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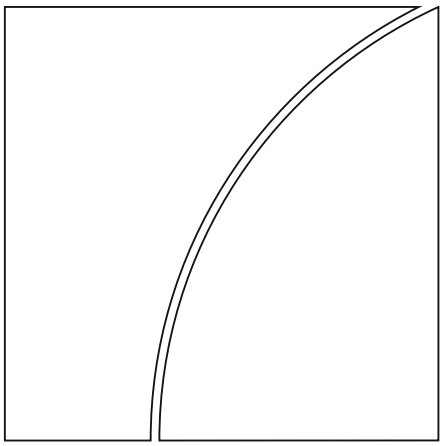

International banking and financial market developments

BIS Quarterly Review
Monetary and Economic Department

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Special features

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

ARS	Argentine peso	MAD	Moroccan dirham
AUD	Australian dollar	MXN	Mexican peso
BGN	Bulgarian lev	MYR	Malaysian ringgit
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
JPY	Japanese yen	ZAR	South African rand
KRW	Korean won		

Countries

AE	United Arab Emirates	CY	Cyprus
AF	Afghanistan	CZ	Czech Republic
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
BY	Belarus	GH	Ghana
BZ	Belize	GN	Guinea
CA	Canada	GQ	Equatorial Guinea
CD	Democratic Republic of the Congo	GR	Greece
CF	Central African Republic	GT	Guatemala
CG	Republic of Congo	GW	Guinea-Bissau
CH	Switzerland	GY	Guyana
CI	Côte d'Ivoire	HN	Honduras
CL	Chile	HK	Hong Kong SAR
CM	Cameroon	HR	Croatia
CN	China	HT	Haiti
CO	Colombia	HU	Hungary
CR	Costa Rica	ID	Indonesia
CV	Cape Verde	IE	Ireland

Countries (cont)

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

Countries (cont)

TJ	Tajikistan	UZ	Uzbekistan
TL	East Timor	VC	St Vincent and the Grenadines
TM	Turkmenistan	VE	Venezuela
TO	Tonga	VG	British Virgin Islands
TR	Turkey	VN	Vietnam
TT	Trinidad and Tobago	ZA	South Africa
TW	Chinese Taipei	ZM	Zambia
UA	Ukraine	AE	advanced economy
US	United States	EME	emerging market economy
UY	Uruguay		

Yet more bumps on the path to normal

Financial markets swung widely, eventually netting a sharp correction, during the period under review, which started in mid-September. Asset prices fell across the board and US government yields widened in October before retracing that increase and dropping further as the selloff of risk assets spread. Volatility and term premia jumped. A further round of turbulence, this time accompanied by lower yields, hit markets in December. The repricing took place amid mixed signals from global economic activity and the gradual, yet persistent, tightening of financial conditions. It also reflected the ebb and flow of ongoing trade tensions and heightened political uncertainty in the euro area. These bumps were a reminder of the narrow path that central banks are treading in their quest for policy normalisation, in a generally challenging policy environment.

Financial conditions became somewhat tighter in the United States. In October, US 10-year government bond yields consistently traded above the 3% threshold that had capped this benchmark during the past 12 months. Higher yields persisted through most of November, driven by real yields, before falling below 3% in early December. Risk premia, including the term premium, picked up and search for yield abated. Spearheaded by the technology sector, US equity valuations dived in October, despite good quarterly earnings announcements. Stock prices were volatile in November and fell again in December. Investors appeared unnerved by poor forward visibility of results, against the background of trade tensions, weakening global conditions and the Federal Reserve's determination to move forward with gradual policy normalisation. Corporate spreads widened, particularly for segments of lower credit quality.

The repricing of risk assets was global. US stock markets dragged down those in other advanced and emerging market economies, in what turned out to be a widespread stock market rout. In Europe, corporate spreads also increased materially, especially for financial firms. In particular, bank valuations came under renewed pressure as political uncertainties grew, notably concerning the Italian budget and, to a lesser extent, Brexit.

After a summer marked by capital outflows and country-level stress, financial conditions remained tight but relatively steady in emerging market economies (EMEs). Currencies depreciated further vis-à-vis the US dollar early in the quarter, reflecting expectations of tightening by the Federal Reserve. But the sharp drop in oil prices provided some relief for oil-importing countries, after an unusual period when both oil and the dollar had gained strength. Portfolio outflows generally waned in EME fixed income, and local currency bond spreads eased.

US real yields and term premia leapt

Prices fell across many asset classes during the review period.[1] The adjustment reflected major central banks' gradual moves towards policy normalisation, coupled with mixed signals from the real economy and increased political risks.

Central banks in large advanced economies (AEs) maintained the course they had outlined earlier in the year. On the back of positive economic data, in September the Federal Reserve raised the fed funds rate policy range by 25 basis points, as widely expected, and continued the runoff of its balance sheet at the preannounced pace. While the "dot plot" suggested a further series of policy rate hikes through 2020, futures markets pointed to a lower path. As anticipated last June, the ECB reduced the monthly pace of its net asset purchases from €30 billion to €15 billion from October, and hinted that it was still on course to end the programmes in December. The ECB Governing Council also reaffirmed its forward guidance with respect to the near-term path of policy interest rates and reinvestment policy after the net asset purchases end. The Bank of Japan kept its policy stance largely unchanged.

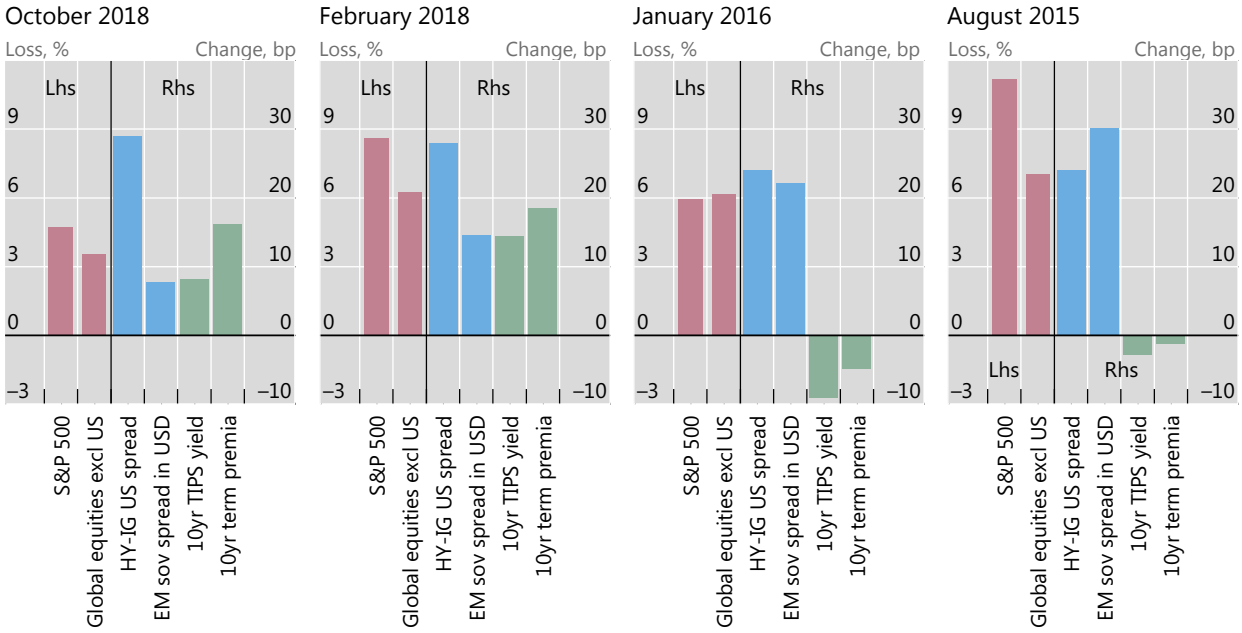
Yet, in early October, markets tumbled as investors became concerned about a seemingly hawkish turn in the Federal Reserve's stance. The plunge followed strong readings for key US economic indicators and a speech by Fed chairman Powell that investors saw as signalling a steeper path of policy rates. Contrary to other recent events of market stress, prices fell across all asset classes, including US government bonds, often seen as an investor safe haven. Long-term real interest rates, as proxied by the yield on 10-year US Treasury inflation-protected securities (TIPS), widened by almost 10 basis points during the initial trading days of October, while stock prices plummeted and corporate default premia surged (Graph 1, first panel). This pattern reproduced closely the moves seen in early February, when a stronger than expected labour market report had led to another sharp market drop as investors fretted over the Fed's policy (second panel).[2] Notably, the term premium embedded in 10-year US Treasury yields spiked during that initial week of October, as it had in the first week of February (last bar in first and second panels).

This pattern of cross-market behaviour is not the usual one in risk-off events. It is instructive to compare asset price and risk premia patterns in the February and October episodes of market stress with those observed in January 2016 and August 2015 (Graph 1, third and fourth panels, respectively). Risk assets lost ground in all cases, both in the United States and globally, with stock prices dropping (the two red bars in each panel) and US high-yield and EME spreads widening (the two blue bars). However, the behaviour of real rates and term premia (the two green bars) differed markedly across the four episodes. In contrast with the patterns observed in October and February 2018, real interest rates dropped in August 2015 and January 2016 as investors shifted positions from risky assets to safer ones. Similarly, the estimated term premium on US Treasuries inched down in both the 2015 and 2016 events. Seen from this perspective, in the two 2018 episodes valuations came under pressure from

[1] 12 September to 5 December 2018.

[2] In February, stock market movements were sharpened by technical factors related to the unwinding of outsize one-directional investor bets on low volatility. See "Volatility is back", *BIS Quarterly Report*, March 2018.

Real yields and term premia jump as risk assets plunge in October[1] Graph 1



[1] The changes are calculated over the following periods (from first panel to fourth panel): 2 October to 10 October 2018; 31 January to 8 February 2018; 31 December 2015 to 8 January 2016; 17 August to 25 August 2015. The changes in the term premium are computed over five-day moving averages.

Sources: T Adrian, R Crump and E Moench, "Pricing the term structure with linear regressions", *Journal of Financial Economics*, October 2013, pp 110–38; www.newyorkfed.org/research/data_indicators/term_premia.html; Bloomberg; Datastream; ICE BofAML indices; JPMorgan Chase; BIS calculations.

a jump in real US Treasury yields and wider term premia, resulting in higher discount rates and an overall repricing of risk.[3]

The rise in long-term real rates lifted US Treasury nominal yields early in the review period. The yield on 10-year TIPS – as noted, a market proxy for long real rates – rose by about 30 basis points from mid-September to early November (Graph 2, left-hand panel).[4] At the same time, 10-year US Treasury nominal yields increased somewhat less in the same period, as measures of inflation compensation eased, possibly in response to investors' revised expectations about a tighter monetary policy path (centre panel). Nevertheless, 10-year US Treasury nominal yields traded consistently above 3% for the first time since mid-2011. The benchmark retreated below 3% only in early December, in light of remarks by senior Federal Reserve policymakers that investors perceived as moderating the hawkish tone from October, and growing uncertainty about the prospects of an easing of trade tensions (right-hand panel).

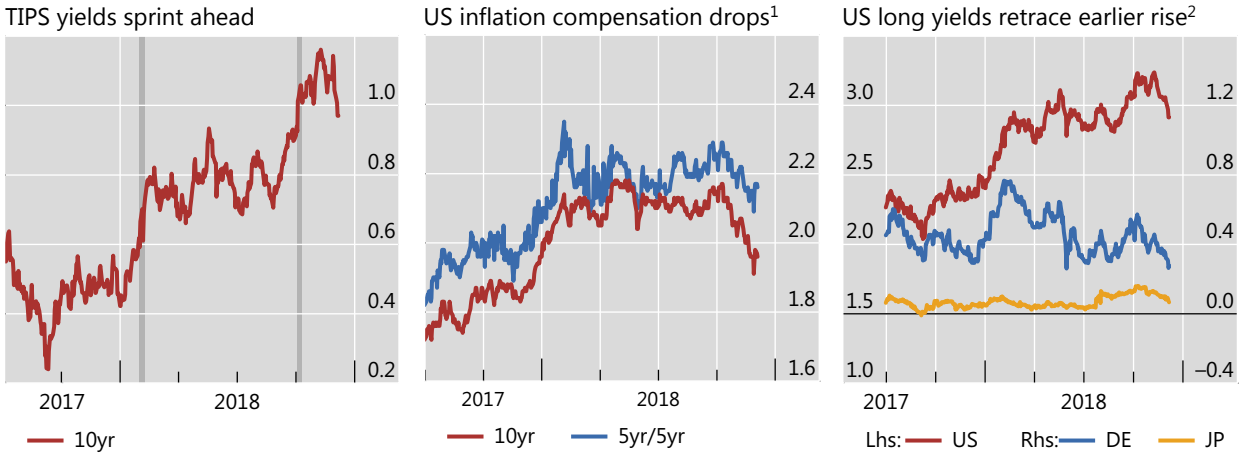
Shifts in both supply and demand factors contributed to higher US yields throughout the year. On the supply side, reflecting in part the tax cut enacted in December 2017, net issuance of US Treasuries between January and October stood at about 4% of lagged GDP, an increase from 2% in the same period of 2017 and the highest level since 2012. On the demand side, the decline in holdings of US Treasuries

[3] For an introduction to term premium concepts and measurement, see B Cohen, P Hördahl and D Xia, "Term premia: models and some stylised facts", *BIS Quarterly Review*, September 2018.

[4] See "Volatility is back", *BIS Quarterly Review*, March 2018.

Real yields drive the increase in US long-term yields

In per cent — Graph 2



The shaded areas in the left-hand panel indicate 31 January to 8 February 2018 and 2 October to 10 October 2018.

[1] Break-even inflation rates. [2] Based on 10-year government bond yields.

Sources: Federal Reserve Bank of St Louis FRED; Bloomberg.

by the Federal Reserve and by key foreign investors continued. As the Fed's policy of reducing its balance sheet gathered pace, its holdings of US Treasuries decreased by more than 2 percentage points to 15% of total marketable securities, about 5 percentage points below the 2014 peak. Holdings of US Treasuries by the foreign official sector (mostly central bank reserve managers) also fell by almost 2 percentage points in 2018 to 26% of the outstanding amount, approximately 8 percentage points below the 2014 levels.

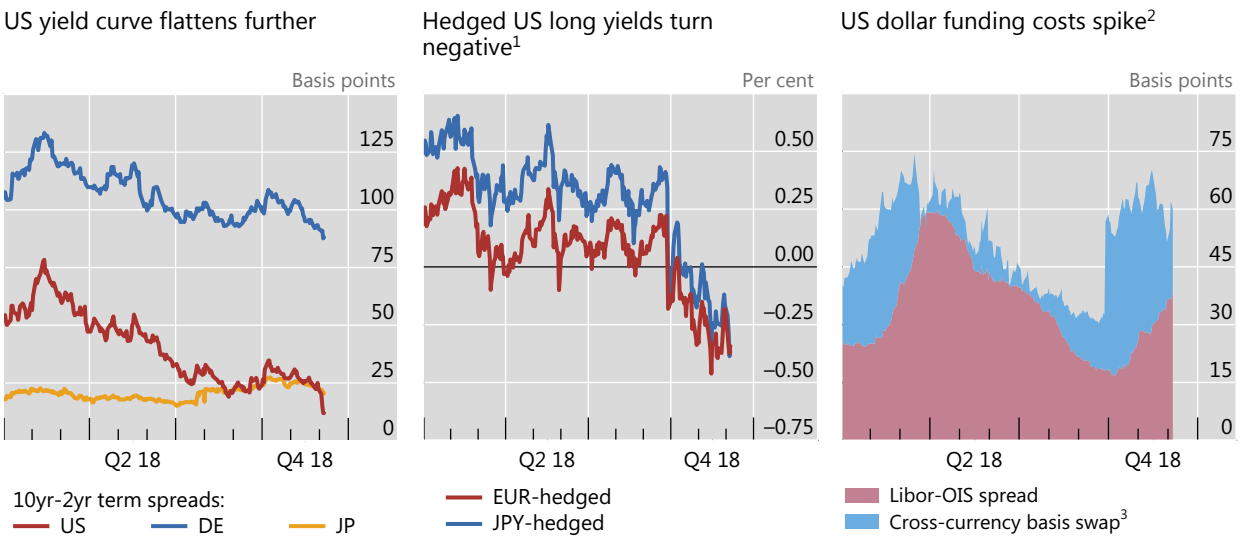
The US yield curve steepened briefly in early October, as US Treasury long yields jumped. Later on, the yield curve resumed the flattening trend that had started in February, closely mirrored by 10-year bund yields and to a lesser extent Japanese government bond yields (Graph 3, left-hand panel). In early December, while stock markets plunged again, the curve inverted at the mid-range when five-year yields fell below two- and three-year yields. The continued flattening of the US yield curve curtailed the appeal of US Treasuries for Japanese and especially euro area investors, as yield curves in their jurisdictions were equally or more steep. Higher FX hedging costs weakened risk appetite further for investors who hedge their positions. These costs reflected a combination of two factors. On the one hand, reliance on short-term instruments for hedging purposes; on the other hand, a widening of the cross-currency basis at the short end in the FX swap market (Graph, 3 right-hand panel).[5] A widening of the Libor-OIS spread, possibly related to euro area bank stress and the quick pace of contraction in banks' reserves in the United States,[6] also contributed to high hedging costs (same panel).

[5] The cross-currency basis rose quickly as soon as the maturity of three-month swap contracts started straddling the end of the year. The spike could have reflected demand for hedged dollar funding ahead of year-end, in light of a variety of regulatory requirements, including but not limited to balance sheet disclosures.

[6] Reserve balances held at the Federal Reserve Banks have dropped by about 20% during 2018.

US Treasuries lose appeal to non-US investors

Graph 3



[1] Ten-year government bond yields; hedge costs based on three-month FX swaps, rolling. [2] Based on three-month tenor. [3] Average across EUR, GBP, JPY cross-currency basis swaps against USD.

Sources: Bloomberg; BIS calculations.

Unsteady markets struggled to rebound

The rise in interest rates early in the review period seemed to dampen the search for yield that has gripped financial markets for quite some time. With diminishing support, stocks bore the brunt of heightened uncertainty about the sustainability of earnings growth, bringing high US valuations somewhat closer to the historical norm. But the impact of US equity market developments rippled through several asset classes and jurisdictions. As December started, stock markets remained unsettled in the midst of uncertainty around trade tensions between the United States and China.

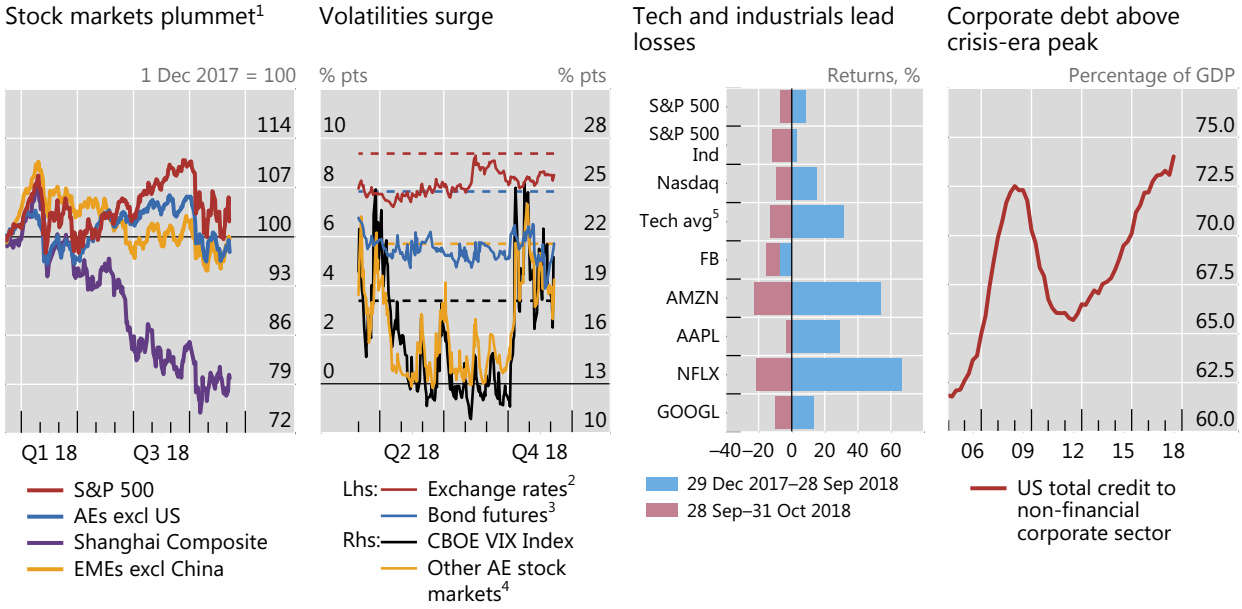
Stock markets across the globe oscillated widely during this period. In October, the S&P 500 lost almost 10% of its capitalisation, erasing all gains since the beginning of the year. Afterwards it traded sideways, with ample swings as investors' sentiment appeared fickle and heavily dependent on incoming data (Graph 4, first panel). The selloff extended to other AE and EME stock markets, most of which had already been flat or declining for much of 2018. Non-US markets on average fell by about 8% in this month, while the Shanghai Composite plummeted by almost 15%. By early December, after a tentative rally sparked by prospects of a reduction in global trade tensions, a renewed bout of volatility left the S&P 500 still 8% below the all-time high reached on 20 September.

Equity implied volatilities surged in October to levels last seen during the spike in February, after remaining subdued for most of the year (Graph 4, second panel). The VIX index reached 25% – not an unusually high value from a historical perspective but still one of the highest since late 2011.[7] By the end of the period under review,

[7] An end-of-day value of 25% is the 83rd percentile of the VIX distribution between January 1990 and September 2018, and the 98th percentile between January 2012 and September 2018.

Stock markets nosedive in October and oscillate widely thereafter

Graph 4



S&P 500 Ind = S&P 500 Industrials index; FB = Facebook Inc Class A; AMZN = Amazon.com Inc; AAPL = Apple Inc; NFLX = Netflix Inc; GOOGL = Alphabet Inc.

The dashed lines in the second panel indicate simple averages over the period 1 January 2002 to 31 December 2006.

[1] For AEs excl US and EMEs excl CN, simple average across country stock indices in local currency. [2] JPMorgan VXY Global index, a turnover-weighted index of the implied volatility of three-month at-the-money options on 23 USD currency pairs. [3] Implied volatility of at-the-money options on long-term bond futures for DE, GB, JP and US; weighted average based on GDP and PPP exchange rates. [4] Implied volatility of the EURO STOXX 50, FTSE 100 and Nikkei 225 indices; weighted average based on market capitalisation. [5] Unweighted average of the tech companies shown in the graph.

Sources: Bloomberg; national data; BIS calculations.

implied volatilities in the US and other AE stock markets remained above the lower plateaus reached earlier in the year. Implied volatilities were steadier in the bond and exchange rate markets (Graph 4, second panel).

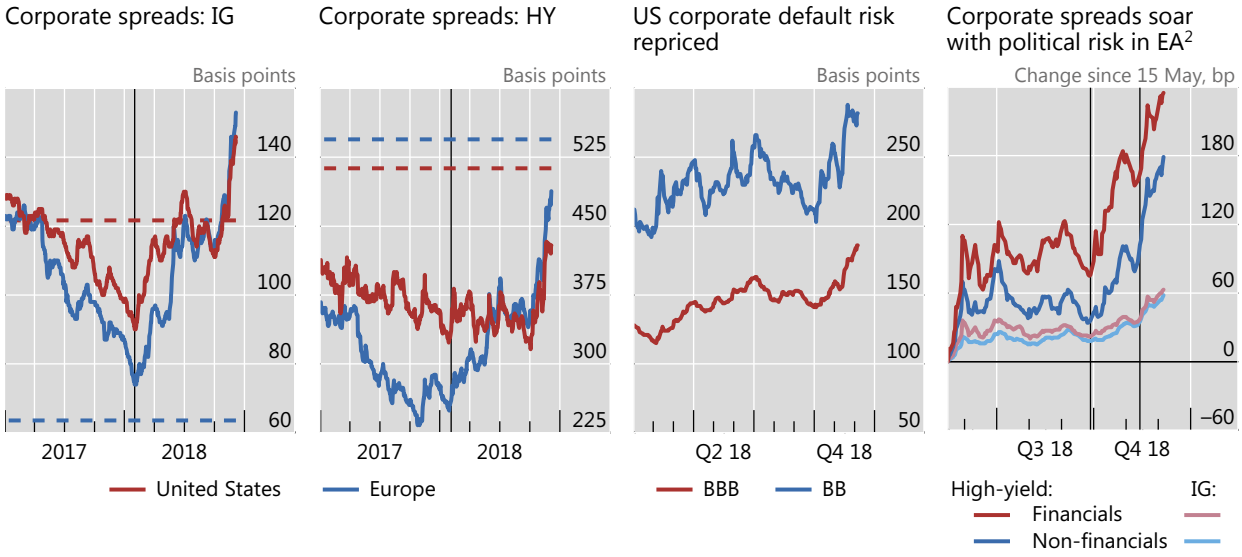
In the United States, stock market losses were particularly sizeable for industrial and technology companies, with some of the largest technology stocks shedding as much as a fifth of their market value (Graph 4, third panel). Earnings announcements in October signalled rising cost pressures for industrial companies and softer demand prospects for technology ones. Industrial and technology stocks had only partially recouped the losses experienced in October before falling again in early December. Even after the market selloff, equity valuations in the United States remained relatively rich, while they were in line with the historical norm in most AEs and EMEs.

A backdrop of stretched corporate balance sheets and weakening lender protection in key loan markets may have compounded investors' concerns. In the United States, corporate debt of non-financial companies stood higher, as a percentage of GDP, than at its Great Financial Crisis (GFC) peak (Graph 4, fourth panel). Bonds with the lowest investment grade rating amounted to one third of bonds outstanding and, over the past year, debt loads had increased the most for companies with weak balance sheets.[8] In addition, "covenant-lite" loans, which afford

[8] Board of Governors of the Federal Reserve System, *Financial Stability Report*, November 2018.

Corporate credit spreads widen across AEs[1]

Graph 5



The dashed lines in the first and second panels indicate simple averages over the period 1 January 2002 to 31 December 2006.

The vertical line in the first and second panels indicates 2 February 2018 (US labour market report triggers stock market jitters). The vertical lines in the fourth panel indicate 27 September 2018 (release of 2019 Italian budget proposal) and 13 November 2018 (Italian government writes to EU to decline modifying its budget proposal).

[1] Option-adjusted spreads. [2] 15 May 2018 corresponds to the leaking of Italian preliminary coalition agreement.

Sources: Bloomberg; ICE BofAML indices; BIS calculations.

lenders fewer safeguards, represented about 80% of the volume of US leveraged loans issued in 2018.[9]

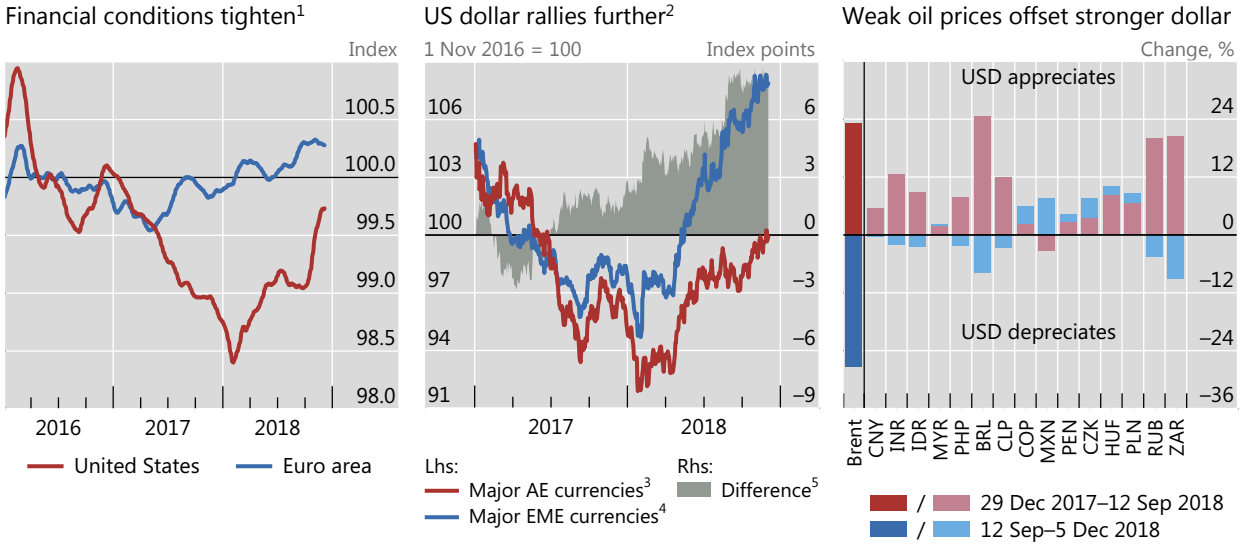
Accordingly, US corporate credit spreads increased further in both the investment grade (IG) and high-yield segments. Spreads broke through the pre-GFC average in the IG sector, rising by about 35 basis points since the beginning of the fourth quarter (Graph 5, first panel, red line). After trending down during the previous year and a half, high-yield spreads jumped by about 100 basis points starting in October, but remained only slightly above the early 2017 level and well below the pre-GFC average (second panel, red line). To some extent, high-yield spreads were swayed by the path of oil prices, given the sizeable participation of shale energy companies in this credit segment. Higher risk premia raised funding costs especially sharply for lower-rated companies. After narrowing in the third quarter, the spread between BB- and BBB-rated corporate credits in the United States began opening again in early October and continued widening in November (third panel). The widening coincided with the increase in Treasury yields and the equity market rout.

In Europe, borrowing costs rose in the wake of heightened political uncertainty. European IG spreads, which had risen rapidly in the first half of 2018, climbed further through the review period, surpassing their US counterparts and more than doubling their pre-GFC average (Graph 5, first panel, blue line). In the high-yield space, European spreads increased rapidly through December and remained higher than US comparables, getting closer to their own pre-GFC averages (second panel, blue line). The impact was particularly negative for high-yield financial corporates (fourth panel).

[9] See T Goel, "The rise of leveraged loans: a risky resurgence?", *BIS Quarterly Review*, September 2018.

Financial conditions tighten to different degrees

Graph 6



[1] Goldman Sachs Financial Conditions Index; an increase indicates tightening; 22-business-day moving average. [2] Trade-weighted dollar indices, Board of Governors of the Federal Reserve System; an increase indicates appreciation. [3] AUD, CAD, CHF, EUR, GBP, JPY and SEK. [4] Other important trading partners (ARS, BRL, CLP, CNY, COP, HKD, IDR, ILS, INR, KRW, MXN, MYR, PHP, RUB, SAR, SGD, THB and VES). [5] Difference between the trade-weighted dollar index for other important trading partners and major currencies.

Sources: Federal Reserve Bank of St Louis FRED; Bloomberg; national data; BIS calculations.

The upshot of these events was a material tightening of financial conditions in the United States and Europe. That said, by some measures US financial conditions remained quite loose, and milder than early last year (Graph 6, left-hand panel, red line). A significant part of the apparent tightening in US financial conditions in the fourth quarter reflected the impact of the stock market fall (Box A). By contrast, financial conditions in Europe tightened further relative to 2017 and most of 2018 (Graph 6, left-hand panel, blue line).

EMEs stabilised but confront challenges

Tighter financial conditions also affected EMEs, especially through further appreciation of the US dollar. The greenback gained ground vis-à-vis both AE and EME currencies (Graph 6, centre panel). However, compared with earlier in the year, the impact of the dollar appreciation was more muted. In part, this reflected the degree to which EMEs had already been shaken the previous quarter. In addition, some EMEs benefited from the sudden drop in oil prices. Lower oil prices may have provided some relief from the double whammy of a strengthening dollar and escalating oil prices, an unusual scenario that had prevailed during the first three quarters of the year (right-hand panel). As the quarter progressed, some EME currencies recouped part of their earlier losses.

Box A

Financial conditions indices: the role of equity markets

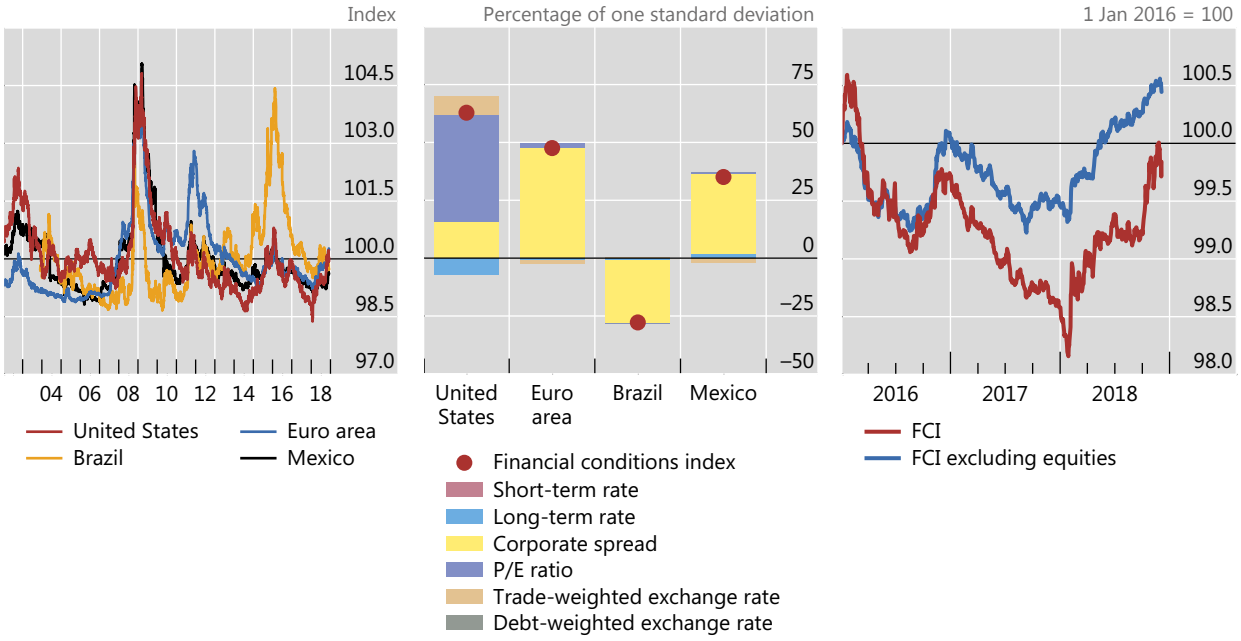
*Anna Zabai**

Changes to financial conditions are often seen as an important channel for monetary policy transmission. Researchers and market analysts have accordingly constructed financial conditions indices (FCIs) for different economies, typically using the weighted average of several key variables, as a way to track and study these effects.① This box examines recent FCI developments in selected economies and argues that FCIs are sensitive to volatile variables, even when these enter the index with a small weight. It illustrates this issue by considering how FCIs in the United States have responded to recent developments in US equity markets.

The left-hand panel of Graph A plots "synthetic" FCIs for the United States, the euro area, Brazil and Mexico. The FCIs were constructed using a similar approach to that employed by Goldman Sachs – including the choice of weights, which are selected using estimates of the relative impacts of changes in the components on GDP growth.② The components comprise interest rates (short-term and long-term), corporate credit spreads, stock market valuations (ie price/earnings (P/E) ratios) and the exchange rate (trade- and debt-weighted). The weights of these variables reflect the structural characteristics of each economy. The variables enter the index in such a way that an increase in the component reflects a tightening of conditions (ie a contraction in funding availability).③

Despite small weights, equities have recently played a large role in driving FCIs

Graph A



[1] Each financial conditions index (FCI) is constructed as the z-score of the weighted average of the underlying components, centred around 100 (that is, the weighted average minus its long-term mean over its long-term standard deviation, plus 100). Therefore, an index value of 101 indicates that financial conditions are one standard deviation above their long-term mean (set equal to 100). [2] Contribution of each component to the index change between 1 October and 4 December 2018, expressed as a percentage of one standard deviation of the index. The index components are short-term and long-term interest rates, corporate spreads, equities and the trade-weighted exchange rate for AEs. For EMEs, the FCIs include the same five components plus a debt-weighted exchange rate to capture FX mismatches. Short rates are policy rate for AEs and three-month government bond yield for EMEs. [3] The ex-equities FCI is computed by excluding equities and redistributing the corresponding weight to the remaining four components of the index. The redistribution maintains the same proportionality between the weights of the included variables as in the main index.

Sources: Bloomberg; Datastream; Dealogic; Euroclear; ICE BofAML indices; JPMorgan Chase; Goldman Sachs; Thomson Reuters; Xtrakter Ltd; BIS locational banking statistics; national data; BIS calculations.

These FCIs suggest that financial conditions in the United States, the euro area and Mexico have been broadly accommodative for a number of years, with the respective FCIs remaining largely below long-term averages in the period since 2013.④ The FCI has been more volatile in Brazil, which experienced a major recession in 2016–17. That said, financial conditions in the United States and the euro area have turned less accommodative in the past year.

In Q4 2018 in particular, the US FCI rose by almost three quarters of a standard deviation, while the FCIs for the euro area and Mexico point to a tightening of one half and about one third of a standard deviation, respectively (Graph A, centre panel). By contrast, financial conditions loosened in Brazil. While recent changes in financial conditions were driven largely by corporate bond spreads in the euro area, Brazil and Mexico, the US FCI rose primarily on the back of a correction in equity valuations.

In fact, equity markets appear to have driven a large part of the loosening of US financial conditions as tracked by these indices in recent years, as well as the more recent tightening. An FCI computed excluding equities would have signalled significantly tighter financial conditions in the United States in the last two years (right-hand panel). The divergence occurs because, in spite of a relatively small weight (5% in the case of the US FCI), equities are relatively more volatile than the other index components.

The high sensitivity of FCIs to equity valuations under this methodology points to the importance of appropriately setting the corresponding weights. Some degree of reliance on market-based finance in funding economic activity, as well as the tendency of corporations to look to the equity market as a signal in their investment decisions, calls for equities to be included in FCIs. Against this, the short-term macroeconomic relevance of equity market developments could be overstated if distributional considerations do not inform the choice of weights. Equity holdings are concentrated among households at the top end of the income and wealth distributions, which tend to have a relatively low marginal propensity to consume. As a result, an index constructed without accounting for these differences may place too high a weight on equity valuations, thereby possibly overstating the boost in activity foreshadowed by a loosening of financial conditions.

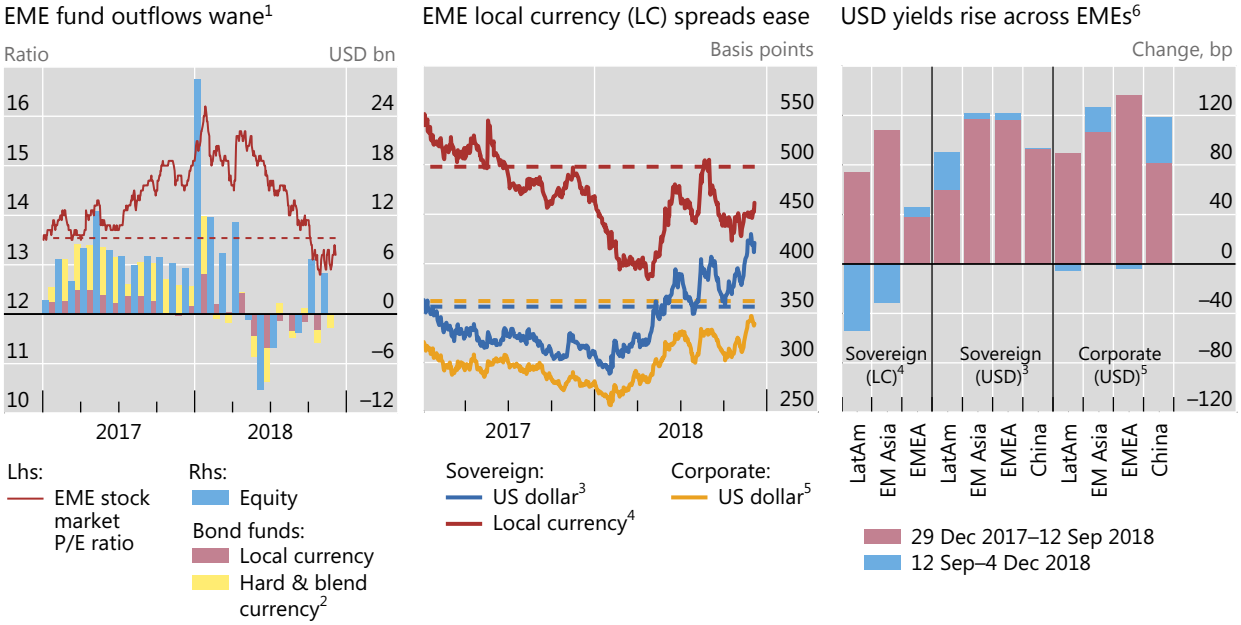
* With many thanks to Nick Fawcett at Goldman Sachs and especially to Katie Craig, Marcus Petersen and Seth Searls at the Federal Reserve Bank of New York for several helpful exchanges. ① Alternatively, a principal component approach may be used. See J Hatzius, P Hooper, F Mishkin, K Schoenholtz and M Watson, "Financial conditions indexes: a fresh look after the financial crisis", *NBER Working Papers*, no 16150, July 2010. ② The choice of weights is discussed in J Hatzius, S Stehn and N Fawcett, "Financial conditions: a unified approach", *Global Economics Analyst*, Goldman Sachs, September 2016; and in the follow-up Goldman Sachs FCI analysis published in the same outlet. The FCIs in Graph A are computed using the same weights underpinning the Goldman Sachs FCIs, with the exception of the FCI for the euro area. While Goldman's euro area FCI includes a "sovereign spreads" variable, this was not included in the euro area FCI in Graph A in order to improve consistency with the US indicator. ③ For example, because higher P/E ratios are associated with a loosening of financial conditions and a boost to economic activity, they enter with a negative sign. Similarly, the dual effect of exchange rates on economic activity – an appreciation tends to dampen activity by depressing net exports, but it also boosts activity by reducing the real value of foreign-denominated debt held by households and corporates – is accounted for by including both trade-weighted and debt-weighted exchange rates in the FCIs for Brazil and Mexico. Only the trade-weighted exchange rate is included for the United States and the euro area, as households and corporates in those two economies do not have significant amounts of foreign-denominated debt. ④ Long-term averages were computed over periods starting 3 January 2000 for the United States, 31 January 2002 for the euro area, 28 November 2003 for Brazil and 2 January 2002 for Mexico; and ending 23 November 2018 in all four cases.

The picture concerning portfolio flows and asset prices was mixed. Outflows turned into inflows for EME equity funds as the large cumulative fall in stock prices recorded over the year brought valuation multiples down to attractive levels, somewhat below long-term averages (Graph 7, left-hand panel). Conditions remained broadly stable in secondary local currency sovereign bond markets. Spreads dropped early in the review period, and then traded sideways before an uptick in early December. Nevertheless, local currency sovereign spreads remained well below their post-GFC averages, but above the trough reached before trade tensions intensified last April (centre panel, red line).

Conditions were less forgiving in the dollar-denominated fixed income segment. Hard currency bond funds continued to experience some moderate outflows. Sovereign and corporate spreads saw some sharp increases in late November, which

Bond market conditions remain tight in EMEs

Graph 7



The dashed line in the left-hand panel indicates the simple average over the period 2 January 1995 to 5 December 2018. The dashed lines in the centre panel indicate simple averages over the period 1 January 2012 to 31 December 2017.

[1] Monthly sums of weekly data up to 28 November 2018. [2] Blend currency funds invest in both local currency and hard currency bonds. [3] JPMorgan EMBI Global (sovereign); stripped spread. [4] JPMorgan GBI index; spread over seven-year US Treasury securities. [5] JPMorgan CEMBI index; stripped spread. [6] Changes in the yield to maturity of each index over the stated periods; regional aggregates are weighted averages based on market value. LatAm = Latin America excl Argentina; EM Asia = emerging Asia excl China; EMEA = emerging Europe, Middle East and Africa excl Turkey.

Sources: Bloomberg; Datastream; EPFR; JPMorgan Chase; BIS calculations.

eased marginally as trade tensions appeared to moderate in the wake of the G20 Leaders' Summit in Buenos Aires (Graph 7, centre panel, blue and yellow lines). In particular, Latin American sovereigns and Chinese corporates saw a large increase in their dollar-denominated bond yields during the review period (right-hand panel, blue bars). Overall, the cost of dollar-denominated debt has risen by 100 basis points or more for most EMEs since the beginning of the year (right-hand panel, red plus blue bars). New issuance by governments and corporations slowed during 2018. However, EMEs face heavy refinancing needs over the next few years.

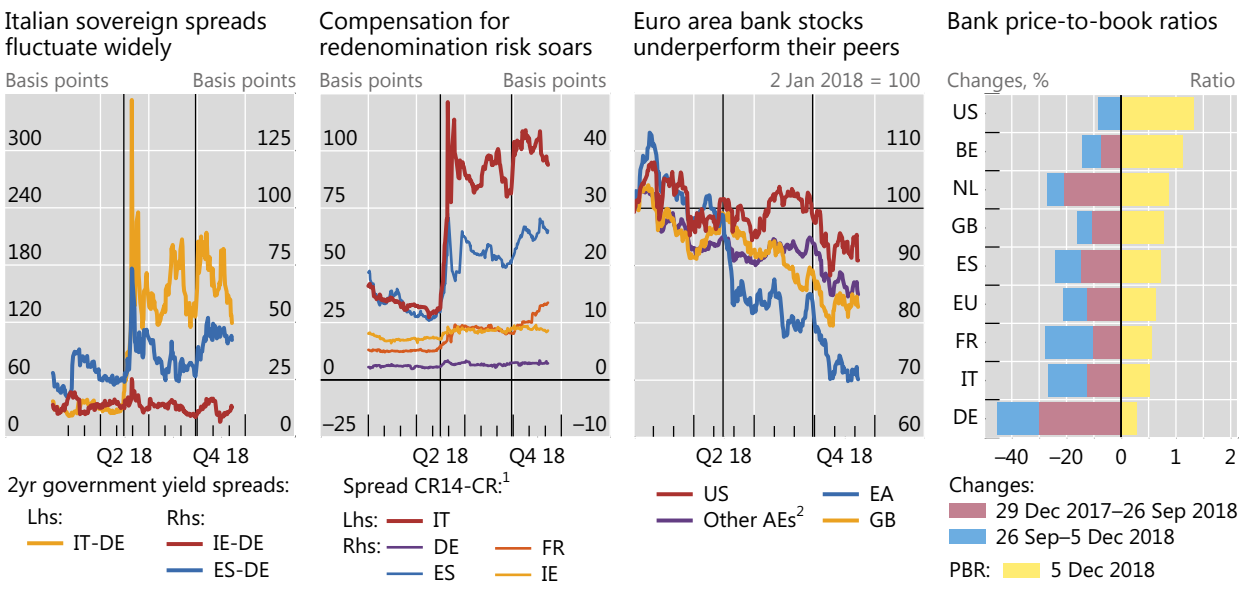
The economic outlook for China remained a concern, in particular for Asian EMEs. The Chinese economy gradually decelerated throughout the year as authorities pressed ahead with a deleveraging policy aimed at keeping financial stability concerns at bay. The pronounced downturn in stock prices, which deepened in October, tightened financial conditions further through its impact on equity-backed loans (Box B). In this context, renminbi depreciation, which is large even vis-à-vis other EMEs, has put some further pressure on other Asian currencies and those of commodity producers.

Political uncertainty continued to buffet euro area banks

Euro area banks suffered further valuation losses during the review period. Heightened political risk was a key factor behind the most recent tumble, as the

European stock valuations extend losses in the wake of political tensions

Graph 8



The vertical lines in the first, second and third panels indicate 15 May 2018 (leaking of Italian preliminary coalition agreement) and 27 September 2018 (release of 2019 Italian budget proposal).

[1] Based on five-year credit default swaps on senior unsecured debt denominated in USD with complete restructuring (CR). CR14 refers to 2014 ISDA rules, which include redenomination as a default event. [2] Weighted average of AU, CA, CH, DK, JP, NO and SE, based on market capitalisation.

Sources: Bloomberg; Datastream; Markit; national data; BIS calculations.

standoff between the European Union and the Italian government over the latter's 2019 budget proposal became increasingly pressing, and prospects for a smooth UK exit from the EU remained uncertain.

Political concerns again buffeted Italian bond markets. Sovereign spreads vis-à-vis German bunds, which had spiked in mid-May,[10] rose again by end-September as the Italian budget draft was unveiled (Graph 8, first panel). The spreads gradually eased over the following weeks. They soared again in mid-November, as the Italian government initially declined to modify its budget proposal, which the EU had rejected in late October. There were signs that investors perceived an increase in the odds of an eventual redenomination of Italian sovereign debt: the cost of credit default swap contracts that included this contingency rose relative to that of contracts that excluded it (second panel). Even then, while rather high, these various spreads did not reach the May peak. And, while contagion to other sovereign yields in the euro area periphery was visible, it was more limited.

Euro area bank stock prices took another dip in the wake of these events. Between mid-May and early December, euro area banks lost almost 30% in market capitalisation (Graph 8, third panel), with half of that loss after the Italian government unveiled its draft budget in September. The losses exceeded by a substantial margin those experienced by banks in other AEs. Moreover, when political tensions eased in late November, European bank stocks failed to recover, even as Italian sovereign spreads edged down.

[10] See "Divergences widen in markets", *BIS Quarterly Review*, September 2018.

Box B

Equity pledge financing and the Chinese stock market

Feng Zhu

Since March 2017, Chinese regulators have pursued concerted measures aimed at reducing leverage in the financial system and managing financial sector risks. These measures have reduced shadow credit sharply since March 2018, exerting pressure on financing by privately owned enterprises (POEs) and small and medium-sized firms. With a slowing economy and falling equity prices, new measures have been taken to contain emerging risks, from equity pledge financing (EPF) – that is, lending extended to key shareholders or managers of listed companies who pledge their shareholdings as collateral. This box reviews the latest developments in EPF, their relationship with the recent market decline, the risks that EPF poses, and how regulators and firms have responded.

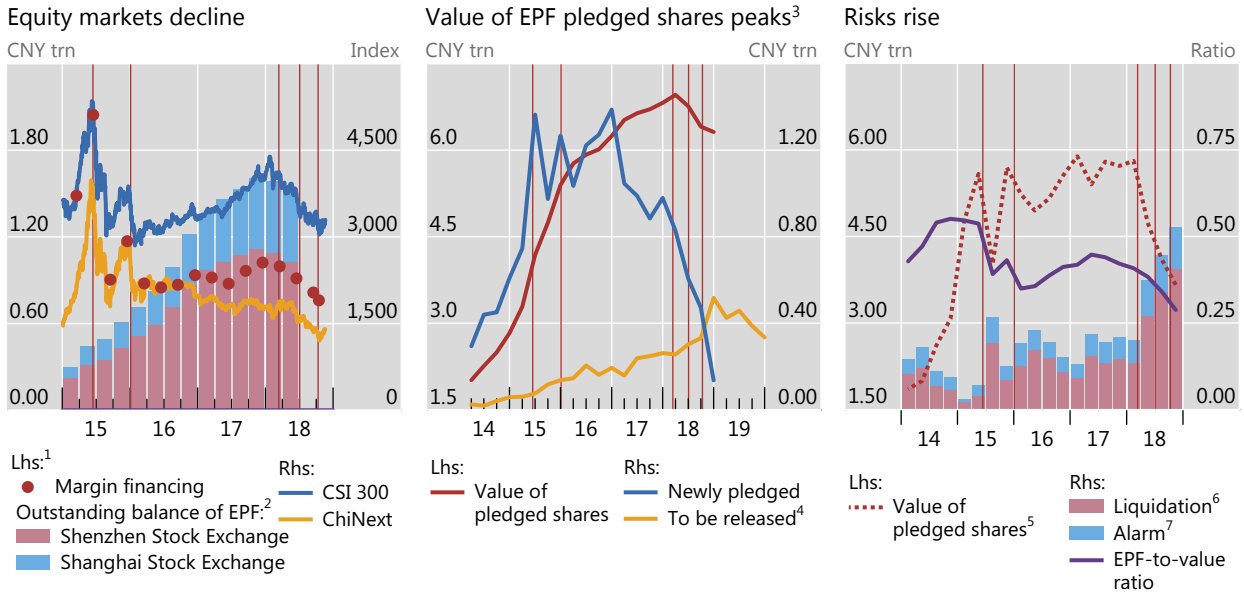
EPF grew very rapidly in China starting in 2014. Though hit hard by the market meltdown in the second half of 2015, EPF recovered strongly, with outstanding equity pledge loans peaking at CNY 1.6 trillion in Q4 2017 (Graph B, left-hand panel). Notably, the value of newly pledged shares had already started to fall sharply from Q1 2017, even as the outstanding amount continued to grow (centre panel).

Chinese stock markets reversed course in 2018. From its peak in January 2018, the CSI 300 Index fell 31% by 18 October, before a moderate recovery (Graph B, left-hand panel). Unlike the 2015 stock market turbulence, where margin financing (ie loans secured against the securities the borrowers purchase) played a key role, the current episode has highlighted the risks of EPF. The Shenzhen Stock Exchange, including the technology-oriented ChiNext Market, saw heavier share price declines; companies listed there tended to be more exposed to EPF risks.

Nevertheless, EPF remains a salient feature of the Chinese equity markets: at end-October 2018, the contract value of pledged shares was CNY 6.3 trillion (Graph B, centre panel). By some estimates, as many as 3,540 listed companies had shares pledged under EPF, with 22.5% of them having over 30% of their shares pledged.

Equity pledge financing in China

Graph B



The red vertical lines indicate: the sharp Chinese stock market declines on 12 June 2015, 3 July 2018 and 11 October 2018; the introduction of a market-wide circuit breaker on 4 January 2016; and new EPF regulations becoming effective on 12 March 2018.

[1] Outstanding loans. [2] Moody's estimates. [3] At contract prices. [4] Value of the underlying shares for maturing EPF loans. [5] At current market prices. [6] Proportion of the pledged shares with their value below the liquidation line, ie 140% (estimate) of the contract value of the associated EPF loan plus its funding costs. [7] Proportion of the pledged shares with their value below the alarm line of 160% (estimate) but above the liquidation line of 140% (estimate). An EPF borrower is expected to top up any shortfall below the alarm line with further pledges.

Sources: Moody's; Shanghai Stock Exchange; Shenzhen Stock Exchange; WIND; BIS calculations.

EPF presents several risks. First, EPF exposes the company to the risk of an unintended change in shareholding structure (a new set of shareholders with a potentially different risk appetite and time horizon) if the pledged shares have to be liquidated. Second, the lenders bear liquidity risks. As of Q3 2018, over 50% of lenders were securities firms. In the event of a default, securities firms are prevented from liquidating the pledged shares immediately, as shareholders with a 5% or higher stake are not allowed to sell more than 1% of their shareholding within 90 consecutive days in the secondary market. This rule, and trading suspensions, reduce the liquidity of the pledged shares. Third, while only 20% of direct EPF lenders were banks in Q3 2018, most EPF lending ultimately relied on bank funding. An EPF failure could weaken banks' balance sheets. As equity prices fell in 2018, many of these risks rose significantly. In Q4 2018, as more EPF loans came due, the underlying pledged shares to be released were estimated at CNY 517 billion, a potentially significant overhang on market valuations.

The Chinese authorities have tightened EPF regulations since September 2017, amid the ongoing efforts to reduce financial leverage and risk. Significant new rules came into effect in March 2018. The rules restricted the EPF-to-value (ETV) ratio to no more than 60% and placed limits on the fraction of a company's shares that can be pledged (both overall, and to a single securities firm or asset management product).

Tighter regulation and falling equity prices have been the main drivers of a sharp decline in EPF in 2018. The market value of pledged shares fell from CNY 5.8 trillion at end-March 2018 to CNY 3.7 trillion at end-October (Graph B, right-hand panel). As share prices fell, the proportion of pledged shares with their current market value falling below the "liquidation" and "alarm" lines (set by lenders relative to the value of the associated EPF loans including funding costs) rose sharply (Graph B, right-hand panel, red and blue bars). Share values below the "alarm" line oblige borrowers to make up the shortfall in collateral, while lenders can force liquidation once prices fall below the "liquidation" line. Forced sales of shares correspondingly picked up as from June.

With their share prices under pressure, listed companies scrambled for solutions. Some requested trading suspensions by exchanges; such suspensions rose significantly in 2018. Nearly 60% of suspensions were applied to companies which had pledged 30% of their shares or more. However, this became more difficult as new guidelines released on 6 November discouraged listed companies from arbitrarily applying for a trading suspension or delaying the resumption of trading without proper justification. Second, firms with strong cash flows turned to stock buybacks, which would raise share prices and lower EPF risks. A third approach involves direct intervention by state funds. State entities have invested heavily in listed private firms this year, taking control of over 20 listed POEs.

The Chinese authorities have recently taken new initiatives to stabilise the equity market, support financing for POEs and contain risks associated with EPF. These include recent targeted measures by the central bank and banking regulators to promote funding for POEs. The People's Bank of China has responded by promoting the issuance of private enterprise support funds and by using monetary policy instruments to support banks' credit extension to private enterprises. Moreover, in October the regulators announced new rules allowing insurers to provide special asset management products to institutional investors for investment in equities and in bonds issued by listed companies and their shareholders, in order to help EPF participants and support POEs. Organised by the Securities Association of China, 11 securities firms agreed to contribute CNY 25.5 billion to a parent asset management plan aimed at helping listed companies with growth prospects but EPF difficulties. Already, two "special bailout bonds" have been issued under the plan. Regulators have also established a pilot "credit protection tool" to support bond financing by POEs. Several local governments have set up funds to support POEs with EPF difficulties. These measures appear to have helped contain EPF risks; the ETV ratio dipped further, to below 30% at end-October.

As a result, price-to-book ratios, a common gauge of valuation for banks, dropped considerably and remained remarkably depressed. By early December, the ratios for French, German and Italian banks had plunged by more than 10% since September, and over 25% since the beginning of the year (Graph 8, left side of the fourth panel). Banks in most European jurisdictions have price-to-book ratios below one (right side of the fourth panel), and sometimes well below that mark, pointing to investors' continuing concerns about profit prospects and, in some cases, asset quality.[11]

[11] See B Bogdanova, I Fender and E Takáts, "The ABC of bank PBRs: what drives bank price-to-book ratios?", *BIS Quarterly Review*, March 2018.

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The geography of dollar funding of non-US banks[1]

Where do non-US banks obtain the funding for the large amount of US dollars they lend? Traditionally, their branches and subsidiaries in the United States were a major source of dollar funding, but the role of these affiliates has declined. Instead, dollars are increasingly raised in the home country. Where dollar funding is raised, however, is distinct from the location of the funding provider, as cross-border liabilities play a large role. In aggregate, a larger share of dollar funding is provided by US residents than is raised at foreign banks' US branches and subsidiaries. In the light of these facts, we discuss potential challenges related to the current geography of dollar funding.

JEL classification: G15, F30, G21.

Internationally active non-US banks have substantial US dollar assets. How do they fund the $12.8 trillion of dollar liabilities that finances their dollar assets?

This article examines the geography of non-US banks' dollar funding by focusing on two related though distinct questions: Where are dollar liabilities booked (booking location)? And where are the funding providers located (counterparty residence)?

To answer these questions, we use various breakdowns of the BIS locational banking statistics (LBS). Our unit of analysis is the national banking systems, that is, all (reporting) banks of a given nationality (eg French or Japanese banks) rather than individual banks (see Box A for more details on how the data are constructed). We focus on dollar funding obtained from third parties (ie "external" funding) and thereby exclude inter-office positions (liabilities within the same banking group).

The basic mapping of US dollar funding by non-US banks is depicted in Graph 1. The geographical location is indicated by the coloured horizontal areas. The rectangles on the liability side of the balance sheet indicate the amount of non-US banks' dollar liabilities booked at three different types of locations: the country of the headquarters (red area), the US branches and subsidiaries (blue area) and other non-US locations (green area). As non-US banks have offices located in different parts of the world, their total dollar liabilities are the sum of liabilities booked at their headquarters and subsidiaries and branches across the globe. The location of the funding providers, or counterparties (rectangles on the right-hand side), can be in the

[1] The authors thank Stefan Avdjiev, Claudio Borio, Stijn Claessens, Ben Cohen, Zuzana Filková, Robert McCauley, Patrick McGuire, Kristina Mićić, Swapan-Kumar Pradhan, Hyun Song Shin, Nikola Tarashev and Philip Wooldridge for valuable comments and suggestions, as well as Jakub Demski for excellent research assistance and Mario Barrantes for invaluable input into the design of Graph 1. The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS.

Key takeaways

- US dollar liabilities of non-US banks grew after the Great Financial Crisis (GFC). At end-June 2018, they stood at $12.8 trillion ($14.0 trillion including net off-balance sheet positions) – as large as at the peak of the GFC.
- Banks raise relatively fewer dollar liabilities in their affiliates in the US since the GFC. This is due to a rise in the share of dollar liabilities booked in the country where banks are headquartered.
- European banks, which traditionally have had a large US footprint, have shrunk their dollar business and the role of their US affiliates since the GFC. At the same time, non-European banks expanded their dollar borrowing quite rapidly, but in recent years have also raised relatively fewer dollars in the US.
- A large share of US dollar liabilities of non-US banks are cross-border (51% at end-June 2018), implying that the location where US dollar funding is raised is different from the location of the funding provider.
- The global share of US dollar funding provided by US residents is significantly higher than that raised at foreign banks' US branches and subsidiaries, though these shares vary across banking systems.

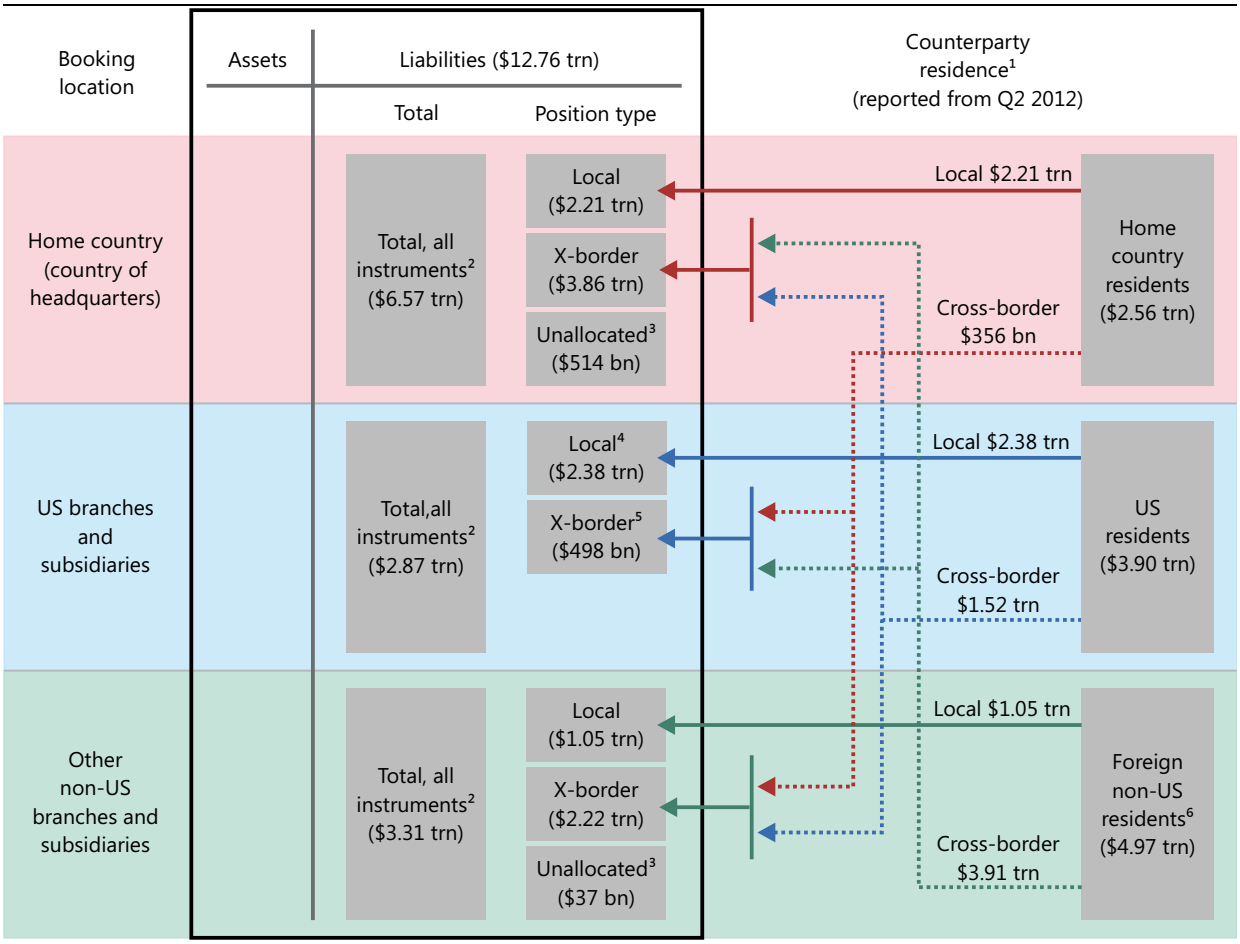
same country (local liabilities) or a different country than the booking location (cross-border liabilities).[2]

We structure our analysis based on the mapping in Graph 1, moving from the booking locations on the left side to the location of funding providers on the right. The first section examines the role of the US branches and subsidiaries of non-US banks (the US as a booking location). It highlights that since the 2007–09 Great Financial Crisis (GFC), their role has declined. European banks, which traditionally had a large footprint in the US, have shrunk their dollar liabilities (McCauley et al (2017)) – in particular those raised through their US branches and subsidiaries. By contrast, non-European banks, which have a relatively smaller US footprint, expanded their dollar borrowing quite rapidly. The second section documents the increased role of the country of the bank's headquarters as a booking location. The third section examines local versus cross-border liabilities (position type) and documents that a large share of dollar borrowing is cross-border. The fourth section contrasts the share of US dollar funding obtained from US residents with the share of dollars booked at the US branches and subsidiaries of non-US banks (right- versus left-hand side of Graph 1). It finds that US residents remain an important source of dollar funding, despite the reduced role of the US operations of non-US banks. The final section discusses potential challenges related to the current geography of dollar funding.

[2] A significant share of liabilities ($1.33 trillion out of $12.76 trillion at end-June 2018) is unallocated by counterparty residence and therefore cannot be assigned to any of the three locations shown in Graph 1. This applies in particular to debt securities which are traded on the secondary market. See Box B for an estimate of unallocated liabilities that can be attributed to US residents.

Mapping on-balance sheet US dollar liabilities of non-US banks

At end-June 2018, excludes liabilities within the same banking group (inter-office positions) Graph 1



[1] $1.33 trillion of US dollar liabilities unallocated by counterparty residence (ie those unallocated by position type plus cross-border positions with unallocated counterparty residence) are not shown. Those are mostly debt securities, where the residence of the holder of the debt security is not reported. [2] Total liabilities, excluding inter-office positions. Instruments include deposits, loans, repurchase agreements and debt securities. [3] Unallocated amounts by position type are mostly debt securities, where the residence of the holder of the debt security is not reported. [4] Local positions booked at the US offices of non-US banks are from the BIS consolidated banking statistics (immediate counterparty basis). [5] In the BIS locational banking statistics, only cross-border US dollar positions booked in the US are reported. Hence, there are no unallocated positions by counterparty type. [6] Includes liabilities vis-à-vis international organisations, which are recorded as cross-border positions.

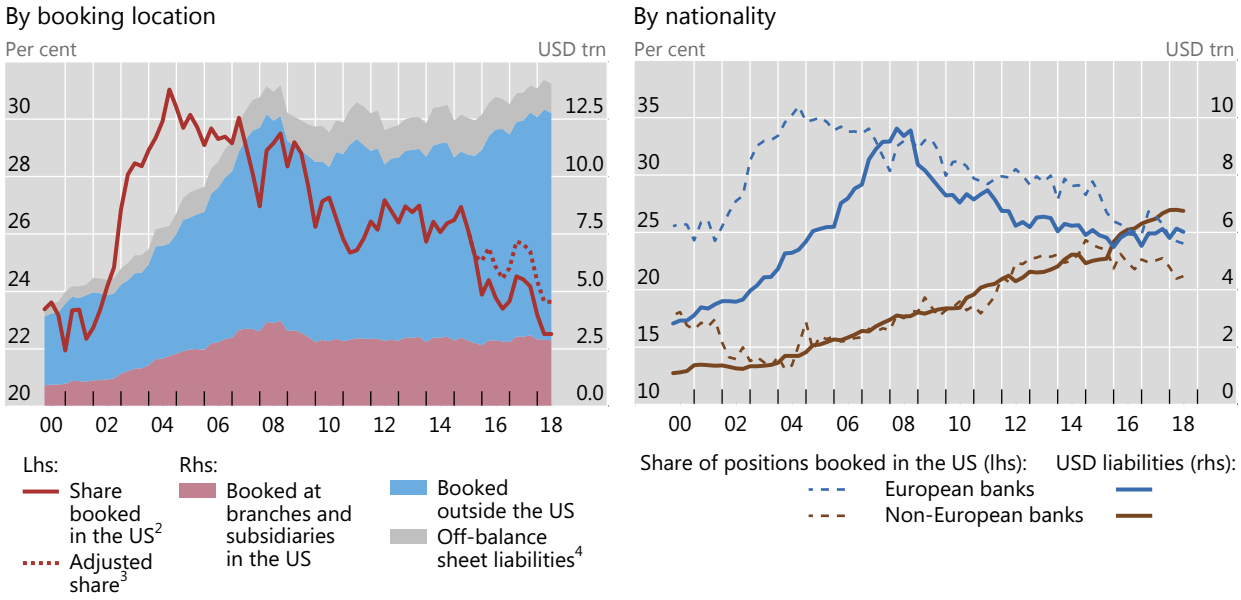
Sources: BIS consolidated banking statistics (immediate counterparty basis); BIS locational banking statistics (by nationality); authors' calculations.

The relative decline of the US as a booking location

In the aftermath of the GFC, non-US banks' on-balance sheet US dollar liabilities have increased steadily (+20%), from $10.6 trillion at end-2009 to $12.8 trillion at end-June 2018 (Graph 2, left-hand panel). On-balance sheet liabilities, however, do not cover all dollar borrowing. Global banks widely use off-balance sheet FX derivatives such as swaps for dollar funding (Borio et al (2017)). The available data do not provide a

US dollar liabilities of non-US banks[1]

Graph 2



[1] External liabilities. Excludes inter-office positions but includes liabilities vis-à-vis unrelated banks. Reporting of US dollar-denominated inter-office positions improves over time, primarily for non-US reporting countries. From end-December 2015 this includes China and Russia as reporting countries. [2] Share of on-balance sheet liabilities booked in the US in total on-balance sheet liabilities. [3] Share excluding US dollar positions reported by China and Russia, which started reporting only in Q4 2015. [4] Mostly FX swaps. Estimated as the difference between global on-balance sheet dollar assets and liabilities. Total of positive off-balance sheet liabilities for all (non-US) banking systems reporting to the BIS banking statistics.

Sources: BIS consolidated banking statistics (immediate counterparty basis); BIS locational banking statistics (by nationality); BIS calculations; authors' calculations.

measure of such borrowing.[3] But estimates of the *net* amounts – under the assumption that banks do not have dollar balance sheet mismatches – can be constructed for many of the largest national banking systems.[4] When these estimates are included, total dollar liabilities reached $14.0 trillion at end-June 2018. We focus on on-balance sheet liabilities, however, as data for off-balance sheet positions are too scarce.[5]

As dollar liabilities rose after the GFC, non-US banks raised relatively fewer dollars in their US affiliates. The share of on-balance sheet dollar liabilities booked by their branches and subsidiaries in the United States declined from 30% at end-September 2008 to 23% at end-June 2018.[6] During the GFC, the US branches and subsidiaries of foreign banks absorbed a major share of the emergency liquidity provided by the Federal Reserve (Fleming (2012)). This led to a temporary rise in the share of dollar liabilities booked in the US. Since then, this share has been on a downward trend.

[3] The BIS OTC derivatives statistics indicate that non-US banks reported $25 trillion (notional) in dollar-denominated FX swap positions as of end-June 2018, but this includes all transactions with a dollar leg (ie dollar-receiving and dollar-providing transactions).

[4] Implied FX swaps are constructed for each bank nationality as the difference between US dollar assets and US dollar liabilities. When dollar assets exceed dollar liabilities, banks are assumed to hedge the mismatch by receiving dollars via FX swaps. For details, see McGuire and von Peter (2009, 2012).

[5] Henceforth, we use the term "liabilities" to include only on-balance sheet items.

[6] China and Russia joined the reporting population in the fourth quarter of 2015. Excluding these two countries yields a share of 24% at end-June 2018.

Box A

Constructing the dollar positions of international banks with BIS statistics

The analysis in this feature requires the estimation of US dollar liabilities by bank nationality (ie where the headquarters are located), broken down by the location of the booking office and the location of the counterparty.① We follow the approach outlined in McGuire and von Peter (2009) and construct dollar positions by combining the BIS consolidated banking statistics on an immediate counterparty basis (CBS) with BIS locational banking statistics by nationality (LBSN). The summary of breakdowns available in the two data sets is given in the left-hand panel of Graph A. The CBS are organised on the principle of bank nationality and present reporting banks' consolidated foreign claims, broken down into international claims and local claims in local currencies (ie local currency positions booked by banks' foreign offices vis-à-vis residents of the host country). They have limited information about bank liabilities, but they do include their local liabilities in local currency. The LBSN are collected from the jurisdiction where the activity takes place, then broken down according to the nationality (headquarters) of the reporting banks. Each bank office (headquarters, branches, subsidiaries) in a BIS reporting country reports cross-border liabilities as well as foreign currency liabilities vis-à-vis residents in that reporting country. Along with the nationality breakdown, the LBSN also break down positions by currency, counterparty sector and, since end-June 2012, counterparty residence.②

The right-hand panel of Graph A illustrates how we combine the two data sets to approximate the US dollar liabilities of non-US banks. Importantly, we exclude interbank positions vis-à-vis offices of the same banking group (ie inter-office liabilities). In the CBS these are excluded by construction by virtue of consolidation, whereas in the LBSN they can be excluded thanks to the counterparty sector breakdown.

As the CBS do not provide a currency breakdown, we only use these data to quantify the local liabilities in local currency booked by non-US banks in the US, where the currency is the dollar by definition (dashed arrows). As the CBS do not provide a counterparty sector breakdown for local positions in local currencies, we cannot distinguish between interbank liabilities (both to US banks and to non-US banks) and liabilities to non-banks. We use the LBSN for all the rest (solid arrows). In particular, we extract cross-border dollar liabilities to US banks and non-banks in the US (solid arrow connecting the stylised locations) as well as cross-border and local liabilities (vis-à-vis US banks, unrelated non-US banks and non-banks located outside the US (solid arrows inside the right-hand box)). These liabilities can be booked either in the home country of any particular non-US banking system (eg a Canadian bank booking US dollar liabilities in Canada) or in BIS reporting countries other than the US and the home country (eg a Canadian bank booking US dollar liabilities through a branch in France). Importantly, these liabilities can themselves be either local or cross-border. An example of the former would be a Canadian bank branch in France booking a US dollar liability vis-à-vis a resident of France; an example of the latter would be a Canadian bank branch in France booking a US dollar liability vis-à-vis a resident of Germany.

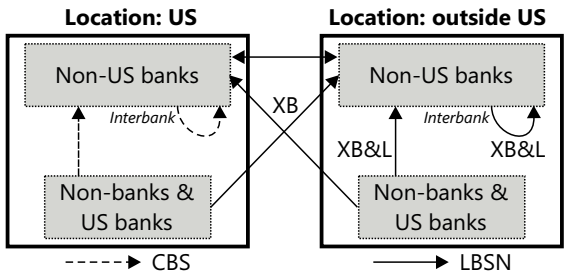
US dollar funding of non-US banks, based on BIS statistics

Graph A

Data sets used and available breakdowns

Breakdowns	CBS	LBSN
(1) Booking location	✓	✓
(2) Counterparty residence[1]	✓	✓
(3) Counterparty sector		✓
(4) Currency	Local (USD)	✓
Types of liabilities used	LLLC	XB&L, LLFC

Bank nationality, location and data set



CBS = consolidated banking statistics (immediate counterparty basis); LBSN = locational banking statistics by nationality; LLLC = local liabilities in local currency; LLFC = local liabilities in foreign currency; XB = cross-border positions; XB&L = cross-border and local positions in foreign currency. All arrows denote US dollar positions representing claims on (liabilities of) non-US banks as a group. The arrows pointing from non-US banks to themselves indicate positions vis-à-vis unrelated non-US banks. We exclude inter-office positions.

[1] Available since end-June 2012 (Avdjiev et al (2015)).

Source: Authors' illustration.

① Most of the article focuses on US dollar liabilities. We therefore restrict the description in this box to dollar liabilities. The logic for building dollar asset positions is analogous. ② Positions are broken down by USD, EUR, JPY, GBP, CHF, the domestic currency of the country where the office is located, and all others. While we do not use the counterparty sector breakdown (other than for subtracting inter-office positions), we include it in the table to illustrate available breakdowns.

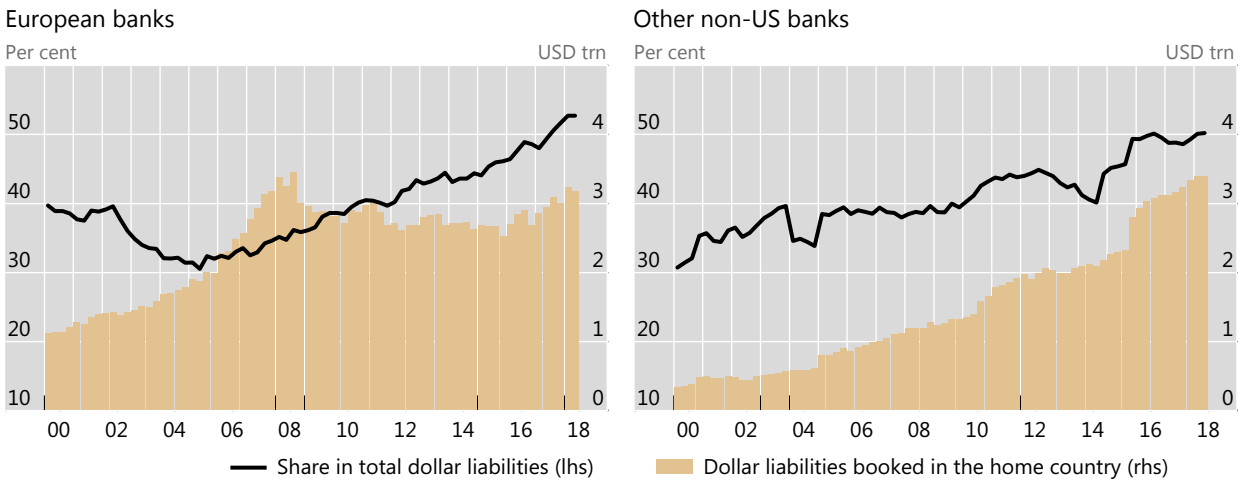
The overall decline in the share of dollars raised in the United States masks contrary trends in dollar borrowing by European and non-European banks. European banks, which traditionally had a large presence in the United States,[7] reduced their dollar borrowing and raised relatively fewer dollars through their US affiliates post-GFC (Graph 2, right-hand panel). By contrast, other non-US banks, notably Australian, Canadian and Japanese ones, expanded their aggregate dollar borrowing at a rapid pace, overtaking European banks in the first quarter of 2016. Their US footprint has been increasing, though from a lower base. Since 2015, however, the share of dollar liabilities booked in the US has been declining for both European and non-European banks.

The rise of dollar liabilities booked in the home country

If the global share of US dollar liabilities booked in the US is declining, where have dollar liabilities moved instead? Non-US banks book an increasing share of their dollar liabilities in their home jurisdictions, ie the country where their headquarters are located. As of end-June 2018, more than 50% of dollar liabilities were booked in the home country.

This trend is visible for both European and other non-US banks (Graph 3). For European banks, this occurs against the backdrop of relatively flat dollar liabilities booked at home in absolute amounts. For other (non-European, non-US) banks, the share of dollar liabilities booked in the home country has been increasing in tandem with the absolute amounts. This is due to a large extent to Canadian and Japanese banks.

Home country US dollar liabilities[1] Graph 3



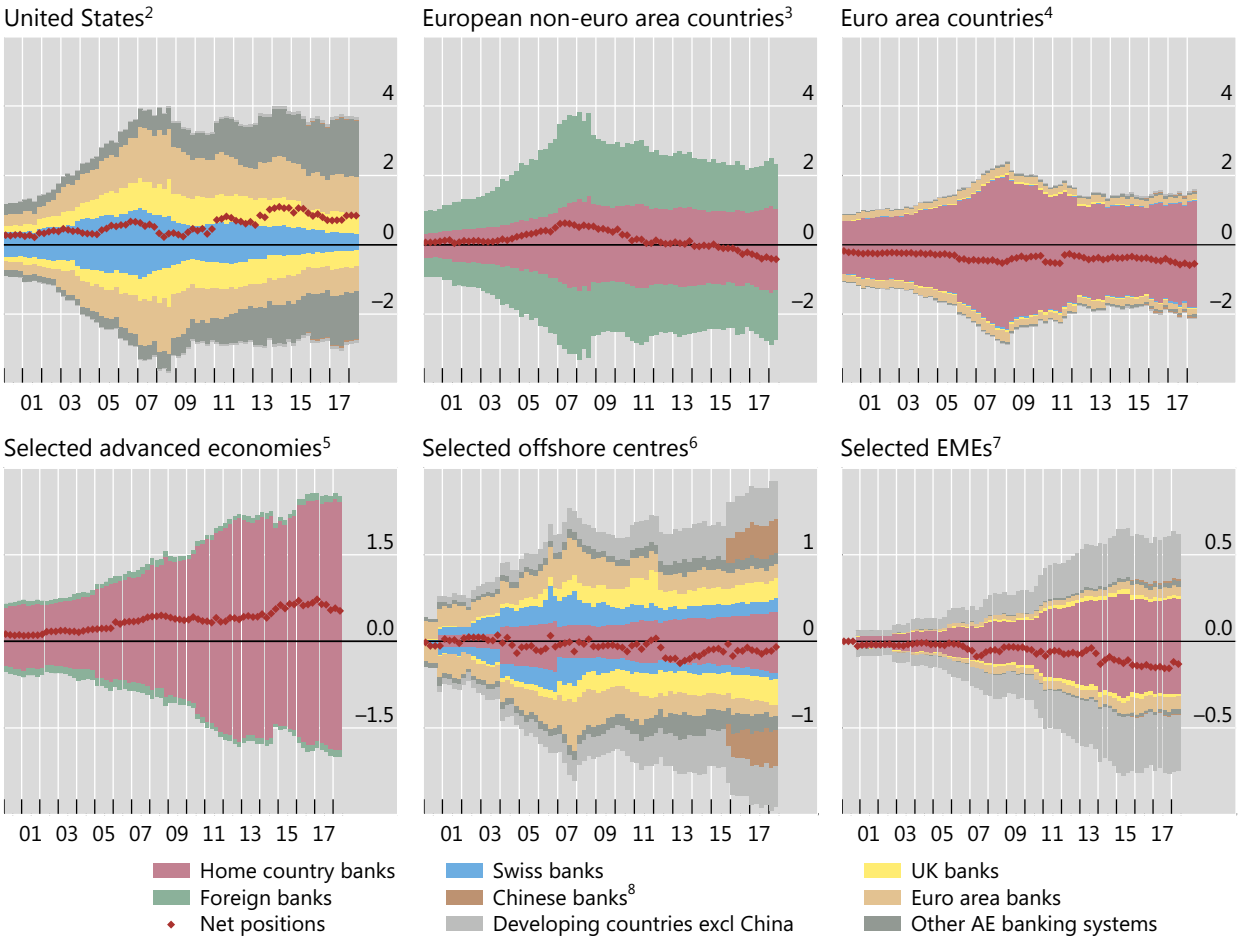
[1] Excludes inter-office positions but includes liabilities vis-à-vis unrelated banks. Reporting of US dollar-denominated inter-office positions improves over time, primarily for non-US reporting countries. Includes China and Russia as reporting countries from end-December 2015. Hong Kong SAR not included in the right-hand panel.

Sources: BIS consolidated banking statistics (immediate counterparty basis); BIS locational banking statistics (by nationality); BIS calculations.

[7] See, in particular, Kreicher et al (2013) and Aldasoro et al (2018).

US dollar positions of non-US banks booked in selected locations, by bank nationality[1]

Assets (+) and liabilities (–), in trillions of US dollars — Graph 4



[1] US dollar-denominated assets (positive values) and liabilities (negative values) of banking systems listed in the legend booked in countries in the panel title. Inter-office positions are excluded. [2] Local positions from the BIS consolidated banking statistics (CBS) are added to nationalities that report CBS statistics (CH, EA, GB and other advanced economies). "Other AE banking systems" area is predominantly driven by Canadian and Japanese banks (CBS local positions). [3] CH, DK, GB and SE. [4] AT, BE, CY, DE, ES, FI, FR, GR, IE, IT, LU, NL and PT. [5] AU, CA and JP. [6] BS, HK, JE, KY, PA and TW. [7] BR, ID, MX, MY, TR and ZA. [8] China joined the reporting population in Q4 2015.

Sources: BIS consolidated banking statistics (immediate borrower basis); BIS locational banking statistics (by nationality).

Graph 4 provides a more detailed overview of where non-US banks book their dollar assets (positive bars) and liabilities (negative bars). The patterns on the liability side are largely mirrored by those on the asset side, suggesting that banks try to match their dollar positions in a given booking location. A positive or negative net position (red dots) can occur due to unmatched inter-office positions or off-balance sheet positions, which are both excluded from our analysis. If dollar assets are greater than liabilities at a given booking location, non-US banks transfer dollars from other offices to this location or raise off-balance sheet funding to finance the dollar assets.

While the US remains the largest single booking location (Graph 4, top left-hand panel), the overall volume of dollar funding raised outside the US has risen. At the same time, there have been notable shifts across non-US booking locations. Non-US banks have reduced their dollar positions booked in European countries, both within and outside the euro area (top centre and top right-hand panels). Meanwhile, dollar funding raised in advanced non-European economies such as Australia, Canada and

Japan has risen sharply (bottom left-hand panel). While the United States and the United Kingdom host branches and subsidiaries with large dollar liabilities of a broad set of bank nationalities, other major booking locations in most advanced economies are dominated by home country banks.

Offshore financial centres (OFCs) continue to be important booking locations for dollar positions (Graph 4, bottom centre panel). While total OFC positions have grown, there has also been a shift within this category from non-Asian to Asian OFCs. By the nature of their business model, dollar assets and liabilities booked in OFCs closely match each other. US dollar liabilities raised in emerging market economies (EMEs) have risen rapidly in recent years (bottom right-hand panel). These locations mostly serve either home country banks or banks headquartered in other EMEs.

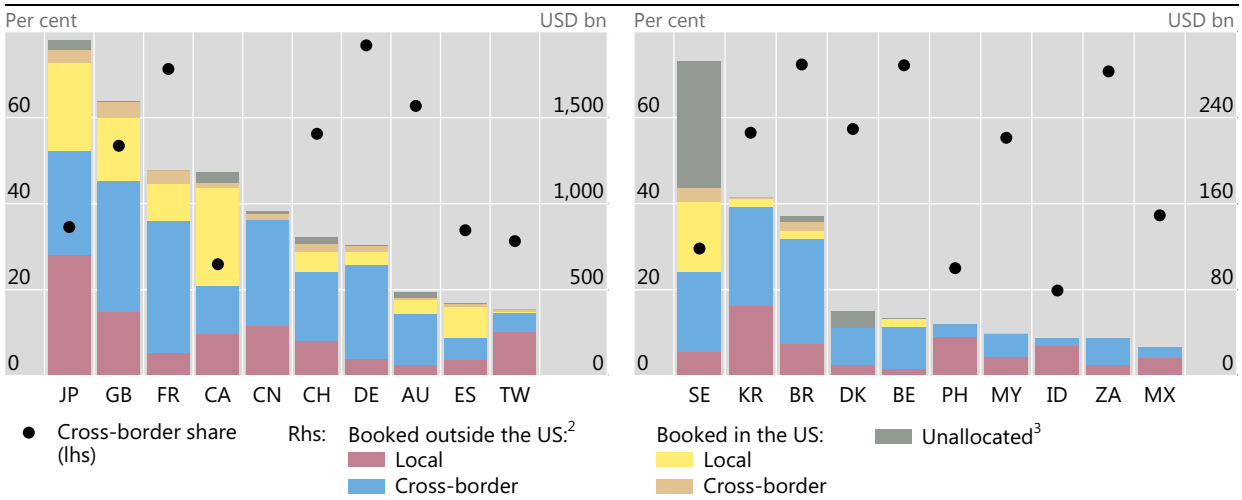
The large cross-border component of dollar liabilities

We now take a closer look at whether US dollar liabilities are *local* or *cross-border* ("position type" in Graph 1; see also Box A for examples).

On-balance sheet dollar liabilities of non-US banks have a significant cross-border component (Graph 5). Overall, the cross-border share for all reporting banking systems stood at 51% as of end-June 2018. For some advanced economy banking systems (eg Australian, French, German, Swiss and UK banks), this is mostly due to the large amount of dollar liabilities booked cross-border outside the US (left-hand

US dollar liabilities[1] of global banks can have a large cross-border component

By bank nationality, end-June 2018 Graph 5



[1] Liabilities vis-à-vis all sectors including local liabilities booked in the US (total, consolidated banking statistics). China, the Philippines, Malaysia, Indonesia and South Africa do not report these statistics. [2] The cross-border share is not reported for China as it does not report local dollar liabilities in the home country. [3] Unallocated by position type – either local or cross-border.

Sources: BIS consolidated banking statistics (immediate counterparty basis); BIS locational banking statistics (by nationality); authors' calculations.

panel, blue bars). In most cases these are largely booked in the bank's headquarters country.[8]

For some bank nationalities, however, the local component is high – typically reflecting local borrowing by the branches and subsidiaries in the United States (Graph 5, yellow bars). This applies to Canadian, Japanese and Spanish banks. Yet these banks also have sizeable cross-border dollar liabilities in absolute terms.

The share of cross-border dollar liabilities is high for many major EME bank nationalities, though the picture is diverse. It is higher for banks from certain countries, including Brazil, Malaysia and South Africa. Banks from other jurisdictions such as Indonesia and the Philippines, however, have relatively small cross-border shares, as most of their liabilities are local and booked outside the US.

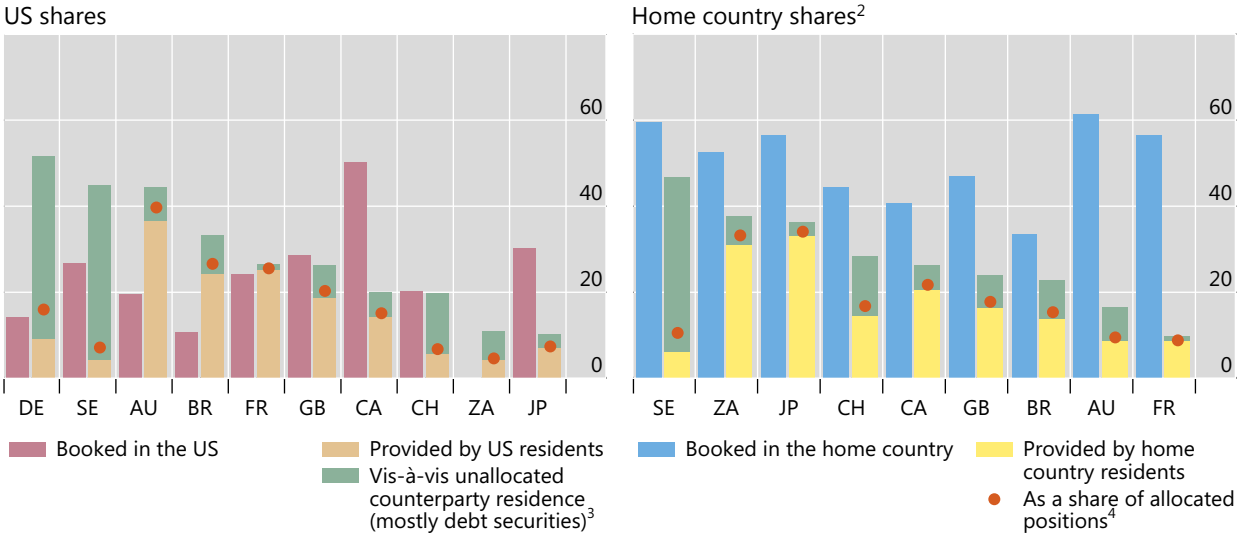
Booking location versus counterparty residence

An implication of the large cross-border share is that the booking location and the residence of the counterparty providing the dollar funding differ to a large degree. In this section, we contrast the share of liabilities booked in the US and in the home country (left-hand side of Graph 1, blue and red areas) and the share of dollar funding provided by US and home country residents (right-hand side, blue and red areas).

At the aggregate level, US residents account for a significantly larger share of dollar liabilities of non-US banks than the share booked at the US branches and subsidiaries of those non-US banks. In other words, while non-US banks still make

Booking location versus counterparty country

As a percentage of total banking system on-balance sheet liabilities,[1] end-Q2 2018 Graph 6



[1] Excluding inter-office positions. [2] Germany is excluded from this panel due to confidentiality. [3] For BR and CH, it is not possible to exclude inter-office positions unallocated by counterparty country. [4] Dollar liabilities provided by US residents as a share of total liabilities minus liabilities unallocated by counterparty country.

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

[8] For instance, a UK bank booking a dollar liability at its headquarters in the UK (ie home country) vis-à-vis a resident in France (ie cross-border).

use of their US affiliates to raise dollars from US residents, there is also a significant cross-border flow of dollars from US residents to their non-US offices – such as the headquarters or an office in an offshore financial centre.

In aggregate, the share of funding provided by US residents in total dollar liabilities stood at 30% at end-June 2018 (versus a share of 23% booked in the United States). But the actual share is probably higher, since a portion of reported liabilities (especially debt securities) are not allocated to any counterparty country ($1.33 trillion at end-June 2018). US dollar-denominated debt securities, however, are to a substantial extent held by US residents (Maggiori et al (2018)). A more realistic estimate of the US resident share is obtained by assuming that the share in the unallocated portion matches that in the portion where residence data are provided (Graph 6, orange dots) – in this case the global share is 34%. It is also possible to allocate part of the unallocated portion by using the Treasury International Capital survey of US holdings of foreign securities. With the help of these data, we estimate that, of the $1.33 trillion unallocated by counterparty country, around $658 billion can be allocated to US residents (Box B). The share of dollar funding provided by US residents would then rise to 36%.

Banks from most countries, especially European ones, fit the aggregate pattern whereby liabilities vis-à-vis US residents exceed liabilities booked in the US (Graph 6, left-hand panel). The most notable exceptions are Canadian and Japanese banks, which book a significant share of their dollar liabilities in the US.

Conversely, dollar liabilities booked in the home country tend to account for a larger share than those provided by residents in the home country (Graph 6, right-hand panel, blue versus yellow bars). Banks book a large share of dollar liabilities in their home countries, but a substantial portion ultimately comes from cross-border lenders in the United States and elsewhere. A precise estimate of these shares depends on how one allocates liabilities which are currently unallocated by counterparty country (green bars). But even if those liabilities were to be entirely

Box B

Estimating non-US banks' dollar debt securities held by US residents

A significant amount of non-US banks' dollar liabilities cannot be allocated to a counterparty country ($1.33 trillion out of $12.76 trillion as of end-June 2018). However, it is possible to allocate parts of this amount to US residents by using the Treasury International Capital (TIC) survey of US holdings of foreign securities,① in combination with the BIS international debt securities statistics (IDS) and locational banking statistics by nationality (LBSN).

As of end-2017, US residents held $701 billion of debt securities issued by non-US banks, 93% of which were dollar-denominated ($652 billion). If we apply the same dollar share to securities issued by other financial institutions, US residents also held $586 billion in this category, an estimated $73 billion of which were issued by firms with non-US banks as ultimate parent.② This leaves $725 billion (= $652 billion+ $73 billion) to be allocated to US residents based on the TIC data. We then subtract non-US banks' dollar-denominated debt securities already allocated to US residents in the LBSN ($227 billion) to reach $498 billion. This represents 49.4% of total dollar liabilities of non-US banks unallocated by counterparty country at end-2017 (which totalled $1 trillion). Our estimate of $658 billion in the main text applies the end-2017 ratio to the $1.33 trillion dollar liabilities unallocated by counterparty country in the second quarter of 2018.

① See ticdata.treasury.gov/Publish/shca2017_report.pdf. Table A15 presents the US holdings of foreign debt securities, and p 20 shows the dollar share of such holdings. ② This number is obtained by using the BIS IDS, as of end-2017, to compute the share of dollar-denominated international debt securities issued by non-US bank-owned other financial institutions in the total issued by non-US other financial institutions. This share, which stood at 12.4% as of end-2017, is very stable over time.

allocated to home country residents (an unlikely scenario), the shares of dollar liabilities booked in the home country would still be larger than those vis-à-vis home country residents.

Conclusion

Non-US banks have very large US dollar liabilities – similar in magnitude to those they had in 2007–08 when markets started to face a dollar squeeze (McGuire and von Peter (2012)). The share of dollar funding raised in the United States by non-US banks' branches and subsidiaries has declined. Yet a significantly larger share of dollar liabilities is nonetheless provided by US residents, by way of cross-border flows.

How might this funding configuration behave in times of market stress? Non-US creditors may be pressured to withdraw funding as they might face a dollar funding squeeze themselves. The fact that a large share of dollars is provided by US residents, who are less likely to face dollar liquidity problems, may therefore alleviate potential funding risks to some extent. On the other hand, the ability to raise dollar funding outside the United States can prove stabilising in a situation where funding conditions in the US become more difficult, as evidenced by the adjustment of non-US banks to the 2016 US money market fund reform (Aldasoro et al (2017)).

The high cross-border share of dollar funding and the increased centralisation of funding by non-US banks at their headquarters highlight the importance of the stability of cross-border flows. Cross-border funding, regardless of the source, may be fickle in a crisis, as the GFC demonstrated (Borio et al (2011)). This is especially true when funding sources are concentrated geographically. It also points to the importance of policy instruments that allow the official sector to provide dollar liquidity in a crisis, such as central bank swap lines (BIS (2014), Mehrling (2015)).

These considerations suggest that it is not clear-cut whether the current geography of dollar funding implies that the funding risks which characterised the dollar shortage around the GFC have increased or decreased. Aspects not discussed here, such as the rise of collateralised borrowing, will also be relevant. Monitoring these developments is complicated by data gaps, such as the lack of consistent information on off-balance sheet derivatives and on the geographic and sectoral distribution of holdings of international debt securities. In any event, the sheer size and complexity of non-US banks' dollar liabilities warrants attention (BIS (2017)).

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The growing footprint of EME banks in the international banking system[1]

This special feature explores the role of banks from emerging market economies (EMEs) in global banking. Over the past decade, the cross-border activity of EME banks has been growing at a faster pace than that of banks from advanced economies. This has been largely driven by increasing EME-to-EME interlinkages, which often make up more than half of EMEs' cross-border borrowing. EME banks make use of their global networks of affiliates abroad for the majority of their cross-border lending to other EMEs. In the cross-border interbank market, EMEs with more developed banking systems tend to be net recipients of funds, whereas EMEs with less developed ones tend to be net providers.

JEL classification: F34, F36, G21.

Emerging market economies (EMEs) have substantially increased their footprint in the global economy over recent decades. They now produce about 40% of global GDP at market exchange rates, and contributed about two thirds of 2017 global GDP growth.

In this special feature, we document how the growing economic importance of EMEs has gone hand in hand with a rapidly increasing presence of EME banks in global banking. We use the locational data of the BIS international banking statistics (IBS) and focus on banks' nationality, while distinguishing between the business of banks' headquarter offices and that of their affiliates abroad. As of mid-2018, the IBS data set comprises data from 47 reporting countries and covers about 95% of total cross-border claims.[2] Recent increases in the number of EMEs that report to the IBS (eg China and Russia starting in 2016, and the Philippines in 2017) and recent statistical enhancements offer unique insights into EME banks' global activity.[3]

[1] Eugenio Cerutti is the Assistant to the Research Department Director at the International Monetary Fund (IMF). We thank Stefan Avdjiev, Claudio Borio, Stijn Claessens, Benjamin Cohen, Ingo Fender, Bryan Hardy, Robert McCauley, Benoît Mojon, Hyun Song Shin, Nikola Tarashev and Philip Wooldridge for their comments. The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS or the IMF.

[2] More information on the coverage of locational banking statistics is available on the BIS website at https://www.bis.org/statistics/lbs_globalcoverage.pdf.

[3] The first quarter of data availability for individual reporting country can be found at https://www.bis.org/statistics/rep_countries.htm.

Key takeaways

- EME banks extend more cross-border lending through their foreign affiliates than from their headquarters. They have created global networks of affiliates that play a crucial role in lending to other EMEs.
- In many EMEs, non-banks obtain more than half of their cross-border borrowing from foreign EME banks. For several EMEs, this cross-border borrowing from EME banks exceeds 25% of their GDP. These EME interlinkages have grown rapidly in recent years and have given rise to extensive interdependencies.
- EME banks' cross-border interbank positions are substantial. Larger EMEs with more developed domestic banking systems tend to act as net borrowers, whereas smaller EMEs with less developed banking systems tend to provide cross-border funds to other banks.

Even though EME banks[4] account for a relatively small fraction of aggregate global banking, the cross-border interlinkages among EME lenders and EME borrowers are substantial and growing rapidly (CGFS (2014)). The offshore networks of EME banks play a key role in their EME business. They channel about two thirds of EME-to-EME cross-border credit through affiliates located in advanced economies (AEs) and offshore financial centres (OFCs).[5] Moreover, this intermediation pattern differs markedly from that of AE banks, which book most of their cross-border EME lending at their head offices.

EME banks provide substantial cross-border credit to EME borrowers, the non-bank sector in particular. For many EMEs, cross-border credit from EME banks to the non-bank sector accounts for the majority of credit from all lenders, and for more than a quarter of GDP.[6] These growing interdependencies are particularly prominent in emerging Asia, Africa and the Middle East.

EME banks' cross-border interbank positions are also substantial. Major EMEs with established banking systems tend to take cross-border credit from banks on net. By contrast, smaller, less developed EMEs tend to provide substantial positive net credit to other banks.

The rest of this special feature is organised as follows. The first section describes how EME banks conduct their cross-border lending business. The second section documents the growing importance of EME-to-EME lending. The third section examines the role of EME banks as recipients or providers of funds in the cross-border interbank market. The last section concludes.

[4] Unless stated otherwise, we refer to EME-headquartered banks as EME banks and to AE-headquartered as AE banks.

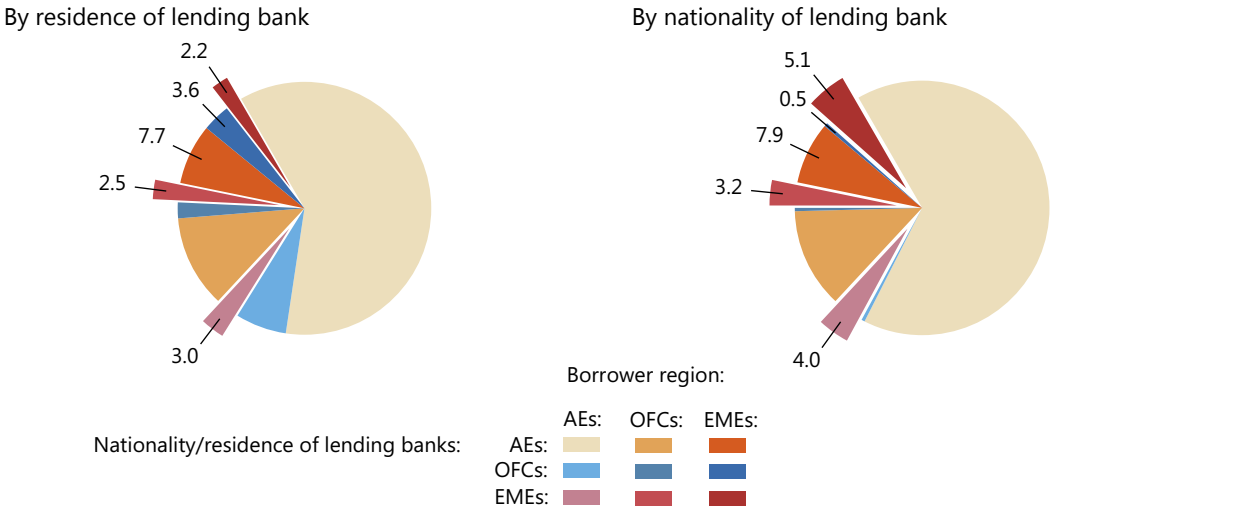
[5] The BIS website (https://www.bis.org/statistics/dsd_lbs.pdf) provides more information on the locational banking statistics and it lists the set of countries defined as AEs, EMEs and OFCs. For this special feature, we excluded The Bahamas, Bahrain, Curaçao and Jersey in relevant tables/graphs from the list of OFCs, as these jurisdictions do not provide individual borrower country details by bank nationality.

[6] Previous research has found that having a diversified set of both EME and AE lender banks can reduce spillover effects originating from lender countries (Shim and Shin (2018)).

Lender-borrower relationships in worldwide cross-border claims[1]

As of end-June 2018; as a percentage of total

Graph 1



AEs = advanced economies; EMEs = emerging market economies; OFCs = offshore financial centres.

[1] Excluding banks located in The Bahamas, Bahrain, Curaçao and Jersey; these reporting jurisdictions do not provide individual borrower country details by bank nationality.

Source: BIS locational banking statistics (by nationality).

EME banks as cross-border lenders

Banks headquartered in EMEs have become more prominent in global banking over the last decade. To sketch the role of EME banks in the international banking system, it is important to distinguish between the lending banks' locations and their nationalities. On a *residence* basis, banks in EMEs accounted for almost 8% of all global cross-border lending in mid-2018 (Graph 1, left-hand panel), up from about 1.5% in mid-2008. However, these numbers neglect the role of EME banks' network of affiliates located outside their home countries. When lending is broken down by bank *nationality* (the jurisdiction in which a bank's headquarters is located), EME banks accounted for more than 12% of global cross-border lending in mid-2018 (Graph 1, right-hand panel), up from about 3% in mid-2008.[7]

The affiliates of EME banks drive a large wedge between the two sets of figures, especially owing to the role of branches and subsidiaries in OFCs (Graph 1, blue slices in both panels). While lending to EMEs by banks *headquartered* in the OFCs accounts for only about 0.5% of all cross-border claims, lending to EMEs by banks (of all nationalities) *located* in the OFCs is equivalent to 3.6%. This reflects, at least in part, the activities of EME bank branches and subsidiaries located in those centres.

EME banks book the majority of their cross-border lending to EMEs at their foreign affiliates (Graph 2). The blue-highlighted cells in Table 1 reflect the shares of EME banks in different locations in total lending to EMEs, and correspond to the arrows in Graph 2. At end-June 2018, almost 40% (or $1,442 billion) of EME banks'

[7] See CGFS (2014) for further discussion.

Cross-border lending to all sectors in AEs and EMEs

By nationality and residence of lender, as of end-June 2018 Table 1

Lenders		Residence of borrowers		
By nationality (parent country)[1]	By residence[2]	AEs	EMEs	All regions[3]
AEs	AE offices[4]	31.0%	20.0%	28.5%
	EME offices	0.6%	1.1%	0.9%
	OFC offices	8.0%	18.0%	9.0%
	Head offices	60.4%	61.0%	61.7%
	All offices	$18,670.9bn	$2,238.1bn	$ 24,851.8bn
EMEs	AE offices	12.5%	26.0%	18.9%
	EME offices[4]	1.6%	6.3%	3.4%
	OFC offices	22.0%	33.3%	26.9%
	Head offices	63.8%	34.4%	50.8%
	All offices	$1,144.8bn	$1,442.1bn	$3,724.1bn
OFCs	AE offices	14.1%	3.2%	14.2%
	EME offices	7.7%	3.6%	8.0%
	OFC offices[4]	14.8%	12.7%	13.8%
	Head offices	63.4%	80.5%	64.0%
	All offices	$122.3bn	$134.8bn	$385.1bn
All parents	AE offices[4]	29.8%	21.6%	27.0%
	EME offices[4]	0.7%	3.2%	1.3%
	OFC offices[4]	8.9%	23.6%	11.4%
	Head offices	60.6%	51.6%	60.3%
	All offices	$19,938.0bn	$3,815.0bn	$28,961.0bn

[1] The nationality "All parents" captures banks from advanced, emerging market and offshore countries, but it does not include those reported under "consortium banks" or "unallocated parent"; banks located in The Bahamas, Bahrain, Curaçao and Jersey are excluded, as these reporting jurisdictions do not provide individual borrower country details by bank nationality. [2] "All offices" = reporting banks' offices in all BIS reporting countries. [3] Includes borrowers resident in offshore centres, international organisations, and entities unallocated by counterparty country. [4] Does not include offices located in the respective home countries where head offices are located.

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

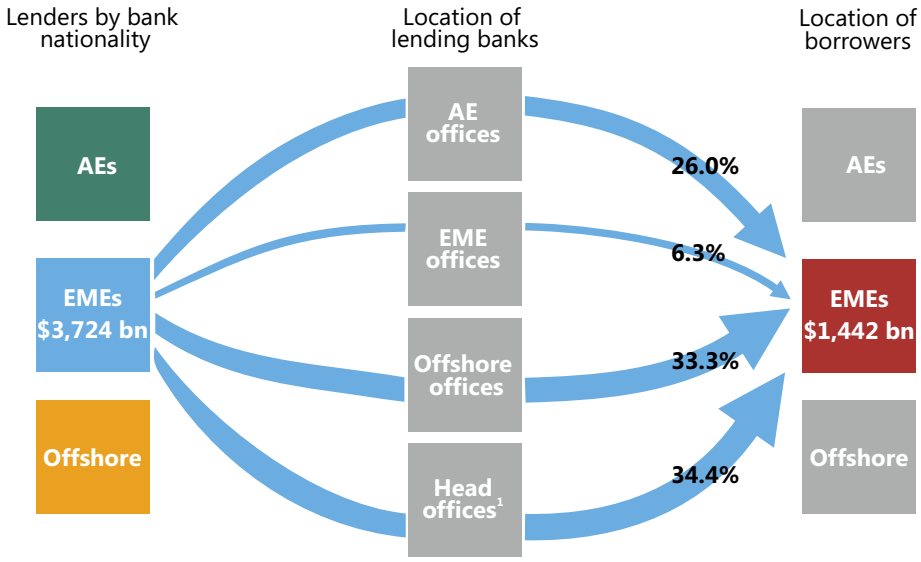
total cross-border claims were loans to EMEs. Of this, two thirds (or $946 billion) was booked at foreign affiliates. They booked the remainder (or $496 billion) at their headquarters.

EME banks' reliance on affiliates to lend cross-border to EMEs sets them apart from their AE peers. The latter extend about 60% of their total cross-border credit to EMEs directly from their head offices, almost twice the share for EME banks. By contrast, there is no such difference with respect to cross-border claims on borrowers in AE countries: both AE banks and EME banks book about 60% of their cross-border claims on AE borrowers at their headquarters.[8]

8 When a different classification is applied to the countries included in Table 1, our findings do not change. For example, if we follow the IMF classification and count banks headquartered in Chinese Taipei, Hong Kong SAR, Korea, Macao SAR and Singapore as AE banks, the average shares of lending from home offices are still very similar.

Cross-border lending to EMEs by EME banks

By nationality of lender, as of end-June 2018 Graph 2



As of end-June 2018, EME banks held cross-border claims worth $3.7 trillion vis-à-vis all borrowers, extended from all their offices in BIS reporting countries. Of that total, $1.4 trillion had been provided to borrowers in EMEs. The blue arrows indicate the split of this total intra-EME lending by location of loan originator. For instance, 33% of these claims held by EME lender banks on EME borrowers have been extended from their offices in offshore centres as reported by BIS member countries.

[1] Refers to the reporting offices of a bank headquartered in the respective home country.

Source: BIS locational banking statistics (by nationality).

Chinese banks bulk large in EME-to-EME lending. As of end-June 2018, they reported cross-border claims worth $919 billion, or 64% of total EME-to-EME activity ($1,442 billion; Table 1 and left-hand panel of Graph 3).[9, 10] The global activities of Chinese corporations and the large infrastructure projects that Chinese banks finance in the context of the Chinese government's "Belt and Road Initiative" (BRI) are likely to have contributed to the above lending volumes.[11]

Banks from other EMEs also make heavy use of their foreign affiliates. For seven out of 13 EME jurisdictions that report to the BIS IBS, the cross-border claims from affiliates dwarf those from head offices (Graph 3, right-hand panel).[12] For example,

9 Chinese cross-border claims fall to $312 billion when lending is measured on a residence basis (Graph 3, left-hand panel, second bar). This points to the significant role that Chinese banks' offshore affiliates play in their overall lending activity, relative to the very small amount of cross-border lending undertaken by non-Chinese banks located in China. McGuire and Van Rixtel's (2012) analysis of cross-border lending in emerging Asia, which combined BIS data with other sources (eg Bankscope), highlighted the hub function of Hong Kong SAR for Chinese banks. The BIS data's new breakdowns help us to shed further light on this intermediation structure.

10 These figures confirm and shed further light on the findings of other studies, based on more limited data, that have pointed to the growing footprint of Chinese banks (eg McGuire and Van Rixtel (2012), Cerutti and Zhou (2018a)).

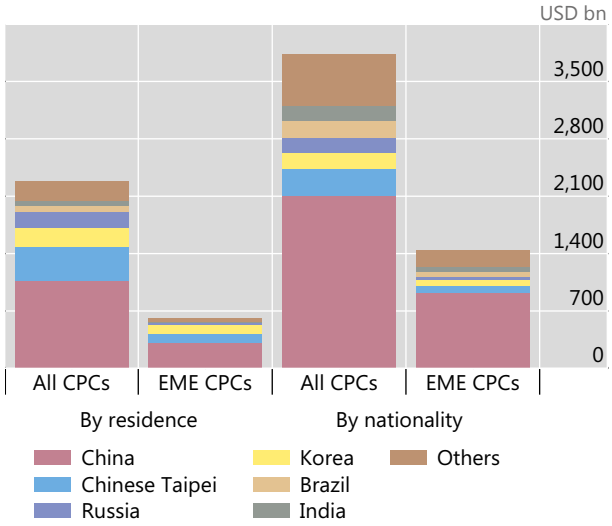
11 See Fitch (2017) or *The Economist* (2018) for an analysis of the link between BRI projects and Chinese banks.

12 Our findings hold, not only if we drop Chinese banks and banks in China as lenders, but also if we exclude China from the set of EME borrowing countries.

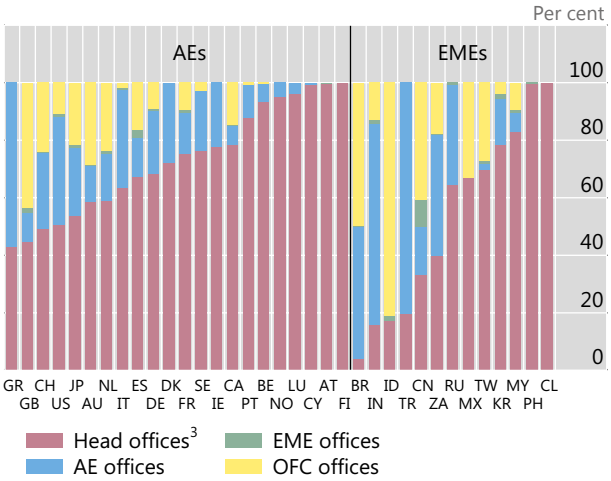
Cross-border claims

As of end-June 2018 Graph 3

Amount outstanding, by EME lender[1]



Claims on EMEs by nationality and by residence of affiliate[2]



[1] All CPCs = all counterparty countries; EME CPCs = counterparties in emerging market economies; "By residence" = banks located in countries indicated in the legends; "By nationality" = banks headquartered in countries indicated in the legends. [2] Excluding banks headquartered in offshore centres; bank nationalities are shown on horizontal axis. [3] Refers to the reporting offices of a bank headquartered in the respective home country.

Source: BIS locational banking statistics (by residence and by nationality).

as of end-June 2018, credit extended by Brazilian banks to other EMEs totalled $67 billion, of which only about 4%, or $3 billion, was booked in Brazil. The corresponding figure for India was $52 billion, of which just 16% was booked in India. Although smaller in overall lending volumes, Indonesian, Mexican, South African and Turkish banks exhibit similar patterns.[13]

The importance of EME banks for EME borrowers

Many EME countries receive more cross-border loans from EME banks than from AE banks. The *non-bank* sector drives this heavy dependence of EME borrowers on EME banks. Table 2 shows the shares of countries in each EME region whose non-bank borrowers receive more than 25%, 50% and 75%, respectively, of their cross-border borrowing from foreign EME banks.

EME banks are the major providers of cross-border credit to non-bank borrowers in developing Asia and Africa. As of end-June 2018, about half of the countries in each region obtain more than 50% of their cross-border credit from foreign EME banks. EME lender banks play lesser roles in emerging Europe and Latin America, with

13 Non-Chinese EME banks' operations are also drivers of regional financial integration among EMEs; see CGFS (2014), McCauley et al (2017) and Cerutti and Zhou (2017, 2018b).

Relative importance of EME lender banks for EME non-bank borrowers[1]

By region of borrower in counterparty country, as of end-June 2018 Table 2

Borrowing region[2]	Share of borrowing counterparty countries[3] (as % of number of countries in respective region)		
	EME credit >25%	EME credit >50%	EME credit >75%
Europe	56.3	18.8	6.3
Latin America and Caribbean	55.6	18.5	3.7
Africa and Middle East	63.5	49.2	23.8
Asia-Pacific	74.4	53.8	33.3

[1] Banks with controlling parents in EME countries. [2] Numbers of counterparty countries included in each counterparty group: 16 for emerging Europe; 26 for Latin America and the Caribbean; 60 for Africa and the Middle East; and 36 for Asia-Pacific. [3] Individual counterparty countries in different regions borrow from different bank nationalities (advanced, emerging and offshore). Taking, as an example, the 16 counterparty countries in emerging Europe (all sectors, all currencies): 56.3% of these borrower countries (ie nine out of 16 countries in the region) receive more than 25% of their total credit from EME banks, and 18.8% (or three out of 16 countries) receive more than 50% of their total credit from EME banks.

Sources: BIS locational banking statistics by nationality; authors' calculations.

the corresponding shares of countries that receive more than half of their borrowing from EME banks at 13% and 15%, respectively.

EME banks take on an even larger role in dollar-denominated lending. In about 60% of African and Asian EMEs, non-banks obtain more than half of their cross-border dollar credit from foreign EME banks. And this is also the case in half of emerging European countries.

Direct cross-border borrowing from EME banks by non-banks also accounts for substantial shares of GDP. For several EMEs, the share is high, exceeding 25% of GDP in some cases. Graph 4 compares the cross-border claims of AE and EME banks on non-bank borrowers in selected EMEs. A large number of borrower countries appear below the 45° line, indicating that cross-border lending to the non-bank sector by EME banks is greater than that by AE banks. Further, EME banks tend to lend more than AE banks to non-banks in countries that already have high levels of cross-border bank debt, especially in emerging Asia.[14]

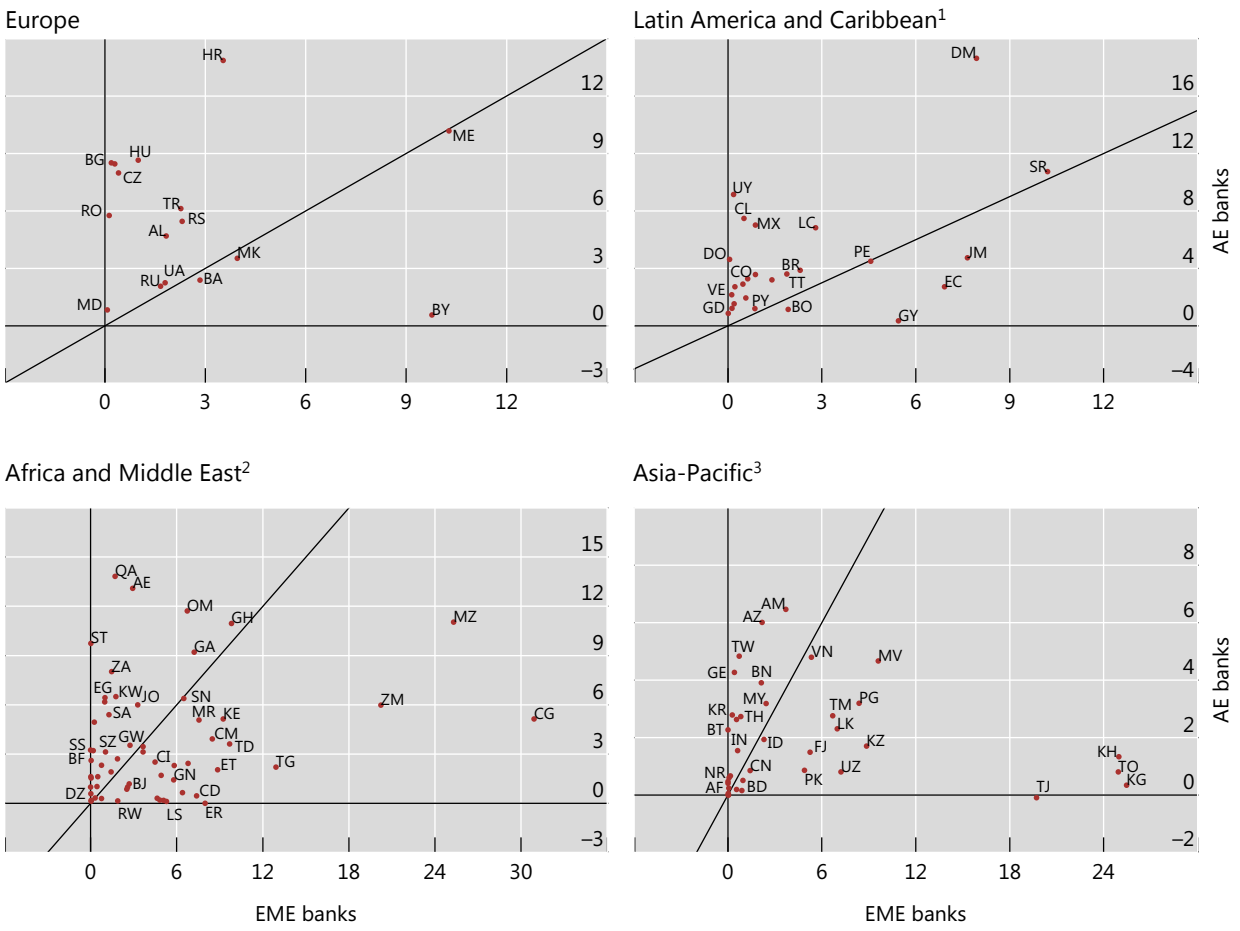
EME banks' cross-border interbank positions on EMEs

Next, we use data on cross-border interbank positions in order to examine the role of EMEs as net recipients or providers of funds. *Net interbank positions* capture the difference between cross-border claims and liabilities vis-à-vis the banking sector (excluding central banks) of a particular counterparty country. If net interbank positions are *positive*, more money flows into the local banking sector than out of it.

[14] When the total cross-border borrowing of a country is regressed on the share of lending that comes from EME banks, the coefficient on the EME share is positive and statistically significant. (Results are available on request.)

Cross-border claims, in all currencies on the non-bank sector, by borrower region

By nationality of lending bank, as of end-2017; as a percentage of GDP — Graph 4



The dots denote the total of cross-border claims on the non-bank sector as a share of the counterparty country's GDP that is borrowed from EME banks (horizontal axis) and AE banks (vertical axis), respectively.

[1] Excludes Belize (6, 83) and St Vincent and the Grenadines (1, 81). [2] Excludes Cabo Verde (4, 44), Djibouti (58, 1), Liberia (53, 631) and the Seychelles (38, 89). [3] Excludes Laos (45, 2), the Marshall Islands (3,405, 13,987) and Mongolia (9, 19).

Sources: IMF, *World Economic Outlook*, October 2018; BIS locational banking statistics (by nationality).

Conversely, *negative* net interbank positions indicate that banks resident in the country place more money in banks abroad than they borrow from foreign banks.[15]

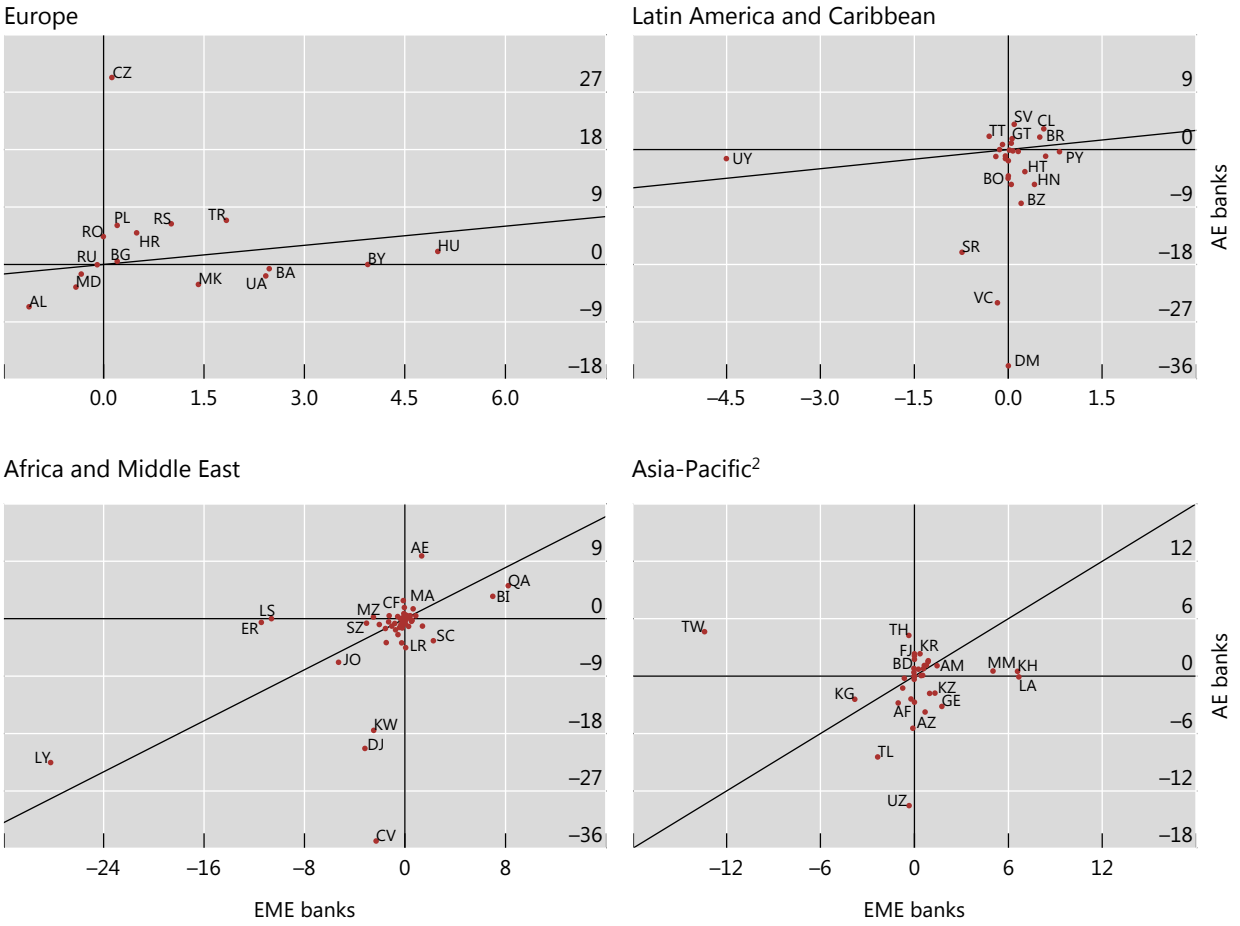
There are significant differences among EMEs when it comes to their cross-border interbank positions. Larger EMEs with more developed domestic banking systems tend to take funds on net. By contrast, smaller EMEs with less developed banking systems tend to provide cross-border interbank funds on net. This is the case for many countries in Africa and the Middle East (Graph 5, bottom left-hand panel).

For countries in emerging Europe, net cross-border interbank positions tend to be markedly positive. Banks in the Czech Republic obtain cross-border interbank funding worth almost 30% of the country's GDP. Banks in Serbia (7.4% of GDP),

[15] Gopinath and Stein (2018) link the role of dollar deposits to the dollar as the predominant invoicing currency of EMEs' imports, thereby influencing the funding structure of banking systems and the currency compositions of central banks' reserve holdings.

Net cross-border interbank claims, excluding positions vis-à-vis central banks, by borrower region

By nationality of lending bank, as of end-2017; as a percentage of GDP — Graph 5



The dots denote the net cross-border interbank claims, excluding positions vis-à-vis central banks, as a share of the counterparty country's GDP that is borrowed from EME banks (horizontal axis) and AE banks (vertical axis), respectively.

[1] Net cross-border claims on counterparty sector banks as a share of the counterparty country's GDP; net claims = claims less liabilities, excluding positions vis-à-vis central banks. [2] Excludes the Marshall Islands (8, –68) and Tuvalu (0, –98).

Sources: IMF, *World Economic Outlook*, October 2018; BIS locational banking statistics (by nationality).

Hungary (7%) and Poland (6.3%) also act as net debtors in the cross-border interbank market.

Latin America exhibits a more nuanced picture and considerably lower net interbank positions in terms of GDP, on average. Banks in Chile (3.8%), Brazil (2.5%) and Colombia (1.1%) are all net recipients of cross-border interbank funds. By contrast, banks in Uruguay (–6%), Mexico (–1.5%) and Peru (–1%) are net providers of cross-border interbank funds.

EMEs in the Asia-Pacific region exhibit similar patterns to those in Latin America. The largest economies (China, India, Indonesia, Korea, Pakistan) are net borrowers on the cross-border interbank market. Chinese Taipei and Thailand have positive net cross-border interbank balances with AE banks, and negative balances against EME banks. Interestingly, several smaller economies (Georgia, Kazakhstan, Laos,

Turkmenistan and Vietnam) exhibit the exact opposite pattern: they are net recipients of cross-border funds from EME banks and net providers to AE banks.

Conclusions

This special feature has explored the role of EME banks in global banking. We have exploited the multiple breakdowns and dimensions available in the BIS IBS, including recent enhancements. Three main findings with important policy implications stand out.

First, EME-headquartered banks have created networks of foreign affiliates that play a crucial role in their cross-border lending to other EMEs. In fact, EME banks extend more cross-border lending through their affiliates abroad than from their headquarters. These intermediation patterns not only characterise the activities of Chinese banks – the largest cross-border players among EME banks – but are also shared by banks from other countries, including Brazil, India, Indonesia and Mexico. These patterns and the growing interlinkages suggest that the assessment of potential spillovers from EME banks to EME borrowers needs to consider affiliate networks and not just the positions of home offices.

Second, in terms of credit to non-bank EME borrowers, interlinkages among EMEs have grown rapidly in recent years and have given rise to extensive interdependencies. In many EME countries, non-bank borrowers obtain more than half of their cross-border loans from EME banks. This pattern is especially pronounced in emerging Asia, Africa and the Middle East. Even though the growing footprint of EME banks' cross-border lending has lessened the traditional dependence of EME borrowers on AE banks, EME interlinkages can also pose significant risks – for example, by EME banks serving as new sources of contagion and propagators of stress.

Third, EMEs display heterogeneity in their net interbank positions. In aggregate, banks in larger, more developed EMEs tend to take cross-border interbank funding on net. By contrast, banks in smaller, less developed EMEs tend to provide cross-border interbank funding on net. These differences should also be taken into consideration when mapping channels of potential spillovers from shocks in both EMEs and AEs.

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The 2008 crisis: transpacific or transatlantic?[1]

This study analyses two hypotheses that ascribe the 2008 US financial crisis to capital inflows. The Asian savings glut hypothesis posits that net inflows into high-grade US public bonds from countries running current account surpluses led to the housing boom and bust. An excess of savings over investment abroad led to an excess of US investment over savings. The European banking glut hypothesis holds that gross inflows into private bonds led to the boom. Leveraging-up by European banks enabled the leveraging-up of US households. Gross flows from Europe better matched US mortgage market trends towards private credit risk, floating interest rates and narrow spreads. What is more, European banks produced, not just invested in, US mortgage-backed securities. Their US securities affiliates held huge exposures to such securities that deserve recognition. Furthermore, European banks' leveraging-up also provided credit that enabled housing booms in Ireland and Spain. These findings favour the European banking glut hypothesis.

JEL classification: E44, F34, G01, G21.

The Great Financial Crisis (GFC) divided the world into three different groups. Some countries experienced housing booms in the years before the crisis, and found themselves at its epicentre: the United States, the United Kingdom, Spain and Ireland. Banks in some other countries had exposed themselves to these booms and suffered banking crises: Germany, Belgium, the Netherlands and Switzerland. Finally, the rest of the world played the role of spectators hit by the seizing-up of the US dollar-based international banking system and the subsequent downward spiral of world trade.

Before the crisis, Bernanke (2005) and others had implicated a set of countries running current account surpluses in the US boom.[2] They argued that a savings glut in Asia (better a dearth of investment in countries hit by the Asian financial crisis in 1997–98) and among some commodity exporters had led to a strong bid for safe US

[1] An earlier version of this paper was presented to the conference "The 2008 Global Financial Crisis in retrospect", University of Iceland, 30–31 August 2018. The author would like to thank Robert Aliber, Michael Bordo, Claudio Borio, Richard Cantor, Jaime Caruana, Guy Cecala, Stijn Claessens, Ben Cohen, Patrick Honohan, Philip Lane, Patrick McGuire, Fernando Restoy, Catherine Schenk, Hyun Song Shin, Marcel Zimmerman, Gyfli Zoega and Daniel Zuberbuehler for helpful discussion and Yifan Ma and Jeff Slee for able research assistance. The views expressed are those of the author and do not necessarily reflect those of the BIS.

[2] Bernanke et al (2011) recognised that domestic vulnerabilities contributed to the crisis; Bernanke (2018) has emphasised the role of financial panic, recalling the "run on repo" of Gorton and Metrick (2012). Several prominent economists in the 2000s worried about current account imbalances and their accumulation into unsustainable net external debt. Summers (2004), Edwards (2005), Obstfeld and Rogoff (2005) and Setser and Roubini (2005) warned of an impending sudden stop of financing that would lead the dollar to plunge and the US economy to enter a recession. Krugman (2007) memorably pictured the dollar reaching a Wile E Coyote moment and then falling.

Key takeaways

- Substantial capital flowed into safe US government bonds and risky US mortgage bonds in the years to 2008.
- US bond market developments in 2000–07 show more of the imprint of the flows into mortgage bonds.
- European banks not only bought risky US mortgage bonds but also manned the production line through their US securities subsidiaries, which were active in packaging and selling such bonds.
- European bank credit also enabled the real estate booms in Ireland and Spain.

bonds. This one-way investment put downward pressure on US bond yields and stimulated US investment, especially in homes. As a result, US spending rose relative to US output, widening the US current account deficit. An excess of Asian saving over investment thus led to an excess of US investment over saving. On this view, these "transpacific" imbalances ultimately caused the GFC (Ferguson (2008), Wolf (2014)).

Others have pointed instead to two-way transatlantic flows. In the 2000s, European banks leveraged up their equity with dollars borrowed from US and other investors and ploughed them into US private debt. More than anything else, they bought private label mortgage-backed securities (MBS), or complex bonds based on them. Their eager buying of such securities enabled their issuance to surpass that of government agency MBS in 2005. Leveraging-up by European banks begat unsustainable leveraging by US households: the transatlantic crisis (Bayoumi (2017)). In support of this view, Borio and Disyatat (2011) found that gross capital flows from Europe to the United States dominated the net capital flows from surplus countries; they denied the link between global imbalances and the GFC. Acharya and Schnabl (2010) showed that banks from both surplus and deficit countries, mostly in Europe, set up conduits that held risky US MBS funded by short-term commercial paper. Shin (2012) dubbed the alternative hypothesis the banking glut.

This special feature argues that, as an account of key features of the GFC, the savings glut story comes up short and the banking glut story gives more satisfaction. While the flows into US bonds from surplus countries may well have exceeded those from European banks, the latter better match developments in the US mortgage market. European banks' US subsidiaries manned the production line of the private label MBS, issuing them as well as investing in them. Moreover, the more exaggerated property booms in Ireland and Spain drew on even larger portfolio and money inflows from European banks. In contrast to US developments, securitisation played little role in the Irish or Spanish booms, but in common with US developments a strong flow of credit from European banks played a big role.

The rest of this article analyses the Asian and European capital inflows, their imprint on the US mortgage market, the role of European banks' US securities affiliates and evidence that European investors were over-represented as buyers of US MBS. One box examines the relationship between external credit flows and domestic credit booms, and another sketches the larger but more traditional capital flows into Ireland and Spain. A final section concludes that European bank leverage enabled the US, Irish and Spanish booms.

Asian savings glut vs European banking glut Table 1

	Asian savings glut	European banking glut
Size of inflow	$1.7 trillion or 10% of US GDP	$0.7 trillion or 5% of US GDP
Direction	One-way	Two-way: European banks borrow dollars
Protagonists	Official reserve managers	Commercial banks
Demand for safe assets	Positive	Negative (ie supply to depositors)
Duration of target bond	Medium- to long-term	Short- to medium-term
Leverage	Most foreign exchange reserves funded with short-term domestic currency instruments	Short-term dollars borrowed from US money market funds and others
Capital gains/losses	Gains on US Treasury bonds; little private MBS	Huge losses on private label MBS

Source: US Treasury et al (2002, 2008); Table 5; author's elaboration.

Comparing and contrasting the two gluts

Let us first compare and contrast the capital flows associated with the savings and banking gluts and then pose two questions: Which flow better matches the big changes seen in the US mortgage market? And how did the role of European banks' US securities affiliates as MBS producers enlarge these banks' footprint in this market?

The differences between the two stories bear emphasis (Table 1). Twice as much money flowed into US bonds from March 2000 to mid-2007 from Asian official holders as flowed into US private asset-backed securities from European banks and others between end-2002 and mid-2007. In the first, official reserve managers purchased safe, longer-term US government obligations, generally funding themselves with domestic currency liabilities. In the second, banks purchased riskier, short-term bonds backed by US mortgages, commercial real estate and other assets, funded by short-term dollar debt. Asian reserve managers took duration risk. European banks took credit and maturity risk, buying risky so-called "spread product" to earn a margin over the cost of short-term funding.

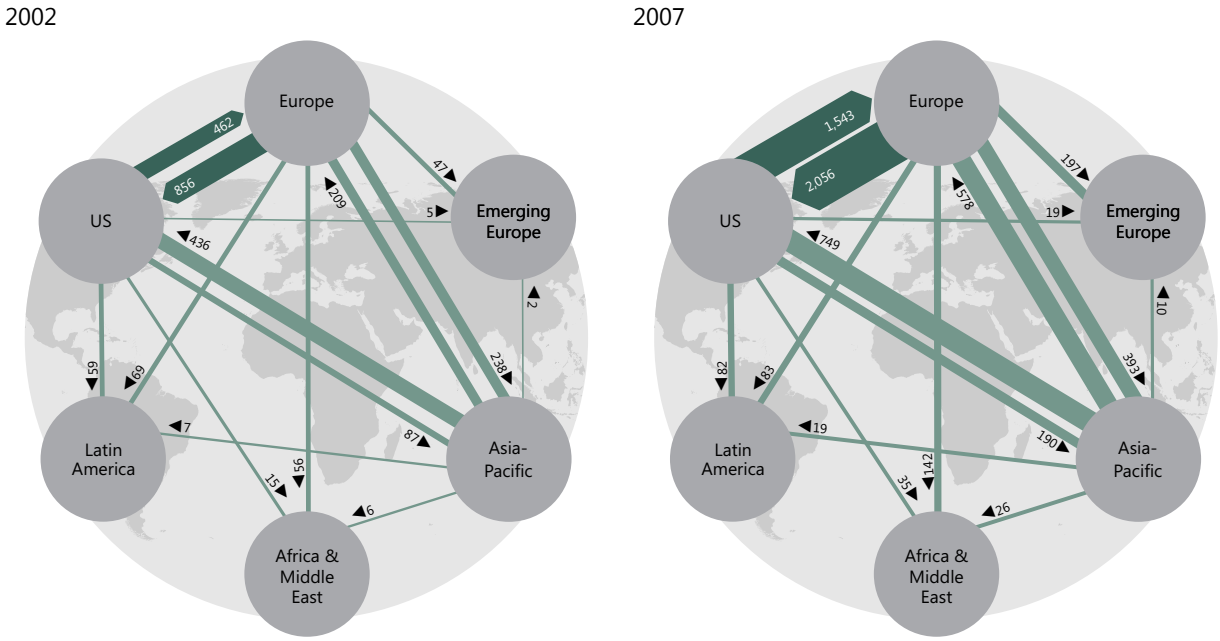
The first story presents itself as a current account story, although some countries built foreign exchange reserves despite running current account deficits and some surplus countries did not build up foreign exchange reserves (Borio and Disyatat (2011)). The flow was one-way. The second story is a capital account story, with gross capital flow running in two directions.

Current accounts drive long-term changes in countries' net international investment positions, albeit with important valuation effects (Gourinchas and Rey (2014)). The evolution of these positions in the United States before the crisis lent itself to an analysis of sustainability that led to dire predictions of dollar crisis as cited above. By contrast, the current account of the euro area, and of Europe as a whole, approximated balance, and few fretted about a sudden stop of European bank intermediation between US investors and highly leveraged US households. Large gross flows from Europe to the US were balanced by flows in the opposite direction: European banks funded portfolios of US assets by "round-tripping" dollar funds from the United States and back again (McGuire and von Peter (2009), Shin (2012) and Avdjiev et al (2016)). Dollars raised from US money market funds (Baba et al (2009)) flowed back Stateside through purchases of private MBS (Graph 1). As a result,

US dollar-denominated cross-border claims: the transatlantic round trip[1]

In billions of US dollars

Graph 1



[1] The thickness of the arrows indicates the size of the outstanding stock of claims. The direction of the arrows indicates the direction of the claims: arrows directed from region A to region B indicate lending from banks located in region A to borrowers located in region B.

Source: Avdjiev et al (2016), based on BIS locational banking statistics.

someone who looked only at the current account balance overlooked the large risk exposures resulting from these accumulating flows.

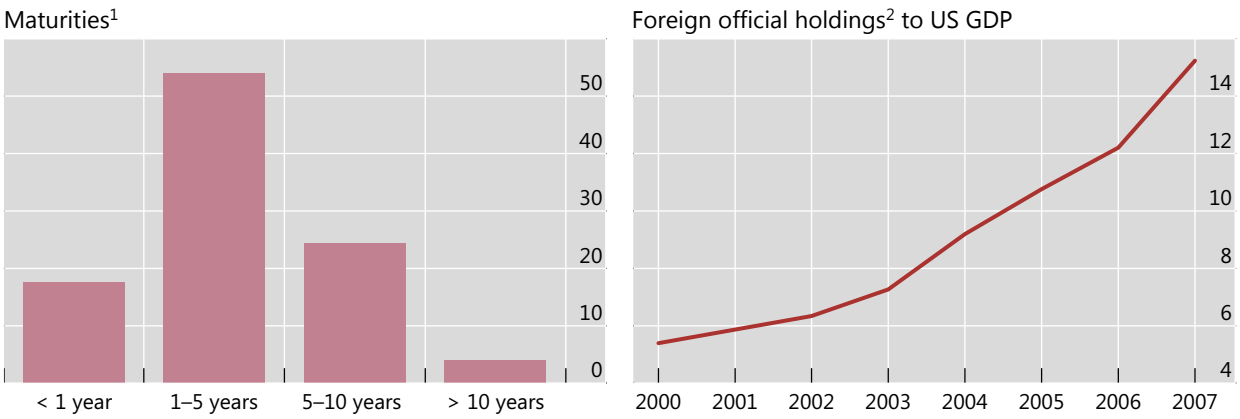
The Asian and European flows also differed in their demand for safe assets. Focusing on the official inflow, Caballero et al (2008) saw it as chasing safe assets that Wall Street had a comparative advantage in producing. In fact, official reserve managers steered clear of risky private MBS, however rated (Ma and McCauley (2014)). Instead they hugged the shore of US Treasury bonds and US government-supported agency bonds. Those developing this thesis overlooked European banks' *provision* of safe assets to US money market funds. These banks invested the proceeds in pseudo-safe MBS, many rated AAA, in a so-called "credit arbitrage" strategy which proved far riskier than expected. Official reserve managers demanded dollar safe assets; European banks supplied them.

Official reserve managers had long since extended maturities from Treasury bills to Treasury and agency notes. Their sweet spot on the yield curve was at medium-term maturities (Graph 2), which provided extra yield to cover the cost of domestic liabilities or dollar depreciation. By contrast, European banks preferred to match their mostly short-term dollar funding with floating rate MBS. Below we discuss how the US mortgage market reshaped itself around their demand, shifting from Treasury bills to Libor as the benchmark reference rate for adjustable rate mortgages (ARMs).

The portfolio values diverged in the crisis. Official reserve managers enjoyed capital gains as US Treasury bond yields fell and the dollar rose (Gourinchas et al (2012), Bénétrix et al (2015)). European banks, along with US securities firms and some large US banks, suffered massive losses and responded by reducing exposures in Europe (Cecchetti et al (2012)) and elsewhere (McCauley et al (2019)).

Foreign official holdings of US Treasury securities

In per cent — Graph 2



[1] 30 June 2007. [2] Comprises long-term US Treasury debt and agency debt.

Source: US Treasury et al (2008), p 11, p 21.

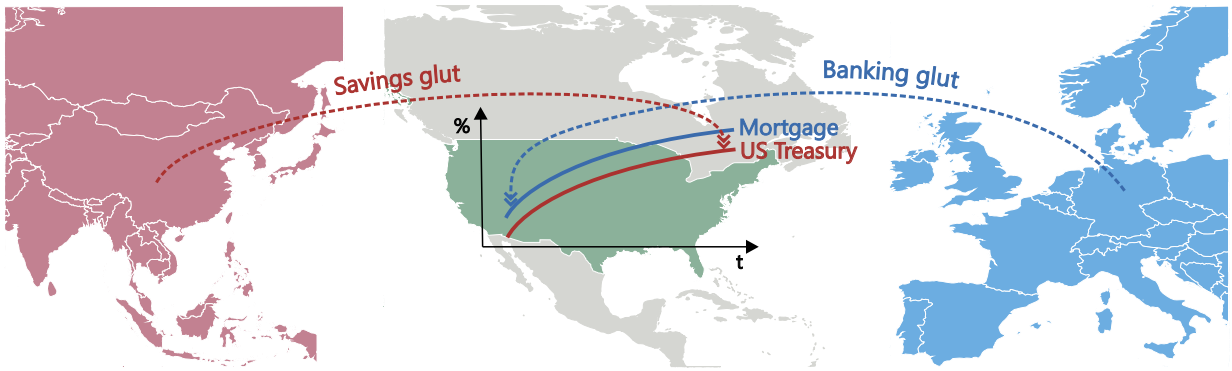
Which capital flow matches US mortgage market trends?

Considerable evidence links inflows of bank credit or of debt capital more generally to credit growth within an economy (Box A). In the lead-up to the GFC, however, two very different capital inflows accompanied the boom in private credit in the United States, especially in the mortgage market, in the 2000s. One way of assessing their relative contributions is to compare the expected impact of each flow to the stylised facts of the evolution of the US bond market in those years.

The Asian savings glut story predicted flows into Treasuries and agencies, lower Treasury yields, higher mortgage spreads and more fixed rate mortgages (Graph 3, red arrow). Risk-averse foreign exchange reserve managers typically prefer safe assets, including US Treasury and agency securities (McCauley and Rigaudy (2011)).

Competing hypotheses: capital flows and the US housing boom

Graph 3



The boundaries shown on this map do not imply official endorsement or acceptance by the BIS.

Source: Author's elaboration.

Box A

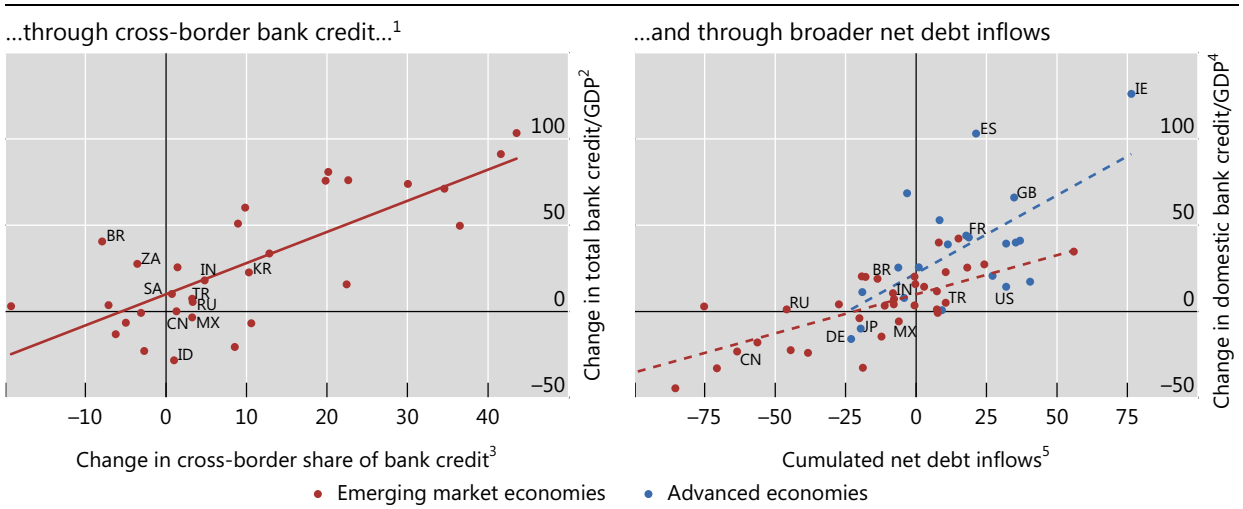
Capital inflows enable domestic credit growth in a boom

Credit booms and capital inflows tend to reinforce one another (Aliber and Kindleberger (2015)). Inflows of foreign capital to banks free them from the constraint of the domestic funding base and thereby enable domestic credit booms. In a sample of 31 emerging market economies between early 2002 and 2008, Avdjiev et al (2012) found that a rise in the share of cross-border bank funding, extended either directly to domestic non-banks or indirectly through banks, helped boost the ratio of bank credit to GDP, a measure of credit booms (Graph A, left-hand panel). Banks found non-core liabilities abroad to fund credit at home (Hahm et al (2013)).

Lane and McQuade (2014), using a broader sample of 62 countries and a more inclusive measure of international capital flows, found a similar dynamic. Here, the larger the net debt inflows, including both portfolio and bank flows, the larger the increase in a given economy's ratio of bank credit to GDP (Graph A, right-hand panel). The inclusion of Ireland, Spain and the United Kingdom shows that a domestic credit boom's reliance on external financing is not a symptom of financial underdevelopment. In fact, in the subsample of 23 advanced economies the response to capital inflows is greater than among EMEs, as the steeper trend line suggests.

Capital flows enable domestic credit growth during the boom…

In per cent — Graph A



[1] Q1 2002–Q2 2008. [2] "Total bank credit" adds to domestic credit (IMF IFS line 32) the stock of cross-border bank credit to non-banks in the country (using the BIS locational banking statistics). [3] "Cross-border share of bank credit" is the share of total bank credit to non-banks received cross-border through direct lending to non-banks and through net lending to banks in the country (if positive). Based on Avdjiev et al (2012). [4] Domestic credit from IMF IFS line 32, from end-2002 to end-2008. [5] Balance of payments net debt inflows as a share of GDP, cumulated over 2003–08. Net debt flows are calculated by aggregating changes in net portfolio debt assets, net other investment and reserve assets, all expressed as inflows. Extends Lane and McQuade (2014).

Sources: BIS (2015), pp 92–3, citing IMF, *International Financial Statistics* and *World Economic Outlook*; BIS international banking statistics.

Given their preference for intermediate-term notes, this inflow should have depressed Treasury yields at such maturities. US Treasury rates should have fallen by more than MBS yields (even with the diversification of reserve managers into agency securities). And the decline in fixed rate mortgage yields should have biased mortgage lending towards those carrying fixed rates.

The banking glut story focuses on the effect of banks as buyers of risky private mortgage debts. Banks favoured the wider spread over US Treasury obligations that unguaranteed mortgages promised. This preference favoured a shift in mortgage finance from publicly guaranteed to private label MBS. Since banks' readiest funding

source is short-term, a banking glut favoured floating rate debt. It would tend to narrow the gap between private yields (especially short- to medium-term) and US Treasury yields, and mortgage spreads in particular (Graph 3, blue arrow).

The first two predicted effects of the Asian savings glut – inflows into US Treasuries and lower Treasury yields – did indeed hold. As noted, $1.7 trillion in official inflows flowed into US Treasury and agency bonds in 2000–07 (Graph 2, right-hand panel). This amounted to about 10% of GDP. Warnock and Warnock (2009) found 10-year yields were 80 basis points lower in 2005 as a result.

But predictions regarding mortgage flows and yields did not pan out. The left-hand panel of Graph 4 shows that, to the contrary, spreads on fixed rate agency and private jumbo MBS actually *narrowed* in the 2000s. Furthermore, rather than this being the heyday of fixed rate mortgages as long promoted by the US agencies, ARMs bulked large among the new mortgages securitised without agency guarantees. As a result, fixed rate mortgages declined from an estimated 78% of MBS issues in 2001 to just 60% in mid-2007 (Goodman et al (2008), Exhibits 1.2 and 1.5). Thus, the fixed rate bonds that reserve managers favoured lost share in the boom. In sum, key bond market developments in the 2000s did not match what might have been expected from a big official flow into Treasury notes (Table 2, first column).

The predictions of the banking glut story perform better (Table 2, second column). First, European banks' demand drove US mortgage finance away from government guarantees to private credit risk. Non-agency mortgages reached 55% of all gross issuance in 2005 and 2006 (Goodman et al (2008), p 6; see also Frankel (2006)). In stock terms, non-agency securitisations reached one third of the total (Graph 5). Second, ARMs predominated in private label MBS, at 62% of private issues (Goodman et al (2008), p 6, p 10), conveniently allowing banks to match their short-term funding. In 2006 ARMs were up to 40% of all MBS issued. In terms of rates, long-term spreads actually narrowed (Graph 4, left-hand panel). Spreads also narrowed for non-agency ARMs relative to agency issues. The centre panel of Graph 4 shows that the spread between subprime ARMs and "conforming", agency ARMs declined by 100 basis points between 2002 and 2006, even as issuance exploded (right-hand panel). One can infer *very* strong demand.

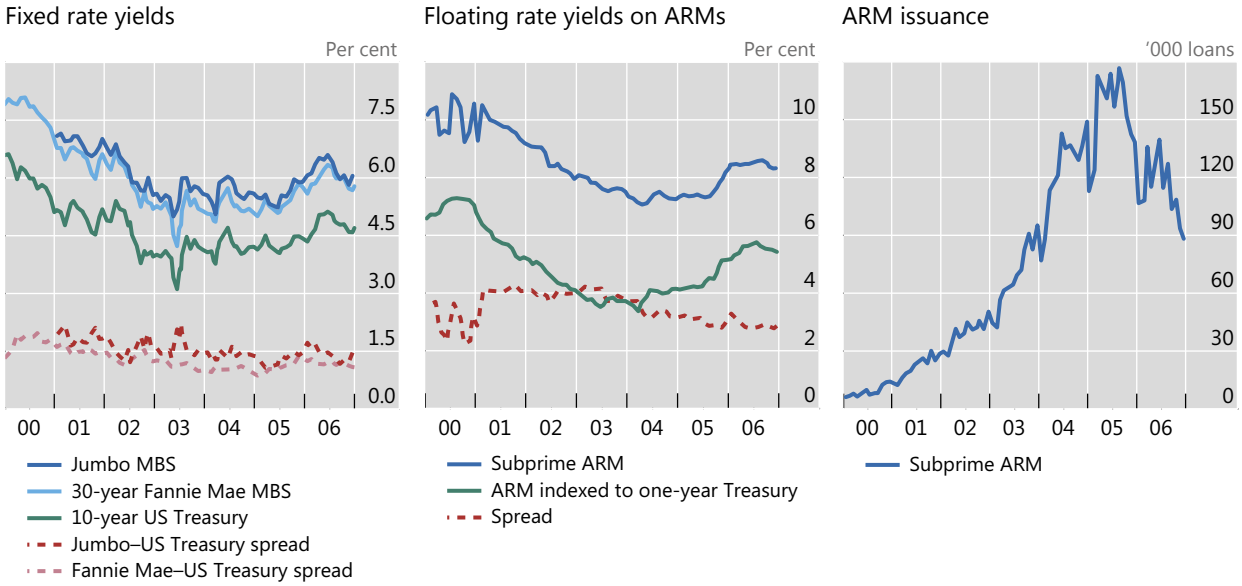
Which capital inflow lines up with developments in the US mortgage market? Table 2

Official investors: buy safe assets		European banks: buy private label MBS	
Favour govt-guaranteed mortgages	✗	Favour wider-spread private label MBS	✓
Favour fixed rate mortgages	✗	Favour adjustable rate mortgages	✓
Widen mortgage–Treasury spread	✗	Narrow mortgage–Treasury spread	✓

Source: Author's elaboration.

Mortgage spreads and issuance, 2000–06

Graph 4



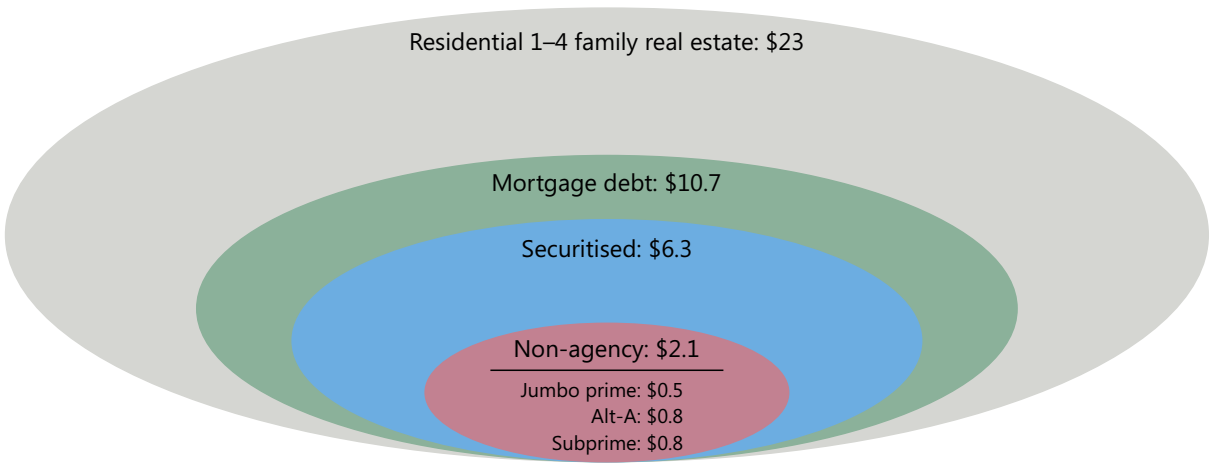
Sources: Bertaut et al (2012), p 227, citing CoreLogic and JPMorgan ABS Research; Bloomberg.

That demand gained strength from European investors in general, and European banks in particular. To appreciate this requires that we recognise that the geography of European banks' balance sheets did not coincide with the borders of Europe (Avdjiev et al (2016)). A full accounting of the role of European banks requires taking the measure of their securities subsidiaries within the United States, mostly funded in the United States. Like the US-owned securities firms with which they competed, their securitisation production lines drove mortgage originators to deliver the raw material (Nadauld and Sherlund (2013)).

Value of US residential real estate and mortgages, June 2007

In trillions of US dollars

Graph 5



Source: Goodman et al (2008), pp 3–4.

European banks as producers of MBS

The usual image of European banks as hapless investors in US MBS in the mid-2000s needs thorough revision. In Zuckerman (2009), Lewis (2010), Dunbar (2011) and US court cases, banks from Dusseldorf or Kiel play the role of sophisticated investors in name only, serving as, in market parlance, "stuffees". However, certain European banks played quite a different role (Bank of England (2007), p 37).

Six European banks produced private label MBS out of their US securities affiliates. They ranked among the top 15 underwriters of subprime MBS (Table 3). RBS's Greenwich ranked first, with a 12% share, above that of Lehman Brothers, Bear Stearns and Morgan Stanley. Collectively, Greenwich, Credit Suisse (ranked fifth). Deutsche Bank (ranked seventh), UBS, Barclays and HSBC claimed a 35–40% share. Crucially, they retained that share as the US securities firms grabbed market share from the big US banks and others in 2004–05 (Table 3, memorandum items).

By 2007, banks' business model of underwriting private MBS had evolved to include holding a substantial fraction of the product on their balance sheets. What Dunbar (2011) and Goldstein and Fligstein (2017) liken to a Henry Ford-type

Non-US banks' US securities affiliates' underwriting of subprime MBS deals[1] Table 3

	1997–2001	2002	2003	2004	2005	2006	2007	Total
Greenwich (RBS)[2]	17	10	16	28	30	30	17	148
Lehman Brothers	10	8	16	20	31	31	14	130
Bear Stearns	5	1	6	23	34	27	16	112
Morgan Stanley	3	4	12	29	29	20	13	110
Credit Suisse	10	10	13	23	25	13	6	100
Merrill Lynch	3	0	4	12	31	34	9	93
Deutsche Bank	4	7	13	15	20	24	8	91
Goldman Sachs	0	3	5	17	20	22	9	76
Bank of America	5	8	14	18	11	6	5	67
Citigroup	0	2	6	9	16	17	14	64
JPMorgan	5	7	7	4	8	21	8	60
UBS	0	1	8	13	15	20	3	60
Barclays	0	0	0	8	15	19	8	50
Countrywide	0	4	8	14	5	0	0	31
HSBC	0	0	0	0	4	13	6	23
Others	13	5	6	2	10	27	2	65
Total	**75**	**70**	**134**	**235**	**304**	**324**	**138**	**1,280**
Memo:								
Of which: foreign bank	*31*	*28*	*50*	*87*	*109*	*119*	*48*	*472*
foreign bank %	*41.3%*	*40.0%*	*37.3%*	*37.0%*	*35.9%*	*36.7%*	*34.8%*	*36.9%*
Of which: US sec firm	*21*	*16*	*43*	*101*	*145*	*134*	*61*	*521*
US sec firm %	*28.0%*	*22.9%*	*32.1%*	*43.0%*	*47.7%*	*41.4%*	*44.2%*	*40.7%*
Of which: US bank etc	*23*	*26*	*41*	*47*	*50*	*71*	*29*	*287*
US bank etc %	*30.7%*	*37.1%*	*30.6%*	*20.0%*	*16.4%*	*21.9%*	*21.0%*	*22.4%*

[1] Shaded rows indicate European bank ownership. [2] Listed separately in the source, Greenwich Capital and RBS Greenwich are combined.

Sources: Nadauld and Sherlund (2013), p 457, based on ABSnet; author's calculations.

production line started with a "warehouse" of mortgages that underwriters would assemble into MBS. They then sliced and diced these into collateralised debt obligations (CDOs) and booked them as trading assets. By 2007, underwriters could sell lower-rated, wider-spread securities, but mostly ended up holding the "super-senior" tranches in their trading books.[3,4]

Contemporary observation and subsequent research confirmed the nexus between underwriting and MBS holdings. The Swiss Federal Banking Commission commented (2008, p 7): "At least towards the end of the mortgage boom, the CDO securitization business functioned only to the extent that market players such as UBS, Merrill Lynch and Citigroup were willing and able to retain 'unattractive' low-yield Super Senior CDO tranches of individual securitizations on the own (trading) books" (see also Zuckerman (2009), p 176). In a study of the holdings of highly rated securitisation tranches across US-owned bank holding companies, MBS underwriting strongly predicted holdings (Erel et al (2014)). For UBS, the Commission (p 5) reported that "the CDO Desk had not only securitized CDOs and sold such CDOs to investors, but had retained the Super Senior CDOs… on its own (trading) books".

The six European banks had $251 billion of private MBS at end-2007 (Table 4). A seventh, ING, held a further $46 billion in its US internet banking thrift. No doubt, the data from 2008 annual reports and official or officially mandated reports are not consistent across banks, with Credit Suisse in particular reporting on a net trading positions basis.[5] Moreover, some of the exposures of the other five banks were hedged, though it is not possible to say how much.[6]

There are good reasons to suppose that these six European banks held this quarter of a trillion dollars' worth of US MBS in mid-2007 on the balance sheets of their US securities affiliates. As described above, their business models involved holding such securities on the US book, and contemporary observation placed them there. In addition, the ex post aggregate profitability of foreign-owned securities firms in 2008 suggest they did.

In particular, European-owned broker-dealers racked up large losses in 2008 from writedowns of assets, consistent with their having retained ultimately toxic bonds on their US books. The US Bureau of Economic Analysis (BEA) reports that European-owned non-banking finance and insurance firms took capital losses from

[3] By contrast, Cayman Island entities owned MBS held in asset-backed commercial paper (ABCP) conduits, designed to keep the assets off the sponsor's balance sheet. US Treasury et al (2008) should have captured these holdings in mid-2007 as foreign. In 2007, European banks sponsored ABCP conduits holding at least $100 billion in US MBS (Moody's (2007), Acharya and Schnabl (2010), p 56, Acharya et al (2013), p 522). The last column of Table 3 thus understates European exposures.

[4] Greg Lippmann at Deutsche Bank emailed about the buyers of MBS tranches in February 2007 (US Senate (2011), p 349): "[T]he other side is all cdos so it is the cdo investors who r on the other side who buys cdos: aaa-reinsurance, ws [Wall Street] conduits, European and Asian banks, aa-high grade cdos, European and Asian banks and insurers….some US insurers, bbb other mezz [mezzanine] abs [asset-backed security] cdos (i.e. ponzi scheme), European banks and insurers, equity some US hedge funds, Asian insurance companies, Australian and Japanese retail investors through mutual funds".

[5] A position could be short over a certain range of prices, but long thereafter. Lewis (2010, Chapter 9) describes how Morgan Stanley took a short position in BBB tranches "netted" against multiple long positions in AAA tranches (sold in part to UBS), with disastrous results.

[6] Deutsche Bank's CDO desk famously put on a multi-billion dollar short (Zuckerman (2009), Lewis (2010), Dunbar (2011)), but US Senate (2011) found that overall the bank remained long and took losses.

Holdings of US non-agency MBS by European banks with US broker-dealers

In billions of dollars at end-2007 Table 4

	Non-agency mortgage-backed bonds			Total assets	Share of total assets
	Residential	Commercial	Total		
Barclays	31	1[1]	32	2,458	1.3%
Credit Suisse[2]	…	…	9	1,208	0.7%
Deutsche Bank	20	…	20	2,840	0.7%
HSBC	26	10[1]	36	2,354	1.5%
RBS	…	…	84	3,645[3]	2.3%
UBS	…	…	68	2,055	3.3%
Total	…	…	251	…	…
Memo: ING	*46*	…	*46*	*1,930*	*2.4%*

[1] Estimated from annual reports. [2] Trading book concept; net of hedges. [3] Assets of RBS before merger with ABN AMRO.

Sources: Barclays (2009), p 106, p 113; Credit Suisse (2009), p 71; Deutsche Bank (2009), pp 19–21; FSA (2011), p 52; HSBC (2009), pp 152–7; ING (2009), p 140; Netherlands House of Representatives (2013); RBS (2009), p 35; UBS (2008), pp 6–7.

"widespread write-downs of financial assets" (Ibarra and Koncz (2009), p 29) of no less than $110.8 billion in that crisis year (Lowe (2011), p 98).[7]

Did European banks hog private US MBS?

A key element of the banking glut view is the drive by European banks to load up on risky US mortgages. However, Bertaut et al (2012) report that private label asset-backed securities (ABS) represented 23% of US bond holdings of European investors in mid-2007, similar to US investors at 20% (Table 5, fourth column). ABS include residential and commercial MBS, and bonds backed by car loans and airline leases.

These data represent holdings by residence. The more telling observation, however, requires data compiled on a nationality basis. As noted, European banks did not confine their balance sheets within European national borders.

If the exposures discussed in the previous section were held in the US books, then European banks did indeed take on more than their share of the risk arising from leveraged US mortgages. From a nationality perspective, such holdings add to European investors' holdings and subtract from US investors' holdings. This is shown in the last two columns of Table 5, which add to the figures reported by Bertaut et al (2012) on a residency basis the exposures booked on US affiliates from Table 4.

[7] The presumption is that UBS's US affiliate took losses on the $25 billion in US ABS transferred at appraised prices by UBS to the SNB-funded Stabilisation Fund in September 2008 (Swiss National Bank (2010), pp 83–5). In the BEA data, foreign-owned non-banking finance and insurance firms reported overall losses of $60 billion in 2008. This sum exceeded the net losses of $40 billion recorded by the rest of foreign-owned firms in the financial sector, including depository institutions. Foreign-owned depository institutions reported capital losses of $41 billion (Lowe (2011), p 98). Much of this loss was presumably accounted for by ING Direct USA, which had boosted returns at its US internet banking thrift, ING Direct, by switching its assets from agency paper to risky Alt-A MBS (Kalse (2009)). Asian- and Canadian-owned non-banking affiliates, absent from Table 4, reported capital losses of only $1.7 billion and $5.7 billion, respectively.

Holdings of bonds issued in the United States by European and US investors

At end-2002 and June 2007 Table 5

	End-2002		June 2007			
			Residence-based		Nationality-based	
	USD bn	Share[1]	USD bn	Share[1]	USD bn	Share[1]
European investors						
Treasuries and agencies	575	57%	704	30%	704	26%
Corporate excluding ABS	340	34%	1,119	47%	1,119	42%
ABS	93	9%	558	23%	855	32%
Total	1,008	100%	2,381	100%	2,678	100%
US investors						
Treasuries and agencies	7,324	54%	8,194	45%	8,194	46%
Corporate excluding ABS	4,349	32%	6,324	35%	6,324	35%
ABS	1,807	13%	3,621	20%	3,324	19%
Total	13,480	100%	18,138	100%	17,842	100%
Memo: ABS outstanding	*1,978*	*12%*	*4,523*	*19%*	*4,423*	*19%*

[1] Share of the investors' portfolio of US bonds that is devoted to the instrument in the row heading.

Sources: Adapted from Bertaut et al (2012), Table 4; author's calculations.

On this showing, European investors, including banks, loaded up on risky US MBS in the years before the GFC. At end-2002, their US bond portfolio resembled that of US investors. Their portfolio consisted of mostly safe Treasury and agency securities, with about a third of it in plain vanilla US corporate bonds. By mid-2007, the profile of European investors' US bonds had veered away from that of US investors towards riskier bonds. Even on a residence basis (Table 5, centre columns), European investors had shifted out of safe Treasury and agency securities into corporate bonds, while US resident portfolios kept Treasury and agency securities in first place. On a nationality basis (two right-hand columns), including holdings at US affiliates, European investors had promoted ABS to second place, above safe assets in third place.[8]

The US mortgage market reshaped its pricing around the needs of foreign banks in the 2000s, highlighting their importance as investors. Historically, ARMs were priced off of national reference rates, mostly one-year Treasury bills. As securitisation picked up with non-US banks as big investors, US mortgage bankers shifted to using offshore Libor as the reference rate. For example, within the stock of Ohio mortgages in July 2008, later vintages of ARMs referred more and more to Libor (Graph 6). The Libor-linked share of subprime reached practically 100%, while that of prime mortgages rose even faster from less than 20% in the turn-of-the-century vintages to 60% by 2008.[9] The benchmark was not "Changed by Wall Street, for Wall Street"

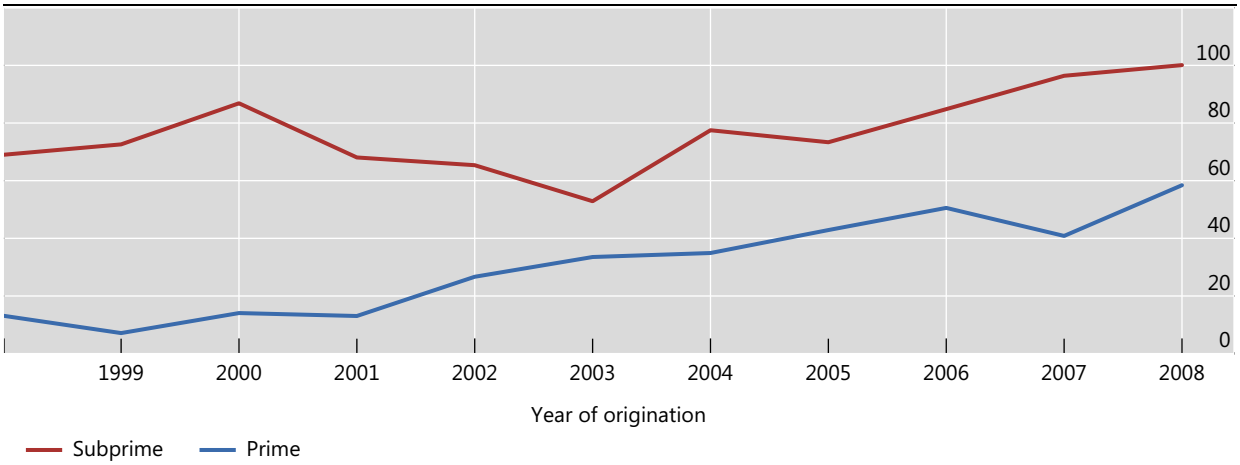
[8] Within ABS, foreign investors had more than their share of ultimately risky mortgage bonds. Beltran et al (2008), Table 6, estimate that non-US investors held 29% of $2.2 trillion in securitised non-agency home mortgages. Including amounts in Table 4 on the assumption that they were held on balance sheets in the United States takes this share above 40%. This share is well above private foreign investors' 14% of US Treasury bonds outstanding or 9% of agency bonds outstanding.

[9] "'It was all about securitization, especially subprime loans,' said Guy D. Cecala, publisher of *Inside Mortgage Finance*, an industry authority. 'You had Wall Street saying, "If we want to sell this overseas,

Libor reference rate share of outstanding US adjustable rate mortgages, Ohio, July 2008[1]

In per cent

Graph 6



[1] Alternative to Libor is the one-year Treasury constant maturity rate as published by the Board of Governors of the Federal Reserve System.

Source: Schweitzer and Venkatu (2009), citing McDash Analytics.

as Morgenson (2012) headlined, but rather for Lombard Street (London) and for Taunusanlage (Frankfurt).

In sum, European banks claimed a market share of a third or more in the production of highly leveraged MBS. Like the US securities firms analysed by Nadauld and Sherlund (2013), as these underwriters ramped up production, they sent a signal to mortgage bankers to extend more credit. Moreover, European investors, especially European banks, bulked large as ultimate holders of such paper as well. The influence of European banks in the market helped to propel Libor to displace US Treasury bills as the preferred reference rate in floating rate US mortgages.

Why did European banks take on so much exposure to private MBS? Dunbar (2011) and Nadauld and Sherlund (2013) highlight the role of leverage regulation, and Bayoumi (2017) easy access to repo finance. However, while regulation and the repo market permitted risky strategies, they do not explain why bank managers chose them. Part of the answer could be that bank managers took aim at market share (UBS (2008), pp 10–11, Zaki (2008), p 11 and p 15, Martin (2013), p 194 and Chapter 13, Augar (2018), p 153) and size, possibly as a defence against takeover. One perceived advantage of size was that it could boost the credit rating since rating agencies considered size when reckoning the odds of government support in extremis (Hau et al (2013), King et al (2016)).

Certainly, European banks did not confine their expansion to US assets or securitised assets. This is evident from their leading role in funding the Spanish and Irish real estate and credit booms. In these cases, they did not rely on securitisation of the US variety, but still contributed to large capital inflows as well as outsize domestic credit and property price booms (Box B).

we have to pick a more international-flavored index." Subprime lenders just started using it overnight, and then it started to spill out into any loan you wanted to securitize'" (Morgenson (2012)).

Box B

The Spanish and Irish cases: larger inflows from European banks, bigger booms

The Irish and Spanish cases resembled the US case in several salient respects. Both featured a large increase in private credit, big run-ups in house prices and, one way or another, a huge inflow of bank capital. The securitisation of mortgages in the United States should not obscure the role of banks as buyers of the bonds (Connor et al (2012)). And rather than just a heavy reliance on floating rate mortgages at the margin, these European economies relied entirely on floating rate mortgages.

The Spanish and Irish booms differed from the US boom in several important respects, however. For one thing, since both Spain and Ireland were part of the euro area, short-term interest rate setting looked to a broader economic domain than these two booming countries in the periphery (Regling and Watson (2010), p 24, Bank of Spain (2017), p 30).

Second, the investment of official reserves from Asia probably exerted less downward pressure on long-term yields in the euro area than such investment put on US Treasury yields. The dollar attracted about two thirds of reserves in the 2000s and the euro only 20–25%. Add the thoroughgoing reliance on floating rate mortgages in these European countries, rather than the long-term fixed rate debt favoured by official reserve managers, and it is hard to pin much of their booms on the Asian savings glut.

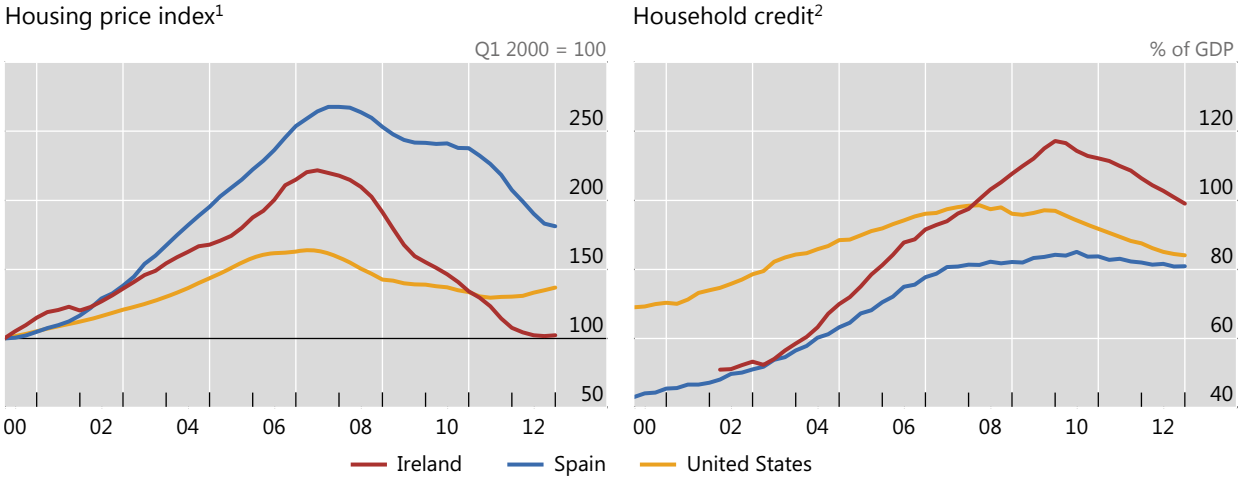
Third, the role of securitisation, the focus of many analyses of the US case, was much reduced in Spain and basically absent in Ireland. In Spain, the regional cajas depended heavily on so-called covered bonds to fund their mortgages, and 75% of these were held by foreign investors (Berges et al (2012)), notably German banks. These do not remove the risk of the mortgages from the originator, so they are better viewed as long-term secured funding rather than as securitisation proper. Other forms of securitisation did not qualify for removal of the assets from the balance sheet owing to limited risk transfer (Almazan et al (2015)).

With little risk transfer of real estate credit, the Irish and Spanish banks only shared their boom exposures to the extent that foreign banks participated in the credit booms directly. In Ireland's case, an RBS subsidiary, Ulster Bank, did manage to run up significant losses, for which the UK rather than the Irish taxpayers ended up paying. In Spain, however, the foreign bank role was limited. On the contrary, the international diversification of the two largest Spanish banks stood them in good stead as earnings abroad stabilised their profitability.

A further aspect that distinguishes the Irish and Spanish cases from the US one is the exposure of banks to property companies. They brought exposure not only to commercial real estate, but also to the construction of houses. On close inspection, the profitability of these in a boom frequently turns on speculation in raw land. This reinforced the banks' exposures to the feedback loop among capital inflows, credit growth and real estate prices.

Housing prices and household credit

Graph B1



[1] Nominal housing price indices, seasonally adjusted. [2] Includes non-profit institutions serving households, not seasonally adjusted.

Sources: OECD; BIS.

Fifth, house prices and household indebtedness traced more extreme trajectories in Ireland and Spain than in the United States. By the lights of the OECD, at least, house prices boomed more in Spain and Ireland than in the United States (Graph B1, left-hand panel). However, the US index conceals significant regional variation: the Case-Schiller 20-city index for the United States more than doubled between 2000 and the peak in mid-2006.

Ireland takes the prize for the largest run-up in household debt of the three as a share of GDP (Graph B1, right-hand panel). It rose by 50% of GDP through 2008, even before the ratio surged as the denominator fell. But Spain was not far behind. On this measure, the US experience was again relatively mild.①

A final way in which the Irish and Spanish cases distinguish themselves from the US case is in the scale of the capital inflow. The left-hand panel of Graph B2 shows the net foreign liabilities of the banks in Ireland with local lending business.② It shows a net inflow of over 50% of GDP (Everett (2017)). Recall that the inflow of official reserves into US Treasuries from end-2000 to mid-2007 amounted to 10% of 2007 GDP, and the change in European investors' holdings of US ABS in the same period amounted to about half that. In other words, even stripping out foreign banks' offshore activity in Ireland, and counting both the transpacific and transatlantic flows to the United States, the inflow of external funding into the Irish banking system was triple these capital flows into the United States.

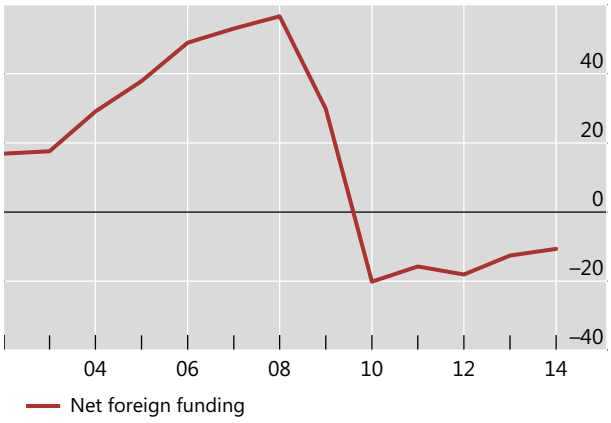
The inflow of bank credit to Spain also reached staggering proportions (Graph B2, right-hand panel). Since Spain does not have a large presence of offshore banking, we simply sum the stock of BIS reporting banks' cross-border claims on non-banks in Spain with their net cross-border claims on banks in Spain (see Avdjiev et al (2012) for further discussion). This aggregate rose from 15% of Spanish GDP to almost 60%.

Despite the differences, the key similarity stands out. European banks enabled credit booms in the United States, Ireland and Spain. The crises also cumulated: US losses crippled many European banks and sapped their defences against strains in Europe.

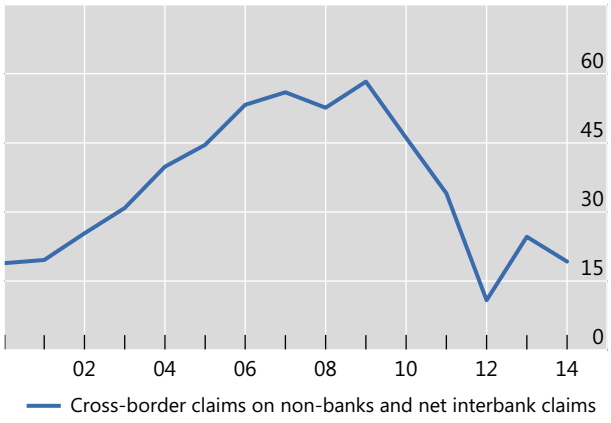
Massive bank flows to the euro periphery

As a percentage of GDP — Graph B2

Net foreign funding of banks in Ireland[1,2]



Bank funding of borrowers in Spain



[1] Deposit, debt security and other liabilities to non-residents less all claims on them of domestic market banks. [2] January 2003 data proxy for December 2002 data.

Sources: Central Bank of Ireland; IMF; BIS locational banking statistics.

① The US data include non-profits. ② Excluding offshore banks; see Honohan (2006), Central Bank of Ireland (2010) and Lane (2015).

Conclusions

The GFC was, in Delong's (2009) phrase, the "wrong crisis" that struck the wrong part of the US bond market (Tooze (2018)). Official reserve managers *could* have staged a sudden stop or even reversal of their purchase of US Treasury bonds. This *could* have imposed a dollar depreciation and a costly adjustment on the US economy. Instead, in 2007–08, highly leveraged European banks scrambled to secure dollar funding as they experienced credit losses – and the dollar appreciated sharply (McCauley and McGuire (2009)). European banks' vulnerability arose from their role as *producers* of the ultimately toxic assets as well as from their role as *investors*. As a result, their affiliates' US balance sheets required massive writedowns in 2008.

The banking glut offers a better account than the savings glut for US mortgage market developments of the 2000s. Large official inflows into US Treasury and agency notes should have reinforced a US mortgage market dominated by fixed rate mortgages that enjoyed government agency guarantees. Instead, we observe a big shift to mortgages priced with floating ("adjustable") interest rates and to more risky, leveraged mortgages that agencies could not guarantee. The dominance of the savings glut with its demand for safe assets should have manifested itself in wider spreads, but the spread of the riskiest mortgages over normal ones actually narrowed.

The banking glut also better accounts for the parallel real estate booms and busts in Spain and Ireland. True, official reserve managers did invest in euro-denominated government bonds. But the Irish and Spanish mortgage markets work on floating rates closely tied to the policy rates set by the ECB. Again, expansion-minded European banks provide a more compelling account of these banking systems' remarkable ease of external financing. In fact, the Irish and Spanish banking systems experienced capital inflows that were huge in relation to the inflows into the United States in the same years.

It would be wrong to argue the banking glut to the exclusion of the savings glut. Along the line that Bertaut et al (2012) argue, the huge inflow into safe assets compressed the term premium on safe assets (lowering the return to taking duration risk), and thereby induced a search for yield in credit. But it would also be wrong to claim that US and European investors responded to this incentive in the same manner. European investors shifted their US bond portfolio in the direction of credit risk markedly more than US investors did.

The Irish and Spanish credit and real estate booms did not require features much emphasised in the US case (eg FCIC (2011)): securitisation with (or without) risk transfer (Connor et al (2012), Carbó-Valverde et al (2012), Almazan et al (2015) and Acharya et al (2013)), reliance on faulty, conflicted ratings (UBS (2008)), or a big government role in the housing market (Rajan (2010), Morgenson and Rosner (2011)). But banks in Ireland and Spain did depend on credit from European banks that were working their equity harder. Occam's razor cuts in favour of one account for such similar and simultaneous phenomena.

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The financial cycle and recession risk[1]

Financial cycle booms can end in crises and, even if they do not, they tend to weaken growth. Given their slow build-up, do they convey information about recession risk? We compare the predictive performance of different financial cycle proxies with that of the term spread – a popular recession indicator. In contrast to much of the literature, our analysis covers a large sample of advanced and emerging market economies. We find that, in general, financial cycle measures provide valuable information and tend to outperform the term spread.

JEL classification: C33, E37, E44.

Once financial cycles peak, the real economy typically suffers. This is most evident around financial crises, which tend to follow exuberant credit and asset price growth, ie financial cycle booms. Crises in turn tend to usher in deep recessions, as falling asset prices, high debt burdens and balance sheet repair drag down growth.

This suggests that the financial cycle could be helpful for gauging recession risk, in particular as booms are drawn out and exhibit systematic patterns. Given the tight link between crises and recessions, this seems to be implied by the large body of work on the leading indicator properties of financial booms for banking crises (eg Borio and Drehmann (2009), Schularick and Taylor (2012) and Detken et al (2014)). Some studies have also documented that credit booms weaken output in the medium run (eg Mian et al (2017) and Lombardi et al (2017)). And some recent work has begun to study the impact of financial conditions on risks to growth (eg Adrian et al (2018)).[2]

But research exploring how financial expansions affect recession risk, ie the likelihood that a recession will develop in the near future – say, one to three years ahead – is scant and predominantly focused on the United States.[3] Assessing recession risk has a long tradition. Probably the most popular variable in this context

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[2] See Claessens and Kose (2018) for a literature review on research exploring macro-financial linkages.

[3] Recent papers making use of financial expansion-related variables, such as financial intermediary balance sheet conditions, property prices, credit growth or credit spreads, include Liu and Moench (2016), Christiansen et al (2017), Ponka (2017) and Guender (2018). All these papers base their analysis on US data only, with the exception of Guender (2018), who instead looks at a set of European countries.

Key takeaways

- We evaluate how far financial cycle proxies can assess recession risks in a large sample of advanced and emerging market economies.
- We find that the proxies provide valuable information even at a three-year horizon.
- Financial cycle proxies generally outperform the term spread.

is the term spread (eg Estrella and Mishkin (1998) and Rudebusch and Williams (2009)). In particular, an inverted yield curve – long-term bond yields below short-term interest rates – is seen as among the best signals of impeding recessions, if not the best.

In this special feature, we examine the ability of financial cycle proxies to convey information about recession risk. We follow the literature very closely to better benchmark our analysis against the corresponding work on the term spread. In contrast to much of the extant analysis, we look at a large sample of advanced and emerging market economies (EMEs).[4]

For advanced economies, we find that financial cycle proxies provide valuable information for a horizon of up to three years, outperforming the term spread. The evidence for EMEs mirrors that for advanced economies, although data limitations prevent out-of-sample tests for this group.

The rest of the article is structured as follows. In the first section, we briefly introduce the notion of the financial cycle and document how the nature of the business cycle, and its link with the financial cycle, have changed in the past 50 years. In the second, we explain our methodology. In the third, we evaluate the performance of financial cycle proxies and compare it with that of the term spread based on full-sample information, ie ex post. In the fourth, we consider out-of-sample exercises, seeking to mimic the information policymakers have when assessing risks in real time, ie ex ante.

A look at the data

The term "financial cycle" refers to the self-reinforcing interactions between perceptions of value and risk, risk-taking, and financing constraints (Borio (2014)). Typically, rapid increases in credit drive up property and asset prices, which in turn increase collateral values and thus the amount of credit the private sector can obtain until, at some point, the process goes into reverse. This mutually reinforcing interaction between financing constraints and perceptions of value and risks has historically tended to cause serious macroeconomic dislocations.

[4] Additional analysis (not shown) indicates that the financial cycle measures are also valuable in assessing recession risk when considering exclusively the United States, which has been the focus of the literature. For this country, the proxies do as well as the spread. Given that we use data from 1985, however, this comparison is based on only three recessions.

The financial cycle can be approximated in different ways. Empirical research suggests that, especially if one is interested in episodes that have proven more damaging for economic activity, a promising strategy is to capture it through *medium-term* fluctuations in credit and property prices. This can be done either in terms of individual series or, preferably, of their combination. In this special feature, we rely on a "composite" financial cycle proxy similar to that in Drehmann et al (2012). In addition, as an alternative, we also look at the debt service ratio, defined as interest payments plus amortisation divided by GDP.[5] Drehmann et al (2018) find a strong link between debt accumulation and subsequent debt service (ie interest payments plus amortisation), which in turn has a large negative effect on growth.[6]

Previous research has identified two important features of the financial cycle.[7] First, financial cycle peaks tend to coincide with banking crises or considerable financial stress. This is not surprising. During expansions, the self-reinforcing interaction between financing constraints, asset prices and risk-taking can overstretch balance sheets, making them more fragile and sowing the seeds of the subsequent financial contraction. This, in turn, can drag down the economy and put further stress on the financial system.

Second, having grown in amplitude over the past 40 years or so,[8] the financial cycle can be much longer than the business cycle. Business cycles as traditionally measured tend to last up to eight years, and financial cycles around 15 to 20 years since the early 1980s. The difference in length means that a financial cycle can span more than one business cycle. As a result, while financial cycle peaks tend to usher in recessions, not all recessions will be preceded by financial cycle peaks.

A first look at the relationship between the composite financial cycle proxy and recessions in the United States and the United Kingdom since the early 1980s illustrates these points (Graph 1). Financial cycle booms took place ahead of recessions in the early 1990s and the late 2000s. At the same time, the shallow recession in the early 2000s in the United States did not coincide with a financial cycle peak: while the economy slowed and equity prices tanked, the financial expansion continued as measured by credit and property prices, only to reverse a few years later, triggering the Great Recession. By contrast, in the United Kingdom, no recession took place in the early 2000s, so that the two recessions coincided with the two financial cycle peaks.

Why has the amplitude of financial cycles grown since the early 1980s, raising their importance for economic activity? The reasons are not yet fully understood, but arguably changes in policy regimes may be partly responsible.

Three such changes deserve particular attention. First, financial markets were liberalised starting around that time. Without sufficient prudential safeguards, this change likely allowed greater scope for the self-reinforcing interactions at the heart of the financial cycle to play out. Second, starting roughly at the same time, inflation-focused monetary regimes became the norm. And the evolving thinking of central

[5] See also Juselius and Drehmann (2015) for a description of the financial cycle in terms of the joint behaviour of leverage – approximated by the ratio of debt to assets – and the debt service ratio.

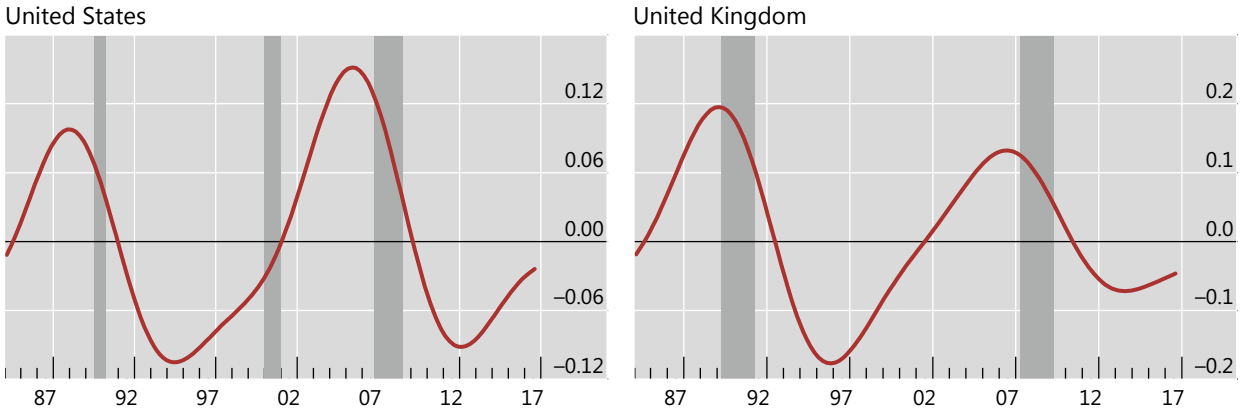
[6] See also Hofmann and Peersman (2017).

[7] See eg Aikman et al (2015), Claessens et al (2012) or Drehmann et al (2012).

[8] For instance, Filardo et al (2018) document the time-varying nature of financial cycles and explore underlying drivers. There is also some evidence that business cycles have become longer in recent years (eg Beaudry et al (2018)).

Financial cycles tend to boom ahead of recessions[1]

Graph 1



The shaded areas represent recessions.

[1] Financial cycles are measured by the composite financial cycle proxy calculated from frequency-based (bandpass) filters capturing medium-term cycles in real credit, the credit-to-GDP ratio and real house prices.

Sources: Economic Cycle Research Institute (ECRI); NBER, national data; BIS; authors' calculations.

banks led them to gradually downplay the role of monetary and credit aggregates. This meant that central banks had little reason to tighten policy if inflation remained low, even as financial imbalances built up. Finally, from the 1990s on, the entry of China and former Communist countries into the world economy, alongside the international integration of product markets and technological advances, boosted global supply and strengthened competitive pressures. Coupled with greater central bank credibility, this arguably made it more likely that inflationary pressures would remain muted even as expansions gathered pace. It also meant that financial booms could build up further and that a turn in the financial cycle, rather than rising inflation and the consequent monetary tightening, might trigger an economic downturn.[9]

These factors were in evidence in the run-up to the Great Financial Crisis. In many countries, short-term output volatility as well as the level and volatility of inflation fell and remained low (the so-called Great Moderation). At the same time, leverage in the financial and non-financial sectors rose. When the financial cycle turned, financial stress emerged and economies worldwide experienced a serious recession.

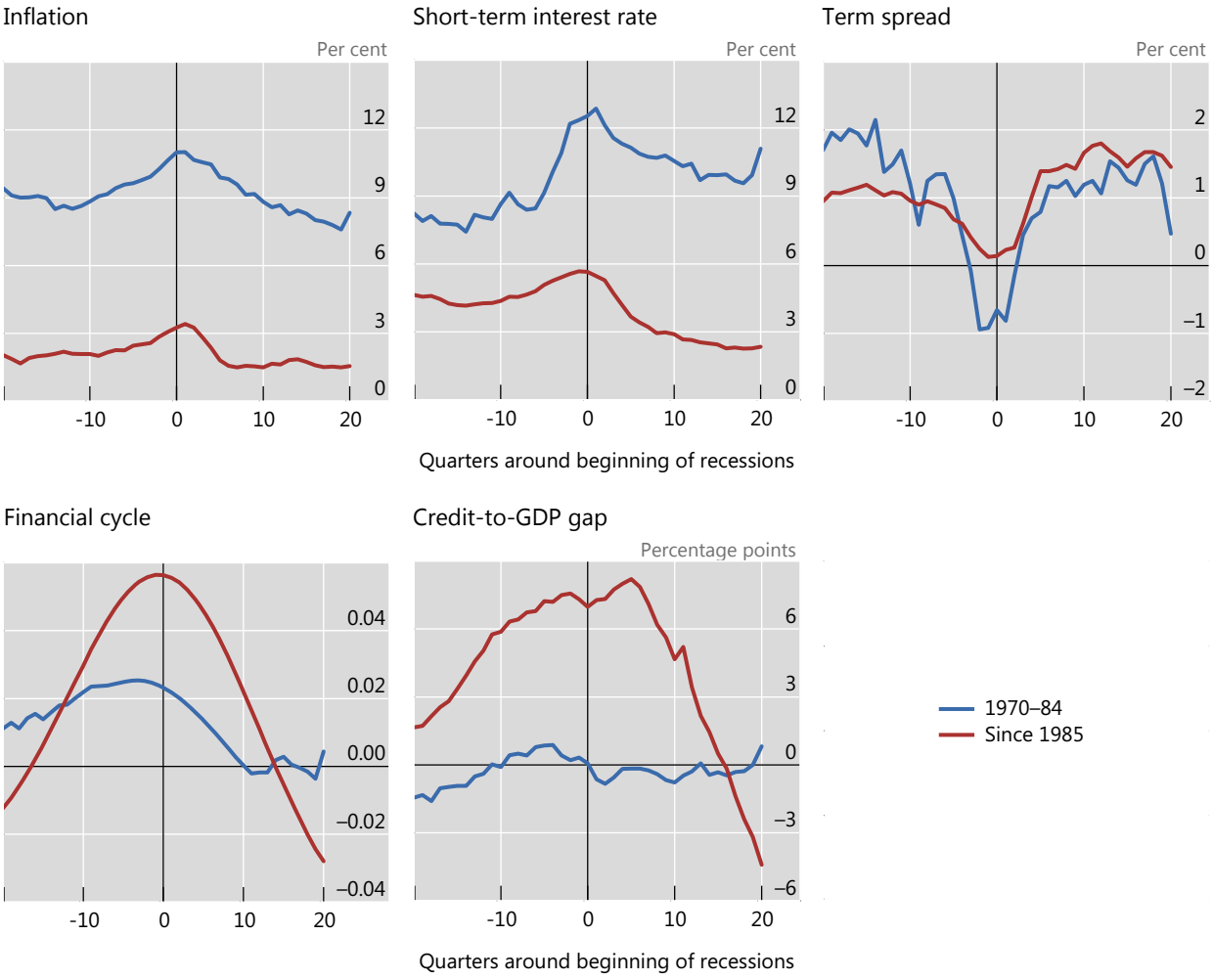
The shift in the nature of recessions is apparent when one takes a long-term cross-country perspective.[10] Graph 2 documents the behaviour of key variables in the five years around business cycle turning points in our sample of 16 advanced economies (vertical lines). In the period 1970–84 (blue lines), inflation and the short-term interest rate tended to increase by several percentage points ahead of cyclical peaks and term spreads tended to plunge and become highly negative (upper panels). At the same time, there was little sign of a financial boom, whether measured by the composite financial cycle proxy or just the behaviour of credit in relation to

[9] For a discussion of changes in policy regimes and their implications for monetary and financial stability, see eg Borio and Lowe (2002) and Borio (2016).

[10] Interestingly, the recessions since the early 1980s have come to resemble those that were the norm under the pre-WWI classical gold standard (eg Huffman and Lothian (1984)) and in the run-up to the Great Depression in the 1920s (Eichengreen and Mitchener (2003)). This was the previous globalisation era; like today's, it was also characterised by price stability and a high degree of both trade and financial integration. See BIS (2018), Chapter 1.

The changing nature of the business cycle[1]

Average of the variables indicated over the selected periods — Graph 2



[1] The horizontal axis denotes quarters around recessions in the business cycles, with the peak date set at zero (vertical lines). Lines show the median evolution across the advanced economies in our sample and events in the respective time period.

Sources: National data; authors' calculations.

GDP (lower panels). By contrast, since 1985 (red lines), inflation has been lower and remarkably stable around business cycle peaks, the short-term interest rate has increased only modestly and the term spread has narrowed far less. Correspondingly, strong financial cycle expansions have been very much in evidence. One could say that there has been a shift from inflation-induced[11] to financial cycle-induced recessions.

[11] Zarnowitz (1999) uses the term "central bank recession" to refer to the common view that recessions are always driven by monetary policy tightening.

Methodology

The previous graphical evidence is highly suggestive of the information that financial cycle proxies can convey about recession risk. We now perform a more systematic analysis. This calls for a number of steps.

The first step is to define the variable to be predicted. Here we follow the most widely used procedure. We take the recession dates from the National Bureau of Economic Research (NBER) or the Economic Cycle Research Institute. These rely on expert judgment based on the behaviour of several variables, such as output and employment. When such recession dates are not available, we rely on a standard business cycle-dating algorithm that identifies peaks and troughs in real GDP (Harding and Pagan (2002)). We do not consider degrees of intensity: either a recession occurs (*R=1*) or it does not (*R=0*). This, of course, means that countries with, on average, higher trend growth rates may experience fewer recessions but as many and equally sizeable slowdowns in growth. This is less of an issue for advanced economies.

The second step is to link different explanatory variables to recessions. Again, we follow a standard approach. We run a panel probit model with our recession indicator on the left-hand side, potential explanatory variables on the right-hand side and a cumulative normal distribution (Φ) describing their relationship. The model produces a probability of a recession based on the information these variables convey. Specifically, we estimate:

$$Prob\left(R_{i,t} = 1 | X_{i,t-h}\right) = \Phi(\alpha + \beta' X_{i,t-h})$$

with single or multiple explanatory variables $X_{i,t}$ for country i at time t, and different horizons (h) of one, two and three years. The estimation results give an indication of whether the explanatory variables are statistically significant in influencing the recession probability.

The final step is to judge forecast performance. Here we calculate several measures, although in the main text we rely on the area under the receiver operating characteristic (ROC) curve (Berge and Jordà (2011)). This curve maps out all possible combinations of type I errors (missed recessions) and type II errors (false alarms). The area under this curve (AUC) provides a convenient and easily interpretable summary measure of the indicator's signalling quality.[12] A completely uninformative indicator has an AUC of 0.5; a perfect one an AUC of 1. The AUC of an informative indicator falls in between and is statistically different from 0.5. To ensure comparability with the existing literature, we also report other standard measures, such as the mean absolute error (MAE), the root mean square error (RMSE) and the log probability score (LPS) (eg Rudebusch and Williams (2009)). As the main insights do not change, we report these in the Online Annex.

[12] A probability can be transformed into a binary indicator, which is equal to 1 ("on") if it is above a critical threshold *T*, and zero ("off") otherwise. A type I error (missed call) occurs if the binary indicator is "off" but a recession follows; and a type II error (false alarm) if it is "on" but no recession follows. By changing the critical threshold *T*, the fraction of type I and type II errors changes. Technically, there is no direct mapping between the significance of coefficients in the probit equation and the AUC, especially if the probit includes more than one variable. In that case, the probit regression coefficients may be statistically significant, even if their inclusion does not change the AUC much.

The three variables considered – the composite financial cycle,[13] the debt service ratio (DSR)[14] and the term spread (the difference between the 10-year government bond rate and the three-month money market rate) – differ in terms of levels and volatility across countries.[15] We thus standardise them by their mean and standard deviation.[16]

For the main analysis, we use quarterly data for 16 advanced economies from 1985 to 2017.[17] We start at the earliest in 1985 given that, as noted, financial cycles have become more prominent since then. And, when all variables are available, we use a homogeneous panel.

To assess the validity of the results more generally, we also look at quarterly data for nine EMEs.[18] Data start at the earliest in 1996 but more often around 2000. One limiting factor is that government bond markets are less developed before then, constraining the sample for the term spread. In addition, property prices are scarcer for earlier dates, limiting the ability to compute the composite financial cycle proxy. In the case of EMEs, therefore, we do not use a homogeneous panel.[19] While we still show results for the composite financial cycle proxy for comparability reasons, these should be treated as indicative given the short time series.

We perform both in-sample and out-of-sample exercises. The in-sample estimation sheds light on the tightness of the lead-lag link between the variables and recessions with the benefit of hindsight (ex post); the out-of-sample analysis evaluates their performance in real time, ie taking into account only the information available up to that point. The latter is a more stringent and useful test, since it replicates the information available to policymakers when they form a judgment of the risks. Because of data limitations, we limit the out-of-sample exercise to advanced economies.

[13] Drehmann et al (2012) use bandpass filters with frequencies from eight to 32 years to extract medium-term cyclical fluctuations in real (inflation-adjusted) credit, the credit-to-GDP ratio and real property prices, which they then average to derive a composite measure of the financial cycle. We modify the approach slightly by applying the filter directly to the log-level of the individual series instead of filtering the growth rates. The data on total credit, credit-to-GDP ratios and long-run property prices are taken from BIS statistics.

[14] While not shown explicitly, results based on other individual financial cycle proxies, such as the deviation of the credit-to-GDP ratio from its long-term trend ("credit gap") or a similar normalisation for property prices ("property price gap") yield broadly similar results.

[15] Data on debt service ratios are published on the BIS website (Dembiermont et al (2015)) from 1999. We extend them backwards using the same methodology but rely on country-specific proxies to backdate the input data in several cases.

[16] This has the additional benefit of implicitly controlling for fixed effects in a similar way to Chamberlain's random effects probit model.

[17] The countries included are Australia, Belgium*, Canada, Finland*, France, Germany, Ireland*, Italy, Japan, the Netherlands*, Norway*, Spain, Sweden, Switzerland, the United Kingdom and the United States. For countries denoted with *, we date business cycles with a business cycle-dating algorithm.

[18] EMEs included are Brazil, the Czech Republic, Hungary, Korea, Malaysia, Poland, Russia, South Africa and Thailand. For these countries, we always date business cycles with a business cycle-dating algorithm. For an EME to be included, we require that all three variables are available and that we have at least 10 years of spread and debt service ratio data. In addition, we also only include an EME if we observe at least one recession in the sample.

[19] The sample is homogeneous for regressions with the debt service ratio and the term spread.

In-sample results

The in-sample results confirm that financial cycle measures provide valuable information for assessing recession risk.

This conclusion is evident for advanced economies, for which a richer sample is available. And this is so regardless of the forecasting horizon. Coefficients for the composite financial cycle measure or the debt service burden are always highly statistically significant (Table 1, first two columns).[20] AUCs underscore this message. For a one-year horizon, the AUCs of both variables are around 0.75 (Graph 3, left-hand panel, red and blue bars). For longer horizons, they decrease for the debt service burden, even though the AUCs remain significantly above the value for an uninformative variable (0.5). But the AUC of the composite financial cycle indicator remains significant and close to 0.7 at the three-year horizon, pointing to the slow-moving nature of this indicator.

Financial cycle proxies help in evaluating recession risk

Regression coefficients from panel probit models — Table 1

Horizon		Financial cycle[1]	DSR	Term spread	Financial cycle and term spread	DSR and term spread
		Advanced economies				
1 year	Financial cycle	0.69***			0.62***	
	DSR		0.61***			0.57***
	Spread			−0.35***	−0.21***	−0.28***
2 year	Financial cycle	0.63***			0.60***	
	DSR		0.38***			0.35***
	Spread			−0.23***	−0.09*	−0.17***
3 year	Financial cycle	0.43***			0.44***	
	DSR		0.16***			0.15***
	Spread			−0.08	0.03	−0.06
		Emerging market economies[2]				
1 year	Financial cycle	0.24***			0.24***	
	DSR		0.25***			0.23***
	Spread			−0.12**	−0.18**	−0.03
2 year	Financial cycle	0.24***			0.24***	
	DSR		0.02			0.05
	Spread			0.06	0.02	0.07

The table reports estimated coefficients from probit regressions for advanced economies and emerging market economies, respectively; ***/**/* indicates significance at the 1/5/10% level.

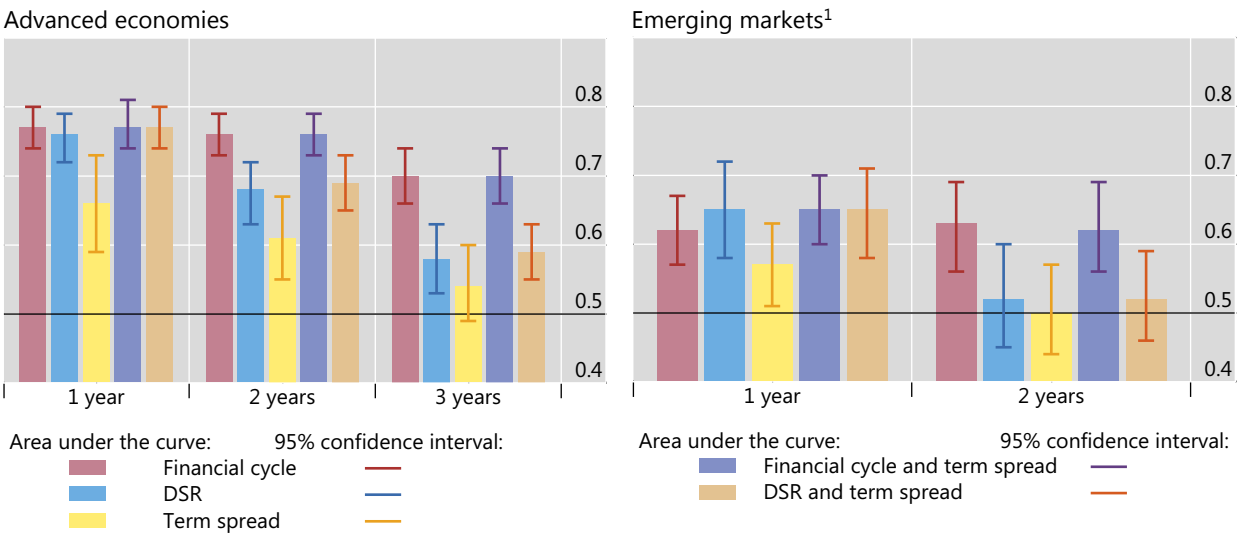
[1] Financial cycles are measured by the composite financial cycle proxy. [2] Given the limited sample, we do not look at a three-year forecast horizon for EMEs.

Source: Authors' calculations.

[20] We obtain standard errors by block bootstrapping in order to account for cross-country correlations.

Financial cycle measures are useful for assessing recession risk around the globe

AUCs for different forecast horizons — Graph 3



The horizontal lines at 0.5 indicate the area under the curve (AUC) of an uninformative, random variable.

[1] No three-year forecast horizons for EMEs, due to the limited sample.

Source: Authors' calculations.

In comparison, the term spread seems to be useful only for evaluating recession risk one and two years ahead. The coefficients and AUCs are not statistically significant at the three-year horizon (Table 1, third column, and Graph 3, yellow bars).

Moreover, even at one- and two-year horizons, the composite financial cycle and debt service ratio outperform the term spread. Their AUCs are higher and the difference is statistically significant.

That said, the financial cycle proxies and the term spread seem to provide complementary information. When they are included jointly in a probit model, they all remain statistically significant up to a two-year horizon. Accordingly, AUCs and other evaluation metrics improve (Table 1, fourth and fifth columns, and Graph 3, purple and tan bars). The improvement, though, is not statistically significant. And at the three-year horizon, the gain is negligible.

The generally weaker performance of the term spread may come as a surprise. One reason is that the literature typically assesses performance at a one-year horizon or less. A second reason is that we use a panel structure, allowing for the estimation of the relevant effects across many countries. While the variables are normalised, the term spread is also affected by credit risk premia for several countries in our sample. As a result, in some episodes, the yield curve steepened rather than flattened ahead of recessions, as was the case for some periphery countries ahead of the 2011–12 euro sovereign debt crisis.[21] But, more importantly, the result likely reflects the changing nature of the business cycle discussed above, in which monetary policy

[21] When we remove the euro area periphery countries (ie Ireland, Italy and Spain), AUCs for the term spread increase to 0.71 and 0.65 at the one- and two-year horizons, respectively, while the information content of the financial cycle proxies is little affected.

tightening has played a smaller role in triggering recessions and the financial cycle has gained prominence (Graph 2).

The strong performance of the financial cycle proxies is all the more remarkable given that the methodology stacks the deck against finding significant predictive power. Since the financial cycle tends to be longer than the business cycle, we cannot expect booms to precede all recessions; there will be misses. And because the financial cycle builds up and recedes slowly (see eg Graph 1), it is likely to sound several "false alarms" before and after the recession has ended. Hence, from the start, the benchmark for the AUC cannot be expected to be 1, ie the AUC of the perfect indicator.

The results for EMEs broadly mirror those for advanced economies. Both financial cycle proxies are informative, albeit less so than in advanced economies. Coefficients and AUCs for the composite financial cycle are always statistically significant, regardless of forecast horizon. The debt service ratio yields the highest AUC at the one-year horizon, although it is not significant at the two-year horizon (Table 1, second column and Graph 3, right-hand panel). Despite less developed bond markets, term spreads also seem to provide some valuable information at the one-year horizon (Table 1, third column).

Out-of-sample results

We perform two exercises to assess the indicators' performance in real time: we examine first the effect of real-time data, and then the combined effect of real-time data and model parameters estimated recursively, ie by adding one observation at a time.

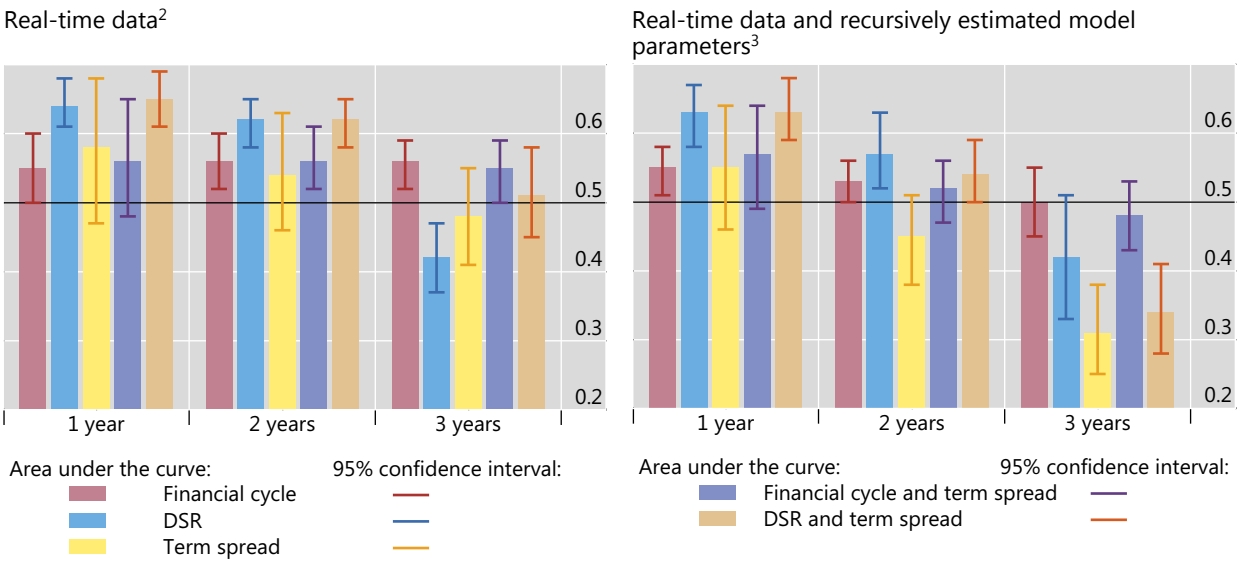
By real-time data, we mean variables normalised by the sample available at that point in time.[22] Specifically, for each quarter we calculate the various financial cycle proxies with information up to that quarter and normalise them accordingly. As small samples will affect the normalisation, we exclude the first 10 years of data and start the forecasting exercise in Q1 1995. Then, to assess the impact of real-time data only, we estimate the models up to Q1 1995 and keep the parameters fixed when forecasting. And to assess the combined effect of real-time data and time-varying model parameters, we re-estimate the models every period a forecast is made (again starting from Q1 1995) and use the resulting coefficients.

Even using real-time data, financial cycle proxies provide valuable information for recession risk, and tend to outperform the term spread (Graph 4). Naturally, forecast performance drops relative to the full-sample results. But the AUC of the debt service ratio is above 0.6 up to the two-year horizon (left-hand panel). While AUCs for the composite financial cycle are lower than in the full-sample estimation, their performance is still statistically significant. In contrast, the AUCs of the term spread are not statistically significant: the signal is statistically indistinguishable from that of an uninformative indicator.

[22] For the data, we would ideally use real-time releases. However, these are not available for the panel, so we use quasi-real-time information, ie we take the latest data vintage and calculate the financial cycle and normalise the variable using data only up to that point.

Financial cycle measures are useful for assessing recession risk in real time[1]

Real-time AUCs for advanced economies and different forecast horizons — Graph 4



The horizontal lines at 0.5 indicate the area under the curve (AUC) of an uninformative, random variable.

[1] We start the forecasting exercise in Q1 1995. [2] Forecasts are calculated using real-time data and fixed parameters estimated with data up to Q1 1995. [3] Forecasts are calculated with real-time data and recursively estimated model parameters, ie by adding one observation at a time.

Source: Authors' calculations.

Allowing for changes in model parameters does not alter the broad message (Graph 4, right-hand panel). Both financial cycle proxies deliver AUCs that are statistically higher than 0.5 up to a two-year horizon, although not beyond. In comparison, AUCs from the term spread do not differ from that of a random indicator at all horizons.[23]

Conclusion

Business cycles may not die of old age (Rudebusch (2016)), but if financial booms develop, they become more fragile. This is the case in both advanced economies and EMEs. Moreover, given that financial cycles build up slowly, the corresponding proxies provide information about recession risk even at a three-year horizon. And when we run a horse race against the term spread – the indicator most widely used to assess recession risk – we find that they outperform the term spread in both in-sample and out-of-sample exercises. The debt service ratio is particular effective in this aspect. These results suggest that financial cycle proxies may be another indicator that could be useful to policymakers, professional forecasters and market participants more generally.

[23] Allowing parameter estimates to vary as the sample is increased seems to reduce forecast accuracy to some extent: the AUCs obtained when parameters are fixed are slightly higher.

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Clearing risks in OTC derivatives markets: the CCP-bank nexus[1]

Systemically important banks and central counterparties (CCPs) interact in highly concentrated over-the-counter (OTC) derivatives markets. We outline the CCP-bank nexus to think about the endogenous interactions between banks and CCPs in periods of stress. As these interactions could potentially lead to destabilising feedback loops, the risks of banks and CCPs should be considered jointly, rather than in isolation.

JEL classification: G01, G18, G21, G23.

Central clearing is a key feature of global derivatives markets. Almost two thirds of over-the-counter (OTC) interest rate derivative contracts, as measured by outstanding notional amounts, are now cleared via central counterparties (CCPs) – up from around one fifth in 2009. The share of central clearing has also grown in other product markets, such as credit derivatives. The increasing use of CCPs is by design. Notably, the G20 leaders agreed in 2009 that standardised OTC derivative transactions should be centrally cleared (G20 (2009)), in recognition of the risk management benefits offered by CCPs.

Increased regulatory attention to CCPs' risk management has accompanied the G20 central clearing mandate. Global standards for the resilience and recovery of CCPs have been strengthened since the crisis (CPSS-IOSCO (2012), CPMI-IOSCO (2017a,b)), guidance has been set out for resolution planning (FSB (2014) and FSB (2017)) and a framework developed for supervisory stress testing of CCPs (CPMI-IOSCO (2018)). These standards buttress the systemic stability benefits of central clearing by strengthening the resilience of the CCPs themselves. But risks in cleared markets remain. In September 2018, a single trader's default wiped out roughly two thirds of the commodities default fund at Nasdaq Clearing AB, a Swedish CCP (Box A).

OTC derivatives markets are closely knit. Two recent reports by international standard setters (BCBS-CPMI-IOSCO-FSB (2017, 2018)) map the interlinkages between CCPs and clearing members, the most important of which tend to be systemically important banks. These interlinkages give rise to questions on interactions, as risks can be generated endogenously (Shin (2010)). For instance, how

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Key takeaways

- Central clearing is a highly concentrated business, in terms of both providers (ie central counterparties (CCPs)) and users (which are, primarily, systemically important banks).
- While central clearing has reduced risk in the financial system overall, banks and CCPs could interact in ways that, in some circumstances, might lead to a destabilising feedback loop, amplifying stress.
- Hence, the risks of banks and CCPs should be considered jointly, rather than in isolation.

does risk management at CCPs affect banks' risk-taking? Conversely, how does banks' risk-taking behaviour affect CCP resilience? Could these interactions lead to a self-reinforcing feedback loop under stress?

Our special feature is a step towards addressing these questions. In describing how a typical CCP manages its risks, we outline the links between its balance sheet and those of its large clearing members ie systemically important banks (henceforth, "banks"). The "CCP-bank nexus" arises as CCPs' risk management and banks' risk-taking interact with one another. We show how, under stress, the nexus could lead to a potentially destabilising feedback loop. The channels for this loop would vary with the level of market stress.

The nexus underscores the potentially endogenous nature of bank and CCP risks, and highlights the need to consider these risks jointly, rather than in isolation. This insight could be useful for future policy work on reducing financial stability risks in OTC derivatives markets.

Admittedly, the analysis in its current form has limitations. We abstract from certain institutional features of derivatives markets. Some of these, such as member ownership of CCPs or member banks' credit lines to CCPs, might affect the interactions outlined in this feature. Hence, it is difficult to draw direct policy inferences from the analysis. In particular, the special feature should not be seen as implicitly evaluating the post-crisis regulatory reforms. Lastly, as this feature focuses exclusively on risks related to central clearing in OTC derivatives, it should not be used to assess the relative merits of central and bilateral clearing.

The rest of this special feature is organised as follows. We first report stylised facts about OTC derivatives markets and the main players in these markets: namely systemically important banks and CCPs. In the second section, we outline how CCP risk management and bank risk-taking interact, ie the CCP-bank nexus. In the third section, we examine three scenarios that illustrate how stress transmission channels work in the CCP-bank nexus. The final section concludes.

Box A

Two defaults at CCPs, 10 years apart

Sarah Bell and Henry Holden

Central counterparties have been described as "unlikely heroes" for their handling of the Lehman Brothers' default (Norman (2011)). CCPs proved resilient during the crisis, continuing to clear contracts even when bilateral markets dried up (Domanski et al (2015)). Lehman had derivative portfolios at a number of CCPs across the world and, with one exception, these were auctioned, liquidated or transferred within weeks of the default without exhausting the collateral Lehman had provided (Cunliffe (2018), Monnet (2010)). One example is the unwinding of Lehman's interest rate swaps portfolio cleared in London (66,390 trades, $9 trillion notional), which used up about a third of the margin held, so that neither the CCP nor its members sustained any losses.

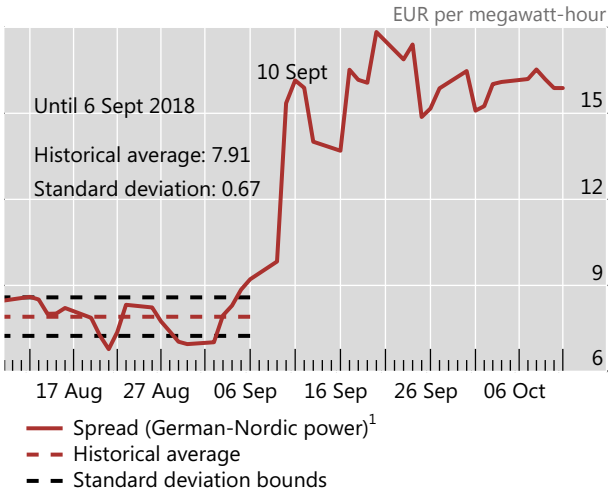
Yet 10 years later, a single trader with a much smaller portfolio presented a CCP with a much greater challenge. That tribulation came on 10 September 2018, when Einar Aas, a Norwegian trader, failed to pay a margin call to the commodities arm of Nasdaq Clearing AB in Sweden. Aas had bet that Nordic and German electricity prices would converge, by trading in futures on the Norwegian commodity derivatives exchange, Nasdaq Oslo ASA, which clears all trades with the Swedish CCP. Weather forecasts and a change in German carbon emission policies pushed the two prices apart, driving the value of Aas's position down sharply (Graph A1, left-hand panel). Correlation strategies of this kind were once described, in the case of Long-Term Capital Management, as "picking up nickels in front of a steamroller" (Lowenstein (2000)). When Nasdaq made a margin call that Aas failed to pay in full, he was put into default the next morning.

The CCP sought to manage the default by selling the position. In the following days, an auction was held for Aas's portfolio with four of Nasdaq's other members. The winning bid resulted in a loss of €114 million in excess of the collateral Aas had provided. For commodities, Nasdaq's "default waterfall" (once Aas's collateral was exhausted) started with capital of €7 million, after which it tapped a €166 million fund made up of contributions from the non-defaulting members (Nasdaq has three services, each with a separate default fund). In the event, this sufficed to absorb the loss resulting from Aas's default. In addition to the funds consumed, another layer of capital was available, as well as a general default fund covering all Nasdaq Clearing's services (Graph A2).

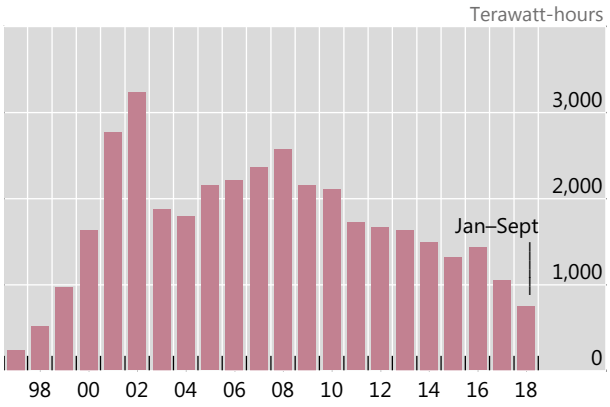
German and Nordic electricity futures markets

Graph A1

German-Nordic spread



Nordic power traded and cleared volumes



[1] Difference between nearest-maturity German and Nordic electricity futures prices.

Sources: Bloomberg; Nasdaq Commodities; authors' calculations.

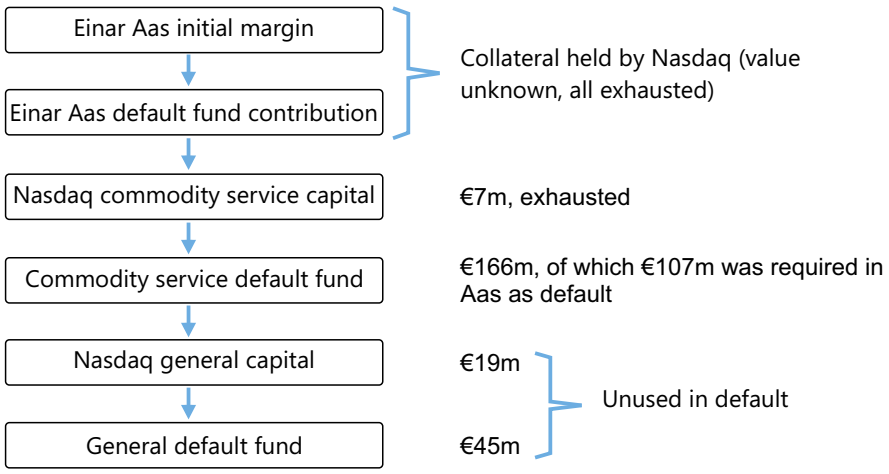
For a CCP to exhaust a defaulter's collateral is unusual, even in the case of a large default such as Lehman's. CPMI-IOSCO (2017b) contains guidance on how CCPs should set their margin to prevent this from happening. The guidance includes calculating initial margins using a sufficiently long time horizon, using assumptions on how liquid the market is, and allowing only for prudent offsets between products. Although there is currently no public record of how much collateral Aas provided, Nasdaq has publicly disclosed how it calculated his initial margins. For his Nordic and German futures positions, Nasdaq required Aas to pay 99.2% of the biggest two-day market movements over the previous year, plus 25% of the biggest two-day movement that year. But the CCP also gave him a correlation offset of 50% on the margin, assuming that German and Nordic electricity prices would continue to move in parallel. Moreover, Aas was not required to pay any additional margin, even though the position made up a large proportion of the Nordic power market – a market that had been shrinking significantly in volume over the past decade (Graph A1, right-hand panel). This was despite the fact that liquidation costs are generally high for portfolios which are large relative to the available market. The reasons for this are unclear, but some observers have suggested that margin-setting may sometimes reflect competitive pressures (Domanski et al (2015)).

How then was Lehman's default handled without losses in hard times, while Aas's default forced a CCP to pass losses to members? Lehman's portfolio, while large and complex, was relatively balanced and part of an even larger market. Although it was in supposedly more complex over-the-counter (OTC) derivatives, CCPs had adequate strategies and collateral in place. This was in stark contrast to Aas's portfolio, which was undiversified and heavily concentrated in a smaller and less liquid market. These episodes underscore the importance of maintaining sufficient market liquidity for central clearing to support default management in stressed conditions, and of applying a reliable long-term perspective in order to set accurate margins (Cunliffe (2018)). So, although Lehman's portfolio was much larger, CCP default management teams could hedge and reduce risks, allowing orderly auctions to take place over a number of weeks following the default.

These two defaults happened 10 years apart, under very different circumstances. Yet the lesson is timeless: sound risk management and preparation make all the difference between a CCP that absorbs a shock, and one that propagates it.

Nasdaq collateral and the default waterfall

Graph A2

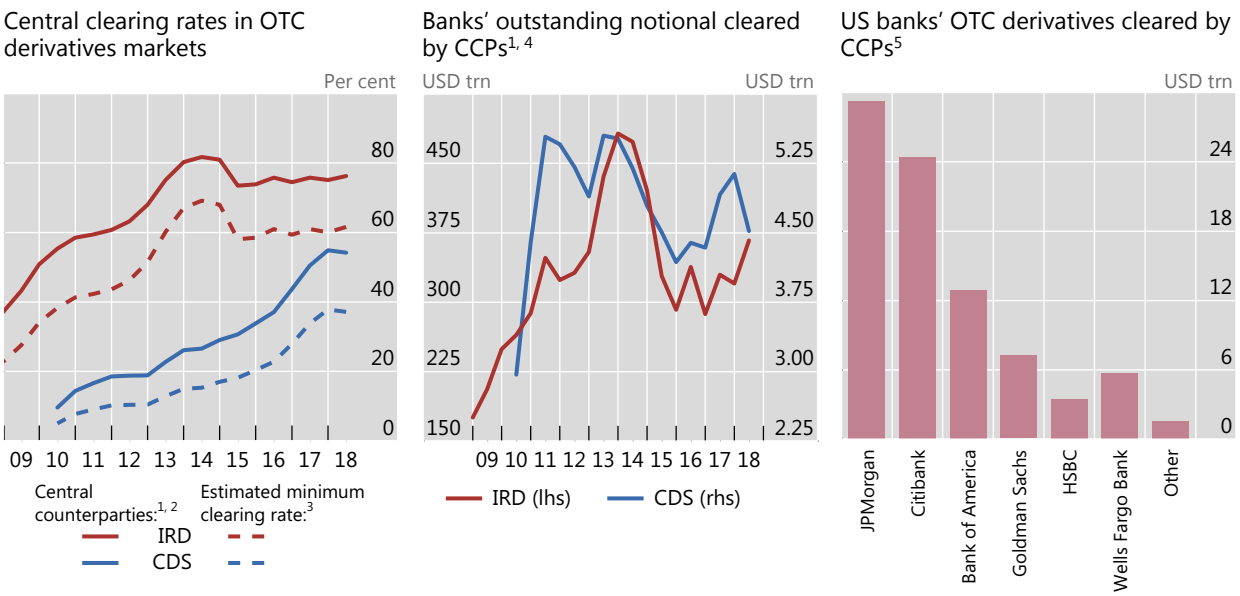


Concentrated clearing

OTC derivatives clearing is characterised by (i) large exposures between banks and CCPs; (ii) a small number of CCPs; and (iii) a small number of banks (BCBS-CPMI-IOSCO-FSB (2017, 2018)). Together, these features underpin the CCP-bank nexus.

On the back of post-crisis policy initiatives, both the share of centrally cleared OTC derivatives contracts and the exposures between banks and CCPs have increased substantially.[2] Estimates based on the BIS derivatives statistics indicate that the central clearing rate has risen from around 20% in 2010 to at least 60% in 2017 for interest rate derivatives (IRD) (Graph 1, left-hand panel, red dashed line) and from roughly 10% to around 40% for credit default swaps (CDS) (blue dashed line).[3] As a result, CCPs clear large notional values of IRD and CDS contracts (Graph 1, centre panel). Currently, these stand at 4.4 times world GDP, up from 2.8 times in 2008. The

Banks and central counterparties (CCPs) have large exposures to each other — Graph 1



CDS = credit default swaps; IRD = interest rate derivatives.

[1] For interest rate derivatives (IRD), data for CCPs prior to end-June 2016 are estimated by indexing the amounts reported at end-June 2016 to the growth since 2008 of notional amounts outstanding cleared through LCH's Swapclear service. [2] As a percentage of notional amounts outstanding against all counterparties. [3] Figures for the share of positions to which CCPs are counterparties (solid line) are used to estimate the proportion of trades that are cleared (dashed line). The latter is estimated as (CCP/2)/(1–(CCP/2)), where CCP represents the share of notional amounts outstanding that dealers report against CCPs. The CCP share is halved to adjust for the potential double-counting of inter-dealer trades novated to CCPs. [4] Banks here refer to the dealer banks that participate in the BIS semiannual survey of OTC derivatives markets, excluding the positions of dealers that report only in the Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity. [5] Outstanding notional amounts cleared by CCPs at Q2 2018. Figures here refer to US banks, including US branches of foreign banks, that report to the US Office of the Comptroller of the Currency (OCC).

Sources: Clarus Financial Technology; LCH.Clearnet Group; OCC; SNL; BIS derivatives statistics; authors' calculations.

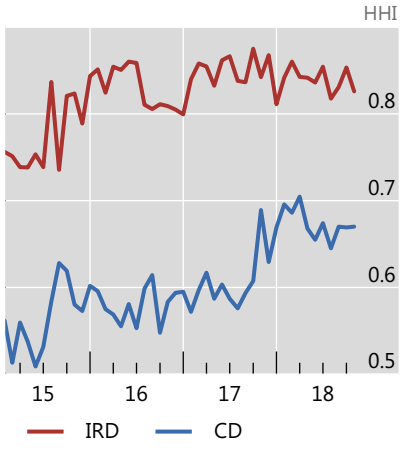
[2] Of course, the increased exposures of banks to CCPs have gone hand in hand with a drop in the direct exposures among banks in OTC derivatives markets.

[3] The central clearing rate is not available directly from reported data, and therefore needs to be estimated. This is done using the share of notional amounts outstanding that dealers report against

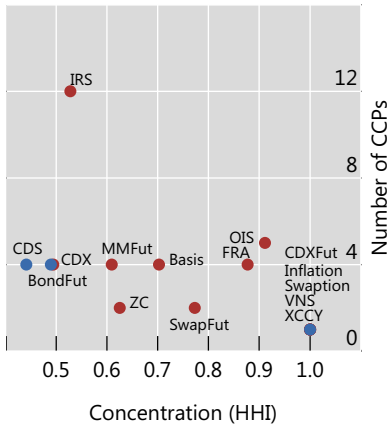
Central counterparties (CCPs) and clearing members are concentrated

Graph 2

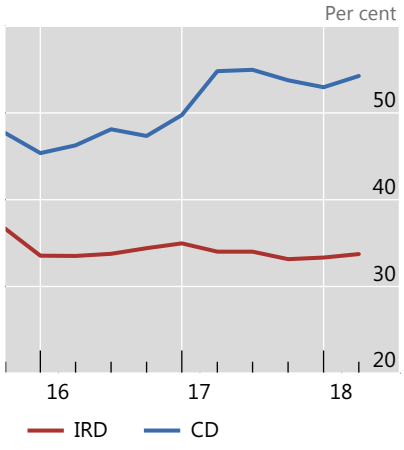
Concentration of CCPs in OTC derivatives markets[1]



Concentration of CCPs in individual products[2]



Five largest clearing members' contribution to CCPs' prefunded resources[3]



CD = credit derivatives; IRD = interest rate derivatives. HHI = Herfindahl–Hirschman Index.

[1] Concentration is measured by the HHI of clearing volume. The HHI ranges from 0 to 1; a higher HHI indicates a more concentrated market. [2] Concentration is measured by the HHI of outstanding notional, average across the period January–September 2018. IRD products: (red dots): basis swaps (Basis), bond futures (BondFut), vanilla fixed float interest rate swaps (IRS), forward rate agreements (FRA), inflation swaps (Inflation), money market futures (MMFut), overnight index swap (OIS), futures on interest rate swaps (SwapFut), swaption, variable notional swaps (VNS), cross-currency swaps (XCCY) and zero coupon swaps (ZC). CD products (blue dots): credit default swap (CDS), credit default swap index (CDX) and futures on credit default swap index (CDXFut). [3] There are four CCPs in IRD: BMEC IRS, CME IRS, JSCC and LCH SwapClear Ltd; and five CCPs in CD: CME CDS, ICC CDS, ICEU CDS, JSCC CDS and LCH CDSClear SA.

Sources: Clarus Financial Technology; authors' calculations.

exposures of individual banks are also large, eg the notional amount of JPMorgan's OTC derivatives exposures to CCPs is about $30 trillion (Graph 1, right-hand panel).

As clearing of OTC derivatives has grown, it has become increasingly concentrated in a few CCPs (Graph 2, left-hand panel). This is the case for credit derivatives (blue line) and even more so for IRDs (red line). Clearing concentration is most obvious at the level of market segments (centre panel). Only a single CCP clears some of the smaller segments – eg swaptions, inflation swaps and CDS index futures. And while interest rate swaps (IRS) are currently cleared by 12 CCPs, the other market subsegments feature six or fewer CCPs.[4]

Netting efficiency is one of the drivers of CCP concentration. Duffie and Zhu (2011) show that CCPs can reduce the aggregate amount of margin by enabling multilateral netting across different counterparties. Thus, the fewer the CCPs through which banks clear their derivatives transactions, the lower the associated collateral and capital requirements.

A handful of systemically important banks typically comprise the main clearing members. The top five clearing member banks contribute around one half of prefunded resources for credit derivatives and more than one third for interest rate

CCPs (solid lines in Graph 1, left-hand panel) and assumptions about the extent to which the reporting population includes the full set of participants. See Wooldridge (2016) and Aldasoro and Ehlers (2018) for details.

[4] Given that some of the product markets are regional, the effective concentration of clearing in these markets is even higher.

derivatives (Graph 2, right-hand panel). A key driver of this concentration is large fixed costs: members need to meet not only CCPs' membership requirements, but also maintain technical infrastructure, contribute to the default fund and have the capacity to monitor CCPs carefully.

In sum, global OTC derivatives clearing is highly concentrated across both banks and CCPs, so that the behaviour of banks and CCPs is closely intertwined.

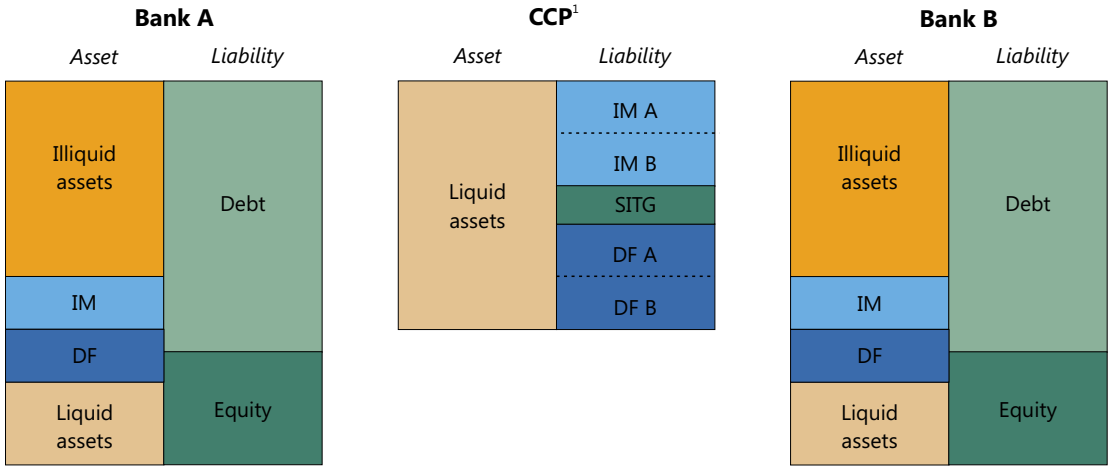
The CCP-bank nexus

Derivatives transactions may hedge but they also generate risks. Specifically, they expose users to market risk, liquidity risk, and counterparty credit risk. The key function of a CCP that clears a derivative transaction between two banks is to manage the counterparty credit risk.

Balance sheet mechanics

For the mechanics of central clearing, consider a simple OTC derivative transaction (eg a CDS contract) between two clearing members, Banks A and B (Graph 3). By clearing this transaction, the CCP severs the bilateral link between the two banks and becomes the counterparty to each of them. First note that, as clearing members, both banks contribute to the CCP's default fund (DF). The DF is part of the CCP's "war chest"

CCP and bank balance sheets at origination of cleared transaction — Graph 3



DF = default fund; IM = initial margin; SITG = CCP skin-in-the-game.

[1] CCPs can draw on additional committed resources, such as cash calls and VM gains haircutting (VMGH). These resources are not prefunded and thus do not appear on balance sheets. CCPs may also have some operational assets in the form of buildings and equipment, which are not shown here as they are not relevant to the issues under discussion.

for managing counterparty risk (see below): it appears as a liability on the CCP's balance sheet and as an asset on the banks' balance sheets.[5]

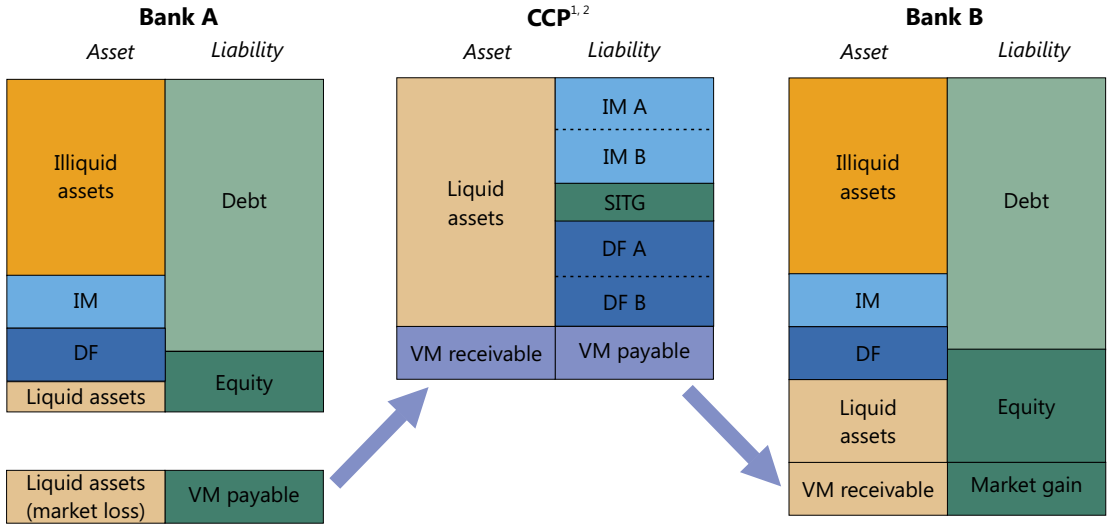
Second, while initially the cleared transaction has zero market value, it has already left a footprint on the balance sheets of the banks and the CCP. Specifically, the CCP requires both banks to post initial margins (IM) for the transaction. The IM – which is a liability for the CCP and an asset for the banks – also adds to the CCP's loss-absorbing capacity. In a hypothetical scenario without any market shocks, the CCP simply repays the IM at the maturity of the transaction.

Graph 3 underscores a key difference between CCP and bank balance sheets. Illiquid assets (eg loans) are a hallmark of the banking model and take up a substantial part of banks' balance sheets. By contrast, CCPs hold exclusively liquid assets.

Market movements affect the price of the derivative, triggering balance sheet adjustments (Graph 4). The bank that has incurred a mark-to-market loss – Bank A in our example – recognises this loss by posting variation margin (VM) with the CCP. In the process, this bank draws down its liquid assets, writing off the same amount of capital on the liability side. In parallel, Bank B receives VM from the CCP and its balance sheet changes symmetrically to that of Bank A. The exchange of VM through the CCP typically takes place daily and prevents the build-up of exposures. Hence, a CCP always has a matched book (see Cecchetti et al (2009), Pirrong (2011)).

CCP and bank balance sheets as price of the cleared contract changes

Graph 4



DF = default fund; IM = initial margin; SITG = CCP skin-in-the-game; VM = variation margin.

[1] CCPs can draw on additional committed resources, such as cash calls and VM gains haircutting (VMGH). These resources are not prefunded and thus do not appear on balance sheets. CCPs may also have some operational assets in the form of buildings and equipment, which are not shown here as they are not relevant to the issues under discussion. [2] The blue arrows show the cash flows generated by a VM call.

[5] In contrast, the default fund's replenishment is accounted for as an expense.

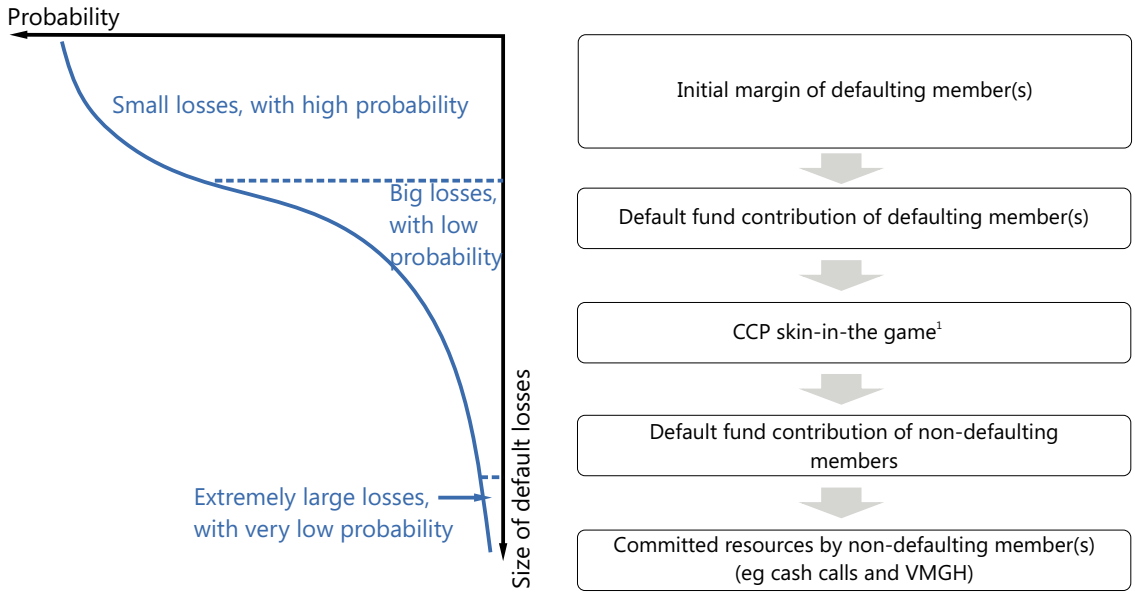
Counterparty credit risk and the default waterfall

In the current context, counterparty credit risk is the risk that a bank does not meet a margin call, ie defaults on its payment obligation to the CCP.[6] When this happens, the CCP still needs to make a payment to the surviving bank. To mitigate this risk, the CCP will aim to fulfil its part of the transaction with the minimum possible loss. The resources on which the CCP can draw will depend on the size of the default loss, as illustrated in the so-called default waterfall (see Domanski et al (2015)) (Graph 5).

Some layers of the default waterfall are not specific to central clearing while others are. In the event of a clearing member's default, a CCP first absorbs losses by drawing on the IM that the defaulter has posted. This is similar to how a counterparty's margin would be used to cover losses in a non-cleared transaction. If the defaulter's IM is insufficient, the CCP has access to resources that would not have been available in a bilateral trade, starting with the defaulting member's contribution to the DF.

The next layer in the waterfall is typically the CCP's own capital, often referred to as "skin in the game" (SITG). But CCPs differ from banks, in that they can continue as going concerns even after exhausting their SITG: they have other resources, sometimes even more junior, to absorb credit losses. For one, the CCP can draw on the DF contributions of all non-defaulting clearing members, not only the one(s) that had initially transacted with the defaulting member(s). It is in this sense that clearing members cross-insure through a mutualised DF. If this does not suffice, the CCP can resort to members' unfunded commitments. It can ask for supplemental funds from

CCP default waterfall — Graph 5



[1] CCP skin-in-the-game (SITG) can come before, along with, and/or after the default fund contributions of non-defaulting members, depending on the CCP's specific rules. Here, we present the typical sequence of CCP SITG. See also Domanski et al (2015).

[6] For simplicity we abstract from the factors behind the bank's payment default and how it relates to insolvency and resolution. These issues are beyond the scope of this article.

surviving members (cash calls) or retain (part of) their variation margin gains (variation margin gains haircutting (VMGH)). In other words, the CCP has loss-absorbing capacity that goes beyond its balance sheet: the CCP itself would not fail as long as the loss mutualisation process continues to work.

Risks and interactions

CCPs manage counterparty credit risk through the different layers of the default waterfall. Banks take into account CCPs' rules in their risk-taking behaviour. Both activities influence each other.

A CCP seeks to ensure that the prefunded resources posted by clearing members (ie IM and DF) are sufficient to cover even extreme losses with high certainty. The IM is set to cover the potential changes in the value of a trade. To this end, the CCP sets IM based on three key parameters: (i) the likelihood of large fluctuations in the price of the underlying asset; (ii) the expected time needed to close the position at fair price; and (iii) the desired confidence level for the loss at default.[7] The CCP sets the size of the mutualised DF so that it can cover default(s) of the largest clearing member(s) at the CCP.[8] Typically, the DF requirements are adjusted less frequently than margins.

The behaviour of banks influences that of CCPs and vice versa. On the one hand, banks' risk-taking affects how IM and DF are determined. For instance, a CCP will require a high IM for a bank with a very concentrated position because it would expect to close the position over a long time period and with a large price impact. On the other hand, contributing to the CCP's default waterfall imposes costs on banks. For instance, the size of IM affects the cost of derivative trading (see eg Pirrong (2013), Murphy et al (2014)). These costs can affect banks' risk-taking.

The default waterfall structure further complicates these interactions, as the size of the losses determines which layers come into play. Hence, the level of market stress affects the interactions between CCPs and banks.

Stress transmission in the CCP-bank nexus

Drawing on historical examples of CCPs for exchange-traded derivatives, this section illustrates the CCP-bank nexus using three stress scenarios that differ in terms of the affected layers of CCP loss-absorbing capacity.[9] The first scenario refers to a medium

[7] CPSS-IOSCO (2012) requires at least 99% of the estimated distribution of future exposures to be covered. Further guidance is provided in CPMI-IOSCO (2017b). Subject to regulatory minimums, CCPs can differ in terms of the specific parameters or methodologies they use for setting margins. IM is posted at the trade's inception, but the CCP can update IM requirements if the above three parameters change.

[8] All CCPs are required at a minimum to cover the default of their largest clearing member (the so-called Cover 1 principle). This minimum is higher (ie covering a default of the largest two clearing members, the so-called Cover 2 principle) for CCPs that are involved in complex products and/or are systemically important in more than one jurisdiction (CPSS-IOSCO (2012)). There are no global standards on the required size of the CCP's SITG, although CPMI-IOSCO (2017b) provides guidance.

[9] Market stress is most appropriately viewed as a continuum. In reality, a stress event can move from one scenario to another, and potentially cover all of the scenarios outlined. This categorisation into

level of stress, where only the IM is at risk (Graph 5 left-hand panel). Higher stress in the second scenario puts at risk further layers of the default waterfall, including the SITG and the DF. The third scenario refers to an extreme level of stress, at which the CCP would turn to unfunded commitments, by calling on member banks.

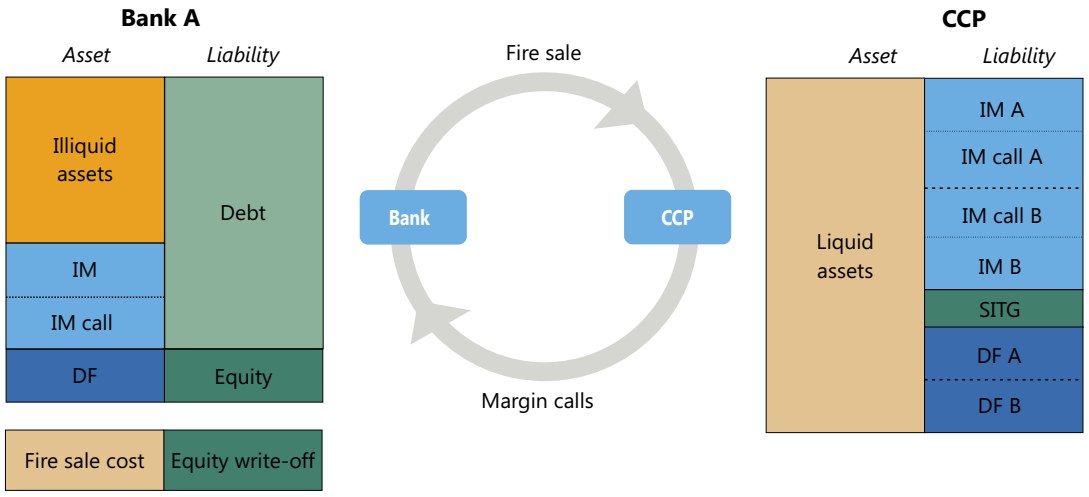
Medium stress: initial margin at risk

In the first scenario, the stress affects only the IM, as in the period following the United Kingdom's Brexit referendum vote in June 2016 (Box B).

The increase in market volatility leads to liquidity strains. As volatility increases, a CCP issues IM calls, because the likelihood of further large fluctuations in the price of the underlying asset also rises (Graph 6, right-hand panel). In meeting IM calls at short notice, en masse, banks may face larger-than-normal haircuts on liquid assets (a "fire sale"), or may even need to tap into their illiquid assets (Graph 6, left-hand panel).

A feedback loop could then arise, as the banks' fire sales might spill over into the derivatives markets, especially if banks sell precisely those assets that were stressed in the first place. The spillback could then exacerbate the very volatility that prompted the IM calls.

The CCP-bank nexus under medium stress[1, 2] Graph 6



DF = default fund; IM = initial margin; SITG = CCP skin-in-the-game.

[1] In this scenario, the stressed bank is Bank A. Hence, this graph focuses on the balance sheets of Bank A and the CCP. [2] The loop in the middle shows the main transmission channel in this scenario: margin calls from the CCP could prompt a fire sale of illiquid assets by Bank A, which might then spill back to the CCP.

three scenarios, which differ in terms of the CCP loss-absorbing capacity involved, is a simplification. There could be alternative categorisations, for instance, centred on banks.

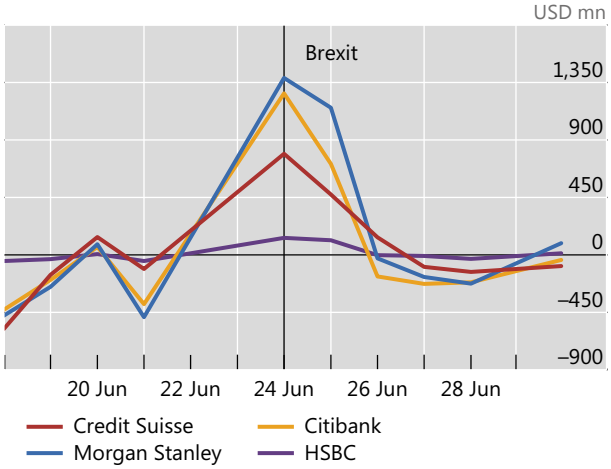
Margining during the Brexit episode

The Brexit referendum led to large margin fluctuations on 24 June 2016. The outcome surprised markets, causing sharp swings in exchange and interest rates and thereby triggering large intraday margin calls for banks in the interest rate swap markets. The margin calls in the days following the referendum are estimated to have been around $27 billion, five times greater than the previous 12-month daily average.① Publicly available data on the size of these margin calls for individual banks are limited. However, according to figures reported by US institutions, Morgan Stanley and Citigroup each received more than $1 billion in margin calls for their client clearing businesses, more than twice as much as normal (Graph B, left-hand panel).

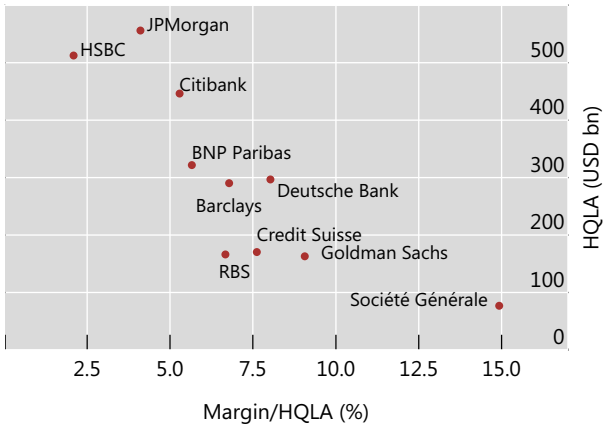
CCP initial margins and bank HQLA

Graph B

Margin calls for US FCMs[1]



Estimated relationship between margin and HQLA for large banks[2, 3]



HQLA = high-quality liquid assets.

[1] Based on daily client segregation data for US futures commission merchants (FCMs). These data cover the net settlement to derivatives clearing organisations, which is essentially the sum of the margin calls received on a given day. HSBC refers to the US branches of HSBC Holdings plc. [2] Data for end-2017. [3] To estimate the total margin for individual banks based on the public data, we make the following assumptions. First, the required margin for a bank is proportional to its outstanding notional in derivatives. Second, a bank's derivatives portfolio consists mainly of credit derivatives (CD) and interest rate contracts (IRD). Third, the proportion of centrally cleared and bilaterally cleared is the same across banks. Fourth, the top 10 clearing members in CD CCPs are the same. The top 10 clearing members in IRD CCPs are the same. Based on these assumptions, we use individual banks' CD and IRD outstanding notionals in SNL and CCPs' top 10 clearing members' IM in Clarus to calculate individual banks' margins.

Sources: CFTC rule 1.55 segregation reports; Clarus Financial Technology; SNL; authors' calculations.

While the Brexit event moved markets, it did not cause widespread turmoil or problems in specific financial institutions. It did, nonetheless, lead to large margin calls and liquidity outflows for banks. Such margin calls, if they were to happen in a more volatile environment, could subject banks to substantial liquidity strain. The reason is that margins represent a relatively large proportion of banks' total high-quality liquid assets (HQLA) (Graph B, right-hand panel). The estimated margins for individual G-SIBs range from 2.5 to 15% of HQLA. Under an adverse scenario, when liquidity is already likely to be under pressure from other sources and markets are experiencing fire sales, margin calls can represent a potentially serious source of liquidity risk. More reassuringly, however, larger institutions tend to have lower margin-to-HQLA ratios, which would tend to limit the systemic ramifications of increased margining.

① This amount covers margin calls by CME Clearing, ICE Clear Credit, ICE Clear Europe, ICE Clear U.S. and LCH Clearnet Ltd. See CFTC (2016).

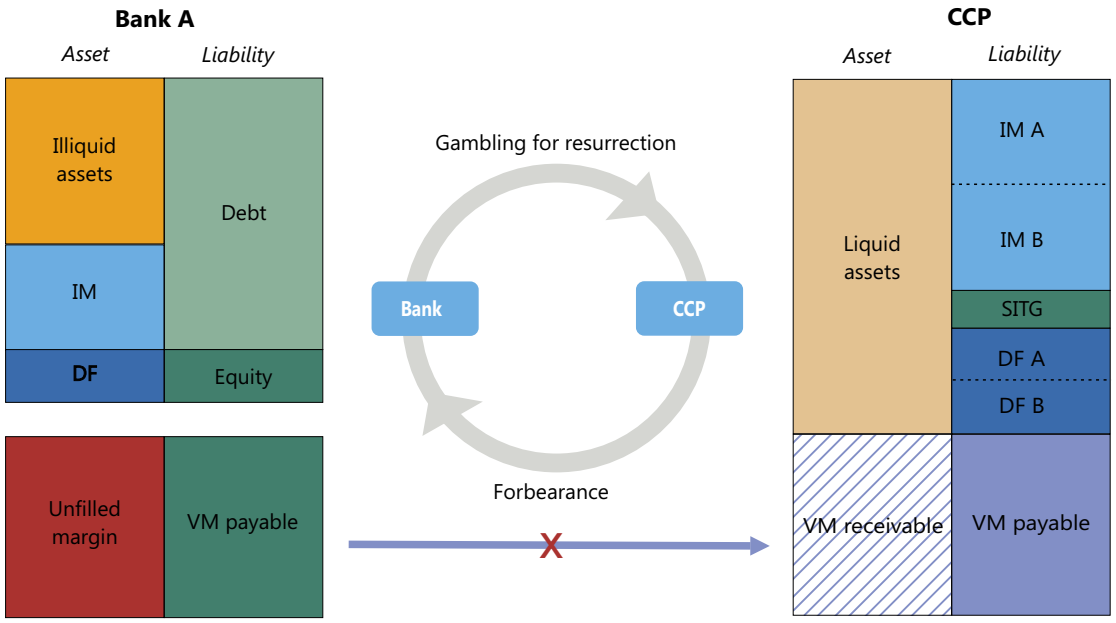
High stress: default fund at risk

The second scenario is based on the French *Caisse de Liquidation des Affaires et Marchandises* (CLAM) case in 1974 (Box C). A key characteristic of this scenario is that the CCP, fearing the depletion of its default fund, postpones margin collections from a stressed bank (ie forbears).

In this scenario, one large clearing member bank cannot meet its VM calls due to the high market stress (Graph 7, red cells in the left-hand panel). Technically, it is in default. However, the default has to be officially acknowledged by the CCP if it wants to use any of the default waterfall funds. Recognising the stressed bank's default (and thus the large associated losses) could cause the CCP to lose its own capital (SITG). Additionally, the CCP could face reputational losses and impaired franchise value. The hope that the bank would be able to pay VM at a later stage incentivises the CCP to forbear recognition of the member default, to the extent possible (crossed arrow in Graph 7).[10]

The CCP's forbearance allows the stressed bank to continue its usual business activities. On the one hand, the CCP acts countercyclically and could potentially avoid destabilising the financial system. On the other hand, banks that are close to failure

The CCP-bank nexus under high stress[1, 2, 3] Graph 7



DF = default fund; IM = initial margin; SITG = CCP skin-in-the-game; VM = variation margin.

[1] In this scenario, the stressed bank is Bank A. Hence, this graph focuses on the balance sheets of Bank A and the CCP. [2] The crossed arrow shows the VM payments that should be made but are forborne by the CCP. The shaded VM receivable indicates that part of the asset is not with the CCP because of the forbearance. [3] The loop in the middle shows the main transmission channel in this scenario: forbearance from the CCP allows Bank A to gamble for resurrection; if this does not work, large losses will spill back to the CCP.

[10] Global standards and national regulations tend to put limits on the margining discretion of CCPs. However, in practice some flexibility likely remains as excessively rigid margining rules might force inefficient bank resolution due to margin calls in times of stress.

are tempted to gamble for resurrection (eg Freixas et al (2004)).[11] Therefore, the CCP's forbearance could interact with gambling-for-resurrection by the stressed bank, leading to even larger credit losses down the road. For instance, CLAM's forbearance enabled the stressed member to pile up even larger positions, which amplified its initial losses (see Bignon and Vuillemey (2017)).

Extreme stress: committed resources at risk

The third scenario stems from extreme market stress that forces the CCP to declare the default of one or more large clearing member banks. Furthermore, the CCP's default-related losses are so large that they exhaust the prefunded resources of the waterfall (IM and DF). The closest example of such a scenario is the failure of the Hong Kong Futures Guarantee Corporation in 1987 (Box C).

In this scenario, surviving member banks are asked to cover any losses remaining after the prefunded resources have been exhausted (Graph 8, right-hand panel). There are two main tools available to the CCP in this setting (left-hand panel).

First, the CCP can issue cash calls, asking all surviving members to cover the remaining losses. In such extreme stress, however, the prudent individual behaviour of surviving members would be to hoard liquidity in order to safeguard their own stability (Morris and Shin (2008)). In other words, the surviving members can refuse to honour their cash calls (dashed arrow on right-hand panel). If they do so, this would

Box C

CCP failures: a rare but present danger

CCP failures are few and far between. There have been only three such instances over the last 50 years: the French *Caisse de Liquidation des Affaires et Marchandises* in 1974,① the Kuala Lumpur Commodity Clearing House in 1983, and the Hong Kong Futures Guarantee Corporation in 1987.② These episodes have some elements in common. First, all three CCPs cleared long-dated derivatives contracts. Second, the weeks before the failure saw unusually high volatility in the underlying asset price. Third, unmet margin calls by the clearing members triggered the failure.

There have also been a number of near-failures associated with periods of market stress (IMF (2010)). In the wake of the October 1987 equity market crash, both the Chicago Mercantile Exchange and the Options Clearing Corporation met with difficulties in receiving the required margin increases from their members. Brazil's BM&F CCP almost failed in 1999 after a devaluation of the Brazilian real caused two clearing members to default.

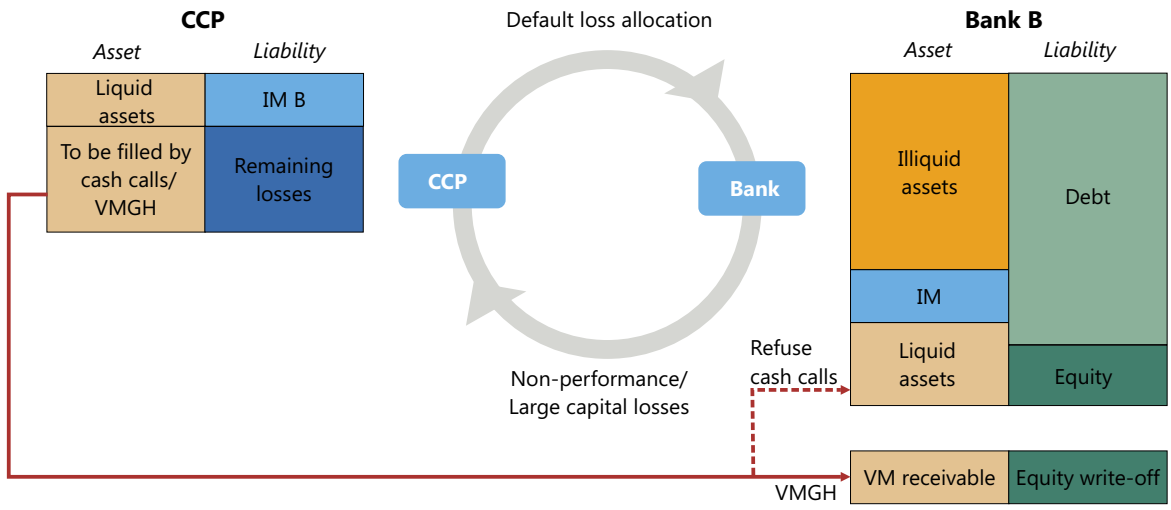
In some cases, CCPs have come under stress in relatively benign market conditions. In December 2013, a Korean CCP dipped into its mutualised default fund after one of its members – a small broker-dealer – defaulted because of a trading error. The surviving clearing members absorbed more than $40 million in losses by replenishing the fund. The more recent case of Nasdaq Clearing AB is discussed in Box A.

Together, these episodes highlight the fact that, while CCPs are designed for safety, they can fail. Preventing and managing these eventualities is the key motivation for the extensive work by regulators to put in place viable recovery and resolution plans (CPSS-IOSCO (2012), CPMI-IOSCO (2017), and FSB (2014, 2017)).

① Bignon and Vuillemey (2017) set out a detailed exposition of the events around the CLAM failure. ② In October 1987, the HKFGC defaulted and remained closed for four days, before being bailed out by the government with an injection of HK$ 1 billion. See the Davison Report (1988) for more details.

[11] Excessive risk-taking makes eminent sense for the failing bank's shareholders: if the gamble succeeds, the institution is saved. If it fails, other stakeholders, most likely the government, will bear the ensuing costs because of limited liability

The CCP-bank nexus under extreme stress[1, 2, 3] Graph 8



DF = default fund; IM = initial margin; VM = variation margin; VMGH = variation margin gains haircutting.

[1] In this scenario, the stressed bank is Bank B. Hence, this graph focuses on the balance sheets of Bank B and the CCP. [2] The red arrows stand for the cash calls and VMGH issued by the CCP. The dashed one refers to the committed payment that is supposed to be made but is not made. [3] The loop in the middle shows the main transmission channel in this scenario: loss allocation by the CCP may lead to a realisation of Bank B's non-performance risk, or push Bank B into large capital losses. These losses can spill back to the CCP, destabilising the system as a whole.

deny resources to the CCP, threaten its recovery and, ultimately, destabilise the financial system as a whole. Even if surviving members do honour their commitments, some of them might have to resort to fire sales in order to access liquidity – thereby putting pressure on the broader derivatives markets and hence back on the CCP (Holden et al (2016)).

Second, the CCP could resort to VMGH. In effect, this would allow the CCP to draw on any VM gains of the non-defaulted clearing members in order to cover losses (solid red arrow on right-hand panel). While VMGH eliminates the risk of non-performance by banks, it implies that certain derivative contracts will no longer hedge other risks that banks have taken on. This could threaten the viability of the non-defaulted banks.

Either tool may place, or threaten to place, non-defaulted banks under stress. In turn, the stress on banks could put further pressure on the CCP. Ultimately, in order to avoid a broader fallout that endangers the entire financial system, the authorities might have to step in to place the CCP in resolution (Cunliffe (2018)).[12]

[12] Given the systemic nature of CCPs, recovery might be more realistic than resolution at this stage.

Conclusion

Regulators are well aware of potential feedback effects between banks and CCPs (eg CPMI-IOSCO (2018)). In fact, regulatory standards for CCPs and banks are set up to work with one another and to reinforce incentives to ensure financial stability. And agencies have considered various second-round effects (eg ESMA (2018)). However, given the complex web of incentives, spanning different institutions and markets, what might transpire under some stress scenarios is less than fully understood.

This special feature has focused on the CCP-bank nexus, ie the two-way interactions between banks and CCPs. Arising from balance sheet interlinkages and the structure of the CCP default waterfall, these interactions can vary with the level of stress. Under some conditions, they might lead to a destabilising feedback loop with potentially system-wide effects. This puts a premium on the joint assessment of banks' and CCPs' risks in order to understand the endogenous build-up of risk.

Even though our framework is stylised, it could help frame policy discussions. Admittedly, we have abstracted from potentially important institutional details, such as the CCP ownership structure or linkages stemming from the provision of credit lines by clearing members. That said, the framework incorporates key institutional characteristics and allows for an intuitive explanation of the often complex interactions between banks and CCPs.

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Annexes

BIS Statistics: Charts

The statistics published by the BIS are a unique source of information about the structure of and activity in the global financial system. BIS statistics are presented in graphical form in this annex and in tabular form in the *BIS Statistical Bulletin*, which is published concurrently with the *BIS Quarterly Review*. For introductions to the BIS statistics and a glossary of terms used in this annex, see the *BIS Statistical Bulletin*.

The data shown in the charts in this annex can be downloaded from the *BIS Quarterly Review* page on the BIS website (www.bis.org/publ/quarterly.htm). Data may have been revised or updated subsequent to the publication of this annex. For the latest data and to download additional data, see the statistics pages on the BIS website (www.bis.org/statistics/index.htm). A release calendar provides advance notice of publication dates (www.bis.org/statistics/relcal.htm).

A Locational banking statistics

B Consolidated banking statistics

C Debt securities statistics

D Derivatives statistics

E Global liquidity indicators

F Statistics on total credit to the non-financial sector

G Debt service ratios for the private non-financial sector

H Property price statistics

I Effective and US dollar exchange rate statistics

J Credit-to-GDP gaps

K Consumer price indices

L Central bank policy rates

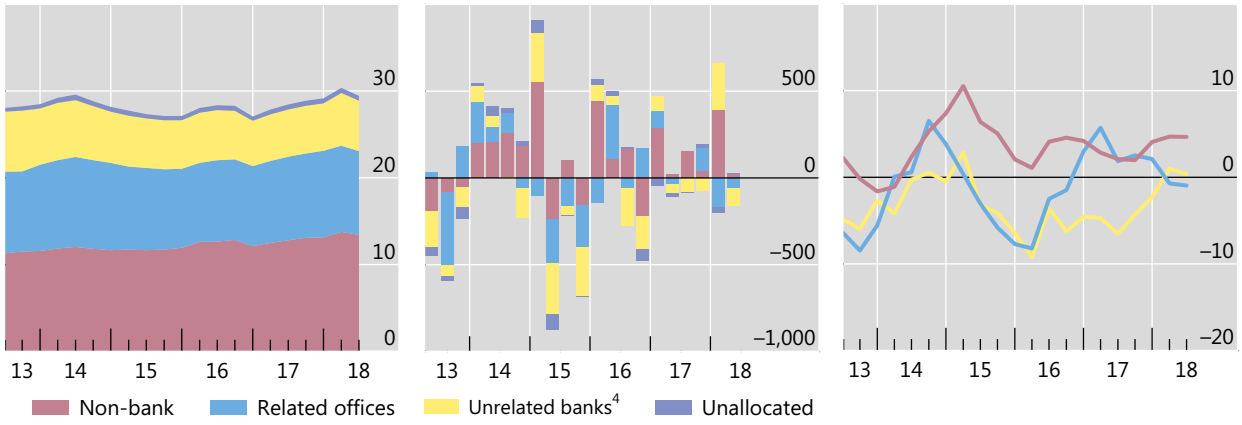
A Locational banking statistics

Cross-border claims, by sector, currency and instrument

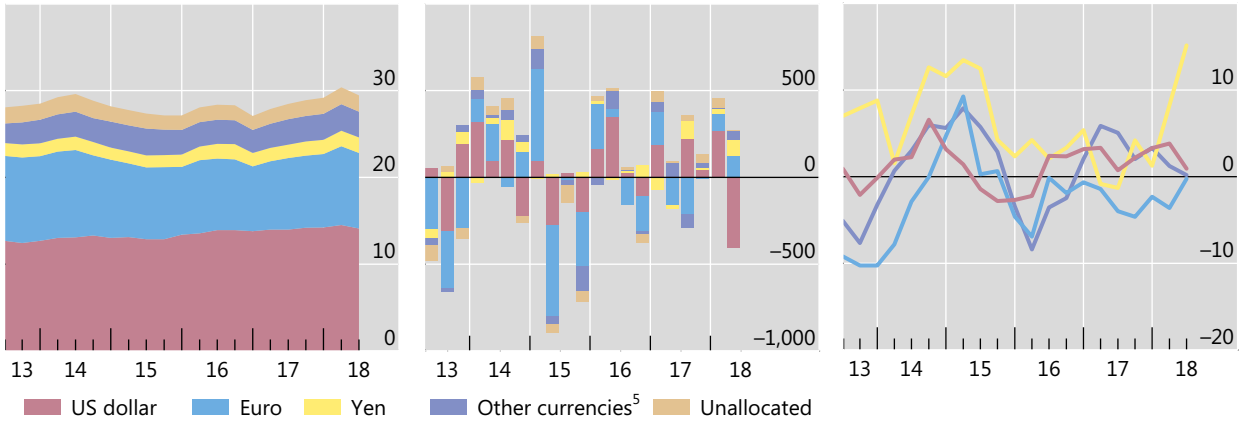
Graph A.1

Amounts outstanding, in USD trn[1] | Adjusted changes, in USD bn[2] | Annual change, in per cent[3]

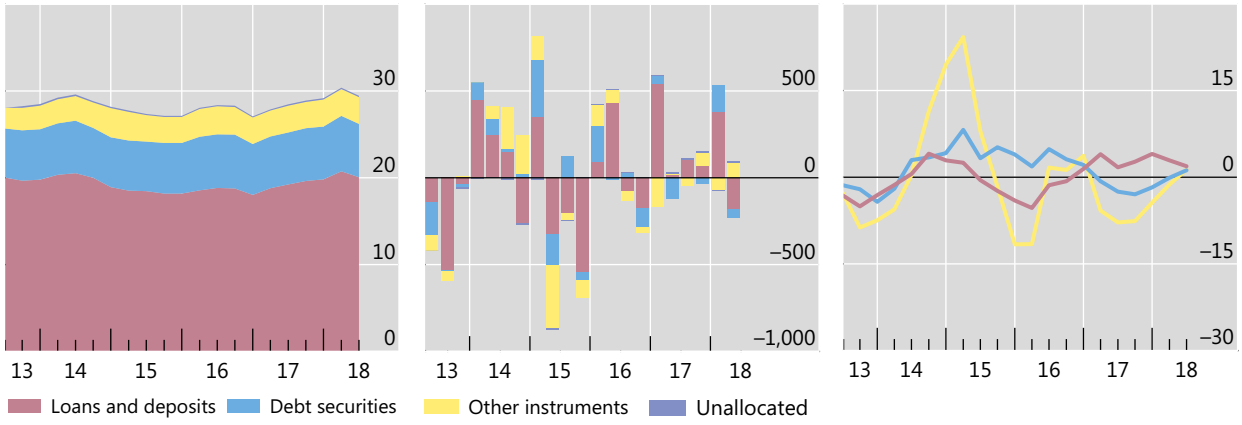
By sector of counterparty



By currency



By instrument



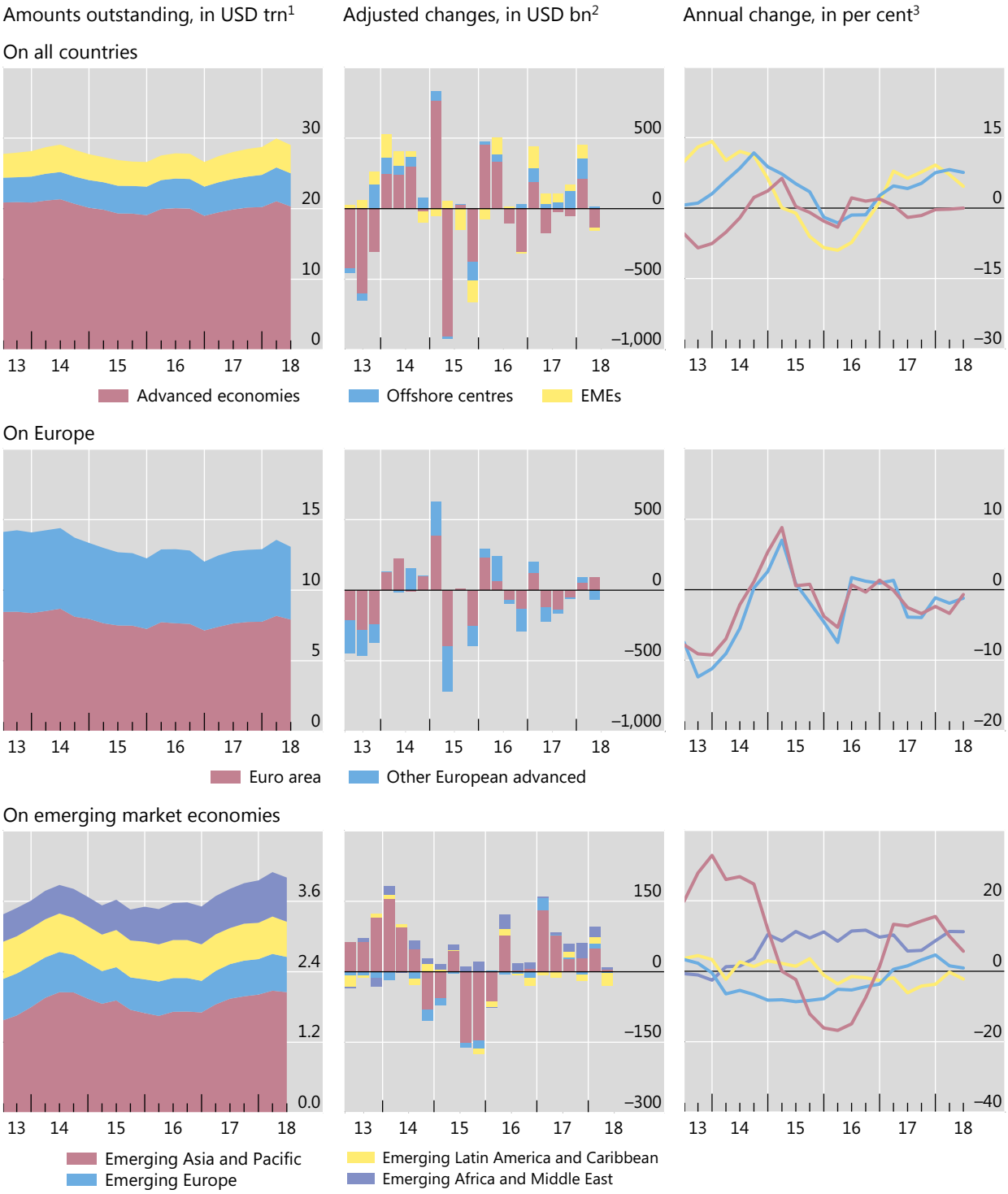
Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

[1] At quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [2] Quarterly changes in amounts outstanding, adjusted for the impact of exchange rate movements between quarter-ends and methodological breaks in the data. [3] Geometric mean of quarterly percentage adjusted changes. [4] Includes central banks and banks unallocated by subsector between intragroup and unrelated banks. [5] Other reported currencies, calculated as all currencies minus US dollar, euro, yen and unallocated currencies. The currency is known but reporting is incomplete.

Source: BIS locational banking statistics.

Cross-border claims, by borrowing region

Graph A.2



Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

[1] At quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [2] Quarterly changes in amounts outstanding, adjusted for the impact of exchange rate movements between quarter-ends and methodological breaks in the data. [3] Geometric mean of quarterly percentage adjusted changes.

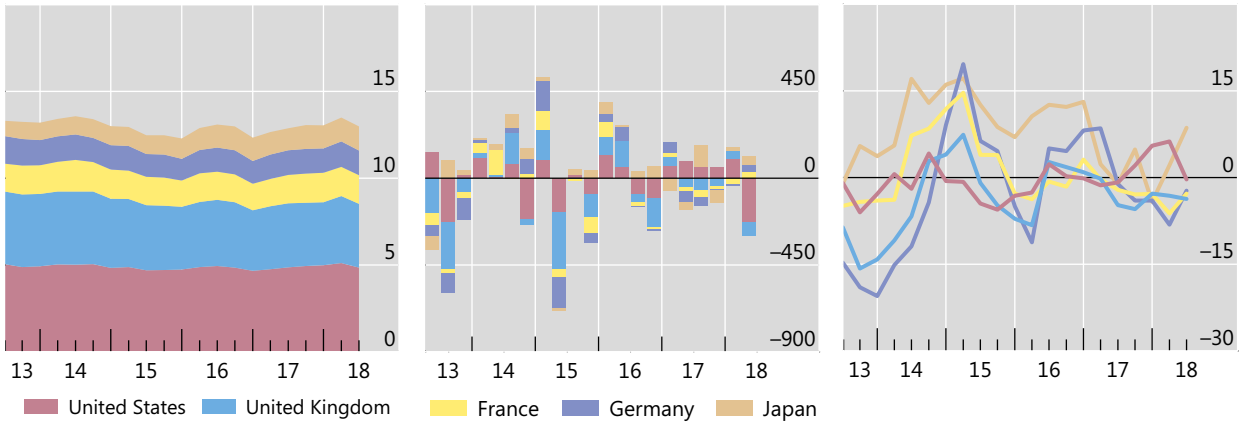
Source: BIS locational banking statistics.

Cross-border claims, by borrowing country

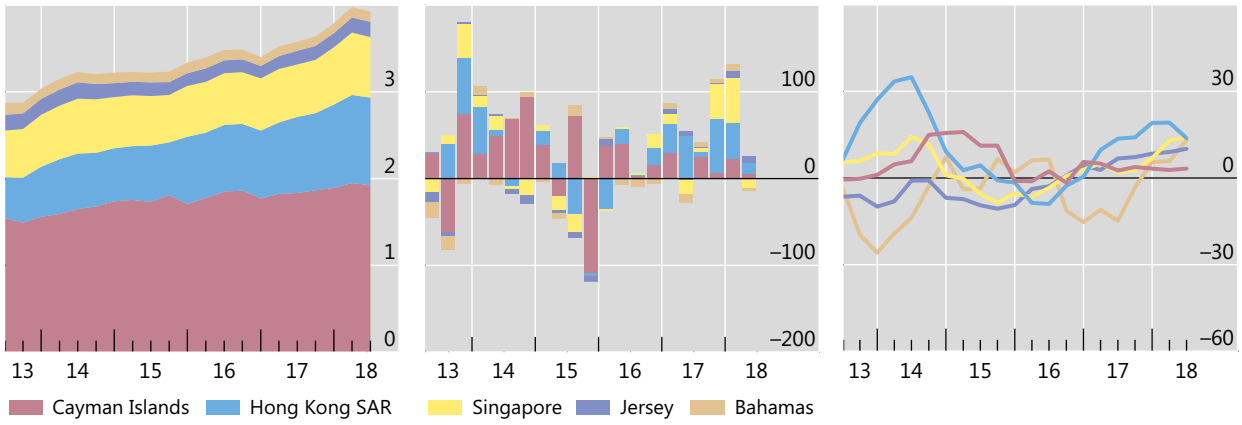
Graph A.3

Amounts outstanding, in USD trn[1] | Adjusted changes, in USD bn[2] | Annual change, in per cent[3]

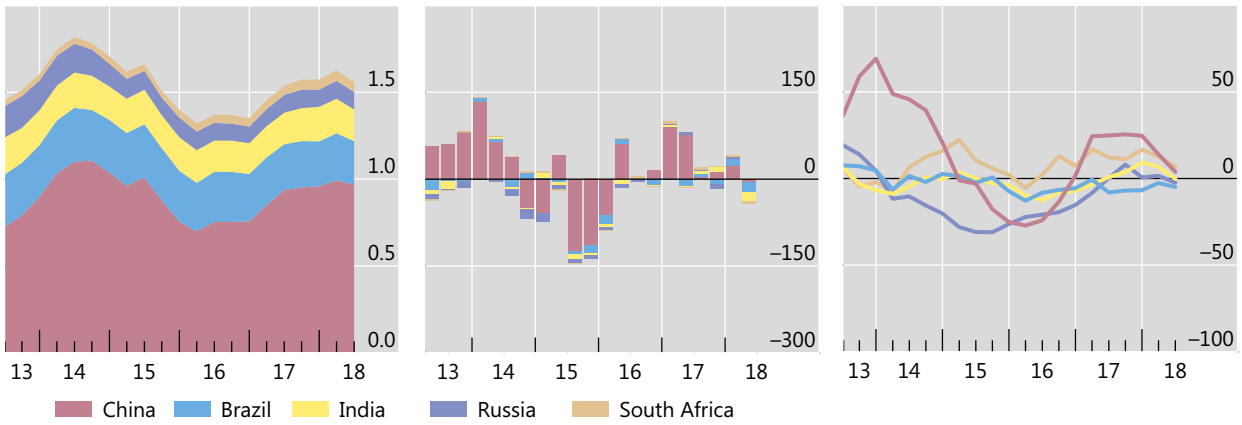
On selected advanced economies



On selected offshore centres



On selected emerging market economies



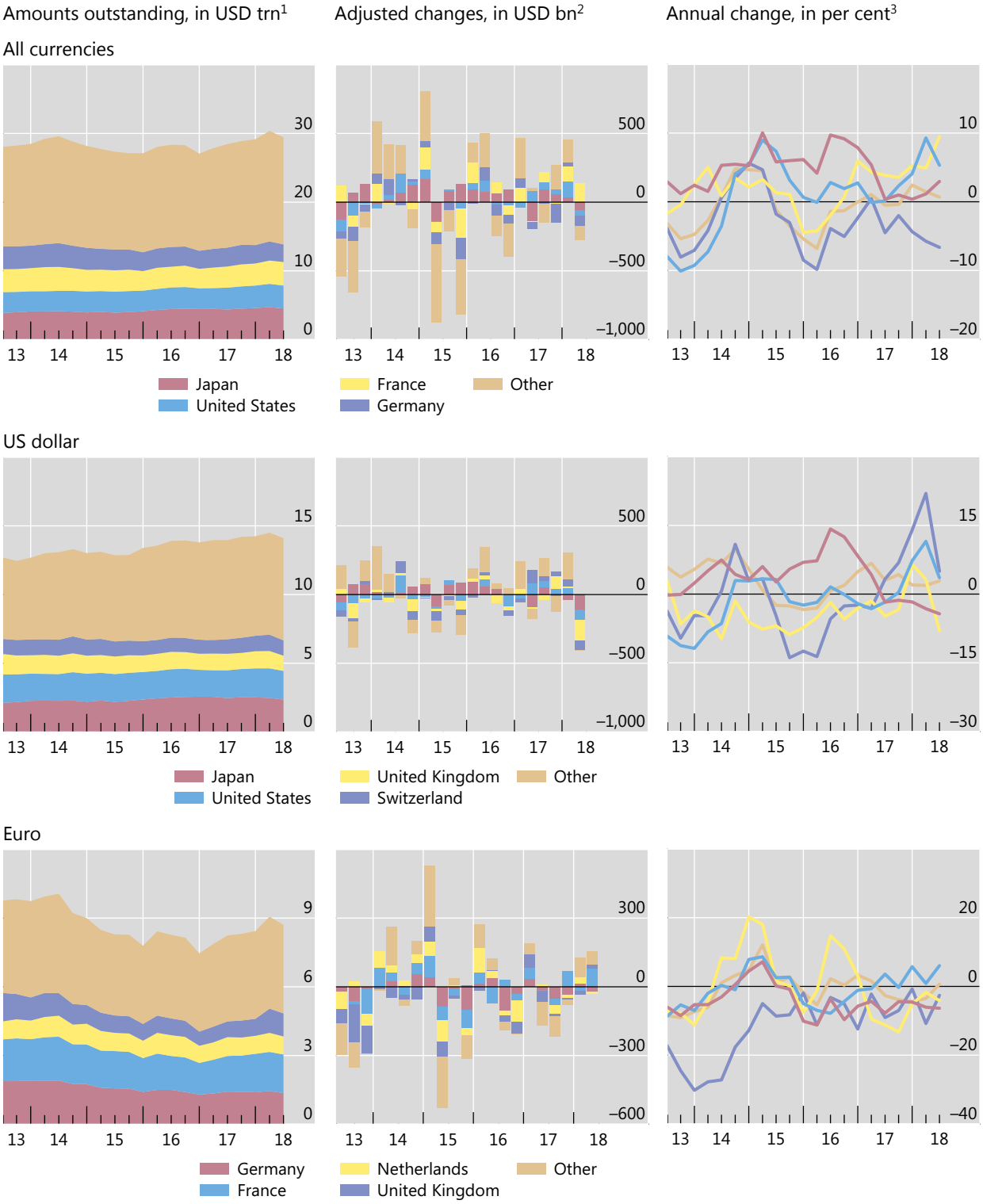
Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

[1] At quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [2] Quarterly changes in amounts outstanding, adjusted for the impact of exchange rate movements between quarter-ends and methodological breaks in the data. [3] Geometric mean of quarterly percentage adjusted changes.

Source: BIS locational banking statistics.

Cross-border claims, by nationality of reporting bank and currency of denomination

Graph A.4



Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

[1] At quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [2] Quarterly changes in amounts outstanding, adjusted for the impact of exchange rate movements between quarter-ends and methodological breaks in the data. [3] Geometric mean of quarterly percentage adjusted changes.

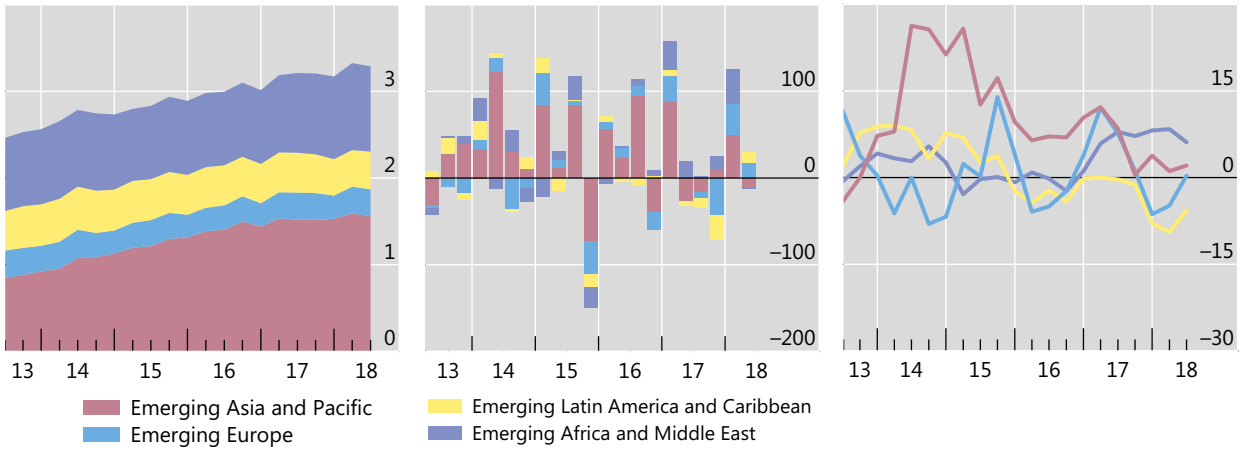
Source: BIS locational banking statistics.

Cross-border liabilities of reporting banks

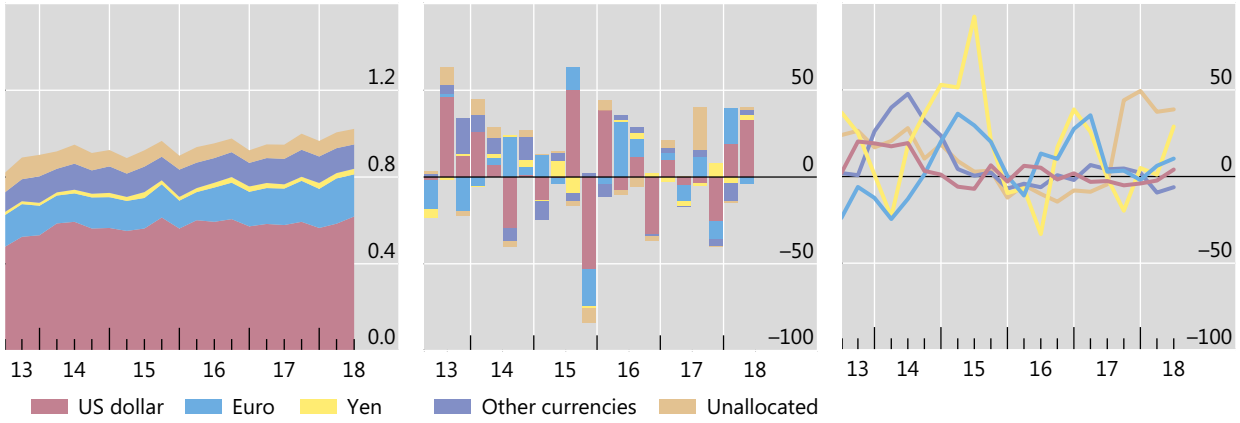
Graph A.5

Amounts outstanding, in USD trn[1] | Adjusted changes, in USD bn[2] | Annual change, in per cent[3]

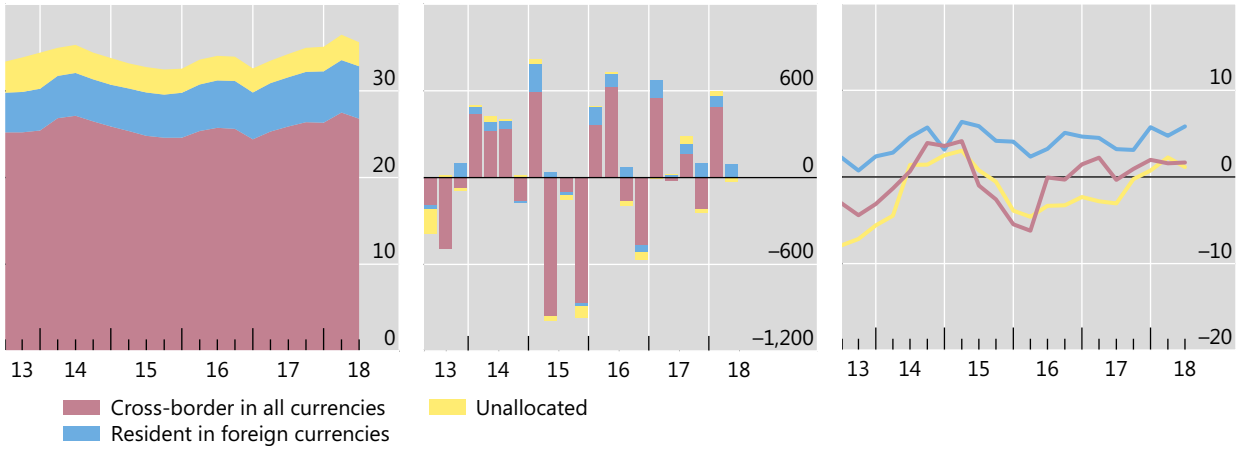
To emerging market economies



To central banks



By currency type and location



Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

[1] At quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [2] Quarterly changes in amounts outstanding, adjusted for the impact of exchange rate movements between quarter-ends and methodological breaks in the data. [3] Geometric mean of quarterly percentage adjusted changes.

Source: BIS locational banking statistics.

B Consolidated banking statistics

Consolidated claims of reporting banks on advanced economies

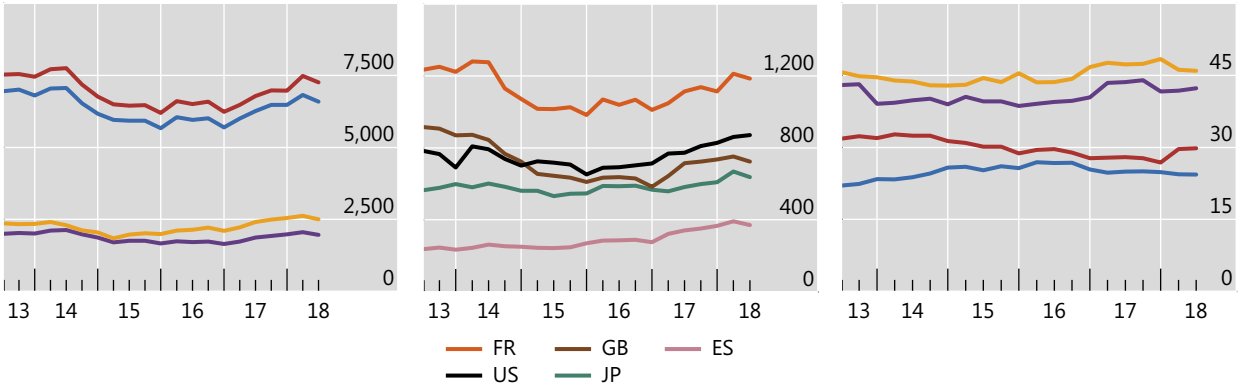
Graph B.1

Foreign claims and local positions, in USD bn[1, 2]

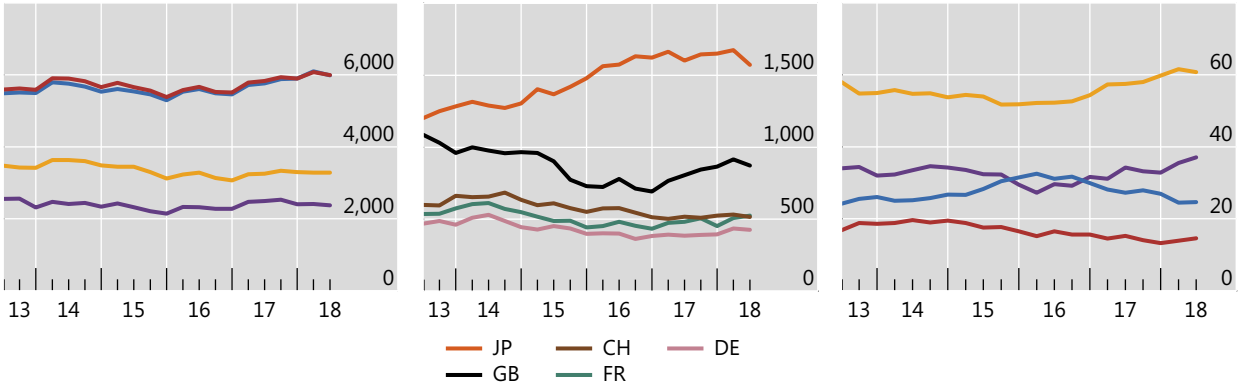
Foreign claims of selected creditors, in USD bn[1, 3]

International claims, by sector and maturity, in per cent[4]

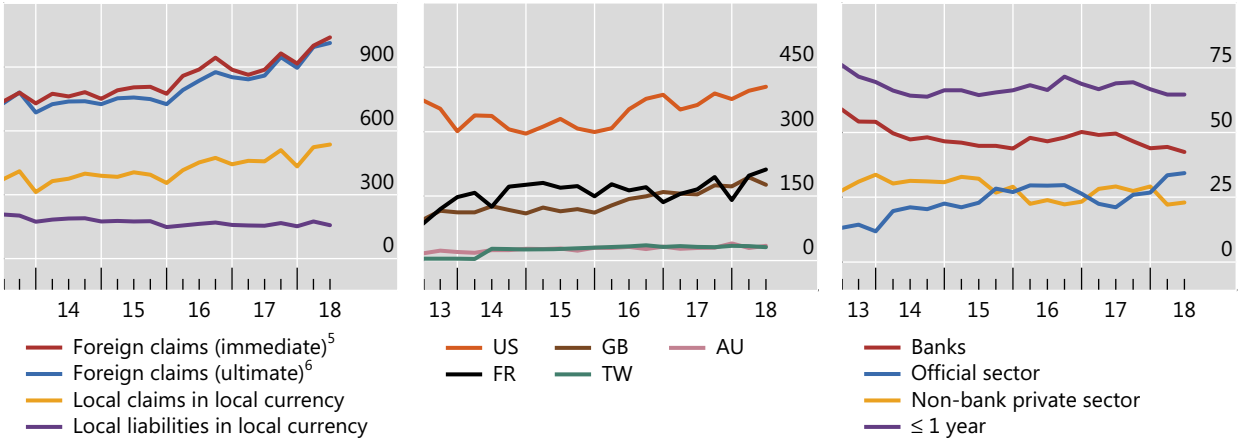
On the euro area



On the United States



On Japan



Further information on the BIS consolidated banking statistics is available at www.bis.org/statistics/bankstats.htm.

[1] Amounts outstanding at quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [2] Excludes domestic claims, ie claims on residents of a bank's home country. [3] Foreign claims on an ultimate risk basis, by nationality of reporting bank. The banking systems shown are not necessarily the largest foreign bank creditors on each reference date. [4] As a percentage of international claims outstanding. [5] On an immediate counterparty basis. Includes the unconsolidated claims of banks headquartered outside but located inside CBS-reporting countries. [6] On an ultimate risk basis.

Source: BIS consolidated banking statistics (CBS).

Consolidated claims of reporting banks on emerging market economies

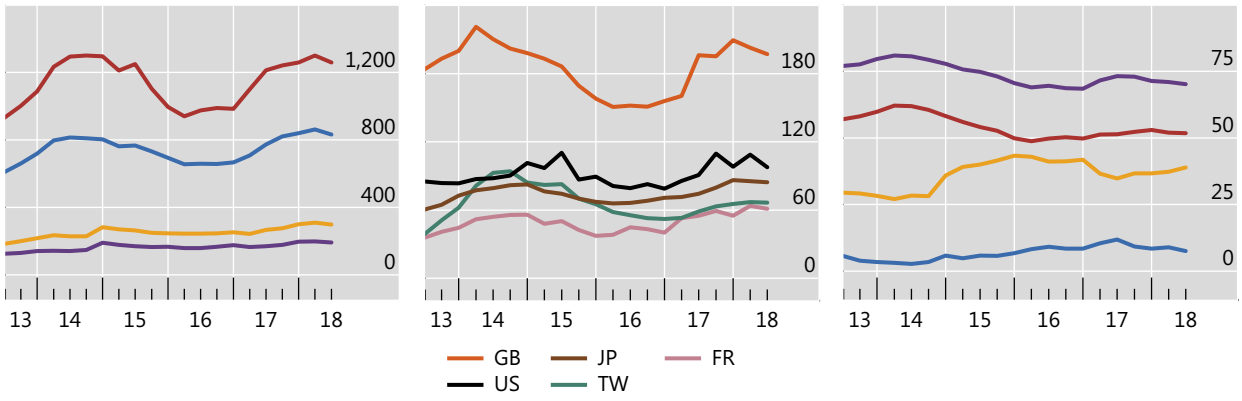
Graph B.2

Foreign claims and local positions, in USD bn[1, 2]

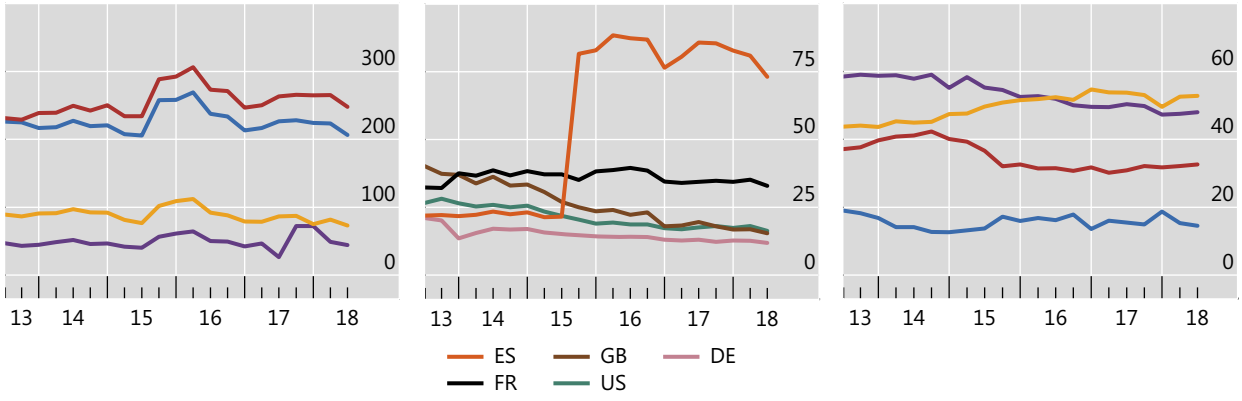
Foreign claims of selected creditors, in USD bn[1, 3]

International claims, by sector and maturity, in per cent[4]

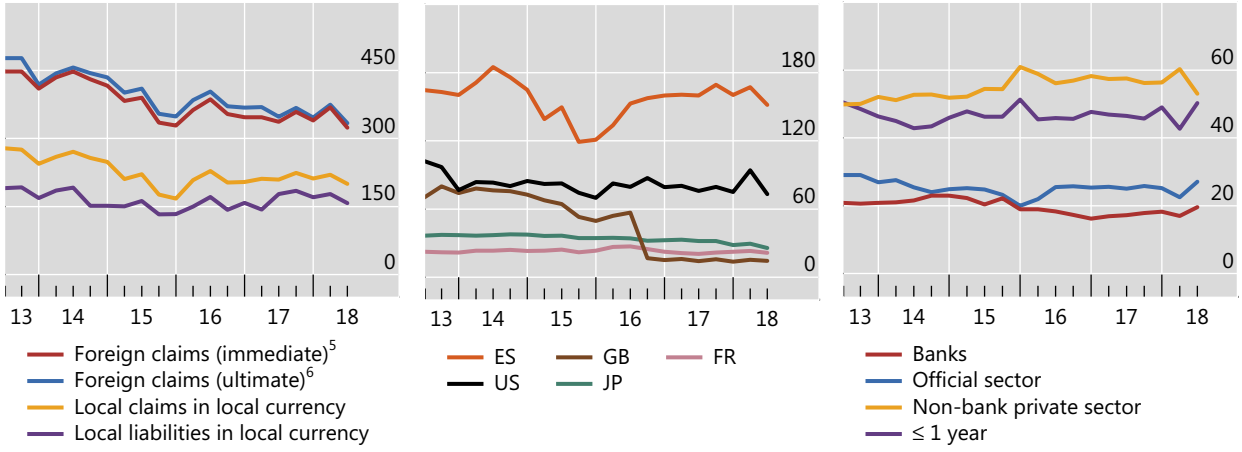
On China



On Turkey



On Brazil



Further information on the BIS consolidated banking statistics is available at www.bis.org/statistics/bankstats.htm.

[1] Amounts outstanding at quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [2] Excludes domestic claims, ie claims on residents of a bank's home country. [3] Foreign claims on an ultimate risk basis, by nationality of reporting bank. The banking systems shown are not necessarily the largest foreign bank creditors on each reference date. [4] As a percentage of international claims. [5] On an immediate counterparty basis. Includes the unconsolidated claims of banks headquartered outside but located inside CBS-reporting countries. [6] On an ultimate risk basis.

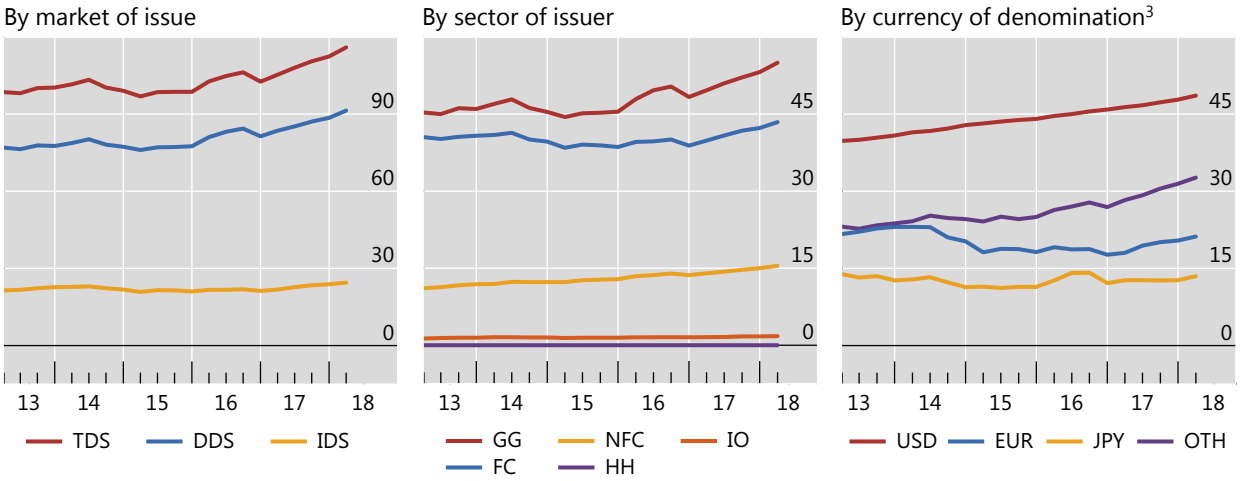
Source: BIS consolidated banking statistics (CBS).

C Debt securities statistics

Global debt securities markets[1]

Amounts outstanding, in trillions of US dollars[2]

Graph C.1



DDS = domestic debt securities; IDS = international debt securities; TDS = total debt securities.

FC = financial corporations; GG = general government; HH = households and non-profit institutions serving households; IO = international organisations; NFC = non-financial corporations.

Further information on the BIS debt securities statistics is available at www.bis.org/statistics/secstats.htm.

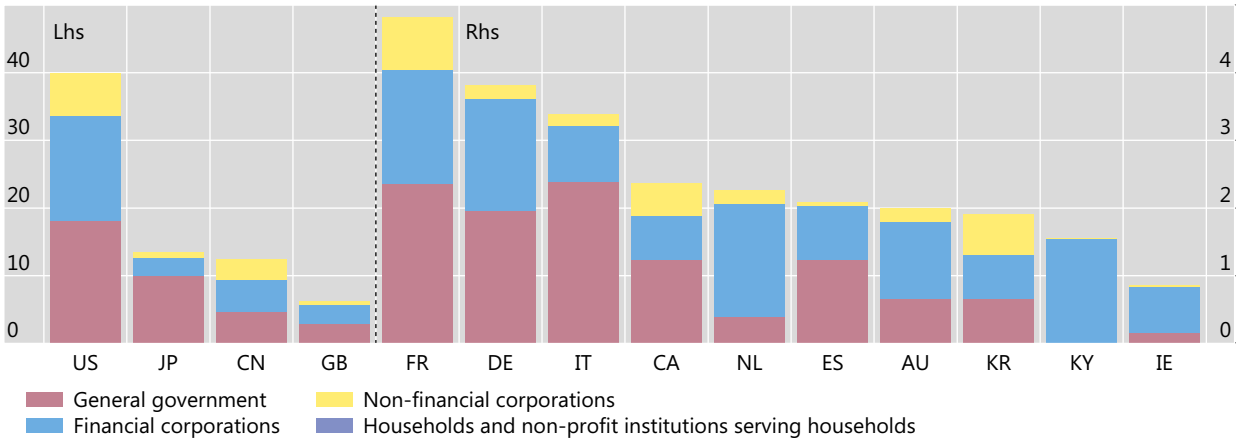
[1] Sample of countries varies across breakdowns shown. For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. For countries that do not report either TDS or DDS, data are estimated by the BIS as IDS. [2] At quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [3] Where a currency breakdown is not available, DDS are assumed to be denominated in the local currency.

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; national data; BIS debt securities statistics; BIS calculations.

Total debt securities, by residence and sector of issuer[1]

Amounts outstanding for the latest available data, in trillions of US dollars[2]

Graph C.2



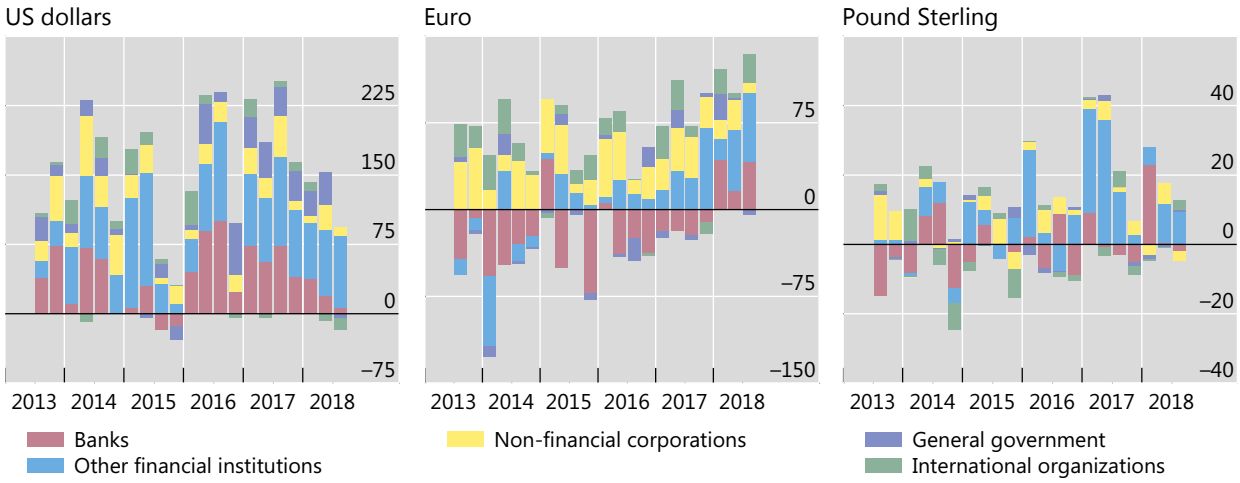
Further information on the BIS debt securities statistics is available at www.bis.org/statistics/secstats.htm.

[1] For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. [2] Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Sources: National data; BIS debt securities statistics.

Net issuance of international debt securities

By issuer sector and currency of denomination, in billions of US dollars — Graph C.3

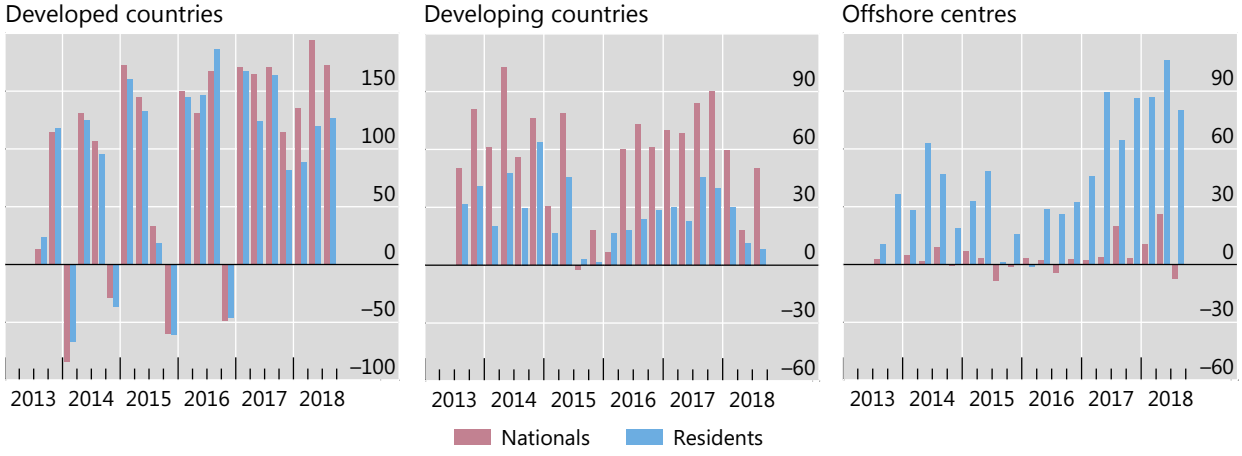


Further information is available at www.bis.org/statistics/secstats.htm.

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; BIS debt securities statistics.

International debt securities issued by financial and non-financial corporations[1]

Net issuance by region, in billions of US dollars[2] — Graph C.4



Further information is available at www.bis.org/statistics/secstats.htm.

[1] Excluding general government. [2] For a list of countries in each region, see Table C1 (http://stats.bis.org/statx/srs/table/c1).

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; BIS debt securities statistics.

D Derivatives statistics

Exchange-traded derivatives

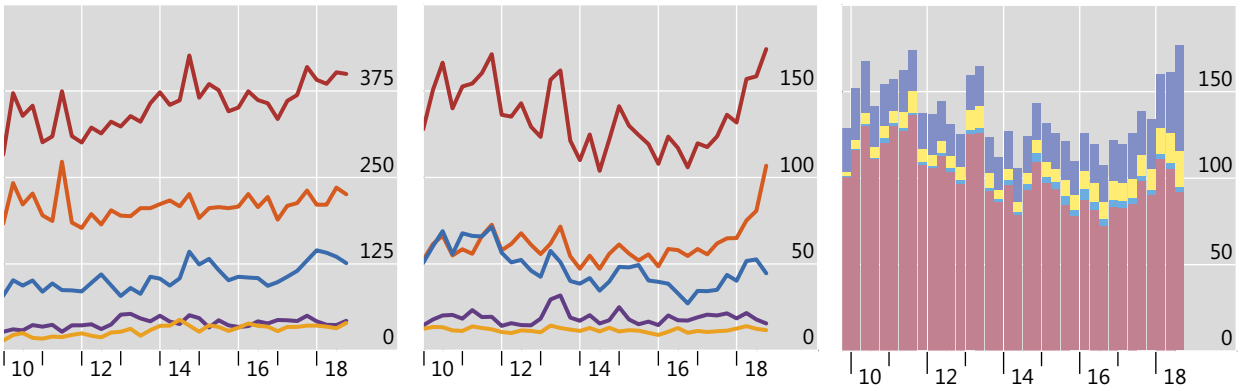
Graph D.1

Open interest, by currency[1]

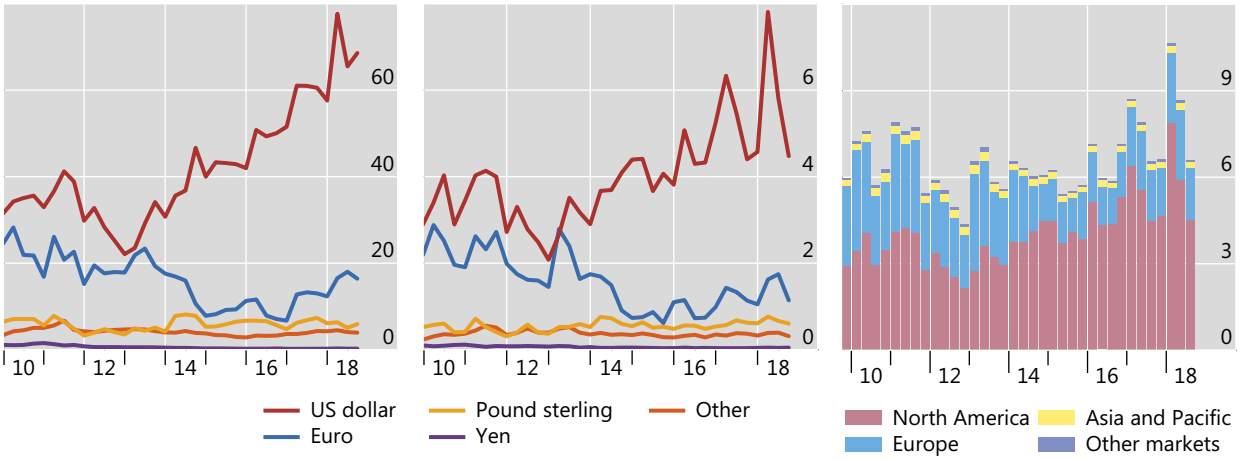
Daily average turnover, by currency[2]

Daily average turnover, by location of exchange[2]

Foreign exchange derivatives, USD bn[3]



Interest rate derivatives, USD trn[3]



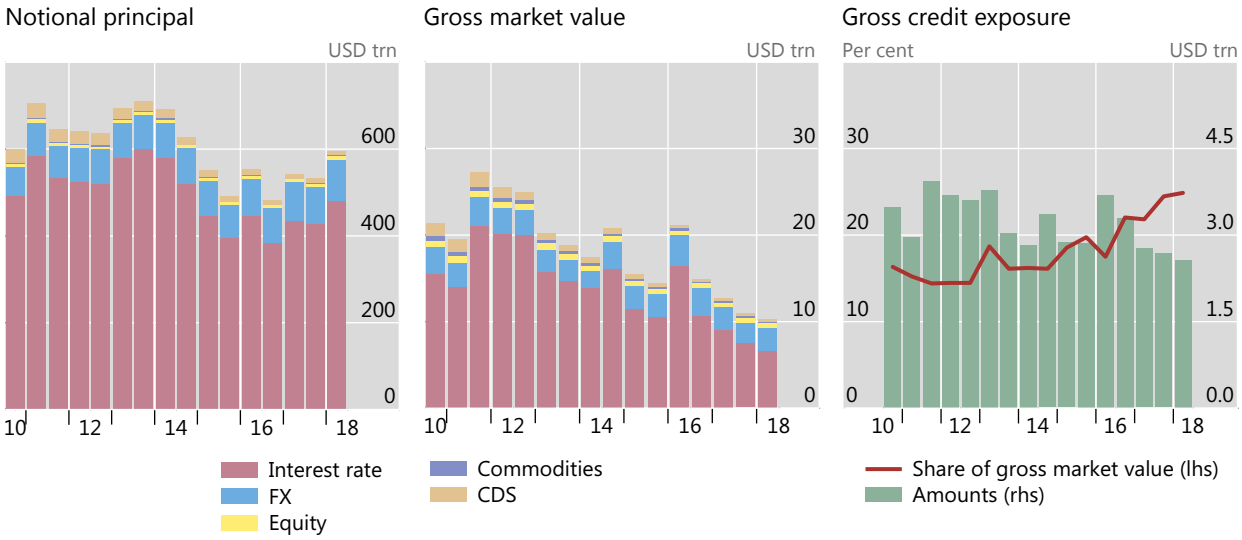
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/extderiv.htm.

[1] At quarter-end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. [2] Quarterly averages of daily turnover. [3] Futures and options.

Sources: Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics.

Global OTC derivatives markets[1]

Graph D.2



Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

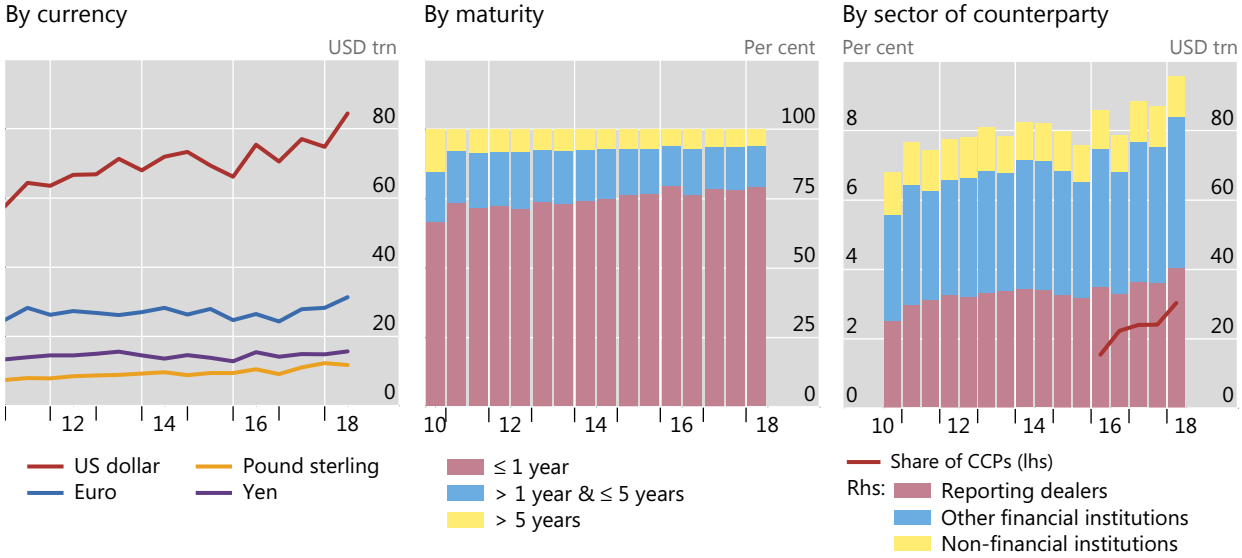
[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC foreign exchange derivatives

Notional principal[1]

Graph D.3



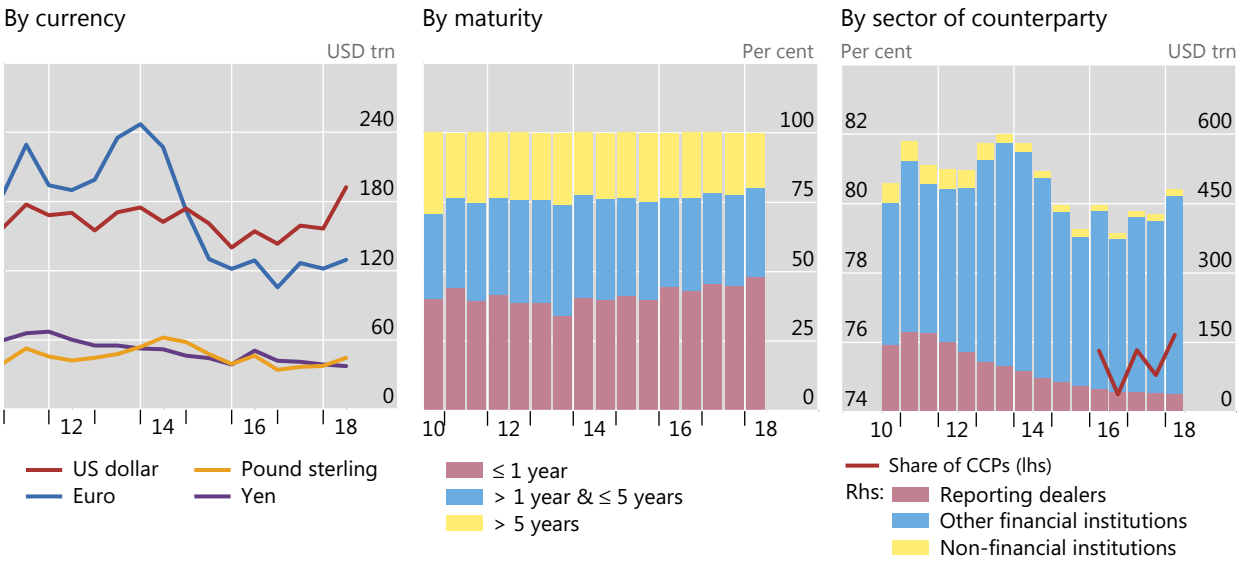
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC interest rate derivatives

Notional principal[1] Graph D.4



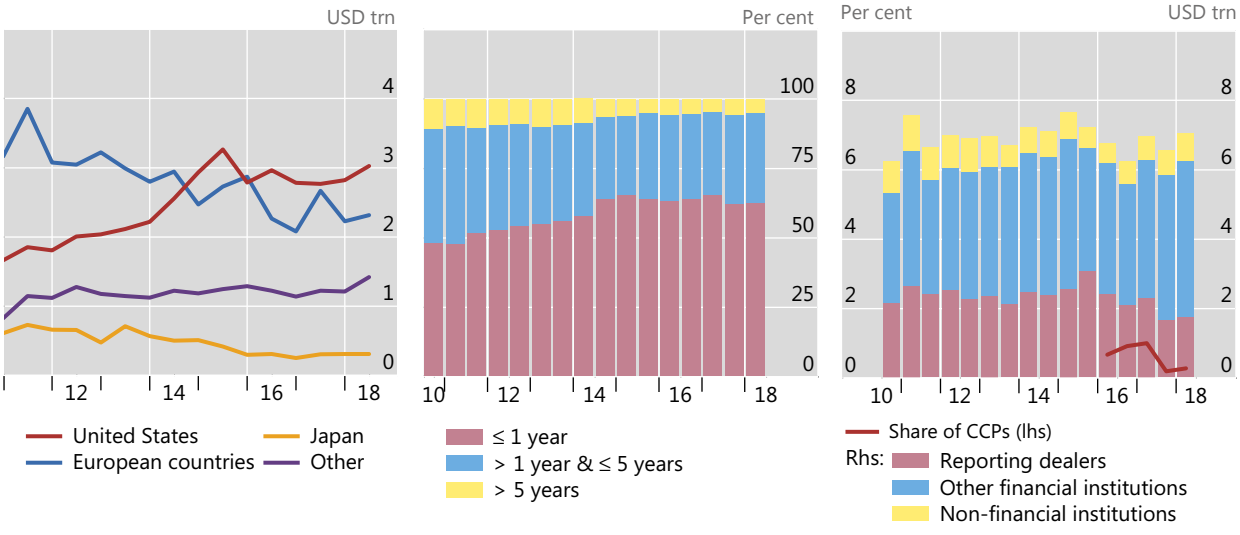
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC equity-linked derivatives

Notional principal[1] Graph D.5



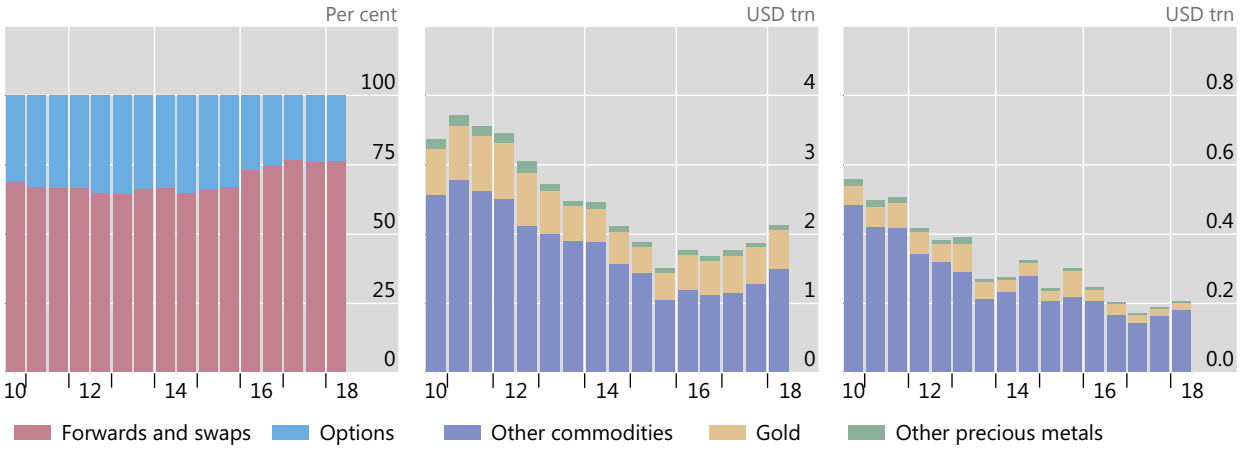
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC commodity derivatives[1]

Graph D.6



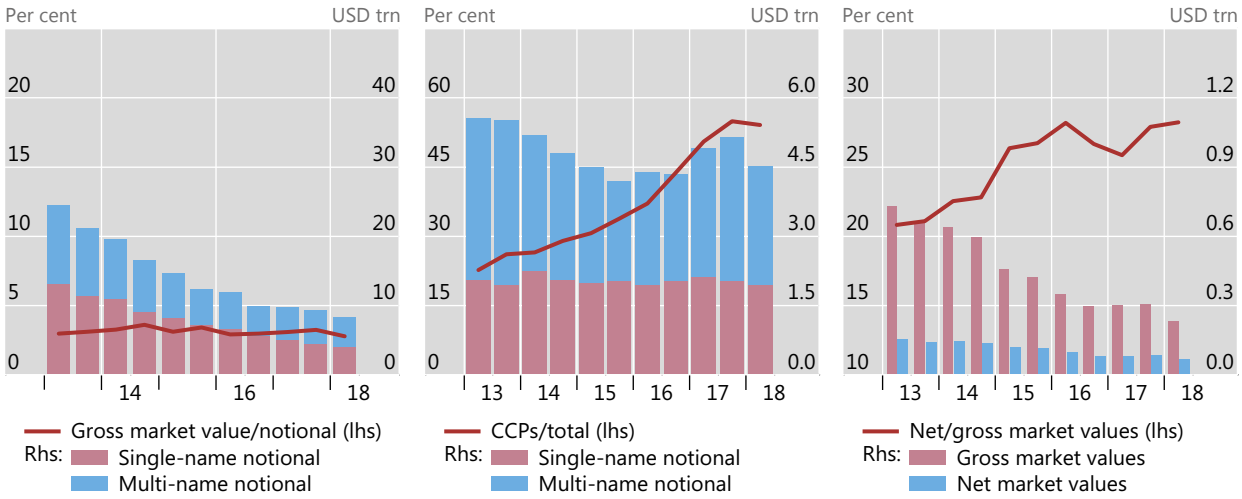
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

Credit default swaps[1]

Graph D.7



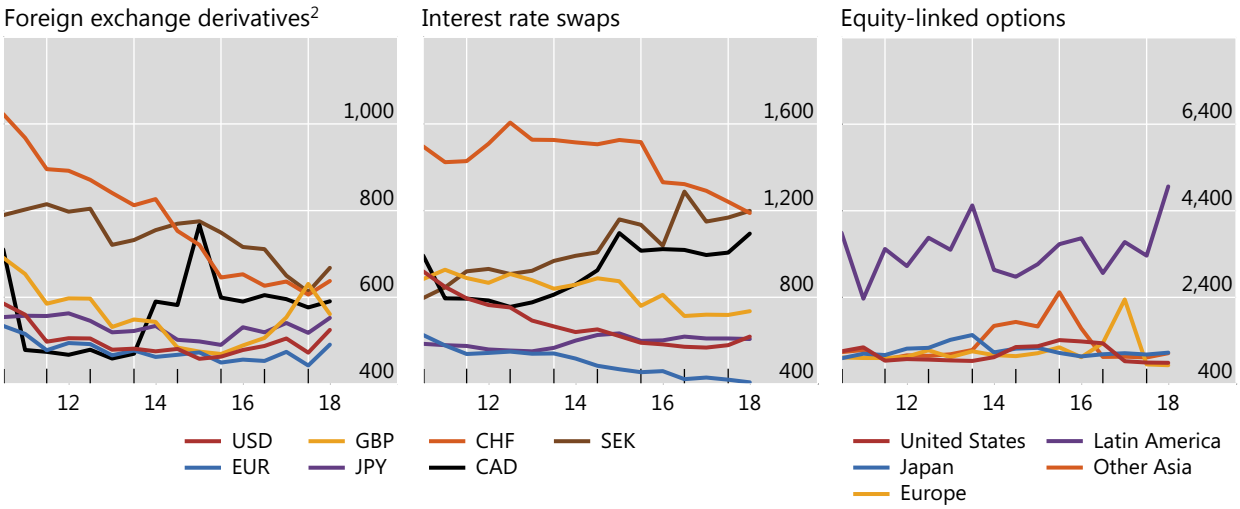
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

Concentration in global OTC derivatives markets

Herfindahl index[1] Graph D.8



Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

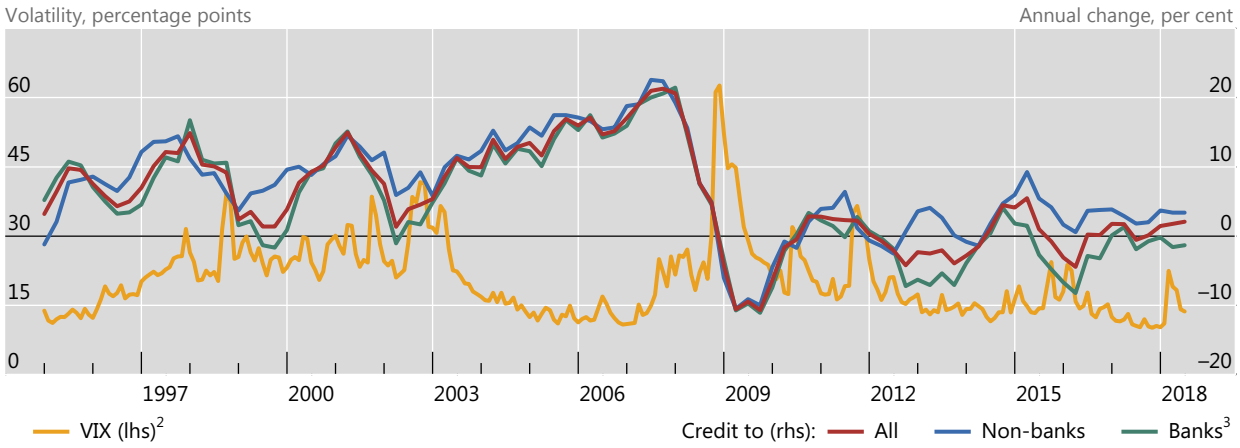
[1] The index ranges from 0 to 10,000, where a lower number indicates that there are many dealers with similar market shares (as measured by notional principal) and a higher number indicates that the market is dominated by a few reporting dealers. [2] Foreign exchange forwards, foreign exchange swaps and currency swaps.

Source: BIS derivatives statistics.

E Global liquidity indicators

Growth of international bank credit[1]

Graph E.1



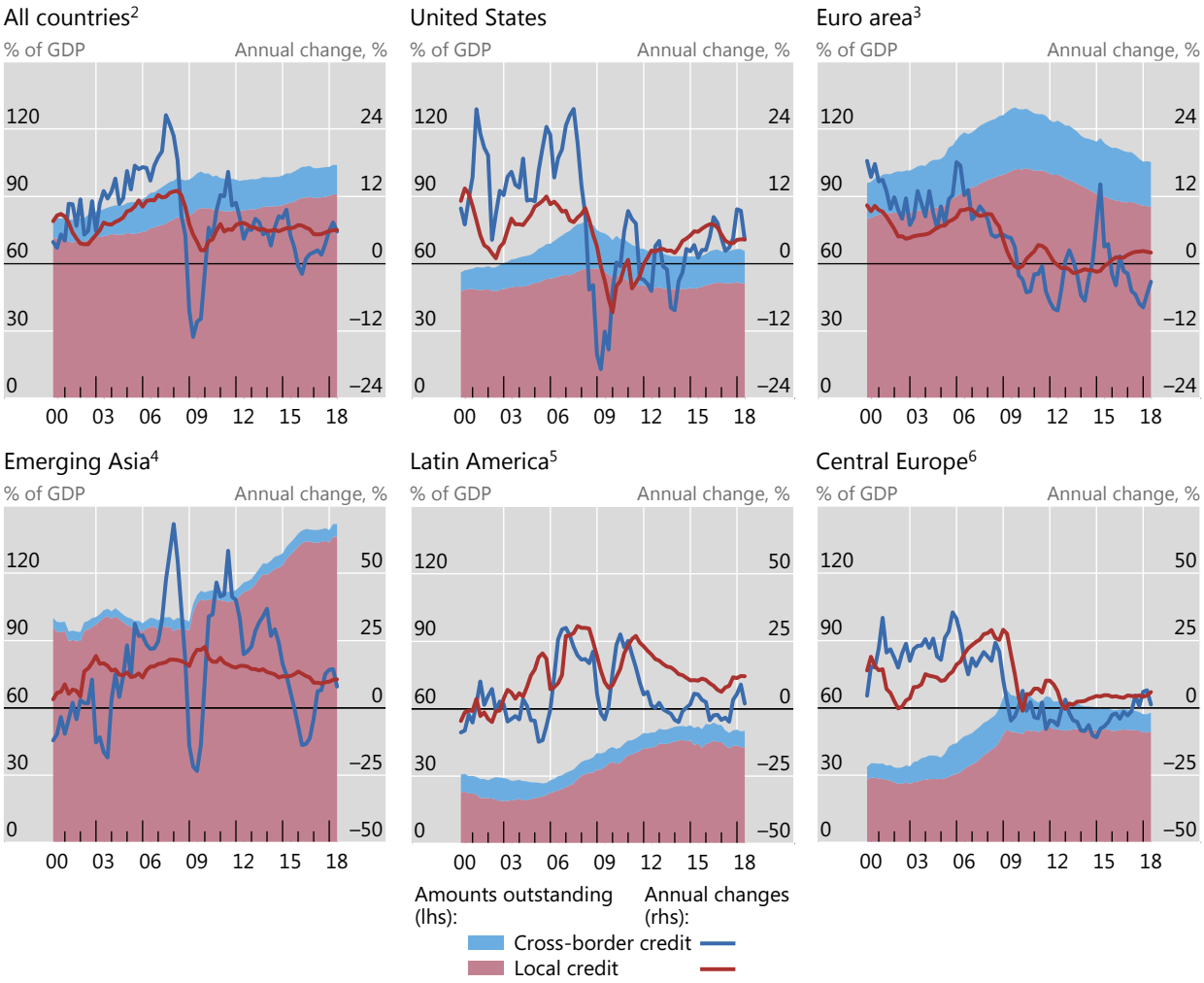
Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

[1] LBS-reporting banks' cross-border claims plus local claims in foreign currencies. [2] Chicago Board Options Exchange S&P 500 implied volatility index; standard deviation, in percentage points per annum. [3] Including intragroup transactions.

Sources: Bloomberg; BIS locational banking statistics.

Global bank credit to the private non-financial sector, by residence of borrower

Banks' cross-border credit plus local credit in all currencies[1] Graph E.2



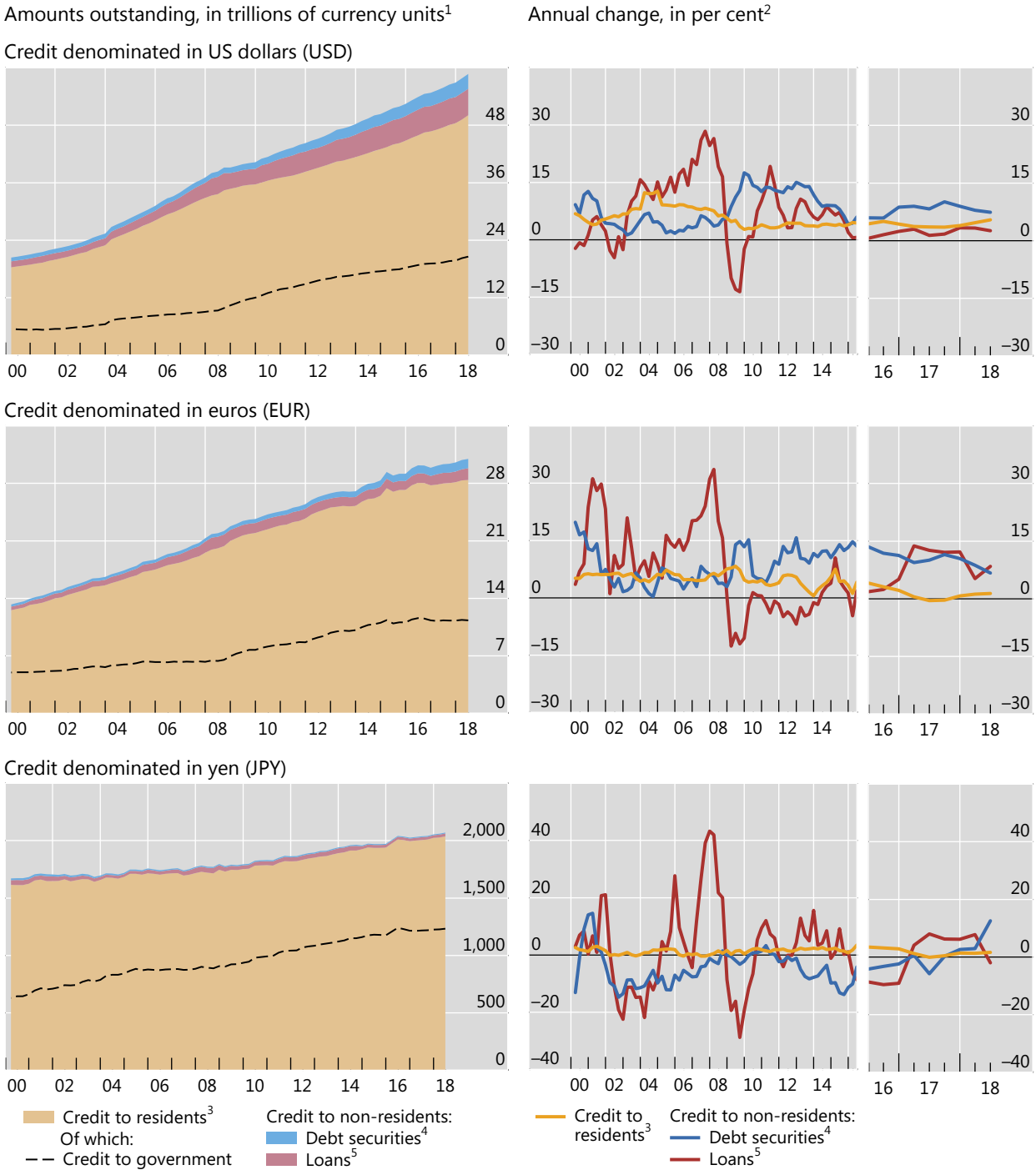
Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

[1] Cross-border claims of LBS reporting banks to the non-bank sector plus local claims of all banks to the private non-financial sector. Weighted averages of the economies listed, based on four-quarter moving sums of GDP. [2] Australia, Canada, Denmark, Japan, New Zealand, Norway, Russia, Saudi Arabia, South Africa, Sweden, Switzerland, Turkey and the United Kingdom, plus the countries in the other panels. [3] Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain. [4] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Singapore and Thailand. [5] Argentina, Brazil, Chile and Mexico. [6] The Czech Republic, Hungary and Poland.

Sources: BIS credit to the non-financial sector; BIS locational banking statistics; BIS calculations.

Global credit to the non-financial sector, by currency

Graph E.3



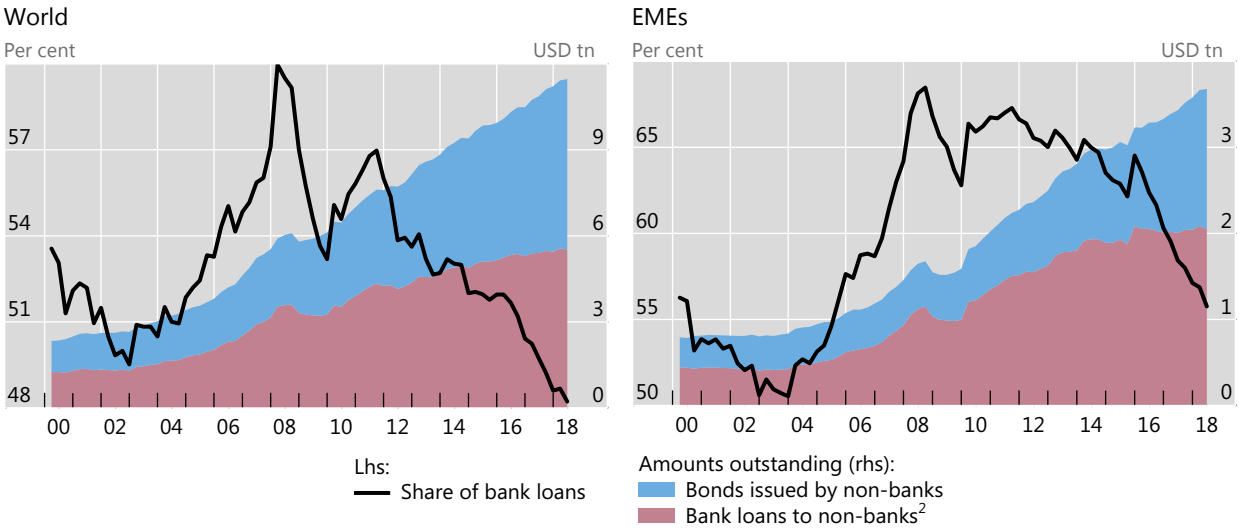
Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

[1] Amounts outstanding at quarter-end. [2] Based on quarterly break- and exchange rate-adjusted changes. [3] Credit to non-financial borrowers residing in the United States/euro area/Japan. National financial accounts are adjusted using BIS banking and securities statistics to exclude credit denominated in non-local currencies. [4] Excluding debt securities issued by special purpose vehicles and other financial entities controlled by non-financial parents. EUR-denominated debt securities exclude those issued by institutions of the European Union. [5] Loans by LBS-reporting banks to non-bank borrowers, including non-bank financial entities, comprise cross-border plus local loans.

Sources: Datastream; Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; national data; BIS locational banking statistics (LBS); BIS calculations.

US dollar-denominated credit to non-banks outside the United States[1]

Graph E.4



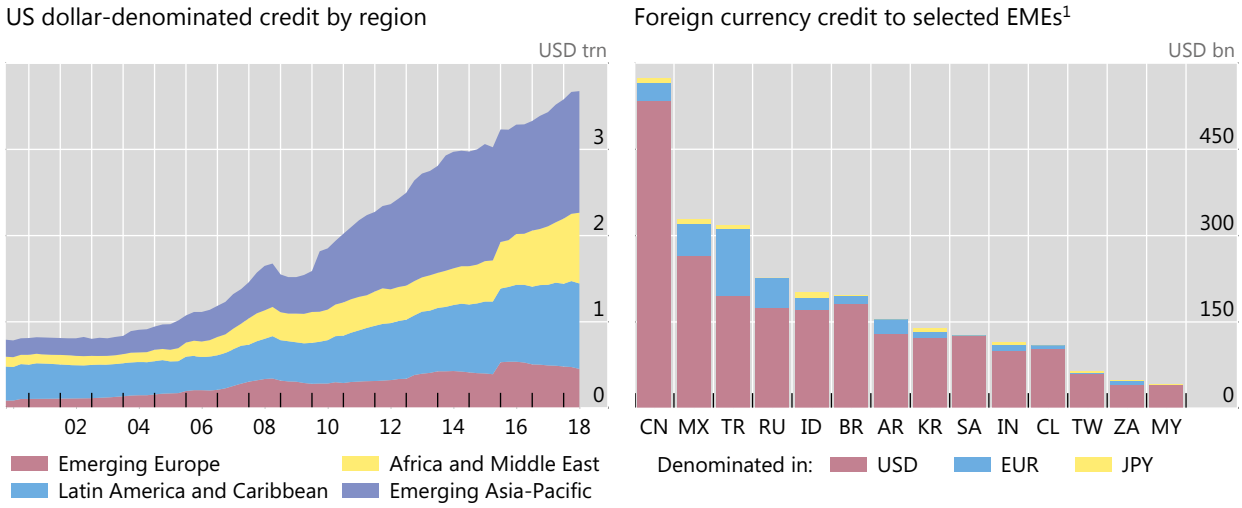
Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

[1] Non-banks comprise non-bank financial entities, non-financial corporations, governments, households and international organisations. [2] Loans by LBS-reporting banks to non-bank borrowers, including non-bank financial entities, comprise cross-border plus local loans.

Sources: Datastream; Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; national data; BIS locational banking statistics (LBS); BIS calculations.

Foreign currency credit to non-banks in EMEs

Graph E.5



Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

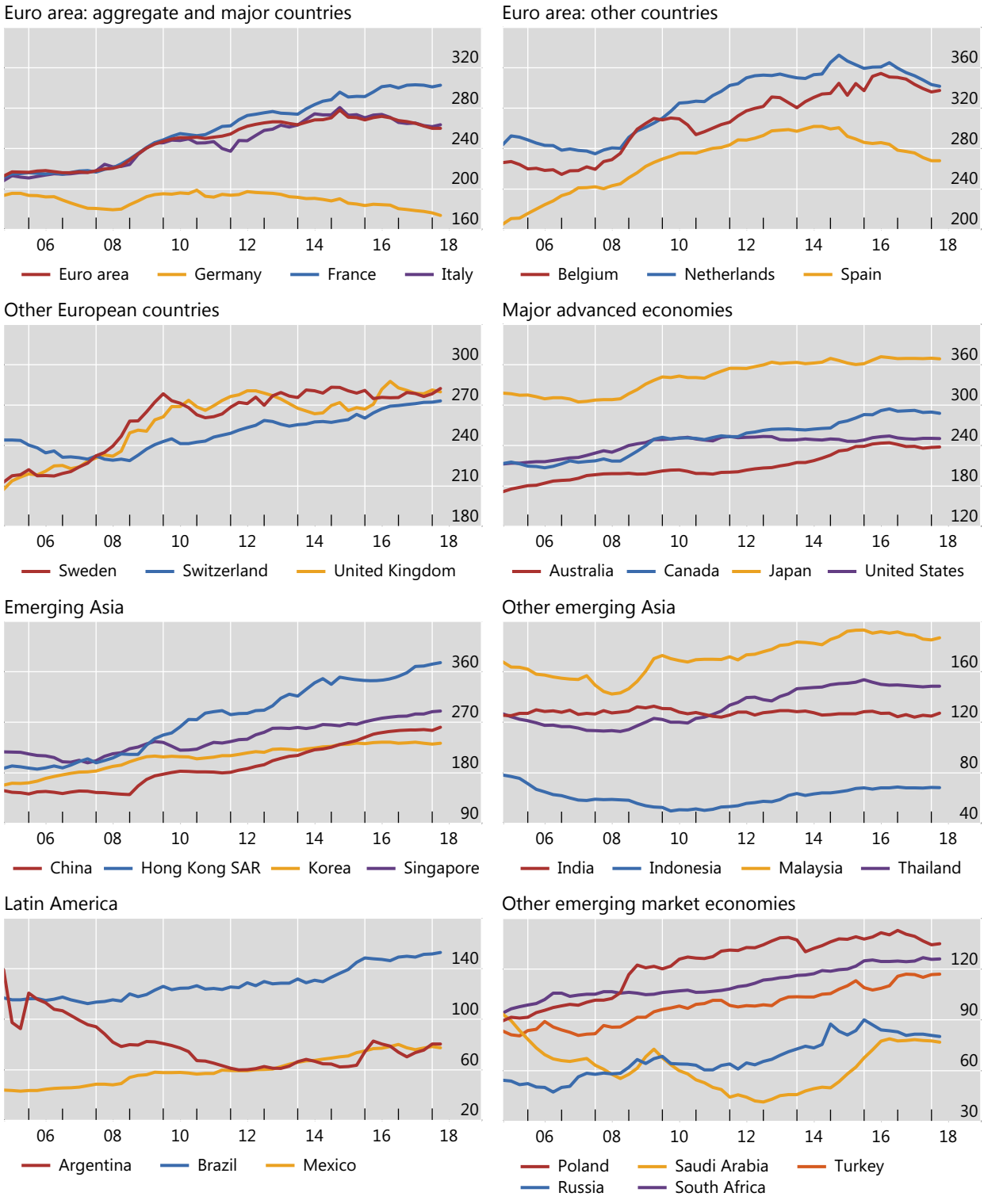
[1] Amounts outstanding for the latest available data.

Sources: Datastream; Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; national data; BIS locational banking statistics (LBS); BIS calculations.

F Statistics on total credit to the non-financial sector

Total credit to the non-financial sector (core debt)

As a percentage of GDP — Graph F.1

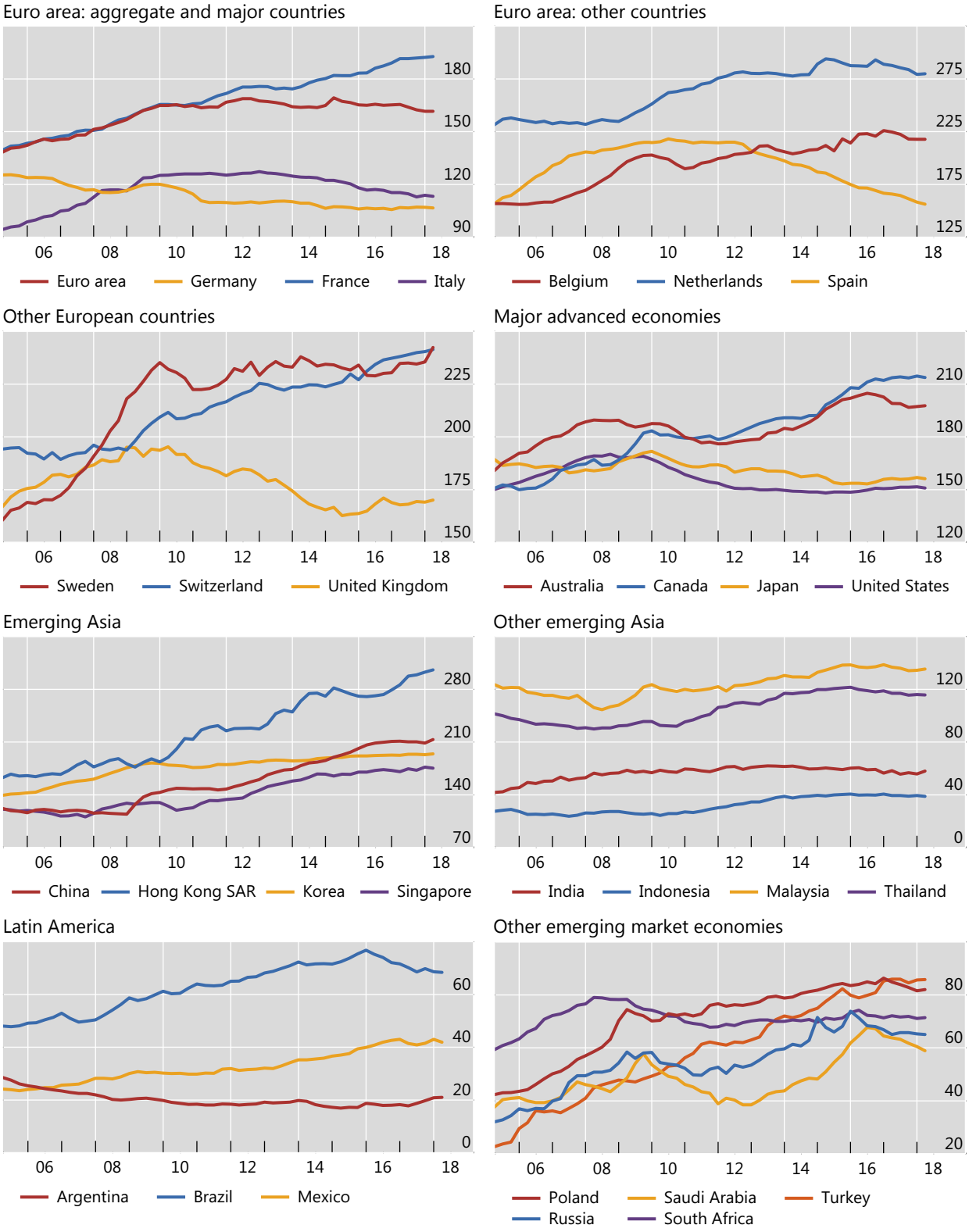


Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

Total credit to the private non-financial sector (core debt)

As a percentage of GDP — Graph F.2



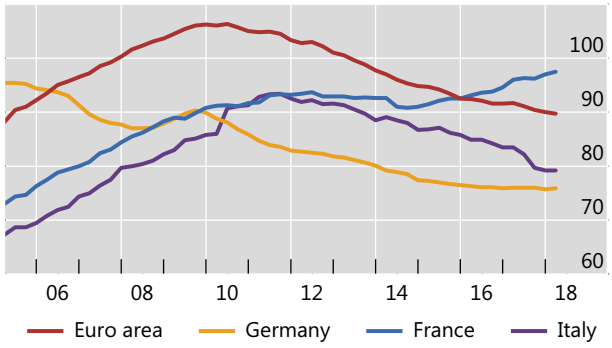
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

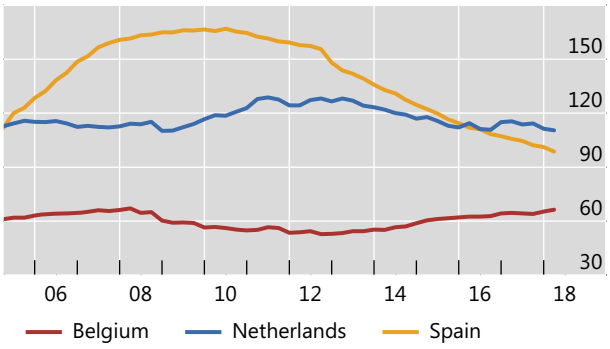
Bank credit to the private non-financial sector (core debt)

As a percentage of GDP — Graph F.3

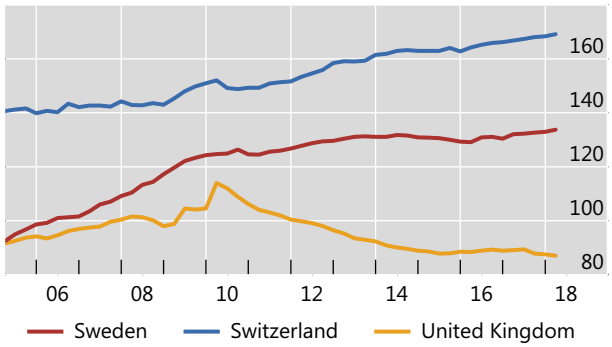
Euro area: aggregate and major countries



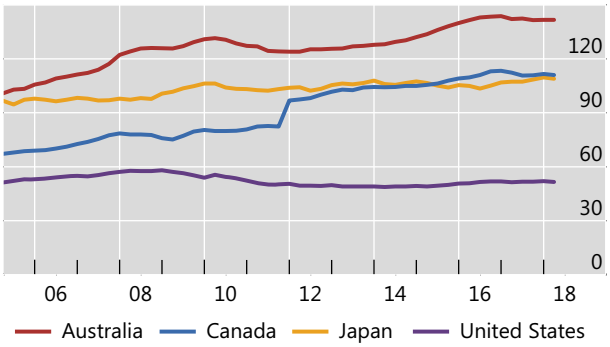
Euro area: other countries



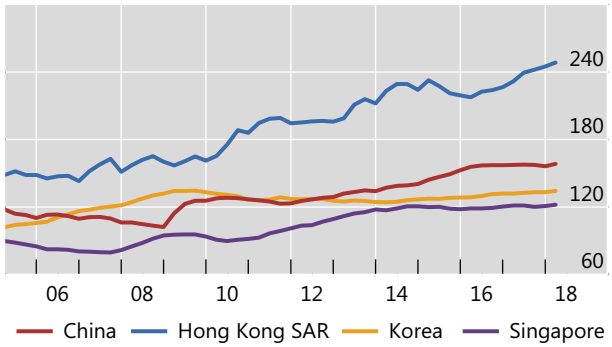
Other European countries



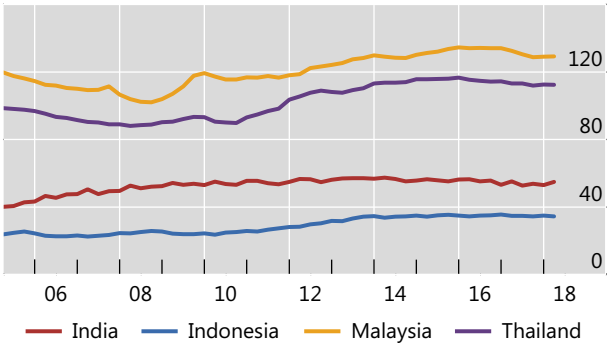
Major advanced economies



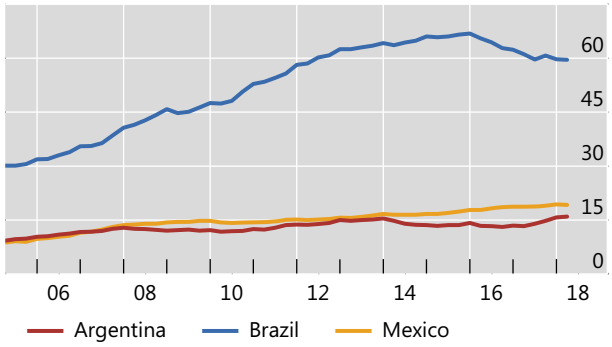
Emerging Asia



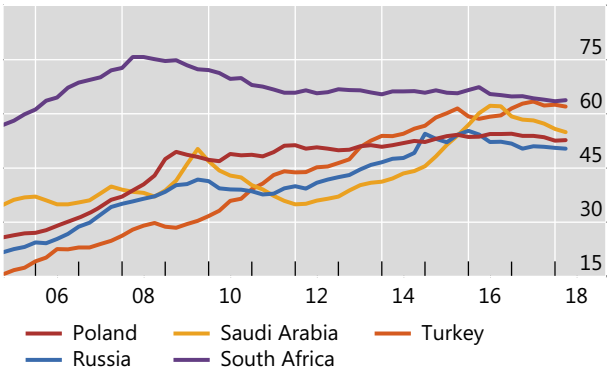
Other emerging Asia



Latin America



Other emerging market economies



Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

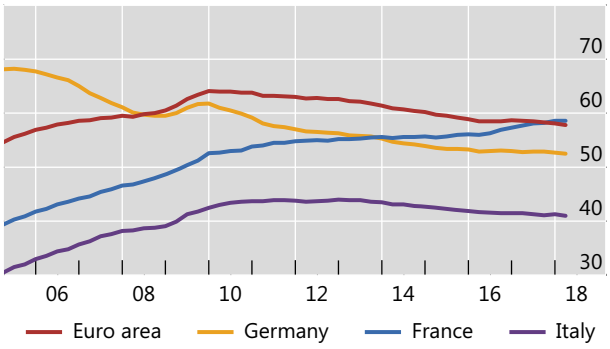
Source: BIS total credit statistics.

Total credit to households (core debt)

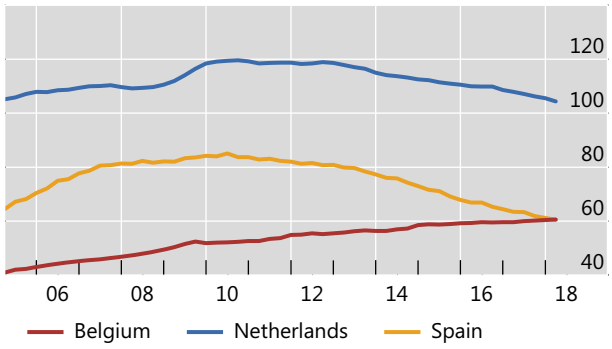
As a percentage of GDP

Graph F.4

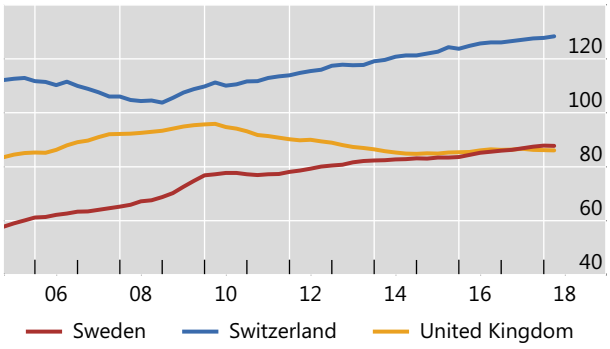
Euro area: aggregate and major countries



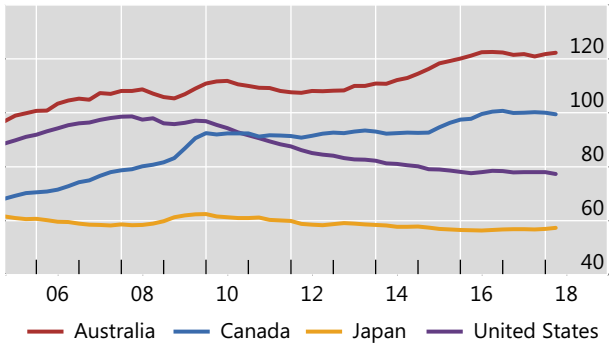
Euro area: other countries



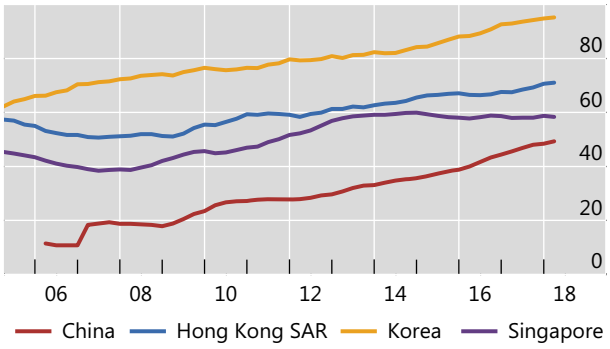
Other European countries



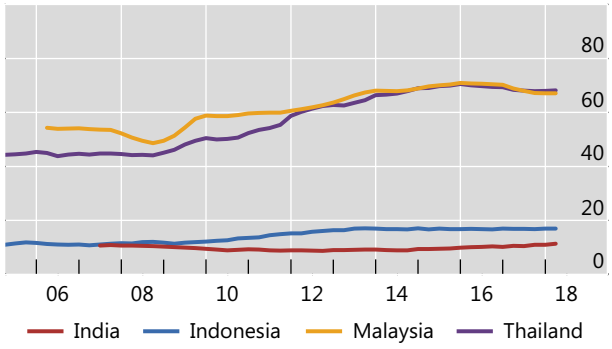
Major advanced economies



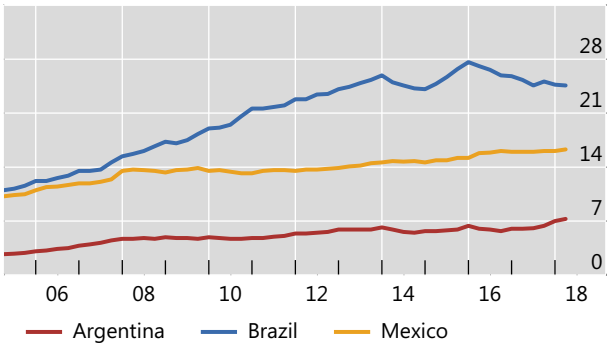
Emerging Asia



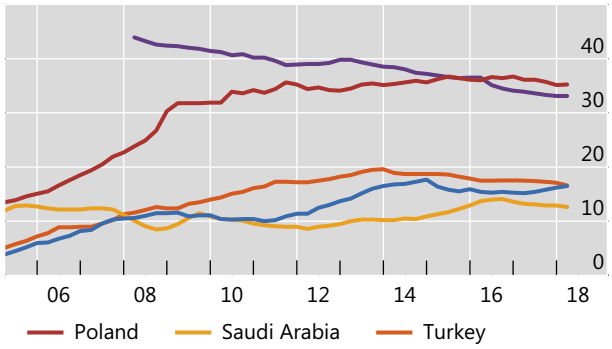
Other emerging Asia



Latin America



Other emerging market economies



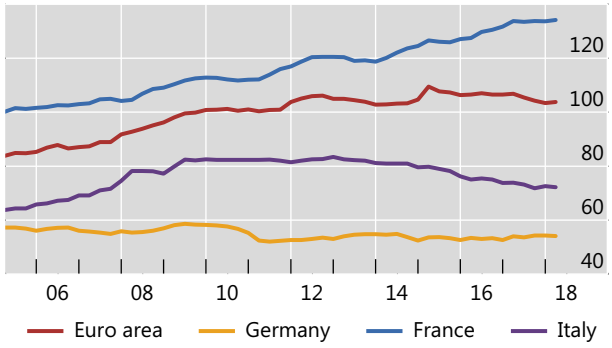
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

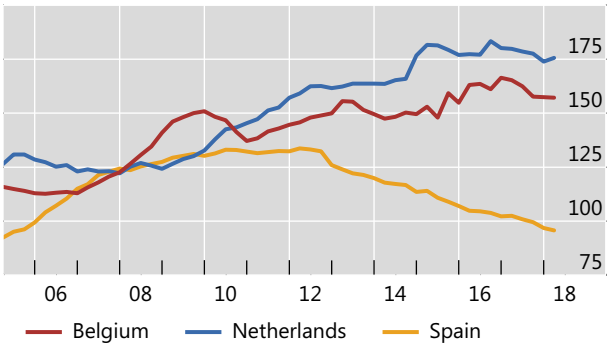
Total credit to non-financial corporations (core debt)

As a percentage of GDP — Graph F.5

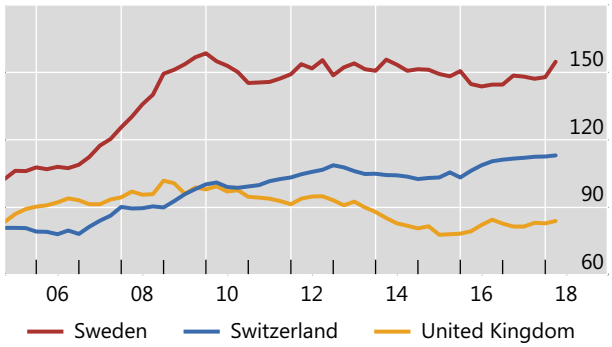
Euro area: aggregate and major countries



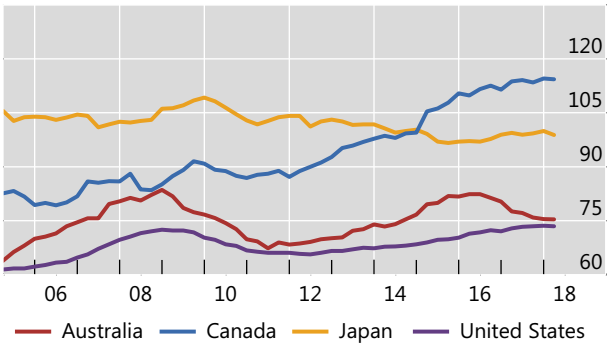
Euro area: other countries



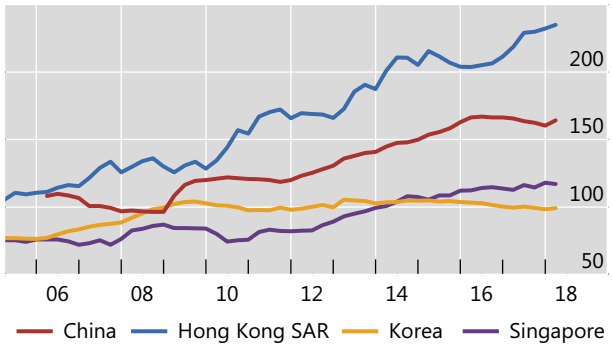
Other European countries



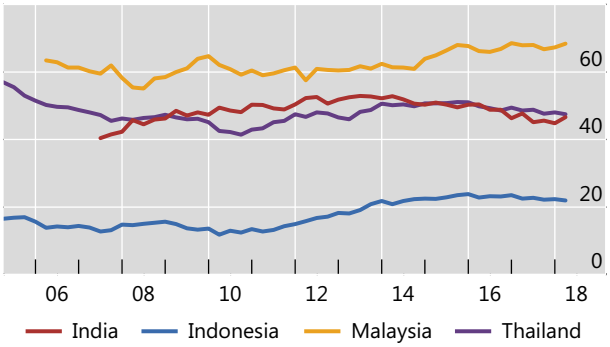
Major advanced economies



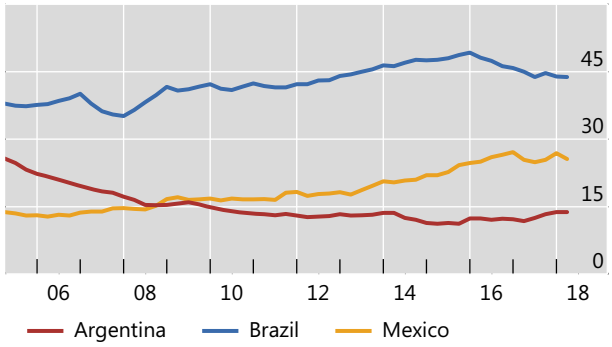
Emerging Asia



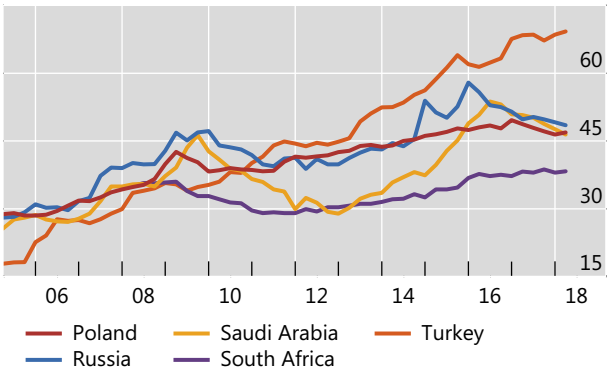
Other emerging Asia



Latin America



Other emerging market economies



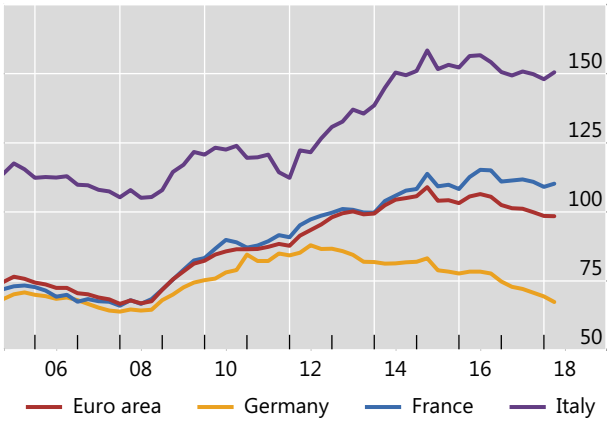
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

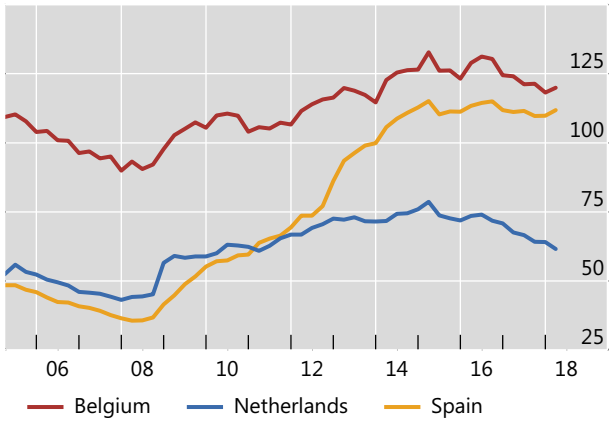
Total credit to the government sector at market value (core debt)[1]

As a percentage of GDP — Graph F.6

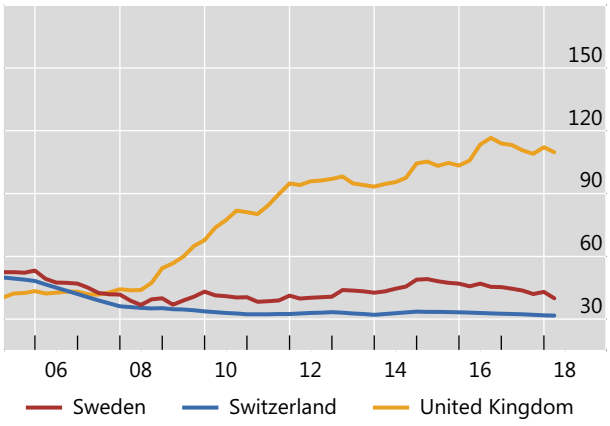
Euro area: aggregate and major countries



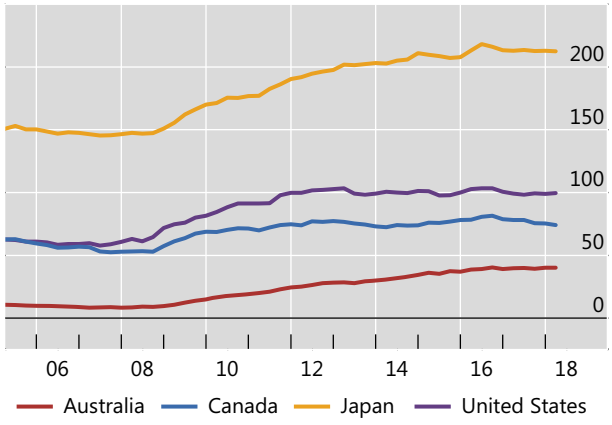
Euro area: other countries



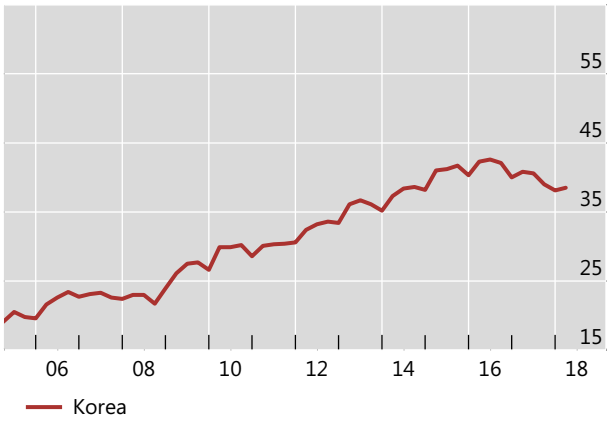
Other European countries



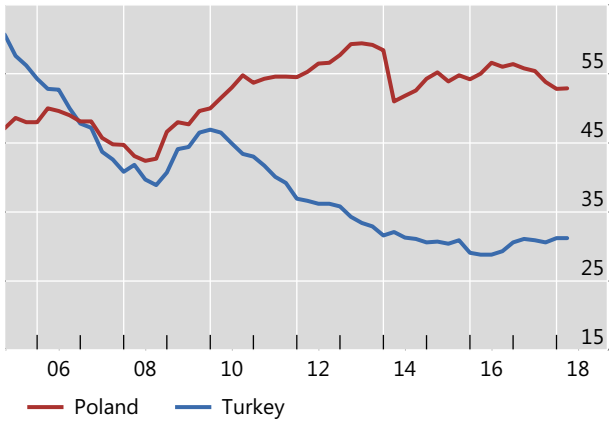
Major advanced economies



Emerging Asia



Other emerging market economies



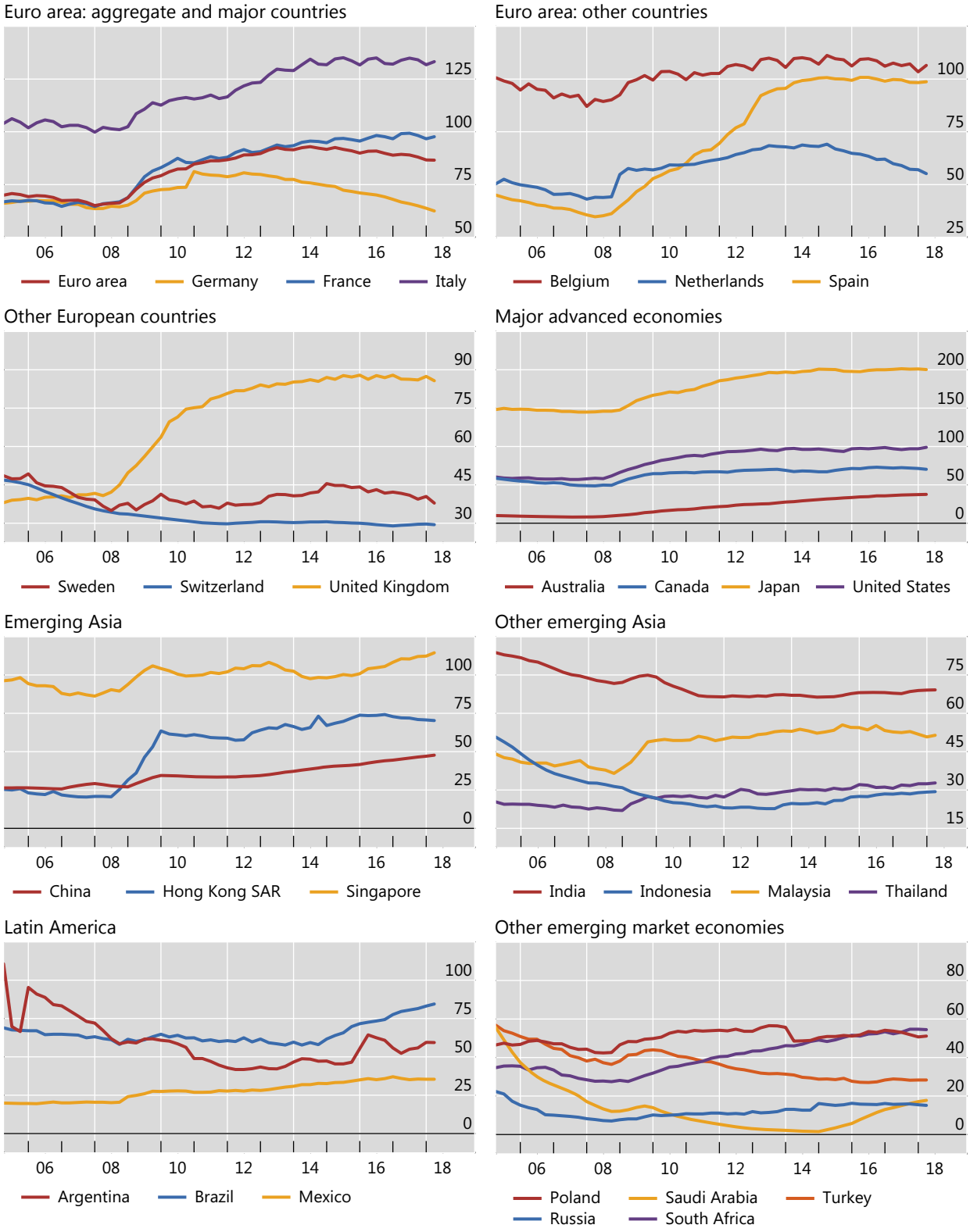
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

[1] Consolidated data for the general government sector.

Source: BIS total credit statistics.

Total credit to the government sector at nominal value (core debt)[1]

As a percentage of GDP — Graph F.7



Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

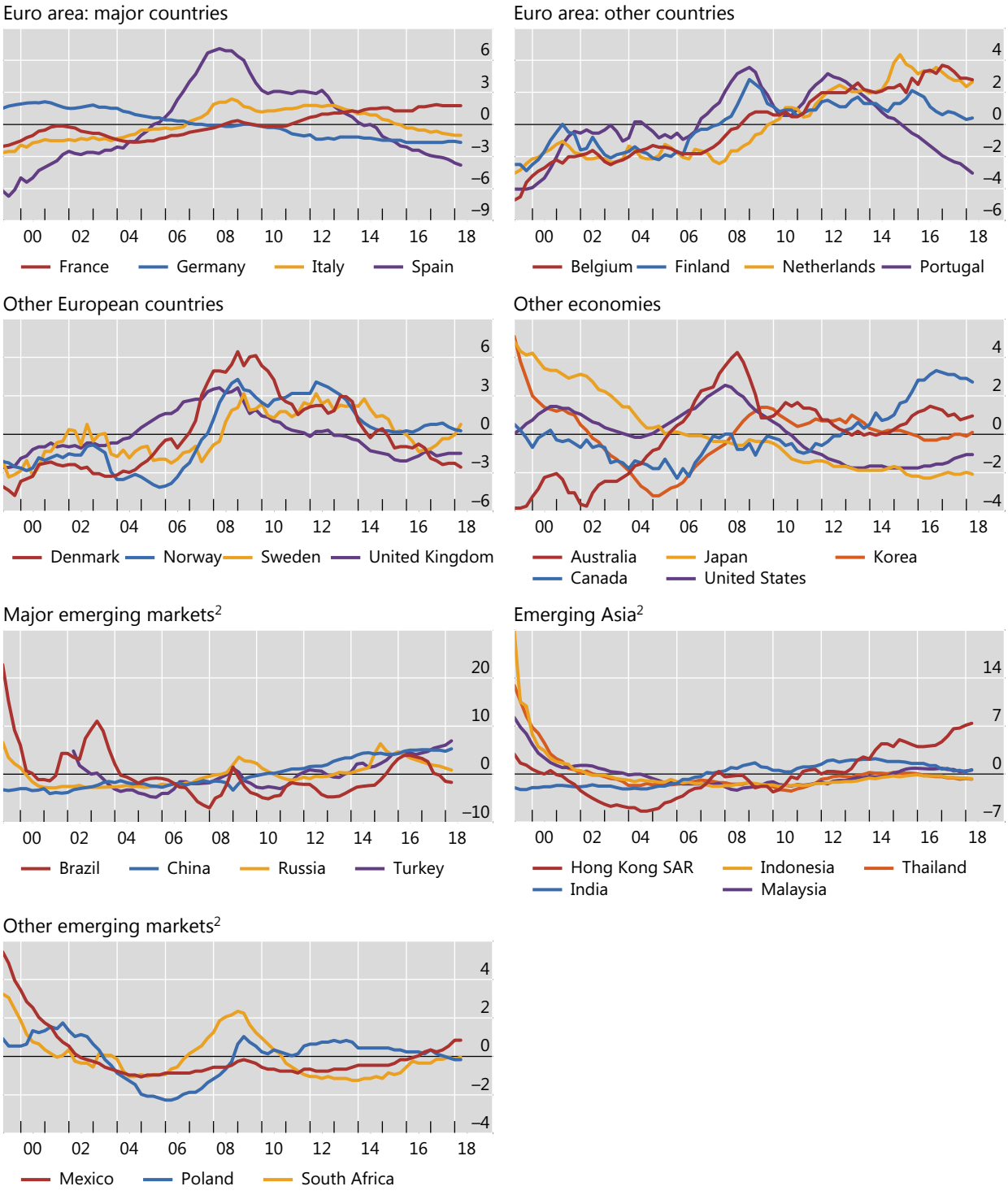
[1] Consolidated data for the general government sector; central government for Argentina, Indonesia, Malaysia, Mexico, Saudi Arabia and Thailand.

Source: BIS total credit statistics.

G Debt service ratios for the private non-financial sector

Debt service ratios of the private non-financial sector

Deviation from country-specific mean, in percentage points[1] Graph G.1



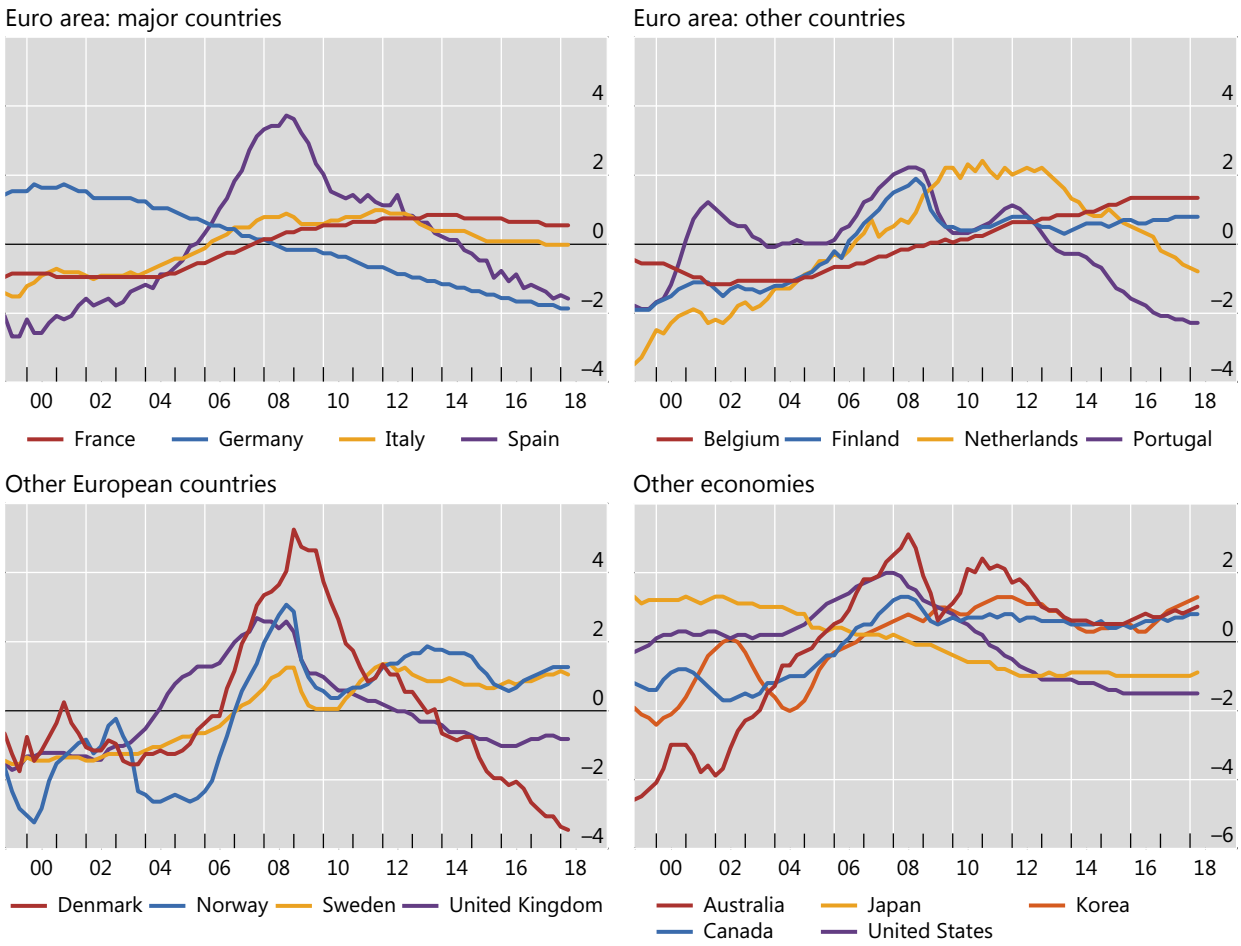
Further information on the BIS debt service ratio statistics is available at www.bis.org/statistics/dsr.htm.

[1] Country-specific means are based on all available data from 1999 onwards. [2] Countries which are using alternative measures of income and interest rates. Further information is available under "Metholodogy and data for DSR calculation" at www.bis.org/statistics/dsr.htm.

Source: BIS debt service ratios statistics.

Debt service ratios of households

Deviation from country-specific mean, in percentage points[1] Graph G.2



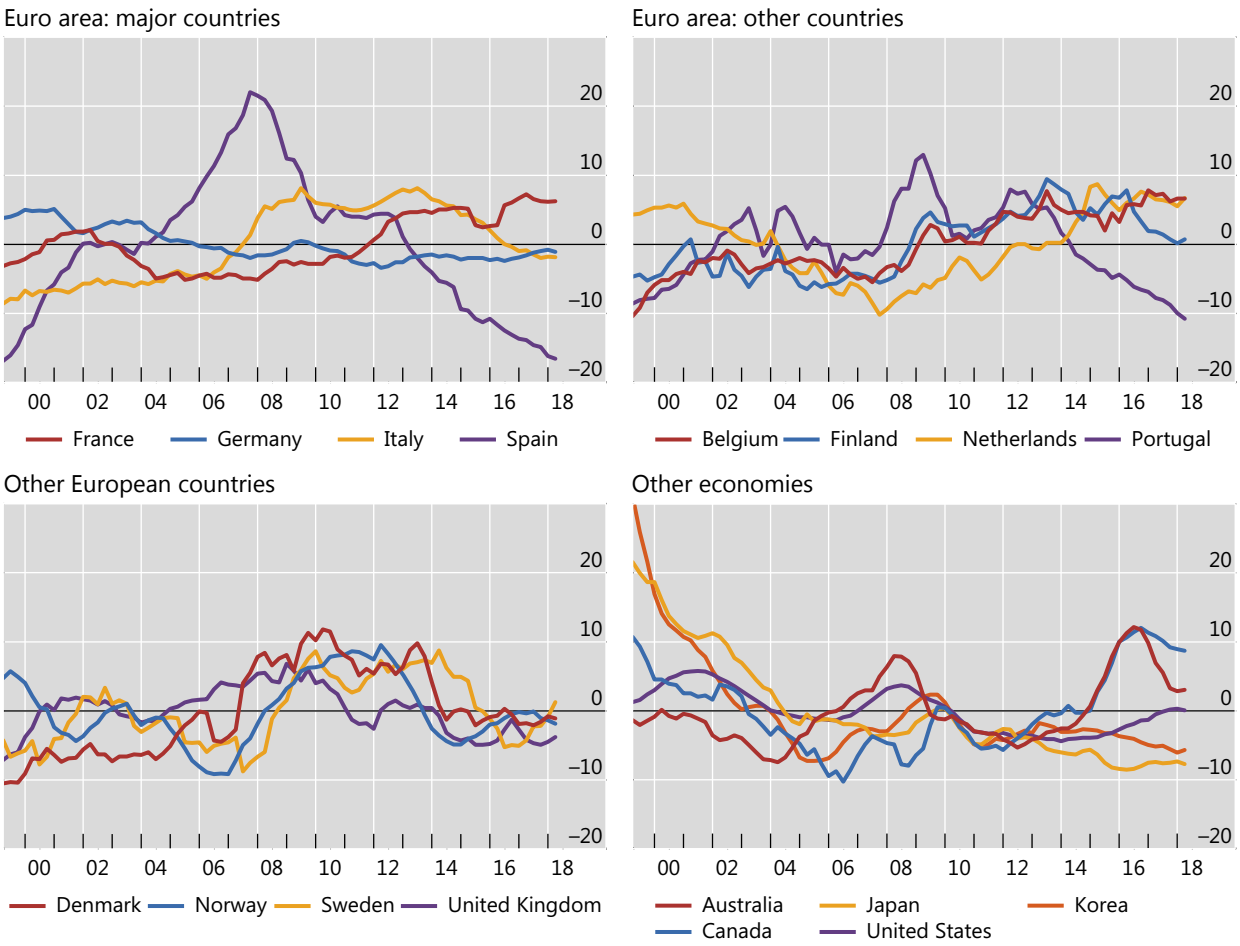
Further information on the BIS debt service ratio statistics is available at www.bis.org/statistics/dsr.htm.

[1] Country-specific means are based on all available data from 1999 onwards.

Source: BIS debt service ratios statistics.

Debt service ratios of non-financial corporations

Deviation from country-specific mean, in percentage points[1] Graph G.3



Further information on the BIS debt service ratio statistics is available at www.bis.org/statistics/dsr.htm.

[1] Country-specific means are based on all available data from 1999 onwards.

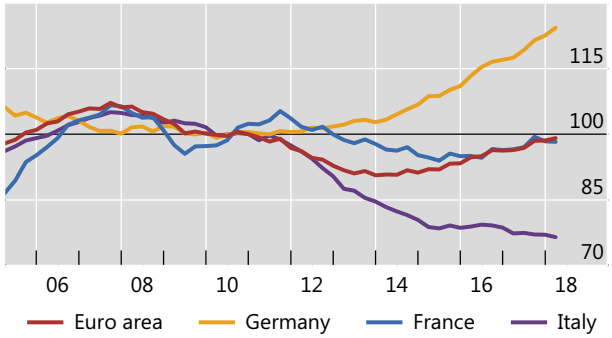
Source: BIS debt service ratios statistics.

H Property price statistics

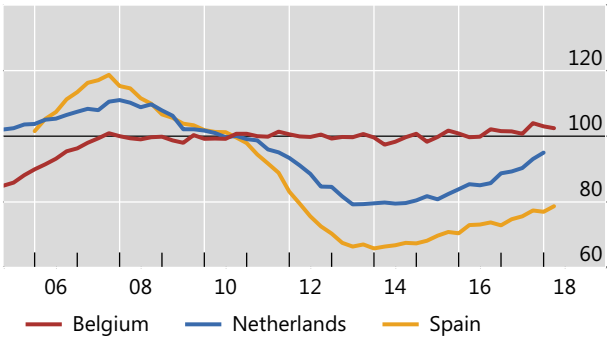
Real residential property prices

CPI-deflated, 2010 = 100 Graph H.1

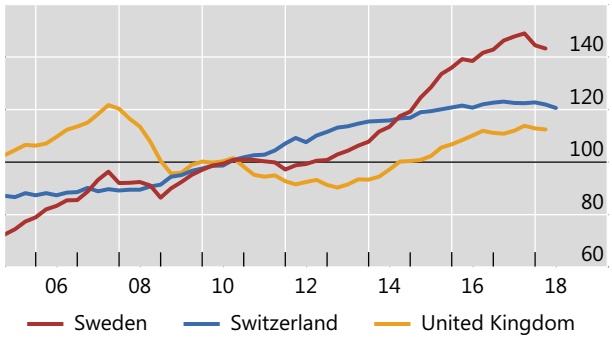
Euro area: aggregate and major countries



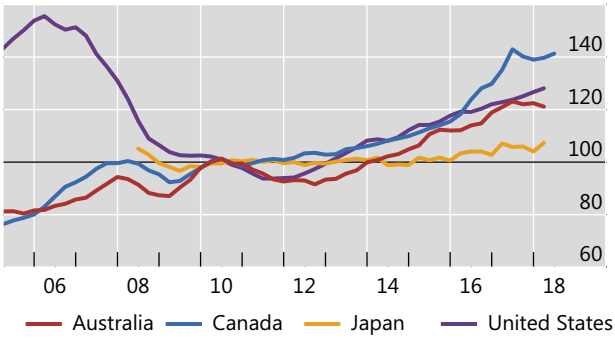
Euro area: other countries



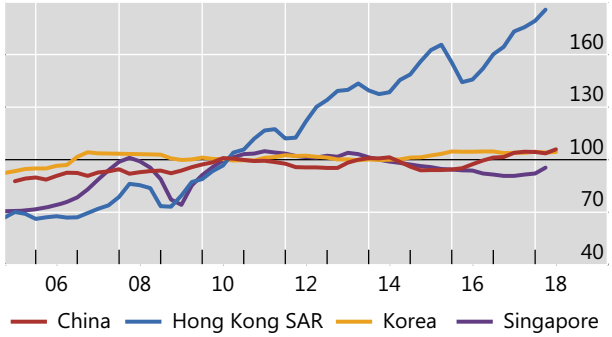
Other European countries



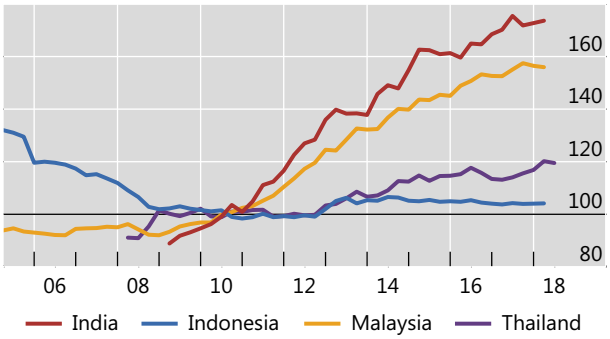
Major advanced economies



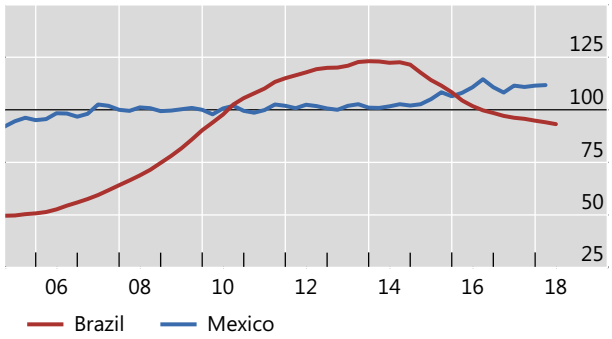
Emerging Asia



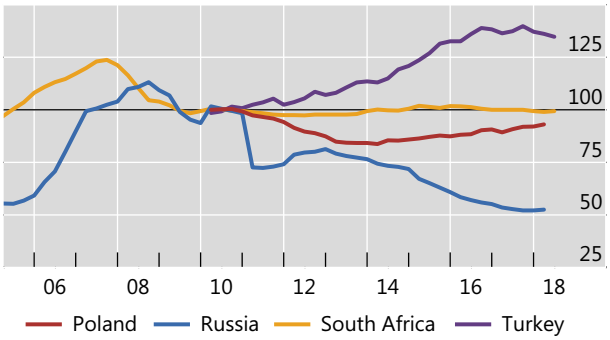
Other emerging Asia



Latin America



Other emerging market economies



Further information on the BIS property price statistics is available at www.bis.org/statistics/pp.htm.

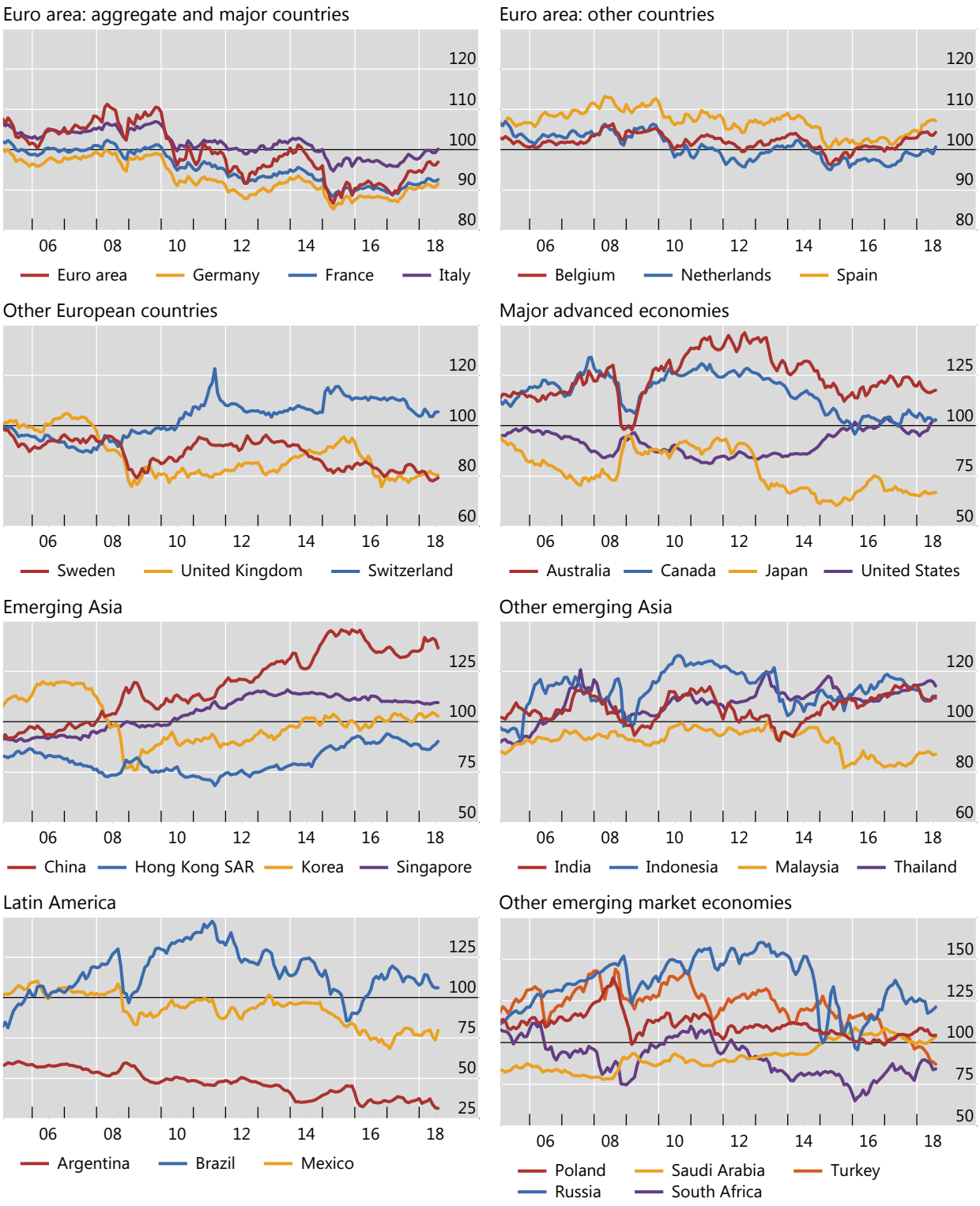
Source: BIS property prices statistics.

I Effective and US dollar exchange rate statistics

Real effective exchange rates

CPI-based, 1995–2005 = 100[1]

Graph I.1



Further information on the BIS effective exchange rate statistics is available at www.bis.org/statistics/eer.htm.

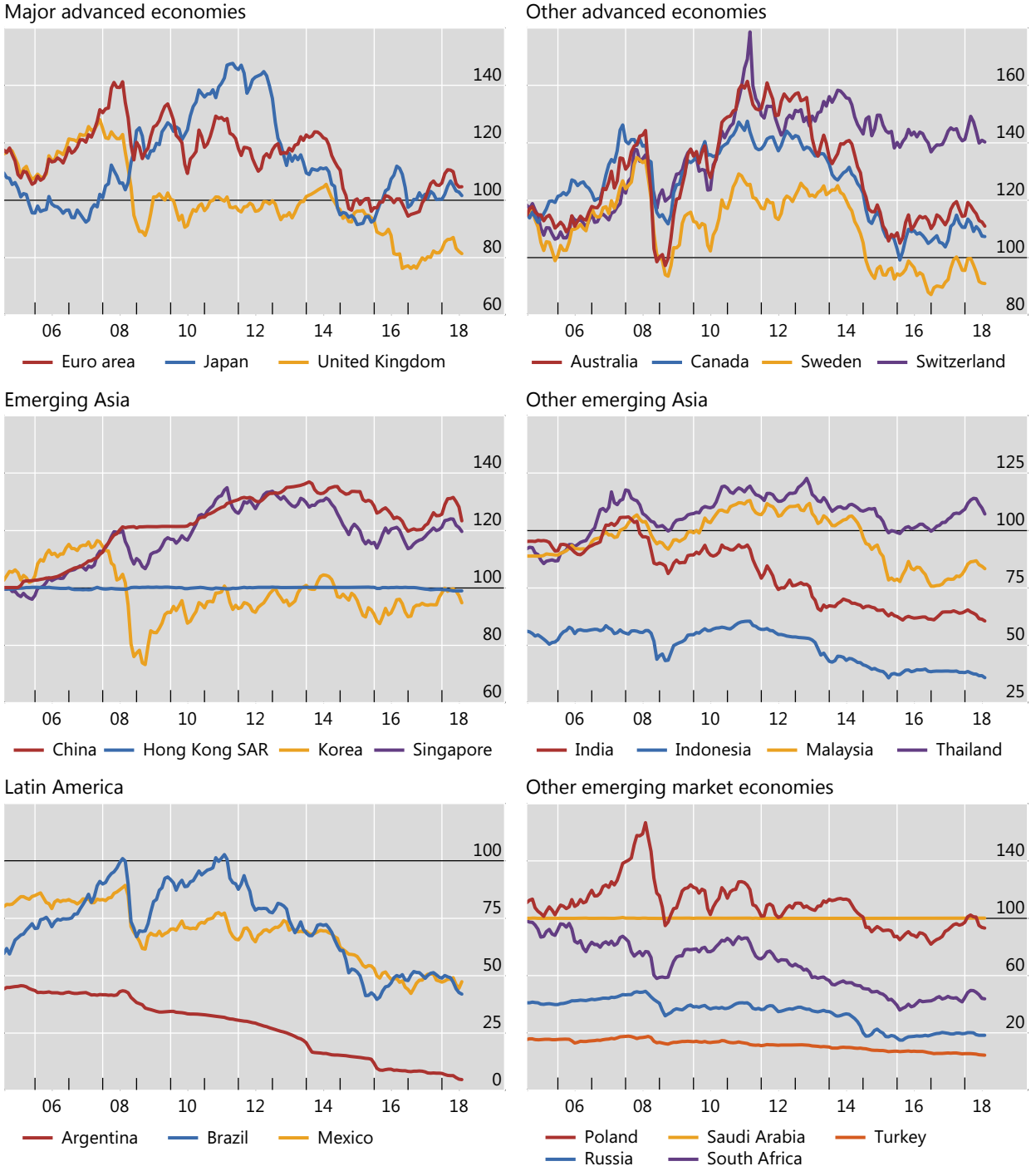
[1] An increase indicates a real-term appreciation of the local currency against a broad basket of currencies.

Source: BIS effective exchange rates statistics.

US dollar exchange rates

Indices, 1995–2005 = 100[1]

Graph I.2



Further information on the exchange rate statistics is available at www.bis.org/statistics/xrusd.htm.

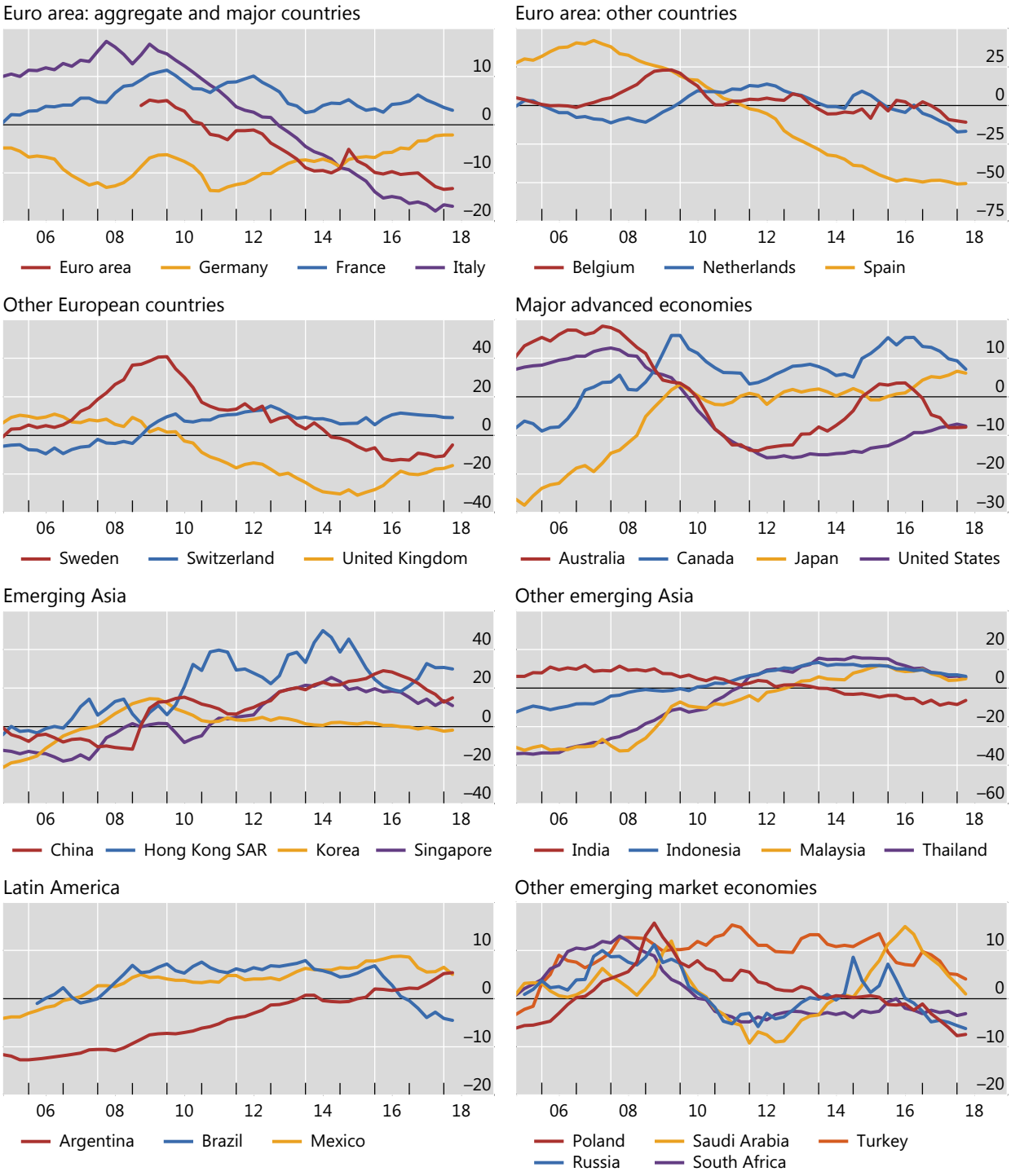
[1] An increase indicates an appreciation of the local currency against the US dollar.

Source: BIS US dollar exchange rates statistics.

J Credit-to-GDP gaps

Credit-to-GDP gaps

In percentage points of GDP — Graph J.1



[1] Estimates based on series on total credit to the private non-financial sector. The credit-to-GDP gap is defined as the difference between the credit-to-GDP ratio and its long-term trend; the long-term trend is calculated using a one-sided Hodrick-Prescott filter with a smoothing parameter of 400,000. Further information on the BIS credit-to-GDP gaps is available at www.bis.org/statistics/c_gaps.htm.

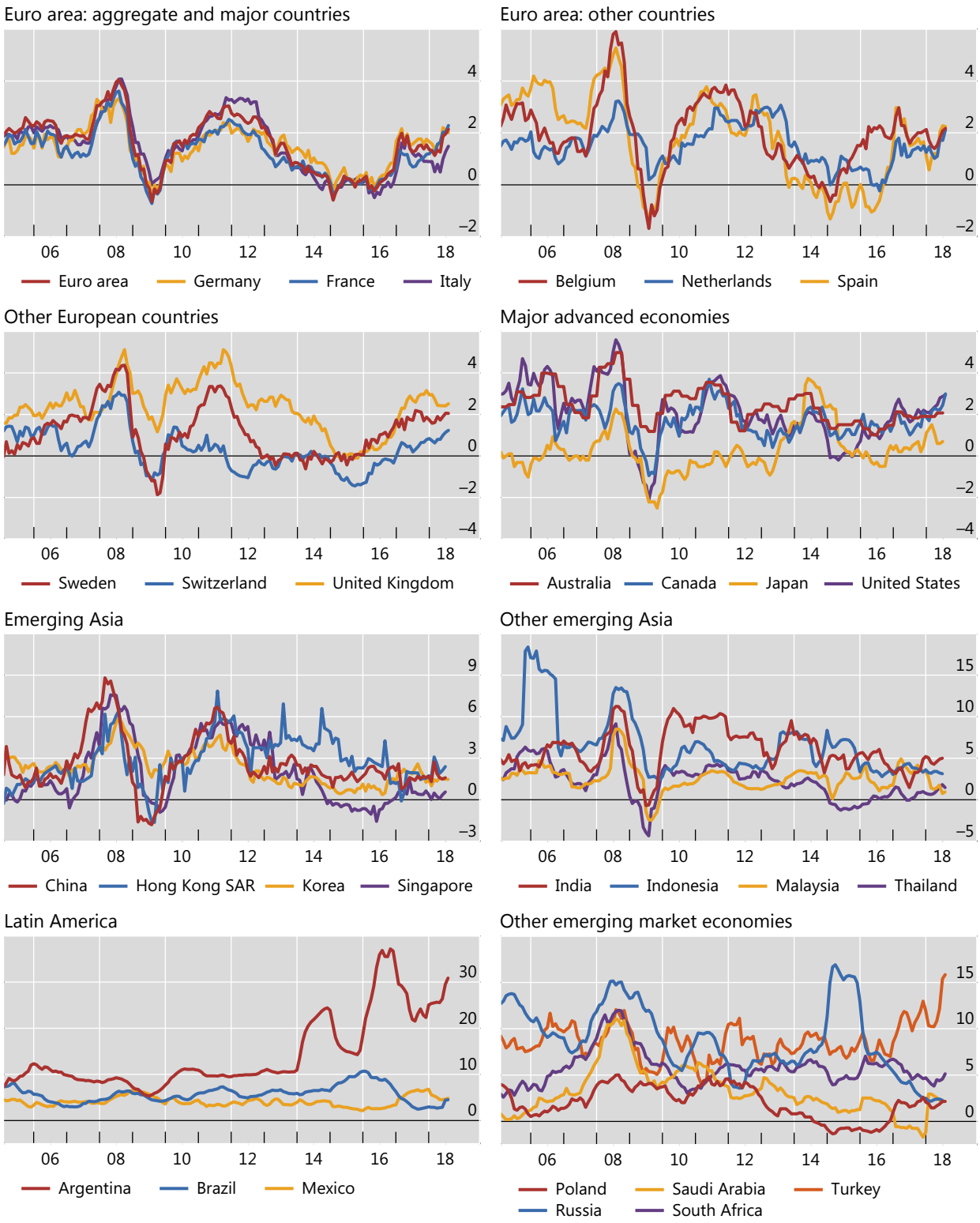
Source: BIS credit-to-GDP gaps statistics.

K Consumer prices

Consumer prices

Year-on-year percentage changes

Graph K.1



Further information on the BIS consumer prices is available at www.bis.org/statistics/cp.htm.

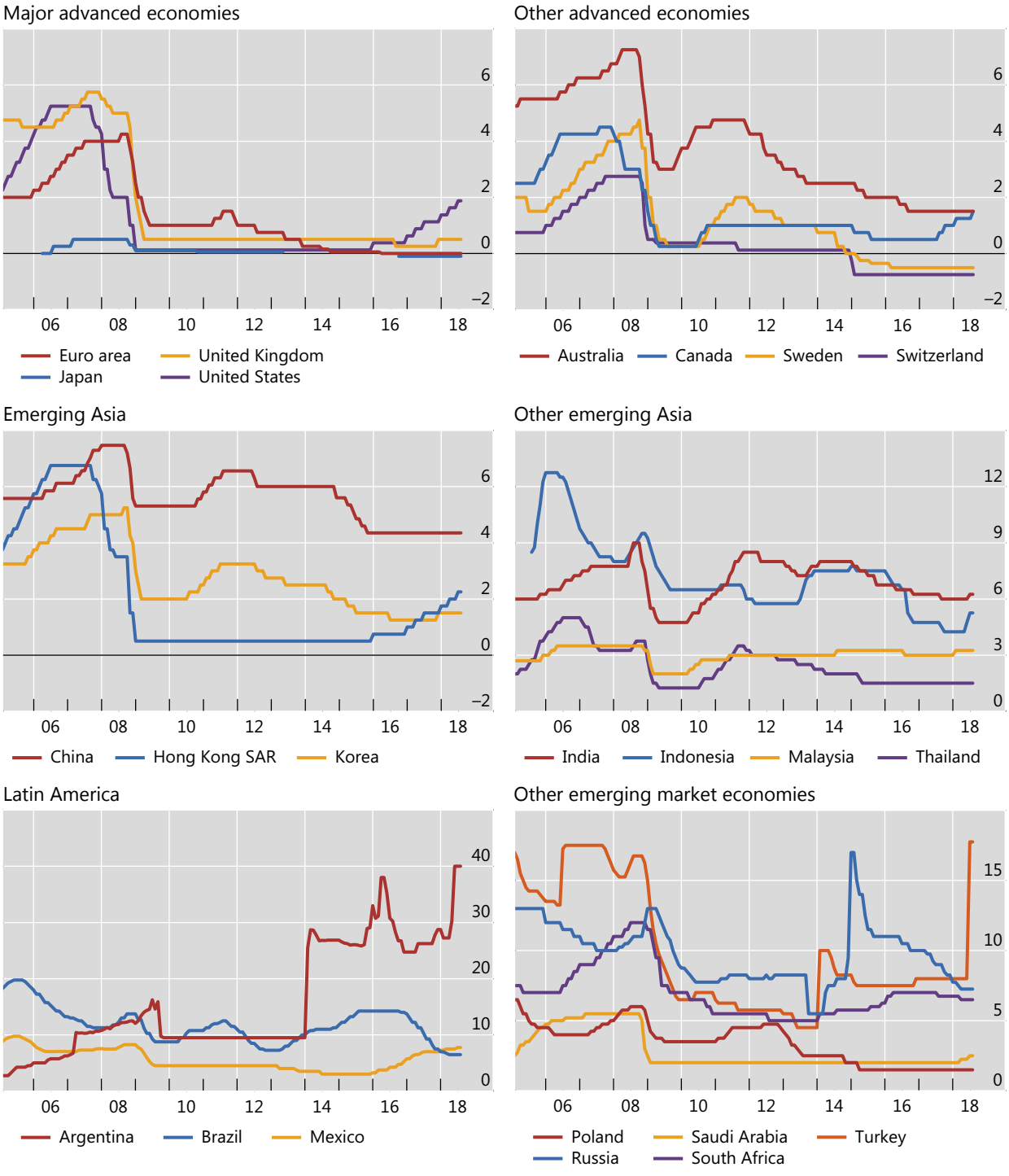
Source: BIS consumer price statistics.

L Central bank policy rates

Central bank policy or representative rates

Month-end; in per cent

Graph L.1



Further information on the policy rates is available at www.bis.org/statistics/cbpol.htm.

Source: BIS policy rates statistics.

Special features in the BIS Quarterly Review

September 2018	Fintech credit markets around the world: size, drivers and policy issues	Stijn Claessens, Jon Frost, Grant Turner & Feng Zhu
September 2018	Regulating cryptocurrencies: assessing market reactions	Raphael Auer & Stijn Claessens
September 2018	The rise of zombie firms: causes and consequences	Ryan Banerjee & Boris Hofmann
September 2018	Term premia: models and some stylised facts	Benjamin H Cohen, Peter Hördahl & Dora Xia
March 2018	Early warning indicators of banking crises: expanding the family	Iñaki Aldasoro, Claudio Borio & Mathias Drehmann
March 2018	Tracking the international footprints of global firms	Stefan Avdjiev, Mary Everett, Philip R Lane & Hyun Song Shin
March 2018	Payments are a-changin' but cash still rules	Morten Bech, Umar Faruqui, Frederik Ougaard & Cristina Picillo
March 2018	The ABCs of bank PBRs: What drives bank price-to-book ratios?	Bilyana Bogdanova, Ingo Fender & Előd Takáts
March 2018	Mortgages, developers and property prices	Michael Chui, Anamaria Illes & Christian Uppe
March 2018	The implications of passive investing for securities markets	Vladyslav Sushko & Grant Turner
December 2017	Is there a debt service channel of monetary transmission?	Boris Hofmann & Gert Peersman
December 2017	Household debt: recent developments and challenges	Anna Zabai

Recent BIS publications[1]

BIS Papers

Central banks and debt: emerging risks to the effectiveness of monetary policy in Africa?
BIS Papers No 99, October 2018

In a period of rising trade protectionism and higher interest rates abroad, there is renewed urgency to ensure that debt, already on an upward path, does not impede the effectiveness of monetary policy in African countries. While central banks can affect the level and composition of debt held or owed by the financial sector if they have supervisory powers, they can only influence government debt indirectly, notably through communications. Advising the government and state-owned companies on debt management and macroeconomic developments might help slow a build-up in debt. Should debt nevertheless rise, certain institutional arrangements, such as rules against direct funding of the government budget, setting an inflation target for monetary policy, and operational independence, could help protect the effectiveness of monetary policy. Pursuing reforms that implement such arrangements could be one way forward for some African central banks.

BIS Working Papers

Non-monetary news in central bank communication
Anna Cieslak and Andreas Schrimpf
December 2018, No 761

We quantify the importance of non-monetary news in central bank communication. Using evidence from four major central banks and a comprehensive classification of events, we decompose news conveyed by central banks into news about monetary policy, economic growth, and separately, shocks to risk premia. Our approach exploits high-frequency comovement of stocks and interest rates combined with monotonicity restrictions across the yield curve. We find significant differences in news composition depending on the communication channel used by central banks. Non-monetary news prevails in about 40% of policy decision announcements by the Fed and the ECB, and this fraction is even higher for communications that provide context to policy decisions such as press conferences. We show that non-monetary news accounts for a significant part of financial markets' reaction during the financial crisis and in the early recovery, while monetary shocks gain importance since 2013.

Gross capital flows by banks, corporates and sovereigns
Stefan Avdjiev, Bryan Hardy, Sebnem Kalemli-Ozcan and Luis Servén
December 2018, No 760

We construct a new data set of quarterly international capital flows by sector, with an emphasis on debt flows. Using our new data set, we establish four facts. First, the co-movement of capital inflows and outflows is driven by inflows and outflows vis-à-vis the domestic banking sector. Second, the procyclicality of capital inflows is driven by banks and corporates, whereas sovereigns' external liabilities move acyclically in advanced and countercyclically in emerging countries. Third, the procyclicality of capital outflows is driven by advanced countries' banks

[1] Requests for publications should be addressed to Bank for International Settlements, Press & Communications, Centralbahnplatz 2, CH-4002 Basel. These publications are also available on the BIS website (http://www.bis.org/).

and emerging countries' sovereigns (reserves). Fourth, capital inflows and outflows decline for banks and corporates when global risk aversion (VIX) increases, whereas sovereign flows show no response. These facts are inconsistent with a large class of theoretical models.

Assessing inflation expectations anchoring for heterogeneous agents: analysts, businesses and trade unions
Ken Miyajima and James Yetman
November 2018, No 759

Forecasts of agents who are actively involved in the setting of prices and wages are less readily available than those of professional analysts, but may be more relevant for understanding inflation dynamics. Here we compare inflation expectations anchoring between analysts, businesses and trade unions for one country for which comparable forecasts are available for almost two decades: South Africa. Forecasts are modelled as monotonically diverging from an estimated long-run anchor point, or "implicit anchor", towards actual inflation as the forecast horizon shortens. We find that the estimated inflation anchors of analysts lie within the 3-6 percent inflation target range of the central bank. However, those for businesses and trade unions, which our evidence suggests may be most relevant for driving the inflation process, have remained above the top end of the official target range. Our results point to challenges for central banks seeking to gain credibility with agents whose decisions directly influence inflation.

Foreign currency borrowing, balance sheet shocks and real outcomes
Bryan Hardy
November 2018, No 758

Emerging market firms frequently borrow in foreign currency (FX), but their assets are often denominated in domestic currency. This behavior leads to an FX mismatch on firms balance sheets, which can harm their net worth in the event of a depreciation. I use a large, unanticipated, and exogenous depreciation episode and a unique dataset to identify the real and financial effects of firm balance sheet shocks. I construct a new dataset of all listed non-financial firms, matched to their banks, in Mexico over 2008q1-2015q2. This dataset combines firm-level balance sheets and real outcomes, currency composition of both assets and liabilities, and firms' loan-level borrowing from banks in peso and FX. This data allows me to control for shocks to firms' credit supply to identify the balance sheet shock and examine its real consequences. I find that non-exporting firms that have a larger FX mismatch experience greater negative balance sheet effects following the depreciation. Among these, smaller firms see a decrease in loan growth, resulting in stagnant employment growth and decreased growth in physical capital relative to firms with smaller FX mismatch. Larger firms with a large FX mismatch also have lower growth in FX loans following the shock, but are able to increase borrowing in peso loans, resulting in relatively higher growth in employment and physical capital. My results imply that firms are subject to net worth based borrowing constraints, and that these constraints are more binding on smaller firms and for loans in FX.

Explaining Monetary Spillovers: The Matrix Reloaded
Jonathan Kearns, Andreas Schrimpf and Dora Xia
November 2018, No 757

Using monetary policy shocks for seven advanced economy central banks, measured at high-frequency, we document the strength and characteristics of interest rate spillovers to 47 advanced and emerging market economies. Our main goal is to assess different channels through which spillovers occur and why some countries' interest rates respond more than others. We find that there is no evidence that spillovers relate to real linkages, such as trade flows. There is some indication that exchange rate regimes influence the extent of spillovers. By far the strongest determinant of interest rate spillovers is financial openness. Countries that have stronger bilateral (and aggregate) financial links with the US or euro area are susceptible to stronger interest rate spillovers. These effects are much more pronounced at the longer end of the yield curve, indicating that while countries retain policy rate independence, financial conditions are influenced by global yields.

Financial structure and income inequality
Michael Brei, Giovanni Ferri and Leonardo Gambacorta
November 2018, No 756

This paper empirically investigates the link between financial structure and income inequality. Using data for a panel of 97 economies over the period 1989-2012, we find that the relationship is not monotonic. Up to a point, more finance reduces income inequality. Beyond that point, inequality rises if finance is expanded via market-based financing, while it does not when finance grows via bank lending. These findings concur with a well-established literature indicating that deeper financial systems help reduce poverty and inequality in developing countries, but also with recent evidence of rising inequality in various financially advanced economies.

Measuring financial cycle time
Andrew Filardo, Marco Jacopo Lombardi and Marek Raczko
November 2018, No 755

Motivated by the traditional business cycle approach of Burns and Mitchell (1946), we explore cyclical similarities in financial conditions over time in order to improve our understanding of financial cycles. Looking back at 120 years of data, we find that financial cycles exhibit behaviour characterised by recurrent, endogenous swings in financial conditions, which result in costly booms and busts. Yet the recurrent nature of such swings may not appear so obvious when looking at conventionally plotted time-series data (that is, observed in calendar time). Using the pioneering framework developed by Stock (1987), we offer a new statistical characterisation of the financial cycle using a continuous-time autoregressive model subject to time deformation, and test for systematic differences between calendar and a new notion of financial cycle time. We find the time deformation to be statistically significant, and associated with levels of long-term real interest rates, inflation volatility and the perceived riskiness of the macro-financial environment. Implications for statistical modelling, endogenous risk-taking economic behaviour and policy are highlighted.

Euro area unconventional monetary policy and bank resilience
Fernando Avalos and Emmanuel C Mamatzakis
November 2018, No 754

This paper examines whether euro area unconventional monetary policies have affected the loss-absorbing buffers (that is the resilience) of the banking industry. We employ various measures to capture the effect of the broad array of programmes used by the ECB to implement balance sheet policies, while we control for the effect of conventional and negative (or very low) interest rate policy. The results suggest that, above and away from the zero-lower bound, looser interest rate policy tends to weaken our measure of euro area banks' loss-absorbing buffers. On the contrary, further lowering interest rates near and below the zero lower bound seems to strengthen (or weaken less) such buffers, which points towards non-linearities arising in the vicinity of the lower bound. Moreover, balance sheet easing policies enhance bank level resilience overall. However, unconventional monetary policies seem to have increased the fragility of banks in the member states hardest hit by the 2011 sovereign debt crisis. In fact, the evidence presented in this paper suggest that the resilience gains of unconventional monetary policies have accrued mostly to banks headquartered in the so-called core euro area countries (Austria, Belgium, Finland, France, Germany, Luxembourg and Netherlands). Finally, unconventional monetary policies seem to have enhanced more the resilience of banks that were relatively stronger, i.e. that were in the higher deciles of the distribution of loss-absorbing buffers.

Currency depreciation and emerging market corporate distress
Valentina Bruno and Hyun Song Shin
October 2018, No 753

How do emerging market corporates fare during periods of currency depreciation? We find that non-financial firms that exploit favorable global financing conditions to issue US dollar bonds and build cash balances are also those whose share price is most vulnerable to local currency depreciation. In particular, firms' vulnerability to currency depreciation derives less from the foreign currency debt as such, but from the cash balances that are built up by using

foreign currency debt. Overall, our results point to a financial motive for dollar bond issuance by emerging market firms in carry trade-like transactions that leave them vulnerable in an environment of dollar strength.

The effects of prudential regulation, financial development and financial openness on economic growth

Pierre-Richard Agénor, Leonardo Gambacorta, Enisse Kharroubi and Luiz Awazu Pereira da Silva
October 2018, No 752

This paper studies the effects of prudential regulation, financial development, and financial openness on economic growth. Using both existing models and a new OLG framework with banking and prudential regulation in the form of capital requirements, the first part presents an analytical review of the various channels through which prudential regulation can affect growth. The second part provides a reduced-form empirical analysis, based on panel regressions for a sample of 64 advanced and developing economies. The results show that growth may be promoted by prudential policies whose goal is to mitigate financial risks to the economy. At the same time, financial openness tends to reduce the growth benefits of these policies, possibly because of either greater opportunities to borrow abroad or increased scope for cross-border leakages in regulation.

Exchange rates and prices: evidence from the 2015 Swiss franc appreciation

Raphael Auer, Ariel Burstein and Sarah M Lein
October 2018, No 751

The removal of the lower bound on the EUR/CHF exchange rate in January 2015 provides a unique setting to study the implications of a large and sudden appreciation in an otherwise stable macroeconomic environment. Using transaction-level data on non-durable goods purchases by Swiss consumers, we measure the response of border and consumer retail prices to the CHF appreciation and how household expenditures responded to these price changes. Consumer prices of imported goods and of competing Swiss-produced goods fell by more in product categories with larger reductions in border prices and a lower share of CHF-invoiced border prices. These price changes resulted in substantial expenditure switching between imported and Swiss-produced goods. While the frequency of import retail price reductions rose in the aftermath of the appreciation, the average size of these price reductions fell (and more so in product categories with larger border price declines and a lower share of CHF-invoiced border prices), contributing to low pass-through into import prices.

Forward guidance and heterogeneous beliefs

Philippe Andrade, Gaetano Gaballo, Eric Mengus and Benoit Mojon
October 2018, No 750

Central banks' announcements that rates are expected to remain low could signal either a weak macroeconomic outlook, which would slow expenditure, or a more accommodative stance, which may stimulate economic activity. We use the Survey of Professional Forecasters to show that, when the Fed gave guidance between Q3 2011 and Q4 2012, these two interpretations co-existed despite a consensus on low expected rates. We rationalise these facts in a New-Keynesian model where heterogeneous beliefs introduce a trade-off in forward guidance policy: leveraging on the optimism of those who believe in monetary easing comes at the cost of inducing excessive pessimism in non-believers.

Whatever it takes. What's the impact of a major nonconventional monetary policy intervention?

Carlo Alcaraz, Stijn Claessens, Gabriel Cuadra, David Marques-Ibanez and Horacio Sapriza
October 2018, No 749

We assess how a major, unconventional central bank intervention, Draghi's "whatever it takes" speech, affected lending conditions. Similar to other large interventions, it responded to adverse financial and macroeconomic developments that also influenced the supply and demand for credit. We avoid such endogeneity concerns by comparing credit granted and its conditions by individual banks to the same borrower in a third country. We show that the intervention reversed prior risk-taking - in volume, price, and risk ratings - by subsidiaries of euro area banks relative to other local and foreign banks. Our results document a new effect of interventions and are robust along many dimensions.

Domestic and global output gaps as inflation drivers: what does the Phillips curve tell?
Martina Jašová, Richhild Moessner and Előd Takáts
September 2018, No 748

We study how domestic and global output gaps affect CPI inflation. We use a New Keynesian Phillips curve framework, which controls for non-linear exchange rate movements for a panel of 26 advanced and 22 emerging economies covering the 1994Q1-2017Q4 period. We find broadly that both global and domestic output gaps are significant drivers of inflation both in the pre-crisis (1994-2008) and post-crisis (2008-2017) periods. Furthermore, after the crisis, in advanced economies the effect of the domestic output gap declines, while in emerging economies the effect of the global output gap declines. The paper demonstrates the usefulness of the New Keynesian Phillips curve in identifying the impact of global and domestic output gaps on inflation.

How do credit ratings affect bank lending under capital constraints?
Stijn Claessens, Andy Law and Teng Wang
September 2018, No 747

Through the lens of credit risk ratings, we investigate how banks determine loan terms under capital constraints. Using a unique and comprehensive supervisory dataset of individual corporate loans in the US, we show that unexpected adjustments to banks' internal rating systems, which only alter how outsiders assess the riskiness of borrowers, trigger changes in loan terms. The effects are asymmetric: downward adjustments to ratings increase spreads by some 40 bps and decrease committed loan sizes and maturities, but upward adjustments lead to much weaker (yet opposite) effects. Importantly, we find effects to be strong for smaller, riskier, and capital constrained banks as well as for borrowers with poorer credit quality and for non-guaranteed loans. Our findings, robust in several ways, highlight the important role of regulatory capital in loan terms.

What drives local lending by global banks?
Stefan Avdjiev, Uluc Aysun and Ralf Hepp
September 2018, No 746

We find that the lending behaviour of global banks' subsidiaries throughout the world is more closely related to local macroeconomic conditions and their financial conditions than to those of their owner-specific counterparts. This inference is drawn from a panel dataset populated with bank-level observations from the Bankscope database. Using this database, we identify ownership structures and incorporate them into a unique methodology that identifies and compares the owner and subsidiary-specific determinants of lending. A distinctive feature of our analysis is that we use multi-dimensional country-level data from the BIS international banking statistics to account for exchange rate fluctuations and cross-border lending.

Financial stress in lender countries and capital outflows from emerging market economies
Ilhyock Shim and Kwanho Shin
September 2018, No 745

We investigate if financial stress in countries where international banks are headquartered is a major driver of banking outflows from emerging market economies (EMEs). We find that when financial stress measured by sovereign or bank CDS spread or corporate bond spread increases, international banks decrease their lending to EMEs, which acts as a major driver of capital outflows from EMEs. In particular, financial stress in lender countries is a more important driver than the local financial conditions and macroeconomic fundamentals of EMEs. Such results generally hold even after the Global Financial Crisis (GFC) period, but to a lesser extent. When we divide the total amount of international lending into subcomponents, cross-border lending to EMEs is more susceptible to financial stress in lender countries than is local lending, and that local lending in foreign currency is more stable than is cross-border lending. Our findings suggest that it is desirable for EME policymakers to promote diversification of lender countries and induce more borrowing from local subsidiaries than cross-border lenders.

Basel Committee on Banking Supervision

Cyber-resilience: range of practices
December 2018

The Basel Committee on Banking Supervision today published the report. It identifies, describes and compares the range of observed bank, regulatory and supervisory cyber-resilience practices across jurisdictions.

Based on analysis of authorities' responses to previous international surveys and on exchanges between international experts, the report gains insight into the effective practices and expectations in place. It also benefited from industry participants' input.

The current challenges and initiatives to enhance cyber-resilience are summarised in 10 key findings and illustrated by case studies which focus on concrete developments in the jurisdictions covered.

Implementation of Basel standards - A report to G20 Leaders on implementation of the Basel III regulatory reforms
November 2018

Full, timely and consistent implementation of Basel III remains fundamental to building a resilient financial system, maintaining public confidence in regulatory ratios and providing a level playing field for internationally active banks. This report updates G20 Leaders on progress and challenges in the implementation of the Basel III regulatory reforms since July 2017, when the Basel Committee last reported to the G20.

The report summarises the steps taken by Basel Committee member jurisdictions to adopt the Basel III standards, banks' progress in bolstering their capital and liquidity positions, the consistency of implementation in jurisdictions assessed since the Committee's last report and the Committee's implementation work plan.

Incentives to centrally clear over-the-counter (OTC) derivatives
November 2018, BCBS & CPMI Papers

The report identifies reform areas that may merit consideration by the relevant standard-setting bodies (SSBs). The findings from the report will inform relevant SSBs regarding any subsequent policy efforts and potential adjustments, bearing in mind the original objectives of the reforms. This does not imply a scaling back of those reforms or an undermining of members' commitment to implement them.

Fifteenth progress report on adoption of the Basel regulatory framework
October 2018

The report includes the status of adoption of the Basel III risk-based capital standards, the leverage ratio, the standards for global and domestic systemically important banks (SIBs) and interest rate risk in the banking book (IRRBB), the Net Stable Funding Ratio (NSFR), the large exposures framework and the disclosure requirements.

Statement on leverage ratio window-dressing behaviour
October 2018

The Basel III leverage ratio standard comprises a 3% minimum level that banks must meet at all times, a buffer for global systemically-important banks and a set of public disclosure requirements. For the purpose of disclosure requirements, banks must calculate the leverage ratio on a quarter-end basis. Certain jurisdictions require banks to calculate the ratio more frequently (eg using averages of exposure amounts based on daily or month-end values).

Heightened volatility in various segments of money markets and derivatives markets around key reference dates (eg quarter-end dates) has alerted the Committee to potential regulatory arbitrage by banks. A particular concern is "window dressing", in the form of temporary reductions of transaction volumes in key financial markets around reference dates resulting in the reporting and public disclosure of elevated leverage ratios.

Window-dressing by banks is unacceptable, as it undermines the intended policy objectives of the leverage ratio requirement and risks disrupting the operations of financial markets. Banks and supervisors should ensure ongoing compliance with the Committee's leverage ratio such that it accurately reflects the resilience of banks and to mitigate any possible disruption to the operations of financial markets that results from window dressing.

Accordingly, in evaluating its leverage ratio exposure, a bank should assess the volatility of transaction volumes throughout reporting periods, and the effect on its leverage ratio requirements. Banks should also desist from undertaking transactions with the sole purpose of reporting and disclosing higher leverage ratios at reporting days only.

Leverage ratio treatment of client cleared derivatives
October 2018

A key element of the Basel Committee's post-crisis Basel III reforms is the introduction of a leverage ratio requirement. The leverage ratio complements the risk-based capital requirements by providing a safeguard against unsustainable levels of leverage and by mitigating gaming and model risk across both internal models and standardised risk measurement approaches. By design, the leverage ratio does not differentiate risk across different asset classes.

This consultative document seeks the views of stakeholders on whether a targeted and limited revision of the leverage ratio's treatment of client cleared derivatives may be warranted, based on the findings of the Committee's review of the impact of the leverage ratio on banks' provision of client clearing services and in consideration of key policy objectives of G20 Leaders both to prevent excessive leverage and improve the quality and quantity of capital in the banking system and to promote central clearing of standardised derivatives contracts.

Stress testing principles
October 2018

The 2009 principles were designed to address key weaknesses in stress testing practices as highlighted by the global financial crisis. Since then, the role of stress testing has rapidly evolved and grown in importance in many jurisdictions. The principles published today have been updated to reflect that stress testing is now both a critical element of risk management for banks and a core tool for banking supervisors and macroprudential authorities. The updated principles are set at a high level so that they can be applied across banks and jurisdictions while remaining relevant as stress testing practices continue to evolve.

The principles are guidelines that focus on the core elements of stress testing frameworks. These include the objectives, governance, policies, processes, methodology, resources and documentation that guide stress testing activities and facilitate the use, implementation and oversight of stress testing frameworks. Each principle is followed by a short description of considerations that are equally relevant for banks and authorities. This description is followed by additional points applicable to either banks or authorities, as follows:

- Additional points for banks: points with particular relevance to (a) banks' own internal stress testing activities and (b) their participation in bank-run supervisory stress tests.
- Additional points for authorities: points with particular relevance to (a) supervisor-run stress tests and (b) the authorities' role in bank-run supervisory stress tests. They also cover the role of authorities in their oversight of banks' internal stress testing activities.

Basel III Monitoring Report
October 2018

This report presents the results of the Basel Committee's latest Basel III monitoring exercise based on data as of 31 December 2017. The Committee established a rigorous reporting process to regularly review the implications of the Basel III standards for banks, and has been publishing the results of such exercises since 2012. For the first time, the report sets out the impact of the Basel III framework that was initially agreed in 2010 as well as the effects of the Committee's December 2017 finalisation of the Basel III reforms.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel NSFR regulations - Kingdom of Saudi Arabia

September 2018

Through its Regulatory Consistency Assessment Programme (RCAP), the Basel Committee monitors the timely adoption of regulations by its members, assesses their consistency with the Basel framework and analyses the quality of intended regulatory outcomes. The RCAP also helps member jurisdictions to identify deviations from the Basel framework and assesses their materiality.

This report describes the Committee's assessment of the implementation of the Basel Net Stable Funding Ratio (NSFR) regulations in the Kingdom of Saudi Arabia. The Saudi Arabian NSFR regulations have been assessed as compliant, which is the highest possible grade.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel large exposures framework - Kingdom of Saudi Arabia

September 2018

Through its Regulatory Consistency Assessment Programme (RCAP), the Basel Committee monitors the timely adoption of regulations by its members, assesses their consistency with the Basel framework and analyses the quality of intended regulatory outcomes. The RCAP also helps member jurisdictions to identify deviations from the Basel framework and assesses their materiality.

This report describes the Committee's assessment of the implementation of the Basel Large Exposure (LEX) regulations in the Kingdom of Saudi Arabia. The Saudi Arabian LEX regulations have been assessed as compliant, which is the highest possible grade.

Speeches

Shelter from the storm

Remarks by Mr Agustín Carstens, General Manager of the BIS, at a seminar at the European Stability Mechanism, Luxembourg, 7 December 2018.

Getting one's house in order, building a resilient and flexible economy, and reducing vulnerabilities - all these things are of first-order importance. But it would be naive to believe that we can avoid all future crises. And when they do occur, having a shelter from the storm is very important. This speech reviews the achievements and unintended consequences of the policy response to the Global Financial Crisis and the subsequent European debt crisis. It then sketches the challenges authorities might face in the years to come and discusses what can be done to safeguard economic and financial stability.

Big tech in finance and new challenges for public policy

Keynote address by Mr Agustín Carstens, General Manager of the BIS, at the FT Banking Summit, London, 4 December 2018.

Large technology companies with established user networks ("big tech") are challenging traditional finance. Having started with payments, in some markets such companies have been expanding into the provision of credit, insurance and even wealth management. They have been doing so either directly or in cooperation with incumbent financial institutions. This raises a host of questions around competition, financial inclusion, data protection and financial stability. Will this growth lead to a more diverse financial system or to new forms of concentration? Is the expansion of big tech driven by efficiency gains, or by arbitrage of the current regulatory system? And how should public policy adapt to these developments in order to protect client data and help sustain strong and balanced growth?

Financial instability: can Big Data help connect the dots?

Remarks by Mr Luiz Awazu Pereira da Silva, Deputy General Manager of the BIS, and Goetz von Peter, Principal Economist at the BIS, based on a speech delivered at the Ninth European Central Bank Statistics Conference on "20 years of ESCB statistics: what's next?", Frankfurt am Main, 11 July 2018.

The Great Financial Crisis fuelled a broad-based expansion of financial statistics. A second, much larger wave of data hits the shores as central banks and the financial sector embrace Big Data. Collecting more data or dots is necessary, but connecting the dots is the critical step for understanding the implications for financial stability. It is the lens that matters: it takes purposeful analysis to turn data into useful information. Financial markets are flush with data, yet the bigger picture can slip out of sight. This is where policymakers and market participants fall short time and again: in run-ups to previous crises, simple aggregates would signal problems yet warnings went unheeded. The onset of a crisis then sharpens the focus on critical data for the management and resolution of the crisis. Later, when the financial cycle turns again, innovation and changing structure make financial risks harder to locate using the existing data.

Ten years after the Great Financial Crisis - where do we stand?

Lecture by Mr Agustín Carstens, General Manager of the BIS, at the People's Bank of China, Beijing, 19 November 2018.

After central banks played a critical role in stemming the Great Financial Crisis, monetary stimulus in subsequent years helped to build the foundations for the recovery. But in its wake, there were unintended side effects and structural changes that will need to be addressed in the normalisation phase. These include high levels of debt, a shift from bank financing to bond financing and the postponement of structural reforms. The unwinding of monetary accommodation currently in progress in core advanced economies is a sign that earlier policies have done their job. Yet, risks are ever present, notably sharp market corrections that could spill over globally due to significant allocations by global asset managers in emerging market economy (EME) local currency bonds. To meet these challenges, policymakers need to adopt growth-enhancing structural reforms and implement fully the agreed post-crisis financial reforms. EME authorities should also be prepared to manage spillovers through the flexible use of policy instruments.

On money, debt, trust and central banking

Keynote speech by Mr Claudio Borio, Head of the Monetary and Economic Department of the BIS, at the Cato Institute, 36th Annual Monetary Conference, Washington DC, 15 November 2018.

This essay examines in detail the properties of a well functioning monetary system - defined as money plus the mechanisms to execute payments - in both the short and long run, drawing on both theory and the lessons from history. It stresses the importance of trust and of the institutions needed to secure it. Ensuring price and financial stability is critical to nurturing and maintaining that trust. In the process, the essay addresses several related questions, such as the relationship between money and debt, the viability of cryptocurrencies as money, money neutrality, and the nexus between monetary and financial stability. While the present monetary system, with central banks and a prudential apparatus at its core, can and must be improved, it still provides the best basis to build on.

Money in a digital age: 10 thoughts

Speech by Mr Agustín Carstens, General Manager of the BIS, at Lee Kuan Yew School of Public Policy, Singapore, 15 November 2018.

New technology has spurred economic growth to the benefit of us all and we should continue to welcome innovation, including in the space of finance and payments. But the claims of its proponents should be tested against the laws of economics, centuries of accumulated wisdom and plain old common sense. Good technology alone does not ensure good economics, just as good economics does not ensure good technology. Technology is only effective once it has

found its economic purpose. We must consider the intended goals and harness the best and most appropriate technology to help us get there.

Distributed ledger technology and large value payments: a global game approach

Presentation by Mr Hyun Song Shin, Economic Adviser and Head of Research of the BIS, at the conference on "Cryptocurrencies and Blockchains", University of Chicago Becker Friedman Institute, 9 November 2018.

Payment systems built around distributed ledger technology (DLT) operate by maintaining identical copies of the history of payments among the participant nodes in the payment system. Cryptocurrencies are perhaps the best-known example of the application of DLT, but the applicability of the technology is much broader. Payment systems based on DLT are compatible with oversight by the central bank, and several central banks have conducted successful trials of interbank payments. In these trials, payment system participants transfer digital tokens that are redeemable at the central bank and use DLT to transfer them to other system participants. Decentralised consensus is achieved through agreement of a supermajority of the participants (typically 75-80%) who collectively validate payments.

Nevertheless, the technology by itself does not overcome the credit needs of the payment system to maintain settlement liquidity. In conventional real-time gross settlement (RTGS) payment systems, the value of daily payments can be over 100 times the deposit balance maintained by the system participant at the central bank. As such, incoming payments are recycled into outgoing payments, and credit provided by the central bank supplements private credit from outside the payment system for the smooth functioning of the system as a whole.

We examine the liquidity properties of decentralised payment systems in an economic model of payments, in which the cost of credit to finance payments enters explicitly.

Financial inclusion in the age of fintech: a paradigm shift

Welcoming keynote address1 by Mr Luiz Awazu Pereira da Silva, Deputy General Manager of the BIS, at the fourth FSI-GPFI conference on standard-setting bodies and innovative financial inclusion: implications of fintech and other regulatory and supervisory developments, Basel, Switzerland, 25 October 2018.

Yuan Fluctuates With Market, PBOC Has Tools to Maintain Control, Agustín Carstens says

Interview with Mr Agustín Carstens, General Manager of the BIS, in Yicai Global, conducted by Ms Yang Yanqing and Ms Zhou Ailin and published online on 1 November 2018.

Money and payment systems in the digital age

Speech by Mr Agustín Carstens, General Manager of the BIS, at the Finance and Global Economics Forum of the Americas and on the occasion of the 70th anniversary of the University of Miami Business School, Miami, 1 November 2018.

Money is one of humankind's most important inventions and is critical to a modern economy, including for the payment of goods and services. Money has evolved through the years with central banks playing an important role. These days, most central banks operate complex systems that allow for safe and efficient payments. Central banks are using the latest technologies to make payment systems more robust, more resilient and more timely, and will continue to play a critical role in pushing the boundaries of how technology can enhance the payments landscape. Money and payments continue to evolve, and the future is promising.

The new supervisory agenda

Keynote address by Mr Agustín Carstens, General Manager of the BIS, at the 13th ASBA-BCBS-FSI High-level Meeting on "Global and Regional Supervisory Priorities", Nassau, 30 October 2018.

Deposit insurance and financial stability: old and new challenges

Keynote address by Mr Agustín Carstens, General Manager of the BIS, at the 17th IADI Annual General Meeting and Annual Conference on "Deposit insurance and financial stability: recent financial topics", Basel, 18 October 2018.

New loan provisioning standards and procyclicality

Panel remarks by Mr Claudio Borio, Head of the Monetary and Economic Department of the BIS, at the High-level conference on "The new bank provisioning standards: implementation challenges and financial stability implications", jointly organised by the Bank of Spain, the Centro de Estudios Monetarios y Financieros (CEMFI) and the BIS Financial Stability Institute (FSI), Madrid, Spain, 18-19 October 2018.

The adoption of the new expected credit loss provisioning standard - IFRS 9 - is a landmark. What are its implications for financial stability? While the new standard is likely to mitigate the procyclicality of the financial system to some extent relative to the previous, incurred loss model, it falls short by a significant margin of what one would like from a financial stability perspective. This points to broader inevitable tensions between accounting and prudential regulation, and calls for the active use of backstops (or so-called prudential filters) to preserve stability. Experience with the operation of the alternative dynamic (countercyclical) credit loss provisioning scheme adopted by the Bank of Spain points to some strengths and weaknesses in the broader macroprudential frameworks in which such arrangements are embedded.

The 'real' illusion: How monetary factors matter in low-for-long rates

Article by Mr Claudio Borio, Head of the Monetary and Economic Department of the BIS, Mr Piti Disyatat, Director of Research, Bank of Thailand, Mr Mikael Juselius, Research Adviser, Monetary Policy and Research Department, Bank of Finland, and Mr Phurichai Rungcharoenkitkul, Senior Economist, Monetary and Economic Department, Bank for International Settlements, in ・VoxEU.org, published on 18 October 2018.

Bringing the BIS to Asia - and Asia to the BIS

Opening remarks by Agustín Carstens, General Manager of the BIS, at the BIS symposium on "New challenges for central banking" to mark the 20th anniversary of the BIS Representative Office for Asia and the Pacific, Hong Kong, 15 October 2018.

The European banking union: what are the missing pieces?

Public lecture by Mr Fernando Restoy, Chairman, Financial Stability Institute, Bank for International Settlements, at the International Center for Monetary and Banking Studies, Geneva, Switzerland, 16 October 2018.

The success of the European banking union project should be gauged in terms of how far the process meets two objectives: ensuring a more closely integrated banking system in the euro zone; and denationalising the value of banks' liabilities. It is shown that progress is still incomplete on both fronts. In order to accomplish the set goals, it may be necessary to consider additional steps, including: (i) completion of a single rulebook; (ii) promotion of a more market-sensitive structure for the banking industry; (iii) swift action to address the implementation challenges of the new resolution framework for systemic banks; and (iv) development of a common administrative insolvency regime for non-systemic institutions.

Challenges for the world economy: implications for Arab economies

Keynote speech by Mr Agustín Carstens, General Manager of the BIS, at the 42nd Annual Meeting of the Council of Arab Central Banks and Monetary Authorities Governors, Amman, 17 September 2018.

A decade after the global financial crisis, the global economy is now solidly expanding. Yet, this expansion is by no means universal. Arab countries in particular have struggled to cope with large swings in energy prices, relying primarily on fiscal policy to stabilise their economies. But this will prove more difficult as the prospect of monetary policy normalisation looms large. Meanwhile, trade tensions could derail world growth and lower energy prices. As borrowing costs rise, the use of fiscal policy as a shock absorber will become more difficult. Hence, there is no alternative to building resilience. In addition to increasing an economy's diversification and flexibility while reducing its vulnerabilities, expanded external cushions such as international reserves or access to external liquidity assistance could play an important part.

BIS Quarterly Review, September 2018 - media briefing

Remarks by Mr Claudio Borio, Head of the Monetary and Economic Department of the BIS and Mr Hyun Song Shin, Economic Adviser and Head of Research of the BIS.

Reflections on the Lehman collapse, 10 years later

Translation of an article by Mr Hyun Song Shin, Economic Adviser and Head of Research of the BIS, in the ・Frankfurter Allgemeine Zeitung (FAZ), 15 September 2018.