

BIS Quarterly Review

**International banking and financial
market developments**

March 2023

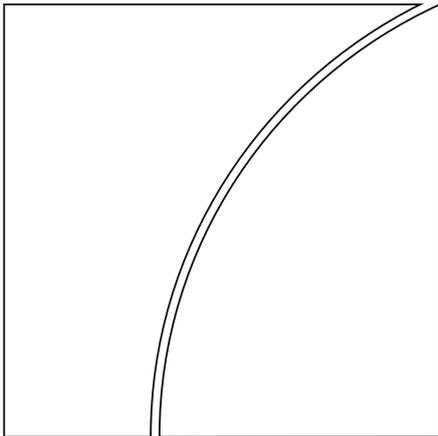


BANK FOR INTERNATIONAL SETTLEMENTS

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BIS Quarterly Review
Monetary and Economic Department

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ISSN 1683-0121 (print)
ISSN 1683-013X (online)

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A technical annex containing detailed explanations for the graphs and tables is included at the end of each chapter.

Notations used in this Review

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

Differences in totals are due to rounding.

The term “country” as used in this publication also covers territorial entities that are not states as understood by international law and practice but for which data are separately and independently maintained.

Abbreviations

Currencies

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

Countries

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

Countries (cont)

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

Countries (cont)

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

Perceptions of risk and policy outlook drive markets

Financial markets extended previous gains during the review period.¹ As inflation readings gradually fell and the pace of policy tightening slowed early in the period, financial conditions eased and risky asset valuations generally rose on the back of perceptions of declining risks. Expectations of significant rate cuts in the near term appeared to firm up, despite cautious central bank communication about the policy outlook. The US dollar depreciated further, lending additional support to assets in emerging market economies (EMEs). Towards the end of the period, however, market developments proved sensitive to news that challenged investors' sanguine attitude.

Investors' expectations about future policy rate paths stood in contrast to central bank communications. While several major central banks slowed the pace of monetary tightening, they remained cautious about the interest rate path going forward, particularly in view of the persistent strength of labour markets. Nevertheless, interest rate futures continued to relay market participants' expectation that rate hikes will end this year, followed by steep rate cuts stretching well into 2024.

Conditions in government bond markets remained sensitive to perceptions of growth, inflation and the attendant policy response. In Japan, tensions remained in fixed income markets, as investors reassessed the yield curve control (YCC) policy. Broad-based and recurrent open market operations by the central bank smoothed market functioning and contained upward pressure on bond yields.

Risky assets registered gains and the US dollar depreciated through most of the review period, before news tempered markets' optimism about the policy outlook. Stock markets experienced bouts of selling pressure but registered positive returns, despite a still subdued earnings outlook. The concurrent fall in forward-looking gauges of market volatility suggested that valuations were boosted by benign risk perceptions. In a similar vein, credit spreads narrowed further, on the heels of declines in perceived default risks, and corporate bond issuance showed signs of recovery in January. US data releases in February steered investors towards anticipating stronger policy headwinds. This led to a slight dollar appreciation and some reversal of risky asset gains, halting their divergence from subdued bank lending in major advanced economies (AEs).

Financial conditions eased moderately in EMEs, largely mirroring those in AEs. Bond yields fell, amid an upbeat backdrop of resilient growth and falling inflation. Equity markets saw wider fluctuations, swayed by the gyrations of the US dollar. The abrupt end to the zero-Covid policy in China reinvigorated its equity market and contributed to the strong performance of risky assets in economies with close links to China. Yet it failed to turn around the lethargic portfolio flows to the country, while such flows did stabilise or even rebounded for most other EMEs.

¹ The review period covers 25 November 2022 to 17 February 2023.

Key takeaways

- Perceptions of the future path of monetary policy shaped markets as central banks continued their fight against inflation.
- A benign assessment of the risk landscape supported risky asset valuations, notwithstanding subdued earnings forecasts.
- EME asset performance was generally strong but was also sensitive to AE financial conditions and to the ebb and flow of the US dollar.

Financial conditions eased as policy tightening slowed

Fixed income markets in major AEs remained focused on monetary policy paths during the review period. Signs of abating inflationary pressures kept a lid on bond yields, while expectations of rate cuts in late 2023 firmed up in derivatives markets. By contrast, central banks remained cautious in their guidance about the policy outlook, against the backdrop of persistently tight labour markets. This sober stance appeared vindicated in early February, when US data releases led to some non-trivial increases in government bond yields.

Financial conditions eased further early in the review period and then broadly stabilised. As of early December, a widely used indicator of global financial conditions had retraced half of the tightening observed during 2022. It hovered thereafter around levels close to its long-term average (Graph 1.A). All this took place on the back of decelerating inflation in the United States and other AEs, in part driven by muted fluctuations in commodity prices. In addition, perceptions of upside inflationary risks among market participants appeared to moderate (Graph 1.B).

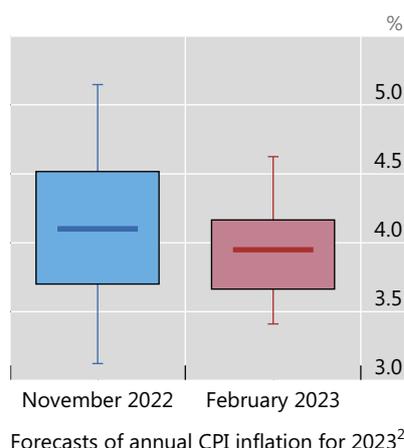
Financial conditions eased but remained sensitive to inflation risks

Graph 1

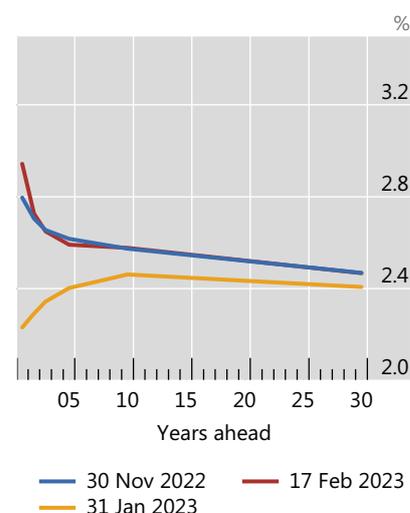
A. Global financial conditions eased...



B. ...while US inflation uncertainty decreased



C. US break-even inflation jumped with signs of economic resilience



The shaded area indicates 25 November 2022–17 February 2023 (period under review).

¹ See technical annex for details. ² Box plots show medians, interquartile ranges and fifth-95th percentiles.

Sources: Bloomberg; Consensus Economics; BIS.

In early February, US data releases brought renewed evidence of strong labour market conditions amid solid growth,² inducing market participants to reassess their inflation expectations. Near-term break-even inflation rates in the United States at mid-February were more than 60 basis points higher than at end-January (Graph 1.C). And the break-even term structure swiftly inverted, returning to the configuration prevalent early in the review period. In the euro area, inflation break-evens reacted less forcefully to the news, while a protracted disinflation process ploughed ahead. Against this backdrop, investors revised upwards their terminal policy rate projections for the United States, and to a lesser extent for the euro area, while pushing out the timing of expected rate cuts (Graph 2.A). Nevertheless, interest rate futures continued to signal a firm expectation that rate hikes would stop before the end of this year and that policy rates would decline materially in 2024.

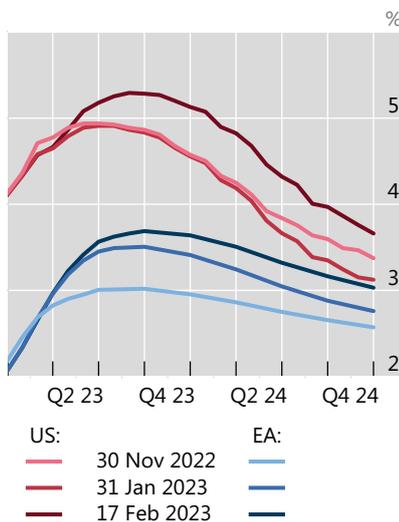
In sharp contrast, central banks remained much more cautious in their communications throughout the review period. Admittedly, most central banks did slow the pace of tightening, including the Federal Reserve and the ECB. Moreover, some EME central banks, which had started tightening much earlier, paused. But in general, policymakers gave no indication that easing was on the horizon, reflecting concerns about still elevated inflation – with core inflation substantially above target – and upside risks that persisted on the back of generally tight labour markets.

Market participants’ muted inflation fears kept a lid on AE bond yields for most of the review period, in contrast to the previous quarter, when turmoil in a major sovereign bond market spilled over to other segments (see Box A). Long-term yields in Germany briefly surpassed previous 2022 highs in late December (Graph 2.B), as

In addition to inflation, policy expectations drove sovereign bond markets

Graph 2

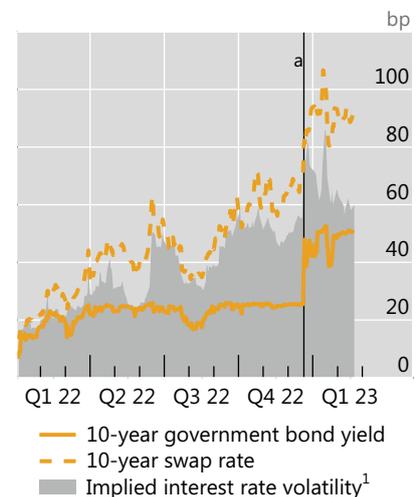
A. Investors anticipated steep rate cuts in 2024



B. Govt bond yields reflected short-lived bouts of selling pressures



C. Expected revisions to YCC swayed fixed income markets in Japan



The shaded area indicates 25 November 2022–17 February 2023 (period under review).

^a Bank of Japan changes yield curve control.

¹ Based on three-month into 10-year swaptions.

Sources: Bloomberg; Refinitiv Eikon; BIS.

² These included strong positive non-farm payroll and retail sales surprises, as well as mild upward revisions to past CPI data.

the ECB reaffirmed its guidance of policy tightening. Following the US data surprises in February, nominal long-term yields began to rise again on the back of widening break-evens and moderate increases in “real” (that is, inflation-adjusted) yields within positive territory, with the exception of Japan, where they stayed negative.

The market for Japanese government bonds (JGBs) experienced some tensions as investors continued to reassess the YCC policy. Long-term yields shifted upwards in December when the Bank of Japan unexpectedly widened the floating band of the 10-year yield (Graph 2.C). Further upward pressures on long-term yields were contained by recurring and broad-based open market operations of the central bank. At the same time, the spread of the 10-year swap rate over the cash yield persisted, as investors appeared to wager on further policy adjustments. And, even after receding from their peaks, forward-looking gauges of volatility stayed elevated, pointing at investors’ uncertainty over the interest rate path.

Credit default swap (CDS) spreads indicated that market participants closely followed political negotiations around the debt limit in the United States. While remaining well below stress levels, CDS spreads for the US government briefly approached 35 basis points in January (Graph 3.A), as the US Treasury once again reached its borrowing limit and uncertainties over the debt ceiling negotiations increased. This contrasted with CDS spreads for Germany and Japan, which tightened during the review period.

Sovereign spreads in the euro area narrowed substantially in the new year, as the worst case macroeconomic scenarios feared in 2022 failed to materialise. A significant decline in projected fiscal deficits, in part resulting from less damaging prospects for energy prices, improved the metrics of euro area sovereigns’ debt sustainability, thus lowering their funding costs. Most notably, spreads of Italian debt over bunds contracted by about 30 basis points over the last six weeks of the review period (Graph 3.B). Those of other sovereigns resumed the narrowing path briefly interrupted in December.

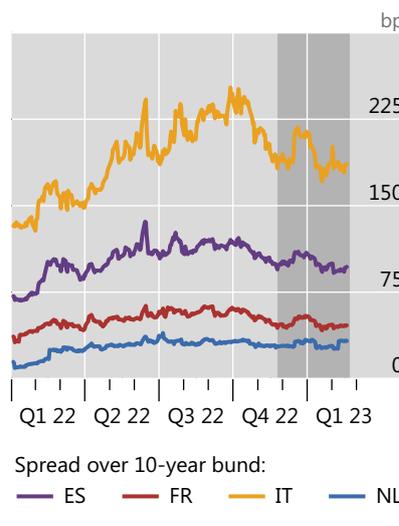
Sovereign spreads mostly narrowed and the US dollar depreciated

Graph 3

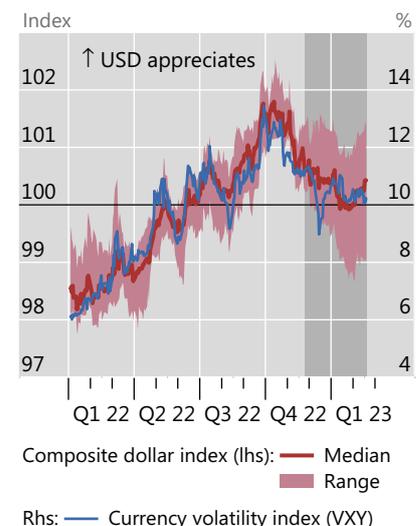
A. US CDS spreads diverged from DE and JP ones on debt limit concerns



B. Euro area sovereign spreads narrowed in the new year



C. Dollar parities co-moved with currency volatility¹



The shaded areas indicate 25 November 2022–17 February 2023 (period under review).

¹ See technical annex for details.

Sources: Bloomberg; Datastream; BIS.

Market turbulence and soaring margins: lessons from two recent episodes

Benjamin H Cohen and Kevin Tracol^①

An increasing share of derivatives transactions is subject to margin requirements, with those for centrally cleared instruments set by central counterparties (CCPs) and those for uncleared ones set by regulatory standards.^② These requirements have been effective in meeting their primary objective – reducing counterparty credit risk. However, in recent periods of large shocks and bouts of market turbulence, margin surges boosted counterparties' demand for liquidity exactly when the supply was short, in some cases exacerbating the turbulence.^③

This box analyses how swings in liquidity demand reflect central clearing margin requirements, paying particular attention to aspects of the underlying model. We draw on a unique data set that estimates margin requirements on hypothetical trades of interest rate swaps (IRS) at LCH SwapClear, a prominent CCP for such derivatives. We focus on two episodes: the Covid-19 shock of March 2020 and the UK “mini” budget turmoil in September 2022. We show that a large component of the calibration of margin requirements – namely one reflecting market developments observed immediately before the time of calibration – is at the root of destabilising dynamics. A stronger precautionary component in the underlying model would dampen these dynamics but may reduce centrally cleared activity.

Margin arrangements normally include two components: variation margin (VM), which reflects current market conditions, and initial margin (IM), which seeks to anticipate future market conditions. When the value of a derivative changes and the losing side makes a payment to the winning side, there is an exchange of VM (usually daily). In addition, each CCP participant has to post an IM to cover potential future VM payments that it may fail to deliver, eg in case of default. Realised VMs in excess of the IM represent a potential “margin breach” that signals a risk for the CCP; if losing counterparties were to fail, IM would not be sufficient to cover the VM payments that these counterparties owe the CCP. The magnitudes of IM and VM depend on the size of the underlying positions and hence trading volumes. In addition, IM may change because of a recalibration of the underlying model that estimates extreme shocks down the road.

Required margin amounts underwent exceptional swings during the stress episodes we consider. In February/March 2020, when the Covid-19 epidemic spread worldwide, market volatility rose dramatically, resulting in sharp increases in both the overall amounts of the VMs exchanged between counterparties and the required IM.^④ The largest daily VM paid to SwapClear reached \$26 billion in Q1 2020, and IM increased by \$28 billion over the same period.^⑤ Both of these values were 40% higher than the previous records. SwapClear witnessed a potential margin breach as high as £558 million in Q1 2020, which was roughly equal to three times the largest value that had yet been recorded (in Q3 2015). IM again rose sharply during the bout of turbulence that followed the UK “mini” budget announcement in September 2022, and potential margin breaches peaked at £698 million, even higher than in March 2020.^⑥

To understand the role of the underlying model in such IM developments, we consider two hypothetical positions, for which we can derive margin requirements while fixing the trading volume. The positions are: the pay-fixed side of a US dollar one-year swap in February/March 2020 (Graph A1.A); and the receive-fixed side of a GBP one-year swap for September 2022 (Graph A1.C). In their respective periods of stress, both positions incurred market losses that necessitated substantial VM payments. In each case, our simulations indicate that the VM level was higher than the concurrent IM, ie there was a potential margin breach. Subsequently, the required amount of IM surged, suggesting that the shocks underpinning the VM payments materially affected the implications of the IM model, even if with a lag of a few days. This surge reinforced the liquidity needs of entities holding the positions we consider, as it came on the heels of VM payments. Such needs generate destabilising dynamics when they arise during market stress, ie when they are procyclical. We thus investigate what aspects of the IM model generate procyclicality.

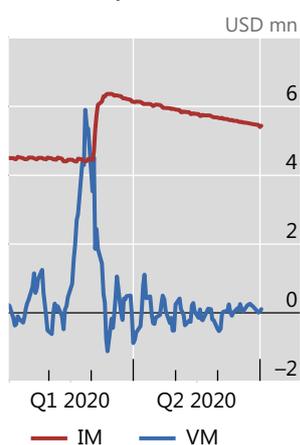
In setting IM for IRS, SwapClear computes two tail risk measures from two historical loss distributions and uses the maximum of the two. One of the measures (expected shortfall (ES)) is based on a history of shocks from the previous 10 years. This risk measure is recalibrated every day to include the latest observation in the set of historical shocks (the “new shocks” effect) and to scale these historical shocks so that their standard deviation reflects the most recent volatility (the “volatility scaling” effect). Both the new shocks and the volatility scaling effects raise ES in times of market stress. The second tail risk measure (stressed value-at-risk (SVaR)) is calibrated on specific historical stress episodes (eg the Great Financial Crisis or the European sovereign debt crisis). Since adjustments to this set of events

are rare, SVaR is stable over time and acts as a floor for IM, surfacing when ES is low during periods of calm. Conversely, a transition from calm to heightened volatility brings ES to the fore by raising it above the SVaR floor. Importantly, the higher the SVaR, the smaller the portion of the ES rise that translates into an IM increase. Overall, while the new shocks and volatility scaling effects introduce procyclicality in IM, an SVaR effect dampens this procyclicality.

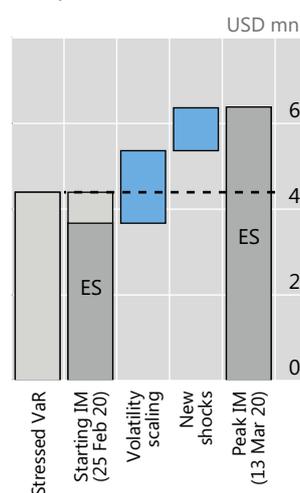
Initial and variation margins for hypothetical interest rate swap positions¹

Graph A1

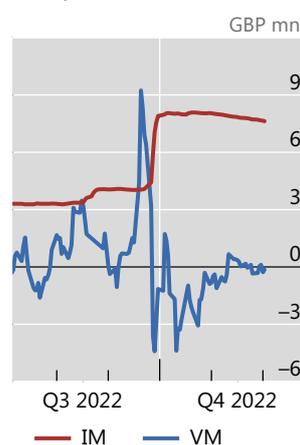
A. VM and then IM surged in February 2020²



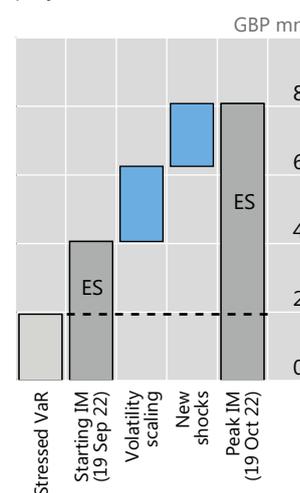
B. Precautionary element dampened the IM rise



C. VM and then IM surged in September 2022



D. Precautionary element played no role³



IM = initial margin; VM = variation margin; VaR = value-at-risk; ES = expected shortfall.

¹ VM is cumulated over five-day periods and IM is based on a five-day closeout period. ² Pay-fixed side of a one-year USD interest rate swap with a notional of \$1 billion. ³ Receive-fixed side of a one-year GBP swap with a notional of £750 million.

Sources: Clarus Financial Technology; authors' calculations.

The stress episodes we focus on highlight the three model-based effects behind IM rises, and in particular the scope for SVaR to dampen IM swings. In both episodes, the volatility scaling effect and, to a lesser extent, the new shocks effect drove the spike in IM for the hypothetical positions (Graphs A1.B and A1.D). The SVaR floor dampened the procyclicality of these two effects during the 2020 episode: only 74% of their combined impact on ES translated into an IM increase for the US dollar interest rate swap. By contrast, a low SVaR did not bind and thus did not play a dampening role in the 2022 episode, during which the IM for the GBP interest rate swap doubled.

The message of our stylised exercise is clear: if policymakers wish to mitigate the perverse effects of sharp adjustments to IM in times of market stress, they need to beef up its precautionary component, ie the SVaR floor, in tranquil times. Of course, raising this component means that the evolution of IM would reflect the current market environment less accurately. And the generally higher IM would increase the cost of entering derivatives positions. This may push activity to the less transparent bilateral markets or have participants shun derivatives, leaving some risks unhedged. From a financial stability perspective, the trade-offs between reducing margin procyclicality and reducing activity in centrally cleared derivatives call for a careful assessment and require a system-wide regulatory approach.

① The views expressed are those of the authors and do not necessarily reflect the views of the BIS. ② Basel Committee on Banking Supervision (BCBS) and International Organization of Securities Commissions (IOSCO), *Margin requirements for non-centrally cleared derivatives*, July 2019. ③ A Schrimpf, H S Shin and V Sushko, "Leverage and margin spirals in fixed income markets during the Covid-19 crisis", *BIS Bulletin*, no 2, April 2020; M Brunnermeier and L Pedersen, "Market liquidity and funding liquidity", *Review of Financial Studies* vol 22, February 2009, pp 2201–38. ④ BCBS, Committee on Payments and Market Infrastructures (CPMI) and IOSCO, *Review of margining practices*, September 2022, and W Huang and E Takats, "The CCP-bank nexus in the time of Covid-19", *BIS Bulletin*, no 13, May 2020. ⑤ According to SwapClear's CPMI-IOSCO quantitative disclosures and Clarus Financial Technology. ⑥ S Aramonte and P Rungcharoenkitkul, "Leverage and liquidity backstops: cues from pension funds and gilt market disruptions", *BIS Quarterly Review*, December 2022, Box B.

The dollar continued to depreciate through most of the review period as US interest rates lacked upward momentum. The dollar's depreciation over the turn of the year was broad-based (Graph 3.C, red line and area), before reversing somewhat in February. Overall, the dollar retraced almost half of its 2022 gains. Given that the broad dollar index co-moves with gauges of currency volatility (blue line), the depreciation supported risk-taking in currency and risky asset markets.

Risky assets buoyed by falling risk premia

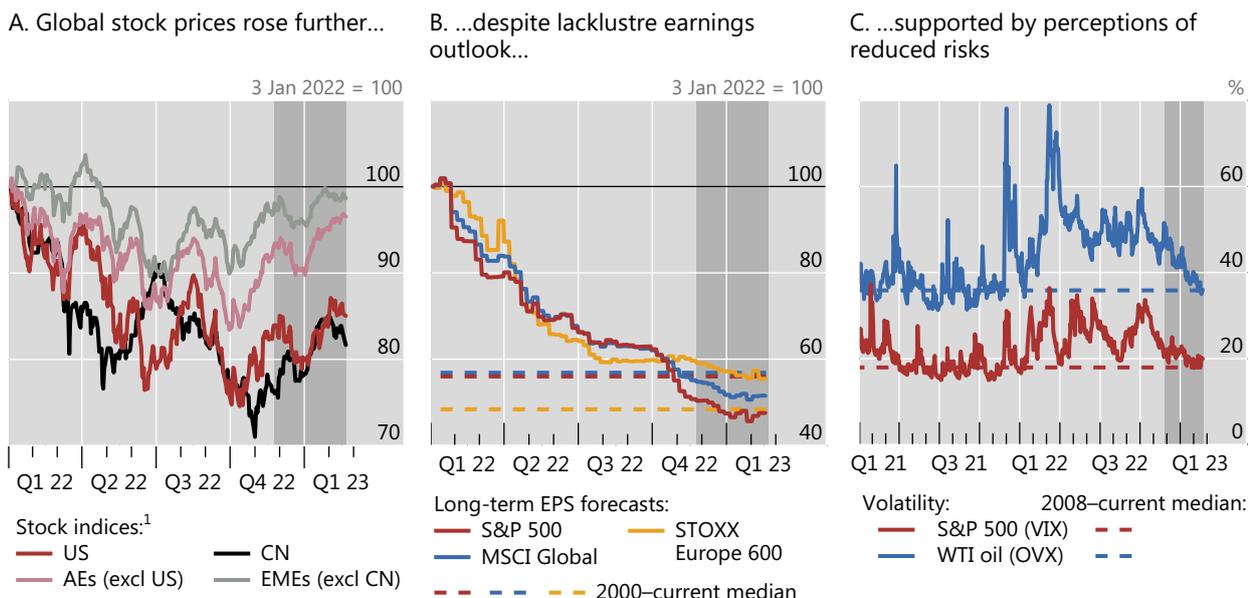
Risky assets extended the rally that had begun in late 2022. Stock and credit market valuations were bolstered by a decline in perceived risks. In this context, corporate bond issuance rebounded strongly in January, after months of limited dynamism, whereas bank lending stayed restrained.

Equity markets continued recovering from their losses earlier in 2022, despite a downward correction in late February. Chinese stocks were boosted by the sudden end of the zero-Covid policy: the CSI 300 index increased by almost 10% between late November and mid-February (Graph 4.A). Other EME stock markets, which had experienced relatively smaller price declines last year, rose back to their pre-2022 levels. Among AEs, the S&P 500 continued to lag other major indices, and the continuously robust performance of European equities stood out. At the sectoral level, the returns of value stocks edged ahead of those of growth and technology stocks.

This strong performance through most of the period under review stood in contrast to firms' recent and expected profitability. Earnings announcements were generally underwhelming, and analysts' near-term forecasts remained downbeat.

Stock markets extended their rally despite weak earnings outlook

Graph 4



The shaded areas indicate 25 November 2022–17 February 2023 (period under review).

¹ See technical annex for details.

Sources: Bloomberg; Datastream; BIS.

Moreover, after aggressively ramping up in 2021, longer-term expectations of earnings per share (EPS) declined to around half of their early 2022 levels (Graph 4.B). In particular, those underpinning US stocks stood well below their historical watermarks. Thus, the stock market rally appeared to be driven mostly by declining equity risk premia, ie the compensation that investors require for exposure to risk (see Box B). In line with this decline, equity and commodity option-implied volatilities retracted to their historical averages (Graph 4.C).

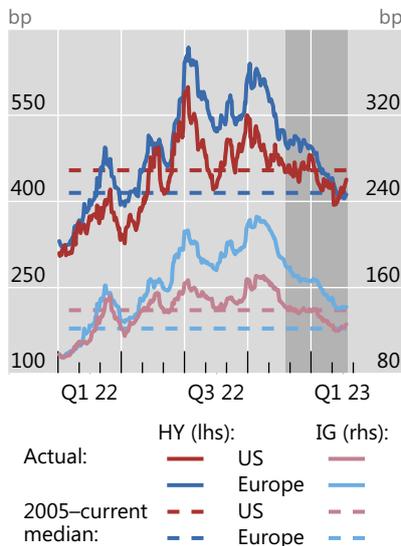
Valuations in corporate credit markets improved along with those of equity markets. Credit spreads narrowed materially during the review period. While the spreads still stayed somewhat above their long-term averages in the euro area, they fell back below such levels in the United States (Graph 5.A). The broad-based drop affected different rating categories. For example, the spreads on BBB credits, a growing segment within investment grade, fell by about 50 basis points, while the spreads on CCC credits, the lowest-quality rung in high-yield, fell by about 250 basis points.

Lower corporate credit spreads seemed to reflect mostly an improvement in investors' default risk perceptions. A decomposition of corporate spreads suggests that their narrowing during the review period owed almost entirely to this improvement (Graph 5.B, red line and blue bars). Similarly, spreads on high-yield corporate bonds declined in line with a fall in expected default frequencies (Graph 5.C). Given that high-yield bonds comprise a sizeable share of floating coupon corporate securities, these bonds might have further benefited from greater investor demand for such securities. Investors generally shift towards floating rate products when rates are rising.

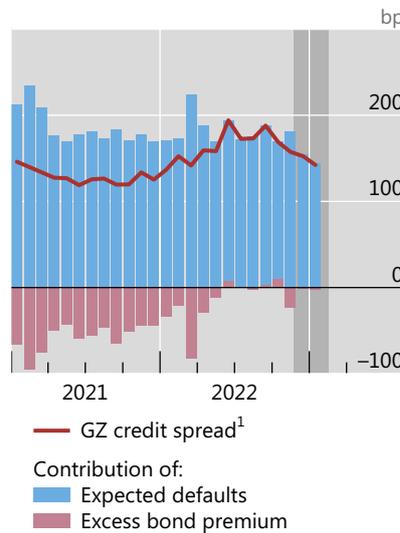
Risk appetite bolstered corporate credit markets

Graph 5

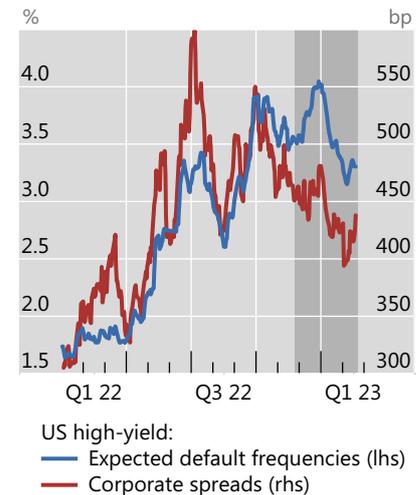
A. Corporate spreads narrowed...



B. ...amid a decline in expected defaults



C. High-yield spreads also moved with measures of default risk



The shaded areas indicate 25 November 2022–17 February 2023 (period under review).

¹ See technical annex for details.

Sources: Board of Governors of the Federal Reserve System; ICE BofAML indices; Moody's; BIS.

Understanding the rally in equity markets

Fernando Avalos and Vladyslav Sushko^①

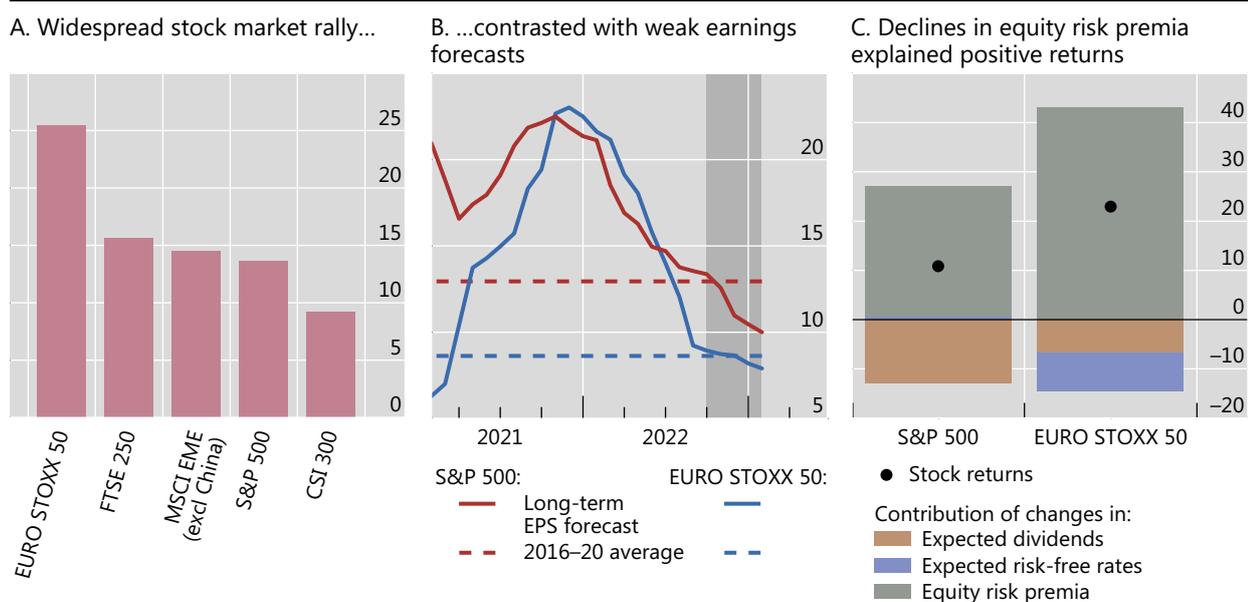
From late September to end-January, major equity markets delivered double-digit returns in Europe, the United States and EMEs. At the upper end, the EURO STOXX 50, a portfolio mostly of large French and German stocks, returned over 25% (Graph B1.A). The S&P 500 delivered a gross return of slightly over 10%, while EME (excluding Chinese) and UK stocks returned almost 15%. Chinese stocks returned slightly less than 10%, with the economy just reopening as the country's zero-Covid policy was ended. Focusing on US and euro area equity markets, this box finds that the gains reflected declines in equity risk premia, ie the compensation for risk demanded by investors, rather than firms' expected performance.

The strong run of global equity markets is hard to reconcile with the macroeconomic backdrop that weighed on expected earnings for most of the period. The long-term outlook for earnings deteriorated in the United States and the euro area. Earnings forecasts had been significantly ramped up in the quarters following the Covid-19 outbreak. But they switched towards a steady and accelerated retreat during all of 2022 (Graph B1.B). The headwinds included expectations of high and volatile energy prices, weak growth forecasts and substantial monetary policy tightening.

Falling risk premia boosted equity market returns¹

In per cent

Graph B1



The shaded area indicates 30 September 2022–31 January 2023.

¹ Stock returns calculated over 30 September 2022–31 January 2023.

Sources: ECB; Board of Governors of the Federal Reserve System; Bloomberg; Datastream; BIS.

In simple terms, a stock's price should be equal to the present discounted value of expected future dividend payments. Thus, valuation changes have two general sources. The first one is changes in investors' perceptions of the firm's future profitability, which determine their expectations of future dividends. The second is changes in the discount rates that investors apply to the expected stream of dividends. Discount rates are composed of "risk-free" rates, capturing the time value of money, and an equity risk premium, capturing the extra compensation required by investors to hold the risky asset. The risk premium fluctuates with investors' perceptions of and appetite for risk – all else equal, a higher risk premium results in a lower price.

We rely on a standard present value model to disentangle the contributions of these sources to the returns of the S&P 500 and the EURO STOXX 50 between September 2022 and January 2023.^② The model is implemented with monthly averages of daily market data for each index. *Expected dividends* are estimated using dividend futures for the initial five years and long-term analyst expectations of earnings per share growth at longer horizons. *Expected risk-free rates* are estimated using zero coupon yields.^③ The *equity risk premium* is then obtained as a residual.

The analysis suggests that the recent market rally owed entirely to the drop in equity risk premia. For both the S&P 500 and the EURO STOXX 50, expected dividends fell during the period, weighing on returns (Graph B1.C, brown bars). Expected risk-free interest rates played an indiscernible role for US equity returns during the period, but exerted a drag on European ones (purple bars), as the pace of ECB tightening picked up. However, substantial falls in equity risk premia more than offset these effects (grey bars), thus leading to the large and positive returns (dots).^④

The plummeting equity risk compensations required by investors could be explained, in part, by a decrease in the perceived risks. In the United States, perceived equity risks dropped in tandem with a perceived fall in US inflation risk, which moderated the expected pace of monetary tightening. In the case of the euro area, the drop in key energy prices from their extreme highs seen earlier in 2022 and the fading likelihood of a deep recession probably played a major role.

① The views expressed are those of the authors, and do not necessarily reflect the views of the BIS. ② The computations are performed in terms of dividend yields, and then re-expressed in terms of stock returns. Initial uses of the underlying present value decomposition date back to J Campbell and R Shiller, "The dividend-price ratio and expectations of future dividends and discount factors", *Review of Financial Studies*, vol 1, 1988, pp 195–227. For a more didactic presentation, see the discussion preceding equation (7.1.24) in J Campbell, A Lo and A McKinlay, *The econometrics of financial markets*, 1997. ③ Dividend data are obtained from the Chicago Mercantile Exchange and Eurex, zero coupon rates are published by the ECB and the Board of Governors of the Federal Reserve, and analysts' expectations are provided by I/B/E/S. ④ The interpretation of these results requires the usual caution. A decomposition implicitly assumes that the model is "correct". The residual, which in other contexts has been likened to "sentiment", subsumes any modelling error.

After a challenging 2022, conditions in primary markets for corporate credit came to be more in line with the easing conditions in secondary markets. Corporate bond issuance began to recover in January (Graph 6.A), led by the investment grade segment and issuance by financial firms. Reportedly, corporate bond financing also benefited from the deployment of investor cash that had remained on the sidelines for most of the second half of 2022.

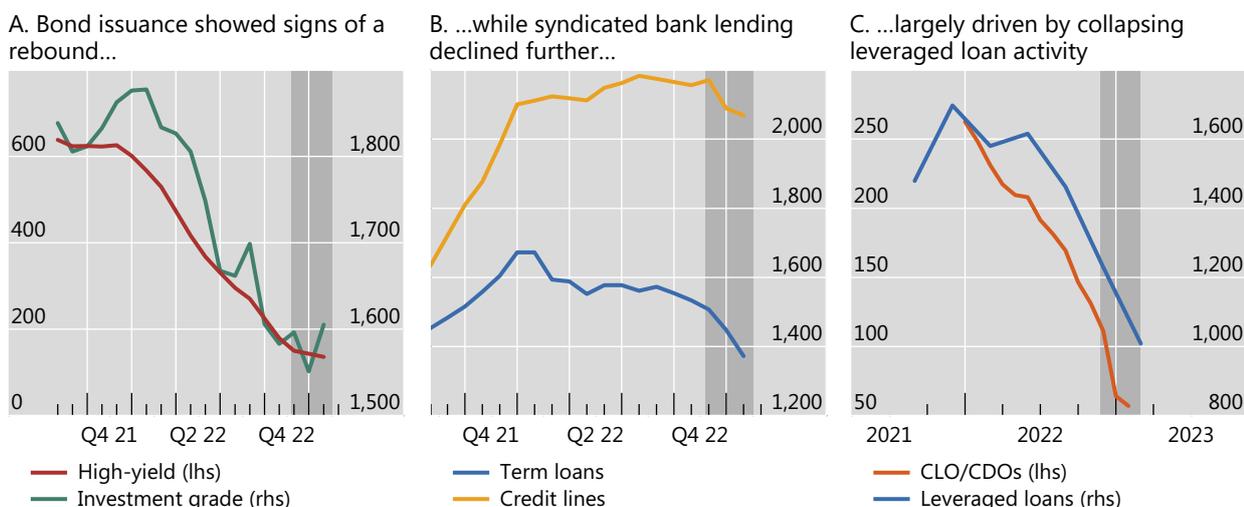
In contrast to the budding recovery of corporate bond issuance, bank lending continued to be restrained. This is in line with the close attention that banks reportedly pay to downside risks in the economic outlook. Syndicated lending remained downbeat (Graph 6.B), particularly in the leveraged loan segment. The persistent pressure in this market segment was in part due to the collapse in the issuance of collateralised loan obligations (CLOs), which had provided an avenue for banks to offload a fraction of high-risk loans from their balance sheets (Graph 6.C). Leveraged real estate lending also faced headwinds, particularly in the euro area, as property values fell amid higher borrowing costs. Moreover, surveys suggested that bank retrenchment was more widespread,³ extending to consumer lending and mortgages. According to these surveys, the underlying drivers included a tightening of lending standards and a drop in loan demand.

³ The ECB released euro area bank lending survey results for the fourth quarter of 2022 on 31 January, while the Federal Reserve released the latest Senior Loan Officer Opinion Survey results, which also generally correspond to the fourth quarter of 2022, the following week.

Corporate bond issuance revived in January, but not bank lending

Twelve-month cumulative issuance; in billions of US dollars

Graph 6



The shaded areas indicate 25 November 2022–17 February 2023 (period under review).

Sources: Dealogic; SIFMA; BIS.

EME financial conditions eased moderately

Financial conditions in EMEs moved in tandem with those in AEs, easing early in the review period and remaining broadly stable afterwards. That said, in February EME exchange rates and portfolio flows proved sensitive to some signs of shifting financial conditions in the United States.

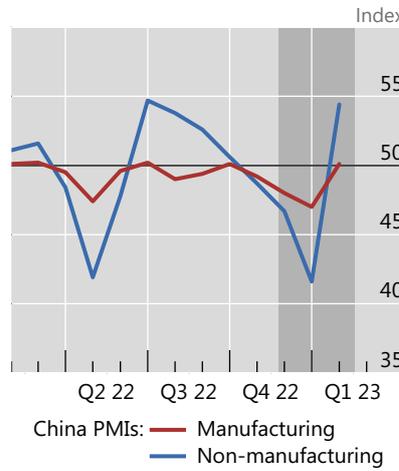
EME financial conditions benefited from both global and regional factors, as well as from domestic growth momentum. For one, they were in line with the strong general performance of risky asset markets. In addition, they reflected resilient growth and falling inflation in most EME regions, which faced only occasional setbacks. EME financial conditions remained fairly accommodative also through a patch of negative macroeconomic news in late 2022 (Graph 7.A).

Developments in China stood out owing to a string of positive economic news and despite some persistent headwinds. A significantly better than expected release of Q4 real GDP in China constituted a sizeable positive surprise for EMEs as a group (Graph 7.A). And, as the country reopened after the Covid-19 lockdown, bank lending in January exceeded forecasts, growing at the fastest pace in 10 months. Leading indicators pointed to an upcoming economic expansion driven by services. The non-manufacturing PMI increased sharply, from contractionary to expansionary readings, in January (Graph 7.B). By contrast, manufacturing PMIs did not foretell an expansion, suggesting a limited contribution to commodity demand and limited upward pressure on commodity prices, at least in the near term.

A. Financial conditions were robust to negative macro surprises



B. Chinese PMIs suggested a services-led recovery



C. EME asset performance correlated with US dollar strength



The shaded areas indicate 25 November 2022–17 February 2023 (period under review).

^a China real GDP release for Q4 2022.

¹ See technical annex for details.

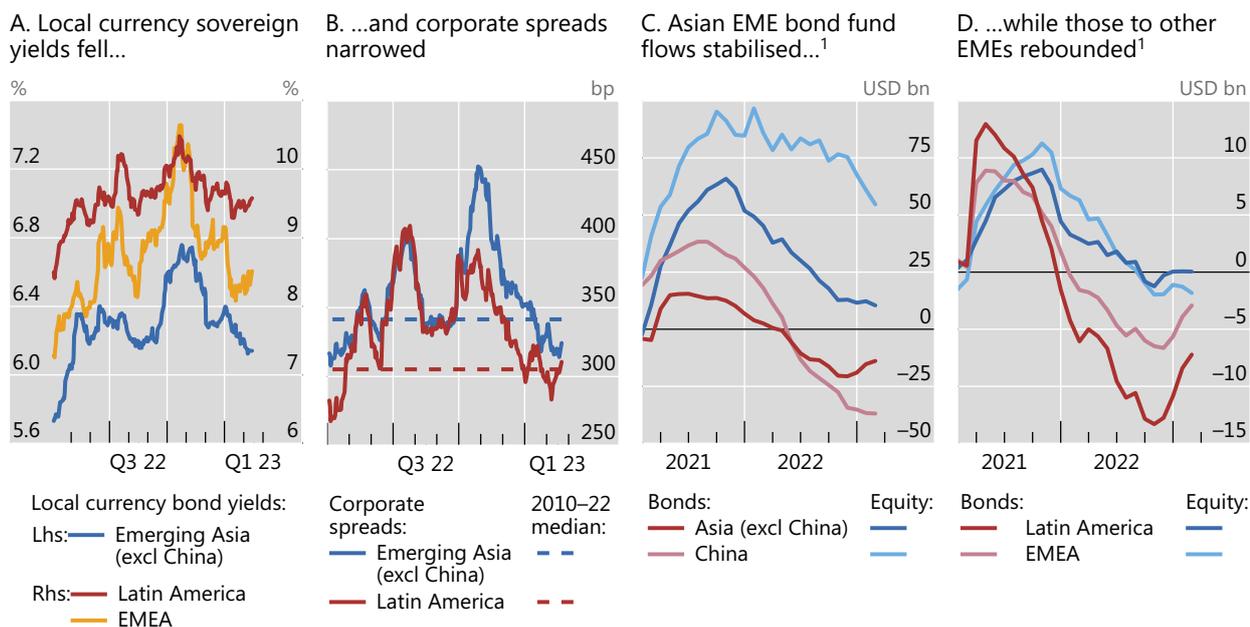
Sources: Bloomberg; Datastream; JPMorgan Chase; BIS.

EME equities fluctuated with the ebb and flow of US dollar strength. As EME currencies recouped more than half of their 2022 losses against the dollar, their stock markets followed suit, and turned from under- to over-performance against global benchmarks (Graph 7.C). By contrast, the subsequent bout of US dollar appreciation in February went hand in hand with a soft patch for EME stocks, which again started trailing the global index.

EME fixed income assets saw a more solid performance. As financial conditions improved and central banks halted or slowed the pace of rate hikes, local currency sovereign yields declined further (Graph 8.A). Improved funding costs allowed some EMEs, particularly those in Asia, to restart issuance in sovereign debt markets. Sovereign yields continued to be higher in Latin America than in other EME regions, partly reflecting a more restrictive policy stance amid higher inflation rates. The stretched fiscal positions of some Latin American sovereigns also contributed to the upward pressure on yields.

The cost of credit declined materially for EME corporates as well. Corporate spreads compressed further, to levels within the recent decade’s averages (Graph 8.B). Spreads narrowed most rapidly in emerging Asia, amid a streak of positive growth news. Corporate funding conditions in the region also benefited from the stabilisation of credit markets in Korea, where authorities took effective measures to address the strains that emerged late in 2022.

The period under review witnessed a general stabilisation and some reversals of portfolio outflows from EMEs. This pattern was evidenced in equity fund flows, with continued outflows from China being the main exception (Graph 8.C). In terms of bond fund flows, EMEs generally experienced a rebound (Graph 8.D).



¹ See technical annex for details.

Sources: EPFR; JPMorgan Chase; BIS.

In a slight departure from these general developments, bond fund outflows resurfaced in February in country-level data. In addition to expectations that US financial conditions might tighten somewhat, local factors included uncertainties around a possible inflation target adjustment in Brazil and selling pressures in Korean fixed income assets after a recent decline in long-term yields. Other EMEs that experienced outflows in the first half of February included the Philippines, Thailand and Mexico. Foreign investor outflows from bond mutual funds in China also continued (Graph 8.C), as benchmark yields remained below those on US Treasuries and domestic monetary policy remained accommodative.

Technical annex

HY = high-yield; IG = investment grade.

Graph 1.A: Goldman Sachs Financial Conditions Index (FCI): a weighted average of country-specific risk-free interest rates, exchange rates, equity valuations and credit spreads, with weights that correspond to the estimated impact of each variable on GDP. A value of 100 indicates average conditions. A higher (lower) value indicates tighter (looser) conditions.

Graph 3.C: The composite dollar index corresponds to standardised USD exchange rates against AUD, CAD, CNY, CZK, EUR, GBP, HUF, INR, JPY, KRW, NOK, SEK and ZAR. The currency volatility index (VXY) corresponds to G10 currency option-implied volatility.

Graph 4.A: S&P 500 index for the United States; Shanghai Shenzhen CSI 300 Equity Index for China. AEs (excl US): weighted average of S&P/ASX 200, S&P/TSX Composite Index, Swiss Market Index, OMX Copenhagen Index, EURO STOXX 600 Index, FTSE 100 Index, Nikkei 225, OBX Stock Index, S&P/NZX 50 Index and OMX Stockholm Benchmark for AEs. EMEs (excl CN): weighted average of Brazil Ibovespa Index, S&P/CLZ IPSA, MSCI Colcap Index, Prague Stock Exchange Index, Hang Seng Index, Budapest Stock Exchange Index, S&P BSE Sensex Index, Jakarta Composite Index, Kospi Index, S&P/BMV IPC Index, FTSE Bursa Malaysia KLCI, S&P/BVL Peru General TRPEN, PSEi Philippine SE Index, WSE WIG Index, Straits Times Index, Stock Exchange of Thailand Index and FTSE/JSE Africa ALL SHR Index for EMEs.

Graph 5.B: The GZ spread has two components: one capturing movements in default expectations, and another representing the procyclical changes in the relationship between measured default risk and credit spreads — the so-called excess bond premium. Published monthly by the Board of Governors of the Federal Reserve, the two components are taken from S Gilchrist and E Zakrajsek, "Credit spreads and business cycle fluctuations", *American Economic Review*, vol 102, no 4, 2012, pp1692–720.

Graph 7.A: See entry for Graph 1.A.

Graph 7.C: The EME composite dollar index corresponds to standardised USD exchange rates against CNY, CZK, HUF, INR, KRW and ZAR.

Graph 8.C–D: Aggregation of weekly data across major economies in each region. Cumulative flows for the past 12 months. Data cover net portfolio flows (adjusted for exchange rate changes) to dedicated funds for individual EMEs and to EME funds with country/regional decomposition.

Prudential policy and financial dominance: exploring the link¹

Since mid-2021, central banks have rapidly tightened monetary policy against the backdrop of historically high debt levels and a strong increase in inflation. Experience over the past five decades reveals that, under broadly similar circumstances, monetary policy tightening could usher in financial stress. We find that prudential policy tightening, whether before or during monetary tightening, helps to avoid such stress. Tighter prudential policy therefore reduces the risk of financial dominance and provides central banks with more policy headroom to fight inflation.

JEL classification: E52, G18.

Since mid-2021, central banks have rapidly tightened monetary policy against the backdrop of multi-decade high debt levels and strong inflationary pressures (Graph 1). This has raised questions about the possible impact on financial stability. So far, the financial system has proved resilient, but existing vulnerabilities could constrain central banks' fight against inflation – so-called financial dominance.

We examine whether prudential policy can increase monetary policy's room for manoeuvre. Based on five decades of data for advanced and emerging market economies, we explore the conditions under which monetary tightening may usher in stress and whether prudential tightening reduces the likelihood of such an outcome. We contribute to the literature by analysing prudential tightening specifically in the context of monetary tightening episodes and by considering various indicators of stress.²

We find that prudential policy tightening helps to prevent financial dominance. Such measures are especially helpful when monetary tightening takes place against the background of strong inflationary pressures, which would induce a more intense tightening, or higher private debt. These are also two key features of today's macro-financial backdrop.

¹ The authors thank Stijn Claessens, Mathias Drehmann, Leonardo Gambacorta, Aaron Mehrotra, Benoît Mojon, Phurichai Rungcharoenkitkul, Hyun Song Shin and Nikola Tarashev for helpful comments and discussions. The views expressed in this article are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

² Previous studies of the interaction of monetary and macroprudential policies focus mostly on its effects on credit, house prices or growth but not on financial stress (eg Bruno et al (2017), Cerutti et al (2017), Gambacorta and Murcia (2020), Kim and Mehrotra (2019), Kuttner and Shim (2016) or Araujo et al (2020) for a survey). A few recent studies separately analyse the effects of macroprudential or monetary policy on financial stress (eg Fernandez-Gallardo (2023), Nakatani (2020), Schularick et al (2021)). To our knowledge, we are the first to study the effects of the interaction between the two policies on financial stress.

Key takeaways

- Monetary policy tightening is more likely to usher in financial stress down the road when rate hikes occur amid high private debt levels or strong inflationary pressures.
- Prudential policy tightening – whether ahead of or during a monetary tightening – helps to reduce the likelihood of financial stress.
- This provides central banks with more room for manoeuvre in their fight against inflation – it reduces “financial dominance”.

The remainder of this special feature proceeds as follows. The first section identifies past monetary tightening episodes. It also analyses the odds of financial stress during such episodes and whether these odds are higher when the macroeconomic environment is comparable with the current one (Graph 1). The second section analyses the impact of prudential measures on the odds of financial stress, with a focus on whether their impact varies if they are taken before or during monetary tightening. The final section draws the policy implications.

Monetary policy tightening and financial stress

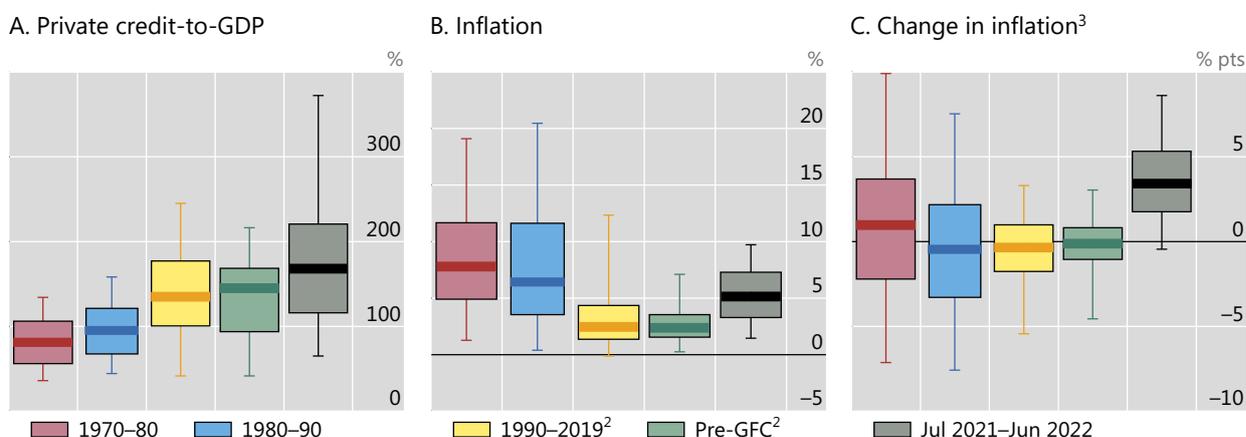
To explore the link between monetary policy tightening and financial stress under conditions that may shed light on current challenges, we proceed in two steps. First, we construct a data set of monetary tightening and financial stress episodes. Second, we examine whether a monetary tightening episode is more likely to be followed by financial stress if it takes place in an environment of high private debt or strong inflationary pressures.

The data set: identifying monetary tightening and financial distress

We focus on monetary tightening episodes involving a material and sustained increase in the policy rate. Importantly, to choose episodes that are more relevant at the current juncture, we seek to isolate those meant to quell – possibly incipient –

Historically high debt levels and inflation increases in 2021–22¹

Graph 1



¹ Box plots show medians, interquartile ranges and fifth–95th percentiles. See technical annex for details. ² Excludes pre-GFC = 2003–07. ³ Year-on-year inflation rate minus its two-year lag.

Sources: World Bank; BIS; authors' calculations.

inflationary pressures and exclude those driven by other factors. In particular, we exclude sharp hikes in response to currency depreciations or sudden capital flow reversals, possibly during financial crises. An episode starts in the month of the first policy rate hike, ends when the policy rate peaks, and features increases over at least four consecutive months.³

The choice of sample period for the analysis raises a quandary. On the one hand, active deployment of prudential measures started only in the 1990s (see below). It is not possible to reliably measure the implications of such measures before then. On the other hand, inflation dynamics similar to the current ones generally prevailed in the 1970s and early 1980s (Graphs 1.B and 1.C). Therefore, examining the link between monetary policy tightening and financial distress only from the 1990s would throw away useful information.

To address this quandary, we vary the sample depending on the specific focus. When considering the link between monetary policy and financial distress, we begin the analysis in 1970; when we consider the interaction with prudential measures, we start in 1990. Robustness checks indicate that the link between monetary policy and financial stress also survives in the subsample beginning in 1990, despite the smaller range of variation in the inflation rate.⁴ Regardless of the focus, the sample ends in 2017 to exclude the Covid-19 recession, which is *sui generis*, and the current monetary tightening episode, which is still under way.

The data set covers 157 monetary tightening episodes for 21 advanced economies (AEs) and 16 emerging market economies. Before 2000, most of the episodes took place in AEs, partly reflecting data availability. The sample is more balanced thereafter (Graph 2.A).

The size and duration of policy rate increases vary across episodes. In about half of them, the policy rate hike exceeds 2 percentage points overall (Graph 2.B) or lasts more than 18 months (Graph 2.C). The rate hikes average some 3 percentage points, below the 5 percentage point average seen in the current monetary tightening phase (Graph 2.B, black dots).⁵

What about indicators of financial stress? Financial stress is hard to miss but varies in intensity and is difficult to measure precisely. To keep the analysis as sharp as possible, in the main text we rely on a zero/one indicator of banking crises (Laeven and Valencia (2020) and Barron et al (2021)).⁶ Our key findings survive if we use a continuous indicator of stress based on narrative sources (Romer and Romer (2017), see Annex).

³ We exclude “tail” events, ie episodes with the policy rate increasing by less than one or more than 30 percentage points in total, or by more than 5 percentage points within one month. In a handful of cases, we adjusted the specific start- and end-month manually, eg when the episode features a transitory, small and short-lived decline in the policy rate (Boissay et al (2022), Cavallino et al (2022)).

⁴ The results are available on request.

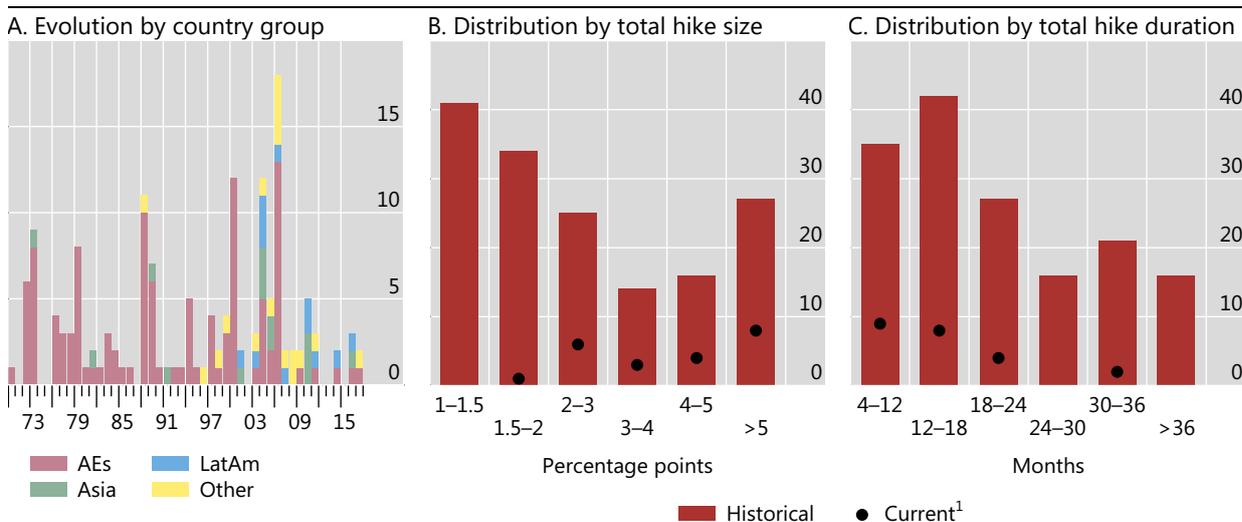
⁵ Fewer than 10% of the episodes last more than three years and there is, on average across countries, one episode every 5.5 years.

⁶ These two lists of banking crises are complementary. Laeven and Valencia (2020) identify a banking crisis based on narratives pointing to large banking system losses, bank runs or recapitalisations. In contrast, Barron et al (2021) associate banking crises with “bank equity crashes” (bank equity prices dropping by more than 30% in a year) or banking panics (eg severe withdrawals of bank funding). They rely on bank equity returns and narrative sources. While the two indicators generally identify the same crises, the starting dates may differ. In those cases, we pick the earlier of the two.

Overview of monetary policy tightening episodes

Count

Graph 2



¹ Monetary policy episodes between the first post-Covid-19 policy rate hike and 8 February 2023. See technical annex for details

Sources: BIS; authors' calculations.

The resulting data set includes 38 episodes associated with crises. No fewer than 33 occurred after 1985 and 20 after 1990. A key reason is that, until the early 1980s, financial systems were largely repressed through a wide array of regulations and controls, both domestic and cross-border. This reduced the scope for the build-up of financial imbalances (eg Borio et al (2018)).

The role of debt and inflation

We now examine how private sector debt and inflation dynamics affect the link between monetary tightening and financial stress. Specifically, we study how the frequency of banking crises after the first interest rate hike depends, in turn, on debt and inflation at the beginning of the monetary policy tightening episode.

A first issue is whether we should focus on the rate of change of credit or its level. There is ample empirical evidence that rapid cumulative credit *growth* is a harbinger of subsequent stress.⁷ However, since only around half of the countries in the sample have seen credit booms recently, the question more relevant for the current period is whether a high *level* of debt also matters. In turn, we measure the level of debt by allocating it to four different categories, each corresponding to a quartile in the distribution of credit-to-GDP over the whole sample in any given country.

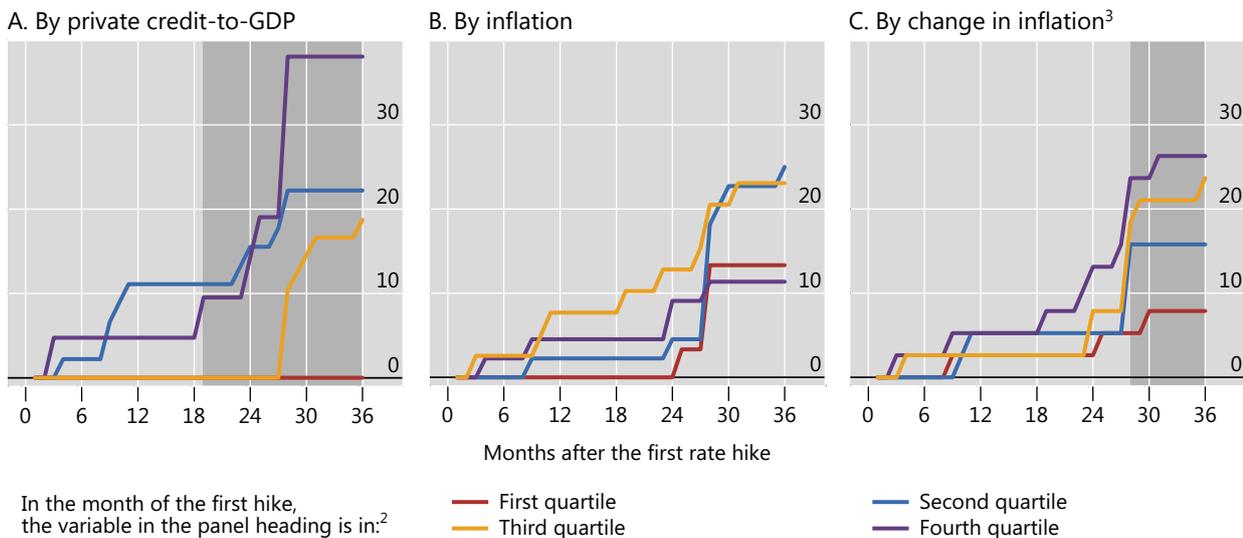
The results indicate that the level of debt matters. A high private debt-to-GDP ratio at the time of the first hike increases the likelihood of financial distress one to three years down the road. After three years, the frequency of crises is around 40% when the ratio is in the top quartile of the country-specific distribution, around 20% when it is in the second or third quartile, and zero when it is in the bottom quartile (Graph 3.A). The difference between the bottom and top quartiles is statistically significant.

⁷ See eg Borio and Lowe (2002), Borio and Drehmann (2009), Mendoza and Terrones (2008) and Schularick and Taylor (2012).

Financial stress during monetary tightening: the role of debt and inflation¹

In percentage points

Graph 3



The shaded areas indicate that the difference between the first and the fourth quartile is statistically significant at the 10% level.

¹ Financial stress measured as the frequency of banking crises. See technical annex for details. ² For the private credit-to-GDP ratio and inflation: quartiles of the country-specific historical distribution. For the change in inflation: quartiles in our data set of monetary tightening episodes. ³ Year-on-year inflation rate at the time of the first hike minus its two-year lag.

Sources: Baron et al (2021); Laeven and Valencia (2020); World Bank; BIS; authors' calculations.

In the case of inflation, and using similar categories, the picture is more nuanced. When we condition on the initial level of inflation, we do not observe a systematic ordering of financial stress frequencies and the differences between frequencies are not statistically significant (Graph 3.B). The picture is different when we condition on the change in the inflation rate (Graph 3.C). The larger the increase in inflation just before the start of the monetary tightening episode, the higher the subsequent incidence of distress.

These findings are intuitive. The initial level of inflation is unlikely to matter *by itself*: it should have an influence on the likelihood of financial stress only to the extent that it induces a larger and more prolonged monetary tightening. The initial increase in inflation is likely to provide a better indication of the need to tighten strongly when the central bank implements the first hike. And the higher the initial level of debt, the greater the pressure on the financial system as the tightening proceeds.

Graph 4 sheds light on some of the mechanisms at work. The stronger and more persistent the rise in inflation, the more forceful and prolonged the policy rate hike (Graphs 4.A and 4.B). As a result, the debt service ratio rises by more (Graph 4.D)⁸ and general financial conditions tighten more strongly, putting pressure on borrowers and depressing strongly property prices, here captured by house prices (Graph 4.E).⁹ Taken together, these forces weigh heavily on economic activity (Graph 4.F). And the larger the initial stock of debt, the stronger the tightening of financial

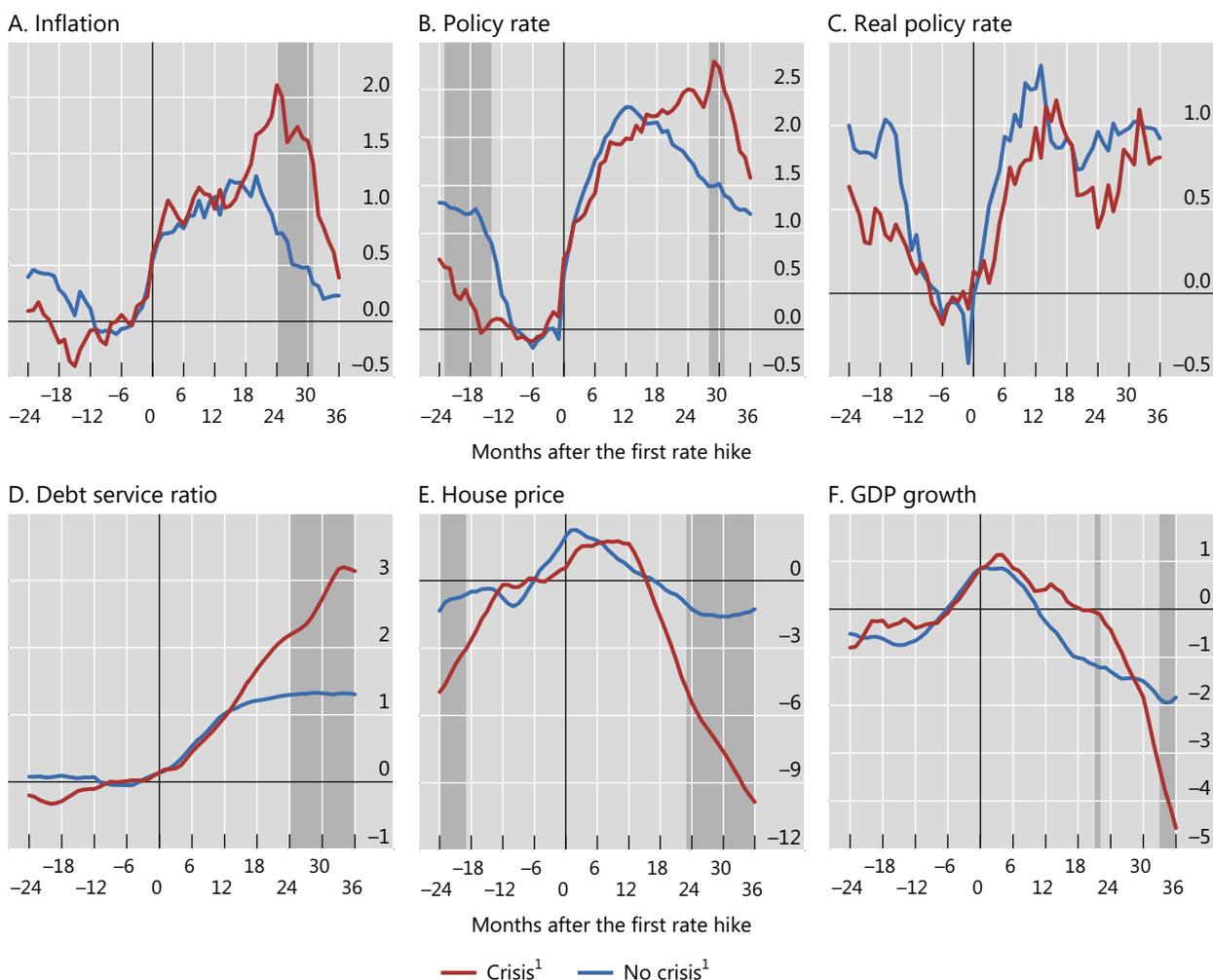
⁸ There is evidence indicating that debt service ratios play a key role in influencing economic activity (Juselius and Drehmann (2020) and Hofmann and Peersman (2017) and are a key predictor of bank credit losses (Juselius and Tarashev (2020)).

⁹ The historical record indicates that commercial property prices have been a much more frequent source of banking stress than house prices. The Great Financial Crisis is more the exception than the rule. That said, house price corrections have a bigger *indirect* impact on banks' soundness, through their adverse effects on aggregate consumption, and the economy at large, as they reduce wealth and tighten funding constraints.

Monetary tightening and financial stress: shedding light on the channels at work

Average, in percentage points

Graph 4



The shaded areas indicate when the difference between the two averages is statistically significant at the 10% level.

¹ Depending on whether or not there is a banking crisis three to five years after the first rate hike. See technical annex for details.

Sources: World Bank; BIS; authors' calculations.

conditions, not least since even borrowers with fixed-rate and long-term debt eventually become directly affected. All this heightens the risk of financial distress.

Prudential policy, monetary tightening and financial stress

One way to increase the resilience of the financial system is to have tight prudential policy in tranquil times. The idea is to have buffers in place, by strengthening lenders' capitalisation and liquidity position or by improving borrowers' ability to withstand a deterioration in their cashflows, income or balance sheets (eg through maximum loan-to-value or debt-to-income ratios). To varying degrees, these measures improve

the ability of the system to withstand a shock and constrain the build-up of imbalances that can cause the shock in the first place.¹⁰

During a monetary tightening episode, the calibration of prudential measures becomes complex. On the one hand, depending on the speed of implementation and transmission of the measures, financial conditions could become too tight precisely when the economy is experiencing a bust. If the effect is strong enough, it could weaken the economy and thus the financial system – a kind of fallacy of composition. On the other hand, more stringent prudential measures increase the financial system’s resilience in the face of tighter financial conditions.

Timing is of the essence and the right timing depends on the nature of the prudential instrument. Some regulatory requirements are designed to be tightened during financial booms, when systemic risk increases, and to be lowered during busts, when systemic risk materialises – so-called macroprudential measures (BIS (2008)).¹¹ In turn, institutions can draw on the released buffers to relieve financial strain and sustain lending. Other regulatory requirements, of a more structural nature, contribute to the system’s resilience, even though they are not calibrated with explicit reference to system-wide effects – so called “microprudential” measures (Crockett (2000) and Borio (2003)). Regardless of the type of the prudential measure, however, greater resilience mitigates potential financial stability risks, and should provide central banks with more headroom to raise their policy rate and fight inflationary pressures without leading to financial stress.¹²

The data set of prudential measures

To examine the impact of prudential measures, we draw on the “iMaPP” database in Alam et al (2019). Starting in January 1990 and ending in August 2017, this comprehensive resource includes data on a monthly frequency and is updated annually – it represents the sample for our test. The starting date is a limitation, but not as serious as it may appear at first sight. Prudential regulation was strengthened around the world starting in the 1980s and at least half of the crises around monetary tightening episodes since 1970 took place after 1990. The sample covers 92 monetary tightening episodes.

A more important limitation of the database is that it does not account for the stringency of prudential measures. Regardless of the type of measure, their adjustment is captured by a binary index (“dummy”). The index takes the value of 1 when the authorities introduce or tighten the prudential requirement and –1 when they loosen or eliminate it.¹³ Thus, while it is possible to get a sense of the impact of different types of measure, all policy interventions are treated alike. For example,

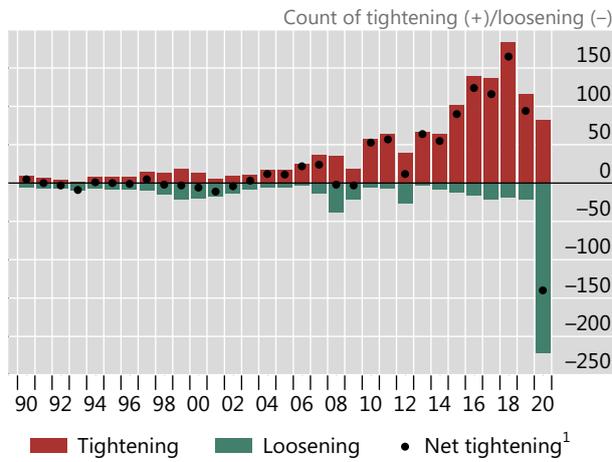
¹⁰ In general, the evidence indicates that borrower-based measures are more effective in reducing the build-up of financial imbalances, in the form of strong credit growth or asset price increases; see Borio et al (2022).

¹¹ Strictly speaking, macroprudential measures need not vary with the state of the economy. For example, low *levels* of loan-to-value or debt-to-income ratios have built-in stabilising properties. This is because they reduce the elasticity of credit expansion with respect to changes in asset prices or incomes, thereby reducing the system’s procyclicality.

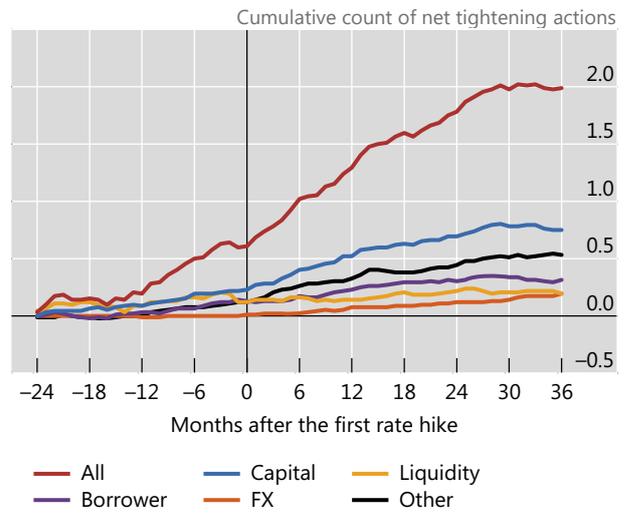
¹² There are two reasons why we combine micro- and macroprudential measures. First, it is sometimes hard to draw a clear line between them. Second, combining them increases the number of observations to work with, thus letting us make more reliable statistical inferences.

¹³ This limitation is shared with all large prudential policy databases. One advantage of ours is that it covers a longer period, going back to the early 1990s.

A. Over time...



B. ...and during monetary tightening episodes²



¹ Tightening minus loosening. ² See technical annex for details.

Sources: IMF iMaPP database (released in January 2021); BIS; authors' calculations.

increasing capital requirements from 1 to 2% is equivalent to increasing them from 1 to 5%.

Graph 5 documents the evolution of prudential measures. Their use has tended to increase since the 1990s, especially after the 2007–09 Great Financial Crisis (GFC) (Graph 5.A), reflecting mainly the implementation of macroprudential frameworks. On balance, measures have been tightened, indicative of the growing efforts to strengthen the financial system. Loosening actions tend to cluster around financial stress episodes, such as the Asian crisis of 1997, the GFC in 2008 and, most starkly, the sui generis Covid-19 crisis.¹⁴

Turning to the relationship with monetary tightening episodes (Graph 5.B), some clear patterns emerge. On net, prudential measures are tightened both before *and* after the first interest rate hike, with little difference in the rate of increase. But after two and a half years, the net tightening stops and, if anything, turns into a loosening (red line). Moreover, this pattern encompasses all types of measure, albeit to different degrees. In most cases, authorities set higher capital or liquidity requirements, or stricter borrower-based rules. In a small number of instances, they also took more stringent foreign currency-related measures.

Test design and findings

Armed with the data set, we proceed to the design of the test. For this analysis, we need to decide how to quantify prudential tightening. We also need to choose the length of the window around the beginning of monetary tightening episodes, over which we consider prudential measures.

¹⁴ For a more detailed discussion of this episode, see Borio and Restoy (2020).

We focus on an indicator of *net* tightening, ie the difference between the number of policy actions that tighten the calibration of prudential instruments and the number of actions that loosen it.¹⁵

We first consider the overall set of measures and then single out those related to bank capital. We split out only bank capital measures because they are by far the most common type (Graph 5.B) and are the only type that allows for reliable statistical inference when considered in isolation.

As regards the window, we consider two years before the initial hike and two years after. Two years before is a period long enough to capture the impact of a given measure. In turn, hardly any prudential measure was adopted, on net, beyond a two-year window after the start of monetary tightening (Graph 5.B).¹⁶

We then carry out two types of test. First, we examine whether the frequency of financial stress depends on whether prudential measures are tightened on net over a given period, *regardless* of the cumulative change in the *number* of measures. Second, we explore if the cumulative change makes a difference. In both cases, and to get a sense of the importance of a policy's timing, we also separately consider measures taken before and after the initial hike in the monetary policy rate.

We find that prudential measures help, regardless of when they are taken.

Consider the first type of test. We see that the frequency of crises is lower after prudential measures are made more stringent, on balance (Graph 6). The improvement is especially large, and statistically significant, three years after the initial interest rate hike – of the order of 15 percentage points (Graph 6.A). The beneficial role of capital is very much in evidence (Graphs 6.C and 6.D).

Similar findings hold once we take into account the cumulative change in the *number* of measures. Here, we need a regression specification:

$$CRISIS_i = \alpha + \beta PPT_i + \theta Z_i + \epsilon_i \quad (1)$$

For each monetary tightening episode i , the regression relates a dummy variable, $CRISIS_i$, which is equal to one if a banking crisis breaks out over the three years after the first rate hike, and the total number of incremental net tightening measures either before or after the first rate hike (PPT_i), as well as control variables (Z_i). The controls are meant to capture the context of the monetary tightening and include dummies related to the level of the credit-to-GDP ratio as well as the change in inflation at the time of the first hike (recall Graph 3). In regression (1), the coefficient of interest is β , which corresponds to the effect of one incremental prudential tightening action on the frequency of a crisis, in percentage points.

The results reinforce the message. Our estimates of the coefficient β in equation (1) reveal evidence that prudential tightening helps reduce the likelihood of distress, regardless of whether it takes place before or after the initial interest rate hike (Graph 7.A). The effect is stronger in the case of bank capital-related instruments, especially when they are tightened early on.

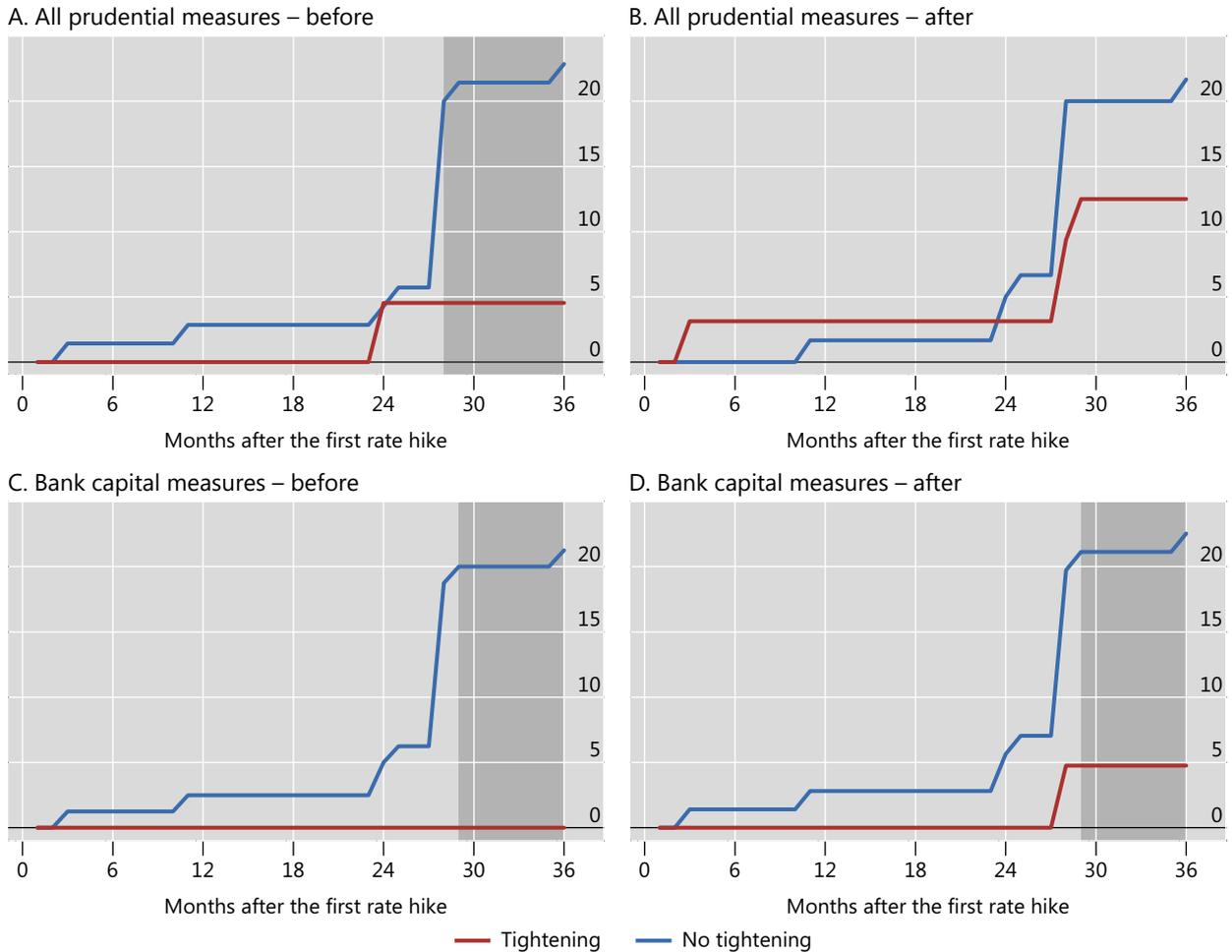
¹⁵ We focus on the net number because there are relatively few loosening actions and most of them take place around a crisis.

¹⁶ Moreover, at that point, the sign of the impact could switch: a loosening would support stability.

Tightening prudential standards helps reduce the frequency of financial stress¹

In per cent

Graph 6



Shaded areas indicate that the difference between tightening and no tightening is statistically significant at the 10% level.

¹ Financial stress measured as the incidence of a banking crisis. Prudential standards tightened during the two years before (after) the first policy rate hike. See technical annex for details.

Sources: Baron et al (2021); Laeven and Valencia (2020); IMF iMaPP database (released in January 2021); BIS; authors' calculations.

Last, we study whether the impact of prudential policy on the frequency of financial stress *depends* on the initial level of debt or change in inflation. Accordingly, we modify equation (1) as follows:

$$CRISIS_i = \alpha + \beta^H PPT_i * INIT_i^H + \beta^L PPT_i * (1 - INIT_i^H) + \theta Z_i + \epsilon_i \quad (2)$$

where $INIT_i^H$ is a dummy variable equal to one if the country's private credit-to-GDP ratio or change in inflation at the time of the first rate hike is above its median and to zero otherwise.¹⁷ In regression (2), the coefficients of interest are β^H and β^L , when the level of credit or change in inflation is initially high or low.

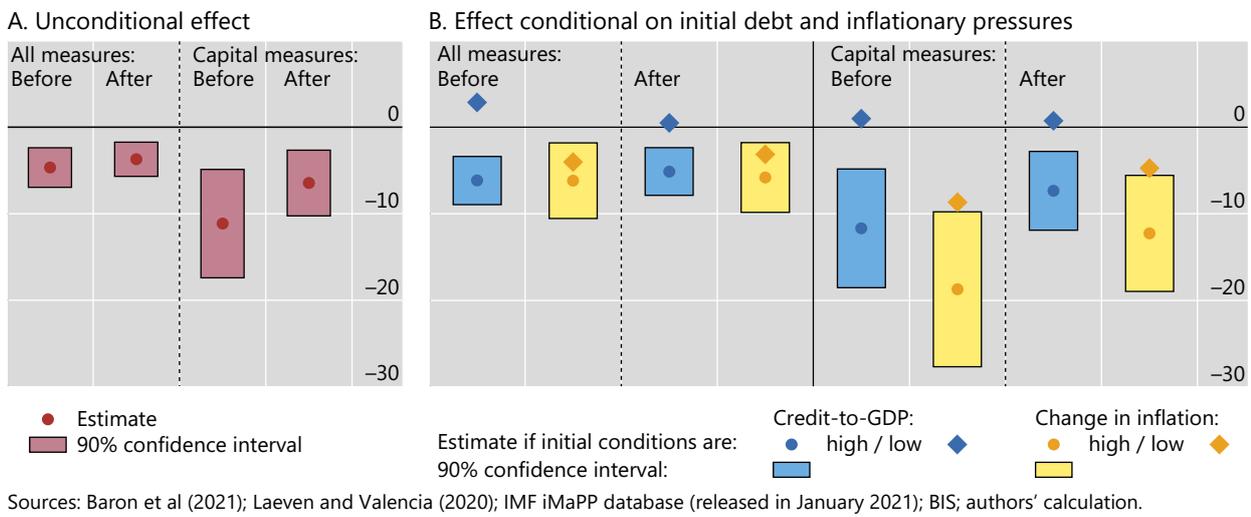
We find that prudential tightening is relatively more effective in reducing the likelihood of financial stress if the monetary tightening takes place in the context of high levels of debt and strong inflationary pressures (Graph 7.B, dots versus diamonds).

¹⁷ Consistent with Graph 3, the median refers to the country's historical distribution in the case of the credit-to-GDP ratio, and to the 92 monetary tightening episodes in the case of the change in inflation.

Prudential tightening reduces the likelihood of stress during monetary tightening

In percentage points

Graph 7



Conclusion

Our findings indicate that tightening prudential policy increases monetary policy's room for manoeuvre. There is evidence that monetary policy tightening raises the likelihood of financial stress down the road if the hikes take place when the initial level of private sector debt is high and inflationary pressures call for a strong policy reaction. This pattern has been present even since the 1990s, when the variation in inflation has been much smaller than in the past. We also provide evidence that prudential measures implemented around monetary tightening episodes, whether before or after the initial interest rate hike, help to reduce the likelihood of financial stress. In sum, prudential policy can allow monetary policy to focus more freely on its fight against inflation, by mitigating the risk of financial dominance.

These findings shed some light on current challenges. All else equal, today's historically high levels of private debt and the surge in inflation would raise the odds that the current monetary tightening might usher in financial stress down the road. But the findings also indicate that a tightening of prudential measures should help to reduce that risk. A number of countries have been tightening prudential policy to tackle financial expansions seen during the post-pandemic recovery. And this comes on top of the post-GFC cumulative strengthening of prudential standards that has substantially increased banks' capital defences.

The findings also shed light on the highly complementary role that monetary and prudential policies can play in a more holistic macro-financial stability framework (Borio et al (2022)). Such a framework is designed to better reconcile price, financial and hence macroeconomic stability, through a more holistic deployment of monetary, prudential and fiscal policies. Developing that framework is still a work in progress.

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Annex

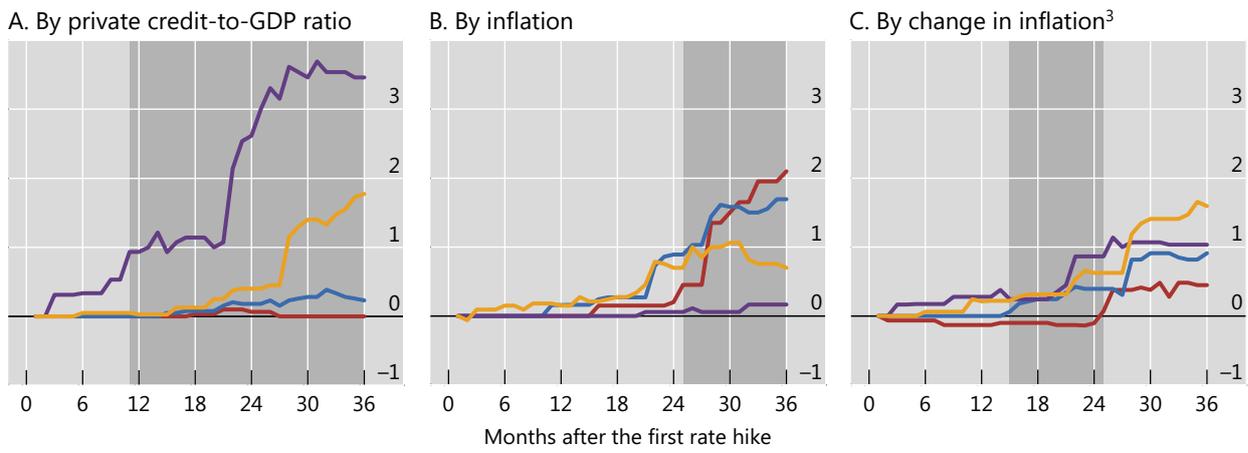
Analysis using Romer and Romer (2017) financial distress index

This annex reports the results based on the index of Romer and Romer (2017), which measures the intensity – as opposed to the incidence – of financial stress. The three graphs below provide the same qualitative messages as those derived in the discussion of Graphs 3, 6 and 7, respectively.

Financial stress during monetary tightening: the role of debt and inflation¹

In Romer and Romer (2017) units

Graph A1



In the month of the first hike, the variable in the panel heading is in:²

— First quartile
— Third quartile

— Second quartile
— Fourth quartile

Based on 157 monetary tightening episodes, subject to data availability. The shaded areas indicate that the difference between the first and the fourth quartile is statistically significant at the 10% level.

¹ Financial stress measured as the Romer and Romer (RR) score, rebased to zero in the month of the first rate hike. ² For the private credit-to-GDP ratio and inflation: quartiles of the country-specific historical distribution. For the change in inflation: quartiles in our data set of monetary tightening episodes. ³ Year-on-year inflation rate at the time of the first hike minus its two-year lag.

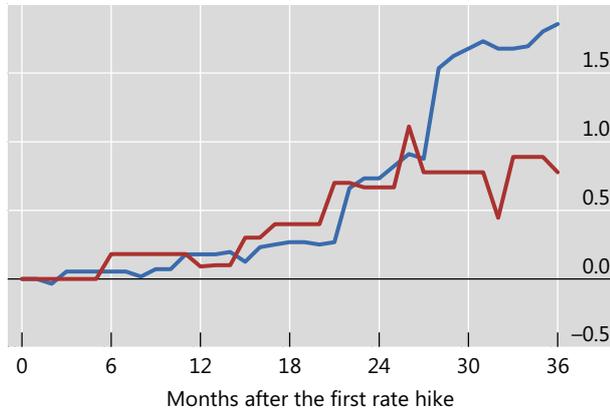
Sources: Romer and Romer (2017); World Bank; BIS; authors' calculations.

Tightening prudential standards helps reduce the intensity of financial stress¹

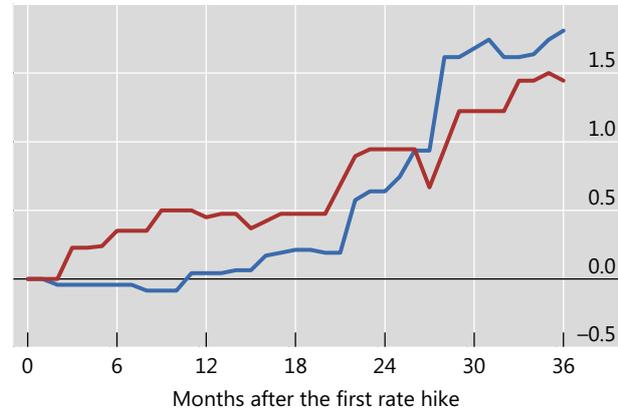
In Romer and Romer (2017) units

Graph A2

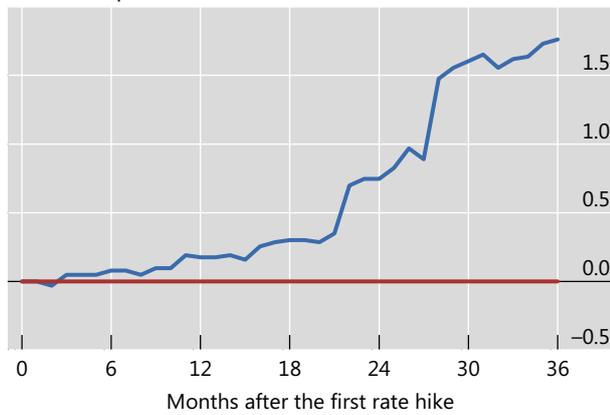
A. All prudential measures – before



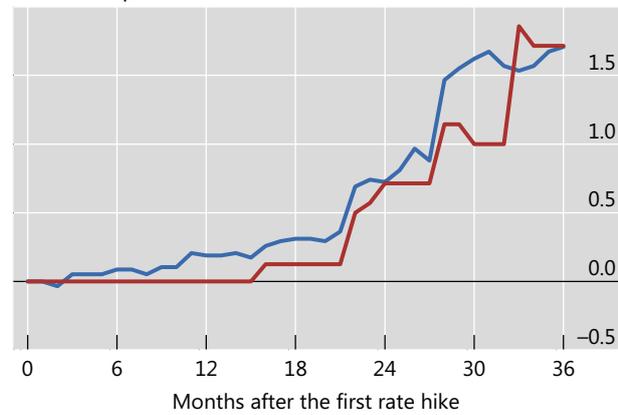
B. All prudential measures – after



C. Bank capital measures – before



D. Bank capital measures – after



— Tightening — No tightening

Based on 92 monetary tightening episodes, subject to data availability. The lower intensity of financial stress observed following prudential tightening is not statistically significant at the 10% level.

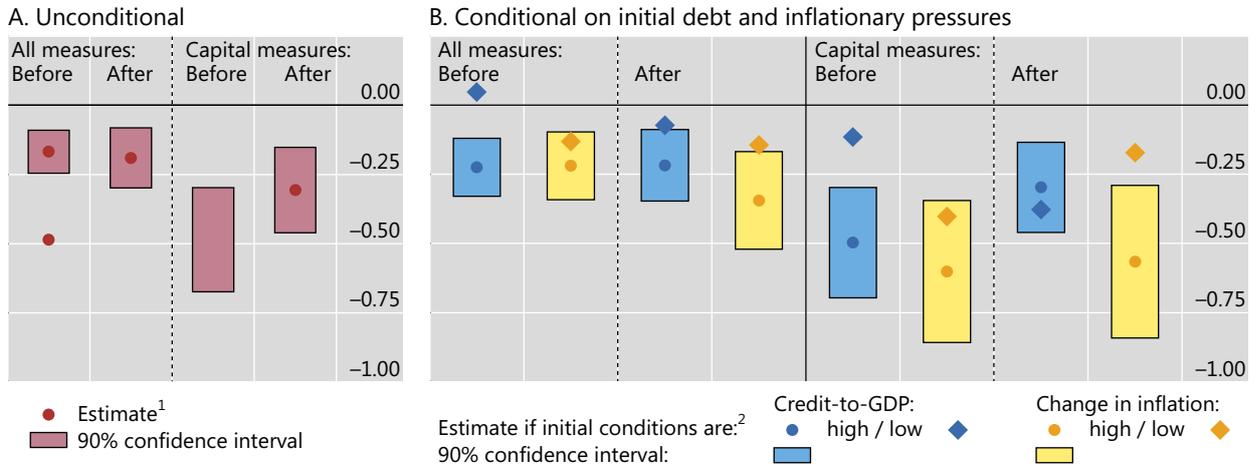
¹ Financial stress measured as the financial distress index in Romer and Romer (2017), rebased to zero in the month of the first rate hike. Prudential standards tightened during the two years before (after) the first policy rate hike.

Sources: Romer and Romer (2017); IMF iMaPP database (released in January 2021); BIS; authors' calculations.

Prudential tightening reduces the intensity of stress during monetary tightening

In Romer and Romer (2017) units

Graph A3



Based on 92 monetary tightening episodes, subject to data availability.

¹ Estimate of coefficient β in the linear regression $RR_i = \alpha + \beta PPT_i + \theta Z_i + \epsilon_i$, where RR_i is the average Romer and Romer (2017) financial distress index in the three years after the first rate hike in episode i , PPT_i is the total number of incremental net tightening measures either in the two years before or in the two years after the first rate hike, and Z_i are a set of control variables. ² Estimates of coefficients β^H and β^L in the linear regression $RR_i = \alpha + \beta^H PPT_i * INIT_i^H + \beta^L PPT_i * (1 - INIT_i^H) + \theta Z_i + \epsilon_i$, where $INIT_i^H$ is a dummy variable equal to one if the private credit-to-GDP ratio at the time of the first rate hike is above the median of its country-specific distribution or if the change in inflation is above the median in the data set of monetary tightening episodes.

Sources: Baron et al (2021); Laeven and Valencia (2020); IMF iMaPP database (released in January 2021); BIS; authors' calculations.

Technical annex

Graph 1: Based on 21 advanced economies (AT, AU, BE, CA, CH, DE, DK, ES, FI, FR, GB, GR, IS, IT, JP, LU, NL, NO, NZ, PT and US) and 16 emerging market economies (CL, CO, CZ, HK, HU, IL, IN, KR, LV, MX, PE, PL, RO, SK, TH and TW).

Graph 2: Based on 157 monetary tightening episodes between March 1970 and August 2017 in 37 countries (see entry for Graph 1, excluding TW).

Graph 3: Based on 157 monetary tightening episodes (see entry for Graph 1), subject to data availability.

Graph 4: See entry for Graph 3. The series are rebased so as to have a zero mean in the 12 months that precede the first rate hike.

Graph 5.B: Based on 92 monetary tightening episodes. Capital: prudential measures taken to strengthen banks' capital position, such as minimum capital ratios, adjustments in risk weights and limits on bank leverage. Liquidity: prudential measures taken to mitigate banks' liquidity and funding risks, such as minimum reserve requirements, liquid asset ratios and core funding ratios. Borrower: prudential measures taken to strengthen borrowers' balance sheet, such as ceilings on the debt service-to-income ratio and the loan-to-value ratio. FX: foreign currency related prudential measures such as capital requirements on FX-denominated loans, limits on FX lending, FX exposures and FX funding, and regulation on currency mismatches. Other: other measures such as limits on loan growth.

Graph 6: Based on 92 monetary tightening episodes.

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Commodity prices, the dollar and stagflation risk¹

Fluctuations in commodity prices and the US dollar exchange rate significantly affect the risk of stagflation. Using quarterly data from 22 non-commodity export-dependent economies for the past 30 years, we find that higher commodity prices and dollar appreciation each raise the odds of weak growth and high inflation. Stagflation risk increases by more when the two drivers rise in tandem – as seen over the past couple of years, in a departure from the historical pattern. Emerging market economies (EMEs) are more affected by changes in commodity prices and in the US dollar exchange rate than are their advanced economy counterparts. This reflects in particular the higher commodity consumption of EMEs and their greater exposure to swings in global financial conditions.

JEL classification: E31, E32, F31, F36, F41, F44.

Displaying an unusual co-movement during much of 2021 and 2022, commodity prices rose alongside increasing dollar strength (Graph 1.A).² Commodity price rises tend to stoke inflation and choke off growth in commodity-importing economies (Igan et al (2022)), while dollar appreciation tends to have similar effects outside the United States, especially in EMEs (Banerjee et al (2020), Hofmann and Park (2020)). Thus, the confluence of such developments over the past couple of years has significantly increased the risk of stagflation, ie that weak growth will coincide with high inflation. Consistent with this, inflation surged worldwide while growth fell in the course of last year (Graph 1.B).

This special feature analyses the impact of commodity price and dollar exchange rate changes on growth and inflation in economies that are not dependent on commodity exports.³ We adopt an “at risk” perspective, focusing on the impact of commodity prices and dollar exchange rate on weak growth (“growth-at-risk”, GaR)

¹ The authors would like to thank Fernando Avalos, Claudio Borio, Stijn Claessens, Thomas Drechsel, Emanuel Kohlscheen, Marco Lombardi, Benoît Mojon, Hyun Song Shin, Nikola Tarashev and Egon Zakrajšek for helpful comments and suggestions. The views expressed are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

² The unusual co-movement may reflect both temporary and enduring factors. Among the former are the adverse financial stability implications of the commodity price surge, which triggered flight-to-safety into the dollar and the more rapid tightening of monetary policy in the United States than in most other economies. The main enduring factor is the transition of the United States from energy importer to exporter, which is causing the dollar to behave like a commodity currency. See Hofmann et al (2023) for a detailed discussion of the forces driving the change in the commodity price-dollar nexus in recent years. For a comprehensive analysis of changes in the association between the dollar exchange rate, global commodity prices and the US terms of trade, see Rees (2023).

³ Non-commodity export-dependent economies are those for which less than 60% of the total merchandise exports comprise commodities, as defined by UNCTAD. See <https://unctad.org/topic/commodities/state-of-commodity-dependence>.

Key takeaways

- Higher commodity prices and dollar appreciation each increase the risk of weak growth alongside high inflation in non-commodity export-dependent economies, ie stagflation risk.
- The combination of surging commodity prices and a strengthening dollar over much of the past two years, a departure from the historical pattern, raised global stagflation risk.
- The evolution of commodity prices or the dollar's exchange rate affect emerging market economies more than advanced economies.

and high inflation (“inflation-at-risk”, IaR). There is a growing literature on GaR (eg Adrian et al (2019), Aikman et al (2019), Hasenzagl et al (2020)) and IaR (eg Lopez-Salido and Loria (2019), Banerjee et al (2020)). This paper brings together the two strands of literature to analyse stagflation risk. Moreover, while previous papers have documented the separate effects of commodity prices and dollar exchange rate on GaR and IaR, we consider the effects together, thus highlighting the importance of recent macroeconomic developments.

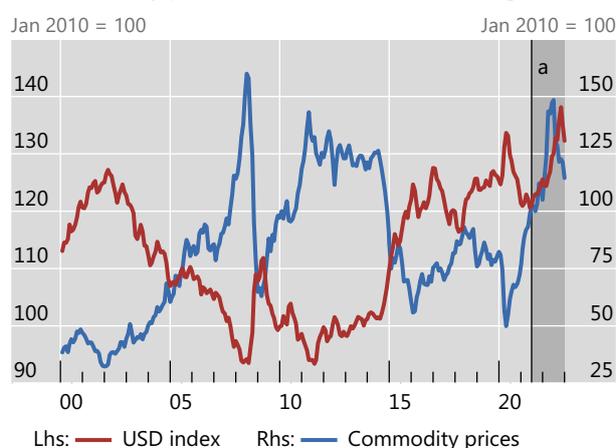
We find that an increase in commodity prices and an appreciation of the dollar each significantly worsen GaR and raise IaR in economies that are not dependent on commodity exports. The combination of commodity price increases and dollar appreciation during 2021/22 therefore exacerbated stagflation risks, in contrast to the preceding period when their effects tended to counteract each other. We also find that commodity prices and the dollar have significantly stronger effects on EMEs than on advanced economies (AEs). This reflects EMEs’ shallower financial markets and the greater weight of commodities in their consumption baskets.

The first section of this special feature reviews the channels through which movements of commodity prices and the dollar affect GDP growth and inflation and derives testable hypotheses. The second estimates the impact of commodity price and dollar changes on GaR and IaR, and explores the empirical relevance of different

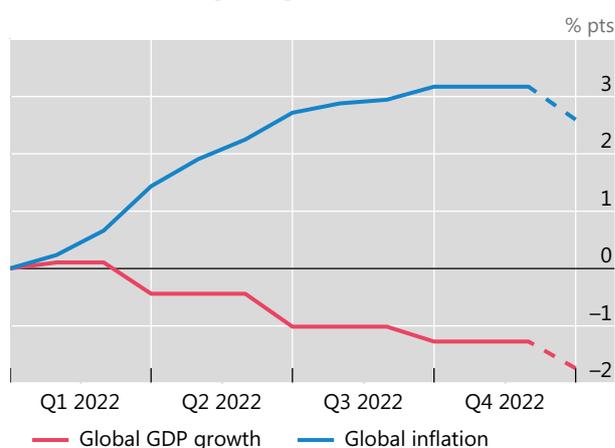
Commodity price and US dollar surged while inflation rose and growth slowed¹

Graph 1

A. Commodity prices and the US dollar exchange rate



B. Cumulative changes in growth and inflation²



^a Turning point in the co-movement between commodity prices and the USD index (June 2021).

¹ See technical annex for details. ² Dashed lines indicate forecasts.

Sources: Board of Governors of the Federal Reserve System; Consensus Economics; Datastream; S&P; national data; authors’ calculations.

channels for transmitting commodity price and dollar exchange rate changes to the macroeconomy. The last section concludes.

Economic impact of commodity prices and the dollar

Channels

Commodity prices and the dollar exchange rate, all else equal, can exert stagflationary effects through two key channels: (i) cost of living and production costs; and (ii) financial conditions. Since different channels dominate in commodity export-dependent economies and the United States, we exclude these economies from the analysis.⁴

Cost of living and production costs

Higher commodity prices can have, all else equal, stagflationary effects through their impact on the cost of living and on production costs (eg Bruno and Sachs (1985), Hamilton (1983, 1996)). They worsen the terms of trade and hence erode real income. More specifically, they push up the cost of living by raising energy and food prices, which in turn lowers disposable income and dampens consumption demand. At the same time, they push up the cost of firms' production through energy and raw material input prices, which may reduce investment demand. Moreover, higher inflation driven by higher commodity prices could prompt a monetary policy response that dampens the real economy (eg Bernanke et al (1997)).

A stronger dollar, all else equal, tends to reinforce the effects of higher commodity prices. Since commodities are commonly invoiced in US dollars, dollar appreciation increases commodity prices in local currency. This directly compounds the stagflationary effects of higher global commodity prices.

The widespread use of the dollar in trade invoicing beyond commodities has a similar effect. For one, import prices outside the United States rise in line with a strengthening dollar, pushing up inflation rates. Arguably, a stronger dollar might also improve the competitiveness of other countries, boosting their net exports and ultimately output. This conventional trade channel, however, rests on the assumption that export and import prices adjust in response to a change in the country's exchange rate. Over short horizons, this may not be the case precisely because of US dollar invoicing (Gopinath et al (2020)). If the invoice price is sticky in US dollar terms, swings in a country's exchange rate against the US dollar would affect imports while doing little to improve its export competitiveness in the short term. Thus, a broad-based dollar appreciation may, in the short run, primarily push up prices for importers and hence dampen overall trade. By driving up inflation and suppressing trade, dollar appreciation may thus exert broader stagflationary effects.

⁴ In commodity-exporting economies, higher commodity prices are associated with an improvement of the terms of trade, ie the relative price of exports in terms of imports, providing a real income boost and loosening financial conditions by improving borrowers' repayment capacity (see Aslam et al (2016) and Drechsel et al (2019)). In commodity export-dependent economies, these channels are particularly pronounced and therefore likely to dominate. In the United States, dollar appreciation has different effects than elsewhere as it would reduce export competitiveness and would tend to be disinflationary by lowering import prices.

Financial conditions

Another key channel through which commodity prices and dollar exchange rate affect economic activity runs through financial conditions. For one, commodity price increases erode the debt repayment capacity of commodity importers and hence their creditworthiness, leading to a tightening of financial conditions.⁵ This adds to the above stagflationary effects of rising commodity prices, as tighter financial conditions dampen real economic activity.

The dollar exchange rate affects global financial conditions more broadly. First, it acts as a barometer of global investor risk appetite, over and above other gauges such as the VIX (Shin (2016)). When investors' risk appetite sags, their flight to safety may both push up the dollar and weaken global economic activity through tighter financial conditions as investors and lenders retrench from risky investments and borrowers.

Second, a stronger dollar directly tightens global credit supply, dampening global real activity. When there are valuation mismatches on borrowers' balance sheets due to unhedged dollar borrowing, a stronger dollar weakens the balance sheets of those dollar borrowers whose liabilities rise relative to assets, the classic "original sin" effect. This furthermore increases tail risk in the overall credit portfolio of global lenders, reducing global dollar credit supply from lenders who face a value-at-risk constraint (Bruno and Shin (2015)). Similar dynamics may play out in local currency government bond markets if tighter dollar credit conditions also tighten risk constraints for global investors holding local currency bonds, giving rise to "original sin redux" (Hofmann et al (2022)).

Testable hypotheses

We use the above channels to formulate the following testable hypotheses for economies that are not dependent on commodity exports.

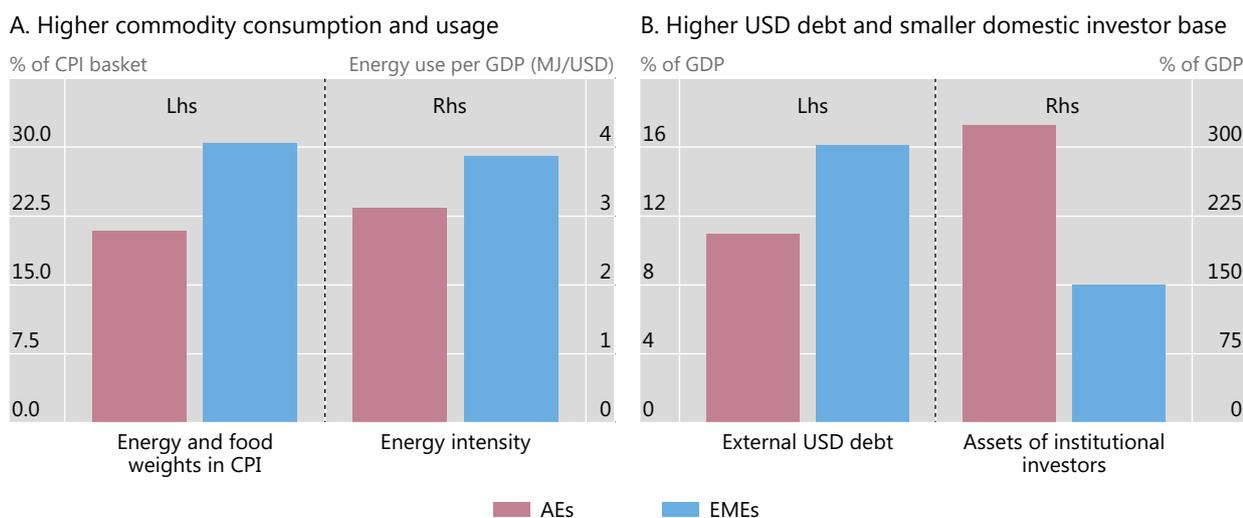
First, higher commodity prices and dollar appreciation are each expected to have stagflationary effects. If this hypothesis is confirmed, commodity prices and the dollar's value would counteract each other when they evolve in opposite directions. By contrast, a move in the same direction would exacerbate stagflation risks.

Second, the strength of the channels would depend on countries' economic and financial structure. Relative to AEs, EMEs feature a greater weight of food and energy in consumption baskets and more energy-intensive production structures (Graph 2.A).⁶ EMEs also have higher dollar debt and generally shallower financial systems, as reflected in their smaller domestic investor bases (Graph 2.B). This implies that higher commodity prices and a stronger dollar should have a more powerful stagflationary effect on EMEs than on AEs. By the same token, within the group of EMEs that we focus on, the strength of the channels should be greater eg for a higher share of food and energy in consumption baskets or for higher external dollar debt.

Since these hypotheses assume implicitly that supply side forces are primarily at work here, we test them by filtering out any confounding demand side factors. Specifically, we control for US economic conditions, which could drive the dollar and also GaR and IaR in other countries. US economic conditions also proxy for global

⁵ This is essentially the financial easing effect of commodity price increases on commodity exporters, as highlighted by Drechsel et al (2019), but playing out in reverse.

⁶ Moreover, in EMEs, inflation is often less well anchored around target and hence more persistent, implying more prevalent second-round effects that amplify the impact of price shocks from commodities or the exchange rate (BIS (2019)).



¹ Based on non-commodity export-dependent economies. See technical annex for details.

Sources: FSB; IEA; national data; BIS international debt securities; BIS locational banking statistics; authors' calculations.

demand, which would drive commodity prices and could directly affect country-level GaR and IaR at the same time.

Empirical analysis

For the analysis, we use quarterly data for 22 non-commodity export-dependent economies, including 15 EMEs and seven AEs, which overall account for 60% of global GDP, over the period Q1 1990–Q4 2019.⁷ We estimate the effect of commodity price and dollar exchange rate changes on GaR and IaR, defined respectively as the lowest 10% of growth outcomes and the highest 10% of inflation outcomes, using fixed effects panel quantile regressions:⁸

$$\Delta^4 y_{i,t+4} = \alpha_{y,i} + \beta_y \Delta \text{dollar}_t + \delta_y \Delta \text{comprice}_t + \gamma_y \Delta y_{i,t-1} + \theta_y X_{i,t} + \varepsilon_{y,i,t+4} \quad (1)$$

$$\Delta^4 p_{i,t+4} = \alpha_{p,i} + \beta_p \Delta \text{dollar}_t + \delta_p \Delta \text{comprice}_t + \gamma_p \Delta p_{i,t-1} + \theta_p Z_{i,t} + \varepsilon_{p,i,t+4} \quad (2)$$

In these equations $\Delta^4 y_{i,t+4}$ stands for the four-quarter real GDP growth four quarters ahead and $\Delta^4 p_{i,t+4}$ for four-quarter consumer price inflation four quarters ahead. Δdollar_t is the quarterly log change in the Federal Reserve's broad dollar index and $\Delta \text{comprice}_t$ the quarterly log change in the S&P GSCI global commodity price index. The regressions further include country fixed effects and lagged quarterly real GDP

⁷ The AEs are CA, CH, DK, GB, JP, SE and EA. The EMEs are CN, CZ, HK, HU, ID, IN, KR, MX, MY, PH, PL, SG, TH, TR and ZA (see technical annex). The analysis also excludes the Covid-19 recession and the subsequent rebound as the extreme movements in real GDP may distort the estimated relationships.

⁸ In the estimation, we follow the approach proposed by Machado and Santos Silva (2019).

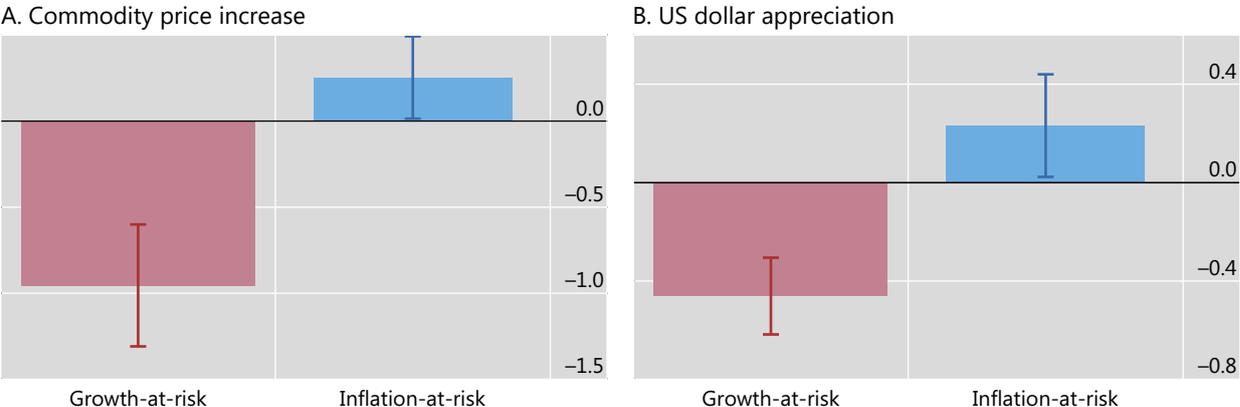
growth and inflation, respectively, as well as a set of variables $X_{i,t}$ (for GaR) and $Z_{i,t}$ (for IaR) that control for domestic and US demand side factors that could affect domestic growth and inflation and therefore confound the supply side forces in focus. Specifically, in both equations, we include US quarterly real GDP growth and the US purchasing managers' index (PMI) as current and forward-looking indicators of US economic conditions.⁹ The domestic controls included in $X_{i,t}$ comprise stock market volatility as a measure of financial conditions, three-year non-financial private credit growth (relative to GDP), the current account balance (relative to GDP), the quarterly inflation rate, the change in the policy rate and a quarterly dummy to capture remaining seasonality.¹⁰ Those in $Z_{i,t}$ comprise domestic real GDP growth and also a quarterly dummy variable.¹¹

The estimated impact on stagflation risk

We find that higher commodity prices and an appreciation of the dollar each significantly raise stagflation risk on average across the 22 economies covered by the analysis (Graph 3). Concretely, a one standard deviation (9.8 ppt) increase in the rate of change in commodity prices lowers four-quarter-ahead GaR and increases four-quarter-ahead IaR, by -0.95 and 0.25 percentage points, respectively (panel A). A one standard deviation increase in the rate of change in the dollar exchange rate (2.5 ppt) lowers four-quarter-ahead GaR and raises four-quarter-ahead IaR by -0.46 and 0.23 percentage points, respectively (panel B).¹² These economically significant increases in the risk of simultaneously weak growth and high inflation are also statistically significant.

Stagflationary impact of higher commodity prices and dollar appreciation^{1,2}

Four-quarter-ahead response to a one standard deviation change, in percentage points Graph 3



¹ Based on non-commodity export-dependent economies. See technical annex for details. ² "At-risk" coefficients refer to the 90th percentile for inflation and the 10th percentile for growth. Error bands based on 90% confidence level.

Sources: IMF; OECD; Datastream; Institute for Supply Management; S&P; national data; BIS credit statistics; authors' calculations.

⁹ US real GDP growth and US PMI also act as controls for the demand side drivers of commodity prices.
¹⁰ Following Aikman et al (2019), we calculated stock market volatility as the quarterly average of the realised daily stock price volatility and three-year credit growth as the three-year change in the non-financial private sector debt-to-GDP ratio.
¹¹ The standard errors are estimated by bootstrapping methods following Banerjee et al (2020).
¹² The GaR and IaR impacts are notably larger than the mean effects obtained from standard fixed effects panel OLS estimation of equations (1) and (2). Specifically, the mean impact of a one standard

The overall stagflationary implications of commodity price and dollar gyrations depend on the direction of their co-movement. As shown in Graph 1.A, commodity prices and the value of the dollar used to move inversely until 2021, after which they moved together. Thus, while the effects of commodity price and dollar gyrations on stagflation risks used to offset each other, they compounded each other in 2021/22.

The combined effect of gyrations in commodity prices and the dollar exchange rate on GaR and IaR can be quantified by using our estimates of equations (1) and (2).¹³ We show this in Graph 4 over three characteristic episodes: the commodity price boom from 2002 to 2008, which was accompanied by dollar depreciation; the commodity price bust from 2011 to 2020, which came with dollar appreciation; and the joint surge in commodity prices and the dollar in 2021/22. In the first two episodes, the contributions of changes in commodity prices and dollar exchange rate largely offset each other for the average country. By contrast, in the third episode, the two factors worked in the same direction, considerably worsening both GaR and IaR. Overall, these results suggest that the particular co-movement of commodity prices and the dollar during any period is of material importance for stagflation risk.

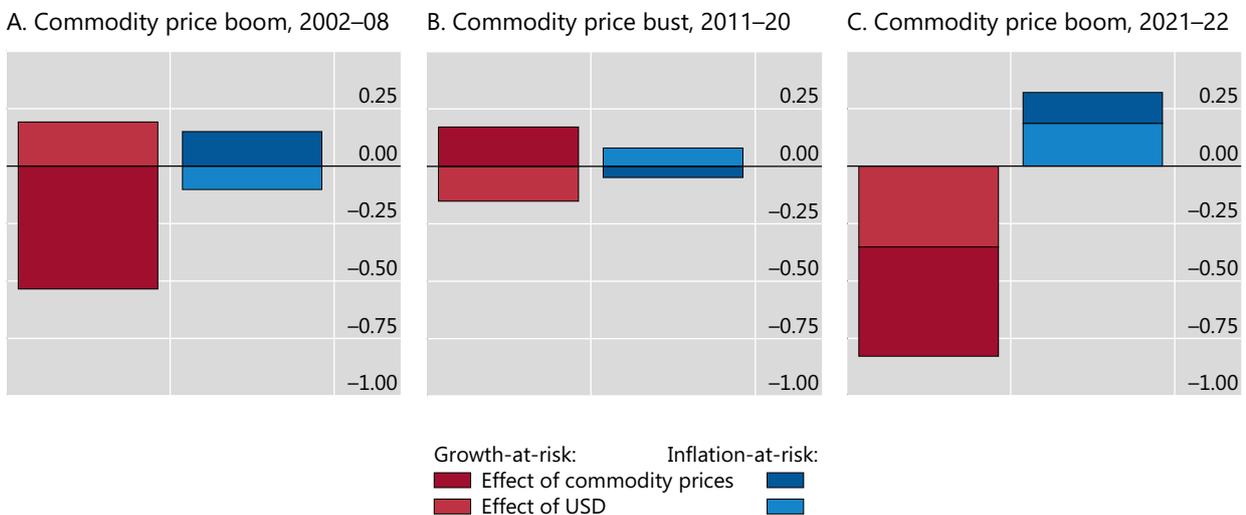
Testing the channels

We now assess the empirical relevance of the channels discussed earlier. First we test the hypothesis that the GaR and IaR of EMEs are more affected by the commodity price and dollar exchange rate changes than are those of AEs. To do so, we re-estimate equations (1) and (2) separately for the EME and AE subsamples.

Contributions of US dollar and commodity prices to growth and inflation-at-risk^{1,2}

Period averages, in percentage points

Graph 4



¹ For non-commodity export-dependent economies. See technical annex for details. ² Based on the estimated impacts from Equation 1 and 2. "At-risk" coefficients refer to the 90th percentile for inflation and the 10th percentile for growth.

Sources: Board of Governors of the Federal Reserve System; IMF; Datastream; S&P; national data; authors' calculations.

deviation increase in the rate of change of commodity prices on growth and inflation is respectively -0.3 and 0.19 percentage points, while the effect of a one standard deviation increase in the rate of dollar appreciation is -0.28 and 0.14 percentage points, respectively.

¹³ The individual contributions are calculated respectively as the average of the quarter-on-quarter changes in commodity prices and the dollar exchange rate within each period, multiplied by the corresponding coefficient in equations (1) and (2).

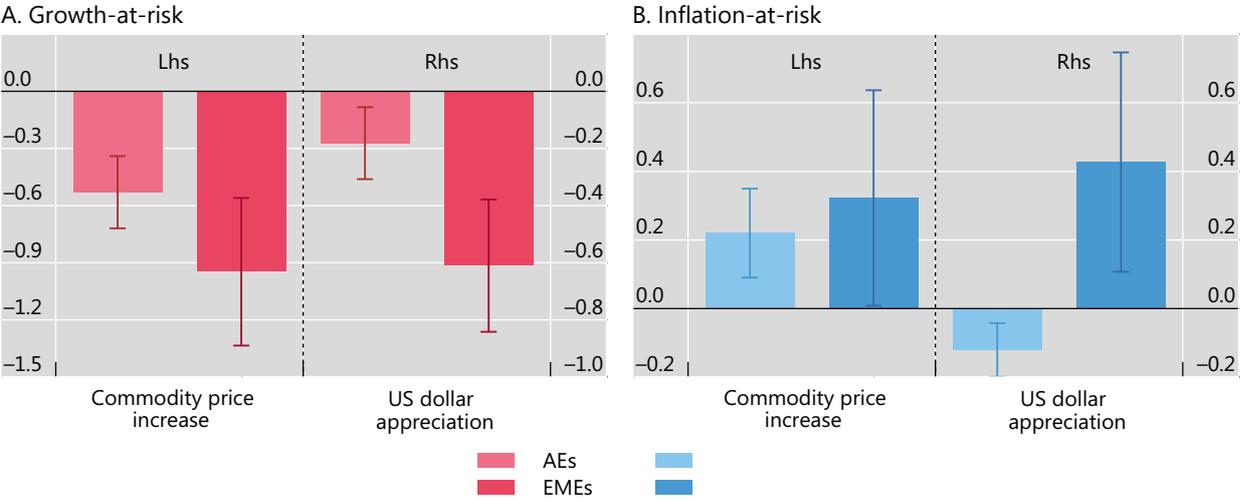
The results suggest that both higher commodity prices and dollar appreciation do have stronger stagflationary effects in EMEs than in AEs (Graph 5). In EMEs, GaR and IaR change by a respective -0.94 and 0.32 percentage points in response to a one standard deviation increase in the rate of change in commodity prices, compared with -0.53 and 0.22 percentage points respectively in AEs. A similar picture emerges for the impact of a one standard deviation increase in the rate of change of the dollar exchange rate. In EMEs, GaR and IaR respectively change by -0.61 and 0.43 percentage points. In AEs, both GaR and IaR fall, by a respective 0.18 and 0.12 percentage points. The latter result probably reflects that, in AEs, dollar invoicing is less widespread and exchange rate pass-through is weaker (see BIS (2019)), mitigating the direct impact of the dollar exchange rate on inflation.

To deepen our understanding of the structural factors behind the differences between AEs and EMEs in the latest results, we test whether these factors could play a similar role across EMEs. Specifically, we split the EMEs into five pairs of groups: (i) high vs low shares of energy and food in consumption baskets; (ii) high vs low shares of energy intensity of production; (iii) high vs low dollar import invoicing (iv) high vs low US dollar debt, capturing the extent of classic original sin; and (v) high vs low foreign ownership of local currency sovereign debt, capturing the extent of original sin redux. Focusing on one split at a time, we then estimate equations (1) or (2) separately for each of the corresponding country groups.

Stronger impact of commodity prices and the dollar exchange rate in EMEs^{1,2}

Four-quarter-ahead response to a one standard deviation change, in percentage points

Graph 5



¹ Based on non-commodity export-dependent economies. See technical annex for details. ² "At-risk" coefficients refer to the 90th percentile for inflation and the 10th percentile for growth. Error bands based on 90% confidence level.

Sources: IMF; OECD; Datastream; S&P; national data; BIS credit statistics; authors' calculations.

Graph 6 highlights some noteworthy results from these estimations. A greater weight of food and energy in consumption baskets is associated with a larger impact of commodity prices on both GaR and IaR (panels A and D). Higher dollar debt and greater foreign ownership of local currency sovereign bonds are associated with a larger impact of dollar appreciation on GaR, highlighting the relevance of both original sin and original sin redux for the international transmission of dollar movements (panels B and C). Finally, greater energy intensity of production (panel E) is associated with larger effects of the dollar exchange rate on IaR. Overall, these results support the notion that the channels discussed in Section 2 matter for the impact of commodity price and dollar exchange rate changes on stagflation risk across EMEs.

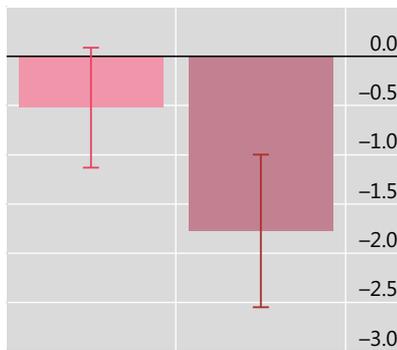
Structural factors affecting EME vulnerability^{1,2}

Four-quarter-ahead response to a one standard deviation change, in percentage points

Graph 6

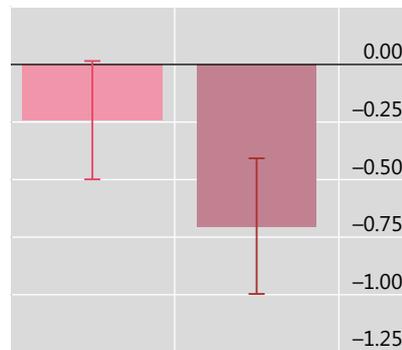
Growth-at-risk

A. Food and energy share in CPI baskets



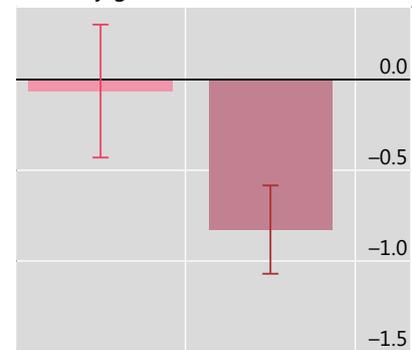
Commodity price increase

B. US dollar-denominated debt



US dollar appreciation

C. Foreign ownership of local currency government bonds

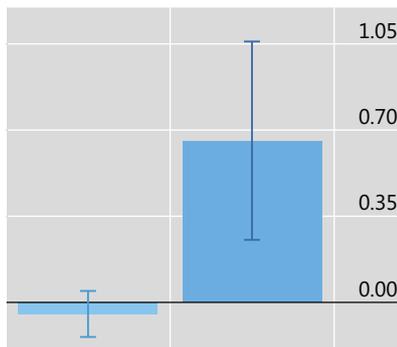


US dollar appreciation

Low High

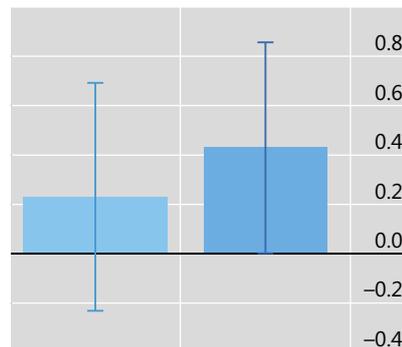
Inflation-at-risk

D. Food and energy share in CPI baskets



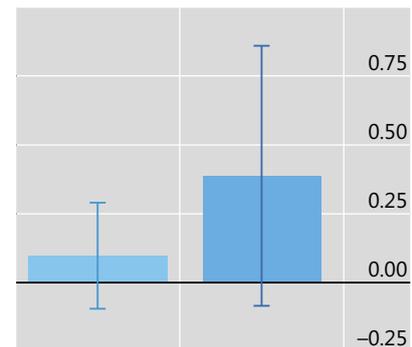
Commodity price increase

E. Energy intensity



Commodity price increase

F. US dollar invoicing for imports



US dollar appreciation

Low High

¹ Based on non-commodity export-dependent EMEs. See technical annex for details. ² High vs low split based on medians, "at-risk" coefficients refer to the 90th percentile for inflation and the 10th percentile for growth. Error bands based on 90% confidence level.

Sources: Arslanalp and Tsuda (2014); Boz et al (2020); Board of Governors of the Federal Reserve System; IEA; IMF; Datastream; national data; BIS credit statistics; BIS international debt securities; BIS locational banking statistics; authors' calculations.

Conclusions

Our analysis suggests that commodity prices and the broad dollar exchange rate are important risk factors for global growth and inflation. Higher commodity prices and a stronger dollar each reduce GaR and raise IaR in economies that are not dependent on commodity exports. Our findings further suggest that the impact on risks is more pronounced for EMEs than for AEs. This reflects more commodity-intensive consumption and production in EMEs as well as their larger dollar debt burdens and shallower financial markets.

The role of commodity prices and the dollar as risk factors was very apparent during 2021/22. In the wake of the Russia-Ukraine war, commodity prices rose steeply, and the US dollar appreciated, before both trends reversed in late 2022. The joint surge in commodity prices and the dollar was associated with a steep rise in inflation and a marked slowdown in economic growth globally during 2022. Our analysis suggests that the individual stagflationary effects of commodity prices and the dollar on non-commodity export-dependent economies have compounded each other over this period as the two variables increased in tandem. This was a break from the historical pattern, when commodity prices and dollar used to move in opposite directions, so that their individual effects on stagflation risk tended to offset each other.

A lasting positive correlation between commodity prices and dollar exchange rate would imply greater challenges for macro-financial stability policies going forward. It could lead to greater macroeconomic volatility and more difficult trade-offs between inflation and output stabilisation.

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Technical annex

CPI = consumer price index.

Graph 1.B: Cumulative increments in real GDP growth and inflation rate since Q1 2022. Aggregates based on the median across countries.

Graph 2: 25 non-commodity export-dependent economies, consisting of 10 AEs (CA, CH, DK, DE, ES, FR, GB, IT, JP and SE) and 15 EMEs (CN, CZ, HK, HU, ID, IN, KR, MX, MY, PH, PL, SG, TH, TR and ZA). Non-commodity export-dependent economies are those for which less than 60% of the total merchandise exports comprise commodities, as defined by UNCTAD. Aggregates based on the simple average across countries.

Graph 2.A: Energy and food weight data are for 2022 or latest, data are missing for CN, HK, ID, TH, ZA and CA. Energy intensity data are for 2019 and is defined as total primary energy supply per unit of GDP 2017 PPP.

Graph 2.B: External USD debt refers to non-banks' total cross-border USD-denominated liabilities (bank loans and debt securities) as a percentage of GDP, as of Q3 2022. Assets of institutional investors refer to the sum of financial assets of insurance corporations, pension funds and other financial institutions (OFIs) as a percentage of GDP in 2021, data are missing for CZ, DK, HU, PH, PL, MY, SE and TH.

Graph 3: 22 non-commodity export-dependent economies, consisting of seven AEs (CA, CH, DK, the euro area, GB, JP and SE) and 15 EMEs (CN, CZ, HK, HU, ID, IN, KR, MX, MY, PH, PL, SG, TH, TR and ZA), for 1990–2019. Graphs show a four-quarter-ahead impact of commodity price increase and US dollar appreciation on growth-at-risk (10th percentile) and inflation-at-risk (90th percentile), estimated by fixed-effect quantile regressions, following Machado and Santos Silva (2019). To remove outliers, we exclude observations corresponding to one-year-ahead inflation above 30%.

Graph 4: Periods covered are Q2 2002–Q2 2008 (A), Q3 2011–Q1 2020 (B) and Q3 2021–Q3 2022 (C).

Graph 5: See above for Graph 3.

Graph 6: See above for Graph 3. External dollar debt is measured as non-banks' total cross-border US dollar-denominated liabilities (bank loans and debt securities) as a percentage of GDP. Foreign ownership of local currency sovereign bonds is measured as the share of central government debt securities denominated in local currency held by foreign investors, as estimated by Arslanalp and Tsuda (2014). Dollar invoicing of imports is the percentage of imports invoiced in the US dollar (Boz et al (2020)). The energy and food weight in consumption baskets are based on those in the national CPI. Energy intensity is measured as total primary energy supply per GDP 2017 PPP. A country is allocated to the high/low group of an indicator if the average value of the indicator over the sample period is above/below the cross-country median of the averages.

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Global supply chain interdependence and shock amplification – evidence from Covid lockdowns¹

Supply disruptions from the Covid-19 pandemic raised questions about the benefits and costs of global value chain (GVC) participation. We use granular data to document the evolution of GVC firm-level linkages in the aftermath of the Covid-19 outbreak and study how they might have affected equity investors' reaction to pandemic-related disruptions. We find that the number of GVC linkages generally declined and was slow to recover for some sectors after the Covid-19 shock but that the volume of the resilient linkages helped to cushion production disruptions. Firms with GVC links to countries undergoing Covid-related lockdowns suffered larger stock price losses than those without such links.

JEL classification: F10, G12, G14, O24.

A rich literature has analysed the trade-offs from participation in global value chains (GVCs), the organisation of production processes, trade and investment across different locations to optimise production. The findings suggest that GVC participation propagates and amplifies risks (Zhang (2021), Huang et al (2022), Mohammad et al (2022)), but could reduce production costs and improve economies' resilience (Ando and Hayakawa (2022), Barrot and Sauvgnat (2016), Kashiwagi et al (2021)). Less frequently discussed is GVC participation at the firm level, and in particular how stock market investors assess GVC linkages in the face of global shocks.

We draw insights from firm-level data to study the evolution of GVCs over several quarters after the Covid-19 outbreak and the role of GVC participation in firms' stock market performance at the time of the outbreak. We find that declines in the number of cross-border linkages were still evident two years after the onset of the pandemic but a rise in the volume of the remaining linkages helped cushion the fallout. Furthermore, our empirical analysis suggests that firms' GVC participation played a role in stock market investors' trading decisions at the start of Covid-induced disruptions. The cumulative returns on firms linked to countries in lockdown declined by 1.5 percentage points more over a week than the returns on other firms, a magnitude similar to the typical volatility of returns in normal times.

¹ The authors thank Ryan Banerjee, Claudio Borio, Stijn Claessens, Jon Frost, Hyun Song Shin, Nikola Tarashev and Egon Zakrajšek for helpful comments and discussions, and Jimmy Shek and Ronald Yip (HKMA) for excellent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the Bank for International Settlements or the Hong Kong Monetary Authority.

Key takeaways

- Firm-level data reveal that the number of global value chain (GVC) linkages were slow to recover in some sectors after the Covid-19 shock but greater volumes at resilient linkages cushioned production disruptions.
- Stock market participants seem to pay attention to GVCs, as share prices declined significantly more after Covid-19 lockdown announcements if firms had GVC links to affected countries.

Examining specific periods in the aftermath of the Covid-19 outbreak, the rest of this article is organised as follows. The first section examines granular data on customer-supplier interlinkages from a sample of global firms as well as data on maritime shipments to the United States. The second section assesses equity investors' sensitivities to firms' GVC linkages. The last section concludes.

GVC trends during the pandemic – stylised facts

We rely on information from two data sets to gauge firm-level GVC interlinkages. The first, from S&P's Capital IQ, provides global snapshots of interfirm business linkages reported within the preceding two years. These snapshots help identify firms' customers and suppliers. The second data set consists of US maritime shipment information (also known as bills of lading (BoL)) from the US Census Bureau.² BoL data typically comprise the company names for both the shipper (ie supplier, exporter or freight forwarder) and consignee (ie the importer, or firm receiving the final merchandise delivery) as well as shipment details (eg volume of trade and product description). While the former data set offers a global coverage of linkages, the latter reveals the intensity of each included linkage, measured by the volume of the shipment quantities.

To examine how GVCs evolved during the pandemic, we first compare two snapshots, building on the work in Zhang (2021) (Graph 1). Firms are depicted by nodes, the size of which is proportional to a firm's importance in the overall network, with more connected nodes taking on larger sizes.³ Customer-supplier relationships are represented by the edges – ie connecting lines – between two nodes. Node colours correspond to the region of the firm's primary location,⁴ while edge colours correspond to the region where the supplying firm is located. The network maps are structured so that nodes sharing more connections are placed closer together.

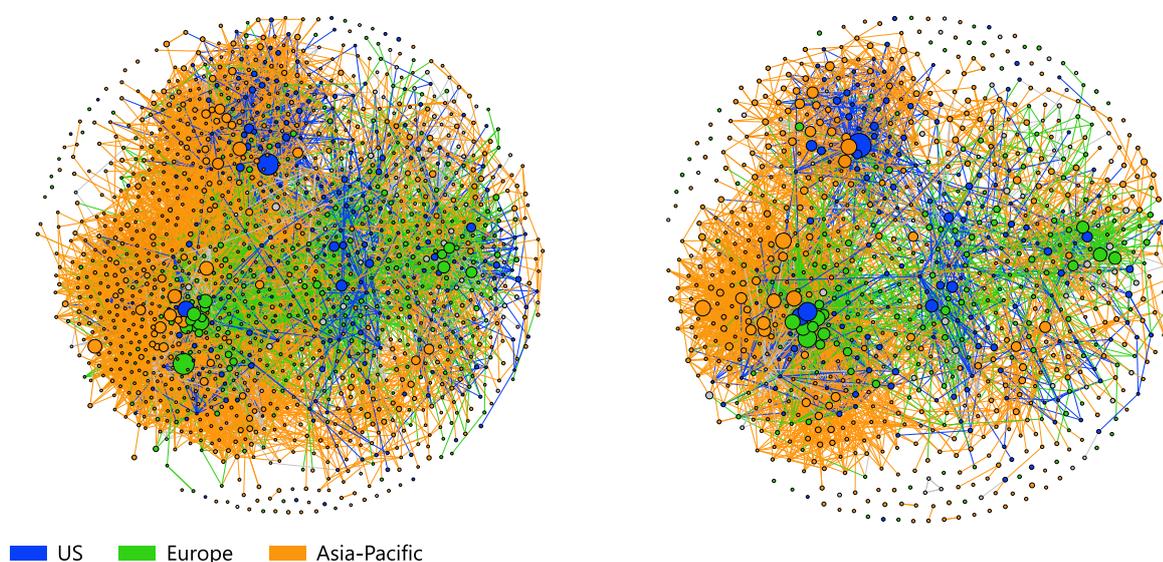
² BoL data used in this analysis were compiled by Datamyne. We focus on the United States because of its central role in GVC networks and the availability of high-quality shipment information.

³ We measure importance with "network centrality", which is determined by a node's number of connections (ie edges) and the connections of its counterparties.

⁴ "Primary location" refers to firms' national headquarters where most, if not all, of the functions are coordinated. This need not be the same as the headquarters of the ultimate parent company.

A. February 2020

B. December 2021



¹ Snapshot of firms' reported customer and supplier relationships within the previous two years. See technical annex for more details.

Sources: S&P Capital IQ Pro; authors' calculations.

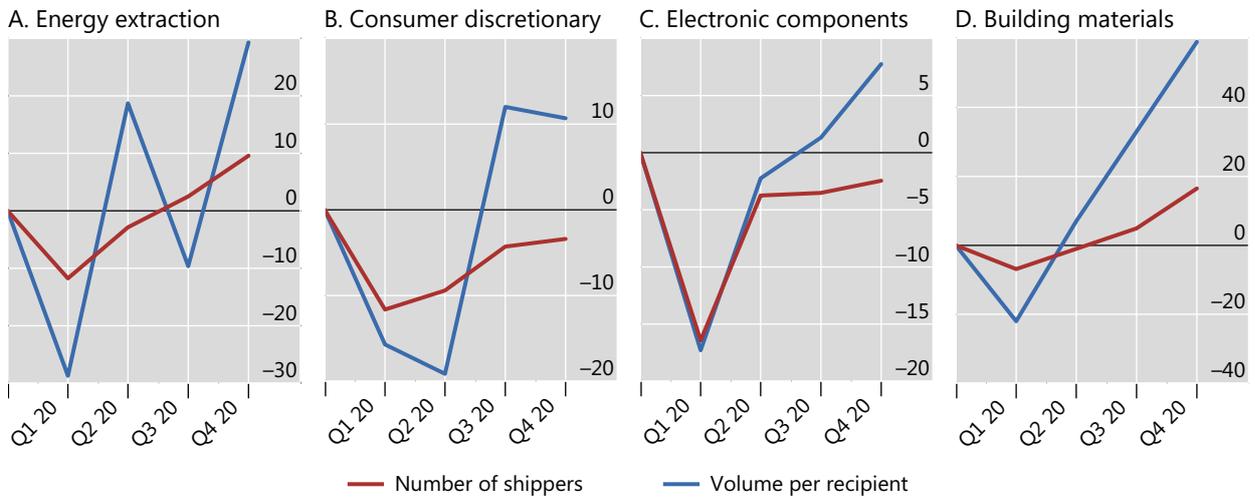
The comparison reveals that GVC networks had yet to fully recover by December 2021. Customer-supplier networks appeared less interconnected, as shown by the less dense patches and the presence of more empty space (Graph 1.B). Indeed, the number of linkages in the sample fell by around 30% over the two-year period.

Zooming in on the number of maritime shippers with links to firms in the United States and the intensity of these links – ie the volume of shipments – paints a more nuanced picture of the GVC evolution in the first year of the pandemic. After a broad-based drop in the number of shippers in the first quarter of 2020, the recovery along this dimension proceeded at a different pace across sectors (Graph 2, red lines). By the end of 2020, 38% of the US recipient sectors – including energy extraction and building materials – saw the number of their maritime shippers return to or exceed its pre-pandemic level. A drag on the general recovery came from sectors hardest hit by the pandemic, such as consumer discretion and electronic components (Graphs 2.B and 2.C). At the same time, nearly half of the sectors saw large rebounds in shipment quantity from resilient suppliers. Expanded production by these suppliers helped cushion production disruptions.

Shipments to the United States: slow recovery and GVC flexibility¹

Cumulative growth rates, Q1 2020 = 0, in per cent

Graph 2



¹ Shipment quantities are measured by 20-foot equivalent units (TEU) per US consignee. TEUs measure shipment cargo capacity.

Sources: US Census Bureau; Datamyne; authors' calculations.

Equity market sensitivity to GVC linkages

To assess the effect of GVC linkages on firms' equity prices, we use an event study framework. The events in focus are lockdown announcements in two significant players in the global GVC network: China and Germany (World Trade Organization (2021)). These events represent exogenous shocks to the state of GVCs as they took place before broad-based supply disruptions became evident and hence before markets, firms and the public at large started anticipating these disruptions' fallout. The announcements were also not confounded initially by similar concurrent events in other parts of the world.

We focus on a global set of listed firms with supply chain linkages in Capital IQ at the beginning of 2020. We use the daily equity returns for these firms from 1 January 2019 to 17 April 2020 – a period that covers stock market performance both before and during the pandemic. To study cross-border effects of GVCs, we consider the share prices only of firms with linkages to China and Germany but exclude those headquartered in these countries. We estimate the following panel regression:

$$Return_{i,t} = \beta MarketReturn_t + \sum_{j=CN,DE} \delta_j Lockdown_j \times GVC_{i,j} + \alpha_i + \mu_t + e_{i,t} \quad (1)$$

first for China's and separately for Germany's lockdowns and linkages. We estimate versions of this equation that differ as regards the period underpinning flow variables.

Baseline version. $Return_{i,t}$ represents the daily percentage change in firm i 's closing equity price.⁵ The dummy variable $Lockdown$ equals 1 on the days of the relevant announcements: for China, these are 23 and 27 January 2020 (announcements of the Wuhan lockdown and an extension of the nationwide lunar new year holiday, respectively); for Germany, it is 16 March 2020 (border

⁵ In a robustness check, we replace the dependent variable with "abnormal return" – ie, deviation from the market return. The results remain qualitatively similar.

closure).⁶ The other 0/1 dummy variable, *GVC*, represents firms' linkages with China or Germany in early 2020 (henceforth, "connected" firms). The variable *MarketReturn* is the return on the broad equity index in the country where a firm is listed. By controlling for co-movements between individual stock prices and benchmark indices, we capture abnormal movements in the former. Finally, α_i and μ_t represent firm and time fixed effects, respectively.⁷

Cumulative returns. To study stock market reactions over longer periods, we calculate the flow variables over these periods. We change the definition of the time fixed effect and the lockdown dummies accordingly, considering now only the first of the two China announcements. We employ local projections in this context.

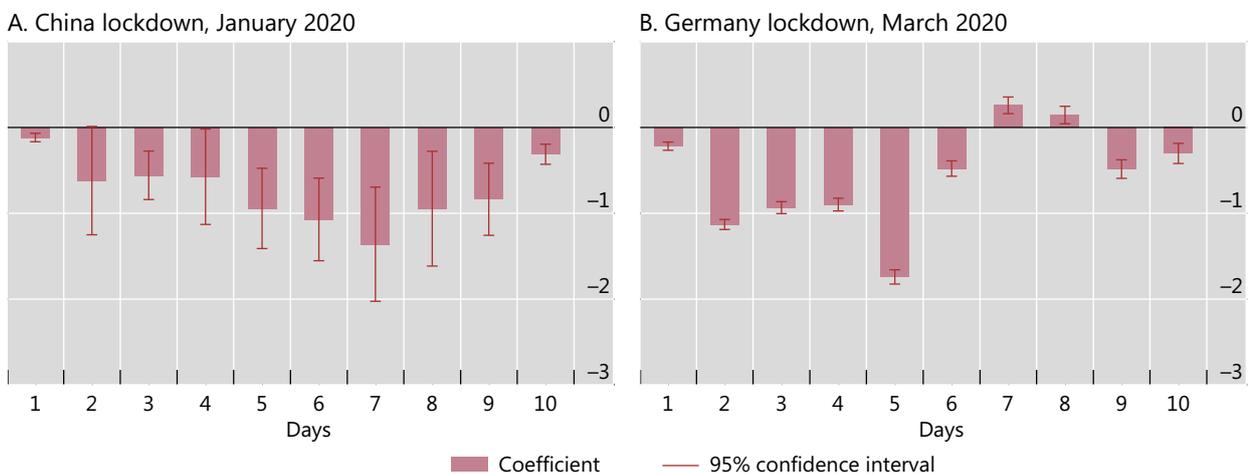
The coefficients of interest are δ_{CN} and δ_{DE} . They capture the extent to which the share price adjustment after a lockdown announcement differs between connected and unconnected firms.

We find that stock market participants interpreted lockdown announcements as worse news for firms with GVC links to the affected country. After a muted differentiation on the announcement day, the equity prices of these firms declined by about 1.5 percentage points more in the course of a week than those of their unconnected peers (Graph 3). In addition to being statistically significant, this difference is economically meaningful, as the median standard deviation of equity returns across firms in our sample is equal to 2.5% in 2019. The differentiation between firms with GVC connections to China or Germany and other firms eventually dissipated, as the increasingly global nature of the Covid pandemic became apparent.

Lockdown announcements affect GVC-linked firms more negatively¹

In percentage points

Graph 3



¹ In a regression of firm-level stock price returns – equation (1) – the estimated coefficients on the interaction terms between *Lockdown* and *GVC* linkages in China and Germany.

Sources: S&P Capital IQ, authors' calculations.

⁶ We also include 0/1 additive dummy variables for: China's announcement on 20 January that the Covid virus was transmissible among humans; the World Health Organization announcement on 11 March that Covid was a global pandemic, and the Federal Reserve's large-scale intervention on 17 March to stabilise financial markets. All these variables are statistically insignificant.

⁷ The firm and time fixed effects absorb the additive *GVC* linkage and lockdown dummy variables. We take into account the time zone differences among stock exchanges.

Conclusion

This article has sought to draw insights from complex GVC networks. Using data on customer and supplier connections following the outbreak of Covid-19, we track the evolution of GVC networks both at the global and the sector levels. In addition, our econometric analysis shows that GVC links can amplify the adverse effect of pandemic-related shocks on company share prices. Such effects underscore that stock market investors pay attention to GVCs. Further research could seek to verify the representativeness of our results by considering other episodes with large exogenous shocks.

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Technical annex

Graph 1: Data cover around 34,000 companies and are part of S&P's Capital IQ. To cross-check these data, we compare them with bill of lading data from Datamyne. The latter comprise information about 456,453 shipments to US consignees in 2020. We establish an 80% overlap between the two data sets for US-based firms that have business relationships with China and/or Germany.

Graph 3: Firms from the data behind Graph 1 that are publicly listed: 21,340 worldwide. Of these, 6,756 (32%) are customers of and/or suppliers to Chinese firms, and 6,127 (29%) are customers of and/or suppliers to German firms.

Covid, central banks and the bank-sovereign nexus¹

The Covid-19 outbreak strongly affected the evolution of the bank-sovereign nexus. In advanced economies, banks played an important role in financing sovereign debt during the first two quarters of 2020 but their participation fell in subsequent quarters. Correspondingly, the share of sovereign debt in banks' portfolios declined. In contrast, central bank reserves soared due to asset purchase and funding-for-lending programmes. In emerging market economies, the rise in banks' holdings of sovereign debt started before the Covid-19 outbreak and accelerated thereafter. From a longer-term perspective, the perceived credit risk of banks tends to co-move more strongly with that of sovereigns when the share of sovereign debt on banks' balance sheets is higher or – keeping this share constant – when the share of reserves is lower.

JEL classification: E58, F34, G21, G32, H63.

The financial health of banks and sovereigns is intertwined. Banks are key investors in sovereign debt² as its liquidity often helps them meet regulatory and internal risk-management objectives. In addition, many sovereigns backstop the financial system in times of trouble. Such connections – the “bank-sovereign nexus” – can lead to destabilising spillovers between the two sectors in times of stress. These spillovers were at the centre of policy debates, particularly during the emerging market economy (EME) crises of the 1980s and 1990s and the euro zone sovereign debt crisis.³

During the Covid-19 pandemic, sovereigns in both advanced economies (AEs) and EMEs issued a large amount of new debt to fund their support packages. This development affected the bank-sovereign nexus as the debt was funded in part directly by banks and in part by other investors but intermediated by banks. Banks in EMEs increased their holdings of sovereign debt from the pandemic's outbreak

¹ The authors thank Iñaki Aldasoro, Claudio Borio, Stijn Claessens, Mathias Drehmann, Egemen Eren, Kumar Jegarasasingam, Patrick McGuire, Benoît Mojon, Andreas Schrimpf, Hyun Song Shin, Koji Takahashi, Nikola Tarashev, Goetz von Peter, Egon Zakrajšek and Fabrizio Zampolli for valuable comments, and Swapan-Kumar Pradhan for excellent research assistance. The views expressed are those of the authors and not necessarily those of the Bank for International Settlements.

² Throughout this article, we use the term “sovereign debt” to refer to debt issued by the general government sector. This excludes publicly owned banks and corporations.

³ Bank lending typically falls following a sovereign debt crisis, and more so for banks that hold more sovereign debt (Gennaioli et al (2018), Popov and van Horen (2014)). The correlation of sovereign and bank risk rises after bailouts are announced (Acharya et al (2014)). While governments backstopped the banking sector in the 2007–09 Great Financial Crisis, during the Covid-19 pandemic they backstopped banks' exposures to the private sector via government-backed loan guarantees. These could also influence the bank-sovereign nexus.

Key takeaways

- Sovereign borrowing surged globally in the wake of the pandemic's outbreak but only banks in emerging market economies steadily increased their holdings of sovereign debt.
- In advanced economies, central bank asset purchases reduced banks' holdings of sovereign debt and, with funding-for-lending programmes, boosted central bank reserves as the pandemic unfolded.
- Bank and sovereign credit spreads are more closely linked when banks hold more sovereign debt or – all else equal – fewer reserves.

through mid-2022 (see also Deghi et al (2022)). In contrast, banks in AEs reduced such holdings over the same period, although they played a key role in funding the sovereign debt issuance in the first two quarters of 2020.

These differences in the evolution of the bank-sovereign nexus stemmed from actions by the respective central banks. In contrast to central banks in major EMEs, those in AEs significantly expanded their balance sheets. In conducting large-scale asset purchase (LSAP) programmes, AE central banks funded purchases of primarily sovereign debt with reserves. Many also engaged in sizeable funding-for-lending (FFL) programmes, which provided financing to banks while also creating more reserves on their balance sheets (Markets Committee (2023)). Consequently, banks in AEs shifted their connection with the official sector away from sovereigns and towards central banks.⁴

We build on research that examines market participants' perceptions of the correlation between sovereign and bank credit risk (Acharya et al (2014), de Bruyckere et al (2013), Fratzscher and Rieth (2019)). We use CDS spreads to account for these perceptions and our contribution stems mainly from studying the role of central bank reserves. We show that the two sectors' CDS spreads co-move more strongly when banks hold more sovereign debt or – keeping sovereign debt holdings constant – when they hold fewer reserves. The latter result is consistent with markets holding the perception that reserves have greater liquidity benefits than sovereign debt. In line with our findings on the evolution of the bank-sovereign nexus across regions, the correlations of bank and sovereign CDS spreads increased in EMEs in 2020–22 but fell in AEs.

The rest of this article takes in turn different perspectives on the links between banks and sovereigns, paying particular attention to developments after the start of the Covid-19 pandemic. The first section discusses the size of banks in the sovereign debt investor pool. We do not consider non-bank investors, such as insurance companies (covered in Box A), investment funds or foreign central banks. The second section examines how the amounts of sovereign debt and reserves on banks' balance sheets have changed. The third turns to the correlation between the perceived credit risk of banks and sovereigns. The final section concludes with some policy considerations.

⁴ This analysis complements literature on sovereign debt investors, which analyses pre-pandemic developments and finds that foreign investors can reduce sovereigns' borrowing costs while increasing refinancing risks (Arslanalp and Tsuda (2014a, 2014b)) and that non-bank investors are the marginal investors and most responsive to changes in the sovereign yield (Fang et al (2022)).

Importance of banks in the sovereign debt market

In examining the stock of sovereign debt and the share held by banks, we use the most recent data from the sovereign investor base estimates of Arslanalp and Tsuda (2014a, 2014b). Our main focus is bank investors – located either in the same country as the sovereign (resident banks) or abroad (non-resident banks). Since LSAPs in AEs were large-scale, we also consider central banks as large investors in sovereign debt. We refer to periods up to Q4 2019 as pre-pandemic and periods from Q1 2020 onwards as post-outbreak.

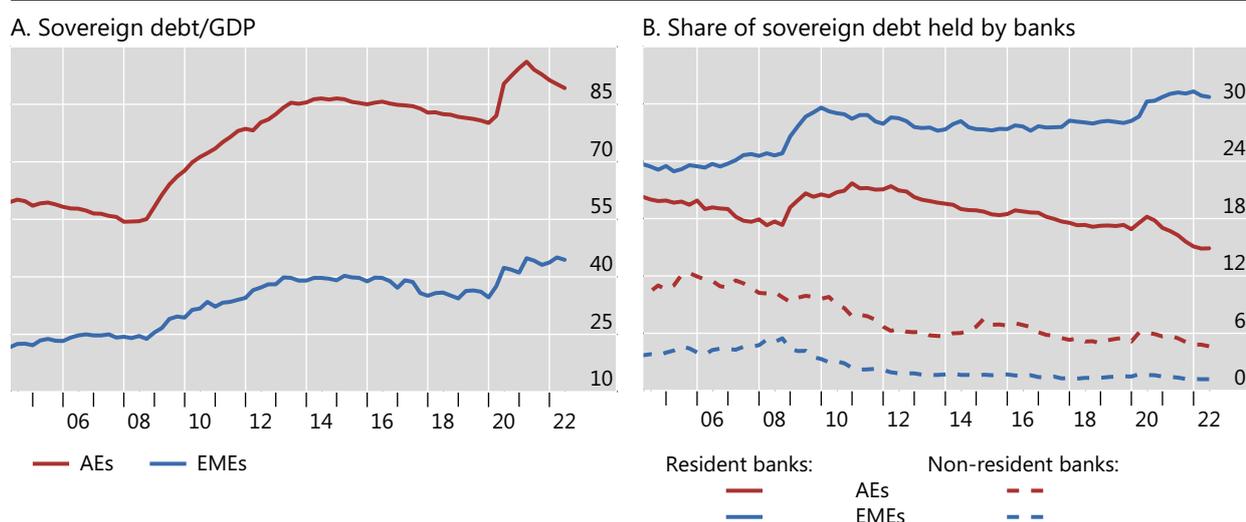
While total sovereign debt expanded similarly in both AEs and EMEs, the share of debt held by banks diverged in the two groups. From Q4 2019 to Q2 2022, the average outstanding debt rose from 80% to 89% of GDP in AEs and from 35% to 44% in EMEs (Graph 1.A). However – after an upward blip in Q1 2020 – the share of AE sovereign debt held by resident banks fell, accelerating a pre-existing downward trend (Graph 1.B). This stood in contrast to banks in EMEs, whose share rose over the post-outbreak period by 3 percentage points to reach 31% at end-Q2 2022.

Nevertheless, banks did play a key role in absorbing sovereign debt in AEs at the pandemic's outset. The increase in sovereign debt in Q1 2020 was initially picked up by banks, mostly resident⁵ (Graph 2.A). This could be related to banks' role as primary market dealers in some economies (Arnone and Ugolini (2005)). Subsequently, banks held a progressively smaller share of cumulative pandemic-related debt issuance, falling from 49% in Q1 2020 to below 12% at mid-2022. In contrast, banks in EMEs remained key sovereign debt investors post-outbreak (Graph 2.B), although non-bank investors were also large holders of this debt (purple bars).

Sovereign debt expansion and bank holdings of sovereign debt¹

Average across country groups, in per cent

Graph 1



¹ Based on 24 AEs and 24 EMEs. See technical annex for details.

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

⁵ Non-resident banks' share was 37%, reflecting primarily intra-euro area investment.

Insurance companies' holdings of sovereign debt^①

Bettina Farkas, Ulf Lewrick, Tomas Stastny and Nikola Tarashev

While sovereign borrowing needs remain large, advanced economy central banks have been reducing their sovereign bond purchases or shedding existing holdings. This puts the spotlight on traditional providers of sovereigns' financing from the private sector – banks (see Hardy and Zhu in the same issue), pension funds and insurance companies (ICs). Against this backdrop, we review the size and geographical distribution of ICs' sovereign debt holdings at the end of the low-for-long era. We also discuss how these holdings have been reflected in credit market pricing and how they relate to ICs' risk management, with an eye to understanding the potential vulnerabilities, particularly in the market for long-duration sovereign debt.

We draw mainly on two data sets from the International Association of Insurance Supervisors (IAIS). They comprise yearly observations from 2019 to 2021. The Sector-Wide Monitoring (SWM) data are at the country level, covering 25 advanced economies (AEs) and 23 emerging market economies (EMEs). The Individual Insurer Monitoring (IIM) data contain detailed information on 61 major ICs from 13 AEs and eight EMEs. We complement these data sets with other publicly available data.

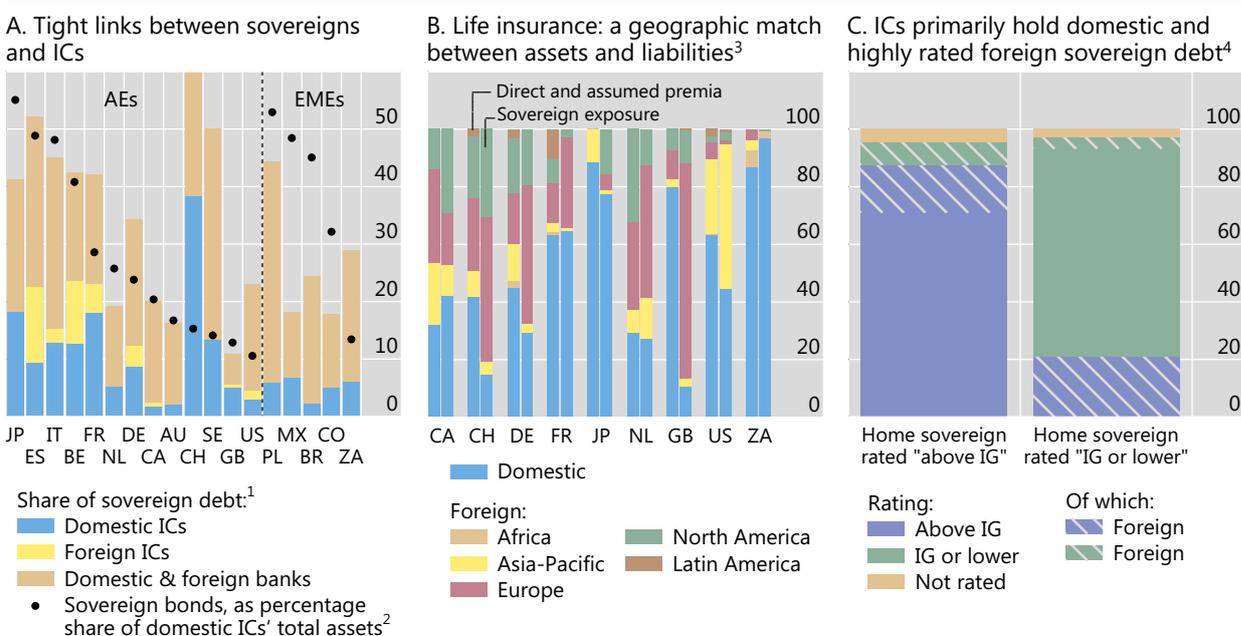
Sovereigns' debt is at the heart of their strong links with ICs. As a share of the total assets of ICs located in several major AEs and EMEs, sovereign bond holdings accounted for more than 20% in 2021 (Graph A1.A, dots). In turn, consistent with the typically large size of the insurance sector, we estimate that these holdings amount to more than one third of the total outstanding sovereign debt in Switzerland and to more than 10% in Japan and large euro area economies. For several European sovereigns, this share is comparable with that of banks' holdings.

Sovereign debt is an integral part of ICs' investment strategy and risk management. Such debt tends to be of longer duration than corporate debt. It thus matches life insurers' long-term liabilities more closely and thereby delivers a better hedge against changes in interest rates.^② We find a close alignment between the geographic

Insurance companies (ICs) are key investors in sovereign debt

In per cent

Graph A1



¹ At end-2021, includes life and non-life ICs (SWM data). ² Excludes unit-linked assets. ³ At end-2021, by region of debt and premium issuance estimates; for 40 major life and composite ICs (IIM data), grouped by headquarter location. ⁴ At end-2021, life and non-life ICs of 23 advanced and 13 emerging market economies (SWM data). "Above IG" is a rating of A– or higher.

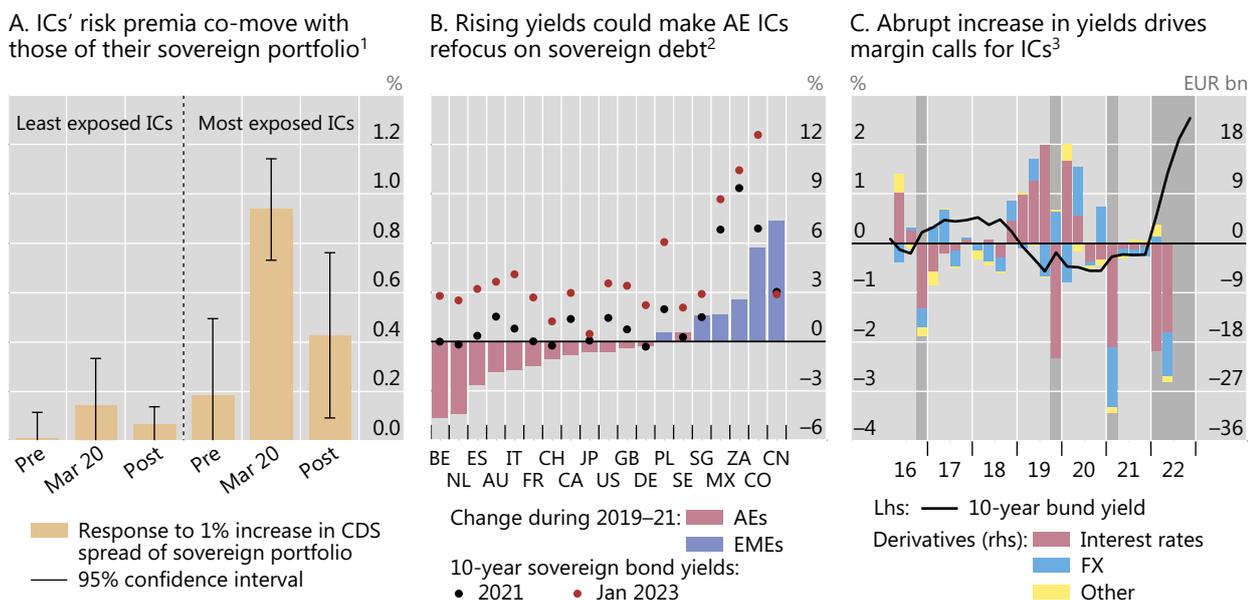
Sources: Arslanalp and Tsuda (2014, updated in 2023); IAIS (SWM and IIM data); authors' calculations.

distribution of major life and composite ICs' sovereign holdings and that of the location of their life insurance liabilities (as proxied by the origin of direct and assumed premia, Graph A1.B). This provides a natural hedge against exchange rate risk but is also consistent with duration-matching, as the valuation approach for assets and liabilities is usually location-specific. As much of the insurance business is domestic, the home country dominates in total sovereign debt holdings (Graphs A1.B and A1.C). When investing in debt issued by foreign sovereigns, life and non-life insurers jointly prefer higher-rated securities (Graph A1.C) and often hedge to mitigate or eliminate the attendant currency mismatches. The higher the credit quality of sovereign debt, the more broadly it is accepted as collateral and the greater its shock-absorbing capacity.

Credit market participants seem to perceive tight financial links between the ICs and the sovereigns that these companies invest in. The March 2020 turmoil provides a case in point (Graph A2.A). While CDS spreads increased across the board in response to a common shock (the outbreak of Covid-19), ICs' sovereign debt holdings played a distinct role. Specifically, after controlling for macro risk factors, we find that the co-movement of sovereigns' and ICs' CDS spreads in March 2020 was statistically and economically significant – roughly one-to-one – only if sovereign debt holdings amounted to a high share of ICs' assets. The phenomenon weakened subsequently as central bank interventions appeased markets but has remained important.³

The path of interest rates has been a key driver of ICs' sovereign debt holdings and is likely to remain so. During the low-for-long era, many ICs in AEs reduced – albeit marginally – their sovereign bond holdings in favour of higher-yielding securities (Graph A2.B). With rates rising, ICs' balance sheets are strengthening as the present value of their assets typically declines by less than that of their liabilities. Coupled with the increased supply of government debt outside central banks' balance sheets, rising rates could lead ICs to favour sovereign over corporate debt. At the same time, duration-matching motives may have the opposite effect. Rising rates tend to open a duration gap that can be closed by reducing the share of assets with the longest duration.

Risk interlinkages and IC demand for sovereign debt in a rising yield environment Graph A2



¹ Estimates from a panel regression of log changes in ICs' CDS spreads on log changes of a weighted average of sovereign CDS spreads (weighted by the share of each sovereign in the ICs' sovereign portfolios) interacted with (least/most) exposed and period dummies. Control variables: log changes of the VIX, week-country fixed effects and company fixed effects. Pre = Jan 2014–Feb 2020; Post = Apr 2020–Nov 2022. Least (most) exposed ICs are those with a sovereign exposure as a share of total investment of at most (at least) 15% (44%) – ie the bottom (top) quartile in the sample. IIM and market data for 24 ICs from 13 jurisdictions. ² Cumulative percentage change in the share of sovereign exposure to total assets (excluding unit-linked business) based on country-level reporting (SWM data). ³ Quarter-on-quarter change in EU ICs' market value of derivatives. The grey-shaded areas indicate quarters with a quarter-on-quarter increase in the 10-year bund yield of more than 25 basis points.

Sources: EIOPA; IAIS (SWM and IIM data); Bloomberg; Markit; authors' calculations.

Abrupt increases in sovereign bond yields can boost ICs' demand for liquidity, with broader financial stability implications. To hedge against falls in interest rates, major ICs hold positions in interest rate swaps that come with margin requirements. Thus, when interest rates rise, ICs incur losses on the market value of their derivatives and need to post variation margins. The faster the hike in sovereign bond yields, the faster the rise in margin calls and the stronger the pressure on ICs to raise liquidity (Graph A2.C), which typically entails sales of sovereign bonds. This could amplify the bond yield increases if ICs' liquidity needs spill over to the sovereign bond market.

① The views expressed in this box are those of the authors and do not necessarily reflect those of the Bank for International Settlements or the International Association of Insurance Supervisors. ② See D Domanski, H S Shin and V Sushko, "The hunt for duration: not waving but drowning?", *IMF Economic Review*, vol 65, 2017; A Ozdagli and Z Wang, "Interest rates and insurance company investment behaviour", mimeo, 2022. ③ The CDS spread interlinkage is also a salient feature of the sovereign-bank nexus (see Hardy and Zhu in the same issue).

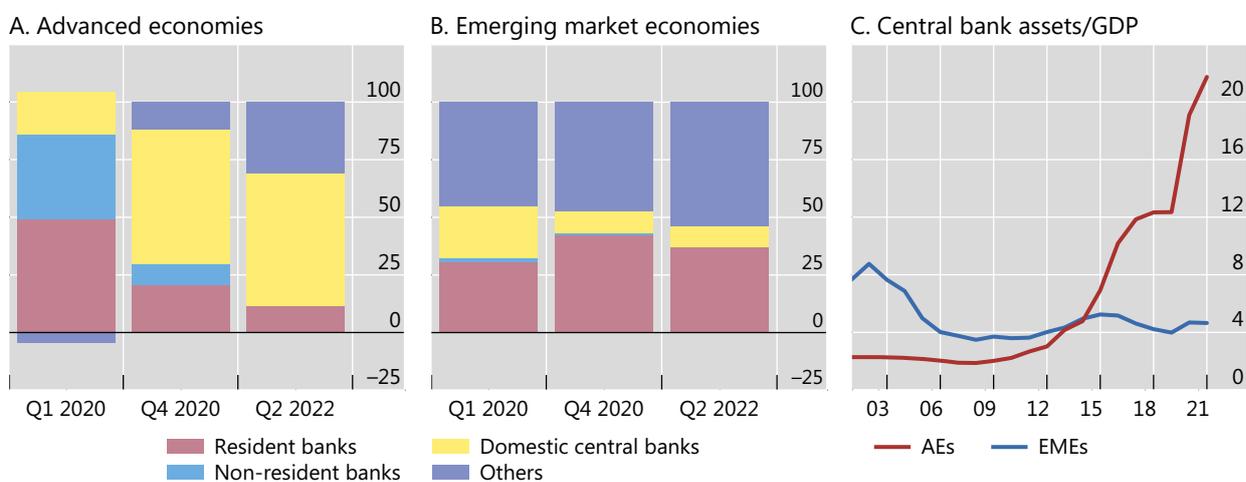
The difference in the sovereign debt holdings of banks in AEs and EMEs stems from actions taken by central banks. The balance sheets of EME central banks changed little relative to economic activity post-outbreak, while those of AE central banks expanded sharply (Graph 2.C). This expansion consisted in large part of sovereign debt purchases. By end-Q2 2022, domestic central banks' holdings of AE sovereign debt accounted for over half of the post-outbreak issuance, replacing banks as the key investors (Graph 2.A, yellow bars).

Banks' and domestic central banks' financing of post-outbreak sovereign debt¹

In per cent

Graph 2

Shares in cumulative of post-outbreak sovereign debt issuance, by investor



¹ Based on 24 AEs and 24 EMEs. See technical annex for details.

Sources: Arslanalp and Tsuda (2014a, 2014b); World Bank; authors' calculations.

Importance of sovereigns in banks' portfolios

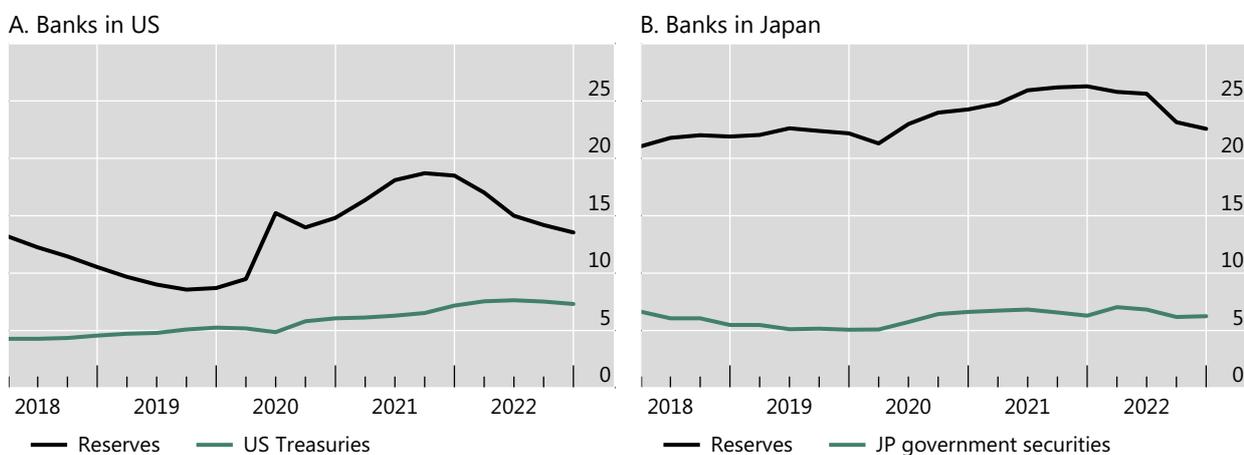
The increase in sovereign debt and the shifts in its financing due to central bank policies had important implications for the composition of bank balance sheets. This section examines the bank-sovereign nexus from the banks' perspective, investigating at the country level how their holdings of sovereign debt and central bank reserves evolved as a share of assets. We rely primarily on data from the BIS locational banking statistics, but first highlight banks located in the two largest sovereign debt-issuing countries, Japan and the United States, on the basis of national data.⁶

Banks in Japan and the United States saw significant increases in their reserves during the post-outbreak period while the shifts in their holdings of domestic sovereign debt were more muted. Reserves expanded from 10% and 22% of assets in Q4 2019 to 18% and 26% by end-2021 for banks in the United States and Japan, respectively (Graph 3). The concurrent rise in banks' holdings of domestic sovereign debt was more pronounced in the United States, where it continued a pre-pandemic trend. The potential underlying drivers are regulatory and market developments after the Great Financial Crisis, such as the introduction of liquidity requirements and bilateral margin requirements for non-centrally cleared derivatives and the transition of interbank lending from unsecured transactions to repo transactions secured by sovereign debt. Also, some banks used US Treasuries in carry trades to exploit the negative interest rate swap basis after 2010 (Du et al (2022)).

Banks' holdings of reserves and government securities in the US and Japan¹

As a percentage of total assets

Graph 3



¹ See technical annex for details.

Sources: Federal Reserves (H4.1, H.8); Bank of Japan; authors' calculations.

⁶ These countries do not yet report the relevant breakdowns to the BIS locational banking statistics.

To examine a broader set of countries and also consider banks' cross-border holdings of sovereign debt, we leverage the BIS locational banking statistics.⁷ These statistics incorporate information on the counterparty sector of bank lending since 2014, including on sovereigns and central banks (see also Garcia Luna and Hardy (2019)). We limit our analysis to jurisdictions that report this information for both local and cross-border positions (18 AEs and six EMEs). In addition to the United States and Japan, this excludes China.⁸

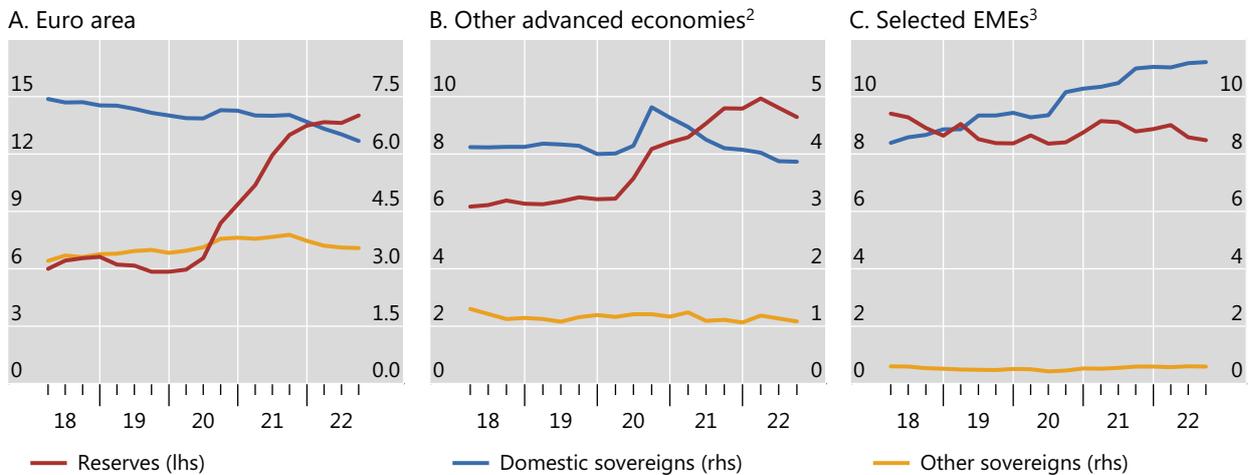
In AEs, bank holdings of domestic sovereign debt temporarily increased in the first year of the pandemic but ultimately fell below pre-pandemic levels. Banks in the euro area accumulated \$236 billion of domestic sovereign debt over the first two quarters of 2020 but shed nearly the same amount thereafter. Ultimately, the expansion of their balance sheets outpaced their sovereign debt holdings, leading to a declining share (Graph 4.A, blue line). Banks in other AEs also built up large positions in domestic sovereign debt in the first two quarters of 2020 (\$505 billion), but this proved to have a temporary impact on the composition of their expanding balance sheets (Graph 4.B, blue line).

Although the share of sovereign debt in total assets hardly changed for banks in AEs after the pandemic's outbreak, LSAP and FFL programmes dramatically increased banks' holdings of reserves. The share of reserves doubled on the balance sheets of banks in the euro area from Q4 2019 to Q3 2022 and increased by a half for banks in

Banks' holdings of reserves and sovereign debt¹

As a share of total claims outstanding on all sectors

Graph 4



¹ See technical annex for details. ² Excludes Japan and the United States. ³ Excludes China.

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

⁷ Cross-border claims on central banks tend to be small. One exception is the euro area, where claims on the ECB are considered cross-border for banks located outside Germany. Thus, in the remainder of this article, we consider all claims on the central bank together (cross-border and local) and interpret this as claims on the domestic central bank.

⁸ The locational statistics reflect banks' residence. The BIS also produces consolidated banking statistics, which are organised by bank nationality and exclude inter-office positions. These data have a longer time series of claims on the foreign official sector (government and central bank combined).

other AEs (Graphs 4.A and 4.B, red lines).⁹ This increase was driven by an expansion of reserve holdings rather than a contraction of other parts of bank balance sheets. As the programmes tapered off in the first half of 2022, these shares plateaued at a high level. Ultimately, these trends reshaped the links of banks with the official sector, away from holding sovereign debt and towards reserves at the central bank.

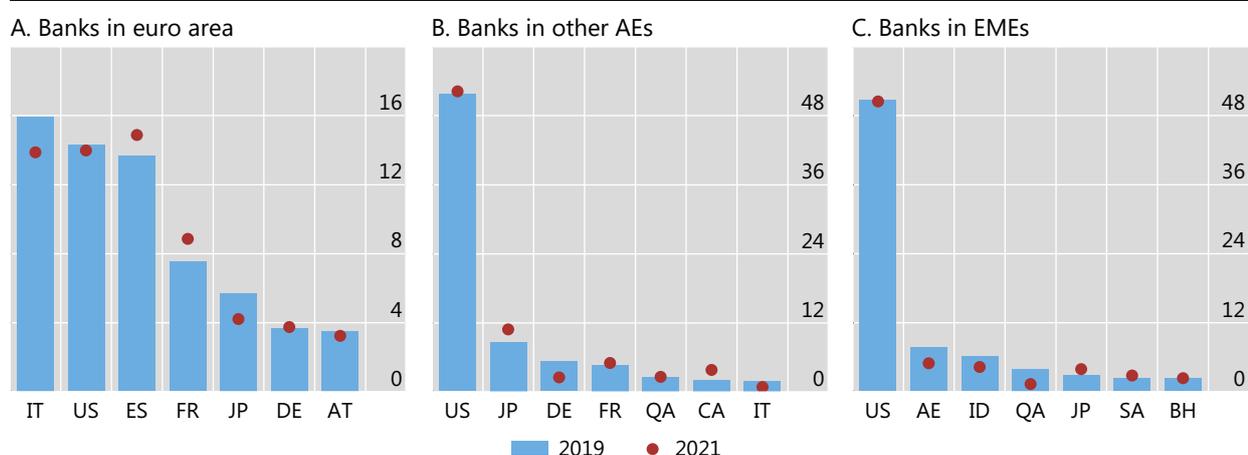
Banks located in our EME sample continuously increased their exposure to domestic sovereign debt during the post-outbreak period, accelerating a pre-pandemic trend. As banks' holdings of domestic sovereign debt rose by nearly \$300 million between Q4 2019 and Q3 2022, their balance sheet share increased from 9% to 11% (Graph 4.C). Central banks' liquidity provision programmes and other measures made it easier for banks to purchase and hold the additional sovereign debt. The rise in sovereign debt holdings was accompanied by a change in the share of reserves that was muted in comparison with AE developments. This reflects the small scale or absence of LSAPs in some EMEs and the sterilisation of the LSAPs' impact on central bank balance sheets in others (Arslan et al (2020)).

The massive pandemic-related rises in sovereign debt supply and the demand for such debt from central banks did not significantly impact banks' cross-border holdings of sovereign debt. Only in the euro area did these holdings rise as a share of assets – through 2021, in a continuation of a pre-pandemic trend – but then the increase was largely reversed (Graph 4.A, yellow line). Further, banks' cross-border holdings of sovereign debt did not show significant geographic shifts (Graph 5).

Banks' cross-border holdings of specific sovereigns' debt¹

As a percentage of banks' total cross-border holdings of sovereign debt, by banks' residence

Graph 5



¹ The largest seven counterparty countries, as of end-2019 for each group of banks. See technical annex for details.

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

⁹ The euro area, in particular, engaged in a substantial FFL programme (TLTRO III) equal in size to its post-outbreak asset purchases, which further boosted central bank reserves there. See Barbiero et al (2022) for more discussions on TLTRO, and Böninghausen et al (2023) for a review of the ECB's pandemic emergency purchase programme.

Bank-sovereign links and the correlation of CDS spreads

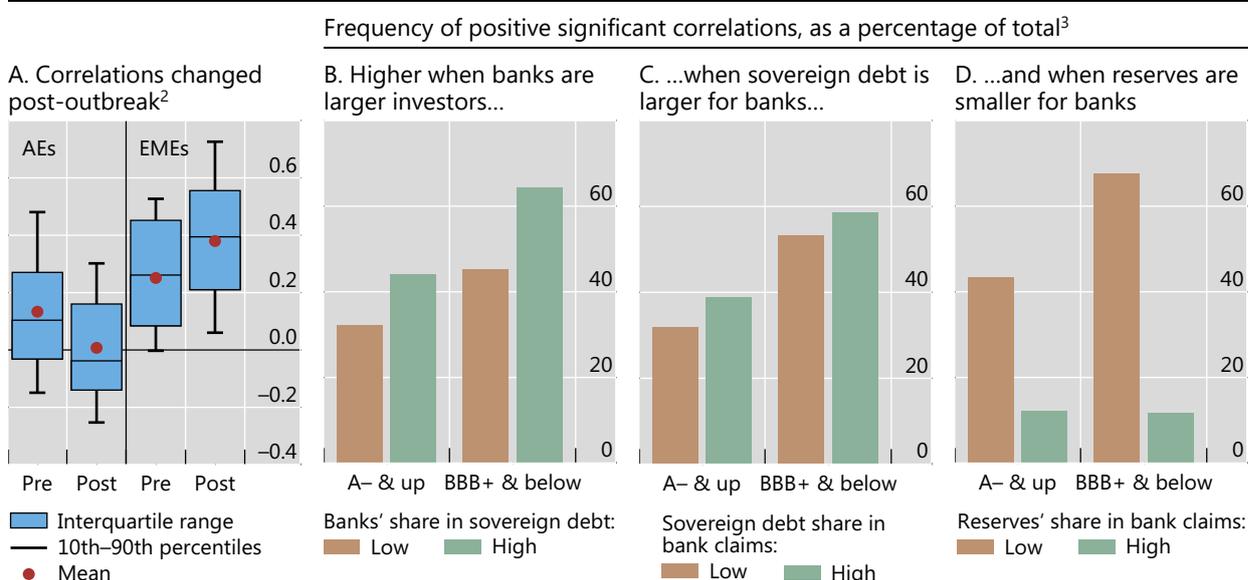
Stronger financial links between banks and sovereigns widen the channels for credit risk to propagate between the two. For example, banks' balance sheets may weaken on the back of sovereign defaults. More frequently, they sustain mark-to-market losses if the sovereign's perceived credit risk rises. This section relates the evolution of the bank-sovereign nexus to perceived credit risk spillovers between the two sectors.

First, we measure these spillovers by deriving the correlation of bank and sovereign credit default swap (CDS) spreads within each quarter from 2017 to 2022. Specifically, we average the daily log changes of CDS spreads across a set of banks in a given jurisdiction and then remove the daily common component of these changes across jurisdictions. We remove a similar component from the corresponding changes for the sovereigns. We calculate the correlation between the two resulting time series in each country (see annex for details).

After the pandemic's outbreak, bank-sovereign CDS correlations declined for AEs but rose for EMEs. In AEs, the bank-sovereign correlation averaged 0.13 pre-pandemic across countries and quarters but fell to effectively zero post-outbreak, a statistically significant drop (Graph 6.A). Within the same time frame, the average correlation in EMEs rose from 0.25 to 0.38, a statistically significant increase. The frequency of statistically significant positive correlations reflects a similar pattern. In AEs, this frequency fell from 30% of the total to 17%, while in EMEs it rose from 53% to 67%. The respective rise and fall in the correlations may relate to the fact that

Correlation of bank and sovereign CDS spreads¹

Graph 6



¹ Correlations of bank and sovereign CDS spreads at the country-quarter level. See technical annex for details. ² Pre-pandemic is 2017–19, post-outbreak is 2020–22. ³ Rating is that of the sovereign; low vs high cut-off in panel B is 25.7%, in panel C 7.5% and in panel D 9.3%. See technical annex for details.

Sources: Arslanalp and Tsuda (2014a, 2014b); Fitch; Markit; BIS locational banking statistics; authors' calculations.

banks' sovereign debt holdings rose in EMEs as the pandemic unfolded but declined in AEs.¹⁰

Second, we seek to shed further light on potential drivers of the CDS spread correlations. Our unit of analysis is the CDS spread correlation between banks and sovereigns in each of 32 countries and within each quarter from Q1 2004 to Q2 2022. We group these correlations – first according to the sovereign's credit rating and then the size of the financial link between banks and sovereigns.¹¹ As a lower-rated sovereign is in general more likely to default, fluctuations in perceived credit risk will be more material for investors holding its debt. For the credit rating groupings, we split the sovereigns into highly rated (A– and above) and other (BBB+ and below). For the financial link groupings, we consider banks' holdings of sovereign debt – either as a share of the sovereign's total outstanding debt (sovereign's perspective) or as a share of banks' assets (banks' perspective). And we split observations into those with strong financial links (top third of the distribution) and weak financial links (bottom two thirds). For each group, we report the frequency of observations that are positive and statistically different from zero.

The frequency of bank-sovereign CDS correlations that are positive and statistically significant increases with the size of financial links or as the sovereign credit rating worsens. This is evident from both perspectives. The frequency is higher when banks make up a larger part of the investor base for the domestic sovereign's debt (Graph 6.B) and when this debt forms a larger share of their balance sheets (Graph 6.C). This relationship holds whether or not we focus on jurisdictions with a higher-rated sovereign (left-hand pairs of bars) or on those with lower-rated sovereigns (right-hand pairs of bars). In general, positive correlations are more frequent for lower-rated sovereigns.

Central bank reserves can reduce the correlation of perceived bank and sovereign risk. As with the holdings of sovereign debt above, we group country-quarter correlations by the share of reserves on banks' balance sheets (high in the top third of the distribution, low in the bottom two thirds). The frequency of positive correlations is lower when reserves form a larger share of a bank's portfolio (Graph 6.D). This finding does not depend in qualitative terms on sovereign credit ratings. That said, when banks' reserves holdings are low, the frequency is higher for those with a worse-rated sovereign (brown bars).

The mitigating effect of central bank reserves on the bank-sovereign CDS co-movement could reflect different views on the two types of public sector liability.¹² For instance, market participants could perceive reserves as less subject to credit risk and as carrying greater liquidity benefits because they can be used to settle

¹⁰ The rising interest rate environment in 2022 doubtlessly also affected CDS spreads, but the correlation of those spreads in our sample was not appreciably different from that in the post-outbreak period more generally.

¹¹ We do not also consider bank credit ratings. It is generally uncommon for banks to be better rated than their sovereign.

¹² A greater share of reserves may also mean a smaller heft of other exposures that correlate strongly with sovereign risk (eg corporate debt constrained by a sovereign ceiling).

payments or meet margin calls at par.^{13,14} Likewise, some national supervisors require banks to satisfy requirements for intraday liquidity needs with central bank reserves.

Refining our analysis by considering continuous measures of sovereign debt and reserve holdings delivers three main messages. First, the patterns shown in Graph 6.B-D are robust (Annex, Table 1). Second, the impact of these links on the correlations of banks' and sovereigns' CDS spreads is economically meaningful. When sovereign debt amounts to 11% of assets, the average for banks in EMEs, the bank-sovereign CDS correlation would be higher by 0.1 than when there are no sovereign debt holdings. For comparison, the average of such correlations in the euro area was near zero in 2009 but rose to a peak of 0.5 during the euro area debt crisis. Third, the moderating impact of reserve holdings on CDS correlations remains when holding the share of sovereign debt constant.

Government-backed loan guarantees, which we do not examine, can in principle affect the results in this section. Such guarantees aim to transfer the credit risk of eligible loans from banks to the sovereign. However, the decline in banks' credit risk can potentially be offset by an increase in the credit risk of their sovereign debt holdings. This is especially the case when the sovereign's capacity to absorb additional risk is compromised. Overall, such guarantees add a new dimension to the bank-sovereign nexus and thus deserve careful examination in future research.

Conclusion

By quantifying the materiality of the sovereign-bank nexus, this article delivers a number of broader messages. For one, the adequate capitalisation and financial health of banks are of paramount importance because they are key investors in the sovereign debt market and can play a stabilising role in early stages of a crisis. In addition, public policy – such as LSAP and FFL programmes but also prudential requirements – can directly affect the bank-sovereign nexus by changing the amount of sovereign debt and central bank reserves on banks' balance sheets. Since such effects also influence the potential for spillovers between sovereigns and banks, they merit authorities' attention in addition to the primary objectives of the policies.

¹³ That said, sovereign bonds would be the highest-quality collateral for entities without access to central bank reserves. Our data do not allow us to rule out a scenario in which central bank interventions, surfacing as higher reserves in the banking system, reduced and stabilised sovereign CDS spreads but not bank CDS spreads.

¹⁴ Brutti (2011) models the liquidity role of sovereign debt in the bank-sovereign nexus.

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Annex

This annex describes the computation of the correlation between bank and sovereign CDS spreads and provides supplementary analysis linking it to measures of the bank-sovereign nexus. We use daily data for CDS spreads of five-year USD contracts, which are the most liquid contracts and are internationally comparable. We compute a bank CDS spread at the country level by averaging the CDS spreads of major banks located in that country. These banks are headquartered primarily in the country, but we also include foreign subsidiaries when they have their own CDS spread.

We construct a measure for the correlation of bank and sovereign CDS prices along the lines of de Bruyckere et al (2013) and Acharya et al (2014), proceeding in three steps. First, we compute the daily log change in CDS prices. Second, we remove global common factors by regressing these changes on time fixed effects α_t :

$$\Delta \log(CDS_{ct}^i) = \alpha_t^i + \varepsilon_{ct}^i,$$

where c indexes countries, t indexes time (day), and i stands either for the banking sector in a country or the sovereign. Third, we calculate the following correlation: $y_{ct} = \text{corr}(\varepsilon_{ct}^{\text{bank}}, \varepsilon_{ct}^{\text{sov}})$ within each country and quarter.

To complement the analysis in the main text, we quantify the relationship of y_{ct} with the size of financial links between banks and sovereigns or central banks. We use three measures of these links: the share of outstanding sovereign debt held by resident banks, $D/TotalD$; the share of domestic sovereign debt on banks' balance sheet, $D/BAssets$; and the share of reserves on banks' balance sheet, $Reserves/BAssets$. We employ a regression approach, which allows us to examine each measure while holding the others constant:

$$y_{ct} = \alpha + \beta_1(D/TotalD)_{ct} + \beta_2(D/BAssets)_{ct} + \beta_3(Reserves/BAssets)_{ct} + u_{ct}$$

The results (Table 1) corroborate those in Graph 6. The correlation is stronger when banks are larger as sovereign debt investors (column 1), sovereign debt is larger on banks' balance sheet (column 2) or reserves are smaller on banks' balance sheet (column 3). The latter result is unaffected by controlling for banks' holdings of sovereign debt (column 4). The coefficient β_2 loses its significance in the last specification because of collinearity between $D/TotalD$ and $D/BAssets$.

Bank-sovereign links and bank-sovereign CDS correlations ¹					Table 1
	(1)	(2)	(3)	(4)	
$(D/TotalD)_{ct}$	0.004***			0.005**	
$(D/BAssets)_{ct}$		0.008***		0.003	
$(Reserves/BAssets)_{ct}$			-0.023***	-0.021***	
Observations	1709	396	396	385	
R ²	0.03	0.02	0.19	0.21	

¹ * p<0.1 ** p<0.05 *** p<0.01

Sources: Arslanalp and Tsuda (2014a, 2014b); BIS locational banking statistics; Markit; Fitch; authors' calculations

Technical annex

Graph 1, Graph 2.B and Graph 2.C: The latest updated data for [AEs](#) and [EMEs](#) released by the authors on 6 January 2023 are used in the article. We use the BIS convention for classifying countries as AEs and EMEs, which differs from that in the source data. AEs comprise AU, AT, BE, CA, DK, FI, FR, DE, GR, IE, IT, JP, LT, LV, NL, NZ, NO, PT, SI, ES, SE, CH, GB and US; and EMEs comprise AR, BR, BG, CL, CN, CO, CZ, EG, HU, IN, ID, KR, MY, MX, PE, PH, PL, RO, RU, ZA, TH, TR, UA and UY. Not available (missing values) for Russia in Q1 2002 and Q2 2002 have been extrapolated. Other investors (Graph 2.B and 2.C) comprise resident as well as non-resident non-banks, and non-resident official sector.

Graph 2.C: Central bank assets are claims on domestic real non-financial sector by the central bank. The data are sourced from the World Bank's Global Financial Development Database (the latest update as of 23 September 2022). Missing values have been interpolated and extrapolated: from 2018 onwards for AR; in 2000 for AT, BE, ES, FI, FR, DE, GR, IT, NL, PT and RU; from 2019 onwards for DK; in 2000 and 2002 for IR; from 2006 to 2014 for LV; from 2004 to 2005 and 2010 to 2019 for RO; in 2004 and from 2007 to 2011 for SE; from 2018 onwards for CH; and in 2021 for TH. Data for Mexico are not available.

Graph 3: Banks in the United States include domestically chartered commercial banks, US branches and agencies of foreign banks and Edge Act and agreement corporations. US Treasuries include the non-MBS Treasury and agency securities. Banks in Japan include city banks, regional banks, trust banks and foreign banks; positions of Japanese banks' foreign branches are excluded.

Graph 4: Based on a constant population of reporting jurisdictions (from Q1 2018) that reported local and cross-border claims on governments (in domestic as well as foreign currencies). Outstanding amounts are adjusted for breaks in series and changes in foreign exchange rates, with first quarter value as the initial stocks. Euro area banks comprise those that are residents in 11 countries: AT, BE, DE, ES, FR, GR, IE, IT, LU, NL and PT. Banks resident in seven other advanced economies (AU, CA, CH, DK, GB, NO and SE). Banks resident in six emerging market economies (ID, KR, MY, TW, SA and ZA).

Graph 5: Share by counterparty calculated after aggregating amounts outstanding within each reporting country group, excluding claims on regional residual counterparties, counterparties unallocated by country and international organisations. The sample of banks comprises euro area banks located in AT, BE, CY, DE, ES, FR, GR, IE, IT, LU, NL and PT; other advanced countries' banks located in AU, CA, CH, DK, GB, NO and SE; and emerging market and developing economies banks located in ID, IN, KR, MY, TW, SA and ZA. In the x-axis, AE=United Arab Emirates.

Graph 6: Correlation of daily log changes in five-year sovereign CDS spreads and in average five-year CDS spreads of banks located in the sovereign's country (only CDS denominated in US dollars included). Day fixed effects are removed from CDS price changes in the panel, and the residuals are then correlated within each quarter for each country. The bars show the share (within each group) of country-quarter observations where the bank-sovereign correlation is positive and statistically different from zero with 90% confidence. For panels B to D, observations are grouped by being above/below the 66th percentile of the bank-sovereign link variable in the panel, as well as by the credit rating of the sovereign.