquidity gauges constructed from order book data is about 0.7–0.8 at a monthly frequency.

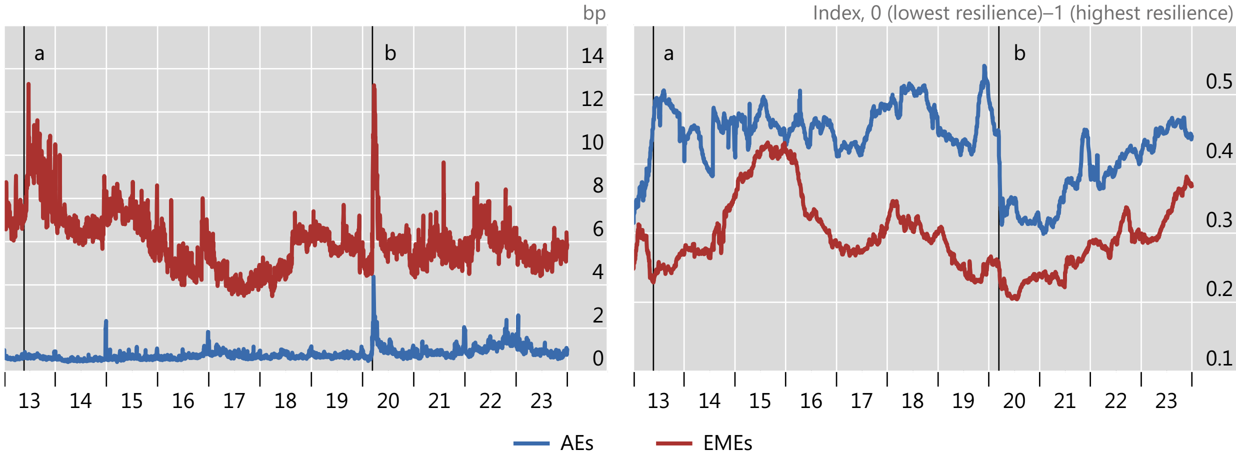
6 Our definition of resilience differs somewhat from that commonly used in the market microstructure literature, where it typically refers to the speed by which the order book is replenished after a temporary imbalance (Harris (1990)).

7 A good example is the Asian Bond Markets Initiative, launched in December 2002 by the Association of Southeast Asian Nations (ASEAN), China, Japan and Korea. This initiative has stimulated the development of domestic bond markets as a source of long-term funding for Asian borrowers. It has also promoted local currency bonds as a new asset class for both resident and non-resident investors.

Liquidity and resilience are still weaker in EMEs than in AEs[1] Graph 2

A. Bid-ask spreads are consistently wider in EMEs

B. Resilience deteriorated with Covid-19, but it is rebounding




[a] Taper Tantrum (22 May 2013). [b] Covid-19 pandemic (11 March 2020).

[1] Simple average across country groups. See technical annex for details.

Sources: O'Sullivan et al (2024); Bloomberg; authors' calculations.

they still lag those in AEs. CGFS (2019) provides a broad overview of the factors that are important for developing deep and liquid markets. These factors range from the fundamental, such as the rule of law and efficient legal and judicial frameworks, to the technical, like the ability to buy back debt or swap illiquid for liquid issues. Two factors are key in developing liquid and resilient government debt markets in EMEs: (i) a broad and diversified investor base and (ii) deep hedging markets.

## The role of the investor base

A diverse investor base is a precondition for liquid markets, as different investment needs, beliefs and strategies make it less likely for all market participants to buy or sell at the same time. A growing literature shows that long-term investors such as pension funds and insurance companies can stabilise markets (Fang et al (2023), Zhou (2024)). Long-term investors rarely sell their securities though; rather, they tend to hold them to maturity. Thus, they need to be complemented by traders with a shorter horizon. These include, in some markets, leveraged investors and high-frequency traders. Bringing these different players together requires market intermediaries – notably market-makers in banks[8] and brokerage houses. Their main function is to facilitate trading and the sharing of risks among the investors.

Diversification of the investor base can also take place across borders. Not only do foreign investors provide additional funds, but they also tend to face different circumstances, trading needs and expectations than local investors. This means that their entry can increase market liquidity and depth (CGFS (2019)). That said, high

Local currency government debt relative to GDP in ASEAN countries rose from 30% in December 2004 to 37% in September 2023.

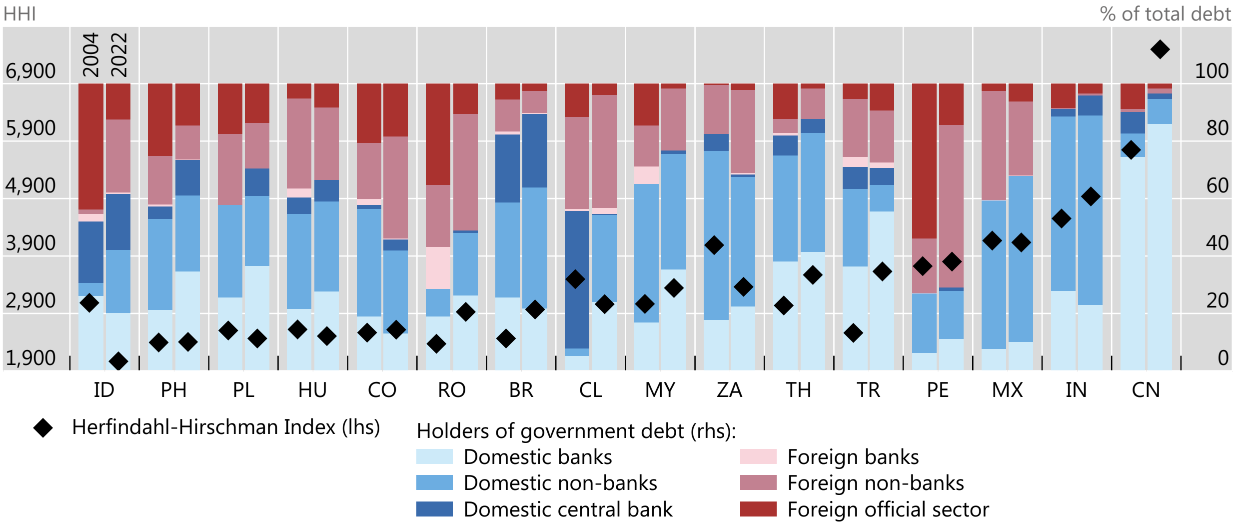
[8] Strictly speaking, this applies only to banks' trading assets. Banks also hold government securities as investments or to meet regulatory standards, which they often hold to maturity.

foreign participation also exposes a market to global risk factors and the potential for adverse spillovers (Carstens and Shin (2019), Ho and Ho (2022), Zhou (2024)). Shocks to global risk aversion may lead foreign investors to retrench and shed EME assets for reasons unrelated to domestic conditions. Without a developed domestic investor base able to step in and absorb foreigners' asset sales, this can lead to large swings in bond prices, which can affect the liquidity and resilience of government debt markets, especially in EMEs.

We analyse the investor base in 16 EMEs, drawing on updated data from Arslanalp and Tsuda (2014). The data break down the investors in government debt into six groups: (i) domestic banks, (ii) domestic non-banks, (iii) the central bank, (iv) foreign banks, (v) foreign non-banks and (vi) foreign official institutions.[9] Among these categories, non-banks encompass a particularly diverse group of participants: institutional investors like pension funds, insurance companies, mutual funds, hedge funds, proprietary trading firms and any other investor that is not a bank.[10]

The composition of the investor base, and the diversification across borders and types of institution, varies greatly across EMEs and over time (Graph 3). In most countries, domestic non-banks are the most important group of investors. But there are exceptions. For example, in China and Türkiye, domestic banks are by far the most important holders of government debt. In Chile, Colombia, Romania and Peru, it is foreign non-banks. What is common across countries is that holdings by the domestic central bank and, especially, the foreign official sector are nowadays small compared with (domestic and foreign) private positions. Some debt markets, notably those of Colombia, Indonesia, the Philippines and Poland have seen the investor base become

The share of different investor groups varies greatly across EMEs and over time | Graph 3




Sources: Arslanalp and Tsuda (2014); authors' calculations.

9 The holdings data do not allow us to distinguish between different instruments, for example local or foreign currency bonds and bank loans. We assume that the holding shares reported in the data apply to local currency bonds, which account for the bulk of public debt in most of the countries in our sample.

10 Fang et al (2023) and Zhou (2024) show that different types of non-banks in the euro area may behave quite differently.

more diversified over time; other markets, eg in India, Mexico and China, have seen less diversity.[11] Finally, foreign banks are the group with the lowest participation in EMEs, with an average of 1.1% of the total government debt holdings in our sample.

## Hedging markets

Market liquidity also depends on the presence and size of complementary markets, such as those for repos and derivatives. Repos allow investors to borrow against their securities holdings when faced with cash needs, rather than selling them. They also support liquidity provision more directly by allowing securities dealers to fund their trading inventories, to reuse securities held by long-term investors for trading and to lever up their securities portfolios (CGFS (2017, 2019)). Derivatives, in turn, permit investors to adjust their exposure to exchange and interest rate risk instead of transacting in the market for the underlying bonds.[12]

While the development of complementary markets has its merits, it also raises certain concerns that warrant consideration. Since repos tend to be short term, relying on them for funding leads to a shortening of maturities and higher roll-over risk. They can also be used to lever up excessively. This can give rise to procyclicality, increasing financial stability risks, especially if the underlying collateral is illiquid (CGFS (2017)). Similarly, derivatives can transmit external shocks instead of dampening them.

Comprehensive data for repo markets are not readily available. According to CGFS (2017), in mid-2016, around $12 trillion of repo and reverse repo transactions against government bonds were outstanding globally. Of these, nearly $9 trillion were collateralised with government bonds. While the share of EMEs in the global total is tiny, some EMEs have quite sizeable repo markets. For instance, in Mexico, the outstanding volume of repos amounted to 21% of outstanding government bonds in mid-2016, which was in line with most AEs (CGFS (2017)).

Over the past decade, growth in the markets to hedge currency and interest rate risk has not kept up with the increase in overall government debt in EMEs (Graph 4.A). While these markets continued to grow – both in terms of dollar volumes and relative to GDP – derivatives turnover fell when expressed relative to government debt outstanding (due to the strong rise of the latter). Some EMEs do have relatively deep markets, but they lag their AE peers (Graph 4.B).

A common obstacle to developing hedging markets is an imbalance between players who want to hedge themselves against a specific risk and those prepared to take the other side. Since macroeconomic risks, such as exchange rate and interest rate risk, are not easy to diversify, financial intermediaries are often not prepared to

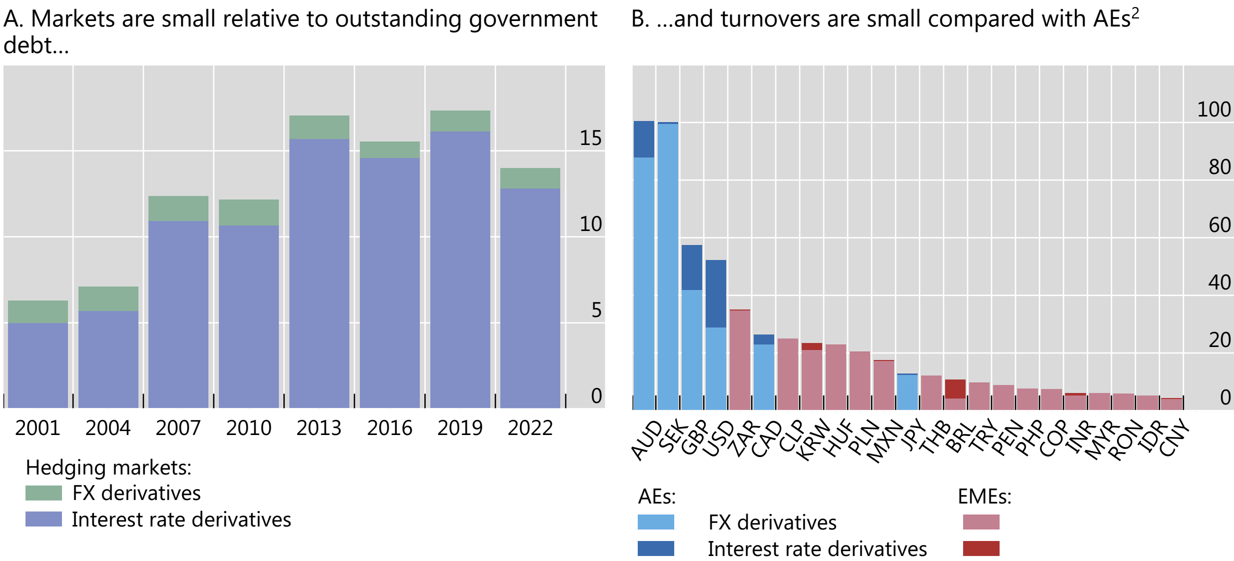
[11] We measure diversification with a Herfindahl-Hirschman index (HHI) proxy, which is equal to the sum of the squared market shares of each investor group. With six groups, it can range from 1,667 to 10,000, with lower values indicating greater diversification.

[12] Reducing currency risk, for instance by allowing foreign investors to hedge, should make markets more resilient. The widening in spreads on EME government bonds in stress periods primarily reflects an increase in the currency risk premium (Ho and Ho (2022)).

Hedging markets in EMEs are still shallow[1]

As a percentage of government debt

Graph 4




[1] See technical annex for details. [2] Figures for 2022.

Sources: IMF; BIS Triennial Central Bank Survey; authors' calculations.

sell the appropriate insurance unless they are able to offload their positions to investors who are exposed to such risks in opposite ways (Upper and Valli (2016)).[13, 14]

## Liquidity after adverse spillovers

Different investor groups can shield or erode government bond market liquidity, both in tranquil times and during episodes of stress. Moreover, major shocks can affect liquidity in EMEs differently, depending on the depth of their hedging markets.

### The type of investor

The composition of the investor base affects how market liquidity responds to external shocks. The role of different investors varies between tranquil and stress periods – the latter defined as periods with the Chicago Board Options Exchange

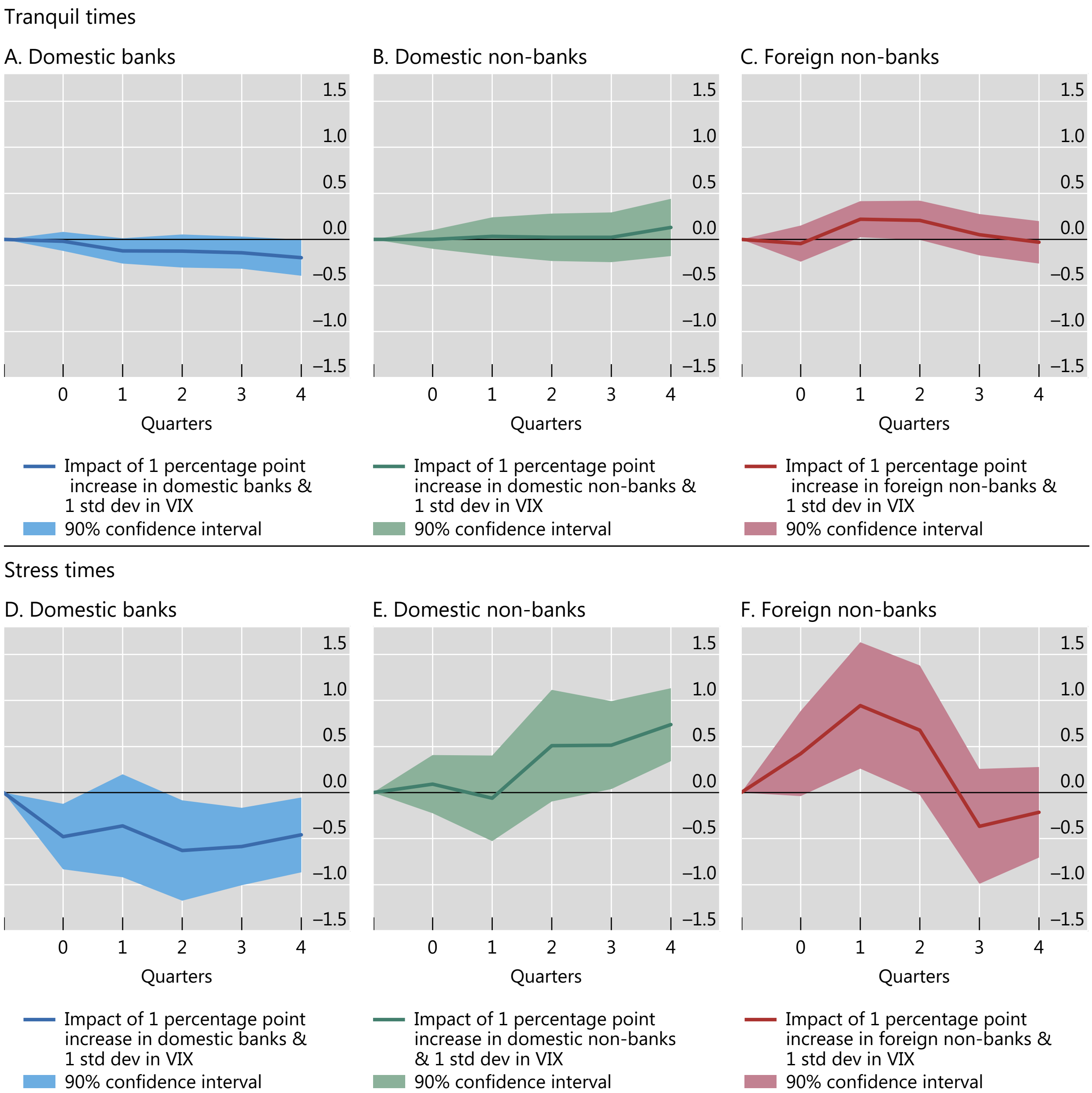
[13] An interesting example of the importance of domestic investors is Chile, where local pension funds had large foreign asset holdings and were required to hedge them in domestic currency. This made them a natural counterparty to foreign investors hedging their investments in assets denominated in Chilean pesos (Avalos and Moreno (2013)). The large-scale pension fund withdrawals in the wake of the Covid-19 pandemic led to a fall in the funds' foreign asset holdings. This could reduce their ability to act as stabilisers in the future (Aldunate et al (2023)).

[14] BIS (2022) discusses other factors that have been holding back derivatives activity in Asian EMEs and policy measures to develop hedging markets in the region.

Volatility Index (VIX) above the 75th percentile of the distribution.[15] Panel local projections (Jordà (2005)) for 16 EMEs show that increases in the VIX – as a measure for global shocks – tend to be associated with deteriorating liquidity (ie widening spreads) in government bond markets.[16] A one standard deviation increase in the VIX

Domestic banks support liquidity in times of stress[1]

In basis points — Graph 5




[1] See technical annex for details.

Sources: Arslanalp and Tsuda (2014); IMF; Bloomberg; national data; BIS Triennial Central Bank Survey; authors' calculations.

[15] The VIX is an amalgam of uncertainty and risk aversion and is widely used in empirical research as a measure of the global price of risk (Bekaert and Hoerova (2014)). High readings of the VIX tend to be associated with periods of investor retrenchment and outflows from risky assets.

[16] See the annex for details.

is linked to a 0.7 basis point (bp) widening in spreads in tranquil times and a 6.7 bp widening in stress times. These relate to an average level of bid-ask spreads of 6.5 bp in our sample.

In tranquil times, a larger share of foreign non-bank investors tends to marginally increase the impact of VIX changes on liquidity. A 1 percentage point (pp) higher share of foreign investors is associated with an additional 0.2 bp widening in the bid-ask spread after an increase of one standard deviation in the VIX (Graph 5.C). A higher share of domestic banks, by contrast, reduces the impact of VIX increases on liquidity, although the results are not statistically significant (Graph 5.A). The role of domestic non-bank investors in tranquil periods is neutral (Graph 5.B).[17] These findings are broadly in line with the literature, in which foreign investors may amplify shocks.

In times of stress, a greater footprint of domestic banks tends to stabilise liquidity, while a greater share of non-banks (both foreign and domestic) tends to amplify liquidity strains (Graphs 5.D, 5.E and 5.F). A 1 pp higher share of domestic banks dampens the impact of a one standard deviation change in the VIX by 0.6 bp (Graph 5.D), or one tenth. By contrast, a similarly higher share of domestic and foreign non-banks amplifies it by 0.7 bp and 0.9 bp, respectively (Graphs 5.E and 5.F).[18] Unfortunately, we are not able to disentangle which types of non-bank investors could explain this finding, ie whether it is insurance companies, mutual funds, hedge funds, proprietary trading firms or others.

## The depth of hedging markets

There are good reasons to believe that liquidity in EMEs with well-developed hedging markets will be more resilient to major shocks. To examine this, we compare liquidity in the 90 days before and after the Great Financial Crisis in 2008, the Taper Tantrum in 2013 and the Covid-19 pandemic in 2020.

Bid-ask spreads widened during all three episodes. The smallest effect was after the Lehman Brothers bankruptcy, at around 1 bp (Graph 6.A). The highest was after both the 2013 Taper Tantrum and the Covid-19 pandemic, at almost 3 bp (Graphs 6.B and 6.C). During the Taper Tantrum and the Covid-19 pandemic, spreads widened more significantly (approximately 3 and 4 bp, respectively) in EMEs with below-median depth in hedging markets. In EMEs with more developed complementary markets, liquidity conditions appeared more resilient, in particular amid the turmoil in fixed income markets during the Covid-19 pandemic.

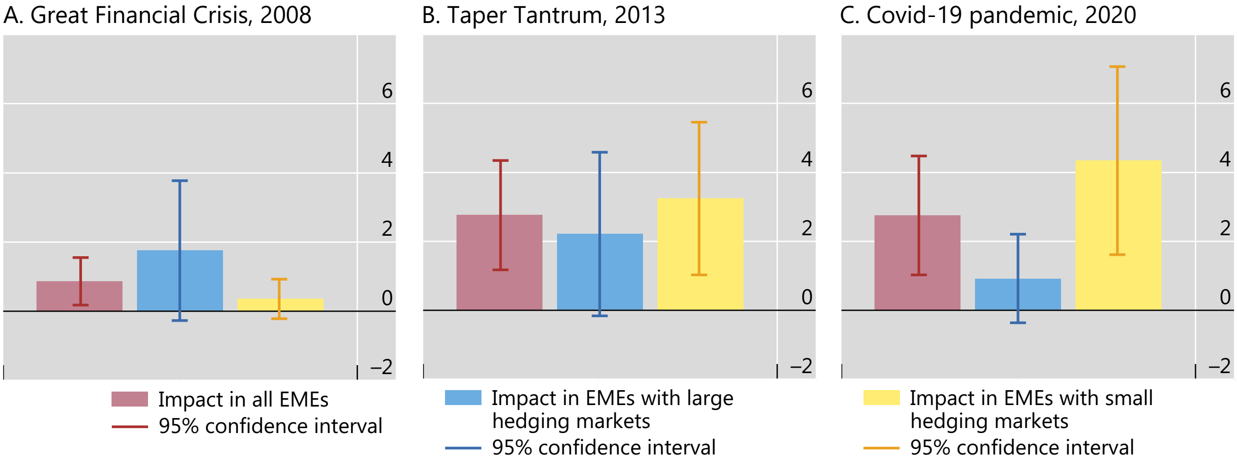
17 The statistical significance and magnitude of the impact of domestic investors increases when we set the cut-off between tranquil and stress periods at the median. In this case, both domestic banks and non-banks dampen the effect of VIX increases, while foreign non-bank investors continue to amplify it. We did not estimate similar responses for the domestic central bank, foreign banks and the foreign official sector, since their shares in total holdings tend to be very small.

18 These findings are largely robust to changes in threshold, the use of alternative measures of the global price of risk and the use of a triple interaction term with changes to the VIX, the type of investor and a dummy variable of a high financial stress regime.

Liquidity is less stable in EMEs with less developed hedging markets[1]

In basis points

Graph 6




[1] See technical annex for details.

Sources: IMF; Bloomberg; BIS Triennial Central Bank Survey; authors' calculations.

## Conclusion

Liquid and resilient government debt markets are key to ensuring the smooth functioning of the financial system. This is especially so in EMEs, where market functioning can easily be buffeted by spillovers. Government bond markets in EMEs tend to be less liquid than those in AEs, and liquidity takes longer to revert to "normal" values after a disruption.

Our main contribution is to show how the investor base and the size of hedging markets matter for the behaviour of liquidity in EMEs. In periods of stress, when bond markets are at risk of outflows and liquidity is most valuable, domestic banks support the stability of liquidity conditions, while domestic and foreign non-banks are associated with less stable liquidity. In parallel, EMEs with well-developed hedging markets appear to be more resilient to major shocks. The results in this article align with financial theory and previous evidence. They underscore the importance for EMEs to foster a diverse investor base and develop their complementary markets.

Going forward, there are numerous avenues for further research. In particular, there is scope to collect and assess data on repo and derivatives markets across countries over time. It would also be useful to gather a full breakdown of debt holdings, especially within the non-bank sector and their country of residence. This would help researchers examine the behaviour and impact of different non-bank investors (see also McGuire et al (2024) in this issue). Finally, on the basis of more granular data, there is scope to further improve the measurement of market liquidity, particularly in times of stress.

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## Technical annex

Graphs 2.A–B: Simple average across 16 EMEs (BR, CL, CN, CO, HU, ID, IN, MX, MY, PE, PH, PL, RO, TH, TR and ZA) and seven AEs (AU, CA, DE, FR, GB, JP and US).

Graph 2.B: The resilience measure is based on O'Sullivan et al (2024). A higher (lower) value denotes a faster (slower) adjustment of spreads to a three-year mean in logs.

Graphs 4.A–B: Average daily turnover in spot and derivatives markets, including exchange-traded derivatives. Turnover is scaled by the government debt of the country issuing the currency.

Graph 4.A: Equally weighted average figures covering 16 EME currencies.

Graphs 5.A–F: Cumulative response from local panel projections for 16 EMEs from Q1 2004 to Q4 2022, where data are available. We regress bid-ask spreads of five-year local currency government bonds on the lag of the same variable, the VIX in logs, the share of the type of investors, the interaction term of the VIX and the investor type, four lags of a vector of controls that includes the level of the yields, the policy rate, the ratio of government debt to GDP, the size of hedging markets and the HHI of holdings. The regressions include fixed effects and Driscoll and Kraay standard errors, accounting for cross-sectional dependence. Tranquil (stress) regimes are defined when the VIX is below (above) the long-term 75th percentile.

Graphs 6.A–C: Panel estimations of the daily data of bid-ask spreads of the five-year government bonds in a 90-day window before and after the three shocks, with country fixed effects. Standard errors clustered by country. EMEs with large (small) hedging market groups are defined as countries above (below) the sample median for the 16 EMEs. The Great Financial Crisis is dated to 15 September 2008, the Taper Tantrum to 22 May 2013 and the Covid-19 pandemic to 11 March 2020.

# Annex: measurement and econometric approach

## Measuring resilience

Following O'Sullivan et al (2024) and earlier work, we measure resilience as the pace of mean reversion in liquidity estimated with the following equation:[19]

$$\Delta L_t = k(\varphi - L_{t-1}) + \varepsilon_t,$$

where $L_t$ denotes the bid-ask spread on day $t$, $\varphi$ the long-run value of liquidity, $k$ the speed of adjustment to this value and $\varepsilon_t$ a normally distributed white noise error. A higher speed of adjustment parameter $k$ indicates higher resilience.

Empirically, we address serial correlation in the residuals by incorporating past liquidity changes as supplementary explanatory variables in the model.[20] For each country's benchmark bonds, we estimate the following empirical model using daily liquidity data:

$$\Delta L/Y_{i,t} = \alpha_i - k_i \frac{L}{Y}_{i,t-1} + b_i \frac{\Delta L}{Y}_{i,t-1} + c_i Vol_{i,t} + \varepsilon_{i,t},$$

where $t$ denotes the time index, $Y$ denotes the relative measure of bid-ask spreads relative to a mean in logs, and our dependent variable $\Delta L/Y_{i,t}$ denotes the spread over a long-run benchmark. Finally, *Vol* denotes the volatility of bonds of the same maturity.

To ensure our resilience measure is robust, we set negative values to zero. This fosters a more meaningful and realistic representation of resilience characteristics in our analysis.

## Measuring the effect of different types of investors on liquidity

We estimate impulse response functions via local projections (Jordà (2005)) to trace out the effects of global shocks on EME liquidity conditions. We use interaction terms to assess how these are shaped by the presence of different investor groups, and we distinguish between tranquil and stress periods. Specifically, we estimate the following equation:

$$Y_{i,R,t+h} = \alpha_{i,R} + \beta_1 y_{i,R,t-1} + \beta_2 VIX_{t,R} + \beta_3 Inv_{i,R,t} + \beta_4 VIX_{t,R} * Inv_{i,R,t} + \beta_n X_{i,R,t-1} + \epsilon_{i,R,t},$$

where $Y_{i,t+h}$ is the cumulative effect of the bid-ask spreads of five-year government bonds for quarters $h$, from 0 to 4 quarters; $y_{i,t-1}$ denotes the lag of the bid-ask spreads; $VIX_t$ is the log of the VIX; and $Inv_{i,t}$ is investor type. $X_{it-1}$ is a vector of domestic variables with four lags that includes the level of five-year government bond yields, the policy rate, the ratio of government debt to GDP, the size of hedging markets and the HHI of holdings. $R$ denotes the regime of interest: tranquil versus stress times.

19 This is different but similar to an error-correction model (ECM). In an ECM, the error correction relates to the last-period's deviation from a long-run equilibrium and it influences its short-run dynamics.

20 This step is crucial in eliminating potential bias in estimating resilience, represented by the parameter $k$.

The stress regime covers observations when VIX levels are in the top quartile, and the tranquil times regime considers data when VIX is below the top quartile. We are interested in the coefficient $\beta_4$ of the interaction between the VIX and the type of investor. The regressions include country fixed effects. Standard errors are clustered by country for a panel of 16 EMEs with quarterly observations, spanning from the first quarter of 2004 to the fourth quarter of 2023. To retain sufficient degrees of freedom, we enter one investor group at the time.

## Measuring the effect of exogenous shocks on liquidity in EMEs with hedging markets of different sizes

We estimate the effect of three different shocks on the bid-ask spreads of all EMEs in our sample. We then distinguish between those with a hedging market larger or smaller than the median. For this, we use the following equation:

$$y_{it} = \alpha_i + \theta EMEs * Shock_t + \epsilon_{it},$$

where $y_{it}$ is the bid-ask spread of five-year government bond yields, and $EMEs$ denotes either all EMEs or those with large or small hedging markets. $Shock_t$ is a dummy equal to one during the 90-day period after each of the stress periods. The regressions include country fixed effects. Standard errors are clustered by country for a panel of 16 EMEs with a 90-day window before and a 90-day window after each shock.

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# International finance through the lens of BIS statistics: residence vs nationality[1]

*Statistics used in international economics generally adopt a residence view, centred on an economy and the units located there. This is natural for understanding the geography of capital flows and other macroeconomic issues. However, the system of national accounts does not reflect the extent of globalisation and the rise of multinational firms and financial intermediaries. Their balance sheets straddle national borders, and their decisions affect many countries in ways that are obscured in residence statistics. This feature uses BIS statistics to show how a nationality view, which groups balance sheets by the country of headquarters, can provide insights on policy-relevant issues such as foreign currency debt, deglobalisation and financial openness.*

*JEL classification: E01, F23, F36, G15.*

The unit of analysis in statistics used in international economics is "the economy". It comprises institutional units with a physical presence under a common jurisdiction, typically a country and its residents (United Nations (2008)). This is the basis on which economic activity is measured. In this *residence view*, anything outside a country's border is external, thereby defining international trade and finance. This geographical lens is appropriate for analysing many issues, such as capital flows. The system of national accounts (SNA), the balance of payments (BoP), the international investment position (IIP), the International Monetary Fund (IMF) Coordinated Portfolio Investment Survey (CPIS) and Coordinated Foreign Direct Investment Survey (CDIS) are all compiled on a residence basis.

In reality, firms' balance sheets straddle national borders. Balance sheets are the locus of financial transmission and thus relevant for financial stability analysis. Multinational banks and corporates have operations around the world, and their decisions affect multiple economies at the same time. Against this backdrop, the residence view can limit understanding of issues involving ownership and control. A growing literature recognises the value of adopting a *nationality view*, which groups (or consolidates) economic units with the affiliates they control abroad. The nationality view complements the residence view by revealing *who* drives changes in international assets and liabilities.

[1] This is the first feature in a series to showcase the BIS international banking and financial statistics and their uses. We thank Iñaki Aldasoro, Doug Araujo, Stefan Avdjiev, Claudio Borio, Gaston Gelos, Branimir Gruić, Bryan Hardy, Benoit Mojon, Andreas Schrimpf, and Hyun Song Shin for their helpful comments, and Swapan-Kumar Pradhan for excellent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

*Key takeaways*

- *Most international statistics are compiled on a residence basis. The alternative nationality view, available in BIS statistics, groups balance sheets by the country of headquarters.*
- *Moving from a residence to a nationality view shows the importance of multinational banks and firms in international finance and helps to reassess the role of financial centres.*
- *The nationality view provides insights about countries' foreign currency debt, financial openness and the drivers of cross-border financial positions.*

The nationality view has a long history in BIS banking statistics. The expansion of international banking activity in financial centres in the 1970s led central banks and regulators to ask banks to consolidate offshore positions with those of their head offices. Consolidated reporting also became best practice in G10 countries and forms the basis of the Basel Framework for regulating internationally active banks. These efforts led to enhancements to the BIS international banking statistics (IBS), which for decades have had the dimensions needed for both a residence and nationality view (in contrast to other benchmark statistical collections used in international finance).

This feature is a primer on how BIS statistics can be used to understand topics in international finance from both a residence and nationality perspective. Moving from residence (entities in Switzerland) to nationality (Swiss entities anywhere in the world) fundamentally alters the interpretation of international statistics. The difference in the respective financial positions can be large: a shift to nationality makes financial centres "disappear" as assets (and liabilities) are reallocated to the countries where the parent companies that own (owe) them are headquartered. This in turn reveals just how concentrated international finance is in large multinational lenders and borrowers from a handful of countries. A shift in their globally consolidated balance sheets has implications far beyond their home country.

The nationality view sheds new light on many topics of policy interest. It provides debt measures that are better aligned with what national issuers ultimately owe. The nationality view also reveals who drives changes in cross-border banking. For example, financial retrenchment in the wake of the Great Financial Crisis (GFC) of 2007–09 was seen by some as broad-based deglobalisation but in fact was largely driven by European banks scaling back their foreign operations. Lastly, measures of countries' "financial openness" that account for multinational banking show most countries to be more open than previously thought.

The rest of this feature is organised as follows. The first section covers definitions and concepts that distinguish the residence view from the nationality view. The second compares how much, and for which countries, measures of international assets and liabilities differ under these two views, using BIS statistics and vendor data. The third section describes three examples where the nationality view provides new insights: foreign currency debt, the post-GFC retrenchment in global banking and the financial openness of countries. The final section concludes.

## Concepts and definitions

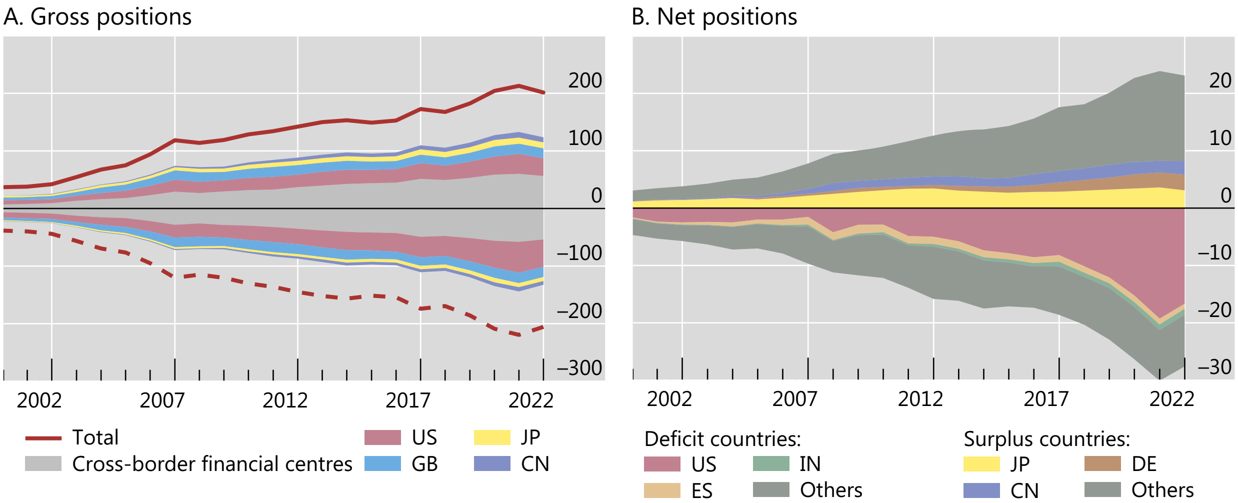
The residence view is centred on an economy, defined as the set of resident institutional units.[2] Residence is determined on the basis of physical presence and being subject to the jurisdiction of the government of a territory (United Nations (2008)). An economy is typically delineated by a country border and is the unit of survey on which the SNA is compiled. Many economic indicators, eg gross domestic product (GDP) or population, have long been measured on this basis.

What falls outside the country border is designated as external. The current account, ie the gap between domestic saving and investment, records flows of goods, services and income between residents and non-residents. The financial account shows the corresponding acquisition and disposal of financial assets and liabilities with non-residents. Capital flows between countries are in turn aggregated, cumulated and revalued every period, giving rise to the IIP, ie the outstanding stock of external assets and liabilities (Graph 1.A).

By referencing a particular economy, residence-based statistics relate international finance to macroeconomic developments in that economy, such as GDP, consumption and saving. Gross external positions yield measures of countries' financial development and integration (Lane and Milesi-Ferretti (2007, 2018), Broner et al (2023)). Countries' positive and negative *net* external positions (Graph 1.B), which reflect cumulative current account surpluses and deficits, underpin discussions about global financial imbalances (eg Bernanke (2005)). The geography of capital flows also

International investment positions, by country[1]

In trillions of US dollars — Graph 1




[1] See technical annex for details.

Sources: The external wealth of nations database (2022); authors' calculations.

[2] All institutional units are allocated to one of five sectors: non-financial corporations, financial corporations, general governments, households and non-profit institutions. Each institutional unit is resident in only one economic territory.

sheds light on a range of issues, including the flow of petrodollars, BoP crises and boom-bust cycles in emerging market economies (EMEs) (Borio et al (2011)).

In line with available statistics, academic work in international economics and finance tends to take the country as the unit of analysis. Furthermore, the perimeters of both currency use and balance sheets are often assumed to align with the country border, an analytical simplification known as the "triple coincidence" (Avdjiev et al (2016)). Accordingly, canonical models in international economics derive external positions from the macroeconomic analysis of individual countries (eg Obstfeld and Rogoff (1996), Tille and van Wincoop (2010)).

In reality, corporate balance sheets, and thus the impact of corporate decisions, straddle country borders. The mere existence of multinational firms violates the assumptions of the triple coincidence. Financial intermediaries, such as banks or corporate financing arms, strategically choose their location to take advantage of the benefits that come with concentration in financial centres (eg London) and/or secrecy, taxation and regulation (eg Caribbean financial centres) (Lane and Milesi-Ferretti (2018), Bertaut et al (2021), Pogliani et al (2022)). This reroutes capital flows via third countries, inflating global capital flows and gross external positions. The financial centres in Graph 1.A (grey areas) accounted for roughly a quarter of global external positions but for only 3% of global GDP (Pogliani et al (2022)).

As a result, residence-based statistics have limitations for analysing issues where ownership and control play a role. As multinational firms adjust their global balance sheets, they transmit shocks from one region to another. A country's external position does not belong to its nationals alone; it can be driven to a large extent by the activity of foreign-owned entities located there. On the flip side, policymakers take interest in the worldwide debt obligations of their domestically headquartered firms, regardless of where they borrow. In short, residence-based statistics obscure the international impact of multinationals' decisions.

Assessing such issues requires a view based on *nationality*, where the organising principle for economic units is *control*. This is the view most natural to multinational firms and intermediaries that manage their global balance sheets. The nationality view groups the balance sheets of resident units with those of the non-resident affiliates they control (with intragroup positions netted out); it excludes the balance sheets of resident units controlled by foreign entities (McGuire and von Peter (2009), IAG (2015), Avdjiev et al (2018)). Typically, the nationality of the consolidated group is the country of its headquarters; in the IBS it is the country of the supervisor of the global consolidated banking group (typically the country of its headquarters) (BIS (2019)).

The nationality view has a long history in BIS banking statistics. The expansion of international banking activity in Caribbean and other financial centres in the 1970s left offshore activity outside the purview of statistics. Central banks therefore asked banks in their jurisdiction to consolidate any positions booked by their offshore offices with those of their head offices. In 1977, the Basel Committee on Banking Supervision (BCBS) reviewed home-host information sharing and the need to consolidate bank balance sheets to capture the activity of subsidiaries everywhere, in line with what was becoming best practice in G10 countries (Goodhart (2011)). These efforts led to the introduction of a nationality breakdown in the BIS locational banking statistics (LBS) and to the collection of the BIS consolidated banking statistics (CBS) starting in 1983. While the nationality view has long been recognised in policy circles (Borio (2013), Tissot (2016), IAG (2015)), a growing academic literature now appreciates its importance (as surveyed by Florez-Orrego et al (2023)).

Even so, many benchmark statistics used in international finance lack the dimensions needed for a complete nationality view (Box A). The BoP/IIP are residence based, as are the key bilateral (country-to-country) CPIS and CDIS data sets. While the BIS LBS and CBS provide a nationality view for the banking sector, comparable data for the non-bank sector are partial at best. As shown in the next section, vendor data on the issuance of debt securities, used to compile the BIS international debt securities (IDS) statistics, and on syndicated loans can be used to consolidate non-banks' *liabilities* (although coverage is incomplete). However, non-banks' consolidated *asset* positions remain a blind spot, in particular for insurance companies, funds and asset managers with international operations.

## Moving from residence to nationality

How far do BIS statistics go in providing a nationality view of international finance? As shown below, consolidation makes many financial centres "disappear", as it reallocates positions to the parent countries of the entities operating there. This, in turn, reveals the extent of concentration in international finance and underscores the significance of large multinational lenders and borrowers headquartered in a handful of countries. Consider the bank and non-bank sectors in turn, using IBS, IDS and vendor data on syndicated loans.

Box A

### Residence and nationality in international financial statistics

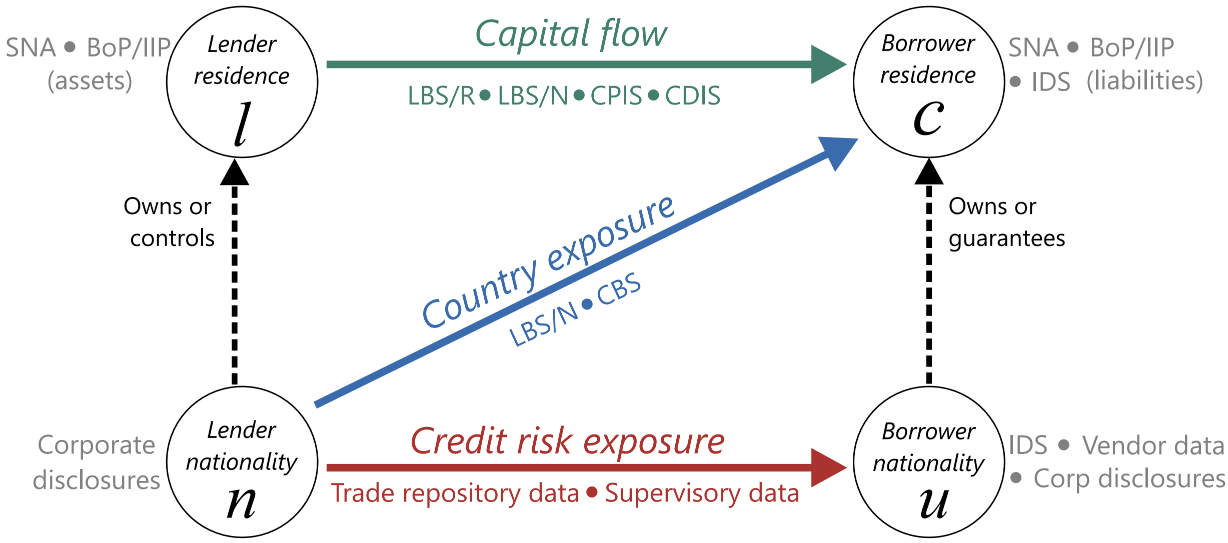
Statistics in international finance differ in how they link financial positions to individual countries. This box provides a simple framework for understanding the country dimensions in international data and classifies benchmark statistics accordingly.

The framework is based on two economic units that transact with each other, one as a lender and one as a borrower (Graph A1). The top two nodes relate to the *residence* view; they identify the country in which the lender and borrower reside. The arrow ($l \rightarrow c$) represents flows or positions between them. The key principle in the residence view is that financial positions of all units resident in the same country are aggregated, regardless of whether these units are controlled by, or otherwise connected to, parent entities located in other countries.

The bottom two nodes in Graph A1 relate to a *nationality* view. While nationality can be defined in various ways, the relevant criterion in international finance is often the location where corporate decision-making and control resides. The lender and borrower units in this case can be interpreted as consolidated corporate groups, each assigned the nationality of the country of their headquarters. The key principle in the nationality view is that the financial positions of all units controlled by the same headquarters are aggregated along the perimeter of their consolidated balance sheet, even if the units that comprise the group reside in different countries.

The residence and nationality views both have merit; the appropriate choice depends on the analytical question. To understand where funds are sourced and used, and how they relate to economic activity in particular countries, the geography of capital flows provided by the residence view ($l \rightarrow c$) is most natural. By contrast, a consolidated view of the lenders' exposures to a particular country ($n \rightarrow c$) is needed if the goal is to monitor the exposure to risks incurred there: *country risk* is the risk that borrowers do not fulfil their obligations for country-specific reasons beyond the counterparty's control; *transfer risk* stems more narrowly from policy measures such as capital controls, payment moratoriums and limitations on convertibility. Supervisory evaluation of counterparty credit risk between two entities in turn requires consolidating the borrower side too ($n \rightarrow u$) to account for parent company guarantees and other credit risk mitigants.

Country dimensions in international financial statistics[1] Graph A1




SNA = system of national accounts; BoP/IIP = balance of payments/international investment position; LBS/R and LBS/N = locational banking statistics by residence and by nationality; CBS = consolidated banking statistics; CPIS = IMF Coordinated Portfolio Investment Survey; CDIS = IMF Coordinated Direct Investment Survey; Supervisory data = bank supervisory data; IDS = international debt securities; Vendor data = eg syndicated loans (Dealogic).

[1] The nodes (*n, l, c, u*) represent lenders (left) and borrowers (right) on the basis of residence (top) or nationality (bottom). The arrows and text in large font describe how these country dimensions relate to each other; the small font lists data sets related to the nodes and arrows.

Source: Authors' elaboration.

How do benchmark data sets in international finance relate to the nodes and arrows in Graph A1? The small font lists data sets next to the nodes and arrows that they relate to. The SNA and BoP/IIP are compiled on a residence basis and cover the financial positions (assets and liabilities) of resident units. These statistics link units directly to economic activity in the same country and abroad, but without information about the allocation of their external positions across counterparty countries. These data sets are thus listed (in grey) next to the upper nodes in Graph A1 and not next to arrows. The BIS IDS are similarly unilateral in that they track only bond liabilities without information about lenders (bond holders). However, the IDS can be organised by both borrower residence and borrower nationality and thus are listed near nodes *c* and *u*.

*Bilateral* data sets, ie those that capture information about both lender and borrower units, link two nodes in Graph A1 and are thus listed next to arrows. The CPIS and CDIS are collected on a residence basis and track cross-border positions with counterparties in specific countries ($l \rightarrow c$). By contrast, the BIS CBS consolidate positions on the lender side (*n*) to track banks' claims on borrowers resident in particular countries ($n \rightarrow c$). The BIS LBS can be organised by both residence (LBS/R) and nationality (LBS/N) and thus are listed next to both the ($l \rightarrow c$) and ($n \rightarrow c$) arrows.

Few bilateral data sets consolidate on *both* the lender and borrower sides. This is the value of non-public supervisory data (eg that compiled in the BIS International Data Hub) used for monitoring counterparty credit risk exposures and funding dependencies. Some vendor data, eg syndicated loans from Dealogic, can also be consolidated by lender and borrower nationality, but the identity of lenders is typically lost once loans are traded in the secondary market. Full consolidation is also possible, in principle, in transaction-level data in trade repositories covering derivatives, repos and other financial instruments, although data aggregation remains a challenge (IFC (2017, 2018)).

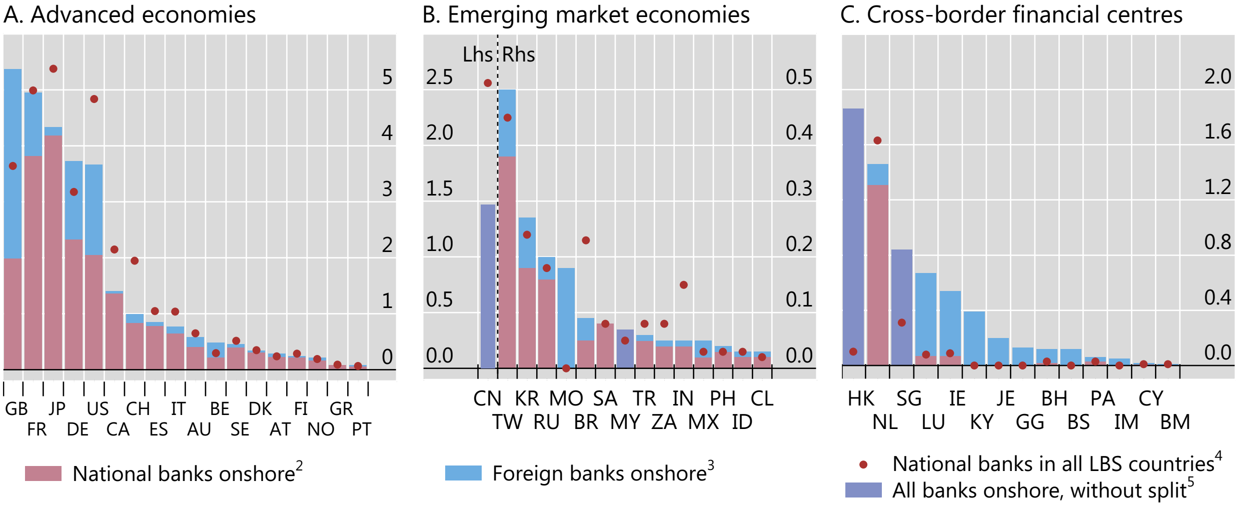
Banks play an important role in intermediating international financial flows.[3] Activity is highly concentrated in a small number of international banks. The 30 global systemically important banks (G-SIBs) headquartered in just 11 countries operate in more than 160 jurisdictions. The IBS reporting population includes far more than the 30 G-SIBs. Even so, banks headquartered in just five countries accounted for well over half of global cross-border claims; each of these banking systems recorded more than $3 trillion.

Multinational banks drive in part the differences between the residence and nationality views for individual countries (Graph 2).[4] In financial centres, the lion's share of cross-border bank positions is booked by foreign banks (blue bars) rather than by banks headquartered there (red bars). The flip side is that banks of a given nationality book cross-border positions from their offices around the world (red dots). Those positions booked outside their home country affect host countries' external positions. Going from residence (bars) to nationality (dots) makes financial centres shrink (eg Luxembourg, Cayman Islands). It also increases the prominence of those countries that are home to multinational banking groups (eg China, Switzerland, United States).

For non-banks, available data provide only a partial nationality view since comprehensive statistics on their consolidated financial holdings (assets) do not exist

Cross-border claims of banks[1]

In trillions of US dollars; as of end-Q3 2023 — Graph 2




[1] See technical annex for details. [2] Banks headquartered and located in the country shown on the x-axis. [3] Banks located in the country on the x-axis but headquartered elsewhere. [4] Banks headquartered in the country on the x-axis; positions booked by offices in LBS reporting countries. [5] All banks located in the country shown on the x-axis (split is masked).

Sources: BIS locational banking statistics (LBS); authors' calculations.

[3] Banking is reflected in several functional categories of the IIP. Loans and deposits are recorded in "other investment". This category makes up a greater share in economies where banks have a more significant role. It accounted for 40% or more of external liabilities for 100 economies, with only 16 of these being advanced economies.

[4] Graph 2 shows bank sector claims; the IBS afford a similar view of bank sector liabilities.

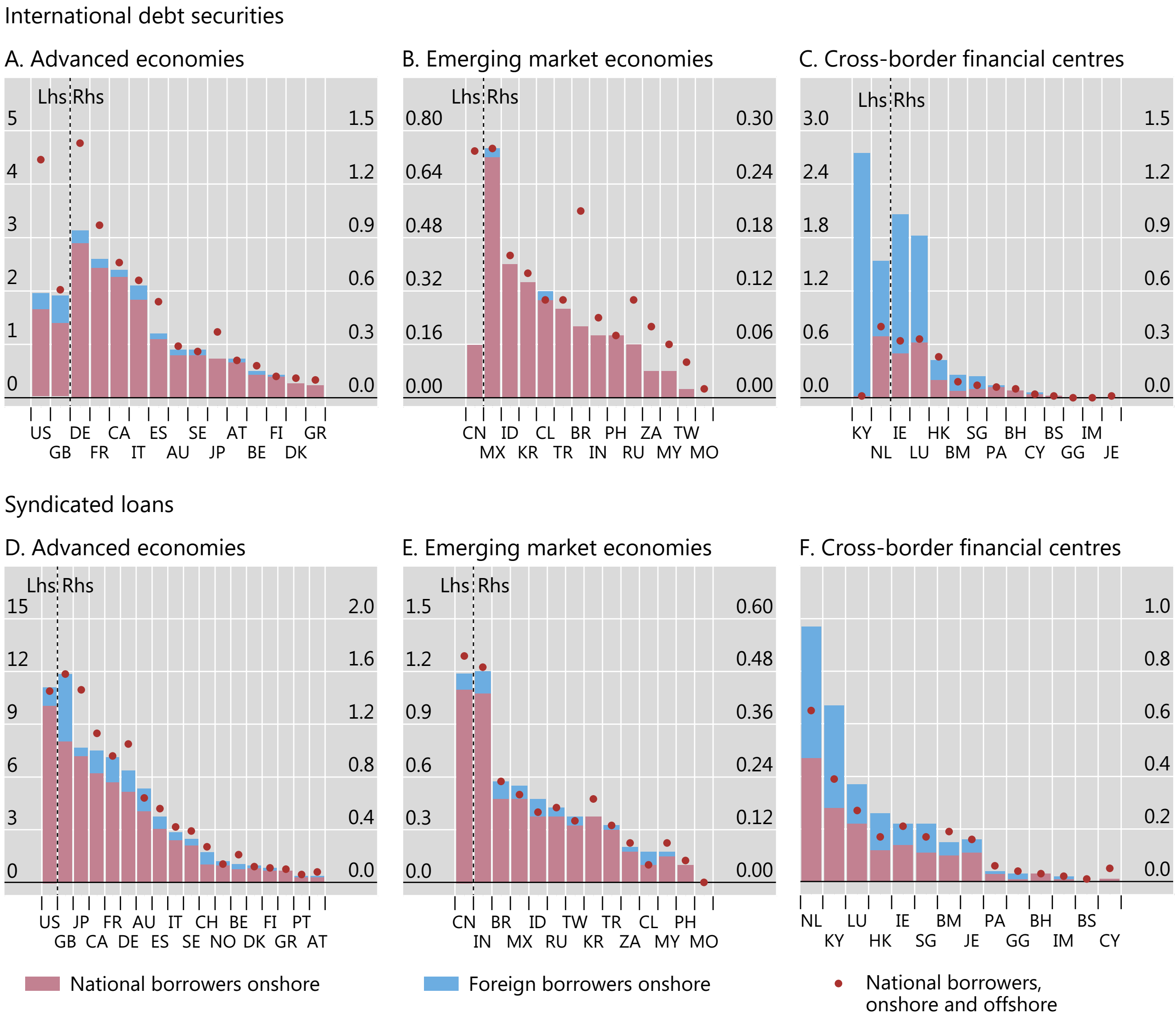
for most countries. A portion of non-banks' liabilities, however, can be tracked using the BIS IDS and vendor data on syndicated loans (Graph 3). For example, corporates resident in the Cayman Islands issue bonds in international markets (Graph 3.C, stacked bars), but the obligors are predominantly subsidiaries of foreign firms (Graph 3.C, blue bars). Foreign obligors also owe the bulk of outstanding debt issued by residents of the Netherlands, Ireland, Hong Kong SAR, Luxembourg, Singapore and Bermuda. From a nationality perspective, the amounts owed by entities headquartered in these countries (except Hong Kong SAR) is considerably less than total resident issuance, and thus the red dots lie below the total of the stacked bars.

For many advanced and emerging market economies, this pattern is reversed (Graphs 3.A and 3.B). Due to offshore issuance, US, Japanese, Chinese and Brazilian obligors' global consolidated debt (red dots) is significantly higher than the amounts owed by residents of the home country (stacked bars). This reflects the reallocation

## Consolidating non-banks' outstanding debt[1]

In trillions of US dollars; as of end-Q4 2023

Graph 3




[1] The non-bank sector comprises non-financial corporations, non-bank financial institutions, households and general government. See technical annex for details. "Onshore" refers to entities located in the country and "Offshore" to entities located elsewhere.

Sources: Dealogic; Euroclear; LSEG, Xtrakter Ltd; authors' calculations.

of the debt of foreign obligors in financial centres (Graph 3.C, blue bars) to the amounts owed by nationals of advanced and emerging market economies.

In syndicated loans, the gap between the residence and nationality views is not as wide (Graph 3, bottom panels). Still, in financial centres, the bulk of loans are to foreign resident borrowers. Reallocating these by nationality again pushes the red dots above the stacked bars for several advanced and emerging market economies.

## Insights from a nationality perspective

Adopting a nationality view helps in understanding many policy-relevant phenomena that are obscured in residence-based statistics. Consider three examples.

### Foreign currency debt

The first example, which follows directly from the discussion above, shows that several countries have incurred more foreign currency debt than is evident in residence-based statistics. This is not a new point. Gruić and Wooldridge (2012), McCauley et al (2015) and Aldasoro et al (2021) examined the debt of non-bank borrowers in several large EMEs and found that the offshore issuance of corporate bonds significantly increased debt amounts in several cases. Coppola et al (2021) conduct a systematic reallocation of corporate bonds to the ultimate obligors, redrawing the global map of bond obligations.

BIS statistics go a long way towards providing a nationality-based view of countries' foreign currency debt. The BIS global liquidity indicators (GLIs) provide estimates of non-banks' US dollar-, euro- and Japanese yen-denominated debt on a residence basis, shown as black dots in Graph 4.[5] The stacked bars show estimated amounts on a nationality basis, constructed using the IDS and syndicated loans to reallocate obligations to the country of the ultimate obligor.[6]

Some countries owe more foreign currency debt on a nationality basis when debt incurred by offshore affiliates is taken into account. Among advanced economies, Japanese non-banks have considerably larger dollar liabilities than the residence-based measure indicates (Graph 4.A). This is mainly because of syndicated loans obtained by offshore affiliates of Japanese companies (contained in the red bar). Similarly, German non-banks' nationality-based measure is also larger, due to both bond issuance by and loans to corporate affiliates offshore. By contrast, for some countries, the nationality debt measure is actually lower than the residence measure. This is most obvious for Luxembourg, the Netherlands and Ireland, which host foreign affiliates that tap international debt markets (and which were treated as cross-border financial centres in Graphs 2 and 3).

[5] The GLIs are compiled by adding cross-border and local loans to non-banks (from the IBS) to outstanding international bonds (in those currencies) issued by resident non-banks (from the IDS). The figures in Graph 4 include debt denominated in a foreign currency (eg euro-denominated debt is excluded in the figures for euro area countries).

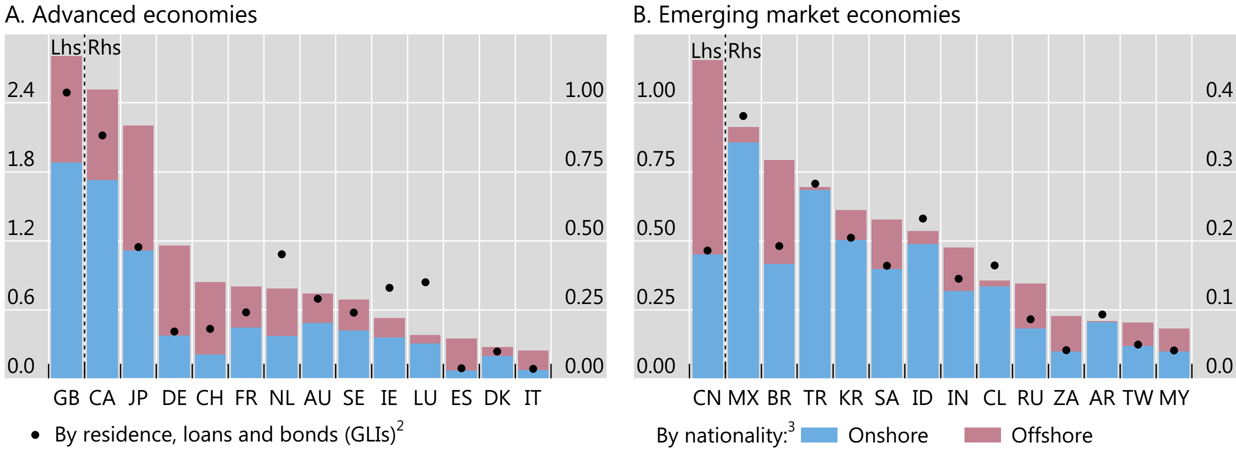
[6] The adjustment of the residence-based loan portion of the GLI is done using syndicated loans, for which the residence and nationality of the borrower is available. However, not all loans are syndicated; no adjustment is made for non-syndicated loans.

In EMEs too, several countries stand out (Graph 4.B). Chinese non-banks have outstanding dollar debt in excess of $1 trillion when offshore issuance is included, more than double the residence measure (black dot). A similar picture emerges for Brazilian and South African non-banks (in terms of ratio if not size). Offshore debt also contributes noticeably to the dollar debt of Saudi Arabian, Indian and Malaysian non-banks. The greater liabilities of borrower countries in turn imply that lenders have larger exposures to those borrowers than is apparent from residence-based statistics. Coppola et al (2021) highlight the rise in exposures to BRICS countries (Brazil, Russia, India, China and South Africa) after including offshore bond issuance.

Non-banks' outstanding debt denominated in US dollars, euros and Japanese yen[1]

In trillions of US dollars; as of end-Q3 2023

Graph 4




[1] Foreign currency loans and bonds denominated in US dollars, euros and Japanese yen. The non-bank sector comprises non-financial corporations, non-bank financial institutions, households and general government. See technical annex for details. [2] Outstanding debt by residence, as tracked in the BIS GLIs. [3] Estimated loan and international debt securities liabilities of non-banks headquartered in the country listed on the x-axis. "Onshore" refers to entities located in the country and "Offshore" to entities located elsewhere.

Sources: Dealogic; Euroclear; LSEG; Xtrakter Ltd; BIS global liquidity indicators (GLIs); BIS locational banking statistics; authors' calculations.

## Deglobalisation in banking?

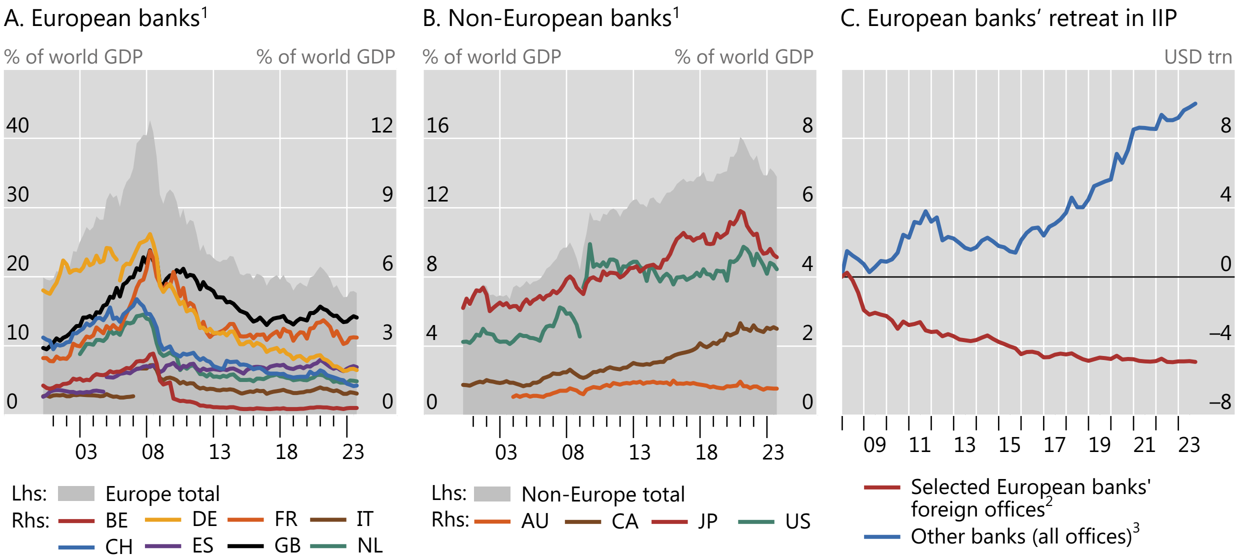
Consider next the evolution of international banking in the aftermath of the GFC. Some observers asserted that global finance had passed its high-water mark and that financial deglobalisation had begun.[7] The decline in cross-border banking positions from most major banking locations seemed to confirm this.

Viewing this through the lens of consolidated balance sheets reveals the banking systems driving these changes. McGuire and von Peter (2009), IMF (2015) and McCauley et al (2019) show that rather than being a general shift, the retreat of global banking was driven by a few banking systems. European banks cut their global operations as they deleveraged their unsustainably risky balance sheets (Graph 5.A). By contrast, US, Canadian, Japanese, Australian and other banking systems maintained or continued to grow their foreign claims (Graph 5.B). These patterns do not come to light as forcefully in the residence view.

[7] See Ghezzi et al (2009). Forbes (2014), Forbes et al (2017) and Eichengreen (2016).

Because European banks had offices of significant size in many countries, their post-GFC deleveraging affected many host countries' IIP positions. Between 2008 and 2016, selected European banking systems shed a cumulative $5 trillion in cross-border claims in their *foreign* offices alone (Graph 5.C, red line).[8] By contrast, other banks with offices in the same countries expanded their cross-border claims by more than $2 trillion. In short, changes in the balance sheets of European banks' foreign affiliates had a larger effect on the external bank asset positions of host countries than did those of all the other banks located in these host countries (including those with head offices in these countries).

Consolidated foreign claims and deglobalisation in banking — Graph 5




Gaps in the plotted series indicate breaks in series reflecting, for example, bank mergers or changes in the reporting population. Country codes denote the nationality of banks.

[1] By bank nationality shown in the legends. See technical annex for details. [2] Cumulative change since Q1 2008 in cross-border claims booked by AT, BE, DK, FR, DE, IT, NL and CH banks' offices outside the home country. [3] Cumulative change since Q1 2008 in cross-border claims booked by all banks other than the selected European banks; includes claims booked in home offices and offices abroad.

Sources: IMF, *World Economic Outlook*; BIS consolidated banking statistics; BIS locational banking statistics; authors' calculations.

## Towards a consolidated wealth of nations

Finally, consider the financial openness of economies. How strong is the trend toward greater international financial integration, especially after the GFC? Lane and Milesi-Ferretti (2007, 2018) have addressed this question by tracking countries' external assets and liabilities as a ratio to GDP. Their work has sparked a line of research that examines country portfolios and valuation effects (Lane and Shambaugh (2010a, 2010b), Gourinchas and Rey (2014) and Bénétrix et al (2015)).

However, measures of financial integration need not start and stop at the border. Foreign ownership and control add a whole new dimension to financial integration, one that the residence perspective ignores. If Australians own banks in New Zealand,

[8] Moreover, European banks also shed local claims booked by their foreign affiliates around the world, which is not reflected in any country's external position.

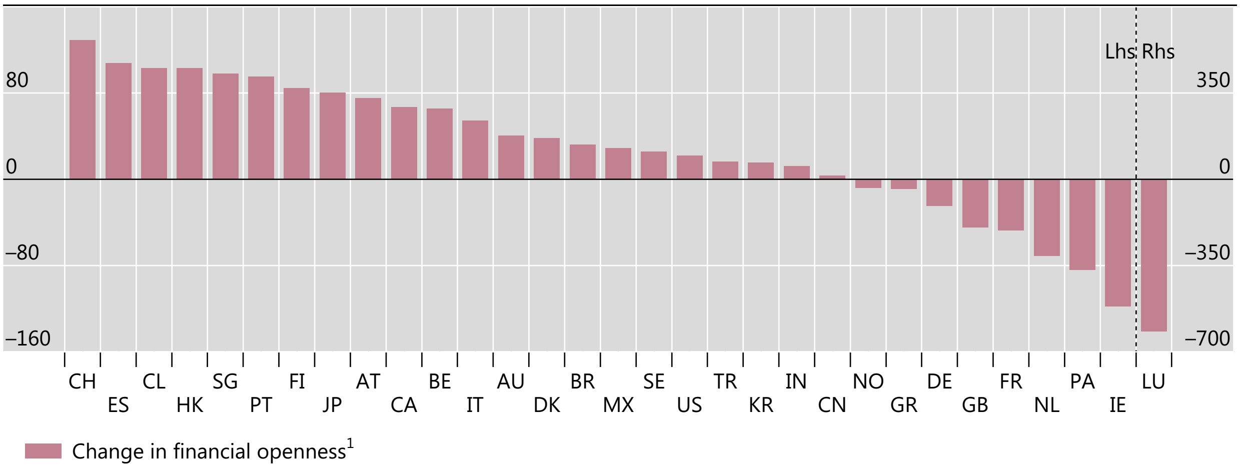
it makes both countries more open: Australia adds to its foreign assets through the local and cross-border claims of its banks in New Zealand; New Zealand adds to its foreign assets because residents' local deposits in Australian banks are claims on foreign entities. In general, banks' positions booked in affiliates abroad add to openness both at home and abroad.

A partial measure of consolidated openness redraws the border around countries' banking operations. As a first step, cross-border bank positions in the IIP of a given country are replaced with the consolidated foreign claims of banks headquartered there. Consolidated foreign claims exclude interoffice positions but include banks' cross-border and local positions booked by their foreign affiliates abroad. In a second step, the deposits of the country's residents placed in foreign banks operating there are added, since these are claims on a foreign institution.[9] These steps transform a country's bank-related external assets to *foreign* assets. The same steps can be taken on the liability side, allowing openness to be defined as foreign assets and liabilities to GDP. Graph 6 shows how these steps contribute to financial openness, keeping other sectors' positions unchanged.

On a consolidated basis, most economies exhibit a greater degree of financial openness than on a residence basis (Graph 6). In aggregate, the consolidated measure is greater by 18% of GDP (weighted average) than the traditional measure based on residence. In addition, the measured openness rises for most economies (22 out of the 31 shown), with the median economy appearing more financially open by about 30% of GDP. Extending this exercise to the balance sheets of multinational

## The contribution of banking to countries' openness

As a percentage of GDP — Graph 6




[1] Change in financial openness when shifting from a residence-based measure to a measure that consolidates bank-related positions. No adjustment is made to positions of other sectors. The consolidated foreign positions of CN banks are estimated using the BIS locational banking statistics by nationality.

Sources: IMF, *International Investment Position* and *World Economic Outlook*; BIS consolidated banking statistics; BIS locational banking statistics; authors' calculations.

[9] Existing statistics identify the immediate counterparty but do not allow us to pierce through possibly several layers of ownership all the way to the ultimate beneficial owner (see Box A). In practice, this means that the counterparties to local bank positions are assumed to be nationals of that location.

firms, where possible, would raise consolidated openness even further (BIS (2015), Avdjiev et al (2018), Sanchez Pacheco (2023)).

## Conclusion

This feature presents how BIS statistics can be used to understand topics in international finance from both a residence and nationality perspective. The latter groups balance sheets by the country of headquarters, based on the organising principle of ownership and control. This is needed to assess the global impact of decisions taken by multinational firms and intermediaries.

The nationality view fundamentally alters our understanding of countries' and sectors' international positions. The bulk of the positions recorded in financial centres are reallocated to the countries where firms are headquartered. This reallocation yields new measures of countries' indebtedness and their financial openness and reveals the importance of multinational firms and intermediaries in international finance. Understanding *who* drives changes in international positions, and *whom* these changes ultimately affect, is crucial for monitoring financial stability.

This cannot be seen in most international financial statistics. BIS statistics are an exception. The BIS IBS provide a joint residence- and nationality-based view of banks' asset and liability positions as well as a similar picture for non-banks, but only for their international bond liabilities. A blind spot is the consolidated asset side of non-banks' balance sheets. The question of who ultimately owns the trillions of dollars' worth of government and corporate bonds traded across borders becomes increasingly salient as non-bank financial institutions gain a larger share in the global financial system.

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## Technical annex

BoP = balance of payments; CBS = consolidated banking statistics; CDIS = Coordinated Direct Investment Survey; CPIS = Coordinated Portfolio Investment Survey; G-SIBs = global systemically important banks; IBS = BIS international banking statistics; IDS = international debt securities; IIP = international investment position; LBS/N = locational banking statistics by nationality; LBS/R = locational banking statistics by residence; SNA = system of national accounts.

Cross-border financial centres comprise the following 22 jurisdictions, as defined in Pogliani, von Peter and Wooldridge (2022): BH, BM, BS, CW, CY, GG, GI, HK, IE, IM, JE, KY, LR, LU, MH, MT, MU, NL, PA, SG, SM and VG. The names of jurisdictions corresponding to ISO codes are provided under the Abbreviations on page viii to x.

Graph 1: Cross-border financial centres comprise the 22 jurisdictions mentioned above.

Graph 2: Cross-border financial centres comprise the subset of 15 jurisdictions that report the BIS locational banking statistics: BH, BM, BS, CW, CY, GG, HK, IE, IM, JE, KY, LU, NL, PA and SG. Data for Russia (RU) relate to Q4 2021.

Graph 3: Data refer to the non-bank sector as immediate borrowers and all sectors as ultimate borrowers. Cross-border financial centres comprise the same 15 jurisdictions as in Graph 2.

Graph 4: Data for outstanding debt on a residence basis (black dots) are from the BIS global liquidity indicators (GLIs; see www.bis.org/statistics/gli/gli_methodology.pdf).

Stacked bars are estimates of outstanding debt on a nationality basis. Data for onshore and offshore bond liabilities are from the IDS.  Onshore loans are estimated as the GLI measure of cross-border and local loans from the BIS locational banking statistics minus the syndicated loans received by foreign entities in that country; offshore loans are syndicated loans to foreign affiliates of non-banks headquartered in that country. No adjustment is made for loans that are not syndicated.

Graph 5: "Europe-total" comprises banks headquartered in 18 jurisdictions: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, NL, NO, PT, SE and TR. "Non-Europe total" comprises banks headquartered in 13 jurisdictions: AU, BE, CA, CL, IN, JP, KR, MX, PA, US, HK, SG and TW.

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