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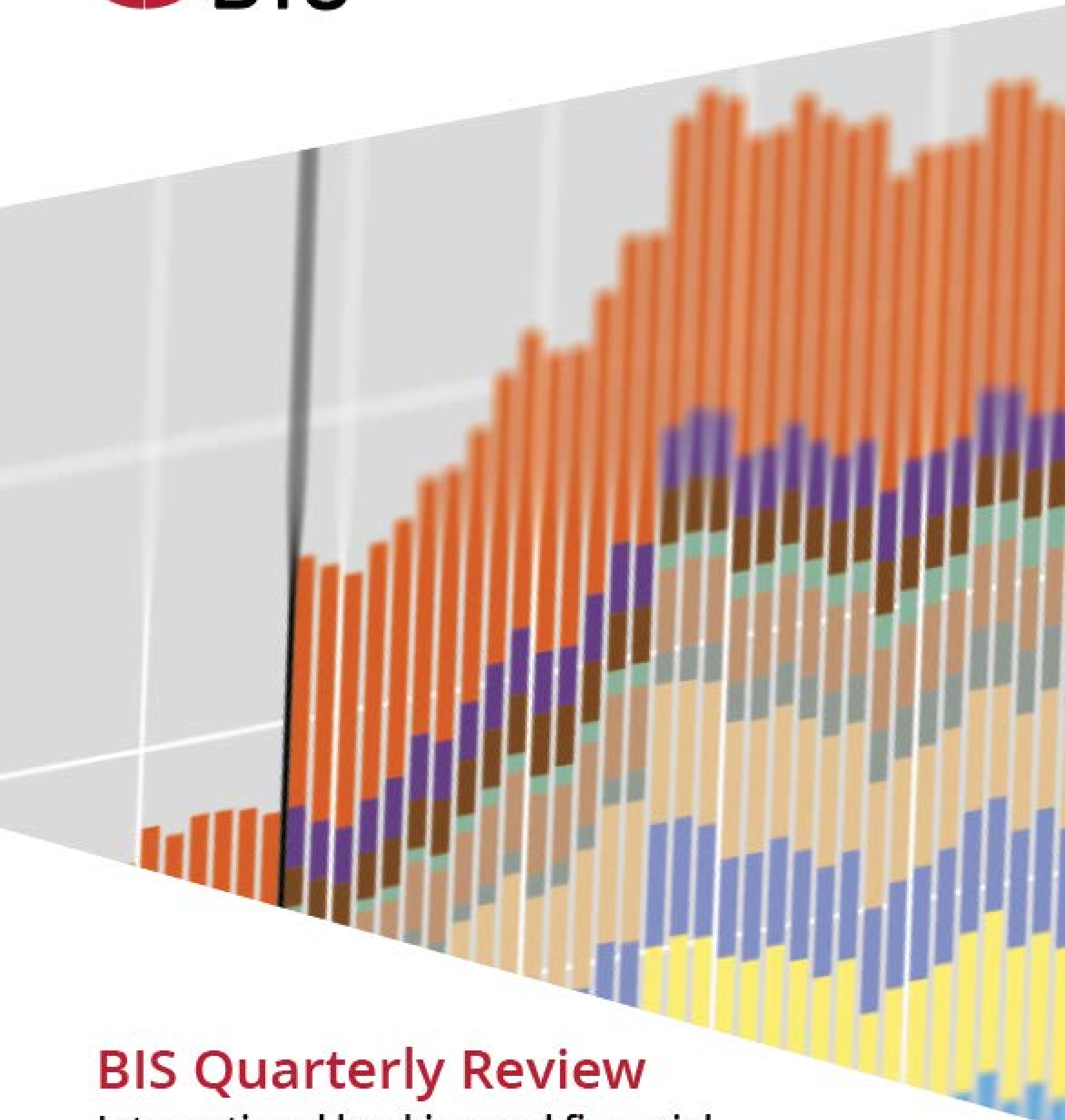

BIS Quarterly Review

International banking and financial market developments

September 2026

BIS Quarterly Review
Monetary and Economic Department

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Articles

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.

Yields climb, yet risk appetite holds firm

Executive summary

In the review period① flare-ups in geopolitical tensions tested the positive momentum that had characterised the first half of the year. Markets faced bouts of volatility as hostilities in the Strait of Hormuz heightened uncertainty about the inflation and monetary policy outlook. On top of that, lingering concerns about the sustainability of fiscal burdens added to the pressure. The prospects of higher rates stemming from these macroeconomic challenges compounded markets' unease about valuations and possible overinvestment in the tech sector, disrupting the equity momentum driven by artificial intelligence (AI). Yet while investors' risk appetite ebbed and flowed, it proved resilient on the whole.

Sovereign yields extended their upward march. Monetary policy expectations fluctuated amid flare-ups in geopolitical tensions and generally benign inflation readings in the United States, but eventually rates edged higher. Investors' uncertainty about the Federal Reserve's reaction function also contributed to higher volatility in July, especially at the front end of the yield curve. At the long end of the term structure, yields rose further, partly driven by rising term premia that reflected fiscal pressures rather than inflation concerns. The pressure on long-term yields played out in core markets globally. In the euro area, these pressures were compounded by a steady widening of sovereign spreads as energy price swings returned to the fore.

The AI-led momentum in global equity markets wobbled amid growing signs of vulnerability in the tech sector. Rising concerns about the future profitability of significant AI investments and the sustainability of large profit margins were fuelled by the increasing leverage of major US tech firms. Nevertheless, despite some price corrections for these firms, valuations stayed elevated across US equities. While bouts of aggregate volatility remained contained, even in the wake of the failure of a highly leveraged AI-focused hedge fund, idiosyncratic risks perked up beneath the surface.

Equity market developments reflected investors' reassessment of prospects in different sectors. In the United States, small caps performed better and outpaced tech firms. In a similar vein, non-US markets took the baton and generally outperformed those in the United States. Across regions, euro area equities posted gains, helped by a smaller tech weight and the strong performance of banks, and emerging market economy (EME) markets also performed well. Amid extreme volatility, Korean markets whipsawed due to heavy semiconductor exposure, magnified by leveraged positioning.

Credit markets reflected the shifts in investors' risk assessments only in part. While spreads remained compressed by historical standards, investors tilted towards higher-quality borrowers. Large tech firms ramped up their bond issuance, especially at longer maturities. By contrast, issuance slowed in riskier segments. In EMEs, corporate spreads broadly narrowed, except for Europe, the Middle East and Africa where they traded sideways. Gold extended its decline from early-year peaks and recovered ground only when fiscal woes gained prominence.

① The review period covers 1 June to 3 September 2026.

Key takeaways

- *Government bond yields rose, especially those with longer maturities, partly driven by looming fiscal challenges pushing up the compensation that investors require to hold longer-term bonds.*
- *AI-driven momentum wobbled, given concerns about valuations and potential overinvestment, but investors reallocated their bets across other sectors and countries, underscoring resilient risk appetite.*
- *Credit markets were relatively unscathed by the ebb and flow of risk appetite, notwithstanding surging bond issuance by large tech firms.*

Long rates march higher

Government bond yields extended their march upward, especially at longer maturities, on the back of a tighter expected policy path and rising term premia – the compensation that investors require to hold longer-term bonds. At the beginning of the review period, optimism over the prospects of a resolution of the conflict in Iran initially led yields to fall. However, they resumed their hike when tensions flared up at the end of June, amid growing concerns over the potential consequences of a prolonged conflict for the near-term inflation outlook, as well as for fiscal balances.

As geopolitical tensions came to the fore, market-based expectations of policy rate trajectories edged up, reflecting possible inflationary pressures in the short to medium run. In the United States and the euro area, the expected hiking of policy rates was gradual across all horizons, while in Japan it was more pronounced and front-loaded, extending until the end of 2027 (Graph 1.A).

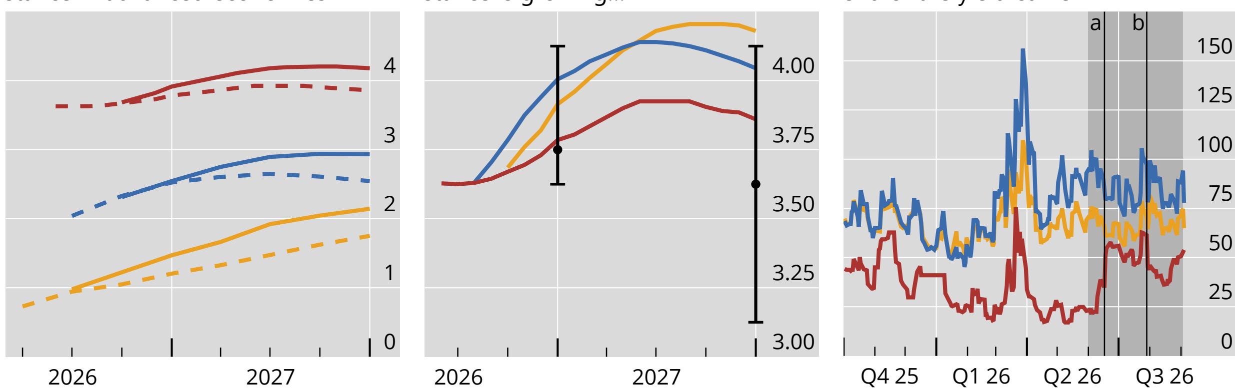
Geopolitical tensions add uncertainty to the monetary policy outlook

In per cent | Graph 1

A. Markets expect a tighter policy stance in advanced economies

B. Uncertainty over the FOMC policy stance is growing…

C. …with more volatility at the short end of the yield curve



Policy rate expectations as of:
US: EA: JP:
- - / - - / - - 1 Jun 2026
— / — / — 3 Sep 2026

June Fed dot plot forecast:
● Median — 10th–90th percentiles
Implied policy rates on:
— 1 Jun 2026 — 3 Sep 2026
— 28 Jul 2026

USD swap option, implied volatility:
— Three months — 10 years
— Two years

FOMC = Federal Open Market Committee.

The shaded area indicates 1 June–3 September 2026 (period under review).

[a] FOMC June meeting press conference (17 June 2026). [b] FOMC July meeting press conference (29 July 2026).

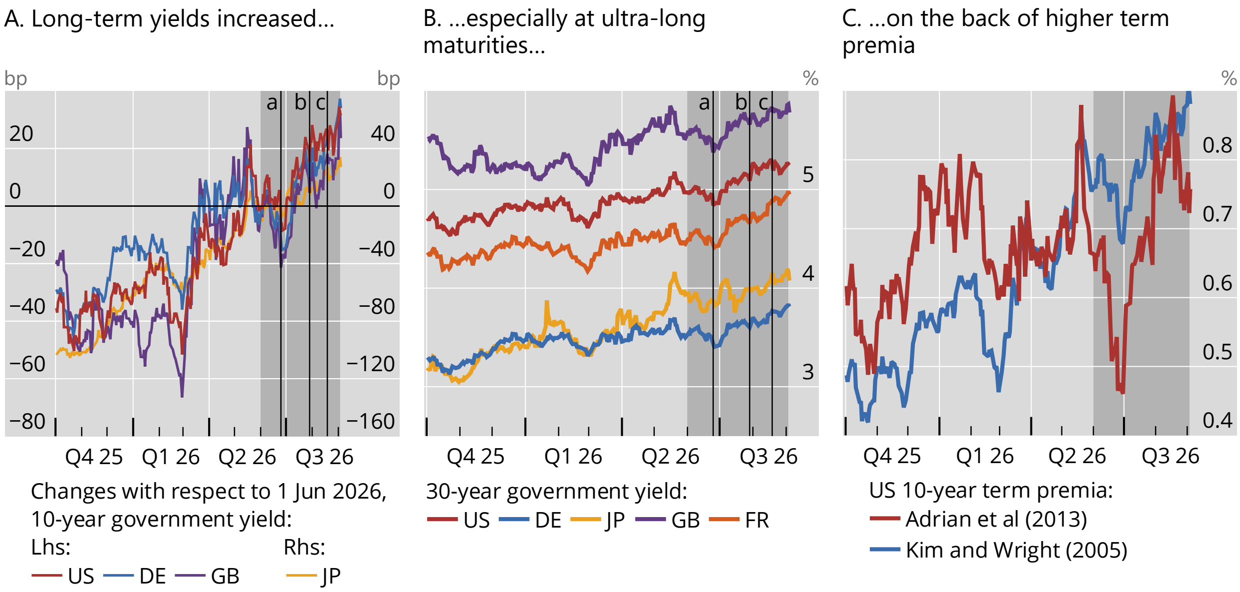
Sources: Board of Governors of the Federal Reserve System; Bloomberg; JPMorgan Chase; BIS.

Markets were especially attuned to any signs of a shift in the policy stance of the Federal Reserve. As the conflict with Iran flared up again at the end of June, markets started pricing a swifter tightening of policy to fend off a possible pass-through of higher energy prices to inflation (Graph 1.B, blue line). Yet the Federal Open Market Committee (FOMC) held rates steady at its end-July meeting, which led market participants to revise downwards their policy expectations. However, markets later reassessed the likelihood of further policy tightening, pricing it higher following Federal Reserve Chair Kevin Warsh's speech at the Jackson Hole Symposium, which was perceived as hawkish (yellow line), as well as a robust labour market reading for August.

The increased policy uncertainty, coupled with more concise communication, was reflected in higher bond market volatility. After the June FOMC meeting, volatility at the short end of the yield curve edged up and remained elevated, while longer maturities experienced a more transitory volatility increase after the July meeting (Graph 1.C). However, despite the uncertainties over the course of monetary policy, market-based measures of inflation compensation remained remarkably stable.

Arguably the main locus of market action was the long end of the yield curve, which saw especially pronounced upward pressure. As the likelihood of a tighter policy path increased at the end of June, 10-year government bond yields also resumed their upward trajectory. Overall, they had risen by 31 basis points in the United States, 34 basis points in Germany, 27 basis points in Japan and 24 basis points

Sovereign bond yields continue their hike | Graph 2



The shaded area indicates 1 June–3 September 2026 (period under review).

[a] First violation of the US-Iran Memorandum of Understanding (25 June 2026). [b] Federal Open Market Committee July meeting press conference (29 July 2026). [c] US Treasury announced an expansion of its liquidity support buyback operations (19 August 2026).

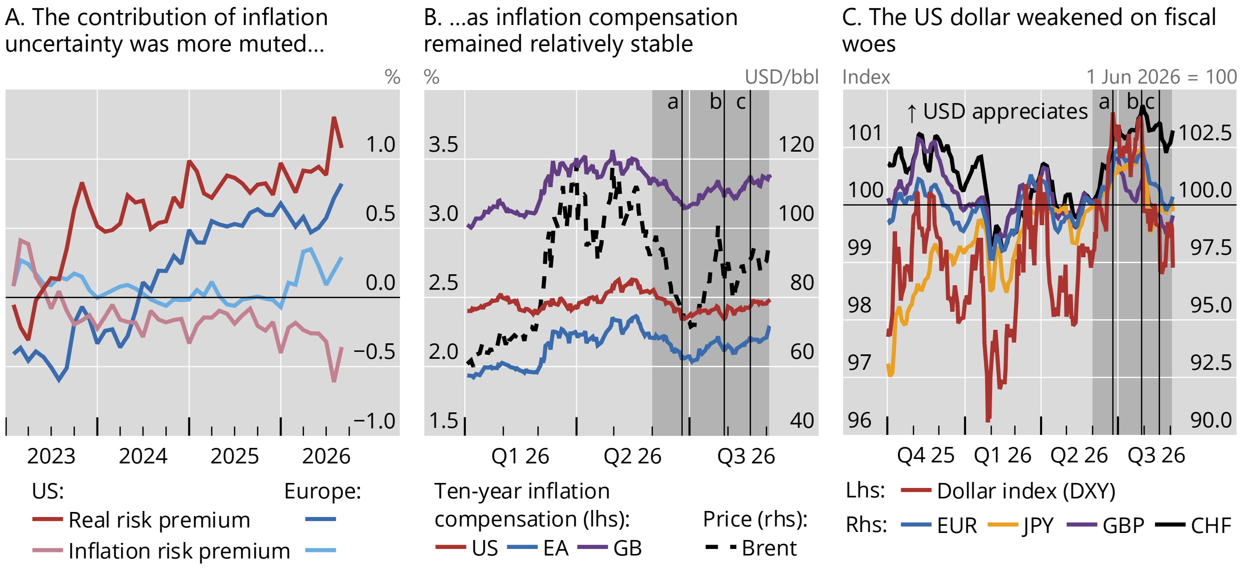
Sources: D Kim and J Wright, "An arbitrage-free three-factor term structure model and the recent behavior of long-term yields and distant-horizon forward rates", *Finance and Economics Discussion Series,* no 2005-33, Board of Governors of the Federal Reserve System, 2005; T Adrian, R Crump and E Moench, "Pricing the term structure with linear regressions", *Journal of Financial Economics,* vol 110, no 1, 2013; Bloomberg; Macrobond; BIS.

in the United Kingdom by the end of the review period (Graph 2.A).[2] Looking at the ultra-long end of the yield spectrum, 30-year yields extended their upward hikes, reaching multi-decade highs in many jurisdictions (Graph 2.B). Against this backdrop, on 19 August, the US Treasury announced a plan to buy back long-dated government bonds to support their liquidity (see Box A). While the announcement initially caused long-term yields to fall, they soon retraced a sizeable part of their initial declines. The announcement also triggered a rebound in gold prices, which had been on a downward trajectory since March.

The upward pressure on bond yields due to shifts in policy expectations was compounded by rising term premia. Following the flare-up of the conflict with Iran at the end of June, term premia for US 10-year government bonds rose by around 10 basis points according to different estimates (Graph 2.C), accounting for about 40% of the overall increase in 10-year yields.

With long-run inflation expectations remaining well anchored, model-based estimates indicate that increases in term premia were primarily driven by their real component (Graph 3.A). Several factors influence this part of the term premium. It can reflect growing uncertainty over the future path of short-term rates, including due to the possibility of higher equilibrium rates on the back of an AI-driven productivity boom. It can be influenced by possible crowding-out effects due to the

Term premia on the rise amid looming fiscal challenges[1] — Graph 3



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[1] See endnotes for details.

Sources: P Hördahl and O Tristani, "Inflation risk premia in the euro area and the United States", *International Journal of Central Banking*, vol 10, no 3, 2014; Bloomberg; LSEG Datastream; national data; BIS.

[2] With rising yields, government bond "cheapness" relative to derivatives has become a prevailing phenomenon across major bond markets (see Box C in the annex). Attracted by the resulting swap spreads, various leveraged, short-horizon investors, eg hedge funds, have become the marginal buyers of government bonds, even of private sector-issued covered bonds in some European markets (see Box D in the annex).

increasing bond issuance of large tech firms. But it is also linked to the fiscal outlook and the looming challenges for debt sustainability. While the precise contributions of these factors are difficult to disentangle, collectively they prompted investors to demand higher compensation for the risks associated with holding long-term government debt.

Market-based measures of longer-run inflation compensation remained relatively stable amid the waxing and waning of the prospects of a resolution of the Iran conflict. In July, as oil prices surged, 10-year inflation swap rates barely moved in the United States and increased only marginally in the euro area. This stands in contrast with the first half of the year, when such gauges moved in lockstep with oil prices, especially in the euro area and the United Kingdom (Graph 3.B). Overall, this signalled that markets became less attuned to the ups and downs in Iran-related news and remained confident that central banks would navigate these challenges.

Movements in interest rate differentials and looming fiscal woes also shaped exchange rate developments. The US dollar appreciated against most major advanced economy currencies until end-July as markets priced in faster policy tightening, but it shed most gains in August (Graph 3.C). The yen had depreciated significantly as the rate differential widened (yellow line), yet it saw a sharp recovery on 31 July following a joint official intervention by the Japanese ministry of finance and the US Treasury, and stabilised thereafter. The US Treasury announcement of 19 August also led to a depreciation of the dollar which persisted longer than the related fall in yields.

Box A

Announcement effects of expanded Treasury buyback operations

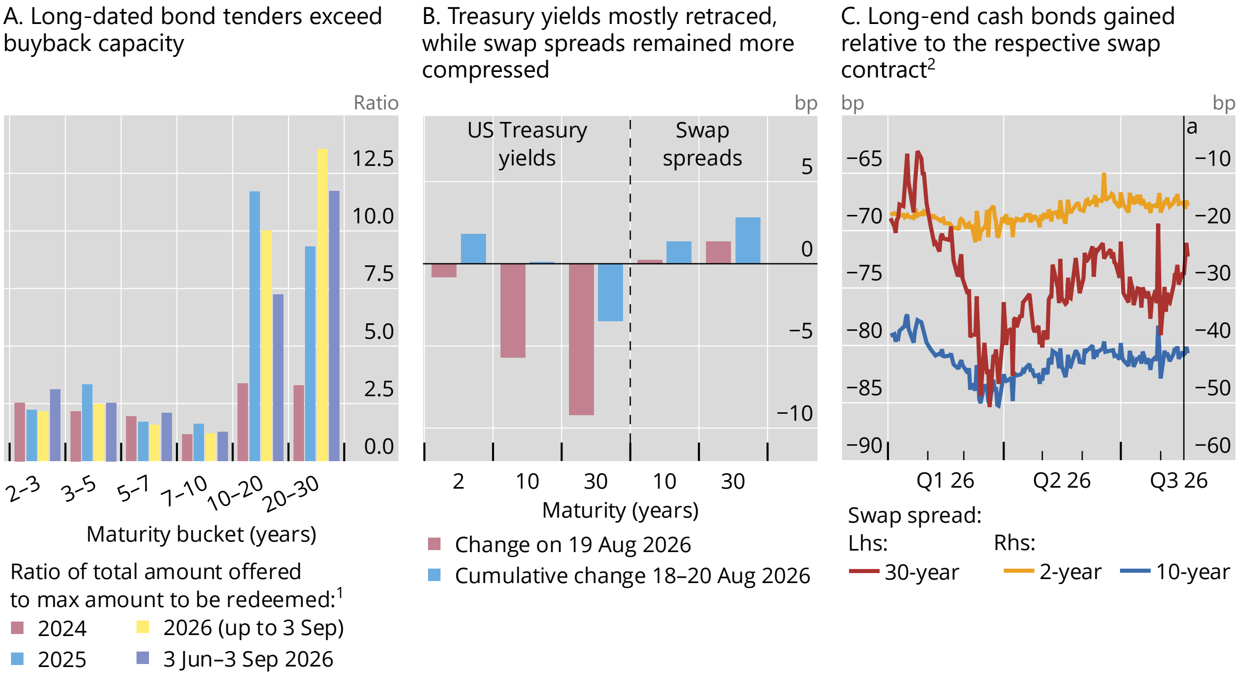
*Puriya Abbassi, Giulio Cornelli, Marco Lombardi, Andreas Schrimpf and Vladyslav Sushko*①

Debt management offices around the world regularly carry out bond buyback operations.② These operations are typically meant to smooth the debt repayment schedule and ensure sufficient liquidity for off-the-run securities, particularly at the long end of the yield curve.

On 19 August the US Treasury announced an extraordinary expansion of its liquidity support buyback operations. This expansion entails doubling the maximum size of nominal long-end securities buybacks, from $2 billion, so far, to at least $4 billion per operation, effective from 9 September through 4 November. The operations will be concentrated in the 10–20-year and 20–30-year segments where liquidity in off-the-run securities had been structurally poorer and upward pressure on yields more pronounced in past weeks. The announcement implies about $14 billion of additional incremental purchases. In the recent tenders for buybacks of long-term Treasuries, the sellers of securities with those tenors were offering eight to 12 times what the Treasury has been willing to buy (Graph A1.A).

The expected effect of these buybacks on the maturity of the Treasury's debt is small. The weighted average maturity (WAM) of outstanding debt will decrease by a negligible amount, estimated at around three days.③ For reference, the WAM has fallen from about 6.3 years in early 2023 to 5.8 years today, mostly due to the Treasury ramping up the issuance of T-bills at the expense of coupon-bearing securities. Also, during the 2011–12 operation Twist 2, the WAM increased from 5.3 to 5.5 years.

The announcement of the buyback expansion had mixed effects on markets Graph A1



[a] US Treasury announced an expansion of its liquidity support buyback operations (19 August 2026).

[1] Average of ratios over buybacks in each period based on the results published by the US Treasury. Liquidity support operations in nominal coupons only. [2] Fixed rate in an interest rate swap minus the corresponding maturity Treasury yield.

Sources: Federal Reserve Bank of New York; US Department of the Treasury; Bloomberg; LSEG Workspace; authors' calculations.

Announcement effects persisted longer in relative prices (spreads) than in the levels of long-term yields. In line with the buybacks targeting the very long end, 30-year and 20-year yields fell around 10 basis points and the 10-year yield fell nearly 6 basis points (Graph A1.B). Measured against the shifts in yields of recent months the reaction was modest and not very lasting. The more persistent response to the announcement showed in swap spreads for ultra-long bonds. Long-dated securities had been trading at a discount to derivatives, which was partly reduced by the prospect of a larger buyer for precisely those securities. These effects are visible in swap spreads, that is, the difference between the swap rate and the yield of cash bonds for the corresponding tenor. Akin to a "local supply effect" in a specific segment, the 30-year spread narrowed on 19 August and further compressed on the following day, while cash yields were already retracing (Graph A1.C).

The signalling value may matter more than sheer quantities. Some market participants interpreted the announcement as potentially signalling further shifts in issuance patterns, towards fewer long-term bonds and a greater share of Treasury bills. The next refunding announcement is scheduled for early November.

① The views expressed here are those of the authors and not necessarily those of the BIS or its member central banks. ② For instance, Canada, Japan, Italy and the United Kingdom conducted buyback operations on their government bonds over the last three decades; for a historical overview, see R McCauley and K Ueda, "Government debt management at low interest rates", *BIS Quarterly Review*, June 2009. For a discussion of the effects of debt management operations on interest rates, see J Chadha, P Turner and F Zampolli, "The interest rate effects of government debt maturity: solving the bond conundrum", *The World Economy*, vol 48, no 8, 2025. ③ The previous buyback operations conducted by the Treasury for a total of $67.5 billion over the period 2000–02 contributed to a negligible reduction of the average length of the debt, from 5.9 years in March 2000 to about 5.8 years in April 2002.

Risk assets stirred but not shaken

Despite some wavering, risk appetite proved broadly resilient to challenges from geopolitical tensions and rising yields. At the end of June, the positive momentum in tech stocks started to falter (Graph 4.A) as the macroeconomic challenges of a prolonged conflict in Iran weighed on sentiment. This was compounded by investors' unease about the future profitability of large AI investments made by hyperscalers – big US tech firms active in cloud computing and data centres.

Some investors reacted to AI woes by reallocating their portfolios towards other sectors and countries, which led to equity returns being more dispersed. At the most extreme, Korean markets plunged (Graph 4.A, orange line), due to their greater exposure to AI-linked firms and the turmoil in a few leveraged investment vehicles (see Box B). Euro area equities instead rose steadily (blue line), outpacing a choppier US market (red line), also thanks to the strong performance of banks. Japan's equity markets retained the positive momentum for the first part of the review period, but reversed their gains as geopolitical tensions intensified and energy prices surged (yellow line). EME equities benefited in this environment, supported in part by capital inflows and investors seeking greater diversification (purple line).

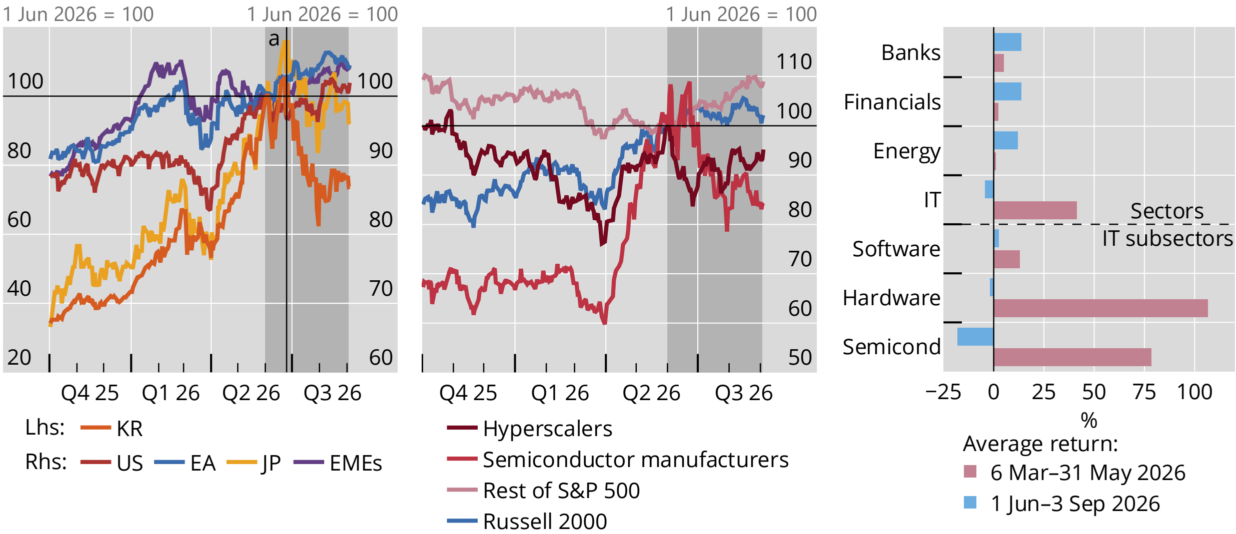
As the rally of tech stocks lost steam, the reallocation extended across sectors and among IT-related subsectors. Within the US stock market, small caps and the rest of the S&P 500 outperformed the hyperscalers and semiconductor manufacturers (Graph 4.B). More traditional sectors extended their positive performance (Graph 4.C). Returns varied markedly within the IT sector as well, reflecting investors' growing selectiveness in AI-connected industries.

US equities lagged those of other AEs and EMEs amid wobbly equity momentum[1] Graph 4

A. US stocks trailed those of other AEs and EMEs

B. Performance dispersion across US equity segments widened

C. Returns across sectors and within IT further diverged



IT= information technology; Semicond = semiconductor manufacturers.

The shaded area indicates 1 June–3 September 2026 (period under review).

[a] First violation of the US-Iran Memorandum of Understanding (25 June 2026).

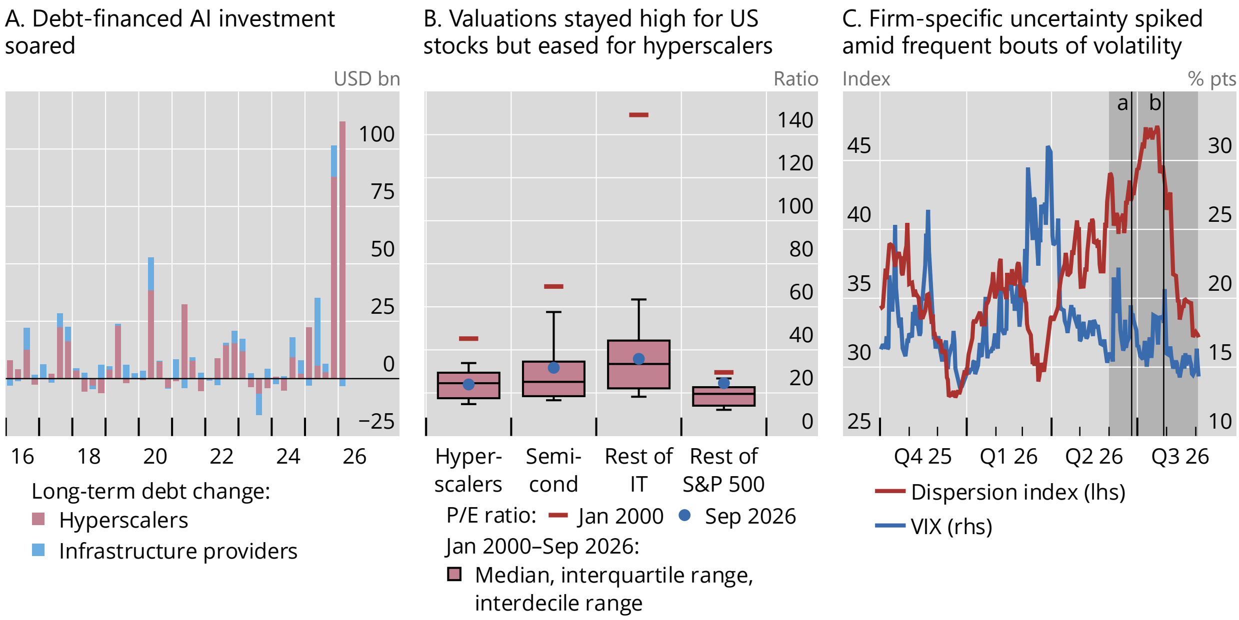
[1] See endnotes for details.

Sources: Bloomberg; LSEG Datastream; LSEG Workspace; national data; BIS.

The faltering momentum in hyperscalers' stock prices, despite their solid earnings, meant a drop in their valuations. Investors demanded a higher premium amid mounting unease about their booming debt issuance (Graph 5.A) and the sustainability of high profit margins. Price/earnings ratios of the broad IT sector thus dropped by between nearly 15% for hyperscalers and 40% for semiconductor manufacturers. After this correction, hyperscalers' valuations appeared to be more moderate, at least by historical standards. By contrast, valuations remained elevated across other US equities: while they were still far from the January 2000 dotcom levels for IT-related sectors, they edged close to those peaks for the rest of the S&P 500 (Graph 5.B).

Despite AI-related jitters and a rise in idiosyncratic risks, overall equity volatility remained contained. The relatively muted spikes in aggregate volatility gauges masked growing fissures, as firm-specific uncertainty and divergence across sectors dominated the risk backdrop (Graph 5.C). In July, the dispersion index – a measure of the gap between average single-stock and index volatility – rose to levels last touched in April 2025, while the VIX increased only modestly. As risk-taking sentiment reasserted itself in August, both measures subsided. Over the full review period, volatility remained broadly compressed even as markets absorbed a sizeable unwind of a hedge fund after its leveraged strategies on AI firms went sideways in July.

Investor concerns about the tech sector endured[1] — Graph 5



AI = artificial intelligence; IT= information technology; P/E = price/earnings; Semicond = semiconductor manufacturers.

The shaded area indicates 1 June–3 September 2026 (period under review).

[a] First violation of the US-Iran Memorandum of Understanding (25 June 2026). [b] Federal Open Market Committee July meeting press conference (29 July 2026).

[1] See endnotes for details.

Sources: Bloomberg; LSEG Datastream; LSEG Workspace; S&P Global Intelligence; BIS.

Credit markets weathered the rise in yields and bouts of turbulence, with spreads remaining compressed near historical ranges (Graph 6.A). Investment grade issuance grew – also sustained by strong long-tenor issuance from hyperscalers – underscoring investor preferences shifting towards higher-quality borrowers (Graph 6.B, blue line). That said, some signs of softening appeared in issuance activity in riskier segments. Specifically, the issuance of high-yield bonds and leveraged loans slowed notably, pointing to a languishing investor appetite in lower-rated securities (purple and red lines). Private credit deal-making also remained weak (yellow line), extending its earlier downturn amid persistent redemption and valuation pressure.

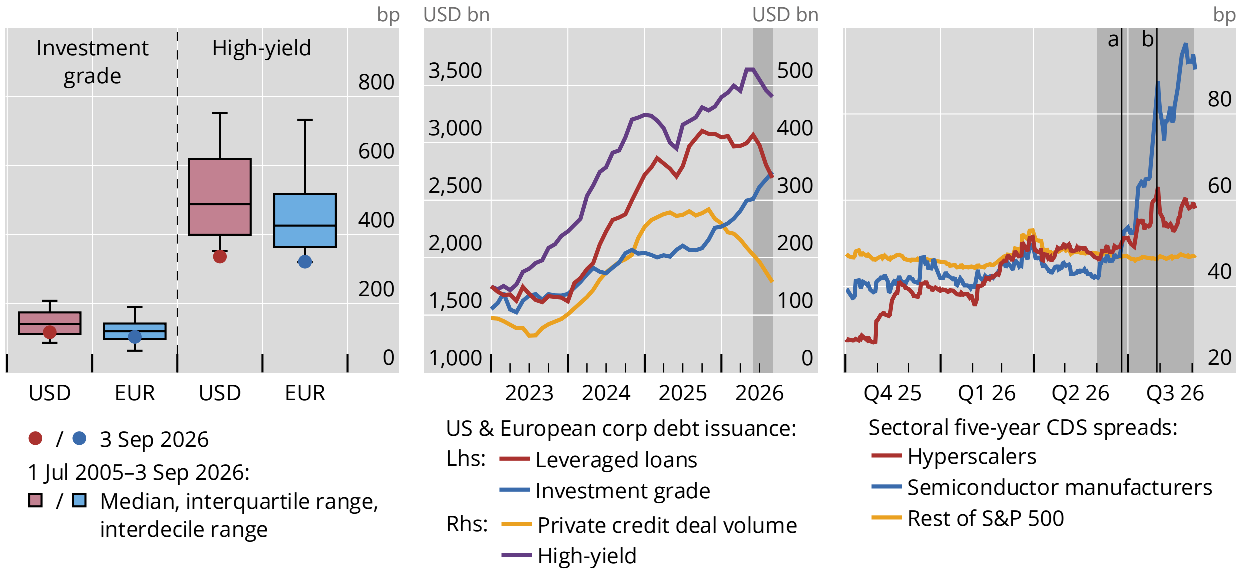
Nonetheless, investors appeared to become more selective, demanding greater risk compensation amid hyperscalers' booming debt issuance. A sign of this is the rise in credit default swap (CDS) spreads – a gauge of the risk of holding debt – of hyperscalers and semiconductor manufacturers. (Graph 6.C, red and blue lines, respectively). By contrast, CDS spreads remained stable for the rest of the S&P Index (yellow line).

Credit markets remained insulated from the wobbly equity momentum[1] — Graph 6

A. Credit spreads stayed at the lower range of historical norms

B. Issuance activity slowed further in riskier segments

C. Rising firm-level uncertainty coincided with higher credit risk



CDS = credit default swap.

The shaded area indicates 1 June–3 September 2026 (period under review).

[a] First violation of the US-Iran Memorandum of Understanding (25 June 2026). [b] Federal Open Market Committee July meeting press conference (29 July 2026).

[1] See endnotes for details.

Sources: Bloomberg; Dealogic; ICE Data Indices; PitchBook Data Inc; S&P Global Intelligence; BIS.

Box B

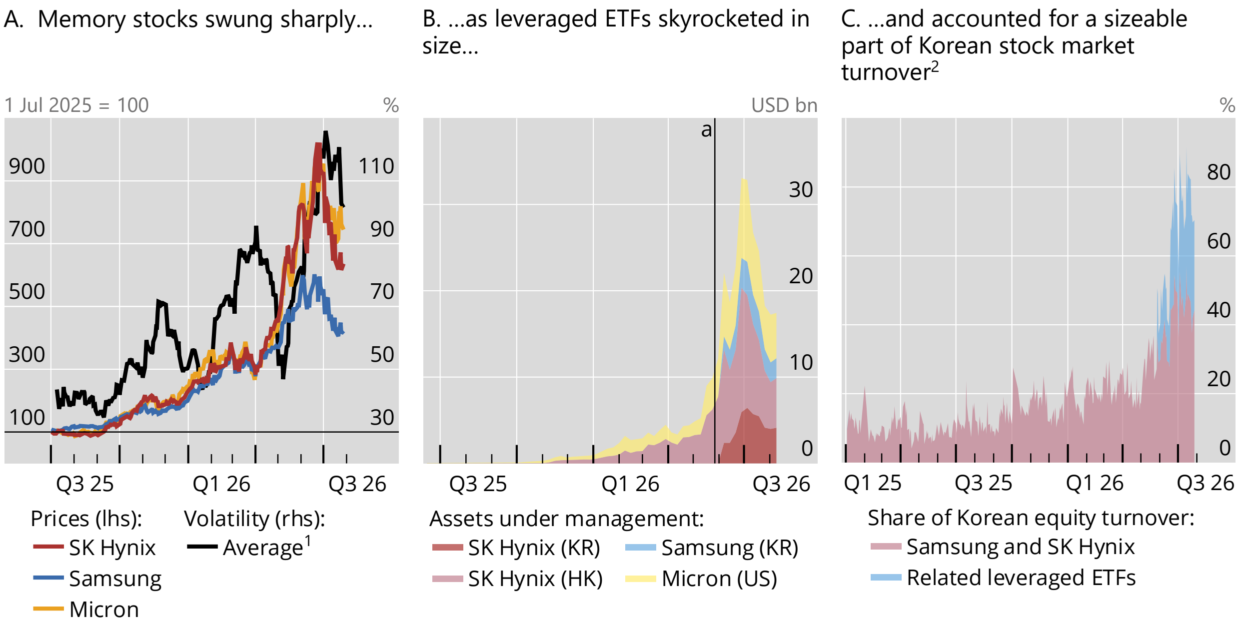
Short on memory? Leveraged ETFs and chip stock volatility

Karamfil Todorov①

Leverage can turn ordinary market moves into outsize ones. When leveraged positions must be adjusted as prices change, the adjustment often tends to run in the same direction as the market, so that leverage amplifies volatility rather than dampening it. Much of this activity is hard to observe, but one part has become highly visible: leveraged single-stock exchange-traded funds (ETFs), whose assets in the United States alone exceeded $190 billion in 2026.② Korea offers an extreme case. Shares of Samsung Electronics and SK Hynix, Korea's dominant memory chipmakers, rose more than threefold in the first half of 2026 and then swung violently, with the wider market following them (Graph B1.A). This box uses the episode to document the amplification mechanism operating via leverage in equity markets. It argues that leveraged ETFs are only the visible tip of a larger set of exposures that also includes listed options and retail structured products.

Leveraged ETFs have grown alongside sharp swings in memory stocks

Graph B1



ETFs = exchange-traded funds.

[a] 16 leveraged single-stock products on Samsung and SK Hynix listed (27 May 2026).

[1] Simple average of the 30-day annualised realised volatility of SK Hynix, Samsung and Micron. [2] Turnover refers to stock trading values on KOSPI (Korea Composite Stock Price Index), KOSDAQ (Korean Securities Dealers Automated Quotations) and KONEX (Korea New Exchange).

Sources: Bloomberg; KRX Data Marketplace; LSEG Workspace; author's calculations.

The common thread running through these instruments is that some financial intermediary must trade in the direction of the market to keep a promise made to investors, amplifying the move. Consider a leveraged ETF that promises twice a stock's daily return. When the stock falls, the fund's leverage mechanically rises above its target, so it must sell to bring leverage back down. When the stock rises, leverage falls below target and the fund must buy. Either way, it trades in the direction of the move.③ The dealer who has sold an option and the issuer of a structured product face the same imperative around the price levels relevant for the contracts. Such positions are known as "short gamma", because the required trade to rebalance grows with the size of the move.

The assets subject to this mechanical rebalancing have grown from a negligible to a sizeable share of trading in the affected stocks within a year. Combined assets of leveraged products on the major memory stocks Samsung, SK Hynix and Micron rose from under $100 million in mid-2025 to a peak above $38 billion in June 2026 (Graph B1.B). The two Korean names that dominate these products accounted for more than 50% of total Korean equity trading value in mid-2026, up from 12% through 2025 (Graph B1.C).

This rebalancing is now large enough relative to the stocks' liquidity to move prices. For SK Hynix, the amount that funds must trade on a 10% move in the share price – the kind of move seen repeatedly in mid-2026 – rose from a few hundred million dollars in late 2025 to almost $5 billion at its June peak, all in the same direction as the move (Graph B2.A). Set against the stock's daily turnover of under $10 billion, such flows could add roughly 2–4 percentage points to a 10% move,④ amplifying sell-offs.

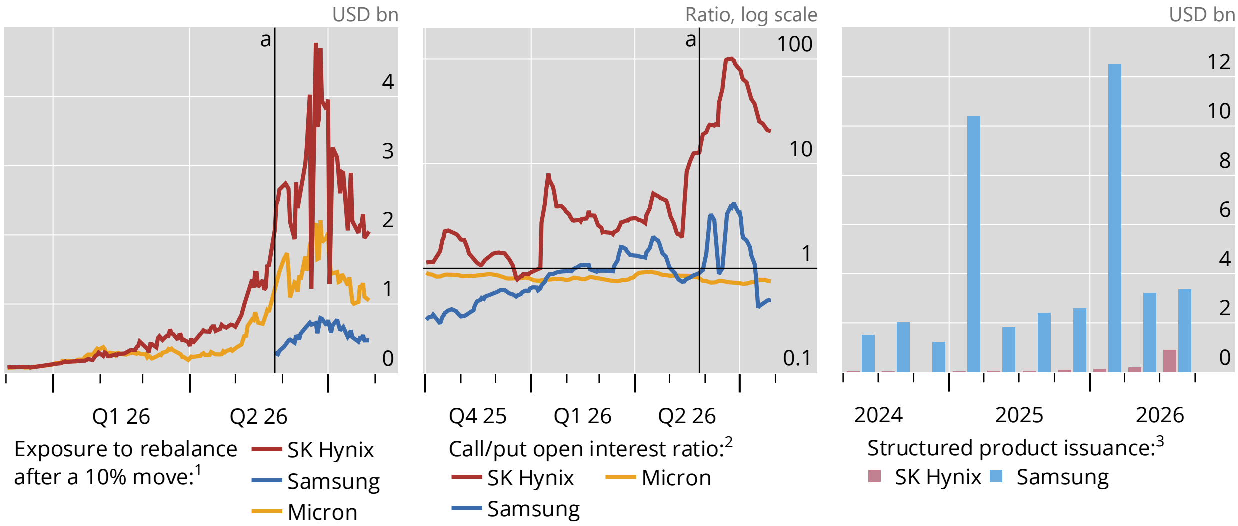
Rebalancing, options and structured products all point to amplification

Graph B2

A. 10% rise in stock price leads to more than $4 billion of mechanical buying by leveraged ETFs

B. Call options outnumber puts for Korean stocks

C. Issuance of structured products rose in 2026



ETFs = exchange-traded funds.

[a] 16 leveraged single-stock products on Samsung and SK Hynix listed (27 May 2026).

[1] Dollar exposure funds must trade to restore target leverage after a 10% move. [2] Total call open interest divided by total put open interest. Five-business-day moving average. [3] Quarterly equity-linked security/equity-linked bond issuance referencing each stock.

Sources: Bloomberg; Korea Securities Depository; KRX Data Marketplace; LSEG Workspace; author's calculations.

Options markets point to the same mechanism via another instrument. Investor demand in the two Korean companies has been overwhelmingly one-sided towards calls. The ratio of call to put open interest on SK Hynix rose about thirtyfold between March and June 2026, peaking near 100, and Samsung showed a milder version of the same pattern. For Micron, by contrast, the ratio stayed below one throughout (Graph B2.B). Demand for calls on this scale leaves dealers who sell them holding the mirror-image position. Hedging it requires the same "buy high, sell low" pattern as the leveraged ETFs, from an entirely separate instrument.

Leveraged ETFs and listed options are not the whole story. Autocallable structured products, widely sold to retail investors in Korea, redeem early with an enhanced coupon if the underlying asset stays above a set barrier, but expose holders to losses if it falls through a lower one. Hedging these products can require large, destabilising trades near the barriers.⑤ Issuance referencing Samsung and SK Hynix rose sharply in the first half of 2026 (Graph B2.C), so that the structured-product channel now likely reinforces the leveraged-ETF one. With the two stocks together exceeding half the KOSPI 200, this pressure reaches index-level products too.

These mechanisms are not new, echoing the amplification encountered in portfolio insurance strategies, volatility-targeting and risk-parity funds. What sets the Korean episode apart is its concentration: a handful of instruments referencing two stocks that dominate an index, in a market where retail participation and leverage are both unusually high. But the main dynamic is general: wherever leveraged and hedging-driven products grow large relative to the liquidity of the underlying asset, price-insensitive demand can amplify moves.

① The views expressed here are those of the author and do not necessarily reflect the views of the BIS or its member central banks. ② Based on ETF.com. ③ K Todorov, "When passive funds affect prices: evidence from volatility and commodity ETFs", *Review of Finance*, vol 28, no 3, 2024. ④ Based on square-root price impact model. ⑤ Hedging near the upper barrier tends to amplify moves, and after a year of strong gains, outstanding products likely sat closer to the upper barrier.

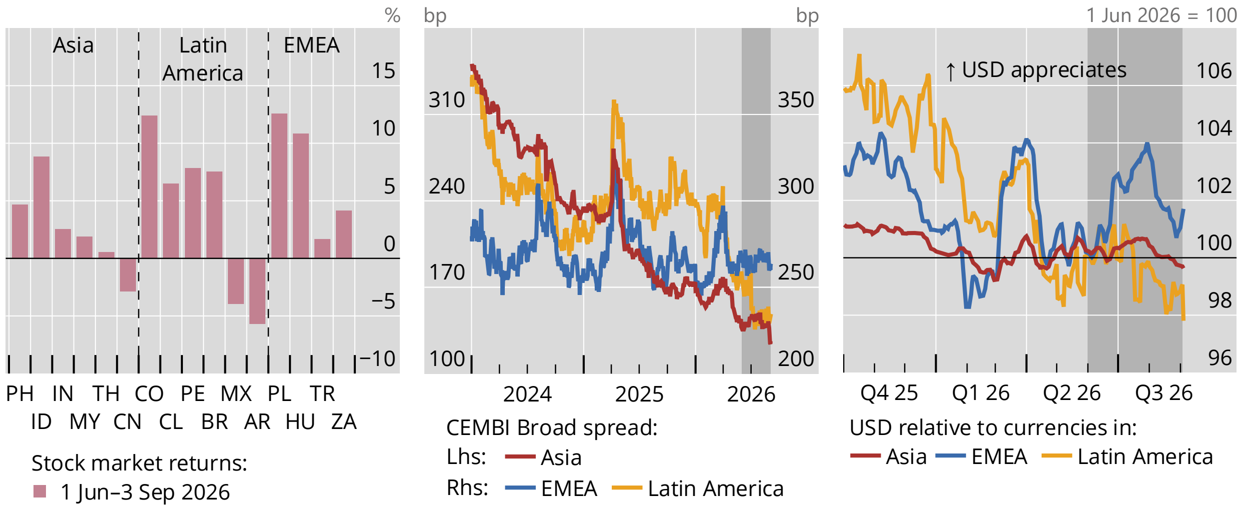
Investors' search for diversification sustained EME assets

Risk assets in EMEs proved resilient to the seesawing of risk appetite throughout the review period, partly supported by capital inflows and reallocations by global investors to diversify risk. Their equity markets generally performed better than those of most advanced economies, and corporate bond spreads narrowed further. Across EME regions, stock market gains were broad-based, with a few exceptions in Latin America (Graph 7.A). Among Asian EMEs, China was the exception, losing nearly 3%, amid signs of fading risk appetite among investors, slowing domestic demand and ongoing weakness in the real estate market. Corporate credit spreads compressed in Asia and Latin America and traded mostly sideways in Europe, the Middle East and Africa (EMEA) (Graph 7.B).

EME exchange rates responded to changes in terms of trade and exposure to energy price shocks across regions as well as to rate differentials. Rising oil and metal prices improved the terms of trade for energy-exporting economies, particularly in Latin America, and led to an appreciation of their currencies (Graph 7.C, yellow line). By contrast, Asian EME currencies were broadly stable while EMEA currencies faced significant headwinds (red and blue lines, respectively). Consistent with the terms of trade channel, in June the dollar's broad appreciation saw commodity importers' currencies hold value relatively better. By contrast, as tensions flared up and the cease fire was broken, energy exporters' currencies posted larger gains.

EMEs benefited from investors' reallocations — Graph 7

A. EME equity gains were widespread with few exceptions — B. EME corporate spreads narrowed across regions[1] — C. Latin American currencies appreciated[1]



EMEA = Europe, the Middle East and Africa.

The shaded area indicates 1 June–3 September 2026 (period under review).

[1] See endnotes for details.

Sources: Bloomberg; JPMorgan Chase; LSEG Datastream; national data; BIS.

Endnotes

Graph 3.A: Decomposition of 10-year yield, based on Hördahl and Tristani (2014).

Graph 3.B: Inflation compensation refers to the rate on the fixed leg of a zero coupon inflation swap.

Graph 3.C: For CHF, EUR, GBP and JPY, five-business-day moving average.

Graph 4.A: EA = STOXX Europe 600; EMEs = simple average of stock market returns in AR, BR, CL, CN, CO, HU, ID, IN, MX, MY, PE, PH, PL, TH, TR and ZA; JP = Nikkei 225; KR = KOSPI 200; US = S&P 500.

Graph 4.B: Hyperscalers = Amazon, Apple, Google, IBM, Meta, Microsoft, Oracle. Semiconductor manufacturers comprise 15 firms classified in the Global Industry Classification Standard (GICS) sub-industry "Semiconductors". The remaining 478 firms are classified as "Rest of S&P 500". Market capitalisation weighted averages. The composition of the S&P 500 is fixed on 3 September 2026.

Graph 4.C: For each sector, simple average of the respective S&P 500 constituents' returns.

Graph 5.A: Quarterly changes in long-term debt (net). Based on global financial statements data for seven hyperscalers and 43 global infrastructure providers operating in the following business segments: power and distribution, engineering and construction, networking, cooling systems and AI neoclouds.

Graph 5.B: Hyperscalers = Amazon, Apple, Google, IBM, Meta, Microsoft, Oracle. Semiconductor manufacturers comprise 15 firms classified in the GICS sub-industry "Semiconductors". Rest of IT comprises 53 firms classified in the GICS sector "Information Technology". The remaining 425 firms are classified as "Rest of S&P 500". The composition of the S&P 500 is fixed on 3 September 2026. Market capitalisation weighted average. For September 2026, data as of 3 September 2026.

Graph 5.C: Dispersion index = Cboe S&P 500 Dispersion Index; VIX = Cboe Volatility Index.

Graph 6.A: Spreads of ICE BofAML index yields to overnight index swap (OIS) rates with matched maturities. 10-year OIS for US investment grade; five-year for the rest. The USD OIS rate is based on the Secured Overnight Financing Rate (SOFR) starting on 11 December 2018. The EUR OIS rate is based on the euro short-term rate (ESTR) starting on 11 October 2019. For USD investment grade, the box plot shows data between 28 July 2008 and 3 September 2026, due to data availability of USD 10-year OIS.

Graph 6.B: Twelve-month moving sum.

Graph 6.C: Hyperscalers = Amazon, Apple, Google, IBM, Meta, Microsoft, Oracle. Semiconductor manufacturers comprise six firms classified in the GICS sub-industry "Semiconductors"; the 203 remaining companies of the S&P 500 with available CDS spreads are classified as "Rest of S&P 500".

Graph 7.B: GDP-PPP weighted average of sub-indices. Asia = CN, ID, IN, MY, PH and TH; EMEA = AE, HU, KW, MA, SA, TR and ZA; Latin America = AR, BR, CL, CO, MX and PE.

Graph 7.C: GDP-PPP weighted average. Asia = CN, ID, IN, MY and TH; EMEA = HU, PL and ZA; Latin America = BR, CL, CO, MX and PE. Five-business-day moving average.

Annex

Box C

Government bond "cheapness" and leveraged swap trades in core markets

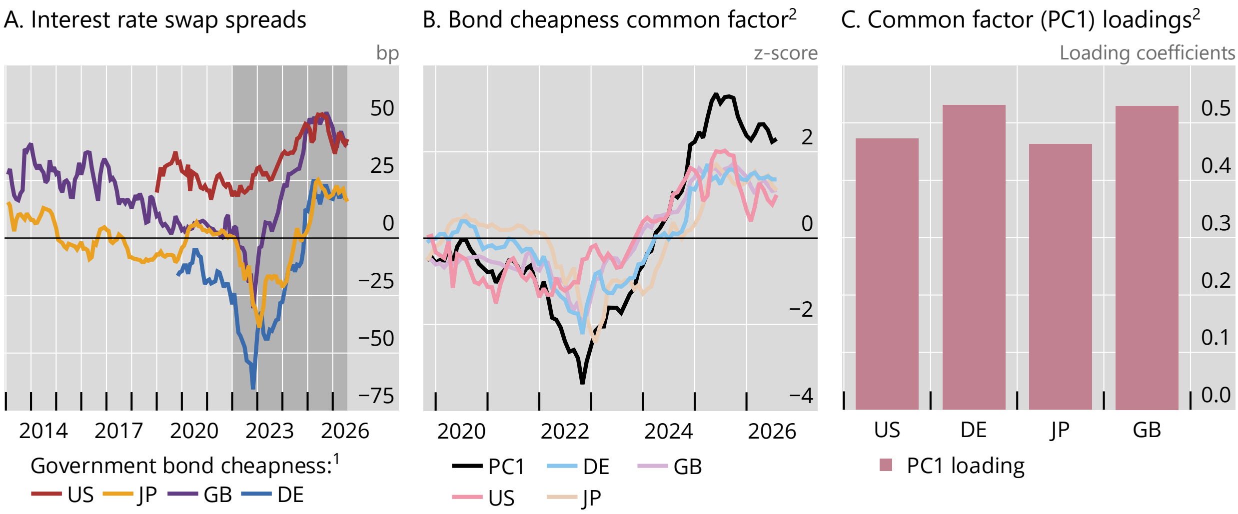
*Vladyslav Sushko and Karamfil Todorov*①

Leveraged relative value (RV) trades – strategies that seek to profit from small price gaps between similar instruments – have grown quickly in bond markets in recent years. This box reviews the appeal of a fast-growing variant, the swap spread trade, which pairs a government bond with an interest rate swap, across the United States, the United Kingdom, the euro area and Japan. In these markets, government bonds have become "cheap" relative to interest rate swaps, creating attractive opportunities for RV traders. These spreads also move closely together: one common factor explains most of their co-movement across core bond markets.

Government bond markets in major advanced economies have had to absorb a large volume of supply in recent years, amid higher issuance and central banks' quantitative tightening. With government bonds increasingly trading at a discount to related derivatives, leveraged investors such as hedge funds stepped in to fill the gap left by institutional investors and constrained dealers. By taking the other side of the supply, these funds have become important warehousers of government bonds, helping markets to clear.② Yet because their trades are highly leveraged and financed with short-term borrowing via repurchase agreements (repos), they can also amplify stress.

The two main RV trade variants with derivatives involve buying a cash bond and selling a futures contract or an interest rate swap. Because the earned spread is small, the strategy relies on high leverage. The cash leg is funded with repo borrowing against the government bond as collateral, often at low or zero haircuts, while the large notional derivatives position is sustained by posting margins. Recently, new RV activity has shifted towards trades that use interest rate swaps.③ In the US Treasury market, the cash-futures basis trades are estimated to have reached $830 billion by the third quarter of 2025, but their growth has moderated, whereas interest rate swap trades are estimated to have risen from $100 billion to $300 billion in just the past year.④

Swap spread trade attractiveness across major government bond markets — Graph C1



PC1 = first principal component.

The shaded area indicates the post-2022 tightening cycle.

[1] 10-year government bond yield minus 10-year swap rate (positive = cheap bond); monthly averages. [2] Based on a principal component analysis of interest rate swap spreads.

Sources: Bloomberg; authors' calculations.

Interest rate swap spreads have become attractive for RV trades across major government bond markets. By 2025, government bond yields exceeded swap rates across the board: by around 50 basis points on average in the United States and the United Kingdom and by about 20 basis points in Germany and Japan (Graph C1.A). Some contraction of the spread in the US towards end-2025 may reflect the relaxation of leverage rules, which allowed major banks to increase the amount of government bonds held on their balance sheets, including as part of the swap spread trade.⑤ The emergence of Bund "cheapness" in late 2024 was widely interpreted as the end of the "collateral scarcity" regime and as investors pricing a durably higher net supply of German paper. In Japan, swap spreads widened as Japanese Government Bond supply increased amid the Bank of Japan's policy normalisation, the abandonment of yield curve control and fiscal expansion.

Principal component analysis indicates that the swap spreads are tightly linked across major sovereign markets. A single factor explains 83% of the common monthly variation in bond cheapness, with the first principal component indicating that all four sovereigns now trade at a discount to swaps (Graph C1.B), with near-identical loadings (Graph C1.C). Such a strong common component highlights just how closely interlinked long-term government bond yields are across markets. It also reflects the similarity of domestic drivers in each economy. These include quantitative tightening, inflation and fiscal concerns – along with structurally lower demand from traditional long-term investors (eg defined benefit pension plans) and dealer constraints.

The growing dependence of core bond markets on leveraged RV trading has financial stability implications. The marginal holder of the cash bond is now a leveraged, repo-financed, short-horizon investor (eg a hedge fund). Its ability to hold the position depends on continuous funding access and stable margins, so a shock to repos or a jump in volatility and margins would pressure all legs at once – as in the March 2020 basis-trade unwind and the partial unwind of the swap trade in April 2025. Furthermore, concentration among funds and their prime brokers, coupled with deepening cross-border links, can turn distress at a few institutions into a market-wide shock.

① The views expressed here are those of the authors and not necessarily those of the BIS or its member central banks. ② D Barth and R J Kahn, "Hedge funds and the Treasury cash-futures basis trade", *Journal of Monetary Economics*, vol 155, 2025. ③ V Sushko and K Todorov, "Sizing up hedge funds' relative value trades in US Treasuries and interest rate swaps", *BIS Quarterly Review*, December 2025. ④ P Monin , "Decomposing hedge funds' U.S. Treasury exposures", *FEDS Notes*, Board of Governors of the Federal Reserve System, 22 June 2026. ⑤ US regulators finalised the relaxation of the enhanced supplementary leverage ratio (eSLR) on 25 November 2025. The rule changes were officially published and set with an effective date of 1 April 2026, allowing banks the option to adopt the modified standards starting 1 January 2026. This eased capital constraints on low-risk operations like US Treasury market intermediation for major global systemically important banks.

Box D

Covered bond spread trades in the Nordics

*Vladyslav Sushko and Karamfil Todorov*①

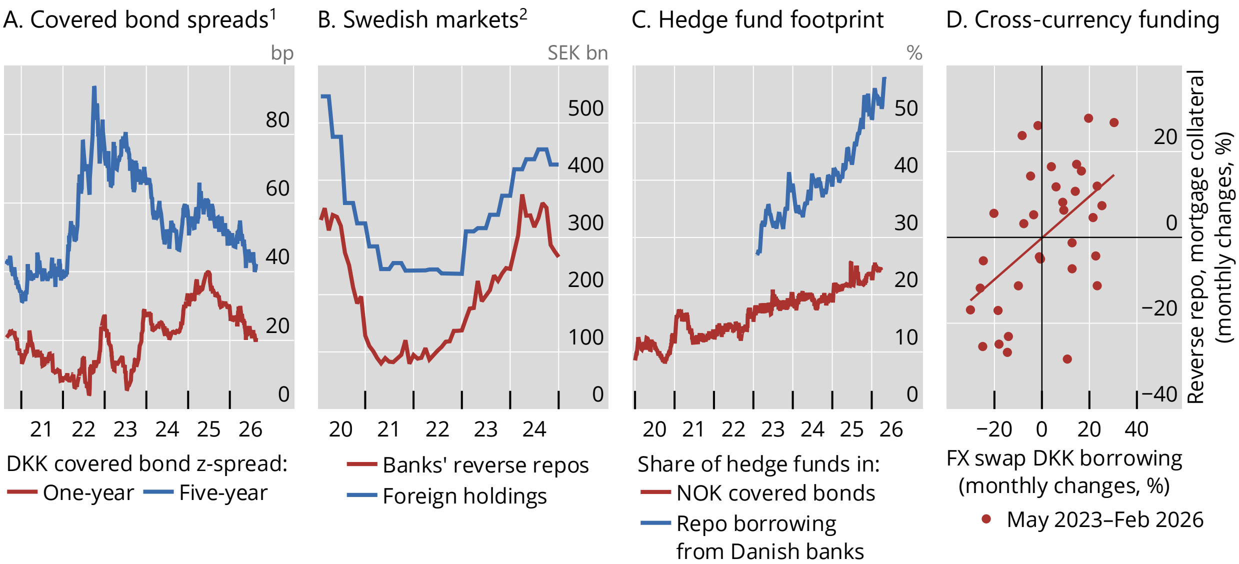
Nordic markets feature their own version of a relative value (RV) trade that profits from price gaps between bonds and interest rate swaps. This trade mirrors the sovereign swap spread trade (see Box C) but uses private sector covered bonds instead. In Denmark, Norway and Sweden, mortgage lenders issue covered bonds for funding. These bonds are considered safe, liquid assets and were long held mainly by banks, but there are limits on how much they can hold. When bonds began trading more cheaply than swaps, hedge funds stepped in to profit from the resulting swap spread, which at times reached 80–90 basis points (Graph D1.A).

Hedge funds' holdings of Nordic covered bonds have grown to a substantial market share and have become more concentrated. In Sweden, foreign investors, largely hedge funds, now hold around a fifth of the SEK 2 trillion covered bond market, with the three largest funds accounting for over 40% of foreign holdings.② Swedish banks provide most of the repo financing for these holdings (Graph D1.B). In Norway, hedge funds now hold about 24% of krone-denominated covered bonds, up from 10% in 2021 (Graph D1.C, red line). Their repo borrowing grew almost fivefold in five years, to over NOK 200 billion.③ In Denmark, the largest funds account for about 60% of repo borrowing, almost twice the share three years ago (Graph D1.C, blue line). Banks often support this repo financing in kroner by swapping from euro, particularly for term repos. Therefore, their DKK repo lending against mortgage collateral is highly correlated with kroner borrowing via FX swaps (Graph D1.D).

The RV trades with Nordic covered bonds are tightly interconnected and concentrated. Hedge funds' repo counterparties consist primarily of large Nordic banks, which also facilitate bond issuances for mortgage lenders. These domestic repo lenders often obtain cash synthetically by swapping from euros. They also hold the covered bonds, considered almost as safe as government bonds, for their own liquidity buffers. These links call for close monitoring of leverage, concentration and cross-currency funding, and for ensuring that banks manage their risks adequately, eg via adequate repo haircuts, so that this core market stays resilient under stress.

Nordic covered bond spreads, leveraged holdings and funding

Graph D1



[1] Spread over the krone benchmark interest rate swap rate such that the sum of discounted cash flows of a covered bond equals its market price. [2] Reverse repos of Swedish banks and their foreign branches. Foreign holdings include a large part of hedge funds' holdings.

Sources: Danmarks Nationalbank; Norges Bank; Sveriges Riksbank; Bloomberg; Jyske Bank; authors' calculations.

① The views expressed here are those of the authors and not necessarily those of the BIS or its member central banks. ② Sveriges Riksbank, "Banks and the Swedish covered bond market", *Financial Stability Report*, 2026:1 and Sveriges Riksbank, "Fact box – Concentration and leveraged foreign holdings in the banks' covered bonds", *Financial Stability Report*, 2025:1. ③ Norges Bank, Financial Stability Reports, 2025 H1 and 2026 H1.

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Financing the digital economy: the role of private credit[1]

Surging loan demand from software and technology (tech) firms materially contributed to the post-2020 growth of direct lending, the main type of private credit. The Covid-19 pandemic accelerated the shift to the digital economy, increasing tech firms' funding needs. Private credit, with its model centred on lending against cash flows and intangible assets, was well placed to meet this demand. Tech firms' share of direct lending doubled to over 40% between 2020 and 2025. Growth was concentrated in US cities with a strong pre-pandemic tech presence, precisely where the shift to the digital economy raised credit demand the most. Tech firm entry and employment subsequently grew more in areas with ample private credit, highlighting how a financial sector adept at financing asset-light borrowers can support innovative firms and growth. Whether the fast growth of the tech sector and private credit are sustainable or ultimately bear risks for financial stability remains an open question.

JEL classification: G21, G23, G32, O33.

With outstanding loan amounts of almost $2.5 trillion as of 2025, private credit has become an important funding source for non-financial corporations. Its fast growth, often attributed to tighter banking regulation and low policy rates, put the market at the centre of policy discussions about the changing nature of financial intermediation and attendant financial stability risks (IMF (2024); BIS (2026); FSB (2026)).

This article re-examines the drivers of private credit's recent growth, with a focus on the role of demand from software and technology (tech) firms, and draws implications for the growth of innovative firms. The analysis uses data on direct loans (a major segment of private credit) from 2010 to 2025 for the United States, the largest private credit market globally.

Our findings are as follows.

First, private credit's lending model was well placed to serve tech firms' credit demand, which surged after 2020. Aggregate borrowing by tech firms rose from around $22 billion (22% of total private credit) in 2010 to over $1 trillion (44%) by 2025. Growth accelerated markedly after 2020, coinciding with the Covid-19-induced (and still ongoing) structural shift of economic activity towards the tech sector,

[1] The views expressed in this article are those of the authors and not necessarily those of the BIS or its member central banks. The authors thank Fernando Avalos, Giulio Cornelli, Mathias Drehmann, Egemen Eren, Jon Frost, Gaston Gelos, Bryan Hardy, Daniel Rees, Andreas Schrimpf and Costas Stephanou for helpful comments and suggestions, and Rudraksh Kansal for excellent research assistance. The authors acknowledge the use of artificial intelligence in research assistance and editorial refinement. Responsibility for all errors remains with the authors.

Key takeaways

- *Private credit, focused on lending against cash flows and intangible assets, met the rising credit needs of software and technology (tech) firms' during the post-2020 shift to the digital economy.*
- *In US cities with a stronger presence of tech firms, private credit expanded faster after 2020; and where private credit expanded more, firm formation and employment in the tech sector rose accordingly.*
- *Our findings highlight how a financial sector capable of financing innovative companies can foster job creation and economic growth, offering lessons for other jurisdictions.*

including in the direction of software and artificial intelligence (AI) firms. Private credit's lending model is well suited to meet loan demand from such firms: it features bespoke loan terms based on lending against recurring revenue and intangible assets rather than common earnings measures and physical collateral.

Second, regression analyses highlight that tech firms' surging loan demand has been a key driver of private credit's rapid growth since 2020. To measure credit demand, we use differences in the concentration of tech firms across US cities, as measured by employment shares. Direct lending followed a similar trajectory across cities before 2020. Afterwards, cities with a higher employment share of tech firms saw a significantly stronger increase compared with those with a lower share. This pattern is consistent with an increase in tech firms' demand for direct loans. However, narrowing loan spreads and the accompanying shift towards borrowers with weaker fundamentals raise concerns about whether risks and vulnerabilities are fully priced.

Third, where private credit was more ample and ready to meet loan demand, the tech sector expanded more. In particular, cities with a stronger increase in private credit subsequently experienced higher firm formation and employment within and outside the tech sector. This positive association suggests that tech firms with access to readily deployable private capital could better attract funding as demand for their products and services increased. In turn, they expanded their operations by more.

The article informs the broader debate on the role of private credit and non-bank financial institutions (NBFIs). Our findings show that tech firms' credit demand amid structural change and the ability of private credit funds to meet this demand were important factors in driving the recent growth of private credit. The regulatory and interest rate environments appear to have been less relevant factors in recent years. A relaxation of bank regulation alone is therefore unlikely to materially reverse private credit's growth. Our findings also underscore how the financial sector's ability to meet the funding needs of innovative firms can support firm formation and growth. Whether the rapid expansion of the tech sector, facilitated by private credit, is sustainable or may entail risks to financial stability remains an open question.[2]

The rest of the article is structured as follows. The first section provides an overview of private credit and its lending model. The second documents the growing concentration of private credit in the tech sector. The third analytically explores the link between tech firms' credit demand and private credit's growth after 2020. We conclude with a discussion of the implications for financial regulation and growth.

[2] For discussions about the broader implications of the AI investment boom and private credit growth for financial stability, see Aldasoro et al (2026) and BIS (2026).

Private credit and its lending model

Private credit generally refers to non-bank credit extended by specialised investment vehicles ("funds") to small or medium-sized ("middle market") non-financial firms. Most funds operate as closed-end structures that lock in capital raised from institutional investors for their life cycle (five to eight years). Fund managers draw on committed capital to finance their investments; undrawn committed capital remains off-balance sheet as "dry powder". The average maturity of loan portfolios matches funds' life cycles, thereby mitigating liquidity and maturity transformation risks.[3]

While funds specialise in certain lending strategies, so-called direct lending is the most common. Direct loans are negotiated directly between lenders and borrowers and held on lenders' balance sheets. This structure enables bespoke covenant arrangements, faster execution and greater flexibility in renegotiation. In contrast, leveraged loans, an alternative source of loan financing for middle-market firms, typically involve multiple lenders in a syndicate, trade on active secondary markets and come with more standardised terms. Direct lending hence differs substantially from other major sources of financing for riskier firms and makes it appealing for borrowers that value flexibility.

Direct lenders specialise in lending against recurring revenue and intangible assets, while banks rely on common earnings measures or loans collateralised by fixed assets. For various reasons, including regulatory ones, banks prefer loans secured by tangible assets (eg real estate or machinery) and assess a borrower's financial health based on target profit measures such as earnings before interest, taxes, depreciation and amortisation (EBITDA) (Dell'Ariccia et al (2021); Degryse et al (2025)). Direct lenders instead often take blanket liens, ie claims on a firm's entire going-concern value, rather than on separable assets, and underwrite against recurring revenue. Such tailored financing benefits firms with scarce tangible collateral and low EBITDA (Block et al (2024); Ivashina (2025)).

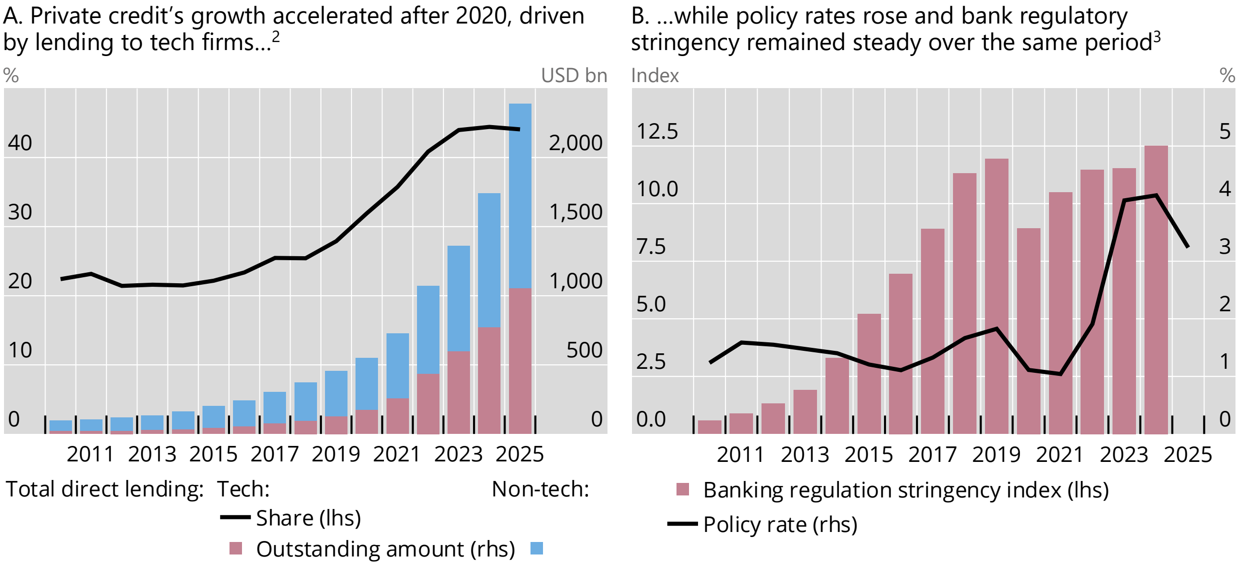
Software and high-tech firms are natural borrowers from private credit funds. For example, the assets of firms in the software-as-a-service (SaaS) industry consist mostly of intellectual property, customer relationships and recurring revenue streams. These assets are difficult to seize, value or liquidate in a standard insolvency scenario (Jang et al (2025)). Similarly, private credit has become an important source of financing for the AI boom (Aldasoro et al (2026)).

Beyond these factors related to private credit's lending model, its broader growth after the Great Financial Crisis (GFC) reflects shifts in the regulatory and macroeconomic environments.[4] Post-GFC banking regulation probably reduced banks' willingness to lend to risky or asset-light firms, which turned to non-bank lenders (Chernenko et al (2022); Davydiuk et al (2024); Doerr et al (2026)). Additionally, banks find lending to private credit funds more attractive than directly lending to middle-market firms, as collateralised loans to private credit funds receive favourable capital treatment (Chernenko et al (2025)). Low policy rates reinforced these trends by incentivising institutional investors to search for yield, steering their portfolios towards private markets (Avalos et al (2025)).

3 Recently, so-called evergreen or interval funds, which allow investors to regularly redeem a portion of their funds, have grown in popularity. If private credit succeeds in attracting more retail investors by migrating to more open-ended structures, liquidity mismatches may rise (Aldasoro et al (2025)).

4 See Avalos et al (2025), Ivashina (2025) and FSB (2026) for a broader discussion.

Private credit expanded despite rising policy rates and easing bank regulation[1] Graph 1



[1] See endnotes for details. [2] Based on data for the US. [3] Based on data for CH, EA, GB, JP, KR and US. An increase in the banking regulation stringency series reflects a net tightening of regulatory policies averaged across the set of economies.

Sources: Alam et al (2019); IMF; PitchBook Data Inc; BIS; authors' calculations.

However, explanations based on changes in banking regulation and policy rates are difficult to reconcile with the rapid growth in private credit since 2020. Globally, total outstanding direct loan volumes increased from around $100 billion in 2010 to over $450 billion in 2019 (Graph 1.A, sum of red and blue bars), a period of (mostly) low policy rates and tightening bank regulation. Yet outstanding amounts grew further to almost $2.5 trillion by 2025, even as policy rates rose in most countries, and bank regulation, if anything, relaxed slightly (Graph 1.B, black line and red bars).[5]

Direct loans to tech firms

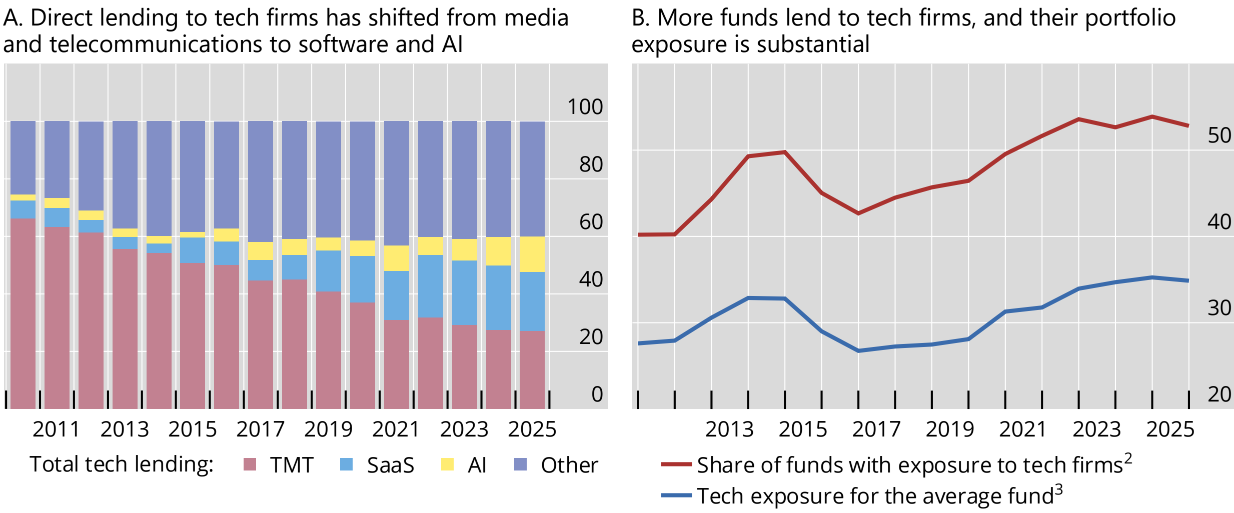
To study private credit's recent growth, we use data from PitchBook Data Inc. The deal-level data provide information on direct loans by private credit funds, including loan amounts, rate spreads, maturity and borrower location and industry. We focus on loans to US-based borrowers, by far the largest market for private credit. The data cover almost 14,000 deals between 2010 and 2025. We classify borrowers into technology ("tech") and non-technology ("non-tech") firms based on the industry description provided by PitchBook (so-called verticals).[6]

[5] To be sure, other factors may have played a role in the post-pandemic growth of private credit, eg the ample liquidity and accommodative monetary policy stance that characterised the pandemic's immediate aftermath. But again, such conditions changed around mid-2022 with both policy rate increases and reductions in central bank balance sheet size – yet private credit still grew stronger. With regard to regulation, while parts of the Basel III package were not yet fully completed or implemented by 2025, the overall trend post-2020 suggests, at a minimum, no tightening.

[6] According to PitchBook Data Inc, "an industry vertical describes a group of companies that focus on a shared niche or specialised market spanning multiple industries". Tech firms operate in one or more of the following verticals: SaaS; Technology, Media and Telecommunications (TMT); Artificial Intelligence and Machine Learning, Big Data or CloudTech; FinTech; CleanTech or Climate Tech; or

Lending to tech firms expanded while fund exposure rose[1]

In per cent | Graph 2



AI = artificial intelligence; SaaS = software-as-a-service; TMT = telecommunications, media and technology.

[1] Based on data for the US. See endnotes for details. [2] The share of funds in a given quarter with at least one outstanding loan to tech firms. [3] The share of loans to tech firms over total loans for the average fund in each quarter.

Sources: PitchBook Data Inc; authors' calculations.

Private credit funds have substantially increased their lending to tech firms. Outstanding loan volumes grew from about $22 billion in 2010 to about $127 billion in 2019 and to over $1 trillion in 2025 (Graph 1.A, red bars). As a share of the total, tech-related lending rose moderately from around 22% to 28% between 2010 and 2019, but surged to almost 45% over the following years (black line).

Within lending to the tech sector, volumes shifted from technology, media and telecommunications (TMT) to SaaS- and AI-related firms. Firms in TMT accounted for two thirds of total tech lending in 2010, but are less than a third today (Graph 2.A, red bars). The SaaS and, more recently, AI sectors increased their shares substantially (blue and yellow bars). In dollar amounts, lending to each category increased.

Alongside expanding loan volumes, private credit funds' exposure to tech firms is high and rising. By the end of 2025, approximately 55% of all private credit funds extended loans to tech firms, up from 40% in 2010 (Graph 2.B, red line). For the average fund, loans to tech firms increased to about one third of the total (blue line).

The rise of private credit: the role of loan demand

The Covid-19 pandemic accelerated the shift towards the digital economy, increasing tech firms' demand for credit. Lockdowns induced a persistent shift to remote work (Brynjolfsson et al (2025)), increasing the demand for cloud infrastructure, collaboration software and cyber security tools. Consumer behaviour tilted towards online shopping, streaming and digital payments (Alfonso et al (2021)). These

one of the following other tech verticals: Digital Health, Cybersecurity, AgTech, AdTech, Supply Chain Tech, Real Estate Technology, Mortgage Tech, Mobility Tech, Marketing Tech, Internet of Things, Mobile, InsurTech, Gaming, ESports or Virtual Reality.

changes, which intensified the demand for tech-related services, in turn increased tech firms' demand for credit. As discussed, private credit, with its focus on lending against cash flows and intangible assets, was well placed to meet that demand.

We examine how direct lending evolved before and after the pandemic, comparing US cities with a larger versus smaller local employment share of tech firms. We expect that cities with a higher pre-existing concentration of tech firms ("tech employment share") experienced a stronger increase in credit demand during and after the pandemic, leading to a stronger increase in private credit.

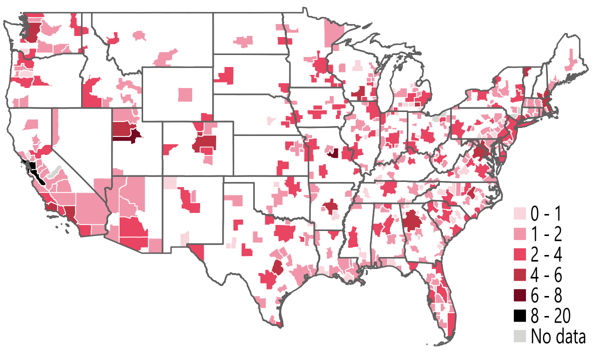
In line with a demand-based explanation, private credit grew substantially more after 2020 in cities with a higher tech employment share. Graph 3.A illustrates that pre-pandemic tech employment shares varied substantially across US cities, defined as core-based statistical areas (CBSAs).[7] Darker red or black areas indicate higher tech employment shares. Graph 3.B plots private credit outstanding for CBSAs with high and low tech employment shares, with the first quarter of 2019 set to 100 for reference. The two series moved closely together throughout 2016–19 but diverged sharply from 2020 onwards. By 2025, outstanding private credit in CBSAs with a high tech employment share was twice as large as in CBSAs with a low share.

We corroborate the demand-based explanation more formally by estimating the following specification at the CBSA-quarter level, using data for the 2016–25 period:

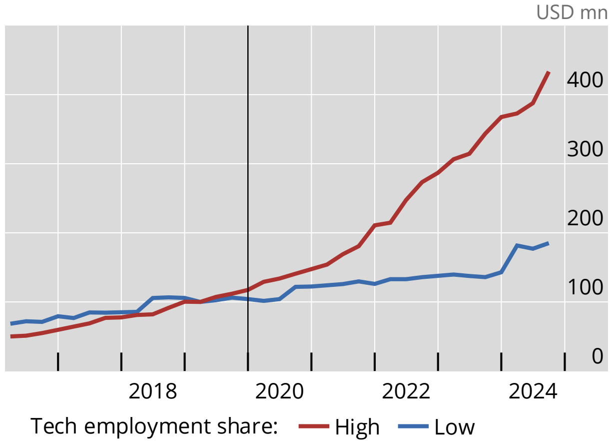
$$\log(PC_{c,t}) = \beta\,(Tech\ emp\ share_c \text{ x } Post_t) + \delta' X_{c,t-1} + \alpha_c + \alpha_t(\alpha_{s,t}) + \varepsilon_{c,t}, \qquad (1)$$

Private credit grew faster from 2020 onwards in cities with a larger tech sector[1] Graph 3

A. Tech employment shares vary substantially across US cities[2]



B. Private credit grew faster post-pandemic in cities with a higher employment share of the tech sector[3]



[1] Based on data for the US. See endnotes for details. [2] Data as of 2019. The white areas indicate regions that do not meet the CBSA criteria. [3] High and low tech employment share denote core-based statistical areas (CBSAs) in the top and bottom tercile of the tech employment share distribution.

Sources: US Census Bureau; PitchBook Data Inc; authors' calculations.

[7] The US Census Bureau defines CBSAs as geographic regions that consist of one or more counties anchored by a population core (an urban area of at least 10,000 people), plus adjacent counties tied to the core by high rates of commuting. Data on employment and the number of firms by region and industry are obtained from the Census Bureau's Business Dynamics Statistics. Tech firms are defined as those operating in North American Industry Classification (NAICS) code 51.

where the dependent variable is the logarithm of outstanding direct loan amounts in CBSA c at quarter t, $Tech\ emp\ share_c$ is each CBSA's 2019 tech employment share and $Post_t$ is an indicator for quarters from the first quarter of 2020 onwards. We include CBSA fixed effects (α_c) to absorb time-invariant regional differences. Year-quarter (α_t) or state-year-quarter fixed effects ($\alpha_{s,t}$) are also included depending on the specification, and account for any aggregate supply factors (eg fund inflows from yield-seeking investors or a change in bank capital requirements) or trends common to all borrowers (eg a benign economic environment) in the same state. In our strictest regression, we further control for lagged employment levels and employment growth ($X_{c,t-1}$). A positive estimated coefficient β indicates that private credit grew relatively faster after 2020 in CBSAs with a larger initial tech footprint.

Private credit expanded more strongly in CBSAs with a higher tech employment share, providing support for the demand-based explanation. In columns (1)–(3) in Table 1, which progressively add fixed effects and controls, the coefficient β is positive and statistically significant. The post-2020 increase in private credit was hence substantially stronger in areas with higher tech employment shares. In our preferred specification in column (3), the estimated coefficient of 21.4 implies that a 2.5 percentage point higher tech employment share (corresponding to the difference between the 90th and 10th percentiles of the distribution) is associated with a roughly 70% stronger rise in private credit after 2020.

To substantiate the claim that the estimates reflect loan demand, we further use data on leveraged loans and loan rates. In principle, CBSA characteristics such as the presence of other industries or private equity firms could be correlated with the tech employment share and lead to a general increase in the local demand for credit, direct loans or other types. To examine this argument, we use leveraged loans, which are less suited to cash flow-based lending against intangible assets (as explained above), as the dependent variable in equation (1). This placebo regression yields a statistically

Direct lending grew faster post-pandemic where tech employment was higher[1] Table 1

	Dependent variable:				
	log(PC)			log(LL)	Rate spread
	(1)	(2)	(3)	(4)	(5)
Tech emp share x Post	23.21***	24.55***	21.37***	0.344	38.16*
	(5.53)	(6.48)	(6.06)	(3.96)	(19.85)
Observations	8,907	8,638	7,656	6,154	331
R-squared	0.837	0.877	0.889	0.935	0.252
CBSA fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	x state	x state	x state	x state
Controls			Yes	Yes	Yes

[1] Results from estimating equation (1). The dependent variable in columns (1)–(3) is the logarithm of outstanding private credit (PC) in core-based statistical area (CBSA) *c* in quarter *t*, *Tech emp share* is the CBSA's 2019 tech employment share and *Post* is an indicator for quarters from Q1 2020 onwards. Column (1) includes CBSA and date fixed effects. Column (2) includes state-quarter instead of date fixed effects, while column (3) further controls for lagged employment levels and employment growth. Column (4) focuses on leveraged loans (LL) instead of direct loans as the dependent variable. In column (5), the dependent variable is the difference in the average rate spread between loans to tech vs non-tech borrowers in each CBSA-quarter cell. Based on quarterly data for the US over Q1 2016 to Q4 2025. For expositional clarity, the constant is not reported. Standard errors clustered at the CBSA level are in brackets. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Sources: PitchBook Data Inc; authors' calculations.

and economically insignificant coefficient estimate (Table 1, column (4)). Funds may also have increased their supply of credit to tech borrowers (but not to other firms) irrespective of changes in loan demand. This supply-driven hypothesis would imply more lending at lower rates. To test this, we use the spread on direct loans to tech firms net of the spread on loans to non-tech firms as the dependent variable (column (5)). The estimated coefficient is positive, which, together with the results in columns (1)–(3), indicates an increase in both the quantity and price of loans, consistent with a demand-driven explanation.[8]

Box A assesses changes in borrower and loan characteristics during the tech lending boom. It shows that borrower fundamentals weakened while loan seniority increased. At the same time, dispersion in rate spreads narrowed, raising concerns about potentially inadequate pricing of risks. The jury is still out on whether private credit exposures to the tech sector foreshadow financial stability risks.

Fostering innovation? Private credit and local employment

Did the availability of private credit foster firm entry and employment growth? Better access to credit can spur firm formation and job creation (Robb and Robinson (2014)). To examine whether a faster expansion of private credit coincided with an increase in employment and the number of firms, we collapse the data to the CBSA-year level and estimate the following specification:

$$\log(X_{c,t}) = \gamma \log(PC_{c,t}) + \mu_c + \lambda_t + \varepsilon_{c,t}, \qquad (2)$$

where the dependent variable is the logarithm of tech sector or total employment in CBSA c and year t, or the logarithm of the total number of firms in the tech sector or in all sectors in CBSA c and year t. PC refers to total outstanding direct loans. We include CBSA (μ_c) and year $(\lambda_{s,t})$ fixed effects. A positive estimated coefficient γ indicates employment increased by more where private credit expanded more.

Private credit volumes are positively associated with local economic activity (Table 2). Column (1) uses the log of total employment in the tech sector as the dependent variable. The estimates suggest that the above-discussed 70% increase in private credit would be associated with about 1.47% higher tech sector employment. For total CBSA employment in column (2), the corresponding number is 0.42%. For the average CBSA, which has 470,000 employees, the latter estimate translates into an increase of almost 2,000 jobs. Higher private credit amounts are also associated with a significant increase in the number of tech and total firms (columns (3) and (4)).[9]

[8] Data on rate spreads are only available for a subset of loans, resulting in the lower number of observations in the regression in column (5). We perform further tests in Annex A. We find that the differential effect of the tech employment share on direct lending relative to leveraged lending remains sizeable and significant when we include CBSA x time fixed effects that absorb any observable and unobservable time-varying CBSA characteristics. Our coefficient of interest remains similar in economic and statistical significance when we control for banks' total small business lending in each CBSA (Annex Table A.1). We obtain no significant coefficient estimate when we use the spread on leveraged loans as the dependent variable (unreported).

[9] We find no comparable effect for leveraged loans; see Annex Table A.2.

Box A

Borrower and loan characteristics amid the tech lending boom

*Puriya Abbassi, Iñaki Aldasoro and Sebastian Doerr*①

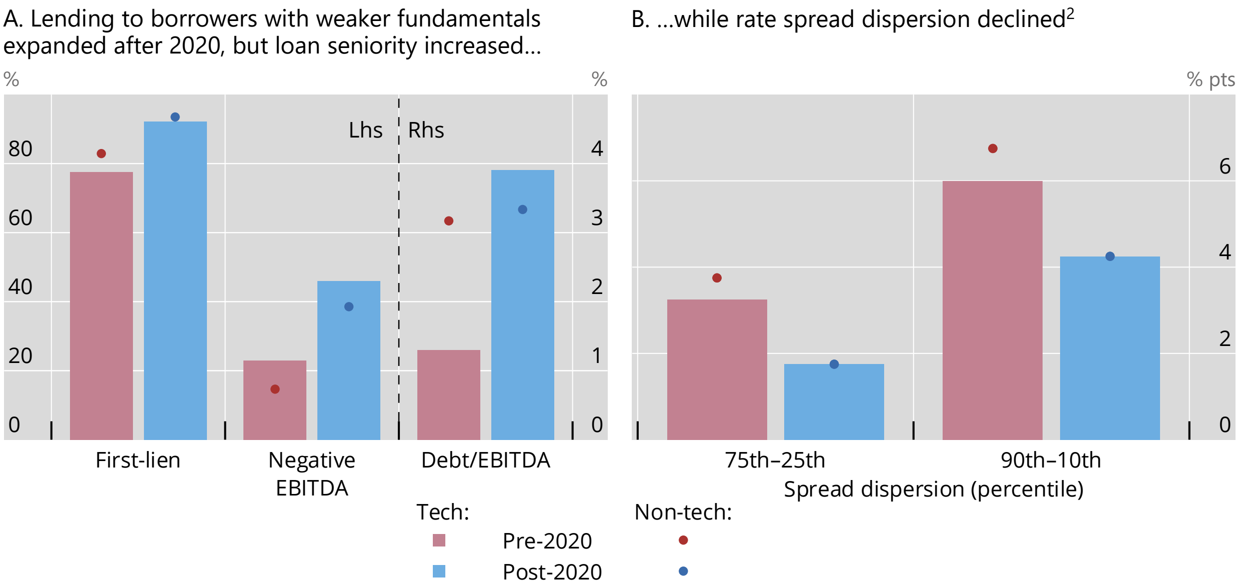
To better understand the terms at which direct loans are issued and to assess changes in borrower quality, this box compares the characteristics of direct loans to tech and non-tech non-financial corporates, as well as the evolution of borrower characteristics before and after the surge in tech lending, based on PitchBook data over the period 2010–25.

Direct lending to tech firms does not substantially differ from that to non-tech firms. Loans to tech firms are on average somewhat larger ($103 million, vs $72 million for firms in other sectors) and do not differ markedly in terms of maturity (about five years), rate spreads (about 6 percentage points) or the share of first-lien loans, which give lenders "first claim" on assets in the event of default (84% for tech vs 87% for non-tech borrowers).

As direct lending to tech firms expanded, borrower fundamentals weakened while loan spreads narrowed. The share of tech borrowers with negative earnings (EBITDA) nearly doubled, from 23% pre-2020 to 46% post-2020 (Graph A1.A, red vs blue bars). Among profitable borrowers, leverage (as measured by the median debt-to-EBITDA ratio) tripled.② Lenders shifted to more senior positions in the capital structure, with the share of first-lien loans rising from 77.6% to 92.2%, improving recovery prospects but leaving default risk tied to borrower cash flow. At the same time, rate spreads across borrowers narrowed: the interquartile range shrank from 3.25 percentage points to 1.75 percentage points, and the 10th-to-90th percentile range fell from 6 percentage points to 4.25 percentage points (Graph A1.B). This convergence in pricing amid rapid loan growth suggests spreads on direct loans may no longer fully account for borrower fundamentals, raising questions about the pricing and management of risks in the private credit market.

Loan characteristics paint a nuanced risk picture post-2020[1]

Graph A1



EBITDA = earnings before interest, taxes, depreciation and amortisation.

[1] Based on data for the US. Tech firms are defined as those operating in one or more of the following verticals listed in the PitchBook Data Inc data: SaaS (software-as-a-service); TMT (telecommunications, media and technology); Artificial Intelligence and Machine Learning, Big Data, or CloudTech; FinTech; CleanTech or Climate Tech; or one of the following other tech verticals: Digital Health, Cybersecurity, AgTech, AdTech, Supply Chain Tech, Real Estate Technology, Mortgage Tech, Mobility Tech, Marketing Tech, Internet of Things, Mobile, InsurTech, Gaming, ESports or Virtual Reality. Pre-2020 sample covers 2015–19 and post-2020, 2020–25. [2] Rate spreads are the annual rate over Libor or SOFR.

Sources: PitchBook Data Inc; authors' calculations.

① The views expressed here are those of the authors and not necessarily those of the BIS or its member central banks. ② Further interdependencies are generated by common exposures, as different lenders often lend to the same tech borrowers; see F Avalos, G Cornelli and E Eren, "AI disruption in private credit: exposure to software firms in BDCs", *BIS Bulletin*, no 126, 2026.

Where private credit expanded, so did employment and firm formation[1]				Table 2
	Dependent variable:			
	log(empl^{tech})	log(empl^{total})	log(no firms^{tech})	log(no firms^{total})
	(1)	(2)	(3)	(4)
log(private credit)	0.021***	0.006***	0.007***	0.004**
	(0.005)	(0.001)	(0.002)	(0.001)
Observations	1,828	1,828	1,828	1,828
R-squared	0.997	0.999	0.998	0.999
CBSA fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes

[1] Results from estimating equation (2). In columns (1)–(2), the dependent variables are logarithm (log) of tech sector employment (NAICS 51, "Information") and log total employment in the borrower's core-based statistical area (CBSA), from the US Census Bureau Business Dynamic Statistics (BDS) (2023 vintage). The dependent variables in columns (3)–(4) are log tech sector number of firms and log total number of firms in the borrower's CBSA, from the BDS. The regressor of interest in both panels is the log of total US dollar origination volume in the CBSA-year, summed across completed floating rate private credit deals to US borrowers, from PitchBook Data Inc. All estimates are contemporaneous within-CBSA associations and include CBSA and year fixed effects. Based on annual data for the US over 2016 to 2025. A constant is included but absorbed for the sake of simplicity. Standard errors, clustered at the CBSA level, are in brackets. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Sources: US Census Bureau; PitchBook Data Inc; authors' calculations.

Of course, the estimates do not establish a causal effect of private credit on real outcomes, which lies outside the scope of this article. Yet the evidence is consistent with the view that private credit, with its bespoke lending model and ample available capital, can support firm entry and job creation in innovative industries.

Conclusion

This article has shown that surging loan demand from tech firms drove private credit growth post-2020, fostering firm entry and employment. These results have implications for the broader debate on private credit and financial stability as well as the role of the financial sector in fostering growth.

First, the role of demand in driving private credit's growth suggests that relaxing bank regulation alone is unlikely to materially shift lending activity from private credit back to banks. While post-GFC bank regulation probably contributed to the initial expansion of private credit, the sector's recent growth has persisted despite rising policy rates and stable regulatory stringency. The jury is still out regarding financial stability risks, as borrower fundamentals weakened and price differentiation declined during the recent private credit boom.

Second, our results highlight how interactions between the financing needs of innovative firms and the financial sector's capacity to meet them can sustain growth. The United States had both a sizeable pre-existing tech sector and a mature private credit market capable of mobilising financing for asset-light firms. This confluence of real and financial factors has supported the expansion of tech firms after 2020 and holds lessons for other jurisdictions seeking to foster innovation and growth.

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Endnotes

Graphs 1.A, 2 and 3.B: Tech firms are defined as those operating in one or more of the following verticals listed in the PitchBook Data Inc data: SaaS (software-as-a-service); TMT (telecommunications, media and technology); Artificial Intelligence and Machine Learning, Big Data, or CloudTech; FinTech; CleanTech or Climate Tech; or one of the following other tech verticals: Digital Health, Cybersecurity, AgTech, AdTech, Supply Chain Tech, Real Estate Technology, Mortgage Tech, Mobility Tech, Marketing Tech, Internet of Things, Mobile, InsurTech, Gaming, ESports or Virtual Reality.

Graph 1.B: The key policy rate represents the GDP-weighted average of central bank policy rates across economies. The bank regulation stringency index is based on the integrated macroprudential policy (iMaPP) index in the IMF iMaPP Database, which captures monthly net changes in prudential policies (+1 for tightening, –1 for loosening, 0 for no change). We focus on the following selected set of banking regulation variables: (i) capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements, but excluding countercyclical capital buffers and capital conservation buffers; (ii) limits on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures (eg Basel III leverage ratio); (iii) minimum requirements for Liquidity Coverage Ratios, liquid asset ratios, Net Stable Funding Ratios, core funding ratios and external debt restrictions; (iv) requirements for banks to maintain a capital conservation buffer, including the one established under Basel III; and (v) limits to loan-to-value ratios, applied to residential and commercial mortgages but also applicable to other secured loans, such as for automobiles. We calculate cumulative sums per country and GDP-weighted averages annually (based on the same set of countries as the policy rate series).

Graph 3: The tech employment share is defined as total employment in North American Industry Classification (NAICS) code 51 over total employment in each core-based statistical area (CBSA) as of 2019. Alaska and Hawaii are not shown in the graph. The US Office of Management and Budget defines metropolitan and micropolitan statistical areas, which are referred to collectively as CBSAs. The general concept of the metropolitan and micropolitan statistical area is that of a core area containing a substantial population nucleus, together with adjacent communities having a high degree of economic and social integration with that core. Metropolitan statistical areas contain at least one urbanised area with a population of 50,000 or more; micropolitan statistical areas contain at least one urban cluster with a population of 10,000–50,000. If specified criteria are met, a metropolitan statistical area containing a single core with a population of 2.5 million or more may be subdivided into metropolitan divisions, which function as distinct areas within the larger metropolitan statistical area. CBSAs are composed of entire counties. There are 388 metropolitan statistical areas, of which 11 are subdivided into 31 metropolitan divisions, and 541 micropolitan statistical areas in the United States and Puerto Rico, as of February 2013. CBSA boundaries and titles are as of February 2013, and reflect the application of the 2010 Standards for Delineating Metropolitan and Micropolitan Statistical Areas to Census Bureau data. All other boundaries and names are as of 1 January 2010.

Annex: Additional results

Direct lending growth post-pandemic: robustness tests[1] — Table A.1

	Dependent variable: log(Amount)			
	(1)	(2)	(3)	(4)
Tech emp share x Post x PC	21.15***	23.62***		
	(6.25)	(6.63)		
Tech emp share x Post	0.07		21.72***	21.27***
	(2.96)		(6.15)	(6.06)
Tech emp share x PC	−5.56			
	(6.49)			
CRA (t-1)				−1.10***
				(0.37)
Observations	10,932	10,932	7,626	7,626
R-squared	0.850	0.954	0.889	0.891
CBSA fixed effects	Y	x PC	Y	Y
Time fixed effects	Y	x CBSA	x state	x state
PC x Post fixed effects	Y	Y		
Sample	PC + LL	PC + LL	PC only	PC only
Controls			Y	Y

[1] The dependent variable is the logarithm of outstanding credit in core-based statistical area (CBSA) *c* at quarter *t*, *Tech emp share* is the CBSA's 2019 tech employment share, *Post* is an indicator for quarters from Q1 2020 onwards and *PC* is an indicator for private credit. Column (1) uses the full sample and includes both CBSA and date fixed effects and the lower-order interaction term of *PC* and *PC*Post*. Column (2) includes CBSA-quarter and CBSA-PC fixed effects instead of CBSA and date fixed effects separately. In columns (3) and (4), the sample is restricted to private credit and further controls for lagged employment levels and employment growth. Column (4) further incorporates banks' total small business lending in each CBSA, ie banks' compliance with the Community Reinvestment Act (CRA). Based on quarterly data for the US over Q1 2016 to Q4 2025. A constant is included but absorbed for the sake of simplicity. Standard errors clustered at the CBSA level are in brackets. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Sources: PitchBook Data Inc; authors' calculations.

No effect on employment and firm formation for leveraged loans[1]

Table A.2

	Dependent variable:			
	$\log(\text{empl}^{\text{tech}})$	$\log(\text{empl}^{\text{total}})$	$\log(\text{no firms}^{\text{tech}})$	$\log(\text{no firms}^{\text{total}})$
	(1)	(2)	(3)	(4)
log(LL)	0.009 (0.013)	0.003 (0.003)	0.012 (0.07)	0.004 (0.004)
Observations	1,463	1,463	1,463	1,463
R-squared	0.996	0.999	0.998	0.999
CBSA fixed effects	Y	Y	Y	Y
Time fixed effects	Y	Y	Y	Y

[1] Results from estimating equation (2), using the logarithm (log) of leveraged loans (LL) as the main explanatory variable. In columns (1)–(2), the dependent variables are log tech sector employment (NAICS 51, "Information") and log total employment in the borrower's CBSA, from the US Census Bureau Business Dynamic Statistics (BDS) (2023 vintage). The dependent variables in columns (3)–(4) are log tech sector number of firms and log total number of firms in the borrower's CBSA, from the BDS. The regressor of interest in both panels is the log of total US dollar origination volume in the CBSA-year, summed across completed floating rate leverage loans to US borrowers, from PitchBook Data Inc. All estimates are contemporaneous within-CBSA associations and include CBSA and year fixed effects. Based on annual data for the US over 2016 to 2025. A constant is included but absorbed for the sake of simplicity. Standard errors, clustered at the CBSA level, are in brackets. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Sources: US Census Bureau; PitchBook Data Inc; authors' calculations.

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Bank executive compensation and risk-taking[1]

This article investigates the evolution of bank compensation practices since the Great Financial Crisis (GFC) and how it relates to bank risk. Despite the lessons learned from the GFC, performance metrics for bank executives generally do not account for risk. EU regulation requiring banks to extend their deferral horizons has reduced risk-taking. By contrast, our evidence is not conclusive regarding restrictions on the share of variable compensation. A case study of the 2023 banking turmoil indicates that bank governance failed to ensure that compensation schemes accounted for risk-taking, to recognise the deterioration of performance and to adjust compensation accordingly.

JEL classification: G21, G28, J33

Bank regulation has long sought to constrain excessive risk-taking by addressing the misalignment of incentives created by limited liability, deposit insurance and implicit too-big-to-fail guarantees. The cornerstones of this effort have been capital regulation, which requires banks to hold loss-absorbing equity so that shareholders retain meaningful "skin in the game", and liquidity regulation, which mandates that banks hold adequate liquid assets to safely carry out maturity transformation.

The Great Financial Crisis (GFC) highlighted the need to complement traditional prudential requirements with reforms in the area of compensation to ensure prudent risk behaviour. In 2009, the Financial Stability Board (FSB) adopted principles and standards for sound compensation (FSB (2009a, 2009b)). These specify that banks should align compensation policy with long-term, risk-adjusted performance. Measures include mandatory deferrals of compensation, malus and clawbacks.[2]

Following this, the issue received less attention. While the FSB monitored implementation progress, it has not systematically assessed the impact of compensation regulation on bank risk. And the wave of research investigating this topic after the GFC subsided over time. The 2023 banking turmoil brought the issue back to the fore. Weak compensation practices were widely regarded as significant

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[2] Malus allows banks to reduce or cancel a granted compensation before it has been paid out. Clawbacks can force managers to return compensation after it has been paid out.

Key takeaways

- *Global standards for bank executive compensation, developed to curb excessive risk-taking, have been implemented differently across jurisdictions. Accordingly, compensation practices have not converged.*
- *There is little evidence that banks use risk-adjusted performance targets in determining manager compensation. Return on equity, a measure rewarding leverage risk, continues to play a large role.*
- *Empirical evidence supports the use of deferrals – where part of compensation is withheld and paid out later – to reduce bank risk. By contrast, the evidence on bonus caps is not conclusive.*

contributors to the failures of both Silicon Valley Bank and Credit Suisse (FSB (2024)). Switzerland is now planning a stricter regulation of compensation. In the United States, a proposal to revise compensation guidelines was also launched after the 2023 turmoil but is now on hold. The United Kingdom, for its part, has softened its compensation guidelines, citing concerns over preserving international competitiveness.

Our article examines how compensation practices and their regulation have evolved following the GFC, and how bank executive compensation relates to bank risk. In particular, we ask the following questions: To what extent have banks across jurisdictions shifted towards longer-term deferred compensation and has this led to a reduction in risk? What performance metrics do banks target in their compensation schemes, and to what extent are they risk-adjusted? What specific weaknesses in compensation schemes has the recent banking turmoil exposed?

The main insights from our analysis are as follows.

First, banks' compensation practices diverge across jurisdictions, reflecting differences in the adoption of FSB standards. While the United States adopted principles-based guidelines, the European Union implemented a bonus cap, limiting the ratio of variable pay to fixed compensation, and deferral requirements, mandating that a portion of variable pay be delayed over a minimum period. Accordingly, EU banks have a lower variable-to-fixed compensation ratio and longer deferral horizons than US banks.

Second, we find little evidence that banks adjust their performance metrics to reflect the risk taken on. Accounting profits and stock market performance clearly dominate in the calculation of compensation, and these metrics rarely account for the cost of equity, which reflects the compensation required by shareholders for the risk they incur. Return on equity (ROE), which rewards leverage risk, continues to play a strong role.

Third, we find that longer deferrals come along with lower bank risk. In line with broader literature, we do not find conclusive evidence on the effects of variable compensation on bank risk.

Finally, our case study (see Box A in the Annex) indicates that banks that failed during the 2023 turmoil were not outliers in terms of deferrals. Rather, bank governance failed to ensure that compensation schemes reflected risk-taking and recognise the deterioration of performance in a timely manner. This highlights the role of governing boards and supervisors in overseeing both the design and the operation of compensation schemes.

Compensation regulation: rationale and post-GFC reforms

Key elements of banks' compensation schemes

Executive compensation typically combines a fixed component with a variable component (cash, equity or options). The payment of variable compensation is subject to a multi-stage process. The bank first sets a firm-wide bonus pool. The pool is then allocated across divisions, and staff members receive a *grant* reflecting their contribution to performance. Part of the grant is paid out immediately. The remainder is *deferred*, with its payout subject to a *vesting* process over a predefined horizon.

Vesting is the process by which a manager acquires legal ownership of the *grant*. It can be time-based, depending on continued employment over a predefined period, or performance-based, depending on whether predefined targets are met. Under performance-based vesting, the same initial grant of shares (or cash amount) can yield a different final number of vested shares (or cash amount), depending on outcomes such as profits or stock market performance.

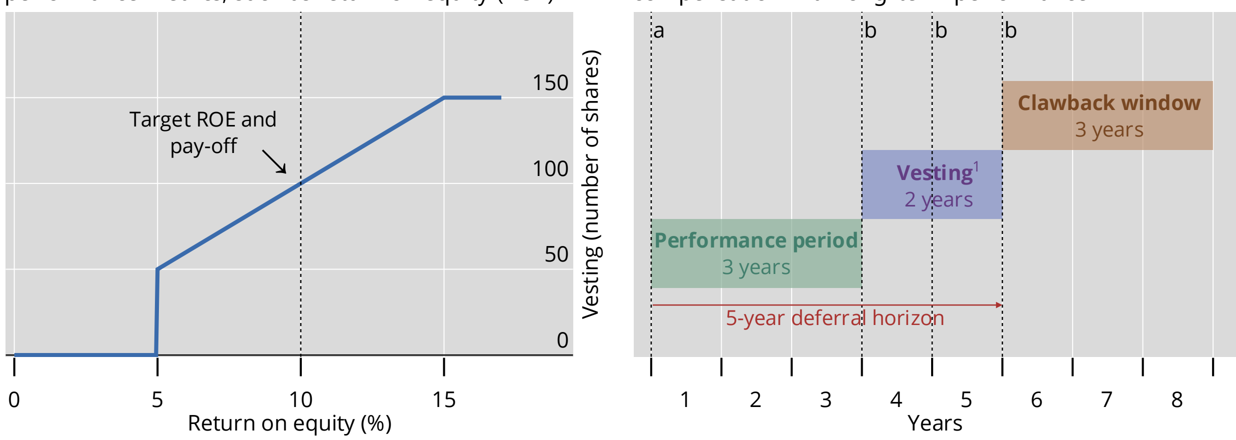
Graph 1.A. illustrates a performance-based vesting scheme tied to ROE. The manager is granted 100 shares corresponding to a target return of 10%. Vesting will be 100 shares when the manager meets the target. Below a 5% return, the grant is forfeited entirely; between 5% and 15% the number of vested shares rises linearly, up to a cap of 150. Banks usually combine accounting- and market-based metrics and weight them to determine overall performance.

Banks can structure deferrals in several ways to align pay with long-term performance. In a five-year deferral, variable compensation can for example be paid out in five annual tranches depending on how ROE evolves in each year. Another approach would be to average ROE, say, over the first three years (Graph 1.B.). Compensation would then vest in three instalments at the end of years three, four and five, based primarily on this average performance. In years four and five, a *malus* would apply. For example, if the capital ratio falls below some critical level in year five, vesting could be zero for that year.

Examples of performance-based compensation schemes — Graph 1

A. Compensation is determined as a function of performance metrics, such as return on equity (ROE)

B. Multi-year deferrals and clawbacks help to align compensation with long-term performance



[a] Grant. [b] Vesting instalments.

[1] Based on targets met during the performance period.

Source: Authors' elaboration.

Clawback clauses offer an additional layer of discipline. They allow the bank to require managers to return all or part of variable compensation after legal ownership has been transferred. They apply only in exceptional circumstances such as severe misconduct or fraud.

Rationale for regulating compensation

Economic theory provides a rationale for regulating bank compensation but also warns about some pitfalls.

While the traditional literature on executive compensation has focused on aligning managers' incentives with those of shareholders, from a societal perspective, the key issues in bank executive compensation lie elsewhere. Fundamentally, bank shareholder interests are likely to differ from those of society since the presence of deposit insurance and state guarantees tend to provide incentive for excessive risk-taking.

Moreover, banks operate with high leverage, and deposits – which represent the core of their liabilities – are spread across a large number of holders with limited incentives to monitor banks' management. Banks are inherently opaque because their loan portfolios tend to be illiquid and information-intensive. These characteristics make it more difficult to contain the so-called risk-shifting problem – the incentive for shareholders to take on excessive risk due to limited liability (Jensen and Meckling (1976)).

In such a configuration, compensation regulation can play a counterbalancing role and prevent banks from designing pay schemes that incentivise managers to take risks at society's expense (John et al (2000); IMF (2014)). Theory generally supports mandatory deferrals. By making bonuses contingent on later performance, they can discourage risk-taking by exposing managers to the long-term consequences of their actions (Hoffmann et al (2022)). But the choice of the horizon is not straightforward (Jarque and Prescott (2010); Hoffmann et al (2022)). When too short, the horizon will fail to capture the materialisation of risk. When too long, it may discourage effort, by making payoffs more distant and uncertain. When effort is related to risk management, an excessively long deferral can even backfire in terms of risk (Hoffmann et al (2022)).

With regard to the bonus cap, theory is split. From a static perspective, a cap can mitigate risk-taking incentives to shift risk onto the taxpayer (IMF (2014); Hakenes and Schnabel (2014)). However, if banks increase fixed pay to compete with sectors or jurisdictions not subject to this requirement, the bonus cap can backfire: projects with a high probability of failure can become attractive. The reason is that the higher fixed pay offers the manager better insurance against failure, while the bonus, even if capped, still offers some reward in case of success (IMF (2014)). Moreover, fixed compensation creates cost rigidities and reduces banks' ability to absorb losses (Asai (2016); Efing et al (2023)).

One stream of the literature recommends linking compensation to risk metrics such as risk premia on banks' debt (Bolton et al (2015); Thanassoulis and Tanaka (2018)). It warns that performance-based vesting, if linked solely to profitability or stock performance, can increase risk incentives. Even a longer deferral cannot fully address this problem, as it does not, per se, prevent shareholders from shifting losses onto the rest of society. Shareholders could still respond by making managers' compensation rise very rapidly with bank value in case of success, to compensate the manager for the downside implied by the deferral (Thanassoulis and Tanaka (2018)).

FSB principles and standards

As part of its response to the malpractices laid bare by the GFC, the FSB set out the principle that significant financial institutions should risk adjust compensation to: (i) reflect risks incurred by employees *before* these risks materialise;[3] and (ii) be sensitive to *realised* risk outcomes, ensuring that employees bear the consequences of their decisions (FSB (2009a, 2009b)).

The FSB defined the following standards for pay structures:

- A substantial proportion of compensation should be variable and linked to performance measures that adequately account for risk. The standards do not set a cap on the ratio between variable and fixed compensation.
- Variable compensation should primarily consist of deferred payments tied to multi-year performance. The FSB recommended that, for senior management, a substantial portion – such as 40–60% – of variable compensation be deferred over at least three years.
- Already paid-out variable compensation should be subject to clawbacks (FSB (2018)), especially in cases of misconduct or major risk management failures.

While the standards include some quantitative parameters, the FSB did not regard their transposition into national regulation as a prerequisite for compliance. It emphasised instead the role of supervisors in promoting adherence.

Finally, the FSB lays out standards for the effective governance of compensation. The governing board must oversee both the design and operation of the compensation scheme. Larger banks should have an independent board compensation committee to monitor compensation on behalf of the board. The Basel Committee on Banking Supervision has incorporated the FSB standards in corporate governance principles for banks (BCBS (2015)).

Implementation of the standards

National jurisdictions implemented the FSB standards in markedly different ways.

Some jurisdictions, such as the United States, Canada and Japan, adopted a principles-based approach without prescribing binding quantitative parameters.[4] After the 2023 turmoil, US supervisory agencies issued a consultation on revised guidelines that would have introduced quantitative deferral requirements (see Box A in Annex). However, only four of the six agencies whose approval would be required joined the proposal, and the Federal Deposit Insurance Corporation withdrew its initial support in 2025.

[3] The FSB recommends in particular that risk adjustments account for the cost and quantity of capital required to support the risks taken.

[4] For instance, the 2010 US inter-agency guidance on sound incentive compensation states: (i) "compensation should balance risk and financial results in a manner that does not encourage imprudent risk taking"; and (ii) "incentive compensation arrangements are likely to be better balanced if they involve deferral of a substantial portion over a multi-year period".

The European Union introduced quantitative requirements for compensation structures, particularly through the 2014 Capital Requirements Directive (CRD IV).[5] For top executives, significant banks should defer at least 60% of variable compensation over a five-year horizon. The EU also went beyond FSB standards by adding a bonus cap, limiting variable compensation to 200% of fixed compensation. As an EU member at the time, the United Kingdom initially applied the cap but abandoned it in 2023 after Brexit. In 2025, it reduced the minimum horizon of deferred compensation to four years.

Other jurisdictions adopted a hybrid approach. Switzerland, for instance, mandates that a significant proportion of variable compensation be deferred for at least three years, with banks allowed to use a "comply or explain" clause. This regulation is under review following the Credit Suisse crisis (see Box A in the Annex).

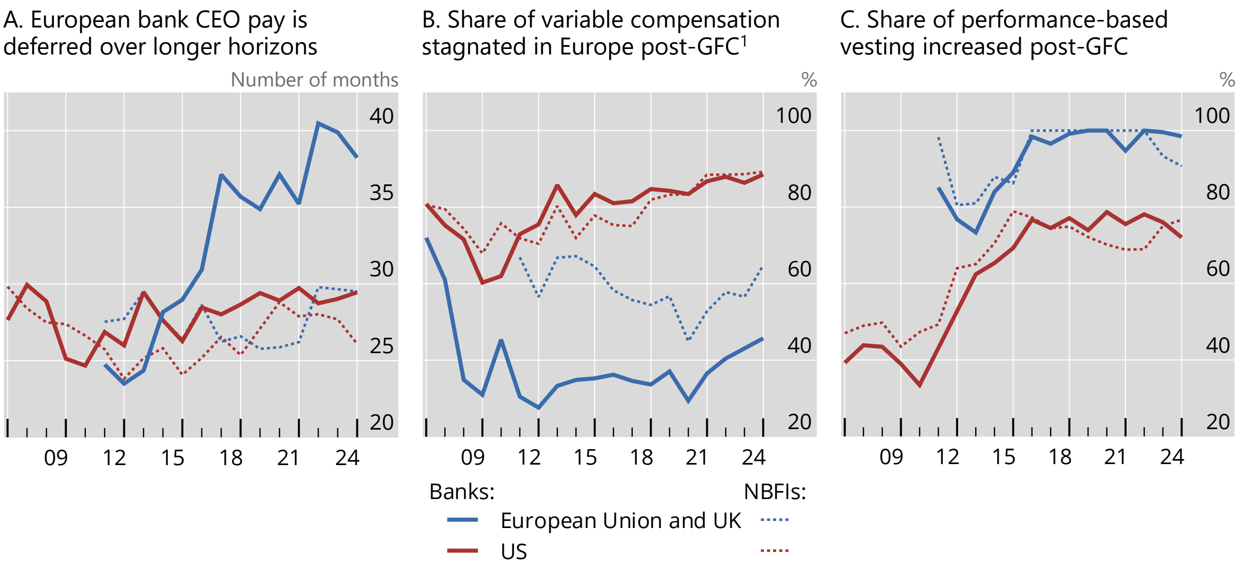
Finally, with regard to performance metrics, most jurisdictions set the principle that they should be risk-adjusted, mainly by accounting for the cost of capital needed to cover the risk of the bank's activities. However, regulation stops short of prescribing specific approaches or metrics.

Changes in bank compensation practices following the GFC

The evolution of banks' compensation practices since the GFC is largely in line with the regulatory stance adopted in the various jurisdictions (see Graph 2).

Evolution of bank CEO compensation practices

Graph 2



GFC = Great Financial Crisis; NBFIs = non-bank financial institutions.

[1] See endnotes for details.

Sources: Bloomberg; ISS Incentive Lab; LSEG Workspace; authors' calculations.

[5] The EU deferral requirement was introduced in several steps. Under the 2011 CRD III, 60% of variable compensation had to be deferred for a horizon of at least three years, with an indication that five years could be appropriate in some cases. Under the 2014 CRD IV, the European Banking Authority specified a minimum of five years for senior management at significant institutions.

First, after the EU adoption of *deferral* rules, the average horizon of variable pay at EU banks rose by about 12 months and is now higher than that at US banks.

Second, following a strong decline in both regions during the GFC, the share of variable compensation remained low at EU banks, consistent with the imposition of the bonus cap. It has, however, risen somewhat in recent years. At US banks, the share of variable compensation returned to pre-crisis levels.

Third, the share of *performance-based vesting* has increased significantly, reflecting a corresponding decline in the share of *time-based vesting*, in line with the regulatory expectation that compensation should reflect performance. The shift is stronger at US banks, because performance-based vesting was less frequent in the United States before the GFC.

Greater reliance on performance-based vesting has made performance metrics key for managers' incentives, but there is little evidence of adjusting them for risk in line with the FSB principles. ROE remains the target with the highest weighting (Table 1). This metric can be artificially inflated by leverage, especially if deposit insurance and implicit state support reduce the cost of bank debt (Pennacchi and Santos (2021)). By contrast, the weight for risk-adjusted metrics such as economic value added (EVA) is low and declining.[6] Total shareholder return (TSR) dominates stock-related performance, while metrics adjusting for the volatility of the stock return – akin to the Sharpe ratio – are rare. The weight assigned to capital management and environmental, social and governance (ESG) has grown over time, but the weight of risk metrics (eg non-performing loans ratio, cost of risk, compliance measurement) remains very low.[7] Comparing regions, US banks tend to weight ROE more than European banks, and they put less emphasis on ESG and capital.

Average weight of performance metrics at US and European banks and NBFIs[1]

In per cent

Table 1

		ROE	Earnings	Revenue /cost	EVA	Stock price	Sub-total	Capital	Climate, ESG	Risk-related	Manage ment[3]	Sub-total
Banks	2011–13	12	12	2	3	13	43	2	1	2	2	7
	2016–18	20	9	5	1	12	47	8	2	1	6	17
	2022–24	22	8	5	0	12	48	9	7	0	9	26
NBFIs[2]	2011–13	13	8	6	0	18	45	6	0	0	1	6
	2016–18	15	11	10	0	13	49	3	1	1	4	10
	2022–24	13	9	10	1	21	54	1	6	0	10	17

ESG = environmental, social and governance; EVA = economic value added; NBFIs = non-bank financial institutions; ROE = return on equity.

[1] Includes 60 firms, with total assets above USD 100 billion. Percentages do not sum to 100%. Part of variable compensation is time-based and therefore not related to performance metrics. Moreover, some metrics set for individual managers cannot be allocated to the main groups of performance metrics. [2] Insurance companies, firms operating in capital market operations such as brokerage and asset management and firms operating in financial services such as consumer and mortgage finance. Based on Global Industry Classification Standard (GICS). [3] Objectives such as governance, strategy, staff engagement and individual performance.

Sources: ISS Incentive Lab; LSEG Workspace; authors' calculations.

[6] EVA represents a risk-adjusted performance metric since it compares profits with the economic cost of capital, which is an increasing function of risk (Stoughton and Zechner (2007)). ECB (2010) discusses the limits of ROE and reviews alternative bank performance metrics.

[7] Some banks set capital targets to facilitate the transition to new capital regimes, such as Basel III. They sometimes also define "hurdle" capital ratios, below which compensation is subject to malus

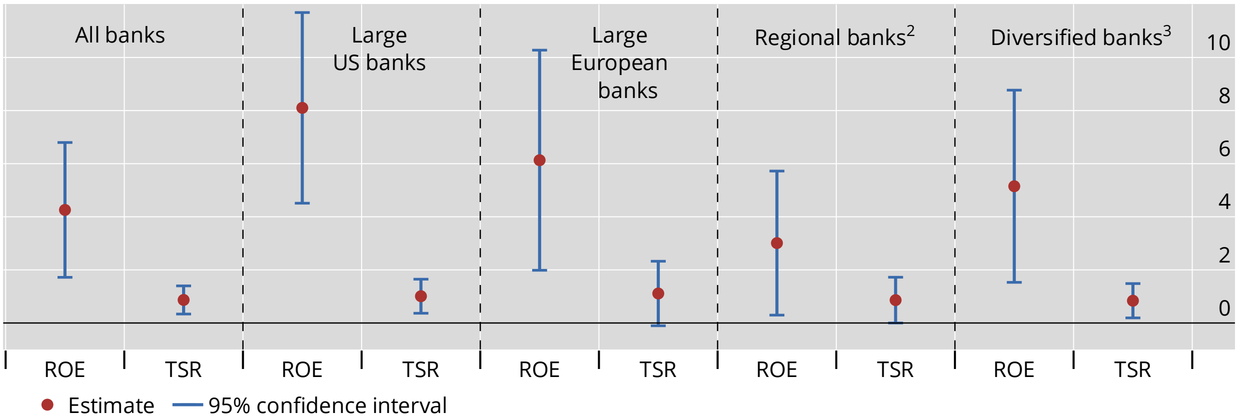
Banks place a higher weight on ROE than do NBFIs, even insurers or capital market firms.[8] Thus, banks' reliance on ROE is unlikely to result from competitive pressure from NBFIs' remuneration policies.

Regression analysis confirms banks' stronger reliance on ROE than on TSR in determining variable compensation (Graph 3). We regress paid compensation on granted compensation, ROE and TSR for US and European banks. A 1 percentage point increase in ROE is associated with a 4% rise in paid compensation, while a 1% increase in TSR corresponds to a mere 1% rise in pay.[9] When capital or risk metrics are included, their coefficient is generally not significant, in line with their low weighting as performance metrics. The stronger reliance on ROE compared with TSR tends to be more pronounced in larger banks, US banks and banks with a diversified business model.

Impact of performance metrics on compensation[1]

In per cent

Graph 3



ROE = return on equity; TSR = total shareholder return.

[1] See endnotes for details. [2] Commercial banks focused on retail banking and small/medium corporate lending, primarily serving specific geographic regions. [3] Banks with a national or global footprint, offering a wide range of services, including investment banking and wealth management.

Sources: Bloomberg; ISS Incentive Lab; LSEG Workspace; authors' calculations.

(see previous section). ESG is a framework for assessing sustainability and ethical practices in environmental, social and corporate governance areas.

8 The weighting of ROE is 11% for insurance companies and 6% for capital market firms (classification based on GICS). Bennett et al (2021) also find that US banks put a greater weight on ROE than non-banks. Cerasi et al (2017) report that the *share* of variable compensation is sensitive to ROE, but that this sensitivity has declined following the GFC.

9 Since TSR varies more widely than ROE, comparing coefficients alone can be misleading. The Shapley decomposition, which calculates the marginal contribution of each variable to explained variance, confirms that ROE plays a stronger role in explaining compensation than TSR.

How does compensation design affect bank risk?

Background and empirical strategy

Our empirical analysis on the relationship between compensation design and risk exploits differences in regulatory responses across jurisdictions. We test whether: (i) a higher proportion of variable compensation is associated with more risk; and (ii) longer deferrals are associated with less risk.

We focus on CEO compensation, for which the Institutional Shareholder Services (ISS) Incentive Lab provides an extensive database on compensation design. The sample comprises 73 US and European (EU and non-EU) banks, which together offer a sharp contrast in regulatory treatment as well as comprehensive data on the design of CEO compensation.

We consider market-based, rating-based and accounting-based risk metrics. Specifically, we measure risk using the expected loss of market value of the bank during a systemic crisis (long-run marginal expected shortfall, or LRMES), the translation of this loss in capital shortfall (systemic risk, or SRISK), Moody's one-year expected default frequency (EDF), Fitch ratings and an accounting-based distance to insolvency referred as the z-score (see endnotes for the definitions). We complement this set of risk metrics with indicators measuring banks' capital adequacy management: the risk-weighted capital ratio, leverage and, in the case of global systemically important banks (G-SIBs), the capital buffer held above the regulatory requirement.

We use two regression approaches. The first examines the relationship between compensation design and bank risk since the GFC. The second examines changes in compensation practice and in bank risk during episodes of regulatory change. This latter approach comes closer to a causal analysis.

Relationship between compensation design and bank risk

We first investigate the relationship between changes in compensation design and bank risk since the GFC. Bank risk is regressed on the deferral horizon applicable to the CEO, the share of variable compensation and variables controlling for banks' characteristics. We estimate the following equation:

$$\begin{aligned} Risk_{i,t} = \beta_0 + \beta_1 \times DeferralHorizon_{i,t-2} + \beta_2 \times ShareVarComp_{i,t-2} \\ + \beta_3 \times LeverageRatio_{i,t} + \beta_4\, X_{i,t} + \alpha_i + \lambda_t + \varepsilon_{i,t}, \end{aligned} \tag{1}$$

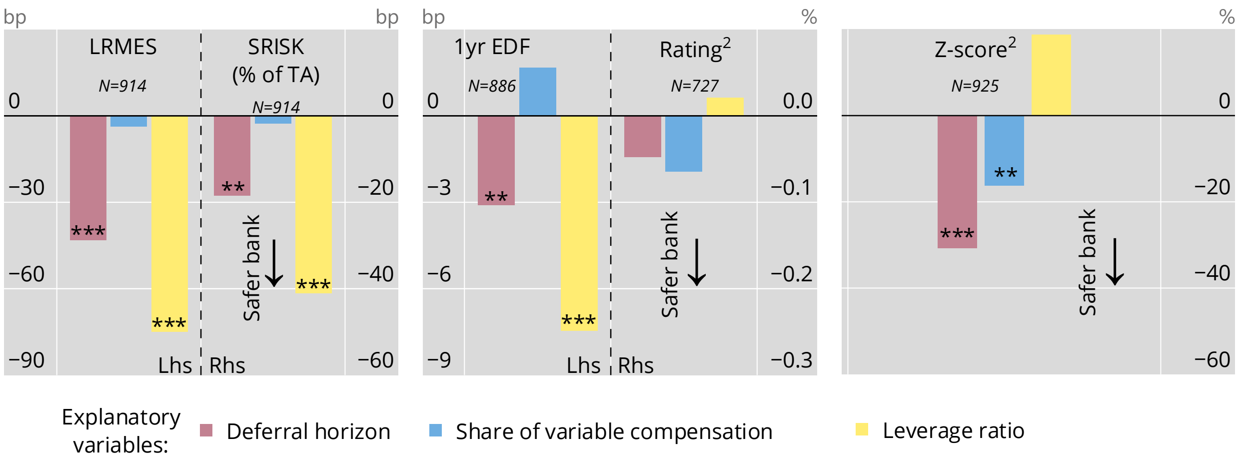
where $X_{i,t}$ includes control variables (total assets, dummy variables for the GFC period (2008–10), deposits over short-term liabilities), α_i is bank fixed effects, and λ_t is year fixed effects. The two-year lag for compensation variables assumes that changes in the compensation design take some time to affect risk measures.[10] Standard errors are clustered at the bank level.

[10] We also ran regressions with no lag. For the z-score, the coefficients are no longer statistically significant, likely due to the fact that it is calculated using a four-year moving window. The other results remain significant, except for the Common Equity Tier 1 management buffer.

Banks with longer deferral horizons tend to be safer[1]

Estimated coefficients

Graph 4



EDF = expected default frequency; LRMES = long-run marginal expected shortfall; SRISK = systemic risk measure; TA = total assets. ***/** denote statistical significance at the 1/5% level, respectively.

[1] See endnotes for details. [2] Inverted so that larger numbers indicate riskier banks.

Sources: Fitch Ratings; ISS Incentive Lab; LSEG Workspace; Moody's; V-Lab; authors' calculations.

Compared with the differences-in-differences setup of the next section, this approach allows us to consider longer time windows, which are not restricted to episodes of regulatory change. However, the approach is susceptible to reverse causality: for instance, more prudent banks might naturally adopt compensation schemes that discipline management. Introducing a lag might help reduce endogeneity.

The results indicate that longer deferrals are associated with lower risk for four out of five risk measures (red bars in Graph 4). By contrast, the share of variable compensation is not significantly correlated with risk (blue bars), except for the z-score, where the correlation is negative – in contrast to what would be expected.

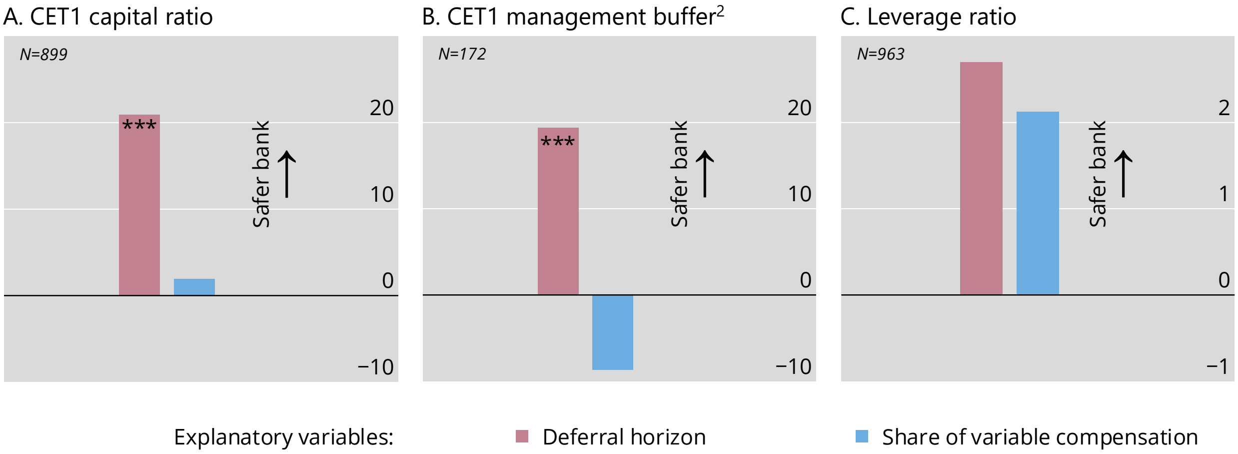
As mentioned above, banks' risk behaviour may also be observed in their choice of capital buffers or leverage. Accordingly, we regress banks' management capital buffers, their capital ratios and their leverage ratios on the two variables reflecting compensation design, this time without controlling for leverage. We find that longer deferrals go hand in hand with a higher Common Equity Tier 1 (CET1) capital ratio and with a larger capital management buffer (Graph 5). By contrast, we find no significant effect for the leverage ratio. Finally, we find no significant results for the share of variable compensation as an explanatory variable.

Overall, the correlation analysis shows that longer deferrals are associated with lower risk and more prudent capital management. By contrast, evidence of a possible link between the share of variable compensation and risk is weak.

Banks with longer deferral horizons tend to maintain stronger capital buffers[1]

Estimated coefficients, in basis points

Graph 5



CET1 = Common Equity Tier 1. *** denotes statistical significance at the 1% level.

[1] See endnotes for details. [2] Covering global systemically important banks (G-SIBs) from 2014 to 2025.

Sources: Baudino et al (2026); ISS Incentive Lab; LSEG Workspace; S&P Global Market Intelligence; authors' calculations.

Impact of episodes of regulatory change

Our second approach uses a differences-in-differences setup and focuses on two regulatory episodes: (i) the EU's introduction of a bonus cap and a mandatory five-year deferral in 2014; and (ii) the removal of the bonus cap for UK banks in 2023.

For the first episode, we investigate whether those EU banks with a larger gap between their practices and the new regulation were also the ones that reduced their risk more after the regulation came into force. The approach capitalises on the fact that EU banks entered that regulatory episode with different compensation practices and that non-EU banks (ie US banks and other European banks) were not subject to the same rules.

The regression analysis compares, for each bank, the evolution of its risk between the periods 2012–13 and 2014–16 and its *distance* from the new compensation regulation measured as of 2013. For example, if a bank had four-year deferrals, its distance was one year. For the deferral horizon, we estimate the following equation:

$$Risk_{i,t} = \beta + \delta \times 1\{i \in EU\} \times 1\{t \geq 2014\} \times \left|5\ years\ - DeferralHorizon_{i,2013}\right|_{+} + \alpha_i + \lambda_{c,t} + \varepsilon_{i,t},^{11} \quad (2)$$

where α_i is the bank fixed effect and $\lambda_{c,t}$ is the country-by-year fixed effect.

This approach is better suited for identifying causal effects of compensation regulation, because it exploits the differential impact of the new rules on the risk behaviour of banks with varying levels of compliance.[12] The approach requires that

[11] $\left|5\ years\ - DeferralHorizon_{i,2013}\right|_{+} = 5\ years\ - DeferralHorizon_{i,2013}$ if $DeferralHorizon_{i,2013} \leq 5\ years$. $\left|5\ years\ - DeferralHorizon_{i,2013}\right|_{+} = 0$ otherwise.

[12] However, the pre-reform gap may also capture other factors influencing risk-taking behaviour. While some endogeneity may persist, including US banks in the analysis, for which the reform does not apply regardless of their pre-reform gap, helps to mitigate this concern.

the "treated group" (subject to regulation) and the "non-treated group" be clearly distinct.[13] Moreover, the treated and non-treated groups must evolve in parallel in the absence of treatment (the so-called parallel trend assumption).

Overall, we find that EU banks needing to increase deferrals more to comply with regulation reduced risk significantly more (Graph 6). Focusing on the risk measures for which the parallel trend assumption is not rejected, we note that longer deferrals lead to a reduction in the systemic risk metric (SRISK) and to an improvement in ratings – which reflect the systemic and idiosyncratic risk, respectively. An increase of one year in the deferral horizon is associated with a reduction in SRISK representing about 15% of its year-to-year variability. For the share of variable compensation, by contrast, we find no impact on risk. A separate regression targeting EU banks – which allows us to concentrate on a more homogeneous sample – delivers similar results for both deferrals and the share of variable compensation.

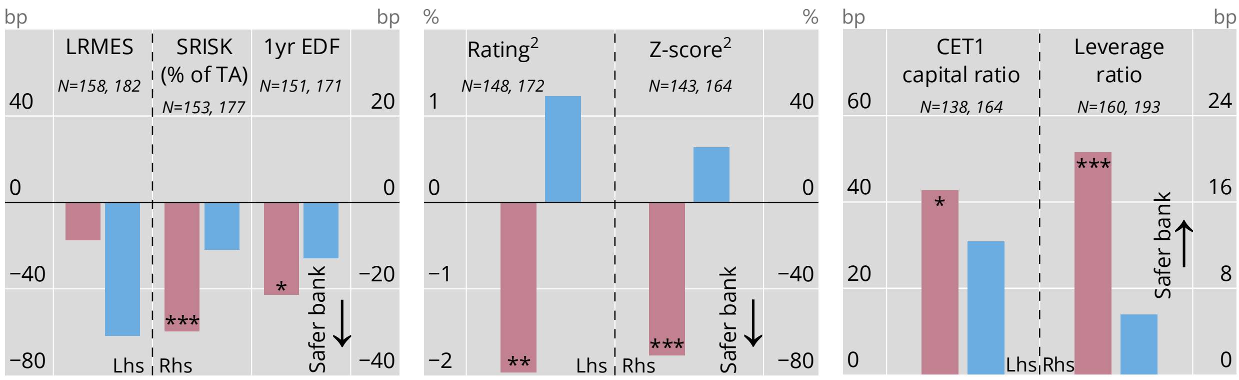
We also find that an increase in deferrals leads to a significant increase in the CET1 capital ratio and in the leverage ratio, implying more prudent capital management. We find the bonus cap has no significant effects.

As our second causal test, we examine the effects of the removal of the bonus cap in the United Kingdom in 2023. We specifically examine whether UK banks that increased variable pay beyond the former regulatory limit of two thirds of total compensation (the equivalent to the 200% cap[14]) experienced an increase in risk

EU banks that had to increase the deferral horizon of compensation became safer[1]

Estimated coefficients

Graph 6



Explanatory variables: ■ Deferral horizon ■ Share of variable compensation

CET1 = Common Equity Tier 1; EDF = expected default frequency; LRMES = long-run marginal expected shortfall; SRISK = systemic risk measure; TA = total assets. ***/**/* denote statistical significance at the 1/5/10% level, respectively.

[1] See endnotes for details. [2] Inverted so that larger numbers indicate riskier banks.

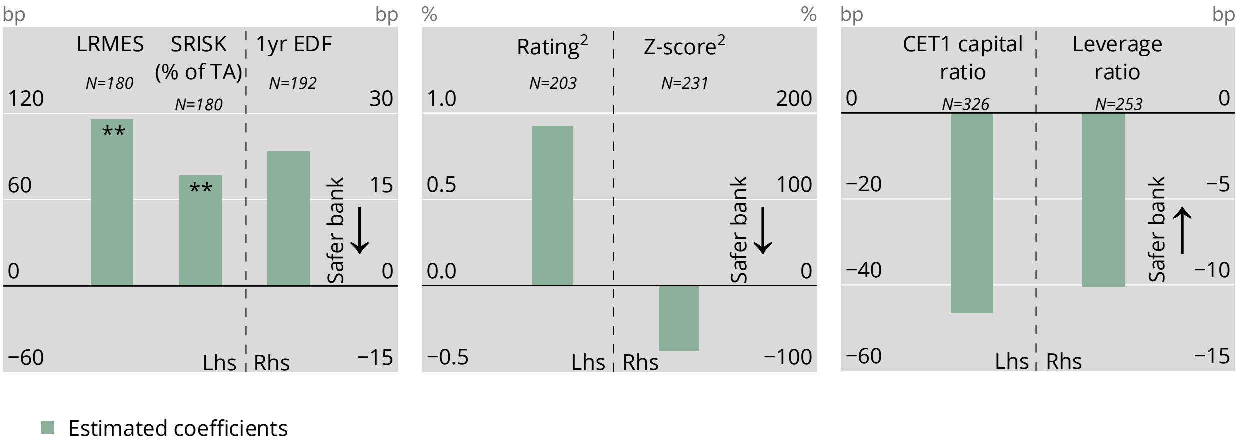
Sources: Fitch Ratings; ISS Incentive Lab; LSEG Workspace; Moody's; S&P Global Market Intelligence; V-Lab; authors' calculations.

[13] The fact that only EU banks were subject to the bonus cap and to quantitative deferral requirements (for both the share to be deferred and the horizon) supports their identification as treated banks. The contrasting evolution for the deferral horizon and the share of variable compensation between the European Union and the United States also indicate that these banks were treated differently, both in terms of regulation and supervision.

[14] The default bonus cap is set at 100%, but this limit is not constraining since shareholders have the option to increase it to 200%.

Following the removal of the bonus cap, UK banks became riskier[1]

Graph 7



CET1 = Common Equity Tier 1; EDF = expected default frequency; LRMES = long-run marginal expected shortfall; SRISK = systemic risk measure; TA = total assets. ** denotes statistical significance at the 5% level.

[1] See endnotes for details. [2] Inverted so that larger numbers indicate riskier banks.

Sources: Fitch Ratings; ISS Incentive Lab; LSEG Workspace; Moody's; S&P Global Market Intelligence; V-Lab; authors' calculations.

during the period 2024–25 compared with 2022–23. Here, we exploit the fact that their EU peers are still subject to the bonus cap. We estimate the following equation:

$$Risk_{i,t} = \beta + \delta \times 1\{i \in UK\} \times 1\{t \geq 2024\} \times |ShareVarComp_i - 2/3|_+ + \alpha_i + \lambda_t + \varepsilon_{i,t,} \quad (3)$$

where α_i is the bank fixed effect and λ_t is the year fixed effect. Standard errors are clustered at the bank level.

Focusing on risk metrics for which the parallel trend assumption is not rejected, LRMES and SRISK, we find a significant rise in risk at UK banks that increased variable compensation (Graph 7). By contrast, when looking at capital management metrics, we find no impact for the leverage ratio or the CET1 ratio.

Overall, our regulatory impact analysis suggests that longer deferral requirements mandated by EU regulation led to a reduction of risk and to more prudent capital management. While this result is consistent with the broader literature, we are the first to examine the effects of EU deferral requirements (see Box B in the Annex). For the bonus cap, our evidence is inconclusive. We find no effect on risk from the introduction of the cap in the European Union, but an impact of its removal in the United Kingdom. The broader literature reveals an even starker divergence (see Box B in the Annex). The introduction of the EU cap leads to an increase of bank risk for some metrics (Colonnello et al (2023)). But its later removal in the UK is also associated with higher risk (De Angelis et al (2025)).

Conclusions

The implementation of the FSB standards on bank compensation varies widely, with some jurisdictions imposing quantitative requirements on the structure and horizon of pay, and others adopting a principles-based approach. This has led to significant differences in banks' practices, both in terms of deferrals and variable compensation.

Our regression analysis suggests that longer deferrals reduce risk, while the results regarding the effectiveness of the bonus cap are inconclusive. This aligns with both theoretical and empirical literature, providing stronger support for deferrals as a risk-reducing mechanism. The effectiveness of the bonus cap can be undermined when market pressure from banks in other jurisdictions (or NBFIs) not subject to this requirement leads to an increase in fixed compensation.

Our results also highlight that measuring bank risk and its relationship with compensation design and regulation is inherently complex. This underscores that regulatory impact analyses need to be broad-based, both in terms of risk indicators and econometric approaches.

Looking at the 2023 turmoil, the failed banks were not fundamentally different from their peers in terms of deferrals (see Box A in the Annex). Rather, bank governance failed to ensure that compensation schemes reflected risk-taking and recognise the deterioration of performance in a timely manner. The turmoil highlights the role of governing boards and supervisors in overseeing the operation of compensation frameworks.

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Endnotes

Graph 2.B: Metrics calculated for banks with total assets above USD 50 billion. The share of variable compensation is based on compensation paid (instead of granted) to cover the period since the GFC (Bloomberg and ISS Incentive Lab). In contrast, the bonus cap is based on granted compensation, which can lead to deviations depending on effective performance. The average deferral horizon and the share of performance-based compensation are calculated based on ISS Incentive Lab data.

Graph 3: We estimate the following equation: $Paid\ compensation_{i,t} = \beta_0 + \beta_1 \times ROE2yr_{i,t} + \beta_2 \times TSR2yr_{i,t} + \beta_3 \times Grant_{i,t-2} + \alpha_i + \varepsilon_{i,t}$.

Compensation is expressed in natural log. Since we focus on the vesting process, we introduce a two-year lag between granted compensation and paid compensation, and we measure performance (ROE and TSR) over the corresponding time interval. We use panel data regression over the period 2005–24 with errors clustered at the firm level and firm-specific fixed effects. The regressions in the panels labelled "All banks", "Regional banks" and "Diversified banks" include banks with total assets exceeding USD 100 billion (ie 53 banks). The regression in the panels labelled "Large US banks" and "Large European banks" focus on banks with total assets exceeding USD 250 billion (ie 35 banks). The business model classification follows the Global Industry Classification Standard (GICS).

Graphs 4, 6 and 7: The risk-related explained variables are defined as follows:

- LRMES estimates the equity loss caused by a 40% market decline (see Brownlees and Engle (2017)).
- SRISK is based on LRMES but accounts for the bank's capital (see Brownlees and Engle (2017)). It is normalised by bank size.
- Moody's EDF estimates a company's probability of default by combining balance sheet and market-based information, such as equity value and stock volatility.
- The rating reflects Fitch's bank individual rating before 2011 and viability rating since 2011. It was rescaled from 0% for the best rating to 100% for the worst. Inverted so that larger numbers indicate riskier banks.
- The z-score measures the distance between a bank's capital buffer and the insolvency threshold, expressed in terms of standard deviations of return on assets. Inverted so that larger numbers indicate riskier banks.

Graphs 4, 5, 6 and 7: The explanatory variables are defined as follows:

- The deferral horizon represents the number of years until the CEO receives compensation in full.
- The share of variable compensation is defined as the ratio of performance-based pay to total compensation, based on granted compensation. The coefficient represents the effect of a 10 percentage point increase.

- The leverage ratio (excluded for regressions where capital is the explained variable) is based on accounting instead of regulatory standards to cover the period preceding the introduction of the Basel leverage ratio. The higher the leverage ratio, the lower the leverage. The coefficient represents the effect of a 1 percentage point increase.

Graphs 5, 6 and 7: The capital-related explained variables are defined as follows:

- The CET1 capital ratio is based on CET1 capital and risk-weighted assets.
- The CET1 management buffer (only for Graph 5) is defined as the difference between the actual capital ratio and capital requirements.
- The leverage ratio is based on accounting instead of regulatory standards to cover the period preceding the introduction of the Basel leverage ratio. The higher the leverage ratio, the lower the leverage.

Graphs 6 and 7: Saturating the model with country-by-year fixed effects allows us to purge variation attributable to supervisory and regulatory changes decided at the national level such as macroprudential buffers (Colonnello et al (2023)). For the parallel trend test, the null hypothesis is that pre-treatment coefficients are equal to zero, implying no differential trends between treated and control banks prior to treatment.

Annex

Box A

The 2023 banking turmoil revealed a misalignment between compensation, risk and performance at some banks

*Bertrand Rime*①

The 2023 banking turmoil was the most significant episode of system-wide stress since the Great Financial Crisis (GFC). Credit Suisse and three US regional banks suffered a massive loss of confidence, making state intervention necessary. The failures highlighted weaknesses in governance, risk management and oversight as well as the vulnerabilities of some banks' business models. Compensation, as part of the banks' governance frameworks, was identified as one important contributor to the failures (FSB (2024)).

Our case study indicates that the failed banks' compensation schemes were not fundamentally different from peer banks in terms of structure. But they relied on performance metrics that did not reflect long-term, risk-adjusted profitability, which especially weakened the disciplining effects of deferrals. This highlights the role of governing boards and supervisors in fostering sound governance.

Credit Suisse

For Credit Suisse, looking at the period 2015–17 seems particularly insightful, as this reveals a material and persistent divergence between compensation and performance, well before the bank's destabilisation.

Credit Suisse was not an outlier in terms of compensation structure. The bank applied deferrals of five years for around 50% of variable compensation, with performance measurement over three years and a malus system. These features were broadly in line with its international peers as well as the guidelines of the banking supervisor, the Swiss Financial Market Supervisory Authority (FINMA), which stipulate that a *significant* percentage must be deferred for at least three years.

The compensation scheme allowed the distribution of compensation despite prolonged low profit or even losses. The bank adjusted performance metrics for the calculation of compensation by excluding goodwill impairments, restructuring expenses and litigation provisions, arguing that this would better reflect operational performance. These adjustments were very material, so that profitability metrics relevant for compensation remained positive over the period 2015–17, despite the bank reporting a cumulative loss under accounting standards. Capital-related performance metrics, which received a high weighting in the bank's compensation scheme at the time, were also adjusted upward: the numerator excluded the effect of losses and provisions related to litigation, while the risk-weighted assets (RWA) calculation partially excluded operational risk surcharges ordered by FINMA.

While the executive board voluntarily cut its own variable compensation in 2017 following controversies with large shareholders, incentive compensation at the bank level declined only moderately. Hau and Rochet (2024) estimate that after accounting for the cost of capital, the period 2015–17 saw an economic loss of CHF 16 billion, while incentive compensation amounted to around CHF 9 billion. Similarly, for the period 2010–22, they estimate an economic loss of CHF 34 billion, compared with incentive compensation around CHF 40 billion.

In its lessons learned report, FINMA (2023) noted that the lack of financial consequences for misconduct and the exclusion of what the bank deemed extraordinary events encouraged an inappropriate risk culture. In this regard, it pointed at the responsibility of the governing board's compensation committee and noted that shareholders approved all compensation proposals.

FINMA also observed that variable remuneration in years of substantial losses conflicted with one key principle in its guidelines, stipulating that poor performance should lead to the reduction or elimination of the compensation pool. At the same time, FINMA noted that its guidelines permitted deviations if they were justified and disclosed under the "comply or explain" approach. In its 2016, compensation report, Credit Suisse mentioned, in particular, staff retention as a justification for variable compensation levels.

In response to the collapse of Credit Suisse, Switzerland plans to establish binding quantitative deferral requirements, retention periods and clawbacks for variable remuneration, at least for systemically important banks (Swiss Federal Council (2026)). Misconduct and violations of supervisory laws would be penalised by a reduction or cancellation of variable remuneration.

US regional banks

The collapse of three US regional banks in March 2023 also illustrates that compensation schemes can fail to align payouts with long-term performance and risk, even when their structures do not appear as outliers compared with peers.

The US Government Accountability Office (GAO (2025)) compared the compensation structures of the three failed banks with their peers and found them broadly similar, including in terms of deferral horizons, performance periods and clawbacks. At the same time, the GAO observed that a three-year performance period could fail to capture risks that emerged over long time frames. Substantial variable compensation was paid out or granted during the two years preceding the banks' failures.

In its review of the Silicon Valley Bank (SVB) failure, the Federal Reserve (2023) concluded that compensation packages of senior management were tied to short-term earnings and equity returns and did not include risk metrics. Therefore, managers had a financial incentive to focus on short-term profit over sound risk management. The report did not determine whether SVB was an outlier in this regard but recommended that supervisors consider how to strengthen alignment of compensation with risk management and long-term performance. It also highlighted that SVB's increasing unrealised losses on its securities portfolio were not adequately captured in the standard accounting metrics used to assess profitability and financial health.

In 2024, four US supervisory agencies proposed revised compensation guidelines requiring a minimum four-year deferral for at least 60% of qualifying incentive-based compensation for senior executives at level 1 institutions. The GAO supported finalisation of the reforms. However, this finalisation would require the approval of two other regulators who did not join the initiative, and the Federal Deposit Insurance Corporation withdrew its initial support in 2025.

① The views expressed here are those of the author and not necessarily those of the BIS or its member central banks.

Box B

Broader empirical literature supports deferrals over bonus caps in reducing bank risk

Gaston Gelos, Bertrand Rime and Kevin Tracol①

This box summarises the broader empirical literature on the relationship between bank risk and compensation design. It discusses seven empirical studies published since the Great Financial Crisis (GFC) that focus on the share of variable compensation, deferrals and their relationship to risk.

The first group of studies (upper block in Table B1) looks at the relationship between bank compensation design and risk in the sense of a correlation analysis, as we do with the first approach. The second group tries to causally identify the impact of specific episodes of regulatory changes on compensation practice and risk, as we do in the second approach.

The studies cover a wide spectrum of risk metrics that overlaps with ours (see footnotes of Table B1 for further details):

- Market-based risk indicators: in addition to long-run marginal expected shortfall (LRMES) and systemic risk (SRISK) described above, they also cover stock volatility, the Sharpe ratio, the credit default swap (CDS) spread, the conditional value at risk (CoVaR), which is an alternative measure of systemic risk introduced by Adrian and Brunnermeier (2016), and the expected shortfall of stock return.
- Accounting-based risk indicators: in addition to the balance sheet z-score and leverage ratio covered in our regressions, they consider return on equity (ROE) volatility, or trading income volatility.

Table B1 provides an overview of the results. To improve comparability, we distinguish between two "regulatory" hypotheses: (i) a higher share of variable compensation is associated with higher risk, supporting the bonus cap; and (ii) longer deferrals are associated with lower risk, supporting mandatory deferrals.

The proportion of results supporting the regulatory hypothesis (marked in green) is higher for deferrals than bonus caps, where results rejecting the hypothesis (in red) or inconclusive ones (in yellow) dominate. Our own results point in the same direction.

Focusing on regulatory impact studies, we note a contrast between Colonnello et al (2023), who find that the introduction of the bonus cap in the European Union either had no impact on bank risk or even increased it, and De Angelis et al (2025), who find that its subsequent removal in the United Kingdom either had no impact on bank risk or increased it. We also find mixed results across the two regulatory episodes.

On deferrals, the only regulatory impact study is Kleymenova and Tuna (2012), who find that mandatory deferrals introduced in 2011 under the UK remuneration code are associated with risk reduction. While we obtain a similar result for the introduction of deferral requirement in the European Union, the results are not directly comparable, since Kleymenova and Tuna (2021) focus on the deferred share of variable compensation, while we focus on the deferral horizon.

Empirical studies looking at the relationship between bank risk and compensation design[1]

Table B1

Author (year) and approach	Sample	Share variable compensation (impact of an increase, expected to be positive)	Deferral (impact of an increase, expected to be negative)
		Correlation-based analysis	
IMF (2014)	International banks, 2005–13	Balance sheet z-score[2]↘, beta↘, equity return volatility↘, LRMES→	Deferral horizon Balance sheet z-score[2]↘, beta→, equity return volatility→, LRMES↘
Efing et al (2015)	DE and CH banks, 2003–11	Trading income volatility↗	...
Bennett et al (2021)	US banks, 2006–18	...	Share of variable compensation linked to long-term performance Expected shortfall↘
Alzayed et al (2024)	US banks, 2011–18	...	Share of variable compensation deferred Balance sheet z-score[2]↘, leverage↘, stock return volatility→
		Causal-based analysis	
Kleymenova and Tuna (2021) Impact of minimum deferrals (UK Code)	UK banks, 2006–12	...	Share of variable compensation deferred CDS↘, CoVaR↘, leverage↘, LRMES→, SRISK % →, stock return volatility↘, Z-score↗
Colonnello et al (2023) Impact of bonus cap introduction (CRD IV)	45 EU banks, 2010–18	Beta↘, CDS ↘, CoVaR→, LRMES↘, Sharpe ratio[2]→	...
De Angelis et al (2025) Impact of bonus cap removal (UK Code)	UK banks, 2021–24	Beta↗, risk-taking measured by capital ratio↗, CDS spread→, expected shortfall→, leverage↗	...

CDS = credit default swap; CoVaR = conditional value at risk introduced by Adrian and Brunnermeier (2016); CRD = Capital Requirements Directive; LRMES = long-run marginal expected shortfall; SRISK = systemic risk measure. Results are aligned with regulatory assumptions/inconclusive/dismissing the regulatory hypothesis. ↘ = risk decreases; ↗ = risk increases; → = risk stable.

[1] LRMES estimates the equity loss caused by a 40% market decline. SRISK is based on LRMES but accounts for the bank's capital. See Brownlees and Engle (2017) for details. CDS spread reflects the price of protection against the bank's default. Trading income volatility is defined as the relative volatility of trading income compared with interest income. The Sharpe ratio divides excess return by return volatility. CoVaR estimates financial system risk conditional on a specific institution's distress. The z-score measures the distance between a bank's capital buffer and the insolvency threshold, typically using accounting metrics, though it may sometimes incorporate market indicators (Kleymenova and Tuna (2021)). Expected shortfall measures average stock return for the worst 5% of daily returns. [2] Z-score, CoVaR and Sharpe ratio are inverted, ie increase with risk.

Sources: Alzayed et al (2024); Bennett et al (2021); Colonnello et al (2023); De Angelis et al (2025); Efing et al (2015); IMF (2014); Kleymenova and Tuna (2021).

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International credit to Africa[1]

International credit to Africa has expanded quickly since the Global Financial Crisis (GFC). Three new elements have distinguished this growth from the past. First, Chinese banks emerged as key lenders on the back of the Belt and Road Initiative. Nevertheless, renminbi usage remained limited, with most international credit still denominated in dollars. Second, more African countries started to borrow internationally following the implementation of debt relief programmes. Third, international bond issuance grew rapidly amid easy financial conditions post-GFC. Beyond these developments, governments remained the dominant borrowers, even increasing their share in international credit in both loans and bonds. London continued to be a key hub from which banks lend to Africa.

JEL classification: F34, F36, G21, F31, G15

While international credit to sub-Saharan Africa (hereafter "Africa")[2] remains small compared with other regions, Africa's economic development, along with its financing, holds global significance due to the region's fast-growing population. The working age population in Africa has already surpassed that in North America and western Europe, and it is set to overtake that in China within the next decade and that in India within 30 years (Graph 1.A).

International credit is particularly relevant for financing investment in Africa, as domestic financing in the region is still maturing (Beck et al (2011)). Indeed, international credit has become increasingly important for the region over the past decade, rising as a share of GDP (Graph 1.B). At the same time, although domestic financial systems have expanded and remained the primary source of credit, the ratio of domestic credit to GDP has been steadily falling. International credit comes with risks, including exchange rate risk, overborrowing or fuelling of domestic credit booms

1 The views expressed in this publication are those of the authors and not necessarily those of the BIS or its member central banks. We thank Iñaki Aldasoro, Stefan Avdjiev, Rashad Cassim, Gong Cheng, Michael Chui, Torsten Ehlers, Leonardo Gambacorta, Gaston Gelos, Patrick McGuire, Benoit Mojon, Nwabisa Ndzama, Daniel Rees, Andreas Schrimpf, Frank Smets, Goetz von Peter and Philip Wooldridge for helpful comments.

2 "Africa" in this article comprises the following 45 countries: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, the Central African Republic, Chad, Comoros Islands, Côte d'Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, the Republic of the Congo, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, South Africa, South Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

Key takeaways

- *International credit to Africa, both loans and bonds, has expanded quickly since the Great Financial Crisis, as more African countries have started to borrow internationally.*
- *Chinese banks became key lenders on the back of the Belt and Road Initiative, though their lending has stalled since 2020.*
- *Following strong issuance growth, international bonds have become a significant part of the borrowing landscape.*

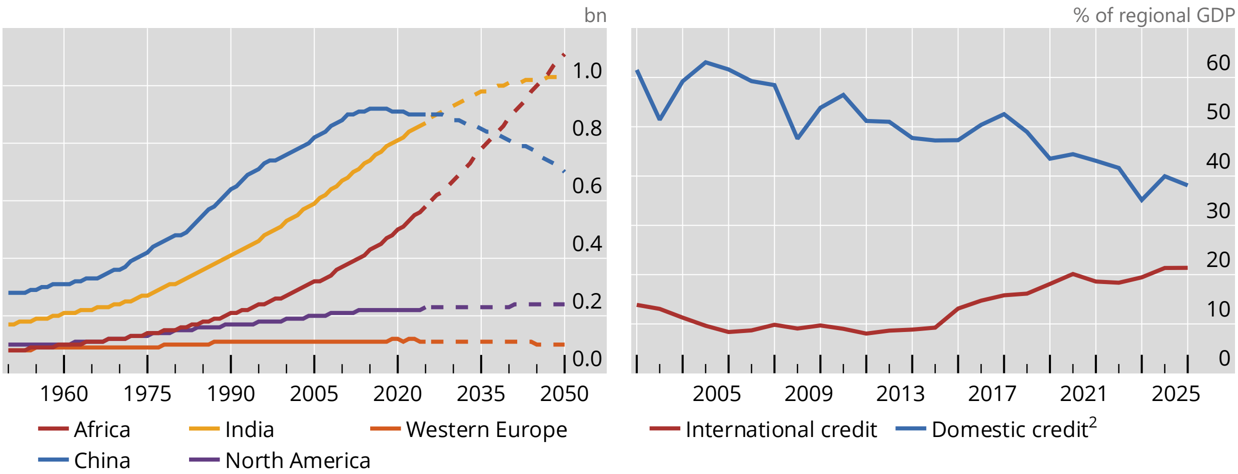
(Ehlers et al (2025)). Nevertheless, it can lower the cost of funding for borrowers in emerging market and developing regions like Africa.

This article examines international credit to Africa and how it has changed over the past half-century. In our analysis, international credit encompasses two primary components: (i) cross-border loans, as captured in the BIS international banking statistics; and (ii) bonds issued in international markets, drawn from the BIS international debt securities statistics. Additionally, we examine local lending by foreign bank affiliates in Africa and domestically issued bonds held by foreigners. By focusing on international credit, our analysis complements existing research on the development of domestic credit in Africa (Manger et al (2023)) and other forms of external financing to the region (Alter et al (2025)).

Since the Great Financial Crisis (GFC), the surge in international credit to Africa has featured three new elements. First, Chinese banks became a dominant provider of bank loans. This growth came on the back of the Belt and Road Initiative (BRI) formalised in 2013 (see Box A). Nevertheless, renminbi usage remained limited, with most international credit still denominated in US dollars. Second, more African countries,

Africa set to dominate global labour supply, relying more on international credit[1] Graph 1

A. African working age population is growing rapidly… B. …while the use of international credit is rising



The dashed lines in panel A after 2025 represent projections.

[1] Africa refers to sub-Saharan Africa, comprising 45 countries. Working age population comprises individuals aged 20 to 64 years old. [2] Domestic credit comprises credit to the private sector and government. The values for 2023 to 2025 are estimated based on available data from 39 out of 45 countries in 2023, 34 in 2024, and 24 in 2025.

Sources: United Nations; World Bank; authors' calculations.

beyond just South Africa, began to borrow substantially from abroad, in both loans and bonds. Third, international bond issuance expanded dramatically as a key conduit for international credit to many countries across Africa. Beyond these developments, governments remained the dominant borrowing sector, even increasing their share in international credit for both loans and bonds. London continued to be a key hub from which international banks lend to Africa. US and South African banks in particular channelled their lending to Africa out of their offices in London.

The article proceeds as follows. The next section reviews the historical context of international lending to Africa from the 1970s to the GFC. Subsequent sections examine the surge in international credit post-GFC, leveraging BIS statistics to provide a deeper dive into the lenders and borrowers and documenting new developments.

Drivers of international credit from the 1970s to the GFC

From the 1970s onwards, international credit to Africa was persistently shaped by three key drivers. First, commodity prices affect international credit. They do so by altering borrowing capacity through shifts in the terms of trade, the value of available collateral and their impact on economic growth. Second, global financial conditions affect the supply of credit from international investors and their willingness to lend to African countries. And third, official lending, such as multilateral lending from the International Monetary Fund (IMF) or bilateral lending between governments, can add substantial financing. Official efforts to relieve debt burdens (eg Paris Club, the Heavily Indebted Poor Countries Initiative) can further improve borrowing capacities.

In the 1970s several of these factors worked together to spur international credit to Africa, particularly from commercial banks. Higher commodity prices, notably oil, expanded borrowing capacity. Higher oil prices also boosted credit supply as Western commercial banks recycled petrodollars (Wiegand (2008)), largely out of their offices in London (McGuire (2004)).[3] With increased demand from newly independent African governments seeking to develop infrastructure, education and other sources of growth (Fliss et al (2024)), international credit to Africa steadily climbed.

Following this boom, many African countries experienced debt crises in the early 1980s, as these factors turned into headwinds. The accumulated international debt proved to be unsustainable when the Federal Reserve hiked US interest rates sharply in 1979–81, increasing debt service costs. Declining oil and other commodity prices in the mid-1980s further reduced African countries' ability to service their debts. As a result, defaults among African governments increased and commercial bank lending retrenched (Graph 2.A) (Fliss et al (2024); Graf von Luckner and Horn (2026); Horn et al (2025)).

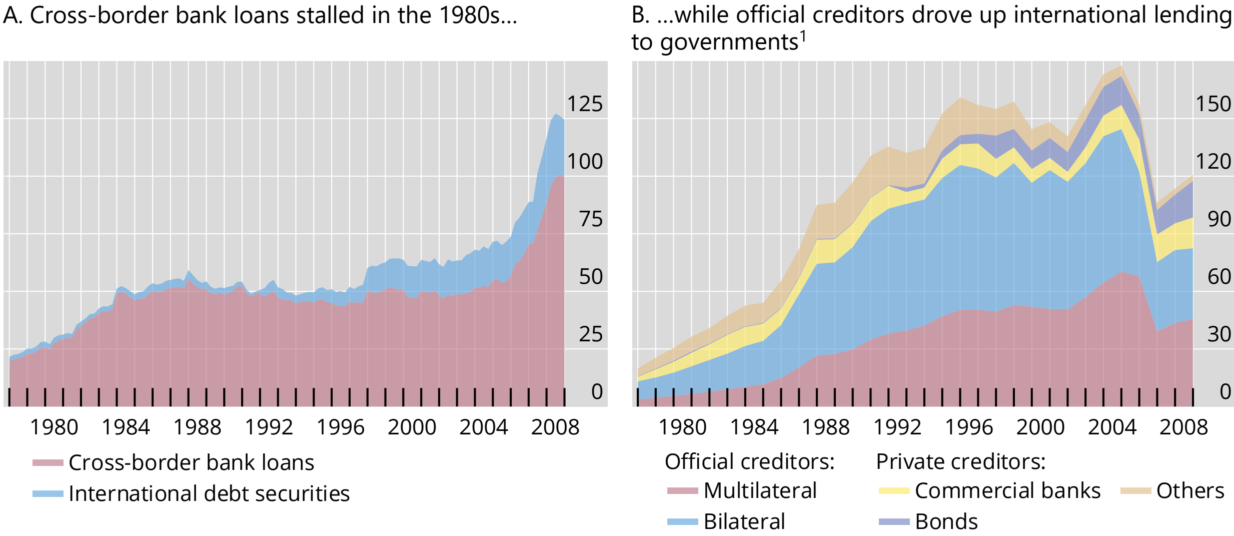
Official sector lending to African governments expanded significantly in the 1980s as cross-border commercial bank lending stalled. Multilateral credit grew from \$6.6 billion in 1980 to \$50.3 billion by 1995, while bilateral credit jumped from \$14.5 billion to \$75.5 billion (Graph 2.B). Nearly 95% of this financing was extended on a concessional basis or as grants, on generally favourable terms (Bhattacharya et al (1997)). Furthermore, the official sector stepped up to coordinate debt relief to Africa

[3] The significantly higher oil prices increased oil-exporting countries' revenues beyond what their domestic economy could absorb. Hence, these petrodollars were deposited in international banks, which would lend them to less developed countries with higher expected returns on investment, such as those in Latin America and Africa (Wiegand (2008)).

Official lending to Africa rose in the 1980s as cross-border bank lending stalled

Amounts outstanding in billions of US dollars

Graph 2



[1] Public and publicly guaranteed long-term debt.

Sources: World Bank; BIS international debt securities statistics; BIS locational banking statistics; authors' calculations.

by restructuring its debt. The Heavily Indebted Poor Countries Initiative by the IMF and World Bank was launched in 1996 to relieve the debt burdens of the poorest countries and was further complemented by the Multilateral Debt Relief Initiative launched in 2005. This debt relief removed debt overhang and thereby improved borrowing capacity in subsequent years.

A rapid expansion of credit to Africa post-GFC

International credit to Africa has grown fast since the GFC. The outstanding volume of cross-border loans more than doubled from around $100 billion at end-2009 to about $264 billion by end-2025 (Graph 3.A). The outstanding volume of international bonds increased more than sevenfold, from around $27 billion to $192 billion during the same period. As a share of African GDP, international bonds rose from 2% in 2013 to 9% in 2024. By 2023, international credit exceeded foreign direct investment to Africa.

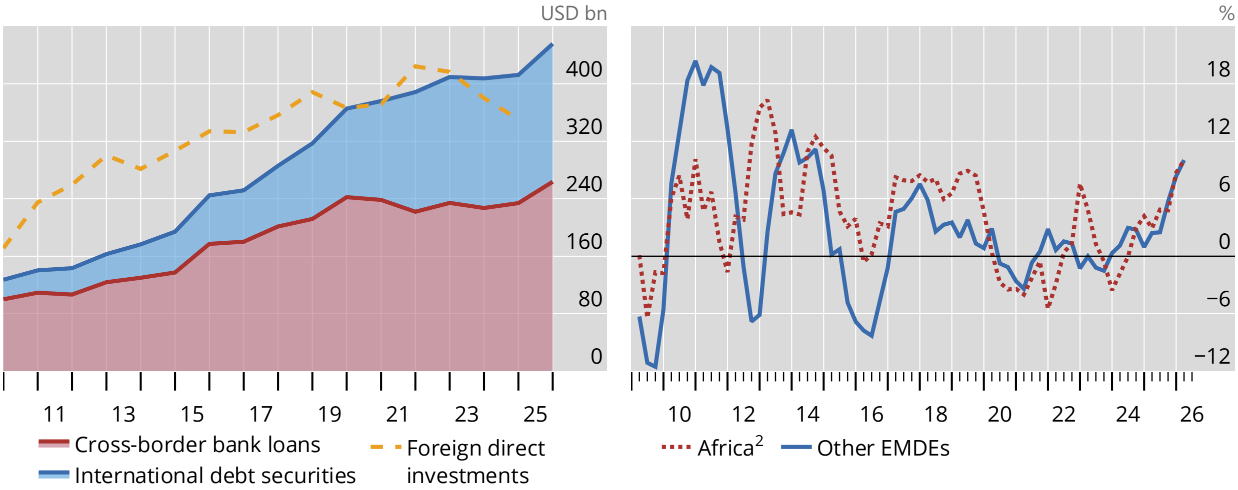
As growth in international credit to Africa accelerated, it outpaced that to other emerging market and developing economies (EMDEs) after 2011. From 2009–11, growth of international credit to Africa lagged that to other EMDEs (2% versus 8% annual growth on average). However, from 2012 to 2019, international credit to Africa grew at an annual average rate of 7%, significantly faster than the 2% growth rate observed in other EMDEs (Graph 3.B).

International credit to Africa grew rapidly after the Great Financial Crisis

Graph 3

A. External financing, notably credit, expanded fast

B. International credit grew faster in Africa than in other EMDEs[1]



EMDEs = emerging market and developing economies.

[1] Annual compounded growth rate. [2] Sub-Saharan Africa, comprising 45 countries.

Sources: IMF; BIS locational banking statistics; authors' calculations.

Bank lenders, new and old

After the GFC, Chinese banks joined Western banks[4] in lending to Africa at scale (Graph 4.A). Under China's Belt and Road Initiative (BRI), various Chinese policy and state-owned commercial banks extended infrastructure loans to borrowers throughout Africa and elsewhere (Box A). These official creditor flows were thus often recorded in cross-border loan data as well. Between 2015, when China began reporting to the BIS banking statistics, and 2020, Chinese banks' outstanding loans grew to a third of the total cross-border loans to Africa, leaving China's as the largest lending banking system.[5] As of end-2025, Chinese banks lend to more than 40 African countries (Graph 4.B, blue bars) and serve as the primary lender to 24 of them (red dots). For 15 countries, they lend more than 50% of the total (black dots). By comparison, French banks, the second largest lender banking system to the region, are the primary lender to only nine countries.

[4] Most cross-border loans in the data are reported from banks located outside Africa. South Africa is currently the only country in Africa that reports data to the BIS banking statistics. For some analysis of cross-border investment of African banking groups within Africa, see Mathieu et al (2019).

[5] Available evidence indicates a steady expansion of Chinese lending to Africa since the early 2000s. However, the BIS international banking statistics include data for China only starting from end-2015. The observed increase in reported loans in the fourth quarter of 2019 primarily reflects expanded coverage of Chinese banks.

Box A

The Belt and Road Initiative and Chinese bank lending to Africa

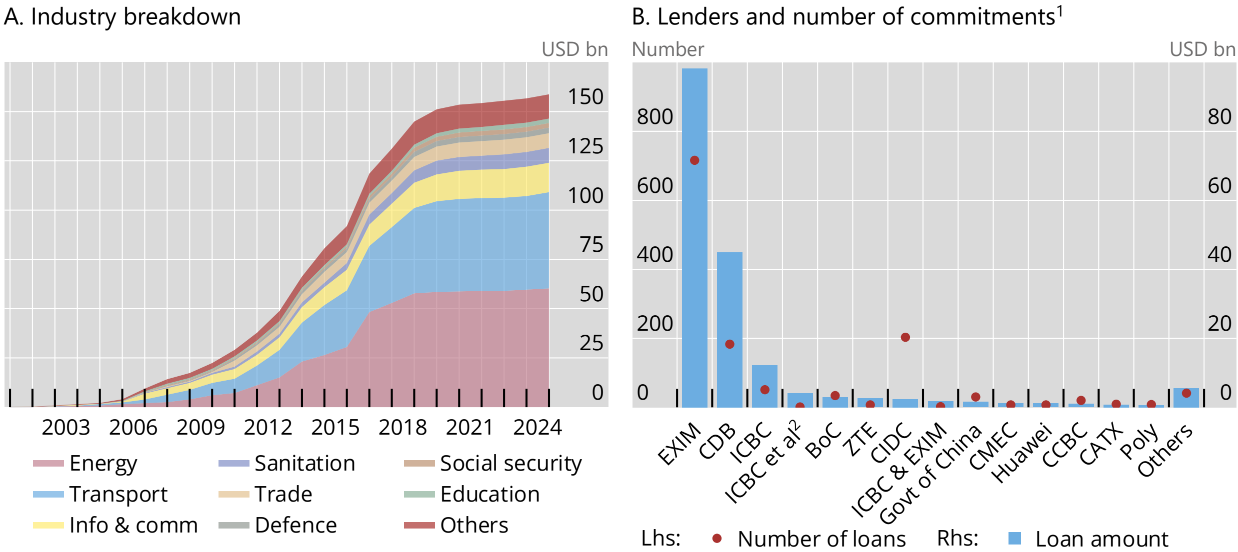
Bryan Hardy, Swapan-Kumar Pradhan and Előd Takáts ①

The Belt and Road Initiative (BRI) has supplied substantial new bank lending from Chinese banks to sub-Saharan Africa (hereafter "Africa") in the last two decades. This box explores the allocation of credit from Chinese lenders via the BRI and how this links to cross-border lending by Chinese banks in the BIS locational banking statistics.

The BRI is a global infrastructure and economic development programme formalised by China in 2013.② The stated intention is to promote trade by land and sea throughout Eurasia and Africa – locations linked by the historic Silk Road. Thus far, the BRI has financed projects in around 150 countries, including most countries in Africa.③ Until 2019, Africa experienced a fast expansion of BRI lending, focusing on energy and transportation projects (Graph A1.A). After 2020, the pace of new investment slowed sharply as concerns started to rise about debt sustainability and low returns from the projects.④ The deteriorating domestic real estate loans of Chinese banks and consequent macroeconomic ripple effects may have also contributed to the slowdown.

Profile of Chinese BRI loan commitments to Africa

Graph A1



BoC = Bank of China Limited; BRI = Belt and Road Initiative; CATX = China National Aero-Technology Import and Export Corporation; CCBC = China Construction Bank Corporation; CDB = China Development Bank; CIDC = China International Development Cooperation Agency; CMEC = China Machinery Engineering Corporation; EXIM = Export-Import Bank of China; Huawei = Huawei Technologies Co Ltd; ICBC = Industrial and Commercial Bank of China Ltd; Info & Comm = Information and communications; Poly = Poly Technologies Inc; ZTE = Zhongxing Telecommunication Equipment Corp.

[1] Cumulative loan commitments as of Q4 2024. [2] Comprises ICBC, EXIM, BoC Beijing Branch, CCBC Beijing Branch, China Minsheng Bank Corp Ltd, Ping An Bank Co Ltd and Shanghai Pilot Free Trade Zone Branch.

Source: Boston University Global Development Policy Center, Chinese Loans to Africa Database, 2026.

Most BRI loans to Africa were extended by two Chinese state-owned policy banks: the Export-Import Bank of China and the Chinese Development Bank. These two individually accounted for 79% of all BRI loans, and for more as part of syndicates with other lenders (Graph A1.B). These banks differ from commercial banks in three main ways: they fund themselves mainly through government-backed bond issuance; they target very large and long-term projects; and they pursue government goals rather than maximising profitability. In Africa, they explicitly targeted financing for government projects such as for trade and infrastructure investment. The five major state-owned commercial banks such as the Industrial and Commercial Bank of China (ICBC) (the third largest BRI lender) also participated in the BRI.

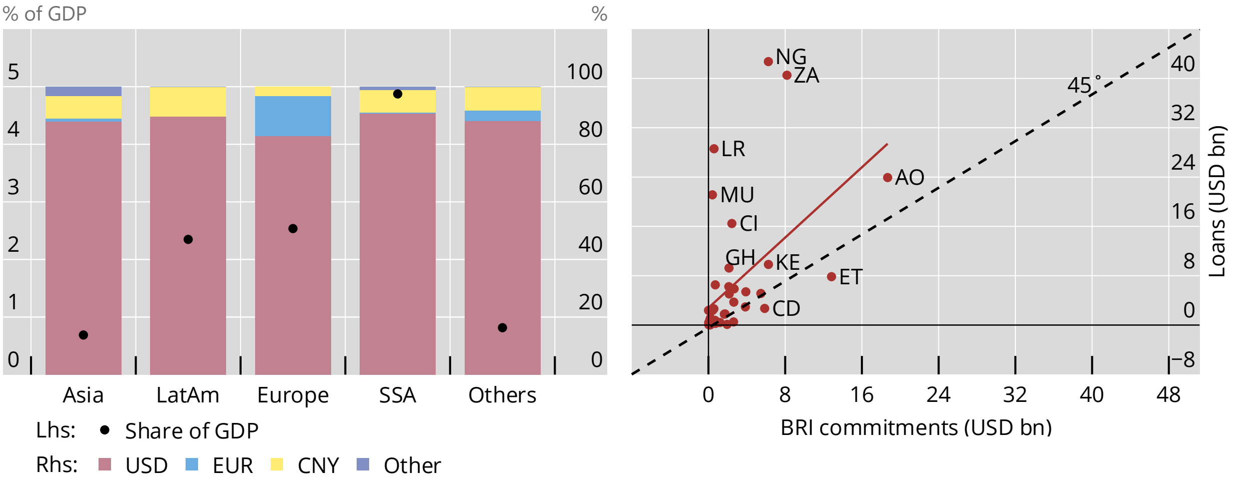
Despite an official strategy to promote the renminbi, 80–90% of BRI lending was denominated in US dollars (Graph A2.A). The use of the US dollar is likely due to advantages such as matching debt denomination with invoiced export revenues in dollars and foreign exchange reserves in dollars.⑤

BRI investment relative to GDP was particularly large in Africa, reaching in total around 5% of GDP, compared with 2.5% in Europe and Latin America (Graph A2.A, dots). Both the comparatively lower GDP of African countries and their large investment needs contributed to this high ratio. Within Africa, the size of these investments varied considerably across countries, reflecting the diverse economic and financial conditions (Graph A2.B, y-axis). Angola ($19 billion) received the most BRI commitments, largely linked to oil infrastructure.

BRI investment increased total international bank lending, but it may have discouraged other lenders. As BRI investments are primarily loans from policy and commercial banks, they are reported in the BIS banking statistics. The cumulative growth in BRI commitments correlate positively with the cumulative growth in cross-border bank lending to borrowers in each country (Graph A2.B, red line). For most countries, the observation falls above the 45-degree line (dotted line), indicating that the total lending growth is larger than BRI commitment growth, which means that banks based in countries other than China have also stepped up lending. This happens in countries with relatively modest BRI commitments, such as Nigeria or South Africa. A few countries fall below the 45-degree line, reflecting potential disinvestment by non-Chinese banks, ie banks from countries other than China decreased their overall lending as BRI progressed. This happens in countries where BRI commitments were relatively large, such as Ethiopia. The reported very restrictive covenants on BRI loans, such as prohibitions from other collective restructuring agreements (eg Paris Club), controls on collateral and callable debts, could discourage other bank lenders.⑥

BRI seems to drive significant Chinese bank lending to Africa — Graph A2

A. Investment commitments by EMDE region[1] — B. Cross-border loans and BRI commitments since 2000[2]



BRI = Belt and Road Initiative; EMDE = emerging market and developing economy; LatAm = Latin America and Caribbean; SSA = sub-Saharan Africa.

[1] GDP of respective region. Dots represent total BRI commitments until 2021 in percentage of 2021 GDP of respective regions. [2] Cross-border loans by BIS reporting banks, including banks in China. The red line is the line of best fit.

Sources: B Burgess and S Custer, *BRI-tagged Chinese official finance dataset*, version 1.0, AidData, 2022; BIS consolidated banking statistics; authors' calculations.

BRI momentum has slowed since 2020, and now the focus is shifting to repayment of existing debts.⑦ The restrictive covenants enabled Chinese lenders to accept little to no haircuts on distressed loans, with relief only provided by extending maturities. Whether these investments are burdens or blessings for the borrowers depend on whether the underlying projects generate returns and whether they discourage other creditors.

① The views expressed here are those of the authors and not necessarily those of the BIS or its member central banks. ② Prior investments that fit the criteria were incorporated into the BRI. ③ Green Finance & Development Center, "About the Belt and Road Initiative (BRI)", https://greenfdc.org/belt-and-road-initiative-about/. ④ Council on Foreign Relations, "The rise and fall of the BRI", https://www.cfr.org/articles/rise-and-fall-bri. ⑤ See E Boz, C Casas, G Georgiadis, G Gopinath, H Le Mezo, A Mehl and T Nguyen, "Patterns of invoicing currency in global trade: new evidence", *Journal of International Economics*, vol 135, 103604, 2022; and L Kodres, L S Shen and D Duffie, "Dollar funding stresses in China", *Federal Reserve Bank of Boston Supervisory Research and Analysis Working Papers*, no 22-3, 2022. ⑥ A Gelpern, S Horn, S Morris, B Parks and C Trebesch, "How China lends: a rare look into 100 debt contracts with foreign governments", *Economic Policy*, vol 38, no 114, 2023. ⑦ S Horn, C Reinhart and C Trebesch, "China's lending to developing countries: from boom to bust", *Journal of Economic Perspectives*, vol 39, no 4, 2025.

BRI-related lending drove up international credit from China, but it often was given on less favourable terms than other official sector lending.[6] While typically extended at below market rates, BRI loans often included restrictive covenants (Gelpern et al (2023)). These covenants may have discouraged investment from other lenders (Kondo et al (2026); Box A). Interestingly, most BRI loans were denominated in US dollars rather than renminbi, limiting the latter's share in international credit (Box A; Box B).

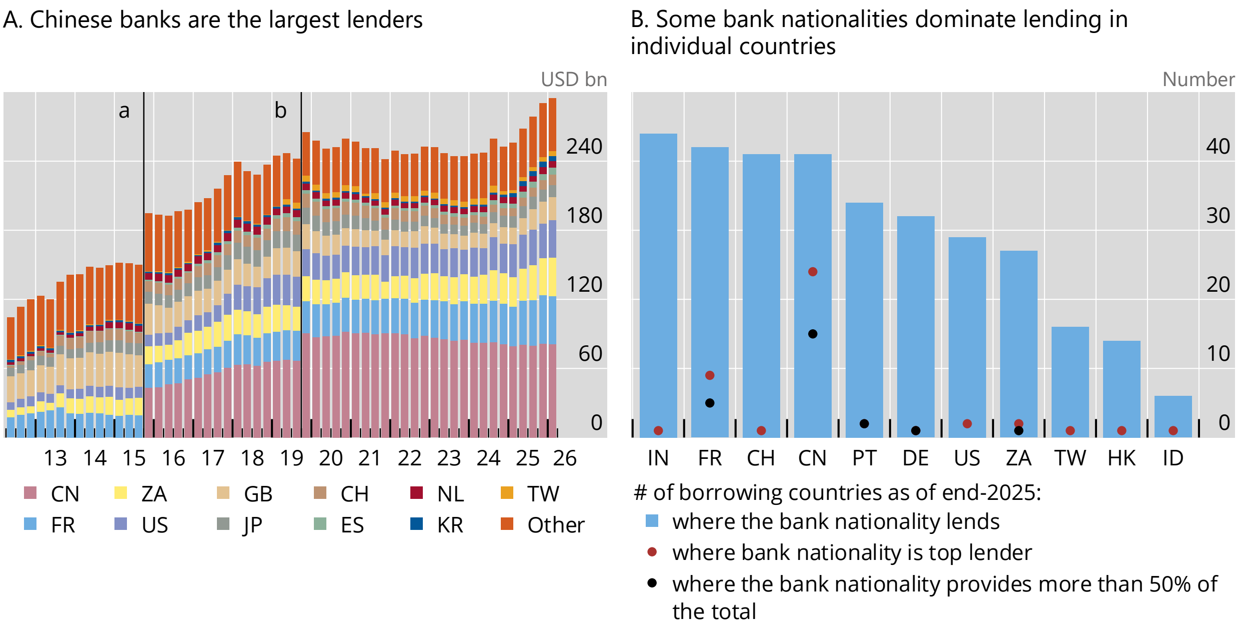
Following the initial surge in BRI investment, dynamics similar to those during the debt crises in the 1980s began to emerge after 2020. Many African borrower countries faced mounting challenges in servicing their debt due to the fall in commodity prices, rising interest rates, the economic fallout from the Covid-19 pandemic and the food price shock in the wake of the Russian invasion of Ukraine (Horn et al (2025)). At the same time, Chinese banks faced headwinds due to falling real estate prices at home. In response to these growing difficulties, lending from China to Africa slowed significantly after 2020.

Cross-border bank lending to Africa started to expand again in 2025 – this time driven by French, South African and US banks (Graph 4.A). While this expansion helped to diversify the mix of Africa's creditors, borrowing by many African countries remained concentrated in only a few lending bank nationalities. At end-2025, 24 borrowing countries received more than half of their cross-border loans from banks of a single nationality (Graph 4.B).

In addition to engaging in cross-border lending, many foreign banks also lend locally from their subsidiaries or branches located in Africa. The BIS consolidated banking statistics capture banks' consolidated positions across their affiliates

Cross-border bank lending to Africa is concentrated in few bank nationalities

Graph 4



[a] China begins reporting to BIS statistics. [b] Coverage of reporting of Chinese banks expanded.

Sources: BIS locational banking statistics; authors' calculations.

[6] Fast-growing BRI lending propelled China to become the largest official creditor globally by 2017, surpassing traditional official creditors such as the IMF and the World Bank (Horn et al (2021)).

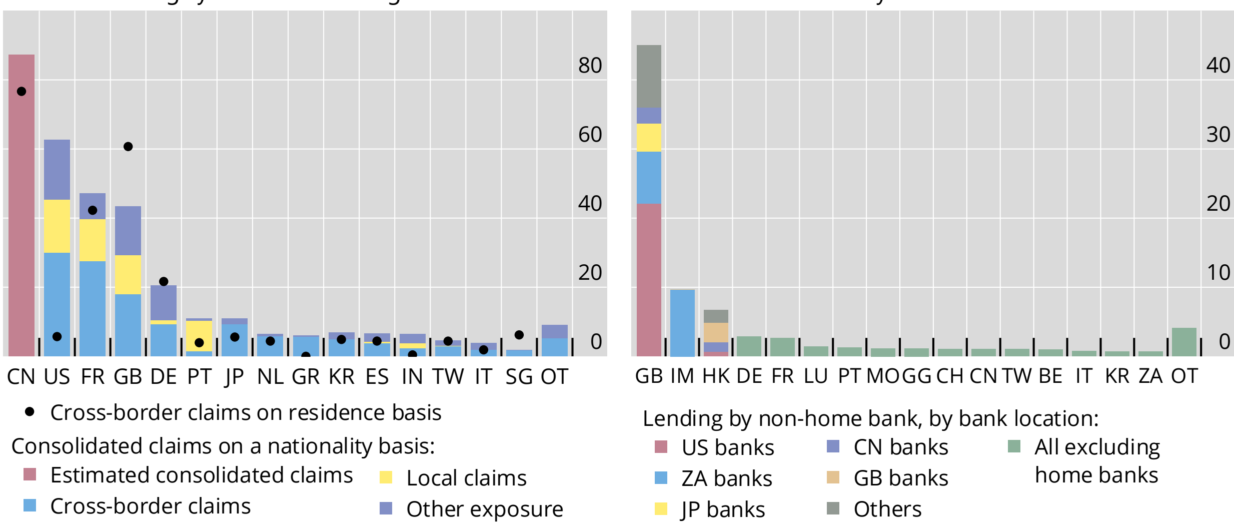
worldwide, for both local lending and cross-border lending. These data show that four banking systems stand out with a significant local presence in Africa: United States, France, United Kingdom and Portugal (Graph 5.A, yellow bars). Local lending by Chinese banks remains unquantified, as China does not report data to the consolidated banking statistics. Nevertheless, a conservative estimate shows that Chinese banks continue to be the largest lenders to Africa by a considerable margin (red bar).[7] In addition to direct lending, some banking systems also have contingent credit and other off-balance sheet exposures (eg credit lines, guarantees or derivatives – purple bars).

While most banks lend either directly from their home office or via local affiliates, London remains a key hub for routing credit to Africa (cf Hardy et al (2024)). Comparing cross-border bank lending of different lending banking systems (Graph 5.A, blue bars) with the volume of such lending by banks located within each country (dots) provides an indicator of whether banks are lending directly from home or through other affiliates outside Africa. When the dot is close to the bar, as with China and the Netherlands, this suggests most lending is done from the home country. When the dot is lower than the bar, as with the United States and Japan, this suggests that more lending is done by affiliates abroad. The data show that US banks channel more than US $20 billion in credit through London, where many other (non-British) banks also locate affiliates that lend to Africa (Graph 5.B). Interestingly, South African banks also route significant lending back to Africa from affiliates in London as well as the Isle of Man.

International bank lending to Africa extended from affiliates locally and in London

Amounts outstanding in billions of US dollars[1] Graph 5

A. A few banking systems lend through local affiliates[2] B. London remains a key hub[3]



[1] As of end-2025. [2] International bank lending, by lender nationality; estimated cross-border and local claims, including interoffice claims, of Chinese banks hosted in 30+ BIS reporting countries; OT = banks of other nationalities. [3] OT = banks in other reporting locations.

Sources: BIS consolidated and locational banking statistics; authors' calculations.

[7] We proxy claims by Chinese banks' local affiliates in Africa with the amount of intragroup funding sent by Chinese banks to their affiliates in the region. This assumes all intragroup funding is on-lent to local borrowers in Africa. Local positions of Chinese bank affiliates could be much larger, supported by other cross-border and local funding sources. Hence, this estimate is a lower bound for Chinese bank lending.

Box B

Original sin in Africa and domestic currency financing from international investors

Bryan Hardy, Swapan-Kumar Pradhan and Előd Takáts ①

Sub-Saharan African countries (hereafter “Africa”), like many other emerging market and developing economies, have historically been unable to borrow from abroad in their own currency – the so called “original sin”.② Borrowing in a foreign currency exposes the borrower to exchange rate risk, a risk that can materialise exactly when debt repayment gets difficult. In the case of South Africa, the original sin seems to have lifted as international investors buy significant amounts of domestic currency bonds.

The US dollar was, and continues to be, the dominant currency for African borrowers (Graph B1). Dollar borrowing allows African countries to benefit from the depth of US dollar markets and match debt denomination with dollar-invoiced commodity export revenues. However, dollar usage varies over time, with the euro taking away some of the dollar’s share after its introduction and again during the post-Covid-19 monetary tightening cycle.③

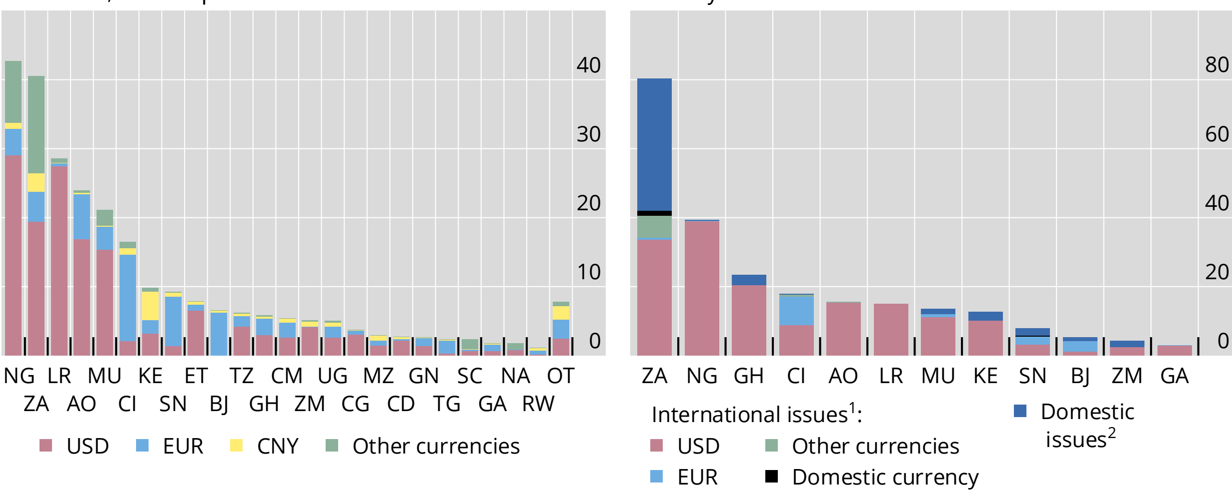
Most African countries rely mainly on dollars in their cross-border bank borrowing (Graph B1.A). However, the euro plays an important role in a few economies. Members of the West African Franc zone, such as Côte d’Ivoire, Senegal, Benin and Togo, use euro-denominated cross-border bank borrowing, mainly due to their peg to the euro as well as their historical connections with France and persistent links with French banks. Furthermore, only about 6% of cross-border loans are denominated in renminbi, despite the prominent role of Chinese banks and the Belt and Road Initiative (BRI) in Africa. Indeed, most BRI loans are denominated in dollars (Box A). Renminbi usage was concentrated in only a few borrowing countries, most notably Kenya. This reflects in part loans from Chinese lenders that were originally in US dollars but were later converted to renminbi to cut debt service costs.④ Loans in domestic currencies are not separately reported in the BIS banking statistics, but they are significant, for instance, in Nigeria and South Africa where the category of “other currencies” is large.

Dollar dominates international credit to Africa, with some exceptions

In billions of US dollars | Graph B1

A. Dollar usage high for most cross-border loan borrowers, euro important for some[1]

B. Few countries have foreigners holding domestic currency bonds



OT = other countries in sub-Saharan Africa.

[1] As of end-2025. [2] As of end-2024. Domestic issues computed as total external portfolio debt minus international bonds.

Sources: External Wealth of Nations; BIS international debt securities statistics; BIS locational banking statistics; authors’ calculations.

Very few African countries have made headway in local currency borrowing in bond markets, the traditional setting for original sin. Most international bonds issued by African entities are denominated in US dollars (Graph B1.B).⑤ In addition, some smaller economies, such as Côte d'Ivoire, Senegal and Benin, issue a portion of their international bonds in euros, again leveraging their historical and economic ties with Europe.

South Africa is the leading exception in overcoming original sin. Borrowers there – mainly the government – can borrow from foreigners in domestic currency to a significant degree. Rand-denominated bonds account for only 4% of South Africa's outstanding international issues, but foreign investors purchase domestically issued bonds in large quantities (Graph B1.B, dark blue bars). Our calculation suggests that domestically issued bonds (likely in domestic currency) purchased by international investors account for about half of South Africa's externally held bonds. This number rises to around 80% when focusing on government bonds.⑥ International investors have also made inroads in the domestic bond markets of Ghana, Kenya, Senegal and Zambia.

As African economies make progress in overcoming original sin, they face additional trade-offs maintaining fiscal sustainability and financial stability. Moving to domestic currency debt reduces currency risk for the borrower but also shifts currency risk to the investor.⑦ Thus, when the exchange rate moves, investors' balance sheets deteriorate. This could lead them to sell their bonds, pushing up yields, which in turn could pose financial stability risks.⑧ A robust domestic investor base can mitigate this dynamic by absorbing the sell-off by foreigners, though perhaps for a lower price. Balancing these risks and trade-offs in African credit may call for deepening capital markets to achieve a healthy mix in the currency and investors.⑨

① The views expressed here are those of the authors and not necessarily those of the BIS or its member central banks. ② B Eichengreen and R Hausmann, "Exchange rates and financial fragility", *Proceedings of the Federal Reserve Bank of Kansas City Economic Policy Symposium,* 1999. ③ The shift to euro credit was common among emerging market and developing economies during this period, as documented in B Hardy and G von Peter, "Global liquidity: a new phase?", *BIS Quarterly Review*, December 2023, and part of a global trend, as shown in K-S Pradhan, E Prasad, E Takats and J Temesvary (2026): "Dollarisation waves: new evidence from a comprehensive international bond database", *BIS Papers*, no 165. ④ See for instance D Miriri, "Kenya's China loan revamp sparks wider interest in yuan switch, AidData says", *Reuters*, 23 June 2026. ⑤ This is consistent with global developments detailed in Pradhan et al (2026). ⑥ Government bonds are the typical object analysed for original sin. See M Onen, H S Shin and G von Peter, "Overcoming original sin: shedding new light on uneven progress", *Economic Policy*, vol 40, no 122, 2025. ⑦ A Carstens and H S Shin, "Emerging markets aren't out of the woods yet", *Foreign Affairs*, 15 March 2019. ⑧ C Bertaut, V Bruno and H S Shin, "Original sin redux: role of duration risk", *BIS Working Papers*, no 1109, 2025. ⑨ M Chui and L Gambacorta, "Africa's public debt amid global headwinds: balancing resilience and vulnerabilities", *BIS Bulletin,* no132, 2026; A Alter, K Khandelwal, T Lemaire, H Mighri, C Sever and L Tucker, "Navigating the evolving landscape of external financing in sub-Saharan Africa", *IMF Working Papers,* no 25/139, 2025.

New borrowers and new instruments

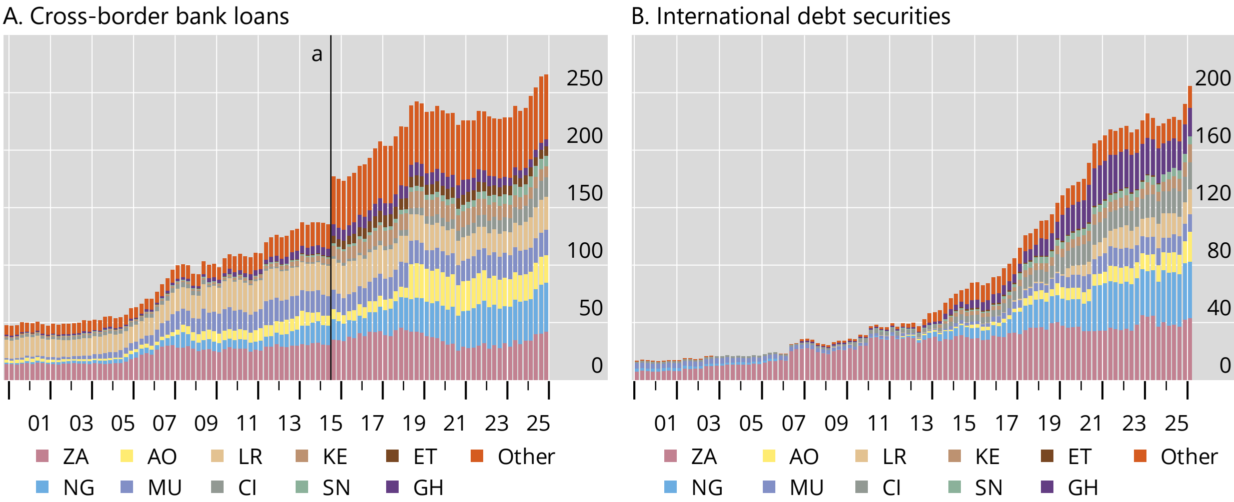
The post-GFC growth in international credit to Africa was driven primarily by new borrowers in both loans and bonds. In cross-border bank lending, Nigeria, Angola and Mauritius joined South Africa and Liberia as larger borrowers (Graph 6.A). Many other smaller countries collectively saw a large increase in loans (orange bars), possibly linked to BRI investments (Box A). In international bond markets, Nigeria, Angola, Ghana, Côte d'Ivoire and others joined South Africa in issuing bonds at scale (Graph 6.B).

Substantial bond borrowing is novel in international credit to Africa. Three developments fostered this broad-based acceleration of bond issuance. First, the post-GFC low interest rate environment prompted search for yield among bond investors, who welcomed an expansion of the set of issuers (Calomiris et al (2022)). Second, borrowers saw improved macroeconomic fundamentals, including from rising commodity prices (Kogan et al (2024)). And third, official debt relief removed debt overhang and provided fiscal space for non-concessional borrowing in international bond markets. The Nigerian government, for instance, was able to successfully issue Eurobonds from 2011 to address fiscal shortfalls and make infrastructure investments

International credit expanded as more countries started to borrow

By borrowing country; in billions of US dollars

Graph 6



[a] China begins reporting to BIS statistics.

Sources: BIS international debt securities statistics; BIS locational banking statistics; authors' calculations.

following an earlier Paris Club deal. Another case is Côte d'Ivoire, which completed its debt relief programme in 2012 and created fiscal space to access new non-concessional financing for development purposes (IMF (2012)).

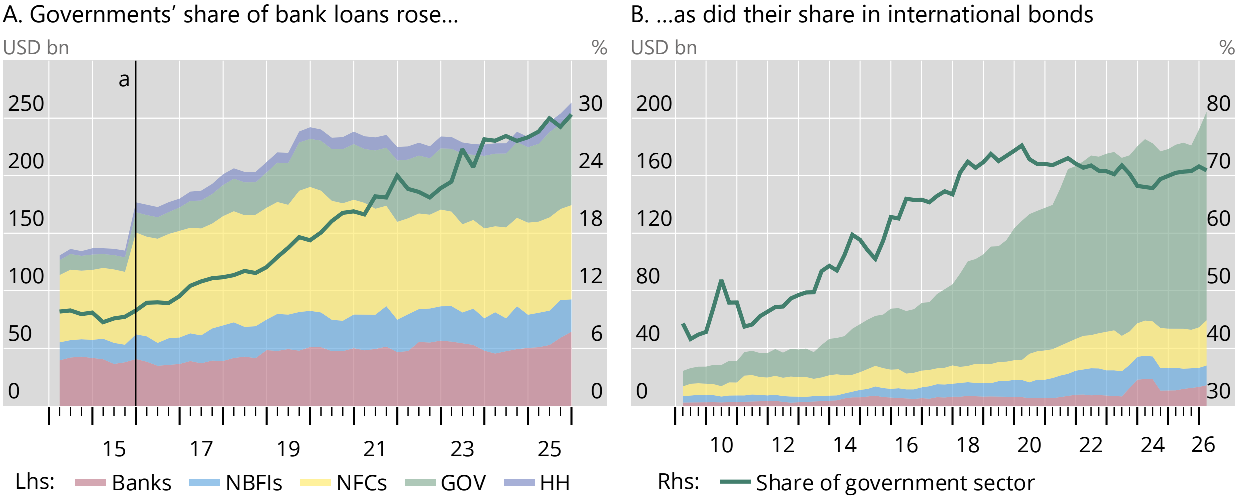
While cross-border bank lending to Africa was oriented towards the private sector historically, governments have increasingly tapped this funding source. The share of loans directly to government borrowers has climbed steadily since 2014, from less than 10% up to 30% in 2025 (Graph 7.A, green area and green line) – on par with non-financial corporations (yellow area). Such loans to governments include some lending from policy banks, such as those in China facilitating BRI loans. Cross-border bank lending, including official flows from policy banks, typically form a key part of government funding for countries with poor access to international bond markets.[8] The latest increase in total cross-border loans in 2025 was driven by both governments (green area) and financial sector borrowers (red and blue areas).

Similarly, governments have been the dominant African borrowers in international bonds as well. They account for around two thirds of all outstanding international debt securities issued by entities in Africa (Graph 7.B). From 2010 to 2025, international debt securities expanded by roughly $163 billion, with government debt accounting for $124 billion of the increase. Indeed, the share of debt securities issued by governments rose as international bond issuance grew. Most African governments borrow internationally in foreign currencies, particularly in US dollars. However, some, notably South Africa, can attract international investors to buy local currency bonds issued in domestic markets (Box B).

[8] Countries with impaired credit histories face difficulties in accessing bond markets. When a government issues new bonds during a restructuring, those new bonds often share an equal legal ranking (pari passu) with existing debt. While this ensures all unsecured creditors have equal rights to repayment, the same ranking with defaulted bonds deters new investors. At the same time, countries with impaired credit histories may still be able to borrow from banks by providing collateral, as the collateral can be used independently of past defaults (Arellano et al (2023); Schumacher et al (2021)).

Governments are the dominant borrowing sector

Graph 7



GOV = government; HH = households including non-profit institutions serving households; NBFIs = non-bank financial institutions; NFCs = non-financial corporations.

[a] China begins reporting to BIS statistics.

Sources: BIS international debt securities statistics; BIS locational banking statistics; authors' calculations.

Conclusion

The rapid expansion of international credit to Africa provides much needed financing. However, increased debt burdens and challenging headwinds in global markets could impair the sustainability of this debt. High concentration in bank lenders poses further risks, as a contraction in credit from one creditor (eg China or France) can significantly affect total financing for many borrowers. The advent of international bonds broadens the investor base to market investors, offsetting this concentration, but these investors can be flighty when global financing conditions turn (Ehlers et al (2025)).

The importance of prudent policies to support debt sustainability in Africa matters beyond what the headline financing figures might suggest. Africa is home to an increasingly large share of the global population, and international credit plays a key role in how this population will prosper. A deeper understanding of international credit will help policymakers navigate the path ahead.

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Core inflation communication in practice[1]

Using a large language model to read central bank publications, we uncover patterns in how central banks communicate about core inflation. Two findings stand out. First, references to core inflation have become more frequent. This probably reflects its greater relevance when low and stable inflation means that headline movements are mostly driven by relative price changes, as in the pre-pandemic period. Second, the range of core inflation metrics cited has broadened. Central banks have avoided selecting a preferred gauge and instead relied on a suite of indicators to identify underlying price pressures. This expansion may introduce new communication challenges, as explaining additional measures can make messaging more complex.

JEL classification: E31, E52, E58

Although inflation targets are defined in terms of headline inflation – a measure intended to capture changes in the cost of the full consumption basket for the average household – central banks routinely refer to core inflation measures in their communications. The purpose of these measures is to identify underlying price pressures. Over time, core inflation metrics have evolved from the long-established approach, which excludes food and energy from headline inflation, to more sophisticated methodologies.

Core inflation measures can help central banks look beyond relative price changes and focus on the persistent forces that are likely to determine the future path of inflation. Indeed, because monetary policy works with lags, central banks commonly focus on where inflation is heading rather than where it stands today.[2] Reading underlying price pressures in a timely manner and communicating them clearly is crucial in a shock-prone world. Recent difficulties in gauging the implications of price pressures – stemming from trade tensions and the ongoing conflict in the Middle East – are a case in point.

1 The views expressed in this article are those of the authors and not necessarily those of the Bank for International Settlements, its member central banks, the Federal Reserve Bank of Dallas or the Federal Reserve System. We thank Matthieu Chavaz, Gaston Gelos, Marco Lombardi, Benoît Mojon, Richhild Moessner, Fernando Perez-Cruz, Daniel Rees, Frank Smets, Taejin Park and Andreas Schrimpf for helpful comments. Brian Roque and Pablo Tomasini provided excellent research assistance. The authors acknowledge the use of artificial intelligence in research assistance and editorial refinement. Responsibility for all errors remains with the authors.

2 The proliferation of core inflation measures may reflect that price pressures relevant for the medium-term path of inflation are not directly observable, and that there is no generally accepted model for computing core inflation. One argument central banks use to justify the selection of a particular core inflation metric over others is its superior predictive power for headline inflation. Nevertheless, central banks typically base their inflation forecasts on more sophisticated multivariate models. Core inflation measures may serve as an interim guide to where headline inflation is heading.

Key takeaways

- *A review of central bank publications over the past two decades using a large language model reveals more frequent mentions of core inflation and communication of a wider range of core inflation metrics.*
- *Low and stable inflation before the pandemic may have increased the focus on core inflation, as it aims to remove the effects of the changes in relative prices that mostly drove headline inflation movements.*
- *The proliferation of core inflation measures presents new communication challenges, underscoring the need for clear and tailored messaging for different audiences.*

Against this backdrop, this article documents how the use of core inflation measures in central bank communications has changed over time, what measures central banks use and what influences the choice between them. While we do not study how core inflation enters into monetary policy decisions or the role it plays in central banks' justification of such decisions, the analysis sheds light on how they refer to this pivotal variable in their publications. We use a large language model to analyse around 8,000 monetary policy statements, meeting minutes and monetary policy (or inflation) reports from 24 economies since 2006, recording the inflation measures central banks allude to and how often they do so. The systematic reading of the documents shows how communication about core inflation has evolved.

We find that central banks have come to refer to core inflation more frequently over the past two decades: they are more likely to discuss it in statements and minutes, and they mention it more often in monetary policy reports. This pattern may be a response to the environment of low and stable inflation that prevailed before the Covid-19 pandemic. Indeed, when inflation is low and stable, headline inflation largely reflects changes in relative prices and core inflation becomes more relevant for the reading of underlying price pressures. The pandemic interrupted this trend, as central banks had to explain generalised price pressures.

Central banks have also widened the range of core inflation metrics they cite, rather than focusing on a single preferred gauge. Confronted with metrics that exhibit offsetting strengths and weaknesses which reflect trade-offs between ease of communication and statistical properties, central banks assemble a portfolio of indicators instead of selecting one. A broader set of metrics can convey more information or give confidence about the robustness of the reading about underlying price pressures. However, it also raises communication challenges: central banks might be asked which measures receive more weight in the analysis, or what they would do if the measures sent conflicting signals. This widening of the range of metrics used suggests that the question of how best to identify underlying price pressures remains unresolved – perhaps because there is no straightforward answer.

The article proceeds as follows. The next section documents the trend of the increasing use of core inflation in central bank publications. The section that follows turns to the metrics they cite. A final section concludes.

References to core inflation in central bank publications

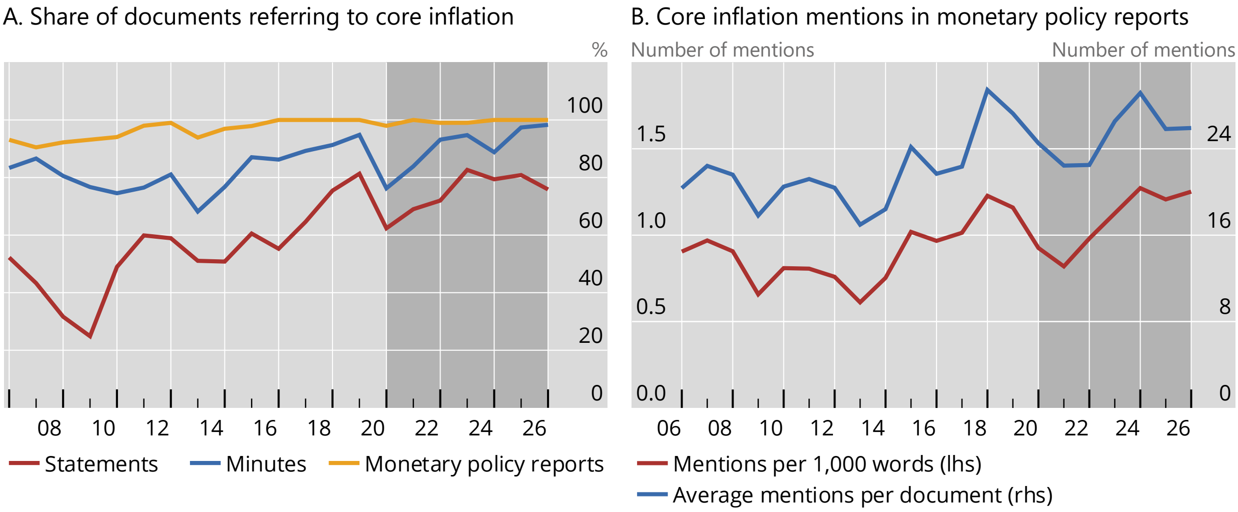
To analyse how central banks have communicated about core inflation, we employ a large language model to systematically review their publications. The body of text includes monetary policy statements, meeting minutes (timely public versions, not transcripts) and monetary policy (or inflation) reports of central banks in 24 economies, consisting of 11 major advanced economies (AEs) and 13 major emerging market economies (EMEs), published since 2006 – around 8,000 documents in total.[3] For each document, the model identified every reference to a measure of inflation – headline and core – and to specific items of the consumption basket (eg energy, food, rent) and recorded the frequency of each.[4] This process (see Annex B) yielded a comprehensive panel at the central bank-document-date level that is used for the analysis below.

The data reveal that central banks have increased the frequency with which they refer to core inflation in their official documents. The proportion of monetary policy statements and of minutes that mention core inflation has risen steadily since 2006 (Graph 1.A). The number of references to core inflation in each monetary policy report has also expanded (Graph 1.B).

The pandemic interrupted the upward trend in references to core inflation in central bank communication. In 2020, the share of statements and minutes mentioning core inflation declined markedly (Graph 1.A), and reports included fewer references (Graph 1.B). The exceptional nature of the disruption and the extraordinary developments central banks faced may account for this change. The levels of those indicators remained relatively low in 2021 and 2022, when inflation was peaking. Core inflation regained prominence in the subsequent disinflationary phase, when central banks relied on it to communicate about the persistence of inflation.

A possible explanation for the rise in references to core inflation is that central banks were adapting their communication to the environment of low and stable inflation prevailing pre-pandemic. Concerns about below-target inflation were specific to AEs, but the period was also one of relative inflation stability for EMEs

References to core inflation by central banks over time[1] Graph 1



The shaded area indicates the pandemic/post-pandemic period.

[1] See endnotes for details.

Sources: Central bank publications; OpenAI GPT version 5.5; authors' calculations.

[3] The 11 AEs are Australia, Canada, the euro area, Hong Kong SAR, Japan, Korea, New Zealand, Sweden, Switzerland, the United Kingdom and the United States. The 13 EMEs are Brazil, Chile, Colombia, India, Indonesia, Malaysia, Mexico, Peru, the Philippines, Poland, South Africa, Thailand and Türkiye.

[4] Annex A shows the number of distinct core inflation measures mentioned by each central bank.

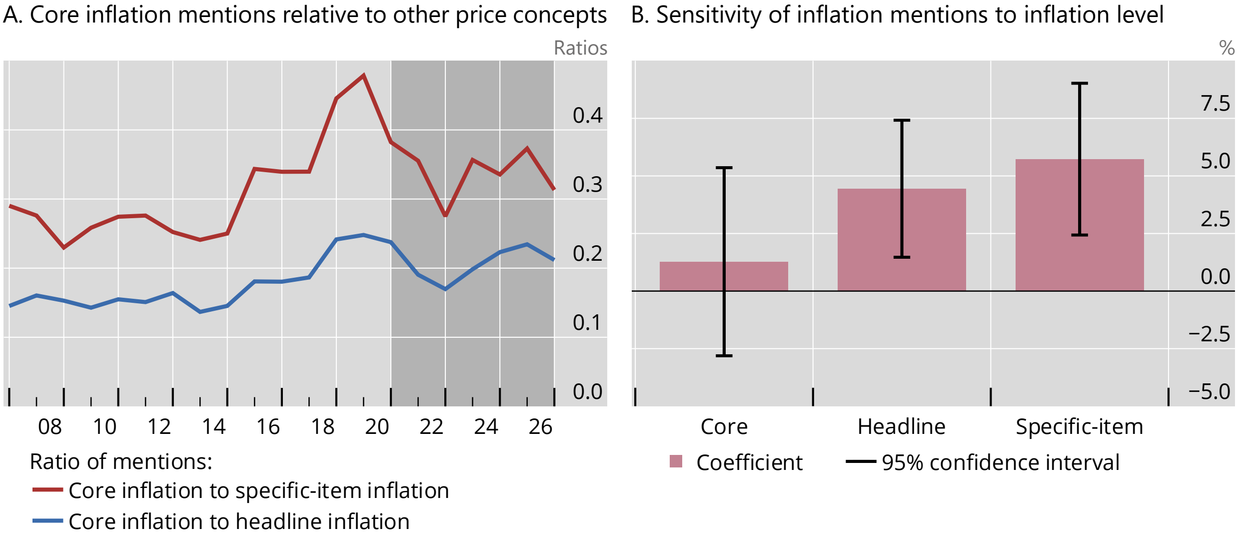
(Americo et al (2025)). When inflation is low and stable, movements in the aggregate price index largely reflect changes in relative prices (BIS (2022)). Headline inflation may then move around for reasons unrelated to underlying price pressures. Consequently, a measure that tries to abstract from relative price changes – a core inflation metric – then becomes more informative and may receive increased attention.[5] Indeed, we find that core inflation references increased relative to headline inflation mentions and to explanations of specific-item inflation in the pre-pandemic period (Graph 2.A).

Core inflation mentions would not be expected to strongly co-move with the prevailing level of inflation in a low and stable inflation environment. This is precisely because core inflation is not useful for explaining the changes in relative prices that mostly drive inflation under such conditions. Instead, if inflation increases at the margin, central banks would be pushed to explain more about the price dynamics of the specific items in the consumer basket driving the changes in relative prices and the implications for headline inflation. Our analysis of monetary policy reports points to patterns in that direction (Graph 2.B). Central banks might also say more about headline inflation for accountability reasons, given the inflation target. Each inflation indicator thus plays a distinct role: headline inflation anchors the target, so centra banks report on it for accountability; core inflation diagnoses underlying price pressures; and item-level gauges account for the relative price changes.

Central banks also explain developments in specific items of the consumption basket to address households' concerns about price increases in salient items, such as food and energy (Box A). This effort to explain is justified: many studies find that inflation expectations are disproportionately shaped by particularly salient and frequently purchased items (eg Dietrich (2024)). Central banks therefore cannot rely on core inflation alone when these items are driving price increases.

Core inflation mentions by central banks relative to those of other price concepts and their sensitivity to the inflation level[1]

Graph 2



The shaded area indicates the pandemic/post-pandemic period.

[1] See endnotes for details.

Sources: Central bank publications; OpenAI GPT version 5.5; authors' calculations.

[5] The fact that core inflation is more closely linked to domestic factors that central banks can influence may have further increased their focus on such indicators (Auer et al (2024)).

Box A

References to price dynamics of specific items in monetary policy reports

One of the findings of this article is that central banks increase references to specific items in the consumption basket when explaining increased inflation. The Covid-19 pandemic was an extreme case: mentions of specific items in monetary policy reports (MPRs) rose markedly (Graph A1.A), as institutions sought to account for prominent relative price movements alongside elevated headline inflation. This box examines which items central banks mention more often in their communications.

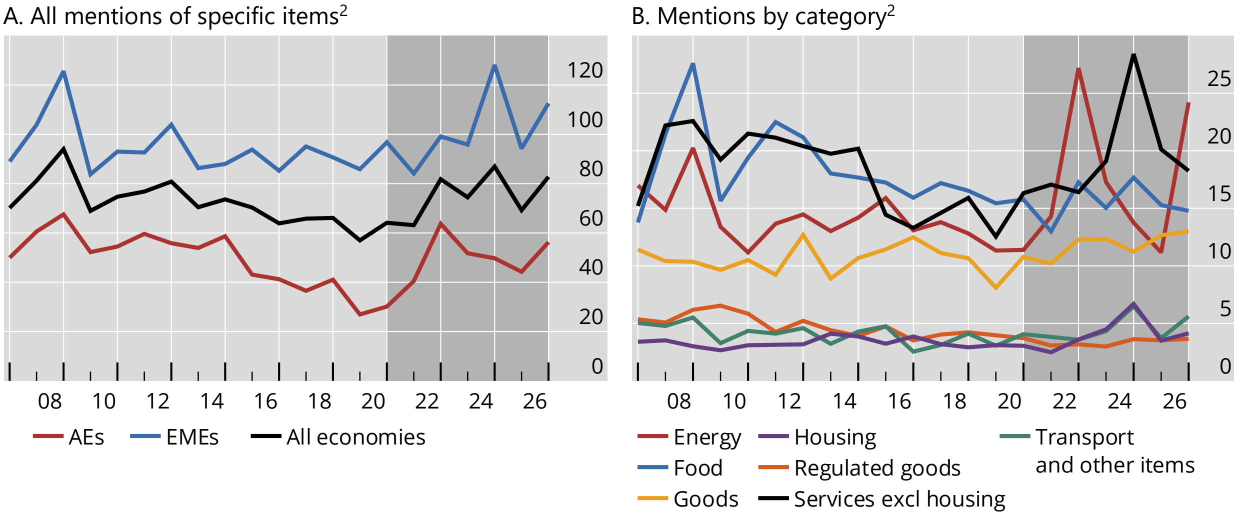
Two findings stand out. First, food and energy are especially salient in the discussion (Graph A1.B). This is perhaps natural, as the most common core inflation measure is constructed by excluding those two categories from the headline indicator. Yet their frequent mention suggests that they remain key sources of relative price changes – especially evident for energy (red line) at the start of the war in Ukraine in 2022 and the Middle East conflict in 2026. Second, central banks also frequently refer to services excluding housing (black line), a measure often seen as more closely linked to domestic cost dynamics and persistence. Indeed, attention to both services and housing intensified during the pandemic inflation surge.

Taken together, these patterns are consistent with the view that central banks complement their communication on headline and core inflation with item-specific discussion to explain contemporaneous inflation dynamics.

References to specific items in the consumer basket in monetary policy reports[1]

Average number of mentions per document

Graph A1



The shaded area indicates the pandemic/post-pandemic period.

[1] Sample economies: AEs = AU, CA, CH, EA, GB, HK, JP, KR, NZ, SE and US; EMEs = BR, CL, CO, ID, IN, MX, MY, PE, PH, PL, TH, TR and ZA. [2] For each year, the average number of references across monetary policy reports in the sample of countries is reported.

Sources: Central bank publications; OpenAI GPT version 5.5; authors' calculations.

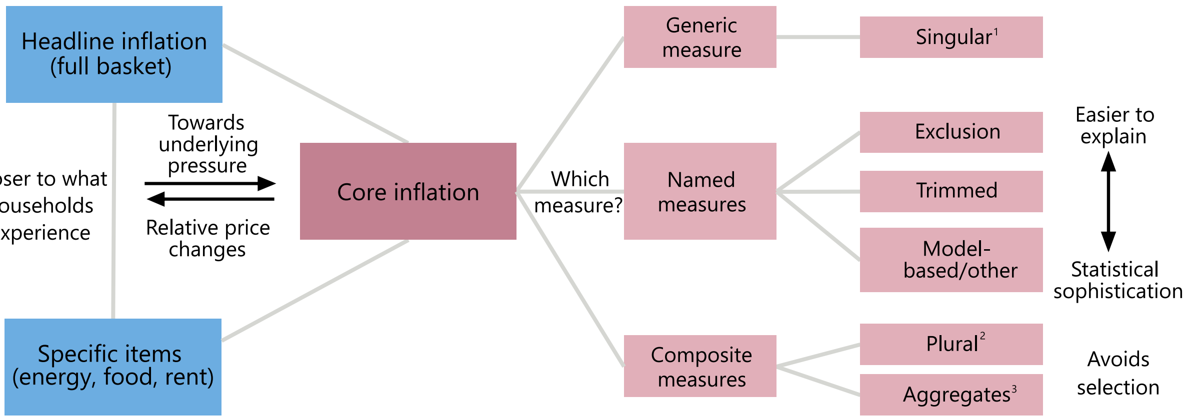
Two additional forces could also have contributed to the growing prominence of core inflation in monetary policy reports: the strengthening of monetary policy frameworks and peer effects in central bank communication. Regarding the first factor, inflation targets became more precisely specified over the period, even as the frameworks around them retained some flexibility (Borio and Chavaz (2025)). At the same time, central banks have sought to become more transparent (Dincer et al (2022)). A central bank held to a more precise objective and required to explain itself more fully has reasons to give more weight to its communication. As the need to explain inflation dynamics beyond the behaviour of headline inflation increased, central banks might have responded by referencing core inflation more frequently in their publications. Regarding the second factor, practices adopted by one institution often spread to others, in both communication and other aspects of central banking (Horvath (2020)). For instance, if some central banks start reporting more extensively on underlying price pressures, others may follow, either because it is deemed valuable or because straying from an emerging practice could prove costly.

The core inflation measures central banks cite

Having established that central banks are communicating more about core inflation, we turn to the question of which core measures they use. Because the properties of each metric involve trade-offs (eg between ease of communication and statistical sophistication), it is not possible to know, a priori, which one central banks would prefer. We thus again rely on the large language model. It classified each cited core measure into one of six categories and recorded the frequency of each measure.

The six core inflation categories are as follows (Graph 3): (i) generic core inflation in the singular – references to core inflation that do not specify a particular computation method; (ii) exclusion-based measures – headline inflation excluding pre-set items (typically but not necessarily food and energy); (iii) trimmed indicators – measures that remove the largest price changes in each period (the share of the consumption basket removed as each central bank considers appropriate); (iv) "other" measures – those not included in the previous two groups (eg double-weighted indices or principal component-based measures); (v) aggregates of core indicators – explicit composites of multiple core metrics (eg average of core inflation metrics); and (vi) generic core in the plural – references to a range or suite of core measures without detailing specific methods.[6]

Defining core inflation's role and choosing which measure(s) to communicate Graph 3



[1] Refers to mentions of core inflation in the singular where the computation method is not explicitly specified. [2] Denotes generic references to core inflation in the plural (eg "core measures", "a range of measures of underlying inflation"). [3] Denotes an explicit average or composite of two or more core inflation measures.

Source: Authors' elaboration.

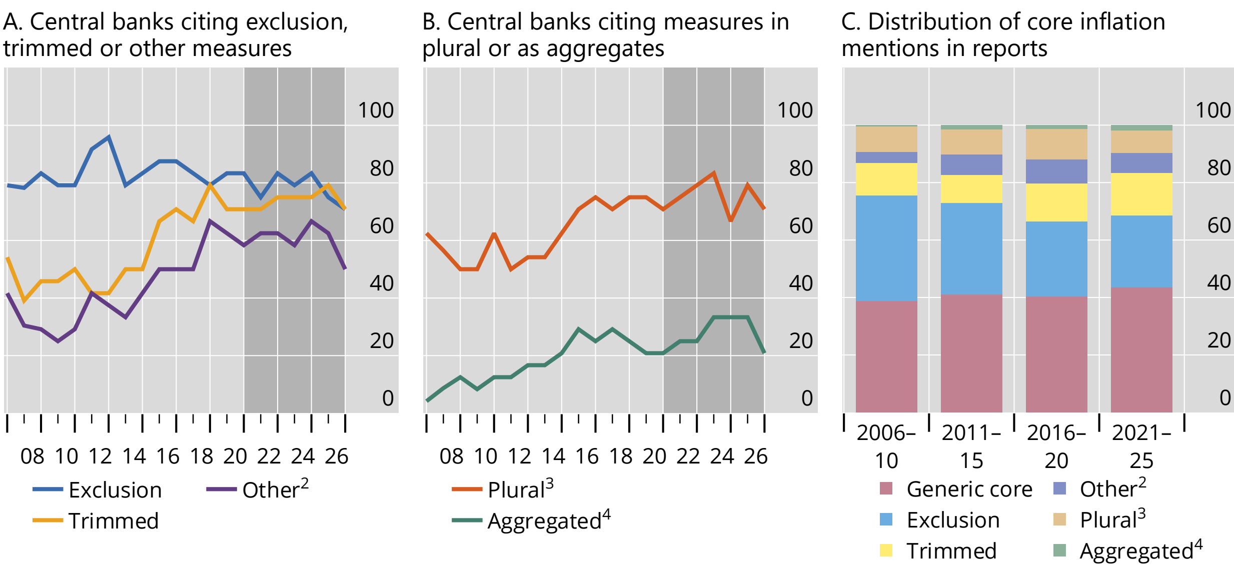
[6] We do not infer the method if it is not explicitly stated where the reference to core inflation is found in the document. Such references are classified as generic core, in either the singular or the plural.

During the pre-pandemic period of 2010–19, central banks progressively broadened the range of core inflation measures referenced in their communications. They assembled a portfolio of measures instead of selecting a single preferred indicator. This broader adoption shows in two dimensions: the increased proportions of central banks citing core measures across categories (Graphs 4.A and 4.B), and the diversification across categories within monetary policy reports (Graph 4.C). While exclusion-based measures remained the principal gauge throughout the period, the use of trimmed means increased considerably. From a low base, aggregates of core indicators gained a more visible foothold in central bank communications. In parallel, references to core inflation in the plural became substantially more prevalent.

The predominance of exclusion-based measures is unsurprising because, apart from being the first core inflation metric to be introduced, they are relatively simpler to compute and communicate. The search for an indicator insulated from the pronounced fluctuations in energy and food prices of the 1970s led to the measure that excludes those two categories (Gordon (1975)), and it has remained the reference point ever since.[7] The measure has probably persisted in communication because it is transparent to readers and does not change with new incoming data. However, it may still fluctuate in response to the volatility of the items it does include. Central banks have the flexibility to decide which categories to exclude, typically focusing on those considered most volatile when the measure is established. However, once this choice is made, it becomes fixed: the excluded categories remain unchanged, even if a different included category emerges as the primary source of relative price volatility.

Core inflation measures communicated by central banks[1]

In percent — Graph 4



The shaded area indicates the pandemic/post-pandemic period

[1] See endnotes for details. [2] Named metrics of core inflation different from exclusion or trimmed. [3] Generic references to core inflation in the plural (eg "core measures", "a range of measures of underlying inflation"). [4] Explicit average or composite of two or more core inflation measures.

Sources: Central bank publications; OpenAI GPT version 5.5; authors' calculations.

[7] Conceptually, when the most volatile prices adjust quickly, excluding them yields an index that better tracks the sticky part of inflation. In models with heterogeneous price stickiness (eg Aoki (2001)), the welfare-optimal policy is to stabilise inflation in the sticky price sector and let flexible prices absorb relative shocks – providing a rationale for exclusion-based core inflation measures.

The main drawback of exclusion-based measures – that they remove only a set of items fixed in advance – could have driven central banks to rely more on trimmed means. A trimmed mean, introduced in the literature much later than exclusion-based metrics, removes the largest price changes of each period, rather than fixing the exclusions in advance (Bryan and Cecchetti (1994)). It therefore adapts as new sources of relative price change emerge. Once the largest price changes are removed, those of the remaining items can be interpreted as a measure of generalised price movements. However, a trimmed mean is harder to explain, precisely because the omitted items change every month.

The search for better estimates of underlying price pressures may have led central banks to broaden their indicator sets to include more statistically sophisticated measures (our "other" category).[8] However, their presence is still limited in central bank publications, probably reflecting a drawback that matters more for communication than for analysis: explaining their construction is often not straightforward, and historical readings can be substantially revised as new data become available (see Sullivan (2022) for an example using Canadian data). The accumulation of core inflation measures can be understood as a response to a fundamental identification problem: underlying price pressures are not directly observable, and a wider set of metrics may offer more information about or greater confidence in how those pressures are behaving. Concordant readings across metrics increase confidence that the message is robust. But this accumulation brings its own communication challenges. Metrics can send conflicting signals, leaving open the question of how a central bank should interpret them. It also raises the question of which measure the central bank prioritises, and why. If that emphasis shifts over time, it may be seen as cherry-picking, at the cost of credibility. And where central banks aggregate multiple metrics into a single composite – whether to simplify communication or to pursue desirable statistical properties (Carlomagno et al (2023)) – the result can become a black box for the audience. While specialist audiences are better equipped to interpret a broader set of indicators, central banks will need to reframe their messages for the public to be more direct and streamlined.

Box B

When do central banks communicate headline inflation, core inflation or specific price components?

The increase in the use of core inflation in central banks' communication documented in this article raises the question of what purpose it serves.① Motivated by that question, this box examines how inflation communication changes under different macroeconomic scenarios. We focus on deviations from two common references for monetary policy: inflation relative to an official target and output growth relative to potential. By differentiating results by inflation metric and type of document, we analyse how central banks communicate inflation under different macroeconomic conditions.

In the econometric exercise, for each document type we estimate the intensity with which it mentions headline, core and item-specific price variations on average. We employ regression models with quarterly data

[8] The academic literature and central bank analysis have sought to guide the selection of core inflation measures by properties such as smoothness, convergence of headline inflation and predictive power for future headline inflation (see eg Ehrmann et al (2018)). The appropriate criterion remains debated. In particular, if forecasting headline inflation is the sole objective, more sophisticated methods that utilise broader information sets tend to outperform traditional core measures (Wynne (2008)). Fundamentally, there is no economic theory prescribing how core inflation should be calculated, nor can any approach be deemed definitively correct (Wynne (2008)).

from the first quarter of 2006 to the second quarter of 2026 and central bank Governor fixed effects to control for changes in communication style. The dependent variable is the quarterly average number of mentions to each inflation concept divided by the respective document's word length. Key explanatory variables include the deviation from potential output growth rate, that of inflation from target and the gap between headline and core inflation (defined here as excluding food and energy from the overall basket).

Results show that communication responds to macroeconomic conditions (Table B1). In particular, stronger deviations from the potential growth rate (up or down) reduce the relative space devoted to the discussion of inflation. In contrast, inflation deviations from target exhibit asymmetric effects depending on their sign and the document type: when inflation increases above target, minutes contain more emphasis on headline inflation and item-level price changes; when inflation falls below target, overall inflation discussion tends to decrease – strongly so in statements and minutes, across all three measures, and for core and item-level price changes in monetary policy reports (MPRs). This suggests that central banks are inclined to reduce mentions of inflation in their communication when it drifts further below target.

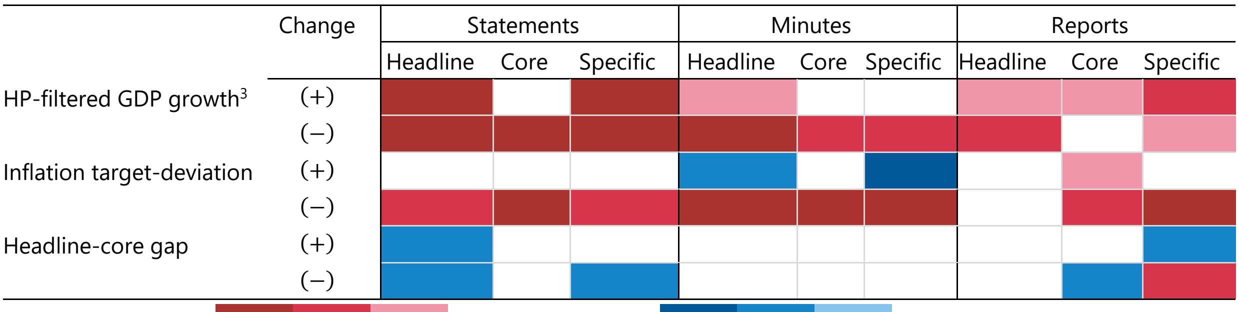
Divergence between headline and core inflation influences which measure central banks prioritise. When headline inflation rises above core, statements place greater emphasis on the headline measure, and MPRs expand item-level discussion – consistent with using components to explain the volatility behind elevated headline readings. Conversely, when core inflation exceeds headline inflation and the gap between the two measures widens, MPRs increase their focus on core inflation and reduce item-level detail, while statements raise headline and item-level emphasis. This indicates that larger divergences in either direction heighten the importance of inflation in statements, while prompting measure-specific shifts in MPRs.

Overall, the econometric exercise shows that the emphasis central banks place on inflation in their communications evolves with macroeconomic conditions. Additionally, depending on whether headline inflation deviates above or below the target, there is notable asymmetry. This may reflect the contrast between negative supply shocks driving inflation higher and structural economic weaknesses pushing it lower – two forces that suggest fundamentally different origins and solutions for inflation. Finally, as the absolute size of the headline-core gap increases, so does the frequency with which inflation metrics are mentioned, confirming the influence that core inflation (or food and energy shocks) has on inflation communication by central banks.

Sensitivity of inflation mentions to the macroeconomic environment[1,2]

Dependent variable: number of inflation mentions per 1,000 words

Table B1



[1] Sample economies: AEs = AU, CA, CH, EA, GB, JP, KR, NZ, SE and US; EMEs = BR, CL, CO, ID, IN, MX, PE, PH, PL, TH, TR and ZA., from 2006Q1 to 2026Q2. [2] Given the non-negative characteristic of the explained variable and the relevant presence of zeros, models are estimated with Poisson pseudo-maximum likelihood estimators (see Santos Silva and Tenreyro (2006)). Models include central bank Governor fixed effects, with standard errors clustered at the Governor level. We add controls for the policy rate path (hikes and cuts) and exchange-rate movements (positive and negative), in addition to institutional and contextual events: "divine coincidence", central bank independence and a crisis indicator. The "divine coincidence" variable is a dummy variable which indicates when the output gap and the inflation-target deviation have the same sign. Central bank independence is proxied by the time-varying Romelli (2022, 2025) index, repeated after 2023 due to the lack of more recent data. Our crisis indicator is a dummy variable constructed by a large language model that indicates whether the document mentions a crisis (global, regional or domestic). [2] The result can be interpreted as output and inflation competing for attention on a single document. Replacing the HP-filtered GDP growth rate with the Hamilton filter's equivalent (eight quarters ahead and four quarter lags) maintains the result for statements, while it somewhat weakens the result for minutes and reports, but without reversing the direction.

Sources: Romelli (2022, 2025); central bank publications; IMF; OpenAI GPT version 5.5; national data; authors' calculations.

① Amaral et al (2025) conducted a survey with 12 central banks and found that several of them either adjust existing underlying inflation measures or create new ones to account for exceptional shocks that raise uncertainty.

Conclusion

The review of central bank communications about core inflation presented in this article reveals two clear trends. First, references to core inflation have become increasingly prevalent. Second, the set of core measures under discussion has broadened. These developments indicate that central banks regard communication on core inflation as valuable.

However, the expanding suite of core inflation indicators comes with a range of communication challenges. Instead of providing a straightforward diagnostic, central banks risk conveying an overly complex message. Specialist audiences are well equipped to engage with more technical communication, and the depth and rigour of such analysis are important for institutional credibility. Nonetheless, these audiences need to be addressed with precise definitions, transparent methodologies and a clear articulation of how signals are interpreted. The broader public, by contrast, may benefit from concise messages anchored in the headline target and the central bank's mandate. Explanations of the principal drivers of high inflation outcomes, especially in salient goods and services items, remain essential.

In a world more prone to shocks, core inflation becomes even more important (Mendes (2025)). Price dynamics will always be subject to disturbances, which appear to have become more frequent (Maechler (2024)), as witnessed during the Covid-19 pandemic, the rise in geopolitical tensions from the war in Ukraine, the return of trade tariffs and the Middle East conflict. These shocks triggered repeated supply side disruptions, which will continue to test the clarity of central bank communication on inflation and its drivers.

Identifying underlying price pressures is inherently uncertain, which makes continued innovation in core inflation measures both unavoidable and desirable. Hence, renewed focus on communication on core inflation could be warranted, particularly on how inflation is explained to different audiences. Improved communication can, in turn, strengthen central bank credibility and help to achieve policy objectives.

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Endnotes

Graphs 1, 2 and 4: The sample covers of 24 economies. AEs = AU, CA, CH, EA, GB, HK, JP, KR, NZ, SE and US. EMEs = BR, CL, CO, ID, IN, MX, MY, PE, PH, PL, TH, TR and ZA.

Graph 1.A: For each year, the lines represent the percentage of documents in the sample of countries that cited at least one core inflation measure.

Graph 2.A: For each year, all mentions of core inflation by central banks in monetary policy reports are divided by all corresponding references to headline inflation, and all core inflation citations are divided by all item-specific inflation mentions.

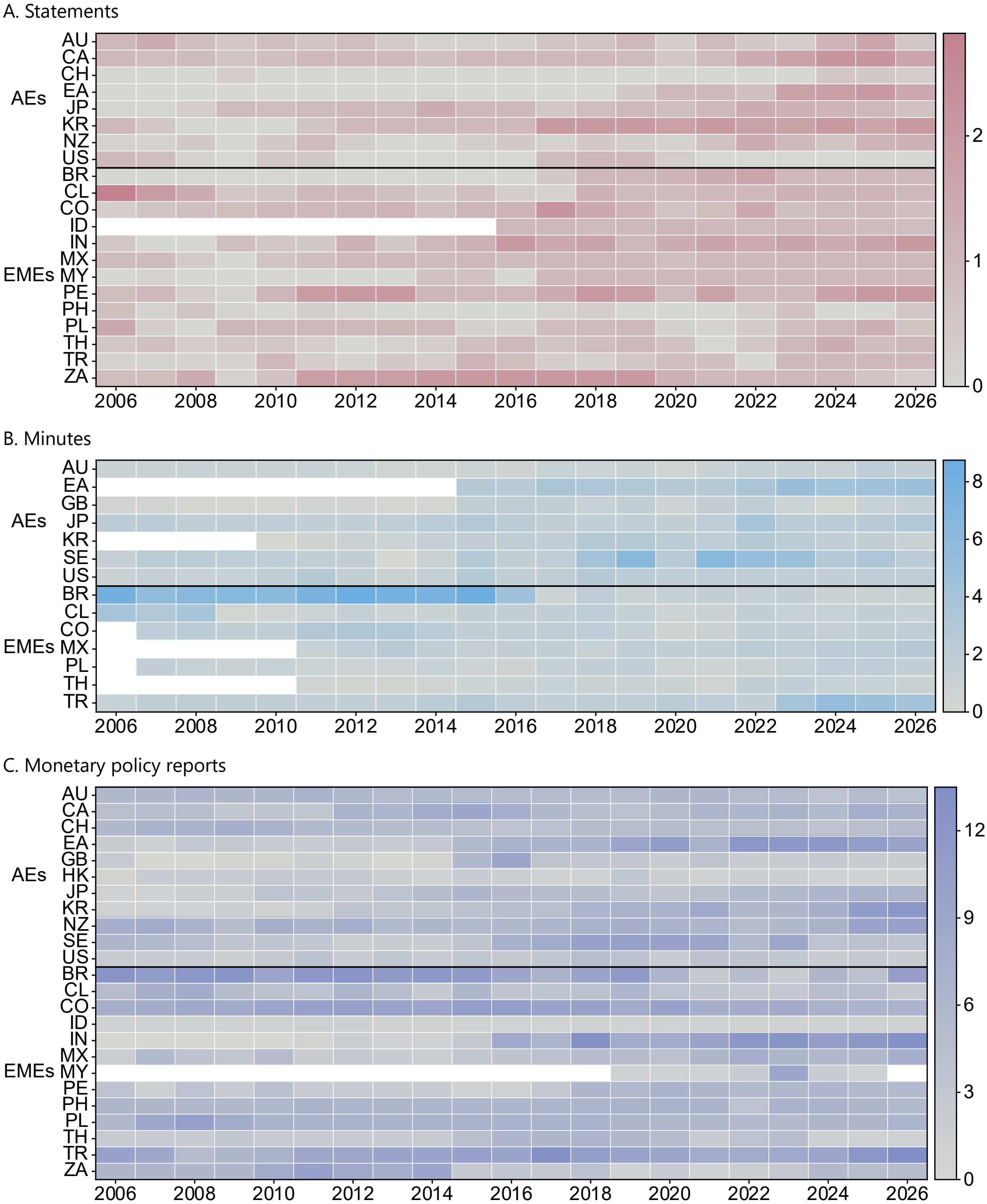
Graph 2B: Sensitivity calculated as the β coefficient in $y_{c,q} = \alpha_c + \beta Inflation_{c,q} + \varepsilon_{c,q}$, where α_c is a central bank fixed effect and y is the log of mentions of inflation; information at the central bank-quarter level. Calculated for monetary policy reports between 2006 and 2025, excluding MY and TR.

Graphs 4.A and 4.B: For each calendar year, the lines represent the percentage of central banks that cited at least one core inflation measure from the specified group in at least one statement, minutes document or monetary policy report.

Annex A: Country heterogeneity in core inflation measures

Number of distinct core inflation measures mentioned by central bank[1]

Average number per year | Graph A.1

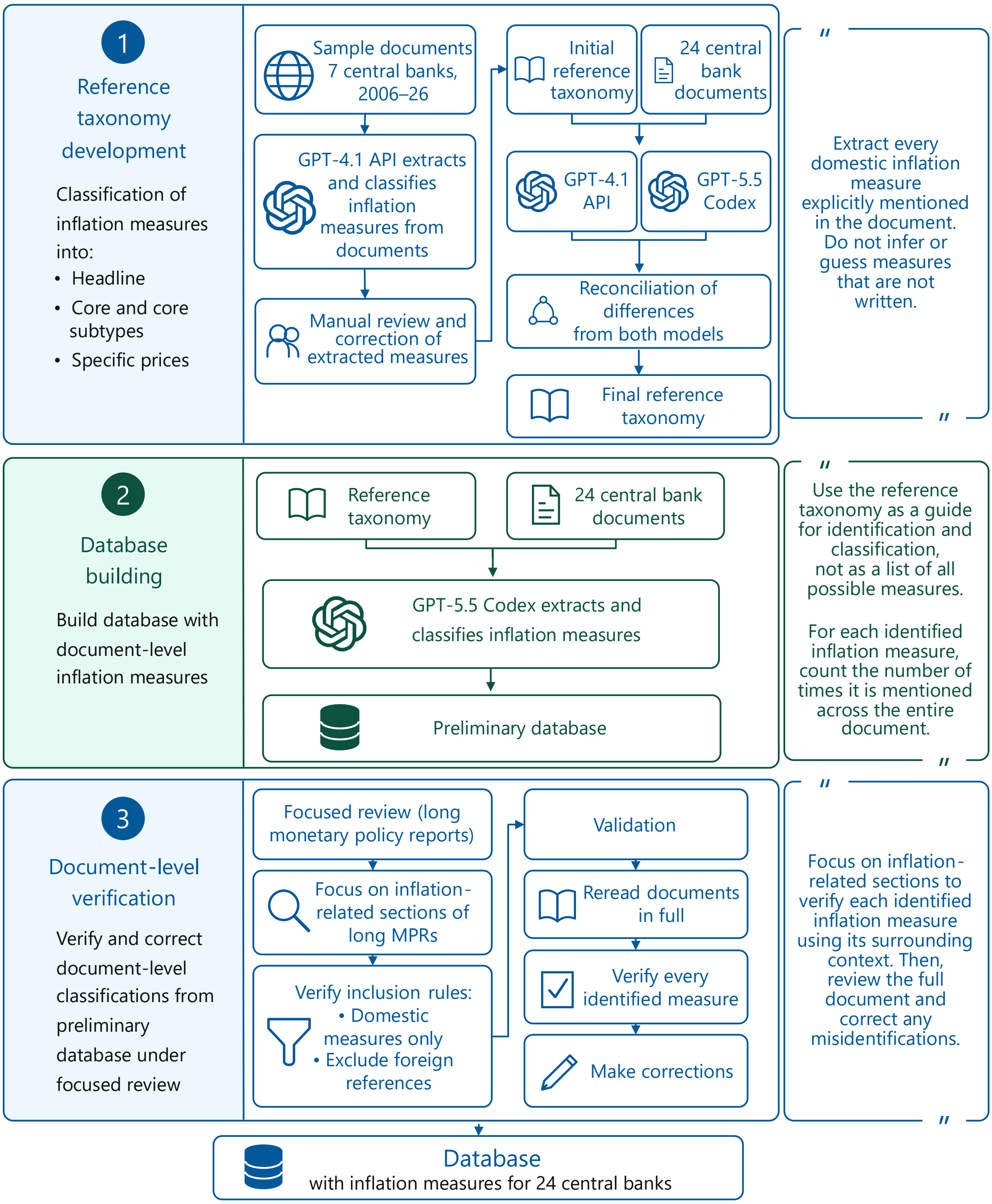


[1] Includes all variants mentioned (eg excluding food and energy and excluding volatiles would be two different variants within exclusion-based measures). The list of publications may vary across panels based on the availability of central bank publications.

Sources: Central bank publications; OpenAI GPT version 5.5; authors' calculations.

Annex B: reading the documents via the large language model (LLM)

LLM-based inflation measures extraction, classification and validation pipeline Graph B.1



Source: Authors' elaboration.

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
BHD	Bahraini dinar	NGN	Nigerian naira
BRL	Brazilian real	NOK	Norwegian krone
CAD	Canadian dollar	NZD	New Zealand dollar
CHF	Swiss franc	OTH	all other currencies
CLP	Chilean peso	PEN	Peruvian sol
CNY (RMB)	Chinese yuan (renminbi)	PHP	Philippine peso
COP	Colombian peso	PLN	Polish zloty
CZK	Czech koruna	RON	Romanian leu
DKK	Danish krone	RUB	Russian rouble
EUR	euro	SAR	Saudi riyal
GBP	pound sterling	SEK	Swedish krona
HKD	Hong Kong dollar	SGD	Singapore dollar
HUF	forint	THB	Thai baht
IDR	Indonesian rupiah	TRY	Turkish lira
ILS	Israeli new shekel	TWD	New Taiwan dollar
INR	Indian rupee	USD	US dollar
ISK	Icelandic króna	VES	bolívar soberano
JPY	Japanese yen	VND	Vietnamese dong
KRW	Korean won	XOF	CFA franc (BCEAO)
MAD	Moroccan dirham	ZAR	South African rand

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
BB	Barbados	EG	Egypt
BD	Bangladesh	ER	Eritrea
BE	Belgium	ES	Spain
BF	Burkina Faso	ET	Ethiopia
BG	Bulgaria	FI	Finland
BH	Bahrain	FJ	Fiji
BI	Burundi	FO	Faeroe Islands
BJ	Benin	FR	France
BM	Bermuda	GA	Gabon
BN	Brunei	GB	United Kingdom
BO	Bolivia	GD	Grenada
BR	Brazil	GE	Georgia
BS	The Bahamas	GG	Guernsey
BT	Bhutan	GH	Ghana
BW	Botswana	GI	Gibraltar
BY	Belarus	GM	The Gambia
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	HK	Hong Kong SAR
CL	Chile	HN	Honduras
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	MW	Malawi
IQ	Iraq	MX	Mexico
IR	Iran	MY	Malaysia
IS	Iceland	MZ	Mozambique
IT	Italy	NA	Namibia
JE	Jersey	NC	New Caledonia
JM	Jamaica	NE	Niger
JO	Jordan	NG	Nigeria
JP	Japan	NL	Netherlands
KE	Kenya	NO	Norway
KG	Kyrgyz Republic	NR	Nauru
KH	Cambodia	NZ	New Zealand
KM	Comoros	OM	Oman
KR	Korea	PA	Panama
KW	Kuwait	PE	Peru
KY	Cayman Islands	PG	Papua New Guinea
KZ	Kazakhstan	PH	Philippines
LA	Laos	PK	Pakistan
LB	Lebanon	PL	Poland
LC	St Lucia	PT	Portugal
LK	Sri Lanka	PY	Paraguay
LR	Liberia	QA	Qatar
LS	Lesotho	RO	Romania
LT	Lithuania	RS	Serbia
LU	Luxembourg	RU	Russia
LV	Latvia	RW	Rwanda
LY	Libya	SA	Saudi Arabia
MA	Morocco	SC	Seychelles
MD	Moldova	SD	Sudan
ME	Montenegro	SE	Sweden
MG	Madagascar	SG	Singapore
MH	Marshall Islands	SI	Slovenia
MK	North Macedonia	SK	Slovakia
ML	Mali	SL	Sierra Leone
MM	Myanmar	SM	San Marino
MN	Mongolia	SN	Senegal
MO	Macao SAR	SR	Suriname
MR	Mauritania	SS	South Sudan
MT	Malta	ST	São Tomé and Príncipe
MU	Mauritius	SV	El Salvador
MV	Maldives	SZ	Eswatini

Countries (cont)

TD	Chad	UG	Uganda
TG	Togo	US	United States
TH	Thailand	UY	Uruguay
TJ	Tajikistan	UZ	Uzbekistan
TL	East Timor	VC	St Vincent and the Grenadines
TM	Turkmenistan	VE	Venezuela
TO	Tonga	VG	British Virgin Islands
TR	Türkiye	VN	Viet Nam
TT	Trinidad and Tobago	ZA	South Africa
TW	Chinese Taipei	ZM	Zambia
TZ	Tanzania	ZW	Zimbabwe
UA	Ukraine		