BIS Quarterly Review

International banking and financial market developments

September 2023

BANK FOR INTERNATIONAL SETTLEMENTS

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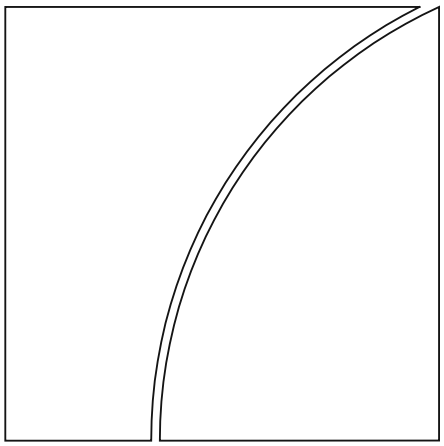

International banking and financial market developments

BIS Quarterly Review
Monetary and Economic Department

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Special features

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	Türkiye	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

Resilient risk-taking in financial markets

With the end of the hiking phase in sight, investors focused on macroeconomic developments during the review period, while staying attuned to their policy implications.[1] Government bond yields rose in advanced economies (AEs), with term structures reflecting increasingly diverse economic outlooks. Despite a spell of de-risking in August, risk-taking was generally resilient, including in emerging market economies (EMEs).

Notable differences marked the evolution of government bond yields in China, the euro area and the United States. While US long-term yields reached highs not seen since before the Great Financial Crisis, such yields barely rose in the euro area. These dissimilar paths were driven by inflation-adjusted, ie real, yields consistent with a stronger economic outlook in the US than in the euro area. As short-term rates rose in the euro area on the back of stubborn inflation, the term structure there inverted further. Bond yields largely declined in China, amid a faltering recovery from Covid restrictions and monetary policy easing.

US Treasuries were at the centre of heightened market volatility in early August. Yield rises accelerated as investors became more convinced that higher rates were here to stay following better than expected US growth numbers. In addition, several, almost concurrent announcements fuelled investor unease and led to a sell-off: an unexpected increase in the issuance of long-dated bonds by the US government; the greater flexibility in the Bank of Japan's yield curve control policy; and a downgrade of the US sovereign credit rating. The upward pressure on US yields spilled over to other AE government bond markets.

Risky assets held up firmly, but also exhibited some divergence across major economies due to the differing outlooks. Consistent with developments in core bond markets, stock returns were higher in the US than in the euro area and China. Likewise, sentiment in corporate credit markets seemed to improve in the US but remained relatively subdued in the euro area. US credit spreads narrowed below historical landmarks and issuance gained some traction. In contrast, bank lending to firms was still sluggish across jurisdictions.

Financial market developments in EMEs reflected a new phase of monetary policy across most jurisdictions as well as external factors. Short yields fell as the monetary policy stance began to turn, with most central banks pausing rate hikes or implementing cuts. Risk-taking continued, with higher-yielding currencies attracting capital inflows. In August, EME spreads and exchange rates also appeared sensitive to the temporary bout of de-risking in AE financial markets: the appreciation of Latin American currencies came to a halt, speculative positions in currency futures declined, and the rise of long-term yields accelerated. In addition, headwinds seemed to emerge from China's slowdown.

[1] The period under review extends from 1 June through 8 September 2023.

Key takeaways

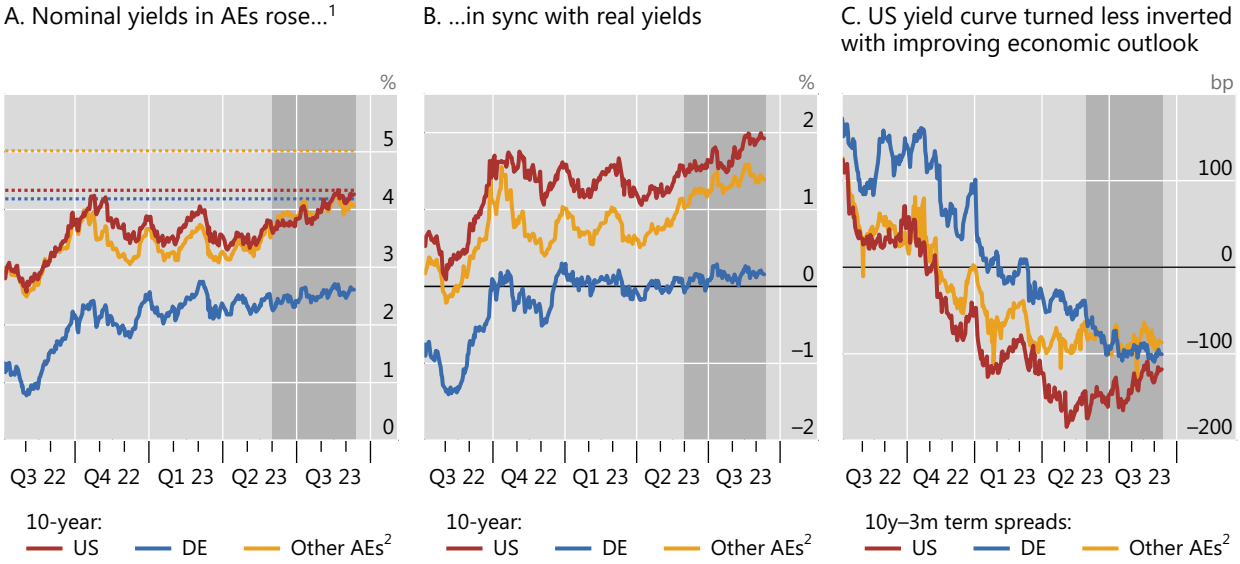
- *Advanced economy government bond yields generally rose, whereas yield curves echoed differences in inflation and economic growth dynamics across jurisdictions.*
- *Risky asset markets were largely resilient, with stock markets also pricing in the diverging growth outlooks across major economies.*
- *Financial markets in EMEs reflected differences in policy outlooks and macroeconomic environments across regions, with some de-risking in August amid mounting concerns over the outlook for China.*

US yields led the way upwards

Disinflation and growth have proceeded unevenly across countries. The stronger performance of US markets has shaped trends in core bond markets during the review period. And investors remained closely attuned to the policy implications of the evolving macroeconomic scenarios for these markets.

The paths of long-term government yields were underpinned by the trajectories of real yields, which seemed to reflect both macroeconomic outlooks and perceptions of the monetary policy stance. Ten-year yields rose across most major AEs and reached their highest levels since the Great Financial Crisis in the US (Graph 1.A). And the country's steadily rising real yields (Graph1.B) were consistent with favourable economic developments, eg a resilient, consumer-led growth. In contrast, long-term nominal yields rose only slightly in Germany and other euro area countries. This reflected largely flat real yields, as the outlook for the region darkened, amid persistent weakness in manufacturing as well as flatlining exports and consumption.

US yields led the way upward, spurred by strong economic outlook — Graph 1



The shaded area indicates 1 June–8 September 2023 (period under review).

[1] The horizontal lines indicate January 2007–June 2008 average. [2] Simple average of AU, CA and GB.

Sources: Bloomberg; Datastream; BIS.

The increase in long-term real yields, particularly in the US, was also consistent with a growing conviction by investors that higher rates were here to stay.

Changes in term spreads reflected differences in the pace of disinflation and growth outlooks across jurisdictions. To be sure, yield curves remained strongly inverted in all major AEs, despite a general perception that deep recessions are likely to be avoided. Yet the inversion of the US yield curve moderated (Graph 1.C), as lower inflation kept a lid on short rates while long yields rose. Meanwhile, yield curve inversion deepened further in Germany, where flatter long yields went hand in hand with quickly rising short rates. The latter rose on high and stubborn inflation, which reinforced perceptions that monetary policy will remain tight in the euro area.

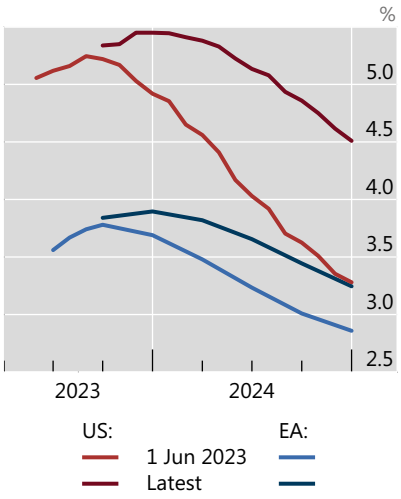
The path of policy rates priced into futures markets in major AEs became more in line with the cautious tone of central banks. The Federal Reserve and the ECB raised policy rates further in July, and emphasised in their communications that future decisions would be data-dependent. Officials also indicated that, while rates might not rise much more, they could stay at their current levels for a prolonged period if inflation remained above target. In accordance with these messages, futures markets in both in the US and the euro area priced in higher rates for 2024 than they had just a few months before (Graph 2.A). And the expected peak in policy rates was pushed higher and later. That said, investors still seemed to anticipate rate cuts as early as the second quarter of 2024, and much deeper in the US than the euro area.

A sell-off of long-term bonds took place in August amid a succession of negative news for US Treasuries. Early in the month, the US Treasury announced a large increase in the issuance of long-maturity securities, catching investors by surprise. This was almost concurrent with the downgrade of the US sovereign credit rating by a major agency. In addition, movements in yields may have been amplified by the lower liquidity of summer trading as well as the partial unwinding of the growing

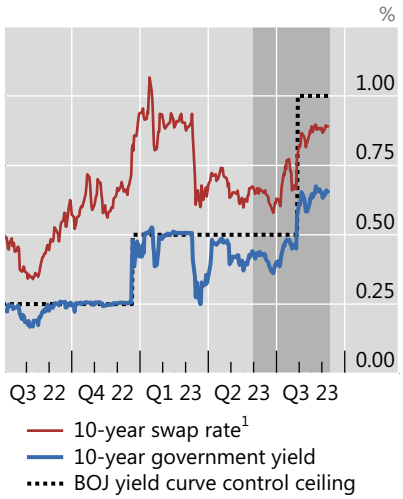
The US dollar fluctuated as policy rate expectations varied across jurisdictions

Graph 2

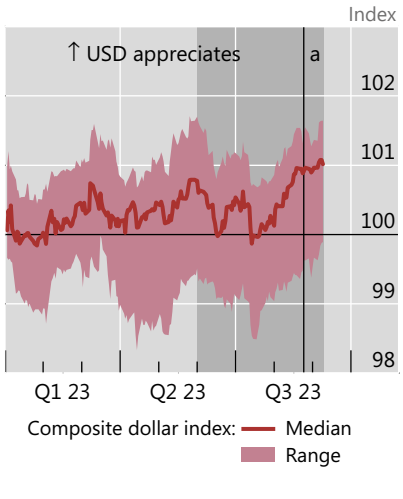
A. Futures-implied policy rate paths shifted upwards and rightwards



B. Yields remained below the implicit YCC ceiling in Japan



C. US dollar appreciated after wide fluctuations[2]



YCC = yield curve control.

[a] Start of Jackson Hole Economic Symposium (24 August 2023).

[1] Simple average of 10-year swap rates from nine different sources. [2] See technical annex for details.

Sources: Bloomberg; Datastream; BIS.

build-up of leveraged speculative positions in US Treasury markets (Box A). Although the sell-off did not last long, it did appear to spill over to government bond markets of other AEs. Yields across AEs subsequently paused their upward momentum after the Federal Reserve's Jackson Hole symposium in late August, as investors appeared more convinced that a pause in rate hikes was in sight, especially following a string of relatively weak US data releases, including a subdued jobs report.

Box A

Margin leverage and vulnerabilities in US Treasury futures

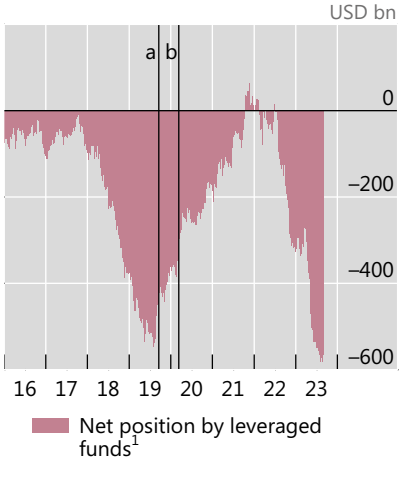
*Fernando Avalos and Vladyslav Sushko*①

Speculative positions by leveraged investors in US Treasuries are back. Over recent months, leveraged funds have built up net short positions in US Treasury futures of about $600 billion (Graph A1.A), with more than 40% of the net "shorts" concentrated in two-year contracts (Graph A1.B).② These funds had been at a comparable level of net shorts in the run-up to the repo market turmoil of September 2019 (marker a) and the US Treasury market dislocations of March 2020 (marker b). This box examines current developments in the light of those experiences. It focuses on the often overlooked leverage associated with futures trading, and how sudden fluctuations in this "margin leverage" may give rise to destabilising margin spirals.③

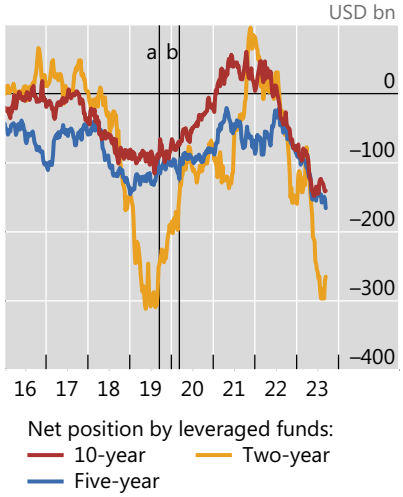
Speculative positions in US Treasury futures rose despite higher initial margins

Graph A1

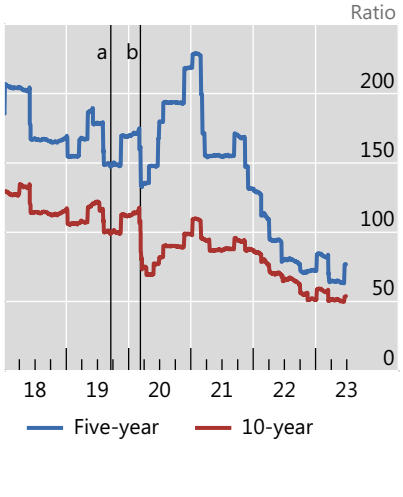
A. Surge of leverage funds' net short positions in US Treasury futures…



B. …has been concentrated at the belly of the yield curve



C. Leverage fell sharply before distress episodes in 2019 and 2020[2]



[a] Repo market stress (17 Sep 2019). [b] "Dash-for-cash" (9 March 2020).

[1] The sum of net positions in two-, five- and 10-year US Treasury futures. [2] Contract price over initial margin.

Sources: Commodity Futures Trading Commission; Bloomberg; Chicago Mercantile Exchange, BIS.

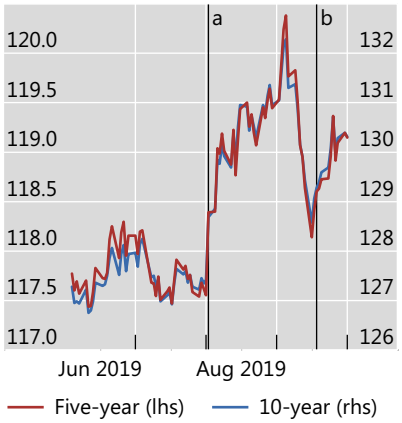
Back in September 2019 and March 2020, price discrepancies between futures and the underlying cash bonds (the cash-futures "basis") encouraged highly leveraged funds to engage in relative value trades. Recent evidence suggests that the same type of trade may be driving the current build up.④ When Treasury futures are priced at a premium relative to cash bonds, a common relative value trading strategy consists of selling futures forward (building short positions in futures), matched by purchases of bonds (long positions in the cash market). Such a trade generates profits because the futures and cash prices eventually converge on the futures contract's expiration date. Since the basis is typically narrow, investors need to boost profits through very high leverage, ie they commit little own capital and borrow the rest. A key way of levering up involves the long positions: investors borrow cash in the repo market (usually having to roll over daily) by posting their US Treasury holdings as collateral.

A less discussed aspect of the leverage involved in the cash-futures basis trade stems from futures markets. When entering a futures contract, traders need to post initial margin (IM), ie cash or highly liquid assets that the central counterparty (CCP) keeps as collateral to protect itself against counterparty credit risk. The ratio of futures contract value relative to the IM determines the allowed leverage. For instance, if traders initiate a futures position for $100 with an IM of $20, they are effectively borrowing $80 and the leverage of the position is 5x (= 100 / 20). Leverage in actual US Treasury futures was very high before the pandemic, at about 175x and 120x on average for five- and 10-year Treasuries, respectively (Graph A1.C). It has declined since 2021, as the increased volatility in the US Treasury market has led to higher required IMs, but is still elevated, at about 70x and 50x, respectively. A rise in IM requirements mechanically induces deleveraging, as traders have to either post additional cash to fulfil IM requirements, or close their positions.

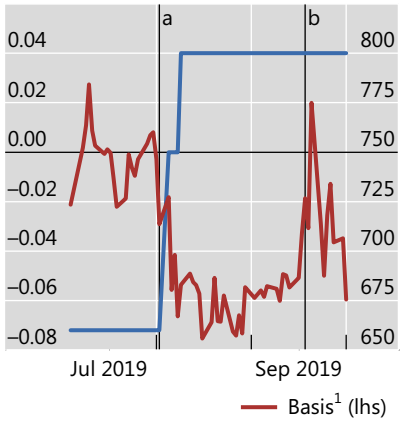
Large initial margin hikes preceded the sudden closing of positions

In US dollars — Graph A2

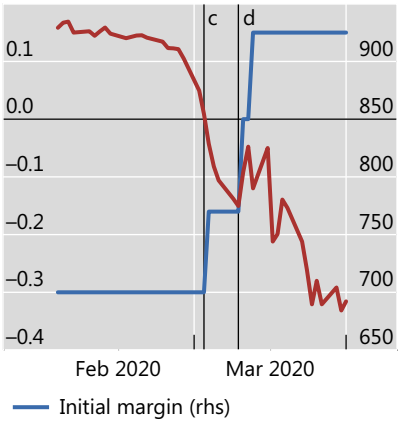
A. As futures prices rose with the hike in IMs…



B. …the basis turned in September 2019…



C. …and March 2020



[a] Increase in margins (1 August 2019). [b] Repo market stress (17 September 2019). [c] Increase in margins (1 March 2023). [d] "Dash-for-cash" (9 March 2020).

[1] Five-year cash-futures basis, expressed as futures price (adjusted by the conversion factor) minus the spot price of the cheapest-to-deliver bond.

Sources: Bloomberg; Chicago Mercantile Exchange; BIS.

A disorderly reduction in margin leverage exacerbated fixed income market distress in both September 2019 and March 2020. The two episodes were preceded by significant hikes in IMs (Graph A1.C, drops before vertical markers), to which leveraged relative value traders appeared to respond at least in part by unwinding their positions. This was evident from the jump in the price of US Treasury futures on the day of the IM rise, in early August 2019 (Graph A2.A). As cash bond prices outpaced the rise in futures prices amid increased volatility, the basis inverted, creating further incentives for winding down the trades (Graph A2.B, red line). The ensuing dynamics placed protracted upward pressure on futures prices (Graph A2.A). Similar market dynamics were observed in March 2020, exacerbating the heightened volatility in US Treasury markets caused by uncertainty and lockdowns (Graph A2.C).

Given these experiences, the current build-up of leveraged short positions in US Treasury futures is a financial vulnerability worth monitoring because of the margin spirals it could potentially trigger. While this channel was well recognised in the March 2020 "dash-for-cash" episode,⑤ other factors garnered more attention in the context of the September 2019 repo market stress.⑥ Yet the margin deleveraging in August 2019 may have presaged the funding market disruptions that followed a month later. Margin deleveraging, if disorderly, has the potential to dislocate core fixed income markets.

① The views expressed are those of the authors and do not necessarily reflect the views of the BIS. ② Hedge funds' net short positions reflect liquidity provision to asset managers, and can be underpinned by a variety of trading strategies. ③ See S Aramonte, A Schrimpf, and H S Shin, "Margins, debt capacity, and systemic risk", *BIS Working Papers*, no 1121, September 2023. ④ See D Barth, R Kahn and R Mann, "Recent developments in hedge funds' treasury futures and repo positions: is the basis trade 'back'?", Board of Governors of the Federal Reserve System, *FEDS Notes*, August 2023. ⑤ S 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. ⑥ See eg F Avalos, T Ehlers and E Eren, "September stress in dollar repo markets: passing or structural?", *BIS Quarterly Review*, December 2019, pp 12–14.

The short-lived sell-off may have been exacerbated by an announcement of the Bank of Japan, which introduced greater flexibility to its yield curve control policy. In late July, the Bank effectively raised the upper bound of the intervention band for the 10-year JGB yield to 1%, while otherwise maintaining its accommodative policy stance. In practice, this new ceiling no longer restricted either JGB yields or 10-year swap rates, both of which remained well below the new operational ceiling (Graph 2.B). In the wake of the announcement, investors fretted over potential spillovers, as Japanese investors could eventually find it profitable to repatriate funds from several asset classes, including US Treasuries.

The US dollar saw wide fluctuations during the review period. After weakening in July, it strengthened persistently, as the US outlook improved and real yields rose further (Graph 2.C), and then lost some momentum again after the Jackson Hole meeting. At the level of currency pairs, differences in the attendant monetary outlooks played a role. The dollar remained largely flat vis-à-vis currencies whose interest rates were expected to remain relatively high, such as the euro and the British pound, and appreciated markedly vis-à-vis those at the opposite end of the spectrum, such as the Scandinavians and the yen. It appreciated similarly against commodity currencies, such as the Australian and Canadian dollar, not least because of perceptions of a weakening demand from China.

Investors ploughed ahead in risky assets

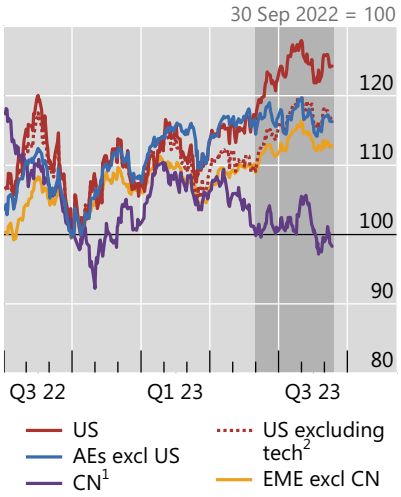
Risky assets extended their gains from the previous quarter, despite a brief pause in August alongside the heightened volatility in fixed income markets. With the end of the hiking cycle perceived to be in sight and the prospects of US recession fading, primary market activity in corporate credit markets regained some dynamism, particularly in the US high-yield segment. However, bank lending remained subdued across jurisdictions.

Beyond the overall gains, equity markets also reflected the diverging economic outlook across major economies. US equities outperformed those in other regions (Graph 3.A), in part because of fading recession fears, and the exuberance about technology stocks. Excluding those stocks, the US market performance was closer to global averages (dashed red line). In turn, the gains were smaller in other AEs, particularly European stocks, in part due to spillovers from China's economic malaise. The losses in Chinese stocks deepened during the review period, as the economic rebound after the lifting of Covid restrictions increasingly disappointed. Reflecting the woes in the property sector, the country's construction and infrastructure stocks were among the worst performers during the review period, together with retailing (Graph 3.B).

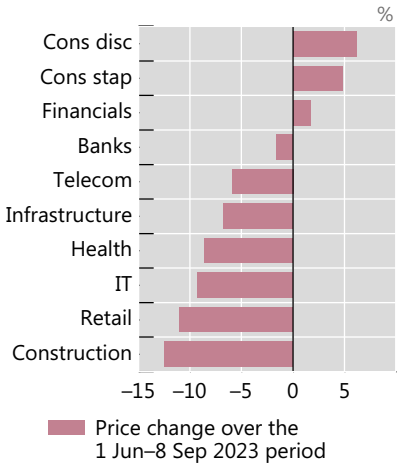
Risk-taking continued in equity markets and reflected diverging outlooks

Graph 3

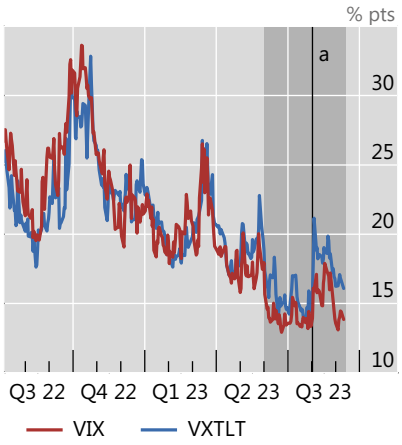
A. Global equity prices generally gained ground



B. China's stock market weighed down by key sectors[3]



C. Volatility rose briefly in August



The shaded area indicates 1 June–8 September 2023 (period under review).

[a] US Treasury announces increase in long-term securities issuance (2 August 2023).

[1] Shanghai Shenzhen CSI 300 index. [2] S&P 500 excluding information technology index. [3] Cons disc = consumer discretionary; cons stap = consumer staples.

Sources: IMF; Bloomberg; Datastream; BIS.

Stock price fluctuations reflected macroeconomic news, as investors digested their policy implications. For example, equity markets lost some ground with a better-than-expected second quarter release of US GDP figures in late July, as it seemed to raise the likelihood of tighter policy ahead.

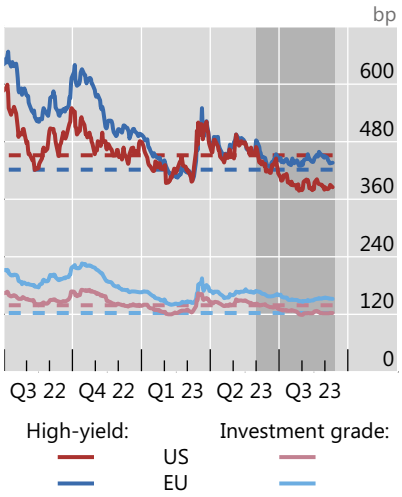
Likewise, equity and bond yield volatilities co-moved as investors interpreted macroeconomic surprises in terms of their implications for future interest rates. The VIX jumped alongside the implied volatility of US long-term yields, as the late July release of better than expected US GDP data suggested higher future interest rates. Subsequently, both receded in the wake of the Jackson Hole meeting and weaker-than-expected US job openings data in late August (Graph 3.C).

Market funding conditions for banks remained somewhat tighter. The banking sector stock subindices continued to trail the broader equity market aggregates in major economies. Recent downgrades of mid-sized US banks by a major rating agency were a probable recent contributing factor, as was a negative watch/outlook for some of their larger peers. Also, conditions in bank short-term funding markets became more discriminating (Box C), as liquidity was gradually removed by central banks' quantitative tightening. At the same time, sovereign debt issuance continued to grow.

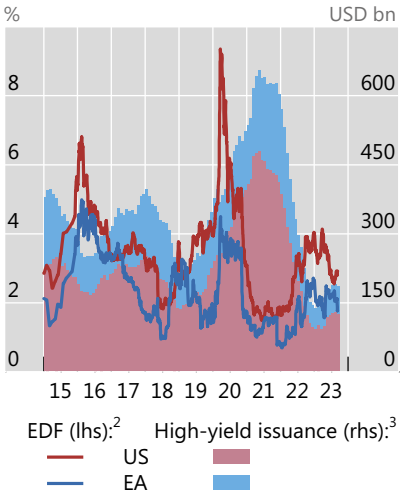
Corporate bond markets showed signs of improvement

Graph 4

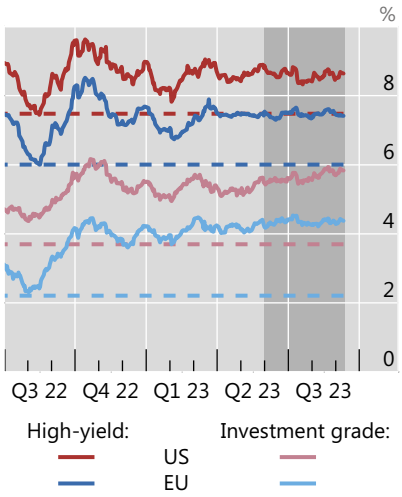
A. Corporate spreads narrowed further in the United States[1]



B. High-yield issuance picked up as expected default frequencies decline



C. Corporate yields remained at high levels[1]



The shaded area indicates 1 June–8 September 2023 (period under review).

[1] The horizontal lines indicate 2005–current medians. [2] Daily average across available non-financial corporate EDF. [3] Twelve-month rolling sum.

Sources: Dealogic; ICE BofAML indices; Moody's; BIS.

Corporate credit spreads, which had narrowed earlier in the review period, found a floor during the de-risking episode of August. Spreads had fallen well below long-term watermarks in the US, in both the investment grade and high-yield segments, indicative of sustained risk-taking (Graph 4.A). On the back of improved sentiment, high-yield issuance regained momentum after the steep decline of 2022 (Graph 4.B, red bars), as the US stock market gains drove a material fall in expected default frequencies (red line). Spread compression was more moderate and issuance scarcer in the euro area, where the direction of expected defaults was less clear amid stagnant economic prospects (blue line).

Despite the compression in credit spreads, corporate funding costs reached highs well above long-term levels as a result of rising benchmark rates. Corporate bond yields in both the investment grade and high-yield segments remained well above their long-term averages (Graph 4.C). This may represent a significant financial burden for some firms going forward. For now, many firms have been able to postpone new borrowing, given their diminished cash needs after strong debt issuance during the low-for-long era (Box B). Nevertheless, corporate default rates have started to edge up. High-yield bond default rates reached 4% in July (Graph 5.A, light red line), taking the aggregate default rate for all US issuers to over 2%. As debt maturities loom large within the next three years, highly leveraged firms with low profitability may come under pressure and defaults may rise further.

Box B

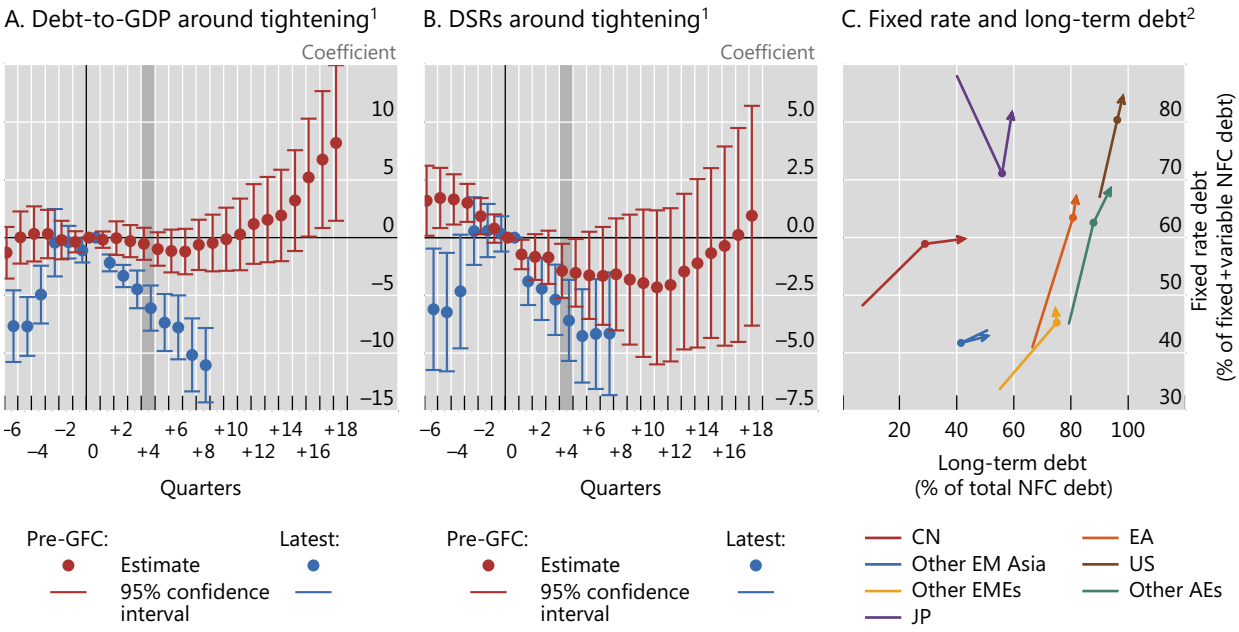
Non-financial corporates' balance sheets and monetary policy tightening

*Miguel Ampudia, Egemen Eren, Marco Lombardi*①

The recent weak growth in credit to non-financial corporates reflects both supply and demand factors, as illustrated in the main text. The supply factors include higher interest rates and overall tighter lending standards. Demand factors include a weakening economic outlook, not least due to tighter monetary policy. In addition, the circumstances preceding the ongoing tightening cycle also helped non-financial corporates (NFCs) build liquidity buffers and, more generally, strengthen their balance sheets. This box documents a decline in debt service burdens since the start of the current tightening episode and argues that this development is exceptional and due to NFCs' pre-positioning during the low interest rate era. It also documents a recent worsening of NFCs' balance sheets and a looming rise in debt refinancing needs at higher interest rates.

There are stark differences between the last pre-GFC tightening episode (2004–07) and the current one in terms of NFC debt-to-GDP and debt service ratios (DSRs). A cross-country analysis suggests that NFC debt-to-GDP and DSRs were flat or even declining prior to the pre-GFC tightening cycle and then steadily increased (Graph B1.A and B1.B, red dots). By contrast, the current tightening episode (blue dots) displays a different pattern: debt-to-GDP and DSRs were increasing before the tightening started, reflecting the effects of the pandemic and the forceful policy response. These ratios subsequently declined, notwithstanding the substantial monetary policy tightening that has been deployed so far.

NFCs took advantage of easy credit conditions — Graph B1



[1] Time fixed effects in a cross-country panel regression of NFC debt-to-GDP and DSRs, including also country fixed effects. The base quarter (vertical line) is Q2 2003 for the pre-GFC period and Q1 2021 for the latest tightening. The shaded area is the quarter in which US monetary policy tightening began. [2] The start (end) of an arrow represents 2008 (2021). The midpoint represents 2019. Median value per country. Only firms reporting between 2008 and 2021 are used.

Sources: IIF; S&P Capital IQ; national data; authors' calculations.

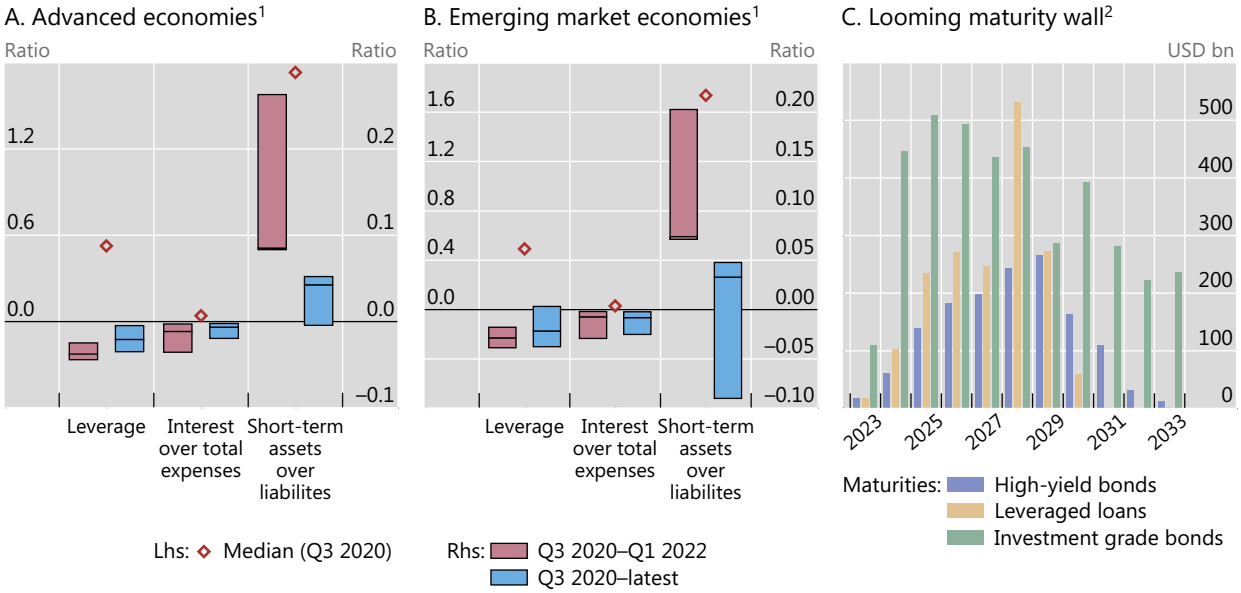
One explanation of these diverging experiences stems from different inflation dynamics in the two episodes. Before the pre-GFC tightening cycle, inflation had been rising gradually and peaked at a very moderate level. By contrast, the current tightening occurred in the wake of an exceptionally swift rebound in economic activity due to the post-pandemic reopening and an unexpected surge of inflation to levels last seen in the 1980s. Thus, while NFCs' nominal revenues increased moderately in the earlier episode, they have surged recently. While such developments

would typically reduce the real value of NFCs' debt burden, all else the same, the ultimate effect depends on the evolution of debt payments.

This underscores the importance of a second distinctive feature of the current episode: the initial composition of NFC debt. In the pre-GFC episode, NFCs' balance sheets featured mostly debt at short maturities and variable rates. As a result, the policy tightening at that time led to a steady and progressive increase in borrowing costs, which overwhelmed the modest increase in nominal revenues, driving the rise in the debt-to-GDP ratio and the DSR. Before the current tightening, by contrast, NFCs took on more debt at long maturities and at fixed rates, benefiting from low interest rates, generous fiscal support packages and easy credit conditions in the wake of the Covid-19 pandemic. To be sure, this process had already started in some jurisdictions during the low-rate period that followed the Great Financial Crisis (Graph B1.C). When the pandemic broke out, the process continued and even intensified for many NFCs. Against this backdrop, NFCs' debt payments have stayed roughly stable despite the ongoing tightening, which – together with the effect of inflation on revenues – depressed the real value of NFCs' debt burden.

Between the pandemic and the start of the tightening cycle, firms not only secured funding at favourable conditions, but also actively strengthened their balance sheets with hefty liquidity buffers. Somewhat paradoxically, this was also facilitated by the increased uncertainty brought about by the pandemic, which prompted firms to postpone investment and use instead the cheap funding secured to acquire liquid assets. Graphs B2.A and B2.B portray this development for NFCs in AEs and EMEs between Q3 2020 and Q1 2022. Relative to initial levels, there were material declines in leverage and in the share of interest expense in total expenses, and a similar increase in the ratio of short-term assets over short-term liabilities (diamonds vs red boxes).

Solid balance sheets are poised to feel the effects of higher rates — Graph B2



[1] The box plots represent changes within periods, 25th, 50th and the 75th percentiles across NFCs. Leverage is calculated as liabilities over assets. [2] Sum of amounts outstanding as of end-August 2023, in the United States. The sample includes around 2,500 high yield bonds, 5,300 leveraged loans and 9,700 investment grade bonds.

Sources: Bloomberg; S&P Capital IQ; author's calculations.

Eventually, NFCs' pre-positioning in the run-up to the current tightening will run its course as a shield against the effect of higher interest rates. Indeed, balance sheets have deteriorated somewhat since the start of the current tightening cycle, as cash balances decreased and new debt was rolled over at higher rates against the backdrop of steadily tightening monetary policy (Graphs B2.A and B2.B, blue boxes). In addition, borrowing demand seems poised to rise, as a significant portion of outstanding debt will mature in three to six years (Graph B2.C). To the extent that NFCs roll their debt over, they will do so at higher interest rates, which will eventually increase the burden of tightening on their balance sheets.

① The views expressed are those of the authors and do not necessarily reflect the views of the BIS.

Box C

Bank CP rates amid asymmetric funding-liquidity conditions across currencies

*Fernando Avalos and Vladyslav Sushko*①

Commercial paper (CP) markets constitute an important source of unsecured funding for banks (Aquilina et al (2023, in this issue)).② Bank CPs are short-term (one- and three-month) and are issued at rates that track other money market rates fairly closely, albeit with a time-varying spread relative to the (nearly) risk-free benchmarks, such as overnight index swap (OIS) rates. A wider (positive) CP-OIS spread indicates tighter funding conditions for banks, reflecting liquidity risk and credit risk premia.③

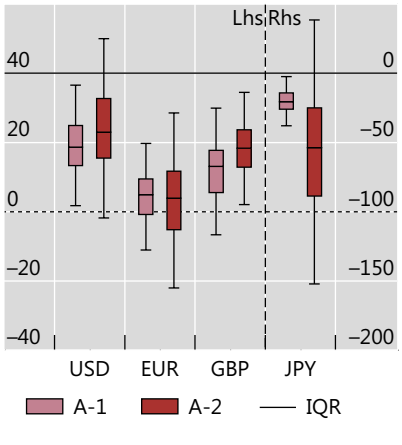
This box studies bank CP spreads across major currencies. It highlights apparent anomalies in CP market pricing that probably stem from abundant liquidity. It also documents how US dollar CP spreads responded to the resolution of the US debt ceiling impasse in early June. The data comprise quotes by CP dealers on the Bloomberg trading platform, posted during the liquid trading hours in Europe and the US: two snapshots per day, from 31 March to 22 August 2023. They also cover issuer identity, tenor, currency denomination and credit rating.

In some currencies, the CP-OIS spread suggests anomalies as regards the compensation that investors demand for liquidity and/or credit risk. While CP-OIS spreads are positive in the US dollar and the British pound, they are approximately zero in the euro and negative in the Japanese yen (Graph C1.A). In the first two currencies, there is thus evidence that liquidity commands a premium, possibly resulting from increased policy rates and reduced bank reserves. In addition, the somewhat wider spreads on lower-rated CP indicate compensation for credit risk (light versus dark red). In comparison, the compressed euro CP-OIS spreads suggest that liquidity is still abundant in the euro area, despite repayments on the ECB's targeted longer-term refinancing operations and its quantitative tightening. Likewise, the similarity of euro spreads across rating categories indicates little compensation for credit risk. Finally, the negative and wide CP-OIS spreads in the yen suggest that yen liquidity continues to be abundant, with investors willing to *pay* a premium to place their yen cash in bank-issued CP.

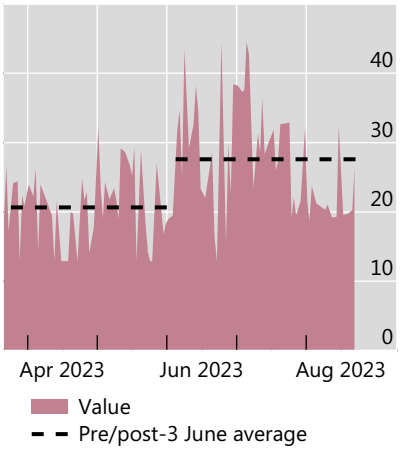
Bank CP spreads across currencies and around the US debt ceiling resolution

In basis points — Graph C1

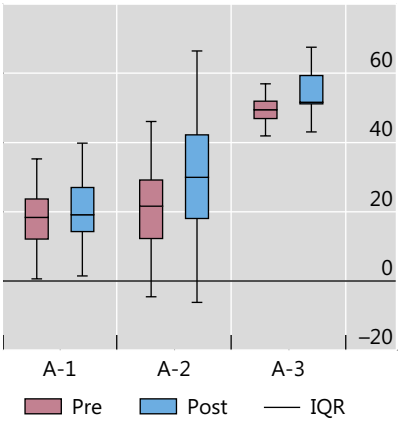
A. CP–OIS spreads across currencies, by issuer rating[1, 2]



B. US dollar CP–OIS rates[2, 3]



C. CP–OIS spreads and the US debt ceiling impasse[2, 4]



[1] 31 March through 22 August 2023 sample period. [2] Three-month tenors. [3] A2-rated CP issuers. [4] Two months before and after the 3 June signing date.

Sources: Bloomberg; BIS.

We also find that bank funding conditions tightened after the US debt ceiling impasse was resolved on 3 June. Namely, the average three-month OIS spread was almost 20 basis points higher for a period of about two months after 3 June compared with about the same period before ((Graph C1.B), dashed lines). This is consistent with investors expecting the debt ceiling resolution to tighten funding liquidity conditions in bank CP markets. This is because the resolution was expected to unleash heavy Treasury bill issuance, materially boosting the supply of low-risk instruments into the short-term funding markets where CP also resides. The effect was most noticeable for CP of the low-rated, A3 issuers (Graph C1.C), which tend to be the first to confront a change in funding conditions. The CP-OIS spread narrowed back in early August, in the wake of the surprise announcement by the US Treasury that new issuance will take place at the long end of the yield curve, which investors did not perceive as a substitute for CP.

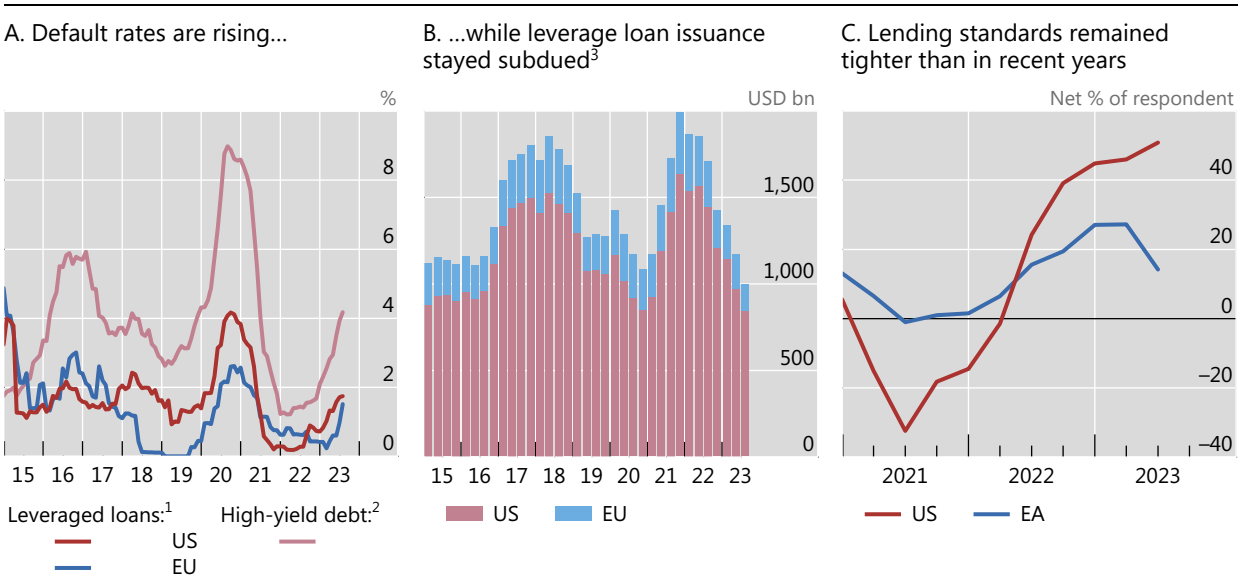
① The views expressed are those of the authors and do not necessarily reflect the views of the BIS. ② M Aquilina, A Schrimpf and K Todorov, "CP and CDs markets: a primer", *BIS Quarterly Review*, September 2023, pp 63 – 76. ③ See, for example, D Gefang, G Koop and S Potter, "Understanding liquidity and credit risks in the financial crisis", *Journal of Empirical Finance*, vol 18, no 5, 2011, pp 903–14.

With default rates on loans also climbing, banks kept their credit extension within modest bounds. Consumer loan delinquency rates rebounded, after being cushioned by fiscal support in the wake of the pandemic. In addition, default rates on leveraged loans rose steadily from below 1% in mid-2023 to approximately 2% most recently in both the US and euro area, with the increase gathering speed in the second half of the year (Graph 5.A, dark red and blue lines). And forward-looking provisions for credit losses surged to the highest levels since the second quarter of 2020. In this context, bank loan growth was weak or negative in all major AEs. Likewise, leveraged loans issuance remained sluggish both in the US and the euro area (Graph 5.B), showing few signs of recovery after the steep decline in 2022.

Both supply and demand factors played a role. For one, survey results indicated tight lending standards (Graph 5.C). And even though market intelligence suggests that banks subsequently became more open to credit extension, they faced weak loan demand. As in the case of corporate bond markets, firms with strong cash buffers were reluctant to borrow at increased lending rates.

Default rates started to edge up and bank lending remained subdued

Graph 5



[1] Twelve-month rolling default rates based, respectively, on Morningstar LSTA US Leveraged Loan Index (LLI) and Morningstar European Leveraged Loan Index (ELLI). [2] Based on Moody's 12-month rolling US speculative-grade default rates. [3] Four-quarter rolling sum.

Sources: Board of Governors of the Federal Reserve System; Datastream; Dealogic; Moody's; PitchBook Data Inc; PitchBook | LCD; BIS.

EMEs confronted with global cross-currents

EME financial markets reflected differences in policy outlooks and macroeconomic environments across regions. As economies grappled with the varying headwinds coming from the slowdown in China, policy outlooks have increasingly diverged.

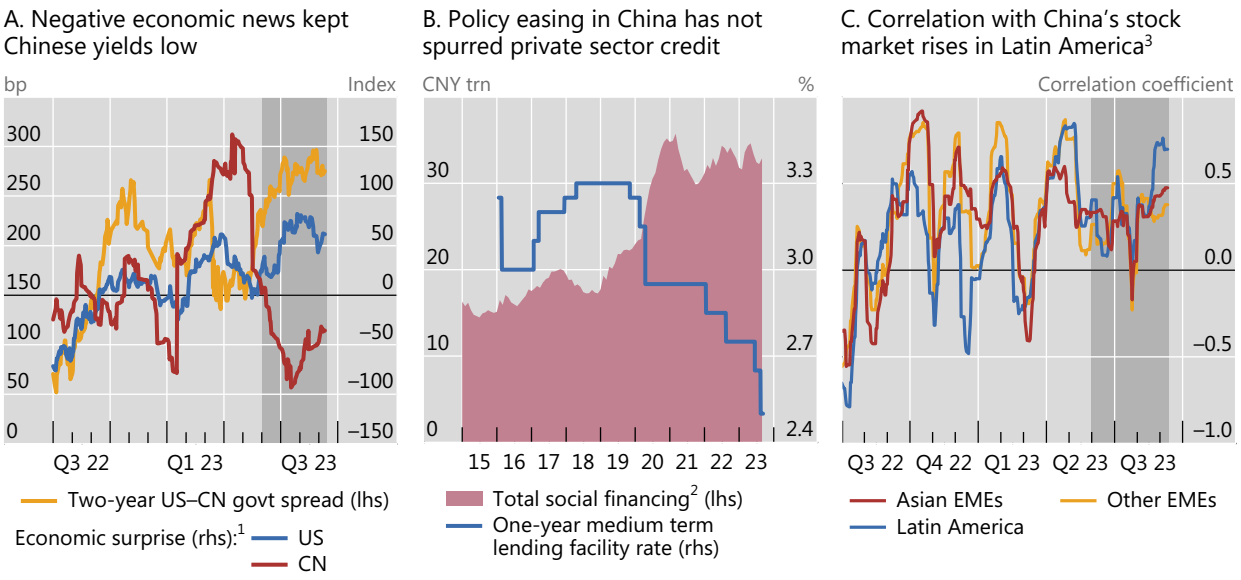
Financial markets reflected China's slowdown. As negative economic surprises piled up during the review period in China, in contrast to the positive surprises in the United States (Graph 6.A, red and blue line, respectively), the respective policy stances diverged. While the Federal Reserve steadily tightened policy during the last two years, the People's Bank of China continued to ease to stimulate credit growth and the economy (Graph 6.B, blue line). Accordingly, the spread between the US and China's two-year government yield widened (yellow line). Despite the easing, growth of credit to the private sector in China was sluggish (red area), and a sustained economic recovery following the lifting of pandemic restrictions failed to materialise.

Investors appeared increasingly concerned about the prospects of global spillovers, should the outlook for China continue to deteriorate. The relatively modest performance of some AE stock markets, as seen above, was one manifestation of that anxiety. In EMEs, correlations with China equities were high during the period under review and rose markedly for Latin American stocks (Graph 6.C). The latter may reflect concerns about the decline in China's demand for commodities, which represent a large share of the region's exports.

Sovereign bond yields reflected the different stages of the respective policy rate cycles across EME regions. Yields on two-year government bonds declined steadily in Latin America and the Europe, Middle East and Africa (EMEA) regions (Graph 7.A). This stemmed from perceptions that the general monetary policy stance in Latin

Financial markets reflected weakness in the Chinese economy

Graph 6



The shaded area indicates 1 June–8 September 2023 (period under review).

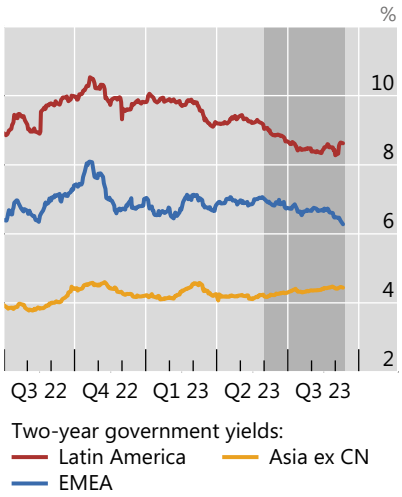
[1] Citi economic surprise index. [2] Twelve-month rolling sum. [3] See technical annex for details.

Sources: Bloomberg; Datastream; BIS.

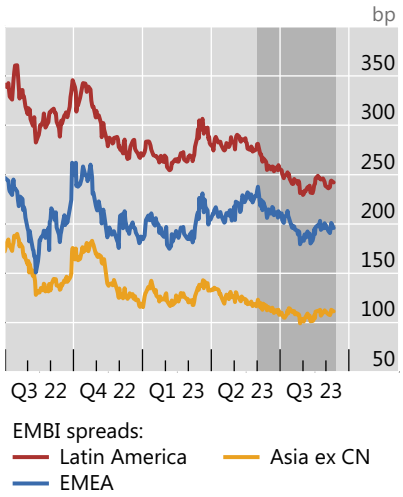
Varying EME macro outlooks permeated into fixed income markets

Graph 7

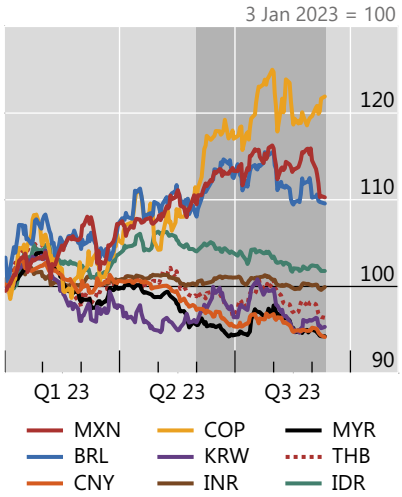
A. EME two-year yields fell outside Asia[1]



B. EMBI spreads remained stable[1, 2]



C. Many EME currencies appreciated against the dollar or remained stable



The shaded area indicates 1 June–8 September 2023 (period under review).

[1] See technical annex for details on country groupings. [2] Strip spreads.

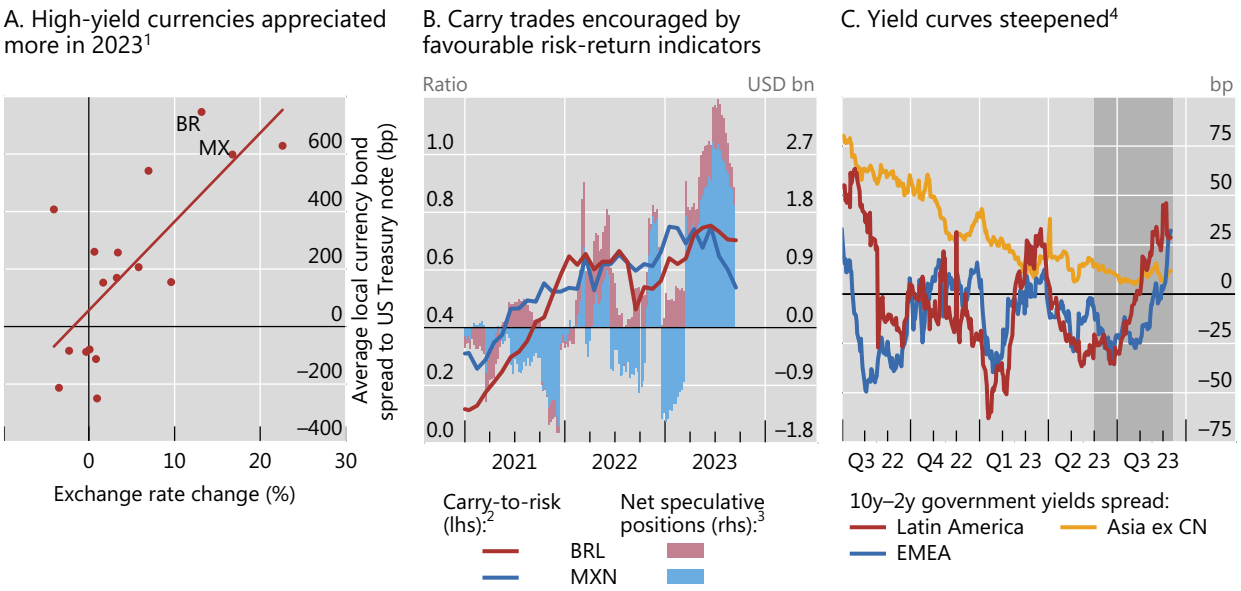
Sources: Bloomberg; Datastream; JPMorgan; BIS.

America was poised to reverse, after steep rate hikes in the past two years. Indeed, the central banks of Brazil and Chile cut policy rates during the review period, with investors expecting the central banks of Colombia and Mexico to follow suit soon, as inflation continued to fall in the region. By contrast, two-year yields in Asian EMEs rose somewhat, even as most central banks in the region put rate hikes on hold. Ostensibly, investors perceived moderate upside risks to inflation.

Foreign investor appetite for EME risk did not wane. Sovereign spreads on US dollar-denominated debt compressed further (Graph 7.B), while the exchange rates of major EMEs either appreciated or held steady (Graph 7.C). Since the beginning of the year, currencies with higher local government bond yields vis-à-vis the comparable US Treasury appreciated further (Graph 8.A). In particular, Latin American currencies, such as the Brazilian real and Mexican peso, appreciated materially against the US dollar. Favourable carry-to-risk ratios provided significant incentives for carry trades (Graph 8.B).

EME spreads and currency markets were sensitive to the temporary bout of de-risking in AE financial markets in early August. Long-term yields in Latin American government bond markets rose and their yield curves steepened (Graph 8.C). In addition, the appreciation of Latin American currencies came to a halt, as carry-to-risk ratios declined and some speculative positions were unwound. Sovereign spreads on US-dollar denominated debt also widened somewhat since August in both Latin America and in EMEA.

Divergence in EME exchange rates seemed to ride on interest rate differentials Graph 8



The shaded area indicates 1 June–8 September 2023 (period under review).

[1] Sample period: January–July 2023. [2] One-month interest rate differential divided by the implied volatility of one-month at-the-money currency options. [3] Proxied by net positions of non-commercial traders. [4] See technical annex for details on country groupings.

Sources: Commodity Futures Trading Commission; Bloomberg; Datastream; BIS.

Technical annex

Graph 2.C: Based on standardised dollar exchange rates (z-scores) against AUD, CAD, CNY, CZK, EUR, GBP, HUF, INR, JPY, KRW, NOK, SEK and ZAR, calculated over the period 3 January 2022–8 September 2023. The index is equal to 100 plus the z-score.

Graph 6.C: Thirty-day moving correlation between log changes of country-level equity index and log change of the Shanghai composite index, averages across countries within the region indicated.

Graph 7.A: Latin America: simple average of BR, CL, CO, MX and PE. Asia ex CN: simple average of ID, IN, KR, MY, PH, TH and SG. EMEA: simple average of CZ, HU, IL, PL and ZA.

Graph 7.B: Latin America: simple average of BR, CL, CO, MX and PE. Asia ex CN: simple average of ID, IN, MY and PH. EMEA: simple average of HU, PL, SA and ZA.

Graph 8.C: Latin America: simple average of BR, CL, CO, MX and PE. Asia ex CN: simple average of ID, IN, KR, MY, PH, TH and SG. EMEA: simple average of CZ, HU, IL, PL and ZA.

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Bank positions in FX swaps: insights from CLS[1]

A combination of CLS data with BIS statistics shows banks' FX swaps positions alongside the currency mismatches on their balance sheets. It sheds light on global dollar flows via FX swaps in key currency pairs and, specifically, on banks' use of these instruments to hedge exchange rate risk, engage in arbitrage or serve customers. Compared with Japanese and euro area banks, US banks have played an outsize role in FX swap markets by using maturity transformation to intermediate in the interbank market and between banks and non-banks.

JEL codes: F31, F34, G15, G21.

Introduction

A typical day sees almost $4 trillion in new FX swap contracts, most of which involve a payment of US dollars (BIS (2022)). Unlike for repo and other forms of debt, the full attendant payment obligations arising from FX swaps are not reported on a balance sheet (Borio et al (2017, 2022)).

The market for FX swaps is two-tiered, with dealer banks at the core, as these instruments trade mainly over the counter (OTC). The dealer-customer segment mostly serves the FX hedging purposes of financial and non-financial customers. In addition, dealer banks transact with each other to offset the imbalances that arise in trades with customers, and to manage liquidity and currency mismatches on their own balance sheets.

This feature examines how banks of various nationalities operate in the FX swap market. It draws on a novel data set (from CLSMarketData) of aggregated and anonymised outstanding FX swap and forward contracts (notional values) that are settled via CLS, the world's largest multi-currency cash settlement system (see Box A). These data provide a detailed picture of interbank positions as well as positions between banks and some of their non-bank customers, with breakdowns by currency pair, maturity and counterparty nationality (eg US banks vis-à-vis euro area banks).

The combination of CLS data and the BIS international banking statistics (IBS) offers a rough picture of banking systems' outstanding off-balance sheet FX derivatives positions in specific currency pairs *alongside* the corresponding

[1] The authors thank Douglas Araujo, Claudio Borio, Stijn Claessens, Robert McCauley, Benoît Mojon, Andreas Schrimpf, Hyun Song Shin, Takeshi Shirakami and Nikola Tarashev for their helpful comments, and Branimir Gruić, Swapan Pradhan and Jhuvesh Sobrun for excellent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

Key takeaways

- *Combining CLS and BIS data helps to track global dollar flows via FX derivatives in key currency pairs and reveals how these flows relate to banks' on-balance sheet currency positions.*
- *US and euro area banks are net providers of US dollars via FX derivatives to Japanese banks and institutional investors in need of FX hedging services.*
- *US banks use FX swaps to borrow dollars short-term from other banks and lend them longer-term to non-banks. This means that US banks are net interbank dollar borrowers in FX swaps.*

on-balance sheet currency positions. It helps separate banks' *interbank FX swap* positions from their broader portfolio of FX derivatives – ie also including forwards and currency swaps. This in turn helps to track global currency flows via derivatives, in particular the channels through which banks accommodate their clients' FX hedging needs and maintain matched currency positions.

This feature presents three findings related to banks' lending and borrowing of US dollars against other key currencies via FX derivatives.

First, dollar lending via FX derivatives has grown as this activity has become lucrative. The dollar basis, ie the premium earned (over money market rates) by lending dollars against other currencies via an FX derivative, has profited banks with ample dollar cash funding. An estimate of US and euro area banks' combined net lending of dollars via FX derivatives surpassed $1 trillion in Q1 2021, more than triple the amount in mid-2013. Japanese banks have consistently been net dollar borrowers via FX derivatives.

Second, the combination of CLS and BIS data shows that banks tend to accommodate customer demand for FX hedging services by turning to the interbank FX swap market. For example, US banks' estimated net off-balance sheet dollar lending to customers grew significantly between 2016 and 2020. They offset this mainly by borrowing dollars via interbank FX swaps rather than via an adjustment of their on-balance sheet positions. Estimates for euro area and Japanese banks also show that shifts in interbank FX swaps offset changes in positions with customers.

Third, US banks stand out as pivotal FX swap intermediaries. In particular, Japanese banks that swap out of yen and into euros, and euro area banks swapping in the other direction, both transact via the US dollar mainly with US banks rather than with each other. In addition, US banks engage in maturity transformation in FX swaps involving the US dollar: they funnel dollars borrowed short term from other banks to non-banks seeking longer-term hedges. Somewhat counterintuitively, this has made US banks net dollar *borrowers* on the interbank market for FX swaps.

The feature proceeds as follows. The first section sets the stage with an overview of the OTC FX derivatives market, its size, the key currencies traded, and the major banking systems that transact in FX swaps. The second section explains how the available data capture banks' use of FX derivatives to hedge, engage in arbitrage or make markets. The third section examines the relationship between banks' on- and off-balance sheet currency positions and the integral role of interbank FX swaps. The final section concludes.

A two-tiered market with dealer banks at the core

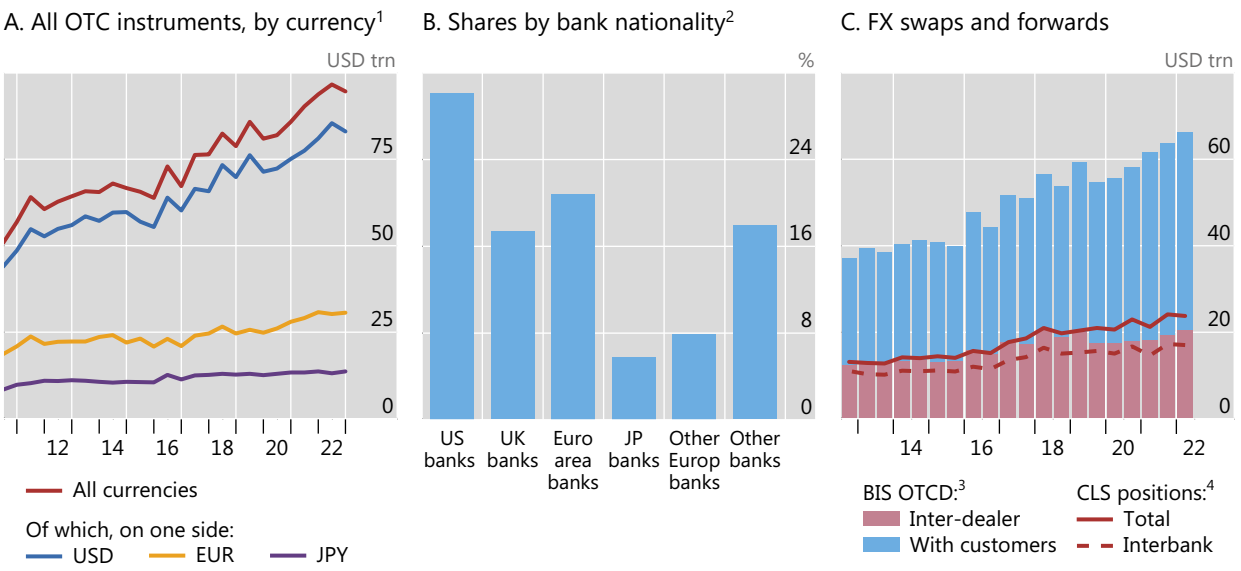
Several types of OTC FX derivative – FX swaps, forwards and currency swaps – involve the exchange of principal (notional) amounts. In an FX swap, two parties exchange currencies (the spot leg) and agree to reverse the trade at a future date at a pre-agreed exchange rate (the forward leg). Once the spot leg is complete, all that remains is the forward leg, at which point the FX swap is indistinguishable from an outright forward. A currency swap is a longer-term swap in which coupons linked to the underlying interest rates are exchanged in addition to the principal.

These FX derivatives create huge payment obligations. The BIS OTC derivatives (OTCD) statistics, which capture outstanding (notional) amounts of internationally active banks in more than 50 jurisdictions, put the global total at $97 trillion in mid-2022 (Graph 1.A). Almost 90% involved the payment of US dollars. The total exceeded global GDP in 2021 ($96 trillion) as well as outstanding global external portfolio investment ($81 trillion) and international bank claims ($40 trillion) at end-2021.

A relatively small number of banks account for the lion's share of outstanding OTC FX derivatives. Estimates derived from banks' financial disclosures at end-2022 suggest that the top five banks reported roughly a third of global outstanding positions and the top 25 banks more than 80%. US banks' sizeable share of the global market puts them well ahead of their euro area, UK and Japanese peers (Graph 1.B).

The most widely used instrument is the FX swap. The OTCD data show that the aggregate of FX swaps and forwards reached $66 trillion in mid-2022 (Graph 1.C, stacked bars), or roughly two thirds of outstanding OTC FX derivatives positions (Graph 1.A). The OTCD data do not separately identify FX swaps and forwards, but

Overview of outstanding OTC FX derivatives — Graph 1



[1] Aggregate of FX swaps, forwards and currency swaps, corrected for inter-dealer double-counting. Non-deliverable forwards, which are not reported separately in the OTCD statistics, should ideally be excluded since they do not involve exchange of principal amounts; these account for a small share of outstanding amounts. [2] Estimates calculated from reported national aggregates (OTCD, OCC, BoJ), not adjusted for inter-dealer double-counting. [3] Total in panel A ("All currencies", red line) excluding currency swaps. [4] Outstanding amounts in the CLS settlement system.

Sources: Bank of Japan (BoJ); US Office of the Comptroller of the Currency (OCC); CLS; BIS OTC derivatives statistics; BIS.

estimates derived using turnover data (BIS (2022)) suggest that FX swaps account for about two thirds of the FX swaps and forwards aggregate.

CLS data captured just over a third of the global FX swaps and forwards aggregate in the OTCD data (Graph 1.C, red solid line) in mid-2022. Since banks rely extensively on CLS to settle trades among themselves, CLS interbank positions come close to the inter-dealer positions in the OTCD statistics: $17 trillion (dashed red line) compared with $21 trillion (red bars). CLS data capture a much smaller share of global positions with customers (blue bars). Much of the analysis that follows relies on the granular CLS data for FX swaps.

Box A

FX swaps and forwards settled via CLS

CLS operates the world's largest multi-currency cash settlement system, which settles FX transactions on a payment-versus-payment (PvP) basis for 18 eligible currencies. PVP mitigates settlement risk by ensuring that a payment in a currency occurs if and only if the payment in the other currency takes place. In 2022, almost half of global FX turnover was settled with risk mitigation such as PvP, most of it via CLS (Glowka and Nilsson (2022)). This box provides a brief description of the main features of outstanding CLS-settled FX swaps and forwards.

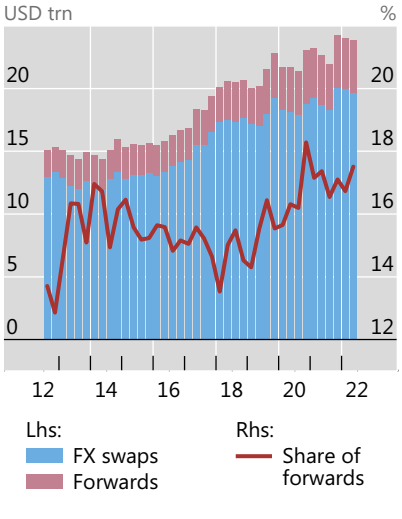
As of 2022, 76 financial institutions were direct members of CLS. These are primarily banks, reflecting the bank-centric nature of the FX swap market as well as strict membership criteria (eg capital, liquidity, risk management and other requirements). Smaller banks, non-bank financial institutions and multinational corporations can also use CLS to mitigate settlement risk via CLS members that serve as CLS third-party service providers (CLS (2022)). CLS thus settles payment instructions on underlying trades that are (i) between two members; (ii) between a member and a third party that participates through a member; and (iii) between third parties that participate through members.

Anonymised and aggregated data from CLSMarketData capture banks' outstanding FX swaps and forwards (notional) with other banks and with a subset of customers. The data are broken down by (1) currency pair; (2) counterparty type; (3) contract tenor (original and remaining maturity); and (4) nationality of the counterparties.①

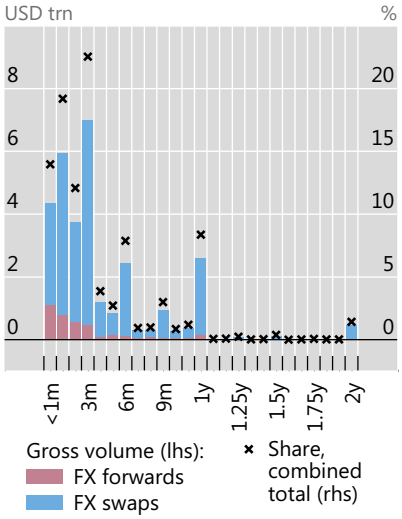
CLS-settled FX swaps and forwards, by maturity

Graph A1

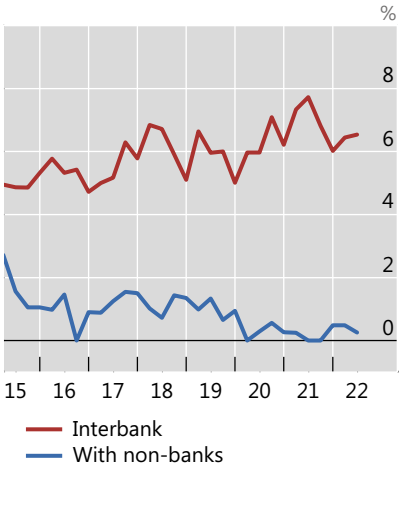
A. Gross outstanding amounts[1]



B. Volumes and shares by maturity[2]



C. Maturity less than 7 days, shares[3]



[1] Quarterly averages. [2] Data as of June 2022. [3] Share of gross FX swap positions with maturities of seven days or less.

Source: CLS.

CLS data exclude (a) trades involving any currency that is not one of the 18 CLS-eligible currencies; (b) trades with counterparties that are not (direct or indirect) CLS members; (c) trades settled by other means (eg bilateral netting or "on-us" in direct trading with customers, see Glowka and Nilsson (2022)); and (d) trades in instruments not settled via CLS. Forwards, which are used mainly by non-banks (largely not CLS members), are underrepresented in the CLS data. CLS also settles some currency swaps, but these are not included in the data set.

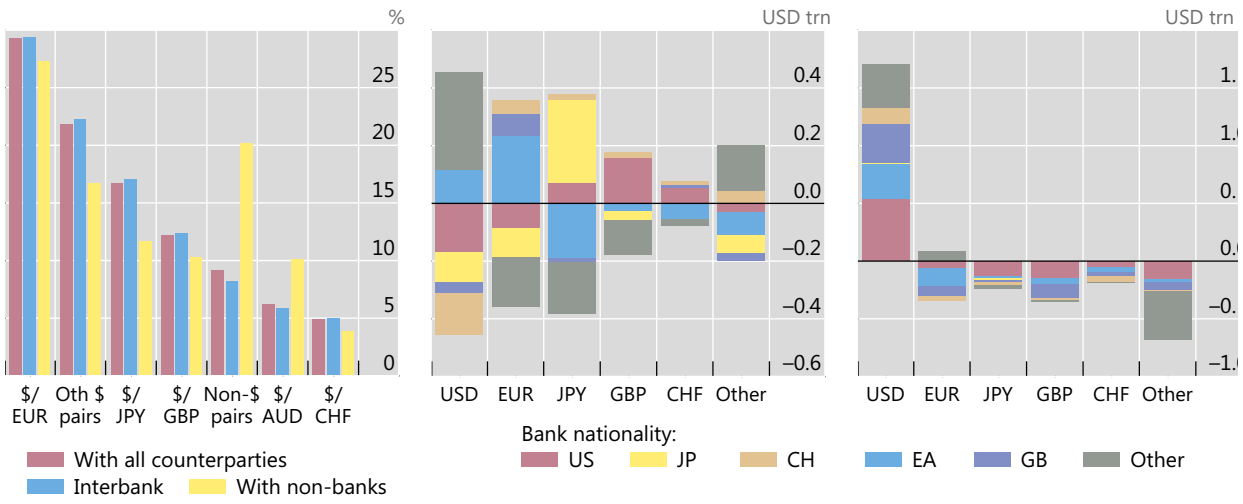
As of mid-2022, outstanding FX swaps and forwards settled via CLS amounted to $24 trillion (Graph A1.A), with FX swaps accounting for more than 80% of the total. Most swaps and forwards settled via CLS are short-term (Graph A1.B). Contracts at the very short end trade mainly among banks (Graph A1.C).

Most CLS trades involve the exchange of US dollars (Graph A2.A, red bars). Positions in the EUR/USD and USD/JPY pairs accounted for almost half of all CLS positions in mid-2022, consistent with their ranking as the top two most-traded currency pairs in global turnover data (BIS (2022)). The top five currency pairs in CLS data – all of which involve the exchange of dollars – accounted for almost 70% of this total. By contrast, positions in non-dollar pairs amounted to less than 10% and tended to be mostly with non-banks (yellow bars).

For a given currency, interbank positions net to zero by market clearing (Graph A2.B). By contrast, the aggregate banking sector runs a net open dollar position with non-banks that transact in CLS FX swaps (Graph A2.C). In mid-2022, US banks funded (hedged) their net dollar lending to non-banks by borrowing dollars from banks (panels B and C, red bars). Euro area banks were net dollar lenders to both banks and non-banks, while Japanese banks borrowed dollars, euros and other currencies in exchange for yen almost exclusively in the interbank market (yellow bars).

Currency shares and positioning in select currencies by banking system

As of June 2022 Graph A2



[1] Share of gross outstanding amounts in selected currency pairs in total gross outstanding amounts, by counterparty type. [2] Net positions by bank nationality. Positive (negative) bars show net lending (borrowing) in a particular currency.

Source: CLS.

① Ranaldo (2023) uses CLS data to examine market structure; Kloks et al (2023) use it to examine FX swap market liquidity; and Bräuer and Hau (2022) use it to examine the link between FX hedging and exchange rates.

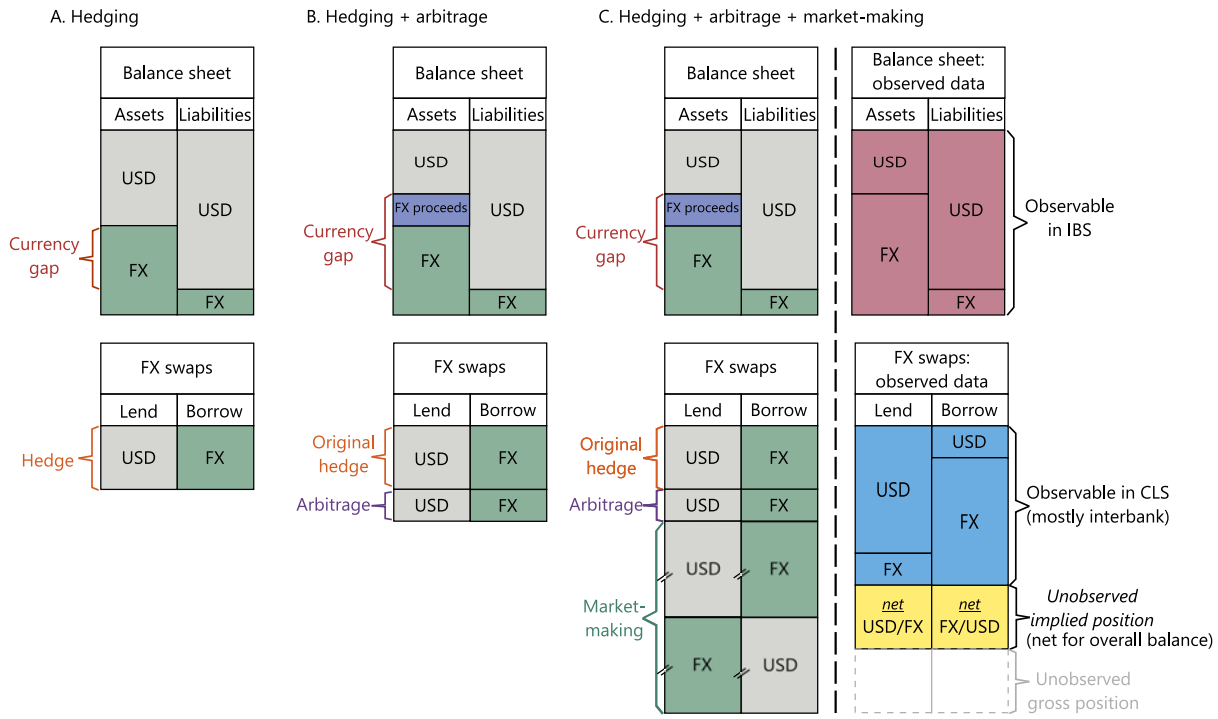
Hedging, arbitrage and market-making

Banks transact in FX derivatives for at least three reasons. First, banks use derivatives to hold foreign currency assets on a hedged basis, in line with supervisory guidance

(BCBS (1980, 2020)). Consider a bank with matched on-balance sheet US dollar and foreign currency assets and liabilities. Using an FX swap, this bank can exchange dollar cash in hand for foreign currency to acquire and hold additional foreign currency assets on a hedged basis. Graph 2.A shows how this transaction introduces a mismatch on the balance sheet – a short dollar "currency gap" – that the off-balance sheet FX swap offsets. The FX swap locks in the forward rate at which the exchange is reversed in the future, thus eliminating the risk of currency movements for the contract's duration.

Stylised bank's on- and off-balance sheet currency positions

Graph 2



Source: Authors' elaboration.

Banks also use FX derivatives to arbitrage, by lending dollars against other currencies to pick up the currency basis.[2] In the example of Graph 2.B, the bank again lends out existing dollar cash and places the FX proceeds (purple area) from the spot leg of the FX swap in foreign currency assets. In terms of currency positions, the hedge and the arbitrage trades are *observationally equivalent*: both create an on-balance sheet mismatch that is offset with an off-balance sheet FX swap.

The motivations for the arbitrage and hedge trades differ. Banks target the basis pickup in an arbitrage trade but the foreign currency asset in the hedge trade. In the former case, they typically place the FX swap proceeds in safe liquid assets, eg a central bank deposit facility or short-term government bills (see Correa et al (2020), Rime et al (2022)). Banks may do so even when the assets have negative yields as long as the basis pickup offers sufficient compensation. Differentiating the two types

[2] Covered interest parity, a no-arbitrage condition, implies that the forward discount should equal the money market rate differential in the two currencies.

of trade thus requires information about the composition of on-balance sheet foreign currency assets and the direction (ie positive or negative) of the currency basis.

Finally, top-tier banks make markets in FX derivatives. When servicing a customer that seeks to borrow dollars in an FX swap, a bank can source the dollars via additional on-balance sheet borrowing, which expands the balance sheet. Since there are regulatory constraints on balance sheet expansion, the bank can alternatively transact with another customer seeking to lend dollars via an FX swap. This creates an offsetting off-balance sheet position that does not require balance sheet space. By standing between end-use customers in this way, banks build up large gross (but offsetting) off-balance sheet forward positions to pay and receive particular currencies (Graph 2.C, left-hand column).

In practice, banks may treat net FX derivatives positions taken for hedging, arbitrage and market-making activities as fungible, in the sense that they manage the *overall* currency position from all activities.

CLS and BIS data together provide only a partial picture of banks' overall currency positions (Graph 2.C, right-hand column). Estimates of banks' on-balance sheet currency positions can be derived from the IBS (red shading), as described in the online statistical annex. However, CLS data capture only the off-balance currency positions that settle via CLS (blue shading), which are mainly interbank FX swap positions (recall Graph 1.C). This leaves unobserved a large portion of banks' FX swaps and forwards with non-banks, and the entirety of their currency swaps.

The analysis below focuses on banks' *net* on- and off-balance sheet positions in major currencies. It is grounded on the assumption that banks do not have "large" unhedged currency positions.[3] With this assumption, CLS and IBS data can be used to derive the *implied* net position in non-CLS FX derivatives that is consistent with an overall hedged position (Graph 2.C, yellow shading).[4] This, in turn, enables us to split banks' overall net off-balance sheet positions into two segments, in accordance with the two-tiered market structure. The first segment, *interbank FX swaps* (CLS data), consists of the short-term instruments that underpin market liquidity and price formation. The second segment, *other FX derivatives* (with banks and non-banks), consists of observed FX swaps with non-banks (CLS data) plus the implied (unobserved) net positions. The average maturity of positions in the second segment is longer than in the first segment (see Box A).[5]

Banks' on- and off-balance sheet currency positions

How do different banking systems use the interbank segment of the FX swap market to manage their net positions taken with customers? We address this question by combining the CLS and IBS data described above, paying particular attention to the flow of dollars via FX swaps between banks of different nationalities.

[3] The analysis does not require that banks maintain a perfect currency hedge, but only that any open position be small relative to observed net CLS FX swap positions. This ensures that the direction and magnitude of the derived positions with customers are indicative of actual but unobserved positions.

[4] For several bank-currency pairs, the IBS currency gap and net CLS FX swaps are similar in levels and co-move for extended periods (see online statistical annex). In some pairs, the currency gap tracks the overall net CLS position and in others it tracks the net CLS position with banks or non-banks.

[5] Turnover data show that FX swaps with non-banks have longer maturities than do those with banks. Currency swaps (with both banks and non-banks) typically have a maturity longer than one year.

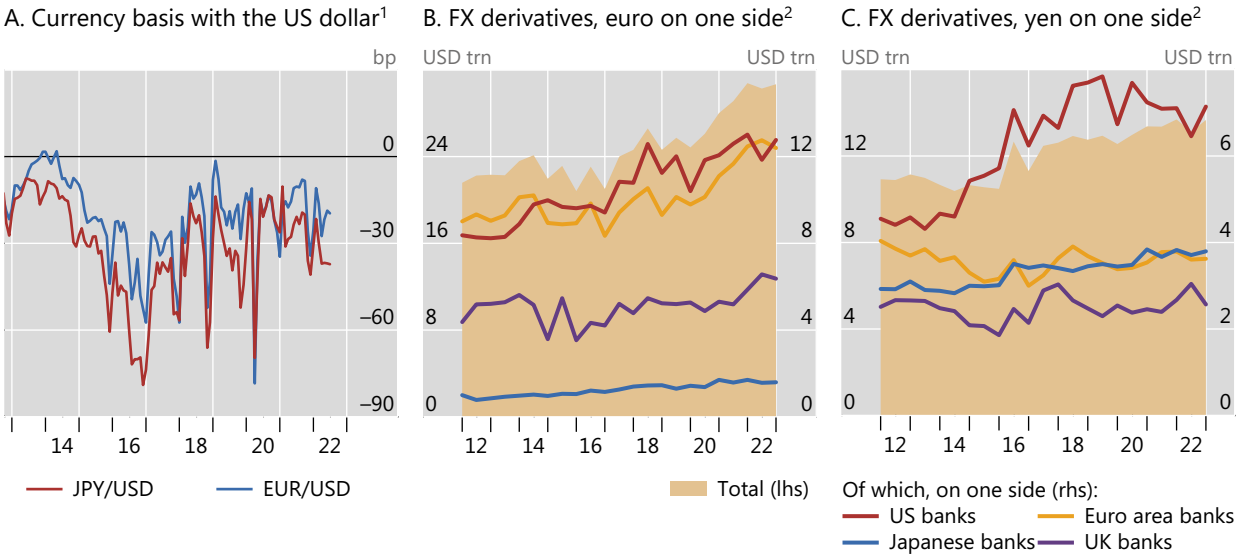
The analysis centres on banks' US dollar, euro and yen positions for two reasons. First, this currency trio captures a substantial portion of global dollar positions in FX derivatives, given that the EUR/USD and JPY/USD are the most-traded currency pairs (BIS (2022)). Second, the currency bases associated with these particular pairs (Graph 3.A) have profited dollar-lending banks.[6] Changes in these bases inform movements in banks' net off-balance sheet positions in the analysis below.

Key players in FX derivatives with the euro and the yen

As dealers, US banks are the largest intermediaries in FX derivatives involving either the euro or the yen. Their gross outstanding FX derivatives involving the euro have stood near $12 trillion since 2016 (Graph 3.B), putting them on one side of roughly 40% of global euro positions and, until recently, ahead of euro area banks (for which the euro is the home currency). In addition, outstanding amounts involving the yen have stood close to $7 trillion since 2016 (Graph 3.C), putting US banks on one side of an even larger share of global yen positions.

Customers on the other side of these trades use FX derivatives mainly for hedging purposes.[7] For example, European and Japanese institutional investors with large foreign currency asset portfolios hedge currency risk by borrowing foreign currency via FX derivatives. Given the size of their balance sheets and the high share of dollar assets in their portfolios, such entities generate a structural demand to borrow dollars via FX derivatives in both the EUR/USD and JPY/USD currency pairs.

Dollar premium and gross outstanding positions in FX derivatives — Graph 3



[1] Three-month FX swap implied basis (Ibor rates replaced with risk-free OIS rates from February 2020 for EUR/USD and from February 2021 for JPY/USD). [2] Outstanding FX swaps, forwards and currency swaps with the euro (panel B) or yen (panel C) on one side. Global total corrected for inter-dealer double-counting; aggregates for national banking systems not adjusted for inter-dealer double-counting.

Sources: Bank of Japan; Bloomberg; BIS OTC derivatives statistics; authors' calculations.

[6] A wide basis reflects the growth in demand for dollar hedges since the Great Financial Crisis (GFC), combined with the limited elasticity of arbitrage capital supplied by banks (see eg Du et al (2018) and Iida et al (2018)).

[7] On FX hedging demand, see Borio et al (2016), Du and Huber (2023) and McGuire et al (2021).

In addition to hedging asset portfolios, financial and non-financial entities also use FX derivatives to hedge their own foreign currency *borrowing*. Entities at times issue longer-term debt in a currency they do not need, to take advantage of low borrowing costs in that currency. To avoid incurring an open currency position, they swap the proceeds back into their home currency (Munro and Wooldridge (2010)). Such issuers tend to use longer-term currency swaps so as to match the duration of the hedge with that of the debt liability. An example is a highly rated European borrower that issues dollar debt and swaps the proceeds into home currency, thus becoming a dollar supplier via FX derivatives. Another is a highly rated US corporate that issues yen debt and swaps the proceeds back into dollars, which makes it a dollar borrower via FX derivatives.

Net dollar lending and borrowing on and off the balance sheet

How do currencies flow via FX derivatives between banks and customers? Examining banks' *net* FX derivatives positions using CLS data helps to unpack the gross positions depicted in Graph 3, which consist mainly of offsetting lending and borrowing. In Graph 4, banks' net *interbank FX swaps* (dotted blue lines) and net position in *other FX derivatives* (dashed blue lines) are depicted alongside the on-balance sheet currency gaps (red lines).

The composition of banks that lend dollars via FX derivatives has evolved since 2013. The short on-balance sheet dollar position – ie the excess of dollar liabilities over dollar assets – of US banks (Graph 4.A, red line), which grew to upwards of $400 billion by 2021, mirrors off-balance sheet dollar lending of similar size.[8] Notably, Graph 4 also shows euro area banks became major net dollar lenders via FX derivatives, on the back of a quadrupling of short on-balance sheet dollar positions between mid-2013 and mid-2021 (Graph 4.D, red line).[9]

Graph 4 also shows US banks to be on *both sides* of FX swap trades involving dollars, euros or yen. Their large but offsetting off-balance sheet dollar positions exceed their on-balance sheet dollar gap, evidence that US banks' *intermediate* between end users of FX derivatives involving the US dollar. Their mirroring off-balance sheet positions in euros prior to 2016 (Graph 4.B) and in yen after 2016 (Graph 4.C) point to EUR/USD and JPY/USD as key currency pairs.

Compared with US banks, euro area and Japanese banks seem to intermediate FX derivatives across counterparty segments to a lesser extent. Euro area banks are net dollar lenders in *both* off-balance sheet segments (Graph 4.D). Similarly, Japanese banks, which are net dollar borrowers via FX derivatives, borrow dollars via both segments (Graph 4.G).

Evolving demand for FX hedges and arbitrage

The swings in banks' net interbank FX swaps can be interpreted in the context of demand for dollar hedges as well as arbitrage in EUR/USD and JPY/USD FX swaps. Consider each currency pair in turn.

[8] The online statistical annex shows the on-balance sheet dollar position of US banks (red line) to roughly track net CLS FX swaps with non-banks before 2016, and overall net CLS FX swaps after 2016.

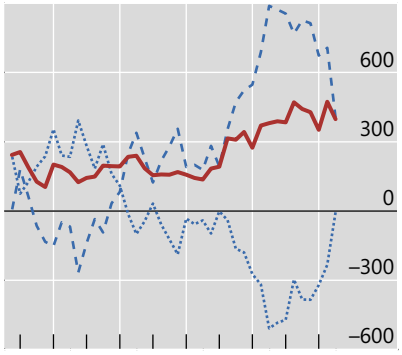
[9] The online statistical annex shows the on-balance sheet dollar position of euro area banks (red line) to roughly track their overall net CLS FX swap position during the entire sample period.

Banks' on- and off-balance sheet net positions in selected currencies

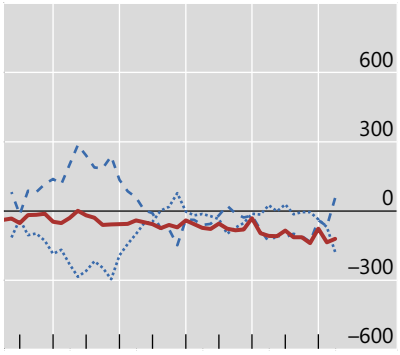
In billions of US dollars; positive value indicates net off-balance sheet *lending* of the currency — Graph 4

US banks

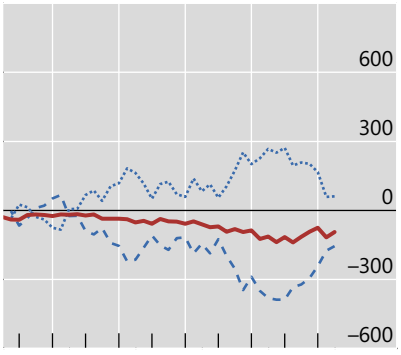
A. US dollar positions



B. Euro positions



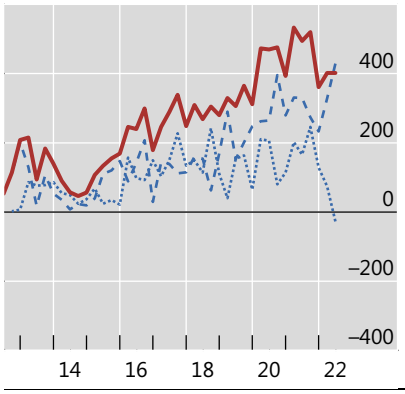
C. Yen positions



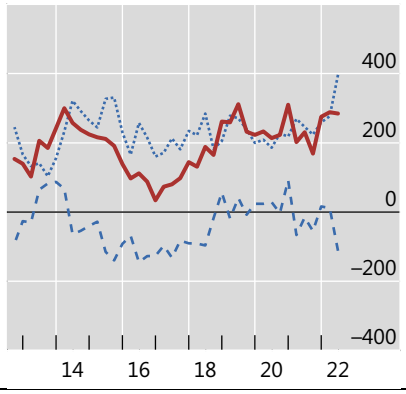
On-balance sheet net position[1] · Interbank FX swaps[2] · Other FX derivatives (all counterparties)[3]

Euro area banks

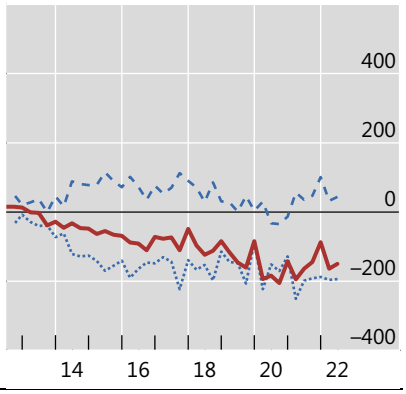
D. US dollar positions



E. Euro positions

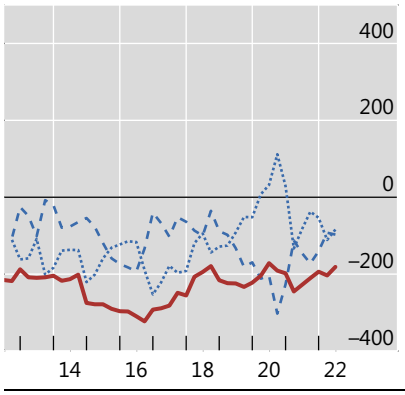


F. Yen positions

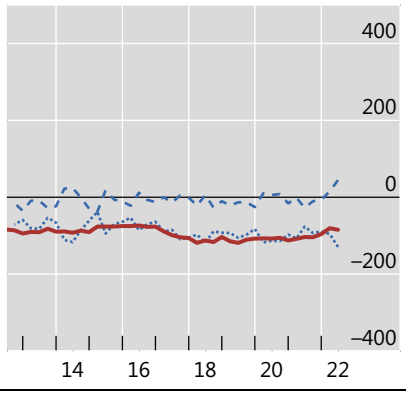


Japanese banks

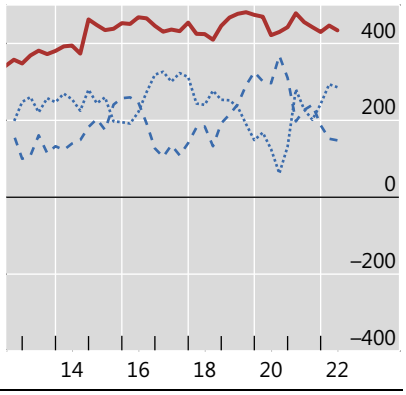
G. US dollar positions



H. Euro positions



I. Yen positions



[1] Banks' on-balance sheet net position (liabilities minus assets) estimated as described in the online statistical annex. [2] Net interbank CLS FX swaps with the currency in the panel title on one side. [3] Estimated net FX derivatives (all instruments) with customers with the currency in the panel title on one side; derived as described in the main text.

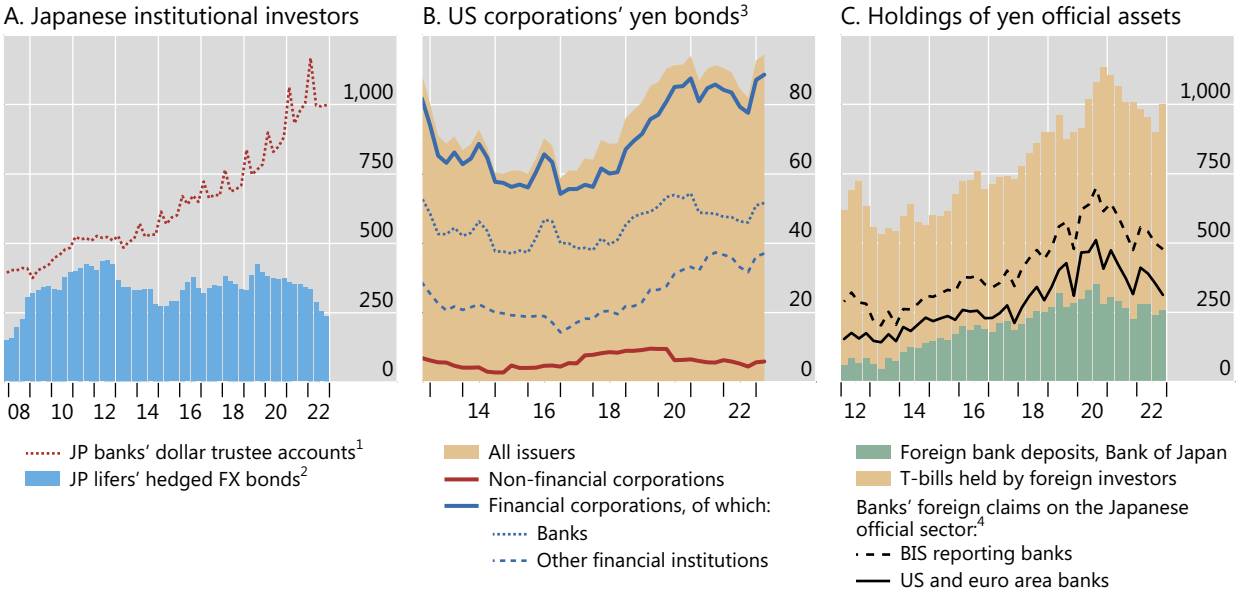
Sources: CLS; BIS international banking statistics; authors' calculations.

A divergence in credit conditions and in euro and US dollar policy rates after the Great Financial Crisis (GFC) incentivised cross-currency bond issuance on a hedged basis.[10] Top-rated bank and non-bank borrowers based in the euro area took advantage of the negative EUR/USD basis swap spread by issuing dollar bonds.[11] Hedging the on-balance sheet dollar liability made these issuers dollar suppliers in EUR/USD FX derivatives. The mirroring net dollar and euro off-balance sheet positions of US banks before 2016 (Graphs 4.A and 4.B) are consistent with these banks borrowing dollars from these issuers in exchange for euros. Such hedges tend to be longer-term currency swaps. Thus, the offsetting net dollar lending of US banks via interbank FX swaps suggests a degree of maturity transformation. Going into 2015, dollar bond issuance by borrowers based in the euro area waned as did US banks' supply of attendant hedges, as the cost advantage disappeared amid declining policy rates in the euro area.

Since 2016, the demand for JPY/USD hedges has grown. Demand for these hedges grew in line with the combined foreign currency asset portfolios of Japanese institutional investors (eg insurance companies and pension funds) and managers of

Hedging demand and arbitrage proceeds in JPY/USD FX swaps

In billions of US dollars — Graph 5



[1] Net US dollar assets in Japanese banks' trustee accounts. [2] Japanese life insurance companies' FX hedged foreign bond holdings, estimated by multiplying the stock of FX bond holdings by a time-varying hedge ratio (calculated as a simple average of the ratios disclosed by 11 Japanese life insurance companies). [3] Outstanding yen-denominated international bonds issued by US financial and non-financial corporations. [4] Includes claims on the government and central bank in Japan.

Sources: Bank of Japan; Japanese Ministry of Finance; The Life Insurance Association of Japan; Barclays FICC Research; Datastream; BIS debt securities statistics; BIS international banking statistics; authors' calculations.

[10] As the GFC gave way to the euro area sovereign debt crisis, credit spreads in the euro widened and synthetic dollar rates in EUR/USD FX swaps spiked, creating incentives for some highly rated euro area issuers to tap US dollar corporate bond markets.

[11] Outstanding dollar-denominated international debt securities of selected euro area entities grew from $1 trillion in Q1 2008 to $1.7 trillion in Q2 2016.

Japanese banks' trustee accounts (Graph 5.A).[12] Adding to this was a surge in issuance of yen bonds by US (and other) corporates (Graph 5.B). By comparison, Japanese banks' own structural demand for dollars via FX derivatives (Graph 4.G, red line) has been relatively flat.

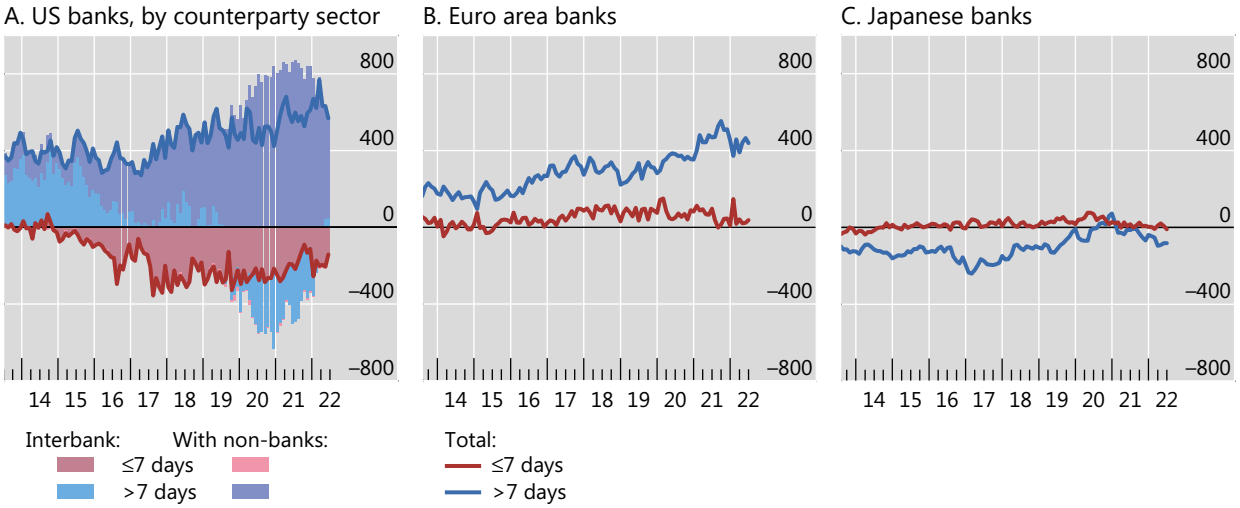
In meeting the demand for JPY/USD hedges, both US and European banks used (to an extent) arbitrage trades. This can be seen by examining the composition of the assets on these banks' balance sheets. Japanese national data show that foreign holdings of current account balances (reserves) at the Bank of Japan and of Japanese government bills have more than doubled since 2014, peaking at over $1 trillion in 2020 (Graph 5.C, stacked bars). A comparison with US and euro area banks' consolidated claims on the Japanese official sector (solid black line) suggests that these banks accounted for roughly a third of that amount. The rise in these holdings since 2014 has contributed to the steady widening in these banks' on-balance sheet yen currency gaps (Graphs 4C and 4F, red lines).[13]

Maturity transformation in CLS FX swaps

US banks' off-balance sheet JPY/USD FX swaps involved maturity transformation that is directly observable in the CLS data. They rolled shorter-term interbank FX swaps to channel longer-term dollars to non-bank customers (Graph 6.A, stacked bars).[14] This

Banks' net US dollar positions, by initial maturity

In billions of US dollars; positive (negative) value implies net dollar lending (borrowing) Graph 6



Source: CLS.

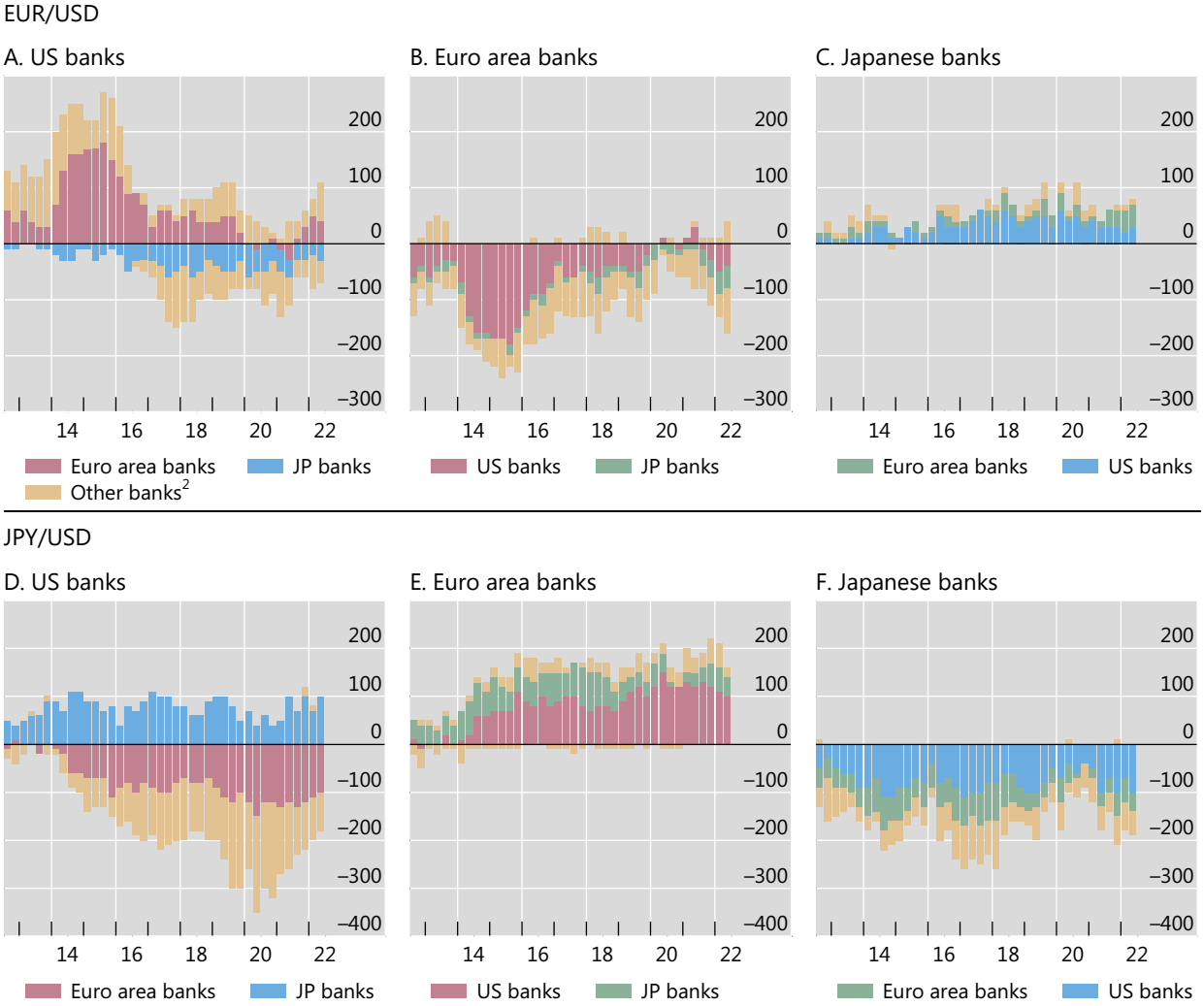
[12] The figures for hedged portfolios of Japanese life insurers are based on a roughly 60% currency hedge ratio (Graph 5.A, blue bars). The hedge ratio for foreign securities holdings in Japanese banks' trust accounts (dotted red line) is much lower.

[13] Since arbitrage capital is limited, arbitrage trades alone did not meet the demand for JPY/USD hedges. US banks thus turned to the inter-dealer FX swap market (Graph 4.C, dotted blue line).

[14] The term structure of currency basis favours such maturity transformation, apart from the quarter-end periods when the term structure tends to invert (Du et al (2018); Borio et al (2016); Abbassi and Bräuning (2021)). During these periods, some major bank dealers step back from intermediation (Krohn and Sushko (2022), while major US banks step in as dollar lenders (Correa et al (2020)).

Net *bilateral* interbank EUR/USD and JPY/USD FX swap positions[1]

In billions of US dollars; positive (negative) value indicates net *lending* (*borrowing*) of US dollars — Graph 7



[1] Banks' net positions in FX swaps and forwards in the currency pairs in the row titles, as settled via CLS. The perspective is that of the banks listed in the panel title; counterparty banks are listed in the legends. Colours indicate bank nationality pairs. [2] Comprises Swiss, UK and Other banks in the CLS network. Positions across these three counterparty groups are not netted, and thus both positive and negative bars can appear.

Source: CLS.

activity materially shifted the maturity profile of US banks' CLS FX swaps (lines) and, somewhat counterintuitively, made these banks net dollar *borrowers* in *interbank* FX swaps (even as they remained overall dollar lenders). Compared with US banks, euro area and Japanese have not noticeably relied on maturity transformation in their dollar FX swaps.

US banks' intermediation in both EUR/USD and JPY/USD FX swap trades has given them a pivotal role in the interbank market, making them dealer banks for other banks. In particular, rather than trade with each other, both euro area and Japanese

banks transact mainly with US banks.[15] This is seen by comparing the red and blue bars with the green bars in Graph 7, which presents net *bilateral* interbank CLS FX swaps. In EUR/USD FX swaps (top row), US banks tend to borrow euros from euro area banks (red bars), and then channel the euros to Japanese banks (blue bars). In JPY/USD FX swaps (bottom row), US banks borrow yen from Japanese banks (blue bars) and channel the yen to euro area banks. By comparison, the *direct* net positions *between* Japanese and euro area banks in either the EUR/USD or JPY/USD pairs were typically smaller (Graphs 7.B,C,E and F, green bars).

Conclusion

Payment obligations that arise from FX swaps are huge, but opaque. The short-term nature of these instruments makes the FX swap market susceptible to funding squeezes, such as those during the GFC and in March 2020 when the Covid-19 pandemic went global. In both cases, only extraordinary policy actions in the form of central bank swap lines restored the smooth flow of dollars.

Monitoring the FX swap market is thus an essential element in financial stability analysis. The combination of BIS and CLS data used in this feature helps to evaluate *how dollars flow* in the FX swap market, and how positions taken there relate to banks' on-balance sheet currency positions. This data combination adds to our monitoring tool kit in two ways.

First, it provides richer measures of banking systems' dollar funding positions. CLS data aggregates contain important information about the size, tenor, currency and counterparty structure of banks' (mostly interbank) FX swaps positions, information not found by examining on-balance sheet currency positions alone. This enables better estimates of the *size* of banks' gross and net outstanding dollar borrowing positions, and more accurate measurement of their rollover needs at particular tenors.

Second, the data combination provides the first (indirect) estimates of banks' net FX derivatives positions in a given currency with customers, something not possible using only BIS or CLS data in isolation. This can aid in global efforts to enhance monitoring of non-bank financial institutions, which account for an ever-larger share of global financial sector activity.

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[15] Recall from Graphs 4.F and 4.H that both euro area and Japanese banks use mainly *interbank* FX swaps (dotted blue lines) to hedge their on-balance sheet mismatches (red lines) in yen and euro, respectively. Euro area banks' net need for yen and Japanese banks' net need for euros make them natural counterparties in the FX swap market.

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Unpacking international banks' deposit funding [1]

This feature examines international banks' deposit funding – traditional deposits, repos and interbank lending. We lay out a framework to interpret the observed evolution in the level and composition of this funding. Netting out interbank lending and abstracting from the effect of central bank quantitative tightening, we find that during the banking turmoil in the first quarter of 2023 the source of banks' deposit funding rotated from the non-financial sector to non-bank financial institutions. This rotation was material in a handful of jurisdictions. In particular, residents of Switzerland moved deposits from international banks located there to domestically oriented banks. Dollar funding of banks in the United States shifted to money market funds, which then increased their (repo) dollar funding of non-US banks.

JEL classification: E44, E51, E58.

The banking turmoil in March 2023 brought renewed attention to bank deposits. A quickening of deposit outflows at several banks – in part due to rising interest rates – prompted financial stability concerns. Rate hikes have also created incentives for depositors to shift away from banks in search of higher returns (Afonso et al (2023)).

This special feature presents a framework for interpreting the evolution of the size and composition of banks' deposits. Key drivers of this evolution are central bank asset purchase/sale programmes, which can affect the size of banks' balance sheets, and the interbank market, which can swell the funding volume for given lending to non-banks. Further, a funding withdrawal can resurface on bank balance sheets as funding from another sector or as a different funding instrument.

Using this framework, we rely heavily on the BIS locational banking statistics (LBS) to study international banks' "deposit funding" – here defined very broadly to include traditional customer deposits, repurchase agreements (repos) and interbank lending. We consider the evolution of this funding since 2018, with a special focus on the first quarter of 2023. In a sample of 27 countries (excluding the United States),[2] the aggregate growth of international banks' deposit funding was effectively nil in

[1] We thank Iñaki Aldasoro, Douglas Araujo, Stefan Avdjiev, Claudio Borio, Stijn Claessens, Patrick McGuire, Benoît Mojon, Andreas Schrimpf, Hyun Song Shin, Jhuvesh Sobrun, Nikola Tarashev and Philip Wooldridge for helpful comments. Swapan-Kumar Pradhan provided excellent research assistance. All errors are our own. The views expressed are those of the authors and do not necessarily represent those of the Bank for International Settlements.

[2] This sample is selected based on countries that report local and cross-border positions, with breakdowns by instrument and sector.

Key takeaways

- *Non-bank financial institutions substituted for the non-financial sector as providers of deposit funding to internationally active banks in Q1 2023. This rotation was globally modest but concentrated in a few jurisdictions.*
- *International banks in Switzerland saw an aggregate decline in deposit funding in Q1 2023, with resident funding providers shifting largely to local banks with a domestic focus.*
- *Dollar deposits in the United States shifted to money market funds in the first half of 2023, which in turn increased dollar lending to banks headquartered outside the United States.*

Q1 2023. We obtain this result after netting out interbank lending and abstracting from the effect of quantitative tightening.

Digging deeper, we find evidence of a rotation of funding sources across banks in the LBS. In Q1 2023, deposit funding from non-bank financial institutions (NBFIs) substituted for that from the non-financial sector (NFS) – households, corporates and governments. The underlying magnitudes were relatively small, as the rotation involved about 0.5% of the outstanding funding from non-banks. In parallel, the internationally active banks in Switzerland saw a 12% drop in funding from both NBFIs and the NFS. Most of this decline from resident non-banks appeared to be reallocated within the country to domestic banks not captured in BIS statistics.

The United States was at the centre of the banking turmoil and is key to dollar funding in the broader banking system. We complement BIS data with other sources to document a similar rotation in dollar funding (see box). Depositors in the United States shifted their dollar deposits to money market funds, which in turn increased their dollar funding to banks headquartered outside the United States.

This feature proceeds in three steps. First, it presents a framework for tracing deposit funding changes through the balance sheets of different sectors in the economy. Second, it describes the definitions and coverage in the LBS and discusses how deposit funding changes in the economy are recorded or missed in the data. Third, it uses the framework to discuss the recent evolution of international banks' deposit funding.

A framework for interpreting changes in aggregate bank funding

This section presents a framework which considers a global economy containing four sectors: a banking sector, an NFS, an NBFI sector and a central bank. The banking sector consists of all banks – both internationally active and purely domestic. The non-financial sector consists of households, non-financial corporations and governments. The NBFI sector includes entities such as money market funds, hedge funds, central counterparties and insurance companies. *Banks are distinct from NBFIs because they can create means of payment – transaction deposits – rather than having to borrow them to finance asset growth.* We provide stylised examples to trace deposit funding changes through the balance sheets of these sectors. Among these examples, we show how quantitative tightening and interbank lending can obscure other

deposit funding changes, and how deposit withdrawals affect (or not) the aggregate balance sheet of the banking sector.

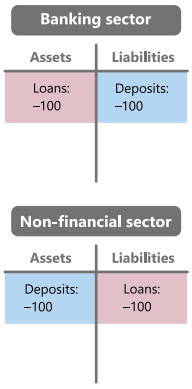
In a closed system, the expansion or contraction of banks' claims is a key driver of the level of deposit funding. Banks generate transaction deposits by extending a loan or acquiring some other asset (eg a bond), and destroy them when the loan/debt is repaid (Graph 1.A).[3] The banking sector's balance sheet thus expands when loans are granted faster than they are repaid and shrinks in the opposite case. Banks can also expand their balance sheet by issuing non-deposit liabilities, but these cannot be used as a means of payment.

Quantitative easing or tightening by the central bank can also affect the level of deposit funding in the banking system by influencing reserves that banks hold (liabilities of the central bank). Take a quantitative tightening episode. If the central bank sells government bonds directly to the banking sector, there is a change in the composition of the sector's asset portfolio (reserves are swapped for bonds) but the level of bank deposits remains unchanged (Graph 1.B). By contrast, if the central bank sells the bonds to non-banks, the latter would use transaction deposits to make the payment, resulting in a decline in the banking sector's balance sheet and, in particular, deposit funding (Graph 1.C).

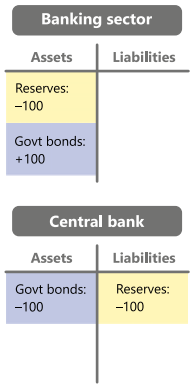
Withdrawn transaction deposits that are not repaying bank lending or driven by central bank asset sales are bound to circle back to the banking system (with some exceptions).[4] The immediate proceeds of a deposit withdrawal are a means of

Deposit creation and destruction[1] Graph 1

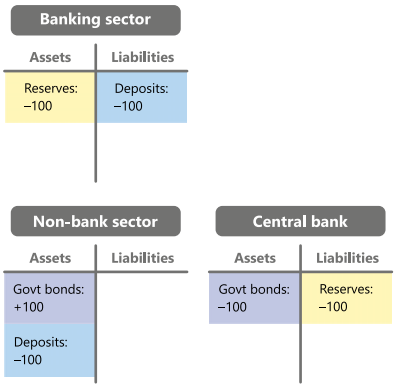
A. Bank/customer-driven destruction



B. Central bank-driven, no deposit change



C. Central bank-driven, decline in deposits



[1] A specific background colour applies to the two sides of the same transaction.

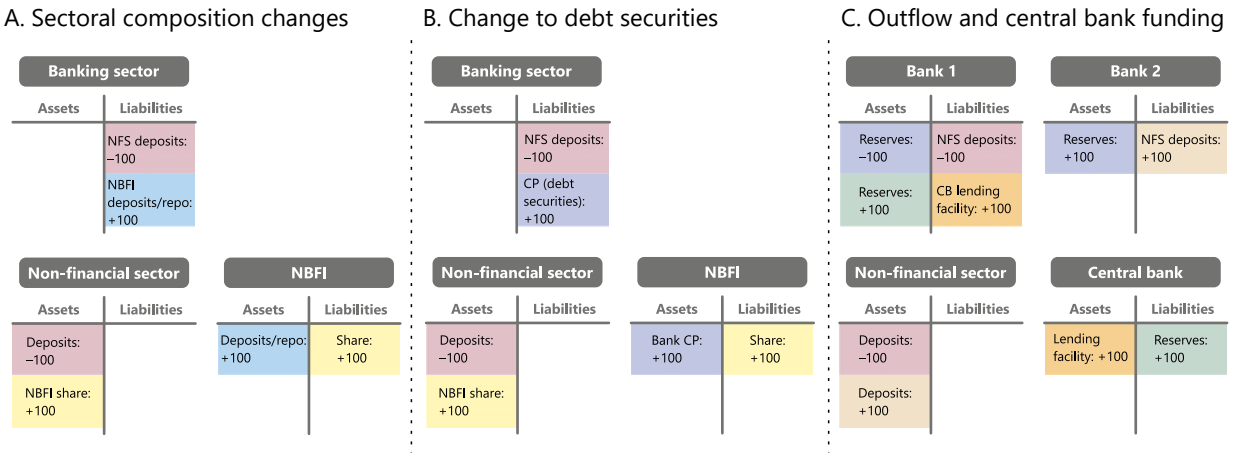
Source: Authors' elaboration.

[3] See the annex of Borio et al (2023) for further discussion. Note that banks' capital adequacy, regulation and supervision will impose limits on the degree of their expansion.

[4] The level of transaction deposits could also be affected by non-banks withdrawing deposits and holding them as physical cash, or by NBFIs placing withdrawn funds at the central bank (eg, in the United States, via the Federal Reserve's Overnight Reverse Repo Facility (ON RRP)). That said, holding large amounts of physical cash is less common in the modern financial system, given restrictions on physical cash payments. In addition, while funds placed in the ON RRP increased over 2021, the facility's size remained rather constant from Q3 2022 to Q1 2023, including during the March 2023 banking turmoil.

Non-financial sector deposit withdrawal[1]

Graph 2



[1] A specific background colour applies to the two sides of the same transaction.

Source: Authors' elaboration.

payment, which the depositor transfers but does not destroy. Even so, the composition of bank funding may change. For instance, if the NFS withdraws deposits and shifts the funds to an NBFI, the NBFI could directly deposit those funds again or provide repo funding to banks (Graph 2.A). In this case, deposits from the NFS fall, but funding from NBFIs rises by an equivalent amount. Alternatively, the NBFI could invest in banks' debt securities (eg a money market fund buying bank commercial paper). In this case, the level of deposits in the banking sector falls, but debt security funding increases by an equivalent amount (Graph 2.B). Even though the chain of events may be longer, the robust takeaway is that a deposit withdrawal from a bank is not equivalent to a deposit funding decline in the banking system.

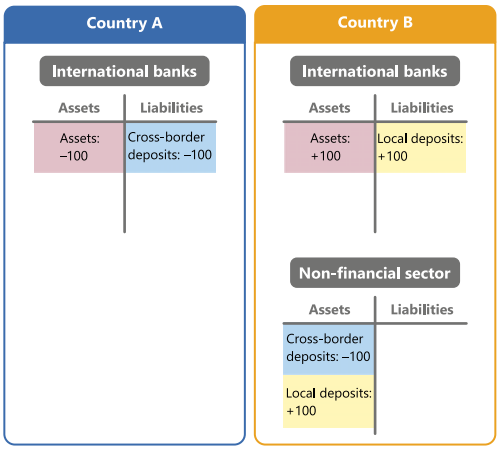
The central bank can backstop the evaporation of funding at specific banks – eg in deposit runs – by providing lending facilities. For instance, if the NFS switches its deposits from one bank to another, a central bank lending facility would eliminate the need for the former bank to reduce its balance sheet (Graph 2.C). Rather, that bank would experience a change in its funding composition.

These simple examples illustrate how the level and composition of bank funding (notably deposits) can change in a global system but abstract from deposit funding reallocation across country boundaries. Keeping global deposits fixed, deposits in one jurisdiction might decline if a cross-border depositor shifts those funds back home (Graph 3.A). Similarly, deposits can fall when resident depositors shift funds to a bank located abroad. This geographic reallocation could involve an initial shift of deposits to NBFIs which then invest in banks abroad (Graph 3.B). In this case, the source of deposit funding in the global banking system would change both sector and country.

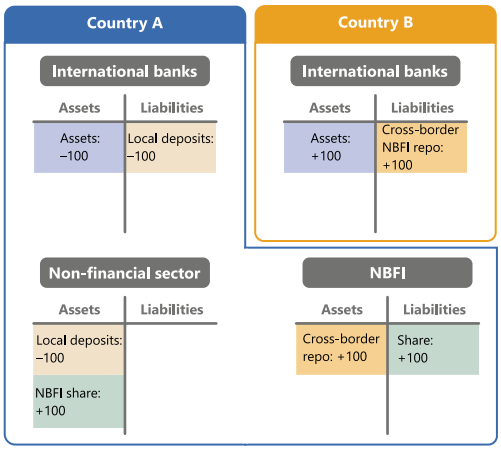
Non-financial sector deposit withdrawal with country borders[1]

Graph 3

A. Cross-border deposit withdrawal to local bank



B. Local deposit shifted cross-border via NBFIs



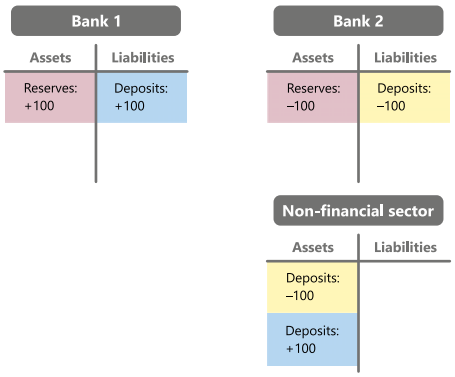
[1] A specific background colour applies to the two sides of the same transaction.

Source: Authors' elaboration.

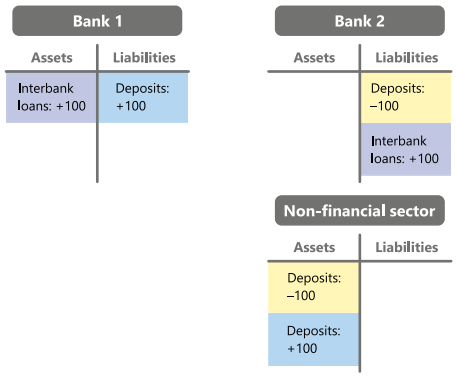
Deposit funding and the interbank market[1]

Graph 4

A. Deposit transfer financed by reserves



B. Deposit transfer financed by interbank loans



[1] A specific background colour applies to the two sides of the same transaction.

Source: Authors' elaboration.

The balance sheet of the banking system swells or contracts as banks borrow from and lend to each other, without changing their aggregate exposure to non-banks. For example, when an NFS depositor moves its funds from one bank to another, the involved banks can finance the transfer by reallocating reserves (Graph 4.A) or by creating an interbank loan (Graph 4.B). In the latter case, examining only bank liabilities will indicate that deposit funding increased, even though the links between the non-bank and bank sectors have not changed. Focusing on non-bank deposit funding while also accounting for the reallocation of deposit funding between banks thus calls for subtracting changes in interbank claims from the corresponding changes in interbank liabilities at the country level.

Bank funding in the BIS locational banking statistics

To trace the evolution of bank deposit funding, one would ideally have complete coverage of all banks. In addition, one would need consistent information on different funding instruments and different types of funding providers, across banks in all countries.

The BIS locational banking statistics (LBS) come closest to such a data set. They contain aggregate balance sheet information for internationally active banks worldwide, organised by bank location. They split bank liabilities by instrument: deposit funding (referred to as "loans and deposits" in the data), debt securities and other.[5] Deposit funding – comprising traditional customer deposits, repos and interbank lending – is the largest category, accounting for over 80% of bank liabilities in the LBS, and the focus of the analysis below. In turn, debt securities comprise bonds as well as commercial paper and negotiable certificates of deposit.[6] The LBS also offer information on the sector of the bank's lender: bank (split into central banks and commercial banks), non-bank financial and non-financial sectors. Collected on a consistent basis across most major banking jurisdictions, these data form the basis for our analysis.

However, the LBS coverage is incomplete and can thus indicate spurious deposit funding changes. First, it excludes the activity of purely domestic banks. As a result, when depositors transfer money from international banks (in the BIS banking statistics) to purely domestic banks (not in the BIS statistics),[7] the level of deposit funding in a country's banking sector is unchanged but will be recorded as a decline (Graph 5.A). The opposite of this case occurred in the United States during Q1 2023, as deposits were moved from regional banks to large international banks (Luck et al(2023)). Still, international banks are typically large and so their positions tend to capture significant domestic banking activity (Avdjiev et al (2015)).[8]

Second, though the LBS already have wide country-level coverage of the major banking jurisdictions, not all countries report to the BIS. A cross-border reallocation of deposits therefore can appear spuriously as a decline in deposits at the global level. This would be the case if a deposit is transferred from a BIS reporting country to a non-BIS reporting country (Graph 5.B).[9]

[5] Recent data include cross-border derivatives. The reporting of this category is incomplete, and so is not considered in the analysis. See Borio et al (2022) for further discussion of banks' off-balance sheet funding via derivatives.

[6] Aquilina et al (2023, in this issue) provide a primer on the market for commercial paper and negotiable certificates of deposit, which also features non-banks as issuers and banks as investors.

[7] A few reporting countries include domestic-only banks in their reporting population.

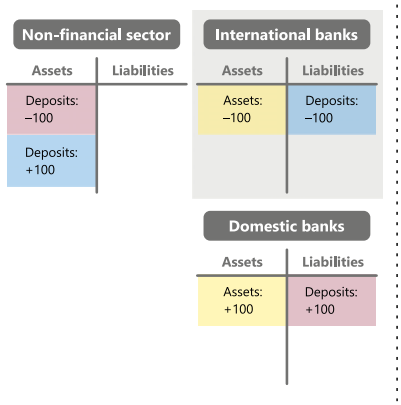
[8] For most countries, more than 80% of domestic non-bank lending is covered. This share is lower in some jurisdictions with large domestically focused banks (eg Brazil, Korea).

[9] The two scenarios in Graph 5 are indistinguishable on the basis of the BIS LBS alone.

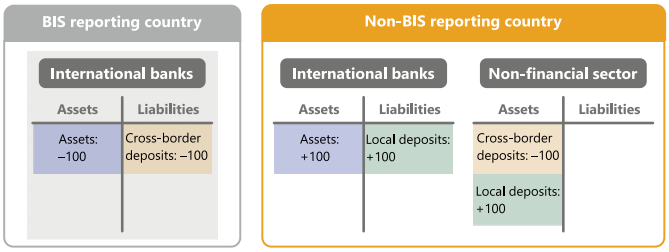
Funding changes and data coverage[1]

Graph 5

A. Deposits move to domestically focused banks



B. Deposits move to non-BIS reporting countries



[1] Gray area indicates the coverage of the BIS locational banking statistics. A specific background colour applies to the two sides of the same transaction.

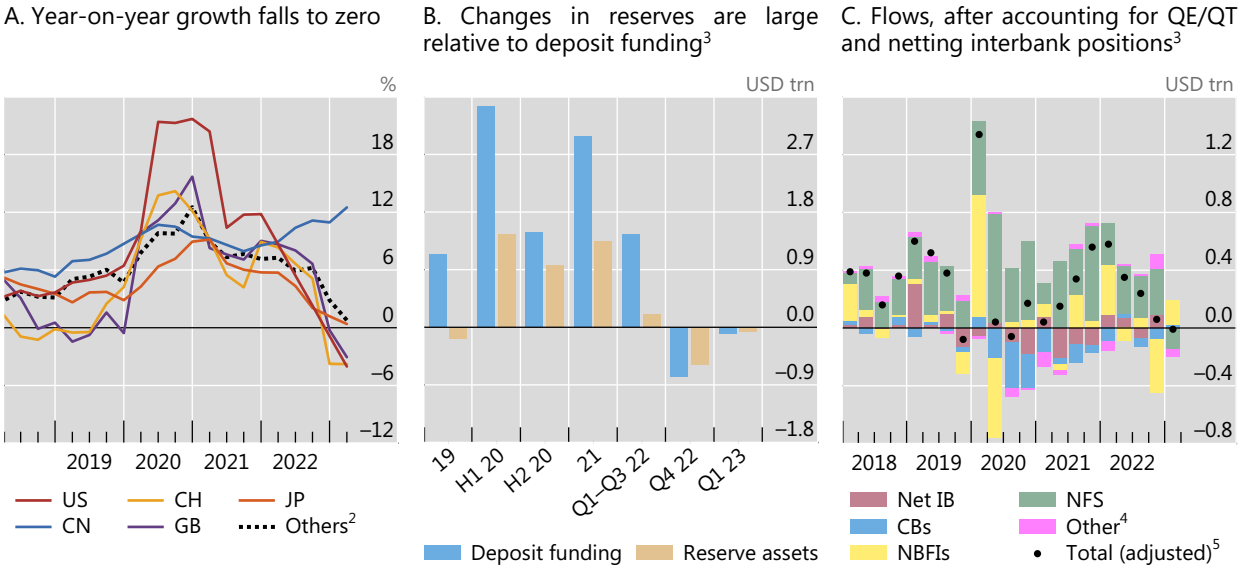
Source: Authors' elaboration.

Third, some countries report only limited instrument or counterparty sector breakdowns, or only cross-border positions. We focus our analysis on deposit funding in jurisdictions that include local positions with sectoral breakdowns in the LBS. This includes Switzerland, the United Kingdom and 25 other economies, but notably excludes Japan, China and the United States. To establish the broad pattern of deposit funding growth worldwide, we consider the growth rate of deposit funding in our main sample alongside that of total deposits from national data (for the United States and China) and total liabilities in the LBS (for Japan). We also examine the cross-border deposit funding flows for the US, Japan and China.

We analyse deposit funding *flows* between banks and non-banks. We thus subtract changes in interbank claims from those of interbank liabilities at the country level.[10] This reduces the size of deposit funding flows in our sample by about 55% over the past five years. The flows we work with are adjusted for valuation effects from exchange rate movements as well as for breaks in series.

[10] The incomplete data coverage in the LBS implies that interbank positions would not net out to zero (either domestically or cross-border). However, in practice, the LBS capture most domestic banking activity in many jurisdictions (Avdjiev et al (2015)) and around 95% of all cross-border interbank activity (BIS (2015)), so aggregate interbank liabilities and claims typically match closely. Netting interbank positions also allows us to abstract from seasonal patterns in aggregate cross-border interbank positions, driven in part by large banks' window dressing at year-ends for regulatory purposes (Garcia et al (2021)).

Deposit funding growth and asset purchase programmes[1] Graph 6



CBs = central banks; net IB = net interbank (liabilities minus claims), excluding positions vis-à-vis CBs.

[1] See technical annex for details. [2] Comprises 25 reporting countries. [3] FX- and break-adjusted changes. Comprises countries included under "others" in panel A plus CH and GB. [4] Includes unallocated by sector. [5] Changes after adjusting for quantitative easing (QE) / quantitative tightening (QT) and net interbank positions.

Sources: People's Bank of China; Board of Governors of the Federal Reserve System; BIS locational banking statistics; authors' calculations.

Recent developments in deposit funding

With our framework in hand, we examine the recent developments in international banks' deposit funding, as captured by the LBS. We first present aggregate developments for our core sample. We then zoom in on the quarter of the banking turmoil (Q1 2023) and examine deposit reallocation across and within countries. The analysis then turns to the case of Switzerland.

Aggregate changes in deposit funding

The growth in deposit funding in major jurisdictions slowed from its 2020 peaks to near zero by Q1 2023. Banks located in the United States, the United Kingdom and Switzerland saw negative year-on-year growth in Q4 2022 and Q1 2023 (Graph 6.A). This slowdown over the last four to five quarters of the data coincides with a period of tightening monetary policy that reduced reserves in the banking system and disincentivised banks to lend.

Central bank asset purchases and sales were a key driver of banks' balance sheet size over the past four years and so can obscure other concurrent drivers of deposit funding. As an initial unwinding of quantitative easing got under way in the second

half of 2022, many countries[11] saw a decrease in banks' reserve assets (Graph 6.B). As illustrated by our framework (Graph 1.C), this mechanically leads to a drop in deposits when non-banks purchase government bonds from the central bank. To gauge this effect, we compare changes in reserves – except those offset by banks purchasing or selling government bonds (Graph 1.B) – and changes in deposits.[12] We find that the size of reserve changes was about 30% of the change in deposits over the past five years, and three quarters of the declines in Q4 2022 and Q1 2023.

We further allocate the aggregate reserve-driven decline in deposit funding by the sector of the funding counterparty. We do so by examining how changes in reserves correlate with changes in sector-level deposits from Q1 2018 to Q1 2023 (see technical annex). For every $1 increase/decrease in reserves, this analysis attributes $0.40 to central bank funding, $0.26 to cross-border net interbank funding, $0.19 to domestic NFS deposit funding and $0.11 to NBFI deposit funding.[13]

After filtering out the mechanical impact of reserves, we look under the hood of aggregate changes in deposit funding during the banking turmoil. We find that these changes are consistent with a reallocation of the source of funding: from the NFS to NBFIs (as in Graph 2.A). The change in Q1 2023 is effectively nil (Graph 6.C, black dots). Zooming in on NFS deposit funding, we see that it decreased, even if by a relatively small aggregate amount: $0.14 trillion, or 0.5% of the $25 trillion in amounts outstanding. Notably, this is the only decline in NFS deposit funding over the past 21 quarters in the data for our sample of countries. It was mirrored by a $0.17 trillion increase in deposit funding from NBFIs.

Deposit funding reallocation within and across countries

Digging deeper into the Q1 2023 evolution of deposit funding reveals that it involved domestic rotations of sources within a handful of jurisdictions.[14] Banks in the United Kingdom in particular saw the largest increase in local funding from NBFIs – $50 billion – alongside a $43 billion decline in NFS deposits (Graph 7.A). The picture was similar in Canada and Italy.

In another likely example of funding circling back to banks, NBFIs also provided *cross-border* deposit funding in Q1 2023. In a wider sample of countries that report cross-border positions in the LBS, the United States was the largest source country for cross-border NBFI funding (Graph 7.B). Consistent with this, in Q1 2023 entities in the United States shifted their (largely US dollar) bank deposits into money market funds (MMFs), most likely in search of higher returns as interest rates on deposits lagged policy rates (Box A).[15] Those MMFs, in turn, increased their dollar lending to

[11] Most central banks in our sample operate a floor system for reserves and shrank their balance sheets in the second half of 2022. A few emerging market economy central banks – operating corridor systems – kept their balance sheet unchanged.

[12] While the mechanical impact of reserves on deposits is symmetric for both quantitative easing and tightening, the monetary and financial stability implications need not be (Acharya et al (2023)).

[13] The remaining sectors did not have a statistically significant relationship; the unattributed changes in reserves are incorporated into the unallocated sector.

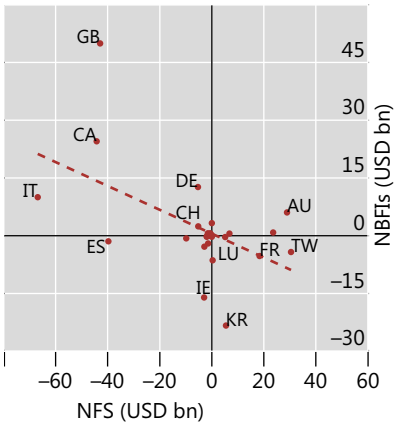
[14] The available data do not allow us to filter out the mechanical effect of reserves at the level of both individual jurisdictions and specific sectors. Given the subdued quantitative tightening in Q1 2023, this should not affect our analysis.

[15] Over Q1 2023, this amounted to about 2% of outstanding deposits in US domestically chartered banks.

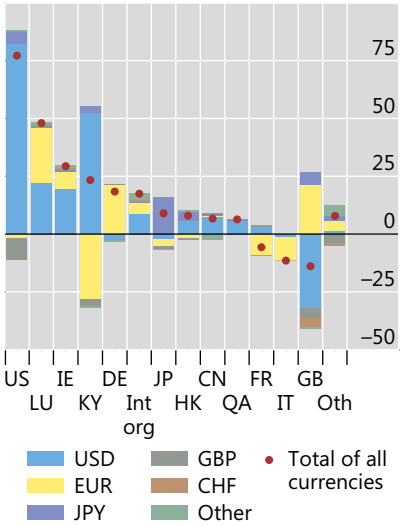
Deposit funding reallocation[1]

FX- and break-adjusted changes, Q1 2023, in billions of US dollars — Graph 7

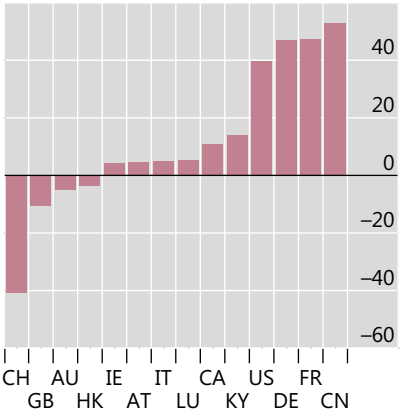
A. Reallocation between domestic NBFIs and NFS[2]



B. Cross-border bank funding from NBFIs expanded, mainly in USD[3]



C. Cross-border non-bank funding declined for banks in Switzerland[4]



[1] See technical annex for details. [2] For 27 reporting countries. [3] For banks in 40 countries that report cross-border deposit liabilities to NBFIs; source countries along the horizontal axis. [4] Changes in deposit liabilities to non-banks by banks in reporting countries; location of reporting banks along the horizontal axis.

Sources: BIS locational banking statistics; authors' calculations.

banks headquartered outside the United States (as in Graph 3.B). NBFIs in financial centres, such as Luxembourg, Ireland and the Cayman Islands, also increased their funding to banks located abroad (Graph 7.B). The bulk of this was also in dollars.

Cross-border deposit funding evolved noticeably for a few key jurisdictions in Q1 2023. Such funding declined the most for banks located in Switzerland, by $41 billion (Graph 7.C). It also decreased for banks in the United Kingdom, by $10 billion. In contrast, banks in the United States, Germany, France and China saw cross-border non-bank deposit funding increase by more than $40 billion each.

Box A

Non-bank financial institutions remain a key driver of non-US banks' dollar funding

*Iñaki Aldasoro, Bryan Hardy and Sonya Zhu*①

Non-bank financial institutions (NBFIs) have grown in importance as a source of US dollar funding for banks headquartered outside the United States (non-US banks).② Rising US policy rates since early 2022 and their limited pass-through to the interest rates of traditional bank deposits generated strong incentives for dollar depositors to seek higher returns outside banks, largely at NBFIs that track policy rates more closely.③ This dollar funding can find its way back to banks when they borrow from NBFIs.

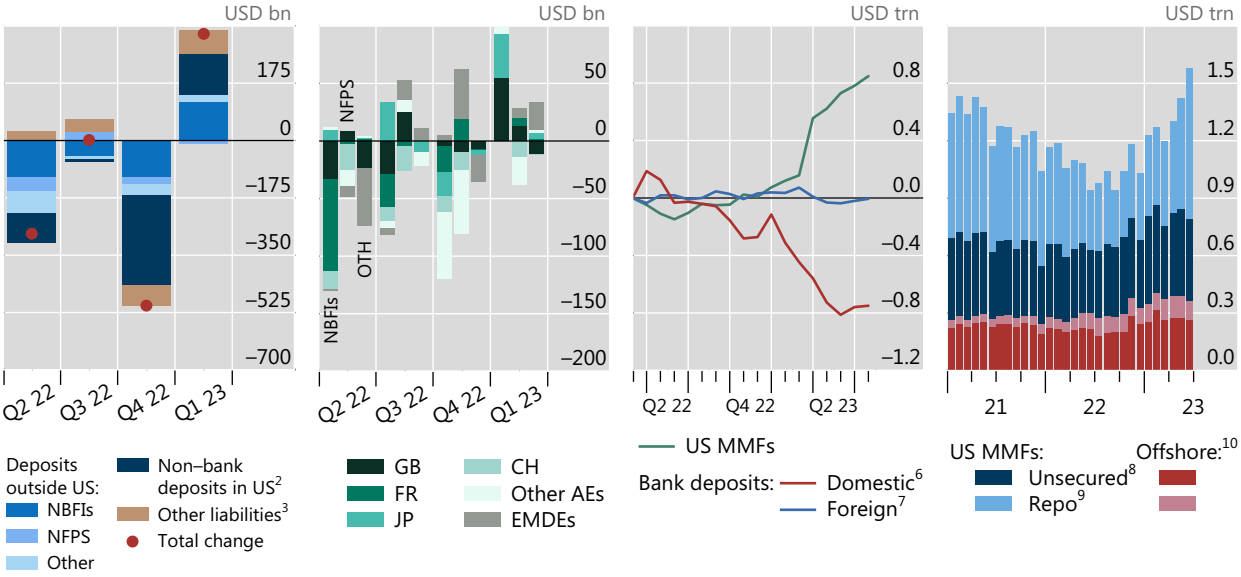
This box examines recent trends in the dollar funding of non-US banks. It analyses funding developments by combining insights from two data sets. First, the BIS international banking statistics (IBS) provide a comprehensive aggregate picture of non-US banks' dollar funding up to Q1 2023, but do not allow for a granular instrument split.④ Second, monthly data on the investments of money market funds (MMFs), an important source of secured and unsecured dollar funding for banks, reveal a more detailed instrument breakdown up to mid-2023.

The IBS show that the global dollar funding of non-US banks increased by $326 billion (or 3%) in the first quarter of 2023. This broke a streak of three consecutive contractions (Graph A1.A). The surge had two main sources: deposit funding from NBFIs booked outside the United States (+$119 billion), and deposit funding from non-banks booked at affiliates in the United States (+$123 billion).⑤

Zooming in on deposit funding booked outside the United States, recent enhancements to BIS data reveal NBFIs' prominent role as funding providers to non-US banks' affiliates in the United Kingdom and Japan (Graph A1.B). Funding from NBFIs to banks located in these two jurisdictions almost single-handedly accounted for the aggregate increase in NBFI deposit funding to non-US banks during Q1 2023. Together with the funding provided to banks in France, it had contributed strongly to the decline observed in previous quarters. By contrast, the non-financial sector played a small role in the net swings in dollar funding to non-US banks outside the US.

Non-US banks' dollar funding grows, driven by non-bank financial institutions

Graph A1



EMDEs = emerging market and developing economies; NBFIs = non-bank financial institutions; NFPS = non-financial private sector (non-financial corporates, households and non-profit institutions serving households).

[1] Adjusted changes in on-balance sheet deposit liabilities of non-US banks, booked by offices in and outside the US. "Other" comprises government and unallocated by non-bank subsectors. [2] Cross-border deposit liabilities to non-banks and local liabilities to residents in the US. [3] International debt securities and liabilities to US banks and central banks. [4] Aggregate deposit liabilities of non-US banks located outside the US; vis-à-vis the non-bank sector. [5] Cumulative changes since March 2022. [6] Domestically chartered banks in the US. [7] Foreign related banks in the US. [8] Funding provided by prime funds, including certificates of deposit, commercial paper and other sources of funding. [9] Includes repos by government, treasury funds and prime funds. [10] US dollar funding to non-US banks provided by MMFs domiciled in Bermuda, the Cayman Islands, Ireland, Luxembourg and Switzerland.

Sources: Federal Reserve, H.8 release; Federal Reserve Bank of St Louis, FRED; Office for Financial Research Money Market Fund Monitor; CRANE; Datastream; Informa iMoneyNet; BIS consolidated banking statistics; BIS debt securities statistics; BIS locational banking statistics; authors' calculations.

The growing size of MMFs was a key driver of the recent increase in dollar funding of non-US banks. US MMF assets swelled in the first half of 2023 alongside a decline in traditional deposits (eg excluding repos) in US domestically chartered banks (Graph A1.C). This pattern suggests a reallocation of funds from low-yielding bank deposits to MMFs. In turn, MMFs – and especially those located in the US – strengthened their already pivotal role as a dollar funding source for non-US banks. The dollar funding provided to non-US banks by MMFs (located both inside and outside the United States) rose by almost $550 billion (or 53%) during the first half of 2023 (Graph A1.D). Most of this increase (+$439 billion) came in the form of repos provided by MMFs located in the US and was concentrated in the second

quarter (light blue bars). Funding sourced from MMFs located outside the United States also rose during the first half of 2023, but more modestly (+$36 billion overall, well below the +$74 billion provided by US MMFs through unsecured funding).

The key role of NBFIs in general – and MMFs in particular – as funding providers to banks underscores their growing interconnectedness.⑥ As most recently evidenced by the March 2020 market turmoil, MMFs can be a flighty source of funding. Stronger reliance on them can thus be a source of bank vulnerabilities.⑦

① The views expressed are those of the authors and do not necessarily reflect the views of the BIS. ② According to the BIS international banking statistics, close to 20% of non-US banks' dollar liabilities come from NBFIs. This is most likely a lower bound, as some of banks' debt securities – which have "unallocated" counterparties – are probably held by NBFIs. ③ See G Afonso, C Huang, M Cipriani, H Abduelwahab and G La Spada, "Monetary policy transmission and the size of the money market fund industry: an update", *Liberty Street Economics*, Federal Reserve Bank of New York, 17 August 2023. ④ In the IBS, deposit funding includes traditional customer deposits as well as interbank funding and repos, but excludes certificates of deposit, commercial paper and other instruments grouped under debt securities. ⑤ Data do not allow a more granular split of the non-bank sector for positions booked in the United States. For further detail, see I Aldasoro and T Ehlers, "The geography of dollar funding of non-US banks", *BIS Quarterly Review*, December 2018, pp 15-26. ⑥ See I Aldasoro, W Huang and E Kemp, "Cross-border links between banks and non-bank financial institutions", *BIS Quarterly Review*, September 2020, pp 61–74. ⑦ See I Aldasoro, E Eren and W Huang, "Dollar funding of non-US banks through Covid-19", *BIS Quarterly Review*, March 2021, pp 31–40.

The case of Switzerland

While Switzerland was a key jurisdiction during the Q1 2023 banking turmoil, the deposit decline for internationally active banks there had started earlier. From Q2 2022 to Q1 2023, both resident and non-resident non-banks (NFS and NBFI) reduced their funding of international banks in Switzerland – by about $30 billion and $180 billion, respectively (Graph 8.A). This amounted to a 12% year-on-year fall in bank deposit funding, the largest since the Great Financial Crisis. Part of the decline corresponds to a decrease in reserves, which fell by about $120 billion.[16] Adding net funding from the banking sector, there was a decline of $71 billion in deposit funding for international banks in Switzerland not connected to the decrease in reserves. This loss of deposit funding was compensated by the $102 billion of funding provided by the central bank (see Graph 2.C).

Zooming in on Swiss residents, they appeared to reallocate their deposit funding from international banks in three different ways. First, they increased their cross-border deposit funding, notably at banks in the United Kingdom (Graph 8.B). Second, data from the Swiss National Bank reveal that they increased their deposits at domestically oriented banks in Switzerland (Graph 8.C, red bars). Indeed, cantonal (regional) and raiffeisen (cooperative) banks in the country saw a rise in deposits equal to roughly 80% of the decline at big banks. The LBS miss this reallocation, as most of these domestically focused banks are not in the reporting population (as illustrated in Graph 4.A).[17] Third, some deposits were probably reallocated to NBFIs which lent abroad in the form of securities (as in Graph 4.B). In line with this, the balance of payments data show that residents of Switzerland increased their holdings of debt and equity securities (ie portfolio investment) abroad (Graph 8.C, blue

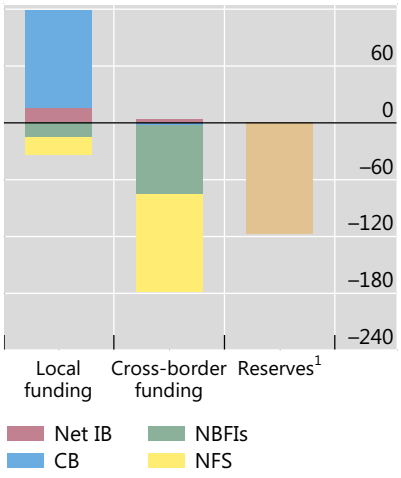
[16] Sight deposits of domestic banks placed at the Swiss National Bank – which constitute the bulk of bank reserves in Switzerland – fell by about CHF 180 billion (about USD 200 billion) during this period.

[17] The data on system deposits provided by the Swiss National Bank are not collected on the same basis as for the LBS data. Hence, the series cannot be used to exactly decompose the reallocation of Swiss resident deposits in the LBS data.

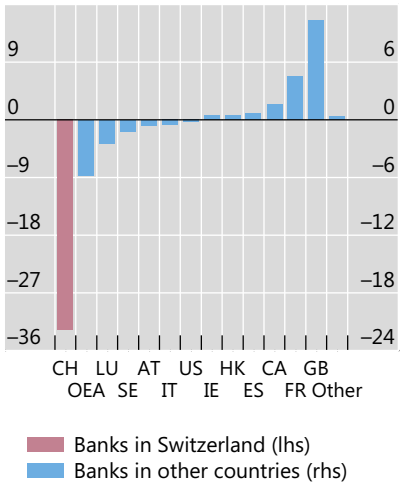
Funding flows in Switzerland

FX- and break-adjusted cumulative changes, Q2 2022–Q1 2023, in billions of US dollars Graph 8

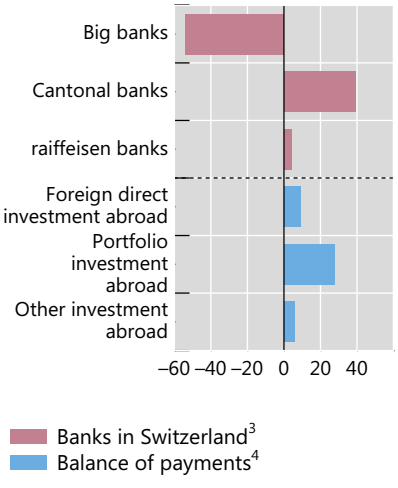
A. International banks in Switzerland lost non-bank deposits



B. Swiss resident non-banks moved some deposits to banks abroad…[2]



C. …but most domestic deposits stayed in Switzerland at cantonal banks



CB = central bank; net IB = net interbank (liabilities minus claims), excluding positions vis-à-vis CBs.

[1] Total adjusted changes in reserves with the Swiss National Bank and holdings of local government debt. [2] OEA = euro area reporting countries excluding AT, ES, FR, IE and IT. Other = the rest of reporting countries. [3] Changes in domestic deposits excluding those related to pension provision. [4] Net acquisition of assets in the balance of payments.

Sources: Swiss National Bank; International Monetary Fund; BIS locational banking statistics; authors' calculations.

bars).[18] The overall drop in domestic Swiss deposits from Q2 2022 to Q1 2023 was nevertheless small (a 1% change), as most of the deposit funding decline from international banks ended up at other banks in Switzerland.

Conclusion

Focusing on the evolution of international banks' deposit funding from the non-bank sector, we find that the banking turmoil in Q1 2023 did not spark a widespread contraction. A few jurisdictions did see a retreat of deposit funding from the NFS. But the broader picture revealed that NBFIs were probably on the receiving end and replaced the NFS as providers of bank funding. This rotation could have reflected concerns about the health of some banks or a search for higher returns.

The shift to NBFIs as funding providers is a trend that has been under way in the banking sector over the past decade (Aldasoro et al (2020)). Importantly, deposit funding from NBFIs can be particularly sensitive to changes in market conditions (Franceschi et al (2023)). Thus, while the feared funding shortages did not generally materialise, the continued changes to the composition of bank funding can have implications for financial stability.

[18] There is no evidence that deposit funding circled back to banks as investment in their debt securities (which declined), as depicted in Graph 2.B.

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Technical annex

The sample of 27 reporting countries comprises AT, AU, BE, BM, BS, CA, CH, CY, DE, ES, FR, GB, GG, GR, ID, IE, IM, IT, KR, LU, MY, NO, PT, SA, SE, TW and ZA. These countries report instrument and detailed sector breakdown of local and cross-border deposit liabilities of banks in their jurisdictions.

Graph 6.A: For US, total deposit liabilities of all commercial banks (Federal Reserve H8 release). For CN, total deposit liabilities of "other depository corporations". For CH and GB, data as reported in the LBS. For JP, total liabilities (including trustee liabilities) of banks, reported in LBS. "Other" comprises 25 out of the sample of 27 reporting countries and excludes CH and GB, which are shown individually.

Graph 6.B: Relates to total of local and cross-border deposit liabilities to all sectors including central banks and unallocated by sector, after netting of interbank deposits and interbank loans (excluding central banks), for the sample of 27 reporting countries.

Graph 6.C: We compare changes in reserves with changes in different segments of deposits across our sample of countries to get an average response of deposits to changes in reserves. This is implemented via the regression $\frac{\Delta Deposit_{i,c,t}}{Total\ Claims_{ic,t-1}} = \alpha_i + \alpha_t + \beta \frac{\Delta Reserves_{c,t}}{Total\ Claims_{c,t-1}} + \varepsilon_{it}$, where c indexes the bank's country, i indexes the counterparty sector of banks' liabilities and t indexes the quarter of the observation. $Reserves_{c,t}$ is banks' claim on the central bank of country c in quarter t less any offsetting flows of local claims on local currency government debt (capped at a maximum offset of the size of the reserve change).

Graph 7.A: Relates to the sample of 27 reporting countries.

Graph 7.B: Countries listed on the x-axis are those with absolute amounts of $5 billion or more. International organisations include regional development banks.

Graph 7.C: Reporting jurisdictions, excluding DK and NL, with an absolute change of $3.5 billion or more are shown on the x-axis. Japan also recorded a large increase but is excluded for confidentiality reasons.

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Interest rate risk management by EME banks[1]

Banks' management of interest rate risk depends on their business model as well as the environment in which they operate. In comparison with banks in many advanced economies, banks in emerging market economies (EMEs) make less use of interest rate derivatives. Instead, they mitigate the impact of rate changes on their net interest income by minimising repricing gaps between assets and liabilities. The management of interest rate risk might become more challenging with the expansion of EME banks' securities holdings.

JEL classification: G21, E40.

The stress triggered by the collapse of Silicon Valley Bank in March 2023 put the spotlight on banks' management of interest rate risk (IRR). Banks manage this risk in various ways, depending on their business model as well as the macro-financial and institutional environment in which they operate. In comparison with banks in many advanced economies (AEs), banks in emerging market economies (EMEs) make less use of derivatives to manage IRR.[2] We find that they limit the repricing gaps between assets and liabilities to reduce the impact of rate changes on their interest income. Specifically, they rely heavily on time deposits for funding, and extend floating rate or short-term loans with interest rate sensitivity similar to that of their deposits.

In a sign of investors' confidence in EME banks' management of IRR, the banking stress in March 2023 did not have a significant effect on EME banks. That episode led investors to reassess banks' vulnerability to higher interest rates. US banks saw their equity prices plunge, along with European and Japanese banks (Graph 1). Those facing persistent market scepticism, as indicated by a low price-to-book ratio, were hit particularly hard (BIS (2023)). In contrast, the equity prices of EME banks continued to track the broader market, as they had since the start of global monetary tightening in 2022. Even the prices of EME banks with low price-to-book ratios held up well.

In recent years, however, EME banks' exposure to interest rate-driven swings in valuation has been growing. In particular, the share of their assets invested in longer duration securities has expanded. This increases the importance of hedging the

[1] The authors thank Douglas Araujo, Claudio Borio, John Caparusso, Stijn Claessens, Rodrigo Coelho, Renzo Corrias, Jon Frost, Ulf Lewrick, Benoit Mojon, Noel Reynolds, Hyun Song Shin, Nikola Tarashev, Christian Upper, Goetz von Peter, Raihan Zamil and Sonya Zhu for valuable comments and discussion. The views expressed in this feature are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

[2] In line with the BIS's country groupings, the following 11 economies are categorised as AEs: Australia, Canada, Denmark, the euro area, Japan, New Zealand, Norway, Sweden, Switzerland, the United Kingdom and the United States. All other economies covered in this feature are categorised as EMEs. These groupings are intended solely for analytical convenience and do not represent an assessment of the stage reached by a particular country in the development process.

Key takeaways

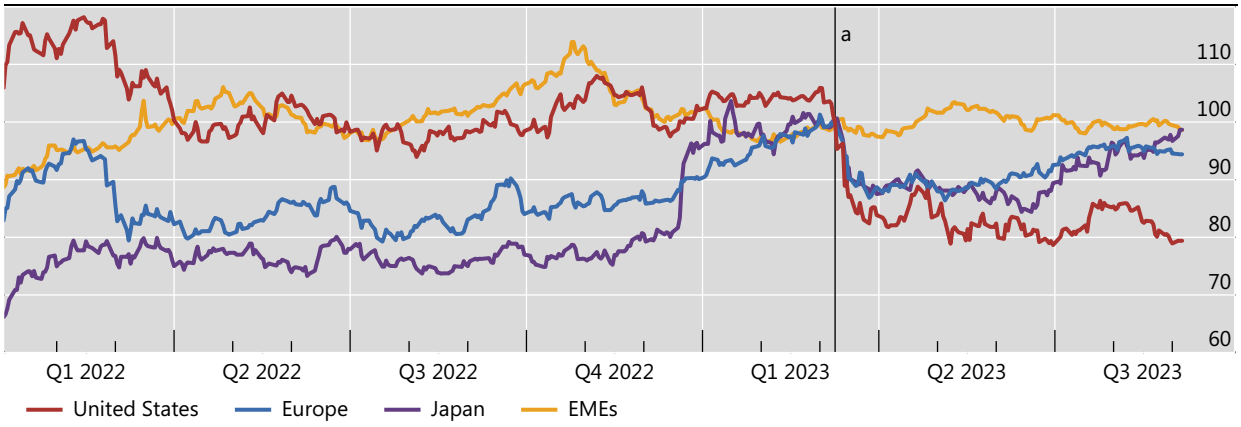
- *Banks in emerging market economies (EMEs) mitigate interest rate risk by extending floating rate or short-term loans with interest rate sensitivity similar to that of their deposits.*
- *EME banks make less use of derivatives to manage interest rate risk than their peers in many advanced economies.*
- *EME banks' securities holdings are increasing – changing the nature of their exposure to interest rate risk.*

impact of interest rate changes on non-interest income, for example, with interest rate derivatives.

The rest of this feature is organised as follows. The next section discusses different ways in which banks are exposed to IRR. The feature then summarises evidence about the sensitivity of net interest income to interest rates and examines how EME banks limit such sensitivity. The subsequent section broadens the perspective to the sensitivity of overall profitability followed by a section on EME banks' increasing securities holdings. The concluding section outlines how approaches to IRR management might need to evolve as balance sheets become more complex. Box A analyses differences in the size and growth of interest rate derivatives markets across countries.

Equity prices of EME banks held up well during the March banking stress[1]

Relative performance of the banking sector, 8 March 2023 = 100 Graph 1



[a] Silicon Valley Bank announced capital-raising.

[1] Performance of banks' equity prices relative to the corresponding broad market index. MSCI indices.

Sources: Bloomberg; MSCI; authors' calculations.

Interest rate risks on banks' balance sheets

Fluctuations in market interest rates directly affect a bank's profits through changes in net interest income and swings in the valuation of outstanding positions. Profits in turn influence a bank's net worth (or economic value). Banks manage these effects through the composition of their assets and liabilities.

The exposure of net interest income to IRR depends on the relative sensitivity of yields on interest-earning assets and interest-bearing liabilities to market rates. The relative sensitivity of yields is in turn influenced by differences in the time remaining to the next repricing, which is dependent on contractual terms for floating rate assets and liabilities, and happens at maturity for fixed rate ones.[3] For example, if loans reprice more frequently than deposits, then higher market rates will boost banks' net interest margins (NIMs). The more sensitive deposit rates are to market rates, however, the stronger the rise in funding costs, thus eroding the boost to margins.

Interest rate moves also affect valuations. The longer the duration of an instrument, the greater the direct impact of rate changes on its (net present) value. Higher rates might further depress valuations indirectly through credit losses as the business cycle matures and borrowers' debt servicing costs rise. Accounting rules determine how such valuation gains and losses are recognised.[4] If a bank does not value assets at market prices, unrealised losses can accumulate on its balance sheet as rates rise. These losses surface if the assets need to be sold, for instance, to meet deposit withdrawals.

Banks can manage IRR by either adjusting the composition of their balance sheet or hedging with derivatives. One approach is to match the interest rate sensitivity of assets and liabilities in specific repricing buckets. This is effective for mitigating IRR when net interest income accounts for the bulk of profits. It is more difficult to implement when the interest rate sensitivity of the asset portfolio is inherently different from that of the funding instruments. In addition, such rigid minimisation of repricing gaps might not suit a bank's business model.

A comprehensive approach to IRR hedging involves matching the interest rate sensitivity of an entire portfolio of assets to that of liabilities so as to minimise the impact of changes in interest rates on a bank's economic value. This can be done, for example, with derivative overlays that leave the balance sheet unchanged but reduce the gap between the effective duration of assets and liabilities. Supervisors frequently require banks to measure their IRR exposure using economic value models, in addition to measuring the impact of rate moves on net interest income (BCBS (2019)).

Interest rate sensitivity of net interest income

Net interest income accounts for a high share of banks' total income, particularly at EME banks. In recent years, net interest income has accounted for around 65% of total income at the median EME bank, compared with less than 55% at the median AE bank (Graphs 2.A and 2.B). Thus the interest rate sensitivity of net interest income has an important influence on a bank's overall IRR exposure.

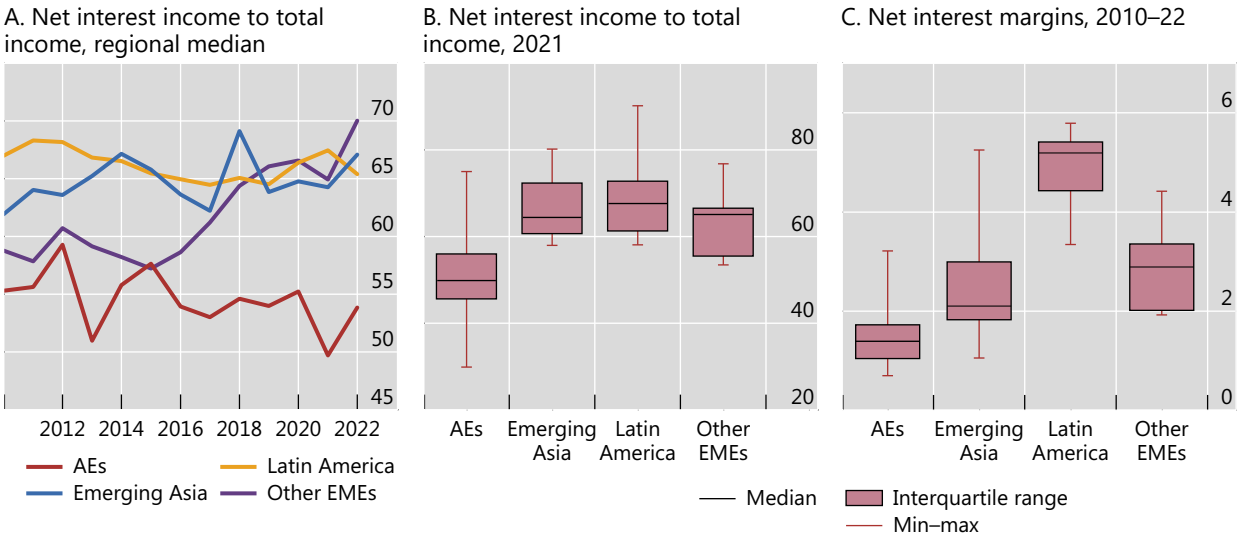
[3] The interest rate sensitivity of yields on a bank's assets and liabilities is also influenced by competition in loan and funding markets.

[4] The accounting and regulatory treatment of valuation gains and losses differs across jurisdictions, and sometimes even across banks within the same jurisdiction (Coelho et al (2023)). Under International Financial Reporting Standards, instruments held for trading are valued at fair value and valuation changes are recognised in non-interest income. Instruments available for sale are also valued at fair value but valuation changes are recognised only in equity. Instruments held to maturity are valued at amortised cost as long as they remain in this category.

EME banks have a greater share of net interest income and higher interest margins[1]

In per cent

Graph 2



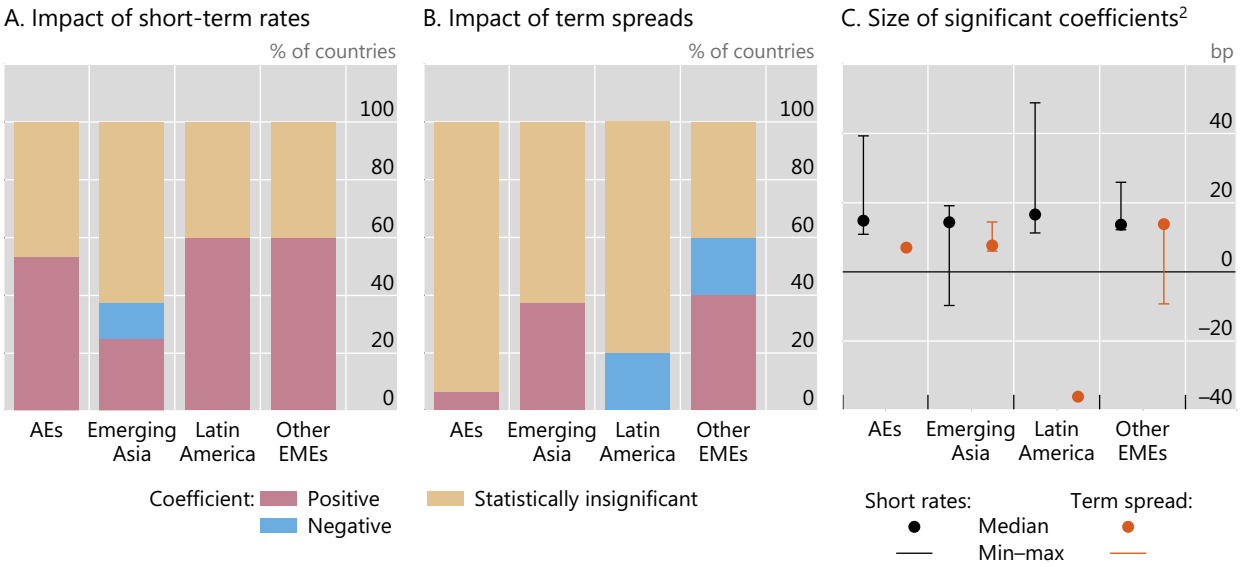
[1] See technical annex for details.

Sources: IMF Financial Soundness Indicators; S&P Capital IQ; authors' calculations.

Interest rate increases are usually found to have a positive impact on net interest income, but the impact is often small. This is particularly the case for short-term rates. The effect of changes to the slope of the yield curve tend to be similar, although less definitive (eg Altavilla et al (2018), Claessens et al (2018), CGFS (2018)).

Interest rate sensitivity of banks' net interest margins[1]

Graph 3



[1] See technical annex for details. [2] Estimated change in NIMs in response to a 100 basis point increase in either short-term rates or term spreads.

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

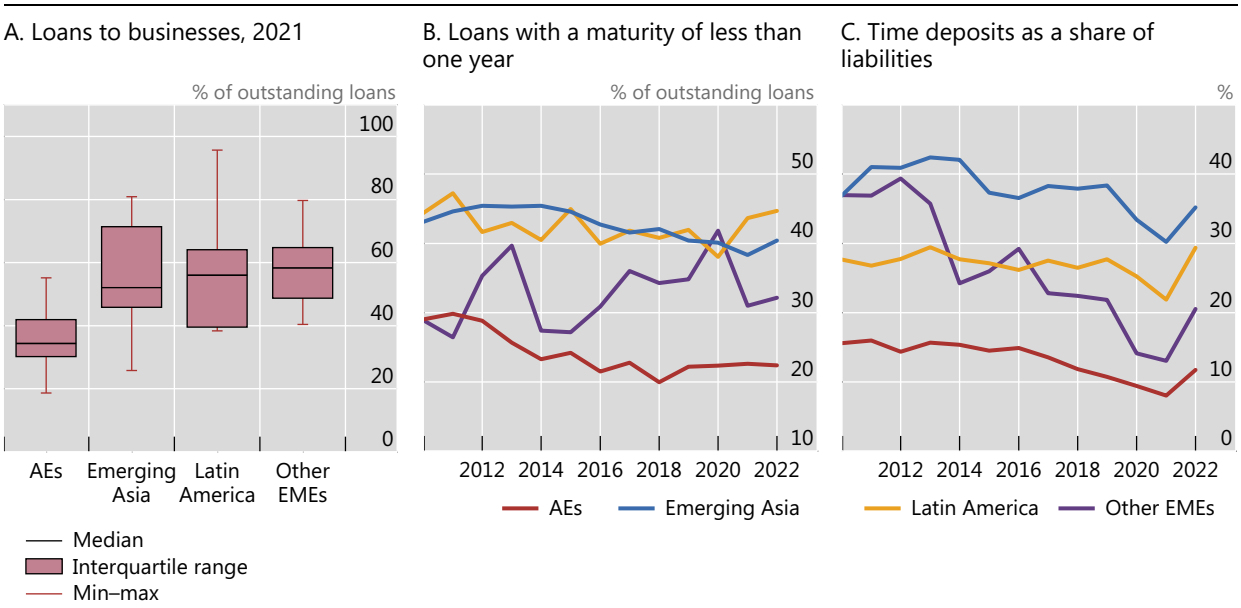
Similar results are found using a sample of over 1,200 banks in 33 countries covering the period 2010–22 (see the technical annex for an explanation of the methodology). Changes in short-term rates have a positive impact on banks' NIMs in a majority of countries in each region, with the exception of emerging Asia (Graph 3.A). The impact of the yield curve's slope is more mixed – it is positive in some countries, negative in others and insignificant in most (Graph 3.B). The level of short-term rates and the slope of the yield curve often move together, so the two variables are sometimes jointly significant despite being individually insignificant.

Even so, the estimated economic significance is typically small. Across banks in each region, a 100 basis point increase in short-term rates tended to boost NIMs by less than 20 basis points over four quarters (Graph 3.C). This compares with an average NIM over the 2010–22 period of about 210 basis points in emerging Asia, nearly 520 basis points in Latin America and roughly 290 basis points in other EMEs (in eastern Europe, the Middle East and Africa) (Graph 2.C). The boost to NIMs was more material for banks in AEs, where NIMs averaged only 140 basis points.

What explains the low interest rate sensitivity of EME banks' net interest income? The composition of their balance sheets suggests that they limit their IRR exposure through frequent repricing of both assets and liabilities.

On the asset side, a high share of EME banks' loans have floating rates or short maturities (or often both). Business loans account for the largest share of EME banks' outstanding loans (Graph 4.A), and they typically have floating rates. Indeed, in most of the countries in our sample, the overwhelming majority of loans to businesses had floating rates as of 2021.[5] By contrast, owing to large residential mortgage markets, lending to households makes up the largest share of AE banks' loan books. In general, mortgages are more likely than business loans to have long maturities at fixed rates.

EME banks lend mainly to businesses and short term, funded by time deposits[1] Graph 4



[1] See technical annex for details.

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

[5] Based on loan-level data from Capital IQ on borrowing by non-financial firms.

The share of short-term loans is similarly high at EME banks. At the median bank in emerging Asia and Latin America, more than 40% of the outstanding loans have a remaining maturity of less than one year (Graph 4.B). By comparison, only 20% of the loans at the median AE bank are similarly short term. Among banks in other EMEs, the share lies in between. Overall, there is evidence that the loan rates of EME banks tend to reprice frequently and thus move with market rates.

On the liability side, EME banks rely heavily on time deposits, which bear interest and have a defined maturity date. Such deposits can be readily matched with assets in specific repricing or maturity buckets. At banks in emerging Asia, time deposits have accounted for about 35% of total liabilities in recent years, and even more historically (Graph 4.C). The share for banks in Latin America was around 30%. In contrast, at the typical AE bank, time deposits recently accounted for only 10% of liabilities. Time deposits at banks in other EMEs were also low in recent years, mainly because of the narrow yield differential with demand deposits in several eastern European countries where policy rates were kept low. At EME banks, demand deposits accounted for most of the remainder of their liabilities.

Time deposits are more expensive than demand deposits but are usually less costly than market funding. Whereas demand deposits typically pay no or minimal interest, interest rates on time deposits adjust with market rates. The higher cost of time deposits comes with a reduced likelihood of unexpected outflows because early withdrawals are either not permitted or allowed only with penalties. This is particularly relevant for EME banks, as they operate in a more volatile macro-financial environment than their AE peers. The higher incidence of interest rate and other shocks in EMEs suggests a higher likelihood of depositors withdrawing funds at short notice. The restrictions associated with time deposits reduce this likelihood.

Interest rate sensitivity of return on assets

Net interest income gives only a partial picture of banks' exposure to IRR as it excludes the impact of valuation changes. For a fuller picture, we now turn to banks' overall profitability, as measured by their return on assets (ROA).

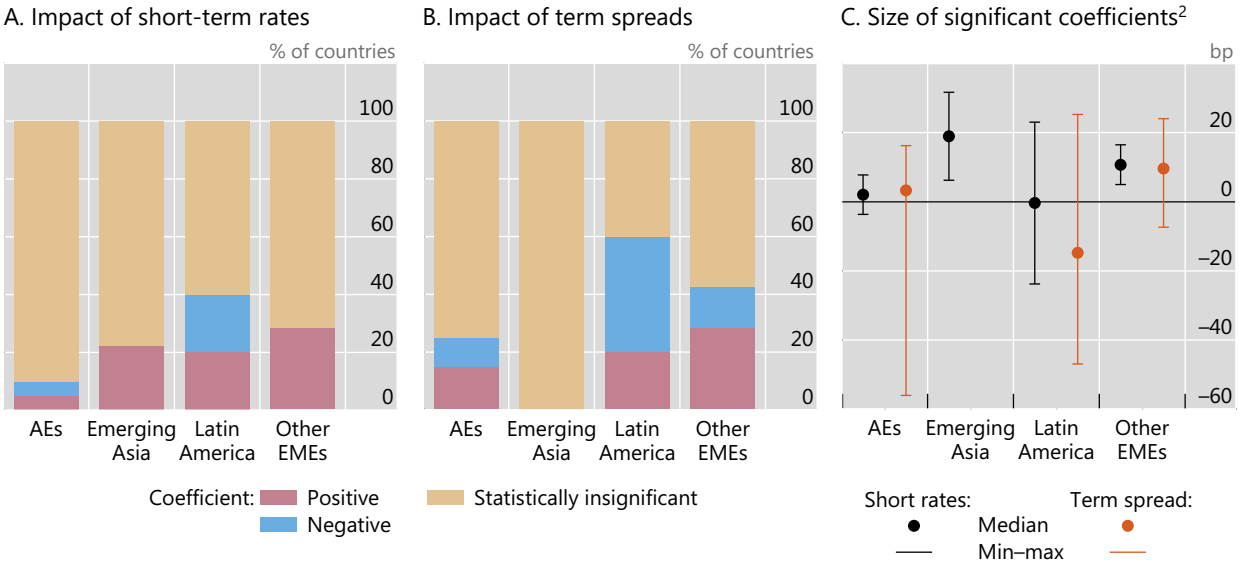
Previous studies generally concluded that banks' ROA was less sensitive to interest rates than NIMs (eg Borio et al (2017)). Using our sample of over 1,200 banks, we find similar results (Graph 5). In the majority of countries, the positive effect of higher rates on net interest income seems to be offset by a negative impact of other factors, such as portfolio valuations. In some countries, particularly in Latin America, the negative impact dominates. In general, the estimated economic significance is smaller than in the case of NIMs.

The use of derivatives likely explains some differences across banks in the sensitivity of their ROA to interest rates.[6] Some banks use interest rate derivatives to reduce mismatches in the duration of their assets and liabilities. For example, a positive duration gap between loans and deposits can be offset with an interest rate swap to receive floating rates.

[6] This assumes that gains and losses on derivatives are recorded in non-interest income. If the requirements for hedge accounting are met then they can be recorded as a component of equity.

Interest rate sensitivity of banks' return on assets[1]

Graph 5



[1] See technical annex for details. [2] Estimated change in ROA in response to a 100 basis point increase in either short-term rates or term spreads.

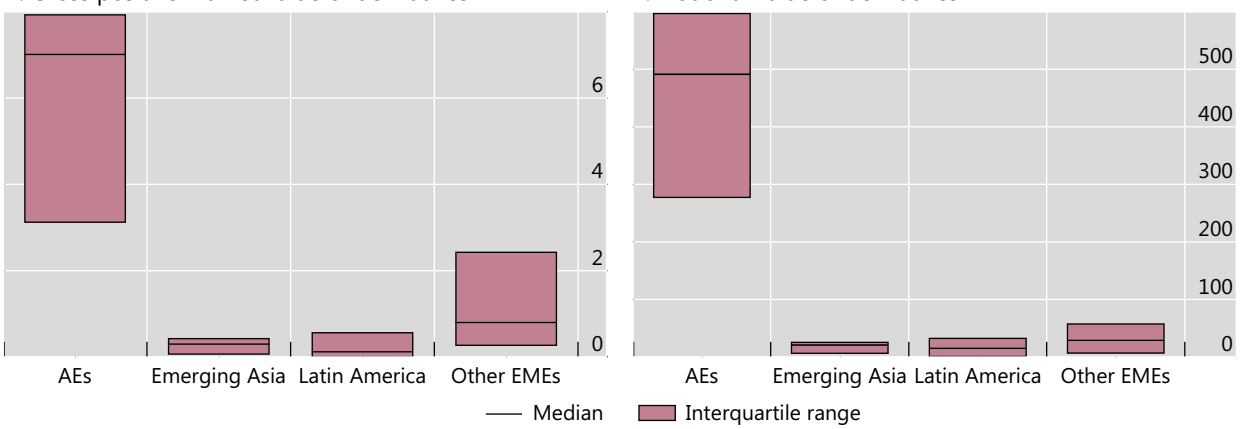
Sources: S&P Capital IQ; authors' calculations.

The use of interest rate derivatives is much greater among banks in AEs, particularly large complex entities, than among those in EMEs. For the median AE banking system, the gross market value of interest rate derivatives was equivalent to almost 7% of total assets in early 2022 (Graph 6.A). Their notional value was about five times larger than total assets (Graph 6.B). By contrast, derivatives were a much smaller proportion of EME banks' assets. Banks in Czechia and South Africa were notable exceptions, with relatively large interest rate derivatives positions. Not coincidentally, these two countries also have deep interest rate derivatives markets (Box A).

EME banks have small interest rate derivatives positions[1]

Over-the-counter interest rate derivatives, as a percentage of bank assets

Graph 6

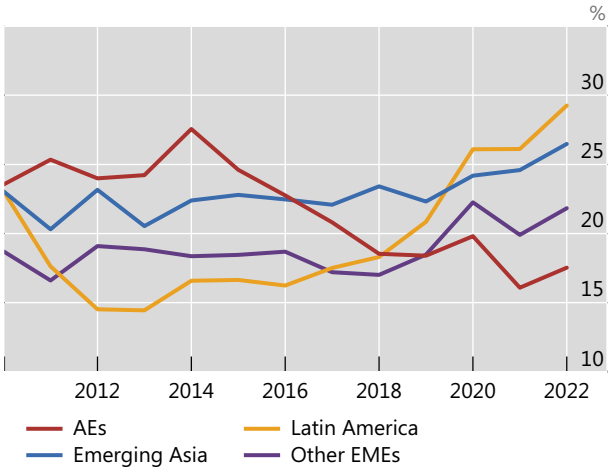


[1] Derivatives at end-June 2022 as a share of bank assets at end-March 2022. See technical annex for details.

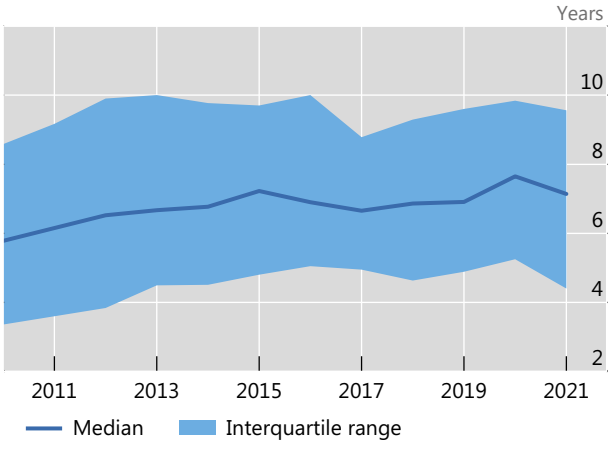
Sources: IMF Financial Soundness Indicators; BIS derivatives statistics; BIS Triennial Central Bank Survey; authors' calculations.

The size and duration of EME banks' securities holdings are increasing[1] Graph 7

A. Securities as a share of total assets



B. Remaining maturity of EME government debt



[1] See technical annex for details.

Sources: S&P Capital IQ; national sources; BIS debt securities statistics; authors' calculations.

Interest rate risk and securities holdings

For EME banks, valuation losses arising from interest rate moves were not, historically, a significant source of exposure to IRR. However, this is changing as the size and duration of their securities holdings increase.

The share of securities in total assets has trended up at EME banks in recent years and has significantly exceeded that at AE banks since the Covid-19 crisis (Graph 7.A). For EME banks, this share rose as they stepped in to absorb the increased supply of government debt. Meanwhile, AE banks' share declined as central banks increased their bond holdings through large-scale asset purchases. In 2022, securities accounted for almost 30% of assets at banks in Latin America, 26% in emerging Asia and 22% in other EMEs, compared with 17% in AEs.

In some cases, along with a higher share of securities, the duration of EME banks' holdings increased, as governments extended the maturity of their debt.[7] The maturity of outstanding government bonds in the median EME increased from less than six years in 2010 to more than seven in 2021 (Graph 7.B).

The increasing size and duration of EME banks' securities holdings change the nature of their IRR exposure. In particular, they increase the importance of hedging the impact of interest rate changes on other (non-interest) sources of income. These impacts are more effectively hedged by managing the interest rate sensitivity of the entire portfolio rather than matching specific repricing buckets, ie minimising duration gaps rather than repricing gaps.

[7] Higher holdings of government debt also tightened the sovereign-bank nexus. This has contributed to an increase in the correlation between bank and sovereign credit default swaps in EMEs since the Covid-19 crisis (Hardy and Zhu (2023)).

Moreover, valuation losses are an important channel through which IRR exposures can become intertwined with funding risks. For example, Silicon Valley Bank had accumulated significant unrealised losses on its securities holdings, and the prospect of realising these losses to meet funding outflows raised solvency concerns that eventually precipitated a depositor run. To the extent that EME banks value their securities portfolios at market prices – which many do (IMF (2023)), not least as a result of supervisory guidance – they need to recognise and address losses promptly and thus the interaction of IRR and funding risk is likely to play out differently.

Conclusions

Net interest income accounts for a high share of EME banks' total income, and they manage the impact of IRR on their net interest income by holding assets and liabilities that reprice frequently. In particular, EME banks extend loans with floating rates or short maturities, mainly to businesses. This limits the repricing gaps with time deposits on which EME banks rely heavily for funding.

As balance sheets become more complex and business models change, hedging the impact of interest rate changes on non-interest sources of income and net worth might become more challenging. Securities already account for a large share of EME banks' assets, increasing their exposure to valuation losses. The duration of banks' assets is also likely to increase as mortgage markets develop, and fee income is likely to expand as asset management grows. This would increase the heft of IRR exposures that are inherently difficult to hedge by minimising repricing gaps.

Interest rate derivatives are a flexible tool for managing IRR, but these markets are still poorly developed in many EMEs. Interest rate derivatives markets in many EMEs lack the depth that banks might need in order to meet an increase in their hedging demand. At the same time, banks' limited participation so far is an important reason why these markets remain illiquid and small (Acharya (2018)). Removing obstacles to foreign participation in local derivatives markets can propel their development (Box A).

Box A

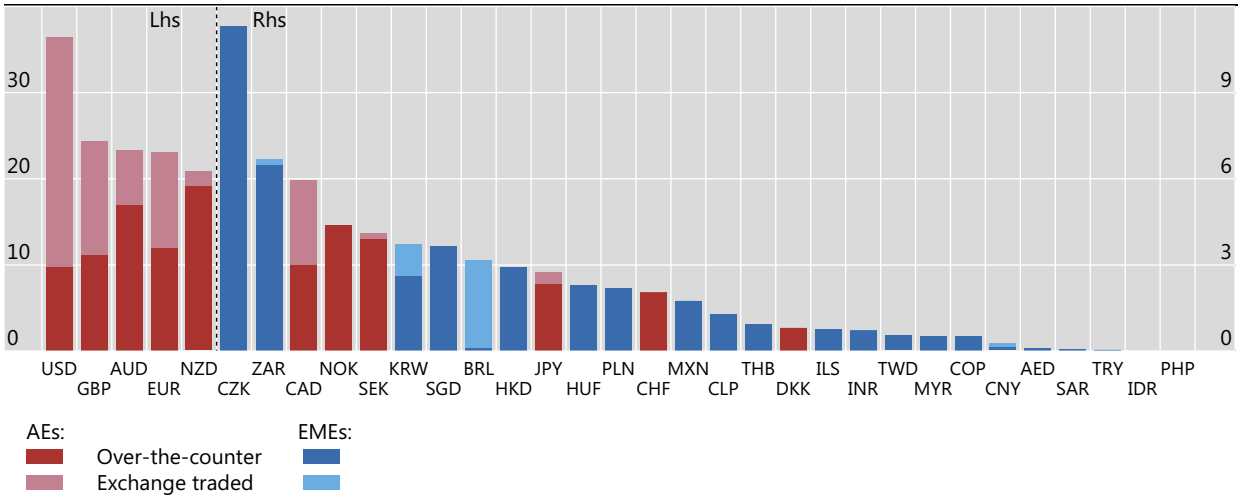
Interest rate derivatives mainly trade internationally

Interest rate derivatives (IRDs) markets in EMEs have gained depth in recent years, yet they remain small relative to the size of the corresponding economy. Their smaller size is explained in part by EMEs' smaller external positions, as an overwhelming share of IRD trading is with non-residents, often driven by investment motives.

According to the latest BIS Triennial Central Bank Survey of over-the-counter (OTC) derivatives markets, IRDs denominated in only a handful of currencies trade actively. The US dollar IRD market is the largest, with daily trading volumes in April 2022 equivalent to about 40% of US GDP (Graph A1).① When similarly benchmarked against economic activity, IRDs denominated in pounds sterling, Australian dollars, euros and New Zealand dollars are the next most actively traded contracts. IRD trading in many EME currencies is negligible. But there are a few actively traded ones. In particular, the turnover of Czech koruna and South African rand contracts are higher shares of the corresponding country's GDP than that of several AEs: around 11% and 7%, respectively, compared with 6% for Canadian dollar contracts and 3% for Japanese yen contracts.

Interest rate derivatives trading is low in most EMEs

Average daily derivatives turnover, as a percentage of GDP[1] Graph A1



[1] Turnover of OTC and exchange-traded derivatives in April 2022 scaled by GDP of the currency-issuing country in 2021.

Sources: IMF World Economic Outlook database; Euromoney Tradedata; Futures Industry Association; Options Clearing Corporation; BIS derivatives statistics; BIS Triennial Central Bank Survey; authors' calculations.

In recent years IRD trading of many EME currencies has grown faster than that of AE currencies. Whereas turnover in the median AE currency declined by 30% between 2019 and 2022, turnover in the median EME currency increased slightly. The fastest growth was seen in IRDs denominated in Colombian pesos, Czech korunas, Chilean pesos, Israeli new shekels and Korean won. Most of this growth was in OTC contracts. For Korean won and Chinese yuan, bond futures traded on exchanges picked up too.

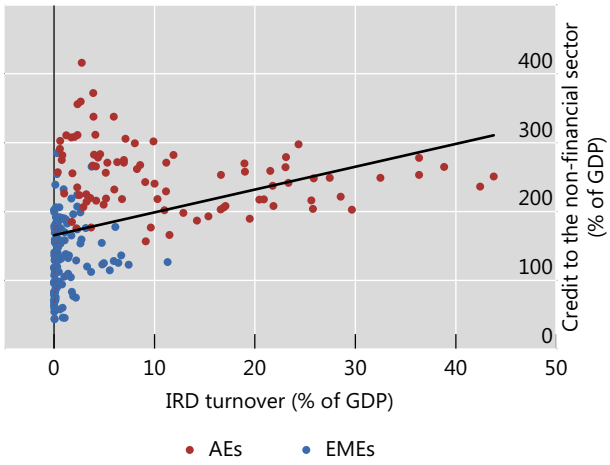
Benchmark rate reforms explain part of the difference in growth rates. Among AE currencies, the shift from interbank offered rates – notably Libor – to nearly risk-free rates reduced fixing risk, which led to a sharp decline in the trading of forward rate agreements and thereby to overall IRD activity (Huang and Todorov (2022)). In EMEs, benchmark rate reforms have progressed more slowly than in the USD market and, consequently, so far IRD trading has been less affected by these reforms.

In general, IRD trading, like the trading of other financial instruments, depends on the size of the local financial system and the diversity of market participants (Caballero et al (2022)). The larger the stock of tradeable assets and the more varied the investor base, the more developed the ecosystem for trading and hedging associated risks tends to be. Accordingly, IRD turnover is positively correlated with the size of domestic credit, an asset class particularly exposed to interest rate risk (Graph A2.A).

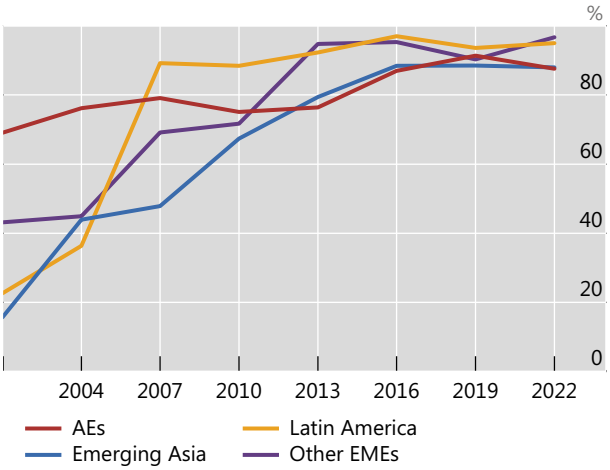
Turnover of interest rate derivatives

Graph A2

A. Turnover is boosted by higher domestic credit…[1]



B. …and is mostly international with at least one counterparty outside the currency-issuing country[2]



[1] Average daily turnover of OTC and listed derivatives. Based on data every three years from 2001 to 2022 (eight survey years). Credit and GDP refer to the year before the survey year. Excluding HKD and SGD as outliers. [2] Turnover of OTC derivatives in April 2022. AEs: AUD, CAD, CHF, DKK, EUR, GBP, JPY, NOK, NZD, SEK and USD. Asian EMEs: CNY, HKD, IDR, INR, KRW, MYR, PHP, SGD, THB and TWD. Latin America: ARS, BRL, CLP, COP, MXN and PEN. Other EMEs: AED, BGN, CZK, HUF, ILS, PLN, RON, RUB, SAR, TRY and ZAR.

Sources: IMF World Economic Outlook database; BIS credit statistics; BIS Triennial Central Bank Survey; authors' calculations.

International financial integration also has an important influence on IRD trading. This is reflected in the share of international trading, ie transactions involving at least one counterparty outside the issuing country, in IRD activity. In April 2022, this share stood above 80% across currencies (Graph A2.B). Onshore trades between residents account for an even smaller share of trading in IRDs than in foreign exchange derivatives: 8% on average in April 2022, compared with 14% (Caballero et al (2022)). The smaller external positions, together with the modest size of local financial systems, are thus important reasons why IRD trading remains relatively low in EMEs.

The high share of international trading suggests that investment motives, rather than hedging, dominate IRD activity. Foreign investors seeking exposure to a local market can invest either in a cash instrument, like government bonds, or in derivatives. Many find it cheaper to transact in derivatives. For example, foreign investors participate in Korea's interest rate futures market mostly to take positions on interest rates and do not hold the underlying bonds (Bank of Korea (2022)).

① The Triennial Survey captures turnover in foreign exchange and OTC derivatives markets during the month of April. More than 1,200 banks and other dealers in 52 countries participated in the 2022 Survey. For details, see www.bis.org/stats_triennial_surveys.

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Technical annex

The analysis in this feature is based mainly on bank-level data from the SNL module of S&P Capital IQ. The sample comprises entities classified by SNL as banks, credit unions, mutuals, mortgage banks or mortgage brokers. Banks for which key balance sheet items, such as total assets, are missing or discontinuous are excluded. Countries where data for fewer than five banks are available are excluded. Whenever feasible, data refer to banks' local operations in a country, ie unconsolidated data, or data at the lowest level of consolidation. The full sample comprises 4,185 banks from 43 countries over the 2010–22 period.

The estimates shown in Graphs 3 and 5 are computed from bank-level regressions of changes in NIMs or ROA on changes in short-term interest rates and term spreads, following Drechsler et al (2021). Regressions on NIMs cover 1,239 banks in 33 countries, and on ROA 1,639 banks in 41 countries. Data are quarterly from Q1 2010 to Q4 2022, although availability varies by bank. The short-term rate refers to the quarterly average of the three-month interbank rate where available; otherwise the three-month local currency government bond yield (in BE, DE, ES, FR, GR, IN, IT, NL, PH and PT) or one-year yield (in AT, FI and IE). The term spread refers to the 10-year government yield minus the short-term rate. The regressors include all lags between zero and three, as well as a constant and bank-level fixed effects. Graphs 3 and 5 show the significance at the 95% level and the sum of coefficients on all four lags.

Aggregates in Graphs 2.C, 4 and 7.A are computed by first taking asset-weighted medians across banks in each country and then the median across countries in a region. Aggregates in Graphs 2.A and 2.B and the denominators used in Graphs 6.A and 6.B refer to banking system data from the IMF Financial Soundness Indicators.

Countries are grouped into regions as follows: AEs (20) = AT, AU, BE, CA, CH, DE, DK, ES, FI, FR, GB, IE, IT, JP, NL, NO, NZ, PT, SE and US; emerging Asia (10) = CN, HK, ID, IN, KR, MY, PH, SG, TH and TW; Latin America (6) = AR, BR, CL, CO, MX and PE; and other EMEs (7) = CZ, HU, IL, PL, SA, TR and ZA. Owing to data availability, some countries are excluded from the regional aggregates shown in some graphs.

Graph 2.A: Excluded: JP and NZ for AEs; HK and TW for emerging Asia.

Graph 2.B: Excluded: AT, JP and NZ for AEs; HK, SG and TW for emerging Asia.

Graph 2.C: Excluded: AR. IL, IN, SA and ZA start in 2011; JP in 2012.

Graph 3: Excluded: AU, BE, FR, GB and IE for AEs; HK and SG for emerging Asia; AR for Latin America; HU and ZA for other EMEs.

Graph 4.A: Excluded: JP and US for AEs. IL starts in 2012, IN in 2013. AR stops in 2021.

Graph 4.B: Excluded: JP and US for AEs. IN starts in 2011. IT stops in 2019.

Graph 4.C. Excluded: FI and SE for AEs. TR for other EMEs: IN starts in 2011, JP in 2012.

Graph 5: Excluded: SG for emerging Asia, AR for Latin America.

Graph 6.A: Excluded: AT, BE, JP, NO and NZ for AEs; HK, ID, PH, SG and TW for emerging Asia; CZ and IL for other EMEs.

Graph 6.B: Excluded: AT, BE, JP, NO and NZ for AEs; HK, PH, SG and TW for emerging Asia; CZ for other EMEs.

Graph 7.B: EMEs = AR, BR, CL, CO, CZ, HK, HU, ID, IL, IN, KR, MX, MY, PE, PH, PL, RU, SA, SG, TH, TR, TW and ZA.

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CP and CDs markets: a primer[1]

Commercial paper (CP) and certificates of deposits (CDs) are important short-term funding instruments for both financial and non-financial entities. We describe the origins and evolution of these markets in major jurisdictions. We show that money market funds (MMFs) are still significant as investors in CP and CDs, although their footprint has shrunk in response to stricter regulation. Various players have filled the gap left by MMFs, with non-financial companies and banks being particularly important in Japan, and non-bank financial institutions in the United States. Historically, US MMFs' absorption of short-term paper has tended to fall during stress episodes, creating strains for issuers in search of dollar funding, such as European banks.

JEL classification: G15, G23, G28.

While the markets for commercial paper (CP) and certificates of deposit (CDs) stagnated in the aftermath of the Great Financial Crisis (GFC), they have recently resumed their upward trajectory. CP and CDs are the instruments most widely used by non-financial and financial companies for short-term funding on an unsecured basis.[2] These markets have also been a locus of funding liquidity crises, notably in the GFC's early phases (Covitz et al (2013)) and more recently in March 2020 (Eren et al (2020), Boyarchenko et al (2021)). Thus, their structure and the evolution of their investor base have important implications for financial vulnerabilities and market functioning.

We study the evolution of the CP and CDs markets over the past decades and analyse the role of key investors. Focusing on major currency areas (euro area, Japan and the United States),[3] we close some gaps in frequently used data on the identity of investors in these markets and document changes to the investor base. A key finding is that money market funds (MMFs) are still significant investors in CP and CDs although their footprint has shrunk in response to stricter regulation. However, MMFs tend to reduce their exposure to CP at times of money market stress. The investor types that tend to pick up the slack differ across jurisdictions: other non-

[1] The authors thank Iñaki Aldasoro, Claudio Borio, Stijn Claessens, Marco Graziano, Wenqian Huang, Sven Klingler, Benoît Mojon, Maria Perozek, Hyun Song Shin and Nikola Tarashev for valuable comments, and Alberto Americo and Pietro Patelli for excellent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the BIS.

[2] CP and CDs are a subset of short-term funding markets (STFMs). Other segments of STFMs include government bills, medium-term notes, foreign exchange swaps, repurchase agreements, securities lending and lines of credit.

[3] While there are CP markets in other jurisdictions – notably, China, where they have grown considerably over the past decade – the quality of the related data is not sufficient for our study.

Key takeaways

- *CP and CDs markets have undergone significant structural changes: after a period of stagnation following the Great Financial Crisis, issuance volumes have been expanding again recently.*
- *MMFs remain key investors in CP and CDs, with US funds being an important source of short-term US dollar funding, especially for European banks.*
- *MMFs retrench during stress – leaving other non-bank financial intermediaries in the United States and banks in Japan to pick up the slack – and potentially propagating shocks across borders.*

bank financial intermediaries in the United States and non-financial corporates and banks in Japan.

The markets for short-term paper are of systemic importance. We document significant interconnectedness across jurisdictions, which can intensify the cross-border spillovers of financial stress. Given the short maturities of these instruments, the potential for sharp pullbacks by core investors creates rollover risks for issuers. US investors, in particular, remain crucial in providing short-term US dollar financing to a number of foreign issuers, and especially to European banks.

The rest of this special feature is organised as follows. The first section reviews the main characteristics of CP and CDs and their historical origins. The second describes key trends in the investor base, with a focus on MMFs and other players that have become more relevant recently. The third section analyses the role played by different types of investor in absorbing CP and CDs issuance, in tranquil times and during crisis periods. The fourth section discusses policy considerations.

CP and CDs markets across jurisdictions

Main funding instruments and their characteristics

To legally qualify as CP, instruments must fulfil various requirements. They must finance "current assets" (eg cash, inventories or future receivables from customers), be sold to institutional investors and have short maturities at issuance. The maturity limit is crucial and varies across jurisdictions: 270 days in the United States and one year in Europe and Japan. In practice, the maturity of CP tends to be much shorter. In the US, the average maturity is around 30 days, while in Europe it is approximately four months. Issuers also have an incentive to have a credit line in place, as credit rating agencies usually require one to rate the CP.

Issued by non-financial corporations (NFCs), banks and other financial institutions, CP is a flexible way of funding short-term needs and managing working capital. It is usually issued at a discount to face value, ie there are no coupon payments. Placement occurs either directly (when the issuer is a large financial institution with a large client network) or through a dealer that intermediates between the borrower and the final investor (eg an MMF). From a regulatory standpoint, issuing CP is advantageous because it does not require the instruments to be registered, unlike other securities such as corporate bonds.

Activity in CP markets is confined mainly to the primary market, with sparse trading in secondary markets, depending on dealers' balance sheet capacity. Given

its short maturity and reliance on programmes that facilitate rolling over issuance and investment, CP rarely trades in secondary markets except in crisis periods.[4] If a sale does occur prior to maturity, it almost always involves a dealer agreeing to buy back previously placed paper, typically to maintain a client relationship.[5] Dealers' willingness to intermediate trades declines during stress times (Blackrock (2020)).

Another key short-term funding instrument, CDs, can be issued only by deposit-taking institutions. The CDs we focus on are known as "negotiable" because their ownership can be transferred in a secondary market.[6] Indeed, while negotiable CDs fulfil similar economic functions as time deposits, their design is similar to that of securities. In practice, CDs rarely trade on secondary markets and investors tend to hold CDs to maturity – a feature shared with CP. For banks with a solid credit standing, CDs are a flexible way of raising wholesale funding quickly.

Historical evolution and main inflection points

Markets for unsecured short-term negotiable debt originally developed in the US. As Alworth and Borio (1993) point out, the US CP market was already flourishing in the late 19th century, with non-financial entities dominating issuance at the time. In the years after World War I, the balance shifted. Banks became the main issuers, as they turned increasingly to this market to finance their credit expansion in a booming economy. The growth in CP issuance ground to a halt during the Great Depression but picked up steam again after World War II (Anderson and Gascon (2009)). It was especially strong from the 1970s to the early 1990s, with outstanding CP volumes increasing more than 16-fold to $500 billion. A key catalyst was the advent of MMFs, which broadened the investor base.[7]

CDs are a more recent innovation but have also been spurred on since the 1970s by the rise of MMFs. The first such instrument was issued by First National City Bank of New York in 1961, in response to US regulations that introduced ceilings on banks' deposit rates. CDs grew quickly over the following decade, and by 1975 there was more than $90 billion in CDs outstanding (OCC (2023)).

Outside the US, CP and CD markets started developing in the 1960s and 1970s, particularly in Europe and Japan. The zeitgeist of liberalisation and deregulation was a key factor, leading to private sector calls to emulate US developments and allow financial intermediaries to flexibly expand their balance sheets. The nucleus of the market in Europe was the issuance of a Eurodollar CD by the London office of First National City Bank of New York in 1966 – five years after the first issuance in the US (Morris and Walter (1998)).[8] In Japan, the first CD was issued in May 1979, with CP following somewhat later, in the 1980s.

[4] An important variant of CP is asset-backed commercial paper (ABCP), typically issued by the off-balance sheet conduits of financial institutions. These institutions maintain control of the underlying assets (Kacperczyk and Schnabl (2010)).

[5] Henceforth, when we refer to CP or CD markets, we mean the primary market unless stated otherwise.

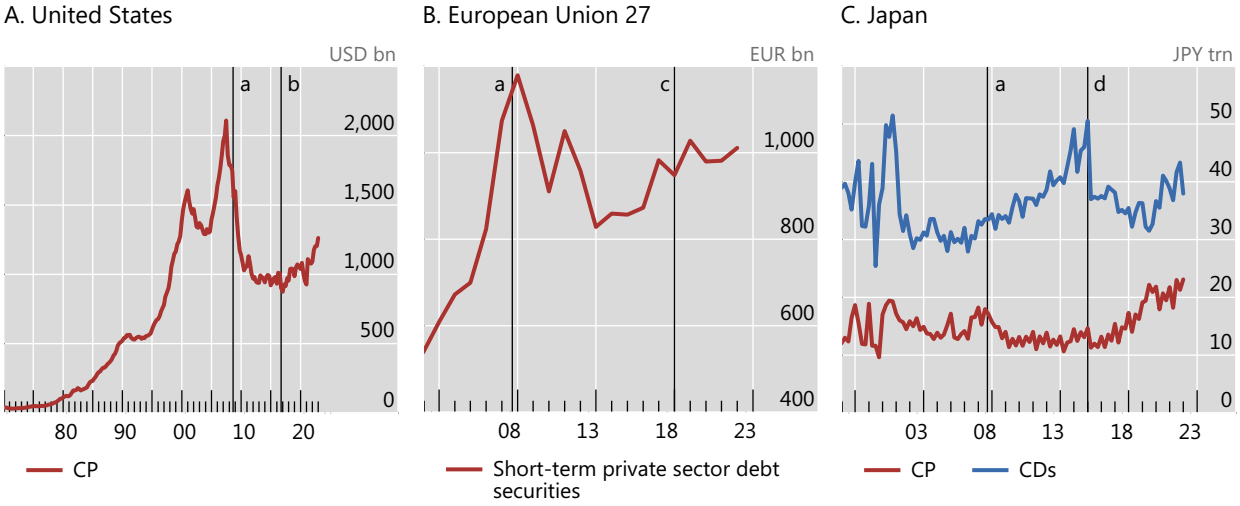
[6] Banks also issue non-negotiable CDs, primarily to retail investors. However, this type of CD is not used for raising large amounts of financing in a flexible manner.

[7] The first MMF, the Reserve Primary Fund, was created in 1970. It was famously liquidated after the GFC as it *broke the buck*, ie its net asset value dropped below $1 per share.

[8] The Eurodollar market, ie the market for dollar deposits in banks outside the US started to develop in London in the 1950s and grew substantially in the following decades (Schenk (1998)).

Size of the CP and CDs markets across jurisdictions

Amounts outstanding — Graph 1



[a] GFC, September 2009. [b] MMF Reform, October 2016. [c] MMF Reform, January 2019. [d] Negative interest rate policy, January 2016.

Sources: Bank of Japan; Board of Governors of the Federal Reserve; European Central Bank; BIS.

European markets for short-term paper have been fragmented. Such markets developed notably in France, Germany, Spain and Sweden in the 1980s to cater mostly to domestic issuers and investors. That said, a Europe-wide CP market established at the same time in London has served for raising US dollar funding outside the United States. The ongoing fragmentation of European CP and CD markets is a key reason for some of the data gaps that limit our analysis below.

While the CP and CD markets shrunk substantially in the GFC and its aftermath, they have staged a comeback in recent years. For instance, at the outset of the GFC, there was more than $2.2 trillion in CP outstanding in the US (Graph 1.A). After contracting and fluctuating around the $1 trillion mark post GFC, the CP market resumed its growth in 2016, reaching $1.3 trillion in outstanding amounts in 2022. The pattern is similar in Europe, with the market contracting by a third post-GFC and then recovering after 2013 (Graph 1.B). In Japan, the post-GFC decline was mainly in CDs (Graph 1.C).[9]

The importance of CP and CDs as a source of financing has generally been on the decline over the past 15 years but remains material in many jurisdictions.[10] Focusing first on the US (Graph 2.A), CP issuance grew faster than other types of financing (such as bank credit or longer-term debt issuance) until the late 1990s. The subsequent relative decline – to 10% of bank credit and to less than 5% of debt securities at end-2022 – is an indication that issuers were seeking to reduce rollover risk. A similar decline resulted in short-term private-sector debt

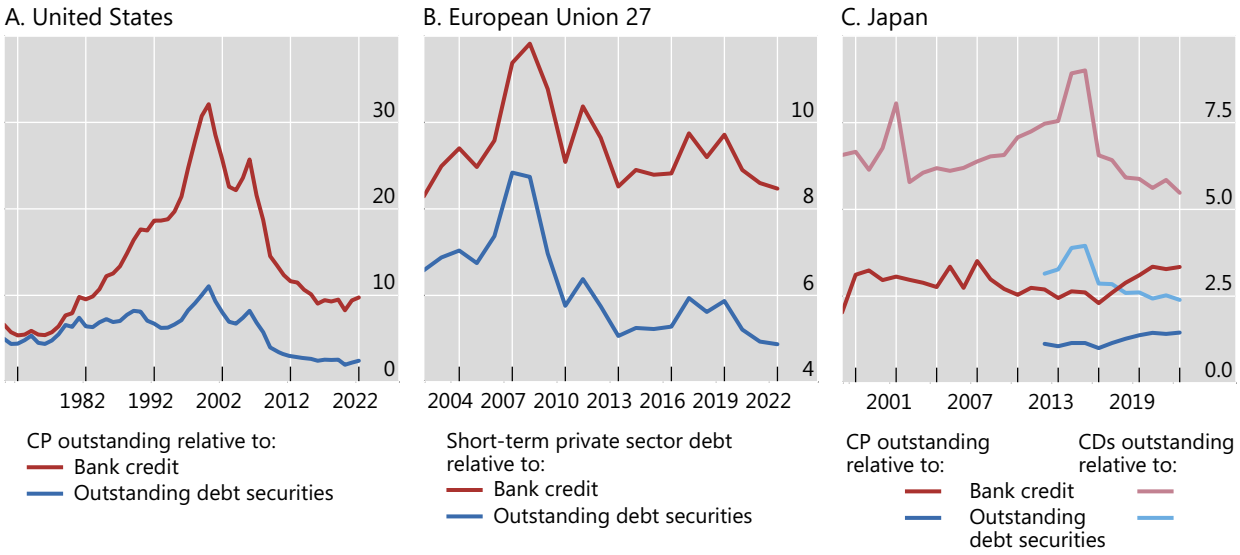
[9] The GFC significantly scarred the asset-backed commercial paper (ABCP) market. At its peak in 2007, ABCP represented more than 50% of US paper outstanding. Currently only around 20% of CP is asset-backed in the US and less than 5% in France (Boyarchenko et al (2021), Bank of France, (2023)).

[10] According to Klingler and Syrstad (2022), CP debt on average accounted for roughly 8% of US non-financial corporates' total debt between 2015 and 2019.

The importance of CP and CDs: issuers' perspective

In per cent

Graph 2



Sources: Bank of Japan; Board of Governors of the Federal Reserve; European Central Bank; Bloomberg; BIS.

amounting to 8.5% of bank credit in Europe (Graph 2.B). An exception in this respect is Japan, where CP and CD markets are much smaller in relative terms (Graph 2.C).

Issuer types

To gain a complete picture of short-term markets, it is important to identify the typical issuers of CP and CDs and document their funding structure. The available data allow for this in the case of CP markets in the US, the short-term funding markets (ie CP and CDs combined) in Europe and the CP and CD markets separately in Japan.[11]

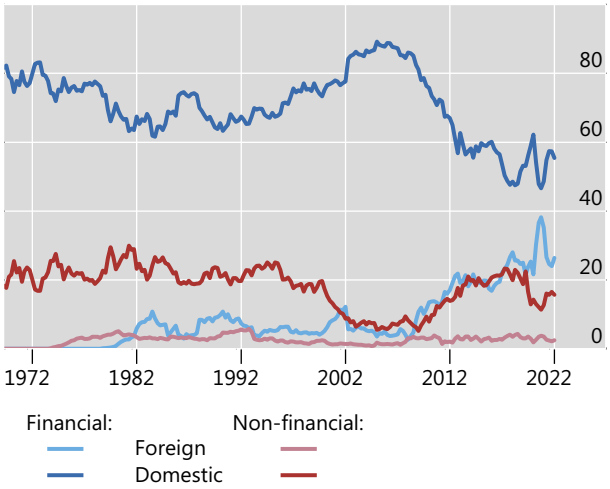
We observe notable differences in the main issuer types over time and across jurisdictions. In the United States, financial institutions remain the largest issuers (approximately 80% of total issuance), with NFCs representing the rest. Among the former, foreign banks have grown in importance since the mid-2000s, accounting for slightly less than half of the overall issuance by financial institutions at end-2022 (Graph 3.A). A key reason is the dollar funding needs of these entities (Aldasoro, Ehlers and Eren (2022), CGFS (2020)). Based on granular MMF portfolio holdings data, we estimate that the largest bank issuers are from the European Union, followed by Canada, Japan, the United Kingdom, Australia and Switzerland. In Japan, NFCs represented 80% of total CP issuance at the beginning of the 2000s but then the share of financial entities rose steadily till 2015 and, despite a subsequent decline, remained above 50% at end-2022 (Graph 3.B).

[11] In the United States, data on CDs are simply not available. In Europe, there is only aggregate information on short-term debt securities, which does not distinguish between CP and CDs, and there are also coverage inconsistencies over time. Detailed quarterly information on holdings of European CP starts only in 2021. In addition, while data on total amounts of securities *outstanding* are disclosed for EU 27 residents, data on securities *held* are only available for euro area residents.

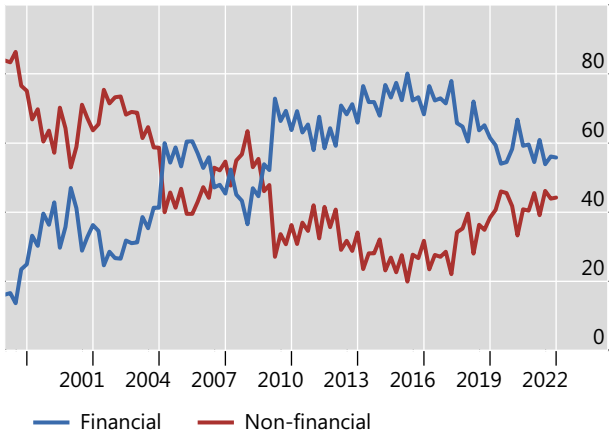
CP market, by type of issuer

As a percentage of issuance volumes — Graph 3

A. United States



B. Japan



Sources: Board of Governors of the Federal Reserve; BIS.

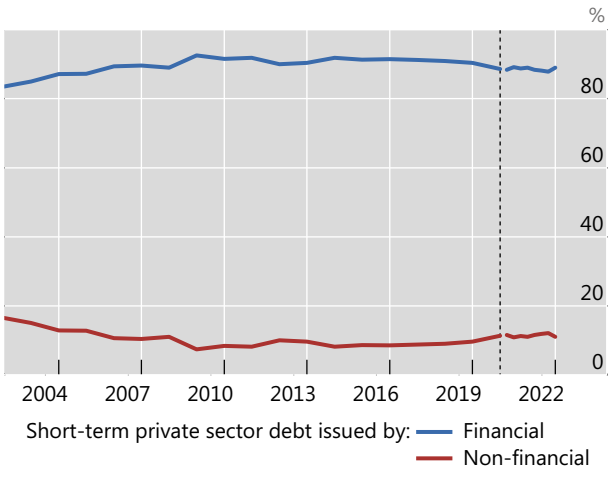
Financial institutions are by far the largest issuers of short-term debt in Europe. At end-2022, these entities accounted for 90% of total issuance of CP and CDs. While most of this funding is raised in euros, issuance in other currencies amounted to around 40% at the end of 2022 (Graph 4.A and 4.B).

CP markets can propagate funding stress across borders and currencies. Some key evidence in this respect stems from the reliance of foreign entities on dollar funding through CP issuance in US markets (Graph 3.A). If they freeze up, these markets could generate significant spillovers should borrowers need to make large

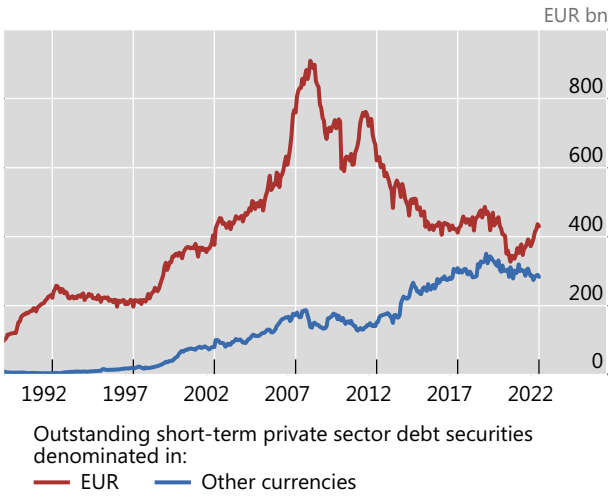
Private sector short-term debt securities in the European Union

Graph 4

A. Issuance in European markets by sector[1]



B. Issuance in European markets by currency



[1] Data until 2020 are annual, quarterly afterward.

Sources: European Central Bank; BIS.

repayments in a currency that they cannot source elsewhere. Historically, the most acute shortages have involved the US dollar, given its status as the world's dominant funding currency. In times of funding stress, central banks have averted adverse financial stability consequences by engaging in large liquidity interventions, drawing on the Federal Reserve's swap lines to obtain US dollars (Eren et al (2020)).

Investors in short-term funding markets

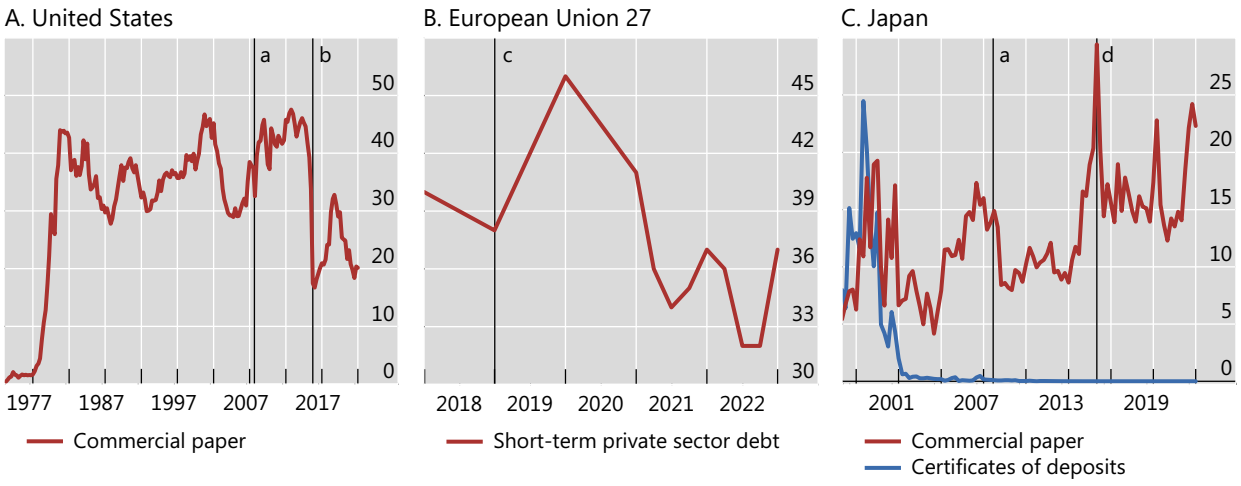
The diminishing role of MMFs

Since their origin in the 1970s, MMFs have been a key investor in CP and CD markets. They were at the root of the markets' buoyant growth in the run-up to the GFC and they have helped to reduce issuance costs (Klingler et al (2023)). But they have also been at the epicentre of episodes of turmoil. Over the past 15 years, their heft has dwindled in all major jurisdictions.

In the US, the role of MMFs shrank after post-GFC financial reforms. At their zenith, just prior to the GFC, MMFs held around 40% of the outstanding CP in the US. However, their share dropped to a mere 20% in late 2022 (Graph 5.A). This reflected various rounds of reforms that imposed constraints on *prime* MMFs – ie the type of MMFs that invest in CP and CDs and whose liquidity mismatches and exposure to run risk had come to the surface during the GFC.[12] Notably, the reform in 2016 led to a contraction in the assets under management of the prime MMF sector – both through

The changing heft of MMFs in short-term funding markets[1]

MMF shares in amounts outstanding, in per cent — Graph 5



[a] GFC, September 2009. [b] MMF Reform, October 2016. [c] MMF Reform, January 2019. [d] Negative interest rate policy, January 2016.

[1] The EU 27 data up to 2020 include all monetary financial institutions rather than just MMFs.

Sources: Bank of Japan; Board of Governors of the Federal Reserve; European Central Bank; BIS.

[12] US MMFs are of two main types: (i) government MMFs that primarily invest in short-term Treasury securities and reverse repos backed by Treasuries; and (ii) prime MMFs that can invest in CP and CDs.

the exit of existing players and through the reallocation of assets to MMFs investing in public sector debt (eg Treasury bills).[13]

The role of MMFs in Europe has also shrunk in recent years. They held around a third of the short-term debt securities issued by European entities in 2022, down from 40% before the 2019 European MMF reform (Graph 5.B).

In Japan, the retrenchment of MMFs affected mainly the CD segment. The launch of the Bank of Japan's zero interest rate policy in 1999 marked the start of Japanese MMFs' withdrawal from the CD market. To some degree, the higher-yielding CP market picked up the slack. While MMFs held around 12% of Japanese CP in the early 2000s, their share grew to 22% by end-2022 (Graph 5.C). That said, since the introduction of negative policy rates in 2016, only so-called money reserve funds have remained active as CP investors. Unlike standard MMFs, investors use these funds not necessarily to earn interest but to temporarily store cash in a brokerage account ahead of adjustments to portfolio positions.

Other types of investor

Over the past 15 years, a diverse group of investors have come in to fill the gap left by MMFs in short-term funding markets. In the US, various financial institutions and NFCs have ramped up holdings of CPs, whereas foreign investors have increased their share in Europe. In Japan, banks, NFCs and the central bank have assumed a dominant role as investors in CP markets.

In the US, investors referred to as "other financial institutions" (OFIs) in the flow of funds accounts, have recently displaced MMFs as the dominant investor type in the CP segment (Graph 6.A). The OFIs sector includes non-bank financial intermediaries such as subsidiaries of foreign financial firms, financial holding companies, clearing houses, and segregated custodial accounts that hold cash collateral. This sector was important up to the mid-2000s but shrank during the GFC and then rebounded steadily in its aftermath, whereas the MMF reform reduced MMFs' role as CP investors. At end-2022, the share of OFIs in CP holdings stood at 28%, exceeding that of MMFs by 8 percentage points.

Non-financial corporates (NFCs) are another group of investors that have significantly ramped up their holdings of US short-term paper. This group includes cash-rich corporates that invest directly in CP and CDs, thus revealing a preference to manage their liquid asset portfolios in-house, rather than outsource them to MMFs. While NFCs held less than 4% of CP outstanding ($57 billion) at the outset of the GFC in 2008, they represented 17% of the total ($210 billion) at end-2022.

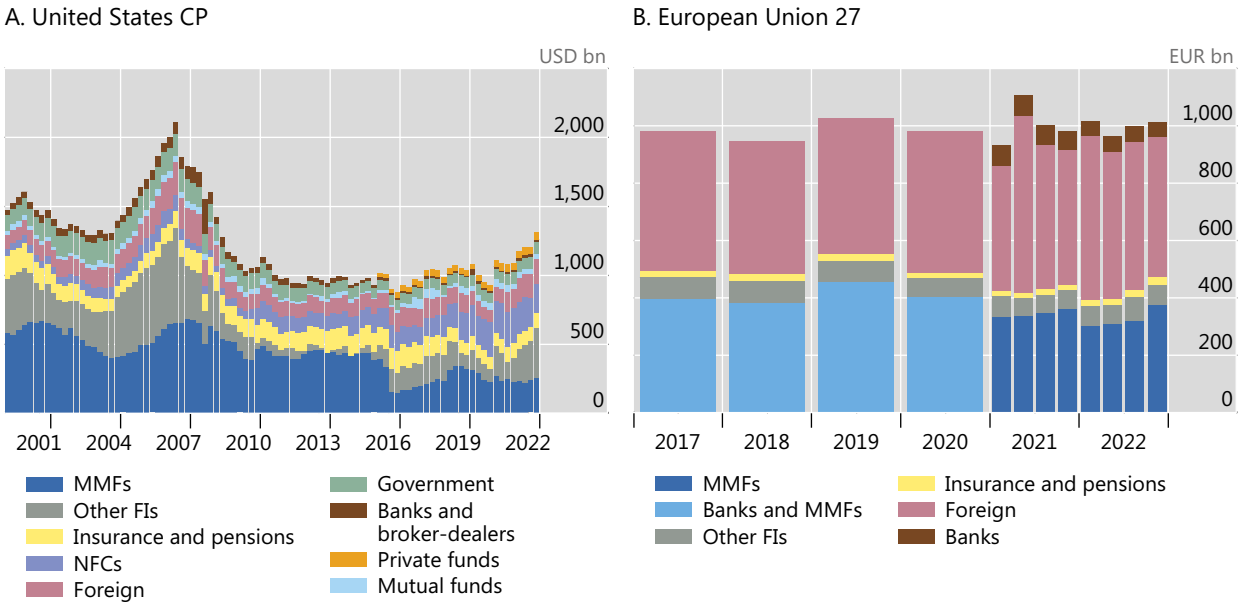
Foreign investors in US paper have also seen their role increase gradually from the early 2000s, stabilising at around 15% after 2015. In December 2022, they held $183 billion of CP (Graph 6.A).

While the investor base is broadly similar in Europe, there are some important differences. The heft of non-euro area investors in the EU 27 is much larger than that of foreign investors in the United States, accounting for nearly 50% of all short-term debt instruments after 2017 (Graph 6.B). US-based investors are especially important

[13] The 2016 MMF reforms increased liquidity requirements for prime funds, required them to have liquidity fees and suspension gates, and forced them to move from a fixed $1 share price to a floating net asset value (NAV). Additional reforms – in response to the events of March 2020 – have been agreed by the SEC in 2023 and will enter into force in 2024.

The investor base in short-term funding markets in the US and Europe[1]

Amounts outstanding — Graph 6



[1] For the European Union data up to 2020 include all monetary financial institutions rather than just MMFs.

Sources: Board of Governors of the Federal Reserve; European Central Bank; Securities and Exchange Commission; BIS.

for European issuers. We estimate that US MMFs and mutual funds account for nearly a quarter of all EU short-term debt securities held by foreigners (or about 13% of the total). This is consistent with the large share of European banks as issuers in the US markets. Overall, we have evidence of a strong dependence of European issuers on US investors for short-term funding needs.

The heft of domestic investors has remained roughly constant in Europe since 2017. More specifically, the share of non-bank and non-MMF financial investors has hovered at around 10% (Graph 6.B). The role of corporates, on the other hand, has not been material: NFCs held less than 2% of European short-term paper at end-2022. A potential reason could be the lower appetite for cash management in euros as opposed to the US dollar, which would be yet another manifestation of the special role of the dollar in investors' liquidity preferences.

The investor base for Japanese short-term paper has evolved quite differently. Unlike in the US and Europe, the role of OFIs and foreign investors has remained minor. By contrast, banks play a major role, holding almost half of the Japanese CP outstanding (Graph 7.A).[14] Furthermore, through its asset purchases, the central bank now holds approximately 10% of CP outstanding.[15] NFCs also play a significant role in Japan, notably in the CDs segment, where they account for 50% of the holdings

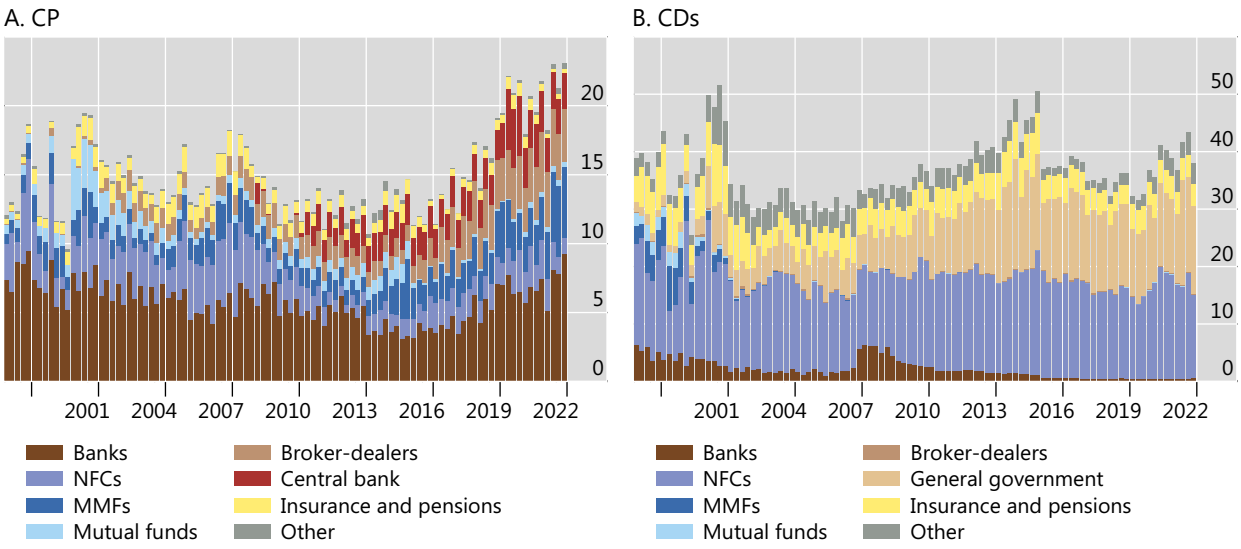
[14] Post-GFC, Japanese banks have come to play a minor role as investors in CDs issued by other banks, in line with the global shrinkage of interbank unsecured funding markets.

[15] In response to the failure of Lehman Brothers in September 2008, the Bank of Japan put in place a number of facilities, including in the CP market. It started buying CP and ABCP in the secondary market in January 2009. Purchases were limited to CP with a residual maturity of less than three months and of high credit quality (Buchholtz (2020)). While the emergency programme ended in December 2009, the BoJ continued buying CP as part of its monetary policy operations.

The investor base in Japan's CP and CD markets

Amounts outstanding, in trillions of Japanese yen

Graph 7



Sources: Bank of Japan; BIS.

(Graph 7.B).[16] Almost all of the remaining CDs are in the hands of government entities, especially local ones.

The emergence of new players

Two new classes of investors in short-term markets have emerged in recent years: private liquidity funds (PLFs) and stablecoin issuers. So far, their role has been confined mostly to US markets. The risks they pose are not as well understood as those posed by less opaque investors, such as MMFs.

PLFs emulate the role of MMFs but are managed privately for big clients and not via open-ended mutual fund structures. They have gradually expanded their presence in US markets in recent years. The holdings of US CP by PLFs more than doubled between 2016 and 2022, from approximately $23 billion to $53 billion (Graph 8.A) – or 5% of all CP outstanding, roughly a fifth of MMF holdings. This expansion took place when prime MMFs – which have similar portfolios (Hiltgen (2017)) – faced pressure to shrink, suggesting that some ultimate beneficiaries saw private liquidity funds as a viable alternative.

While PLFs seem less exposed than MMFs to the risk of redemptions, their unfettered rise could still cause financial stability concerns. PLFs typically have a stable NAV but, unlike MMFs, do not offer daily liquidity to their investors. At the end of 2022, two thirds of PLFs' assets at most could be redeemed in a single day (Graph 8.B), compared with 100% for MMFs. This implies much weaker first-mover incentives[17] for

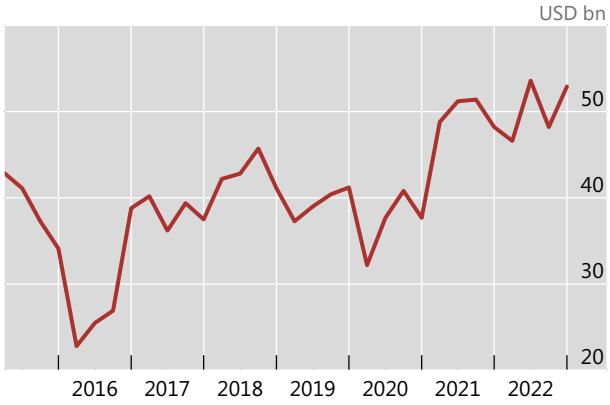
[16] For Japanese corporates, CDs serve as a substitute for time deposits, and they frequently buy newly issued CDs to foster a good relationship with their bank (Totan (2009)).

[17] First-mover advantage occurs when investors who redeem their shares first do so on more favourable terms than investors in the same fund who redeem late (Chen et al (2010)). In an open-ended fund,

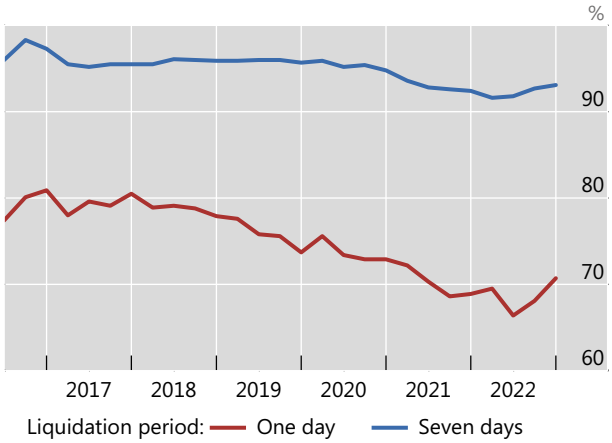
Private liquidity funds in the US

Graph 8

A. CP holdings



B. Share of redeemable assets



Source: Securities and Exchange Commission.

PLF investors. Yet, these funds might be still exposed to runs in the case of mounting fears about the value of CP. However, much less information is available for monitoring PLFs than for MMFs.

Stablecoin issuers are another new class of investors in the CP and CD markets. Based on the limited public disclosures, we estimate that stablecoin issuers could have been material holders of short-term paper in 2021, when crypto markets boomed. At their peak, individual stablecoin issuers' holdings of CP and CDs were likely to have been of similar magnitude as those of large MMFs – ie an estimated $65 billion (around 6% of total CP outstanding). After 2021, however, when various high-profile collapses rocked crypto markets, and as yields on safer government bills increased, the importance of stablecoin issuers as CP and CD investors declined substantially. If the crypto market rebounds and new players enter, eg as the August 2023 announcement by PayPal indicates,[18] a proper analysis of the attendant risks would require better data than are currently available.[19]

The role of investors in tranquil and stress times

From a financial stability perspective, it is important to assess how far key investor groups could be expected to absorb issuance in times of stress. Some investors may act procyclically and exacerbate stress by not rolling over investments, while others

this can happen as redeeming investors do not pay the transaction costs of their redemptions, or because asset managers sell more liquid assets first.

[18] On 7 August 2023, PayPal announced the launch of its own stablecoin to facilitate payments between merchants and buyers on their platform. The stablecoin will be backed by "dollar deposits, US treasuries and cash equivalents" (see PayPal Stablecoin).

[19] First, in their disclosures, stablecoin issuers generically refer to CP without specifying the currency denomination or the issuer's country of origin. While it is likely that they invest in dollar-denominated paper, uncertainty remains (Barthélemy et al (2022)). Second, it is not clear from voluntary disclosures that the definition of CP and CDs used by stablecoin issuers matches the commonly used one. Finally, in some cases, the holdings of CP and CDs are disclosed only jointly.

could step in and thus stabilise prices. In assessing such differences in investor behaviour, we use data that let us study only the US and Japanese CP markets.

We seek to estimate how far different groups of investors will absorb CP and CDs issuance. Building on Fang et al (2023), we regress the relative change in the volume of securities held by a given sector on the percentage change in total securities outstanding (as a proxy for net issuance):

$$\frac{H_t^s - H_{t-1}^s}{O_{t-1}} = \alpha^s + \left(\beta_{stress}^s \cdot 1_{stress} + \beta_{no\ stress}^s \cdot 1_{no\ stress}\right)\frac{O_t - O_{t-1}}{O_{t-1}} + \varepsilon_t^s,$$

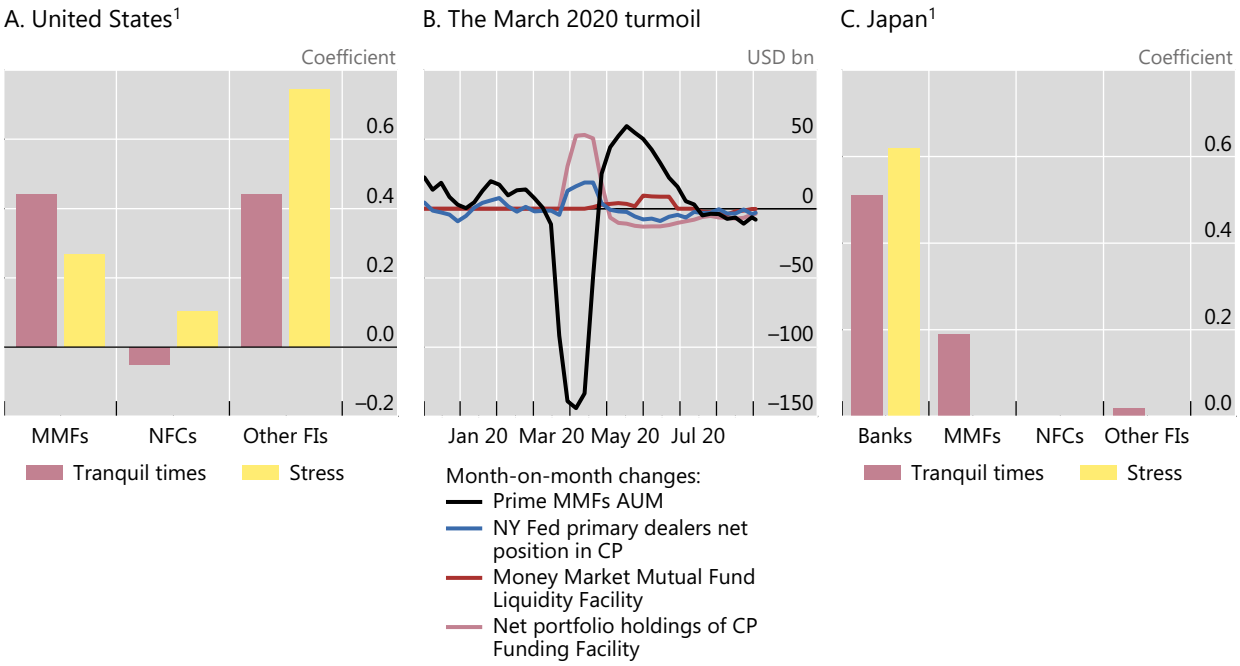
where H_t^s is the amount of CP held by sector s at time t, and O_t is the total amount of CP outstanding. The coefficient β_{stress}^s captures the fraction of CP issuance absorbed by sector s in stress times, and $\beta_{no\ stress}^s$ gives the corresponding share in tranquil times. We use quarterly data and identify periods of money markets stress using the relevant indicator proposed by Aldasoro, Hördahl and Zhu (2022). We define stress periods as the ones where that indicator is above the 90th percentile.

We find procyclical behaviour by US MMFs and NFCs, with OFIs picking up the slack in times of stress. MMFs absorb 44 cents of every CP dollar issued in normal times but only 27 cents in times of stress (Graph 9.A). The gap left by MMFs is filled by the OFI sector, which absorbs 74% of all CP issued in stress compared with 44% in tranquil periods.

We confirm these findings by zooming in on the March 2020 market turmoil, for which we use data on MMFs flows, dealer inventories and the take-up of central bank facilities. We find again that US MMFs significantly scaled down their CP holdings (Graph 9.B), amid massive redemptions in this particular episode. This added to the upward pressure on inventories that dealers were experiencing at the time. MMFs

Behaviour of CP investors in stress and tranquil times

Graph 9



[1] The equation is explained in the text. The data used for the US are from Q1 2000 to Q4 2022; while for JP from Q1 1998 to Q4 2022.

Sources: Federal Reserve Bank of New York; Bloomberg; iMoneyNet; BIS; authors' calculations.

ramped up their CP positions only after the central bank intervened with targeted liquidity support.

MMFs in Japan absorb virtually no CP issuance during stress, with banks stepping in instead. Banks absorb 62% of new CP issued during stress relative to slightly more than half in normal times (Graph 9.C). This finding suggests that the Japanese system depends on bank intermediaries to play a stabilising role.[20]

Policy considerations

CP and CDs markets are growing again after several years of post-GFC stagnation. In this article, we document the genesis and development of these markets, the changes in the investor base, and the role of different investors in times of stress. Our analysis has policy implications in two broad areas.

First, the interconnectedness of short-term funding markets has important financial stability implications. Non-US banks – notably European ones – crucially rely on the US CP market, and on MMFs in particular, for short-term borrowing. Major redemption shocks to US-based MMFs may thus impair the funding of these foreign entities, leading to international spillovers. Most recently, these mechanisms were at play during the "dash for cash" in March 2020 (Aldasoro et al (2021), Eren et al (2020)).

Second, further work on filling data gaps is warranted, not least to assess the potential build-up of hidden risks in the system. Such work would involve information on the CD market segment in the US. Similarly, there would be great value in separate data on CP and CD markets in Europe, over a period that is longer than that for the current data on the region's short-term funding markets. Given the role that other financial intermediaries have played so far in the US CP market, there is also a case for more granular information on the sector's composition.

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[20] We run a similar analysis for the Japanese CDs market and find that NFCs also play an important role as stabilisers in stress periods. Hence, it is possible that banks issue new CDs that are bought by NFCs, and then use the proceeds to stabilise the CP market.

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