

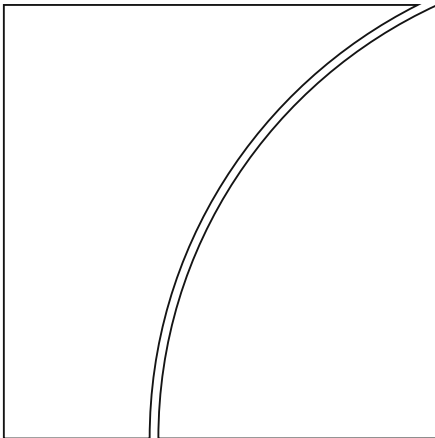


BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

September 2017

International banking
and financial market
developments



BIS Quarterly Review
Monetary and Economic Department

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International banking and financial market developments

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Notations used in this Review

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

Differences in totals are due to rounding.

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

Abbreviations

Currencies

ARS	Argentine peso	LTL	Lithuanian litas
AUD	Australian dollar	LVL	Latvian lats
BGN	Bulgarian lev	MAD	Moroccan dirham
BHD	Bahraini dinar	MXN	Mexican peso
BRL	Brazilian real	MYR	Malaysian ringgit
CAD	Canadian dollar	NOK	Norwegian krone
CHF	Swiss franc	NZD	New Zealand dollar
CLP	Chilean peso	OTH	all other currencies
CNY (RMB)	Chinese yuan (renminbi)	PEN	Peruvian new sol
COP	Colombian peso	PHP	Philippine peso
CZK	Czech koruna	PLN	Polish zloty
DKK	Danish krone	RON	Romanian leu
EEK	Estonian kroon	RUB	Russian rouble
EUR	euro	SAR	Saudi riyal
GBP	pound sterling	SEK	Swedish krona
HKD	Hong Kong dollar	SGD	Singapore dollar
HUF	Hungarian forint	SKK	Slovak koruna
IDR	Indonesian rupiah	THB	Thai baht
ILS	Israeli new shekel	TRY	Turkish lira
INR	Indian rupee	TWD	New Taiwan dollar
JPY	Japanese yen	USD	US dollar
KRW	Korean won	ZAR	South African rand

Countries

AE	United Arab Emirates	KY	Cayman Islands
AR	Argentina	LB	Lebanon
AT	Austria	LT	Lithuania
AU	Australia	LU	Luxembourg
BE	Belgium	LV	Latvia
BG	Bulgaria	MO	Macao SAR
BH	Bahrain	MT	Malta
BM	Bermuda	MU	Mauritius
BR	Brazil	MX	Mexico
CA	Canada	MY	Malaysia
CH	Switzerland	NG	Nigeria
CL	Chile	NL	Netherlands
CN	China	NO	Norway
CO	Colombia	NZ	New Zealand
CR	Costa Rica	PE	Peru
CZ	Czech Republic	PH	Philippines
DE	Germany	PL	Poland
DK	Denmark	PT	Portugal
EA	euro area	RO	Romania
EE	Estonia	RS	Serbia
ES	Spain	RU	Russia
FI	Finland	SA	Saudi Arabia
FR	France	SE	Sweden
GB	United Kingdom	SG	Singapore
GR	Greece	SK	Slovakia
HK	Hong Kong SAR	SL	Slovenia
HR	Croatia	TH	Thailand
HU	Hungary	TR	Turkey
ID	Indonesia	TW	Chinese Taipei
IE	Ireland	UA	Ukraine
IL	Israel	US	United States
IN	India	UY	Uruguay
IR	Iran	VG	British Virgin Islands
IS	Iceland	VN	Vietnam
JP	Japan	ZA	South Africa
KR	Korea	AEs	advanced economies
KW	Kuwait	EMEs	emerging market economies

Strong outlook with low inflation spurs risk-taking

Monetary policy came sharply back into focus in global financial markets. In late June, market participants interpreted speeches by the ECB President and the Bank of England Governor as possible signs of the beginning of a broader-based tightening in major advanced economies other than the United States. Long-run government bond yields jumped. However, they soon softened in response to weak inflation data and central bank statements that investors perceived as having a more dovish tone. Moreover, low realised inflation led markets to also anticipate an even more gradual path for US monetary policy tightening than at the beginning of June.

Propelled by reduced expectations of monetary tightening in the United States and positive macroeconomic news, global markets surged. US equity markets reached new historical highs in August, and emerging market economy (EME) equities steamed ahead. Corporate credit spreads were at, or close to, their narrowest levels since the beginning of 2008. Both realised and implied volatility in all major asset classes, and for bonds in particular, were subdued. The MOVE – a measure of implied volatility in the US Treasury market – reached new historical lows. In mid-August, volatilities spiked somewhat due to rising political risks in the United States and increased geopolitical tensions relating to North Korea. But even as political tensions remained high, they returned to low levels by the beginning of September.

The shifting outlook for the future paths of monetary policy and increased US policy uncertainty put strong downward pressure on the US dollar. As macro news was also better than expected globally while disappointing in the United States, the dollar depreciated vis-à-vis all major advanced economy and EME currencies. The dollar lost most ground against the euro, given the strengthening economic outlook in the euro area and monetary policy signals.

Low measures of volatility and a depreciating dollar supported a “risk-on” phase. It whetted investors’ appetite for EME assets as carry trades delivered large returns. Equity market investors used record amounts of margin debt to lever up their investments, even though price/earnings ratios indicated that equity valuations might be stretched by historical standards. And there were some signs of search for yield in debt markets: issuance volumes in leveraged loan and high-yield bond markets rose while covenant standards eased.

A brighter outlook and subdued inflation drive markets up

Monetary policy took centre stage at the end of June. Market participants interpreted a speech by the President of the ECB on 27 June as providing a signal of a forthcoming tapering of quantitative easing in the euro area. Within three days, German 10-year government bond yields increased by more than 20 basis points (Graph 1, left-hand and centre panels). On 28 June, the Governor of the Bank of England hinted at possible rate increases, driving UK 10-year yields 25 basis points higher.

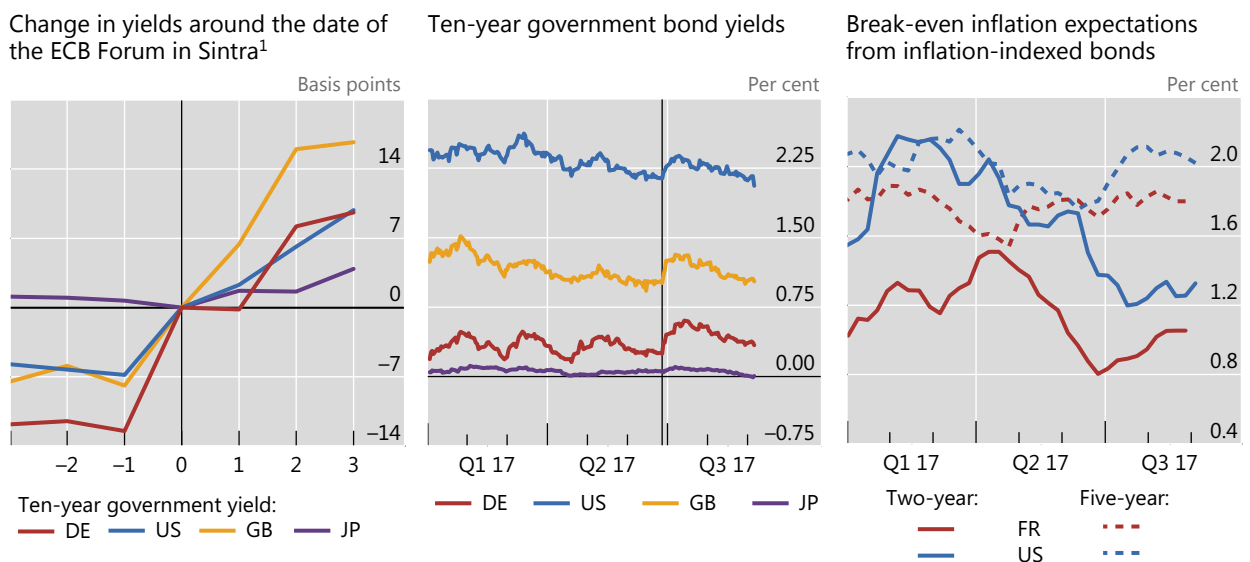
Long-term yields rose globally in anticipation of an end to the exceptionally easy monetary policy in major advanced economies other than the United States. The prospects of a simultaneous tightening jolted markets.

The rise of global yields came to a halt as investors took cues from further central bank announcements and higher inflation did not materialise. Subdued wage pressures, despite tightening labour markets, contributed to low headline inflation in the United States and the euro area of 1.7% and 1.3%, respectively, in July. Low inflation fed into low inflation expectations (Graph 1, right-hand panel), which were further depressed in the United States by fading prospects for a large fiscal stimulus. In Japan, inflation remained close to zero, and inflation expectations changed little after 20 July when the Bank of Japan delayed the timeline for reaching its inflation target.

Against this backdrop, market participants expected a more gradual tightening, in particular in the United States. Despite a small uptick after the ECB President's speech, rate hike expectations in the euro area and Japan remained minimal (Graph 2, first panel). In June, market prices had already been implying a much more gradual pace of tightening than in previous episodes in the United States and the

Monetary policy takes centre stage

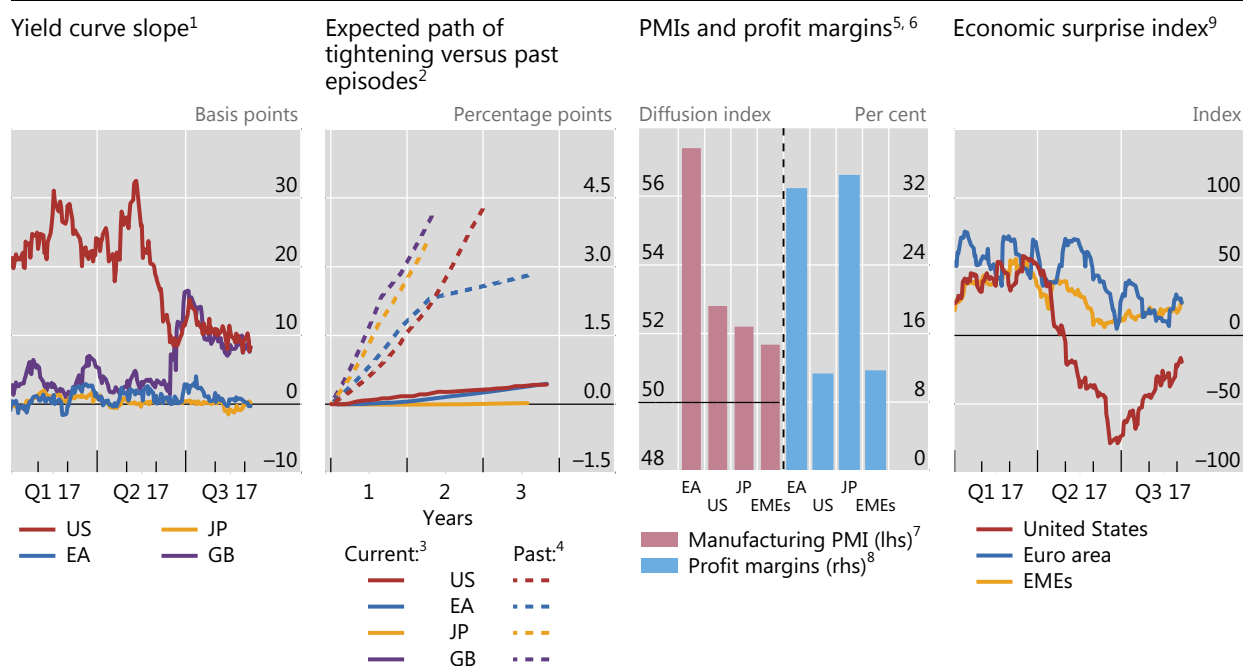
Graph 1



The vertical line in the centre panel indicates 27 June 2017 (ECB Forum on Central Banking, Sintra).

¹ 27 June 2017 corresponds to zero on the horizontal axis; the other values on that axis correspond to the number of days before/after 27 June 2017.

Sources: Bloomberg; BIS calculations.



¹ Difference between one-year and one-month overnight index swap rates. ² For US, fed funds 30-day future; for EA, three-month Euribor; for JP, three-month euroyen Tibor; for GB, 90-day sterling. ³ As of 6 September 2017. ⁴ From start of monetary policy tightening. Normalisation episodes (average across episodes, where applicable): for EA, 1999–2000 and 2005–08; for JP, 1989–90; for GB, 1988–89, 2003–04 and 2006–07; for US, 1987–89, 1994–95, 2004–06 and 2015–17. ⁵ A value of 50 indicates that the number of firms reporting business expansion and contraction is equal; a value above 50 indicates expansion. ⁶ Values for July 2017. ⁷ For EMEs, weighted average based on GDP and PPP exchange rates of BR, CN, IN, MX, RU and TR. ⁸ Growth in profit margins from July 2016 to July 2017. For EMEs, countries included in the MSCI EM index. ⁹ Citi Economic Surprise Index.

Sources: Bloomberg; Datastream; BIS calculations.

United Kingdom (Graph 2, second panel). While events in late June pushed up rate hike expectations somewhat, the “missing inflation” flattened yield curves again. Accordingly, the market-implied probability of at least one rate rise within one year fell from 60% in early July to around 30% in early September in the United States. Long-term bond yields fell steadily, with the US yield reaching levels last seen in November 2016.

Despite subdued inflation in advanced economies, the global macro outlook was upbeat. Market commentators label such an environment the Goldilocks scenario – where the economy is “not too hot, not too cold, but just right”.

The purchasing managers’ index (PMI), a leading indicator of economic activity, signalled continued economic expansion in advanced economies (Graph 2, third panel). In Japan, profit margins rose rapidly. The economy grew in the second quarter at an annualised rate of 4% – the fastest pace in more than two years, beating expectations by a wide margin.

The economic outlook for the euro area was particularly positive. As the area recorded its lowest unemployment rate in nine years, the manufacturing PMI rose to its highest level since 2011. Euro zone economic confidence breached even pre-crisis levels. The profit margins of European companies also grew strongly (Graph 2, third panel), even though their overall profitability remained below that of their US or EME

How did markets react to bank distress in Europe?

Bilyana Bogdanova and Mathias Drehmann

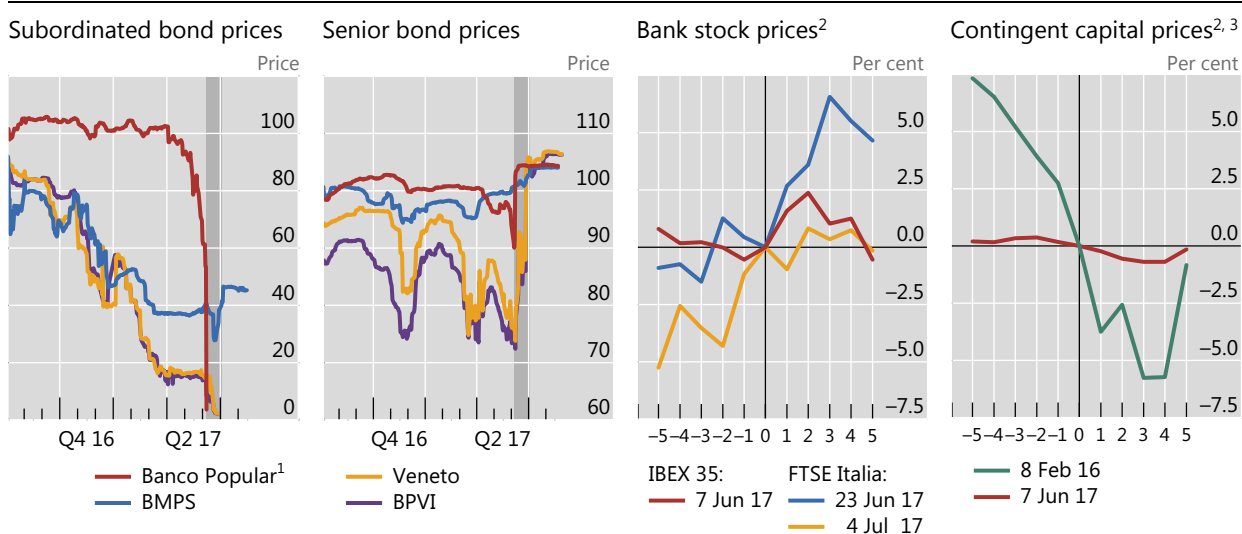
Four banks in Italy and Spain failed or were recapitalised in June and July. This box takes a closer look at those events and the spillovers to market conditions for banks in Europe.

Investors did not fully anticipate the failure of the Spanish bank, Banco Popular Español. On 7 June, it was the first bank to be put into resolution under the Bank Recovery and Resolution Directive of the European Union. It was acquired by Spain's Banco Santander (for a symbolic sum) the following day. Equity and subordinated debt prices had weakened in the run-up to the event. Yet subordinated Additional Tier 1 (AT1) debt was still trading at 70 cents to par at the end of May, a few days before the start of the resolution process that was to wipe the bank out (Graph A, first panel). Prices for unsecured debt, on the other hand, decreased relatively little and actually increased after 7 June (Graph A, second panel).

For the Italian banks, by contrast, problems had been unfolding for several months and markets had already priced in a significant debt writedown ahead of the announcements of official intervention. On 23 June, European authorities decided that Banca Popolare di Vicenza (BPVI) and Veneto Banca would be wound up under normal Italian insolvency proceedings, coupled with state aid to facilitate market exit. Equity and subordinated debt, which had already been trading at depressed levels since late 2016, were written down to zero, while senior bondholders and depositors were spared (Graph A, first two panels).^① Discussions on how to deal with Banca Monte dei Paschi di Siena (BMPS) had been under way since the end of December 2016, when the bank had failed to raise private capital and equity trading had been suspended. By June, subordinated debt holders had already anticipated much of the losses

No contagion from bank failures in Europe

Graph A



The shaded areas in the first two panels indicate the period 7 June to 4 July 2017.

¹ For subordinated debt, AT1 contingent capital instrument. ² Percentage changes over the stated window. Zero indicates the following event dates: 8 February 2016 (Deutsche Bank's statement on AT1 payments capacity), 7 June 2017 (the Single Resolution Board's (SRB's) endorsement of the resolution scheme for Banco Popular Español), 23 June 2017 (the SRB's resolution decision on Banca Popolare di Vicenza and Veneto Banca) and 4 July 2017 (the European Commission's approval of a precautionary recapitalisation for Banca Monte dei Paschi di Siena). ³ Markit iBoxx USD liquid developed markets AT1 contingent capital index.

Source: Bloomberg.

they would face and the prices of the securities they held rose after the European Commission approved the precautionary recapitalisation on 4 July (Graph A, first panel). Prices of senior debt instruments also rose from the beginning of June, when it became clear that they would not be written down (Graph A, second panel).

Following these events, the reduced uncertainty seemed to support the outlook for other banks in Europe (Graph A, third panel). Spanish banks' equity prices rose somewhat in the few days after the announcement of Banco Popular's takeover by Banco Santander. While the authorisation of the precautionary recapitalisation of BMPS on 4 July had a muted impact as it was aligned with market expectations, Italian bank shares rose substantially after the liquidation of Veneto Banca and BPVI. Overall, the FTSE Italia All Share Banks index climbed by 10% from the beginning of June to the end of July, outperforming the STOXX Europe 600 Banks index, which returned nearly 5%.

Despite the first ever conversion of AT1 instruments, there was also no evidence of contagion in the market for contingent convertible instruments after the failure of Banco Popular (Graph A, fourth panel). The developed markets AT1 CoCo index reacted little compared with early 2016, when Deutsche Bank had sparked market anxiety because of the potential for a suspension of coupon payments. After edging down in the week of Banco Popular's failure, the index went up by 2% from the beginning of June to the end of July. Moreover, European banks continued to issue contingent capital instruments, with around €15 billion successfully sold from April to August 2017.

① While losses were covered by bonds being written down in all three cases, retail junior debtholders can apply for compensation under certain eligibility criteria.

counterparts. The positive outlook was further underpinned by progress in cleaning up bank balance sheets (Box A) and by reduced policy uncertainty following the presidential and parliamentary elections in France.

US macroeconomic data were strong, but the US economy underperformed relative to market expectations. In July, the US unemployment rate fell to levels last seen in 2001. At the same time, the Citi Economic Surprise Index reached its lowest point since 2011, indicating that economic data poorly matched market expectations (Graph 2, fourth panel). That said, rising and better than expected profit margins supported equity markets.

Investors were also positively surprised by the macro news coming from EMEs. Corporate profit margins rose. And while the outlook was not as optimistic as for advanced economies, PMIs indicated a macroeconomic expansion for major EMEs. Growth in China held up unexpectedly well, at around 7% in the second quarter, giving a major boost to market confidence.

Market participants' concerns about financial stability risks in China also retreated. At the beginning of the year, strong capital outflows and rapidly shrinking FX reserves had prompted market jitters against the backdrop of persistent aggregate credit growth and high credit-to-GDP ratios.¹ Since then, credit growth has slowed even though house prices continue to rise, partly driven by property developers (Box B). China's net capital inflows have turned positive, and its foreign exchange reserves have stabilised.²

¹ For a further discussion of credit developments and early warning indicators of financial crisis for China, see "Highlights of global financial flows" in this issue.

² See the Statistical Release "BIS international banking statistics at end-March 2017", issued in July 2017.

Property markets and real estate companies

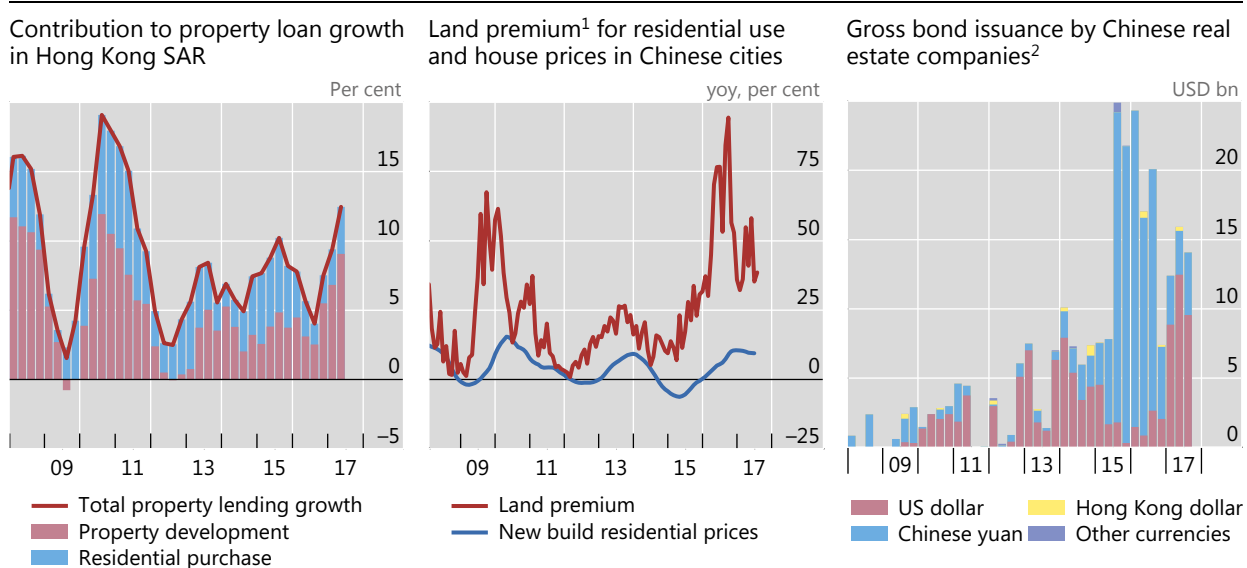
Michael Chui, Anamaria Illes and Christian Upper

The beginning of normalisation of monetary policy in the United States and the tightening of macroprudential measures in a number of emerging Asian countries seem to have helped slow credit growth in these economies over the past year. However, property prices have remained firm. In some jurisdictions, such as China and Hong Kong SAR, house prices have risen further, and this has coincided with a pickup in property developers' borrowing through bank loans and debt securities.^① This box discusses how property developers have contributed to rising property prices and to what extent their fast-growing activities could become a cause for concern for the authorities.

One channel through which property developers have propped up housing demand is the offering of financing schemes to potential buyers. For example, although between 2009 and 2015 the Hong Kong Monetary Authority (HKMA) introduced seven rounds of macroprudential measures to tighten mortgages, over the past two years property developers have increasingly offered attractive financing schemes to prospective buyers in an effort to boost sales. Often, the offers have not involved an assessment of borrowers' repayment ability. There is little information on how exactly these financing schemes are funded. But lending to finance property development has become the dominant contributor to the pickup in total property lending growth during this period (Graph B, left-hand panel).^② To protect banking sector stability, in June 2017 the HKMA tightened the limits on the maximum amounts that banks can lend with respect to the cost and site value of construction projects; from August, it also phased in higher risk weights for credit exposures to property developers.

Property loan growth, land premium and property developers' bond financing

Graph B



¹ For the major 100 cities, defined as $100\% \times (\text{hammer price} - \text{initial bid}) / \text{initial bid}$. ² Comprising 106 Chinese-owned companies listed on the Shanghai, Shenzhen and Hong Kong stock exchanges.

Sources: Hong Kong Monetary Authority; Thomson Reuters Eikon; WIND.

Lending to prospective buyers and fierce competition among developers have pushed up land prices. With demand for housing remaining strong, companies can afford to bid aggressively for land, as the higher cost can be passed on to home buyers. The land premium (the difference between the hammer price and initial bid) paid by property developers for plots in major Chinese cities has been quite high since mid-2015. In the past, this premium has tended to be a leading indicator of residential price inflation (Graph B, centre panel).

Overseas expansion of property developers could add an international dimension to the phenomenon. For example, Singapore reported that property developers (mostly foreign-owned) bid aggressively at land auctions in the first half of 2017. Companies paid on average 29% more for residential plots than for comparable sites sold in the past five years. Partly in response to these aggressive bids, the Monetary Authority of Singapore issued a warning that “the risk of a renewed unsustainable surge in property prices is not trivial”.^③

Aggressive bids by developers that do not ultimately meet strong demand could pave the way for a sharp market adjustment. The profit margins of developers could then be squeezed, and homeowners could suffer significant valuation losses. In this context, a Singapore minister warned local residents in 2015 about the risk of oversupply when investing in the large residential projects then under construction in neighbouring Malaysia. The developers (dominated by a few Chinese companies) planned to establish a total of 336,000 new residential units, slightly more than the entire stock of private homes in Singapore in 2015.

Naturally, foreign currency borrowing could leave those property developers lacking corresponding revenues vulnerable to currency mismatches, unless these risks were hedged. Market data reveal that, among the 106 Chinese-owned listed real estate firms, many of which have been active outside China, gross bond issuance has increased sharply since 2012, reaching a peak of around \$25 billion per quarter in late 2015 and early 2016. Since then, their bond issuance has moderated somewhat (Graph B, right-hand panel).^④ The share of US dollar-denominated debt, which was initially very high, dried up between 2015 and 2016 but increased again sharply in 2017. The State Council’s guidelines, approved on 18 August of this year, which aim to curb Chinese companies’ seemingly overambitious investments abroad in a range of sectors, including property, should be seen against this backdrop.

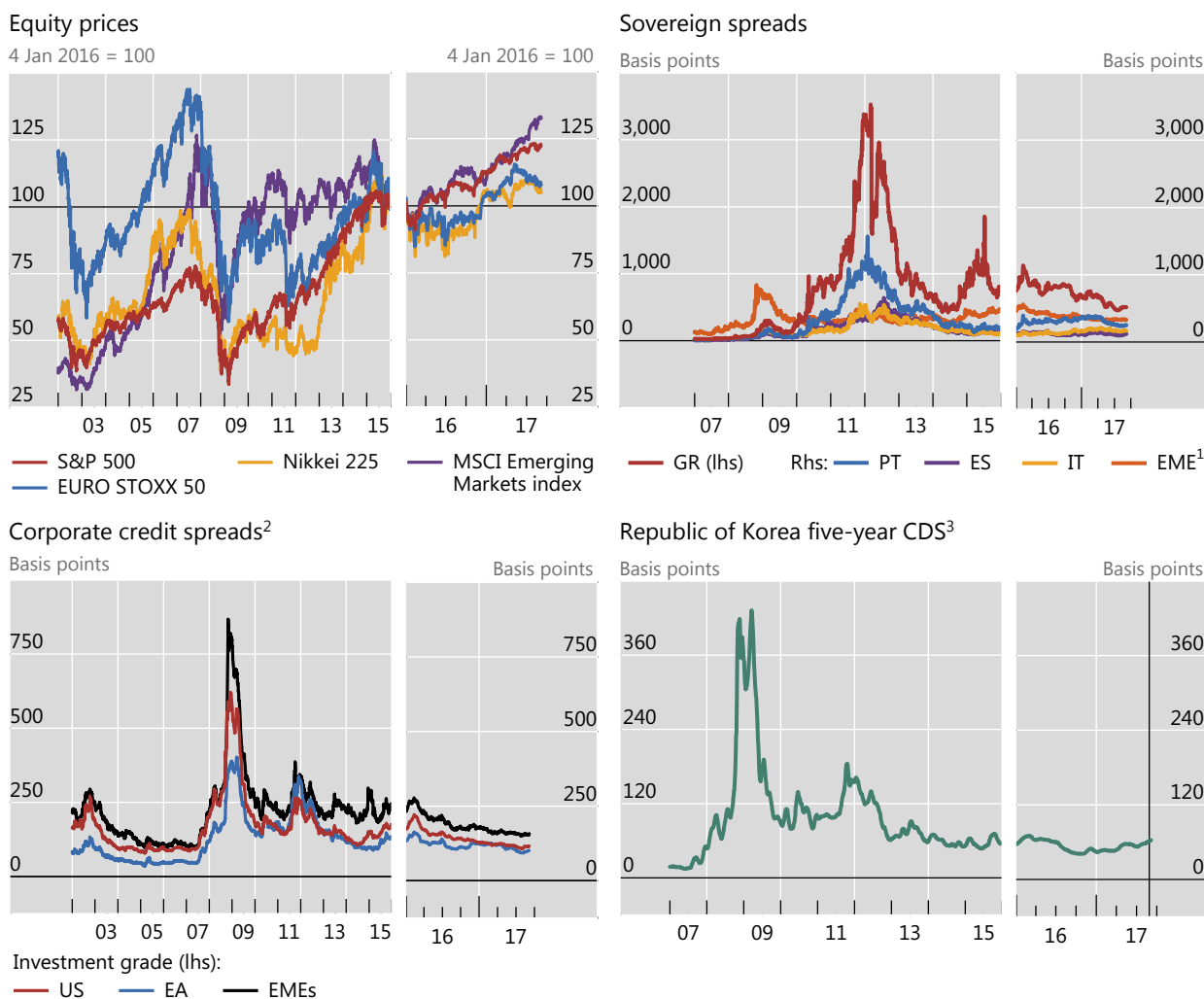
① To some extent, this is reminiscent of the run-up to the Spanish and Irish banking crises, where lending to property developers played an important part. See Bank of Spain, “Exposición de las entidades de depósito españolas al sector inmobiliario”, *Informe de Estabilidad Financiera*, March 2010; and K Whelan, “Ireland’s economic crisis: the good, the bad and the ugly”, *Journal of Macroeconomics*, vol 39, June 2013, pp 424–40. ② According to the HKMA definition, property lending consists of two main categories: (i) loans to finance property development and investment in properties (including uncompleted properties); and (ii) loans to individuals for the purchase of residential properties for own occupation or investment purposes. ③ Remarks by R Menon, Managing Director, Monetary Authority of Singapore, at the MAS Annual Report 2016/17 Media Conference, Singapore, 29 June 2017. ④ For example, in terms of market capitalisation, Chinese real estate firms account for around 50% of the sectoral total in the JPMorgan Chase Corporate Emerging Market Bond Index.

The strong global macro backdrop and reduced expectations of interest rate increases in the US boosted stock markets (Graph 3, top left-hand panel). US equity indices reached new peaks in early August, and EME equities steamed ahead. While European and Japanese stocks softened somewhat in recent months, they have still returned around 11% and 14%, respectively, since early September 2016.

Credit markets remained buoyant. Sovereign bond spreads continued to tighten slowly in the euro area. They remained broadly flat for EMEs, but below the previous five-year average (Graph 3, top right-hand panel). In June, Argentina took advantage of the favourable market conditions to issue a 100-year US dollar-denominated bond with a yield around 8%. And Greece returned to capital markets in July, selling a five-year bond denominated in euros with a 4.6% yield. Other infrequent or new issuers, such as Iraq and Belarus, also tapped bond markets, while Tajikistan prepared its benchmark offering of a 10-year dollar-denominated bond.

Corporate credit spreads were tight and falling. In mid-August, they stood at, or just a few basis points off, their lowest levels since the beginning of 2008. But they remained well above the levels prevailing before the Great Financial Crisis (Graph 3, bottom left-hand panel).

The overall positive market mood was disrupted by political events from mid-August onwards. However, while dominating headlines, politics did not weigh strongly on markets. Stock markets fell initially from their historical highs amid rising political risks in the United States and increased geopolitical tensions relating to North Korea. Yet the effects were short-lived. Even South Korean credit default swaps



The vertical line in the bottom right-hand panel indicates 29 August 2017 (North Korean missile launched over Japan).

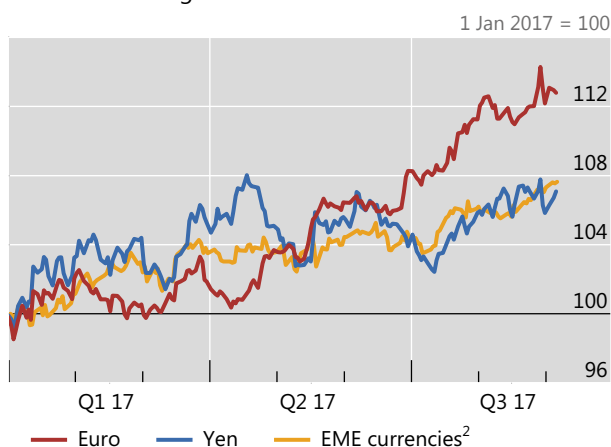
¹ JPMorgan EMBI Global index, z-spread to worst. ² Option-adjusted spreads over treasuries. ³ Credit default swaps on senior unsecured debt, five-year maturity.

Sources: Bank of America Merrill Lynch; Bloomberg; Datastream; JPMorgan Chase; Markit; BIS calculations.

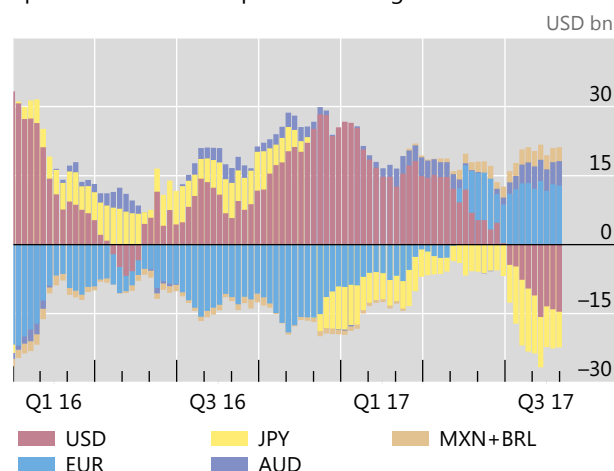
hardly budged and the Korean won scarcely moved against the dollar after North Korea fired a long-range missile over Japan and conducted its biggest ever nuclear test a few days later (Graph 3, bottom right-hand panel).

Shifting global outlook reverberates in FX markets

Shifting expectations about the future paths of monetary policy and the change in the relative macro outlook across major economic regions, along with political risks, put strong downward pressure on the US dollar. As the expected path of future Federal Reserve rate hikes shifted downwards and the US economy underperformed relative to market expectations, the dollar depreciated against all major advanced economy currencies (Graph 4, left-hand panel). Movements against the yen were

Nominal exchange rates¹

Speculative US dollar positions swing to net short



¹ Vis-à-vis the US dollar. An increase indicates appreciation of the local currency ² JPMorgan Emerging Market Currency Index (EMCI).

Sources: US Commodity Futures Trading Commission; Bloomberg; BIS calculations.

muted given the minimal change in the Bank of Japan's policy outlook. Moreover, speculative positions, as reported by the Commodity Futures Trading Commission (CFTC), in US dollars vis-à-vis other currencies swung to net short at the beginning of Q3 (Graph 4, right-hand panel). This indicated expectations of a continued depreciation of the dollar.

Dollar depreciation was most pronounced against the euro – around 7% since mid-June. The dollar lost most ground after the ECB President's remarks in June about inflationary forces being back in the euro area. The depreciation came to a halt in early August, partly due to concerns over the potential of a strong currency adversely affecting the euro area economy. But the dollar resumed its decline against the euro at the end of August.

The dollar also fell against most EME currencies. With the exception of central and eastern European currencies, which tend to follow the euro, exchange rate adjustments of the dollar vis-à-vis EME currencies were not particularly strong and volatility was low.

Is volatility exceptionally low?

Buoyant markets and a falling dollar went hand in hand with subdued volatility in all major asset classes (Graph 5, left-hand panel). Bond market volatility across the globe was extremely low. The MOVE, a measure of implied US bond market volatility, fell to new historical troughs in August. At the same time, the VIX, which measures the implied volatility of US equity markets, reached levels close to the very low ones last seen in 2005. While volatilities remained low compared with historical benchmarks, they edged up somewhat and experienced a few spikes following political events in August.

Low expected volatility and a low volatility premium both seem to have contributed to the overall decline in the VIX. This is suggested by a decomposition of

the VIX into the conditional variance of stock returns (the volatility that would be expected from actual stock return volatility in the recent past) and the equity variance premium (the extra amount investors are willing to pay to protect themselves from volatility) (Graph 5, right-hand panel).³ Both of these factors, along with the VIX itself, fell to their lowest points in several years, although they remained above their historically compressed pre-crisis levels.

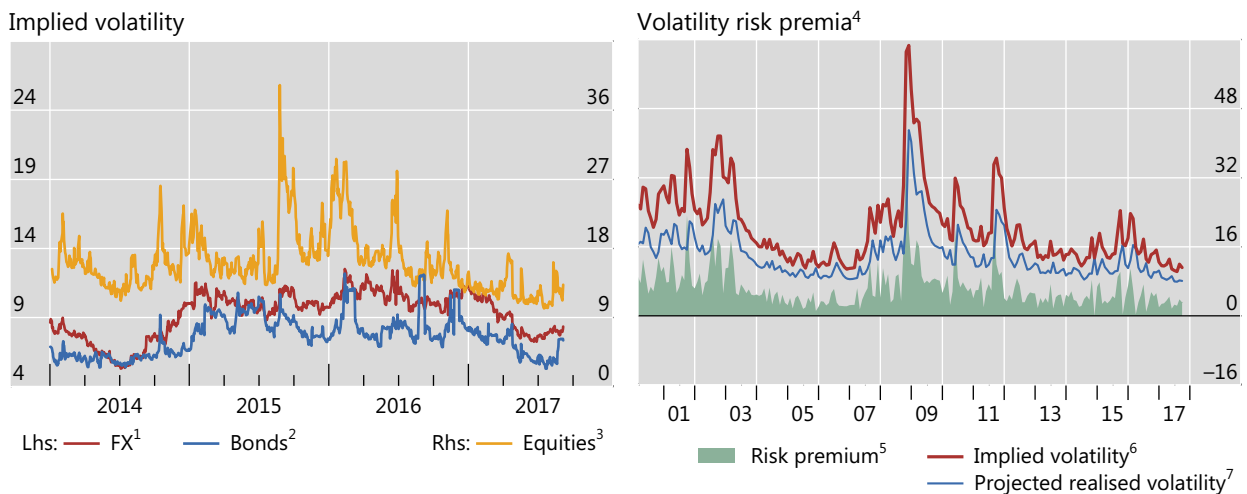
Low stock market volatility has been typical of monetary tightening cycles since the early 1990s. During such episodes, both the VIX and 30-day realised stock market volatility have tended to stand between half and one standard deviation below their long-run averages (Graph 6, left-hand panel). This may have been due in part to the fact that volatility tends to be lower when equity markets rise, and tightening episodes tend to happen when such markets are rising. When set against this benchmark, the average VIX in the last 90 days prior to 5 September was not so unusual.

Recent bond market volatility, however, has been extremely low by historical standards, in line with extraordinarily low bond yields and gradual rate hike expectations. The MOVE index, for instance, has been unusually depressed in recent months, despite the increase in the federal funds target rate in June. This contrasts with previous tightening episodes, during which bond market-implied volatility was close to its long-term average (Graph 6, left-hand panel).

Implied volatilities and volatility risk premia are low

In percentage points

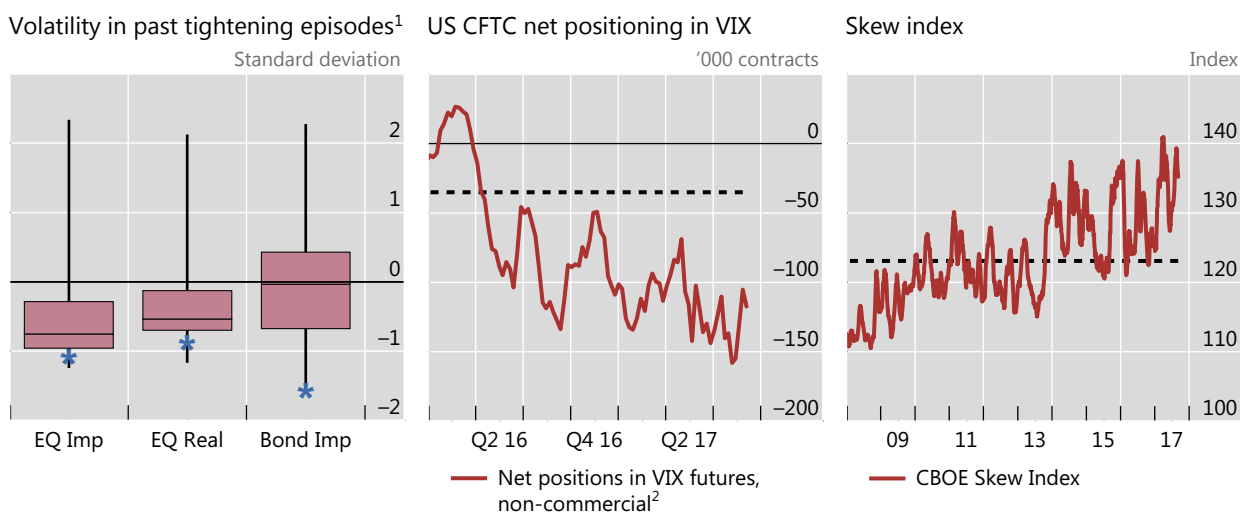
Graph 5



¹ JPMorgan VXY Global index. ² Implied volatility (IV) of at-the-money options on long-term bond futures of DE, GB, JP and US; weighted average based on GDP and PPP exchange rates. ³ IV of S&P 500, EURO STOXX 50, FTSE 100 and Nikkei 225 indices; weighted average based on market capitalisation. ⁴ Monthly averages of daily data. ⁵ Estimate obtained as the difference between implied volatility and projected realised volatility; see G Bekaert, M Hoerova and M Lo Duca, "Risk, uncertainty and monetary policy", *Journal of Monetary Economics*, vol 60, no 7, 2013, pp 771–88. ⁶ VIX, Chicago Board Options Exchange S&P 500 implied volatility index. ⁷ Forward-looking estimate of realised volatility; see T Anderson, F Diebold, T Bollerslev and P Labys, "Modeling and forecasting realized volatility", *Econometrica*, vol 71, no 2, March 2003, pp 579–625.

Sources: Bloomberg; Oxford-Man Institute, <http://realized.oxford-man.ox.ac.uk/>; BIS calculations.

³ See M Lombardi and A Schrimpf, "Volatility concepts and the risk premium", *BIS Quarterly Review*, September 2014, pp 10–11. For the methodology, see G Bekaert, M Hoerova and M Lo Duca, "Risk, uncertainty and monetary policy", *Journal of Monetary Economics*, vol 60, no 7, 2013, pp 771–88.



The dashed horizontal lines in the centre and right-hand panels indicate the long-term averages of the corresponding series (2007–latest).

¹ The blue asterisks represent the last 90-day average prior to 5 September 2017; EQ Imp = VIX, EQ Real = S&P 500, Bond Imp = Merrill Lynch's MOVE Index; the box plots capture three episodes: February 1994–April 1995, July 1999–June 2000 and July 2004–July 2006. Data are standardised based on the historical averages and standard deviations from 1990. ² A negative number indicates an aggregate net short position in VIX futures taken by non-commercial traders.

Sources: US Commodity Futures Trading Commission (CFTC); Bloomberg; Datastream; BIS calculations.

Large net short speculative positions on VIX futures signalled expectations that volatility would remain low. US CFTC net short positions on VIX futures – ie bets against rising volatility – reached record levels at the end of July (Graph 6, centre panel). In line with the somewhat higher VIX, they decreased in August but remained three times higher than the average for the last 10 years.

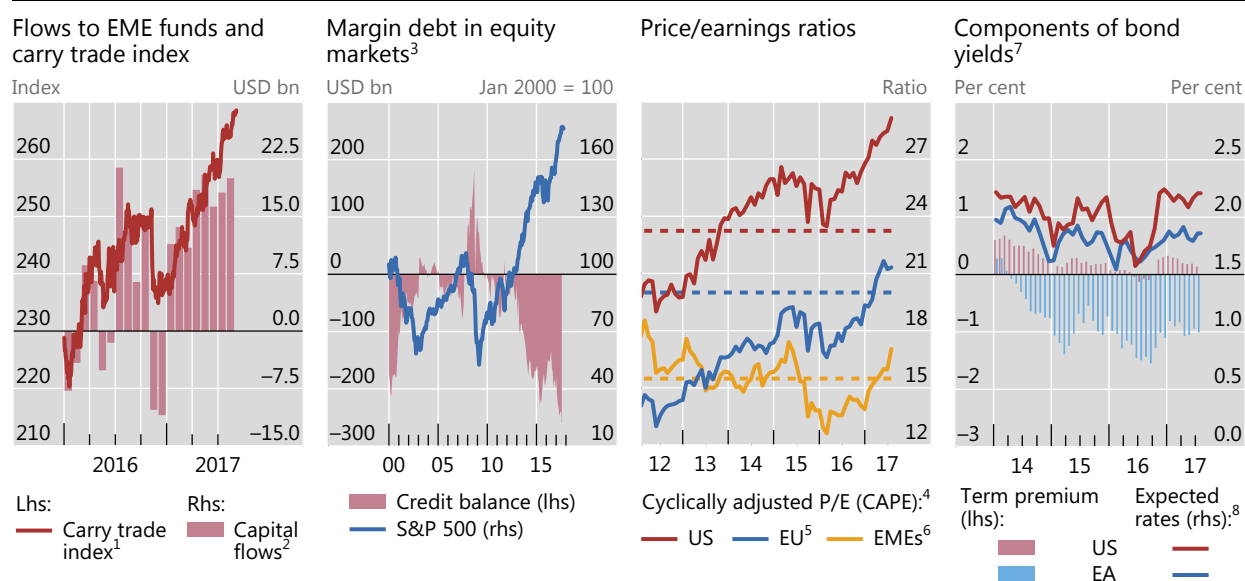
At the same time, markets priced in the risk of large asset price declines. The CBOE Skew Index – a measure of tail risk in the S&P 500 index – was high compared with its historical values (Graph 6, right-hand panel). This suggests that investors were pricing in a significant likelihood of large asset price drops.

A "risk-on" phase

As is typical for periods of low volatility and a falling dollar, a "risk-on" phase prevailed.

Against the backdrop of persistent interest rate differentials and a depreciating dollar, returns from carry trades rose sharply and EME equity and bond funds saw large inflows during the period under review (Graph 7, first panel). Speculative positions also pointed to patterns of broader carry trade activity: large net short positions in funding currencies, such as the yen and Swiss franc, and large net long positions in EME currencies and the Australian dollar (Graph 4, right-hand panel).

Equity market investors also employed record amounts of margin debt to lever up their investments. In fact, margin debt outstanding was substantially higher than during the dotcom boom and around 10% higher than its previous peak in 2015 (Graph 7, second panel).



The dashed lines in the third panel indicate the long-term averages of the CAPE ratio (December 1982–latest for EU and US; January 2012–latest for EMEs).

¹ The Bloomberg EM-8 Carry Trade Index measures the cumulative total return of a buy-and-hold carry trade position that is long eight EME currencies (BRL, IDR, INR, HUF, MXP, PLN, TRY and ZAR) and fully funded with short positions in the US dollar. It is assumed that the investment is in three-month money market securities, with each of the eight EME currencies assigned an equal weight in the currency basket. ² Monthly data; for August 2017, weekly data up to 30 August (scaled by an adjustment factor). ³ Credit balance is calculated as the sum of free credit cash accounts and credit balances in margin accounts minus margin debt. ⁴ For each country/region, the CAPE ratio is calculated as the inflation-adjusted MSCI equity price index (in local currency) divided by the 10-year moving average of inflation-adjusted reported earnings. ⁵ European advanced economies included in the MSCI Europe index. ⁶ Weighted averages based on GDP and PPP weights of BR, CN, HK, IN, KR, MX, PL, RU, SG, TR, TW and ZA. ⁷ Decomposition of the 10-year nominal yield according to an estimated joint macroeconomic and term structure model; see P Hördaahl and O Tristani, “Inflation risk premia in the euro area and the United States”, *International Journal of Central Banking*, September 2014. Yields are expressed in zero coupon terms; for the euro area, French government bond data are used. ⁸ Difference between the 10-year nominal zero coupon yield and the 10-year estimated term premium.

Sources: Barclays; Bloomberg; Datastream; EPFR; New York Stock Exchange; BIS calculations.

While margin debt levels breached new records, traditional valuation benchmarks, such as long-run average price/earnings (P/E) ratios, indicated that equity valuations might be stretched. Recent market moves pushed cyclically adjusted P/E ratios for the US market further above long-run averages. Cyclically adjusted P/E ratios also exceeded this benchmark for Europe and for EMEs, though by a smaller amount (Graph 7, third panel). That said, given the unusually low bond yields, valuations may not be out of line when viewed through the lens of dividend discount models. Indeed, estimates of bond yield term premia remained unusually compressed, well below historical averages in the United States and drifting further into negative territory in the euro area (Graph 7, fourth panel). This suggests that equity markets continue to be vulnerable to the risk of a snapback in bond markets, should term premia return to more normal levels.

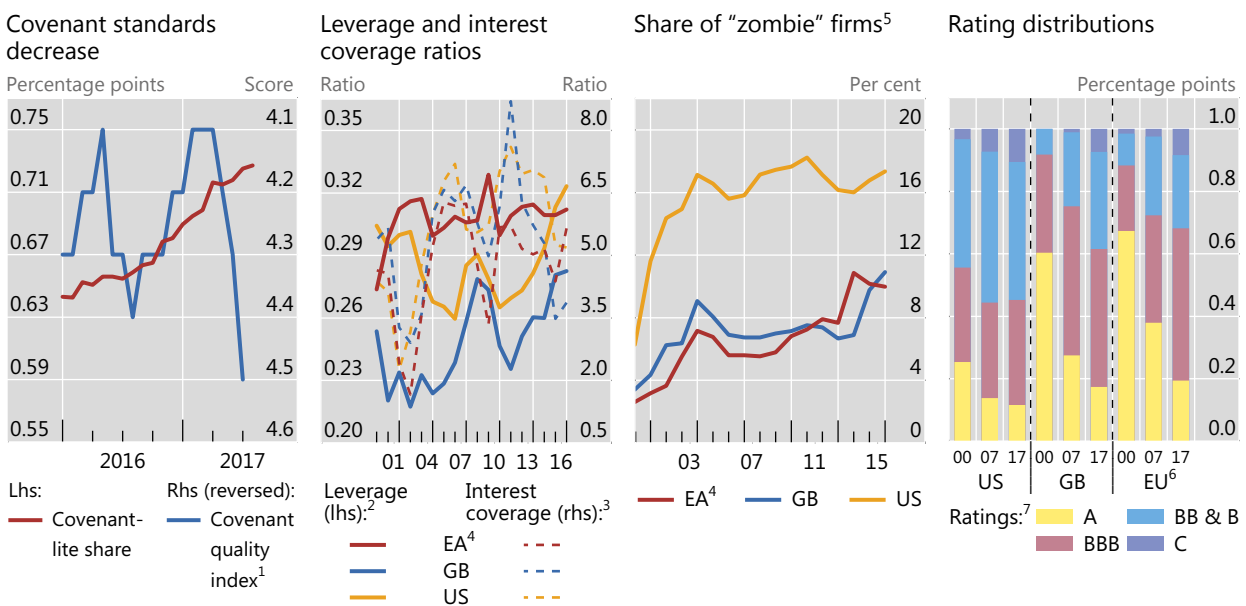
There were also some signs of search for yield in debt markets, as issuance volumes of leveraged loans and high-yield bonds rose while covenant standards eased. The global volume of outstanding leveraged loans, as recorded by S&P Global Market Intelligence, reached new highs (above \$1 trillion). At the same time, the share of issues with covenant-lite features increased to nearly 75% from 65% a year earlier (Graph 8, left-hand panel). Covenant-lite loans place few to no restrictions on the

borrowers' actions and as such might signal a less discriminating attitude on the part of lenders while potentially fostering excessive risk-taking on the part of borrowers. According to Moody's, the covenant-lite share in the high-yield bond market also increased while covenant quality declined to the lowest levels since Moody's started to record these numbers in 2011.

While corporate credit spreads were tightening, the health of corporate balance sheets deteriorated. Leverage of non-financial corporates in the United States, the United Kingdom and, to a lesser extent, Europe has increased continuously in the last few years (Graph 8, first panel). Even accounting for the large cash balances outstanding, leverage conditions in the United States are the highest since the beginning of the millennium and similar to those of the early 1990s, when corporate debt ratios reflected the legacy of the leveraged buyout boom of the late 1980s. And despite ultra-low interest rates, the interest coverage ratio has declined significantly. While the aggregate interest coverage ratio remained well above three, a growing share of firms face interest expenses exceeding earnings before interest and taxes – so-called “zombie” firms (Graph 8, third panel).⁴ The share of such firms has risen especially sharply in the euro area and the United Kingdom. At the same time, the distribution of ratings has worsened (Graph 8, fourth panel). The share of investment grade companies has decreased by 10 percentage points in the United States, 20 in

“Risk on” in debt markets

Graph 8



¹ Three-month rolling average; a higher score corresponds to a weaker covenant. ² Computed as aggregate long- and short-term liabilities divided by aggregate total assets. ³ Computed as aggregate earnings before interest and taxes (EBIT) divided by aggregate interest expense. ⁴ BE, DE, ES, FR, IT and NL. ⁵ “Zombie” firms are defined as listed firms with a ratio of EBIT to expenses below one, with the firm aged 10 years or more. ⁶ AT, BE, DE, DK, ES, EE, FI, FR, GR, IE, IT, LU, NL and PT. ⁷ A = Aaa–A3; BBB = Baa1–Baa3; BB and B = Ba1–B3; C = Caa1–C.

Sources: Bloomberg; Moody's Analytics CreditEdge; S&P Global Market Intelligence; <https://www.bloomberg.com/gadfly/articles/2017-07-13/junk-bonds-work-with-less-of-a-safety-net-for-investors>; BIS calculations.

⁴ Given a lack of reporting, in particular by small firms, the share of “zombie” firms cannot be computed for 2016.

the euro area and 30 in the United Kingdom from 2000 to 2017.⁵ The relative number of companies rated A or better has fallen especially sharply, while the share of worst-rated (C or lower) companies has increased. Taken together, this suggests that, in the event of a slowdown or an upward adjustment in interest rates, high debt service payments and default risk could pose challenges to corporates, and thereby create headwinds for GDP growth.

⁵ Investment grade companies are rated BBB or better.

Highlights of global financial flows¹

The BIS, in cooperation with central banks and monetary authorities worldwide, compiles and disseminates data on activity in international financial markets. It uses these data to compile indicators of global liquidity conditions and early warning indicators of financial stability risks. This chapter analyses recent trends in these indicators. It is based on the latest data for international banking markets, available up to March 2017, and for international debt securities, available up to June 2017.

Takeaways

- International bank claims continued to grow in the first quarter of 2017, led by 2.8% year-on-year growth of claims on the non-bank sector. Year-on-year growth in interbank claims turned positive for the first time since the first quarter of 2015.
- The stock of international debt securities grew by 4.1% year on year in the second quarter of 2017, led by increased net issuance from the non-bank sector.
- Growth in euro-denominated credit to the non-financial sector outside the euro area picked up, led by a 12.3% rise in bank loans in the year to end-March 2017.
- The outstanding stock of US dollar credit to non-banks in emerging market economies (EMEs) advanced to \$3.4 trillion at end-March 2017. The increase was driven entirely by higher debt securities issuance.
- Credit-to-GDP ratios remained well above trend levels for a number of jurisdictions, including Canada, China and Hong Kong SAR. In most cases, these large gaps coincided with property price gaps above critical thresholds.
- The outstanding government debt of EMEs has doubled since 2007 (see box), as debt securities issuance accelerated. The increase in debt was accompanied by longer average maturities and a greater use of fixed rate instruments.

¹ This article was prepared by Iñaki Aldasoro (Iñaki.Aldasoro@bis.org) and Torsten Ehlers (Torsten.Ehlers@bis.org). Statistical support was provided by Kristina Bektyakova, Bat-el Berger, Zuzana Filkova and Matthias Loerch.

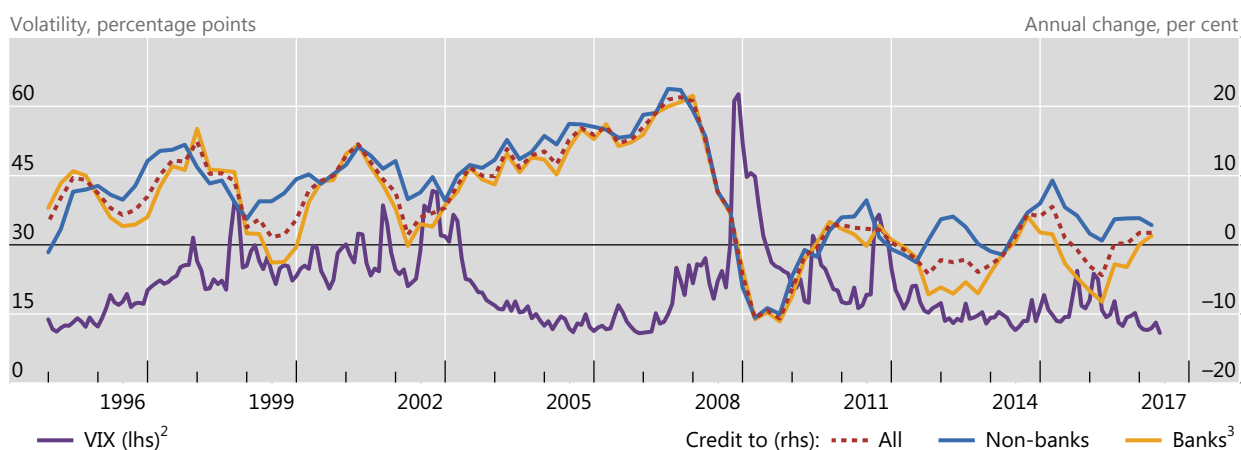
Global liquidity conditions continued to ease in early 2017

Against a background of subdued financial market volatility, and building on the trend from recent quarters, global credit conditions as measured by the BIS global liquidity indicators (GLIs) eased in early 2017.² International bank credit (cross-border claims plus local claims in foreign currency)³ continued to grow in late 2016 and early

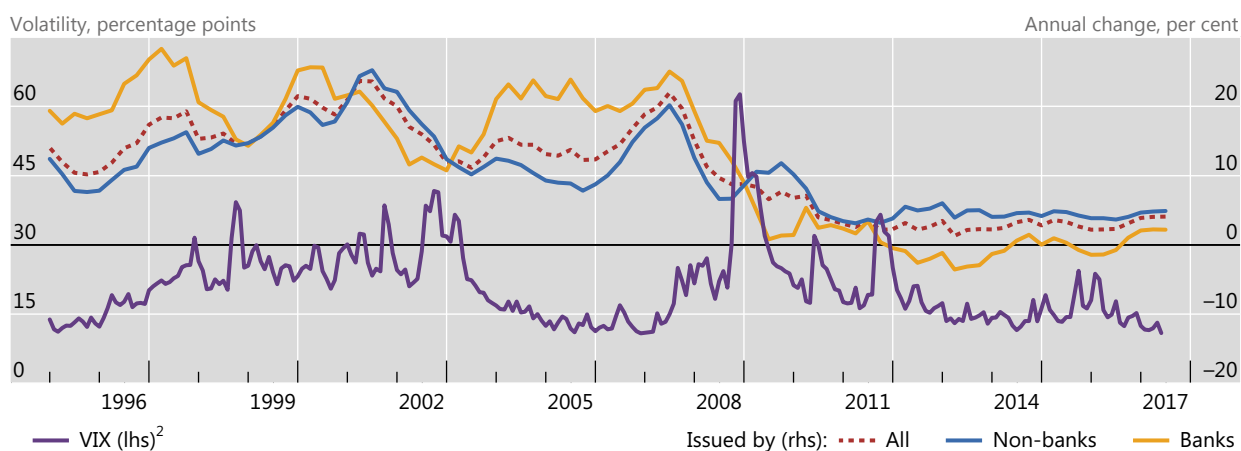
International bank credit, international debt securities and volatility

Graph 1

International bank claims¹



International debt securities⁴



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. ⁴ All instruments, all maturities, all countries. Immediate issuer basis.

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

² A description of the methodology used to construct the BIS GLIs is available at www.bis.org/statistics/gli/gli_methodology.pdf.

³ International bank credit as used in the BIS GLIs corresponds to the BIS locational banking statistics' definition. International bank credit captures banks' cross-border claims in all currencies and their local claims in foreign currencies, where local claims refer to credit extended by banks' affiliates located in the same country as the borrower. Changes are corrected for exchange rate effects and breaks in series.

2017 (Graph 1, top panel). With a year-on-year growth rate of 1.7% in the first quarter of 2017, the stock of international bank claims stood at \$32.0 trillion at end-March. As in recent quarters, the growth in international bank claims was led by credit to non-banks, which reached three consecutive years of positive growth in Q1 2017. Interbank claims, in turn, posted positive year-on-year growth for the first time since the first quarter of 2015.

The stock of international debt securities⁴ also grew in the first half of 2017 (Graph 1, bottom panel). Net issuance of \$277 billion and \$283 billion in the first and second quarters of 2017, respectively, took the outstanding stock to \$22.7 trillion as of end-June 2017, a 4.1% increase compared with a year earlier. The stock of banks' debt securities grew further (2.2% year on year in Q2 2017), reaching rates last seen at the beginning of 2011. Outstanding international debt securities of non-banks, however, grew even faster in the year to end-June 2017 (4.9%).

In parallel with the broad increase in international bank claims and debt securities, foreign currency credit to non-residents continued to expand in Q4 2016 and Q1 2017 (Graph 2). US dollar-denominated debt securities and euro-denominated bank loans led the way.

Total outstanding US dollar credit (bank loans plus debt securities issuance) to the non-financial sector outside the United States rose from \$8 trillion at end-September 2016 to \$8.2 trillion at end-March 2017 (Graph 2, top panels); or from \$10.5 trillion to \$10.7 trillion if non-bank financial borrowers are included. The stock of US dollar-denominated debt securities issued by non-financials outside the US grew by 8.6% year on year through Q1 2017 (top right-hand panel). Growth in bank loans picked up slightly, to 2.9% in Q1 2017, compared with a year earlier.

At end-March 2017, outstanding euro-denominated credit to borrowers outside the euro area reached €2.3 trillion (\$2.4 trillion) to non-financial borrowers (Graph 2, centre panels), or €2.8 trillion (\$3.0 trillion) if non-bank financials are included. The growth in net issuance of euro-denominated debt securities by non-financials outside the euro area remained high, but came down slightly in the beginning of 2017. Year-on-year growth in outstanding debt securities decreased somewhat to 9.3% in the first quarter of 2017. Growth in euro-denominated bank claims, on the other hand, picked up considerably to 12.3% in Q1 2017, the highest year-on-year growth rate since Q3 2008.

Yen-denominated credit to the non-financial sector outside Japan, for which overall amounts are significantly smaller (¥30.4 trillion or \$271 billion at end-March 2017), halted its year-on-year decline in the first quarter (Graph 2, bottom panels). Bank claims recovered noticeably, growing 3.7% year on year in the first quarter of 2017. At the same time, the year-on-year growth in net international debt securities issuance in yen by issuers outside Japan reached positive territory for the first time since Q3 2011, as the outstanding stock rose by 0.6% in the first quarter of 2017 compared with a year earlier.

⁴ The BIS defines international debt securities as securities issued by non-residents in all markets. For details, see B Gruić and P Wooldridge, "Enhancements to the BIS debt securities statistics", *BIS Quarterly Review*, December 2012, pp 63–76.

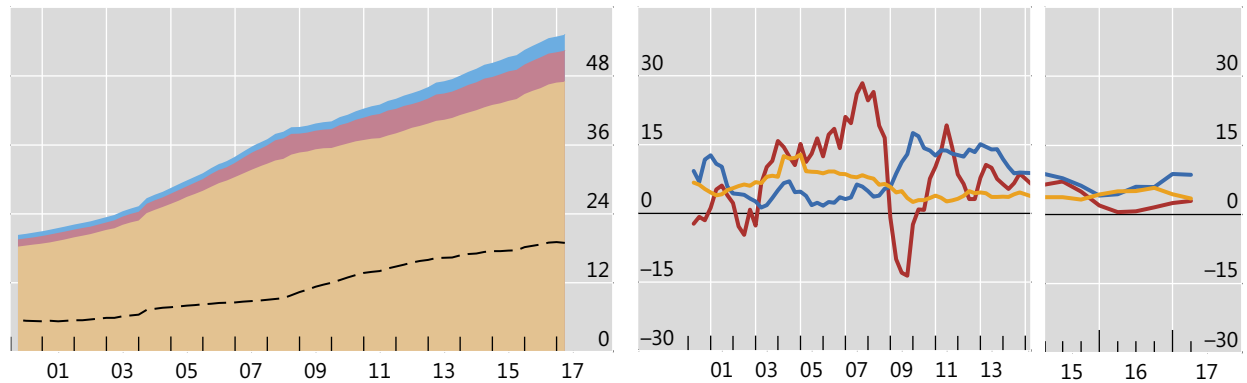
Global credit to the non-financial sector, by currency

Graph 2

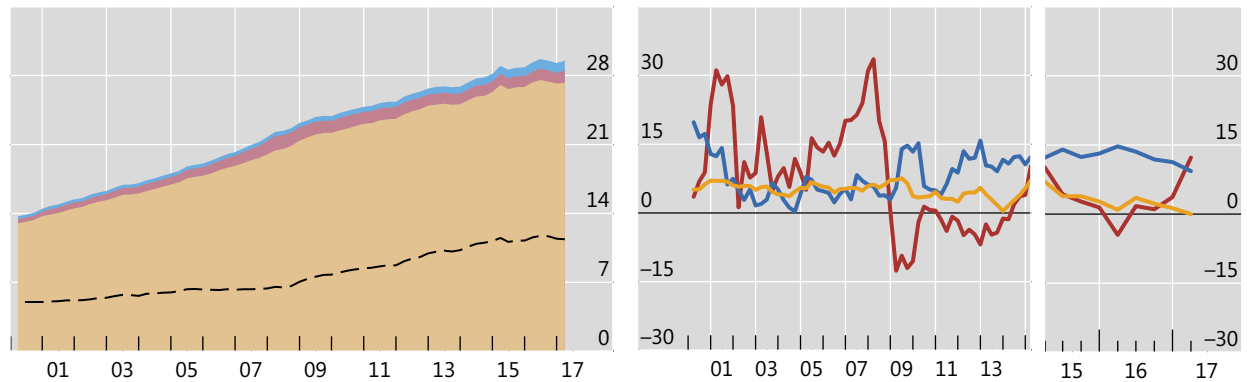
Amounts outstanding, in trillions of currency units¹

Annual change, in per cent²

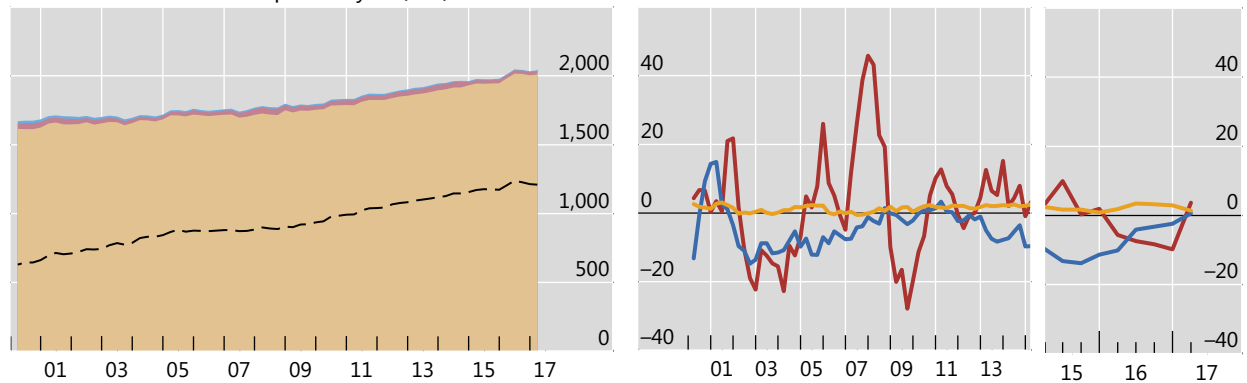
Credit denominated in US dollars (USD)



Credit denominated in euros (EUR)



Credit denominated in Japanese yen (JPY)



Credit to residents³
 Credit to non-residents:
 Of which:
 Debt securities⁴
 Loans⁵

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

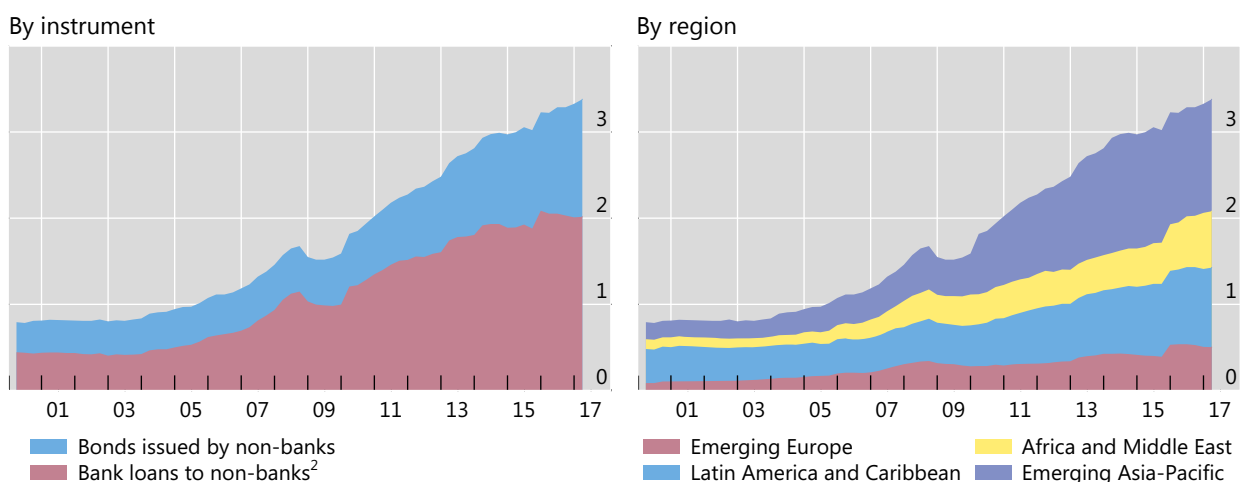
US dollar credit to EME borrowers continued to grow, rising to \$3.4 trillion at end-March 2017.⁵ The expansion was entirely driven by increased debt securities issuance, as outstanding bank claims fell during the same period (Graph 3, left-hand panel). The bulk of the increase came from US dollar borrowing by residents of Africa and the Middle East (\$59 billion), especially through net bond issuance by governments in oil-exporting countries. This was followed by emerging Asia (\$39 billion) and Latin America (\$19 billion). US dollar credit to borrowers of emerging Europe, however, declined by \$25 billion between end-September 2016 and end-March 2017.

Early warning indicators for stress in domestic banking systems – which by their nature change little from quarter to quarter – continue to signal vulnerabilities in some jurisdictions (Table 1, with data up to Q1 2017). According to the BIS early warning indicators,⁶ credit-to-GDP gaps (the difference between current credit-to-GDP ratios and their recent trend levels) stand above critical thresholds in Canada, China and Hong Kong SAR (first column). Relative to prior readings, the credit-to-GDP gaps have narrowed somewhat.⁷ In most cases, the warning signal given by credit-to-GDP gaps

US dollar-denominated credit to non-banks in EMEs¹

Amounts outstanding, in trillions of US dollars

Graph 3



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

⁵ Due to changes in methodology, the amount of total outstanding US dollar credit to EMEs for end-September 2016 was revised downwards. See www.bis.org/statistics/gli/gli_methodology.pdf for additional details.

⁶ These indicators have often successfully captured financial overheating and signalled banking distress over medium-term horizons in the past. For details on how the thresholds are determined, see the notes to Table 1. For a discussion of the indicators and their interpretation, see "[Highlights of global financing flows](#)", *BIS Quarterly Review*, March 2016, p 28.

⁷ See "[Highlights of global financing flows](#)", *BIS Quarterly Review*, March 2017, p 20.

coincided with property price gaps also above critical thresholds (contemporaneous or recent, marked with asterisks – see footnote 1 in Table 1).

Debt service ratios, which aim to capture aggregate principal and interest payments in relation to income for the total private non-financial sector, remain below critical thresholds, with the exception of Hong Kong SAR (second column). Assuming a 250 basis point increase in interest rates (with 100% pass-through), the debt service ratio indicator points to potential risks in Canada, China and Hong Kong SAR (third column). However, these numbers are meant to be only broadly indicative of the exposure of debt service to higher yields under stress scenarios, and should not be treated as a formal stress test. Moreover, in contrast to what is assumed for simplicity and comparability in the indicator, increases in rates usually take time to translate into higher debt service ratios. The speed and extent of the pass-through depend on a variety of factors, including the share of debt at floating rates, maturity profiles and changes in borrower behaviour.

Early warning indicators for stress in domestic banking systems

Table 1

	Credit-to-GDP gap ¹	Debt service ratio (DSR) ²	DSR if interest rates rise by 250 bp ³
Australia	-4.6	1.2	5.1
Brazil	-4.9	2.0	3.5
Canada	11.3*	3.1	7.3
Central and eastern Europe ⁴	-11.2	-1.7	-0.4
China	22.1	5.4	8.7
France	2.8	1.4	4.6
Germany	-3.4	-1.9	-0.1
Hong Kong SAR	35.0*	7.4	12.1
India	-5.8	1.0	2.1
Indonesia	7.7*	0.6	1.3
Italy	-14.5	-0.7	1.3
Japan	7.0*	-1.8	0.9
Korea	-1.1	0.0	3.7
Malaysia	7.4*	0.7	3.1
Mexico	7.4	0.9	1.7
Nordic countries ⁵	-7.1	-0.3	3.5
South Africa	-1.8	-0.1	1.3
Spain	-48.9	-3.3	-0.5
Switzerland	7.0*	0.0	3.1
Russia	-3.3	2.1	3.4
Thailand	9.0*	-0.5	1.4
Turkey	9.7	5.4	7.2
United Kingdom	-19.0	-1.4	1.5
United States	-7.6	-1.3	1.3
<i>Legend</i>	<i>Credit/GDP gap > 10</i>	<i>DSR > 6</i>	<i>DSR > 6</i>
	<i>2 ≤ Credit/GDP gap ≤ 10</i>	<i>4 ≤ DSR ≤ 6</i>	<i>4 ≤ DSR ≤ 6</i>

Data up to Q1 2017. Thresholds for red cells are chosen by minimising false alarms conditional on capturing at least two thirds of the crises over a cumulative three-year horizon. Thresholds for beige cells for the credit-to-GDP gap are based on guidelines for countercyclical capital buffers under Basel III; those for the DSR are chosen by minimising false alarms conditional on capturing at least two thirds of the crises over a two-year horizon.

¹ For those economies where the credit-to-GDP gap is above a critical threshold, asterisks indicate a property price gap also above a critical threshold in at least one of the last five years. For a derivation of critical thresholds for credit-to-GDP and property price gaps, and their measurement, see M Drehmann, C Borio and K Tsatsaronis, "Anchoring countercyclical capital buffers: the role of credit aggregates", *International Journal of Central Banking*, vol 7, no 4, 2011, pp 189–240. ² Difference between DSRs for the private non-financial sector and country-specific long-run averages. For the calculation of DSRs, see www.bis.org/statistics/dsr.htm; for the derivation of critical thresholds, see M Drehmann and M Juselius, "Do debt service costs affect macroeconomic and financial stability?", *BIS Quarterly Review*, September 2012, pp 21–35. ³ Assuming that interest rates increase by 250 basis points and that all other DSR components stay fixed. ⁴ Simple average of CZ, HU and PL. ⁵ Simple average of FI, NO and SE.

Sources: National data; BIS; BIS calculations.

Recent trends in EME government debt volume and composition

Kristina Bektyakova

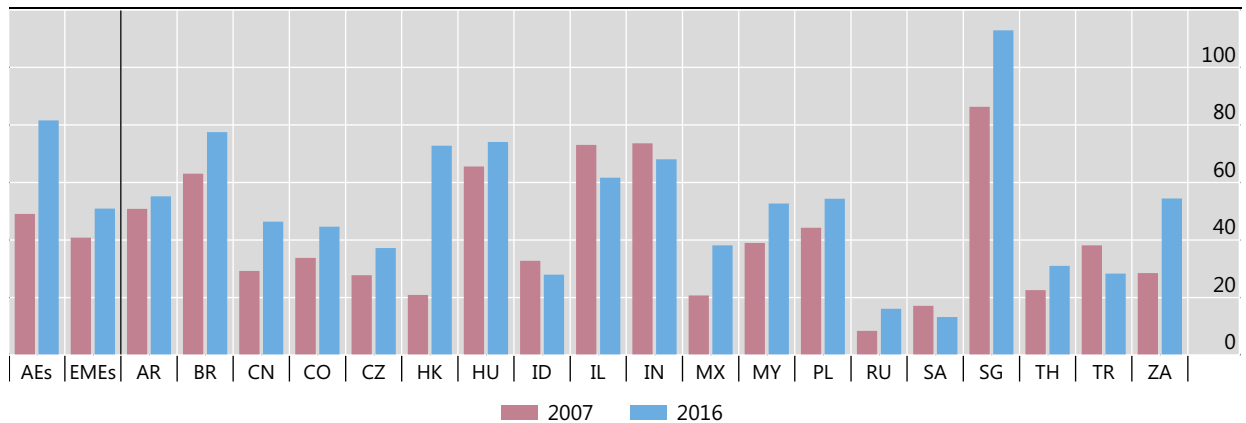
At the end of 2016, the government debt of EMEs totalled \$11.7 trillion, more than twice the figure at end-2007. Brazil, China and India accounted for around \$8 trillion of this amount. Government debt as a share of GDP rose from 41% to 51% over the same period (Graph A1).

The composition of government debt has changed significantly over time. As debt levels have risen, EME governments have made greater use of domestic and international bond markets: the average share of borrowing through debt securities rose from 62% in 2002 to 80% in 2016. Borrowing is mostly done in local currencies, at longer maturities and at fixed rates. Domestic issuance greatly exceeds international issuance, though the latter is on the rise.^①

General government debt to GDP¹

At end-year, in per cent

Graph A1



AEs = AU, BE, CA, DE, ES, GB and US. EMEs = AR, BR, CN, CO, CZ, HK, HU, ID, IL, IN, MX, MY, PL, RU, SA, SG, TH, TR and ZA.

¹ Nominal values.

Source: BIS total credit statistics.

For the 23 jurisdictions sampled and presented in Graph A2, total central government^② borrowing constituted around \$4.4 trillion, of which 14% was denominated in or linked to foreign currencies as at end-2016. The foreign currency share has declined considerably over the past 15 years: it stood at 32% at end-2001.

The majority of the debt securities denominated in or linked to a foreign currency were issued internationally. More than 90% of international debt issued by the sampled countries was in US dollars or euros, with the dollar's share rising from 65% at end-2007 to 75% at end-2016. International issues accounted for 35% of total outstanding government debt securities for Saudi Arabia, 32% for Turkey and 30% for Indonesia and Poland. In nominal terms, the leading issuer on international markets is the Mexican central government, with \$67 billion outstanding, of which \$47 billion is denominated in US dollars, followed by Turkey, with \$64 billion, with \$53 billion in dollars (Graph A3, centre and right-hand panels).

The share of outstanding domestic government bonds denominated in or linked to a foreign currency is minimal for most jurisdictions (Graph A2). Many countries have reduced such borrowing in recent years. Turkey, for example, used to issue substantial amounts of government debt locally in foreign currency, but had redeemed all of these instruments by the end of 2011 (Graph A3, right-hand panel).

Argentina is an exception to this pattern. It has increased both domestic and international debt issuance linked to or denominated in foreign currency. The Argentine central government has \$56 billion of international debt securities outstanding, of which \$37 billion is denominated in US dollars. Around 56% of Argentina's

outstanding domestically issued central government bonds are denominated in foreign currency, amounting to \$41 billion at end-2016. This share has been rising steadily since 2007, when it stood at 28%.

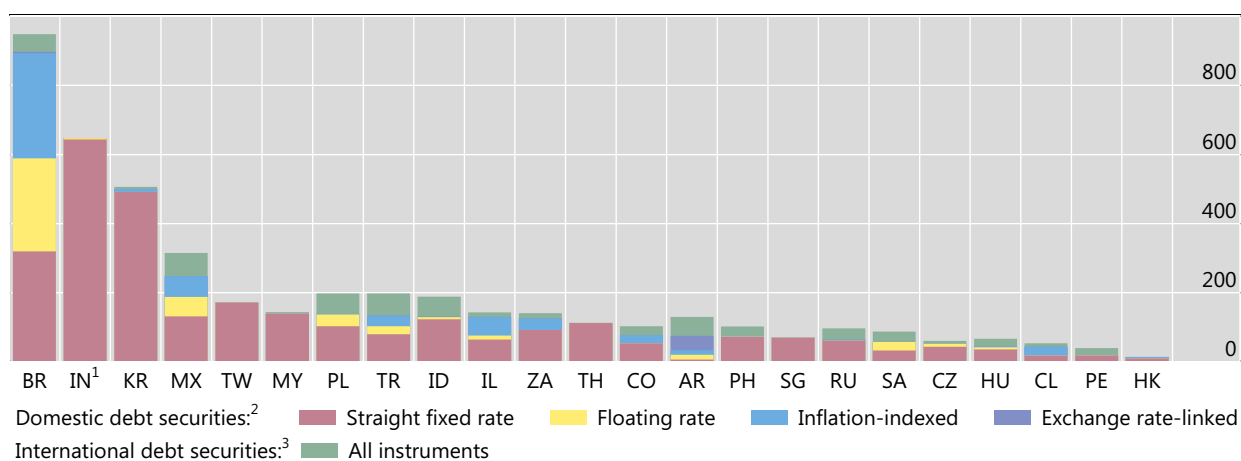
Another notable development in the realm of EME government debt relates to its average maturity, which has risen sharply and for many EMEs is now comparable to that of advanced economies. The average remaining maturity of the sampled EMEs' central government debt securities, 7.7 years, is now only slightly below that of advanced economies, at eight years. The Mexican government has more than doubled the remaining maturity of its domestic debt in the last decade, from around four to eight years. Similar increases also took place in the Philippines and Korea. Among the 23 EMEs sampled by the BIS, South African domestic government debt has the longest remaining maturity at the end of 2016: 16 years. This is considerably longer than in a number of advanced economies – remaining maturity averages 5.7 years for Australia, around 6.5 years for Canada, Germany and Spain, and 5.6 years for the United States – and comparable to the United Kingdom (17.5 years).

Longer maturities have gone hand in hand with greater use of fixed rate instruments (Graph A2). The average share of domestic fixed rate instruments across the sampled EMEs was 75% at end-2016, up from 60% at end-1999. The respective shares for advanced economies were 90% and 94%. Chinese Taipei, Malaysia, Singapore and Thailand issue only straight fixed rate bonds. Chile expanded its share of fixed rate government bonds from zero at the end of 2005 to 11% in 2007 and 40% at the end of 2016. Indonesia increased the share of its outstanding bonds with fixed rates from 20% at end-1999, to 65% in 2007 and to around 94% at end-2016. Almost all of the international issues by the sampled countries were at a fixed rate, with an average remaining maturity of nine years.

EME central government debt securities

Amounts outstanding by instrument type and residence at end-2016, in billions of US dollars

Graph A2



¹ At end-2015. ² Bonds and notes issued in domestic market with original maturity exceeding one year. ³ Debt securities where the country information associated with registration domain (ISIN), listing place or governing law is different from the country of residence of the issuer. All instruments, all maturities.

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

There have also been notable changes in the use of inflation-linked debt securities. Some countries have made greater use of this indexation, taking advantage of generally benign inflation conditions. The Brazilian and Mexican governments have been replacing domestic exchange rate-linked and floating rate instruments with fixed rate and inflation-indexed bonds. At end-2016, inflation-indexed bonds accounted for around 34% of domestic Brazilian central government bonds, compared with negligible amounts a couple of decades ago (Graph A3, left-hand panel). A similar shift towards inflation-indexed bonds has happened in advanced economies. In Australia, Canada, Germany, the United Kingdom and the United States, inflation-indexed bonds have accounted for a rising proportion of outstanding government bonds, making up on average around 9% of the outstanding debt stock.

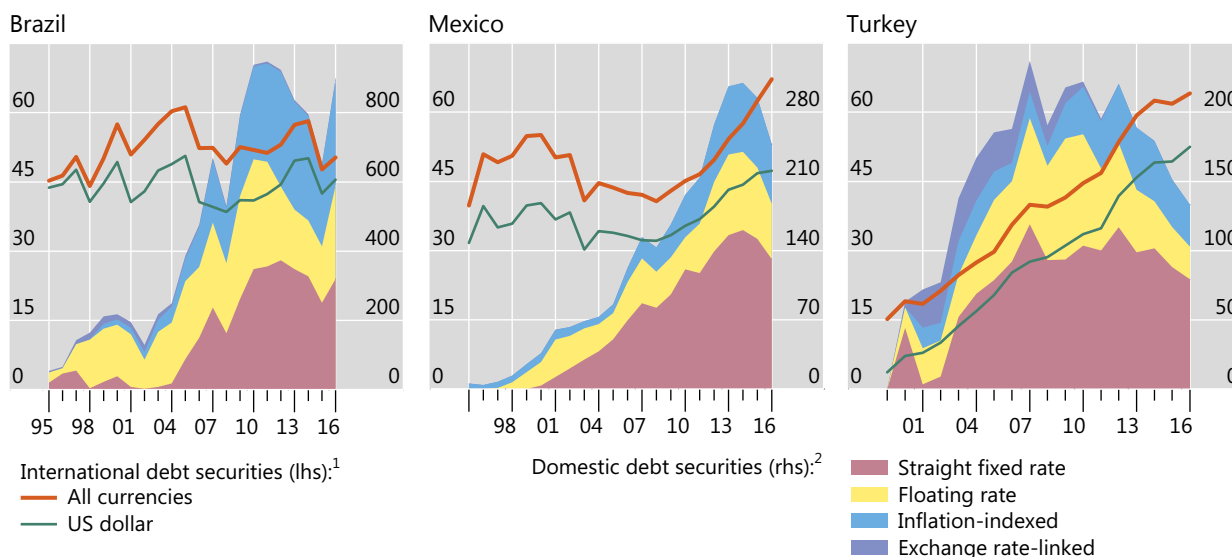
Taken together, these trends should help strengthen public finance sustainability by reducing currency mismatches and rollover risks. The fall in the share of FX-linked debt in the early 2000s may have helped

shield EMEs from the global market turbulence of the 2007–09 crisis and its aftermath. Longer maturities and fixed rate debt have also supported the broader expansion and development of capital markets in EMEs: with lengthened government yield curves, other domestic issuers obtain a useful benchmark for their own debt. At the same time, increased duration means that a global rise in bond yields could have a greater impact than previously on the market value of debt, potentially increasing rollover risks and other adverse feedback mechanisms.^③

EME central government debt securities over time

Amounts outstanding by instrument type, in billions of US dollars

Graph A3



¹ Debt securities where the country information associated with registration domain (ISIN), listing place or governing law is different from the country of residence of the issuer. All instruments, all maturities. ² Bonds and notes issued in domestic market with original maturity exceeding one year.

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

① For further information, see Committee on the Global Financial System, *Financial stability and local currency bond markets*, CGFS Papers, no 28, June 2007. Table C2 in the BIS Statistical Bulletin, updated annually by the BIS from national data, provides an overview of the instrument and maturity structure of central government bond markets for a sample of 30 countries, of which 23 are EMEs. See www.bis.org/statistics/c2.pdf. ② The central government is still the dominant debtor in most countries, accounting on average for 75% of total general government debt at end-2016. But borrowing by other government levels is high in China and India, accounting for around 65% of the total for both countries at end-2015. ③ See B Gruić, M Hattori and H S Shin, "Recent changes in global credit intermediation and potential risks", *BIS Quarterly Review*, September 2014, pp 17–18.

Recent enhancements to the BIS statistics

The BIS regularly seeks to enhance its statistical offerings to support monetary and financial stability analysis, in close coordination with central banks and other national authorities and international organisations.

The exposure of economies to foreign currency risk is one potential source of vulnerability that has received increased attention in recent years, and the relevant data gaps are being addressed in the second phase of the Data Gaps Initiative (DGI) endorsed by the G20 (BIS-FSB-IMF (2015), FSB-IMF (2017)).

Concurrently with this issue of the Quarterly Review, the BIS is expanding the data it publishes on exchange rates, on the currency composition of cross-border positions and on foreign currency debt. Specifically, the BIS is introducing new statistics in the following areas:

- a currency breakdown of cross-border loans and deposits, from the BIS locational banking statistics (LBS);
- country-level estimates of total US dollar, euro and yen credit, as part of the BIS global liquidity indicators; and
- long time series on bilateral US dollar exchange rates for the currencies of approximately 190 economies.

The BIS also continues to enhance its data offerings and statistical tools in other areas. In particular, with the current issue the BIS is:

- introducing a data set of long time series on central bank policy rates, covering 37 countries plus the euro area, with data in some cases going back to 1946; and
- enhancing the tools provided on the BIS website for analysis of the LBS.

Locational banking statistics by currency and new web tools¹

A unique feature of the LBS is their currency breakdown. Banks participating in the LBS report the currency in which their assets and liabilities are denominated, allocated into seven buckets: their domestic currency (ie that of the country where the bank is located), five major currencies (US dollar, euro, yen, sterling, Swiss franc), and a residual category for all other foreign currencies. The quality and completeness of these data were improved as part of the enhancements to the international banking statistics agreed by the Committee on the Global Financial System following the 2007–09 global financial crisis (Avdjiev et al (2015)).

With this issue of the Quarterly Review, the BIS is expanding the currency breakdown of banks' cross-border positions published in [Table A6.1](#). Whereas previously the currency breakdown was published only for total cross-border assets and liabilities – loans and deposits, debt securities, derivatives and other instruments combined – it is now also published for banks' loans and deposits. These currency details are available for counterparties in over 200 countries, from Q4 1995 onwards, when loans and deposits were first reported separately from total assets and liabilities in the LBS.

Data about the currency denomination of loans and deposits are especially useful for analysing the foreign currency exposures of emerging market economies (EMEs). Bank loans can be added to debt securities to estimate the build-up of total foreign currency debt, as discussed in the next section. Funds deposited with banks abroad are also an important component of EME residents' foreign currency assets.² Banks' US dollar- and euro-denominated claims and liabilities vis-à-vis a selection of EMEs are shown in Graph 1.

With the release of this Quarterly Review, the BIS is also implementing a number of other improvements intended to make the international banking statistics more accessible to users. First, users can now view and download breaks in series through the BIS Statistics Explorer. In the LBS and consolidated banking statistics (CBS), quarterly changes in amounts outstanding are affected by exchange rate movements as well as modifications to how the data are compiled. Such modifications arise from changes in methodology, reporting practices or reporting population and result in "breaks" in series across time. Breaks can be very large, such as in 2009 when US investment banks started to report the CBS after becoming bank holding companies (Avdjiev and Upper (2010)). In the LBS, the BIS estimates underlying flows by using the currency breakdown and breaks to adjust the quarterly changes. The size of these breaks is now shown alongside the published data on amounts outstanding and adjusted changes, confidentiality restrictions permitting.

Second, the BIS Statistics Explorer now includes annual growth rates. These are calculated from adjusted changes and so are not simple changes in amounts outstanding between t and $t-4$. Exchange rate- and break-adjusted changes are first used to calculate a quarterly growth rate, and then quarterly growth rates are

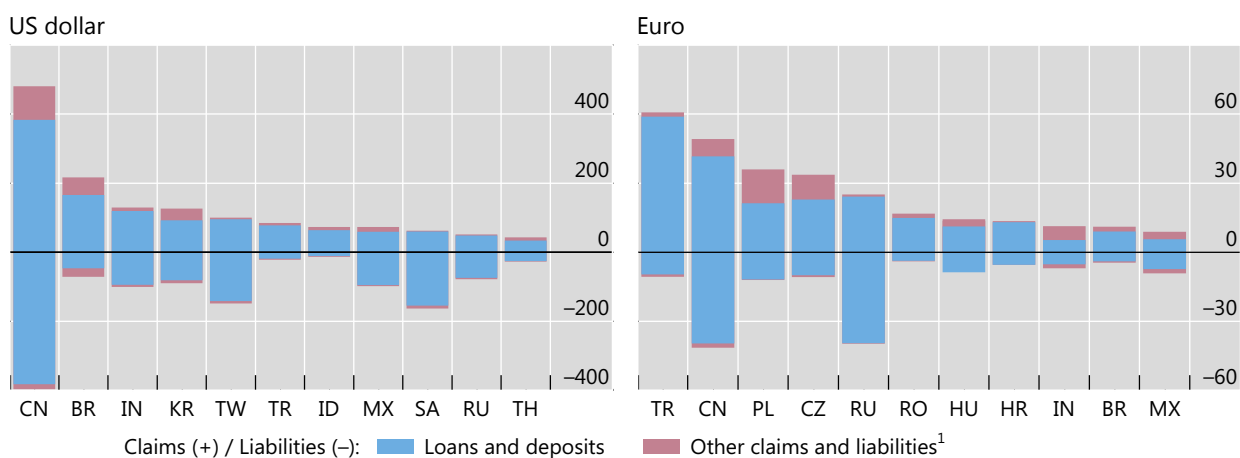
¹ This section was prepared by Pamela Pogliani and Philip Wooldridge.

² In many EMEs, official reserves account for the largest share of deposits with banks abroad. Foreign currency assets held by sectors other than the central bank can be estimated by combining LBS-reporting banks' liabilities to the bank sector in a country with data from the IMF's reserve template on central banks' placements with commercial banks (Wooldridge (2006)).

LBS-reporting banks' cross-border claims on and liabilities to selected EMEs, by currency of denomination

Amounts outstanding at end-March 2017, in billions of US dollars

Graph 1



¹ Calculated as total positions minus loans and deposits.

Source: BIS locational banking statistics (LBS, [Table A6.1](#)).

compounded over four quarters to calculate an annual percentage change.³ Importantly, adjusted changes and annual percentage changes are calculated only for the LBS because a currency breakdown is not available for the CBS.

Finally, the matrix of creditor banking systems and borrower countries first published in September 2016 is being expanded and made available in a new table in the *BIS Statistical Bulletin* and BIS Statistics Explorer, [Table A6.2](#).⁴ This new table shows the bilateral cross-border positions of banks located in up to 29 LBS-reporting countries against counterparties in more than 200 countries, with breakdowns by instrument (all instruments, loans and deposits) and sector (all sectors, non-bank sector). These geographical details can be used to analyse how shocks might propagate across borders and sectors (BIS (2016)).

³
$$\text{Annual percentage change}_t = \left(\prod_{k=0}^3 \left(\frac{\text{Adjusted change}_{t-k}}{\text{Amount outstanding}_{t-k-1}} + 1 \right) - 1 \right) \times 100$$

⁴ These data, like all other data available in the *BIS Statistical Bulletin* and BIS Statistics Explorer, can also be downloaded from the [BIS Statistics Warehouse](#) or in a [single CSV file](#).

Total US dollar, euro and yen credit by country⁵

Following up on work by the Committee on the Global Financial System (CGFS (2011)) to investigate the measurement, drivers and policy implications of global liquidity, the BIS estimates a set of global liquidity indicators (GLIs). The BIS GLIs combine BIS international banking and debt securities statistics with other data sets to provide various measures of the ease of global credit conditions.

The most widely cited GLI is the BIS's estimates of total credit by currency of denomination, in particular total US dollar credit to non-bank borrowers residing outside the United States. Such credit grew rapidly in the years following the 2007–09 financial crisis, as shown in Graph 2. Previously, the BIS published estimates for US dollar, euro and yen credit to non-residents only at the global level and for four EME regions. To facilitate more in-depth analyses, the BIS is now publishing these foreign currency credit (FCC) estimates at the country level for 14 EMEs.

The country-level FCC estimates aim to provide a comprehensive measure of credit extended by bank and non-bank creditors to non-bank borrowers in a given country. They are constructed by combining data on three sources of foreign currency credit: international debt securities, cross-border bank loans, and local bank loans (Graph 2, left-hand panel). While international debt securities and cross-border bank loans are available for over 200 countries from the BIS international debt securities statistics and LBS, respectively, data on loans extended locally by banks in foreign currency (LLFX) are less readily available. The LBS represent a unique source in this respect, as they provide comparable data on LLFX with a currency, sector and instrument breakdown for most of the 46 reporting countries.⁶ For countries that do not report LLFX in the LBS, national data are sometimes available from other sources, though often without a currency breakdown (only all foreign currencies combined).

The availability of LLFX constrains the selection of country-level FCC estimates published by the BIS. Among the 14 jurisdictions selected, 11 report LLFX data in the LBS: Brazil, Chile, Chinese Taipei, India, Indonesia, Korea, Malaysia, Mexico, Russia, South Africa and Turkey.⁷ To boost global coverage, FCC estimates are also published for two non-LBS reporting countries, Argentina and Saudi Arabia, as well as for China, which is an LBS-reporting country but does not report LLFX data. For Argentina and China LLFX are approximated using national data, while for Saudi Arabia LLFX are not included in the FCC estimates. Collectively, the above 14 jurisdictions account for roughly two thirds of US dollar and yen credit to all EMEs and for slightly over half of euro credit to all EMEs.⁸

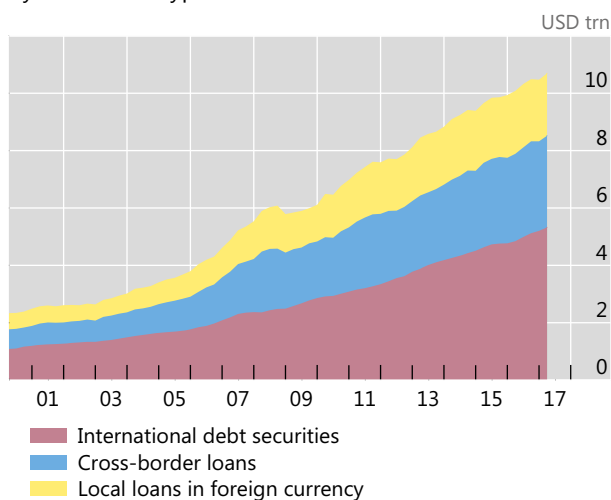
⁵ This section was prepared by Stefan Avdjiev, Bat-el Berger and Can Yang.

⁶ Two LBS-reporting countries, China and the United States, do not report LLFX.

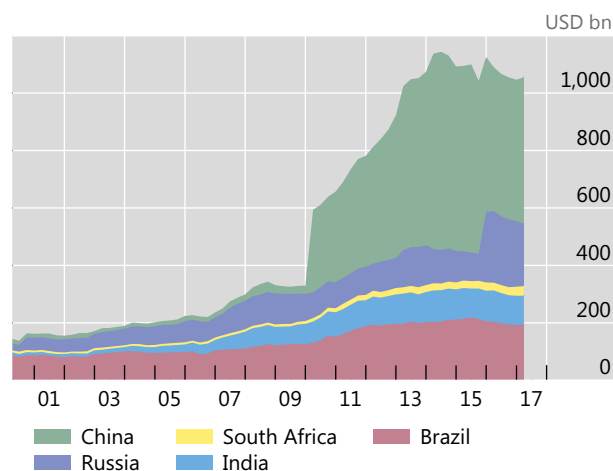
⁷ For the period prior to their becoming an LBS-reporting country, the BIS does not estimate LLFX for individual countries. Therefore, the FCC estimate jumps when LLFX are added. For details about the sources of data for LLFX, see the explanation on the [GLI homepage](#).

⁸ As the availability of data on LLFX improves, the BIS plans to publish FCC estimates for additional countries.

US dollar credit to borrowers outside the United States, by instrument type



US dollar credit to borrowers in selected EMEs¹



For definitions and sources, see www.bis.org/statistics/gli.htm.

¹ For the country-level estimates, breaks in series occur in the period in which data on LFX become available for the respective country: for Brazil, Q4 2002; for China, Q1 2010; for India, Q4 2001; for Russia, Q4 2015; for South Africa, Q3 2009.

Source: BIS global liquidity indicators.

The FCC estimates can be used to analyse a number of important policy questions.⁹ First, they provide a key measure of the extent to which major global funding currencies – US dollar, euro and yen – are used beyond the borders of their respective home jurisdictions. Second, by gauging the foreign currency indebtedness of borrowers in a given country, they provide an indication of the degree to which the respective local economy is exposed to exchange rate fluctuations. Foreign currency lending often generates currency mismatches on borrowers' balance sheets. This leaves the borrowing economy vulnerable to currency fluctuations and, ultimately, allows financial conditions in the borrowing country to be affected by the decisions of the central banks in control of the major global funding currencies.

Despite the importance of foreign currency debt for financial stability, few countries publish comprehensive data. Therefore, the BIS FCC estimates fill an important data gap. National authorities are encouraged under the G20 DGI to disseminate the currency composition of international financial assets and liabilities in their external debt statistics and the international investment position (IIP). Few currently do, although improvements are being implemented.¹⁰

Furthermore, the external debt and IIP statistics have an important conceptual limitation: they focus exclusively on positions between residents and non-residents. As a consequence, they capture only exposures to counterparties located in other

⁹ For further discussion of the implication of foreign currency credit for financial stability, see Borio and Disyatat (2011), Rey (2015), McCauley et al (2015) and Shin (2016). For additional sources, see publications on the [GLI homepage](#).

¹⁰ National data are available from the World Bank's [Quarterly External Debt Statistics](#) (QEDS) and, for IIP data, through the IMF's [Special Data Dissemination Standard](#). As of mid-2017, only 17 countries provided a breakdown of external debt by currency in QEDS, in supplementary table 2.1, and even fewer the currency details requested in Tables A9-I to A9-II of the IIP.

countries. However, the foreign currency exposures of the borrowers in a given country are not limited to their cross-border liabilities. Banks can extend locally booked loans denominated in a foreign currency, which would not be captured by residency-based statistics. Such foreign currency local positions can be quite substantial. As the left-hand panel of Graph 2 illustrates, locally extended loans make up about a quarter of total US dollar-denominated credit outside the United States.

That said, the BIS FCC estimates also have important limitations.

First, these indicators only capture the foreign currency liabilities of a given country. To accurately measure the overall currency mismatch of the borrowers in a given country, one should also take into account the foreign currency composition of the respective assets.

Second, the foreign currency composition of assets and liabilities does not necessarily equal a country's overall foreign currency exposure, as holdings of financial derivatives or hedging instruments can mitigate, amplify or transfer foreign currency exposures. It is therefore possible that, for some countries, the foreign currency amounts reported in the FCC series are not representative of actual exposures. For example, data from a 2013 foreign currency exposure survey by the Australian Bureau of Statistics show that hedging reduced the foreign currency liabilities of the private non-bank sector in Australia from 17% of GDP to 11% of GDP (Rush et al (2013)).

Third, the FCC estimates capture borrowing by the residents of a country rather than by its nationals. As a consequence, foreign currency debt incurred by offshore affiliates is not reallocated in the FCC estimates to the country in which the parent company is headquartered. This might underestimate FCC in EMEs, as they are increasingly using foreign affiliates to issue debt securities and then repatriating these funds back to their home country (Avdjiev et al (2014)).

Last but not least, debt denominated in foreign currencies may represent a relatively small share of total debt in some countries, such as China (Berger (2016)). Any assessment of its potential to influence the macroeconomic conditions should take this into account. FX credit developments thus need to be analysed in the context of the size and evolution of total credit.

Long series on US dollar bilateral nominal exchange rates¹¹

The BIS nominal exchange rate data set contains USD exchange rates for the currencies of approximately 190 economies at daily, monthly, quarterly and annual frequencies. These exchange rate series, which draw on central bank data as well as other sources, are used for the calculation of the BIS nominal and real effective exchange rate series and as an input to the BIS International Banking and Financial Statistics. With this issue of the Quarterly Review, the BIS is now publishing these data on its website and will update the data set on a weekly basis.

While several institutions publish time series on exchange rates (some with a country coverage similar to the one of the BIS), the BIS data set is unique in several respects. First, it combines current and historical data in a single data set with the highest possible level of consistency and comparability across countries.¹² Second, the time series are available in multiple frequencies. The data can be downloaded and visualised conveniently using the various BIS statistical tools on the website, such as the BIS Statistics Warehouse, BIS Statistics Explorer and full CSV files. Finally, the BIS has benefited from the background information provided by the central banks on their time series (specific measure or collection time).

Daily data are available for 79 currencies. While the starting date of most daily series ranges from 1970 to 1995, series starting in the 1950s are available for 14 currencies. For lower frequencies, more historical data are available: the monthly, quarterly and annual series are substantially longer than the daily ones for several currencies. These time series are calculated as end-of-period figures or as averages over daily data, but extended backwards with the additional low-frequency historical data. Most monthly, quarterly and annual series start in 1957. The longest exchange rate series is for GBP/USD, for which monthly data are available starting in 1791 (Graph 3).

For the most recent periods, daily data from the ECB is the main source, complemented with data from the US Federal Reserve. Exchange rates are measured at 13:15 GMT for the ECB data and 17:00 GMT for the Federal Reserve. Using data mainly from these institutions, each of which supplies data on a large number of currencies, maximises comparability across countries in terms of quotation time and market. Data are taken from other BIS member central banks for periods for which no data from the ECB or the Federal Reserve are available. The Deutsche Bundesbank is a key source for historical data. The International Monetary Fund's *International Financial Statistics* is another source for historical information, as it includes monthly and quarterly exchange rates for 190 economies going back to the 1950s. The documentation of the BIS data set provides detailed information on the sources used for each currency and time period.

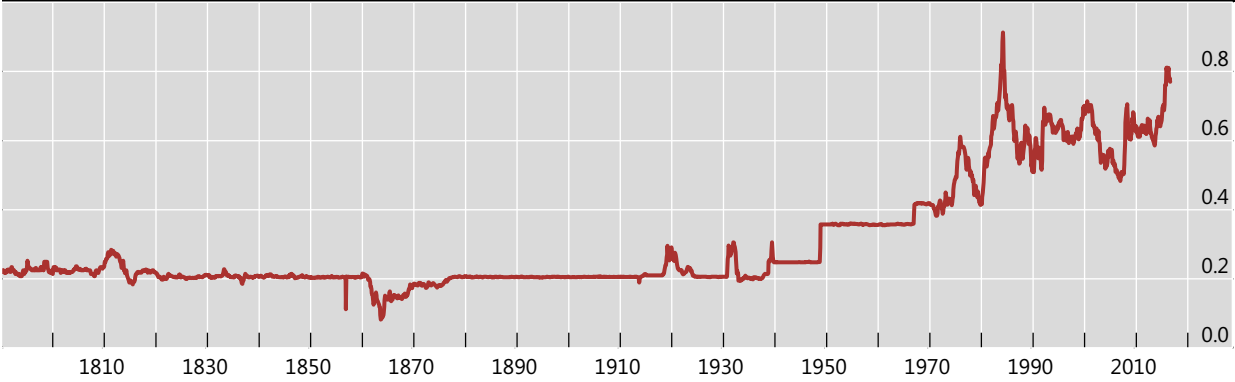
¹¹ This section was prepared by Lilian Arquete, Christian Dembiermont and Robert Szemere.

¹² Some institutions publish current and historical time series in separate data sets. Other data sets cover exchange rates collected in various countries at various times of the day (sometimes in various time zones) or based on differing measures of the exchange rate (offer/bid/middle or transactions). The BIS addresses these issues by relying mainly on data of major central banks quoting exchange rates for a large number of currencies. However, for periods when data from these sources are not available, some of the above-mentioned cross-country inconsistencies are still present in the BIS data set.

Two hundred years of nominal exchange rates

Pounds sterling per US dollar

Graph 3



Sources: Deutsche Bundesbank; European Central Bank; Bank of England; Board of Governors of the Federal Reserve System; BIS.

Long series on central bank policy rates¹³

The BIS has already published time series on central bank policy rates for selected countries in its publications on an irregular basis (especially in its Annual Reports). Now, the BIS is releasing a data set on the monetary policy rates of 38 central banks (Graph 4). In undertaking this work, the BIS has collaborated closely with national central banks who participated in the selection of the policy rate(s). The data set also contains historical information on policy rates, going back to 1946 for several countries.¹⁴

The BIS data set is unique in three respects. First, this is the only data set containing both current and historical data for a large number of countries. Second, central banks informed the BIS on which interest rates to consider as policy rates. Third, as far as possible, the metadata contain information on the time lag between the announcement of the new rate and the day it becomes effective.

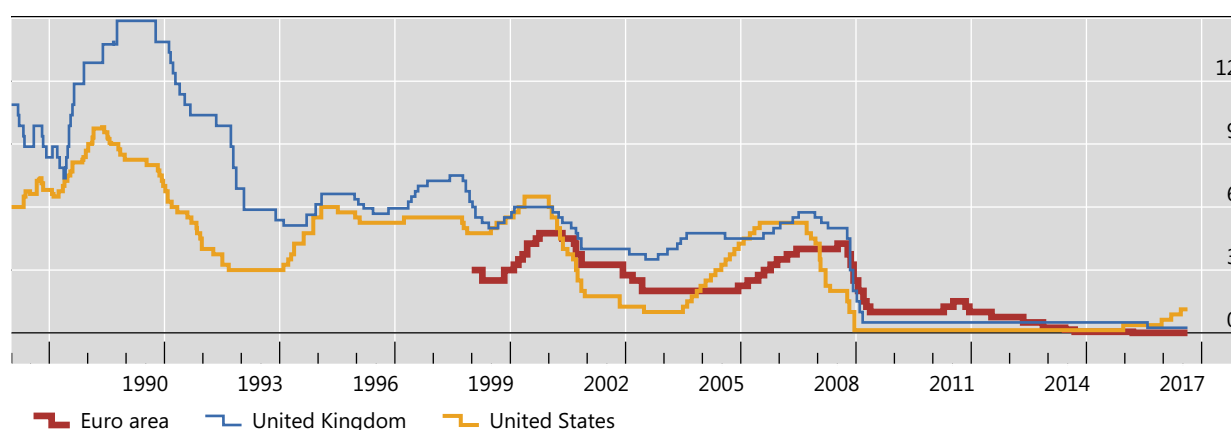
The BIS will update the data set once a week. Similarly to other BIS data sets, the policy rate series can be downloaded and visualised conveniently using the various BIS statistical tools on the website, such as the BIS Statistics Warehouse, BIS Statistics Explorer and full CSV files.

The data set presents the target or, when that is not available, the traded rate for the central bank's main policy instrument. Several central banks implement their monetary policy based on more than one interest rate. For central banks that communicate a target band, the middle of the band is shown unless the central bank has suggested that a different rate be shown. For central banks that changed their main policy instruments during the period covered in the data set, the BIS time series show the sequence of policy instruments used to conduct monetary policy in consecutive periods. The documentation identifies the breaks for all these time series.

Development of central bank policy rates over the last three decades

In per cent

Graph 4



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

¹³ This section was prepared by Christian Dembiermont and Robert Szemere.

¹⁴ To avoid breaks in series and facilitate users' data management, the BIS data build on a number of underlying series and therefore cannot be considered official national indicators.

The choice of interest rate to be shown in the data set is less obvious for periods when monetary policy was not conducted with an interest rate instrument – for example, under monetary base targeting. For those periods, the most widely referenced money market or central bank interest rate is taken. The documentation clearly highlights the interest rates selected for those periods.¹⁵

¹⁵ See Borio (1997), Markets Committee (2009) and Blindsell (2014) on the complexity and diversity of monetary policy targets across central banks.

References

- Avdjiev, S, M Chui and H S Shin (2014): "Non-financial corporations from emerging market economies and capital flows", *BIS Quarterly Review*, December, pp 67–77.
- Avdjiev, S, P McGuire and P Wooldridge (2015): "Enhanced data to analyse international banking", *BIS Quarterly Review*, September, pp 53–68.
- Avdjiev, S and C Upper (2010): "Impact of the reclassification of US investment banks", *BIS Quarterly Review*, March, p 19.
- Berger, B (2016): "Debt-weighted exchange rate indices", *BIS Quarterly Review*, December, pp 100–2.
- Bank for International Settlements (2016): "Recent enhancements to the BIS statistics", *BIS Quarterly Review*, September, pp 35–44.
- Bank for International Settlements, Financial Stability Board and International Monetary Fund (2015): Work on foreign currency exposures, report to G20 Finance Ministers and Central Bank Governors, 25 August.
- Blindsell, U (2014): *Monetary policy operations and the financial system*, Oxford University Press.
- Borio, C (1997): "The implementation of monetary policy in industrial countries: a survey", *BIS Economic Papers*, no 47, August.
- Borio, C and P Disyatat (2011): "Global imbalances and the financial crisis: link or no link?", *BIS Working Papers*, no 346, May.
- Committee on the Global Financial System (2011): "Global liquidity – concepts, measurement and policy implications", *CGFS Papers*, no 45, December.
- Financial Stability Board and International Monetary Fund (2017): *The financial crisis and information gaps: Second phase of the G20 Data Gaps Initiative (DGI-2): Second progress report*, September.
- Markets Committee (2009): *Monetary policy frameworks and central bank market operations (updated version)*, Bank for International Settlements, May.
- McCauley, R, P McGuire and V Sushko (2015): "Global dollar credit: links to US monetary policy and leverage", *Economic Policy*, vol 30, no 82, pp 187–229.
- Rey, H (2015): "Dilemma not trilemma: the global financial cycle and monetary policy independence", *NBER Working Papers*, no 21162.
- Rush, A, D Sadeghian and M Wright (2013): "Foreign currency exposure and hedging in Australia", Reserve Bank of Australia, *Bulletin*, December.
- Shin, H S (2016): "Global liquidity and procyclicality", speech at the World Bank conference on "The state of economics, the state of the world", Washington DC, 8 June.
- Wooldridge, P (2006): "The changing composition of official reserves", *BIS Quarterly Review*, September, pp 25–38.

FX swaps and forwards: missing global debt?¹

What would balance sheets look like if the borrowing through FX swaps and forwards were recorded on-balance sheet, as the functionally equivalent repo debt is? We combine various data sources to estimate the size, distribution and use of this “missing” debt and to begin to assess its implications for financial stability. A key finding is that non-banks outside the United States owe large sums of dollars off-balance sheet through these instruments. The total is of a size similar to, and probably exceeding, the \$10.7 trillion of on-balance sheet dollar debt. Even when this debt is used to hedge FX risk, it can still involve significant maturity mismatches.

JEL classification: F31, F34, F41.

Every day, trillions of dollars are borrowed and lent in various currencies. Many deals take place in the cash market, through loans and securities. But foreign exchange (FX) derivatives, mainly FX swaps, currency swaps and the closely related forwards, also create debt-like obligations. For the US dollar alone, contracts worth tens of trillions of dollars stand open and trillions change hands daily. And yet one cannot find these amounts on balance sheets. This debt is, in effect, missing.

As a result, we know little about it. How much is owed, by whom and for what purpose: trade hedging, asset-liability management, market-making? What does it imply for measures of international credit like the BIS global liquidity indicators (GLIs)? Answers to these questions can inform assessments of global financing conditions and financial stability. For instance, serious strains seized the FX swap market during the Great Financial Crisis (GFC). In response, central banks had to replace lost dollar funding that financed dollar assets (McGuire and von Peter (2009), BIS (2017)).

This special feature frames the issues and suggests some answers. To do so, it breaks ground in combining data on the aggregate amount of outstanding derivatives contracts (from the BIS derivatives statistics) with information from the international banking statistics and from ad hoc surveys to form a view of the size, geography and use of the missing foreign currency debt. The more detailed analysis focuses on the dollar segment, given the currency’s outside role in the foreign exchange and other financial markets.

¹ We thank Mary Barth, Stijn Claessens, Benjamin Cohen, Dietrich Domanski, Neil Esho, Ingo Fender, Ruby Garg, Hiroyuki Ito, Scott Nagel, Noel Reynolds, Hyun Song Shin, Kostas Tsatsaronis, David Williams and Philip Wooldridge for comments and discussions. We are also grateful to Jakub Demski, Denis Pêtre and Jeff Slee for research assistance. The views expressed are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

The debt remains obscured from view. Accounting conventions leave it mostly off-balance sheet, as a derivative, even though it is in effect a secured loan with principal to be repaid in full at maturity. Only footnotes to the accounts report it.

Focusing on the dominant dollar segment, we estimate that non-bank borrowers outside the United States have very large off-balance sheet dollar obligations in FX forwards and currency swaps. They are of a size similar to, and probably exceeding, the \$10.7 trillion of on-balance sheet debt. On the other side of the ledger, as much as two thirds of the dollar-denominated bonds issued by non-US residents could be hedged through similar off-balance sheet instruments. That fraction seems to have fallen as emerging market borrowers have gained prominence since the GFC.

The implications for financial stability are hard to assess. This requires a more granular analysis of currency and maturity mismatches than the available data allow. Much of the missing dollar debt is likely to be hedging FX exposures, which, in principle, supports financial stability. Even so, rolling short-term hedges of long-term assets can generate or amplify funding and liquidity problems during times of stress.

The first section recalls the relationship between FX swaps, currency swaps and forwards as well as their accounting treatment, explaining how the missing debt arises. The second takes a bird's eye view of the aggregate market, including its instruments, currencies and counterparties. The third relates aggregate market data to the hedging of trade and the asset-liability management of non-banks. The fourth delves into banks' role, tracing banking systems' post-GFC reliance on the market for funding. The fifth estimates adjustments to the GLIs.

Accounting treatment, data sources and gaps

Three closely related instruments allow off-balance sheet foreign currency borrowing and lending: FX swaps, currency swaps and (outright) forwards. In an FX swap, two parties exchange two currencies spot and commit to reverse the exchange at some pre-agreed future date and price. Currency swaps are like FX swaps, except that the two parties agree to exchange both principal and interest payment streams over a longer term. FX swaps mature within a year (providing "money market" funding); currency swaps have a longer maturity ("capital market" funding). A forward is a contract to exchange two currencies at a pre-agreed future date and price. After a swap's spot leg is done, what is left is the agreed future exchange – the forward leg.

These transactions are functionally equivalent to borrowing and lending in the cash market. Yet the corresponding debt is not shown on the balance sheet and thus remains obscured. To see why, consider three deals that highlight the functional similarity and accounting differences. The box goes step by step; here we summarise.

An investor wants to buy a foreign currency security with domestic cash but does not wish to run FX risk. Then, three transactions are equivalent. The agent may:

1. combine a spot and forward FX deal, ie buy the required FX spot, purchase the security and sell the same amount of FX forward;
2. use an FX swap, ie swap the domestic currency for the foreign currency and purchase the security;
3. keep the domestic cash and finance the security by borrowing in the foreign repo market, incurring outright debt.

Accounting for FX swaps, forwards and repurchase agreements: a simple analysis

This box explains how the accounting treatment of borrowing and lending through the FX swap and related forward market gives rise to missing debt. It does so with the help of simplified T-accounts. In the process, it also shows what would happen if FX swaps were treated the same as repurchase agreements (repos) – two transactions that can be considered to be forms of collateralised lending/borrowing. The table shows the corresponding balance sheets, with the subscript X denoting foreign currency positions.

Assume that an agent wishes to purchase a foreign currency asset, A, and hedge the corresponding FX risk. The agent begins with holdings of local currency C, and no debt, ie C equals net worth, E (left-hand panel).

A stylised comparison of balance sheets

Starting position Balance sheet		Cases 1 and 2: spot exchange plus forward				Case 3: repurchase agreement	
C	E	Net basis		Gross basis		Gross basis	
		A _x	E	A _x	E	A _x	E
				F	F _x	C	A _x
						[C has value F]	[A _x has value F _x]

One option (case 1) is for the agent to use the available cash to buy foreign currency in the FX market, purchase the foreign asset and at the same time enter an outright forward contract, committing to sell an equivalent amount of foreign currency for domestic currency at an agreed price at maturity. The forward creates an obligation to come up with foreign currency (a liability), matched by the right to receive the domestic currency (an asset), both equal to the current value of the foreign currency asset. The obligation to repay is a form of debt.

Table A also shows two possible ways of recording the transaction in the accounts: on a net basis, ie the way it is currently done, and on a gross basis, with the rights and obligations being explicitly shown as assets and liabilities, denoted by F (for forward). Recording on a net basis shows an apparent currency mismatch: the asset is in foreign currency, A_x, and the equity in domestic currency, E. This apparent mismatch disappears if the transaction is recorded on a gross basis, as the forward foreign currency liability, F_x, offsets the foreign currency asset, A_x.

Next, imagine that the agent entered an FX swap instead (case 2). The accounts would be *identical* to those in case 1. This is because an FX swap consists of two legs: the exchange today (or spot leg) and the commitment to exchange in the future – precisely the forward leg. The only difference from case 1 is that two transactions become one contract with the same counterparty.

Now assume that the agent decided to avoid the FX risk by keeping the cash in domestic currency and financing the foreign security in the foreign repo market (case 3). That is, the agent finances the security at purchase by immediately selling it while committing to buy it forward at an agreed price. (Here we abstract from the haircut so that the security is altogether self-financing.) Current accounting principles require that this be reported on a gross basis, so that the balance sheet doubles in size. Yet the position is functionally equivalent to that of an FX swap or forward. There is no FX risk, and the agent needs to finance the future obligation (debt) by coming up with the corresponding foreign currency to settle the forward leg (cases 1 and 2) or to repurchase the foreign currency-denominated asset (case 3). The only difference is that in case 3 the agent has the freedom to use the domestic currency cash to buy another domestic currency asset rather than having it tied up in a forward claim.

Why such a difference in accounting treatment? One reason is that forwards and swaps are treated as derivatives, so that only the net value is recorded at fair value, while repurchase transactions are not. Since the value of the forward claim exchanged at inception is the same, the fair value of the contract is zero and it changes only with variations in exchange rates. Yet, unlike with most derivatives, the full notional amount, not just a net amount as in a contract for difference, is exchanged at maturity. That is, the notional amounts are not purely used as reference for the income streams to be exchanged, such as in interest rate derivatives. Another reason is the definition of control, which for cash requires control over the cash itself (eg a demand deposit) but for a security just the right to the corresponding cash flows. This determines what is recognised and not recognised on the balance sheet.

In each case, the investor's economic situation is much the same. To be sure, the investor may deal with different counterparties and face different operational issues. And, if market prices are not perfectly aligned, one strategy may pay off better than the others. For instance, the misalignment of cash and FX borrowing rates ("failure of covered interest parity") has received much attention recently.² But in each case, the investor holds the foreign security without bearing its FX risk. In each case, the investor takes on foreign currency debt – in the form of a forward (case 1), the forward leg of the FX swap (case 2) or the amount borrowed in the cash repo market (case 3). And, in each, the investor must pay foreign currency to settle the maturing debt.

Yet, despite this basic equivalence, the amounts borrowed through swaps and forwards *never* show up on any balance sheet while those related to repos do. Agents do not have to report the nominal (principal) amounts they have committed to exchange on the balance sheet, only the marked-to-market values ("replacement cost" values). These start at zero with the exchange of equal values but become positive or negative as exchange rates move.³ The marked-to-market value averages about 3% of the notional amount for FX forwards and 6–9% for currency swaps.⁴ One needs to look deep into the footnotes to the accounts to learn about the principal amounts. As a result, the corresponding amount of debt remains obscured.⁵

This makes it very difficult to measure the debt and funding involved. The balance sheets show only the final outcome of a series of swap and forward transactions. As the box outlines, this shows as an *apparent* currency mismatch. For instance, if a bank swaps its home currency for dollars, its dollar assets end up exceeding its dollar liabilities. Moreover, for highly active dealer banks, the balance sheet shows only the net result of a possibly huge number of deals for dealer banks very active in the market.

In what follows, we piece together the amount and distribution of this missing debt from three different sources. We combine top-down with bottom-up analysis.

The first source is the BIS derivatives statistics, which draw on reports from 73 global dealer banks. The reports break down the total nominal amounts of FX swaps/forwards and currency swaps by instrument, three counterparty types (dealer banks, other financial institutions and non-financial customers), seven currencies and three maturity buckets. FX swaps and forwards are treated together since, as noted above, after the spot exchange only the forward position survives. That said, BIS statistics on FX turnover show that FX swaps are the modal instrument (see below).

The second source is the BIS international banking statistics, which cover about 8,350 internationally active banks. The reporting population outnumbers that of the derivatives statistics, but the value overlap is great given the concentration of international banking. We use the *apparent* currency mismatches visible on-balance sheet to infer the amounts of swaps and forwards. *Assuming* that the net FX position

² See the papers and presentation prepared for the BIS symposium on covered interest parity, "CIP – RIP?", at <http://www.bis.org/events/bissymposium0517/programme.htm>.

³ Dealers maintain the secured nature by agreeing to credit support annexes. The mark-to-market loser regularly hands over cash or securities ("variation margin") to the mark-to-market winner.

⁴ Gross market values do not take into account the value of any collateral posted as currencies move. The cited percentages rise with exchange rate volatility. They roughly doubled at the end of 2008.

⁵ Why such a difference? The main reasons seem to be that: (i) FX swaps/forwards are treated as derivatives while repos are not; and (ii) specific criteria are defined for ascertaining control in the case of securities and cash (see box). This results in an asymmetry in the treatment of cash (the two FX streams) and securities in what are in effect repo-like transactions.

is zero, as typically encouraged by bank supervisors, we estimate the net use of swaps as the net positions in a given currency. Even then, data limitations defy precise estimates. Moreover, as mentioned before, the resulting net positions are likely to underestimate the gross debt positions, especially for dealer banks.

The third source includes ad hoc surveys on institutional investors' and asset managers' use of derivatives. These are coupled with occasional specific disclosures.

These three sources, together with BIS data on international debt securities and global trade, provide a sense of the instruments' use. Triangulating between the various sources also allows a rough cross-check of the approximations made.

The market: a bird's eye view

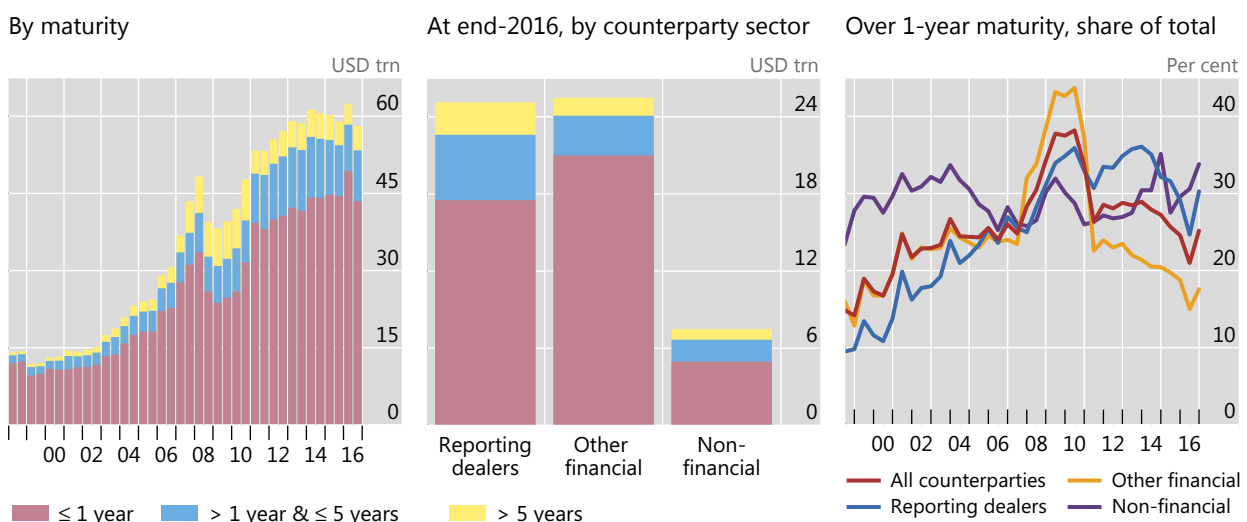
The outstanding amounts of FX swaps/forwards and currency swaps stood at \$58 trillion at end-December 2016 (Graph 1, left-hand panel). For perspective, this figure approaches that of world GDP (\$75 trillion), exceeds that of global portfolio stocks (\$44 trillion) or international bank claims (\$32 trillion), and is almost triple the value of global trade (\$21 trillion).

The outstanding amount has quadrupled since the early 2000s but has grown unevenly (Graph 1, left-hand panel). After tripling in the five years to 2007, it fell back sharply during the GFC, even more than international bank credit. This most likely reflected a reduction in hedging needs, as both trade and asset prices collapsed.

The maturity of the instruments is largely short-term (Graph 1, centre and right-hand panel). At end-2016, three quarters of positions had a maturity of less than one year and only a few percentage points exceeded five years. Turnover data show that the modal forward (a customer-facing instrument) matures between one week and one year while the modal swap (an inter-dealer instrument) within a week (BIS (2016)). The long-term share has risen since the 2000s, as capital markets have boomed.

Maturity of FX swaps/forwards and currency swaps (notional amounts)

Graph 1

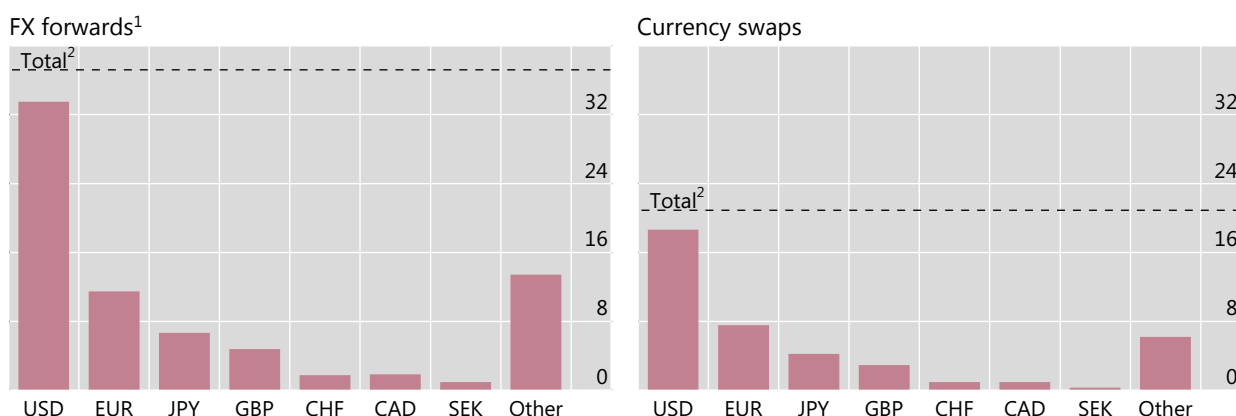


Source: BIS derivatives statistics.

Currency composition of FX swaps/forwards and currency swaps

Notional amounts outstanding at end-December 2016, in trillions of US dollars

Graph 2



¹ Including FX swaps. ² The dashed line represents the total for all currencies. Because two currencies are involved in each transaction, the sum of the individual currencies equals twice the total.

Source: BIS derivatives statistics.

The dollar reigns supreme in FX swaps and forwards. Its share is no less than 90% (Graph 2), and 96% among dealers (Table 1). Both exceed its share in denominating global trade (about half) or in holdings of official FX reserves (two thirds). In fact, the dollar is the main currency in swaps/forwards against every currency. For instance, it predominates in forwards in the Norwegian krone, the Swedish krona and the Polish zloty, currencies that trade in the spot market more against the euro.⁶

While outstanding amounts lump FX swaps with forwards, turnover data show that FX swaps are the instrument of choice. Swaps/forwards and currency swaps amounted to over \$3 trillion per day in 2016, over 60% of total FX turnover (Moore et al (2016)). Of that, FX swaps accounted for three quarters, forwards for 22% and currency swaps for the rest.

Outstanding FX swaps/forwards and currency swaps, end-2016

In trillions of US dollars (US dollar-denominated in parentheses)

Table 1

		Total \$58 (\$52)			
		Customer \$33 (\$28)		Inter-dealer \$25 (\$24)	
		Non-financial \$7.5 (\$5.1)		Financial \$25.5 (\$22.5)	
FX swaps/forwards	\$5.1	FX swaps/forwards	\$18.9	FX swaps/forwards	\$13.3
(World trade ¹)	(\$21)	(Global x-border portfolio)	(\$44)		
Currency swaps	\$2.4	Currency swaps	\$6.6	Currency swaps	\$11.9
(Int'l debt securities ²)	(\$4.8)	(Int'l debt securities)	(\$8.4)		

¹ Merchandise trade and commercial services. ² All instruments, all maturities, all countries excluding residents. Immediate issuer basis.

Sources: IMF, Coordinated Portfolio Investment Survey; WTO; BIS semiannual OTC derivatives statistics and debt securities statistics.

⁶ The dollar persists here more owing to network externalities than to inertia; see BIS (2010, pp 57–8).

The counterparty breakdown of outstanding amounts provides a big-picture indication of obligors and, indirectly, uses (Table 1). Reporting dealer positions vis-à-vis customers amount to \$33 trillion,⁷ or over half (57%) of the total; the rest, \$25 trillion, are positions among reporting institutions themselves (“inter-dealer”). This large share is a trademark of decentralised, over-the-counter (OTC) markets.⁸ Non-dealer financial firms bulk large among customers, with a share of about 80%.

Drilling down to non-financial and financial customers

Before turning to a more detailed analysis of the inter-dealer market based on the BIS international banking statistics, we discuss non-financial and financial customers’ use of the various instruments. Consider each in turn.

Non-financial customers: international trade and liability hedging

Apart from speculative use, the non-financial sector employs FX forwards and currency swaps to hedge international trade and foreign currency bonds, notably those issued to cheapen funding costs. Since most international trade contracts are short-term, forwards serve as hedges. When hedging bond issues in foreign currency, firms and governments typically match the bond maturity and that of the currency swap (McBrady et al (2010), Munro and Wooldridge (2010)).

Thus, one can relate non-financial FX swaps/forwards and currency swaps, in an admittedly stylised fashion, to international trade and bond issuance, respectively (Table 1). If firms use \$5.1 trillion of short-term FX forwards to hedge global trade of \$21 trillion, then the ratio implies that importers and exporters hedge at most three

Non-financials’ hedging of world trade and international debt securities issued Table 2

	FX swaps/forwards		Currency swaps	
	Change	% change	Change	% change
World trade	0.66** (2.34)	0.63** (2.70)		
International debt securities			0.29*** (3.65)	1.07*** (4.39)
Number of observations	23	23	37	37
R-bar squared	0.19	0.24	0.19	0.22

The elasticity of FX forwards to the value of world trade at 0.63 is insignificantly different from unity. ***/** denotes statistical significance at the 1/5% level; standard errors in parentheses.

Sources: WTO; BIS debt securities statistics; authors’ calculations.

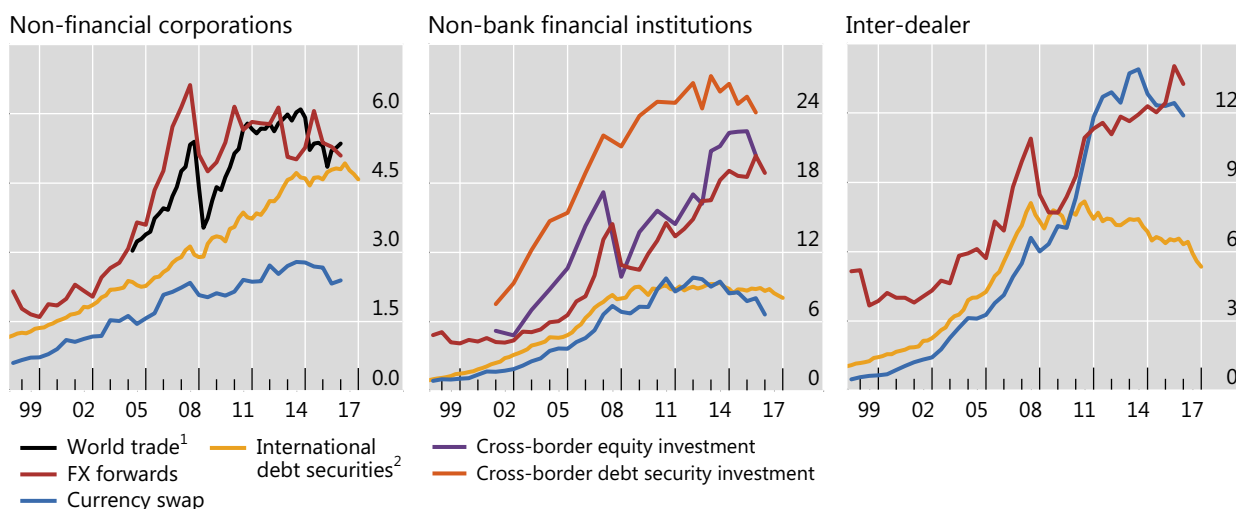
⁷ The gross market value of these positions amounted to \$1.5 trillion (\$1.3 trillion for dollars) at end-2016.

⁸ Only 1% of FX transactions are centrally cleared (Wooldridge (2017)), and most of those remain limited to non-deliverable forwards (McCauley and Shu (2016)). At end-2007, before interest rate swaps were centrally cleared, the inter-dealer share of such positions stood at almost 40%.

FX swaps/forwards and currency swaps, global trade and international debt securities

In trillions of US dollars

Graph 3



¹ Merchandise trade and commercial services. ² All instruments, all maturities, all countries excluding residents. Immediate issuer basis.

Sources: IMF, Coordinated Portfolio Investment Survey; WTO; BIS semiannual OTC derivatives statistics and debt securities statistics.

months' trade. Similarly, if firms and governments use \$2.4 trillion of currency swaps to hedge \$4.8 trillion of international bonds, then they hedge half or less.

Inspection of the corresponding time series provides some evidence for these links (Graph 3, left-hand panel). Non-financials' FX swaps/forwards (red line) co-move with world trade (black). Similarly, there is a visible, if weaker, co-movement between international bonds outstanding (yellow) and longer-term currency swaps (light blue).

Simple bivariate regression analysis provides further support for the posited links (Table 2). A \$1 billion increase in quarterly global trade in goods and services over a half-year is significantly associated with a \$660 million increase in non-financial entities' swap/forward positions (first column).⁹ Likewise, a \$1 billion increase in international securities outstanding coincides with a \$290 million rise in non-financial firms' currency swaps (column 3); the link is one to one in percentage terms (column 4).

Non-bank financial customers: hedging assets and liabilities

Other non-bank financial firms come in two groups. The first comprises institutional investors, asset managers and hedge funds that use FX forwards to hedge their holdings and to take positions. The second includes non-bank financial firms that use currency swaps to hedge their FX bonds. Consider each group in turn.

Surveyed institutional investors and asset managers use outright forwards (90% and 69%, respectively), followed by FX swaps (48% and 33%) and, to a lesser extent, currency swaps (37% and 19%) (IMF (2011)). Hedge ratios vary by asset class.

⁹ In percentage changes (log differences), a 1% increase in global trade is associated with a 0.63% increase in non-financials' FX swaps/forwards (column 2). The R^2 suggests that variation in world trade is associated with about a fifth to a fourth of the variation in their use of these instruments.

Non-bank financials' hedging of assets held and international debt securities issued Table 3

	FX swaps/forwards		Currency swaps	
	Change	% change	Change	% change
Cross-border portfolio assets	0.13 (1.61)	0.62*** (2.92)		
Own international debt issues			1.02*** (5.18)	0.95*** (6.42)
Number of observations	29	29	37	37
R-bar squared	-0.13	0.01	0.39	0.4

***/** denotes statistical significance at the 1/5% level; standard errors in parentheses.

Sources: IMF, Consolidated Portfolio Investment Security; BIS debt securities statistics; authors' calculations.

Those for foreign currency bonds range from 50 to 100%; those for foreign equities 20 to 60%.¹⁰ Heavy use of FX forwards widens maturity mismatches (see below).¹¹

Broad brush, one can compare non-bank financial FX swaps/forwards with global cross-border securities holdings. If \$18.9 trillion of FX forwards hedge a \$44 trillion portfolio, then institutional investors would hedge as much as 40%.¹² Graph 2 (centre panel) suggests that non-bank financial forwards declined with the value of cross-border securities' holdings in 2008. A simple regression confirms some link, with a 1% rise in holdings associated with a 0.6% rise in forwards (Table 3).

The \$6.6 trillion in currency swaps that non-bank financial firms have contracted stand at almost 80% of their outstanding international debt securities. Regression analysis supports such a high hedge ratio (Table 3, third and fourth columns). However, given the activity of hedge funds in the currency swap market, the 80% should be regarded as an upper bound on non-bank financial firms' hedging.

Drilling down to banks

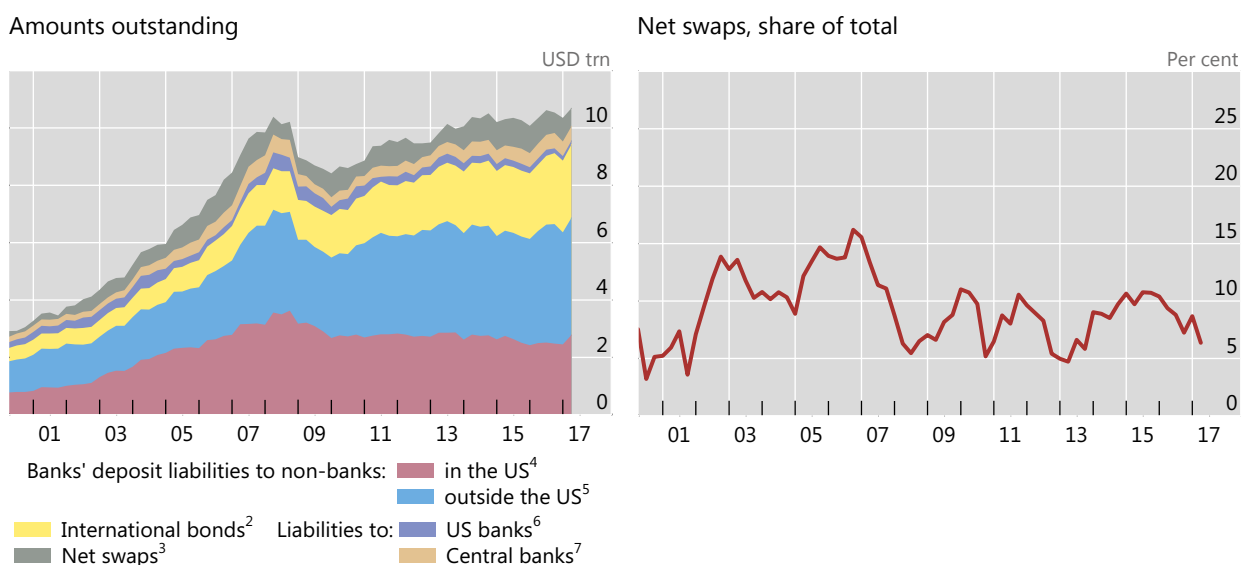
As noted, as long as one assumes that banks roughly match their FX exposures, BIS international banking statistics offer a detailed picture of the geography of banks' use of FX swaps/forwards – their main hedging instrument. We focus on the dollar, given its dominance in international finance, generally, and in the market, in particular.

FX swaps were a key part of non-US banks' total US dollar funding, amounting to an estimated \$0.6 trillion, roughly 6% of the total in March 2017 (Graph 4). The rest, about \$9.4 trillion, mostly took the form of deposits from US and non-US non-banks (red and blue areas), and dollar debt securities (yellow area).

¹⁰ See D'Arcy et al (2009), ABS (2013, p 6), Rush et al (2013), Kadota et al (2017) and Hilander (2014, Table 5).

¹¹ Institutional investors' hedging practice can be defended for equities, which vary in price and have no maturity (D'Arcy et al (2009)). Melvin and Prins (2015) describe equity investors' common practice of adjusting their hedges on the last day of the month at the widely used 4 pm London "fix".

¹² Such a comparison abstracts from cross-country differences in hedge ratios, and the unique US position. Heavy global dollar bond issuance allows US investors to diversify credit risk without incurring FX risk: 75% of US-held foreign bonds are dollar-denominated (US Treasury et al (2017)).



¹ Excluding positions reported by China and Russia, both of which started reporting to the locational banking statistics as from Q4 2015. ² US dollar-denominated issuances by non-US public and private banks; includes bonds, medium-term notes and money market instruments. ³ Estimated net swaps from other currencies into US dollar by non-US banks, on the assumption that on-balance sheet dollar assets in excess of on-balance sheet dollar liabilities are funded with swaps. ⁴ US dollar-denominated local liabilities (total) plus US dollar-denominated cross-border liabilities to non-banks by foreign affiliates in the United States; local liabilities are sourced from consolidated banking statistics on an immediate counterparty basis. ⁵ US dollar-denominated liabilities to non-banks by non-US banks located outside the United States. ⁶ US dollar-denominated interbank claims of US banks. ⁷ US dollar-denominated liabilities to official monetary authorities (central banks) by non-US banks.

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; BIS consolidated banking statistics (immediate counterparty basis) and locational banking statistics; BIS calculations.

We sort banking systems into US dollar net borrowers and lenders via FX swaps (Graphs 5 and 6). As noted, net borrowers' balance sheets show more dollar assets than liabilities, offset by missing off-balance sheet dollar debt.¹³ Net borrower banks use these dollars, along with those from FX reserve managers (red lines), to fund claims on non-banks (green lines) and other banks (solid and dashed blue lines).

Japanese banks had by far the largest on-balance sheet mismatch in dollar positions at end-Q1 2017 (top right-hand panel). They were net borrowers of an estimated \$1 trillion via FX swaps.¹⁴ Borio et al (2016) argue that constraints on global banks' balance sheets, combined with increasing demand for cross-currency funding by Japanese banks, pension funds and other non-bank financial entities, led the yen/dollar basis to widen after 2014.¹⁵

¹³ Graphs 5 and 6 plot two estimates for net interbank borrowing (solid and dashed blue lines) and net FX swaps (shaded area and dashed black line). In the locational banking statistics, banks report cross-border inter-office positions. These positions should sum to zero for each banking system but often do not. The two estimates treat such discrepancies differently. See McGuire and von Peter (2009).

¹⁴ This is an upper-bound estimate. In the locational banking statistics, Japan reports the dollar positions of Japanese banks inclusive of their trustee positions, or positions booked on behalf of clients, which are likely to have a lower hedge ratio. See Borio et al (2016) for a more detailed discussion.

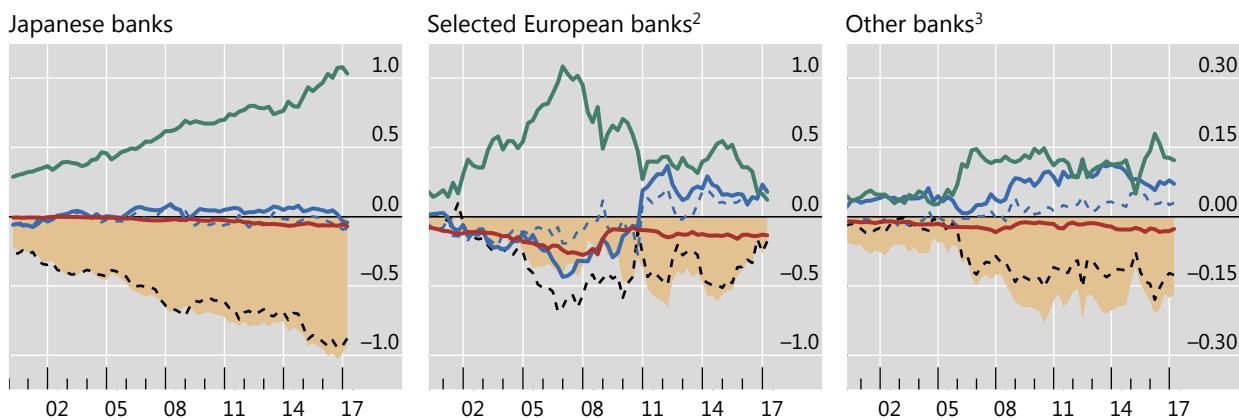
¹⁵ See footnote 2. See also Aldasoro et al (2017) for evidence of differential pricing in dollar funding markets; Japanese banks pay a premium to borrow via repos from US money market funds.

Non-US banks' dollar net on-balance sheet positions, by counterparty sector¹

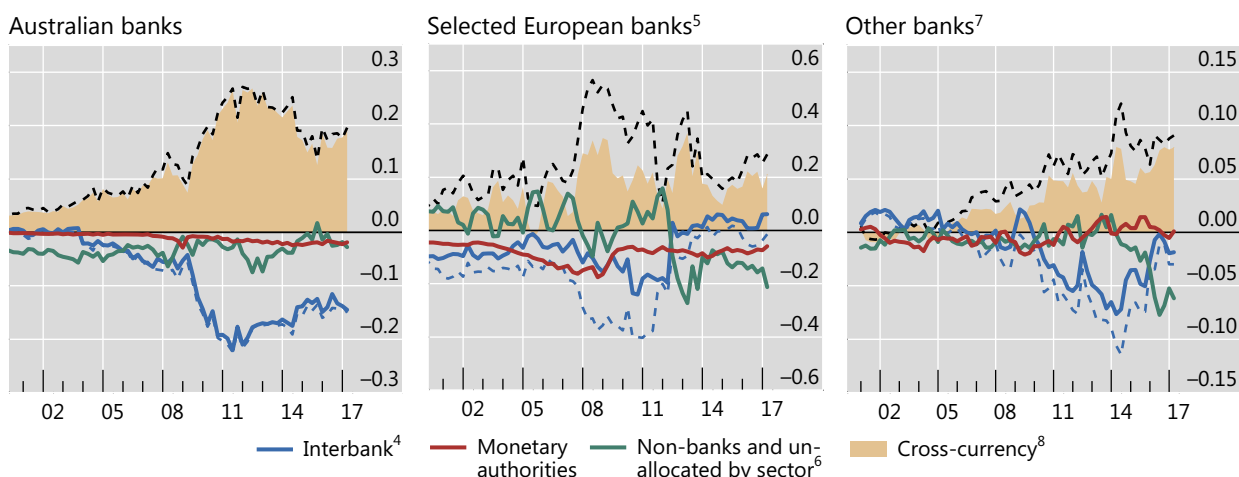
In trillions of US dollars

Graph 5

US dollar borrowers via FX swaps



US dollar lenders via FX swaps



¹ Estimates aggregate the worldwide on-balance sheet cross-border and local positions reported by internationally active banks headquartered in the country/region shown/listed. Net positions are assets less liabilities. ² Banks headquartered in CH, DE, ES, GB, GR, IT and NO. ³ Banks headquartered in CA, IN, MX and PA. ⁴ Estimated net interbank lending to other (unaffiliated) banks. The dashed blue line is an alternative estimate where inter-office positions, which should net to zero but may not in the data, are incorporated. ⁵ Banks headquartered in AT, BE, DK, FI, FR, LU, NL, PT and SE. ⁶ International positions vis-à-vis non-banks and counterparties unallocated by sector plus local positions vis-à-vis US residents (all sectors) booked by banks' offices in the United States (no sectoral breakdown is available for these positions). ⁷ Banks headquartered in BR, SG, TR and TW. ⁸ Implied cross-currency funding (ie FX swaps), which equates US dollar assets and liabilities. The dashed black line is an alternative estimate where inter-office positions, which should net to zero, are incorporated.

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

For their part, several large European banking systems also draw dollars from the FX swap market to fund their international dollar positions (top centre panel). Pre-GFC, German, Dutch, UK and Swiss banks, in particular, had funded their growing dollar books via interbank loans (blue lines) and FX swaps (shaded area). The meltdown in dollar-denominated structured products during the crisis caused funding markets to seize up and banks to scramble for dollars. Markets calmed only after coordinated central bank swap lines to supply dollars to non-US banks became unlimited in October 2008.

Post-GFC, these European banks' aggregate dollar borrowing via FX swaps declined, along with the size of their dollar assets. In particular, German, Swiss and

UK banks reduced their combined reliance on FX swaps from \$580 billion in 2007 to less than \$130 billion by end-Q1 2017.

The bottom panels of Graph 5 show aggregates for the non-US banks that, on net, lend dollars through FX swaps in order to square their books. Australian banks (bottom left-hand panel), for example, have relied on direct dollar interbank and bond borrowing (blue line) to fund mostly Australian dollar investments at home, and with an estimated \$200 billion in FX swaps hedging the currency risk.¹⁶ Selected European and non-European banking systems add almost \$300 billion to this total.

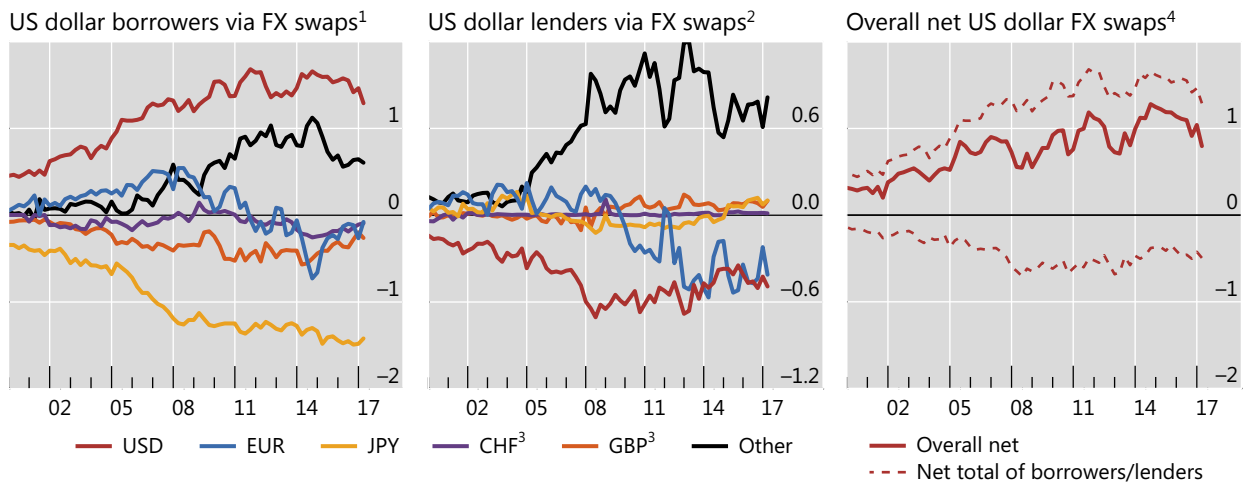
Non-US banks' net dollar lending through the FX swap market falls short of their net borrowing, with the gap widening over time (Graph 6, right-hand panel).¹⁷ More specifically, dollar borrowing against other major currencies, like the yen and the euro (left-hand panel), exceeds dollar lending against secondary and emerging market currencies (centre panel).

Who, then, lends dollars to non-US banks via the FX swap market? Four candidates are: US banks, central banks, European agencies and supranational organisations, and private non-banks. All of these appear to provide some funding, with US banks and central banks together closing about half the gap.

Non-US banks' estimated net FX swap positions, by currency

In trillions of US dollars

Graph 6



¹ Banking systems shown in Graph 5 with more on-balance sheet US dollar assets than US dollar liabilities *in a given quarter*. ² Banking systems shown in Graph 5 with less on-balance sheet US dollar assets than US dollar liabilities *in a given quarter*. ³ Positions booked by offices located in Switzerland (for CHF) and in the United Kingdom (for GBP). CHF and GBP positions reported by offices located elsewhere are included in "other". ⁴ The dashed lines are the red lines in the left-hand and centre panels, and the solid red line is the overall net positions in US dollars.

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

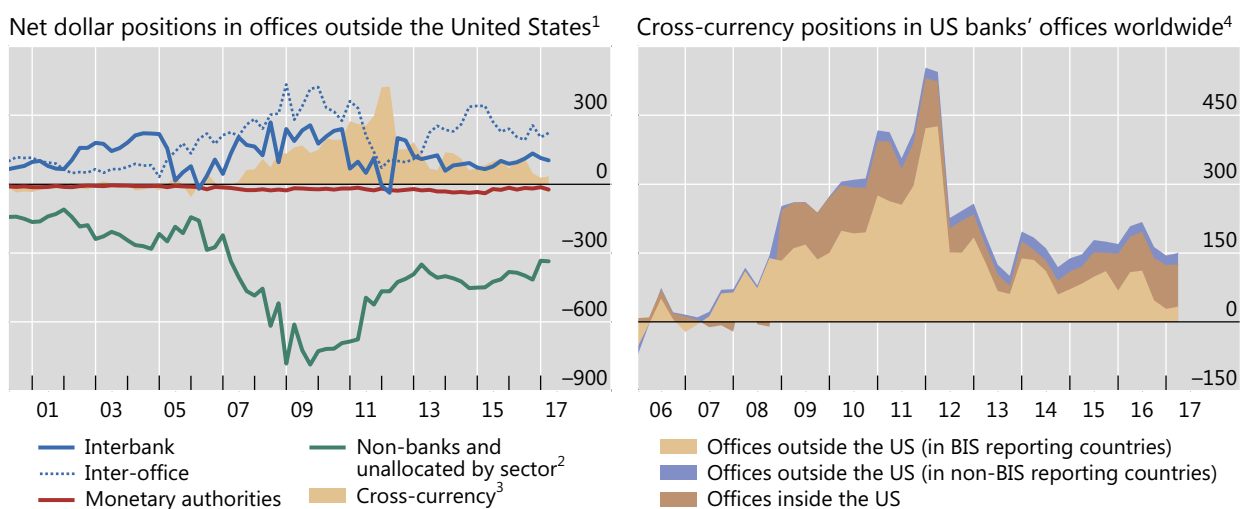
¹⁶ See ABS (2013) and Rush et al (2013) on hedging by Australian banks.

¹⁷ BIS data provide only a partial picture of the dollar books of banks headquartered in China, Korea, Russia and many other countries. An aggregation of these banks' *observed* dollar positions, however, suggests that they are, overall, net borrowers of dollars via FX swaps, pointing to an even wider gap than shown in Graph 6. BIS data do not capture at all the dollar positions of other non-reporting banking systems, some of which may be dollar lenders via FX swaps (eg oil-producing countries).

Estimates of US banks' US dollar lending via FX swaps

In billions of US dollars

Graph 7



¹ Aggregated on-balance sheet US dollar positions of US banks located in countries that report to the BIS locational banking statistics; excludes US banks' positions booked in offices located in the United States. ² International positions vis-à-vis non-banks and counterparties that are unallocated by sector. ³ Implied cross-currency funding (ie FX swaps), which equates US dollar assets and liabilities. ⁴ Estimates generated by adding the shaded area in the left-hand panel for US banks' offices outside the United States (in BIS reporting countries) to (a) US banks' cross-border non-US dollar positions booked by offices inside the United States and (b) US banks' net local claims in local currencies vis-à-vis countries that do not report to the BIS locational banking statistics. For (a), US banks' home offices' local non-US dollar positions are not included, and are assumed to be small. For (b), the implicit assumption is that US banks' net local currency positions are funded by providing US dollars for local currencies via FX swaps.

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

As regards the first candidate, US banks naturally lend dollars via FX swaps: \$150 billion in the latest data (Graph 7). This figure combines positions from offices outside and inside the United States. BIS data offer a fairly complete picture of US banks' positions outside the country (left-hand panel): they point to \$33 billion in net lending at end-Q1 2017, down from more than \$400 billion in 2011 (shaded area). The corresponding estimate for offices inside the country is less precise (right-hand panel).¹⁸

Second, central banks lend dollars via FX swaps against either their own currency or third currencies. *Against their own currency*, some Asian central banks provide about \$200 billion in swaps as they manage the domestic liquidity consequences of FX reserve accumulation (Graph 8, left-hand panel).¹⁹ They first buy dollars spot (increase their FX reserves) and then drain domestic liquidity by swapping (lending) the dollars for (against) domestic currency. On net, however, central banks' dollar supply against their own currencies is close to zero, since other central banks are

¹⁸ In the BIS locational banking statistics, the United States does not report resident banks' local positions, which prevents measuring US banks' global dollar asset and liability positions. The estimate in the right-hand panel of Graph 7 for "Offices inside the US" is inferred from these banks' net non-dollar positions, and assumes that non-dollar local positions are small.

¹⁹ The counterparties of the central banks are not in all cases reporters to the BIS banking statistics, in which case they cannot help explain the gap identified previously.

actually borrowing dollars via FX swaps (centre and right-hand panels).²⁰ They do so in order to finance their accumulation of FX reserves without incurring currency risk (“borrowed reserves”). Against *foreign currencies*, some central banks lend dollars via swaps in the management of their FX reserve portfolio. For instance, the Reserve Bank of Australia swaps US dollars for yen (DeBelle (2017)). We estimate that such operations by reserve managers sum to at least \$300 billion.

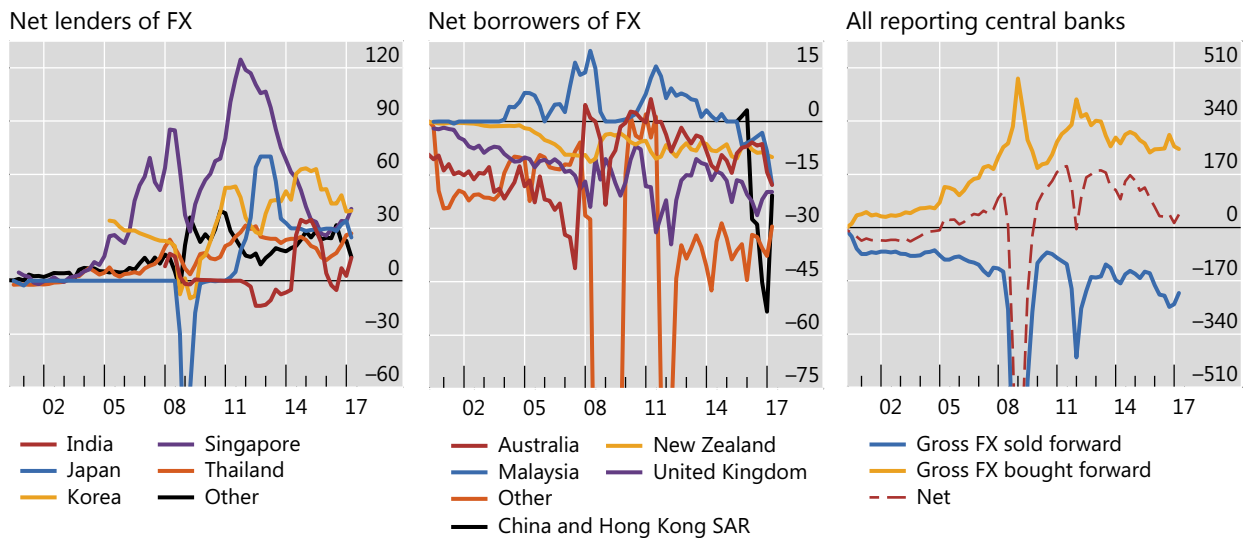
Third, European supranationals and agencies have opportunistically borrowed dollars to swap into euros to lower their funding costs. While their operations mostly require euros, they have done so to take advantage of the breakdown in covered interest parity (Borio et al (2016)). Five European supranationals and agencies together had over \$400 billion in dollar debt in June 2017. We estimate that these alone have provided \$300 billion in swaps against the euro.

Fourth, non-bank private sector entities can provide hundreds of billions of dollars. Like US banks, US-based asset managers are obvious candidates. In June 2014, the then largest US bond fund, PIMCO’s Total Return Fund, reported \$101 billion in currency forwards, no less than 45% of its net assets (Kreicher and McCauley (2016)). Since the overall US holdings of foreign currency bonds were \$600 billion at end-2015, a 50% hedge ratio would extrapolate to \$300 billion. On the equity side, US investors’ hedge ratios are thought to be 40–50% for advanced economy equities (Melvin and Prins (2015)).²¹ In addition, US firms that hold cash in

Central banks’ forward positions against domestic currency¹

In billions of US dollars

Graph 8



¹ Aggregated short and long positions in forwards and futures in foreign currencies vis-à-vis the domestic currency (including the forward leg of FX swaps).

Source: IMF, Special Data Dissemination Standard (SDDS).

²⁰ In some cases, the authorities finance some foreign exchange reserves by swapping domestic currency into dollars. Whereas dollar-lending central banks typically have a long FX position, dollar-borrowing central banks can hold reserves while also avoiding a long FX position.

²¹ Hedge ratios for Japanese equities can be higher. ETFdb.com data show that, out of the top 22 exchange-traded funds that invest in Japanese equities, those with “hedged” in the fund title had combined assets of \$29 billion.

offshore affiliates to avoid US corporate tax on repatriated earnings could be sizeable lenders as well.

Potential adjustments to the GLIs

As part of its GLIs, the BIS has been regularly publishing estimates of the dollar debt of non-banks outside the United States. These *cash market* obligations, both bank loans and bonds, totalled \$10.7 trillion at end-March 2017. What would be the corresponding additional debt borrowed through the *FX derivatives markets*? As we explain next, the order of magnitude is similar: the missing debt amounts to some \$13–14 trillion. But the implications for financial stability are quite subtle and require an assessment of both currency and maturity mismatches.

Obtaining such estimates requires a series of steps and assumptions. First, the BIS OTC derivatives statistics report total dollar-denominated forwards and swaps outstanding vis-à-vis customers (our proxy for non-banks) of \$28 trillion (in parentheses in Table 1). Second, we need to make an assumption about the *direction* of non-banks' positions. We could assume that the amount of dollars lent and borrowed through derivatives by customers is matched. This would require reporting dealers, as a sector, to be also balanced: data slippage aside, customers and dealers make up the whole market. If so, to obtain the total amount of non-banks' gross dollar borrowing through FX forwards, one would divide by two. This gives \$14 trillion.²² The previous section, however, suggested that banks as a whole use the market for *net dollar borrowing*. If so, one could subtract that amount from the total before dividing. Even then, an upper estimate of the banks' net position would be, say, \$2 trillion. This would imply (after dividing the remaining amount by two) a lower amount of non-bank dollar borrowing of \$13 trillion. Finally, we need to estimate the fraction of that debt held by non-US residents. If US residents use the bulk of their derivatives for hedging purposes, the amount would be small.²³

Just as for the case of the \$10.7 trillion worth of on-balance sheet debt, this additional dollar debt contracted through FX derivatives is to some extent supported by dollar revenues and/or assets, ie currency-matched. The previous analysis suggests that the whole amount of that debt *could* be rationalised by hedging activity, be it trade or asset holdings. It also indicates that a portion of dollar off-balance sheet *lending*, estimated at as much as \$3 trillion, may hedge the on-balance sheet dollar bond debt included in the existing GLI estimate.²⁴ That ratio has declined as emerging market bond issuers have gained prominence (McCauley et al (2015), Bruno and Shin (2017)). Such hedging can support financial stability, especially if maturities

²² This also assumes that dealers – and not customers – have matched positions in which the dollar serves as the vehicle currency, eg a swap from yen to dollars matched with one from dollars to euros.

²³ US imports of \$2.7 trillion are 90% dollar-denominated. US non-banks have sold only \$600 billion in non-dollar-denominated debt to non-residents (US Treasury et al (2016)). Many leveraged accounts (eg Commodity Trading Advisor funds) sell dollars in the futures market rather than in the OTC market.

²⁴ For non-financial borrowers, the ratio of their outstanding currency swaps to their international debt securities suggests a 50% hedge ratio (Graph 3, left-hand panel). Applying this to their \$2.8 trillion in dollar bonds suggests that as much as \$1.4 trillion may be hedged. Similarly, the maximum implied hedge ratio for non-bank financial entities of 80% (Graph 3, centre panel) suggests that as much as \$1.8 trillion of their \$2.2 trillion in dollar bonds is hedged. Together, as much as 66% of non-banks' \$5 trillion in outstanding dollar bonds may be hedged.

are matched. At the same time, the reinsurance cannot be complete. Experience shows that FX derivatives can also be used to take open positions, including in the form of carry trades. And off-balance sheet debt can cause or amplify strains, especially in the case of FX options (which are beyond the scope of this analysis). The available statistics do not allow us to identify the extent of speculative use.

Regardless of whether the off-balance sheet debt is currency-matched or not, it has to be repaid when due and this can raise risk. To be sure, such risk is mitigated by the other currency received at maturity. Most maturing dollar forwards are probably repaid by a new swap of the currency received for the needed dollars. This new swap rolls the forward over, borrowing dollars to repay dollars.

Even so, strains can arise. In particular, the short maturity of most FX swaps and forwards can create big maturity mismatches and hence generate large liquidity demands, especially during times of stress. Most spectacular was the funding squeeze suffered by many European banks during the GFC. Indeed, in response, the Swedish bank supervisor has applied liquidity requirements separately to banks' dollar and euro positions (Jönsson (2014)). But non-banks may also face similar problems when they run such mismatches, both on- and off-balance sheet. During the GFC, central banks extraordinarily extended dollar credit to non-banks in Brazil (\$10 billion programme) and Russia (\$50 billion).²⁵ Moreover, even sound institutional investors may face difficulties. If they have trouble rolling over their hedges because of problems among dealers, they could be forced into fire sales.²⁶

Conclusion

Obligations to pay dollars incurred through FX swaps/forwards and currency swaps are functionally equivalent to secured debt. In contrast to other derivatives, agents must repay the principal at maturity, not just the replacement value of the position. Moreover, they could replicate those positions through transactions in the cash and securities markets that would show up on-balance sheet. But because of accounting conventions, this debt does not appear on the balance sheet: it has gone missing.

All this greatly complicates any assessment of the missing debt's total amount and distribution, and hence of its implications for financial stability. In this special feature, we have taken a first step. That said, a fuller assessment would require better data to help evaluate the size and distribution of both currency and maturity mismatches. The analysis also points to deeper and more complex questions about the accounting conventions themselves. At issue is the definition of derivatives and control, which gives rise to the asymmetric treatment of cash and other claims in repo-like transactions. These questions, together with their regulatory implications, would merit further consideration.

²⁵ See Stone et al (2009) and Vnesheconombank (2009).

²⁶ Such investors might be able to settle the existing contract by obtaining dollars through the spot market against incoming currencies, putting upward pressure on the dollar exchange rate. But if the FX swap market was closed, so that the investors could not renew the contract, they would either have to live with a currency mismatch or sell the underlying security (or, if possible, repo it out to obtain the dollars, as in the example in the box).

References

Aldasoro, I, T Ehlers and E Eren (2017): "The Japan repo premium and US dollar intermediation", forthcoming in *BIS Working Papers*.

Australian Bureau of Statistics (2013): "Foreign currency exposure – Australia", March, ABS no 5308.0, October.

Bank for International Settlements (2010): *80th Annual Report*, June.

——— (2016): "Triennial Central Bank Survey: OTC interest rate derivatives turnover in April 2016", September.

——— (2017): *87th Annual Report*, Chapter V, June.

Borio, C, R McCauley, P McGuire and V Sushko (2016): "Covered interest parity lost: understanding the cross-currency basis", *BIS Quarterly Review*, September, pp 45–64.

Bruno, V and H S Shin (2017): "Global dollar credit and carry trades: a firm-level analysis", *The Review of Financial Studies*, vol 30, no 3, pp 703–49.

D'Arcy, P, M Idil and T Davis (2009): "Foreign currency exposure and hedging in Australia", Reserve Bank of Australia, *Bulletin*, December, pp 1–10.

Debelle, G (2017): "How I learned to stop worrying and love the basis", speech at the BIS symposium "CIP – RIP?", 22 May.

Du, W, A Tepper and A Verdelhan (2017): "Covered interest rate parity deviations in the post-crisis world", presentation at the BIS symposium "CIP – RIP?", 22 May.

Eklund, J, J Milton and A Rydén (2012): "Swedish banks' use of the currency swap market to convert funding in foreign currencies to Swedish kronor", Sveriges Riksbank, *Economic Review*, no 2, pp 18–43.

Hilander, E (2014): "Short-term funding in foreign currency by major Swedish banks and their use of the short-term currency swap market", Sveriges Riksbank, *Economic Review*, no 1, pp 1–23.

International Monetary Fund (2011): "Long-term investors and their asset allocation", *Global Financial Stability Report*, September.

——— (2017): *Coordinated portfolio investment survey*.

Jönsson, B (2014): "An examination of the liquidity coverage ratio (LCR) in Swedish kronor", Sveriges Riksbank, *Economic Commentaries*, no 6.

Kadota, S, N Oshikubo, L Sharavdemberel, Y Funakubo and D Fernandez (2017): "Japan portfolio rebalancing update: shift to cautious and selective stance", Barclays FICC Research, 3 August.

Kreicher, L and R McCauley (2016): "Asset managers, eurodollars and unconventional monetary policy", *BIS Working Papers*, no 578, August.

McBrady, M, S Mortal and M Schill (2010): "Do firms believe in interest rate parity?", *Review of Finance*, vol 14, no 4, pp 695–726.

McCauley, R, P McGuire and V Sushko (2015): "Dollar credit to emerging market economies", *BIS Quarterly Review*, December, pp 27–41.

McCauley, R and C Shu (2016): "Non-deliverable forwards: impact of currency internationalisation and derivatives reform", *BIS Quarterly Review*, December, pp 81–93.

McGuire, P and G von Peter (2009): "The US dollar shortage in global banking", *BIS Quarterly Review*, March, pp 47–63.

Melvin, M and J Prins (2015): "Equity hedging and exchange rates at the London 4 pm fix", *Journal of Financial Markets*, no 22, pp 50–72.

Moore, M, A Schrimpf and V Sushko (2016): "Downsized FX markets: causes and implications", *BIS Quarterly Review*, December, pp 35–51.

Munro, A and P Wooldridge (2010): "Motivations for swap-covered foreign currency borrowing", *BIS Papers*, no 52, July, pp 145–85.

Rush, A, D Sadeghian and M Wright (2013): "Foreign currency exposure and hedging in Australia", Reserve Bank of Australia, *Bulletin*, December, pp 49–57.

Stone, M, C Walker and Y Yasui (2009): "From Lombard Street to Avenida Paulista: foreign exchange liquidity easing in Brazil in response to the global shock of 2008–09", *IMF Working Papers*, no WP/09/259.

US Treasury, Federal Reserve Bank of New York and Board of Governors of the Federal Reserve System (2017): *US portfolio holdings of foreign securities as of December 31, 2015*, January.

Vnesheconombank (2009): *Annual Report*, 2008.

Wooldridge, P (2017): "Central clearing makes further inroads", *BIS Quarterly Review*, June, pp 8–9.

Central bank cryptocurrencies¹

New cryptocurrencies are emerging almost daily, and many interested parties are wondering whether central banks should issue their own versions. But what might central bank cryptocurrencies (CBCCs) look like and would they be useful? This feature provides a taxonomy of money that identifies two types of CBCC – retail and wholesale – and differentiates them from other forms of central bank money such as cash and reserves. It discusses the different characteristics of CBCCs and compares them with existing payment options.

JEL classification: E41, E42, E51, E58.

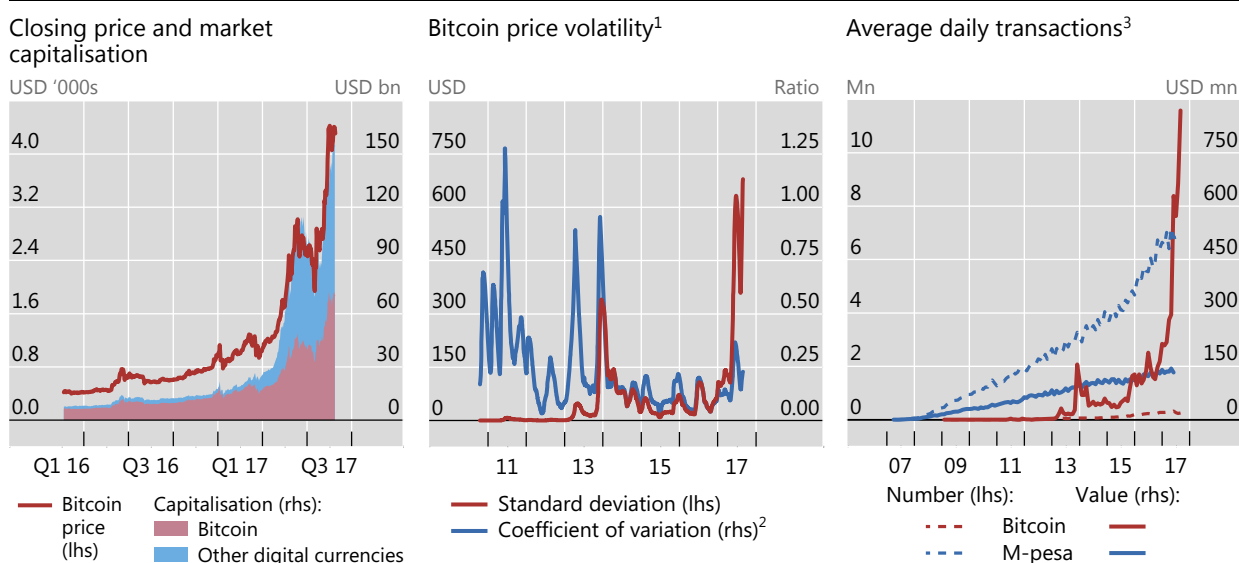
In less than a decade, bitcoin has gone from being an obscure curiosity to a household name. Its value has risen – with ups and downs – from a few cents per coin to over \$4,000. In the meantime, hundreds of other cryptocurrencies – equalling bitcoin in market value – have emerged (Graph 1, left-hand panel). While it seems unlikely that bitcoin or its sisters will displace sovereign currencies, they have demonstrated the viability of the underlying blockchain or distributed ledger technology (DLT). Venture capitalists and financial institutions are investing heavily in DLT projects that seek to provide new financial services as well as deliver old ones more efficiently. Bloggers, central bankers and academics are predicting transformative or disruptive implications for payments, banks and the financial system at large.²

Lately, central banks have entered the fray, with several announcing that they are exploring or experimenting with DLT, and the prospect of central bank crypto- or digital currencies is attracting considerable attention. But making sense of all this is difficult. There is confusion over what these new currencies are, and discussions often occur without a common understanding of what is actually being proposed. This feature seeks to provide some clarity by answering a deceptively simple question: what are central bank cryptocurrencies (CBCCs)?

To that end, we present a taxonomy of money that is based on four key properties: *issuer* (central bank or other); *form* (electronic or physical); *accessibility* (universal or limited); and *transfer mechanism* (centralised or decentralised). The

¹ The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. We thank Claudio Borio, Stijn Claessens, Benjamin Cohen, Dietrich Domanski, Hana Halaburda, Krista Hughes, Jochen Schanz and Hyun Song Shin for comments as well as Aleksander Berentsen, James Chapman and Paul Wong for insightful discussions. We are grateful to Codruta Boar for excellent research assistance.

² See Andolfatto (2015, 2016), Broadbent (2016), Raskin and Yermack (2016) and Skingsley (2016).



¹ Ninety-day moving averages. ² Ratio of standard deviation to mean. ³ Monthly averages. For bitcoin, estimated transaction value in USD; for M-pesa™, transaction value in KES converted into USD.

Sources: Central Bank of Kenya; CoinDance; CoinDesk; www.blockchain.info; authors' calculations.

taxonomy defines a CBCC as an electronic form of central bank money that can be exchanged in a decentralised manner known as *peer-to-peer*, meaning that transactions occur directly between the payer and the payee without the need for a central intermediary.³ This distinguishes CBCCs from other existing forms of electronic central bank money, such as reserves, which are exchanged in a centralised fashion across accounts at the central bank. Moreover, the taxonomy distinguishes between two possible forms of CBCC: a widely available, consumer-facing payment instrument targeted at retail transactions; and a restricted-access, digital settlement token for wholesale payment applications.⁴

But what might the two types of CBCC offer that alternative forms of central bank money cannot? For the consumer-facing kind, we argue that the peer-to-peer element of the new technology has the potential to provide anonymity features that are similar to those of cash but in digital form. If anonymity is not seen as important, then most of the alleged benefits of retail CBCCs can be achieved by giving the public access to accounts at the central bank, something that has been technically feasible for a long time but which central banks have mostly stayed away from.

On the wholesale side, the assessment of CBCCs is quite different. Wholesale payments today do not offer cash-like anonymity. In particular, transactions that occur in wholesale systems are visible to the central operator. Hence, the case for wholesale CBCCs depends on their ability to improve efficiency and reduce settlement

³ The purest form of peer-to-peer transaction is a cash exchange. On a computer network, the peer-to-peer concept means that transactions can be processed without the need for a central server.

⁴ It is common to divide payments into retail and wholesale segments. Retail payments are relatively low-value transactions, in the form of eg cheques, credit transfers, direct debits and card payments. By contrast, wholesale payments are large-value and high-priority transactions, such as interbank transfers. The distinction might become less relevant in a world with CBCCs. In that case, our usage would reflect the types of payment primarily targeted by CBCCs.

costs. Here, the answer depends on a number of technical issues that still need to be resolved. Some central banks have experimented with wholesale CBCCs, but none has announced yet that it is ready to adopt this technology.

The first section presents the taxonomy underlying our definition. The following two sections discuss the features of the two basic CBCC types, retail and wholesale, drawing on historical examples and projects that are currently under way. A concluding section reflects on some of the issues that central banks need to consider in this area going forward.

A new form of central bank money

Our starting point for defining CBCCs is a report on cryptocurrencies published in 2015 by the Committee on Payments and Market Infrastructures (CPMI (2015)).⁵ This report sought to provide a definition of the new class of currencies represented by bitcoin and altcoins (alternatives to bitcoin) that had emerged using the same technology. The report identifies three key characteristics of cryptocurrencies: they are *electronic*; are *not the liability of anyone*; and feature *peer-to-peer* exchange.⁶

Cryptocurrencies utilise DLT (Box A) to allow remote peer-to-peer transfer of electronic value in the absence of trust between contracting parties. Usually, electronic representations of money, such as bank deposits, are exchanged via centralised infrastructures, where a trusted intermediary clears and settles transactions. Previously, peer-to-peer exchange was restricted to physical forms of money.

Some – but not all – of these features are also common to other forms of money (Graph 2, left-hand panel). Cash is peer-to-peer, but it is not electronic, and it is a central bank liability. Commercial bank deposits are a liability of the bank that issues them. Nowadays, they are in electronic form and are exchanged in a centralised manner either across the books of a given bank or between different banks via the central bank. Most commodity monies, such as gold coins, may also be transferred in a peer-to-peer fashion but are neither the liability of anyone nor electronic.⁷

It may seem natural to define CBCCs by adapting the CPMI's definition to say that they are electronic central bank liabilities that can be used in peer-to-peer exchanges. But this ignores an important feature of other forms of central bank money, namely *accessibility*. Currently, one form of central bank money – cash – is of course accessible to everyone, while central bank settlement accounts are typically available only to a limited set of entities, mainly banks (CPSS (2003, p 3)). In this spirit, Bjerg (2017) includes *universally accessible* (ie easy to obtain and use) in addition to *electronic* and *central bank-issued* in defining the new concept of central bank digital currency (Graph 2, right-hand panel).

⁵ The report's title is *Digital currencies*, but it notes that such schemes are frequently also referred to as "cryptocurrencies", reflecting the use of cryptography in their issuance and their validation of transactions.

⁶ Cryptocurrencies have no intrinsic value and are only held in the belief that they might be exchanged for goods or services at a later point in time.

⁷ In the Middle Ages, payments at times required the services of a money changer to assay and value the coins being used.

What is distributed ledger technology?①

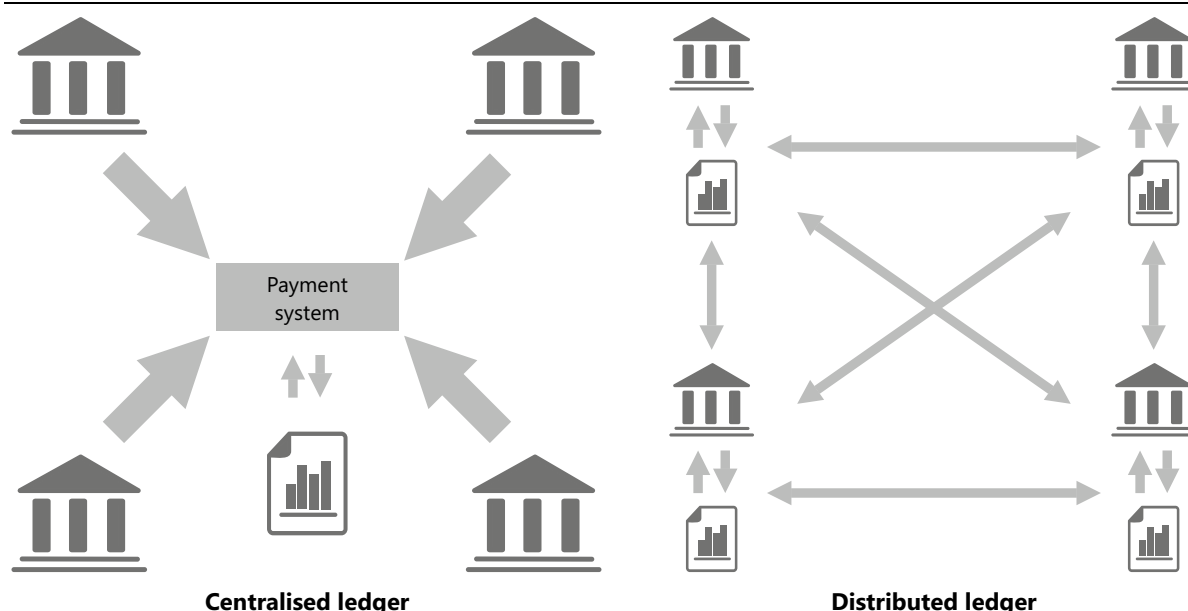
Distributed ledger technology (DLT) refers to the protocols and supporting infrastructure that allow computers in different locations to propose and validate transactions and update records in a synchronised way across a network. The idea of a distributed ledger – a common record of activity that is shared across computers in different locations – is not new. Such ledgers are used by organisations (eg supermarket chains) that have branches or offices across a given country or across countries. However, in a traditional distributed database, a system administrator typically performs the key functions that are necessary to maintain consistency across the *multiple copies* of the ledger. The simplest way to do this is for the system administrator to maintain a master copy of the ledger which is periodically updated and shared with all network participants.

By contrast, the new systems based on DLT, most notably Bitcoin and Ethereum, are designed to function without a trusted authority. Bitcoin maintains a distributed database in a decentralised way by using a consensus-based validation procedure and cryptographic signatures. In such systems, transactions are conducted in a peer-to-peer fashion and broadcast to the entire set of participants who work to validate them in batches known as “blocks”. Since the ledger of activity is organised into separate but connected blocks, this type of DLT is often referred to as “blockchain technology”.

The blockchain version of DLT has successfully powered Bitcoin for several years. However, the system is not without drawbacks: it is costly to operate (preventing double-spending without the use of a trusted authority requires transaction validators (miners) to employ large amounts of computing power to complete “proof-of-work” computations);② there is only probabilistic finality of settlement; and all transactions are public. These features are not suitable for many financial market applications. Current wholesale DLT payment applications have therefore abandoned the standard blockchain technology in favour of protocols that modify the consensus process in order to allow enhanced confidentiality and scalability. Examples of protocols currently being tested by central banks include Corda and Hyperledger Fabric. Corda replaces blockchain with a “notary” architecture. The notary design utilises a trusted authority and allows consensus to be reached on an individual transaction basis, rather than in blocks, with limited information-sharing.

Distributed ledger system

Graph A

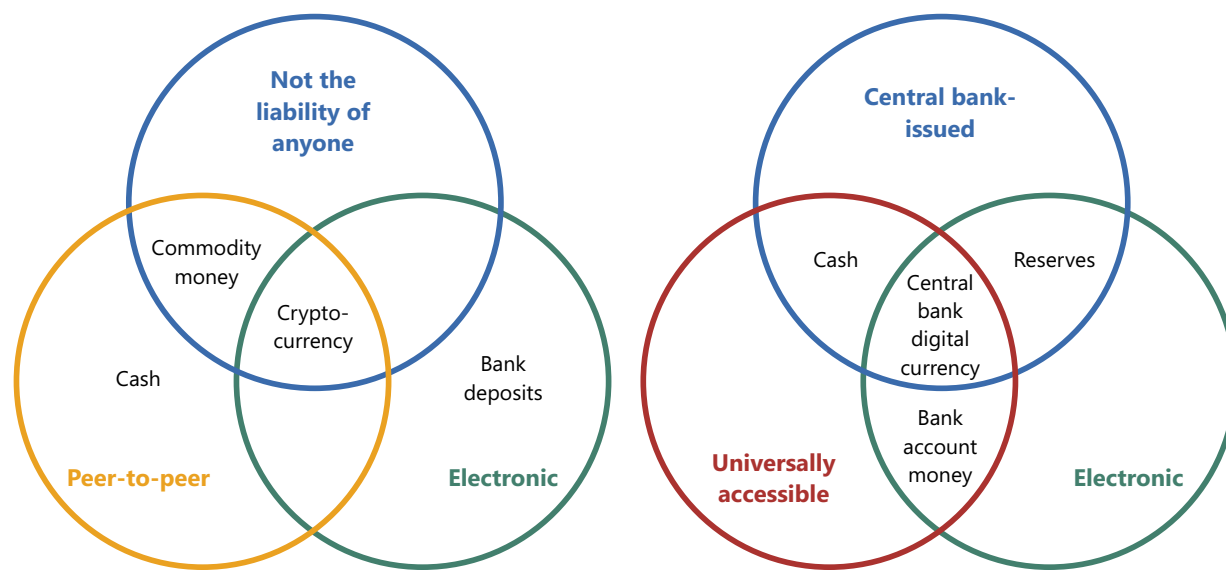


Source: Santander InnoVentures (2015).

① See also Chapman et al (2017), CPMI (2015) and Benos et al (2017). ② The amount of energy currently being used by Bitcoin miners is equal to the energy consumption of Lebanon and Cuba (see <http://digiconomist.net/bitcoin-energy-consumption>). For a detailed description of proof-of-work, see https://en.bitcoin.it/wiki/Proof_of_work.

Cryptocurrency, CPMI (2015)

Central bank digital currency, Bjerg (2017)



We combine the properties discussed in CPMI (2015) and Bjerg (2017) to establish a new taxonomy of money. Our properties are: *issuer* (central bank or other); *form* (electronic or physical); *accessibility* (universal or limited); and *transfer mechanism* (centralised or decentralised, ie peer-to-peer). This taxonomy reflects what appears to be emerging in practice and distinguishes between two potential types of CBCC, both of which are electronic: central bank-issued and peer-to-peer. One is accessible to the general public (retail CBCC) and the other is available only to financial institutions (wholesale CBCC). Again, a Venn diagram is useful for illustration.⁸ The four-ellipse version in Graph 3, which we call the *money flower*, shows how the two potential types of CBCC fit into the overall monetary landscape.

In principle, there are four different kinds of electronic central bank money: two kinds of CBCCs (the shaded area) and two kinds of central bank deposits. The most familiar forms of central bank deposits are those held by commercial banks – often referred to as settlement accounts or reserves. The other form is, at least in theory, deposits held by the general public. Tobin (1987) refers to this form as *deposited currency accounts* (DCAs).⁹ So far, central banks have generally chosen not to provide DCAs.

Universally accessible forms of money that are not issued by the central bank include (privately created) cryptocurrency, commodity money, commercial bank

⁸ A four-circle Venn diagram covers only 14 of the $2^4 = 16$ possible combinations. Hence, in the case of four sets, Venn (1881) suggested using ellipses in order to show all cases.

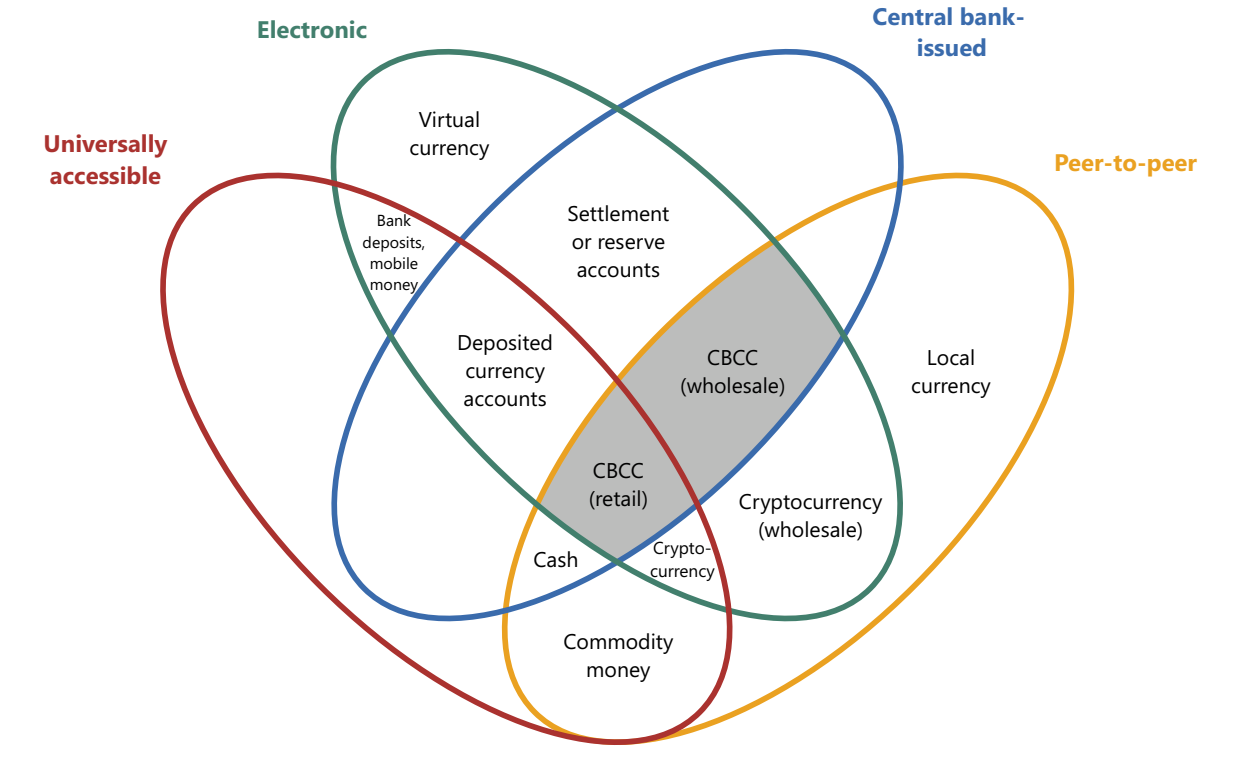
⁹ In a 1987 speech, Nobel laureate James Tobin argued that, in order to avoid relying too heavily on deposit insurance to protect the payment system, central banks should “make available to the public a medium with the convenience of deposits and the safety of currency, essentially currency on deposit, transferable in any amount by check or other order” (Tobin (1987, p 6); see also Tobin (1985)). That is, people should be able to store value without being subject to the risk of bank failure.

deposits and mobile money.¹⁰ Cryptocurrency borders CBCC given that only one of its properties differs. The other three currency forms are more removed because they are, in addition, either physical or “not peer-to-peer”. A number of other forms of money are not universally accessible. Local (physical) currencies, ie currencies that can be spent in a particular geographical location at participating organisations, populate the right-hand petal of the flower. The upper left-hand petal contains virtual currencies, which are “electronic money issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community” (ECB (2012)). There is also the possibility of a private sector wholesale version of cryptocurrency. It would be transferred in a peer-to-peer fashion by means of a distributed ledger, but only between certain financial institutions.

Box B uses this taxonomy to classify different examples of money from the past, present and future according to where they would fit in the money flower. The remainder of this feature discusses the two types of CBCC in further detail and highlights some of the many issues central banks will need to consider if they ever chose to adopt them. We start with the retail variant and then turn to the wholesale one.

The money flower: a taxonomy of money

Graph 3



¹⁰ Mobile money is an electronic wallet service that allows users to store, send and receive money using their mobile phones. The value stored in the wallets may be liabilities of the service provider or claims on money held in trust at a commercial bank.

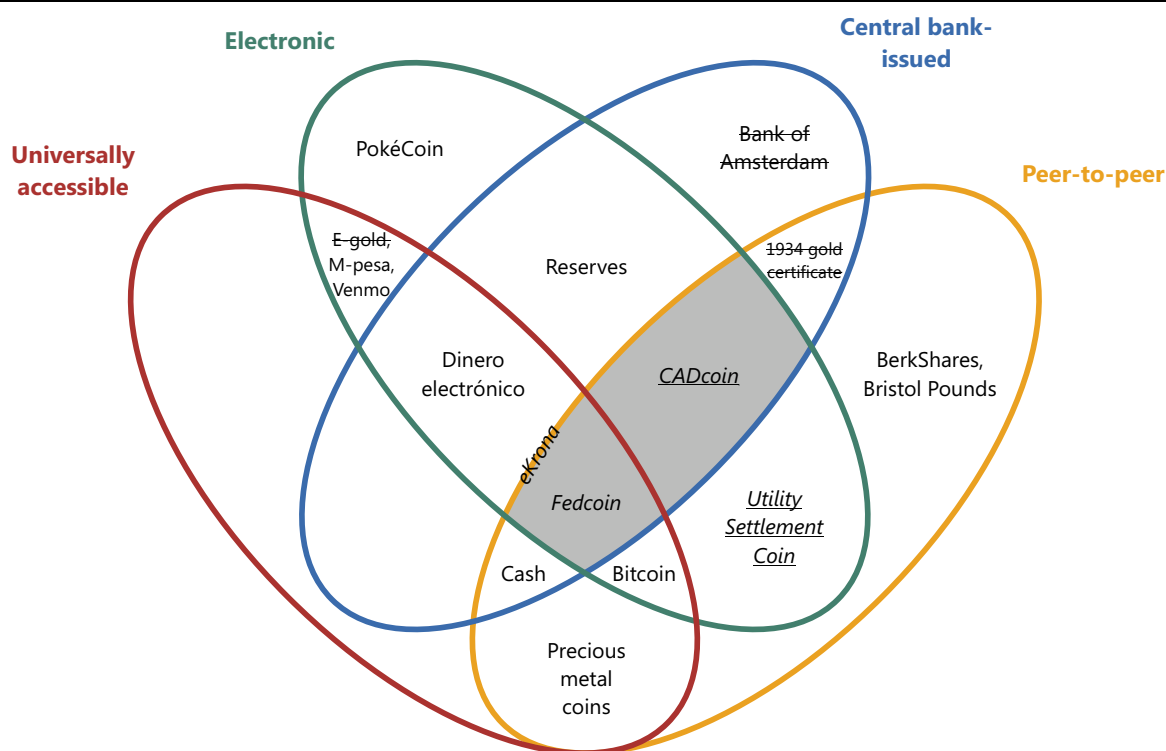
The money flower with selected examples

Graph B fills out the money flower with examples of money from the past, present and possibly the future. Starting at the centre, we have **Fedcoin**, as an example of a retail CBCC. The concept, which was proposed by Koning (2014) and has not been endorsed by the Federal Reserve, is for the central bank to create its own cryptocurrency. The currency could be converted both ways at par with the US dollar and conversion would be managed by the Federal Reserve Banks.^① Instead of having a predetermined supply rule, as is the case with Bitcoin, the supply of Fedcoin would, much like cash, increase or decrease depending on the desire of consumers to hold it. Fedcoin would become a third component of the monetary base, alongside cash and reserves. Unlike Bitcoin, Fedcoin would not represent a competing, private “outside money” but would instead be an alternative form of sovereign currency (Garratt and Wallace (2016)).

CADcoin is an example of a wholesale CBCC. It is the original name for digital assets representing central bank money used in the Bank of Canada’s proof of concept for a DLT-based wholesale payment system. CADcoin has been used in simulations performed by the Bank of Canada in cooperation with Payments Canada, R3 (a fintech firm), and several Canadian banks but has not been put into practice.

The money flower: example

Graph B



A standard font indicates that a system is in operation; an *italic* font indicates a proposal; an *italic and underlined* font indicates experimentation; a ~~font~~ font indicates a defunct company or an abandoned project.

In Sweden, the demand for cash has dropped considerably over the past decade (Skingsley (2016)). Already, many stores do not accept cash and some bank branches no longer disburse or collect cash. In response, the Riksbank has embarked on a project to determine the viability of an **eKrona** for retail payments. No decision has yet been taken in terms of technology (Sveriges Riksbank (2017)). Hence, the eKrona is located on the border between deposited currency accounts and retail CBCCs.

Dinero electrónico is a mobile payment service in Ecuador where the central bank provides the underlying accounts to the public. Citizens can open an account by downloading an app, registering their national identity number and answering security questions. People deposit or withdraw money by going to designated transaction centres. As such, it is a (rare) example of a deposited currency account scheme. As Ecuador uses the US dollar as its official currency, accounts are denominated in that currency.

Bitcoin is an example of a non-central bank digital currency. It was invented by an unknown programmer who used the pseudonym Satoshi Nakamoto and was released as open-source software in 2009 along with a white paper describing the technical aspects of its design (see Box A for further details).

PokéCoin is a currency used for in-game purchases in the Pokémon Go game and an example of a virtual currency.

Utility Settlement Coin (USC) is an attempt by the private sector to provide a wholesale cryptocurrency. It is a concept proposed by a collection of large private banks and a fintech firm for a series of digital tokens representing money from multiple countries that can be exchanged on a distributed ledger platform (UBS (2016)). The value of each country's USC on the distributed ledger would be backed by an equivalent value of domestic currency held in a segregated (reserve) account at the central bank.

The **Bank of Amsterdam** (the Amsterdamse Wisselbank) was established in 1609 by the City of Amsterdam to facilitate trade. It is often seen as a precursor to central banks. A problem at the time was that currency, ie coins, was being eroded, clipped or otherwise degraded. The bank took deposits of both foreign and local coinage at their real intrinsic value after charging a small coinage and management fee. These deposits were known as bank money. The Wisselbank introduced a book-entry system that enabled customers to settle payments with other account holders. The Dutch central bank was established in 1814 and the Bank of Amsterdam was closed in 1820 (Smith (1776), Quinn and Roberds (2014)).

The **1934 series gold certificate** was a \$100,000 paper note issued by the US Treasury and used only for official transactions between Federal Reserve Banks. This was the highest US dollar-denominated note ever issued and did not circulate among the general public. It is an example of non-electronic, restricted-use, government-backed, peer-to-peer money.

Examples of privately issued local currencies include the **Bristol Pound** and **BerkShares**, located in the right-hand petal. Stores in Bristol, United Kingdom, give a discount to people using Bristol Pounds, whereas BerkShares are purchased at 95 cents on the dollar and are accepted at retail stores in the Berkshires region of Massachusetts at face value.

Precious metal coins are examples of commodity money. They can be used as an input in production or for consumption and also as a medium of exchange. This is in contrast to fiat money, which has no intrinsic use. Although commodity money is largely a thing of the past, it was the predominant medium of exchange for more than two millennia.

E-gold account holders used commercial bank money to purchase a share of the holding company's stock of gold and used mobile phone text messages to transfer quantities of gold to other customers. Payments between e-gold customers were "on-us" transactions that simply involved updating customer accounts. E-gold ultimately failed. But before it shut down in 2009, it had accumulated over 5 million account holders.^② Many current private mobile payment platforms, such as **Venmo** (a digital wallet with social media features popular with US college students) and **M-pesa**[™] (a popular mobile money platform in Kenya and other East African countries), employ a similar "on-us" model. Users transfer either bank deposits or cash to the operator, who gives them mobile credits. These credits can be transferred between platform participants using their mobile devices or redeemed from the operator for cash or deposits. The daily number of M-pesa transactions dwarfs those conducted using Bitcoin. However, in terms of value, worldwide Bitcoin transfers have recently overtaken those conducted on the M-pesa platform (Graph 1, right-hand panel).

① Straightforward arguments derived from Friedman (1959) and Klein (1974) suggest that if the Federal Reserve were to maintain one-to-one convertibility with Fedcoin, it would also need to control the supply of Fedcoins. ② The company ran into trouble with the authorities over anti-money laundering violations and for operating a money transmitter business without the necessary state licence; see <http://legalupdate.e-gold.com/2008/07/plea-agreement-as-to-douglas-l-jackson-20080721.html>. E-gold account statistics can be found at <http://scbbs.net/craigs/stats.html>.

Retail central bank cryptocurrencies

Retail CBCCs do not exist anywhere. However, the concept of a retail CBCC has been widely discussed by bloggers, central bankers and academics. Perhaps the most frequently discussed proposal is Fedcoin (Koning (2014, 2016), Motamedi (2014)).¹¹ As discussed in Box B, the idea is for the Federal Reserve to create a cryptocurrency that is similar to bitcoin. However, unlike with bitcoin, only the Federal Reserve would be able to create Fedcoins and there would be one-for-one convertibility with cash and reserves. Fedcoins would only be created (destroyed) if an equivalent amount of cash or reserves were destroyed (created) at the same time. Like cash, Fedcoin would be decentralised in transaction and centralised in supply. Sveriges Riksbank, with its eKrona project, appears to have gone furthest in thinking about the potential issuance of a retail CBCC (Box C).

A retail CBCC along the lines of Fedcoin would eliminate the high price volatility that is common to cryptocurrencies (Graph 1, centre panel).¹² Moreover, as Koning (2014) notes, Fedcoin has the potential to relieve the zero lower bound constraint on monetary policy. As with other electronic forms of central bank money, it is technically possible to pay interest on a DLT-based CBCC. If a retail CBCC were to completely replace cash, it would no longer be possible for depositors to avoid negative interest rates and still hold central bank money.

Any decision to implement a retail CBCC would have to balance potential benefits against potential risks. Bank runs might occur more quickly if the public were able to easily convert commercial bank money into risk-free central bank liabilities (Tolle (2016)). There could also be risks to the business models of commercial banks. Banks might be disintermediated, and hence less able to perform essential economic functions, such as monitoring borrowers, if consumers decided to forgo commercial bank deposits in favour of retail CBCCs. These benefits and costs are, however, not unique to retail CBCCs. They are the same for DCAs. What, then, is the key difference between retail CBCCs and DCAs? The answer lies with the peer-to-peer aspect of CBCCs and, more specifically, with anonymity.

Anonymity

Bitcoin was designed to be a “peer-to-peer version of electronic cash” (Nakamoto (2009, p 1), and this allows transactions to be anonymous. All bitcoin transactions are publicly recorded using the payer’s and the payee’s public addresses.¹³ However, very much like e-mail addresses, bitcoin public addresses do not need to reveal the true identity of users.¹⁴ This means that a person sending bitcoin to a public address

¹¹ The Federal Reserve has not endorsed or officially commented on the proposal.

¹² See Yermack (2015), Bolt and van Oordt (2016) and Garratt and Wallace (2016) for discussions relating to digital currencies and price volatility.

¹³ Luther and Olson (2015) argue that bitcoin is a practical application of what is termed “memory” in the monetary economics literature. Kocherlakota (1998) shows that both money and memory are devices capable of facilitating exchange. Memory can, however, implement more allocations than money, so that money can be viewed as a form of memory but not the other way around.

¹⁴ See Nakamoto (2009, Section 10).

The case of Sweden

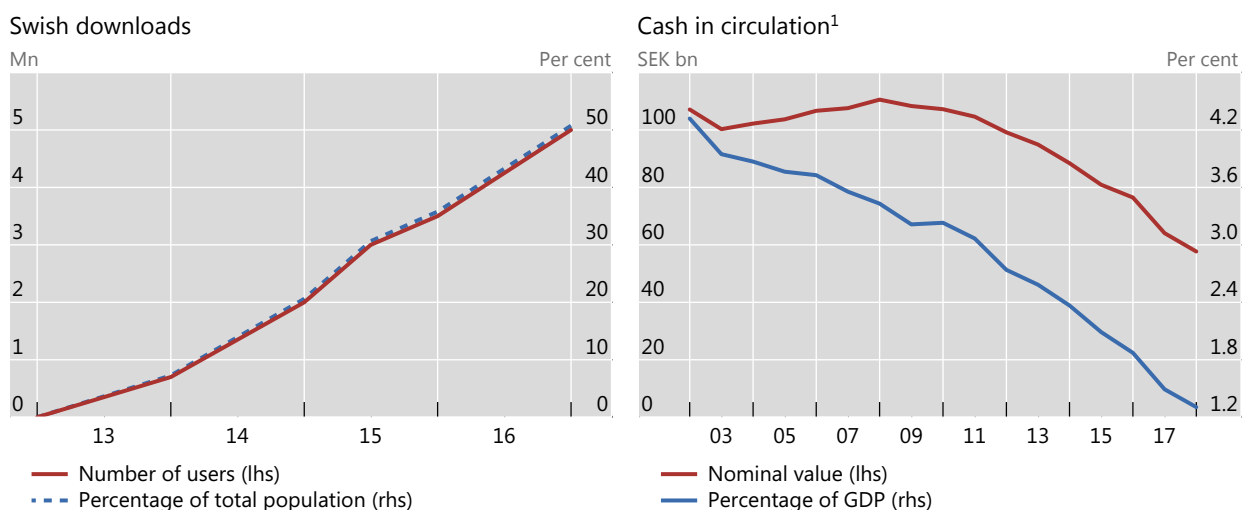
Sweden has one of the highest adoption rates of modern information and communication technologies in the world. It also has a highly efficient retail payment system. At the end of 2016, more than 5 million Swedes (over 50% of the population) had installed the Swish mobile phone app, which allows people to transfer commercial bank money with immediate effect (day or night) using their handheld device (Graph C, left-hand panel; see also Bech et al (2017)).

The demand for cash is dropping rapidly in Sweden (Graph C, right-hand panel). Already, many stores no longer accept cash and some bank branches no longer disburse or collect cash. These developments are a cause for concern for the Riksbank (Skingsley (2016)). Will the payment system continue to be safe and efficient without cash? Even if cash is not used every day, it is a backup option in crisis situations. Will those without access to bank services still be able to manage their payments?

The Riksbank currently has a so-called eKrona project under way to determine whether it should supply digital central bank money to the general public. The project is considering different technical solutions, but no decision has been taken as to whether to focus on a DCA or a retail CBCC structure. The project is expected to be finalised in late 2019 (Sveriges Riksbank (2017)).

Sweden

Graph C



¹ Measured as an annual average.

Sources: IMF, *International Financial Statistics*; United Nations, *World Population Prospects*; www.getswish.se; national data; authors' calculations.

need not reveal his/her true identity to the recipient (*counterparty anonymity*) or to other members of the Bitcoin community (one form of *third-party anonymity*).¹⁵

Kahn et al (2005) and McAndrews (2017) emphasise legitimate reasons for counterparty anonymity in transactions. Payees and payers may want to reduce the risk of identity theft, the possibility that the counterparty might follow them home and rob them, or more innocuous annoyances like directed advertising and solicitations (spamming). Similarly, a lack of third-party anonymity may be regarded as revealing too much information about a person's private activities. In his proposal

¹⁵ Third-party anonymity means that a person's true identity is not revealed to anyone not directly involved in a transaction. In more general applications, this would include a system operator.

for *Digicash*, David Chaum (1983) makes this argument by pointing out that “knowledge by a third party of the payee, amount, and time of payment for every transaction made by an individual can reveal a great deal about the individual’s whereabouts, associations and lifestyle”.¹⁶

Counterparty anonymity seems less controversial than third-party anonymity. Many observers have argued that third-party anonymity in payments should not be allowed because it facilitates criminal activity, such as tax evasion, terrorist financing or money laundering. Rogoff (2016) argues that \$100 bills should be removed from circulation for the same reasons.

It is unclear how much consumers actually value anonymity of either sort in order to protect their privacy. Athey et al (2017) look at how much effort people make to protect their privacy in relation to digital currencies. In an experimental setting, they find that subjects, in general, do not devote the small amount of time needed to read through the e-wallet description that is necessary to meet their own stated preferences for privacy. Similar findings emerged from a survey of economics students at the University of California, Santa Barbara, on usage of Venmo (a digital wallet with social media features). Of the 669 respondents, 80% were users. Of these users, 44% allowed their Venmo transactions to be public (visible to everyone on the internet) and another 21% allowed all of their Facebook friends to see their transactions. Finally, while *Digicash* is regarded as a precursor to bitcoin, there may not have been sufficiently high demand for the third-party anonymity it provided as it was never widely adopted. It filed for bankruptcy in 1998.¹⁷

The technology behind CBCCs could allow central banks to provide a digital cash substitute with anonymity properties similar to those of cash. In its role as issuer, the central bank would need to decide whether or not to require customer information (the true identity behind the public address). This would determine the extent to which the retail CBCC would provide third-party anonymity.

While it may look odd for a central bank to issue a cryptocurrency that provides anonymity, this is precisely what it does with physical currency, ie cash. Perhaps a key difference is that, with a retail CBCC, the provision of anonymity becomes a conscious decision. It is worth recalling that the anonymity properties of cash are likely to have emerged out of convenience or historical happenstance rather than intent.

¹⁶ *Digicash* was launched in the 1990s as a means of transferring bank deposits from one customer to another without revealing the payer’s identity to his/her bank (ie it provided third-party anonymity). It did this by using cryptographic techniques to create a pool of untraceable *Digicash* from customer deposits. *Digicash* is interesting in that it provided third-party anonymity without requiring autonomy from commercial banks. Commercial banks still held and transferred the deposits held by customers using the *Digicash* scheme.

¹⁷ One potential reason for its lack of success is that it did not provide autonomy from a central authority. Nick Szabo’s proposal for “bit gold” offers an autonomous version of e-gold that uses proof-of-work chains. Bit gold represents a big step in the evolution of digital cash towards bitcoin (<https://unenumerated.blogspot.ch/2005/12/bit-gold.html>).

Wholesale central bank cryptocurrencies

While CBCCs for retail payments remain at the conceptual stage, some central banks have completed proofs of concept for DLT-based applications.¹⁸ One of the reasons for the interest in DLT is that many central bank-operated wholesale payment systems are at the end of their technological life cycles. The systems are programmed in obsolete languages or use database designs that are no longer fit for purpose and are costly to maintain.

Projects Jasper and Ubin

Project Jasper at the Bank of Canada (Chapman et al (2017)) and Project Ubin at the Monetary Authority of Singapore (MAS (2017)) simulate real-time gross settlement (RTGS) systems on a DLT platform. In an RTGS system, payments are processed individually, immediately and with finality throughout the day (CPSS (1997)).

Unlike the retail payment applications discussed above, wholesale systems have restricted access, ie they are permissioned rather than permission-less. Usually, access is restricted to financial institutions. Moreover, the costly proof-of-work validation (Box A) needed to prevent double-spending in retail schemes is replaced by less energy-consuming alternatives, such as a trusted notary (eg the central bank).

A key challenge in any CBCC application is how to transfer central bank money to the distributed ledger.¹⁹ Both Jasper and Ubin chose a digital depository receipt (DDR) approach. A DDR is a claim on central bank reserves held in a segregated account against which the central bank issues digital tokens on the distributed ledger. In Jasper, the digital tokens – initially known as *CADcoins*²⁰ – are created at the beginning of the day and redeemed at the end. In Ubin, banks acquire or redeem digital tokens at any point during the day and can keep them on the distributed ledger overnight. Hence, transfers on the DLT platform of the Singaporean proof of concept are not restricted to the opening hours of MAS.

Project Jasper also implements a liquidity-saving mechanism (LSM) on the DLT platform. While RTGS systems minimise settlement risk, they can be demanding in terms of liquidity. Consequently, many RTGS systems around the world are augmented by mechanisms that periodically seek to offset payments against each other in a queue and settle only the net amounts (Bech and Soramäki (2001)). Distributed ledgers are decentralised, so implementation of a centralised queue requires a clever work-around (Project Jasper (2017)).

The two projects show that central bank money can be transferred on a distributed ledger in real time, in realistic volumes and with an LSM. Nevertheless, none of the current initiatives to update or replace existing wholesale payment systems are considering the adoption of DLT. Both the Bank of England (2017) and Bank of Canada (Ho (2017)) conclude that DLT is not yet mature enough for current

¹⁸ Central banks have not limited themselves to wholesale payment applications of DLT. The Hong Kong Monetary Authority (HKMA) has developed proofs of concept for trade finance and mortgage loan applications in collaboration with industry participants (HKMA (2016)). The Bank of France has developed a DLT version of its Single European Payments Area (SEPA) Creditor Identifier database (Bank of France (2016)).

¹⁹ The CPMI-IOSCO Principles for Financial Markets Infrastructures hold that settlement should occur in central bank money whenever practical and available.

²⁰ See Garratt (2016).

adoption. Yet most central banks that are considering modernising their core payment infrastructure stress the need to make new systems inter-operable with future DLT platforms.

Securities settlement

Looking beyond the immediate horizon, many industry participants see significant potential for DLT to increase efficiency and reduce reconciliation costs in securities clearing and settlement.²¹ One potential benefit of DLT-based structures is immediate clearing and settlement of securities, in contrast to the multiple-day lags that currently exist when exchanging cash for securities (and vice versa).²² Progress in this direction was recently achieved by a joint venture between the Deutsche Bundesbank and Deutsche Börse, which developed a functional prototype of a DLT-based securities settlement platform that achieves delivery-versus-payment settlement of digital coins and securities (Deutsche Bundesbank (2016)).

Conclusion

As it stands, cash is the only means by which the public can hold central bank money. If someone wishes to digitise that holding, he/she has to convert the central bank liability into a commercial bank liability by depositing the cash in a bank. A CBCC would allow consumers to hold central bank liabilities in digital form.²³ But this would also be possible if the public were allowed to have central bank accounts, an idea that has been around for a long time.²⁴ We argue that the main benefit that a consumer-facing retail CBCC would offer, over the provision of public access to (centralised) central bank accounts, is that the former would have the potential to provide the anonymity of cash. In particular, peer-to-peer transfers allow anonymity vis-à-vis any third party. If third-party anonymity is not of sufficient importance to the public, then many of the alleged benefits of retail CBCCs can be achieved by giving broad access to accounts at the central bank.

Whether or not a central bank should provide a digital alternative to cash is most pressing in countries, such as Sweden, where cash usage is rapidly declining. But all central banks may eventually have to decide whether issuing retail or wholesale CBCCs makes sense in their own context. In making this decision, central banks will have to consider not only consumer preferences for privacy and possible efficiency gains – in terms of payments, clearing and settlement – but also the risks it may entail for the financial system and the wider economy, as well as any implications for monetary policy (Bordo and Levin (2017)). Some of the risks are currently hard to assess. For instance, at present very little can be said about the cyber-resilience of CBCCs, something not touched upon in this short feature.

²¹ Mainelle and Milne (2016) estimate that synchronised share databases can reduce back office costs by up to 50%. A study led by Santander InnoVentures (2015) estimates that \$15–20 billion could be saved annually in the broader banking industry.

²² Through the use of smart contracts, the technology also allows for the settlement time/date of a transaction to be specified by the relevant parties.

²³ One simple reason why a consumer might want to do this is to avoid the credit risk associated with commercial bank liabilities.

²⁴ Who should and should not have access to central bank money is a recurring policy issue. See CPSS (2003), CGFS (2015) and Bank of England (2017) for more detailed discussions.

References

Andolfatto, D (2015): "Fedcoin: on the desirability of a government cryptocurrency", *MacroMania*, blogpost, 3 February.

——— (2016): "Is bitcoin a safe asset?", *MacroMania*, blogpost, 27 March.

Athey, S, C Catalini and C Tucker (2017): "The digital privacy paradox: small money, small costs, small talk", Stanford University Graduate School of Business, *Research Papers*, no 17–24.

Bank of Canada (forthcoming): "White paper on Project Jasper".

Bank of England (2017): "Bank of England extends direct access to RTGS accounts to non-bank payment service providers", press release, 19 July.

Bank of France (2016): "La Banque de France mène une expérimentation de 'blockchain' interbancaire", press release, 15 December.

Bech, M, Y Shimizu and P Wong (2017): "The quest for speed in payments", *BIS Quarterly Review*, March, pp 57–68.

Bech, M and K Soramäki (2001): "Gridlock resolution in payment systems", Danmarks Nationalbank, *Monetary Review*, December.

Benos, E, R Garratt and P Gurrola-Perez (2017): "The economics of distributed ledger technology for securities settlement", Bank of England, *Staff Working Papers*, no 670, August.

Bjerg, O (2017): "Designing new money – the policy trilemma of central bank digital currency", *Copenhagen Business School (CBS) Working Paper*, June.

Bolt, W and M van Oordt (2016): "On the value of virtual currencies", Bank of Canada, *Staff Working Papers*, no 42, August.

Bordo, M and A Levin (2017): "Central bank digital currency and the future of monetary policy", *NBER Working Papers*, no 23711, August.

Broadbent, B (2016): "Central banks and digital currencies", speech at the London School of Economics, 2 March.

Chapman, J, R Garratt, S Hendry, A McCormack and W McMahon (2017): "Project Jasper: are distributed wholesale payment systems feasible yet?", Bank of Canada, *Financial System Review*, June, pp 1–11.

Chaum, D (1983): "Blind signatures for untraceable payments", *Advances in Cryptology*, proceedings of Crypto '82, pp 199–203.

Committee on the Global Financial System (2015): "Central bank operating frameworks and collateral markets", *CGFS Papers*, no 53, March.

Committee on Payment and Settlement Systems (1997): *Real-time gross settlement systems*, March.

——— (2003): *The role of central bank money in payment systems*, August.

Committee on Payments and Market Infrastructures (2015): *Digital currencies*, November.

Deutsche Bundesbank (2016): "Joint Deutsche Bundesbank and Deutsche Börse blockchain prototype", press release, 28 November.

- European Central Bank (2012): *Virtual currency schemes*, October.
- Friedman, M (1959): "The demand for money: some theoretical and empirical results", *The Journal of Political Economy*, vol 67, no 4, pp 327–51.
- Garratt, R (2016): "CAD-coin versus Fedcoin", *R3 Report*, 15 November.
- Garratt, R and N Wallace (2016): "Bitcoin 1, bitcoin 2, ... : an experiment in privately issued outside monies", University of California, Santa Barbara, Department of Economics, *Departmental Working Paper*, October.
- Ho, S (2017): "Canadian trial finds blockchain not ready for bank settlements", *Reuters Business News*, 25 May.
- Hong Kong Monetary Authority (2016): *Whitepaper on distributed ledger technology*, 11 November.
- Kahn, C, J McAndrews and W Roberds (2005): "Money is privacy", *International Economic Review*, vol 46, no 2, pp 377–99.
- Klein, B (1974): "The competitive supply of money", *Journal of Money, Credit and Banking*, vol 6, no 4, pp 423–53.
- Kocherlakota, N (1998): "Money is memory", *Journal of Economic Theory*, vol 81, no 2, pp 232–51.
- Koning, J (2014): "Fedcoin", *Moneyiness*, blogpost, 19 October.
- (2016): "Fedcoin: a central bank issued cryptocurrency", *R3 Report*, 15 November.
- Luther, W and J Olson (2015): "Bitcoin is memory", *The Journal of Prices & Markets*, vol 3, no 3, pp 22–33.
- Mainelle, M and A Milne (2016): "The impact and potential of blockchain on the securities transaction lifecycle", *SWIFT Institute Working Papers*, no 7.
- McAndrews, J (2017): "The case for cash", *Asian Development Bank Institute Working Paper Series*, no 679.
- Monetary Authority of Singapore (2017): *The future is here – Project Ubin: SGD on distributed ledger*.
- Motamedi, S (2014): "Will bitcoins ever become money? A path to decentralised central banking", *Tannu Tuva Initiative*, blogpost.
- Nakamoto, S (2009): "Bitcoin: a peer-to-peer electronic cash system".
- Project Jasper (2017): "A Canadian experiment with distributed ledger technology for domestic interbank payments settlement", white paper prepared by Payments Canada, R3 and the Bank of Canada.
- Quinn, S and W Roberds (2014): "How Amsterdam got fiat money", *Journal of Monetary Economics*, vol 66, September, pp 1–12.
- Raskin, M and D Yermack (2016): "Digital currencies, decentralized ledgers and the future of central banking", *NBER Working Papers*, no 22238, May.
- Rogoff, K (2016): *The curse of cash*, Princeton University Press.
- Santander InnoVentures (2015): *The Fintech 2.0 Paper: rebooting financial services*.
- Skingsley, C (2016): "Should the Riksbank issue e-krona?", speech at FinTech Stockholm 2016, 16 November.

Smith, A (1776): *An inquiry into the nature and causes of the wealth of nations*, W Strahan and T Cadell, London.

Sveriges Riksbank (2017): *Project plan for the eKrona*, 14 March.

Tobin, J (1985): "Financial innovation and deregulation in perspective", *Bank of Japan Monetary and Economic Studies*, vol 3, no 2, pp 19–29.

——— (1987): "The case for preserving regulatory distinctions", in *Proceedings of the Economic Policy Symposium*, Jackson Hole, Federal Reserve Bank of Kansas City, pp 167–83.

Tolle, M (2016): "Central bank digital currency: the end of monetary policy as we know it?", *Bank Underground*, blogpost, 25 July.

UBS (2016): "Utility settlement coin concept on blockchain gathers pace", press release, 24 August.

Venn, J (1881): *Symbolic logic*, MacMillan and Co, London.

Yermack, D (2015): "Is bitcoin a real currency?", in D Lee (ed), *The Handbook of Digital Currency*, Elsevier, pp 31–44.

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What are the effects of macroprudential policies on macroeconomic performance?¹

Macroprudential policies are designed to make financial crises less likely or less severe. At the same time, they might also curb output growth by affecting credit supply and investment. Using data for a panel of 64 advanced and emerging market economies, this special feature investigates empirically the effects of macroprudential policies on long-run economic performance. We find that countries that more frequently use macroprudential tools, other things being equal, experience stronger and less volatile GDP growth. These effects are influenced by each economy's openness and financial development. Finally, we find that non-systematic macroprudential interventions tend to be detrimental to growth.

JEL classification: G10, G21, O16, O40.

Long before the term even existed, macroprudential policies were used to address financial stability concerns, particularly among emerging market economies (EMEs). Their popularity has greatly increased in recent years, especially during and after the Great Financial Crisis (GFC) of 2007–09. Yet our understanding of these policies, and their effects on macroeconomic performance, is still open to debate. For example, while the use of macroprudential policies is typically motivated by the need to contain systemic risk and thus contribute to macroeconomic stability (IMF-FSB-BIS (2011, 2016), Galati and Moessner (2017)), it has also been suggested that these policies could harm economic activity (Sánchez and Röhn (2016)).²

Macroprudential interventions should be judged primarily on whether they reduce the occurrence of financial crises, their ultimate goal. Alas, measuring this capability remains an elusive task, given the relative infrequency of crises, and the difficulty of precisely attributing them to fundamental factors. One possible way of assessing the effectiveness of macroprudential policies is to evaluate their impact on economic growth and its volatility over the long term. These two measures of effectiveness are closely linked to economic well-being, and could thus be seen as a

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² See also Fender and Lewrick (2016) for a cost-benefit analysis of Basel III reforms.

desirable by-product of properly conducted macroprudential policies. Furthermore, from an ex post perspective, financial crises would entail higher macroeconomic volatility. In other words, “[a] resilient economy absorbs exogenous shocks and recovers quickly” (BIS (2016)). Any assessment of macroprudential policies from this perspective should consider the potential of an intertemporal trade-off between growth and volatility. But, despite the growing body of research on the effectiveness of macroprudential policies on bank risk and lending,³ the econometric evidence for their impact on long-run growth is still limited.

Using data for a panel of 64 advanced and emerging market economies, this special feature investigates empirically the link between macroprudential policies and economic performance as measured by output volatility and growth over a five-year period. We find, first, that the more a country uses macroprudential policies, the higher is the growth rate of its per capita GDP and the less volatile its GDP growth, ie we find no evidence of a trade-off. Second, the beneficial effects of macroprudential policies on output growth and volatility are found to depend on the economy’s degree of openness and financial development. For economies that are either very open or very financially developed (but not both), macroprudential policies tend to be less effective. On the other hand, with a sufficiently high degree of development and openness, macroprudential measures gain in effectiveness. The composition of the market for financial intermediation and the degree of foreign competition could play a role in generating these results (eg Cerutti et al (2017a)). Finally, we find that the non-systematic part of macroprudential interventions – that is, the part not explained by fundamentals – appears to hamper growth.

The rest of the article consists of five sections. The first presents the main channels through which macroprudential policies could affect output growth and volatility. The second section reviews the main characteristics of macroprudential tools and presents some stylised facts. The third section empirically tests the effects of macroprudential tools in moderating business cycle fluctuations and enhancing real output growth. The fourth estimates the role of non-systematic macroprudential policies on macroeconomic performance. The last section summarises the main results.

How can macroprudential policies affect output growth and volatility?

Macroprudential policies are typically designed to increase the financial system’s resilience, thus reducing the systemic risks arising from financial intermediation.

It could be argued that macroprudential policies may succeed in shoring up macroeconomic stability but only at the cost of excessively curbing economic activity and long-term growth. In other words, there is a trade-off between stability and sustainable prosperity. But it might also be that no such trade-off exists: that is, more stable economies could better sustain and foster economic growth. This perspective

³ Agénor and Pereira da Silva (2017) study the impact that regulatory constraints arising from macroprudential policy may have on the risk-taking incentives of financial intermediaries, and how this might lead to suboptimal levels of lending.

is especially relevant from a policy viewpoint. Which of these perspectives will emerge in the data will depend, among other things, on how stabilisation is pursued.⁴

A number of papers have explored empirically how volatility could affect growth, and how different policies shape this relationship.⁵ While earlier research found a *negative* link between volatility and growth (eg Kormendi and Meguire (1985), Ramey and Ramey (1995)), more recent evidence suggests that it is not volatility itself, but rather policy-induced volatility that appears to hamper growth (Fatás and Mihov (2012)). On the monetary policy side, for example, Aghion et al (2012) find that *countercyclical* monetary policy can increase labour productivity at the industry level. Similar evidence emerges for fiscal policy. In particular, Aghion et al (2014) find that *procyclical* fiscal policies reduce growth, while countercyclical fiscal policies appear to boost it. In other words, properly conducted fiscal policy can support growth by smoothing the business cycle. Moreover, they find that financial factors (credit constraints, competition in the financial sector etc) are key elements in the transmission channel linking fiscal policy to growth.

The analysis of the link between macroprudential policies and growth has received less attention so far. Currently, the costs and benefits of specific macroprudential tools, such as countercyclical capital buffers or dynamic provisioning for banks, are the subject of vigorous debates between policymakers, industry representatives and academics. The main focus is on the possible short-term impact on lending margins and quantities (Jiménez et al (2016), Drehmann and Gambacorta (2012)). That said, poorly designed macroprudential policies, by limiting the ability of the market to freely allocate financial resources, could in principle reduce efficiency, eventually hampering economic growth.⁶

However, macroprudential measures could also boost growth. After all, they are designed to increase the financial system's resilience and tame the financial cycle (BCBS (2010)). Moreover, macroprudential tools can mitigate the adverse effects of capital flow volatility on economic growth (Neanidis (2017)) by encouraging the build-up of buffers (IMF (2017)). We can think of at least two channels through which macroprudential policies could be conducive to higher long-term growth. First, macroprudential policies can limit (if not prevent) the occurrence of financial crises, which are typically followed by slow recoveries and long periods of low productivity. Second, to the extent that macroeconomic (and financial) volatility reduces growth (as discussed above), and to the extent that macroprudential policies reduce such volatility, macroprudential policies should be positively linked to longer-term growth.

⁴ It has been argued that low volatility for long periods of time does not necessarily mean that financial imbalances are not building up, and that this "can lull policymakers into a false sense of security" (Borio and Drehmann (2009)). For example, Borio (2011b) suggests that "after all, the seeds of the global financial crisis were sown during the Great Moderation."

⁵ One channel through which volatility could affect growth runs through investment decisions (Dixit and Pindyck (1994), Aghion et al (2010)).

⁶ Angelini et al (2014) point out that even countercyclical macroprudential policies, which dampen macroeconomic volatility by restricting banking activity in the boom phase, could have a negative impact on the steady state level of output and investment. Evaluating the effects of recent changes of regulation more generally, Elliott et al (2012) and Elliott and Santos (2016) point to the quantitatively small negative effects of Basel III regulation on GDP growth. See also MAG (2010a,b, 2011).

Some evidence on macroprudential policies

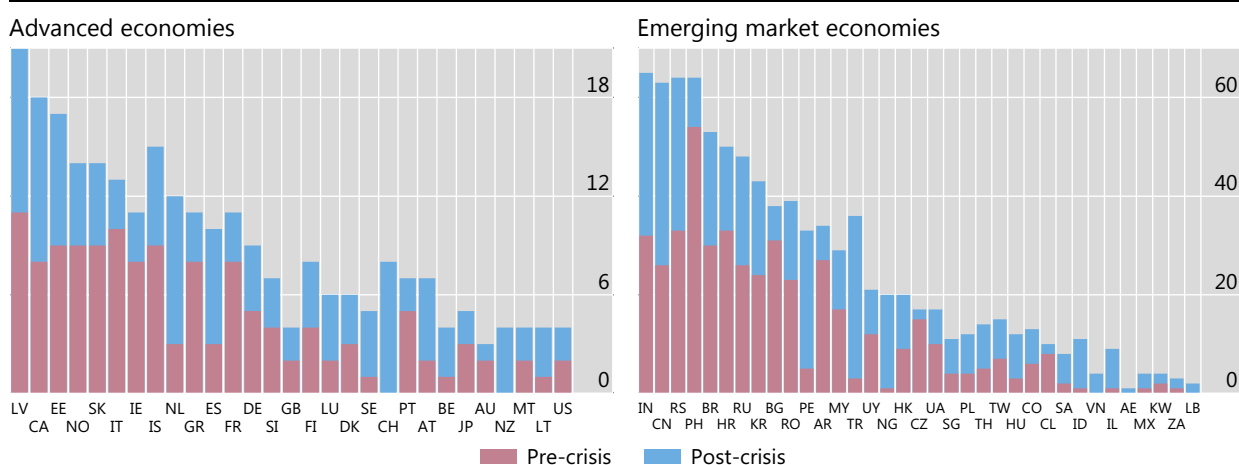
We base our analysis on the macroprudential data collected by Lim et al (2011, 2013), Kuttner and Shim (2016) and Cerutti et al (2017b), who between them counted 1,149 macroprudential policy actions adopted in 64 countries in the period 1990–2014.⁷ Graph 1 summarises these data and highlights the different degree of activism between advanced and emerging market economies (left- and right-hand panels, respectively), as well as before and after the GFC (red and blue bars, respectively). Macroprudential activism is clearly greater among EMEs across the whole sample than among advanced economies, and has increased over time across both groups.⁸ Graph 1, furthermore, provides clear evidence of a sizeable heterogeneity across countries, and also within each group, that does not appear to be simply explained by size, openness, regional or other factors, a point to which we will return at the end of this article.

The heterogeneity across countries of tools, institutional settings and experience with macroprudential policies has motivated researchers to develop a detailed characterisation of these policies.⁹ In particular, provided that financial stability can be seen as the overarching goal of macroprudential policy tools, specific measures

Policy activism varies between countries¹

Number of policy actions

Graph 1



¹ The sample covers 1,149 macroprudential policy actions adopted in 64 countries (29 AEs and 35 EMEs). The database is constructed using information in Cerutti et al (2017b), Kuttner and Shim (2016) and Lim et al (2011, 2013). Data for the pre-crisis period cover the 1990–2007 period, while the post-crisis period refers to 2008–14.

Sources: IMF; BIS; authors' calculations.

⁷ As our various macroprudential data sets cover different periods, we used Cerutti et al (2017b) only for the years 2013 and 2014. We checked the robustness of our results by considering different approaches to merging the data and by using imputation methods to merge the data for the years 2013 and 2014. The virtually identical results are available upon request from the authors.

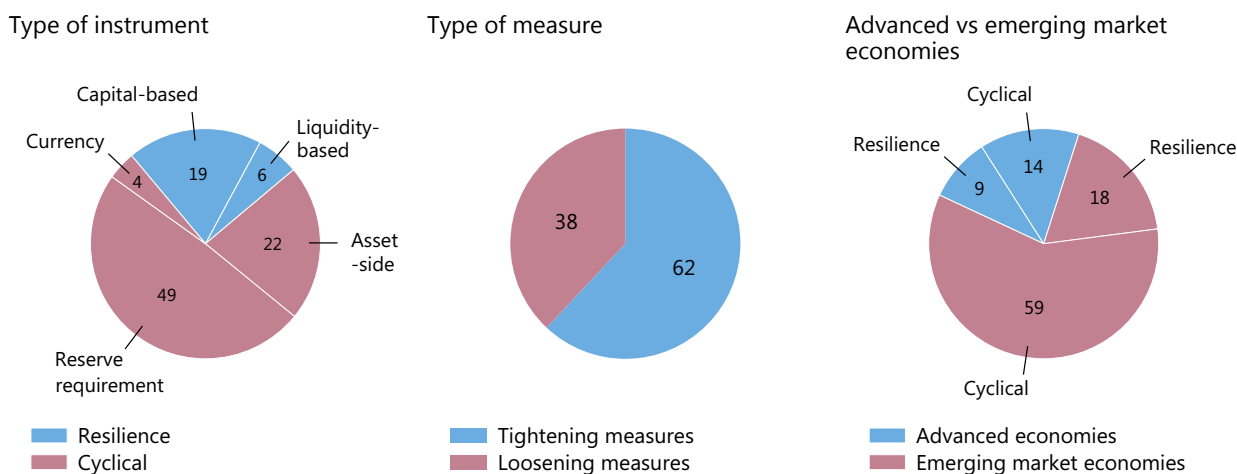
⁸ Activism across EMEs displays a marked upward trend, which might have reached its peak around the time of the GFC. See Altunbas et al (2017) for a more detailed description.

⁹ See Demirgüç-Kunt et al (2013) for an overview. In response to the paucity of macroprudential data, the G20 in 2009 promoted the Data Gaps Initiative (IMF-FSB (2009); see also Buch (2017)).

Use of macroprudential instruments¹

In per cent

Graph 2



¹ The sample covers the period 1990–2014. Macroprudential tools for resilience include (a) capital-based instruments (countercyclical capital requirements, leverage restrictions, general or dynamic provisioning) and (b) liquidity requirements. Cyclical macroprudential tools include (c) asset-side instruments (credit growth limits, maximum debt service-to-income ratio, limits to banks' exposures to the housing sector as a maximum loan-to-value ratio); (d) changes in reserve requirements; and (e) currency instruments (variations in limits on foreign currency exchange mismatches and net open positions).

Source: Authors' calculations.

tend to be motivated by specific objectives. Borio (2011a) and Claessens et al (2013), for example, classify commonly used policy tools according to the goals for which they might be best suited. Macroprudential tools whose main objective could be *enhancing the resilience* of the financial sector include (a) capital-based instruments (countercyclical capital requirements, leverage restrictions, general or dynamic provisioning) and (b) liquidity-based requirements.

Instruments that, in addition, would be better suited to *smoothing the credit cycle* would include (c) asset-side instruments (credit growth limits, maximum debt service-to-income-ratios, limits to bank exposures to the housing sector such as maximum loan-to-value ratios); (d) changes in reserve requirements; and (e) currency instruments (limits on foreign currency exchange mismatches and net open positions).

Interestingly, only one quarter of the measures were aimed at directly increasing the financial sector's resilience. These include measures that set or adjust capital, liquidity or provisioning requirements (Graph 2, left-hand panel). By contrast, the vast majority of measures were intended to smooth the cycle – ie they were used countercyclically to mitigate an expected credit boom or credit crunch. More than half involve changes in reserve requirements. Overall, 60% of the interventions were intended to tighten financial conditions (Graph 2, centre panel). Of all the macroprudential measures adopted, 80% were taken by EMEs (Graph 2, right-hand panel).

It is important to note that since "macroprudential measures" typically affect the cost of credit, some of them could equally well be described as "non-interest rate monetary policy tools" (Kuttner and Shim (2016)). This alternative classification could appear particularly apt for reserve requirements, which have traditionally fallen within the toolbox of monetary policy instruments, both among EMEs and among advanced economies (see eg Friedman (1990)). Identifying the precise motivation (monetary

policy vs macroprudential) behind these interventions is very difficult, in particular across 64 heterogeneous countries. To address this issue, our data set adopts surveys to exclude interventions that were not explicitly motivated by macroprudential objectives (Cerutti et al (2017a)). But, in any event, the key aspect we seek to uncover is whether or not these measures can be aimed at increasing macroeconomic stability, and whether they operate through the credit channel, quite independently of the specific label.

An important limitation of the available data set is that it does not quantify the size of the adjustments and refers only to their frequency.¹⁰ Mindful of this limitation, we try to build our inference in two steps. First, we use the observed frequency of macroprudential decisions as an explanatory variable for output growth and its volatility. The result could be due either to systematic (and one hopes sensible) policies, or to more erratic components, or to both. Thus, in a second stage, we try to isolate the non-systematic component of macroprudential policy interventions, and estimate its contribution to growth. We believe that these two complementary steps can shed some light, albeit tentatively, on the link between macroprudential “activism” and macroeconomic performance.¹¹

With this caveat in mind, we provide in Table 1 some first-pass evidence on the relationship between macroprudential tools, per capita GDP growth and its volatility. The table divides the sample of 64 countries into those that are more active in the use of macroprudential tools and those that are less active. The split is based on an index of activism that counts the number of macroprudential measures activated in the period 1990–2014. A country is considered “more active” if the total number of macroprudential measures is above the median for the whole sample. The data suggest that countries which used macroprudential tools more frequently are also those that experienced (i) an average GDP per capita growth that is 1 percentage point higher than that of other countries over the sample period (the results are the same for simple real GDP growth); (ii) higher output volatility; and (iii) higher overall output growth, even after controlling for this higher volatility.

This evidence is only suggestive. The rest of this article analyses these relationships more rigorously through econometric models that attempt to measure the impact of macroprudential policies after accounting for other relevant factors.

¹⁰ In general, knowledge of the frequency of policy decisions (eg monetary or fiscal) by itself would not reveal much about the links between policy and economic outcomes. For example, frequent policy interest rate changes could be due to frequent changes of the underlying fundamentals, or to erratic policy decisions – two alternatives with economic implications that are likely to be opposite. With sufficient data at hand, one could hope to disentangle the two cases, and thus sharpen the inference on the economic implications of policy. But this is not feasible with our data set.

¹¹ Different systematic policies can, of course, deliver very different outcomes. In an interconnected world, furthermore, it is the combination of policies across countries that determines the outcome – for example, whether or not countries take an inward-looking perspective. In relation to macroprudential policies, Agénor et al (2017) provide two theoretical characterisations of policies (cooperative and non-cooperative) with strikingly different outcomes. Empirically, we are bound to focus our attention on the identification of actual policies as opposed to describing alternative hypothetical outcomes.

Activism in the use of macroprudential policies and macroeconomic performance¹

Table 1

Variables	(a) More active countries	(b) Less active countries	Test difference of effects between groups of countries H ₀ : (a) – (b) ≠ 0
	Mean (std error)	Mean (std error)	
GDP per capita growth	0.028 (0.001)	0.016 (0.001)	0.012*** (0.001)
Output volatility (SD)	0.041 (0.000)	0.033 (0.000)	0.007*** (0.000)
GDP per capita growth/SD	0.849 (0.042)	0.643 (0.040)	0.206*** (0.058)

¹ Averages over the period 1990–2014. This table divides the sample of 64 countries into those that are more active in the use of macroprudential tools and those that are less active. The split is based on an index of activism that counts the number of macroprudential policies activated during the period 1990–2014. A country is considered “more active” if the sum of the total macroprudential measures is above the median for the whole sample. As more than one country has the same median level, we split the countries into 34 “more active” countries and 30 “less active” countries. The macroprudential measures are summed over the following categories over the period 1990–2014: capital-based instruments, liquidity-based instruments, asset-side instruments, reserve requirements and currency instruments.

Source: Authors’ calculations.

Macroprudential policies, finance and economic performance

Panel data analysis can help us derive more precise conclusions about the link between growth, macroeconomic volatility and macroprudential policies. We need to be careful in controlling for unobserved factors, whether across countries or time-varying, that might have an influence on the level and volatility of growth not captured by our set of observable variables. And we need to correct for possible reverse causality, ie that a country might choose to implement certain macroprudential policies in response to growth and volatility.

To account for possible unobserved factors we use country and time fixed effects, while we treat the reverse causality problem by using the dynamic Generalised Method of Moments (GMM) panel methodology (see eg Arellano and Bond (1991) and Blundell and Bond (1998)). More precisely, we follow the modelling approach of Beck and Levine (2004), adapting it to study the link between output growth/volatility and the use of macroprudential tools.

Our baseline econometric model is the following:

$$Y_{i,t} = Y_{i,t-1} + \delta MaP_{i,t} + \beta FD_{i,t} + \gamma OPEN_{i,t} + \nu FD_{i,t} * MaP_{i,t} + \lambda MaP_{i,t} * OPEN_{i,t} + \zeta FD_{i,t} * OPEN_{i,t} + \xi FD_{i,t} * MaP_{i,t} * OPEN_{i,t} + \omega' X_{i,t} + \eta_i + \theta_t + \varepsilon_{i,t} \quad (1)$$

where the dependent variable $Y_{i,t}$ is either the five-year (non-overlapping) standard deviation of real per capita GDP growth ($\sigma \Delta y_{i,t}$) or the five-year (non-overlapping) average real per capita GDP growth ($\Delta y_{i,t}$), and i and t represent country and time

period respectively.¹² The key variables in the specification are macroprudential activism (*MaP*, given by the logarithm of the five-year sum of the number of changes in *MaP* measures in a given country),¹³ indicators of financial development (*FD*, taken from Sahay et al (2015)),¹⁴ and openness (*OPEN*, where we use the Chinn and Ito (2006) index). The regressions also include interactions of these three variables. We estimate the equation for three measures of $MaP_{i,t}$: the total for all tools, resilience-oriented measures, and cyclically oriented measures. $X_{i,t}$ includes a set of control variables, while η_i are country fixed effects (taking care of the unobserved heterogeneity) and θ_t is a time fixed effect, aimed at taking care of unobserved time-varying factors common across countries. Control variables include an index for independence of the supervisory authority (Barth et al (2004)), which indicates the degree to which the supervisory authority is able to make decisions independently of political considerations (the index ranges from 0 to 1, with higher values indicating greater independence). This index could be interpreted as a proxy for policy constraints, akin to that used by Fatás and Mihov (2012). Other control variables are the average number of years of schooling (in logs), government consumption (in logs), the inflation rate, the real interest rate, the effective exchange rate and a financial crisis dummy.¹⁵

The regression results suggest that more frequent use of macroprudential measures tends to reduce economic volatility (Table 2, left-hand part, column I). Measures targeting resilience seem to be relatively more effective (compare the size of the coefficients in columns II and III). This suggests that, controlling for reverse causality, macroprudential policies tend to promote a more stable macroeconomic environment.

Key structural features of the economy – openness and financial development in particular – also appear to influence the impact of macroprudential measures. For

¹² The results presented in this paper are based on annual GDP data. An appendix, available from the authors on request, reports results based on quarterly GDP data. Using quarterly data does not affect the results qualitatively, although there are some quantitative differences. The case for using quarterly data was particularly strong for the calculation of output growth volatility, given the short window (five years). Yet the comparison of annual and quarterly data suggests that annual data are more reliable for a number of EMEs, especially in the early part of the sample. Bekaert and Popov (2012), in a growth/volatility analysis involving many countries, made the same choice. Furthermore, they opted for a five-year window to calculate GDP growth moments, as we do in this paper.

¹³ The logarithm helps reduce the effect of tail observations. Our results are robust to alternative specifications, including a specification in levels and a specification that reduces tail observations by winsorising the macroprudential policy index at the 1% level. Note that both a tightening and a loosening of the macroprudential instrument count for one change each, as we consider the *number* of changes as opposed to the *direction* of changes.

¹⁴ The financial development index (FD) is constructed by aggregating six sub-indices for the “depth”, “access” and “efficiency” of financial institutions and financial markets. The weights are obtained from principal component analysis, reflecting the contribution of each underlying series to the variation in the specific sub-index. The FD index is normalised between 0 and 1.

¹⁵ The introduction of the crisis dummy aims at sharpening the inference on the effects of macroprudential policies on economic performance, as macroprudential policy activism tended to be higher during the GFC. The crisis dummy takes the value of 1 if the country is in a financial crisis in a given year. To date a financial crisis, we rely on a combination of Borio and Drehmann (2009), Laeven and Valencia (2012) and Reinhart and Rogoff (2009). Following Bech et al (2014), the dummy takes the value of 1 in the crisis year and in all the subsequent years of falling real GDP. As an additional robustness test, we also run the regressions excluding the observations referring to financial crisis periods. This reduces the number of observations from 343 to 249. The results, not reported for the sake of brevity, are very similar.

Do macroprudential policies reduce output volatility and enhance output growth?

Table 2

Explanatory variables	Dependent variable: (a) output volatility			Dependent variable: (b) growth rate of real GDP per capita		
	Total	Resilience	Cyclical	Total	Resilience	Cyclical
	(I)	(II)	(III)	(IV)	(V)	(VI)
MaP (index)	-0.0090** (0.0039)	-0.0152** (0.0060)	-0.0082** (0.0040)	0.0147*** (0.0057)	0.0175** (0.0077)	0.0155** (0.0062)
FD	-0.0534*** (0.0115)	-0.0456*** (0.0090)	-0.0495*** (0.0110)	0.0823*** (0.0192)	0.0684*** (0.0158)	0.0797*** (0.0183)
OPEN	-0.0002 (0.0024)	0.0006 (0.0018)	-0.0011 (0.0024)	0.0125*** (0.0032)	0.0120*** (0.0032)	0.0141*** (0.0032)
FD x MaP	0.0193** (0.0076)	0.0285** (0.0135)	0.0185** (0.0077)	-0.0291** (0.0117)	-0.0406*** (0.0152)	-0.0303** (0.0129)
MaP x OPEN	0.0011 (0.0019)	0.0031 (0.0031)	0.0019 (0.0021)	-0.0047** (0.0023)	-0.0101*** (0.0038)	-0.0049* (0.0028)
FD x OPEN	-0.0013 (0.0048)	-0.0017 (0.0039)	-0.0000 (0.0046)	-0.0291*** (0.0072)	-0.0279*** (0.0065)	-0.0308*** (0.0070)
FD x MaP x OPEN	-0.0009 (0.0038)	-0.0060 (0.0067)	-0.0017 (0.0040)	0.0107** (0.0050)	0.0226*** (0.0072)	0.0103* (0.0059)
Other controls ¹	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes
Number of observations	343	343	343	343	343	343
Number of countries	64	64	64	64	64	64
Serial correlation test ²	0.179	0.165	0.211	0.376	0.396	0.345
Hansen test ³	0.689	0.442	0.706	0.291	0.119	0.776

The dependent variables are (a) the five-year standard deviation of real GDP per capita growth and (b) the five-year average in the real growth rate of GDP per capita. The financial development (FD) index is described in Sahay et al (2015). The index is normalised between 0 and 1. The openness measure (OPEN) is the Chinn-Ito index. Robust standard errors in parentheses; */**/** denotes statistical significance at the 10/5/1% level in the first-stage regression.

¹ We also include the lagged dependent variable, the log of initial GDP per capita, real interest rate, inflation rate, government consumption, average years of schooling, banking crisis dummy (1 = banking crisis, 0 = none), exchange rate against other currencies, and an index for independence of supervisory authority (Barth et al (2004)) that indicates the degree to which the supervisory authority is able to make decisions independently of political considerations (the index ranges from 0 to 1, with higher values indicating greater independence). ² Reports p-values for the null hypothesis that the errors in the first-difference regression exhibit no second-order serial correlation. ³ Reports p-values of the null hypothesis that the instruments used are not correlated with the residuals. The estimation period is 1984–2014. We use the first observation in the sample (the five-year average 1984–89) as instrument in the regression. Due to the lack of data for the macroprudential index in this period, we have imposed that the use of macroprudential policies was negligible (zero) in this period. Given the observed trend in the measure, this assumption appears plausible to us. As an alternative, we tried to impute the missing values using a “random forest” algorithm (implemented in R); our results remained qualitatively unchanged.

Source: Authors' calculations.

example, assuming a totally closed economy (OPEN = 0), the coefficient on the term capturing the interaction between financial development and macroprudential activism, FDxMaP (fourth row), suggests that the more financially developed the economy is, the *less* effective are macroprudential policies in reducing volatility. The same conclusion would be reached for increasing openness. In contrast, macroprudential measures are *more* effective if *both* financial development and

openness are sufficiently large (row seven). Putting these two results together suggests that the interaction between openness and financial development can affect the impact of policy on economic performance.¹⁶

More active macroprudential policies are also associated with higher per capita GDP growth (Table 2, right-hand part, first row). Financial development¹⁷ (second row) and openness¹⁸ (third row) also appear to have a direct positive impact on growth.¹⁹ As regards the interaction between macroprudential policies, openness and financial development, the conclusions are the same as for volatility. In isolation, greater openness or financial development each seem to dampen the positive effect of policy activism on growth. However, the coefficient on the interaction between the two structural factors with policy activism indicates a stronger effectiveness of macroprudential policies.

Given the complexity of these interactions, it is instructive to illustrate the results through a concrete quantitative example. In particular, Table 3 shows the net effect of doubling the macroprudential policy indices (over five years) for three different scenarios: (i) the case in which financial development and openness are at their sample mean (the average economy); (ii) the case in which openness is at the mean, while financial development is one standard deviation above the mean; and (iii) vice versa. The reported values are expressed in percentages of sample averages of the left-hand variables. So, for example, on average the effect on volatility of doubling macroprudential policy activism is about -0.30% of the average standard deviation of output growth (Table 3, first cell) and 14.57% of the average per capita output growth (fourth cell). By moving to a larger degree of financial development (one standard deviation above the mean), we observe that both volatility and growth are increased by more macroprudential policy activism (Table 3, second row). With the exception of the resilience measures, a (one standard deviation) larger degree of openness (with FD at its mean) increases the effectiveness of macroprudential policy, resulting in lower volatility and higher growth. The former effect is clearly driven by the triple interaction, suggesting that macroprudential policy tends to be particularly effective for countries with financial development and openness above their mean. Aware of

¹⁶ The effective exchange rate regime does not appear to have systematically affected the degree of macroeconomic volatility in our sample, as the estimated coefficients are statistically insignificant. Similar results are obtained using a dummy for the exchange rate regime (fixed or floating), as the frequency of macroprudential intervention might be related to foreign exchange interventions in some countries, at least in some periods.

¹⁷ Other researchers have found a similar result. The link between finance and growth is typically explained by (i) the reduction of the cost of acquiring and processing information and thereby improving resource allocation (Diamond (1984), Boyd and Prescott (1986)); (ii) monitoring investments and exerting corporate governance after providing finance (Stiglitz and Weiss (1983), Jensen and Meckling (1976)); (iii) facilitating the trading, diversification and management of risk and pooling of saving (Acemoğlu and Zilibotti (1997)); and (iv) easing the exchange of goods and services (Greenwood and Smith (1996)). For a review, see Levine (2005). Cecchetti and Kharroubi (2012) find that the level of financial development is positively correlated with GDP growth up to a point, after which it has a negative effect. Similar results are found in Gambacorta et al (2014).

¹⁸ The literature is not unanimous on the positive impact of openness on growth (Rodríguez and Rodrik (2000), Baldwin (2004)). The possibility that higher growth induces openness (reverse causality) calls for caution in the interpretation of findings. Attempts to deal with this issue appear to confirm the influence of openness, albeit not a particularly strong one (eg Lee et al (2004)).

¹⁹ We also tested the direct impact of GDP growth volatility on the level of GDP growth, finding a negative but not statistically significant sign (not reported for the sake of brevity). All other results remain unchanged. This result is consistent with the finding of Fatás and Mihov (2012), who report that the impact of GDP volatility on growth is insignificant once policy volatility is included separately in the regression.

Net effect of doubling macroprudential policy index under three scenarios

Table 3

	Volatility			Growth		
	Total	Resilience	Cyclical	Total	Resilience	Cyclical
	(I)	(II)	(III)	(IV)	(V)	(VI)
Mean	-0.30%	-3.05%	1.04%	14.57%	6.09%	11.69%
Mean + std dev FD	8.94%	1.01%	8.03%	1.77%	1.59%	0.16%
Mean + std dev OPEN	0.41%	-6.79%	1.63%	44.43%	28.44%	33.94%

The effects are expressed in percentages of the average standard deviation (Volatility) or the average growth (Growth) for a doubling of the index of macroprudential activism. As the lagged dependent variables in the regressions turned out to be statistically not different from zero, these effects are equivalent to those in the long run. The first row corresponds to the effect of doubling the MaP index when FD and OPEN are at their sample mean value. The second row is as above, but with FD increased by one standard deviation (std dev) above the mean. In the third row, FD is at its mean value, while OPEN is one standard deviation above its mean.

Source: Authors' calculations.

the crudeness of our macroprudential policy indicators, and of having neglected statistical significance in these calculations, we take these quantitative examples with a grain of salt, and consider more noteworthy the statistical significance and direction of the estimates.

What would be the implications for our interpretation of the results if our econometric methodology did not successfully correct for reverse causality? Our interpretation would actually be strengthened in the case of the volatility regression. For example, it could be that countries experiencing faster economic growth or higher macroeconomic volatility (eg EMEs) react by adopting macroprudential policies more frequently. In this case, the true relationship would be stronger than what we actually find. As concerns the growth regression, however, the possibility of reverse causality weakens our findings. If faster economic growth were to lead to a greater use of macroprudential policies (even controlling for volatility), the true coefficient could be smaller than we show, possibly even of the opposite sign. This is an important caveat to bear in mind in interpreting our results. One way of dealing with this problem would be to use longer periods to compute average growth, as the five-year growth rates used in this article could capture periods of excessive or unsustainable growth. Unfortunately, the limited time dimension of our sample prevents us from examining growth rates over longer horizons.

Non-systematic macroprudential interventions and growth

Researchers studying other areas of policy often attempt to distinguish non-systematic, ad hoc policy actions from those based on systematic policy rules. For example, Fatás and Mihov (2012) identify the systematic component of fiscal policy by assuming that it should be related to economic activity. They then estimate a policy rule linking changes in government spending to changes in real GDP, and treat the residual as a measure of non-systematic fiscal policy. They find that the latter component contributes to growth-reducing volatility. Similarly, many analyses of monetary policy postulate a "Taylor rule" (typically linking monetary policy rates to the output gap and inflation) as the systematic policy component, and then examine the macroeconomic impact of the estimated residual (Taylor (1993)).

Following this literature, we attempt to measure the non-systematic component of macroprudential policy. In particular, we estimate the following regression:

$$MaP_{index_{i,t}} = \alpha_i + \beta \Delta \left(\frac{Credit}{GDP} \right)_{i,t} + \gamma Capital\ inflows_{i,t} + \delta \Delta GDP_{i,t} + \omega' X_{i,t} + \eta_i + \theta_t + \varepsilon_{i,t} \quad (2)$$

where $MaP_{index_{i,t}}$ is the macroprudential aggregate index, in country i at time t , which allows us to evaluate the overall effectiveness of macroprudential tools when more than one measure is activated. Differently from regression (1), we consider in this case not only the number of macroprudential policy tools activated but also their sign, in order to identify their countercyclical properties. Positive values of the index indicate a net tightening in macroprudential policies in a given year, while negative values indicate an easing. The index is equal to zero if no action has taken place or if the actions balance each other out.²⁰ The model includes as main explanatory variables the growth rates of the credit-to-GDP ratio, real GDP growth and net capital inflows.²¹ We include country and time fixed effects, and a vector of additional

Macroprudential reaction function

Table 4

Explanatory variables	Dependent variable: Macroprudential aggregate index ¹	
	Baseline model (I)	Forward-looking measure for credit (II)
Credit growth	0.2444*** (0.0731)	0.4834*** (0.1377)
Capital inflows ²	0.0147** (0.0067)	0.0156** (0.0071)
Output growth	2.4783** (1.1046)	2.2432** (1.0837)
Other controls ³	yes	yes
Country fixed effects	yes	yes
Time fixed effects	yes	yes
Number of observations	1,418	1,361
R ²	0.1689	0.1772

¹ The macroprudential aggregate index is the number of macroprudential tools activated in country i at time t . Positive values of the index indicate a tightening in macroprudential policies in a given year, while negative values indicate an easing; the index is equal to zero if no action has taken place. ² The growth rate of the net external position (Lane and Milesi-Ferretti (2017)). ³ Additional controls include the lagged value of the dependent variable, the real interest rate, inflation rate, exchange rate against other currencies, the openness measure (Chinn-Ito index), and a banking crisis dummy (1 = banking crisis, 0 = none). Robust standard errors in parentheses; */**/** denotes statistical significance at the 10/5/1% level. The estimation period is 1990–2014.

Source: Authors' calculations.

²⁰ Following Kuttner and Shim (2016), we calculate the aggregate macroprudential index summing up all the different dummies for the various macroprudential tools. This means that if multiple actions in the same direction are taken within a given year, the variable could take on the values of 2 or –2, or even 3 and –3. It also means that a tightening action and a loosening action taken within the same year could cancel each other out. This indicator weights each tool in the same way and will be considered in our baseline regression.

²¹ The capital inflows are measured as growth rate of the net external position, and are taken from Lane and Milesi-Ferretti (2017).

controls ($X_{i,t}$): the effective exchange rate, the real interest rate, the inflation rate, an openness measure (Chinn-Ito index) and a banking crisis dummy (1 = banking crisis, 0 = none).

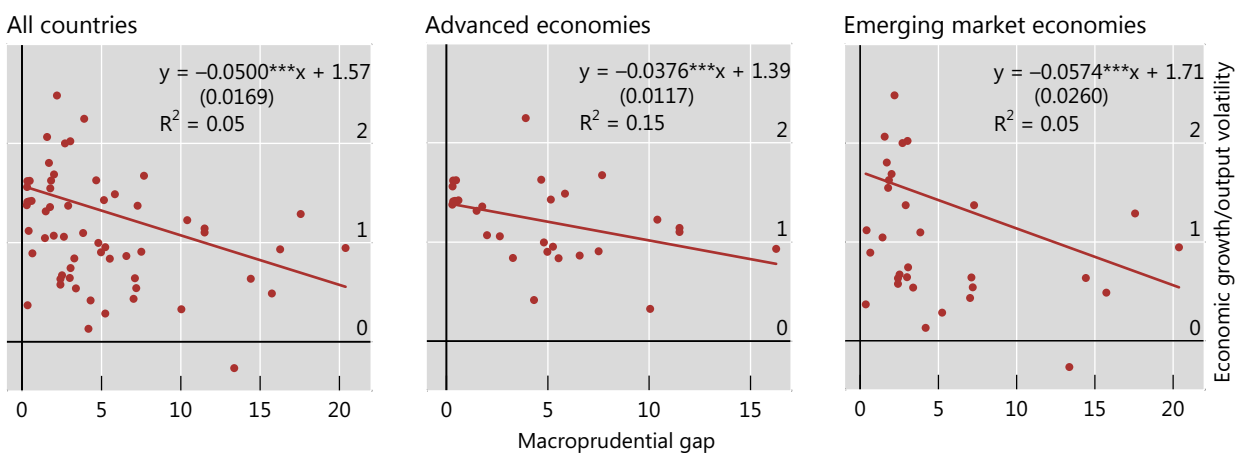
In line with our expectations, we find that actual macroprudential policies are tightened when the growth rates of credit-to-GDP, real GDP and net capital inflows increase, and vice versa (Table 4). We also include a forward-looking measure for the growth of the credit-to-GDP ratio (based on its past value and monetary policy conditions) to capture the fact that policymakers could base their decision on projections. This inclusion does not change the results (Table 4, column II).

Our measure of “non-systematic” macroprudential policy is given by $\varepsilon_{i,t}$, ie the residual in equation (2). We use this residual to construct a measure of the “macroprudential gap”, which we define as the cumulative sum of non-systematic macroprudential policy actions over the sample period. In particular, we measure the macroprudential gap as the sum over the whole period of the absolute value of $\varepsilon_{i,t}$, divided by the average level of the *MaP_index*. Ideally, we would want to calculate the residual of an hypothetical regression of changes in values of *MaP* instruments. Since we only observe the *frequency* and *sign* of *MaP* changes, our residual can be seen only as a very rough approximation. Our measure must be interpreted as the non-systematic (or non-fundamental) component of decisions about changing *MaPs*, ie the error one would commit by predicting a change (up or down) in *MaP*, conditional on the explanatory variables in the regression.

The left-hand panel of Graph 3 plots this macroprudential gap on the horizontal axis against the ratio of GDP per capita growth to its standard deviation on the vertical axis. This measure captures the fact that both higher growth and macroeconomic stability are typically indicators of good economic performance. The regression line shows a negative correlation between these two variables. This suggests that countries with a wider macroprudential gap experienced worse macroeconomic performance over the sample period (lower growth relative to volatility). This result is also statistically significant when the sample is split between advanced and emerging market economies (centre and right-hand panels, respectively).

Macroprudential gap and economic performance

Graph 3



Standard errors in parentheses; ** denotes statistical significance at the 5% level.

Source: Authors' calculations.

An important caveat should be mentioned at this point. As with all estimates of reduced-form policy functions (whether fiscal, monetary or macroprudential), there is a considerable risk of not adequately capturing the true policy reaction function. General equilibrium reasoning suggests that many variables will be correlated with macroprudential intervention, so that a number of candidate empirical rules are conceivable. Given the nature of our data, and in particular the lack of detail concerning the values of macroprudential interventions, we do not pursue more sophisticated identification schemes in this article.

Conclusions

The main aim of macroprudential tools is to reduce systemic risks and the frequency of deep financial crises. Effective policy interventions should thus be reflected in a more stable economy. Yet it has been argued that macroprudential measures achieve higher stability at the cost of a suboptimal level of credit and investment, which could hinder long-run economic growth. The debate on the existence and strength of such effects – and thus on the net benefits of macroprudential interventions – is still open.

This feature attempts to shed light on these crucial policy questions. It investigates empirically the link between macroprudential policies and two key measures of economic performance: growth and its volatility. We find that the more active a country is in the use of macroprudential measures, the higher and less volatile is its per capita GDP growth. However, these beneficial effects depend crucially on the country's stage of financial development and degree of openness. When either, but not both, of these structural features is particularly advanced, the beneficial effect of macroprudential measures on volatility appears to be dampened, if not reversed. For particularly open *and* financial developed countries, the net effect of macroprudential interventions on economic activity is especially beneficial. Further research is needed to shed light on the possible causes of these empirical regularities.²²

Finally, we find that a measure of non-systematic macroprudential policy tends to be negatively correlated with GDP growth relative to its volatility. This result could suggest that macroprudential policies, like any therapy, can have side effects and must be properly administered.

²² The result for the interaction of macroprudential policies and openness suggests that the international dimensions of macroprudential policies could play an important role. The international effects of macroprudential policies and the role of cooperation go beyond the scope of this feature, but some preliminary results reported in Agénor et al (2017) indicate that the gains from cooperation could be sizeable. Nevertheless, their magnitude could be asymmetrical, pointing to potential political economy obstacles to such cooperation.

References

- Acemoglu, D and F Zilibotti (1997): "Was Prometheus unbound by chance? Risk, diversification and growth", *Journal of Political Economy*, August, vol 105, no 4, pp 709–51.
- Agénor, P-R, E Kharroubi, L Gambacorta, G Lombardo and L Pereira da Silva (2017): "The international dimensions of macroprudential policies", *BIS Working Papers*, no 643, June.
- Agénor, P-R and L Pereira da Silva (2017): "Capital requirements, risk-taking and welfare in a growing economy", *BIS Working Papers*, forthcoming.
- Aghion, P, G Angeletos, A Banerjee and K Manova (2010): "Volatility and growth: credit constraints and the composition of investment", *Journal of Monetary Economics*, vol 57, no 3, pp 246–65.
- Aghion, P, E Farhi and E Kharroubi (2012): "Monetary policy, liquidity, and growth", *NBER Working Papers*, no 18072.
- Aghion, P, D Hemous and E Kharroubi (2014): "Cyclical fiscal policy, credit constraints, and industry growth", *Journal of Monetary Economics*, vol 62, pp 41–58.
- Altunbas, Y, M Binici and L Gambacorta (2017): "Macroprudential policy and bank risk", *BIS Working Papers*, no 646, June.
- Angelini, P, S Neri and F Panetta (2014): "The interaction between capital requirements and monetary policy", *Journal of Money, Credit and Banking*, vol 46, no 6, pp 1073–112.
- Arellano, M and S Bond (1991): "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations", *Review of Economic Studies*, vol 58, no 2, pp 277–97.
- Baldwin, R (2004): "Openness and growth: what's the empirical relationship?", in R Baldwin and L Winters (eds), *Challenges to globalization: analyzing the economics*, University of Chicago Press, pp 499–526.
- Bank for International Settlements (2016): "Economic resilience: a financial perspective", note submitted to the G20 on 7 November.
- Barth, J, G Caprio and R Levine (2004): "Bank regulation and supervision: what works best?", *Journal of Financial Intermediation*, vol 13, pp 205–48.
- Basel Committee on Banking Supervision (2010): *An assessment of the long-term impact of stronger capital and liquidity requirements*, August.
- Bech, M, L Gambacorta and E Kharroubi (2014): "Monetary policy in a downturn: are financial crises special?", *International Finance*, vol 17, no 1, pp 99–119.
- Beck, T and R Levine (2004): "Stock markets, banks, and growth: panel evidence", *Journal of Banking and Finance*, vol 28, no 3, pp 423–42.
- Bekaert, G and A Popov (2012): "On the link between the volatility and skewness of growth", *NBER Working Papers*, no 18556.
- Blundell, R and S Bond (1998): "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, vol 87, no 2, pp 115–43.
- Borio, C (2011a): "Implementing a macroprudential framework: blending boldness and realism", *Capitalism and Society*, vol 6, no 1.

- (2011b): *“Central banking post-crisis: What compass for uncharted waters?”*, *BIS Working Papers*, no 353, September.
- Borio, C and M Drehmann (2009): *“Assessing the risk of banking crises – revisited”*, *BIS Quarterly Review*, March, pp 29–46.
- Boyd, J and E Prescott (1986): *“Financial intermediary-coalitions”*, *Journal of Economic Theory*, vol 38, no 2, April, pp 211–32.
- Buch, C (2017): *“Data needs and statistics compilation for macroprudential analysis”*, keynote remarks at the Irving Fisher Committee–National Bank of Belgium Workshop.
- Cecchetti, S and E Kharroubi (2012): *“Reassessing the impact of finance on growth”*, *BIS Working Papers*, no 381, July.
- Cerutti, E, S Claessens and L Laeven (2017a): *“The use and effectiveness of macroprudential policies: new evidence”*, *Journal of Financial Stability*, vol 28, pp 203–24.
- Cerutti, E, R Correa, E Fiorentino and E Segalla (2017b): *“Changes in prudential policy instruments – a new cross-country database”*, *International Journal of Central Banking*, vol 13, no 1, pp 477–503.
- Chinn, M and H Ito (2006): *“What matters for financial development? Capital controls, institutions, and interactions”*, *Journal of Development Economics*, vol 81, no 1, pp 163–92.
- Claessens, S, S Ghosh and R Mihet (2013): *“Macro-prudential policies to mitigate financial system vulnerabilities”*, *Journal of International Money and Finance*, vol 39, pp 153–85.
- Demirgüç-Kunt, A, E Detragiache and O Merrouche (2013): *“Bank capital: Lessons from the financial crisis”*, *Journal of Money, Credit and Banking*, vol 45, no 6, pp 1147–64.
- Diamond, D (1984): *“Financial intermediation and delegated monitoring”*, *Review of Economic Studies*, vol 51, no 3, pp 401–19.
- Dixit, A and R Pindyck (1994): *Investment under uncertainty*, Princeton University Press.
- Drehmann, M and L Gambacorta (2012): *“The effects of countercyclical capital buffers on bank lending”*, *Applied Economic Letters*, vol 19, no 7, pp 603–8.
- Elliott, D, S Salloy and A Santos (2012): *“Assessing the cost of financial regulation”*, *IMF Working Papers*, no 233.
- Elliott, D and A Santos (2016): *“Estimating the cost of financial regulation”*, *IMF Staff Discussion Notes*, no 12/11.
- Fatás, A and I Mihov (2012): *“Fiscal policy as a stabilization tool”*, *CEPR Discussion Papers*, no DP8749, January.
- Fender, I and U Lewrick (2016): *“Adding it all up: the macroeconomic impact of Basel III and outstanding reform issues”*, *BIS Working Papers*, no 591, November.
- Friedman, B (1990): *“Targets and instruments of monetary policy”*, *Handbook of Monetary Economics*, vol 2, pp 1185–230.
- Galati, G and R Moessner (2017): *“What do we know about the effects of macroprudential policy?”*, *Economica*, forthcoming.

- Gambacorta, L, J Yang and K Tsatsaronis (2014): “Financial structure and growth”, *BIS Quarterly Review*, March, pp 21–35.
- Greenwood, J and B Smith (1996): “Financial markets in development, and the development of financial markets”, *Journal of Economic Dynamics and Control*, vol 21, pp 145–81.
- International Monetary Fund (2017): “Increasing resilience to large and volatile capital flows: the role of macroprudential policies”, *IMF Policy Paper*, July.
- International Monetary Fund and Financial Stability Board (2009): “The financial crisis and information gaps”, Report to the G-20 Finance Ministers and Central Bank Governors, October.
- International Monetary Fund, Financial Stability Board and Bank for International Settlements (2011): “Macroprudential policy tools and frameworks”, Update to G20 Finance Ministers and Central Bank Governors, February.
- (2016): “Elements of effective macroprudential policies: Lessons from international experience”, Joint Report, August.
- Jensen, M (1993): “The modern Industrial Revolution, exit, and the failure of internal control systems”, *Journal of Financial Economics*, vol 3, pp 305–60.
- Jensen, M and W Meckling (1976): *Theory of the firm: managerial behavior, agency costs and ownership structure*, Harvard University Press.
- Jiménez, G, S Ongena, J-L Peydró and J Saurina (2016): “Macroprudential policy, countercyclical bank capital buffers and credit supply: evidence from the Spanish dynamic provisioning experiments”, *Journal of Political Economy*, forthcoming.
- Kormendi, R and P Meguire (1985): “Macroeconomic determinants of growth: cross-country evidence”, *Journal of Monetary Economics*, vol 16, no 2, pp 141–63.
- Kuttner, K and I Shim (2016): “Can non-interest rate policies stabilise housing markets? Evidence from a panel of 57 economies”, *Journal of Financial Stability*, vol 26, pp 31–44.
- Laeven, L and F Valencia (2012): “Systemic banking crises: an update”, *IMF Working Papers*, no 163.
- Lane, P and G Milesi-Ferretti (2017): “International financial integration in the aftermath of the global financial crisis”, *IMF Working Papers*, no 17/115.
- Lee H-Y, L Ricci and R Rigobon (2004): “Once again, is openness good for growth?”, *Journal of Development Economics*, vol 75, pp 451–72.
- Levine, R (2005): “Finance and growth: Theory and evidence”, in P Aghion and S Durlauf (eds), *Handbook of Economic Growth*, vol 1A, Elsevier, pp 865–934.
- Lim, C-H, A Costa, F Columba, P Kongsamut, A Otani, M Saiyid, T Wezel and X Wu (2011): “Macroprudential policy: what instruments and how to use them? Lessons from country experiences”, *IMF Working Papers*, no 11/238, November, pp 1–85.
- Lim, C-H, I Krznar, F Lipinsky, A Otani and X Wu (2013): “The macroprudential framework: policy responsiveness and institutional arrangements”, *IMF Working Papers*, no 13/166, July.
- Macroeconomic Assessment Group (2010a): *Assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements – Interim Report*, Financial Stability Board and Basel Committee on Banking Supervision, August.

——— (2010b): *Assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements – Final Report*, Financial Stability Board and Basel Committee on Banking Supervision, December.

——— (2011): *Assessment of the macroeconomic impact of higher loss absorbency for global systemically important banks*, Financial Stability Board and Basel Committee on Banking Supervision, October.

Neanidis, K (2017): "Volatile capital flows and economic growth: the role of macro-prudential regulation", University of Manchester, *Discussion Paper Series*, no 215.

Ramey, G and V Ramey (1995): "Cross-country evidence on the link between volatility and growth", *American Economic Review*, vol 85, no 5, pp 1138–51.

Reinhart, C and K Rogoff (2009): "The aftermath of financial crises", *American Economic Review*, no 99, May, pp 466–72.

Rodríguez, F and D Rodrik (2000): "Trade policy and economic growth: a skeptic's guide to the cross-national evidence", *NBER Macroeconomics Annual*, no 15, pp 261–325.

Sahay, R, M Čihák, P N'Diaye, A Barajas, R Bi, D Ayala, Y Gao, A Kyobe, L Nguyen, C Saborowski, K Svirydzenka and S Yousefi (2015): "Rethinking financial deepening: stability and growth in emerging markets", *IMF Staff Discussion Notes*, no SDN/15/08.

Sánchez, A and O Röhn (2016): "How do policies influence GDP tail risks?", *OECD Economics Department Working Papers*, no 1339.

Stiglitz, J and A Weiss (1983): "Incentive effects if terminations: applications to credit and labor markets", *American Economic Review*, vol 73, no 5, pp 912–27.

Taylor, J (1993): "Discretion versus policy rules in practice", *Carnegie-Rochester Conference Series on Public Policy*, vol 39, pp 195–214.

Green bond finance and certification¹

Financing of investments through green bonds has grown rapidly in recent years. But definitions of what makes a bond “green” vary. Various certification mechanisms have evolved to allow more granularity as well as continuity in assessment. Green bonds have been priced at issuance at a premium on average relative to conventional bonds, but their performance in the secondary market over time has been similar. A relatively large share of green bonds are in sectors subject to environmentally related credit risks. More consistent green bond standards across jurisdictions could help to further develop the market.

JEL classification: G24, O16, Q50.

Green bonds are fixed income securities which finance investments with environmental or climate-related benefits. Green bonds are an integral component of “green finance” more generally, which aims to “internalize environmental externalities and adjust risk perceptions” for the sake of increasing environmentally friendly investments (G20 GFSG (2016)). Economic theory teaches that a first-best solution for closing the gap between the private and social costs of pollution would be a mix of lump sum taxes and subsidies, with regulations to impose implicit prices following closely behind. Green finance can also help to alleviate these externalities, through market-based means. It acts by increasing the flow of funds to environmentally beneficial projects, essentially reducing their costs, as well as by heightening awareness of the financial risks related to environmental change.²

How can investors be sure that the proceeds of green bonds are invested in an environmentally friendly way, and not merely “green-washed” to give the appearance thereof? While there is no single global definition of what precisely constitutes an “environmentally beneficial” use of proceeds, different standards have gained acceptance among market participants. Various organisations have started to provide green label certifications that indicate adherence to particular definitions of green, including “shades” of green. In so doing, they align the incentives of those who want to invest in these bonds, and make it easier for asset managers to satisfy those preferences. Green bonds could also conceivably serve as a hedge against

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² See the proceedings of the conference co-organised by the Official Monetary and Financial Institutions Forum (OMFIF), the BIS and the World Bank Group in Frankfurt on 13 July 2017; see also Weidmann (2017) and Pereira da Silva (2017).

environmentally related financial risks,³ though in this case additional information is needed about the sensitivity of various bonds to such risks, beyond just the quality of “greenness” itself .

In this feature we provide an overview of the state of the green bond market. We show that, a decade into the development of the market, there still are numerous labels for green bonds. We highlight how the various certification mechanisms for greenness have been evolving so as to allow more granularity as well as continuity in assessment. Consistent with other research, we document that green bonds at issuance have been priced at a premium on average relative to conventional bonds, while their performance in the secondary market has been similar to other bonds if currency risks are hedged. Finally, we document that green bonds are exposed to environmentally related financial risks to a relatively high degree.

The rest of this feature proceeds as follows. After providing a definition of green bonds, we briefly review the growth and composition of labelled green bond issuance from two different sources. The third section examines and classifies the various green labels provided by the private sector to certify green bond issuance. The fourth section focuses on the market pricing, financial performance and risks of green bonds. The conclusion summarises the policy implications.

The market for green bonds

The market for bonds with a green label⁴ has grown rapidly in recent years. It started with the European Investment Bank’s “climate awareness bond” issued in 2007, which is widely seen as the first bond with a green label. A key catalyst for subsequent market development was the introduction in January 2014 by the International Capital Market Association (ICMA) of the Green Bond Principles, which are the basis for many of the existing green labels (ICMA (2014)). Since then, the market for labelled green bonds has expanded dramatically: in 2016, aggregate issuance surpassed the \$100 billion mark, and the first half of 2017 has already seen a total issuance of around \$60 billion (Graph 1). The market for green bonds is nevertheless still very small compared with the wider global bond market, with a share of less than 1.6% of global debt issuance in 2016.⁵

The composition of green bond issuance has evolved considerably over time (Graph 1, left-hand panel). Through 2013, issuance predominantly came from supranationals (ie international organisations such as the European Investment Bank). Issuers from advanced economies in Europe and the United States dominated in 2014 and 2015. Since 2016, issuers from emerging market economies (EMEs), particularly

³ Transition risks, ie the financial impact of changes in environmental regulation, are typically seen as the most significant risk bond investors face. Carney (2015) notes that “while a given physical manifestation of climate change – a flood or storm – may not directly affect a corporate bond’s value, policy action to promote the transition towards a low-carbon economy could spark a fundamental reassessment”.

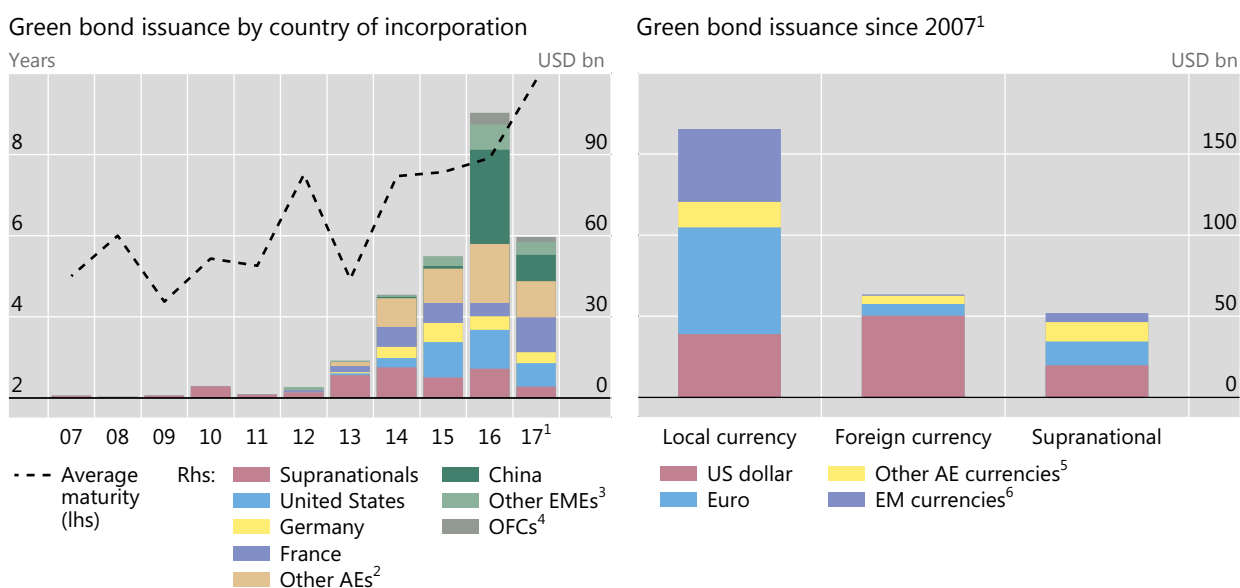
⁴ The universe of bonds for which proceeds are used for environmentally beneficial projects, but which do not carry a green label, is still likely to be quite large (Climate Bonds Initiative (2015)). But as the green label becomes more commonly used, it becomes more and more likely that issuers will seek this label to distinguish themselves.

⁵ Based on an estimate of total global debt capital market issuance of \$6.69 trillion in 2016 (see www.dealogic.com/insights/key-trends-shaped-markets-2016/).

Rapid growth in green bond issuance most recently in EMEs

Climate Bonds Initiative and Bloomberg lists of labelled green bonds, in billions of US dollars

Graph 1



¹ Up to mid-June 2017. ² AT, AU, BE, CA, CH, DK, ES, EE, FI, GB, IT, JP, LU, LV, NL, NO, SE and SI. ³ AE, AR, BR, CL, CO, HK, IN, IR, KR, MX, PE, PH, PL, SG, TR, TW and ZA. ⁴ Offshore financial centres (OFCs): BM, CR, KY, MO, MU and VG. ⁵ AUD, CAD, CHF, GBP, JPY, NOK, NZD and SEK. ⁶ BRL, CNY, COP, HUF, IDR, INR, MAD, MXN, MYR, PEN, PHP, PLN, RUB, SGD, TRY, TWD and ZAR.

Sources: Bloomberg; Climate Bonds Initiative; authors' calculations.

corporates in China, have provided a large share of global issuance. The maturity of green bonds is typically medium-term, averaging between seven and eight years in 2014–16, but lengthened in the first half of 2017.

Issuance tends to cover a wide range of currency denominations. While supranationals have tended to issue in euros and dollars, some EME entities have made use of local currencies (Graph 1, right-hand panel).

Issuers of green bonds tend to be highly rated, with only a small fraction rated below investment grade (Graph 2, left-hand panel). More bonds with earmarked claims on the cash flows of an individual project (ie project bonds) could help diversify issuers and credit risks (Standard & Poor's (2017a), Caldecott (2012); Ehlers et al (2014)). Project bonds naturally entail higher credit risks, given the high initial uncertainties of new investment projects (Ehlers (2014)). These could cater to investors looking for higher yields.

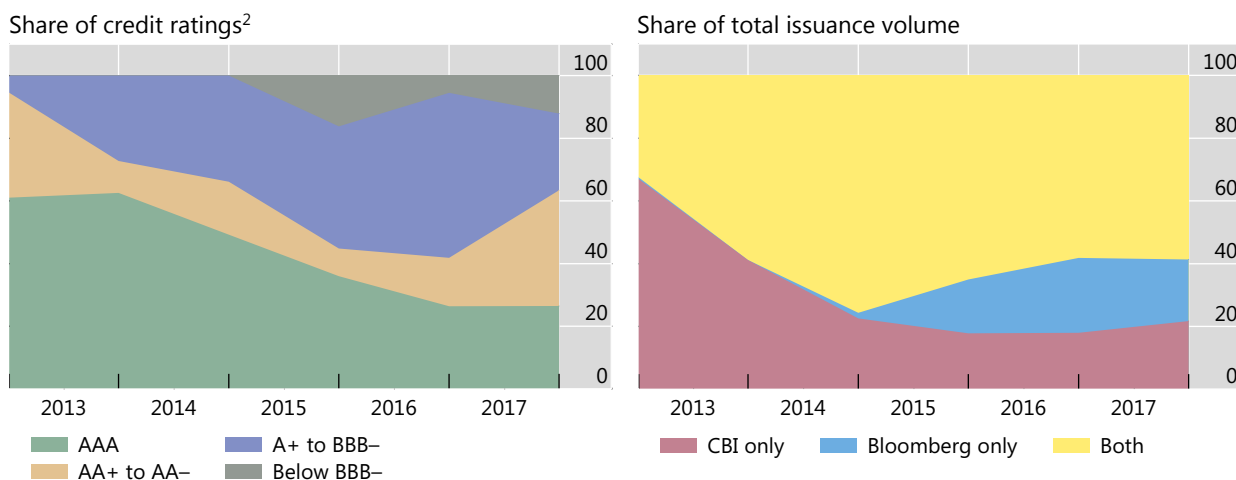
The above numbers aggregate figures from two widely used and broad-based lists of green bonds: those of the Climate Bonds Initiative (CBI) and Bloomberg. The CBI is an international non-profit organisation, funded by grants from non-profit and government sources as well as revenue from public sector contracts. Bloomberg is a widely used financial data and service provider. Both lists selectively include bonds with different types of green labels.

The two lists, and hence the corresponding volumes of issuance, do not coincide. The aggregate issuance of labelled green bonds from 2007 through the second quarter of 2017 in the CBI list equals \$234 billion (comprising 1,092 individual issues). By contrast, Bloomberg counted \$216 billion in green bond issuance (comprising 779 individual issues). Only \$169 billion (624 individual issues) worth of bonds are

Distribution of green bond ratings and amounts issued¹

In per cent

Graph 2



¹ For 2017, issuance data up to mid-June. ² Average rating of Standard & Poor's, Moody's and Fitch; expressed in Standard & Poor's categories.

Sources: Bloomberg; Climate Bonds Initiative (CBI); authors' calculations.

present on both lists. The Bloomberg list of green bonds was less extensive prior to 2014, but since then the overlap has been greater (Graph 2, right-hand panel).

Forms of green bond certification

For investment in green bonds to take off, it is important for both asset managers and their principals to be able to identify the bonds that actually have environmental or climate-related benefits. Asset managers may have the resources to make an informed judgment on their own. Indeed, global initiatives such as the Financial Stability Board's (FSB) Task Force on Climate-Related Financial Disclosures aim to make better environmental information readily available (FSB TCFD (2016)). Still, external certification allows asset managers to show beneficiaries that they are indeed investing in green bonds when requested to do so, and may be more cost-effective. A variety of forms of green bond certification have emerged, which all aim at ensuring that the use of funds and subsequent revenue is tied to green investment (Table 1).

The ICMA Green Bond Principles are so-called "voluntary process guidelines" that outline general criteria that most certification schemes follow. They were put together by major private financial institutions under the aegis of the ICMA (ICMA (2015)). The Principles provide prospective issuers with guidance on the key components of green bond issuance, namely: (i) the use of proceeds for environmentally sustainable activities; (ii) a process for determining project eligibility; (iii) management of the proceeds in a transparent fashion that can be tracked and verified; and (iv) annual reporting on the use of proceeds.

Though this section reviews international certification mechanisms available to any issuer, many jurisdictions have developed their own national taxonomies of what constitutes eligibility as a green bond. Most notably, China's Green Bond Finance Committee has issued a Green Bond Endorsed Project Catalogue (People's Bank of

Characteristics of different green bond identification and certification schemes Table 1

	CBI Climate Bonds Certification	Green bond indices ¹	CICERO Second Opinions	Moody's Green Bond Assessments	Standard & Poor's Green Evaluations
Use of funds must be tied to green investment	Yes	Yes	Yes	Yes	Yes
Eligibility criteria differ by sector	Yes	Yes			Yes
Ex post monitoring/assessment				Yes	
Granular assessments of greenness			Yes	Yes	Yes
Quantitative weights for specific factors				Yes	Yes

¹ Bank of America Merrill Lynch, Barclays MSCI, Standard & Poor's and Solactive.

China (2015)). For large domestic markets, this is a sensible option, but to the extent that international harmonisation is an issue, domestic guidelines run the risk of limiting the value of any particular green certification scheme to the domestic investor base. The ongoing initiative to improve the consistency of definitions and methodologies for determining the eligibility of green projects across the jurisdictions of China and the European Union represents perhaps the most significant effort to address this issue (European Investment Bank (2017)).

Climate Bond Certification

As discussed above, the CBI maintains a list and database of green bonds issued since 2009. The bonds in its database have green labels, but inclusion in the database does not constitute an opinion by CBI as to the correctness of the label.

The CBI also provides standards and a certification procedure. While the Green Bond Principles are very general, the CBI's Climate Bonds Standard establishes sector-specific eligibility criteria to judge an asset's low carbon value and suitability for issuance as a green bond. Assets that meet the CBI standard are then eligible for Climate Bond Certification, after an approved external verification that the bond meets environmental standards and that the issuer has the proper controls and processes in place.

A limitation of the CBI standard is that it does not necessarily mandate monitoring and verification on an ongoing basis (Table 1, first column). It is highly useful for investors to have an entity regularly renew its certification, particularly if they intend to maintain the investment over a multi-year horizon.

Green bond indices

Green bond indices identify specific bonds as green via a stated methodology, and allow investors to invest in a portfolio of green bonds to diversify risks (Table 1, second column). To this extent, the green bond index providers also effectively act as institutions of certification. At present, global green bond indices are compiled by Bank of America Merrill Lynch, Barclays MSCI, Standard & Poor's and Solactive.⁶ Each

⁶ In addition, there are several internationally listed green bond indices focusing on specific jurisdictions – in particular China. For instance, the Shanghai Green Bond Index Series (developed by

has its own methodology for choosing the components of the index. While advertising consistency with the Green Bond Principles, each index also specifies additional factors such as size and liquidity, as well as the specific industry sectors for which the proceeds are used.

Index providers can arguably serve an ongoing monitoring function, since they can discard entities from an index as well as include them. However, since many inclusion criteria for green bond indices are much less concrete than those for conventional bonds (such as minimum levels of market liquidity and credit ratings), it remains to be seen whether the index providers can monitor such environmental criteria on a continuous basis.

External reviews

Though it is not a part of the four main Green Bond Principles, it was recommended in the 2015 edition of the Principles that green bond issuers “use external assurance to confirm alignment with the key features of Green Bonds”. This can include second opinions and verifications. From 2016, the Principles referred to “external reviews” rather than “external assurance”, while the list of recommended external reviews was expanded to include those provided by rating agencies (ICMA (2016)).

A limitation of the CBI standard and inclusion in the green bond indices is their binary nature: a bond is either green or not. More granular assessments could contain valuable information for investors, such as the degree of environmental benefits, or whether environmental benefits are likely to persist. Indeed, the following providers of green certification make more granular assessments.

CICERO is a climate research institute based in Oslo (Table 1, third column) and the leading provider of second opinions. It evaluates the issuer’s framework for both project selection and investment (CICERO (2016)). CICERO provides three different degrees of positive assessment (“shades of green”), reflecting the bond’s adherence to a long-term vision for a low-carbon, “environmentally resilient” society. However, CICERO reviews the green bond framework at the time of issuance. Ex post changes in the framework or environmental impact are not monitored, unless the issuer specifically requests it.⁷

Moody’s Green Bond Assessments. The first public methodology for the assessment of green bonds by a ratings agency was published by Moody’s Investors Service in March 2016 (Table 2, second column). Green Bond Assessments (GBAs) are intended to “assess the relative likelihood that bond proceeds will be invested to support environmentally friendly projects”, in line with the Green Bond Principles (Table 2, first column). As with their credit rating products, Moody’s employs numerous quantifiable factors in determining the GBAs, with the explicit aim of

the Shanghai Stock Exchange in collaboration with China Securities Index Co), or the CUFÉ-CNI Green Bond Index Series (developed by the Shenzhen Securities Information Co together with the International Institute of Green Finance) are indices based on green bonds issued in China which are also listed in Europe on the Luxembourg stock exchange.

⁷ More regular monitoring is now implicitly recommended by the Green Bond Principles though not necessarily delegated to third parties. In 2016, the Principles were updated to state that issuers should “... keep readily available up to date information on the use of proceeds to be renewed annually until full allocation and as necessary thereafter in the event of new developments”.

Comparison of Green Bond Principles and rating agencies' green certifications

Table 2

Green Bond Principles	Moody's Green Bond Assessments	Standard & Poor's Green Evaluations ¹
<p><i>Use of proceeds</i> Use should be described and present clear environmentally sustainable benefits.</p>	<p><i>Use of proceeds</i> Assessment depends on percentage of proceeds allocated to eligible project categories. Weighted 40% as a factor.</p>	<p><i>Mitigation</i> Assesses the environmental impact of financing proceeds over the life of the assets. Weighted 60% as a factor.</p>
<p><i>Process for project evaluation and selection</i> Decision-making process should be outlined; in particular, how projects fit into green categories, eligibility criteria and environmental sustainability objectives.</p>	<p><i>Organisation</i> Sub-factors: effectiveness of environmental governance and organisation structure; rigorous review and decision-making process; qualified personnel and/or reliance on third parties; explicit criteria for investment selection; external evaluations for decision-making. Weighted 15% as a factor.</p>	<p><i>Governance</i> Considers whether well defined procedures in place for:</p> <ul style="list-style-type: none"> - Selecting projects eligible to be financed - Appraising and managing environmental impact - Complying with environmental regulations <p>Weighted 19% as a factor.</p>
<p><i>Management of proceeds</i> Net proceeds should be tracked by formal internal process.</p>	<p><i>Management of proceeds</i> Sub-factors: segregation and tracking of proceeds on accounting basis; tracking of the application of proceeds by environmental category and project type; reconciliation of planned investments against allocations; eligibility rules for investment cash balances; external or independent internal audit. Weighted 15% as a factor.</p>	<p><i>Governance</i> Considers whether well defined procedures in place for preventing proceeds of the bond from being used for other purposes than the intended green financings. Weighted 6% as a factor.</p>
<p><i>Reporting</i> Issuers should provide annual list of projects to which proceeds are allocated.</p>	<p><i>Disclosure on use of proceeds</i> Sub-factors: description of green projects; adequacy of funding to complete projects; quantitative descriptions of targeted environmental results; methods and criteria for calculating performance against targets; reliance on external assurances. Weighted 10% as a factor.</p> <p><i>Ongoing reporting and disclosure</i> Sub-factors: reporting and disclosure post-issuance; ongoing annual reporting; granular detail on nature of investment and environmental impact; quantitative assessment of impacts to date; comparison of assessments of impacts with projections at time of issuance. Weighted 20% as a factor.</p>	<p><i>Transparency</i></p> <ul style="list-style-type: none"> - Use of proceeds reporting - Impact reporting and disclosure - External verification of impact data <p>Weighted 15% as a factor.</p>

¹ The methodology of Standard & Poor's Green Evaluations differs between instruments that finance mitigation projects and those that finance adaptation projects. The comparison of the table focuses only on the evaluations of instruments that finance mitigation projects, or those that "bring environmental benefits and target areas such as natural resources depletion, loss of biodiversity, pollution control, and climate change".

Sources: International Capital Market Association (2015); Moody's Investors Service (2016a); Standard & Poor's (2017b).

increasing their transparency and replicability. Regular review is anticipated, similar to the way regular credit ratings are refreshed over a multi-year horizon.⁸

Standard & Poor's Green Evaluations. Standard & Poor's introduced Green Evaluations in 2017 (Table 2, third column). The focus of these ratings is broader than that of GBAs, as they include a technical environmental impact assessment component, along with governance and transparency components. A score between zero and 100 is intended to evaluate the relative ranking of the overall expected lifetime environmental impact relative to maintaining the status quo – after discounting for qualities of the governance and transparency of the bond's use of proceeds.

Notwithstanding its broader focus, the S&P methodology can also be viewed as mostly in line with the Green Bond Principles, while providing transparency with regard to the quantitative importance of various factors, and considerable granularity in the final assessment. That said, each score is a point-in-time evaluation, and is removed from the S&P website after at most 18 months. In this sense, ex post assessment is not provided unless requested as part of a separate evaluation.

The pricing of green bonds, financial performance and risks

For the green bond market to channel a significant amount of funds into environmentally friendly projects, green bonds should also fulfil the needs of both issuers and investors. Looking at the same issuer, the risk characteristics of a green bond are essentially identical to those of a conventional bond: while the proceeds from the issuance of a green bond are earmarked for environmentally friendly projects, green bonds are serviced from the cash flows of the entire operations of the issuer – not just the green project.

These characteristics have implications for the pricing of green bonds and their attractiveness for investors. A premium at issuance over comparable bonds without a green label would indicate that a significant number of investors value the label, enough to give issuers an extra incentive to issue bonds that have it. At the same time, these investors will still be interested in an acceptable financial performance of green bonds over time. Another consideration is the exposure to credit risks related to environmental change. That green bonds support environmentally beneficial projects does not necessarily imply lower exposure to such risks. The rest of this section discusses these issues further.

The green bond premium

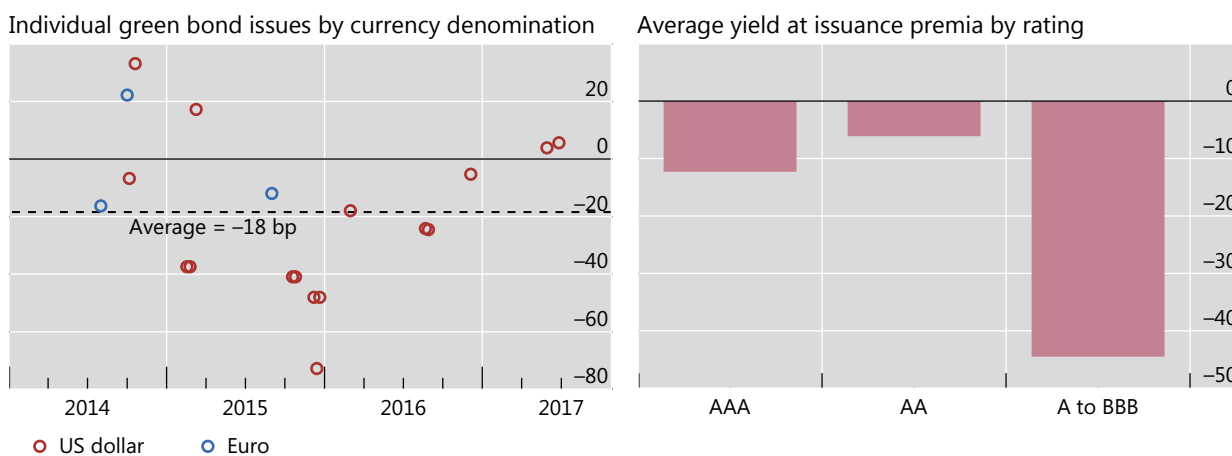
Does the green label influence the price that issuers are willing to pay (in other words, the yield spread over risk-free rates that they are willing to accept) for a bond? A large body of literature documents that factors unrelated to credit risks can significantly

⁸ ESG ratings, which assess a firm's performance across a weighted average of environmental, social and governance (ESG) issues, provide many of the same attributes. In June 2016, the Green Bond Principles statement by ICMA recognised that the "use of proceeds" bond concept might be applied to themes beyond the environment, such as bonds financing projects with social objectives, or with a combination of social and environmental objectives. However, the green bond label is still reserved for investment projects providing clear environmental benefits. Since ESG ratings are not specifically focused on environmental benefits, they are not considered in this feature.

Credit spreads at issuance of green versus non-green bonds¹

In basis points

Graph 3



¹ Relative differences in credit spreads at issuance compared with a non-green bond of the same issuer at the closest possible date. The average closest date of a non-green bond issue by the same issuer is around seven days before the issue date of the green bond. Sample was restricted to pari passu bonds of at least two-year maturity at issuance, at least \$10 million issuance amount and currency of denomination being either euros or US dollars. Credit spreads are calculated as the spreads of yields at issuance over the yield curve of US Treasury securities (for US dollar-denominated bonds) and German Federal Treasury securities (for euro-denominated bonds) of the same maturity at issuance date; if the same maturity was not available, the available points of the respective yield curve were interpolated.

Sources: Board of Governors of the Federal Reserve System; Deutsche Bundesbank; Bloomberg; authors' calculations.

influence bond yield spreads, such as specific demand and supply factors (eg Collin-Dufresne et al (2001), Greenwood and Vayanos (2014)) or liquidity premia (eg Longstaff (2004), Amihud et al (2006)). If a sizeable population of investors is willing to pay a premium (accept a lower spread) for green bonds, this should show up in the pricing of the bonds at issuance.

To analyse the price effect of the green label, we compare the credit spreads at issuance of a cross-section of 21 green bonds issued between 2014 and 2017 with the credit spreads at issuance of conventional bonds of the same issuers at the closest possible issue date (Graph 3). As most issuers of green bonds also regularly issue conventional bonds, this comparison allows us to control for issuer-specific idiosyncratic factors, including credit risk. We do not include any project bonds, as claims on cash flows could possibly be on different projects with different risk characteristics. We further restrict the sample to pari passu fixed rate bonds, to avoid the influence that debt seniority or the uncertainty of floating rates could have on the pricing at issuance. We look for conventional bonds of roughly the same maturity, and restrict our matched pairs to US dollar- and euro-denominated green bonds, as spreads over local benchmark rates tend not to be as stable for bonds issued in EME currencies.

Our results indicate that green bond issuers *on average* have borrowed at lower spreads than they have through conventional bonds. This confirms the results from other recent studies (eg Zerbib (2017), Barclays (2015)). The mean difference in spread in our sample is around 18 basis points.⁹ Overall, this is consistent with a high

⁹ An 18 basis point lower credit spread would be significant relative to the potential costs of a green label or rating. The certification fee for the green label of the Climate Bonds Initiative is a flat 0.1 basis points of the issue value (though the CBI also requires the external engagement of a party that verifies

demand for green bonds (CBI (2017), OECD (2016)) relative to supply – in other words, enough investors have a preference for holding green bonds to influence the issue price. When we segment the sample by rating category, it appears that the green yield difference is greater for riskier borrowers (Graph 3, right-hand panel). Recall that we compare credit spreads at issuance of *pari passu* bonds from the same issuer, so this result does not reflect differences in credit risk (or other factors) across issuers within the same rating category. Again, this finding is consistent with previous work (Zerbib (2017)).

At the same time, we also document considerable variation across the individual green bond issues in our sample (Graph 3, left-hand panel). The standard deviation of the premium is 27 basis points. Not all issuers were able to take advantage of a yield discount at issuance: five out of the 21 green bond issues priced at spreads above the matched conventional bonds. We also could not document yield premia for higher levels of greenness as determined by the more granular assessments of the major rating agencies.¹⁰

Financial performance over time

Returns to investors from green bonds will reflect their performance over time, in particular when investors do not intend to simply hold them until maturity. The average premium at issuance will not necessarily translate into a noticeable underperformance in secondary market trading. Investors in the secondary market may well price in a different premium from primary market investors.¹¹ Many investors will also be interested in the realised volatility of green bonds as a metric of financial performance.

Green bond indices are a good starting point to analyse the secondary market performance of green bonds from an investor perspective. Green bond indices contain a diversified broader portfolio of bonds¹² and thereby provide a good means of comparison with the performance of other bond indices that are suitable for a wide range of investors. We analyse so-called hedged returns, which measure returns in US dollars that can be achieved by hedging the currency exposures of the underlying index. As green bond indices differ notably from other global bond indices in their currency composition, currency movements alone can have an outsize impact on relative returns.

procedures and reports). As for the green assessments of the major rating agencies, even if they were to be as expensive as a normal credit rating (3–5 basis points of the issue volume (White (2002))), the costs would be far less than 18 basis points.

¹⁰ These new assessments have so far tended to be at one end of the spectrum: for instance, the 26 bond issues with Moody's GBAs as of end-July 2017 were all at the highest level (GB1). The 10 available bond issues with green rating evaluations by Standard & Poor's rank between 67 and 92 (out of 100), but the only four of these bonds for which we could find yields are from the same issuer and therefore have the same score. This does not allow us to make meaningful comparisons of the pricing of bonds across different green bond ratings. Likewise, because of a paucity of yield data, we cannot compare the impact of the rating agency assessments with those of the other green labels.

¹¹ Buy and hold investors will have decided *ex ante* that the benefits of holding the individual issue to maturity equal or outweigh the premium.

¹² Some analysts, however, have argued that green bond indices are less diversified than other much broader bond indices (Fitch Ratings (2017)). Nevertheless, the green bond indices we consider represent an accurate overall picture of the financial characteristics of the green bond market at its current stage of development.

Green bond indices: return characteristics

Annualised monthly total returns, July 2014–June 2017; in per cent

Table 3

		Hedged returns ¹				Unhedged returns ²			
		Cumulative over 36 months	Mean (1)	Std dev (2)	Sharpe ratio = (1)/(2)	Cumulative over 36 months	Mean (1)	Std dev (2)	Sharpe ratio = (1)/(2)
Green bond indices	Standard & Poor's	.	.	.	.	-4.18	-1.48	18.44	-0.08
	BofA Merrill Lynch	9.17	3.06	8.64	0.35	-6.45	-2.15	18.92	-0.11
	Solactive	.	.	.	.	-4.52	-1.51	18.66	-0.08
	Barclays MSCI	10.23	3.41	9.61	0.35	-3.43	-1.14	17.23	-0.07
Global bond indices	Broad-based	11.26	3.75	11.64	0.32	3.46	1.15	14.97	0.08
	AA average rating	10.29	3.43	10.21	0.34	0.97	0.32	14.16	0.02
	A average rating	11.02	3.67	10.99	0.33	3.12	1.04	14.08	0.07

¹ Total returns for indices hedged against currency risks, which are more comparable across indices that differ in their currency composition. They represent a close estimation of the return that can be achieved by hedging the currency exposures of the underlying index by selling foreign currency forwards at one-month forward rates. Hedged returns are not exact measures of the true returns, since they do not include transaction costs for hedging contracts. Those can be considered small, in particular, since euro exposures present the largest foreign currency component (see also Graph 1). Bid-ask spreads on EUR/USD forwards, which are an indicator of transaction costs, are usually between 1 and 1.5 bp. ² Total returns from holding a simple position in the respective index. Green bond indices differ substantially in their currency composition from the global bond indices. Hence, currency movements will significantly affect return differentials between green bond and global bond indices.

Sources: Bloomberg; Barclays; authors' calculations.

Overall, the performance of *hedged* green bond indices has been similar to that of global bond indices of comparable credit rating composition¹³ (Table 3, left-hand columns). Even though the available green bond indices by Bank of America Merrill Lynch, Barclays MSCI, Standard & Poor's and Solactive diverge slightly in their composition (CBI (2015)), their return characteristics hardly differ. The ratio of average monthly hedged returns to their standard deviation (Sharpe ratio), which is a standard measure for risk-adjusted performance, was in some cases even slightly higher for green bond indices than for global bond indices, though that difference was not statistically significant.

Total returns in US dollars on *unhedged* green bond indices, however, have exhibited higher volatility than those of broad-based bond indices (Table 3, right-hand columns). As the currency composition of the green bond indices is very diverse, and much less tilted towards the US dollar than is the case for global indices, movements in the currency of denomination of some green bonds in the indices increase the measured return volatility. This points to the importance of the availability of currency hedges for investors in green bonds.¹⁴

¹³ The universe of labelled green bonds from Bloomberg and CBI has an average rating of slightly below AA. The average maturity and duration of the global bond indices and the different green bond indices are quite similar, but sectoral and currency compositions differ.

¹⁴ Importantly, some researchers (eg Andersson et al (2016)) have shown that it is possible to construct a portfolio of green instruments that has an identical performance to that of a broader market index. This would provide a product for a wide range of green investor that yields a financial performance equal to that of a diversified market portfolio, but with environmental benefits.

The green label and exposure to environmental risks

Carney (2015) describes the potentially severe impact of climate change on the economy as a “tragedy of the horizon”: investors and other actors do not sufficiently take the risks into account as they materialise only over a long horizon. Indeed, a number of academic studies have documented a tendency for investors to inadequately price environmental risks (Hong et al (2016) and references therein). This is despite already strong evidence of severe financial impacts of both *physical risks*, due to climate-related events such as droughts and floods, and *transition risks*, such as the risk of a material change in environmental regulations (Caldecott et al (2014)). For instance, rating agencies now plan to take account of the financial risks related to the transition to stricter carbon emission rules implied by the Paris agreement when they analyse credit risks of bond issuers from polluting sectors (eg Moody’s Investors Service (2016b)).

One question is whether green bonds can provide an instrument for investors to hedge against these environmentally related financial risks. If these risks materialise, bonds from issuers in polluting sectors may be subject to significant revaluations. To the extent that issuers of green bonds are better shielded against large revaluations, they could serve as an efficient risk management instrument.

But this need not be the case. Green bonds generally comprise investor claims on an entity’s overall operations. A large and diversified energy company may invest a considerable amount in green projects, but other parts of its business (for instance coal power plants) may expose it to environmentally related credit risks, such as changes in carbon regulations. There may also be green bonds whose income stream is vulnerable to climate change quite apart from transition risk (for example, wind farms subject to flood risk). In the case of almost all green bonds, the exposure to environmentally related credit risks is a function of the entire company’s business. Only a few green bonds are project bonds, where claims are on the cash flows of the financed green project itself.

Environmental credit risk composition of all rated bonds versus green bonds only¹

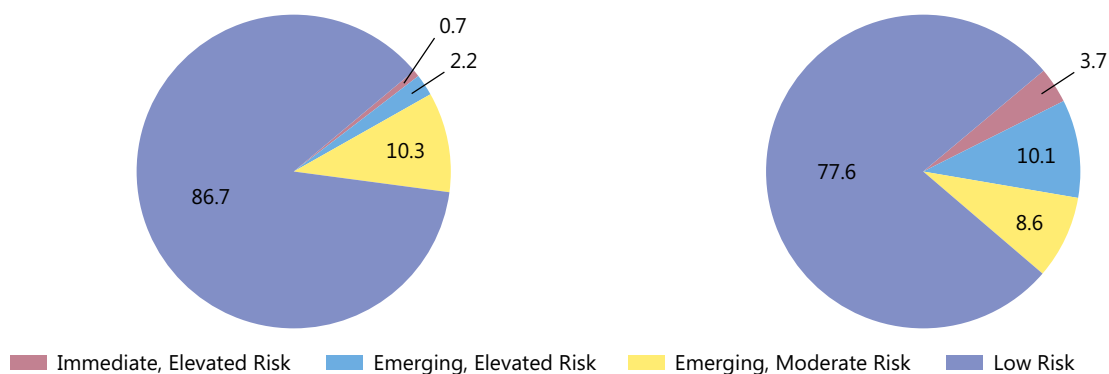
In per cent

Graph 4

Total rated debt (2015)

Green bonds

Share of total issuance since 2007²



¹ Aggregate issuance of bonds by issuers from sectors which belong to the risk categories shown, as defined by Moody’s. See Moody’s Investors Service (2015). In cases where industrial classification is ambiguous, we use equal weights to distribute the issuance volume across relevant sectors. ² Through mid-June 2017.

Sources: Bloomberg; Climate Bonds Initiative; Moody’s; authors’ calculations.

Indeed, the evidence suggests that green bonds are more, not less, exposed to environmentally related credit risks. Moody's provides a classification of credit exposures to environmental risks at the sectoral level (Moody's Investors Service (2015) and Annex Table A1).¹⁵ Within the universe of corporate debt rated by Moody's, 13.2% is issued by institutions in industries with moderate or greater exposure to environmental credit risk, and around 2.9% in industries classified as either immediate or emerging elevated risk (Graph 4, left-hand panel). By contrast, when we examine the industry composition of green bonds alone, we see that 22.4% of green bonds are issued in sectors with moderate or greater exposure to environmental credit risk, and nearly 14% in industries classified as elevated risk (right-hand panel). Thus, the percentage of green bonds in high-risk sectors exceeds that for overall rated debt by a factor of four.

Conclusion

Green bond principles and standards are an important step towards promoting green finance. Since the introduction of the Green Bond Principles by the ICMA in January 2014, the issuance of labelled green bonds has increased rapidly, with a growing number of issuers from the private sector and EMEs. Several green bond indices have also been introduced, allowing a broader group of investors to take a diversified position in green bonds. The evidence suggests that investors place value on the green label at issuance, even though the post-issuance financial performance of green bonds is comparable with that of conventional bonds. However, for this still relatively small market to grow more, several further developments need to take place.

First, the various existing definitions and labels for green bonds pose a challenge for investors, who may benefit from more consistent standards. The ongoing work to improve the consistency of standards in China and the European Union are promising in this regard. At the same time, more ongoing monitoring by "second opinion" providers, rating agencies or other forms of continuous third-party verification may be needed. Even if asset managers utilise the green label simply to signal to ultimate investors their fulfilment of green mandates, the information value of those labels can depreciate over time as technology evolves or policies of the issuer change.

A second informational aspect that is not covered by current green certification schemes is the environmentally related financial risks of green bonds. While the management of environmental risks extends far beyond green bonds, it is important to avoid the misperception that green bonds are insulated from such risks. In fact, among all rated bonds, those with a green label are more likely to be in sectors that are exposed to such risks. Green bond standards could be enhanced to highlight the degree of financial risks stemming from environmental factors so as to further encourage investors to manage these risks effectively.

¹⁵ Credit risks from environmental exposures are defined as the risks to a borrower's ability to repay caused by physical climate events or changes in environmental regulations.

References

- Amihud, Y, H Mendelson and L Pedersen (2006): "Liquidity and asset prices", *Foundations and Trends in Finance*, vol 1, no 4, pp 269–364.
- Andersson, M, P Bolton and F Samama (2016): "Hedging climate risk", *Financial Analysts Journal*, vol 72, no 3, pp 13–32.
- Barclays (2015): "The cost of being green", *US Credit Focus*, September.
- Caldecott, B (2012): "Green infrastructure bonds: accessing the scale of low cost capital required to tackle climate change", *Climate Change Capital*.
- Caldecott, B, J Tilbury and C Carey (2014): "Stranded assets and scenarios", Smith School of Enterprise and the Environment, *Discussion Paper*, January.
- Carney, M (2015): "Breaking the tragedy of the horizon – climate change and financial stability", speech given at Lloyd's of London, 29 September.
- CICERO (2016): *Framework for CICERO's 'Second Opinions' on green bond investments*, April.
- Climate Bonds Initiative (2015): *Bonds and climate change – the state of the market in 2015*, July.
- (2017): *Green bond pricing in the primary market: Q4 2016 snapshot*, March.
- Collin-Dufresne, P, R Goldstein and J Spencer Martin (2001): "The determinants of credit spread changes", *Journal of Finance*, vol LVI, no 6, December, pp 2177–207.
- Ehlers, T (2014): "Understanding the challenges for infrastructure financing", *BIS Working Papers*, no 454, August.
- Ehlers, T, F Packer and E Remolona (2014): "Infrastructure and corporate bond markets in Asia", in *Financial flows and infrastructure financing*, Reserve Bank of Australia, conference volume, July.
- European Investment Bank (2017): "New People's Bank of China and EIB initiative to strengthen green finance", press release, 22 March.
- Fitch Ratings (2017): "Green bond funds face diversification challenge", special report, August.
- FSB Task Force on Climate-Related Financial Disclosures (2017): *Final report: recommendations of the task force on climate-related financial disclosures*, June.
- G20 Green Finance Study Group (2016): *Green finance synthesis report 2016*, September.
- Greenwood, R and D Vayanos (2014): "Bond supply and excess bond returns", *Review of Financial Studies*, vol 27, no 3, pp 663–713.
- Hong, H, F Li and J Xu (2016): "Climate risks and market efficiency", *NBER Working Papers*, no 22890.
- International Capital Market Association (2014): *Green Bond Principles*, January.
- (2015): *The Green Bond Principles 2015*, March.
- (2016): *The Green Bond Principles 2016*, June.
- Longstaff, F (2004): "The flight-to-liquidity premium in US treasury bond prices", *The Journal of Business*, vol 77, no 3, pp 511–26.

Moody's Investors Service (2015): "Environmental risks – heat map shows wide variations in credit impact across sectors", September.

——— (2016a): *Green Bonds Assessment (GBA)*, March.

——— (2016b): "Moody's to analyse carbon transition risk based on emissions reduction scenario consistent with Paris agreement", June.

Organisation for Economic Co-operation and Development (2016): "Mobilising bond markets for a low-carbon transition", *Green finance and investment*, April.

People's Bank of China (2015): "Announcement No. 39," December.

Pereira da Silva, L (2017): "Green finance: can it help combat climate change?", remarks at the Global Public Investor Symposium on "Green bond issuance and other forms of low-carbon finance", Frankfurt am Main, 13 July, organised by the BIS, OMFIF, the Deutsche Bundesbank and the World Bank Group.

Standard & Poor's (2017a): "We won't solve for green finance unless we solve for infrastructure", *S&P Global Market Intelligence*, April.

——— (2017b): "Green evaluation analytical approach", *S&P Global Market Intelligence*, April.

Weidmann, J (2017): "Green bond issuance and other forms of low-carbon finance", speech at the Global Public Investor Symposium on "Green bond issuance and other forms of low-carbon finance", Frankfurt am Main, 13 July, organised by the BIS, OMFIF, the Deutsche Bundesbank and the World Bank Group.

White, L (2002): "The credit rating industry: an industrial organisation analysis", in R Levich, G Majnoni and C Reinhart (eds), *Ratings, rating agencies and the global financial system*.

Zerbib, O (2017): "The green bond premium", July.

Annex

Moody's sectoral environmental risk classification

Credit exposure to environmental risks

Table A1

Environmental risk classification	Description	Relevant industry examples
Immediate, Elevated Risk	Sectors are already experiencing material credit implications as a result of environmental risk. Rating changes have either already been occurring for a substantial number of issuers or ratings changes are likely within the next three years.	Unregulated utilities and power companies.
Emerging, Elevated Risk	Sectors overall have clear exposure to environmental risks that, in aggregate, could be material to credit quality over the medium term (three to five years), but are less likely in the next three years.	Automobile manufacturers, power generation projects.
Emerging, Moderate Risk	Sectors have a clear exposure to environmental risks that could be material to credit quality in the medium to long term (five or more years) for a substantial number of issuers. However, it is less certain that the identified risks will develop in a way that is material to ratings for most issuers.	Regulated electric and gas utilities with generation, sovereigns – developing countries, environmental services and waste management, paper and forest products.
Low Risk	Sectors in this category have either no sector-wide exposure to meaningful environmental risks or, if they do, the consequences are not so likely to be material to credit quality.	Supranationals and sovereigns – developed countries, banks and finance companies, consumer goods, semiconductors and technology hardware.

Source: Moody's Investors Service (2015).

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).

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A Locational banking statistics

Cross-border claims, by sector, currency and instrument

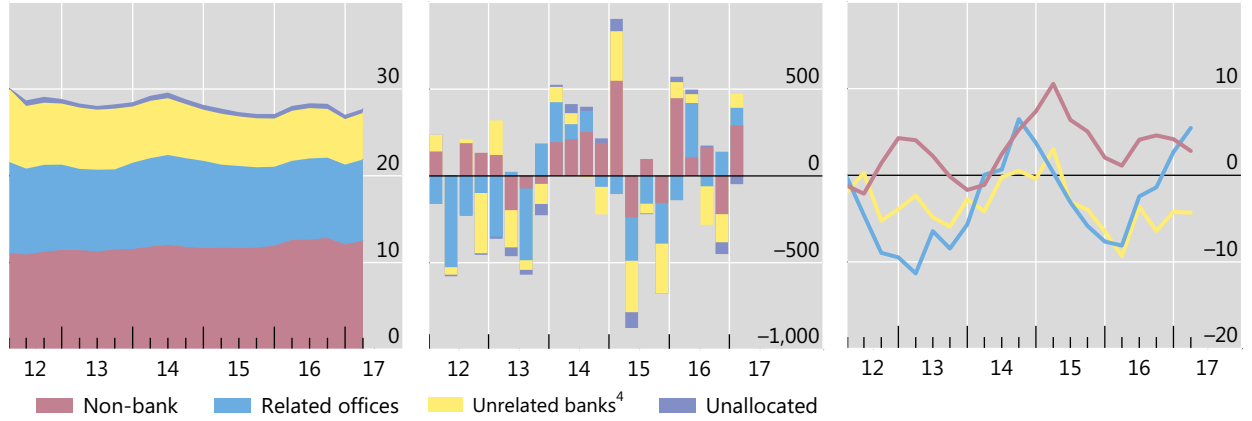
Graph A.1

Amounts outstanding, in USD trn¹

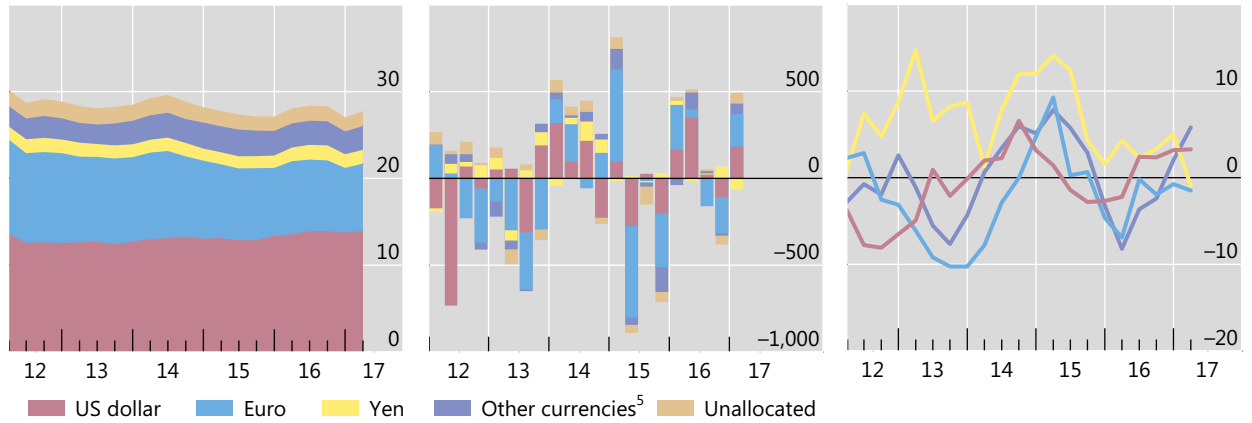
Adjusted changes, in USD bn²

Annual change, in per cent³

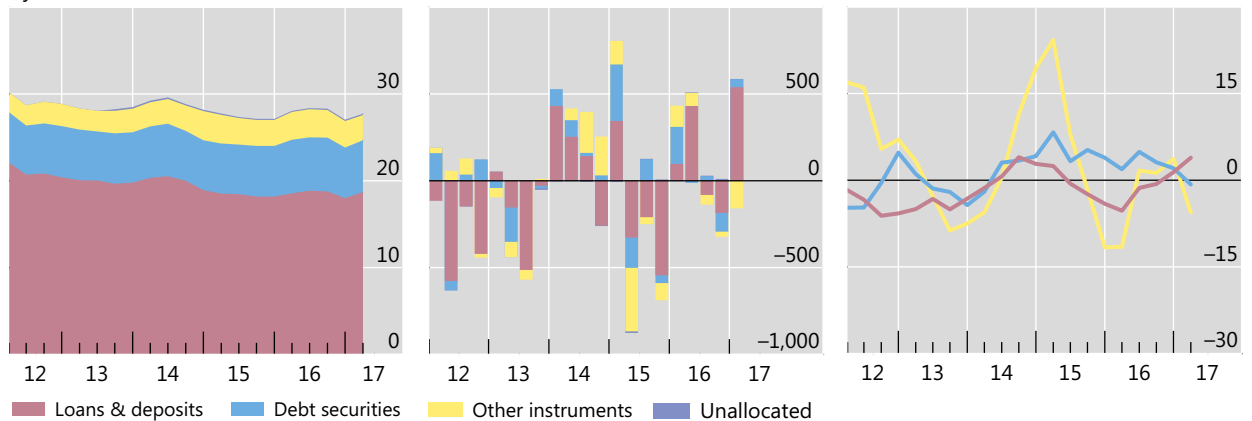
By sector of counterparty



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

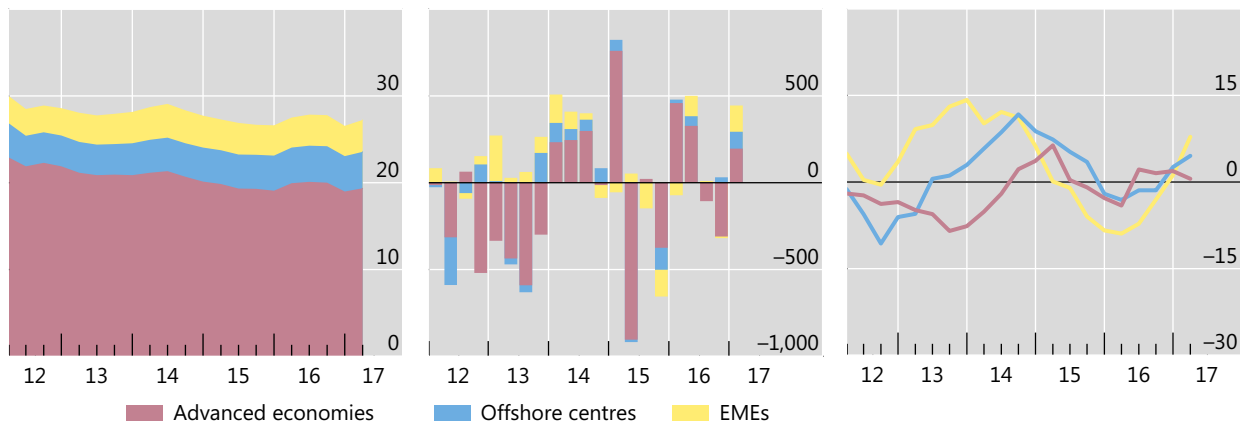
Graph A.2

Amounts outstanding, in USD trn¹

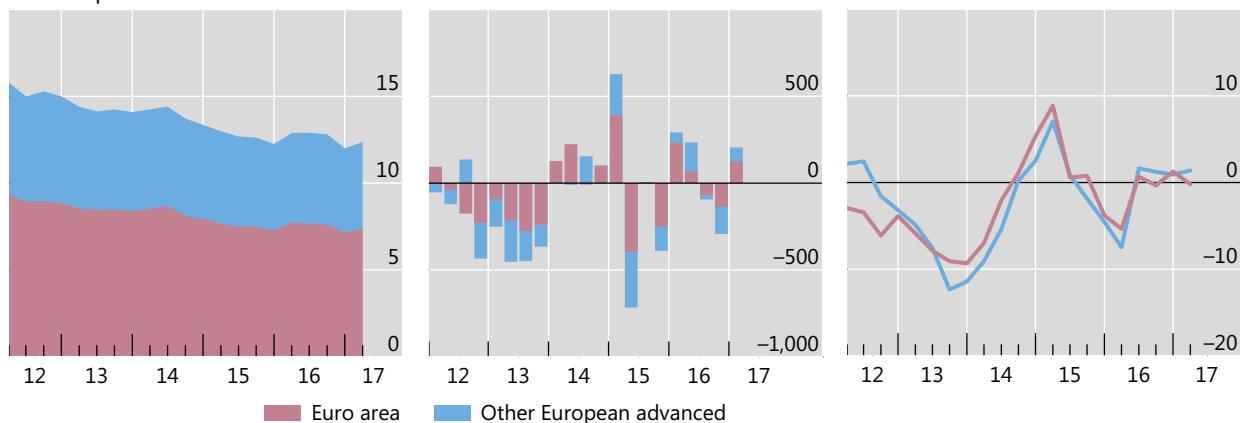
Adjusted changes, in USD bn²

Annual change, in per cent³

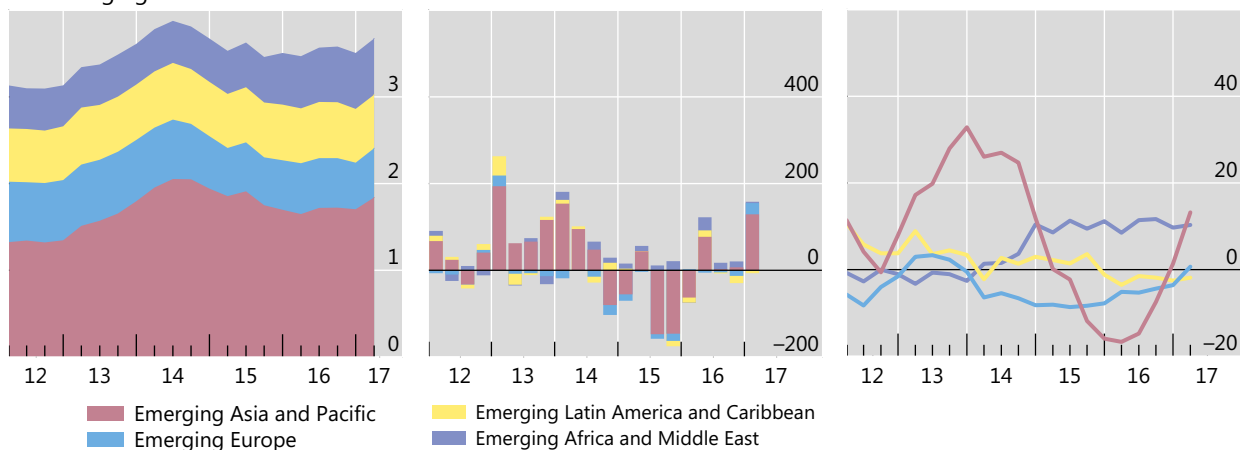
On all countries



On Europe



On 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 borrowing country

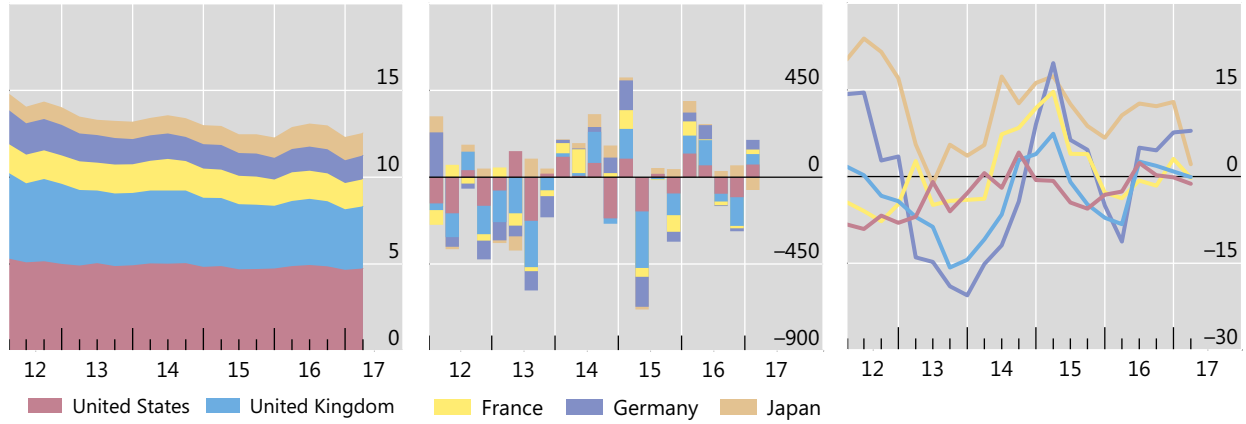
Graph A.3

Amounts outstanding, in USD trn¹

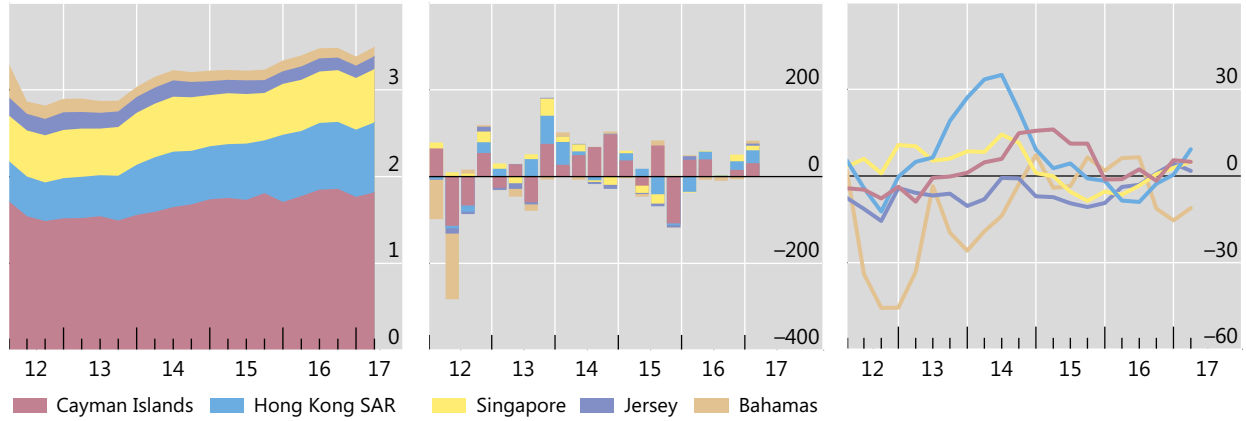
Adjusted changes, in USD bn²

Annual change, in per cent³

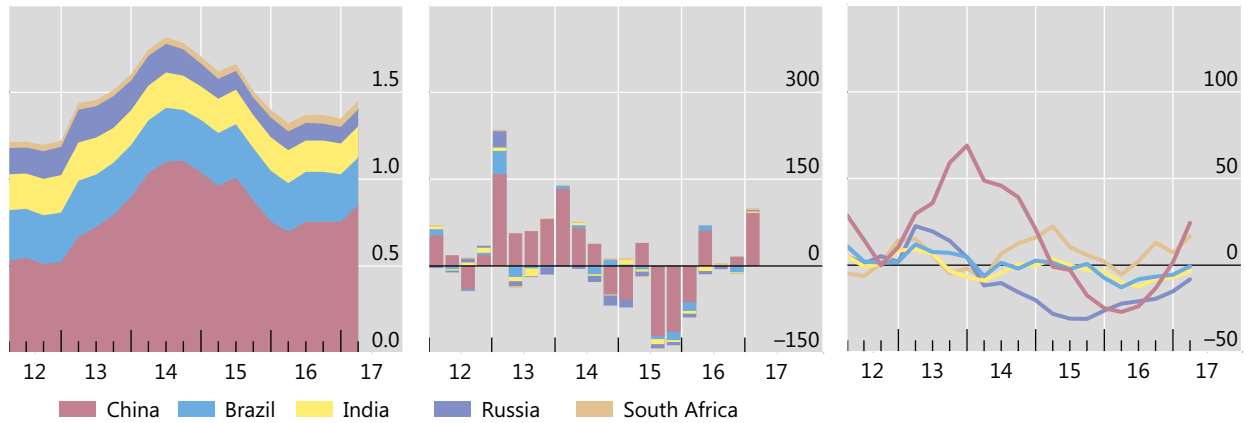
On selected advanced economies



On selected offshore centres



On selected emerging market economies

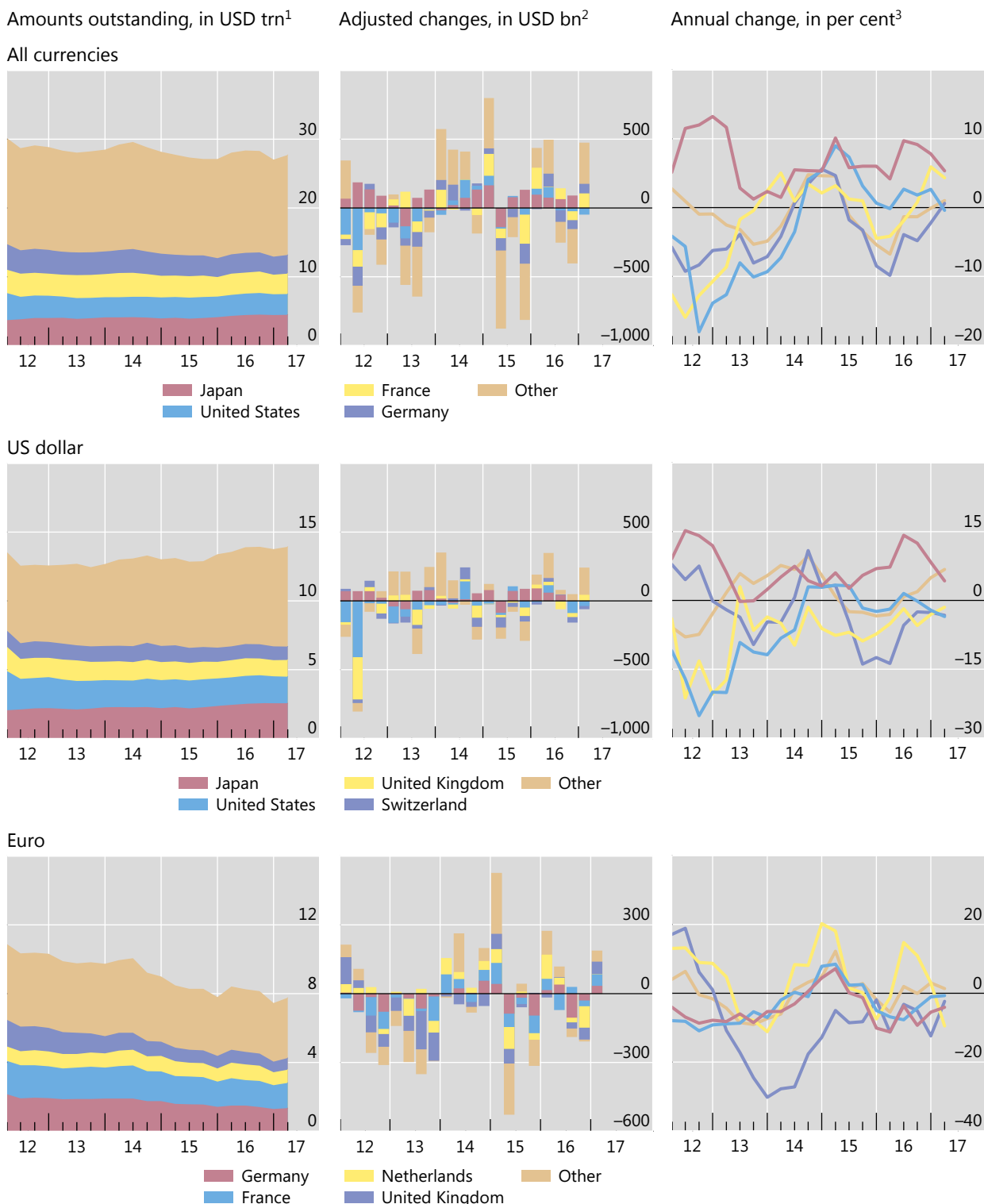


Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

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

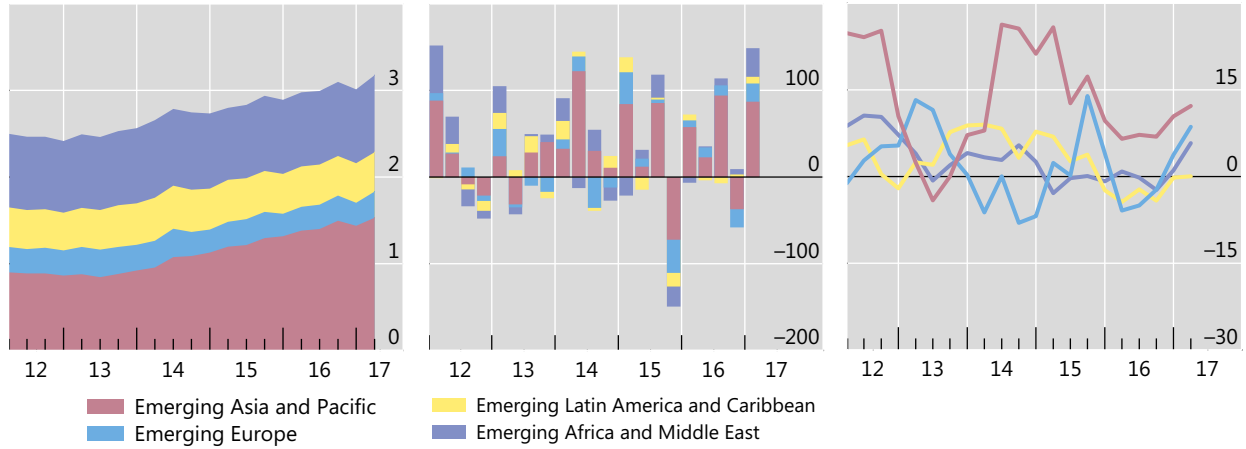
Graph A.5

Amounts outstanding, in USD trn¹

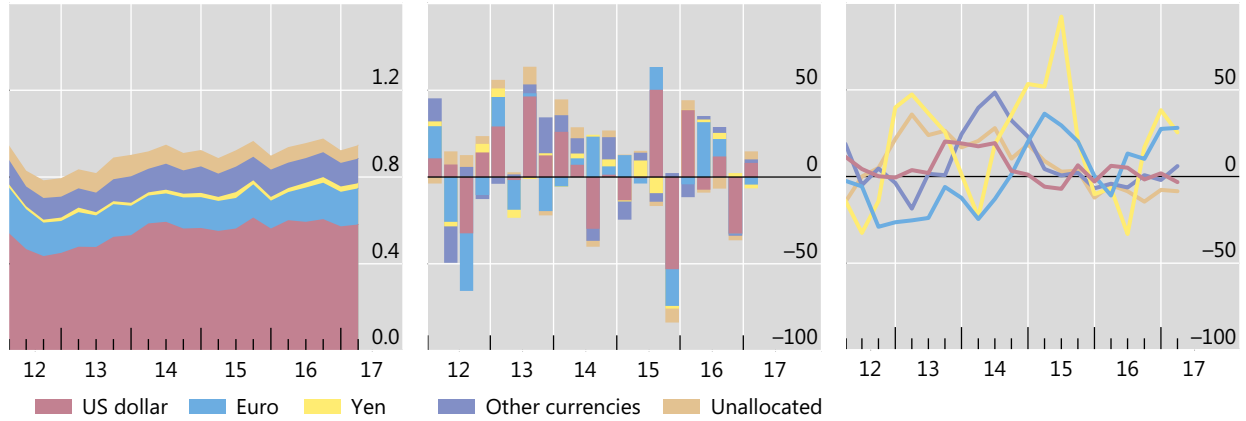
Adjusted changes, in USD bn²

Annual change, in per cent³

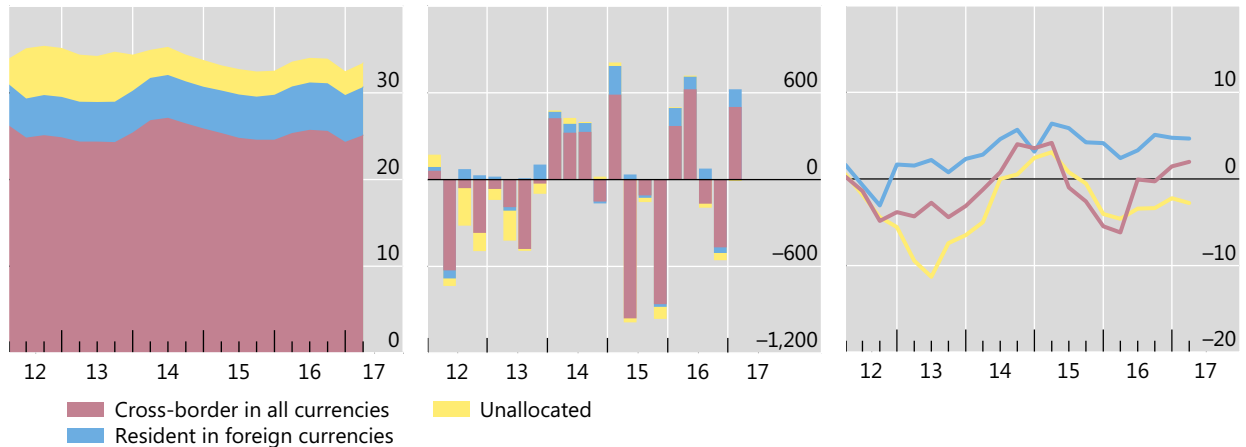
To emerging market economies



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

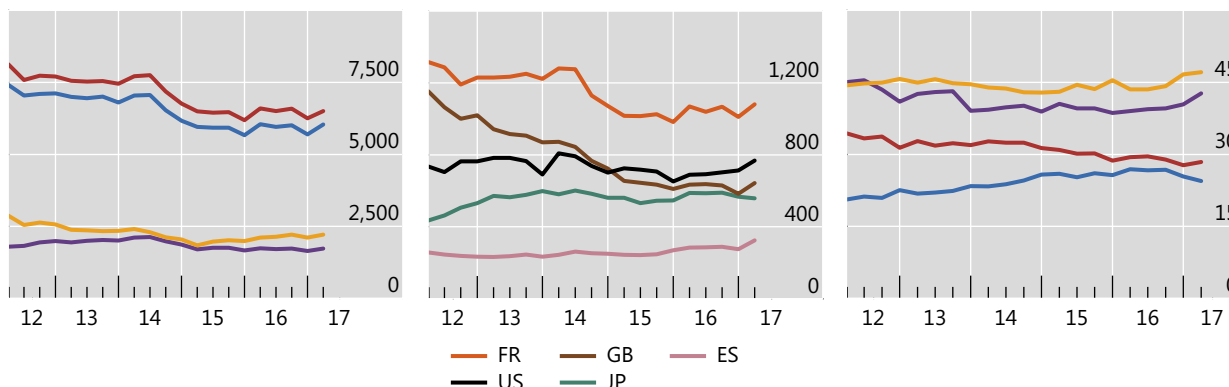
Graph B.1

Foreign claims and local positions, in USD bn^{1,2}

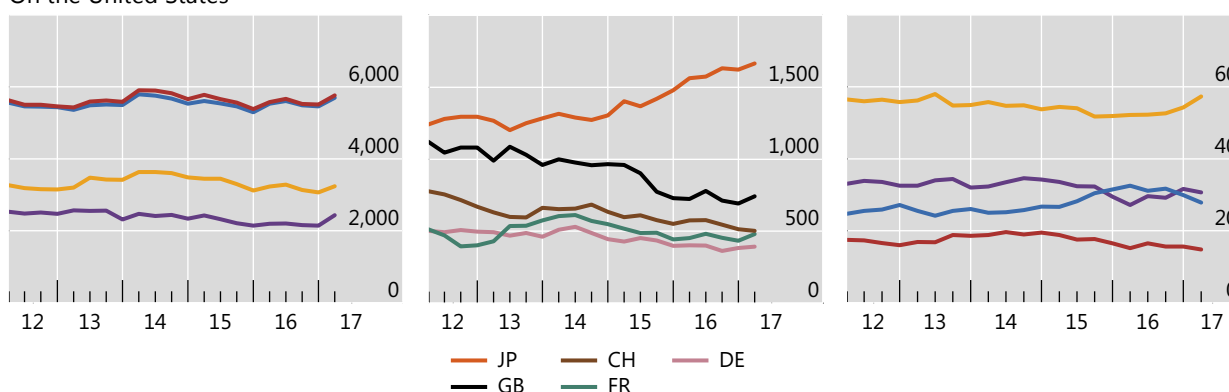
Foreign claims of selected creditors, in USD bn^{1,3}

International claims, by sector and maturity, in per cent⁴

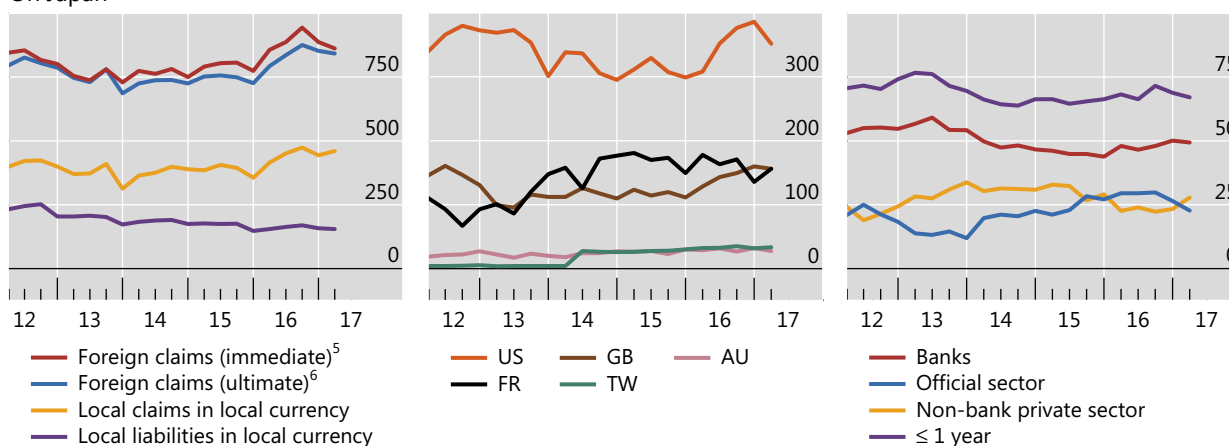
On the euro area



On the United States



On Japan



AU = Australia; CH = Switzerland; DE = Germany; FR = France; GB = United Kingdom; JP = Japan; NL = Netherlands; US = United States.

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

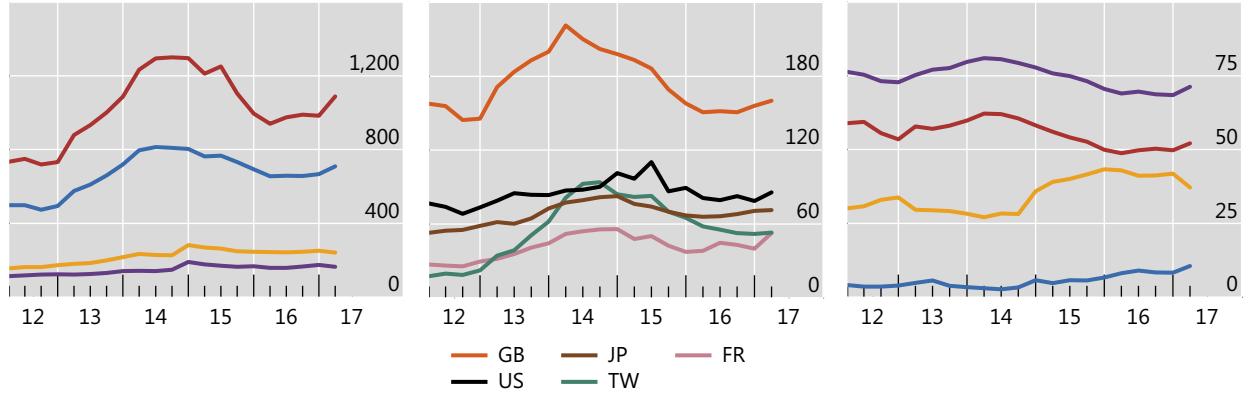
Graph B.2

Foreign claims and local positions, in USD bn^{1,2}

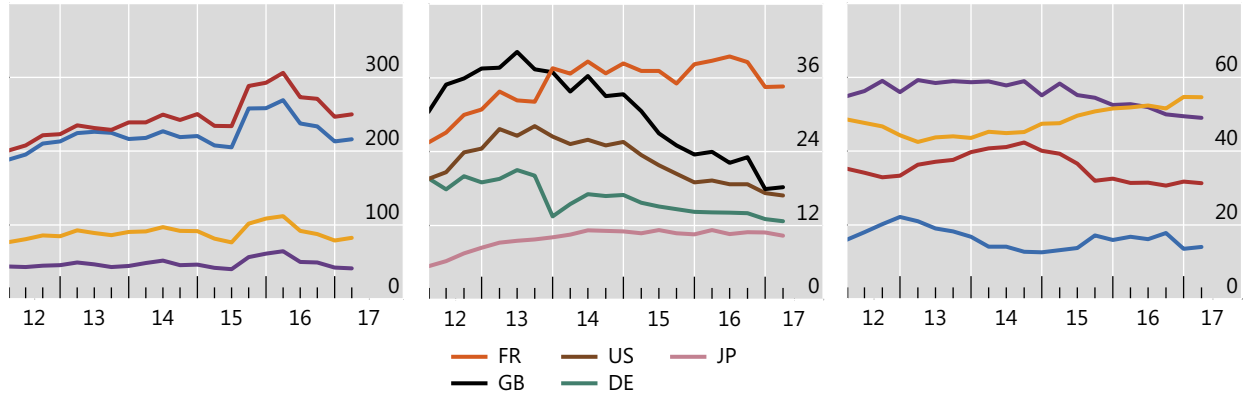
Foreign claims of selected creditors, in USD bn^{1,3}

International claims, by sector and maturity, in per cent⁴

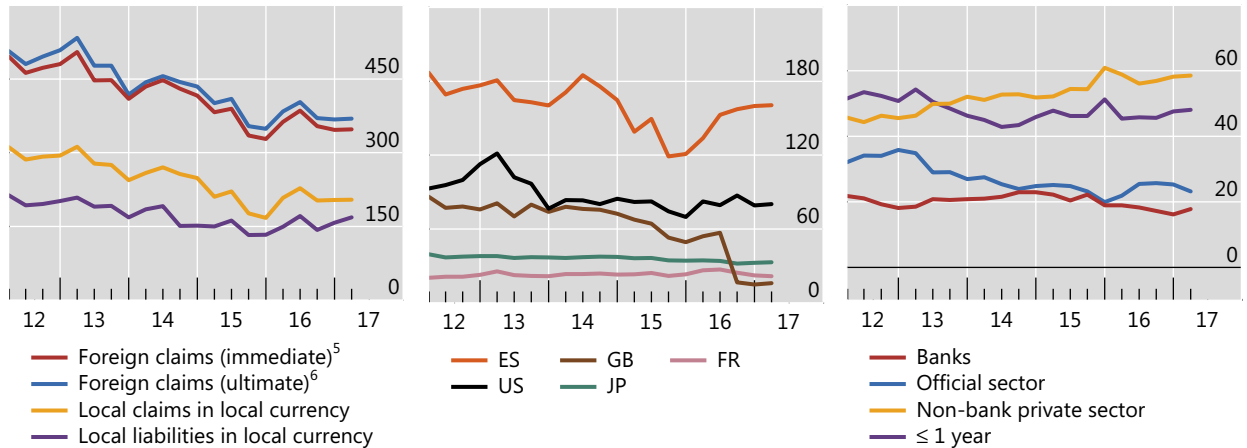
On China



On Turkey



On Brazil



AU = Australia; DE = Germany; ES = Spain; GB = United Kingdom; GR = Greece; JP = Japan; NL = Netherlands; TW = Chinese Taipei; US = United States.

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.

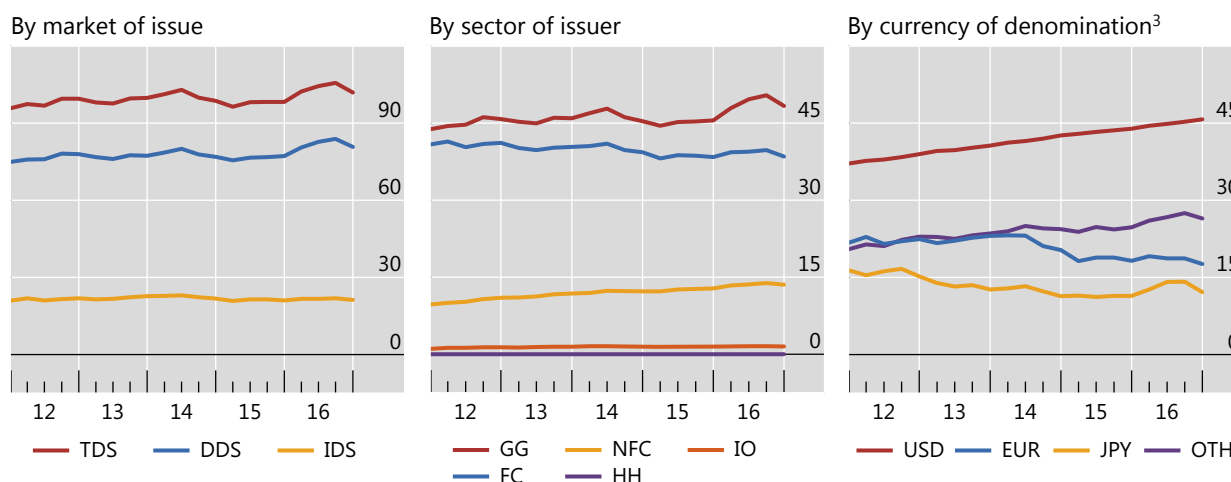
Source: BIS consolidated banking statistics (CBS).

C Debt securities statistics

Global debt securities markets¹

Amounts outstanding, in trillions of US dollars²

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.

EUR = euro; JPY = yen; OTH = other currencies; USD = US dollar.

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

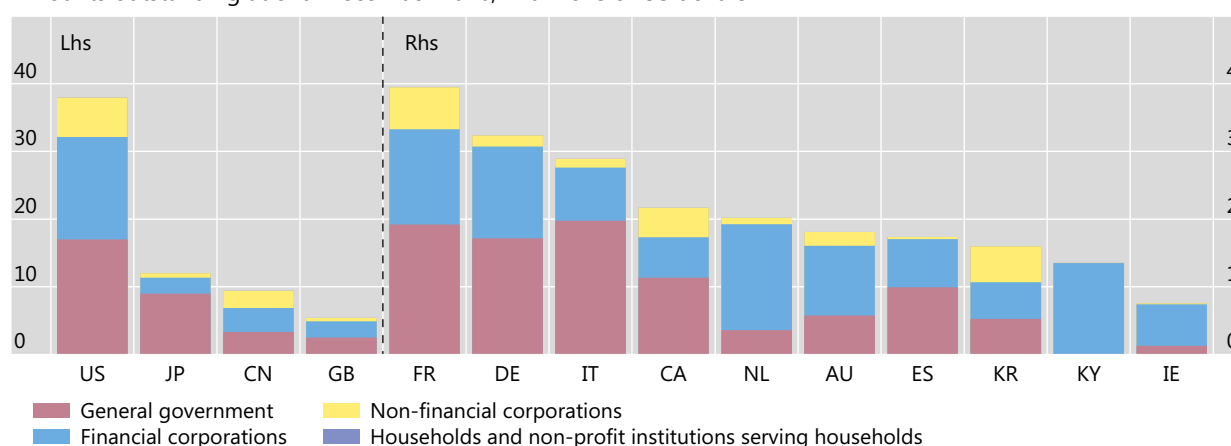
¹ Sample of countries varies across breakdowns shown. For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. For countries that do not report either TDS or DDS, data are estimated by the BIS as IDS. ² At quarter-end. Amounts denominated in currencies other than the US dollar 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: IMF; Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; national data; BIS debt securities statistics; BIS calculations.

Total debt securities, by residence and sector of issuer¹

Amounts outstanding at end-December 2016, in trillions of US dollars²

Graph C.2



AU = Australia; CA = Canada; CN = China; DE = Germany; ES = Spain; FR = France; GB = United Kingdom; IE = Ireland; IT = Italy; JP = Japan; KR = Korea; KY = Cayman Islands; NL = Netherlands; US = United States.

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

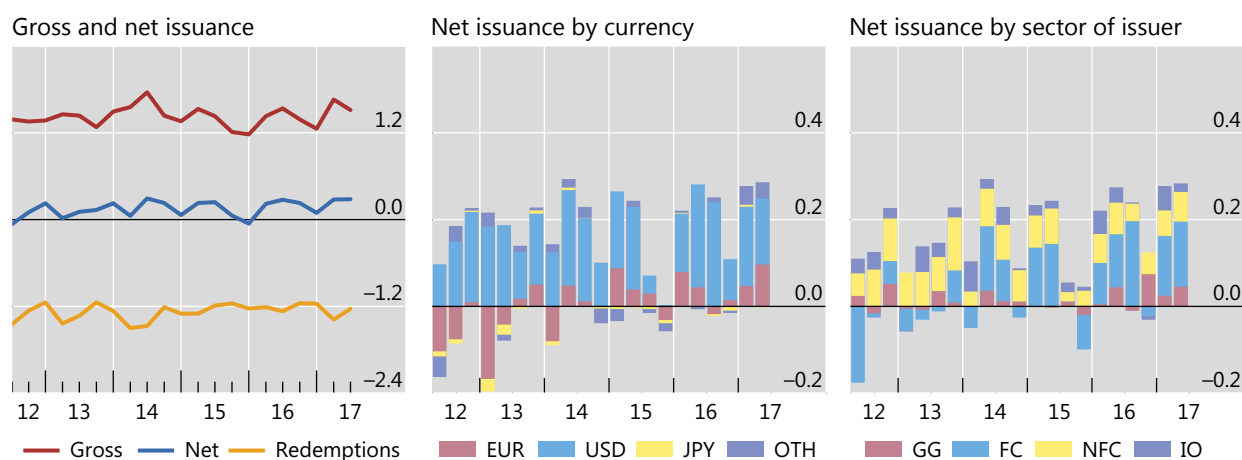
¹ For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. ² Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Sources: National data; BIS debt securities statistics.

International debt securities, by currency and sector

In trillions of US dollars

Graph C.3



EUR = euro; JPY = yen; OTH = other currencies; USD = US dollar.

FC= financial corporations; GG = general government; IO = international organisations; NFC = non-financial corporations.

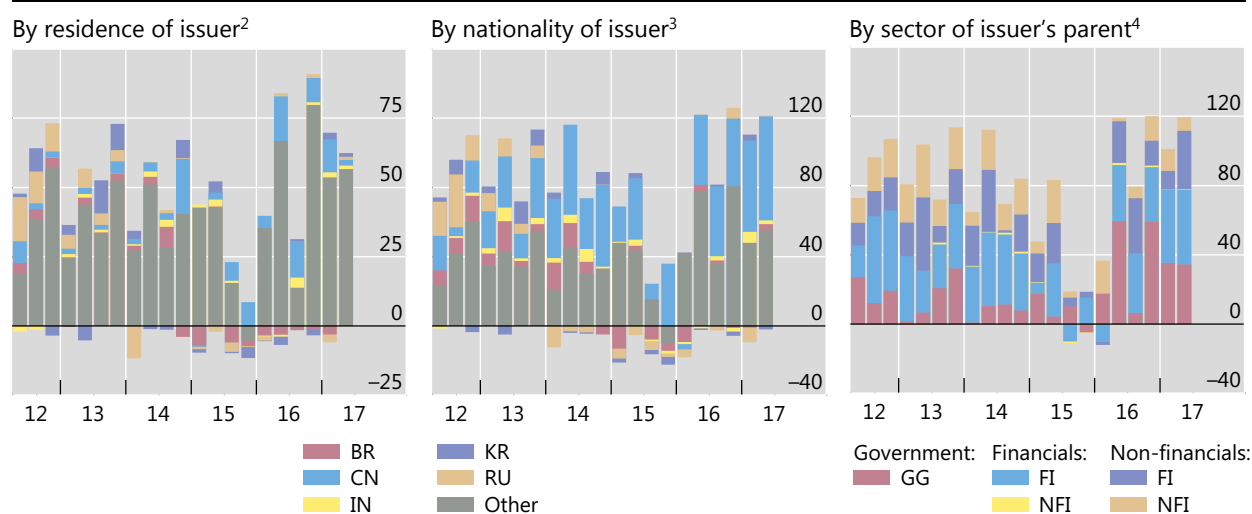
Further information on the BIS debt securities statistics is available at www.bis.org/statistics/secstats.htm.

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

International debt securities issued by borrowers from emerging market economies¹

Net issuance, in billions of US dollars

Graph C.4



BR = Brazil; CN = China; IN = India; KR = Korea; RU = Russia.

FI = financial corporations; GG = general government; NFI = non-financial corporations.

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

¹ For the sample of countries comprising emerging market economies, see the glossary to the *BIS Statistical Bulletin*. ² Country where issuer resides. ³ Country where issuer's controlling parent is located. Includes issuance by financing vehicles incorporated in offshore financial centres with parents based in an emerging market economy. ⁴ By nationality, ie issuers with parents based in an emerging market economy. Issuers are grouped by sector of their parent.

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

D Derivatives statistics

Exchange-traded derivatives

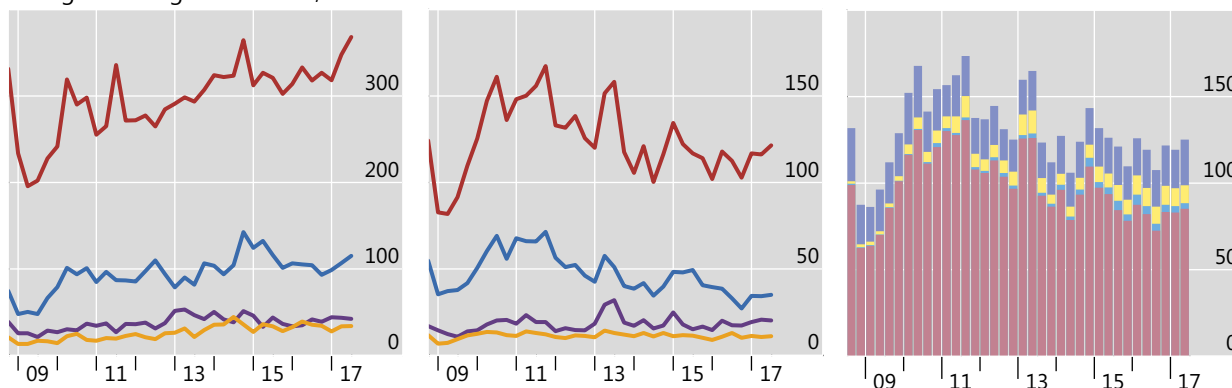
Graph D.1

Open interest, by currency¹

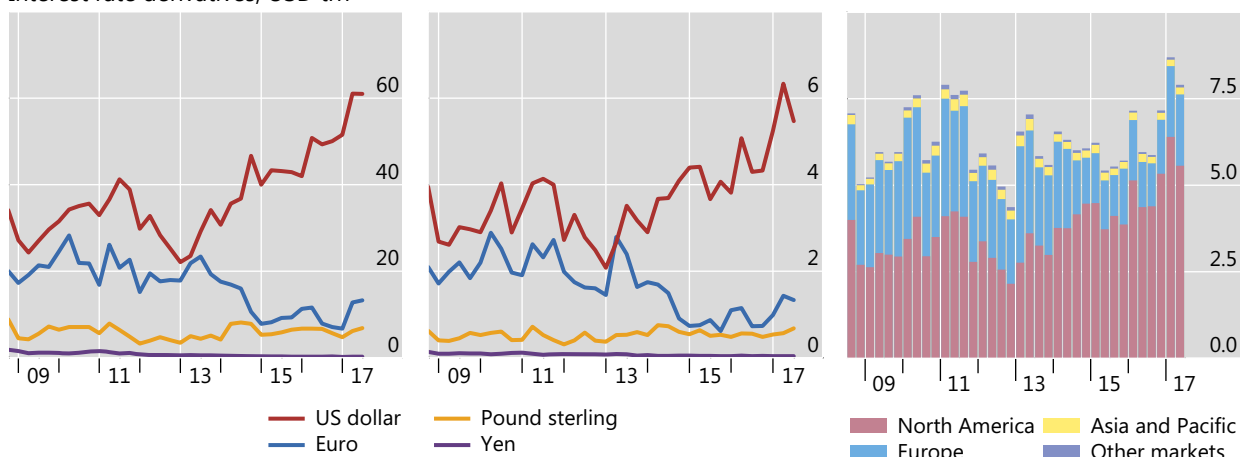
Daily average turnover, by currency²

Daily average turnover, by location of exchange²

Foreign exchange derivatives, USD bn³



Interest rate derivatives, USD trn³



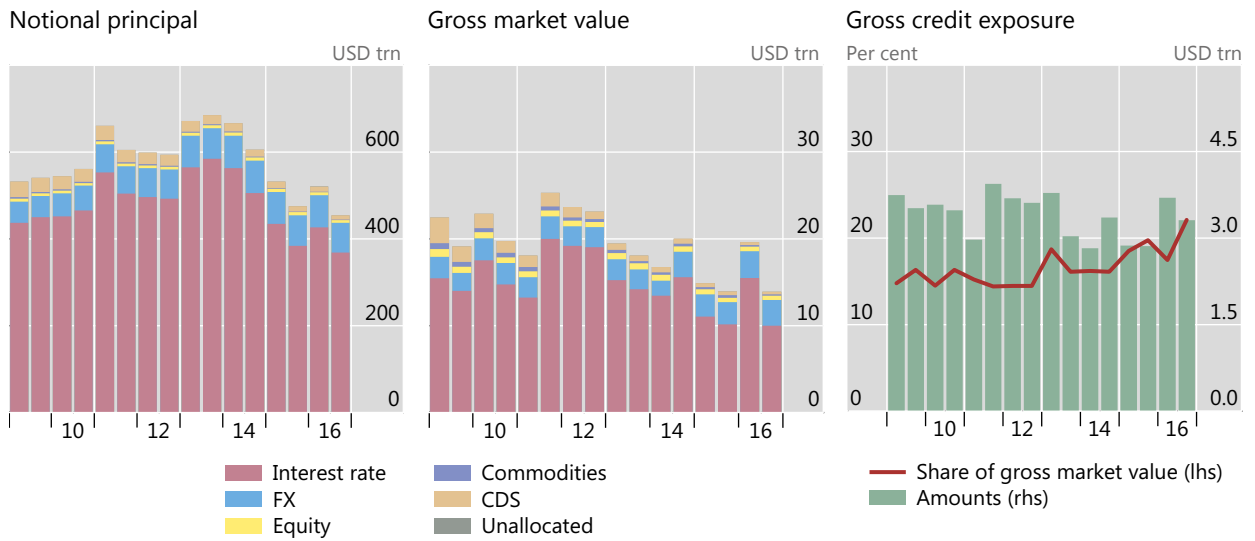
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/extderiv.htm.

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 markets¹

Graph D.2



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

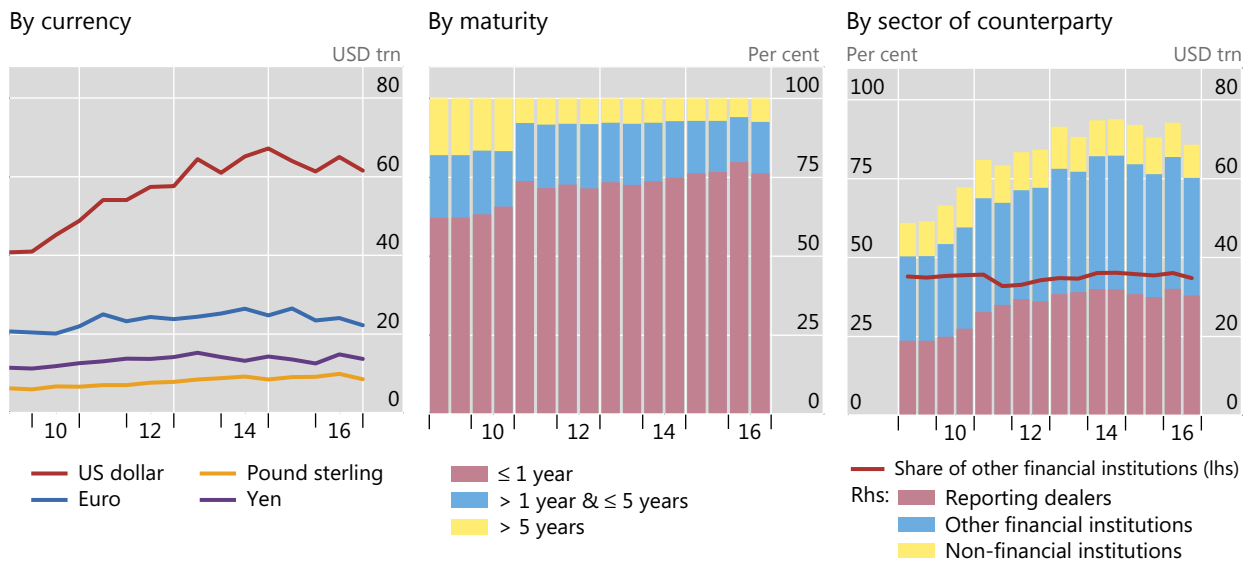
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC foreign exchange derivatives

Notional principal¹

Graph D.3



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

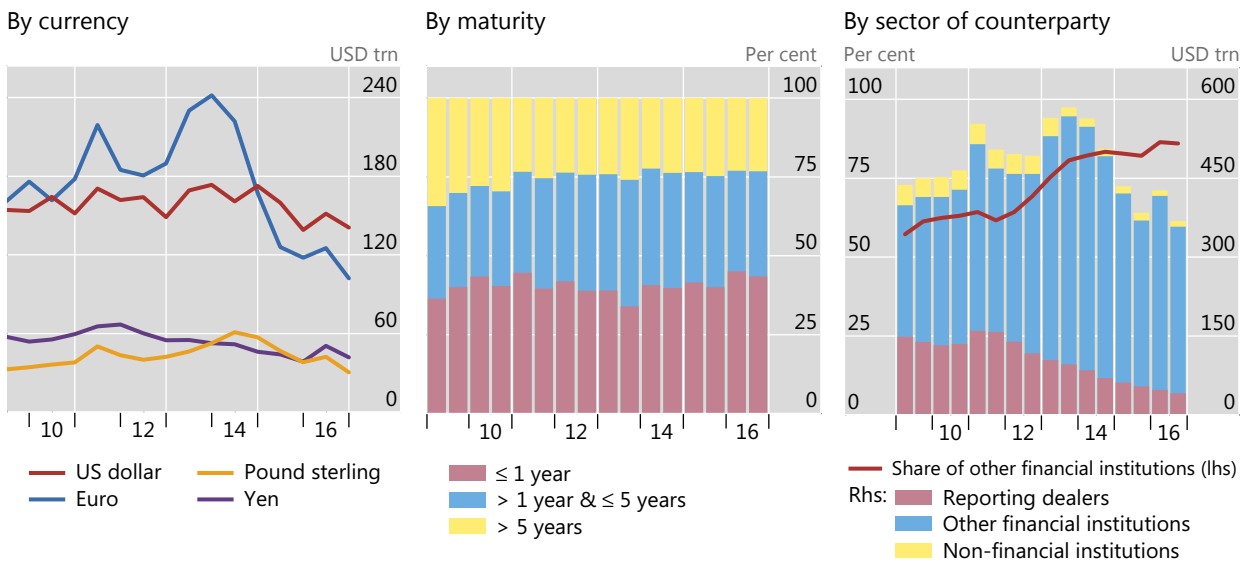
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC interest rate derivatives

Notional principal¹

Graph D.4



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

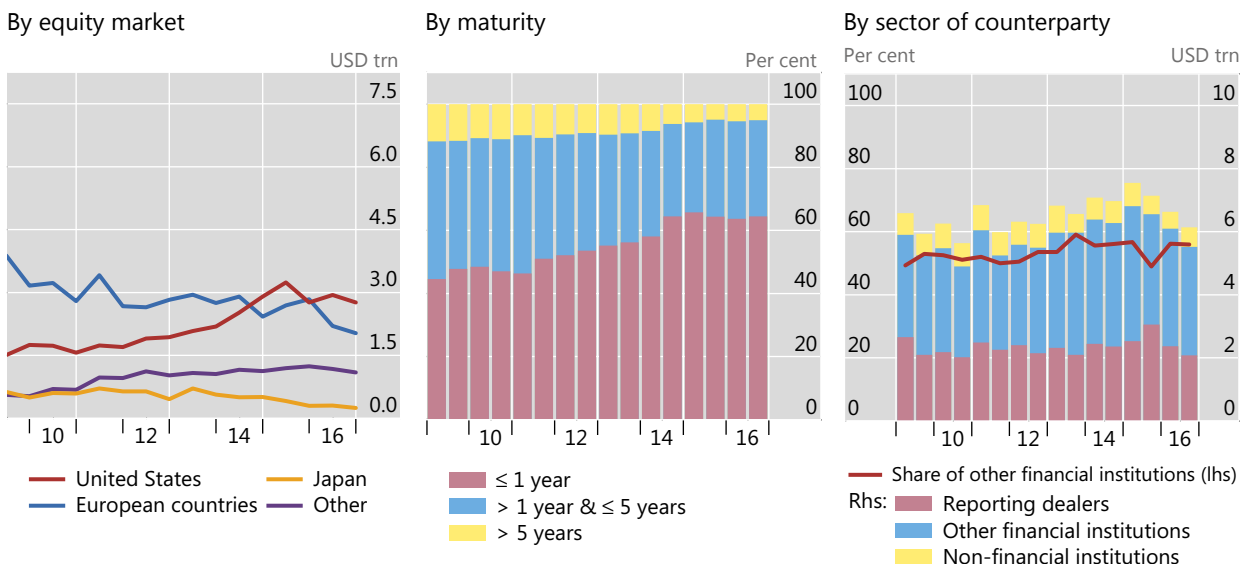
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC equity-linked derivatives

Notional principal¹

Graph D.5



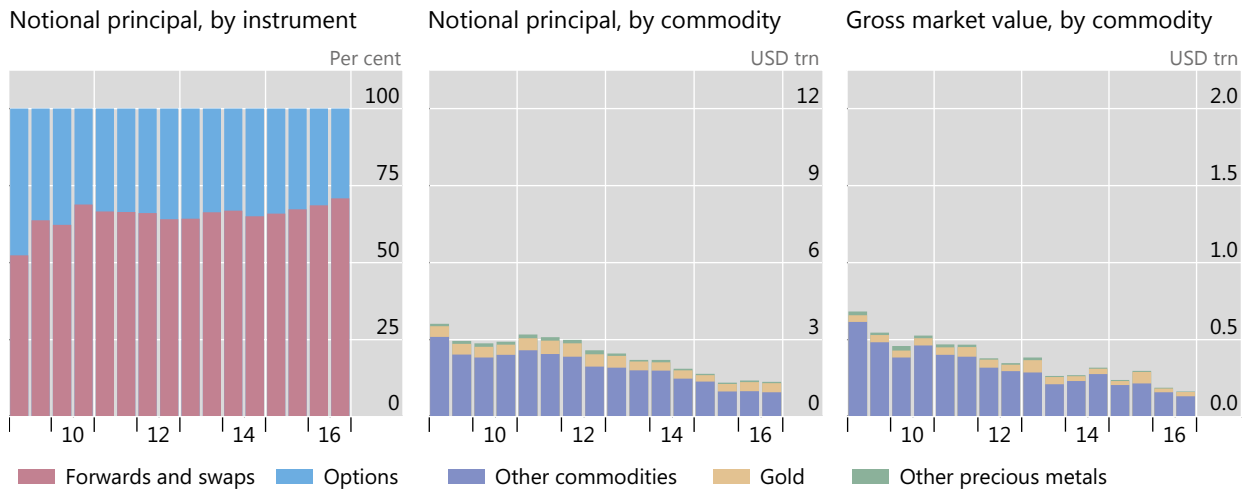
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

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 derivatives¹

Graph D.6



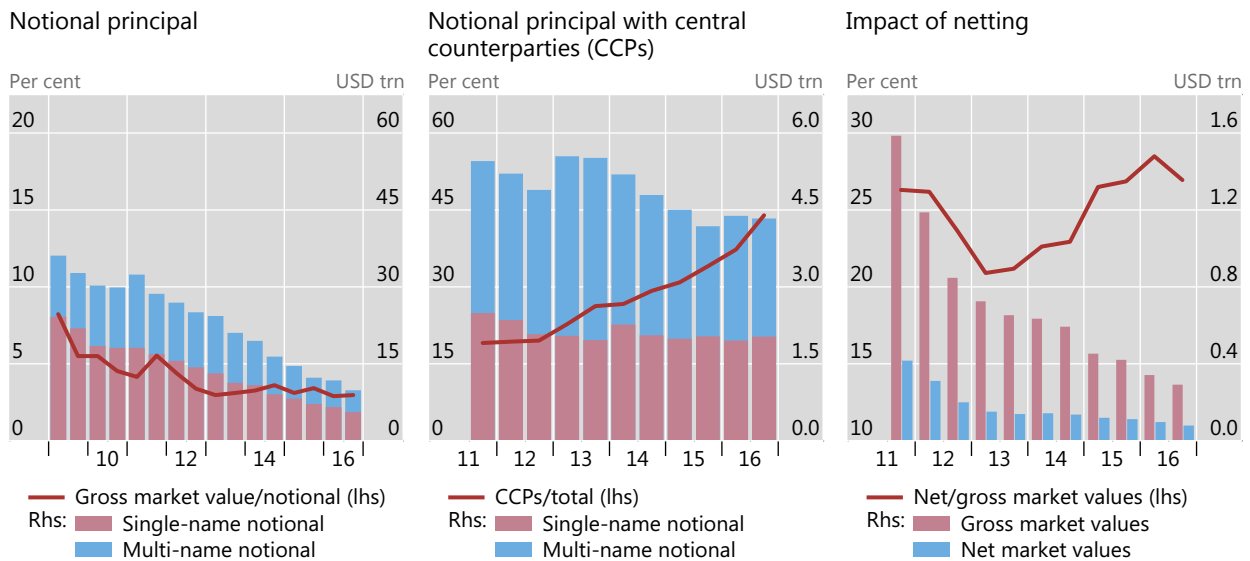
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

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 swaps¹

Graph D.7



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

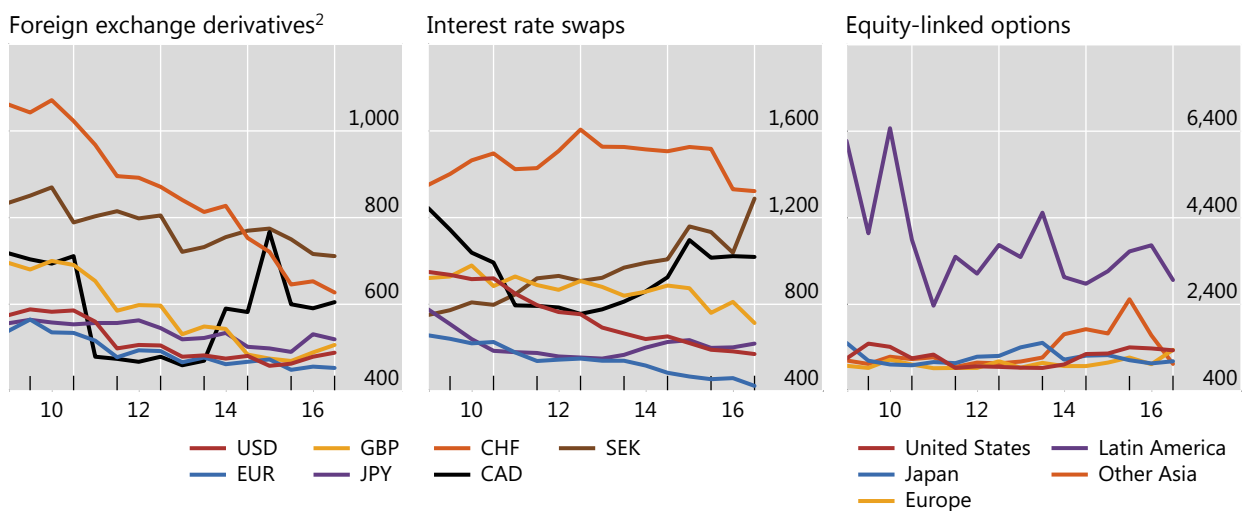
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

Concentration in global OTC derivatives markets

Herfindahl index¹

Graph D.8



CAD = Canadian dollar; CHF = Swiss franc; EUR = euro; GBP = pound sterling; JPY = yen; SEK = Swedish krona; USD = US dollar.

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

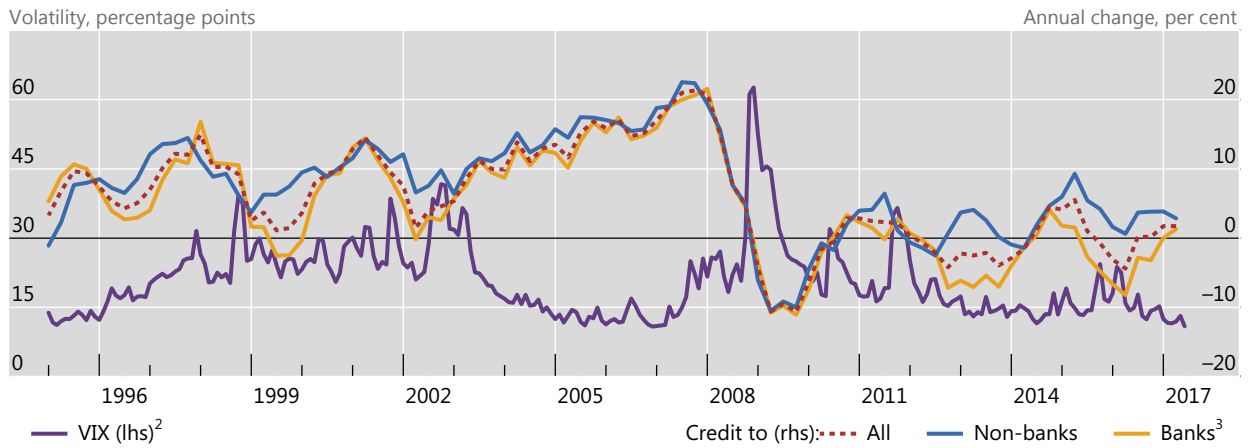
¹ The index ranges from 0 to 10,000, where a lower number indicates that there are many dealers with similar market shares (as measured by notional principal) and a higher number indicates that the market is dominated by a few reporting dealers. ² Foreign exchange forwards, foreign exchange swaps and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

Source: BIS derivatives statistics.

E Global liquidity indicators

Growth of international bank credit¹

Graph E.1



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

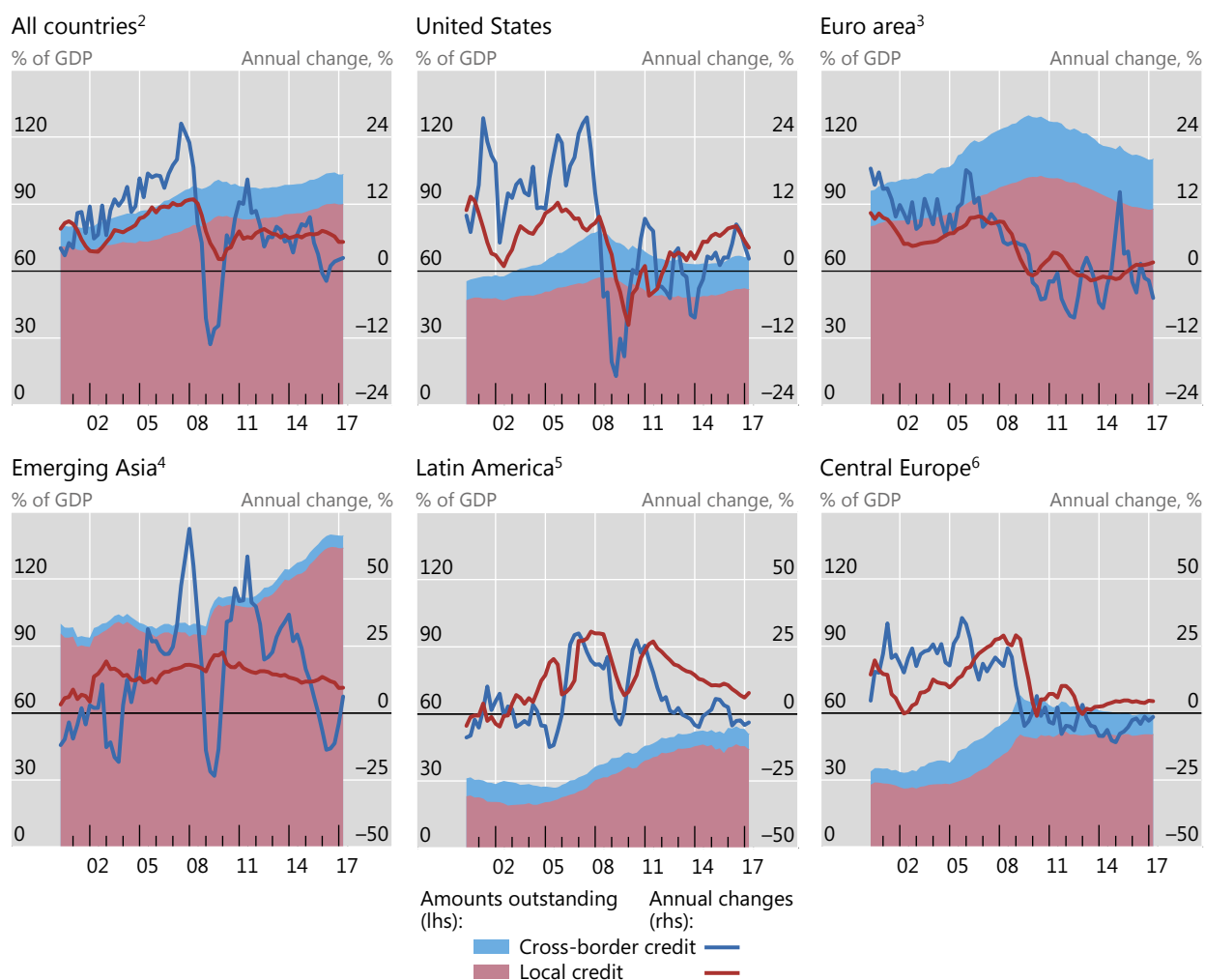
¹ LBS-reporting banks' cross-border claims plus local claims in foreign currencies. ² Chicago Board Options Exchange S&P 500 implied volatility index; standard deviation, in percentage points per annum. ³ Including intragroup transactions.

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 currencies¹

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.

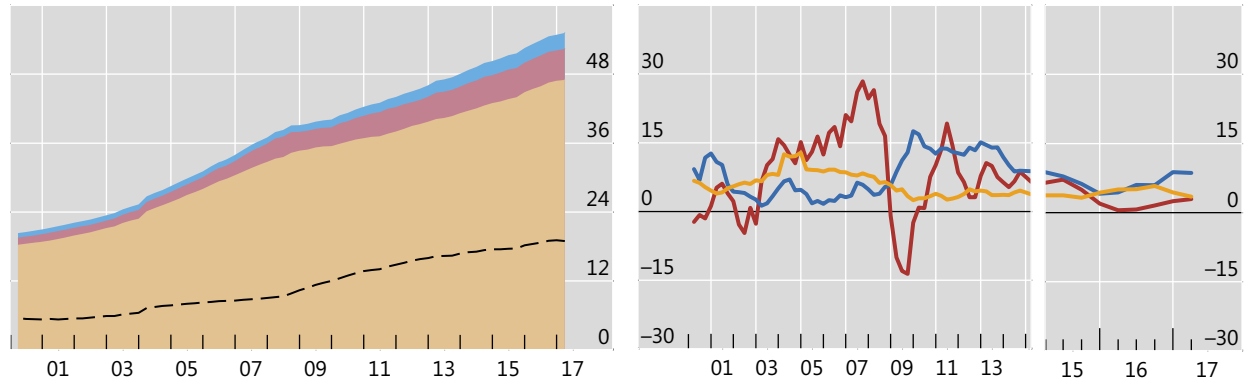
Global credit to the non-financial sector, by currency

Graph E.3

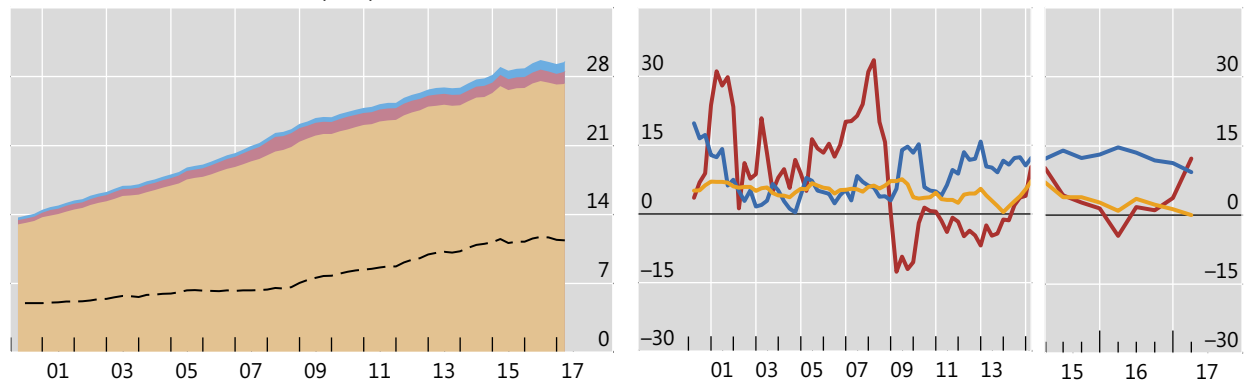
Amounts outstanding, in trillions of currency units¹

Annual change, in per cent²

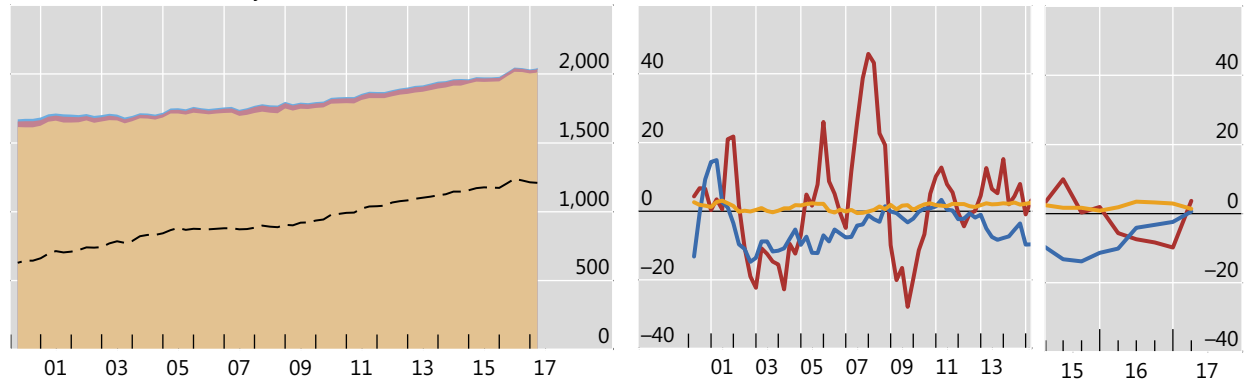
Credit denominated in US dollars (USD)



Credit denominated in euros (EUR)



Credit denominated in yen (JPY)



Credit to residents³ Credit to non-residents:
 Debt securities⁴
 Loans⁵
 Credit to government

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

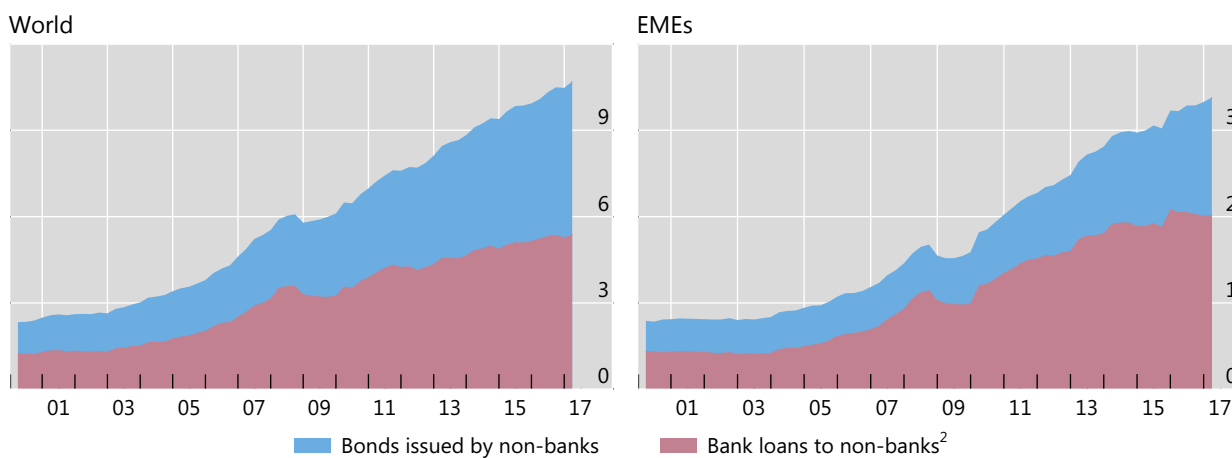
¹ Amounts outstanding at quarter-end. ² Based on quarterly break- and exchange rate-adjusted changes. ³ Credit to non-financial borrowers residing in the United States/euro area/Japan. National financial accounts are adjusted using BIS banking and securities statistics to exclude credit denominated in 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: Bloomberg; 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 States¹

Amounts outstanding, in trillions of US dollars

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

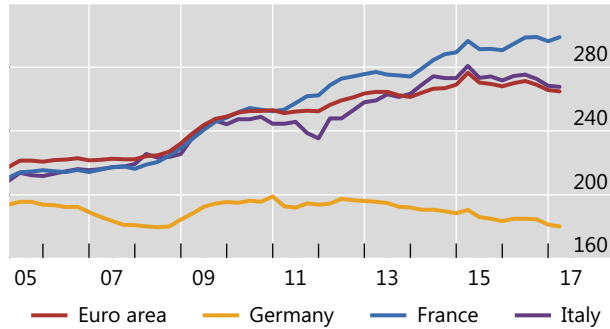
F Statistics on total credit to the non-financial sector

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

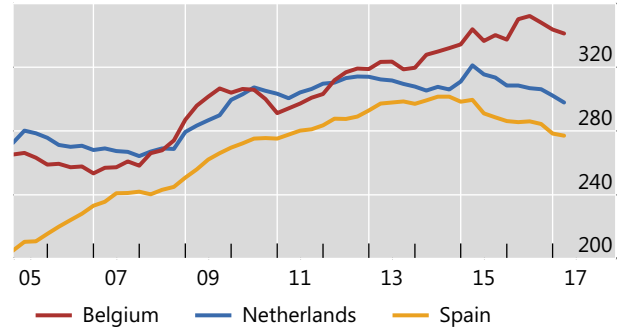
As a percentage of GDP

Graph F.1

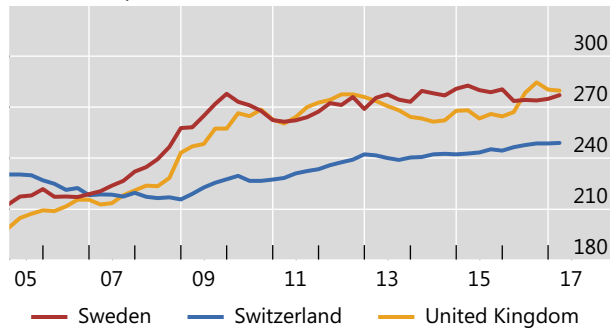
Euro area: aggregate and major countries



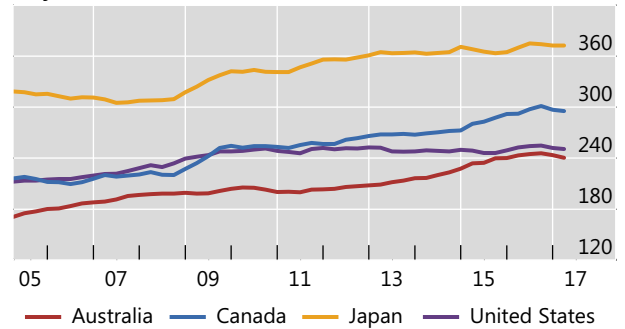
Euro area: other countries



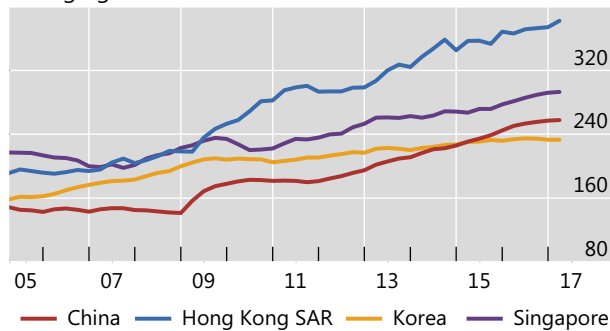
Other European countries



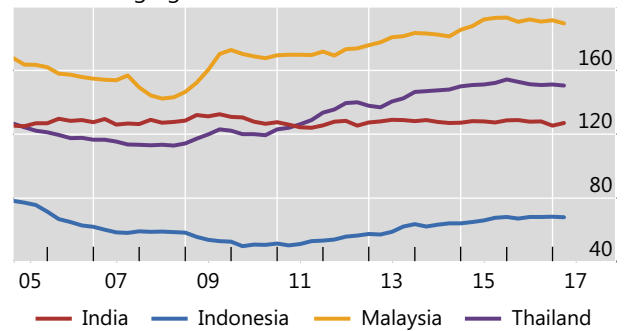
Major advanced economies



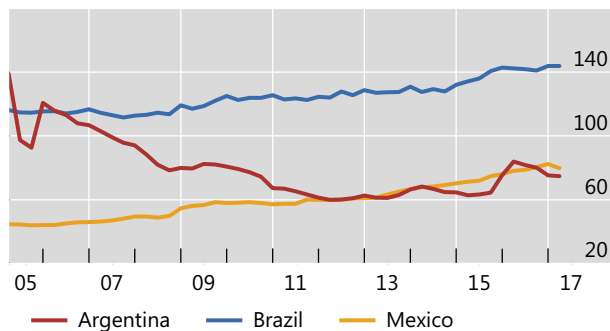
Emerging Asia



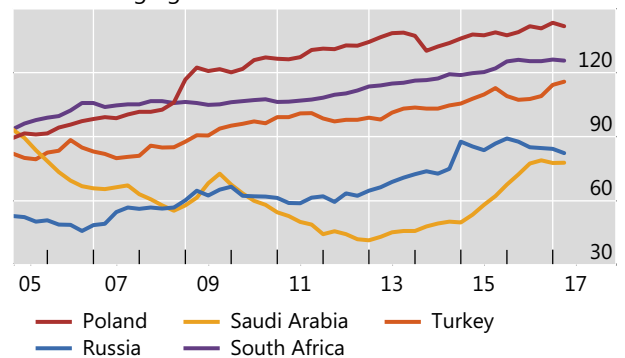
Other emerging Asia



Latin America



Other emerging market economies



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

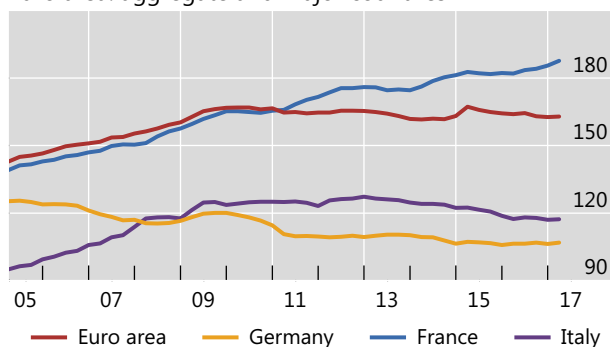
Source: BIS total credit statistics.

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

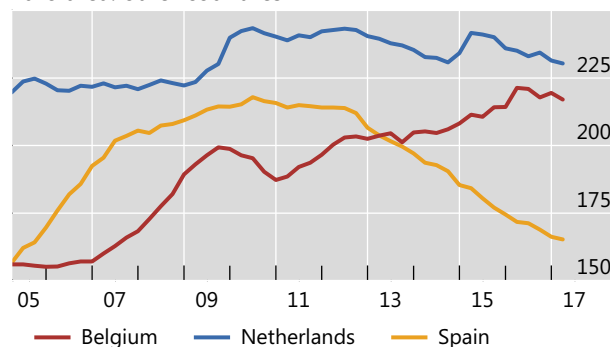
As a percentage of GDP

Graph F.2

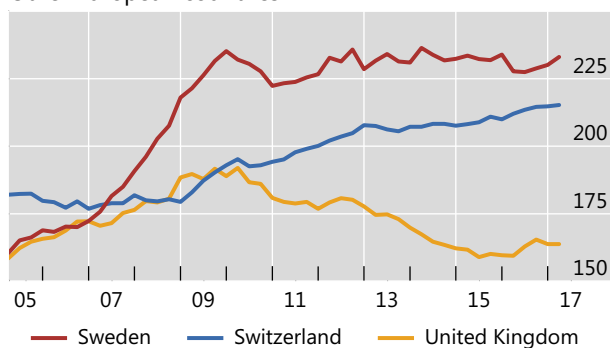
Euro area: aggregate and major countries



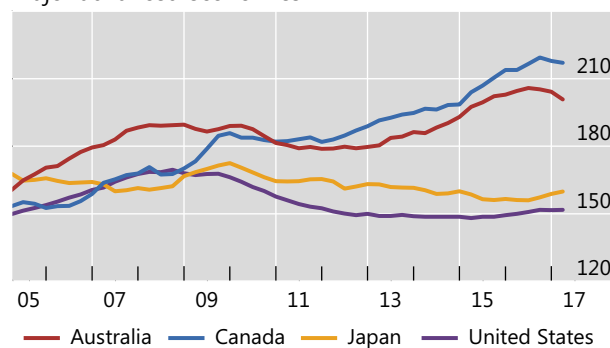
Euro area: other countries



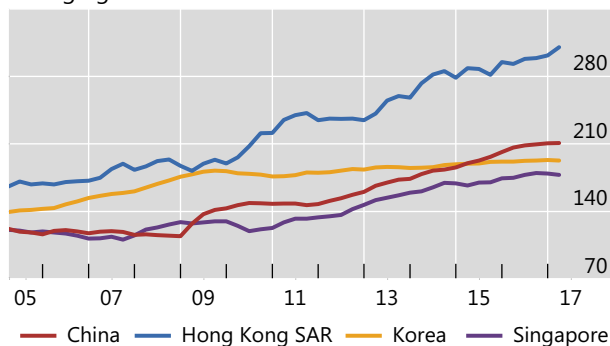
Other European countries



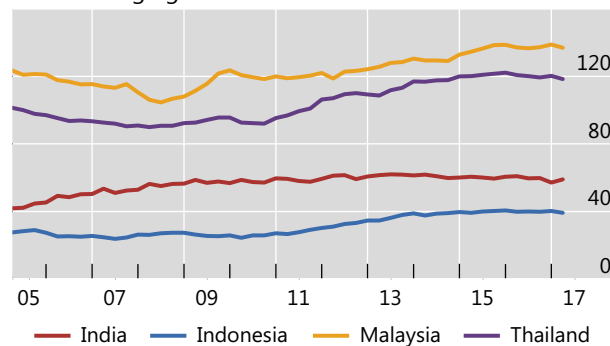
Major advanced economies



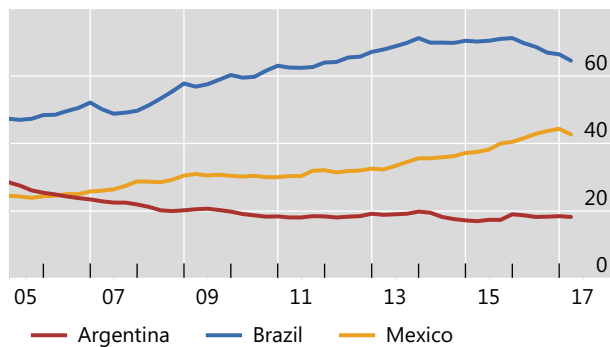
Emerging Asia



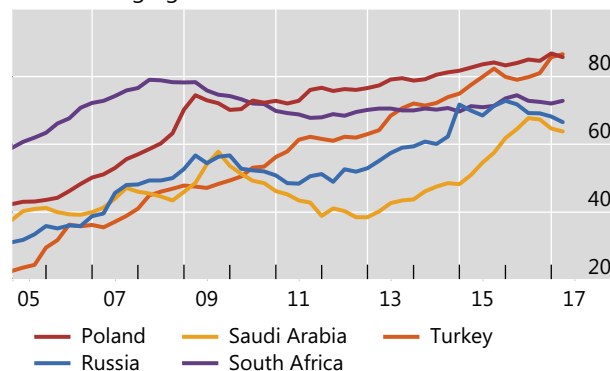
Other emerging Asia



Latin America



Other emerging market economies



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

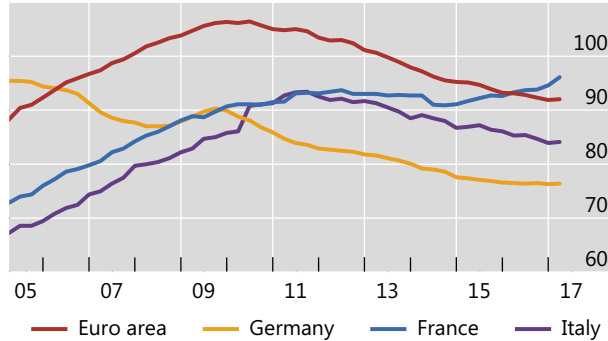
Source: BIS total credit statistics.

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

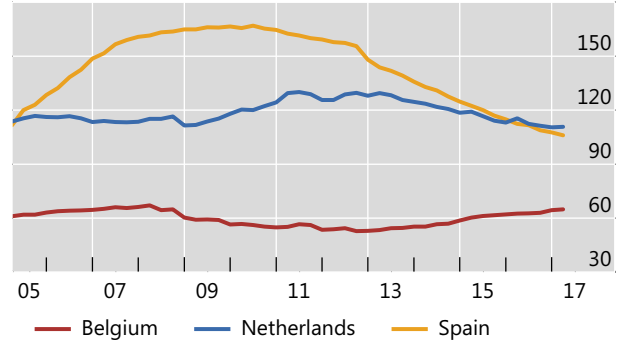
As a percentage of GDP

Graph F.3

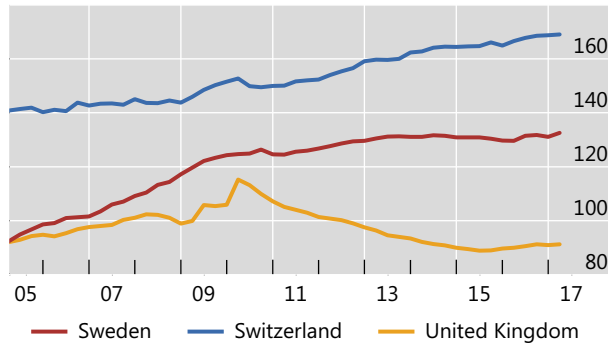
Euro area: aggregate and major countries



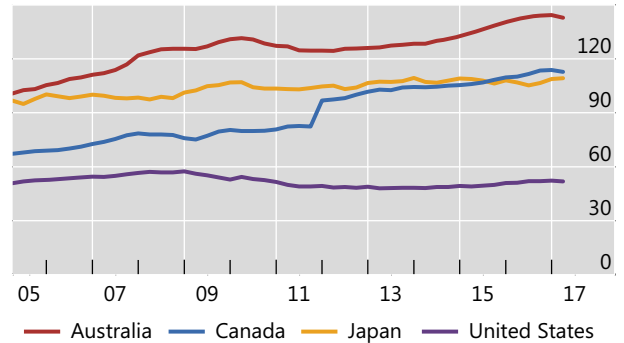
Euro area: other countries



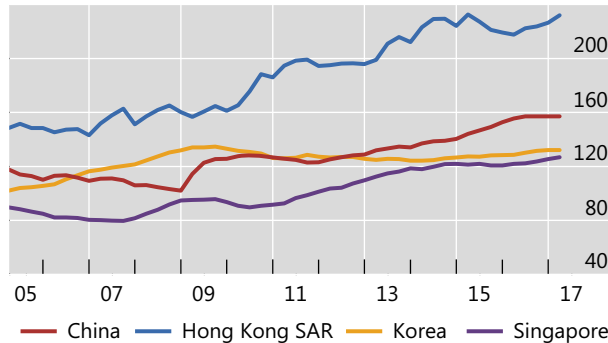
Other European countries



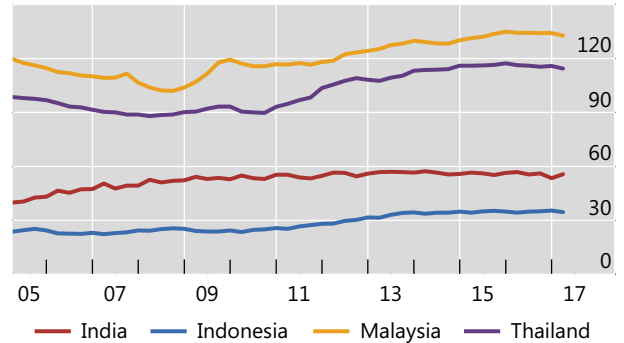
Major advanced economies



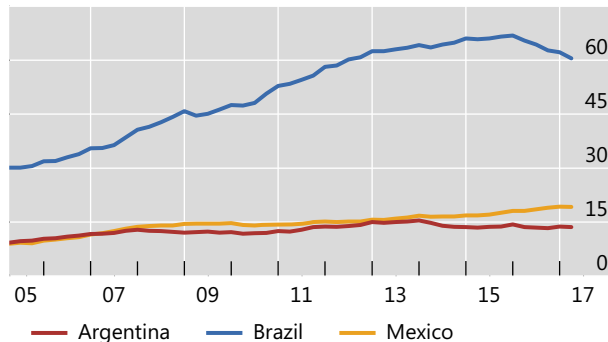
Emerging Asia



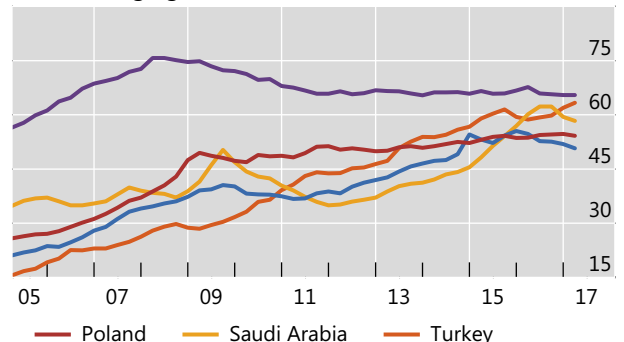
Other emerging Asia



Latin America



Other emerging market economies



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

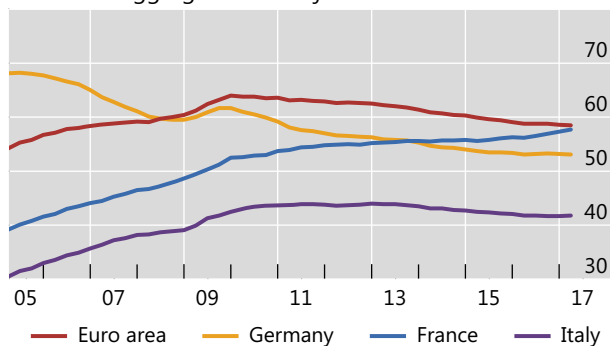
Source: BIS total credit statistics.

Total credit to households (core debt)

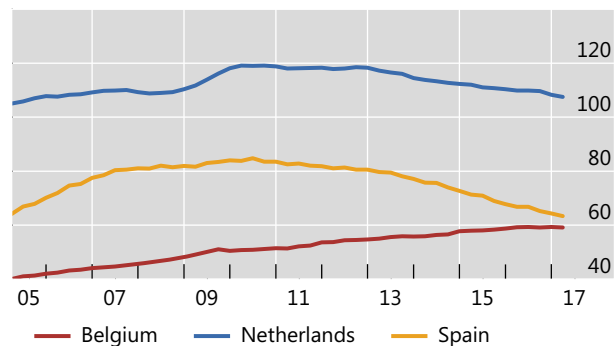
As a percentage of GDP

Graph F.4

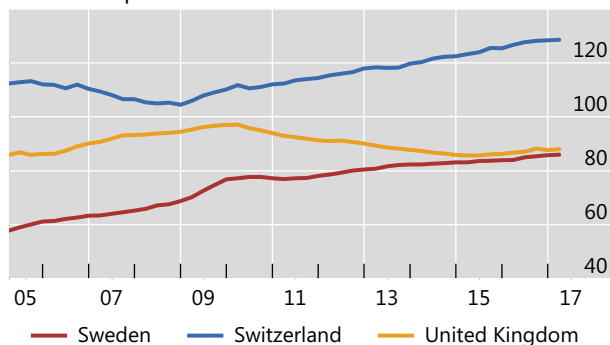
Euro area: aggregate and major countries



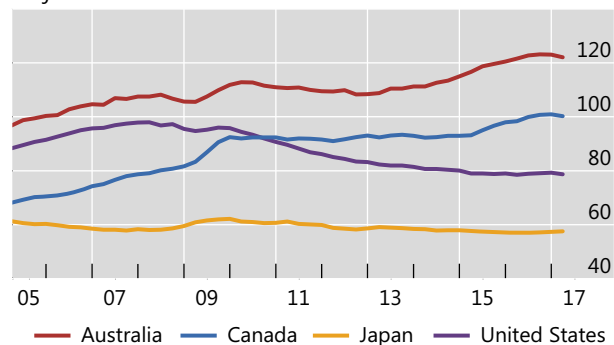
Euro area: other countries



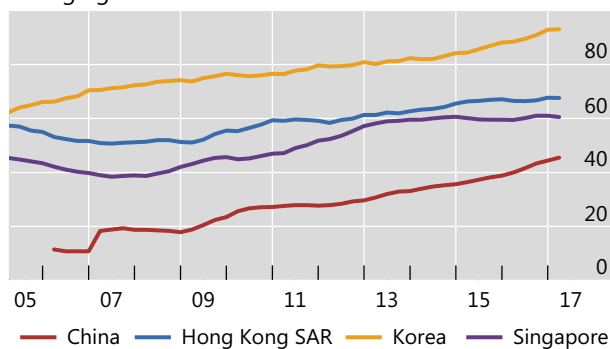
Other European countries



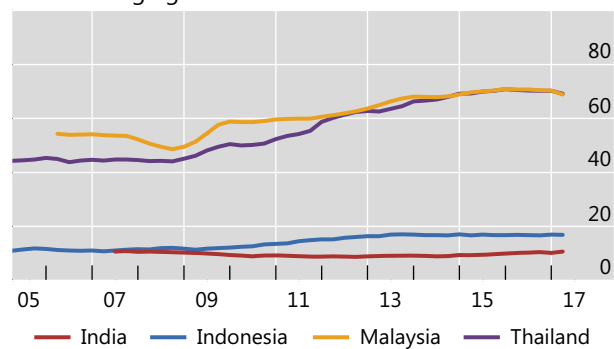
Major advanced economies



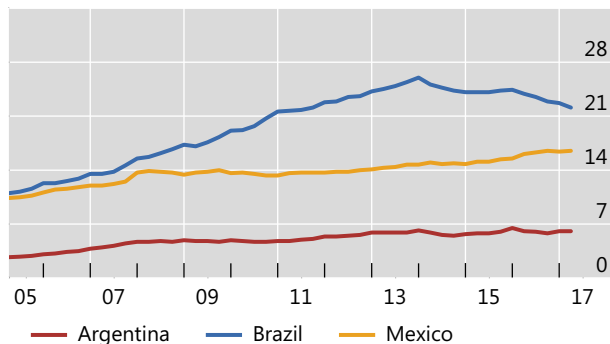
Emerging Asia



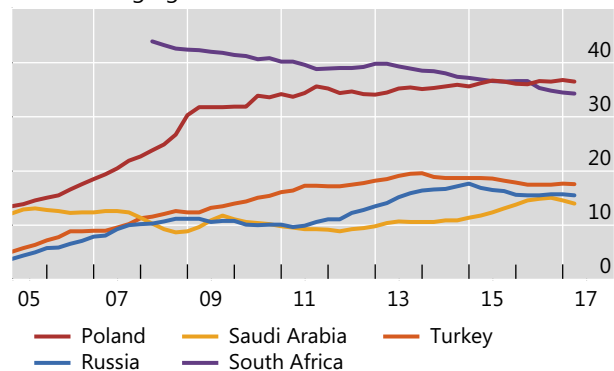
Other emerging Asia



Latin America



Other emerging market economies



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

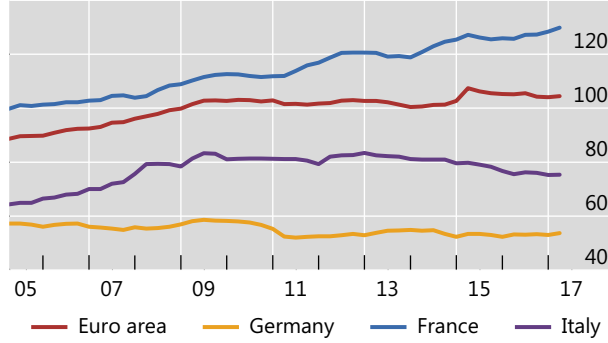
Source: BIS total credit statistics.

Total credit to non-financial corporations (core debt)

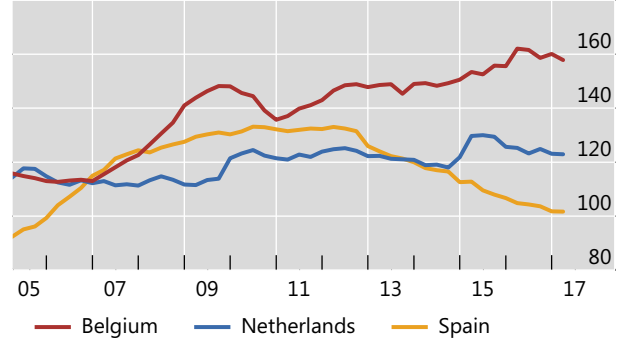
As a percentage of GDP

Graph F.5

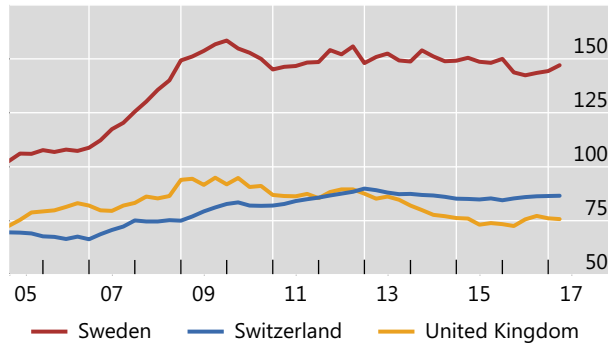
Euro area: aggregate and major countries



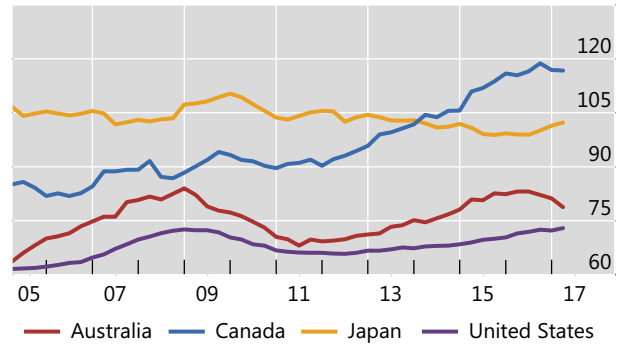
Euro area: other countries



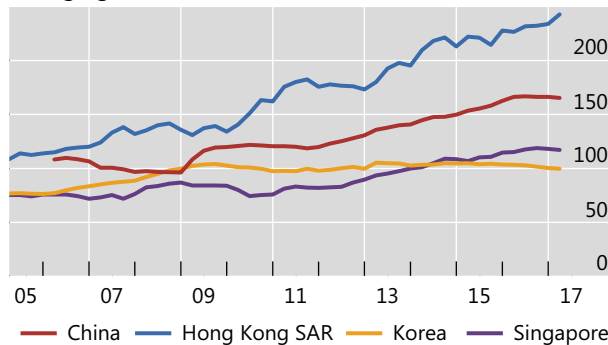
Other European countries



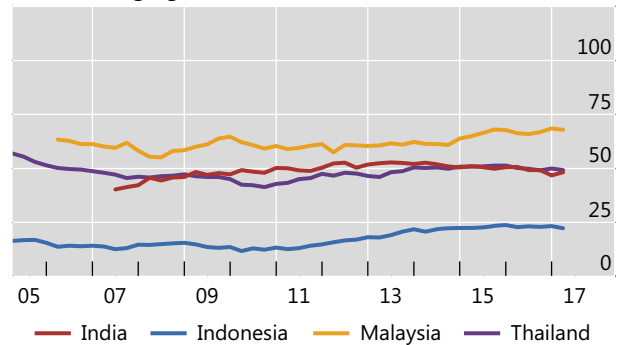
Major advanced economies



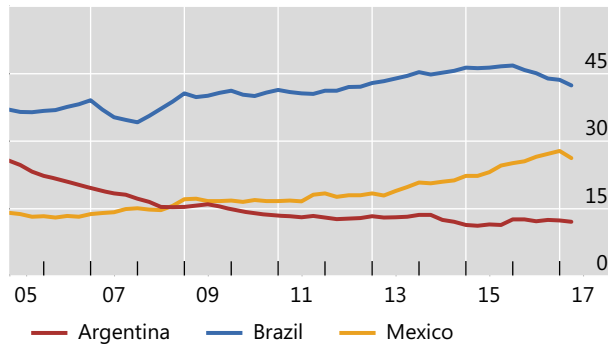
Emerging Asia



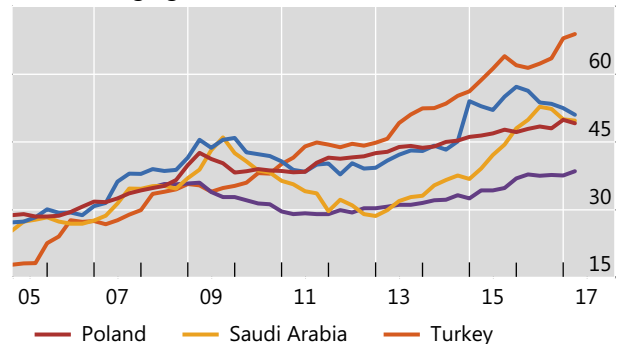
Other emerging Asia



Latin America



Other emerging market economies



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

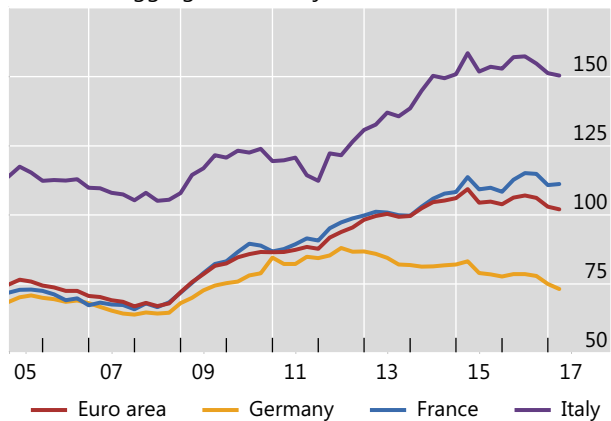
Source: BIS total credit statistics.

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

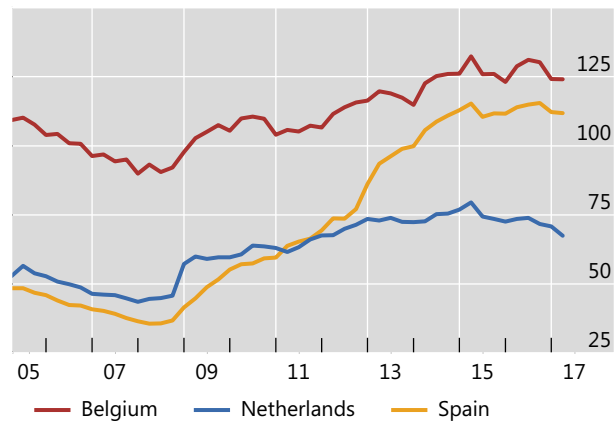
As a percentage of GDP

Graph F.6

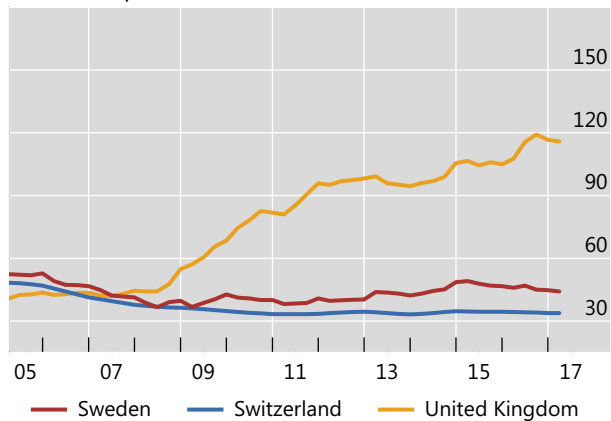
Euro area: aggregate and major countries



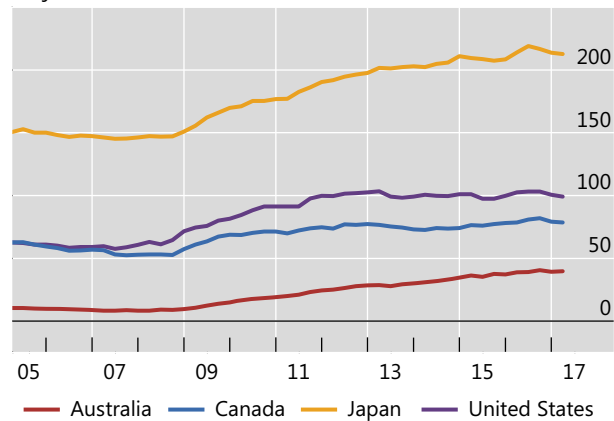
Euro area: other countries



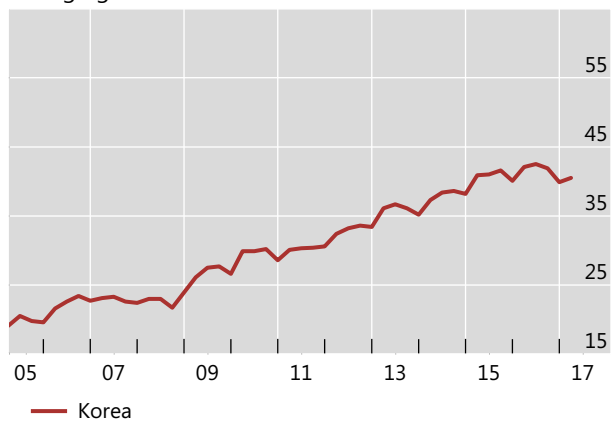
Other European countries



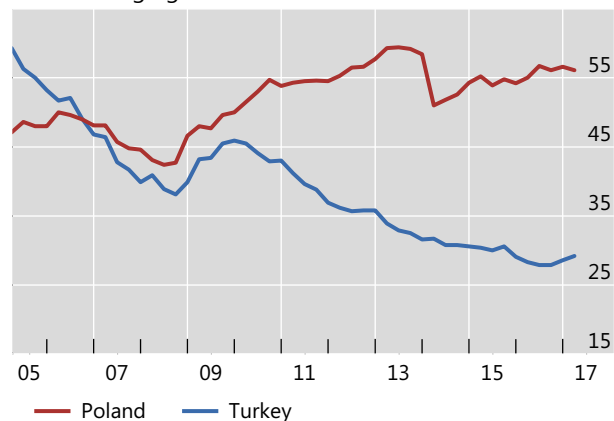
Major advanced economies



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.

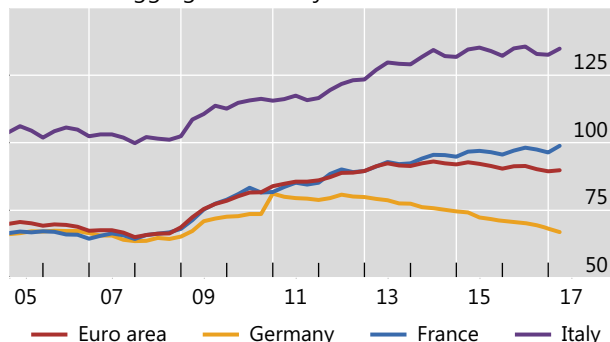
Source: BIS total credit statistics.

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

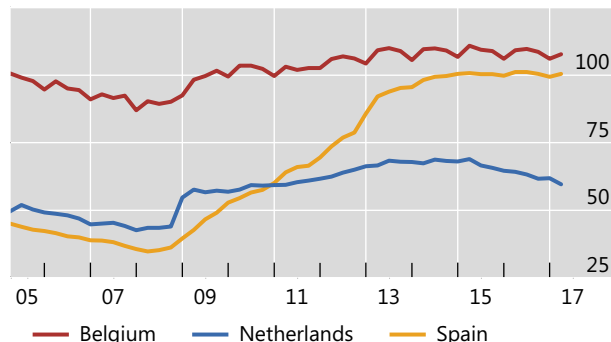
As a percentage of GDP

Graph F.7

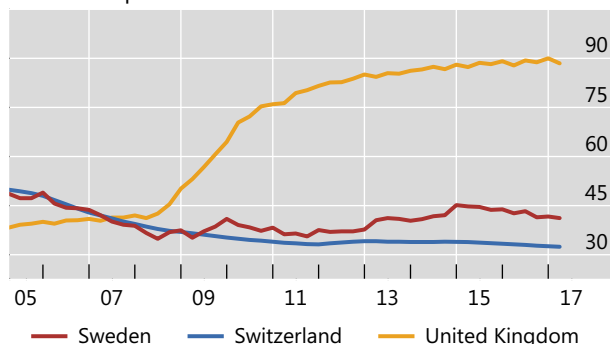
Euro area: aggregate and major countries



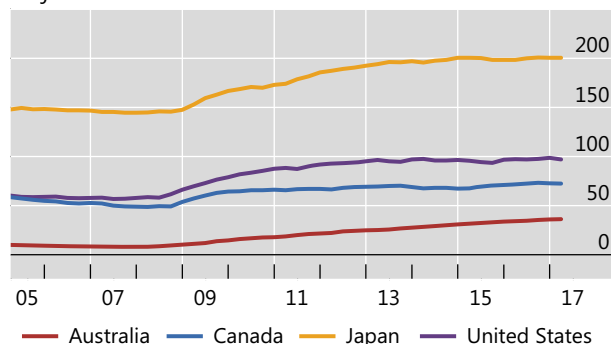
Euro area: other countries



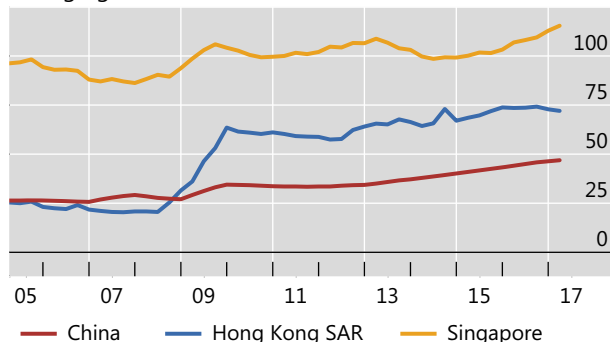
Other European countries



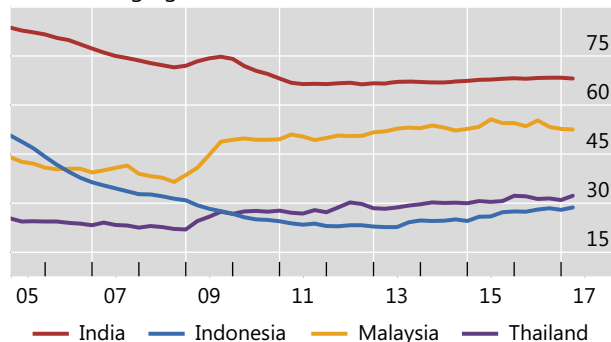
Major advanced economies



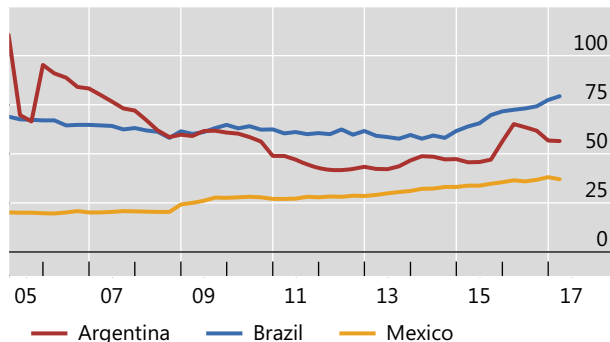
Emerging Asia



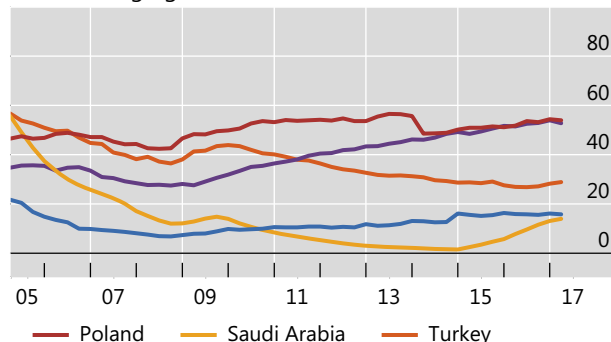
Other emerging Asia



Latin America



Other emerging market economies



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

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

Source: BIS total credit statistics.

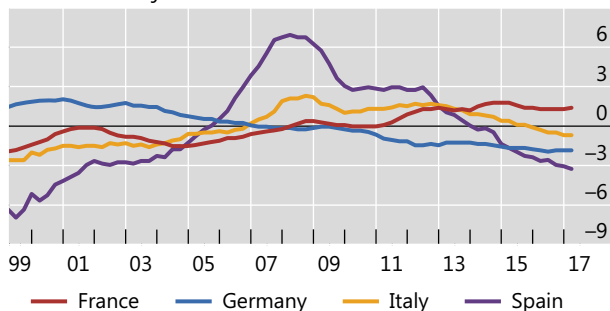
G Debt service ratios for the private non-financial sector

Debt service ratios of the private non-financial sector

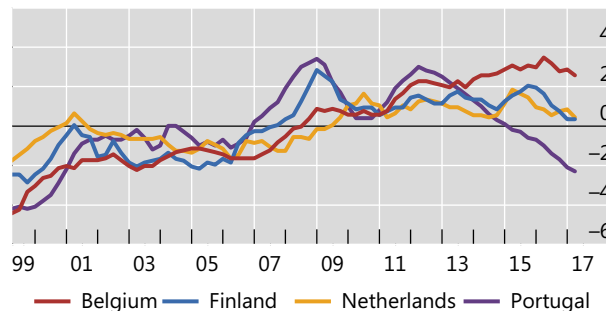
Deviation from country-specific mean, in percentage points¹

Graph G.1

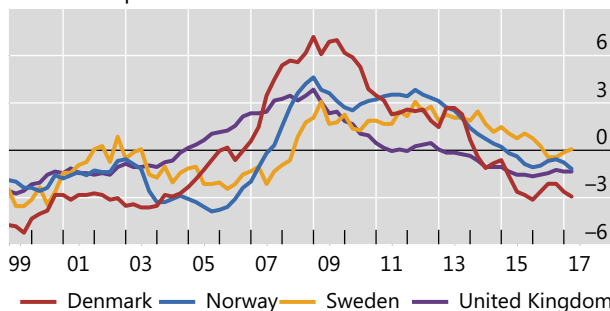
Euro area: major countries



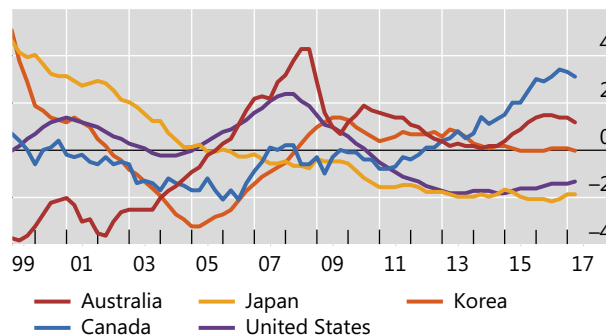
Euro area: other countries



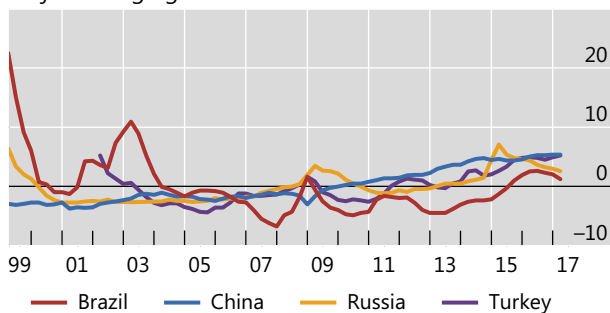
Other European countries



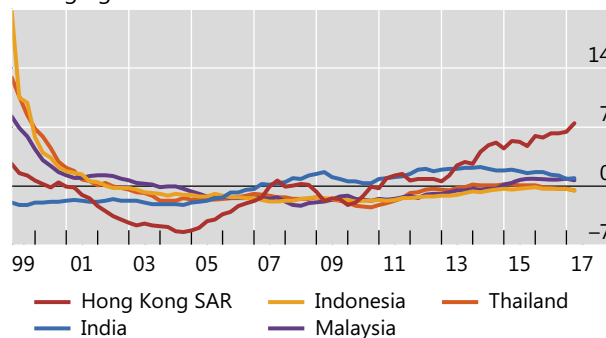
Other economies



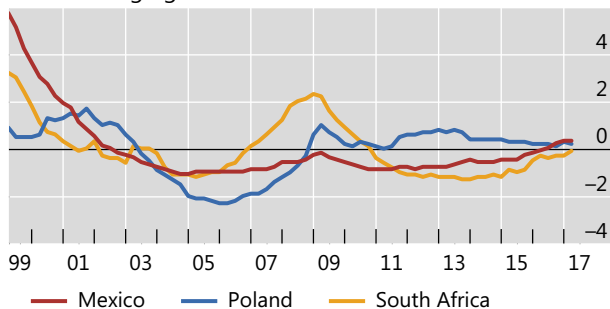
Major emerging markets²



Emerging Asia²



Other emerging markets²



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 "Methodology and data for DSR calculation" at www.bis.org/statistics/dsr.htm.

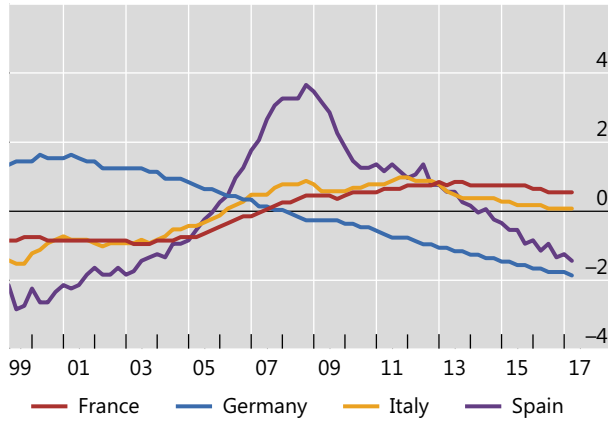
Source: BIS debt service ratios statistics.

Debt service ratios of households

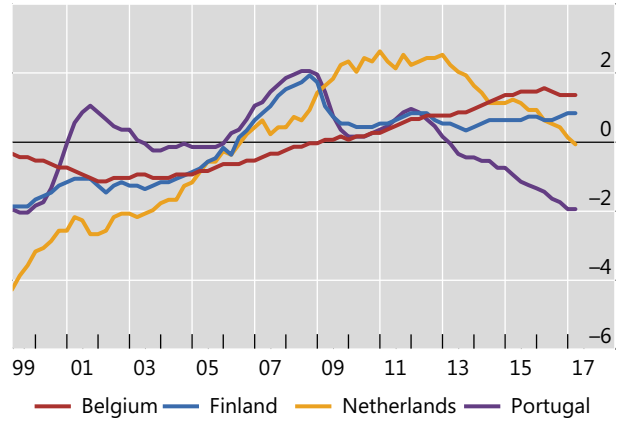
Deviation from country-specific mean, in percentage points¹

Graph G.2

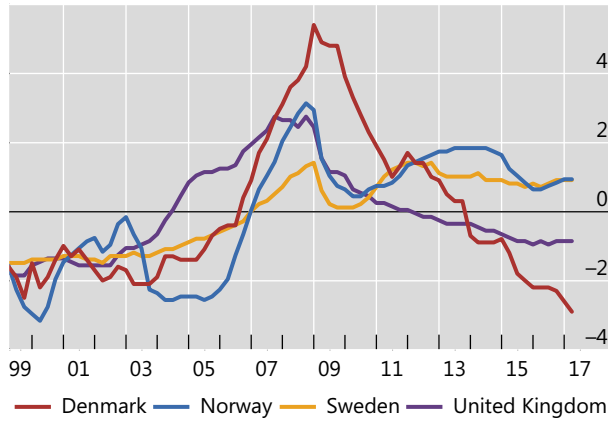
Euro area: major countries



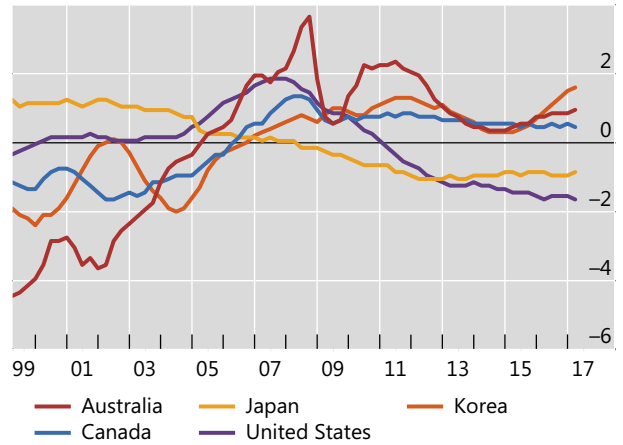
Euro area: other countries



Other European countries



Other economies



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.

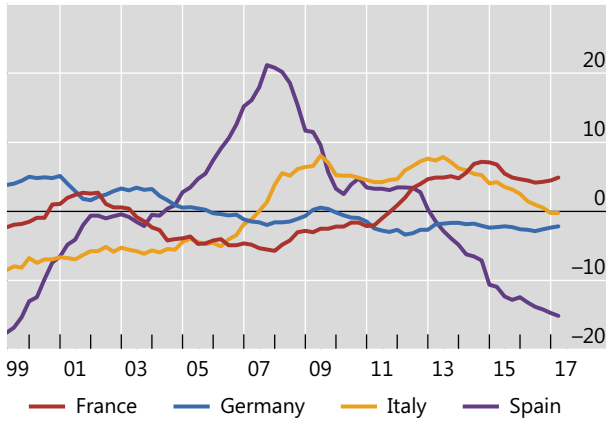
Source: BIS debt service ratios statistics.

Debt service ratios of non-financial corporations

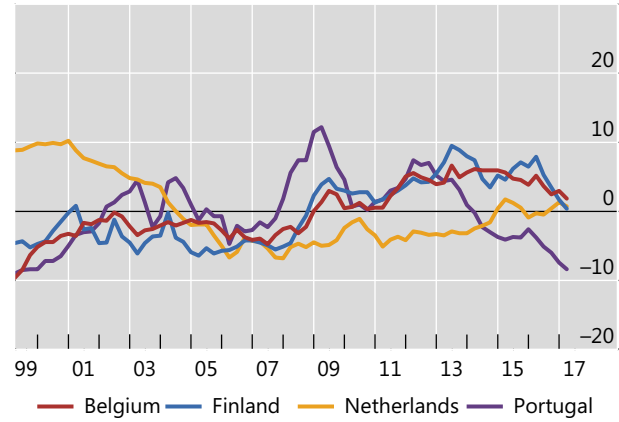
Deviation from country-specific mean, in percentage points¹

Graph G.3

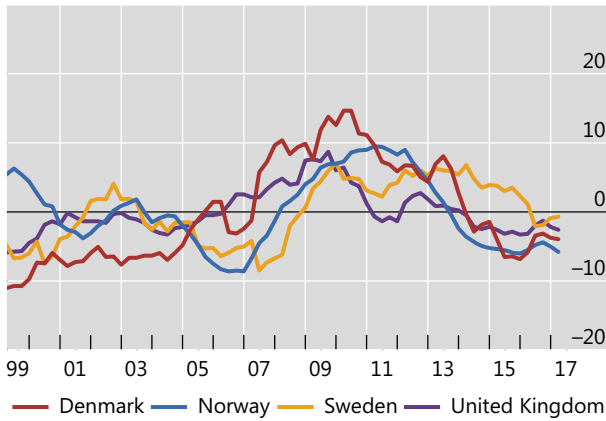
Euro area: major countries



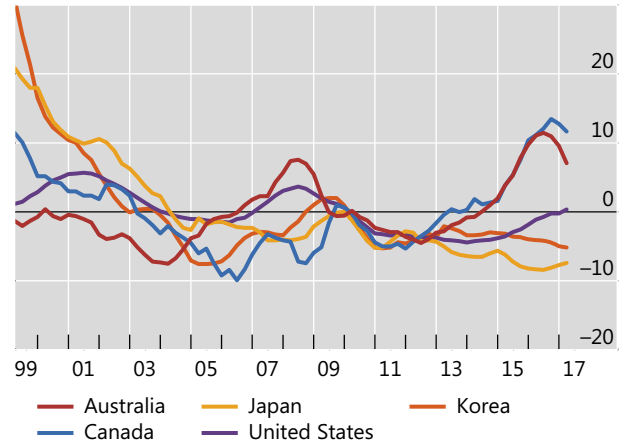
Euro area: other countries



Other European countries



Other economies



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.

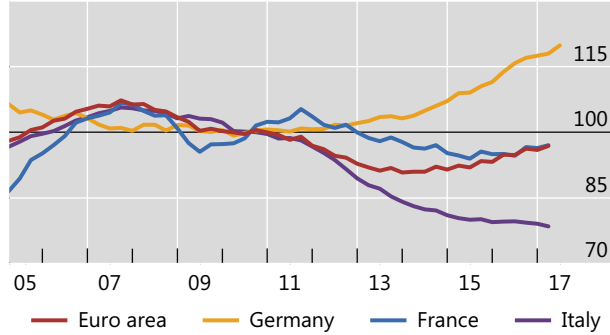
H Property price statistics

Real residential property prices

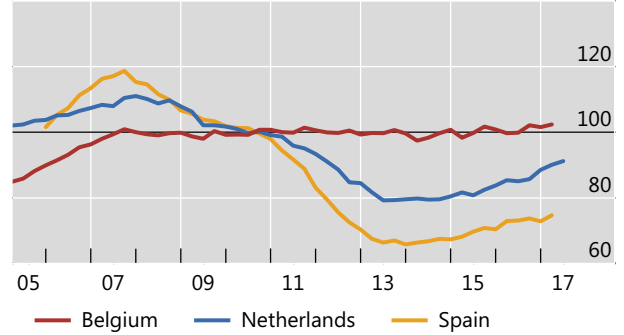
CPI-deflated, 2010 = 100

Graph H.1

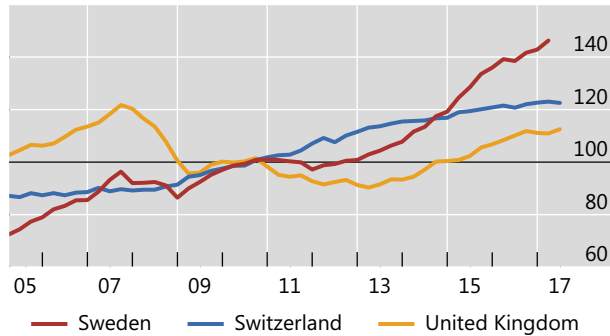
Euro area: aggregate and major countries



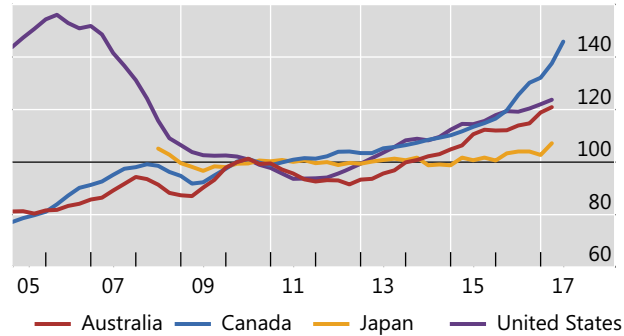
Euro area: other countries



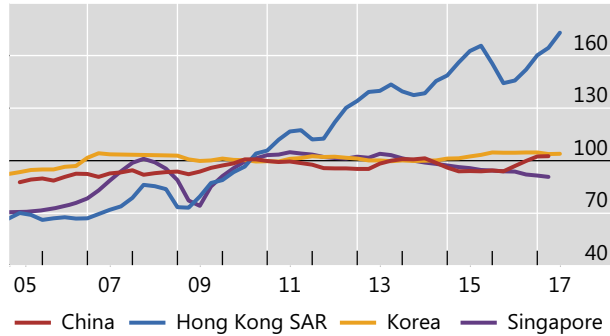
Other European countries



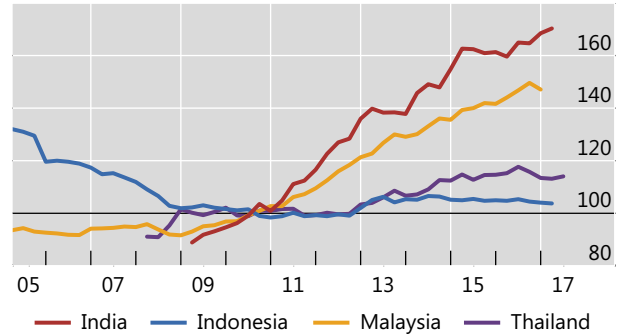
Major advanced economies



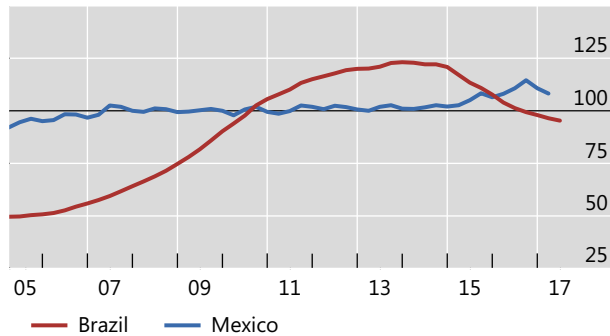
Emerging Asia



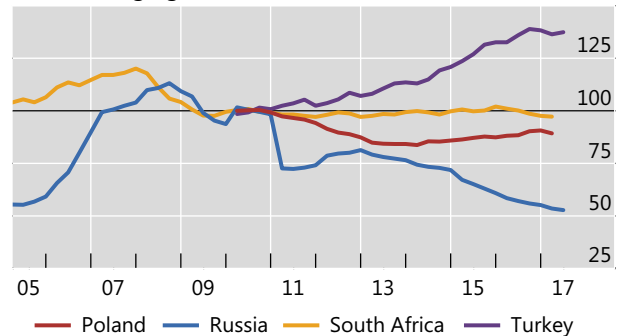
Other emerging Asia



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.

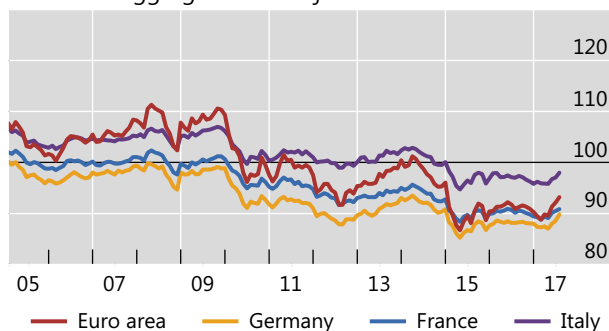
I Effective and US dollar exchange rate statistics

Real effective exchange rates

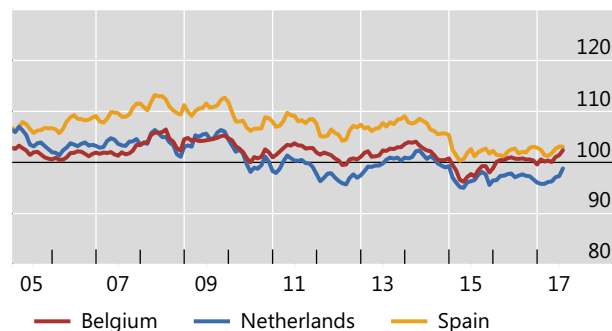
CPI-based, 1995–2005 = 100¹

Graph I.1

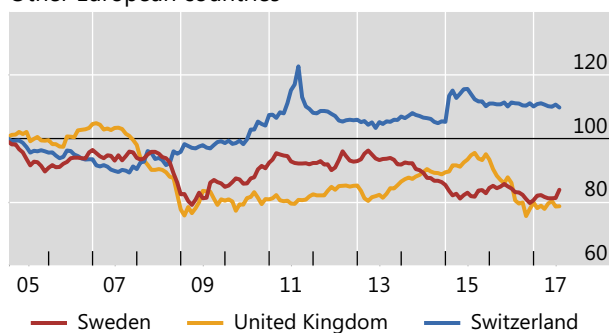
Euro area: aggregate and major countries



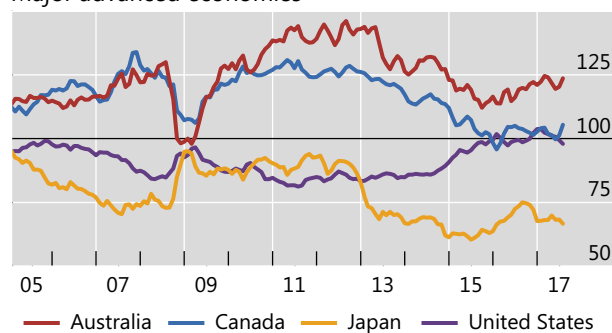
Euro area: other countries



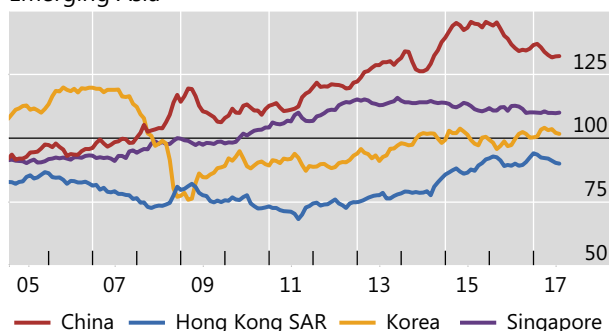
Other European countries



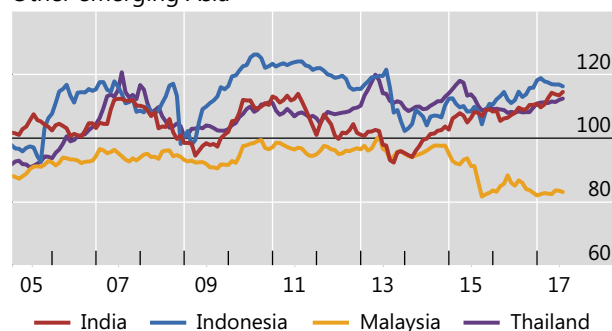
Major advanced economies



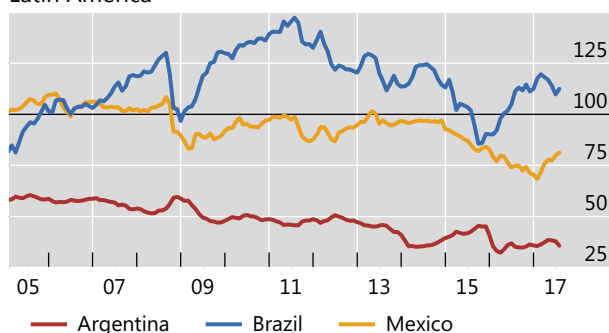
Emerging Asia



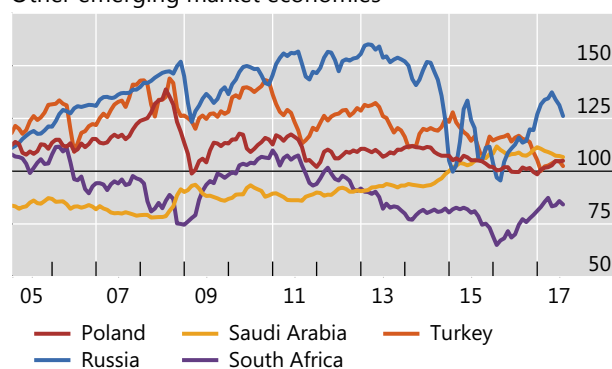
Other emerging Asia



Latin America



Other emerging market economies



Further information on the BIS 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.

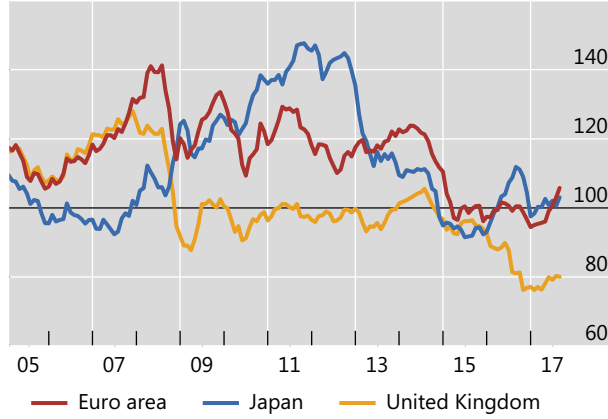
Source: BIS effective exchange rates statistics.

US dollar exchange rates

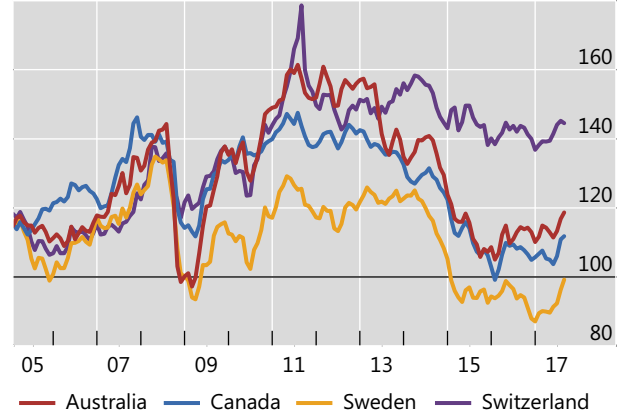
Indices, 1995–2005 = 100¹

Graph I.2

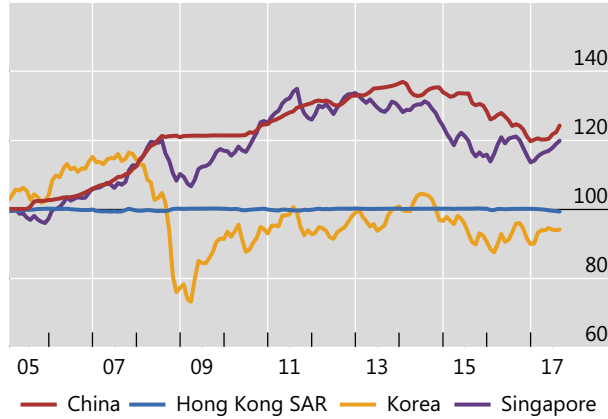
Major advanced economies



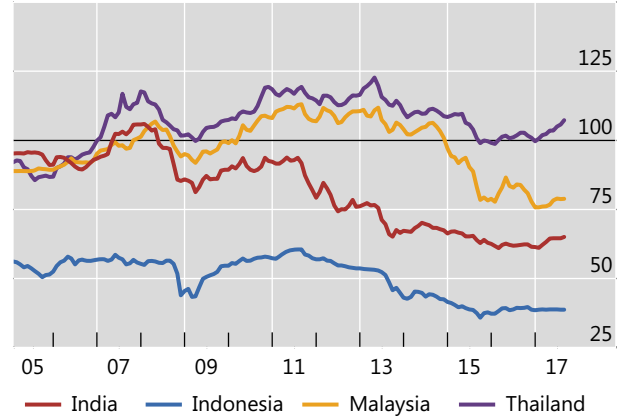
Other advanced economies



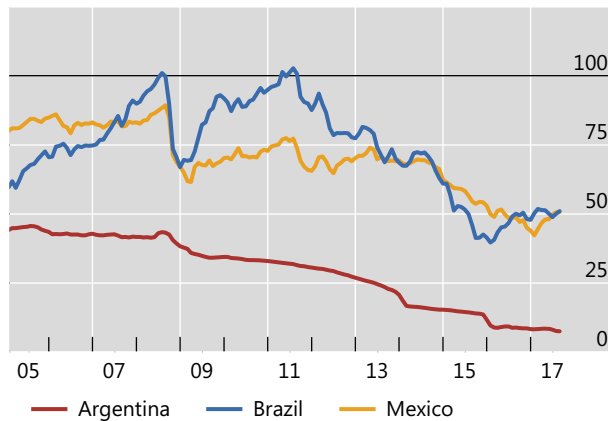
Emerging Asia



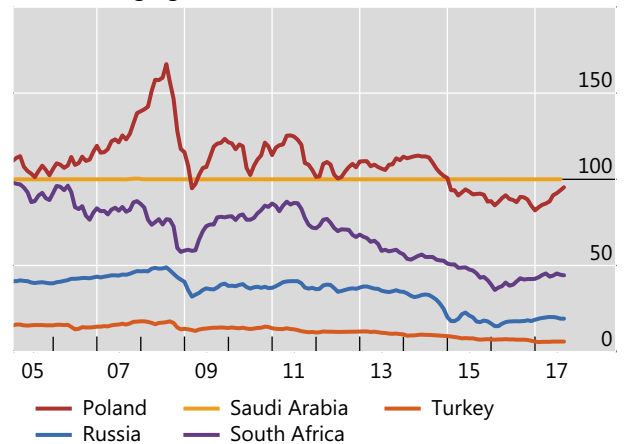
Other emerging Asia



Latin America



Other emerging market economies



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.

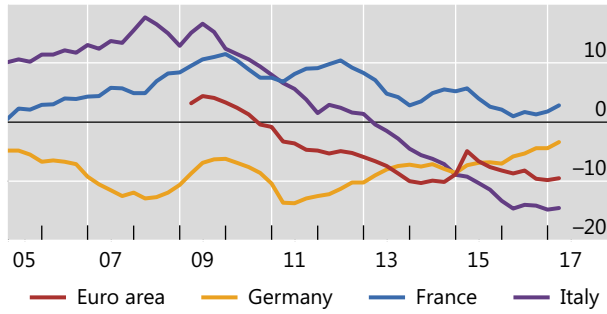
J Credit-to-GDP gaps

Credit-to-GDP gaps

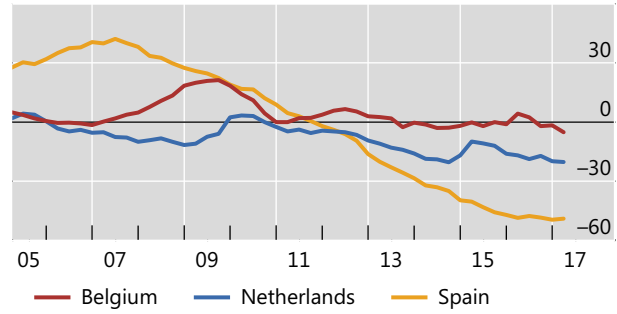
In percentage points of GDP

Graph J.1

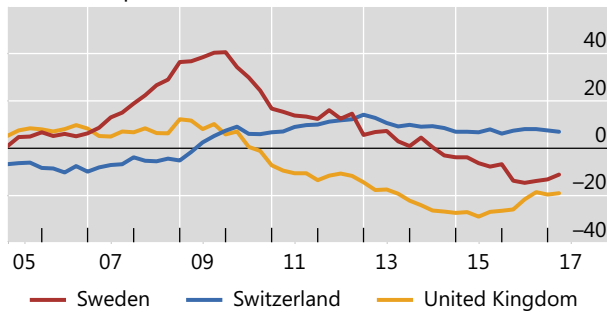
Euro area: aggregate and major countries



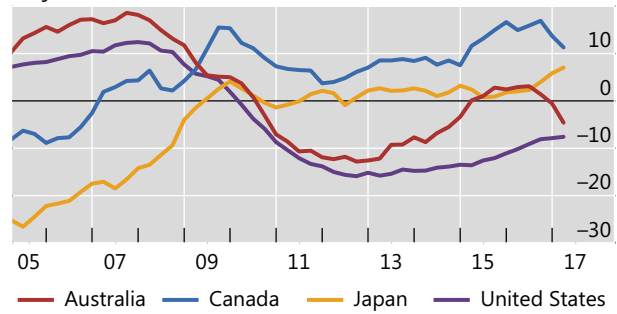
Euro area: other countries



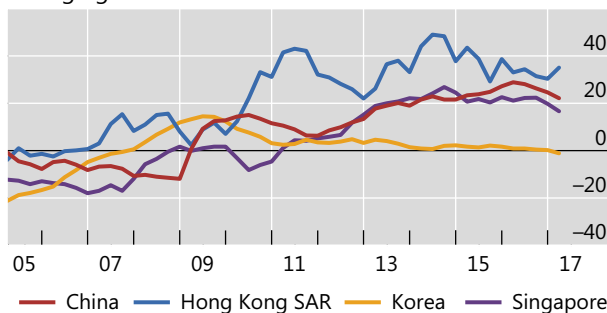
Other European countries



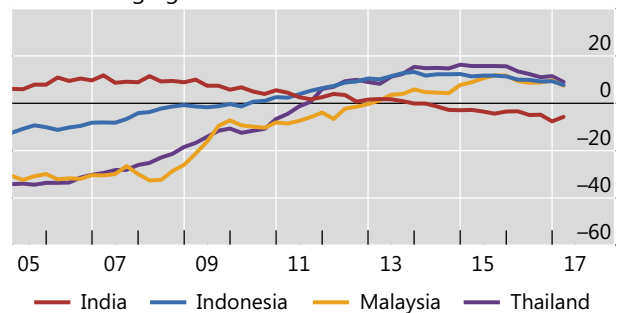
Major advanced economies



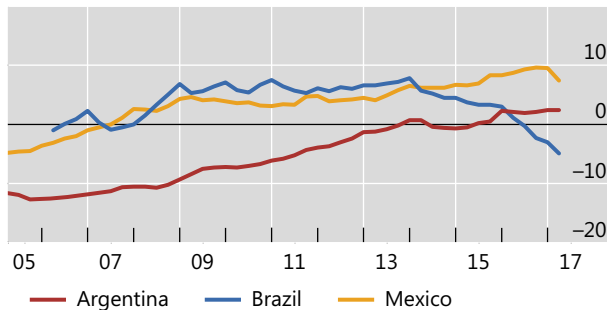
Emerging Asia



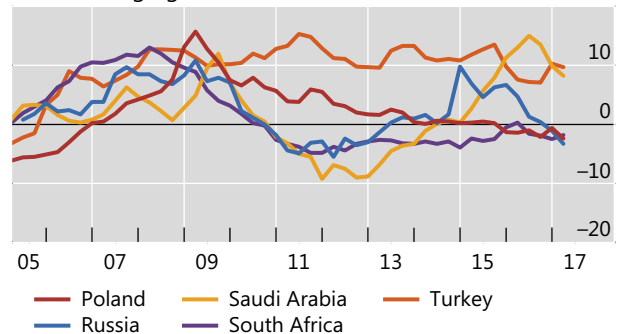
Other emerging Asia



Latin America



Other emerging market economies



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.

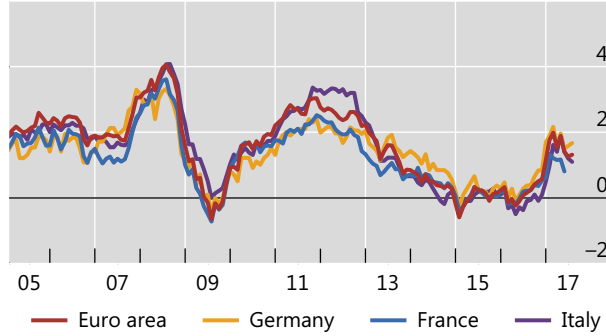
K Consumer prices

Consumer prices

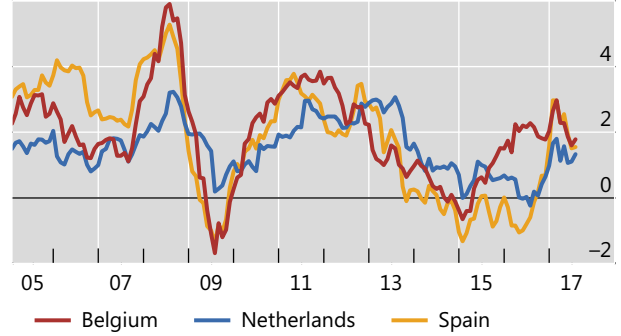
Year-on-year percentage changes

Graph K.1

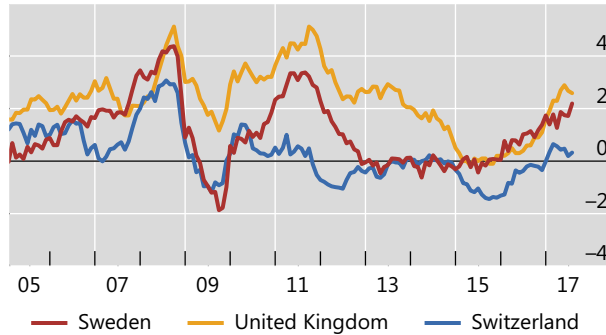
Euro area: aggregate and major countries



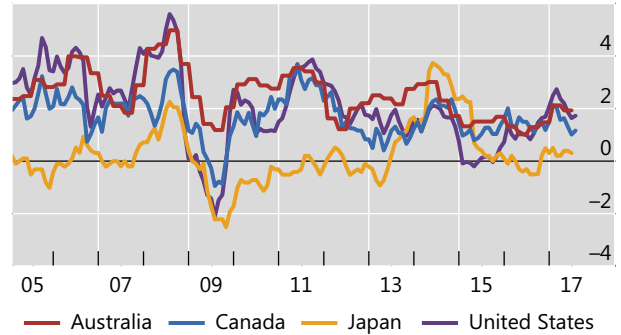
Euro area: other countries



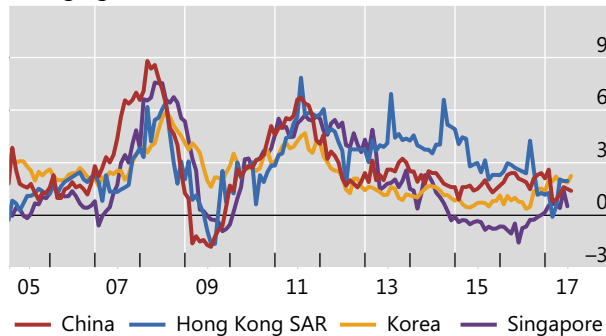
Other European countries



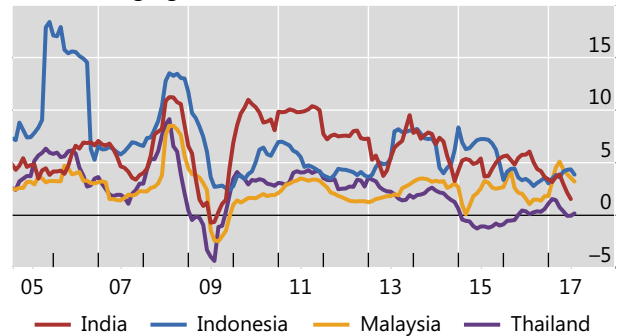
Major advanced economies



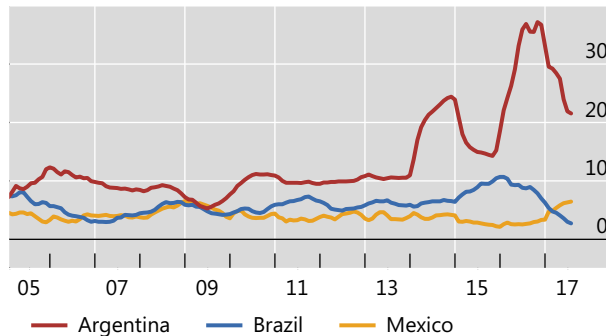
Emerging Asia



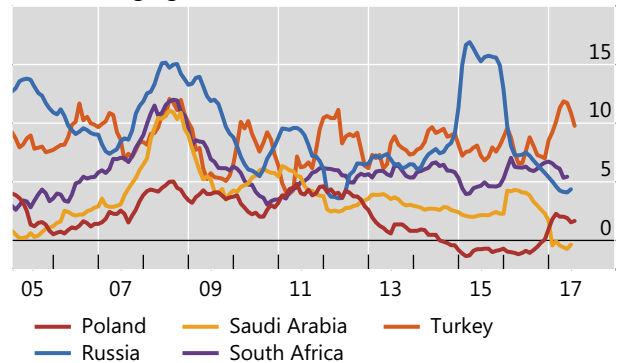
Other emerging Asia



Latin America



Other emerging market economies



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

Source: BIS consumer price statistics.

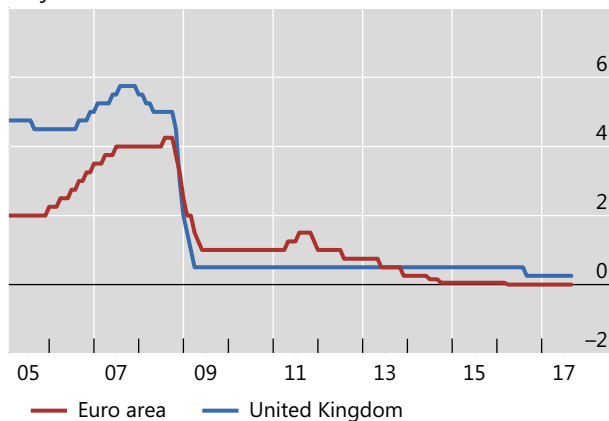
L Central bank policy rates

Central bank policy or representative rates

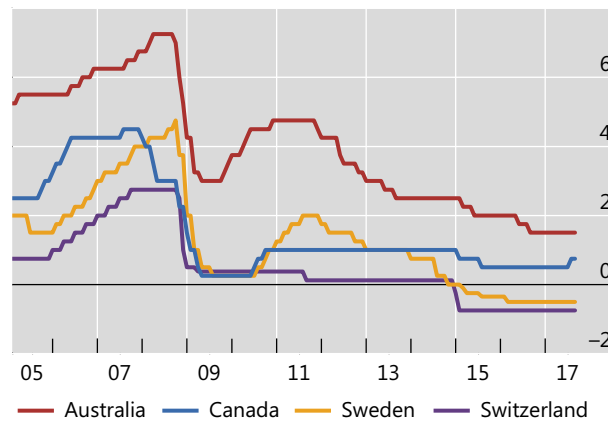
Month-end; in per cent

Graph L.1

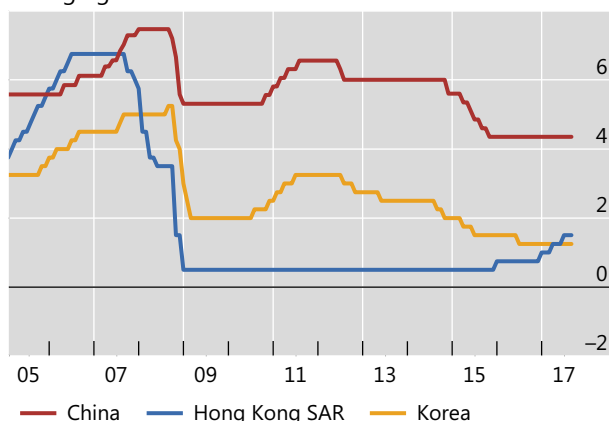
Major advanced economies



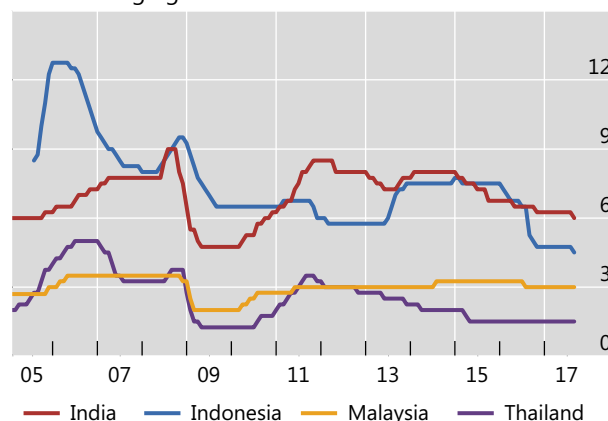
Other advanced economies



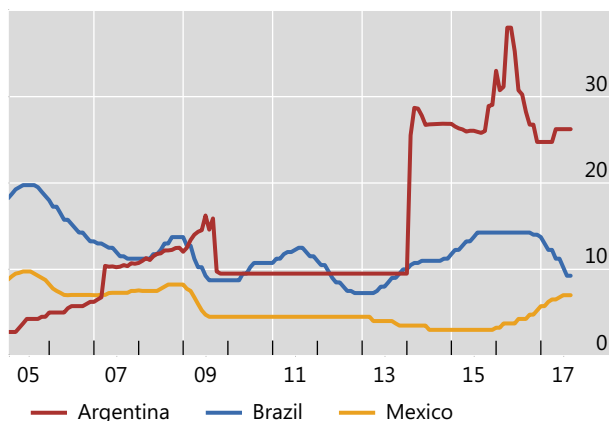
Emerging Asia



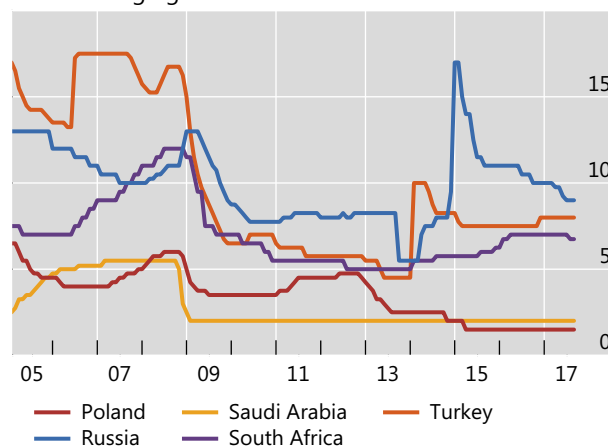
Other emerging Asia



Latin America



Other emerging market economies



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

March 2017	Consumption-led expansions	Enisse Kharroubi & Emanuel Kohlscheen
March 2017	The new era of expected credit loss provisioning	Benjamin Cohen & Gerald Edwards Jr
March 2017	The quest for speed in payments	Morten Bech, Yuuki Shimizu and Paul Wong
March 2017	The bond benchmark continues to tip to swaps	Lawrence Kreicher, Robert McCauley & Philip Wooldridge
December 2016	Downsized FX markets: causes and implications	Michael Moore, Andreas Schrimpf and Vladyslav Sushko
December 2016	The changing shape of interest rate derivatives markets	Torsten Ehlers & Egemen Eren
December 2016	Emerging derivatives markets?	Christian Upper & Marcos Valli
December 2016	Non-deliverable forwards: impact of currency internationalisation and derivatives reform	Robert McCauley & Chang Shu
December 2016	Does the financial channel of exchange rates offset the trade channel?	Jonathan Kerns & Nikhil Patel
September 2016	Covered interest parity lost: understanding the cross-currency basis	Claudio Borio, Robert McCauley, Patrick McGuire & Vladyslav Sushko
September 2016	Foreign exchange market intervention in EMEs: what has changed?	Dietrich Domanski, Emanuel Kohlscheen & Ramon Moreno
September 2016	Domestic financial markets and offshore bond financing	Jose Maria Serena & Ramon Moreno
September 2016	The ECB's QE and euro cross-border bank lending	Stefan Avdjiev, Agne Subelyte & Elod Takats

Recent BIS publications¹

BIS Papers

Building Resilience to Global Risks: Challenges for African Central Banks **BIS Papers No 93, August 2017**

The policy response of many African commodity exporting economies to the slump in commodity prices after mid-2014 has been markedly different from that of commodity exporters elsewhere. First, few African countries allowed their currency to depreciate as much as other EMEs, for instance in Latin America. Instead they resorted mainly to administrative controls, despite the high economic costs associated with such measures. Second, many African economies kept their policy rates very low despite considerable exchange rate pressure and rising inflation. Again, this differs from the response of many Latin American commodity exporters, who raised policy rates in order to keep inflation expectations anchored. Finally, many African economies have been less successful than other EMEs in shielding their banks from the fallout of lower commodity prices, sharp depreciation and feeble growth.

Long-term issues for central banks **BIS Papers No 92, August 2017**

The 15th BIS Annual Conference took place in Lucerne, Switzerland, on 24 June 2016. The event brought together a distinguished group of central bank Governors, leading academics and former public officials to exchange views on the topic "Long-term issues for central banks". The papers presented at the conference and the discussants' comments are released as BIS Working Papers 653 to 656.

BIS Working Papers

How important is the Global Financial Cycle? Evidence from capital flows **Eugenio Cerutti, Stijn Claessens and Andrew K Rose** **August 2017, No 661**

This study quantifies the importance of a Global Financial Cycle (GFCy) for capital flows. We use capital flow data disaggregated by direction and type between Q1 1990 and Q4 2015 for 85 countries, and conventional techniques, models and metrics. Since the GFCy is an unobservable concept, we use two methods to represent it: directly observable variables in centre economies often linked to it, such as the VIX; and indirect manifestations, proxied by common dynamic factors extracted from actual capital flows. Our evidence seems mostly inconsistent with a significant and conspicuous GFCy; the two methods combined rarely explain more than a quarter of the variation in capital flows. Succinctly, most variation in capital flows does not seem to be the result of common shocks nor stem from observables in a central country like the United States.

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/>).

Informal one-sided target zone model and the Swiss franc

Yu-Fu Chen, Michael Funke and Richhild Moessner

August 2017, No 660

This paper develops a new theoretical model with an asymmetric informal one-sided exchange rate target zone, with an application to the Swiss franc following the removal of the minimum exchange rate of CHF 1.20 per euro in January 2015. We extend and generalize the standard target zone model of Krugman (1991) by introducing perceived uncertainty about the lower edge of the band. We find that informal soft edge target zone bands lead to weaker honeymoon effects, wider target zone ranges and higher exchange rate volatility than formal target zone bands. These results suggest that it would be beneficial for exchange rate policy intentions to be stated clearly in order to anchor exchange rate expectations and reduce exchange rate volatility. We also study how exchange rate dynamics can be characterized in models in which financial markets are aware of occasional changes in the policy regime. We show that expected changes in the central bank's exchange rate policy may lead to exchange rate oscillations, providing an additional source of exchange rate volatility, and to capture this it is important to take into account the possibility of regime changes in exchange rate policy.

Effects of capital controls on foreign exchange liquidity

Carlos Cantú

August 2017, No 659

The literature on capital controls has focused on their use as tools to manage capital and improve macroeconomic and financial stability. However, there is a lack of analysis of their effect on foreign exchange (FX) market liquidity. In particular, technological and regulatory changes in FX markets over the past decade have had an influence on the effect of capital controls on alternative indicators of FX liquidity.

In this paper, we introduce a theoretical model showing that, if capital controls are modelled as entry costs, then fewer investors will enter an economy. This will reduce the market's ability to accommodate large order flows without a significant change in the exchange rate (a market depth measure of liquidity). On the other hand, if capital controls are modelled as transaction costs, they can reduce the effective spread (a cost-based measure of liquidity). Using a panel of 20 emerging market economies and a novel measure of capital account restrictiveness, we provide empirical evidence showing that capital controls can reduce cost-based measures of FX market liquidity. The results imply that capital controls are effective in reducing the implicit cost component of FX market liquidity but can also have a negative structural effect on the FX market by making it more vulnerable to order flow imbalances.

The Distance Effect in Banking and Trade

Michael Brei and Goetz von Peter

August 2017, No 658

The empirical gravity literature finds geographical distance to be a large and growing obstacle to trade, contradicting the popular notion that globalization heralds "the end of geography". This distance puzzle disappears, however, when measuring the effect of cross-border distance relative to that of domestic distance (Yotov, 2012). We uncover the same result for banking when comparing cross-border positions with domestic credit, using the most extensive dataset on global bank linkages between countries. The role of distance remains substantial for trade as well as for banking where transport cost is immaterial - pointing to the role of information frictions as a common driver. A second contribution is to show that the forces of globalization are also evident in other, less prominent, parts of the gravity framework.

Quality Pricing-to-Market

Raphael Auer, Thomas Chaney and Philip Sauré

August 2017, No 657

This paper analyses firm's pricing-to-market decisions in vertically differentiated industries. We first present a model featuring firms that sell goods of heterogeneous quality levels to consumers who are heterogeneous in their income and thus their marginal willingness to pay for quality increments. We derive closed-form solutions for the unique pricing game under

costly international trade. The comparative statics highlight how firms' pricing-to-market decisions are shaped by the interaction of consumer income and good quality. We derive two testable predictions. First, the relative price of high qualities compared to low qualities increases with the income of the destination market. Second, the rate of cost pass-through into consumer prices falls with quality if destination market income is sufficiently high. We present evidence in support of these two predictions based on a dataset of prices, sales, and product attributes in the European car industry.

Demographics will reverse three multi-decade global trends

Charles Goodhart and Manoj Pradhan

August 2017, No 656

Between the 1980s and the 2000s, the largest ever positive labour supply shock occurred, resulting from demographic trends and from the inclusion of China and eastern Europe into the World Trade Organization. This led to a shift in manufacturing to Asia, especially China; a stagnation in real wages; a collapse in the power of private sector trade unions; increasing inequality within countries, but less inequality between countries; deflationary pressures; and falling interest rates. This shock is now reversing. As the world ages, real interest rates will rise, inflation and wage growth will pick up and inequality will fall. What is the biggest challenge to our thesis? The hardest prior trend to reverse will be that of low interest rates, which have resulted in a huge and persistent debt overhang, apart from some deleveraging in advanced economy banks. Future problems may now intensify as the demographic structure worsens, growth slows, and there is little stomach for major inflation. Are we in a trap where the debt overhang enforces continuing low interest rates, and those low interest rates encourage yet more debt finance? There is no silver bullet, but we recommend policy measures to switch from debt to equity finance.

The FinTech Opportunity

Thomas Philippon

August 2017, No 655

This paper assesses the potential impact of FinTech on the finance industry. I document first that financial services remain surprisingly expensive, which explains the emergence of new entrants. I then argue that the current regulatory approach is subject to significant political economy and coordination costs, and therefore unlikely to deliver much structural change. FinTech can improve both financial stability and access to services, but this requires significant changes in the focus of regulations.

World changes in inequality: an overview of facts, causes, consequences and policies

François Bourguignon

August 2017, No 654

This paper reviews various issues linked to the rise of inequality observed particularly in developed countries over the last quarter century. Various data on the time profile of inequality are examined, which do not always fit the common view that inequality is everywhere trending upwards. Overall, changes in inequality appear to be very country-specific. The same conclusion obtains when examining the causes of these changes. There is little doubt that common forces affected the distribution of income in most countries, but idiosyncratic factors have amplified their effects in some cases and offset them in others. Country-specificity also holds with regard to policies aimed at correcting inequality, even though globalisation imposes constraints on some key redistribution tools such as taxation and the regulation of financial markets. International coordination and, in particular, more transparency in cross-border financial operations are needed if governments are to recover some autonomy in these matters.

Dollar pricing redux

Camila Casas, Federico Díez, Gita Gopinath and Pierre-Olivier Gourinchas

August 2017, No 653

A country's exchange rate is at the center of economic and political debates on currency wars and trade competitiveness. The real consequences of exchange rate fluctuations depend critically on how firms set prices in international markets. Recent empirical evidence has challenged the dominant 'producer currency' pricing and 'local currency' pricing paradigms in

the literature. In this paper we propose a new paradigm, consistent with the empirical evidence and characterized by three features: pricing in dollars, strategic complementarity in pricing and imported inputs in production. We call this the 'dollar pricing' paradigm and contrast its theoretical predictions with prior approaches in a general equilibrium New Keynesian model. We then employ novel data for Colombia to evaluate the implications of exchange rate fluctuations associated with commodity price shocks and show that the findings strongly support the dollar pricing paradigm.

The discontinuation of the EUR/CHF minimum exchange rate in January 2015: was it expected?

Michael Funke, Julius Loermann and Richhild Moessner
July 2017, No 652

We derive risk-neutral probability densities for future euro/Swiss franc exchange rates as implied by option prices. We find that the credibility of the Swiss franc floor somewhat decreased as the spot exchange rate approached the lower bound of 1.20 CHF per euro. We also compare the forecasting performance of a random walk benchmark model with an error-correction model (ECM) augmented with option-implied break probabilities of breaching the currency floor. We find some evidence that the augmented ECM has an informational advantage over the random walk when using one-month break probabilities. But we find that one-month option-implied densities cannot predict the entire range of exchange rate realizations.

Segmented money markets and covered interest parity arbitrage

Dagfinn Rime, Andreas Schrimpf and Olav Syrstad
July 2017, No 651

This paper studies the violation of the most basic no-arbitrage condition in international finance - Covered Interest Parity (CIP). To understand the CIP conundrum, it is key to (i) account for funding frictions in U.S. dollar money markets, and (ii) to study the challenges of swap intermediaries when funding liquidity evolves differently across major currency areas. We find that CIP holds remarkably well for most potential arbitrageurs when applying their marginal funding rates. With severe funding liquidity differences, however, it becomes impossible for dealers to quote prices such that CIP holds across the full rate spectrum. A narrow set of global top-tier banks enjoys risk-less arbitrage opportunities as dealers set quotes to avert order flow imbalances. We show how a situation with persistent arbitrage profits arises as an equilibrium outcome due to the constellation of market segmentation, the abundance of excess reserves and their remuneration in central banks' deposit facilities.

Financial deglobalisation in banking?

Robert Neil McCauley, Agustín S Bénétrix, Patrick McGuire and Goetz von Peter
June 2017, No 650

This paper argues that the decline in cross-border banking since 2007 does not amount to a broad-based retreat in international lending ("financial deglobalisation"). We show that BIS international banking data organised by the nationality of ownership ("consolidated view") provide a clearer picture of international financial integration than the traditional balance-of-payments measure. On the consolidated view, what appears to be a global shrinkage of international banking is confined to European banks, which uniquely responded to credit losses after 2007 by shedding assets abroad - in particular, reducing lending - to restore capital ratios. Other banking systems' global footprint, notably those of Japanese, Canadian and even US banks, has expanded since 2007. Using a global dataset of banks' affiliates (branches and subsidiaries), we demonstrate that the who (nationality) accounts for more of the peak-to-trough shrinkage of foreign claims than does the where (locational factors). These findings suggest that the contraction in global lending can be interpreted as cyclical deleveraging of European banks' large overseas operations, rather than broad-based financial deglobalisation.

Monetary policy transmission and trade-offs in the United States: Old and new
Boris Hofmann and Gert Peersman
June 2017, No 649

This study shows that, in the United States, the effects of monetary policy on credit and housing markets have become considerably stronger relative to the impact on GDP since the mid-1980s, while the effects on inflation have become weaker. Macroeconomic stabilization through monetary policy may therefore have become associated with greater fluctuations in credit and housing markets, whereas stabilizing credit and house prices may have become less costly in terms of macroeconomic volatility. These changes in the aggregate impact of monetary policy can be explained by several important changes in the monetary transmission mechanism and in the composition of macroeconomic and credit aggregates. In particular, the stronger impact of monetary policy on credit is driven by a much higher responsiveness of mortgage credit and a larger share of mortgages in total credit since the 1980s.

Credit ratings of domestic and global agencies: What drives the differences in China and how are they priced?
Xianfeng Jiang and Frank Packer
June 2017, No 648

The market for the credit ratings of Chinese firms is large and growing. We focus our analysis on the firms that have ratings from both domestic and global agencies. Despite the similar symbols, the rating scales of the domestic and global agencies differ: domestic agencies rate firms that are jointly rated higher than global agencies by 6-7 notches on average. Focusing on the rank order of domestic and global credit ratings, we test for differences in the determinants of ratings across global and domestic agencies. We find asset size is weighed more heavily as a positive factor by domestic agencies, and leverage is weighed more heavily as a negative factor by global agencies. Profitability and state-ownership are weighed more positively by global rating agencies. The influence of the variables is generally stable across a variety of robustness checks. In spite of these differences, both domestic and global ratings appear to be priced into the market values of rated bonds.

The evolution of inflation expectations in Japan
Masazumi Hattori and James Yetman
June 2017, No 647

We model inflation forecasts as monotonically diverging from an estimated long-run anchor point towards actual inflation as the forecast horizon shortens. Fitting the model with forecaster-level data for Japan, we find that the estimated anchors across forecasters have tended to rise in recent years, along with the dispersion in estimates across forecasters. Further, the degree to which these anchors pin down inflation expectations at longer horizons has increased, but remains considerably lower than found in a similar study of Canadian and US forecasters. Finally, the wide dispersion in estimated decay paths across forecasters points to a diverse set of views across forecasters about the inflation process in Japan.

Macroprudential policy and bank risk
Yener Altunbas, Mahir Binici and Leonardo Gambacorta
June 2017, No 646

This paper investigates the effects of macroprudential policies on bank risk through a large panel of banks operating in 61 advanced and emerging market economies. There are three main findings. First, there is evidence suggesting that macroprudential tools have a significant impact on bank risk. Second, the responses to changes in macroprudential tools differ among banks, depending on their specific balance sheet characteristics. In particular, banks that are small, weakly capitalised and with a higher share of wholesale funding react more strongly to changes in macroprudential tools. Third, controlling for bank-specific characteristics, macroprudential policies are more effective in a tightening than in an easing episode.

Accounting for debt service: the painful legacy of credit booms

Mathias Drehmann, Mikael Juselius and Anton Korinek

June 2017, No 645

When taking on new debt, borrowers commit to a pre-specified path of future debt service. This implies a predictable lag between credit booms and peaks in debt service which, in a panel of household debt in 17 countries, is four years on average. The lag is driven by two key features of the data: (i) new borrowing is strongly auto-correlated and (ii) debt contracts are long term. The delayed increase in debt service following an impulse to new borrowing largely explains why credit booms are associated with lower future output growth and higher probability of crisis. This provides a systematic transmission channel whereby credit expansions can have long-lasting adverse real effects.

The shifting drivers of global liquidity

Stefan Avdjiev, Leonardo Gambacorta, Linda Goldberg and Stefano Schiaffi

June 2017, No 644

The post-crisis period has seen a considerable shift in the composition and drivers of international bank lending and international bond issuance, the two main components of global liquidity. The sensitivity of both types of flow to US monetary policy rose substantially in the immediate aftermath of the Global Financial Crisis, peaked around the time of the 2013 Fed "taper tantrum", and then partially reverted towards pre-crisis levels. Conversely, the responsiveness of international bank lending to global risk conditions declined considerably post-crisis and became similar to that of international debt securities. The increased sensitivity of international bank flows to US monetary policy has been driven mainly by post-crisis changes in the behaviour of national lending banking systems, especially those that ex ante had less well capitalized banks. By contrast, the post-crisis fall in the sensitivity of international bank lending to global risk was mainly due to a compositional effect, driven by increases in the lending market shares of better-capitalized national banking systems. The post-2013 reversal in the sensitivities to US monetary policy partially reflects the expected divergence of the monetary policy of the US and other advanced economies, highlighting the sensitivity of capital flows to the degree of commonality of cycles and the stance of policy. Moreover, global liquidity fluctuations have largely been driven by policy initiatives in creditor countries. Policies and prudential instruments that reinforced lending banks' capitalization and stable funding levels reduced the volatility of international lending flows.

The international dimensions of macroprudential policies

Pierre-Richard Agénor, Enisse Kharroubi, Leonardo Gambacorta, Giovanni Lombardo and Luiz Awazu Pereira da Silva

June 2017, No 643

The large economic costs associated with the Global Financial Crisis have generated renewed interest in macroprudential policies and their international coordination. Based on a core-periphery model that emphasizes the role of international financial centers, we study the effects of coordinated and non-coordinated macroprudential policies when financial intermediation is subject to frictions. We find that even when the only frictions in the economy consist of financial frictions and financial dependency of periphery banks, the policy prescriptions under international policy coordination can differ quite markedly from those emerging from self-oriented policy decisions. Optimal macroprudential policies must address both short run and long run inefficiencies. In the short run, the policy instruments need to be adjusted to mitigate the adverse consequences of the financial accelerator, and its cross-country spillovers. In the long run, policymakers need to take into account the effects of the higher cost of capital, due to the presence of financial frictions. The gains from cooperation appear to be sizable. Nevertheless, their magnitude could be asymmetric, pointing to potential political-economy obstacles to the implementation of cooperative measures.

The effects of monetary policy shocks on inequality in Japan

Masayuki Inui, Nao Sudo and Tomoaki Yamada

June 2017, No 642

The impacts of monetary easing on inequality have been attracting increasing attention recently. In this paper, we use the micro-level data on Japanese households to study the

distributional effects of monetary policy. We construct quarterly series of income and consumption inequality measures from 1981 to 2008, and estimate their response to a monetary policy shock. We find that monetary policy shocks do not have a statistically significant impact on inequality across Japanese households in a stable manner. When considering inequality across households whose head is employed, we find evidence that, before the 2000s, an expansionary monetary policy shock increased income inequality through a rise in earnings inequality. Such procyclical responses are, however, scarcely observed when the current data are included in the sample period, or when earnings inequality across all households is considered. We also find that transmission of income inequality to consumption inequality is minor, including during the period when procyclicality of income inequality was pronounced. Using a two-sector dynamic general equilibrium model with attached labor inputs, we show that labor market flexibility is central to the dynamics of income inequality after monetary policy shocks. We also use the micro-level data on households' balance sheets and show that distributions of households' financial assets and liabilities do not play a significant role in the distributional effects of monetary policy.

China's evolving monetary policy rule: from inflation-accommodating to anti-inflation policy

Eric Girardin, Sandrine Lunven and Guonan Ma

June 2017, No 641

This paper aims to enhance the understanding of China's monetary policy rule since the mid-1990s, focusing on the role of inflation. It investigates the rule followed by the People's Bank of China (PBoC) by considering both the structural economic transformation of China and its evolving monetary policy framework.

Our newly constructed monthly composite discrete monetary policy index (MPI), which combines price, quantity and administrative instruments, shows a change in style towards smoother but more contractionary policy moves from 2002 onwards. The estimation of a dynamic discrete-choice model à la Monokroussos (2011) implies that, from this point onwards, the conduct of monetary policy has been characterised by implicit inflation targeting. While the PBoC's behaviour up to 2001 was reminiscent of that in the inflation-accommodating G3 economies of the United States, euro area and Japan up to 1979, it has been characterized since 2002 by a policy rule similar to the post-1979 anti-inflation (forward-looking) policy of the G3. An accurate estimation of the monetary policy rule from 2002 needs to consider China as an open economy, as a result of its rapid liberalisation of trade and finance after its WTO accession. As such, the influence of US interest rates has become increasingly significant for Chinese monetary policy.

Basel Committee on Banking Supervision

Implications of fintech developments for banks and bank supervisors - consultative document

August 2017

The Basel Committee on Banking Supervision today released a consultative document on the implications of fintech for the financial sector. Sound practices: Implications of fintech developments for banks and bank supervisors • assesses how technology-driven innovation in financial services, or "fintech", may affect the banking industry and the activities of supervisors in the near to medium term.

Various future potential scenarios are considered, with their specific risks and opportunities. In addition to the banking industry scenarios, three case studies focus on technology developments (big data, distributed ledger technology, and cloud computing) and three on fintech business models (innovative payment services, lending platforms and neo-banks).

Although fintech is only the latest wave of innovation to affect the banking industry, the rapid adoption of enabling technologies and emergence of new business models pose an increasing challenge to incumbent banks in almost all the scenarios considered.

Banking standards and supervisory expectations should be adaptive to new innovations, while maintaining appropriate prudential standards. Against this background, the Committee has identified 10 key observations and related recommendations on the following supervisory issues for consideration by banks and bank supervisors:

1. the overarching need to ensure safety and soundness and high compliance standards without inhibiting beneficial innovation in the banking sector;
2. the key risks for banks related to fintech developments, including strategic/profitability risks, operational, cyber and compliance risks;
3. the implications for banks of the use of innovative enabling technologies;
4. the implications for banks of the growing use of third parties, via outsourcing and/or partnerships;
5. cross-sectoral cooperation between supervisors and other relevant authorities;
6. international cooperation between banking supervisors;
7. adaptation of the supervisory skillset;
8. potential opportunities for supervisors to use innovative technologies ("suptech");
9. relevance of existing regulatory frameworks for new innovative business models; and
10. key features of regulatory initiatives set up to facilitate fintech innovation.

The Committee welcomes comments on all aspects of this consultative document. Comments should be uploaded by Tuesday 31 October 2017 via the following BCBS link. All comments will be published on the website of the Bank for International Settlements unless a respondent specifically requests confidential treatment.

The interplay of accounting and regulation and its impact on bank behaviour July 2017

Accounting rules and disclosure standards are important determinants for banks' incentives and behaviour, and the recent financial crisis, where criticism was voiced (eg regarding the role of fair value accounting of financial assets and incurred loss provisioning of loans), is just another example of the importance and relevance of banks' financial reporting in a regulatory and supervisory context.

In March 2013, the Basel Committee's Research Task Force initiated a work stream that deals with aspects of the interplay of accounting and regulation and its impact on bank behaviour from a research perspective. Specifically, the work stream was tasked to "identify ways in which the interaction between accounting and regulatory rules provides incentives that affect the risk taking of financial institutions", and it commenced research on specific aspects of loan loss provisioning, disclosure rules, fair value accounting, and prudential filters.

In summary, the results described in this report as well as the conclusions from other studies reported in Basel Committee working paper 28 suggest that both in the context of loan loss provisioning and the valuation of banks' assets, there is a tension between backward-looking and forward-looking measurement. This observation is also consistent with the mixed picture that is given by the analytical results regarding several research questions. One conclusion is that corner solutions in one or the other direction do not seem optimal, and that an adequate mix of the two concepts may be superior. The other conclusion is that further evidence on the research questions posed is clearly needed. For example, all projects of the work stream focus on quantities, but not on prices of financial instruments (eg loan rates or yields of securities). Therefore, researchers are encouraged to further address the interplay of accounting and regulation and its impact on bank behaviour from an academic perspective.

Criteria for identifying simple, transparent and comparable short-term securitisations - consultative document

July 2017

The Basel Committee on Banking Supervision (BCBS) and the International Organization of Securities Commissions (IOSCO) today released the consultative document *Criteria for identifying simple, transparent and comparable short-term securitisations* (the short-term STC criteria).

The short-term STC criteria maintain and build on the principles in the *Criteria for identifying simple, transparent and comparable securitisations* issued by BCBS-IOSCO in July 2015. The criteria published today take account of the characteristics of asset-backed commercial paper (ABCP) conduits, such as (i) the short maturity of the commercial paper issued, (ii) the different forms of programme structures and (iii) the existence of multiple forms of liquidity and credit support facilities.

The criteria aim to assist the financial industry in its development of simple, transparent and comparable short-term securitisations. They were designed to help the parties to such transactions to evaluate the risks of a particular securitisation across similar products and to assist investors with their conduct of due diligence on securitisations. The BCBS has concurrently issued a consultative document *Capital treatment for simple, transparent and comparable short-term securitisations* outlining how the short-term STC criteria could be incorporated into the regulatory capital framework for banks.

BCBS and IOSCO welcome comments on all aspects of this consultative document. Comments on the proposals should be provided by Thursday 5 October 2017, via upload through the following BCBS link, or by e-mail to IOSCO_consultation-03-2017@iosco.org. All comments will be published on the websites of the Bank for International Settlements and IOSCO unless a respondent specifically requests confidential treatment.

Capital treatment for simple, transparent and comparable short-term securitisations - consultative document

July 2017

The Basel Committee on Banking Supervision today released the consultative document *Capital treatment for simple, transparent and comparable short-term securitisations*. The Committee's proposed capital treatment supplements the consultative document *Criteria for identifying simple, transparent and comparable short-term securitisations* issued jointly with the International Organization of Securities Commissions (IOSCO).

The consultative document sets out additional guidance and requirements for the purpose of applying preferential regulatory capital treatment for banks acting as investors in or as sponsors of simple, transparent and comparable (STC) short-term securitisations, typically in asset-backed commercial paper (ABCP) structures. The additional guidance and requirements include that:

investors have access to key monthly information on the performance and key characteristics of the ABCP structure;

the redemption risk of the underlying assets is addressed from the sponsor's perspective; and

the transactions funded by the conduit have an enforceable legal structure and that the relevant information is disclosed by the sponsor to investors.

The proposed treatment is also consistent with the Committee's July 2016 revisions to the securitisation framework. The 2016 standard sets out additional guidance and requirements for differentiating the capital treatment of STC term securitisations from that of other securitisations. Similarly, provided that the proposed criteria are met, STC short-term securitisations will receive the same reduction in capital requirements as other STC term securitisations. This enhances the framework's risk sensitivity without significantly increasing banks' operational burden in computing the applicable capital relief.

The Committee welcomes comments on all aspects of this consultative document. Comments should be uploaded by Thursday 5 October 2017 using the following BCBS link. All comments will be published on the website of the Bank for International Settlements unless a respondent specifically requests confidential treatment.

Implementation of Basel standards

July 2017

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 August 2016, 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.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III LCR regulations – China

July 2017

In China, the LCR applies to all commercial banks with total assets of at least 200 billion Chinese renminbi (CNY). It was implemented via three regulations on reporting, minimum LCR requirements and disclosure. These were issued in December 2013, February 2014 and December 2015, respectively, and came into effect in January 2014, March 2014 and December 2015.

Overall, as of 31 March 2017, the LCR regulations in China are assessed as compliant with the Basel LCR standards. This is the highest possible grade. All four components are also assessed as compliant, with no gaps identified between the Basel LCR standards and the Chinese regulations. The Assessment Team compliments the CBRC on its implementation of an alignment with the Basel LCR framework.

In some respects, the Chinese LCR framework is stricter than the Basel standards, particularly with respect to the definition of high-quality liquid assets (HQLA).

In addition to the formal assessment of the LCR standard and disclosure requirements, this report contains annexes that summarise China's implementation of the LCR monitoring tools and the Basel Committee's principles for sound liquidity risk management, as well as the key national discretions and approaches that the CBRC has adopted when implementing the LCR. These annexes show how national authorities implement certain aspects of the Basel standards that are not in scope of the formal RCAP-LCR assessment. Over time, this information will provide a basis for designing sound practices and additional supervisory guidance that will benefit the regulatory community and the banking industry. This should raise the consistency of LCR implementation and improve the ratio's effectiveness in practice.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III LCR regulations - European Union

July 2017

This report presents the findings of the RCAP Assessment Team on the adoption of the Basel Liquidity Coverage Ratio (LCR) in the European Union (EU) and its consistency with the minimum requirements of the Basel III framework. The assessment is based on the EU LCR rules of the Capital Requirements Regulation (CRR) and the Fourth Capital Requirements Directive (CRD IV), supplemented by the Commission Delegated Act 2015/61 and the European Banking Authority (EBA) standards and guidelines in force as of 31 March 2017. The assessment was limited to the delegation of these directives and regulations to the nine Member States of the EU whose central banks and/or prudential supervisory agencies are Basel Committee members (Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Spain, Sweden and the United Kingdom ("the nine Member States")).¹

The RCAP Assessment Team was led by Mr Rob Urry, Deputy Registrar of Banks, Bank Supervision Department of South African Reserve Bank (SARB). The Assessment Team comprised two technical experts, drawn from Australia and Indonesia (Annex 1). The main counterpart for the assessment was the European Commission (EC), which in turn coordinated with other EU and Member States' authorities. The overall work was coordinated by the Basel Committee Secretariat with support from SARB staff.

The assessment focuses on the consistency and completeness of the EU LCR rules with the Basel minimum requirements. Issues relating to prudential outcomes, the liquidity position of individual banks or the effectiveness of the EU authorities' supervisory effectiveness were not in the scope of this RCAP assessment. The assessment relied upon the EU regulations and other information and explanations provided by the EC and EBA and ultimately reflects the expert view of the Assessment Team on the documents and data reviewed. Where deviations from the Basel framework were identified, they were evaluated for their current and potential impact on the reported LCR for a sample of internationally active banks in the nine Member States. The materiality assessment relied upon the data, information and computations provided by the EBA. Some findings were evaluated on a qualitative basis in instances where appropriate quantitative data were not available. The overall assessment outcome was then based on the materiality of findings (in both quantitative and qualitative terms) and expert judgment. The Assessment Team followed the methodology and guidance provided in the RCAP Handbook for Jurisdictional Assessments.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III LCR regulations - United States of America
July 2017

This report presents the findings of an RCAP assessment on the domestic adoption of the Basel Liquidity Coverage Ratio (LCR) standard in the United States (US) and its consistency with the minimum requirements of the Basel III framework.

The focus of the assessment was on the consistency and completeness of US regulations with the Basel minimum requirements, with respect to the regulations applied to those US banks that are internationally active and of significance to domestic financial stability. Issues relating to prudential outcomes, the liquidity position of individual banks or the US authorities' supervisory effectiveness were not within the scope of this RCAP assessment. The assessment relied upon data, information and materiality computations provided by the US authorities and was based on US regulations in force as of 31 December 2016. The Basel Committee discussed and approved the report, which ultimately reflects its judgment on the consistency and completeness of the US implementation of the LCR.

The assessment began in April 2016 and consisted of three phases: (i) completion of an RCAP questionnaire (a self-assessment) by the US authorities; (ii) an assessment phase (July to December 2016); and (iii) a post-assessment review phase (January to June 2017). The second phase included an evaluation of the self-assessment provided by the US authorities as well as an on-site assessment, which involved discussions with US authorities and representatives of US banks. These exchanges provided the Assessment Team with a deeper understanding of the implementation of the Basel LCR in the US. The third phase consisted of a two-stage technical review of the assessment findings: first, by a separate RCAP Review Team and feedback from the Basel Committee's Supervision and Implementation Group (SIG); and second, by the RCAP Peer Review Board and the Basel Committee. This two-step review process is a key part of the RCAP process, providing quality control and ensuring integrity of the assessment findings. The Assessment Team prepared a draft report based on (i) its assessment and discussions with the US authorities and (ii) discussions of the report by the Committee's Supervision and Implementation Group (SIG). This report was later updated by the Basel Committee's Secretariat to reflect the views of the Peer Review Board and, ultimately, of the Basel Committee.

**Simplified alternative to the standardised approach to market risk capital requirements
- consultative document
June 2017**

In January 2016, the Basel Committee on Banking Supervision published the standard Minimum capital requirements for market risk. The standard includes an internal models approach and a standardised approach to measuring market risk capital requirements.

In order to facilitate adoption of this standard for banks other than those that are large and internationally active, this document sets out the Committee's proposal for a simplified alternative to the market risk standardised approach. The proposed reduced sensitivities-based method represents a simplified version of the sensitivities-based method (SbM), which is the primary component of the standardised approach. Significant simplifications relative to the SbM include:

- removal of capital requirements for vega and curvature risks

- simplification of the basis risk calculation

- reduction in risk factor granularity and the correlation scenarios to be applied in the associated calculations

Use of the proposed reduced SbM would be subject to supervisory approval and oversight, and would be available only to banks that meet certain qualitative and quantitative criteria. As proposed, for banks that adopt the reduced SbM, the standardised approach market risk capital requirement would be the sum of three components: (i) the risk charges under the reduced SbM (as proposed in the consultative document); (ii) the default risk charge; and (iii) the residual risk add-on, with the latter two to be calculated as specified in the January 2016 standard.

As an alternative, the Committee also seeks feedback on whether retaining a recalibrated version of the Basel II standardised approach to market risk would better serve the purpose of including a simplified method for market risk capital requirements in the Basel framework.

The Committee welcomes comments on all aspects of this consultative document and the proposed standards text. Comments on the proposals should be uploaded here by Wednesday 27 September 2017. All comments will be published on the website of the Bank for International Settlements unless a respondent specifically requests confidential treatment.

**Range of practices in implementing the countercyclical capital buffer policy
June 2017**

The Basel Committee on Banking Supervision introduced the countercyclical capital buffer (CCyB) policy as part of the Basel III reforms. The countercyclical capital buffer aims to ensure that banking sector capital requirements take account of the macro-financial environment in which banks operate. Its primary objective is to use a buffer of capital to achieve the broader macroprudential goal of protecting the banking sector from periods of excess aggregate credit growth that have often been associated with the build-up of system-wide risk.

In 2010, the Committee issued the Guidance for national authorities operating the countercyclical capital buffer. While this document provides key requirements for CCyB policies that national authorities should follow in designing their CCyB framework and making buffer decisions, national authorities retain considerable flexibility to design the particular details of their policies in a manner that best reflects specific national circumstances.

The document on Range of practices in implementing the countercyclical capital buffer policy examines how jurisdictions have used this flexibility in designing their CCyB policies, drawing on information from a survey undertaken by the Committee as well as the website of CCyB decisions maintained by the Committee. It details the various national CCyB policy frameworks and operational aspects, underlining the varying discretionary elements of jurisdictions' CCyB policy frameworks and practices.

This document also highlights the importance of implementing the Basel standards and provides information on implementation practices related to CCyB policies. In particular, this document provides evidence that CCyB policy frameworks differ markedly with respect to:

their governance structures;

the number of indicators used to identify periods of excess credit and systemic risk;

the degree of reliance on formal versus judgmental approaches in making CCyB decisions; and

their communication and reciprocity practices.

Furthermore, the final section of the report outlines some issues that were identified in the context of the cross-jurisdiction comparisons, which could be further discussed over the medium term as experience with the CCyB policy is gained.

Basel III - The Liquidity Coverage Ratio: frequently asked questions June 2017

The Basel Committee on Banking Supervision today issued a second set of frequently asked questions (FAQs) and answers on Basel III's Liquidity Coverage Ratio (LCR). This new set of FAQs are grouped according to the paragraph number of the related issue within the LCR framework and have been combined with existing FAQs published in April 2014.

To promote consistent global implementation of these requirements, the Committee periodically reviews frequently asked questions and publishes answers along with any necessary technical elaboration of the rules text and interpretative guidance. The Committee has received a number of interpretation questions related to the January 2013 publication of the LCR standard.

Sound management of risks related to money laundering and financing of terrorism: revisions to correspondent banking annex - final document June 2017

The Basel Committee on Banking Supervision has finalised its revisions to the annex on correspondent banking.

These revisions are included in a new release of the guidelines on the Sound management of risks related to money laundering and financing of terrorism • , which was first published in January 2014, with a first revised version issued in February 2016.

The revisions are consistent with the Financial Action Task Force (FATF) guidance on Correspondent banking services issued in October 2016 and serve the same objective of clarifying rules applicable to banks conducting correspondent banking activities. They form part of a broader initiative of the international community to assess and address the decline in correspondent banking coordinated by the Financial Stability Board • .

The text includes proposed revisions to annexes 2 (Correspondent banking) and 4 (General guide to account opening) of the Basel Committee's guidelines on the Sound management of risks related to money laundering and financing of terrorism. The revisions guide the banks in the application of the risk-based approach for correspondent banking relationships, recognising that not all correspondent banking relationships bear the same level of risk and including an updated list of risk indicators that correspondent banks should consider in their risk assessment.

A consultative version - Revisions to the annex on correspondent banking - was issued in November 2016. The Basel Committee wishes to thank all those who took the trouble to express their views during the consultation process.

Committee on Payments and Market Infrastructures

Methodology of the statistics on payments and financial market infrastructures in the CPMI countries (Red Book statistics)

May 2017 No 168

Under the guidance of the Committee on Payments and Market Infrastructures (CPMI) and in cooperation with central banks in CPMI jurisdictions, the BIS compiles statistics on payments and financial market infrastructures, the so-called Red Book statistics.

The CPMI today published a revised methodology of the Red Book statistics, which updates and enhances indicators on cashless payments and financial market infrastructures to reflect the substantial changes that the payment landscape has undergone over the past decade. The Red Book statistics will in future include more information on the role of non-banks, on online and contactless payments and on fast payments. The revised methodology also clarifies how to count debit and credit cards, and which retail cashless payments count as domestic and which as cross-border.

The revised methodology replaces that which has hitherto been appended to each annual Red Book PDF publication. It is complemented by an outline of the new structure of the statistical tables, which illustrates the relationship between indicators by means of numerical examples.

The 2017 Red Book (reporting end-2016 data, to be published in September and December 2017) will still use the old methodology. The new Red Book statistics will be published in a new user-friendly internet-based format.

Implementation monitoring of PFMI: Level 2 assessment report for Singapore

July 2017 No 167

The Committee on Payments and Market Infrastructures (CPMI) and the International Organization of Securities Commissions (IOSCO) continue to closely monitor the implementation of the Principles for financial market infrastructures (PFMI). The principles within the PFMI (the Principles) set expectations for the design and operation of key financial market infrastructures (FMIs) to enhance their safety and efficiency, and, more broadly, to limit systemic risk and foster transparency and financial stability. The Principles apply to all systemically important payment systems (PSs), central securities depositories (CSDs), securities settlement systems (SSSs), central counterparties (CCPs) and trade repositories (TRs) (collectively FMIs). These FMIs collectively clear, settle and record transactions in financial markets. In line with the G20's expectations, CPMI and IOSCO members have committed themselves to implementing and applying the PFMI in their respective jurisdictions.

This report presents the conclusions drawn by the CPMI and IOSCO from a Level 2 assessment of whether, and to what degree, the legal, regulatory and oversight frameworks, including rules and regulations, any relevant policy statements, or other forms of implementation applied to systemically important PSs, CSDs/SSSs, CCPs and TRs in Singapore, are complete and consistent with the Principles.

The work on the Level 2 assessment was carried out as a peer review from August 2016 to May 2017. The assessment reflects the status of Singapore's legal, regulatory and oversight framework as of 15 July 2016. Accordingly, assessment ratings reflect the implementation measures in place as of 15 July; other measures that were introduced after this date, or other material developments, are noted where relevant but were not considered in assigning ratings of consistency.

The Monetary Authority of Singapore (MAS) is the sole authority responsible for regulation, supervision and oversight of FMIs in Singapore.

The assessment found that Singapore has consistently adopted all but one of the Principles across FMI types. For PSs, CSDs/SSSs and CCPs, all the Principles have been implemented in a complete and consistent manner. For TRs, all the Principles, except for Principle 24 (disclosure

of market data by trade repositories), have been implemented in a complete and consistent manner. Some gaps were observed between the regulatory framework in Singapore and Principle 24. It is acknowledged that MAS is actively considering appropriate requirements for TRs to publish the data in a manner that will help to achieve the objectives of the public disclosure.

**Implementation monitoring of PFMI: Fourth update to Level 1 assessment report
July 2017 No 166**

The Committee on Payments and Market Infrastructures (CPMI) and the International Organization of Securities Commissions (IOSCO) continue to closely monitor the implementation of the Principles for financial market infrastructures (PFMI). The PFMI are international standards for payment, clearing and settlement systems, and trade repositories. They are designed to ensure that the infrastructure supporting global financial markets is robust and well placed to withstand financial shocks.

This report provides jurisdictions' updated self-assessments of their progress towards adopting the legislation, regulations and other policies that will enable them to implement the 24 Principles for FMIs and four of the five Responsibilities for authorities included in the PFMI. It shows that progress continues to be made by the 28 participating jurisdictions since the previous update in June 2016. The next update of the Level 1 assessment will be conducted in 2018.

**Chairs' Report on the Implementation of the Joint Workplan for Strengthening the Resilience, Recovery and Resolvability of Central Counterparties
July 2017 No 165**

This report describes how the 2015 workplan to strengthen the resilience, recovery and resolvability of central counterparties (CCPs) has been implemented. It was produced by the Chairs of the FSB Standing Committee on Supervisory and Regulatory Cooperation (Norman Chan), the FSB Resolution Steering Group (Elke König), the Committee on Payments and Market Infrastructures (Benoît Coeuré), the International Organization of Securities Commissions (Ashley Alder), and the Basel Committee on Banking Supervision (Stefan Ingves).

The report highlights the various guidance and reports published under the workplan, the establishment of crisis management groups (CMGs) for CCPs that are systemically important in more than one jurisdiction ('SI>1') and sets out actions in the next phase, which include:

- the continued monitoring of implementation of the principles in the Principles for Financial Market Infrastructures regarding resilience and recovery of CCPs, and finalisation of the framework on supervisory stress testing for CCPs;

- the implementation of the FSB Key Attributes of Effective Resolution Regimes for Financial Institutions consistent with the expectations regarding CCP resolution and resolution planning expanded upon in the FSB guidance, supported by (i) the establishment of CMGs for CCPs that are SI>1, including the home jurisdiction, and adoption of cooperation agreements; and (ii) further work on financial resources to support resolution and on the treatment of CCP equity in resolution;

- additional analysis of central clearing interdependencies to assess whether the key findings are stable over time; and

- further work to assess incentives to clear centrally arising from the interaction of post-crisis reforms.

**Analysis of Central Clearing Interdependencies
July 2017 No 164**

The Committee on Payments and Market Infrastructures (CPMI), the Financial Stability Board (FSB), the International Organization of Securities Commissioners (IOSCO) and the Basel Committee on Banking Supervision (BCBS) today published a study on interdependencies in central clearing.

The network relationships analysed in this report are generally characterised by a core of highly connected central counterparties (CCPs) and financial institutions and a periphery of less highly connected CCPs and financial institutions. Financial resources provided to CCPs are concentrated at a small number of CCPs and exposures to CCPs are concentrated among a small number of institutions.

The study is one of the key substantive priorities set out in the joint workplan on CCP resilience, recovery and resolvability, along with the CPMI-IOSCO CCP resilience guidance, the CPMI-IOSCO CCP recovery guidance and the FSB CCP resolution guidance.

Resilience of central counterparties (CCPs): Further guidance on the PFMI - Final report July 2017 No 163

CCPs have become increasingly critical components of the financial system in recent years, due in part to the introduction of mandatory central clearing for standardised over-the-counter derivatives in some jurisdictions. It is, therefore, vital that each CCP is sufficiently resilient to withstand clearing member failures and other stress events.

The final report on Resilience of central counterparties (CCPs): Further guidance on the PFMI aims to improve the resilience of CCPs by providing guidance on the principles and key considerations in the Principles for Financial Market Infrastructures (PFMI) regarding financial risk management for CCPs. The report focuses on five key aspects of a CCP's financial risk management framework: governance, stress testing for both credit and liquidity exposures, coverage, margin, and a CCP's contribution of its financial resources to losses. The guidance should be understood in the context of the principles-based approach reflected in the PFMI, which recognises CCPs' differing organisations, functions and designs, and the different ways to achieve a particular result.

The guidance is not intended to impose additional standards for CCPs beyond those set out in the PFMI. However, CCPs may need to make changes to their rules, procedures, governance arrangements and risk management frameworks in order for practices to be consistent with the guidance. Relevant authorities may also determine that it is necessary to make changes to their regulatory frameworks. CCPs should promptly identify any areas where changes are necessary, and address them as soon as practicable, so that implementation of the necessary changes is completed no later than the end of 2017.

Recovery of financial market infrastructures - Revised report July 2017 No 162

CPMI and IOSCO have published further guidance on the principles and key considerations in the Principles for Financial Market Infrastructures (PFMI) that relate to recovery planning. This further guidance revises the 2014 recovery report, and is intended to further strengthen recovery arrangements for financial market infrastructures.

Compared to the 2014 recovery report, the revised guidance provides additional clarifications in four areas: (i) operationalisation of the recovery plan; (ii) replenishment; (iii) non-default related losses; and (iv) transparency with respect to recovery tools and how they would be applied.

A track-change version of the revised report showing changes from the 2014 recovery report is available upon request by contacting cpmi@bis.org.

Framework for supervisory stress testing of central counterparties (CCPs) - consultative report July 2017 No 161

In April 2015, the G20 finance ministers and central bank governors asked the Financial Stability Board to work with the CPMI, IOSCO, and the Basel Committee on Banking Supervision to develop and report back on a workplan for identifying and addressing any gaps and potential financial stability risks relating to CCPs that are systemic across multiple jurisdictions and for helping to enhance their resolvability. This consultative report, Framework for supervisory stress testing of central counterparties (CCPs) • , published today by the CPMI and IOSCO addresses one aspect of this joint CCP Workplan.

The supervisory stress testing framework is designed to support tests conducted by one or more authorities that examine the potential macro-level impact of a common stress event affecting multiple CCPs. Among other things, such supervisory stress tests could help authorities better understand the scope and magnitude of the interdependencies between markets, CCPs and other entities such as participants, liquidity providers and custodians.

Published with this report is a cover note listing some of the specific issues on which the CPMI and IOSCO are soliciting input. Comments should be submitted by Friday, 22 September 2017 via e-mail to both the CPMI Secretariat and the IOSCO Secretariat.

**Harmonisation of critical OTC derivatives data elements (other than UTI and UPI) - third batch, consultative report
July 2017 No 160**

G20 Leaders agreed in 2009 that all over-the-counter (OTC) derivatives contracts should be reported to trade repositories (TRs) as part of their commitment to reforming OTC derivatives markets with the aim of improving transparency, mitigating systemic risk and preventing market abuse. Aggregation of the data reported across TRs will help ensure that authorities can obtain a comprehensive view of the OTC derivatives market and its activity.

Following the 2014 FSB Feasibility study on approaches to aggregate OTC derivatives data, the FSB asked the CPMI and IOSCO to develop global guidance on the harmonisation of data elements reported to TRs and important for the aggregation of data by authorities, including Unique Transaction Identifier (UTI) and Unique Product Identifier (UPI).

This consultative report is part of the Harmonisation Group's response to that mandate. It complements the consultative report on Harmonisation of key OTC derivatives data elements (other than UTI and UPI) - first batch, on Harmonisation of critical OTC derivatives data elements (other than UTI and UPI) - second batch, on Harmonisation of the Unique Transaction Identifier and two consultative reports on Harmonisation of the Unique Product Identifier.[1] CPMI-IOSCO have issued the final technical guidance on UTI in February 2017, plans to issue the one on UPI around mid-2017 and on critical data elements early 2018.

The report seeks general and specific comments and suggestions from respondents by 30 August 2017, using the dedicated response form. The completed form should be sent to both the CPMI secretariat and the IOSCO secretariat.

Following feedback from market participants, the original consultation period (until 30 August 2017) has been extended to 15 September 2017 cob only for data elements related to prices, quantities and other payments (from section 2.37 to section 2.63 of the consultative report).

Speeches

Jaime Caruana's intervention before the Spanish Parliament

Speech Intervention of Jaime Caruana, General Manager of the BIS, before the Spanish Parliament's Committee of Inquiry about the financial crisis in Spain and the financial assistance programme, Madrid, 25 July 2017.

Green finance: can it help combat climate change?

Remarks by Luiz Awazu Pereira da Silva¹ at the conference organised by the BIS, OMFIF, the Deutsche Bundesbank and the World Bank Group, Frankfurt, 13 July 2017.

The economics of climate change

"Greenhouse gas (GHG) emissions are externalities and represent the biggest market failure the world has seen".² A comprehensive and illuminating departure point for understanding the economics of climate change is the 2007 Stern Review.³ Our past and present production and consumption patterns have emitted excessive greenhouse gases (GHGs), especially

carbon dioxide, whose accumulated concentration above critical thresholds⁴ in the atmosphere affects global average temperatures, causing what is known as "global warming" or "climate change" (CC). That, in turn, affects our entire socioeconomic system through complex channels. All this can have severe consequences for global sociopolitical-economic equilibria: standards of living, productivity, refugees and massive migration, etc. And all this involves the ingredients that make collective rational decisions difficult: considerable uncertainty, large time lags before becoming apparent (especially to CC sceptics), free riding and collective action problems. That is because while CC is global, its origins are local (the tragedy of the commons), and its effects will be felt only after our generation's lives (the tragedy of the horizon⁵). The effects are most likely irreversible, but the science must address significant layers of uncertainty. Therefore, we are dealing with a subject that mixes uncertainty, risk, prioritising ethical choices and international coordination for the common good.

The best science today recommends stabilising the stock of GHGs below a certain target and thus acting to control and reduce new flows or emissions now in order to avoid causing irreversible damage beyond 2050. The mitigating measures naturally have a cost of abatement. Changes have to occur in production and consumption habits, and not just the obvious candidates like transportation and energy. For the sceptics that prefer a "wait and see" approach, a pure self-interested risk management strategy recommends buying the proper insurance as a kind of "pari Pascalien",⁶ ie hedging against such a systemic global risk even if it has a small probability. There are many options for abatement, ranging from improving our current energy efficiency, to changing our energy matrix to renewable sources, to tackling non-energy emissions/damages in agriculture and deforestation. Ironically, in some options, benefits exceed costs and might create a new, virtuous, low carbon growth cycle. New technology is fundamental to reduce risk and lower abatement costs (we will come back to that later).

However, as of now and facing uncertainty, any good policy to combat CC requires a "price" to act as an incentive to reduce a negative externality such as GHGs, in line with basic welfare economics. The price needs to reflect what we already know about the medium- to long-term additional costs of CC. In theory, such a "shadow price" incorporating the social cost of carbon (SCC) would be enough to reduce emissions in a perfect Walrasian world and should be used in economic and financial calculations, in particular in the cost-benefit analysis of investment projects, to take into account these negative externalities (eg congestion, pollution, toxic emissions). But the "right price of carbon" is a tricky issue;⁷ we need to be pragmatic and use various metrics to reach emission targets, calculating abatement costs while incorporating all the available information on new technologies that reduce them.

The political economy of climate change

The political economy of CC is about who will pay for what, and when and how to share the burden of abatement costs. It boils down to how CC negative externalities can be priced and incorporated into practical decision-making processes in a way that is sustainable from a sociopolitical viewpoint. If we want to limit environmental risk, there is a maximum amount of emissions permissible before our ecosystem's threshold is exceeded. Limiting emissions raises obvious issues of fairness in burden sharing. The political economy issues related to CC risks arise from misperceptions of a stock-flow problem. Our atmosphere is a stock, a finite common good that has been depleted/consumed throughout a known history of industrial development with flows of emissions of GHGs. Historically, advanced economies' emissions flows were responsible for a larger share of the depletion/consumption of the stock. They are now enjoying a higher standard of living but the remaining absorptive capacity of the stock (the atmosphere) allows limited new flows of emissions of GHGs. Thus, how should we respond to the claims of developing countries for rights to emissions since they are now beginning to industrialize and thus are increasingly responsible for the new flows? Now that the finite common good is much smaller, how to limit emissions of rich and poor while maintaining a sense of justice (more on that later)?

How can we incentivise limits and controls for everyone? First, there is the classical way of dealing with externalities through general Pigovian⁸ taxes and subsidies. Then there is the

possibility of trading emission rights through market mechanisms and auctions. Third, one can use an implicit pricing through regulations and standards that incentivises shifts towards new, less carbon-intensive technologies. Finally, there could also be implicit pricing through reputation and exposure, by creating processes for disclosing climate-related financial assets and financed projects.⁹

We are dealing with a very large, potentially irreversible, negative externality with significant distributional effects across social groups and both rich and poor countries. The textbook first best solution is to use taxes and subsidies, but such a direct and transparent treatment might create political economy difficulties and, if so, delay decisions and create inertia. Therefore, a pragmatic second best solution is to use a combination of instruments that are equivalent to implicit pricing, ranging from taxes and subsidies, to carbon pricing and trading, environmental standards and regulations, and information and awareness, etc with the involvement of all agents in the economy and across several sectors.

The financial sector, central banks and climate change

Implicit pricing through indirect interventions is a delicate balancing act. For example, how can the financial sector look at CC? As the single biggest negative externality of modern times, CC entails considerable risks. We need to act now given the implications for financial stability and future generations. But how can you correct distortions using the financial sector without inadvertently creating other types of distortions? How fast can you change the incentives for financial market participants and make them adjust credit and portfolio decisions accordingly? Can you and should you use credit allocation, subsidised interest rates, etc and at the same time avoid a misperception about fairness in bearing costs? There are many experiments, especially in emerging market economies (EMEs) where such subsidised credit created other macroeconomic problems. To be fair, there are also instances where it also allowed productivity-enhancing investment and growth. At any rate, it is a complex discussion that needs to take into account governance structure, availability of instruments and the existing set of immediate risks.

Moreover, some are advocating a special role for central banks and financial regulators,¹⁰ suggesting direct involvement using a wide range of instruments: climate change-related disclosures, regulatory incentives such as differentiated capital requirements, and even "green" quantitative easing (QE). Could direct central bank intervention targeting "green finance" products influence returns on green finance and be a new instrument for changing the climate course? Indeed, the emergency situation of the Global Financial Crisis (GFC) extended the role of central banks. But can "new" and even more unconventional monetary policies go further in the direction of favouring green financial instruments without creating other problems?

Changes in mandates and institutional arrangements are also very complex issues because they deal with sociopolitical equilibria, reputation and credibility. We observed that during the GFC. There is a danger of overstretching the role and mandates of central banks and financial regulators to areas where political economy problems signal that society has yet to settle debates. Naturally, having institutions of last resort to solve crises is useful, but they cannot be a substitute for a thorough discussion about fundamental issues such as CC, most likely the "mother of all structural reforms" that will require changes in deep-rooted habits of consumption and production. There is a role for public institutions, including central banks, to guide and lead by example but perhaps not to bypass, replace or over-stretch the necessary debates in civil society. Nevertheless, it is important that the financial sector use its pivotal position to raise awareness, including through its own pricing of risk and reputation. Finally, an active but transparent role by public entities to finance innovation and R&D to promote investment that limit/mitigate CC is also paramount.

The challenge will be to understand the risks and opportunities that these new policy questions bring to all of us - policymakers, the industry and society - ranging from the possible smart financing of climate change innovation, on the one hand, to increasing moral hazard, on the other.

Climate change and the financial sector: five practical steps and the way forward

Even without instruments such as "green QE", central banks and financial regulators can certainly think of practical, market-oriented ways for the financial sector to increase the flow of instruments that could meet the investment requirements of asset holders.

First, in practice, there is a need to map and identify the possible CC-related risks for the financial sector. That implies quantifying the impact on insurance liabilities and on the value of financial assets that may arise from losses related to climate change (flooding, storms, etc). That might also imply assessing potential litigation costs from losses or damages due to the effects of CC. As we suspect, if perceptions of such large liabilities arise, it might entail an asset repricing. Hence, it could impact financial stability locally and globally. One way forward, as suggested by the FSB, is to disclose CC-related information, governance practices and "moving climate-related issues into mainstream annual financial filings (-). Improved practices and techniques, including data analytics, should further improve the quality of climate-related financial disclosures and, ultimately, support more appropriate pricing of risks and allocation of capital in the global economy".¹¹

Second, the financial sector can contribute to fund private sector investment in CC-related new technologies that is likely to bring economic and financial upsides. There are foreseeable benefits from adjusting to an economy with a smaller carbon footprint, where new policies and technology could cause a positive re-evaluation of a large range of asset classes. More generally, as green energy producers become growing sectors, there are plentiful business opportunities associated with rising income and employment as substitutes for the traditional "brown economy" (eg fossil fuels, coal, etc). Some technologies will become efficient and commercially viable/profitable. From that point, there could be some significant positive valuation effects for classes of assets and the real producers and financial intermediaries linked to these new technologies. Therefore, there needs to be financial and analytical support to construct new indices and work on practical initiatives such as the ones envisaged in the forthcoming sessions of this conference.

Third, there is a need to support the growth and consistent universal standards for label recognition of green finance, a reflexion that we have been doing at the BIS.¹² In that regard, green bonds are bonds that must be aligned with the four core components of the International Capital Market Association's Green Bond Principles (GBP) and where the proceeds will be exclusively applied to financing eligible green projects, aiming to address CC, natural resource depletion, biodiversity conservation and/or pollution. The first green bond, the so-called "Climate Awareness Bond", was issued 10 years ago, in June 2007, by the European Investment Bank. The largest issuers of green bonds are supranational and state agency issuers. This year to date, a total of USD 35 billion in green bonds have been issued. While the total amount of outstanding green bonds has reached around USD 200 billion, they still account for only a very small proportion of financial flows (0.2% of the total number of bonds outstanding, ie USD 100 trillion). Among green bond investors, four major types of institutional investors may be identified. First are pure green investors, which are investors with green investing mandates, offering green bond funds. Second are socially responsible investors, who are investors with established socially responsible mandates, but who are not necessarily required to buy bonds designated as green. The third group are asset managers that report a positive impact on franchise value for green investments. Finally, investors classified as banks/corporate/insurance, the treasuries of which move towards socially responsible investing.

Fourth, with this type of green finance funding, there is a greater chance of accelerating research on new technologies and creating synergies to ignite a new business cycle and the win-win situation mentioned above. Reigniting growth through investment in low carbon technologies is most likely more sustainable from a macroeconomic and environmental perspective than any of the previous consumption-led and household debt-based recoveries.¹³ This new business cycle would be most welcome. If it begins to take shape, supported by green financing sources at the very moment where the post-GFC recovery strengthens in advanced economies, it would be an important supportive element for the post-GFC policy normalisation.

Finally, fifth, last but not least, CC requires international cooperation, as it is a unique global problem. There has been uneven progress so far in mitigating CC. Collective action and stated commitments have flourished in multilateral conferences and internationally agreed commitments such as the COP21¹⁴. But it seems that we are still not on the right path to significantly reduce our GHG emissions, even if there are some small signs of improvement.¹⁵ However, recently global debates have been dominated by a reaction against multilateralism, international cooperation and coordination. New recent sociopolitical developments favour populist, national responses, protectionism and a simplistic view of globalisation as a scapegoat¹⁶ for all problems such as within-country income inequality to job losses and global financial crises and despite globalisation's recognised contribution to a substantial rise in living standards and falling poverty over the past half-century. This mindset obviously does not favour the efforts to combat CC as it delays collective action and reneges on some advanced economies accepting binding and challenging targets. However, and paradoxically, it has also triggered a wake-up call in many local communities that are committed more than ever to achieving their own objectives and working for the global common good.

As mentioned earlier, developing countries need to see that their support for action combating CC needs to take into account their lower stage of industrialization. Thus, CC actions require international cooperation between advanced and developing countries and the recognition of the need for technology transfers and increases in official development assistance to developing countries.

On balance, this might create more support and trigger the necessary impulse through debate. "It is intensive public discussion that will [-] be the ultimate enforcement mechanism".¹⁷ For us in the financial sector, this is certainly a contribution that we can make. Thus, the answer to the question of whether green finance can help combat climate change is yes. The financial sector can play a positive role: mapping and identifying CC-related risks; strengthening the process of labelling green finance instruments in a rigorous and credible way; fostering private sector investment in CC-related new technologies; accelerating research on new technologies and creating synergies to ignite a new business cycle; helping to engineer a virtuous new less carbon-intensive growth cycle; and being respectful of the challenges of international cooperation. These are a few among many elements that the BIS had in mind when accepting to co-organise this event with OMFIF, the Deutsche Bundesbank and the World Bank.

General Manager's speech: Looking beyond the here and now

Speech and presentation of the key messages of the BIS Annual Report delivered by Mr Jaime Caruana, General Manager of the BIS, on the occasion of the Bank's Annual General Meeting, Basel, 25 June 2017.

Global growth has broadened and strengthened during the past year, and the near-term outlook appears the best in a long while. The most promising policy strategy is to take advantage of these tailwinds to build greater economic resilience, nationally and globally, so as to be better prepared for future adverse events. One aspect is to preserve the benefits of trade and financial openness. The other is to adopt a longer-term perspective in policymaking. This entails enhancing policy space and strengthening the capacity of the economy to adapt to long-term trends. Building resilience is first and foremost a domestic task. But certain challenges call for a global response and require international cooperation. Completing Basel III is a priority in this regard.

How much do we really know about inflation?

Presentation on the BIS Annual Report by Mr Claudio Borio, Head of the Monetary and Economic Department, on the occasion of the Bank's Annual General Meeting, Basel, 25 June 2017.

An obvious policy question at the current juncture is whether an inflation flare-up could bring to an end the expansion under way. This question, in turn, begs an even more fundamental one: how much do we really know about the inflation process? Based on analysis presented in BIS Annual Reports, this presentation reaches three conclusions: we may be

underestimating the influence that globalisation has had on inflation; if so, a flare-up may not be that likely; and if the hypothesis is correct, it would also point to refinements to current monetary policy strategies.

Globalisation: real and financial

Presentation on the BIS Annual Report by Mr Hyun Song Shin, Economic Adviser and Head of Research, on the occasion of the Bank's Annual General Meeting, Basel, 25 June 2017.

Many years into the crisis, there are finally some consistent signs of a rebound in activity, some reflation and more optimism in markets, with a rise in equities and higher confidence. But the puzzling element is that policy uncertainty is very high while volatility is very low. What's going on? Perhaps the most significant risk for financial markets now is the risk of complacency and self-delusion with positive but only short-term indicators. There seems to be an underestimation of the long-term consequences of political risks in a context of increasing scepticism about trade/financial integration and international cooperation.

Banking regulation and supervision after the crisis - where are we now, and what lies ahead?

Speech by Mr Fernando Restoy,¹ Chairman, Financial Stability Institute, Bank for International Settlements, at the CIRSF Annual International Conference, Lisbon, 1 June 2017.

I would like to briefly return to the efforts currently under way to finalise the post-crisis regulatory reforms, of which Basel III is a significant component. This is certainly not the first time the Basel Committee has gone through difficult negotiations to reach an agreement, and I'm sure it won't be the last. But I am confident that the Committee will once again achieve a successful outcome.

Indeed, having recently experienced an extremely costly financial crisis and the attendant disturbances in the functioning of the international financial system, the need for robust international regulatory standards is more evident now than ever before. In a world in which internationally active financial groups transmit risks seamlessly across borders, there should be a shared interest across all jurisdictions that such groups meet sufficiently stringent standards of solvency and liquidity. Moreover, to the extent that an integrated global financial system contributes to effective risk-sharing across jurisdictions and regions and amplifies investment and funding opportunities for firms and households wherever they are located, it is vital that we do what we can to facilitate the operations of international players and promote a level playing field through the harmonisation of both prudential requirements and, ideally, supervisory practices.

As I mentioned before, however, globally harmonised standards and practices need not be applied to all banks in all jurisdictions. It may be appropriate to apply simpler rules and less intrusive practices in the case of smaller, less sophisticated banks, as is the case now in many jurisdictions. But at the same time, we need to keep in mind that the application of the proportionality principle should not compromise the stringency of the prudential requirements. It should also carefully weigh potential distortions in the normal functioning of market forces.

In any event, notwithstanding the current emphasis on finalising the last few pieces in the post-crisis reforms, I anticipate that the focus of the international regulatory community will soon shift from standard setting to policy implementation matters. For its part, the Basel Committee signalled this shift in its recently published 2017-18 workplan, which has the Committee paying greater attention to supervisory matters. And let me just mention that, through its various activities, the Financial Stability Institute will support authorities' renewed focus on implementation. I would be happy to provide more information about our work in this area in the discussion that follows, or on the sidelines of the meeting.