

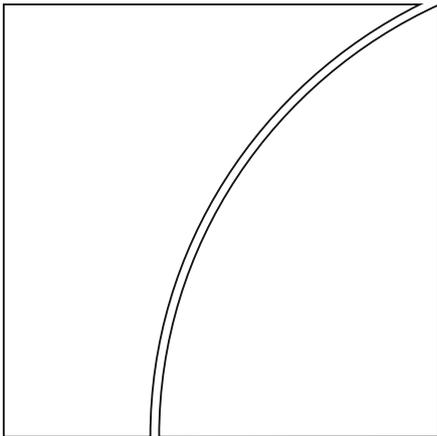


BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

December 2016

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.

A paradigm shift in markets?

Global bond yields have continued to rise markedly in recent months. After core fixed income markets had plumbed new historical depths this summer, overall yields had jumped sharply by the end of November – in fact by a magnitude similar to that of the taper tantrum of May–September 2013. But despite record high duration risk, there were few signs of stress in credit markets as spreads remained tight and volatility was contained.

Initially supported by positive macroeconomic news globally, the rise in yields sharply accelerated after the US presidential election. Bond market reactions around election day resembled those surrounding the first election of Ronald Reagan in 1980. Buoyant US equity markets also echoed that distant event, suggesting that markets expected a boom in the United States and higher corporate profits on an anticipated shift towards more expansionary fiscal policy, lower taxes and laxer regulation. Accordingly, market odds of tighter monetary policy increased in the United States and the dollar strengthened.

The global rise in yields and the strengthening of the dollar weighed on the assets of emerging market economies (EMEs). Until early November, EMEs were unscathed by developments in advanced economies. Then, investor sentiment shifted markedly. Bond outflows and exchange rate depreciation in the post-election week were even larger than at the height of the taper tantrum.

However, credit and equity market reactions in EMEs were more muted than in 2013, possibly reflecting a different economic and financial backdrop. EME funds had already experienced large outflows instead of steady inflows in recent years, defusing pressures on asset valuations. A prospective boom in the United States may also have been seen to benefit EMEs. Yet risks remain, in particular given a high degree of political uncertainty in several key jurisdictions. In addition, 10% of EMEs' dollar-denominated corporate debt is scheduled to mature in 2017, which could put further pressure on EME financial markets.

Short-term dollar funding rates rose significantly, mainly in response to changes in regulations pertaining to prime money market funds that took effect in October. A 70% decline in assets under management by these funds since October 2015, combined with a shift in their portfolios towards shorter maturities, led to a substantial widening of Libor-OIS spreads. But this did not cause any major disruption, in contrast to earlier periods of similar spread widening.

Markets resilient amid major change in outlook

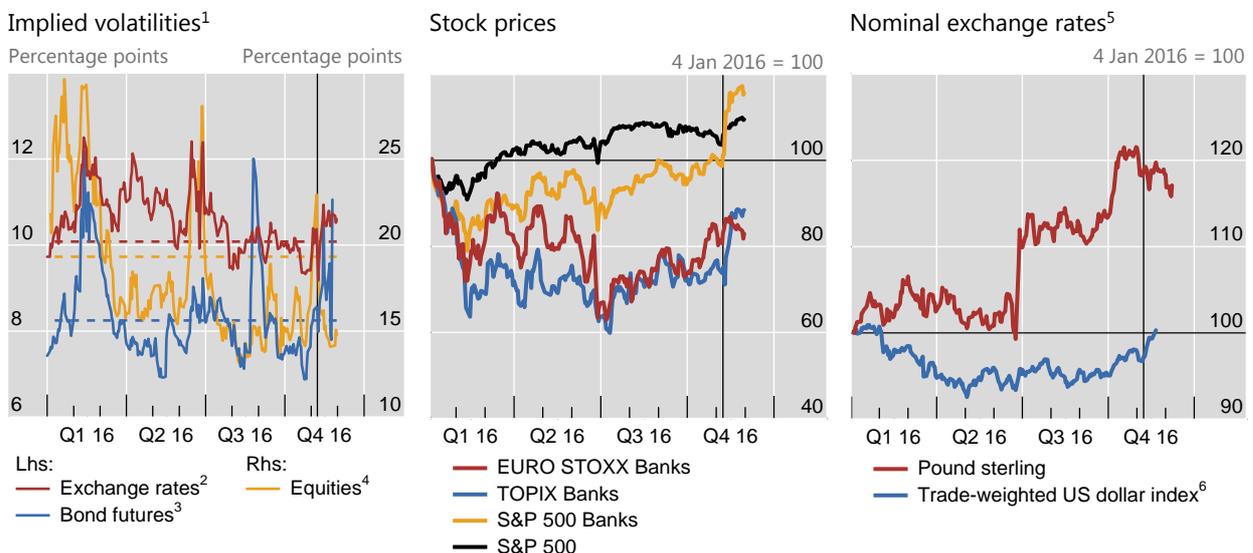
In the weeks leading up to the US election, markets continued their recovery from the financial shock triggered by the UK Brexit vote on the back of a string of positive macroeconomic news. Volatility was at or below historical averages (Graph 1, left-hand panel). Equities held up well (Graph 1, centre panel), and credit spreads remained tight. Bond yields in advanced economies kept edging higher following their record lows in the summer. Market developments reflected better than expected third quarter GDP growth in advanced economies, and the release of manufacturing purchasing managers' indices – a leading indicator of growth – signalling an economic expansion in most countries.

At the beginning of October, growing expectations of a “hard” Brexit exerted renewed depreciation pressure on the pound sterling (Graph 1, right-hand panel), although this did not reverberate much through financial markets globally. Even a “flash crash” on 7 October, when, within a few seconds, the pound lost 9% vis-à-vis the US dollar before quickly recovering, propagated few ripples in the wider marketplace.

On 8 November, markets swung wildly as they were caught off guard by a political outcome for the second time this year. As the surprise result of the US election crystallised during election night, S&P 500 futures plunged as much as 6%, 10-year Treasury yields declined by almost 20 basis points, and the dollar weakened

US election shakes markets

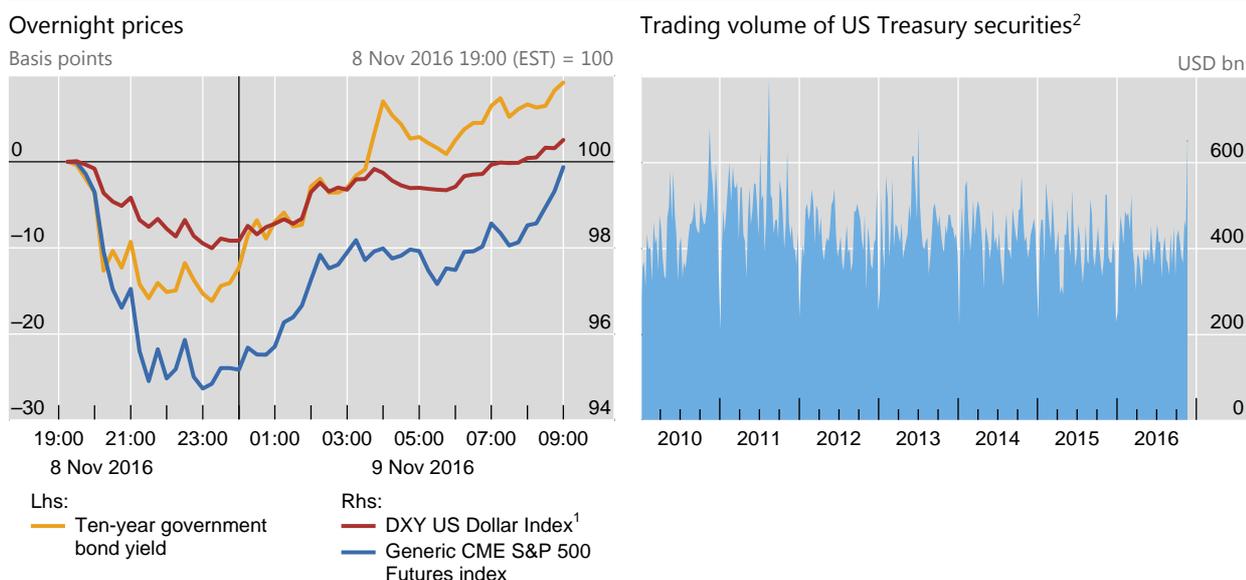
Graph 1



The vertical line indicates 8 November 2016, the day of the US presidential election.

¹ The dashed horizontal lines represent simple averages for the period from 2010 to the present for each implied volatility series. ² JPMorgan VXY Global index, a turnover-weighted index of the implied volatility of three-month at-the-money options on 23 USD currency pairs. ³ Implied volatility of at-the-money options on long-term bond futures of Germany, Japan, the United Kingdom and the United States; weighted average based on GDP at PPP exchange rates. ⁴ Implied volatility of the S&P 500, EURO STOXX 50, FTSE 100 and Nikkei 225 indices; weighted average based on market capitalisation. ⁵ An increase indicates depreciation of the local currency against the US dollar. ⁶ Trade Weighted US Dollar Index: Major Currencies (DTWEXM). An increase indicates an appreciation of the US dollar in trade-weighted terms.

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



¹ Indicates the general international value of the US dollar computed by ICE using the rates supplied by 500 banks. ² Average daily trading volume of primary dealers in US Treasury securities, weekly data.

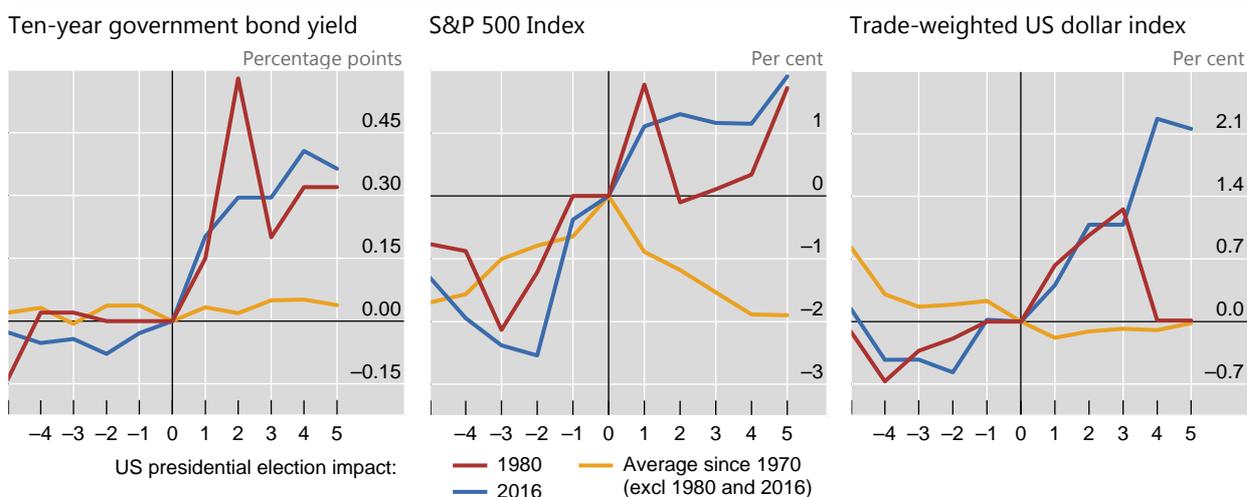
Sources: Federal Reserve Bank of New York; Bloomberg.

by 2% against a basket of currencies (Graph 2, left-hand panel). These initial moves amounted to approximately five standard deviations of daily price changes. However, they were more than reversed within a few hours as market participants revised their views on the impact of the likely shift in US economic policy and as the president-elect gave a conciliatory acceptance speech.

Market functioning proved resilient despite large price moves overnight and over the following days. Market liquidity remained adequate. The trading volume of US Treasuries increased and was above its long-run average (Graph 2, right-hand panel). Similarly to what happened post-Brexit, volatilities in both equity and bond markets returned within a few days to levels that had prevailed before the event.

In the first few days after the election, markets turned abruptly. Both US equity and bond yields climbed higher, mirroring dynamics observed around the election of Ronald Reagan in 1980 (Graph 3). This suggested that markets priced in faster growth and higher corporate profits in the United States on an anticipated shift towards more expansionary fiscal policy, lower taxes and laxer regulation. In particular, campaign pledges to launch a \$1 trillion fiscal stimulus package – equivalent to around 5% of US GDP – and to cut personal and corporate taxes were reaffirmed, although the details of those plans remained unclear. As a result of the positive mood, US stock indices scaled record highs by late November (Graph 1, centre panel).

In anticipation of a relaxation of banking regulation and of higher interest rates, US bank stocks outperformed the buoyant market (Graph 1, centre panel). Those stocks were boosted across the board by the prospect of a cyclical upswing and higher net interest margins. The rally was strongly supported by expectations that the Dodd-Frank Act – the cornerstone of enhanced US financial regulation after the Great Financial Crisis (GFC) – would be weakened. Japanese bank stocks benefited from the uplifted mood, while stocks of their European counterparts remained broadly flat.



¹ Evolution of market reactions five business days around election dates: 4 November 1980 (first election of Ronald Reagan), 8 November 2016 (election of Donald Trump).

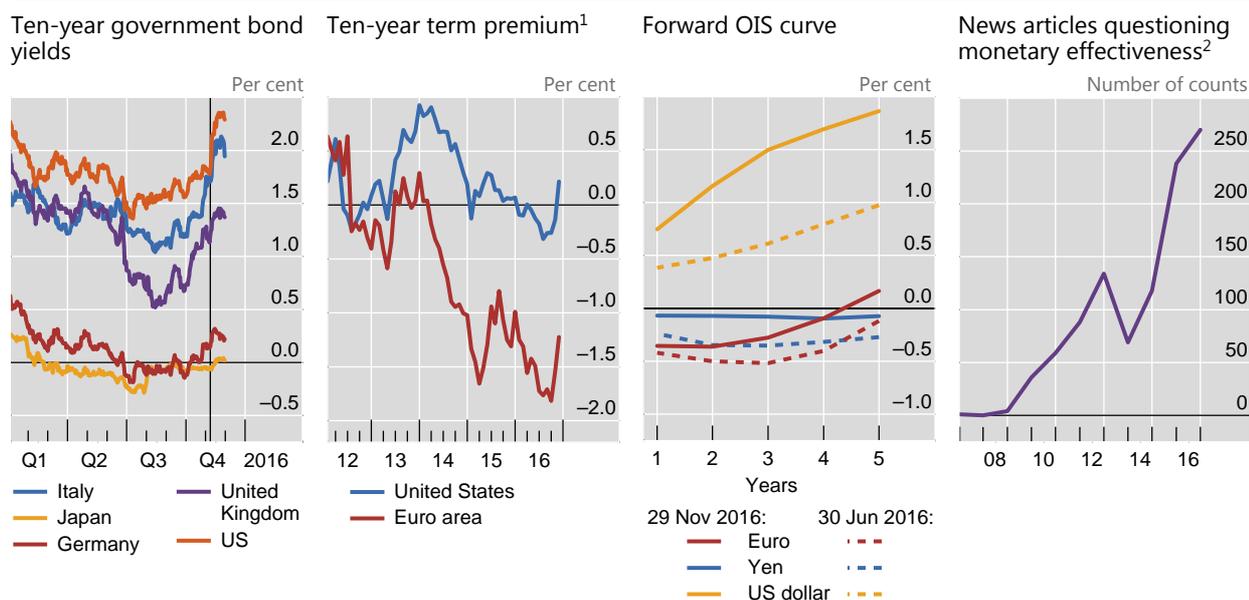
Sources: Board of Governors of the Federal Reserve System; Bloomberg; BIS calculations.

Bond markets sell off

The sharp pickup in yields after the US election accentuated a trend that had been under way since the middle of the year (Graph 4, first panel). Before 8 November, 10-year Treasury yields had already gained nearly 50 basis points from their historical lows of the beginning of July. Yields jumped by a further 20 basis points in response to the election outcome. This was the largest one-day yield change since the taper tantrum, and was greater than all but 1% of one-day movements in this yield over the last 25 years. And yields rose further to gain in total nearly 100 basis points since the summer – a similar change to that seen during the taper tantrum.

Both expectations of tighter monetary policy and higher term premia contributed to the increase in yields (Graph 4, second panel). The market-implied probability that the Federal Reserve would raise rates in December rose from just above 50% at the beginning of the quarter to nearly 100% by the end of November. The market also saw a slightly less gradual pace of tightening, even though it remained below the path implied by forecasts of the members of the Federal Open Market Committee and would continue to be slow by historical standards (Graph 4, third panel). In addition, a marked repricing of term premia played a significant role. The shift in sentiment in November brought term premia into positive territory, albeit at still very depressed levels.

With the exception of Japan, government bond yields in major advanced economies mirrored the dynamics of US Treasury yields (Graph 4, first panel). Recovering from their historical lows in the summer, they saw similar increases to those of the taper tantrum. By mid-November, 10-year UK gilts had made up all the ground lost after the Brexit vote. Similarly, euro area 10-year government bond yields increased on average by around 50 basis points. As in the United States, both monetary policy expectations and term premia rose. Japan's 10-year bond yields, on



The vertical line indicates 8 November 2016, the day of the US presidential election.

¹ Based on a joint macroeconomic and term structure model – see P Hördahl and O Tristani, “Inflation risk premia in the term structure of interest rates”, *BIS Working Papers*, no 228, May 2007; for the euro area, French government bond data; based on preliminary data for November 2016. ² Total number of articles per year from major news outlets that mention “ineffective”, “less effective” or “limits of monetary policy” in the context of discussions about the Bank of Japan or the ECB. The number for 2016 is annualised.

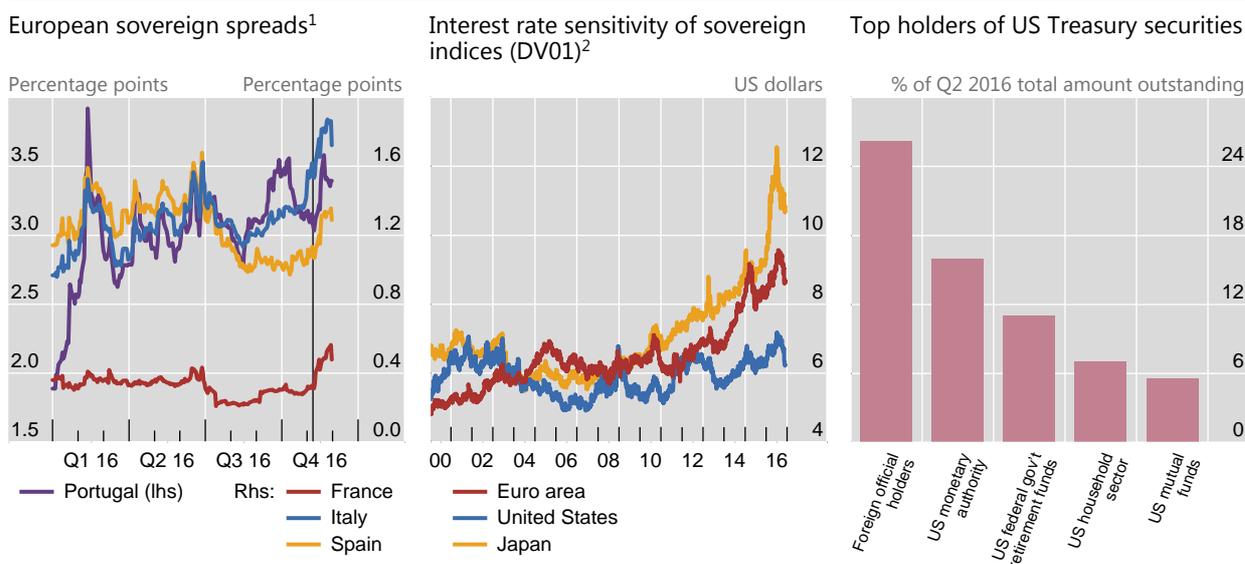
Sources: Bloomberg; Factiva; BIS calculations.

the other hand, fell somewhat after 21 September, when the Bank of Japan announced its new “yield curve control” policy, before returning to positive territory in November.

Apart from the direct spillovers from the US Treasury market, another factor behind the rise of government bond yields in Japan and the euro area was waning expectations of further monetary easing (Graph 4, third panel). This reflected the improved macroeconomic backdrop as well as political and economic headwinds to further easing. In recent years, market commentators have increasingly raised questions about the effectiveness of monetary policy (Graph 4, fourth panel). Concerns have also arisen about the potentially harmful consequences of low or negative rates for the financial sector. In addition, some analysts have questioned whether a scarcity of eligible securities may at some point reduce the ability of central banks to maintain their bond purchase programmes.

Yield spreads among euro area government bonds also widened. The markets of France, Italy, Portugal and Spain were the most affected, with spreads vis-à-vis the German 10-year bund rising by 30–60 basis points from the summer until end-November (Graph 5, left-hand panel). Increased political uncertainty seems to have been one driver, as both Italy and France will go to the polls in the coming months. The outcome of the Italian referendum on 4 December added further political and economic uncertainty to the outlook.

Markets in advanced economies adjusted in an orderly fashion to the rapid increase in yields despite record high duration risk. While bond portfolios stayed very vulnerable to interest rate changes as measured by duration (Graph 5, centre panel), corporate credit spreads remained tight in contrast to the taper tantrum. From July



The vertical line indicates 8 November 2016, the day of the US presidential election.

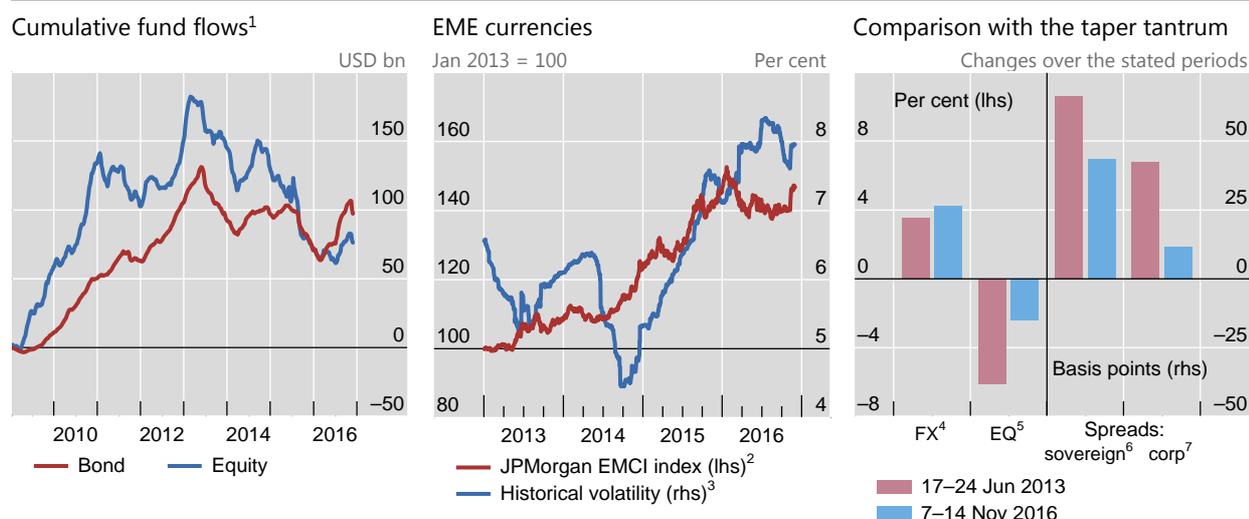
¹ Spread of local currency 10-year government bond yields to the comparable German bond yield. ² Dollar variation in the bond's value per 1 percentage point change in the bond yield; it is proportional to the product of the bond's price times its modified duration.

Sources: Board of Governors of the Federal Reserve System; Bank of America Merrill Lynch; Bloomberg; national data; BIS calculations.

to November, spreads in the United States actually narrowed, with end-November levels almost at their year low. Corporate spreads in the euro area widened slightly. However, they were still 20% lower than after the Brexit vote. In addition, the volatility of bond markets remained well contained (Graph 1, left-hand panel).

The limited market impact of higher yields may in part have reflected the capacity of major holders of government bonds to bear mark-to-market losses (Graph 5, right-hand panel) as well as limited evidence of negative feedback loops through hedging activities. For instance, around 40% of US Treasuries are owned by the Federal Reserve and the foreign official sector. Pension funds (the third largest holders of Treasuries) and insurance companies may even benefit from rising rates in the medium term, as a normalised yield environment would allow them to more easily meet promised returns. However, valuation losses in the short run may affect profits and capital depending on accounting standards. In addition, the hedging activities of the US government-sponsored enterprises (GSEs), which contributed to the bond market turbulence of 1994, are much lower now. This is because, as part of quantitative easing policies, GSEs sold a large share of their portfolios to the Federal Reserve, which does not hedge its securities.¹

¹ For a detailed discussion, see T Ehlers and E Eren, "The changing shape of interest rate derivatives markets", *BIS Quarterly Review*, December 2016.



FX = exchange rate; EQ = equity index.

¹ Cumulative weekly flows since the beginning of 2009; data up to 23 November 2016. ² JPMorgan Emerging Market Currency Index (EMCI) fixing. An increase indicates a depreciation of EME currencies against the US dollar. ³ One-year moving standard deviation of daily percentage changes, in annual terms. ⁴ JPMorgan EMCI fixing; a positive value indicates a depreciation of EME currencies against the US dollar. ⁵ Simple average of EME equity indices. ⁶ JPMorgan EMBI Global index, stripped spread. ⁷ JPMorgan CEMBI index, stripped spread.

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

Emerging market economies under pressure

Emerging market economies experienced a substantial swing in investor sentiment in the aftermath of the US election. Until the end of October, EMEs had been largely unaffected by rising yields in advanced economies. EME equity markets had remained flat and exchange rates stable, while credit spreads had fallen by around 80 basis points since mid-year. At the same time, EME bond and equity funds had increased assets under management by more than \$50 billion after inflows had sharply picked up at the beginning of July. Debt securities issuance by EME borrowers had also continued at a steady pace in the second and third quarters.² After the US election, EME currencies fell, credit spreads widened and stock markets declined.

EME exchange rate depreciations and bond outflows in mid-November were even larger than at the height of the taper tantrum. EMEs experienced the largest recorded weekly outflows from bond funds in the week after the US election (Graph 6, left-hand panel). Equity market investors also withdrew large amounts from funds (same panel). In line with the large outflows, EME exchange rates reacted more sharply than in the worst week of the taper tantrum (right-hand panel).

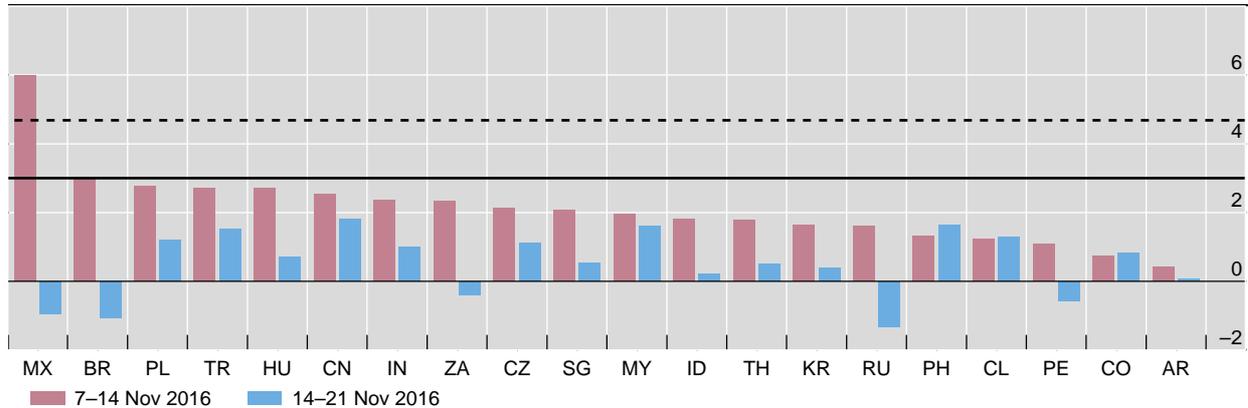
The exchange rate fluctuations occurred on the back of much higher FX volatility and a stronger dollar than in 2013. Compared with the post-financial crisis low at the onset of the taper tantrum, EME currency volatility was already 40% higher at the end of the third quarter of this year (Graph 6, centre panel). Over the last two years,

² See "Highlights of global financial flows", *BIS Quarterly Review*, December 2016.

US election moves exchange rates by less than three standard deviations¹

Changes in nominal bilateral exchanges rates against US dollar

Graph 7



The solid horizontal line equals three. The dashed horizontal line shows the change in JPMorgan Emerging Market Currency Index (EMCI) fixing, scaled by realised volatility over the period 17–24 June 2013 (taper tantrum).

¹ Changes in the nominal exchange rate against the US dollar over the corresponding period, scaled by realised volatility. Volatilities are calculated as the standard deviation of daily price changes over a one-year horizon as of end-week before the corresponding event (for the US election, 4 November 2016; for the taper tantrum, 14 June 2013). A positive number indicates a depreciation of the local currency against the US dollar.

Sources: National data; BIS calculations.

volatility had increased steadily alongside a stronger dollar. From May 2014 to its peak in January 2016, the dollar had appreciated by more than 40% against a basket of EME currencies.

The post-election exchange rate movements were large but not extreme once this increase in overall market volatility is taken into account. For all EMEs except Mexico, the one-week change around the US election was less than three standard deviations of weekly changes (Graph 7), substantially lower than the more than 4.5 standard deviation move of June 2013 – the height of the taper tantrum. Furthermore, after the severe initial shock, currency markets stabilised in the second post-election week. And despite the continued general upward pressure on the dollar, several EME currencies recouped some of the lost ground during that week, particularly in Latin America. By end-November, despite these swings, the January 2016 levels had still not been breached by either the dollar basket or by most bilateral rates.

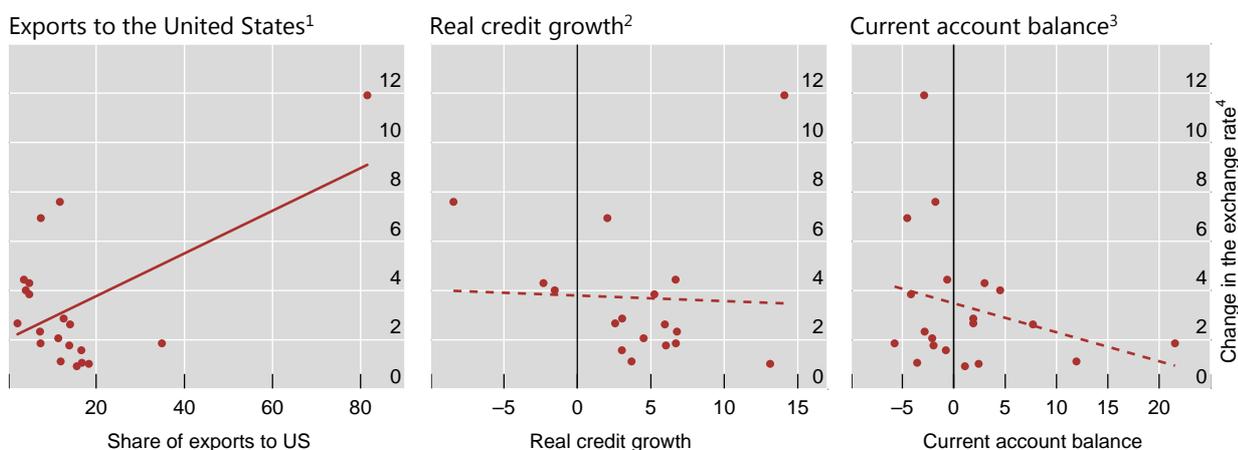
In contrast to the taper tantrum, measures of domestic imbalances were not at the forefront of EME market reactions this autumn. For instance, from May to September 2013 investors had appeared to discriminate most forcefully against countries that had experienced rapid credit growth and large current account deficits.³ These factors did not play a role in the recent episode (Graph 8, centre and right-hand panels). Equally, trade links with the United States appeared not to drive fluctuations in general despite concerns about the increasing mood of protectionism there (Graph 8, left-hand panel). The statistical relationship between trade exposure to the United States and the currency depreciation is only significant because of the

³ See Bank for International Settlements, *84th Annual Report, Box II.A*, June 2014.

Few common drivers of EME exchange rate fluctuations

In per cent; latest available data

Graph 8



A solid (dashed) regression line denotes a significant (insignificant) relationship at the 5% level.

¹ As a percentage of total exports. The regression line is insignificant when Mexico is excluded from the sample. ² Year-on-year growth. ³ As a percentage of GDP; annualised data. ⁴ A positive value indicates a depreciation of the local currency against the US dollar over the period 7–14 November 2016.

Sources: IMF, *International Financial Statistics*; Bloomberg; Datastream; national data; BIS calculations.

Mexican peso,⁴ which was hardest hit, falling 12% in one week, reflecting concern over potential changes to not only the trade but also the immigration policies of the United States.

Also different from the 2013 episode was that EME credit and equity market reactions were more muted, possibly reflecting a different economic and financial backdrop (Graph 6, right-hand panel). The taper tantrum prompted a sudden capital outflow from EMEs after a long period of strong inflows dating back to 2009 (Graph 6, left-hand panel). In contrast, EME funds had suffered massive outflows between 2013 and 2015 – equal to approximately 60% of inflows before the taper tantrum – in the wake of depreciating and more volatile exchange rates, and a weaker outlook for EMEs. Credit had also been extended at fixed rates at relatively long maturities in recent years, reducing the risk of immediate negative feedback spirals. More sanguine credit and equity market reactions may also have reflected the fact that, going forward, EMEs may benefit from any expected boost to US growth.

Despite relatively limited asset market reactions in November, uncertainties facing EMEs loom large. Vulnerabilities are both external and domestic in nature. On the external side, in the aftermath of the US election, EME assets repriced the changing prospects of a boom in the United States, higher global yields, a rising dollar and the potential for a backlash against free trade. The trade-offs between these different channels may change quickly, in particular given high political uncertainty. Market dynamics could also be influenced by continued large historical exposures of EME funds. Moreover, nearly 10% of EME dollar-denominated corporate debt is scheduled to mature in 2017. Thus, close to \$120 billion will need to be either rolled

⁴ The statistical results are robust to using different measures of trade exposures to the United States, such as the US-specific weight in the trade-weighted exchange rate or a measure capturing direct and indirect trade linkages based on R Auer, A Levchenko and P Sauré, “International inflation spillovers through input linkages”, BIS, mimeo, 2016.

over or paid back, which could put further pressure on EMEs. Domestically, a number of EMEs still face imbalances related to recent periods of rapid credit growth.⁵

Dollar funding costs rise in the wake of reform

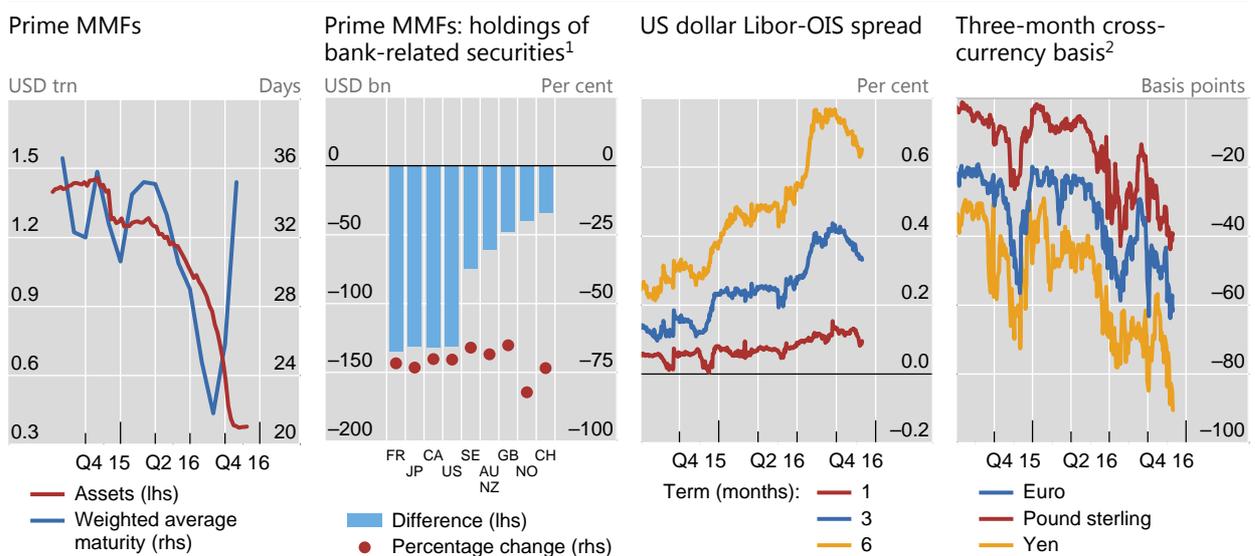
In October, global financial markets concluded a year-long adjustment to an important shift in the intermediation of wholesale bank funding. A set of US regulatory reforms focusing on prime money market funds (MMFs) – a major source of short-term dollar funding for banks globally – was fully implemented on 14 October 2016. Runs on MMFs in September 2008 were at the centre of the most acute phase of the GFC. The US Securities and Exchange Commission’s rules now require institutional prime MMFs – those that invest in a mix of public and private sector obligations – to adopt a floating net asset value structure. Funds are now also allowed to impose liquidity fees and redemption gates in the event of a large increase in outflows.

The anticipation of the new rules had reduced the size of prime funds by almost 75% since October 2015. In absolute terms, the total assets of these funds declined by more than \$1 trillion (Graph 9, first panel). At the same time, assets managed by MMFs that invest solely in government securities or repos, and are not subject to the new regulations, increased by a similar amount.

With rapidly shrinking assets under management, prime MMFs cut their funding to banks worldwide. The reduction was particularly evident for banks in Canada, France and Japan. Since last October, the amount of credit provided by these funds to financial institutions in each of these three countries fell by around \$130 billion.

Dollar funding rates increase as MMF reform takes effect

Graph 9



¹ Changes over the period from end-October 2015 to end-October 2016. ² Three-month basis swap spreads versus the US dollar.

Sources: US Securities and Exchange Commission; Investment Company Institute; Bloomberg.

⁵ See “Highlights of global financial flows”, *BIS Quarterly Review*, September 2016.

This amounted to no less than a 70% contraction in short-term dollar funding obtained from prime MMFs (Graph 9, second panel).

To have sufficient flexibility in the event of rapid withdrawals, prime MMFs also shortened the maturity of their assets. They lowered the weighted average maturity of their investments from almost 36 days in October 2015 to close to 20 days in August 2016 (Graph 9, first panel). From the trough, however, average maturities had recovered fully by the end of October 2016.

These portfolio shifts have driven short-term dollar funding costs notably higher, in particular for relatively longer-term liabilities (Graph 9, third panel). On average, the one-month US dollar Libor-OIS spread was 5 basis points wider in November of this year than in October 2015, while the average three-month and six-month US dollar Libor-OIS spreads widened by 20 and 36 basis points, respectively. The costs of alternative dollar funding sources, such as cross-currency basis swap spreads (which add to the costs of issuing in a non-dollar currency and swapping the proceeds into dollars), have also turned higher, pointing to ongoing anomalies in this market (Graph 9, fourth panel).⁶

These significantly wider Libor-OIS spreads had limited spillover effects on broader financial markets. Earlier episodes of wide spreads during the GFC and the European sovereign debt crisis were driven by a deterioration of bank creditworthiness and had led to tighter financial conditions more generally. In contrast, the current widening of spreads is largely due to changes in regulation. Borrowers that have been funded through the MMF sector have sought funding through other vehicles and markets. For instance, Canadian banks have increased their net issuance of long-term international debt securities by more than US\$20 billion since the beginning of the year (see Graph 5 in "Highlights of global financial flows", *BIS Quarterly Review*, December 2016). That said, the wider spreads have nevertheless had an impact on borrowing costs for firms and households that have borrowed at rates tied to Libor.

⁶ For further discussion, see C Borio, V Sushko, R McCauley and P McGuire, "The failure of covered interest parity: FX hedging demand and costly balance sheets", *BIS Working Papers*, no 590, October 2016; and S Avdjiev, W Du, C Koch and H S Shin, "The dollar, bank leverage and the deviation from covered interest parity", *BIS Working Papers*, no 592, November 2016.

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. This chapter summarises the latest data for international banking markets, available up to June 2016, and for international debt securities, available up to September 2016. One box looks at new BIS data on positions with central counterparties, and another at China and Russia as new reporting countries to the BIS locational banking statistics.

Takeaways

- International lending stagnated during the second quarter of 2016. While global cross-border claims rose by \$489 billion between end-March and end-June 2016, intragroup activity accounted for most of the increase. On a consolidated basis, after excluding intragroup positions, banks' international claims were virtually unchanged.
- In contrast to the overall trend, claims on emerging market economies (EMEs) grew by \$124 billion in Q2 2016, ending a run of three consecutive quarterly declines. The increase was led by a \$61 billion rise in claims on China. Cross-border lending to the rest of emerging Asia, Middle East and Latin America also rose.
- The BIS consolidated banking statistics (CBS) point to a gradual shift in the composition of international interbank credit across regions over the past year. The share of international lending to banks in advanced economies rose by 4 percentage points, while international lending to banks in EMEs dropped by 3 percentage points.
- International debt securities issuance by EMEs was \$57 billion (21%) lower in the third quarter of 2016 compared with the second quarter, but 75% higher with respect to the third quarter of 2015.
- The trend towards greater use of the euro as a funding currency slowed in the third quarter, as dollar issuance by financial institutions resumed and reached a record high.

¹ This article was prepared by Cathérine Koch (catherine.koch@bis.org) and Gianpaolo Parise (gianpaolo.parise@bis.org). Statistical support was provided by Kristina Bektyakova, Swapan-Kumar Pradhan and Jana Sigutova.

- New data on central counterparties (CCPs) show that central clearing has made significant inroads in over-the-counter (OTC) interest rate derivatives markets but is less entrenched in other segments. Box A examines these trends.
- As of December 2016, the BIS locational banking statistics (LBS) provide a finer breakdown of the non-bank sector and inter-office transactions by individual counterparty country. Further, China and Russia have recently begun contributing to the BIS LBS. Box B presents the new data from these two countries.

Recent developments in the international banking market

International bank lending stagnated during the second quarter of 2016. Even though cross-border claims rose by \$489 billion during Q2 2016, the BIS LBS² reveal that the majority of the increase was driven by intragroup activity. At end-June 2016, cross-border claims stood at \$28.4 trillion, up \$125 billion from a year earlier.³

In terms of currencies, the aggregate rise in unconsolidated cross-border lending was primarily driven by a \$340 billion increase in US dollar-denominated claims (Graph 1, bottom panels). Cross-border lending in euros grew by \$48 billion. In addition, BIS reporting banks extended more cross-border credit denominated in sterling (\$40 billion) and Swiss francs (\$32 billion). By contrast, cross-border claims denominated in yen saw a \$16 billion decline.

According to the BIS CBS⁴ on an immediate counterparty basis, international claims⁵ on banks actually fell slightly, from \$4,255 billion to \$4,245 billion, while international claims on the non-bank private sector rose from \$8,553 billion to \$8,602 billion during the same period.

Divergent trends in consolidated and unconsolidated interbank lending

The divergent trends in the consolidated and unconsolidated data reflect a sizeable increase in cross-border positions within banking groups. Cross-border claims on banks, which in the LBS capture positions with related offices as well as with other banks, climbed by \$351 billion in the second quarter of 2016. While this represented the largest quarterly increase since the same quarter in 2010, the annual growth rate

² The locational banking statistics are based on the location of banking offices and capture the activity of all internationally active banking offices in the reporting country regardless of the parent bank's nationality. Banks record their positions on an unconsolidated basis, including those vis-à-vis affiliates of the banking group in other countries.

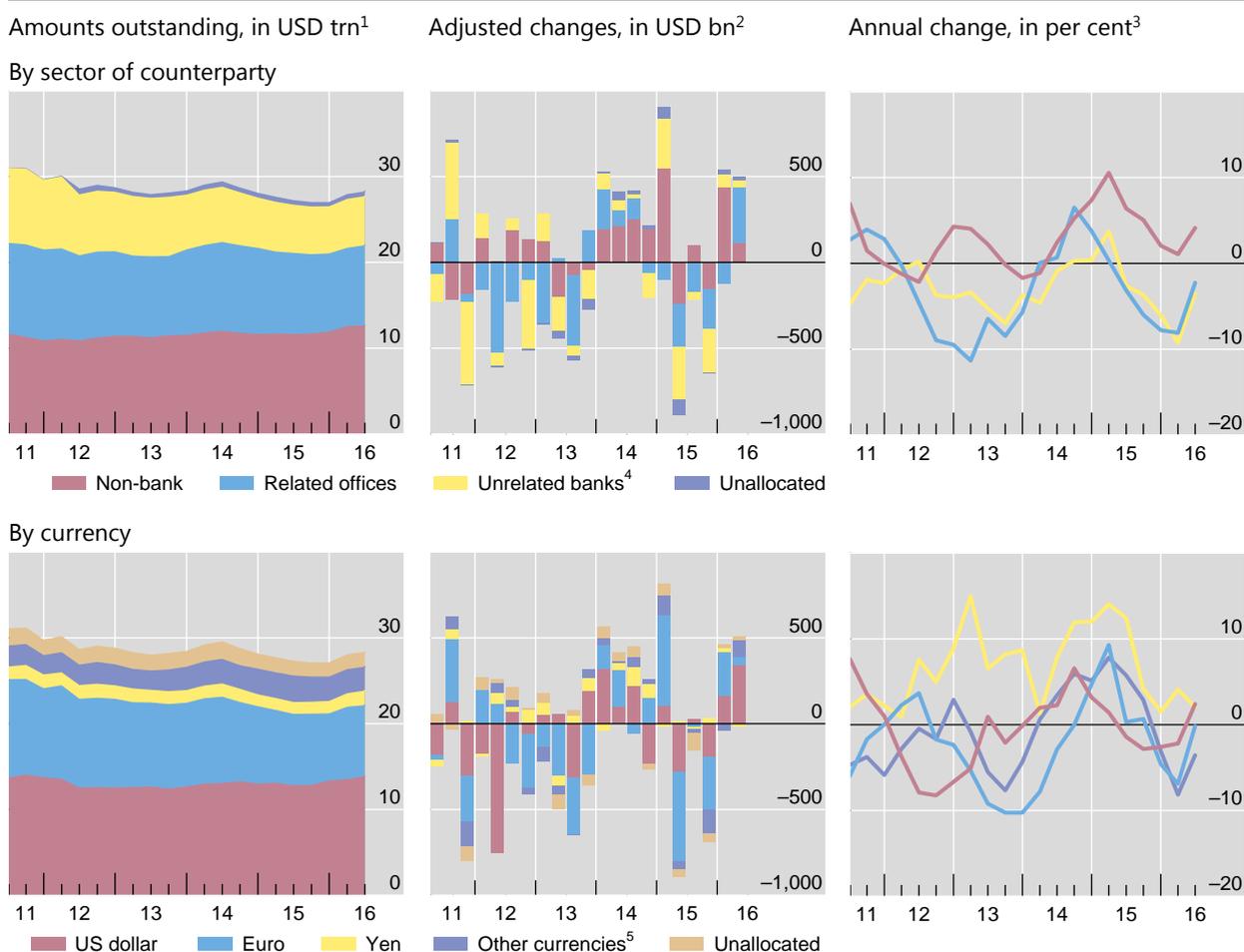
³ Sum of quarterly changes in outstanding amounts. Quarterly changes are adjusted for the impact of exchange rate movements between the respective quarter-ends and for methodological breaks in the data series in the LBS.

⁴ The CBS are based on the nationality of reporting banks and are reported on a worldwide consolidated basis, ie excluding positions between affiliates of the same banking group. Banks consolidate their inter-office positions and report only their claims on unrelated borrowers without providing a currency breakdown. As a consequence, exchange rate-adjusted changes are not available in the CBS.

⁵ International bank claims are the sum of banks' cross-border claims and their local claims denominated in foreign currencies.

Cross-border claims, by sector and currency

Graph 1



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.

of cross-border interbank claims remained in negative territory, at -3% in the year to end-June 2016. More than 90% of the quarterly rise in interbank claims was due to a rise in claims on related offices (Graph 1, top panels).⁶ For stocks of both claims and liabilities, the intragroup subsector accounted for about 60% of all outstanding interbank cross-border positions in mid-2016.

With respect to the recipients of interbank funding, cross-border claims on banks in Germany expanded the most. A rise in euro-denominated claims fuelled the \$80 billion increase. Cross-border claims on banks in the United Kingdom

⁶ As of this release, covering data up to the second quarter of 2016, the BIS LBS provide a more detailed breakdown of inter-office positions by counterparty country. They also provide a finer sectoral breakdown, splitting the non-bank sector by individual counterparty country into a non-bank financial and non-financial component (see next section).

(+\$62 billion) and the United States (+\$46 billion) also grew, mainly driven by US dollar-denominated positions.

Turning to the lenders, banks in the United Kingdom reported the highest increase in cross-border interbank claims (+\$128 billion), followed by banks in Japan (+\$80 billion) and the United States (+\$69 billion). US dollar-denominated claims on related offices dominated the rise in interbank credit reported by banks in Japan (55%) and the United States (86%). By contrast, cross-border inter-office transactions denominated in euros accounted for about 60% of the overall increase in cross-border interbank lending reported by banks in the United Kingdom.

The CBS reveal a gradual shift in the composition of international interbank credit across regions during the past year. Claims on banks in advanced economies (as a share of global interbank claims) rose by 4 percentage points, accounting for 72% of all international interbank claims in mid-2016. Over the same period, the share of international lending to banks in EMEs contracted by 3 percentage points, to 21% of the total, as a result of three consecutive quarterly declines. International interbank claims on offshore centres made up 7% as end-June 2016, slightly below the 8% reported a year earlier.

More cross-border lending extended to the non-bank sector

Cross-border claims on non-banks, as reported to the LBS, rose by \$115 billion between end-March and end-June 2016 (Graph 1, top panels). This aggregate number masks significant variation across instruments. While banks extended more credit to non-banks in terms of cross-border loans (+\$166 billion), their debt securities holdings fell by \$104 billion.

The \$115 billion non-bank increase in the second quarter of 2016 resulted from a \$141 billion rise in claims on non-bank financial institutions, and a \$34 billion fall in lending to the non-financial sector. In mid-2016, claims on the non-bank financial sector accounted for about 39% of all non-bank claims, while claims on non-financial entities captured about half. For cross-border liabilities, these shares amounted to 48% and 39%, respectively. Residual shares accrue to a category of unallocated positions vis-à-vis non-banks.

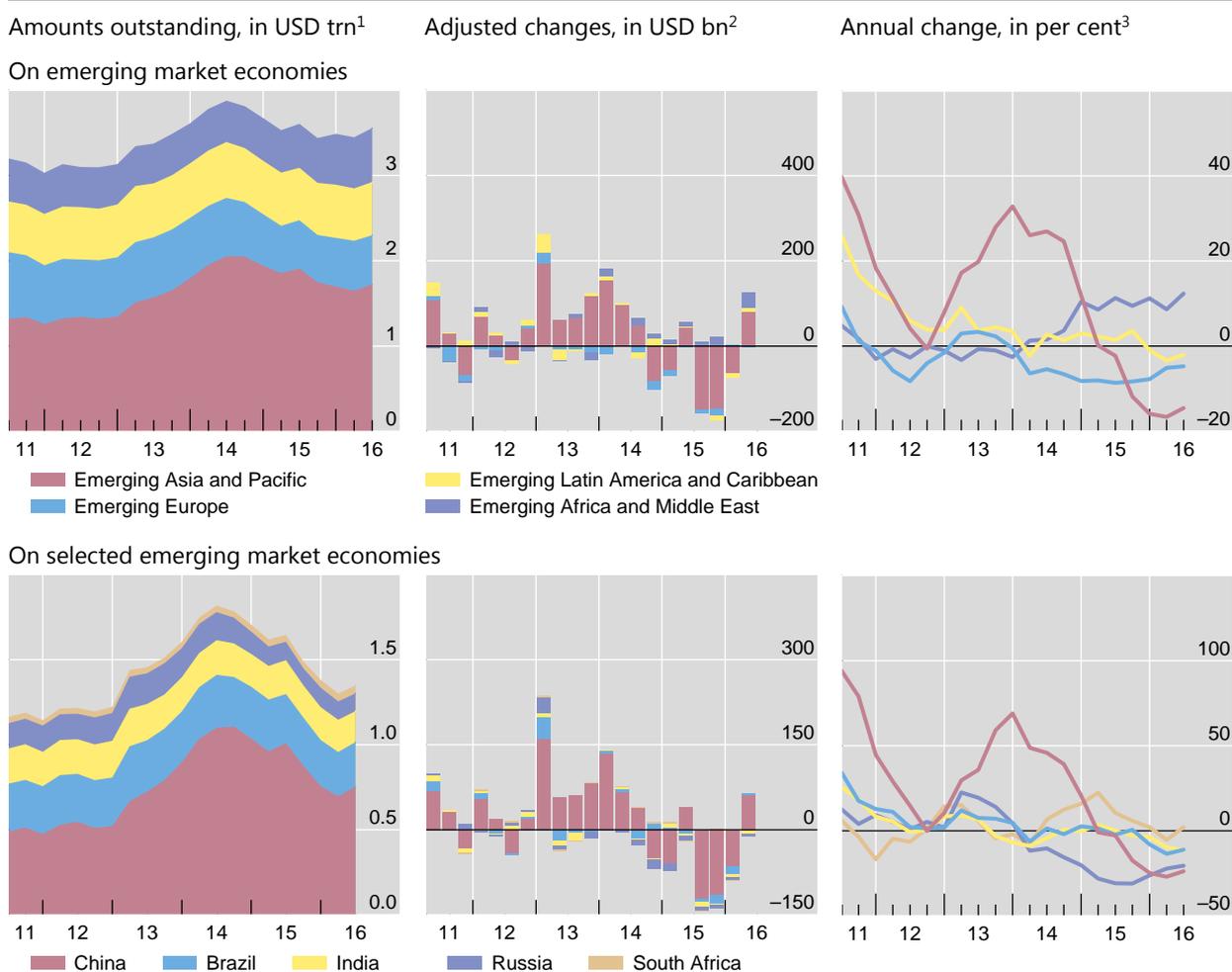
Cross-border lending to EMEs picks up

The second quarter of 2016 saw a substantial rise in cross-border lending to EMEs, in parallel with high levels of international debt securities issuance (as discussed below). According to the LBS, cross-border claims on EMEs rose by \$124 billion (Graph 2, top panels). However, this only partially offset the \$372 billion drop that took place during the previous three quarters. The outstanding stock of cross-border claims on EMEs was \$3.6 trillion at end-June 2016, down 7% from a year earlier and well below its mid-2014 peak of \$3.9 trillion. All major EME regions, with the exception of emerging Europe, shared in the latest quarterly increase.

The \$61 billion rise in cross-border lending to China dominated the \$80 billion expansion in lending to emerging Asia. Despite this recent strength, claims on China and emerging Asia remained well below the levels observed a year ago (by 24% and 15%, respectively). The picture for other major economies in emerging Asia varied markedly. Korea (+\$11 billion), Thailand and Pakistan (+\$3 billion each) saw an increase in cross-border claims on their residents. By contrast, lending to India

Cross-border claims, by borrowing region and country

Graph 2



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

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

Source: BIS locational banking statistics.

contracted by \$7 billion, down 11% in the year to end-June 2016. Since the first quarter of 2015, cross-border claims on India fell by a cumulative \$27 billion, taking the outstanding stock to \$182 billion as of mid-2016.

Cross-border lending to Latin America and the Caribbean grew by \$10 billion. Most of this reflected higher claims on Mexico (+\$7 billion), Brazil and Ecuador (+\$2 billion each).

Lending to emerging Europe contracted by \$2 billion during Q2 2016. At \$578 billion outstanding, cross-border claims were 4.7% below the levels observed a year earlier. Regional developments, however, varied considerably across individual countries. Cross-border lending to Russia dropped by another \$5.3 billion in the second quarter, to just \$103 billion outstanding, down from a peak of \$189 billion at end-March 2013. This latest quarterly drop took the annual rate of decline to -21%. Cross-border lending to Romania also saw a \$1.2 billion decline. By contrast, cross-border claims on Poland and the Czech Republic expanded by \$1.7 billion and

\$1.6 billion, respectively. Cross-border lending to residents of Turkey also grew, by \$1.3 billion in Q2 2016, or 3% in the year to end-June 2016.

The latest \$35 billion quarterly rise in cross-border lending to Africa and the Middle East pushed the annual growth rate to 12% and the outstanding total to its highest level on record (\$ 632 billion). The overall expansion was led by a rise in cross-border claims on oil exporters, including the United Arab Emirates (+\$16 billion), Saudi Arabia (+\$9 billion) and Qatar (+\$4 billion). These developments coincided with increased international debt securities issuance by borrowers from those countries (see below). The CBS on an immediate counterparty basis indicate that banks incorporated in France, Japan, Italy and the United Kingdom were the largest providers of international credit to residents of Africa and the Middle East.

International debt securities issuance reverts to dollars

International debt securities issuance during the third quarter of 2016, at \$1.4 trillion, was 10% lower than in the previous quarter.

Borrowers in advanced economies issued \$150 billion on net over the third quarter, a 40% increase, with less gross issuance but an unusually low level of repayments (Graph 3, left-hand panel). Net issuance for the first nine months of 2016 is now well ahead of its pace in 2015, and indeed is at its highest level since 2009.

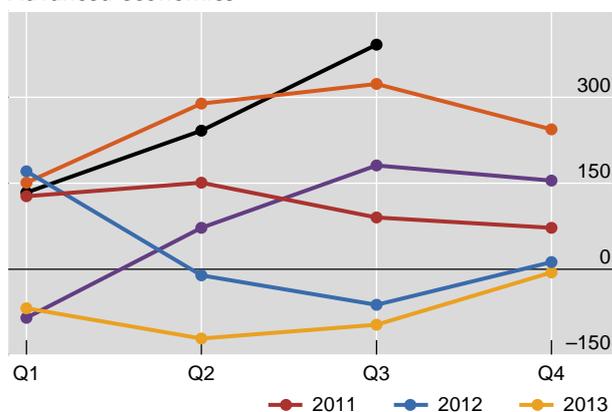
In EMEs, net borrowing on international securities markets in Q3, at \$83 billion, was 35% below that of the previous quarter, when the issuance volume was unusually large. Cumulative EME debt issuance during the first three quarters of the year was 73% higher than that in the first three quarters of 2015, though it still lagged the rapid pace of issuance seen in each of the three years up to 2014 (Graph 3, right-hand panel).

International debt securities¹

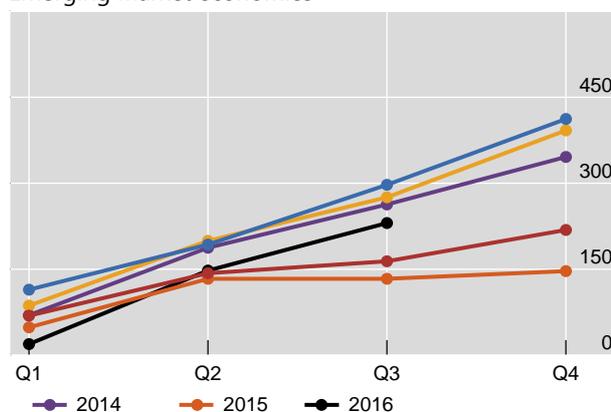
Cumulative net issuance,² in billions of US dollars

Graph 3

Advanced economies³



Emerging market economies^{3,4}



¹ All issuers, all maturities, by nationality of issuer. ² Net cumulative quarterly issuance. ³ See the *BIS Statistical Bulletin* for a list of countries. ⁴ Includes Hong Kong SAR and Singapore.

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

The lower EME net issuance figure in the third quarter largely resulted from weaker government borrowing. In particular, sovereign borrowing by oil producers slowed. However, this anticipated a record \$17.5 billion sovereign bond issue by Saudi Arabia in October and followed an extraordinary issuance level in the second quarter, which had been fostered by the fiscal needs of oil exporters (mostly Oman, Qatar, and the United Arab Emirates) in response to low oil prices. Debt issuance by private financial and non-financial companies in EMEs recovered strongly in the third quarter after the turbulent beginning of the year.

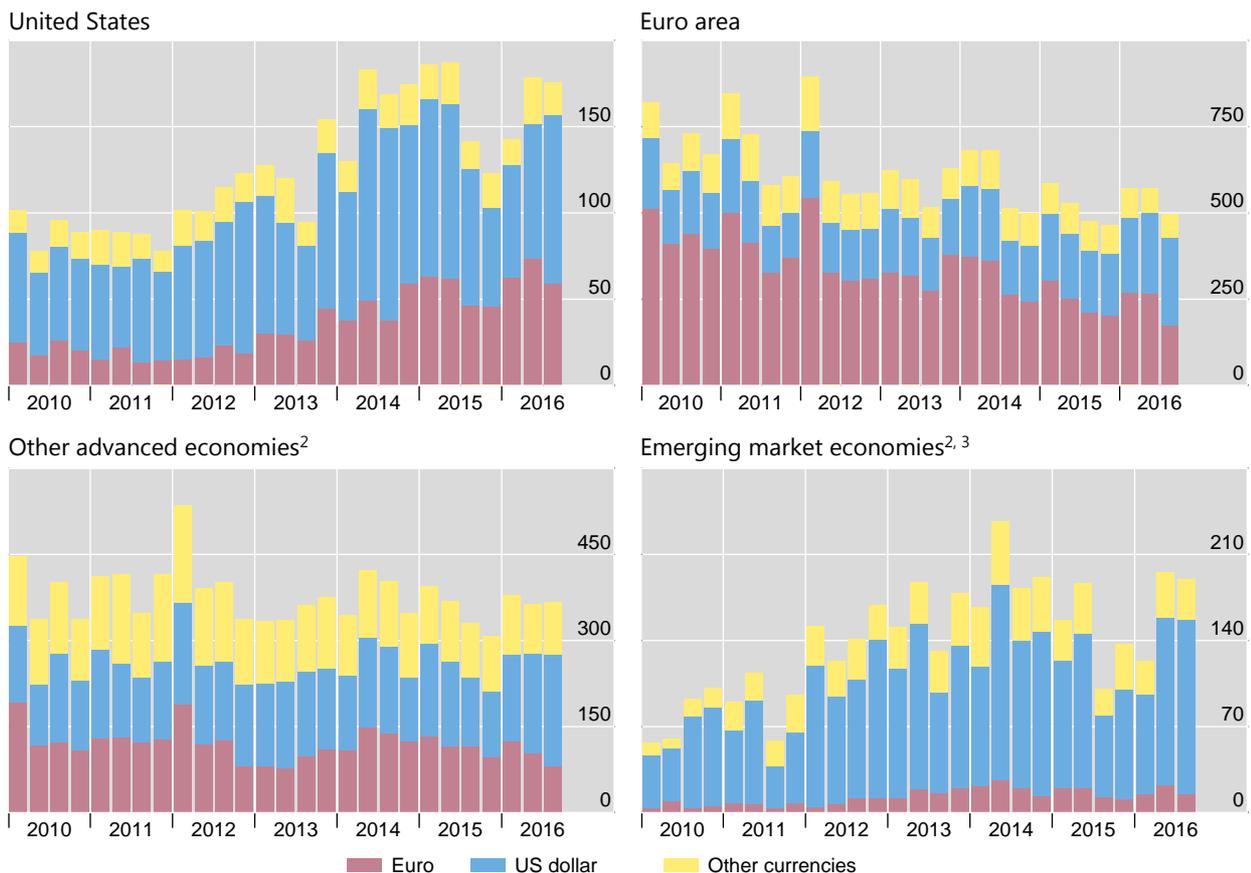
The trend towards greater use of the euro as a funding currency was interrupted in the third quarter (Graph 4). International issuance in euros fell to \$351 billion, the lowest value in the last 13 years. This was particularly evident in the borrowing patterns of financial and non-financial firms in the euro area (upper right-hand panel).

At the same time, issuance in US dollars reached a record value of \$792 billion. Dollar borrowing was supported by the widening of US dollar Libor, mostly resulting from the regulatory change in the prime money market fund industry in the United

International debt securities – financial and non-financial issuers¹

Gross issuance, in billions of US dollars

Graph 4



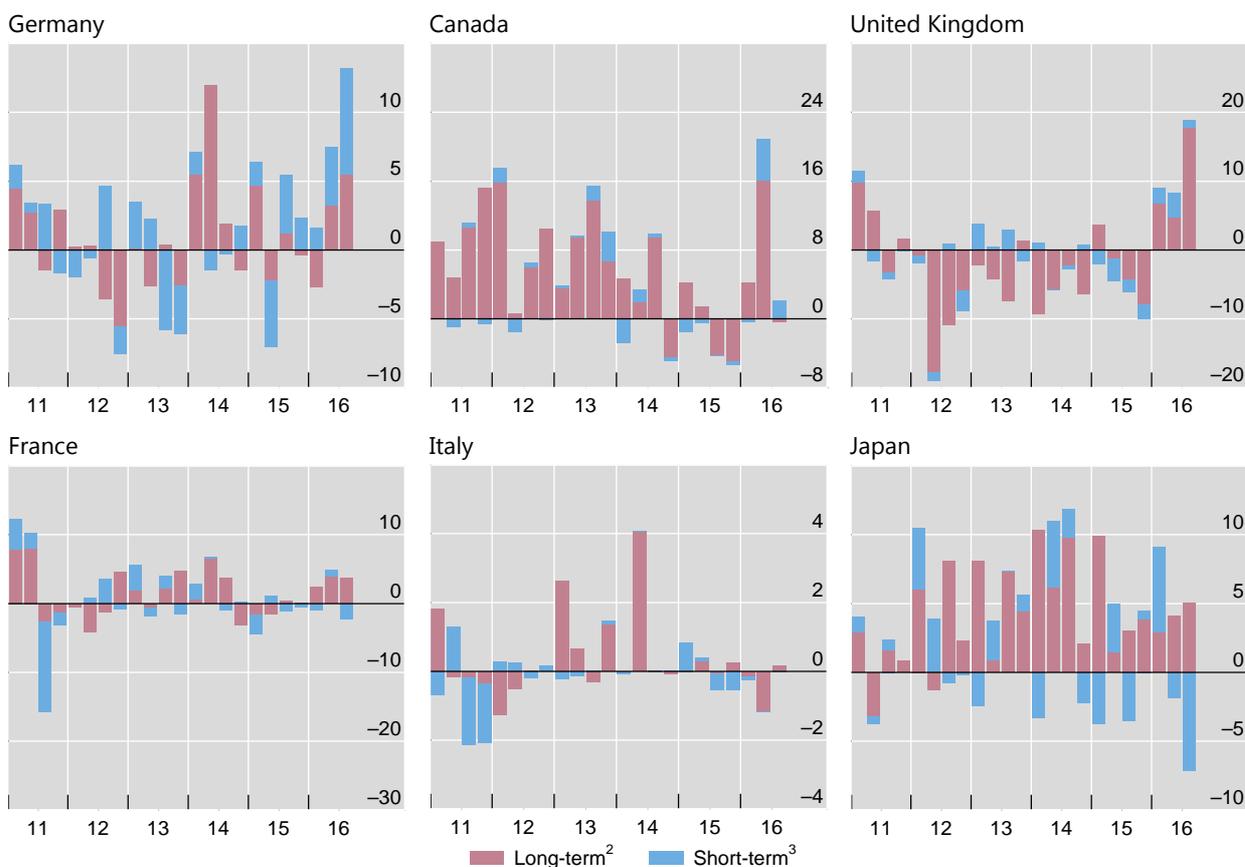
¹ Financial and non-financial headquarters, by nationality of issuer. ² See the *BIS Statistical Bulletin* for a list of countries. ³ Includes Hong Kong SAR and Singapore.

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

Net issuance of international debt securities by banks¹

By original maturity, in billions of US dollars

Graph 5



¹ US dollar-denominated, by private and public banks, by nationality of issuer. ² Bonds and notes. ³ Money market instruments.

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

States.⁷ This hindered the supply of short-term dollar funding for European and Japanese banks and pushed them to borrow through longer-term instruments.

Partly reflecting funding shifts related to the money market reform, total euro-denominated borrowing by financial firms in the third quarter was the lowest in the last nine years, while US dollar-denominated borrowing was the highest. German, French, Canadian and UK banks have increased their net borrowing of international debt securities in 2016 (Graph 5). Banks from these countries issued on net \$90 billion of dollar-denominated short and long-term securities on international markets in the first three quarters of 2016, compared with net repurchases of \$25 billion in the whole of 2015. Most of these issues were bonds and notes (including medium-term notes, red bars), though German banks also made use of shorter-term money market instruments (blue bars). Japanese and Italian net borrowing patterns were little changed in aggregate, though Japanese banks redeemed a relatively large volume of short-term instruments in the third quarter.

⁷ See "A paradigm shift in markets?", BIS Quarterly Review, December 2016.

To some extent, the shift from the euro to the dollar in the third quarter may also have arisen because of changes in the relative costs of borrowing in the two currencies across countries. The widening cross-currency basis and higher dollar funding costs made it relatively more expensive for US nationals to issue in foreign currencies such as the euro and then swap the proceeds back into dollars. At the same time, it became relatively cheaper for foreign nationals to borrow in the US dollar debt markets and swap the proceeds back into local currencies.

Central clearing predominates in OTC interest rate derivatives markets

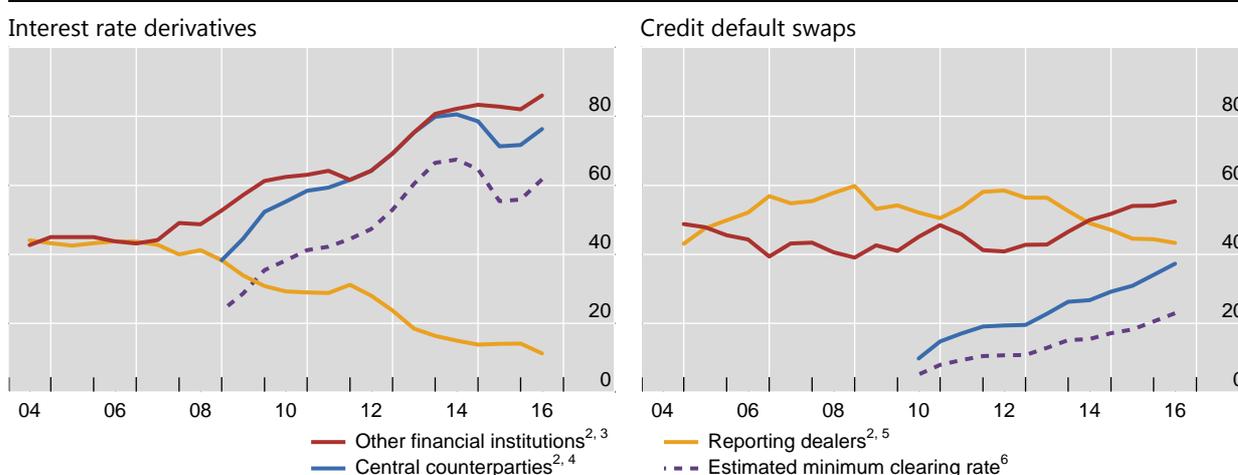
Philip Wooldridge

New BIS data show that central clearing has made significant inroads into over-the-counter (OTC) interest rate derivatives markets but is less prevalent for other OTC derivatives. Central clearing is a key element in authorities' agenda for reforming OTC derivatives markets to reduce systemic risks. As of end-June 2016, 75% of dealers' outstanding OTC interest rate derivatives contracts were against central counterparties (CCPs), compared with 37% for credit derivatives and less than 2% for foreign exchange and equity derivatives. Overall, 62% of the \$544 trillion in notional amounts outstanding reported by dealers was against CCPs, and 41% of the \$21 trillion in gross market value.

Growth of central clearing

Notional amounts outstanding by counterparty, in per cent¹

Graph A1



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

¹ As reported in the semiannual survey of OTC derivatives markets, excluding the positions of dealers that report only in the Triennial Survey. ² As a percentage of notional amounts outstanding against all counterparties. ³ Including central counterparties but excluding reporting dealers. ⁴ For interest rate derivatives, data for CCPs prior to end-June 2016 are estimated by indexing the amounts reported at end-June 2016 to the growth since 2008 of notional amounts outstanding cleared through LCH's SwapClear service. ⁵ Adjusted for the double-counting of positions between dealers (that are not novated to CCPs). ⁶ Proportion of trades that are cleared, estimated as $(CCP / 2) / (1 - (CCP / 2))$, where CCP represents the share of notional amounts outstanding that dealers report against CCPs. CCPs' shares are halved to adjust for the potential double-counting of inter-dealer trades novated to CCPs.

Sources: LCH.Clearnet Group Ltd; BIS OTC derivatives statistics.

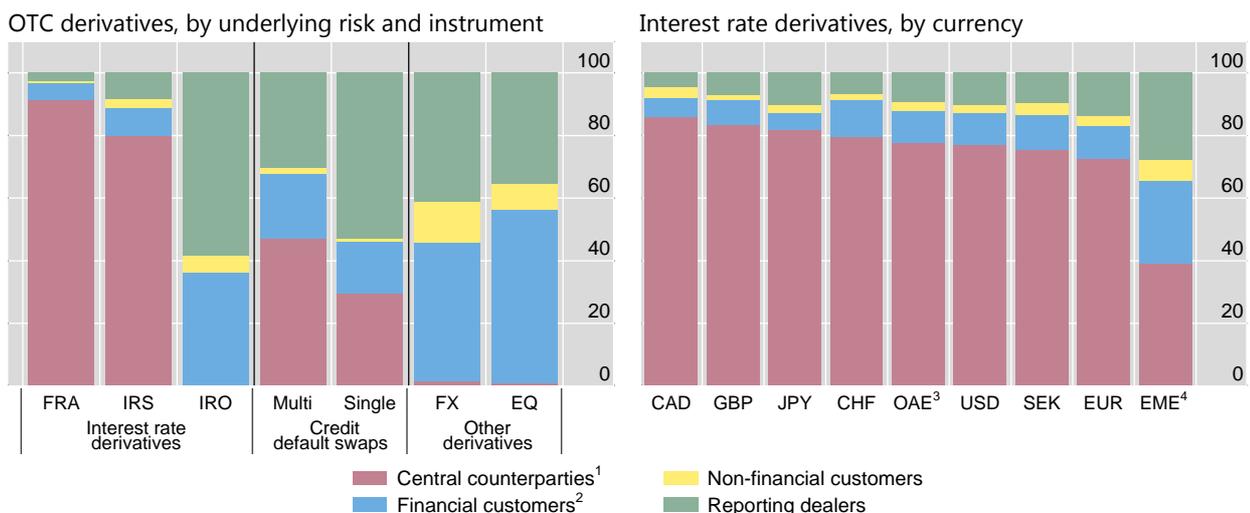
In the BIS OTC derivatives statistics, data on CCPs were previously collected only for credit default swaps (CDS), whereas starting from end-June 2016 CCPs were separately identified for all types of OTC derivatives.Ⓐ Dealers report their outstanding positions in terms of notional amounts, which provide a measure of the aggregate amount of risk that they transfer from other counterparties to CCPs, as well as market values, which provide a measure of their counterparty exposure to CCPs. While outstanding positions against CCPs are not synonymous with the proportion of trades that are cleared through CCPs – known as the clearing rate – the former can be adjusted to approximate the latter. In the OTC derivatives statistics, a trade between two dealers that is subsequently novated to a CCP is captured twice: each dealer reports an outstanding position against the CCP. Therefore, under the extreme assumption that all positions with CCPs were initially inter-dealer contracts, a lower bound on the clearing rate can be estimated by halving outstanding positions against CCPs. Inter-dealer trades novated to CCPs would thereby be counted only once.Ⓑ However, this underestimates the significance of clearing because an (unknown) portion of cleared trades are not between dealers and thus not double-counted in the BIS statistics. Moreover, CCPs' share of outstanding positions is lower than their share of trades because compression is more common for cleared trades.Ⓒ

While comprehensive data on central clearing are available only from end-June 2016, the share of outstanding positions with other financial institutions – with which CCPs were previously grouped indistinguishably – can be used to approximate the pace of the shift in activity towards CCPs. For OTC interest rate derivatives, this share has been climbing steadily since 2007, from 44% of notional principal at end-June 2007 to 86% at end-June 2016 (Graph A1, left-hand panel). In contrast, the inter-dealer segment declined markedly in importance over this period, from 43% to 11%. These opposing trends were probably driven in part by the novation of inter-dealer contracts to CCPs. Using data from LCH to backdate the BIS statistics on CCPs, the clearing rate for OTC interest rate derivatives is estimated to have more than doubled between 2008 and 2016; it could plausibly have tripled (Graph A1, left-hand panel).

Significance of central clearing

Notional amounts outstanding by type of counterparty, at end-June 2016, in per cent

Graph A2



Further information on the BIS Triennial Central Bank Survey is available at www.bis.org/publ/rpfx16.htm.

EQ = equity-linked derivatives; FRA = forward rate agreements; FX = foreign exchange derivatives; IRO = interest rate options; IRS = interest rate swaps; multi = multi-name credit default swaps; single = single-name credit default swaps.

¹ Contracts between reporting dealers that are subsequently novated to CCPs are recorded twice. ² Excluding central counterparties and reporting dealers. ³ Other advanced economy (OAE) currencies: AUD, DKK, NOK and NZD. Data are reported by a small sample of dealers and thus are incomplete. ⁴ Emerging market economy (EME) currencies: ARS, BGN, BHD, BRL, CLP, CNY, COP, CZK, HKD, HUF, IDR, ILS, INR, KRW, MXN, MYR, PEN, PHP, PLN, RON, RUB, SAR, SGD, THB, TRY, TWD and ZAR. Data are reported by a small sample of dealers and thus are incomplete.

Source: BIS Triennial Central Bank Survey.

In the OTC interest rate derivatives market, the share of notional amounts booked against CCPs was highest for forward rate agreements, at 91% at end-June 2016 (Graph A2, left-hand panel). This is equivalent to a clearing rate of at least 84%, although this is probably an underestimate. For interest rate swaps, the share booked against CCPs was 80%, which is equivalent to an estimated minimum clearing rate of 66%. However, for interest rate options, central clearing was close to zero. Across major currencies, the importance of CCPs was uniformly high, ranging from 72% for interest rate derivatives denominated in euros to 86% for those in Canadian dollars, with US dollars in between at 77% (Graph A2, right-hand panel). Among EME currencies, it was significantly lower.

Central clearing has also gained in importance in credit derivatives markets. The proportion of outstanding CDS cleared through CCPs has increased steadily since these data were first reported, from 10% at end-June 2010 to 37% at end-June 2016. After adjusting for the potential double-counting of trades, this was equivalent to an increase in the estimated minimum clearing rate from 5% to 23% (Graph A1, right-hand panel). The share of CCPs is higher for multi-name than for single-name products: 47% versus 29% for notional amounts outstanding (Graph A2, left-hand panel). Multi-name products, which consist primarily of contracts on CDS indices, tend to be more standardised than single-name products and consequently more amenable to central clearing.

In other segments of OTC derivatives markets, central clearing was negligible. For FX derivatives, the share of outstanding notional amounts cleared through CCPs was 1.5% at end-June 2016, and for OTC equity derivatives 0.7% (Graph A2, left-hand panel). For commodity derivatives, CCPs' share is not known because a counterparty breakdown for this asset class is not collected in the BIS OTC derivatives statistics.

The relatively low shares for FX and equity derivatives are explained partly by differences in the regulations that apply to different derivatives. Regulators in most of the major derivatives markets require certain standardised OTC derivatives to be centrally cleared, particularly interest rate swaps, CDS and non-deliverable FX forwards; deliverable FX derivatives and equity derivatives are often not covered by these requirements. Also, some instruments, such as options, are currently not offered for clearing by CCPs. That said, regulators continue to expand clearing requirements, and many are also starting to require higher capital and margin for non-centrally cleared derivatives.^④ This strengthens the incentive to move trades to CCPs. In the United States and other key markets, margining requirements began to be phased in starting in September 2016, so their impact on clearing will only become clear in future data.^⑤

① See BIS, "[OTC derivatives statistics at end-June 2016](#)", statistical release, November 2016. ② Clearing rates published by other organisations typically refer to trading volumes, not outstanding positions, and count each trade only once. Volume-based statistics are influenced by the maturity of trades; contracts with very short maturities are captured each time the contract is rolled over during the period in which volumes are measured. ③ For a discussion of compression, see T Ehlers and E Eren, "[The changing shape of interest rate derivatives markets](#)", *BIS Quarterly Review*, December 2016, pp 53–65. ④ See Financial Stability Board, "[OTC derivatives market reforms: eleventh progress report on implementation](#)", August 2016. ⑤ See R McCauley and C Shu, "[Non-deliverable forwards: impact of currency internationalisation and derivatives reform](#)", *BIS Quarterly Review*, December 2016, pp 81–93.

China and Russia join the BIS locational banking statistics

Koon Goh and Swapan-Kumar Pradhan

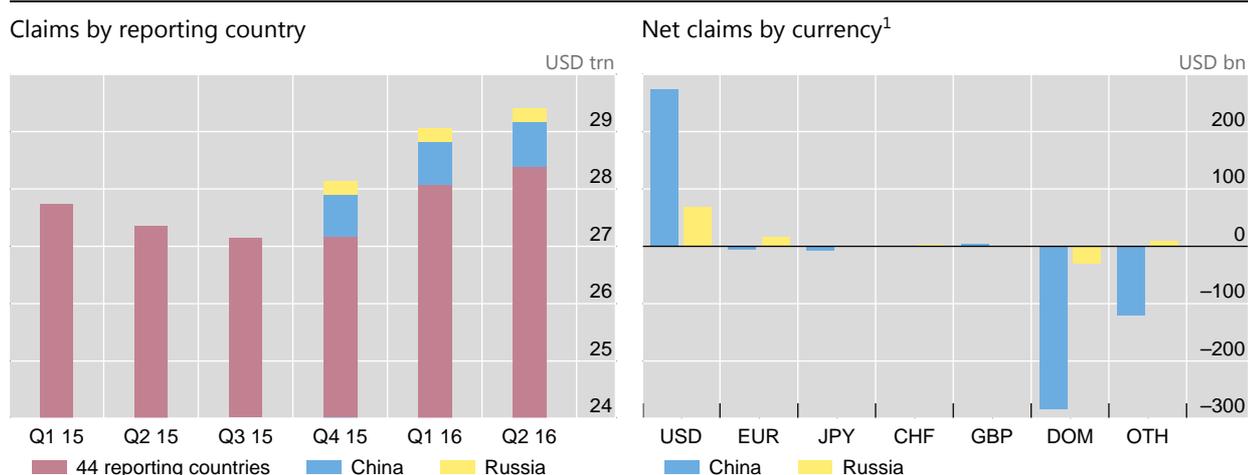
China and Russia have started to report to the BIS locational banking statistics (LBS), taking the number of LBS-reporting countries from 44 to 46.^① A total of 12 EMEs now report to the LBS, along with 12 offshore financial centres and 22 advanced economies. Expanding the LBS-reporting population had been identified as a priority as part of the enhancements to the banking statistics agreed by the Committee on the Global Financial System in 2012 as well as the Data Gaps Initiative launched by the IMF and FSB in 2009 with the endorsement of the G20.^②

The LBS reported by China are compiled from nearly 650 deposit-taking institutions located on the mainland, while those reported by Russia are compiled from about 700 institutions.^③ Many of these institutions are affiliates of banks headquartered abroad: the reporting banks in China represent some 35 nationalities, and those in Russia nearly 30 countries. In China, foreign banks are allowed to operate through branches or subsidiaries, but in Russia they can operate only through subsidiaries.

The claims and liabilities of domestic and foreign banks located in China and Russia have been included in global aggregates in the LBS since end-December 2015. At end-June 2016, banks in China reported outstanding cross-border claims of \$778 billion and liabilities of \$918 billion, while banks in Russia reported claims of \$240 billion and liabilities of \$171 billion (Graph B, left-hand panel). This makes China the 10th largest cross-border creditor in the international banking market, and Russia the 23rd largest.

Cross-border positions of banks in China and Russia

Graph B



DOM = domestic currency of the respective reporting country, ie CNY for China and RUB for Russia; OTH = other foreign currencies.

¹ At end-June 2016. Net claims are defined as claims minus liabilities.

Source: BIS locational banking statistics (Table A5).

The inclusion of China and Russia resulted in a 3.8% increase in the global total for LBS-reporting banks' outstanding cross-border claims at end-December 2015 and a 4.8% rise in outstanding cross-border liabilities. For some individual borrower countries, the impact was much larger. For example, the addition of China and Russia resulted in double-digit increases in the outstanding claims of LBS-reporting banks on some offshore centres and developing countries in Africa and eastern Europe. That said, the bulk of the two countries' cross-border claims was on advanced economies.

Turning to the currency composition of their cross-border claims and liabilities, at end-June 2016 banks in both China and Russia were net lenders of US dollars, with dollar claims exceeding dollar liabilities by \$275 billion (claims: \$549 billion; liabilities: \$274 billion) and \$69 billion (claims: \$163 billion; liabilities: \$94 billion), respectively (Graph B, right-hand panel). Domestic currency-denominated cross-border liabilities of banks in Russia were \$54 billion, more

than double their cross-border claims in roubles (\$24 billion). However, \$358 billion, or 39%, of Chinese banks' cross-border liabilities were denominated in renminbi. Renminbi-denominated cross-border claims of banks in China stood at \$73 billion, much less than their cross-border liabilities.

Turning to positions with local residents, at end-June 2016 banks in Russia reported local claims of \$1.1 trillion on all borrowers, equivalent to 80% of GDP and about four times greater than their cross-border claims. About 76% of these local claims were denominated in roubles, and the rest mainly in US dollars. The US dollar liabilities of banks in Russia to Russian residents exceeds their US dollar lending to residents by \$18 billion. China does not yet report local positions to the BIS.

Chinese and Russian banking groups are spreading their networks globally. Chinese banks operate in more than 20 of the 46 LBS-reporting countries and Russian banks in 15 reporting countries. Based on the (incomplete) data currently reported to the BIS by LBS-reporting countries that host Chinese and Russian banks, the cross-border claims of Chinese banks, including intragroup positions, totalled about \$1,480 billion at end-June 2016 and those of Russian banks about \$230 billion. This makes Chinese banks the eighth largest lenders in the international banking market and Russia banks the 19th largest.

① These changes were implemented after the preliminary release of the LBS for the second quarter in October 2016. ② Committee on the Global Financial System, *Improving the BIS international banking statistics*, CGFS Papers, no 47, November 2012. ③ For more information about the LBS reported by China, see H Hu and P Wooldridge, "International business of banks in China", *BIS Quarterly Review*, June 2016, pp 7–8.

Glossary

Agency model: Method for executing client orders without taking inventory risks. Dealers running an agency model charge a commission for placing a customer's order with the market and for finding a counterparty willing to take the opposite side of the transaction.

Algorithmic trading: Automated trading for which a computer algorithm decides the submission and execution of orders (see also "High-frequency trading").

Application programming interface (API): Set of rules and specifications followed by software programmes to communicate with each other, and an interface between different software programmes that facilitates their interaction. Prerequisite for algorithmic trading.

Bid-ask spread: Difference between the price a dealer receives for selling a security or currency (ask) and the price a dealer pays for buying a security or currency (bid).

Broker: Financial intermediary that matches counterparties to a transaction without being a party to it. A broker can operate electronically (electronic broker) or by telephone (voice broker).

Broker-dealer: Financial intermediary whose activities include acting as both broker and dealer in financial markets.

Buy-side: Refers to a market participant that acts as a dealer's customer.

Central counterparty (CCP): Entity that interposes itself between the two sides of a cleared transaction, becoming the buyer to the seller and the seller to the buyer.

Centralised limit order book (CLOB): A trading protocol whereby outstanding offers to buy or sell are stored in a queue and filled in a priority sequence, usually by price and time of entry. Orders to buy at prices higher than the best selling price and orders to sell at prices lower than the best buying price are executed. The use of a CLOB is common for highly standardised securities and small trade sizes.

Credit default swap (CDS): Agreement whereby the seller commits to repay a debt obligation (eg bond) underlying the agreement at par in the event of default. To secure this guarantee, a regular premium is paid by the buyer during a specified period.

Credit derivative: Derivative for which the redemption value is linked to a specified credit-related event such as a bankruptcy, a credit downgrade, non-payment or default. For example, a lender might use a credit derivative to hedge against the risk of a borrower's default. Common credit derivatives include credit default swaps (CDS), total return swaps and credit spread options.

Cross-currency basis: Difference between the implied interest cost of borrowing one currency against another in the currency swap market, and the actual interest rate for borrowing that currency directly in the cash market.

Currency option: Contract that gives the holder the right (without imposing the obligation) to buy or sell a currency at an agreed exchange rate during a specified period.

Currency swap: Longer-term instrument, typically of more than one year, whereby two parties simultaneously borrow and lend an equivalent amount of funds in two different currencies. At maturity, the borrowed amounts are exchanged back at the initial spot rate; but during the life of the swap, the counterparties periodically exchange interest payments. In a cross-currency basis swap, the reference interest rates are the respective Libor rates plus the basis, such that one party pays (receives) a lower (higher) interest rate than the corresponding Libor rate.

Dark pool: Trading platform in which pre-trade transparency is deliberately limited, typically by withholding information about market depth or likely transaction price. Dark pools limit transparency in order to induce liquidity suppliers to offer greater quantities for trade.

Dealer: Financial intermediary that stands ready to buy or sell assets with its clients.

Direct price stream: Trading not intermediated via a third party whereby a liquidity provider streams prices at which trades can be executed directly with another party.

Electronic communication network (ECN): System for the electronic matching of buy and sell orders for financial instruments.

Electronic direct trading: Bilateral trade conducted electronically without the involvement of a third party. This includes trades conducted via single-bank trading platforms but also via direct electronic price streams with API connectivity.

Electronic indirect trading: Trade executed over an electronic matching system. This could include trades conducted via multi-dealer platforms, ECNs operating on a CLOB or dark pools.

Electronic market-maker: Firm that provides prices on electronic trading (e-trading) venues and continuously submits limit orders to buy or to sell, thereby providing liquidity to those traders requiring immediacy via marketable orders. Some electronic market-makers also stream prices on a continuous basis either directly or via electronic platforms.

E-trading desk: Trading desk that generates continuous algorithmic price quotes for clients via different types of electronic trading venues and protocols.

Foreign exchange swap: Transaction involving the exchange of two currencies on a specific date at a rate agreed at the time of the contract's conclusion (the short leg), and a reverse exchange of the same two currencies at a date further in the future at a rate (generally different from the rate applied to the short leg) agreed at the contract's initiation (the long leg).

Forward contract or outright forward: Contract between two parties for the delayed delivery of financial instruments or commodities in which the buyer agrees to purchase and the seller agrees to deliver, at an agreed future date, a specified instrument or commodity at an agreed price or yield. Forward contracts are generally not traded on organised exchanges and their contractual terms are not standardised.

Forward rate agreement (FRA): Interest rate forward contract in which the rate to be paid or received on a specific obligation for a set period of time, beginning at some time in the future, is determined at contract initiation.

Government-sponsored enterprise (GSE): Term that can be applied to a number of entities and organisations but is usually used to refer to the two federal housing finance agencies in the United States: Fannie Mae (formerly the Federal National Mortgage Association) and Freddie Mac (formerly the Federal Home Loan Mortgage

Corporation). Previously private corporations with public charters, both agencies have been under US government conservatorship since September 2008.

Gross credit exposure: Gross market value minus amounts netted with the same counterparty across all risk categories under legally enforceable bilateral netting agreements. Gross credit exposure provides a measure of exposure to counterparty credit risk (before collateral).

Gross market value: Sum of the absolute values of all outstanding derivatives contracts with either positive or negative replacement values evaluated at market prices prevailing on the reporting date. The term “gross” indicates that contracts with positive and negative replacement values with the same counterparty are not netted. Nor are the sums of positive and negative contract values within a market risk category (such as foreign exchange, interest rates, equities and commodities) set off against one another. Gross market values provide information about the potential scale of market risk in derivatives transactions and of the associated financial risk transfer taking place. Furthermore, gross market values at current market prices provide a measure of economic significance that is readily comparable across markets and products.

Hedge fund: Unregulated investment fund and various types of money managers, including commodity trading advisers (CTAs), that share (a combination of) the following characteristics: often follow a relatively broad range of investment strategies that are not subject to borrowing and leverage restrictions (with many of them therefore using high levels of leverage); often have a different regulatory treatment from that of institutional investors and typically cater to high net worth individuals or institutions; often hold long and short positions in various markets, asset classes and instruments; and frequently use derivatives for position-taking purposes.

High-frequency trading (HFT): Algorithmic trading strategy that profits from incremental price movements with frequent, small trades executed in milliseconds for very short investment horizons. HFT is a subset of algorithmic trading.

Hot potato trading: The quick passing of currency inventory imbalances (due to an exogenous shift in the demand and supply of currencies) around the inter-dealer market.

Index CDS product: Multi-name CDS contract with constituent reference credits and a fixed coupon that is determined by an administrator such as Markit (which administers the CDX and iTraxx indices). Index products include tranches of CDS indices.

Institutional investor: Long-term investor such as a mutual fund, a pension fund, an insurance company, a reinsurance company or an endowment fund. Sometimes referred to as real money investors.

Interest rate option: Contract that gives the holder the right (without imposing the obligation) to pay or receive an agreed interest rate on a predetermined principal during a specified period.

Interest rate swap: Agreement to exchange periodic payments related to interest rates in a given currency. Such payments can be for fixed against floating rates or for floating against floating rates (based on different floating rate indices).

Internalisation: Process whereby a dealer seeks to match staggered offsetting client trading flows on its own books instead of immediately trading the associated inventory imbalance in the inter-dealer market.

Inter-office or Intragroup: Designates business between affiliates of the same corporate group.

Latency: Delay between the transmission of information from a source and the reception of the information at its destination. One specific example is the time that elapses between the placement of an order in an electronic trading system and the execution of that order. The delay can be affected by factors such as geographical distance or bandwidth congestion.

Latency-driven trading: Trading strategy that attempts to profit from latency differentials across traders or trading platforms.

Latency floor: Minimum latency applied to trades executed at a trading venue.

London interbank offered rate (Libor): Benchmark rate for short-term unsecured borrowing among banks. Used as the floating rate for interest rate swaps.

Liquidity aggregator: Technology that allows participants to simultaneously obtain streamed prices from several liquidity providers/pools. Computer algorithms allow customisation of the price streams for both the liquidity provider and the receiving counterparty.

Market-maker: Financial intermediary that stands ready to buy or sell assets by continuously quoting bid and ask prices that are accessible to other traders or registered participants of a trading platform.

Multi-bank trading platform: Electronic trading system that aggregates and distributes quotes from multiple FX dealers.

Multi-name CDS: CDS contract that references more than one name – for example, a portfolio or basket of CDS, or a CDS index.

Net market value: Similar to gross credit exposure, with the difference that netting is restricted to one type of derivative product instead of all product types. In the OTC derivatives statistics, net market values are reported for CDS only.

Non-deliverable forward: Contract for trading the difference between an agreed forward exchange rate and the spot rate at maturity, settled with a single payment for one counterparty's net profit.

Non-financial sector or customer: Sectoral classification that refers collectively to non-financial corporations, general government and households.

Notional amount outstanding: Gross nominal or notional value of all derivatives contracts concluded and still open on the reporting date.

Notional value: Value of assets underlying a derivatives contract at the spot price.

Novation: Process in which a bilateral derivatives contract is replaced by two new bilateral contracts between each of the market participants and a CCP.

Official sector financial institutions: Sectoral classification that refers collectively to central banks, sovereign wealth funds, international organisations, development banks and other public financial agencies.

Offshore trading: Trading of an instrument denominated in a given currency reported by sales desks outside the respective currency area. For instance, US dollar offshore trading is global trading of US dollar instruments minus turnover in US dollar instruments reported by sales desks in the United States. This implies that cross-border trades in which one of the counterparties is located in the respective currency area are excluded from the offshore definition of trading.

Onshore trading: Trading of an instrument denominated in a given currency, where at least one counterparty is residing in the respective currency area (ie local counterparty). Trades of local reporting dealers with cross-border counterparties (“onshore-offshore” trades) are included in onshore trading.

OTC (over-the-counter) market: Refers to bilateral trading between two counterparties which takes place outside an organised exchange.

Overnight index swap: Interest rate swap where the floating leg is tied to an overnight rate index, such as the overnight federal funds rate in the United States and the EONIA rate in the euro zone.

Pip: Currency quoting unit equal to 0.0001 for most currency pairs that are displayed to four decimal points. For currency pairs displayed to two decimal points, most notably the USD/JPY pair, a pip is equal to 0.01. Typical currency quoting precision is a fraction (one tenth) of a pip.

Portfolio compression: Service that allows for a reduction of gross notional amounts of OTC derivatives contracts while keeping economic exposures unchanged by bilaterally or multilaterally cancelling offsetting trades.

Prime broker: Institution (usually a large and highly rated bank) that facilitates trading for its clients (often institutional funds, hedge funds and other proprietary trading firms). Prime brokers enable their clients to conduct trades, subject to credit limits, with a group of predetermined third-party banks in the prime broker’s name.

Prime of prime: Situation in which a non-dealer bank has an account with an FX dealer prime broker and extends those prime brokerage services to other market participants, such as FX retail aggregators.

Principal model: A mode of trading whereby a dealer commits its balance sheet, thus using its own inventory to meet client orders and to make gains or losses from trades. A dealer will charge a bid-offer spread as compensation for the inventory risk it incurs.

Principal trading firm (PTF): A firm that invests, hedges or speculates for its own account. This category may include specialised high-frequency trading firms as well as electronic non-bank market-making firms. Sometimes referred to as proprietary trading firm.

Reporting dealer: Bank that is active as a market-maker (by offering to buy or sell contracts) and participates as a reporting institution in the Triennial Central Bank Survey.

Request for market (RFM): Request for a quote where the client does not reveal the direction of the desired trade (buy or sell). An RFM is a request to see a two-sided or “market” quote rather than a one-sided quote.

Request for quote (RFQ): Request for a price quotation from a trading platform member to another member. Systems for sending RFQs vary according to: whether the direction of the order (buy or sell) is revealed; how many participants and what kind of participants may receive a quote; and whether the quotes are executable or indicative.

Retail aggregator: Term used for online broker-dealers who stream quotes from the top FX dealers to retail customers (individuals and smaller institutions) and aggregate their trades.

Retail-driven transaction: Transaction with a financial institution that caters to retail investors, including electronic retail-focused trading platforms and margin brokerage

firms. Retail-driven transactions also include reporting dealers' direct transactions with "non-wholesale" investors (ie private individuals) executed online or by other means (eg phone).

Sales desk: Unit of a dealer bank responsible for taking client orders and other aspects of client service and relationship banking.

Trading desk: Unit of a dealer bank that is responsible for trade execution, once client orders have been received.

Single-bank trading platform: Proprietary electronic trading system operated by an FX dealer for the exclusive use of its customers.

Single-name CDS: Credit derivatives contract where the reference entity is a single name.

Spot transaction: Outright transaction involving the exchange of two currencies at a rate agreed on the date of the contract for value or delivery (cash settlement) in two business days or less.

Turnover: Number of transactions within a given time period.

Voice direct trading: Trade originated personally by phone, fax, e-mail or other messaging system.

Voice indirect trading: Trade agreed by a voice-based method but intermediated by a third party (voice broker).

Abbreviations

Currencies

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

Countries

AR	Argentina	LT	Lithuania
AU	Australia	LV	Latvia
BG	Bulgaria	MX	Mexico
BH	Bahrain	MY	Malaysia
BR	Brazil	NO	Norway
CA	Canada	NZ	New Zealand
CH	Switzerland	PE	Peru
CL	Chile	PH	Philippines
CN	China	PL	Poland
CO	Colombia	RO	Romania
CZ	Czech Republic	RU	Russia
DK	Denmark	SA	Saudi Arabia
EE	Estonia	SE	Sweden
GB	United Kingdom	SG	Singapore
HK	Hong Kong SAR	SK	Slovakia
HU	Hungary	TH	Thailand
ID	Indonesia	TR	Turkey
IL	Israel	TW	Chinese Taipei
IN	India	US	United States
JP	Japan	ZA	South Africa
KR	Korea		

Downsized FX markets: causes and implications¹

For the first time in 15 years, FX trading volumes contracted between two consecutive BIS Triennial Surveys. The decline in trading by leveraged institutions and “fast money” traders, and a reduction in risk appetite, have contributed to a significant drop in spot market activity. More active trading of FX derivatives, largely for hedging purposes, has provided a partial offset. Many FX dealer banks have become less willing to warehouse risk and have been re-evaluating their prime brokerage business. At the same time, new technologically driven non-bank players have gained firmer footing as market-makers and liquidity providers. Against this backdrop, FX trading is becoming increasingly relationship-driven, albeit in an electronic form. Such changes in the composition of market participants and their trading patterns may have significant implications for market functioning and FX market liquidity resilience going forward.

JEL classification: C42, C82, F31, G12, G15.

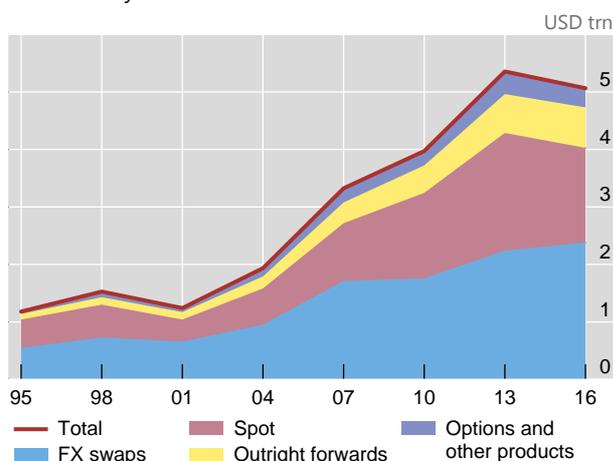
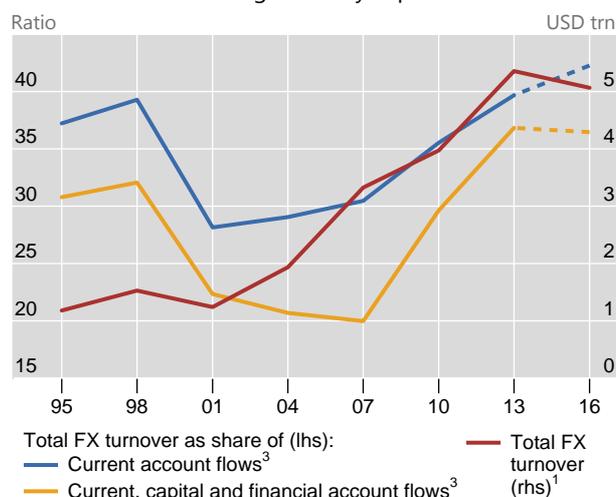
This article explores the evolution of trading volumes and structural shifts in the global foreign exchange (FX) market, drawing on the 2016 Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity (in short, “the Triennial”). Central banks and other authorities in 52 jurisdictions participated in the 2016 survey, collecting data from close to 1,300 banks and other dealers.

For the first time since 2001, global FX trading declined between two consecutive surveys. Global FX turnover fell to \$5.1 trillion per day in April 2016, from \$5.4 trillion in April 2013 (Graph 1, left-hand panel). In particular, spot trading fell to \$1.7 trillion per day in April 2016, from \$2.0 trillion in 2013. In contrast, trading in most FX derivatives, particularly FX swaps, continued to grow. In addition, a number of emerging market economy (EME) currencies gained market share, most notably the renminbi.²

Part of the decline in global FX activity can be ascribed to less need for currency trading, as global trade and capital flows have not returned to their pre-Great

¹ The authors thank Claudio Borio, Alain Chaboud, Benjamin Cohen, Dietrich Domanski, Robert McCauley, Hyun Song Shin, Christian Upper, Philip Wooldridge and Laurence Wright for useful comments and suggestions. We are grateful to Angelo Ranaldo for sharing data on FX market liquidity. We also greatly appreciate the feedback and insightful discussions with numerous market participants at major FX dealing banks, buy-side institutions, electronic market-makers, retail brokers and electronic trading platforms. We are also grateful to Denis Pêtre and Tsvetana Spasova for compiling the underlying data and Amy Wood and Ingomar Krohn for excellent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the BIS.

² See BIS (2016a) for the preliminary statistical release of the 2016 Triennial results, including details of FX turnover across currency pairs, instruments, counterparties and trading locations.

Turnover by instrument¹FX turnover relative to gross daily capital flows²

¹ Adjusted for local and cross-border inter-dealer double-counting, ie “net-net” basis; daily averages in April. ² Gross daily capital flows are estimated by dividing the annual sum of inflows and outflows by 365. ³ Current, capital and financial account flows for 2016 are estimated by extrapolating the average annual growth for 2014 and 2015.

Sources: IMF, *International Financial Statistics*; BIS Triennial Central Bank Survey; authors’ calculations.

Financial Crisis (GFC) growth rates (Graph 1, right-hand panel). However, conventional macroeconomic drivers alone cannot explain the evolution of FX volumes or their composition across counterparties or instruments. This is because fundamental trading needs only account for a fraction of transactions. Instead, the bulk of turnover reflects inventory risk management by reporting dealers, their clients’ trading strategies and the technology used to execute trades and manage risks.

This special feature examines these structural factors and changes in trading patterns underpinning global FX activity. Some major takeaways are as follows. The composition of participants changed in favour of more risk-averse players. The greater propensity to transact FX for hedging rather than risk-taking purposes by these investors has led to a decoupling of turnover in most FX derivatives from that in spot and options trading. Patterns of liquidity provision and risk-sharing in FX markets have also evolved. The number of dealer banks willing to warehouse risks has declined, while non-bank market-makers have gained a stronger footing as liquidity providers, even trading directly with end users. These shifts have been accompanied by complementary changes in trade execution methods. Market structure may be slowly shifting towards a more relationship-based form of trading, albeit in a variety of electronic forms.

The rest of the article is organised as follows. The first section focuses on the changing composition of FX market participants and its implications for the configuration of the main FX instruments. The second section discusses the changing patterns of liquidity provision, the growth of electronic non-bank market-makers and new forms of risk-sharing in wholesale FX markets. The third section looks at the associated changes in trade execution methods, which appear to be gravitating towards relationship-based electronic trading models. The conclusion highlights some implications for policy and financial stability.

The changing composition of FX markets

The past three years have seen large shifts in FX market activity, in terms of both participants and instruments (Table 1). Hedge funds, non-financial end users and smaller banks have reduced their market presence. In contrast, institutional investors have increased their participation, notably for hedging purposes. And certain algorithmic strategies primarily based on speed have reached a saturation point. These shifts have contributed to the decoupling of FX spot trading from activity in most FX derivatives.

Trends in FX market participation

Participation in FX markets has shifted towards less leveraged and more risk-averse participants. A first indication of such a shift is that trading involving institutional investors, such as insurance companies and pension funds, grew by a third between 2013 and 2016 (Table 1). These types of long-term investors tend to exhibit lower tolerance for foreign currency risk in their portfolios and use FX markets to hedge such risks. Indeed, their FX swap trading volume rose by approximately 80% to more than a quarter of a trillion US dollars per day in 2016.

Global FX market turnover in April 2016, by counterparty and instrument

Table 1

Net-net basis,¹ daily averages in April 2016

	Turnover in 2016	2013–16 change	2013–16 percentage change
	USD bn		
Global FX market	5,070	–290	–5
By counterparty			
Reporting dealers	2,120	50	2
Other financial institutions	2,560	–250	–9
Of which:			
Non-reporting banks	1,110	–160	–13
Institutional investors	800	190	32
Hedge funds and principal trading firms	390	–190	–32
Non-financial customers	380	–90	–19
By instrument			
Spot	1,650	–390	–19
Outright forwards	700	20	3
FX swaps	2,380	140	6
Currency options	250	–80	–24
Currency swaps	80	30	52

¹ Adjusted for local and cross-border double-counting. Turnover and absolute change rounded.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

Drivers of aggregate FX turnover

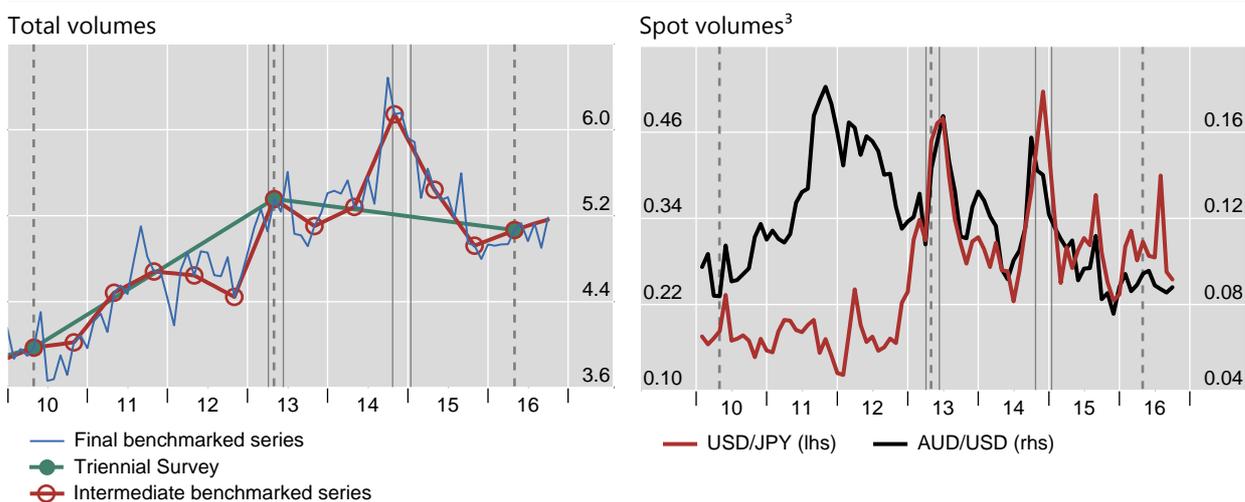
The macroeconomic backdrop has pointed to a moderation of the underlying demand for (spot) FX trading. Global trade (as a share of GDP) and global capital flows have fallen since 2013. Hence, global FX turnover has actually held up well relative to gross current, capital and financial account trading needs (Graph 1, right-hand panel). Trading with non-financial customers has dropped by about 20% (Table 1), another sign pointing to a decline in FX transactions associated with global trade.

The overall fall in turnover conceals important nuances about the evolution of FX turnover between the 2013 and 2016 Triennials. To see this, we follow Bech (2012) and Bech and Sobrun (2013) and compute measures of benchmarked FX volumes using a combination of sources, including the more frequent FX surveys conducted by regional foreign exchange committees, information from major electronic trading platforms and CLS settlement volumes. The higher-frequency perspective reveals an even more pronounced drop in trading activity. FX activity actually peaked in September 2014, at \$6.5 trillion per day (Graph A, left-hand panel). Volumes fell off steeply thereafter, to less than \$5 trillion per day in November 2015, before recovering somewhat by April 2016.

Evolution of benchmarked foreign exchange volumes at higher frequency¹

Net-net basis,² in trillions of US dollar equivalents

Graph A



The dashed vertical lines indicate the dates when Triennial Surveys were conducted; the solid vertical lines indicate key policy announcements in April 2013 (Bank of Japan quantitative easing), June 2013 (May/June US taper tantrum and news about WM/Reuters fix), October 2014 (Bank of Japan quantitative easing expansion) and January 2015 (removal of Swiss franc peg).

¹ Benchmarking series are calculated using the technique described in Bech (2012) and Bech and Sobrun (2013). The CLS data are seasonally adjusted before the benchmarking technique is applied; semiannual data refer to April and October observations. ² Adjusted for local and cross-border inter-dealer double-counting. ³ Based on breakdowns by currency pair from the foreign exchange committees in Australia, London, New York, Singapore and Tokyo.

Sources: Foreign exchange committee surveys; CLS; CME; EBS; Hotspot FX; Thomson Reuters; BIS Triennial Central Bank Survey; BIS calculations.

Several factors, some due to central bank policy measures, seem to have led to this pattern. The previous Triennial took place amid heightened FX activity against the background of policy easing by the Bank of Japan in April 2013 (Rime and Schimpf (2013)). FX trading then continued to rise until June 2013. This was the month when attention turned to the London 4 pm WM/Reuters fixing scandal. The same month coincided with the “taper tantrum”, when expectations mounted that the US Federal Reserve would begin tapering its asset purchases. Trading volumes rebounded again in the second half of 2014, against the background of further easing by the ECB, including the introduction of negative policy rates, and an expansion of the Quantitative and Qualitative Monetary Easing (QQE) programme by the Bank of Japan that October. Indeed, major policy innovations by the Bank of Japan appeared to trigger heightened trading activity in the JPY/USD currency pair and related crosses, such as AUD/USD (Graph A, right-hand panel). This, in turn, contributed to spikes in total global FX market activity.

Aggregate volumes were also driven by the interaction of several macroeconomic developments with the micro drivers discussed in the text. The outsize price moves in the wake of the Swiss National Bank's abandonment of the Swiss franc's peg against the euro on 15 January 2015 sent shockwaves through the prime brokerage industry, causing prime brokers to raise fees and cut clients. This has further reduced participation by hedge funds and other leveraged players in FX markets, as they have already been experiencing low returns. Some banks also cut their business exposures to retail margin brokerage, which affected market access for retail aggregators. High-frequency trading (HFT) firms were also faced with tighter FX market access from the decline in prime brokerage as well as from various measures to curb HFT activity which were put in place by major FX trading venues beginning in mid-2013. All these developments had a disproportionate impact on spot trading, because the above-mentioned market participants seek returns by taking open currency positions or, in the case of HFT, focus on the most liquid instruments.

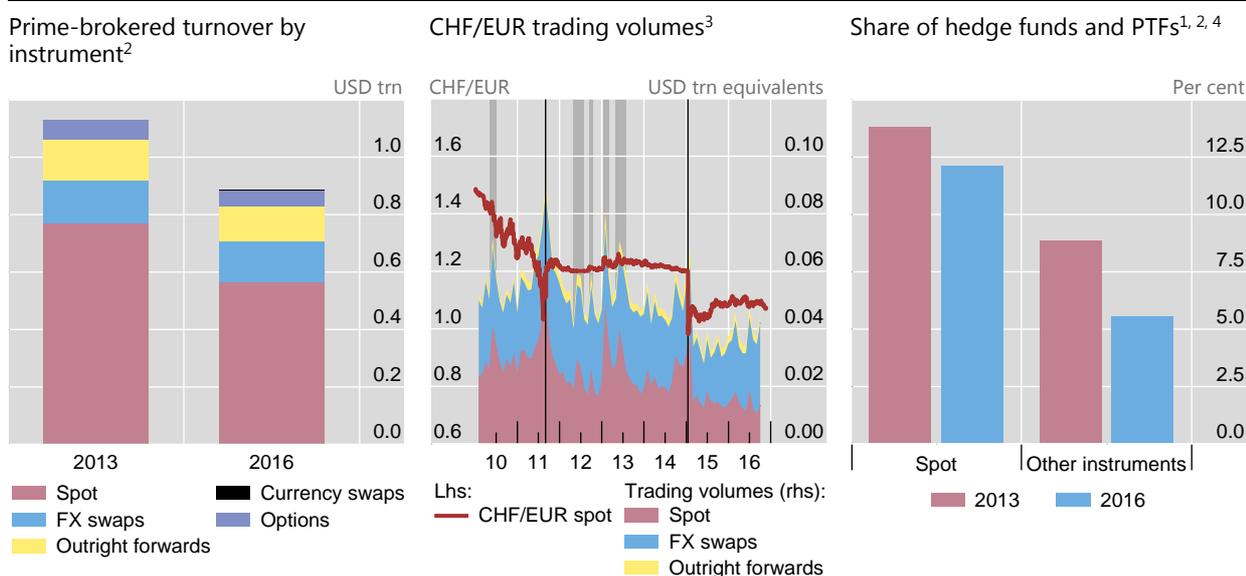
By contrast, trading in FX swaps rose because of the increase in currency hedging activity by long-term institutional investors, as they rebalanced their international portfolios on the back of central bank quantitative easing programmes. Similarly, FX liquidity management among dealer banks increased, as money market rates and lending spreads in major currencies diverged, which also contributed to the rise in FX swap turnover.

Second, and particularly striking, FX turnover via *prime brokers*³ fell sharply compared to 2013 – by 22% overall, and by close to 30% in spot markets (Graph 2, left-hand panel).

The drop in prime brokerage reflects a combination of factors. On the supply side, banks have been reassessing the profitability of their prime brokerage business

Prime brokerage volumes, the Swiss franc shock and trading by hedge funds and PTFs¹

Graph 2



The shaded areas in the centre panel indicate subperiods in May/June 2010 (SNB abandons earlier interventions) and in 2012 and 2013 (repeated interventions to defend the 1.20 exchange rate floor); the vertical lines indicate September 2011 and January 2015 (SNB decisions on the CHF/EUR rate).

¹ PTFs = principal trading firms. ² Adjusted for local and cross-border inter-dealer double-counting, ie "net-net" basis; daily averages in April. ³ Trading activity as reported by CLS, not seasonally adjusted. ⁴ As a percentage of turnover in particular FX instruments in April 2013 and April 2016.

Sources: CLS; Datastream; BIS Triennial Central Bank Survey; authors' calculations.

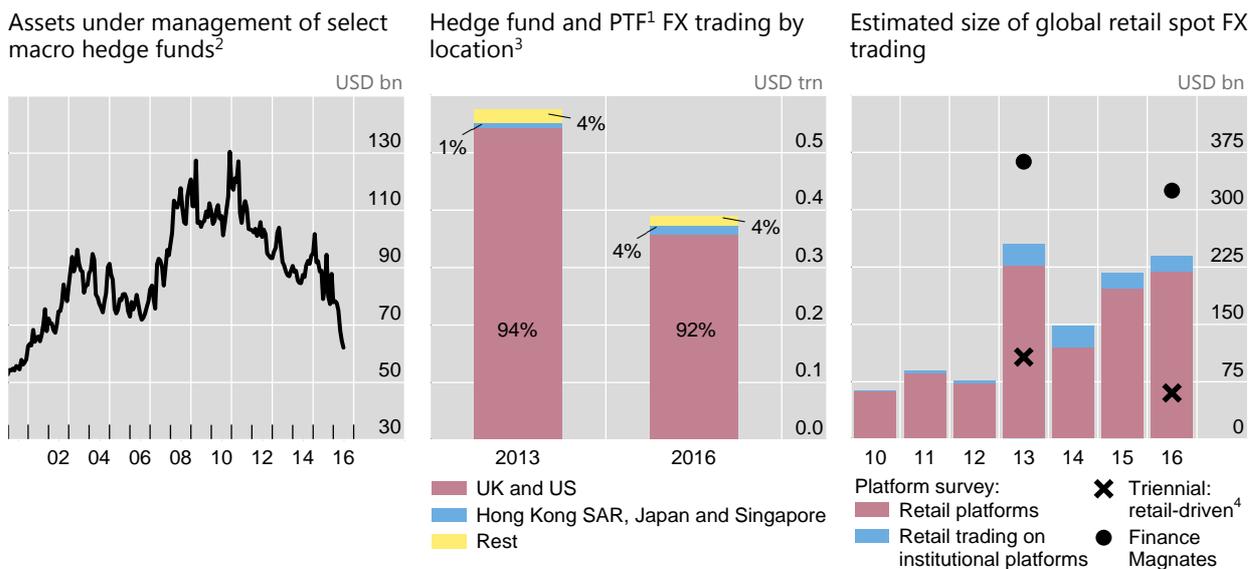
³ For definitions of technical terms, see the glossary in BIS (2016b).

in the wake of post-GFC regulatory reforms, low overall profitability and deleveraging pressures. A number of major prime brokers raised capital requirements, introduced tighter admission procedures and raised fees. In addition, the prime brokerage industry was jolted by the outsize price moves following the Swiss National Bank's decoupling of the Swiss franc from the euro on 15 January 2015 (Graph 2, centre panel), with FX dealer banks taking further steps to mitigate risks associated with FX prime brokerage. Interviews confirm that prime brokers have focused on retaining large-volume clients, such as large principal trading firms (PTFs) engaged in market-making (see below), while shedding retail aggregators, smaller hedge funds and some high-frequency trading (HFT) firms.

On the demand side, reduced trading by *hedge funds* and *PTFs* has been a key driver behind the drop in prime-brokered activity (Graph 2, right-hand panel). Hedge fund returns have been under pressure post-crisis, with assets under management falling further after the Swiss franc shock (Graph 3, left-hand panel).⁴ The fall in PTF activity, in turn, largely reflects the saturation of HFT strategies focused on aggressive fast trade execution and short-term arbitrage.⁵ The introduction of "speed bumps" in the form of latency floors by major inter-dealer platforms made such strategies less attractive (see below).

Hedge fund and PTF¹ trading activity, and retail FX trading

Graph 3



¹ PTF = principal trading firm. ² US dollar global macro hedge funds excluding those with a commodity and discretionary thematic focus. ³ Total FX trading adjusted for local and cross-border inter-dealer double-counting, ie "net-net" basis; share of FX trading adjusted for local inter-dealer double-counting, ie "net-gross" basis. ⁴ Adjusted for local and cross-border inter-dealer double-counting, ie "net-net" basis; daily averages in April.

Sources: Finance Magnates; Hedge Fund Research; Markets Committee survey of trading platforms, 2016; BIS Triennial Central Bank Survey; authors' calculations.

⁴ Global macro hedge funds have been faced with low FX volatility and an appreciation of typical carry trade funding currencies (that is, those with low interest rates), such as the Swiss franc and Japanese yen. At the same time, some traditional carry investments (high interest rate currencies such as the Australian dollar, as well as several EME currencies, such as the Mexican peso), have seen significant depreciation pressures.

⁵ See also Markets Committee (2011) for an analysis of HFT trading in FX markets and Markets Committee (2016) for a discussion of algorithmic trading in fixed income markets.

While declining in the aggregate, hedge fund and PTF activity has also been increasingly shifting towards Asian financial centres, albeit from a very small base (Graph 3, centre panel). Specifically, FX trading by hedge funds and PTFs in London and New York dropped by 50% and 10%, respectively, but rose by 88% in Hong Kong SAR, more than doubled in Singapore and tripled in Tokyo. Combined, Asian financial centres now account for 4% of trading by hedge funds and PTFs, compared with 1% in 2013. In part, this shift reflects the increased liquidity of Asian currencies, inducing PTFs to co-locate closer to the corresponding trading venues.

The *retail brokerage* segment was particularly affected by bouts of extreme volatility because retail traders are typically offered very high leverage against small initial margin requirements. Retail margin brokers were thus particularly exposed to losses stemming from the volatility that followed the removal of the Swiss franc's peg to the euro. As a result, some major FX dealing banks scaled down their business exposure to retail brokerage platforms. This, in turn, led retail aggregators to increasingly seek access to FX trading venues via a "prime-of-prime" relationship, whereby they are prime-brokered by a non-dealer bank, which is itself prime-brokered by an FX dealing bank. This migration of retail FX trading to venues at arm's length from FX dealer banks has contributed to the decline in spot trading classified as retail-driven in the Triennial (Graph 3, right-hand panel).

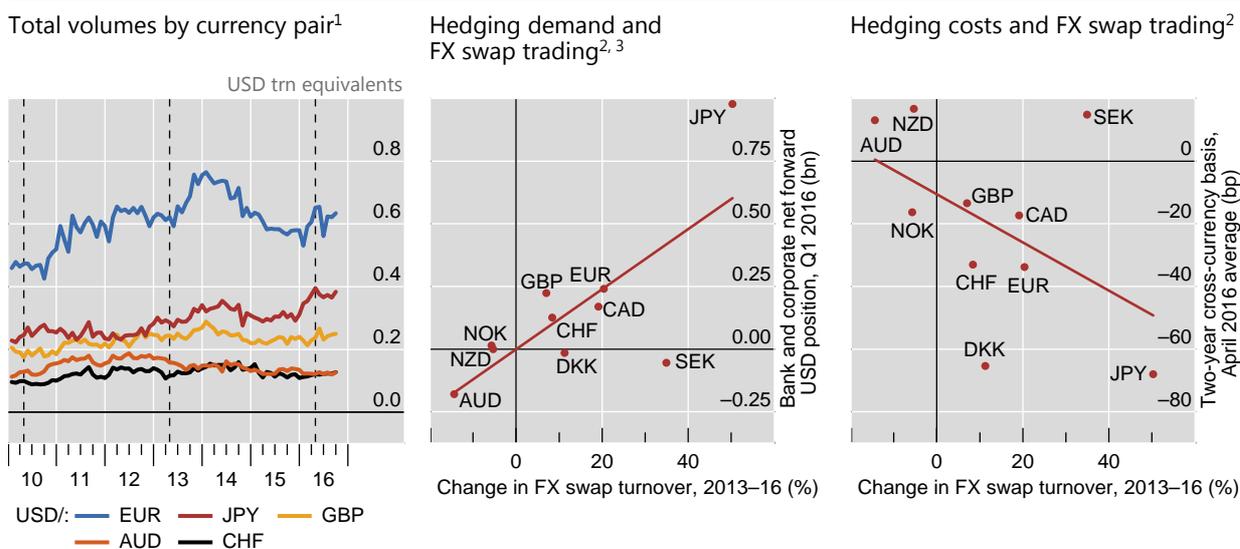
Implications for FX market activity across instruments

The decline in leverage and risk aversion also affected activity across FX instruments. On the one hand, the decline in FX trading by leveraged players and "fast money" traders, such as hedge funds and certain types of PTFs, contributed to a disproportionate fall in turnover in spot and FX options (Table 1). Their trading strategies often generate returns by taking directional exposures to currency movements using spot and options contracts. Similarly, HFT strategies tend to focus on spot trades because of the standardisation and liquidity of the instruments.

On the other hand, trading in derivatives used for FX funding by banks and for hedging by institutional investors and corporates actually increased. Most notably, turnover in FX swaps, the most actively traded instrument, rose by a further 6% (Table 1). Trading in (longer-dated) currency swaps also saw a significant pickup, albeit from a relatively low base (see also Box B for a description of similar shifts in renminbi trading).

FX swap trading rose more in jurisdictions where measures of the underlying FX hedging needs of banks and corporates were the largest (Graph 4, centre panel). Major currency areas that eased monetary policy further in 2015 and 2016, such as the euro area and Japan, experienced a particularly steep rise in FX swap turnover against the US dollar (Graph 4, left-hand panel). This is consistent with rising demand for FX swaps as investors seek returns in higher-yielding currencies, and borrowers seek funding in lower-yielding currencies. Similarly, the turnover in FX swaps shows close association with currency risk hedging costs, as proxied by the cross-currency basis (Graph 4, right-hand panel), pointing again to the demand push for FX swaps from currency hedgers.⁶

⁶ See Borio et al (2016) for an analysis of FX hedging demand and the cross-currency basis anomaly.



The dashed vertical lines in the left-hand panel indicate the dates when Triennial Surveys were conducted.

¹ Benchmarked series are calculated using the technique described in Bech (2012) and Bech and Sobrun (2013). The CLS data are seasonally adjusted before the benchmarking technique is applied; semiannual data refer to April and October observations. ² Adjusted for local and cross-border inter-dealer double-counting, ie “net-net” basis. ³ Bank hedging of US dollar assets via FX swaps estimated as the difference between gross consolidated US dollar assets and liabilities of BIS reporting banks in each currency jurisdiction; corporate hedging demand proxied by outstanding debt securities liabilities denominated in the respective currencies issued by non-financial corporates headquartered in the US (reverse yankee bonds).

Sources: Borio et al (2016); foreign exchange committee surveys; Bloomberg; CLS; EBS; Thomson Reuters; BIS debt securities statistics, international banking statistics and Triennial Central Bank Survey; BIS calculations.

New mechanisms of liquidity provision

Dealer banks have been adjusting their business models to their reduced capacity to warehouse risk and tighter limits on proprietary trading. In the process, a handful of top-tier dealer banks have consolidated their position as liquidity providers, attracting further customer flows, including from other banks. At the same time, these top FX dealer banks have also faced increasing competition from non-bank electronic market-makers. The composition of the latter has shifted away from those pursuing more aggressive latency-driven trading strategies to more passive strategies based on market-making. As a result, these firms have expanded their business to become top liquidity providers in FX markets.

Bifurcation of banks’ role in FX market-making

Among dealer banks, there has been further bifurcation between the few large banks that remain willing to take risks onto their balance sheets as principals and other institutions that have moved to an agency model. The top-tier dealer banks that intermediate the lion’s share of customer flows have maintained their position as large flow internalisers (Box C), price-makers and liquidity providers. By contrast, many other banks are increasingly acting simply as conduits, effectively sourcing liquidity from the largest dealers and passing it on to their clients. Thus, the warehousing of inventory risk falls onto the top-tier FX dealers.

The rise and financialisation of the renminbi

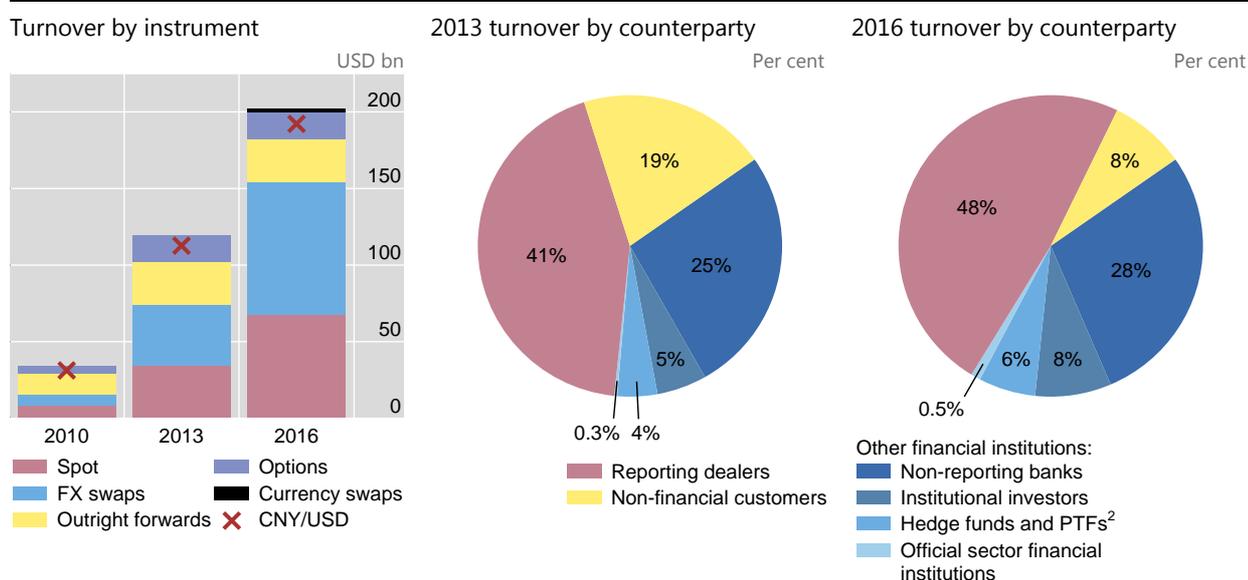
Renminbi turnover has approximately doubled every three years over the past decade and a half (Graph B, left-hand panel). Total daily turnover has reached over \$200 billion or 4% of global FX turnover. This makes the Chinese currency the eighth most traded currency in the world, overtaking the Mexican peso and only slightly behind the Swiss franc and Canadian dollar.

Along with the rise in the overall trading of the renminbi, its use as a financial instrument and to back financial rather than trade transactions has also increased. In the past, most of the limited turnover was in spot transactions. The Triennial reveals that spot now amounts to less than half of total turnover, while the share of FX swap trading has reached 40%. Associated with this, trading among financial institutions is now much more prevalent, while the share of renminbi trading with non-financial customers has declined steeply, from 19% in 2013 to 8% in 2016 (Graph B, centre and right-hand panels). However, the prominent role of the CNY/USD pair has not changed: 95% of renminbi trading is against the US dollar, and there is no serious liquidity in any other CNY pairs.

The rise of the renminbi comes with greater financialisation

Net-net basis,¹ daily averages in April

Graph B



¹ Adjusted for local and cross-border inter-dealer double-counting. ² PTFs = principal trading firms.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

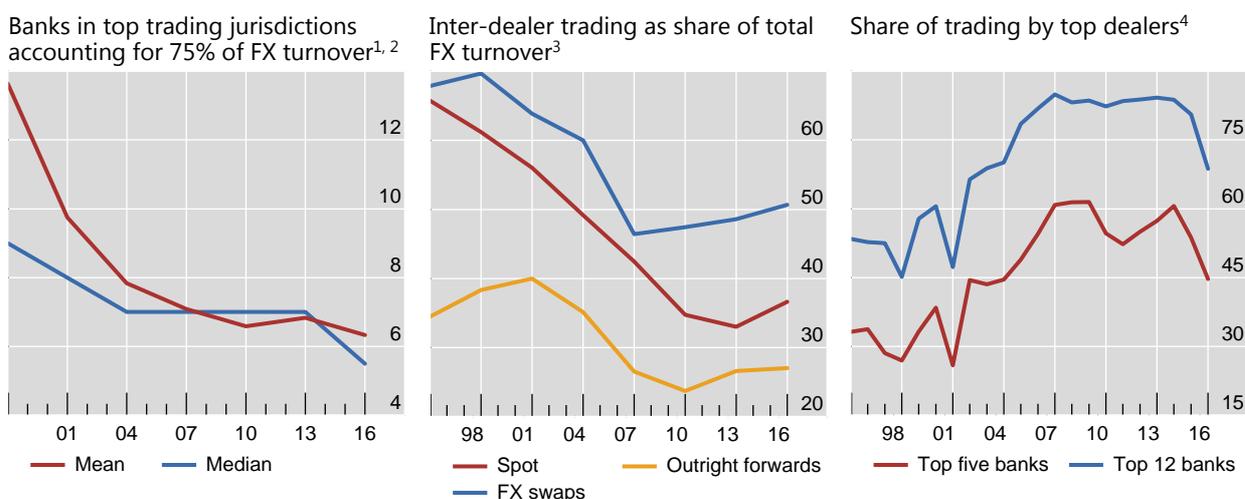
Renminbi trading volumes are growing rapidly, and the currency is becoming more financialised. The share of derivative compared with spot trading, and of financial compared with non-financial counterparties, are approaching that of well established and liquid currencies. Also, according to McCauley and Shu (2016), in line with RMB internationalisation, trading in offshore deliverable RMB forwards increased significantly, while that in non-deliverable forwards declined since the last survey. However, there are still impediments to the renminbi becoming a truly international currency. In addition to the low liquidity outside the CNY/USD pair, these include capital controls, the wedge between the offshore and onshore exchange rates, and ineligibility for CLS settlement. At the same time, the rapid growth of renminbi trading and the development of the associated financial markets (Ehlers et al (2016)) suggest that these hurdles may be cleared faster than might be expected.

Recent survey data underline this increasing bifurcation. On the one hand, the number of banks accounting for 75% of FX turnover has declined further since the last Triennial (Graph 5, left-hand panel). On the other hand, the share of inter-dealer trading has picked up for the first time since the 1995 survey (Table 1 and Graph 5,

Bank dealers under pressure

In per cent

Graph 5



¹ Australia, Brazil, Denmark, France, Germany, Hong Kong SAR, Japan, Singapore, Sweden, Switzerland, the United Kingdom and the United States. ² Spot, outright forwards and FX swaps. ³ Adjusted for local and cross-border inter-dealer double-counting, ie “net-net” basis; daily averages in April. ⁴ Based on Euromoney rankings.

Sources: Euromoney Foreign Exchange Survey 2016; BIS Triennial Central Bank Survey; authors’ calculations.

centre panel). Taken together, these developments indicate that liquidity flows from a handful of top-tier FX dealer banks to the other banks.

This type of inter-dealer trading between core and periphery is very different from the classic “hot potato” trading of inventory imbalances, which used to be the main driver of trading growth among dealers. The hot potato trading of FX inventory imbalances, as described by Lyons (1997), Evans and Lyons (2002) and Killeen et al (2006), refers to dealer banks trading anonymously with each other via inter-dealer brokers (see below). Nowadays, major FX dealers can stream prices on secondary venues or respond to requests for quote from other banks.

Electronic non-bank market-makers emerge as liquidity providers

New technologies have enabled non-bank market participants to gain ground as market-makers and liquidity providers. While previously focused on HFT strategies, these *electronic non-bank market-makers* are becoming some of the largest liquidity providers on primary trading venues and have been making inroads in direct e-trading with customers.⁷ When non-banks appeared in the *Euromoney* magazine rankings for the first time this year, their share was already 6% of the market-maker segment. And, given that most non-bank market-makers do not disclose their trading volumes, their actual market share is probably higher. In contrast, the share of top dealer banks in total FX trading with clients fell sharply (Graph 5, right-hand panel).

⁷ The diverse set of non-bank electronic market-makers includes XTX Markets, Virtu Financial, Citadel Securities, GTS and Jump Trading. These market-makers’ trading volume is captured in the Triennial because their trades are prime-brokered by a dealer bank. They are active on multilateral trading platforms, where they provide prices to banks’ e-trading desks, retail aggregators, hedge funds and institutional clients. According to market sources, the typical daily volume per individual firm is estimated to be in the vicinity of \$10 billion – and up to \$40 billion for the very top firms – with the highest concentration in spot trading.

How large are FX dealers' trade internalisation ratios?

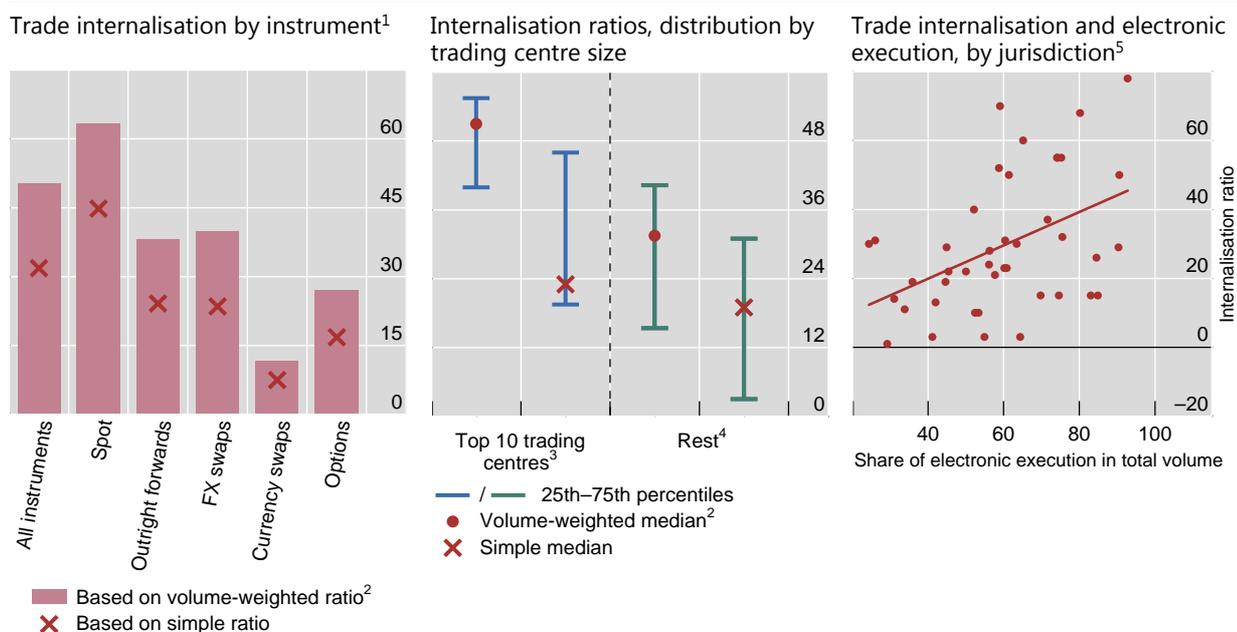
Internalisation refers to the process whereby dealers seek to match staggered offsetting client flows on their own books instead of immediately hedging them in the inter-dealer market.^① Until now, solid data on this phenomenon have been scarce. Analysis has often relied on soft information obtained via market contacts. The 2016 Triennial aimed to address this information gap with a supplementary question on trade internalisation.

The bifurcation of liquidity provision described in the main text has meant that only a small number of bank dealers have retained a strong position as flow internalisers. This small set of global banks has increasingly faced competition from sophisticated technology-driven non-bank liquidity providers, some of which have also morphed into internalisers. As these large internalisers effectively become deep liquidity pools, their need to manage inventory via hot potato trading has fallen, contributing to a decline in turnover on venues such as EBS and Reuters. The declining share of inter-dealer trading observed between 1995 and 2013 (Graph 5, centre panel) has also been partly ascribed to a rise in trade internalisation. Yet while internalisation is known to have had a strong imprint on market structure, there have hardly been any numerical data on this crucial market phenomenon.

Trade internalisation across market segments and financial centres

In per cent

Graph C



¹ Internalised volume for each instrument calculated as a product of average turnover volume in each instrument in April 2016 (on net-gross basis) in each jurisdiction and the corresponding internalisation ratio. For each instrument, aggregate internalisation ratio by instrument calculated as the sum of internalised turnover volume across reporting jurisdictions divided by the sum of total turnover volume across reporting jurisdictions. ² Weighted by each reporting dealer's trading volumes, excluding zeros and non-reporting. ³ Australia, Denmark, France, Germany, Hong Kong SAR, Japan, Singapore, Switzerland, the United Kingdom and the United States. ⁴ Remaining 40 jurisdictions that supplied internalisation ratios. ⁵ Jurisdictions with at least one of the ratios equal to zero have been excluded.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

It is not surprising that, according to the Triennial, internalisation ratios are highest for spot, at 63% (Graph C, left-hand panel). Spot trading is the most standardised instrument and the segment of the foreign exchange market with the deepest penetration of electronic trading. However, these aggregate figures mask a high degree of heterogeneity across banks and jurisdictions. Internalisers with a large e-FX business can have much larger internalisation ratios (even above 90% in some major currency pairs). The extent to which the ability to internalise is a

feature of large dealing banks can be gleaned by the much lower internalisation ratios when these are not weighted by reporting banks' trading volumes (left-hand and centre panels). While internalisation is most significant for spot, other important FX instruments also feature fairly high internalisation ratios (approximately 40% for both outright forwards and FX swaps).

A locational breakdown suggests that internalisation ratios overall tend to be higher for larger FX trading centres (Graph C, centre panel). A large and diverse set of clients is key to a successful business model based on internalisation, and such a client base is most easily served via a major FX trading hub. From a risk management perspective, a business model based on internalisation is easier to operate when the bank's e-trading desk attracts a large client flow. Therefore, as one might expect, a cross-jurisdictional comparison shows that the internalisation ratio of FX dealers is positively correlated with the proliferation of e-trading (right-hand panel).

① Bank and non-bank liquidity providers running an internalisation model benefit from access to large volumes of order flow originating from a diverse set of clients. Rather than immediately offloading inventory risk accumulated from a customer trade via the inter-dealer market, flow internalisers may hold open inventory positions for a short time (often not more than a few minutes) before matching against the flow of another customer. By internalising trades this way, they can benefit from the bid-ask spread without taking much risk, as offsetting customer flows come in almost continuously.

Non-bank electronic market-makers are a very diverse group. Some have a comparative advantage in internalising large volumes because of their presence across different markets. Such firms use algorithmic strategies to hedge their FX exposures with positions in other asset classes, such as futures. Others utilise sophisticated algorithmic strategies, mostly aimed at earning bid-ask spreads with minimal inventory risk. By pooling liquidity across clients and trading venues, the largest non-bank electronic market-makers can quote very tight bid-ask spreads in wholesale markets and even to end users. Non-bank liquidity providers have thus made a dent in what was traditionally the realm of dealer banks.

Shift towards relationship-driven electronic trading

Changes in the composition of market participants, liquidity provision and risk-sharing in FX markets have gone hand in hand with changes in trade execution methods. The 2016 Triennial results suggest that the structure of FX markets may be slowly moving from anonymous trading towards a more relationship-based form of activity. The traditional over-the-counter (OTC) structure of the FX market has been fairly robust, albeit in a more sophisticated electronic form. Within the electronic trading landscape, there has been a notable shift from indirect electronic execution via multilateral trading platforms⁸ to direct (or bilateral) trading between a dealer and a counterparty (Graph 6, left-hand panel).⁹

⁸ One example is platforms such as Reuters Matching and EBS with centralised limit order books as the main trading protocol. Non-banks can also access these platforms via prime brokerage relationships. Another example are multi-dealer electronic communication networks (ECNs), allowing customers to trade directly with a range of dealers, using a suite of trading protocols, such as price streams from individual dealers or requests for quotes.

⁹ The continued resilience in voice trading even in spot markets suggests that market participants at times prefer to avoid primary electronic venues due to concerns about price impact and information leakage. Another way to minimise price impact when executing block trades and to avoid certain counterparties (eg HFT firms) is trading through dark pools – a category first introduced with the 2016 Triennial. Yet these accounted for a relatively minor part of FX activity in April 2016, with only some 2% of all electronic trades in 2016 being executed via dark pools.

Electronic relationship trading thrives

Dealer banks appear to have focused more on retaining a relationship-driven market structure, where bilateral OTC transactions dominate. Bilateral trading takes place primarily via proprietary *single-bank trading platforms* operated by FX dealing banks, or electronic price streams via application programming interface (API) connectivity.¹⁰ Clients, such as smaller regional banks, can obtain liquidity from global FX dealer banks and non-banks by directly receiving quotes via an API price stream.

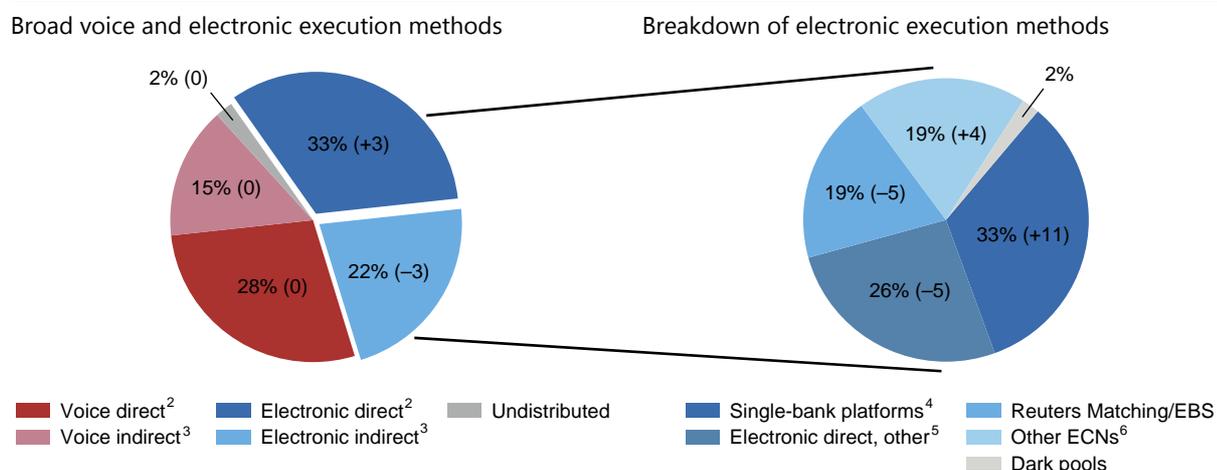
The strong rise in direct electronic trading is thus mostly due to a 6% rise in the share of total FX trading via single-bank platforms (Graph 6, right-hand panel and Table 2). This reflects active competition by major FX dealer banks to attract buy-side customers to their platform. For example, the platforms of top dealer banks have been enhancing services such as cross-asset trading and pre- and post-trade analysis.

Major banks' investments in their single-dealer platforms support their position as liquidity providers and large trade flow internalisers (Box C). When providing liquidity to their customers via proprietary trading platforms or direct API streams, banks are often able to quote narrower spreads compared with those on anonymous primary electronic venues, such as EBS and Reuters, because of the lower risk for them of trading against a more informed counterparty.¹¹ Moreover, banks are able to offer multiple price streams to different types of clients.¹² This form of price discrimination

Market structure gravitates to electronic relationship-driven OTC model

Net-net basis,¹ daily averages in April; percentage shares in turnover, change in percentage shares since 2013 in parentheses

Graph 6



¹ Adjusted for local and cross-border inter-dealer double-counting. ² Refers to trades not matched via a third party. ³ Refers to deals matched via a third party – either a voice broker or an electronic matching platform. ⁴ Single-bank trading systems operated by a single dealer. ⁵ Other electronic direct execution methods, eg direct electronic price streams. ⁶ Electronic communication networks.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

¹⁰ Examples are Citi Velocity, JPMorgan's Morgan Markets, UBS Neo and Deutsche Bank's Autobahn.

¹¹ Dunne et al (2015) shows similar inversion for trading in sovereign bond markets.

¹² Price streams with "last look" tend to have the narrowest spreads, because they give the liquidity provider (under certain circumstances) the ability to reject an order even when it matches their price quote.

Execution method by instrument in 2016, percentage shares

Table 2

Net-net basis,¹ daily averages in April 2016

	Voice			Electronic								Un-distributed
	Direct ²	Indirect ³	Total	Direct ²			Indirect ³				Total	
				Single-bank platforms ⁴	Other ⁵	Total	Reuters/EBS	Other ECNs ⁶	Dark pools	Total		
Spot	25 (0)	9 (-1)	33 (-1)	25 (11)	18 (-6)	43 (5)	13 (-3)	9 (1)	1	23 (-4)	65 (1)	1 (0)
Outright forwards	37 (5)	9 (-5)	45 (0)	16 (3)	17 (-2)	32 (1)	5 (0)	14 (3)	1	20 (-1)	52 (0)	2 (-1)
FX swaps	25 (-1)	20 (0)	45 (-1)	16 (3)	13 (1)	29 (5)	12 (-4)	11 (3)	1	24 (-4)	53 (1)	3 (0)
Currency swaps	35 (2)	22 (6)	57 (8)	4 (-3)	16 (-2)	21 (-4)	3 (-2)	14 (6)	0	18 (-2)	38 (-6)	5 (-2)
Options	48 (5)	24 (6)	73 (11)	10 (4)	6 (-9)	16 (-6)	4 (-1)	6 (-3)	0	10 (-5)	26 (-10)	2 (-1)
Total	28 (0)	15 (0)	43 (1)	18 (6)	15 (-3)	33 (3)	11 (-3)	11 (2)	1	22 (-3)	55 (0)	2 (0)

Percentage shares of total FX volumes for each counterparty segment; totals do not sum to 100 due to incomplete reporting; values in parentheses report the change in percentage share since the 2013 survey; in percentage points.

¹ Adjusted for local and cross-border inter-dealer double-counting. ² Refers to trades not matched via a third party. ³ Refers to deals matched via a third party – either a voice broker or an electronic broker. ⁴ Single-bank trading systems operated by a single dealer. ⁵ Other electronic direct, eg direct electronic price streams. ⁶ Electronic communication networks.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

allows them to extract higher rents from market-making and remain profitable as intermediaries.

In addition, FX volumes have also migrated to other *electronic communication networks* (ECNs), where dealers can stream prices or respond directly to clients using a request-for-quote (RFQ) protocol.¹³ Hence, other ECNs, which include multi-bank electronic trading platforms like Currenex, Hotspot and FXall, have seen their share edge up (Graph 6, right-hand panel, and Table 2). Such secondary multilateral trading venues are geared towards matching dealers and end clients, rather than engaging in inter-dealer hot potato trading, and allow certain aspects of relationship trading to be retained. Hence, their rise also goes hand in hand with the bifurcation of dealers' FX business models and the increase in trading with institutional investors.

Shift away from traditional anonymous trading venues

As the relationship-driven model of FX trading has thrived, trading on primary electronic venues has fallen. This is especially the case for platforms which rely on *centralised limit order books* (CLOBs) as their primary trading protocol, such as EBS and Reuters Matching (Table 2). As discussed above, traditional anonymous inter-dealer hot potato trading has been largely replaced by the flow of liquidity from the

¹³ In response to the success of the electronic relationship-driven model of FX trading, platforms such as EBS have introduced new facilities to allow direct e-trading. Such facilities give participants alternatives to the traditional CLOB trading protocol. Driven by similar considerations, Thomson Reuters acquired FXall, a multi-bank trading platform based on the RFQ trading protocol.

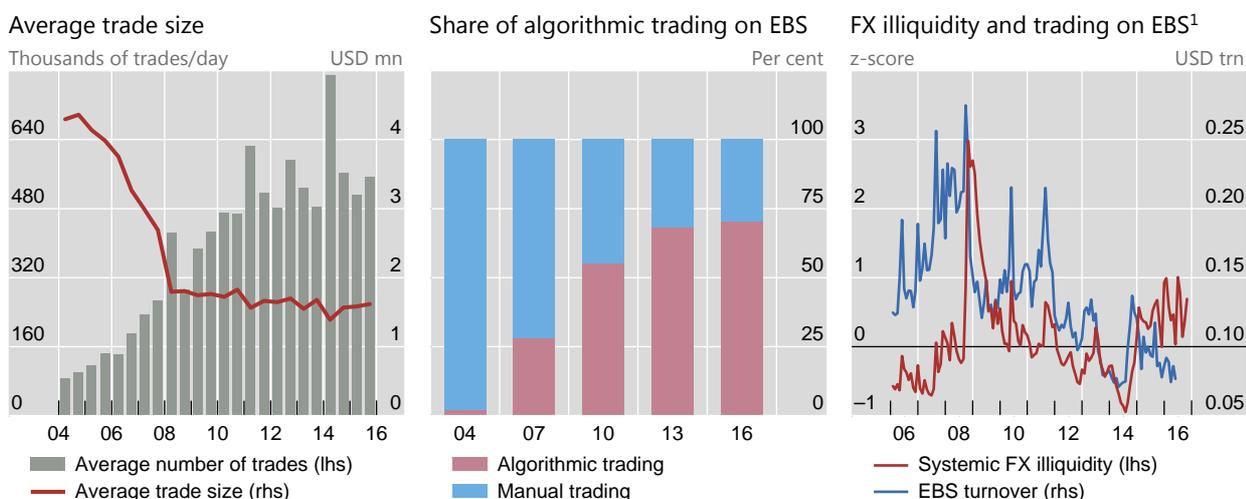
top dealer banks and non-bank market-makers to smaller dealer banks on ECNs that do not use CLOBs as a trading protocol.

Another factor which contributed to the decline of trading on primary electronic venues is the levelling-off of HFT, as EBS and other platforms have introduced “speed bumps” in the form of latency floors.¹⁴ In addition, as discussed above, bank prime brokerage for HFT firms has declined. Indeed, average trade size on institutional trading platforms has been relatively stable in recent years, indicating that automated trading has levelled off (Graph 7, left-hand panel). Data provided by EBS also point to a stagnation of automated trading over the past three years (Graph 7, centre panel). As noted above, a major exception is electronic market-makers; while CLOBs used to be their home turf, they have now also made inroads into direct electronic trading.

Nevertheless, traditional inter-dealer electronic trading venues continue to be vital to FX market functioning. First, electronic venues such as EBS and Reuters Matching play a key role in price discovery. According to market sources, EBS and Reuters Matching have remained the primary reference sources for benchmark pricing of major currency pairs. Second, multilateral trading platforms provide a crucial backstop when FX market conditions worsen. Specifically, FX trading volumes fall back onto CLOBs when volatility spikes or market liquidity deteriorates, as can be gleaned from the rise in trading on EBS when FX markets become less liquid (Graph 7, right-hand panel). This is because while dealers can internalise large FX flows and

Trade sizes, algorithmic trading and trading on primary inter-dealer venues

Graph 7



¹ The systematic (market) FX illiquidity measure is from Karnaukh et al (2015) and is a standardised indicator based on a composite measure of relative bid-ask spreads and bid-ask spreads adjusted for the currency variance, covering 30 currency pairs.

Sources: Karnaukh et al (2015); New York Foreign Exchange Committee; CLS; EBS.

¹⁴ In an attempt to insulate themselves from HFT, several large dealer banks were behind the April 2013 launch of the trading platform ParFX, which applied randomised pauses (measured in milliseconds), known as latency floors, to orders executed on the platform. EBS followed by introducing a latency floor on the AUD/USD pair in August 2013, and then extended it to a number of other currencies in the following months. Similarly, Reuters Matching introduced latency floors in 2014. However, it is also important to note that, in addition to these “speed bumps”, trading platform providers have also been adjusting other parameters, including the granularity of pricing (measured in fractions of a pip) and minimum quote life.

quote narrow spreads to their customers in good times, their need to hedge inventory risk on an anonymous basis in the inter-dealer market rises sharply in stress episodes.

Conclusion

This article explores the main drivers behind the fall in global FX volumes since the last Triennial Survey in 2013, discussing a number of structural changes in the market ecosystem as well as implications for market functioning.

The fall in global trade and gross capital flows in recent years partly explains why FX spot activity has fallen. Diverging monetary policies in major currency areas and the rise of long-term investors in FX markets have also played an important role. These factors have led to a rise in the volume of trading for hedging and liquidity management rather than for taking currency risk. The two main FX instruments, spot and FX swaps, have thus been pulled in different directions. Changes in FX market structures have also played an important role. The decline in prime brokerage has been associated with a fall in trading by hedge funds and principal trading firms, with spot market volumes contracting as a consequence.

In wholesale FX trading, a more pronounced bifurcation of liquidity provision can be observed among dealers. While some banks have successfully built a business model around client flow internalisation and warehousing risk, others merely act as a conduit by operating an agency model. In this environment, the electronic relationship-driven OTC model has thrived, whereas volumes on primary wholesale electronic trading venues have declined. In addition, bank dealers have been facing increased competition from electronic market-makers. Some of these technologically driven players have also emerged as flow internalisers, but the majority of non-bank market-makers often do not bring much risk absorption capacity to the market.

Such changes in the composition of market participants and their trading patterns may have implications for market functioning. While relationship-driven, direct dealer-customer trading on heterogeneous electronic trading venues delivers lower spreads in stable market conditions, its resilience to stress may be tested going forward. For example, non-bank market-makers may have higher exposure to correlation risk across asset classes. There are also indications of rising instances of volatility outburst and flash events. Tentative evidence suggests that market participants rush to traditional anonymous multilateral trading venues when market conditions deteriorate. Hence, the risk-sharing efficacy of the evolving FX market configuration is still uncertain. Any major changes to liquidity conditions might have consequences for market risk and the effectiveness of the hedging strategies of corporates, asset managers and other foreign exchange end users.

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The changing shape of interest rate derivatives markets¹

We analyse recent developments in over-the-counter (OTC) interest rate derivatives markets using the results of the 2016 BIS Triennial Central Bank Survey. Overall, turnover in both OTC and exchange-traded markets has expanded moderately since 2013. The average daily turnover of US dollar-denominated instruments has nearly doubled, driven by contracts with short maturities. Turnover of euro-denominated instruments has halved. We argue that monetary policy has been an important factor behind these changes. Despite a tightening of US monetary policy, activity in long-maturity US dollar contracts has remained subdued, which we attribute to reduced hedging demand from government-sponsored enterprises. Regulatory reforms have continued to influence market structure. To date, OTC markets have not lost market share to exchanges. In fact, regulatory changes are making OTC markets more similar to exchanges.

JEL classification: E43, G15, G18, G21, G23.

Interest rate derivatives markets have undergone significant structural shifts over the last three years. Between April 2013 and April 2016, while average daily turnover increased moderately, the currency composition of activity saw the most pronounced change since the inception of the BIS Triennial Central Bank Survey in 1995 (Graph 1). Turnover measured in notional amounts nearly doubled for US dollar-denominated interest rate derivatives, while it halved for euro-denominated contracts.

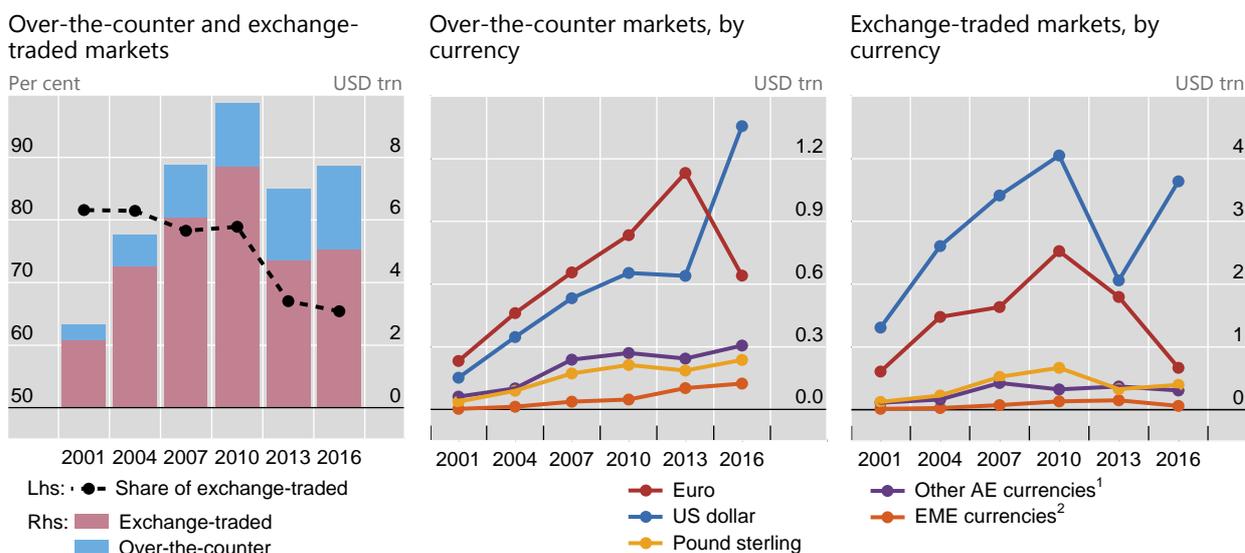
The relative sizes of over-the-counter (OTC) and exchange-traded derivatives markets also changed. Turnover in exchange-traded markets remained higher than in OTC markets, but OTC markets continued to grow faster. Average daily turnover in OTC markets increased by 16% over the last three years, to \$2.7 trillion in April 2016. Most OTC interest rate derivatives activity consisted of swaps and forward rate agreements (FRAs). In exchange-traded markets, where futures and options are the most actively traded instruments, turnover increased at a slower rate, by 7.8% to \$5.1 trillion. As a result, the share of exchange-traded interest rate derivatives in total turnover has fallen slightly, from 67% to 65.5% (Graph 1, left-hand panel).

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, Ben Cohen, Frank Packer, Hyun Song Shin, Laurence White and Philip Wooldridge for their valuable comments as well as Charles Himmelberg, Tomasz Jakubczyk and Oliver Schmidt for insightful discussions. We are grateful to Jeff Slee for his excellent research assistance and Denis Pêtre and Tsvetana Spasova for guidance on the use of the Triennial Survey data. See the glossary (BIS (2016c)) for definitions of relevant technical terms.

Turnover and currency composition in interest rate derivatives markets

Notional amounts, daily averages in April

Graph 1



¹ Other advanced economy (AE) currencies: AUD, CAD, CHF, DKK, JPY, NOK, NZD and SEK. ² Currencies which joined the euro zone drop out as from the starting date of the euro. For exchange-traded markets, this comprises all currencies other than EUR, GBP, USD and other AE currencies. For over-the-counter markets, emerging market economy (EME) currencies: ARS, BGN, BHD, BRL, CLP, CNY, COP, CZK, EEK, HKD, HUF, IDR, ILS, INR, KRW, LTL, LVL, MXN, MYR, NLG, PEN, PHP, PLN, RON, RUB, SAR, SGD, SKK, THB, TRY, TWD and ZAR.

Sources: Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics and Triennial Central Bank Survey.

What are the drivers behind these developments? For one thing, interest rate derivatives markets have been adapting to a number of regulatory changes, as part of the broader financial reform agenda adopted by the G20 countries. The reforms aim at increasing transparency and limiting financial stability risks in OTC derivatives markets. Several elements of this agenda have been put into practice over the last three years, such as the move to central clearing, and to exchange-based or electronic trading of standardised OTC derivatives.

Monetary policy has also played an important role, particularly with respect to differences in market trends across currency segments. Using more granular data from the Depository Trust & Clearing Corporation (DTCC), we show that most of the increase in the outstanding amount of US dollar-denominated contracts was due to trading activity in short-term instruments, while the outstanding amount of euro-denominated contracts declined for all maturities. We argue that this reflected the divergent stance of monetary policies, given a heightened probability of policy rate increases in the United States and no anticipated change in the euro area. For longer-maturity contracts, however, activity in the US dollar segment was essentially flat. We suggest that reduced hedging activity by government-sponsored enterprises (GSEs) was a key factor, as the Federal Reserve took over a large part of their mortgage portfolios.

The rest of the article is structured as follows. The first section analyses the Triennial Survey data on turnover by currency, instrument, location and counterparty. The second provides a comprehensive estimate of the share of centrally cleared OTC interest rate derivatives contracts outstanding and discusses a number of regulatory developments. The third focuses on the possible drivers of turnover in OTC markets, in particular the changing maturity composition of swaps and the link with monetary

policy. The fourth provides an explanation for the lacklustre activity seen in long-maturity US dollar-denominated swaps. The final section concludes.

OTC interest rate derivatives turnover in April 2016

Globally, average daily turnover in OTC interest rate derivatives markets increased by 16%, to \$2.7 trillion, between the preceding Triennial Survey in April 2013 and the current survey in April 2016 (Table 1). The increase in turnover is almost twice as large (28%) when the amounts are adjusted for exchange rate changes,² reflecting the broad appreciation of the US dollar against other currencies during this period.³

The increase in turnover was entirely driven by swaps (Graph 2, left-hand panel). At \$1.9 trillion, the turnover of swaps amounted to around 69% of the total market turnover of OTC interest rate derivatives in April 2016. All other instruments, including FRAs and options, saw declines in turnover over the last three years.

Derivatives contracts denominated in euros used to be the most actively traded by some margin, but they were supplanted in April 2016 by US dollar-denominated

OTC interest rate derivatives turnover – top five AE and EME currencies

Notional amounts, daily averages in April¹

Table 1

	Amounts (USD bn)			Growth rate, 2013–16 (%)		Global share (%)	
	2010	2013	2016	Unadjusted	FX-adjusted ²	2013	2016
All currencies	2,054	2,311	2,677	15.9	28.5	100.0	100.0
US dollar	654	639	1,357	112.3	112.3	27.7	50.7
Euro	834	1,133	641	-43.4	-35.0	49.0	23.9
Pound sterling	213	187	237	27.2	36.0	8.1	8.9
Australian dollar	37	76	108	41.8	92.2	3.3	4.0
Yen	124	69	83	20.4	35.5	3.0	3.1
EME currencies ³	47	102	123	21.1	54.5	4.4	4.6
Mexican peso	5	10	26	167.9	283.4	0.4	1.0
South African rand	5	16	16	2.5	64.5	0.7	0.6
Korean won	16	12	13	4.6	7.0	0.5	0.5
Singapore dollar	4	4	12	225.9	255.6	0.2	0.4
Chinese renminbi	2	14	10	-29.7	-27.1	0.6	0.4

¹ Adjusted for local and cross-border inter-dealer double-counting, ie “net-net”. ² Using end-April 2016 US dollar exchange rates. ³ See footnote 2 of Graph 1 for a list.

Sources: BIS Triennial Central Bank Survey; authors’ calculations.

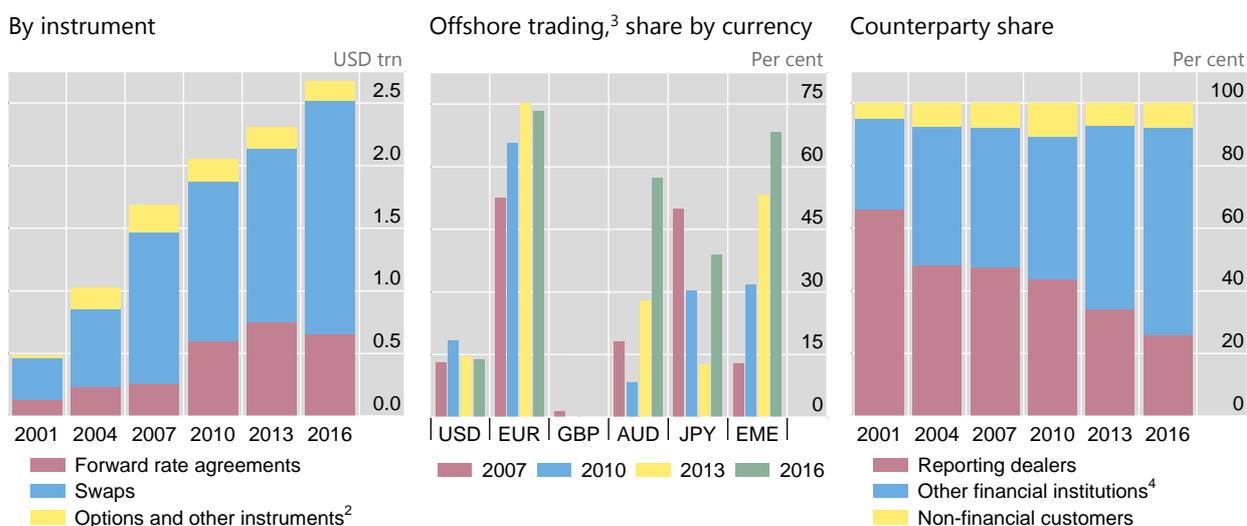
² Currency adjustments were made on the basis of average US dollar exchange rates in April 2016. Since many currencies depreciated against the US dollar between April 2013 and April 2016, turnover amounts for April 2013 were adjusted downwards, resulting in higher overall growth of turnover.

³ Part of the reported increase is likely to have been due to more comprehensive reporting by dealers. The major change in the currency composition is, however, unlikely to have been affected in a significant way. Data are subject to change.

OTC interest rate derivative instruments, offshore trading and counterparty shares

Turnover in notional amounts, daily averages in April¹

Graph 2



EME = currencies of emerging market economies.

¹ Adjusted for local and cross-border inter-dealer double-counting, ie "net-net" basis. ² The category "other instruments" covers highly leveraged transactions and/or trades where notional amount is variable and a decomposition into individual plain vanilla components was impractical or impossible. ³ See footnote 4 in the main text for a definition of offshore trading and an explanation of the zero offshore trading share for sterling since 2010. ⁴ Financial institutions that are not reporting dealers in the survey. Importantly, this includes central clearing counterparties and swap execution facilities as well as smaller commercial banks, securities houses, mutual funds, pension funds, hedge funds, money market funds, building societies, central banks and residual differences.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

contracts. Turnover of US dollar OTC interest rate derivatives more than doubled to \$1.4 trillion per day between April 2013 and April 2016, accounting for 51% of global turnover (Table 1, final column). This increase was driven by interest rate derivatives with short maturities (see below). At the same time, the turnover of euro-denominated instruments almost halved, to \$641 billion. Even after adjusting for the impact of the euro's depreciation against the dollar, the fall was substantial (-35%).

While global activity in OTC interest rate derivatives markets continued to be dominated by US dollar- and euro-denominated contracts, turnover in instruments denominated in emerging market economy (EME) currencies continued to grow (Table 1, bottom half). The growth was particularly evident once exchange rate changes were taken into account. In April 2016, the notional turnover of such contracts represented 4.6% of the global market, up from 4.4% in April 2013. However, trends in activity were uneven across currencies. The strong growth in Mexican peso-denominated contracts made that segment the top-traded EME currency segment for OTC interest rate derivatives, taking this spot from the Brazilian real. The notional turnover of interest rate contracts denominated in Chinese renminbi fell, in contrast to the increase in renminbi FX trading (Upper and Valli (2016)). Average daily turnover also declined for OTC interest rate derivatives contracts denominated in Brazilian reais and Indian rupees, but rose for others, such as the Hungarian forint, the Chilean peso and the Colombian peso (BIS (2016b)).

OTC interest rate derivatives turnover – top five trading locations, by currency

Notional amounts, daily averages in April¹

Table 2

	Amounts (USD bn)			Growth rate, 2013–16 (%)		Global share (%)	
	2010	2013	2016	Unadjusted	FX-adjusted ²	2013	2016
United States	642	628	1,241	97.5	102.8	23.2	40.8
US dollar	533	546	1,168	113.8	113.8	73.7	78.0
Euro	33	27	7	-74.8	-71.0	2.1	0.9
EME currencies ³	6	22	37	66.3	148.9	18.8	28.7
LAT currencies ⁴	4	19	34	78.4	179.4	58.3	82.7
United Kingdom	1,235	1,348	1,180	-12.4	-0.9	49.9	38.8
US dollar	186	110	215	95.2	95.2	14.9	14.4
Euro	668	928	574	-38.2	-29.0	70.5	74.9
Local currency	234	190	247	30.4	39.4	92.0	94.7
EME currencies ³	0	29	32	9.4	53.9	25.0	25.1
CEE currencies ⁵	0	9	12	32.3	60.6	62.6	72.8
France	193	146	141	-3.0	9.4	5.4	4.6
US dollar	24	17	27	61.0	61.0	2.3	1.8
Euro	142	122	101	-17.4	-5.1	9.3	13.1
EME currencies ³	0	1	0	-26.3	-1.0	0.6	0.4
Hong Kong SAR	18	28	110	293.5	349.2	1.0	3.6
US dollar	3	3	48	1,266.6	1,266.6	0.5	3.2
Euro	1	1	1	23.1	41.4	0.1	0.1
Local currency	3	2	5	167.7	167.4	66.5	78.3
EME currencies ³	6	11	18	64.9	81.7	9.1	13.7
ASI currencies ⁶	6	11	18	64.9	81.7	22.5	36.9
Singapore	35	37	58	56.2	75.5	1.4	1.9
US dollar	10	12	5	-56.2	-56.2	1.6	0.3
Euro	2	1	0	-95.2	-94.5	0.1	0.0
Local currency	4	3	10	200.0	227.3	71.3	66.6
EME currencies ³	12	9	15	60.0	79.4	8.0	11.7
ASI currencies ⁶	12	9	15	60.2	79.5	19.8	31.5

¹ Adjusted for inter-dealer trades within the same jurisdiction, but not for cross-border trades between dealers, ie “net-gross”. ² Using end-April 2016 US dollar exchange rates. ³ Does not include HKD or SGD. See footnote 2 of Graph 1 for a list of EME currencies. ⁴ Latin American (LAT) currencies: ARS, BRL, CLP, COP, MXN and PEN. ⁵ Central and eastern European (CEE) currencies: BGN, CZK, EEK, HUF, LTL, LVL, PLN, RON, RUB, SKK and TRY. Currencies which joined the euro zone drop out as from the starting date of the euro. ⁶ Emerging Asian (ASI) currencies: CNY, IDR, INR, KRW, MYR, PHP, THB and TWD.

Sources: BIS Triennial Central Bank Survey; authors’ calculations.

The aggregate increase in the turnover of contracts denominated in EME currencies was entirely driven by offshore trading (Graph 2, centre panel).⁴ It rose by

⁴ Offshore trading is defined as the global notional turnover of a given currency (“net-net”, ie adjusted for both local and cross-border inter-dealer double-counting) minus all trades where at least one counterparty is residing in the respective currency area (“net-gross”, ie adjusted for local inter-dealer double-counting). For instance, US dollar offshore trades would be defined as global trades of US

55% (111% on an FX-adjusted basis) between April 2013 and 2016, even as onshore trading declined. Four of the top five trading locations by overall turnover (Table 2) – with the exception of France – have also established themselves as major trading hubs for the trading of EME currency-denominated contracts. For instance, 73% of global turnover in contracts denominated in central and eastern European currencies took place in the United Kingdom and 83% of trades denominated in Latin American currencies in the United States. For contracts denominated in emerging Asian currencies, Hong Kong SAR and Singapore accounted for market shares of 37% and 31%, respectively. The rise of turnover in Hong Kong and Singapore was driven by increased activity in contracts denominated in Japanese yen and Australian dollars, as offshore trading rose substantially in those market segments (Graph 2, centre panel).⁵

Changes in the currency composition of derivatives activity led to shifts in the relative importance of trading locations (Table 2). Traditionally, the United Kingdom had been the top global trading hub, but turnover there dropped by 12% between surveys, to \$1.2 trillion per day in April 2016. As a result, the share of the United Kingdom in global turnover declined from 50% to 39%. This largely reflected the fall in euro-denominated OTC interest rate derivatives business, since the United Kingdom is a major trading hub for the euro segment, accounting for 75% of global trades. Offshore trading of US dollar-denominated contracts is much less prominent (Graph 2, centre panel). As a result, the rise in US dollar-denominated turnover went hand in hand with increased activity in the United States, which became the largest global trading hub for OTC interest rate derivatives.

The shares accounted for by the various counterparties in OTC interest rate derivatives markets continued to extend their previous trend (Graph 2, right-hand panel). There was a further decline in the share of trading among reporting dealers (mainly large banks), from 34% in April 2013 to 26% in April 2016. The share of trades with non-financial customers picked up but remained comparatively low at 7.9%. By far the largest share of turnover in OTC interest rate derivatives markets was attributable to “other financial institutions”, which captured two thirds of the market in April 2016. This reflected the tendency of banks to pare down proprietary trading and market-making, which allowed new players such as electronic market-makers and platforms to enter the fray (CGFS (2014)), which is a development similar to that observed in OTC FX derivatives markets (Moore et al (2016)). In part, this results from regulatory reforms that have promoted electronic trading and central clearing in OTC markets, as highlighted in the following section.⁶

dollar-denominated contracts minus turnover of US dollar-denominated contracts reported in the United States. This implies that the trades with cross-border counterparties reported in the respective currency area are excluded from offshore trades. In some cases, very low offshore trading volumes can be due to “over-netting”, as cross-border inter-dealer double-counting is overestimated.

⁵ See Upper and Valli (2016) for a further discussion of the evolution of derivatives markets in EMEs.

⁶ Both electronic trading platforms (including swap execution facilities) and central clearing counterparties are captured under “other financial institutions” in the Triennial Survey. See also footnote 4 in Graph 2.

Regulatory reforms and the structure of OTC markets

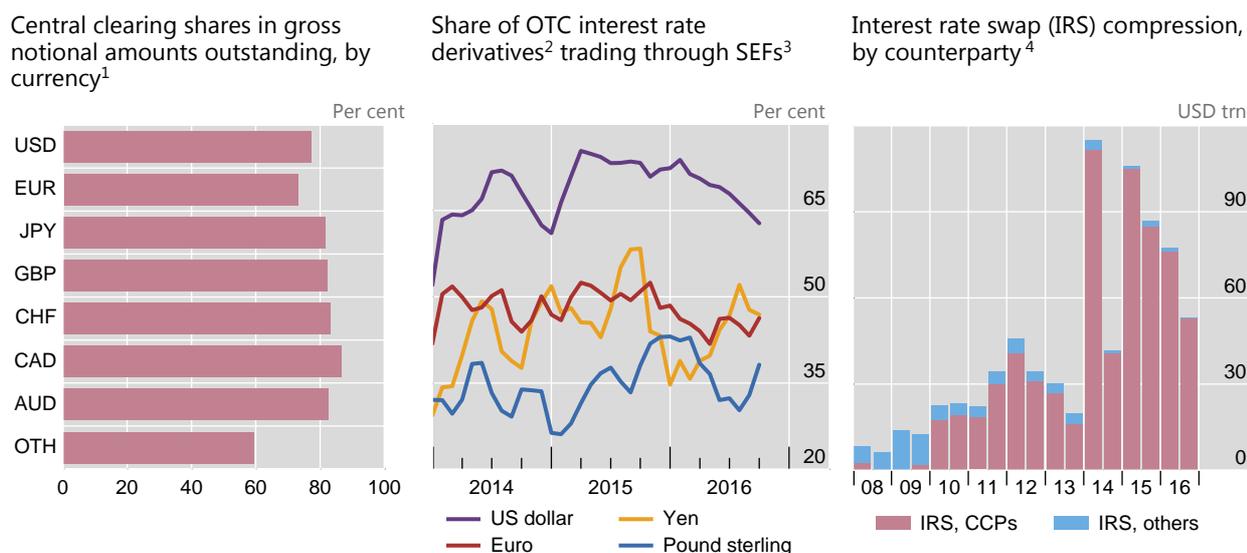
The G20 OTC derivatives market reform agenda has reshaped the structure of these markets in a number of ways in recent years. Even though the speed of implementation of the reforms has varied across jurisdictions, the impact on global OTC markets is already evident.

Central clearing of derivatives, aimed at reducing counterparty risks, has gained ground. The 2016 Triennial Survey marked the first time data had been collected on the share of centrally cleared contracts. The survey found that more than 70% of the gross notional amounts outstanding of OTC interest rate derivatives were centrally cleared in June 2016 for all major currency segments (Graph 3, left-hand panel).⁷ The Financial Stability Board (2016) reported a similar share of centrally cleared OTC interest rate derivatives turnover, which averaged 76% of weekly aggregate transactions during the first half of 2016.⁸

Electronic trading has also become more prevalent. Since the mandatory execution requirements for swap trades came into effect in October 2013 as part of

OTC interest rate derivatives markets adapt to regulatory reforms

Graph 3



OTH = other currencies.

¹ As of June 2016. ² Aggregate of fixed-floating, basis, fixed-fixed and indexed swaps as well as forward rate agreements. ³ Notional turnover volume in a given month traded through a swap execution facility (SEF) as a share of total notional turnover of on- and off-SEF trades; combines data from major trade repositories. Three-month rolling averages. ⁴ At half-year end. Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date. Gross notional amount compressed is double-counted inside a central counterparty (CCP) and single-counted outside a CCP.

Sources: Clarus Financial Technology, TriOptima triReduce; BIS derivatives statistics and Triennial Central Bank Survey.

⁷ Turnover data are reported on a pre-novation basis, whereas outstanding data are reported on a post-novation basis.

⁸ See Wooldridge (2016) for further discussion of trends in central clearing of OTC interest rate derivatives.

the Dodd-Frank Act, swap execution facilities (SEFs) have served to move a large share of OTC swap trading to electronic platforms (Graph 3, centre panel).

Another key element of the G20 reform agenda has been the introduction of initial and variation margins for non-centrally cleared contracts. This has recently come into effect in the United States, Japan and Canada, and will be implemented in Europe and Asia in 2017 (FSB (2016)). Such margining requirements could raise the costs of OTC trading and thereby encourage a shift in trading activity to exchanges.

OTC markets have adapted to regulatory changes by a wider adoption of portfolio compression (Graph 3, right-hand panel). Such compression reduces capital charges and trading costs by shrinking notional amounts outstanding, while leaving net exposures unchanged.⁹ The increasing use of clearing houses has facilitated trade compression, as they allow for an efficient identification of offsetting exposures.

Drivers of trading dynamics in the OTC market

Activity in US dollar-denominated OTC interest rate derivatives contracts overtook activity in euro-denominated instruments between April 2013 and April 2016. What are the drivers of this major shift? We expand our analysis by using OTC interest rate derivatives data compiled by the DTCC. The DTCC captures a large share of the market (Abad et al (2016)) and provides data on gross notional amounts outstanding by currency. It also provides more detailed information than the Triennial Survey on instrument types and maturity breakdowns, and offers data at a weekly frequency.

Our expanded analysis points to additional key facts. First, increased activity in overnight index swaps (OIS) was the main contributor to increased trading in US dollar-denominated instruments (Graph 4, left-hand panel). As OIS instruments typically have short maturities,¹⁰ an increase in outstanding amounts translates into a pronounced increase in turnover and can explain the rise in US dollar-denominated contracts in the Triennial Survey between April 2013 and April 2016. In the euro-denominated market segment, the decline in turnover was due to a decline in both OIS and interest rate swaps (Graph 4, centre panel). Second, in the US dollar market segment, gross notional amounts outstanding increased for shorter maturities. However, they actually declined for maturities of five to nine years, while longer maturities showed only limited increases. As a result, the share of notional amounts with maturities of five years and above declined (Graph 4, right-hand panel). In the euro-denominated market, by contrast, notional amounts outstanding fell across all maturities, with the largest decline occurring in instruments with short maturities (Graph 4, right-hand panel).

Diverging monetary policies were an important determinant of the contrasting developments seen in the US dollar- and euro-denominated OTC interest rate derivatives markets.¹¹ The fact that the increase in activity in US dollar-denominated contracts stemmed mostly from the OIS market, which is linked to policy rates,

⁹ See also Schrimpf (2015).

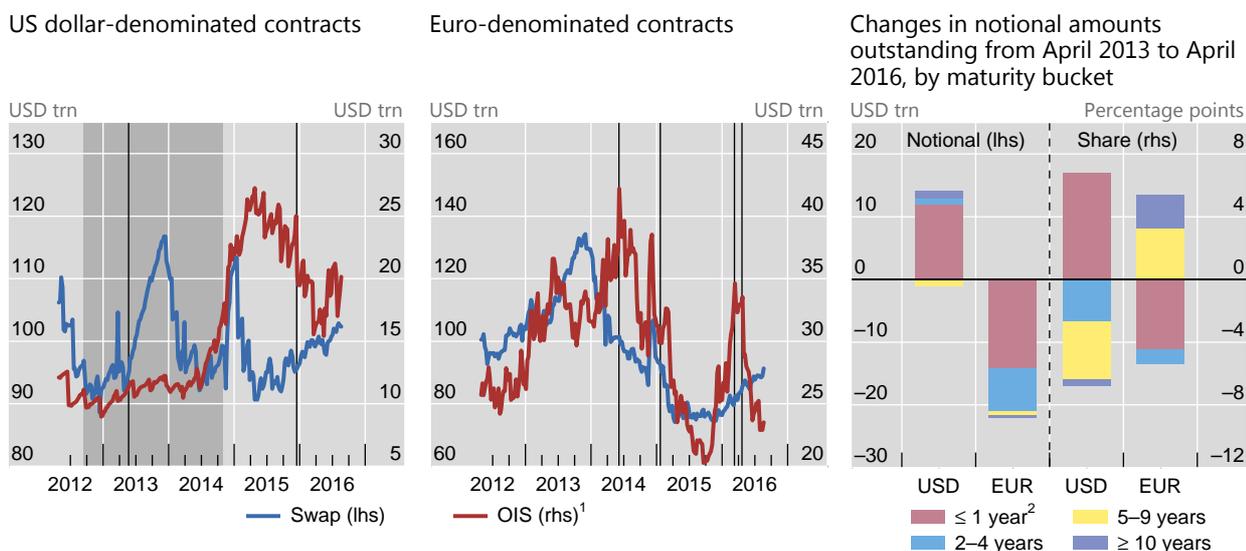
¹⁰ According to the DTCC data, as of 29 April 2016, OIS with a term ending in 2016 accounted for around 80% of US dollar-denominated contracts and 54% of euro-denominated contracts in terms of notional amounts outstanding.

¹¹ See Kreicher and McCauley (2016) on the impact of monetary policy on exchange-traded interest rate derivatives, in particular eurodollar futures.

Interest rate swap versus OIS contracts and maturity composition

Notional amounts outstanding

Graph 4



The shaded area in the left-hand panel indicates 13 September 2012 to 18 December 2013 (QE3) and 18 December 2013 to 31 October 2014 (tapering); the vertical lines indicate 22 May 2013 (taper tantrum) and 16 December 2015 (first rate hike after June 2006). The vertical lines in the centre panel indicate 5 June 2014 (deposit facility rate goes negative), 22 January 2015 (ECB expands asset purchases), 10 March 2016 (deposit facility rate goes further negative) and 21 April 2016 (ECB further expands its asset purchase programme).

¹ For euro-denominated contracts, EONIA rate. ² Term up to one year ahead.

Source: The Depository Trust & Clearing Corporation.

pointed to increased hedging and speculative demand in anticipation of rate rises. In contrast, the decline in the notional amounts outstanding of both short- and long-maturity contracts in the euro-denominated market suggests that in April 2016 market participants did not expect rate changes for several years. These expectations were reflected in OIS rates (Graph 5, right-hand panel).

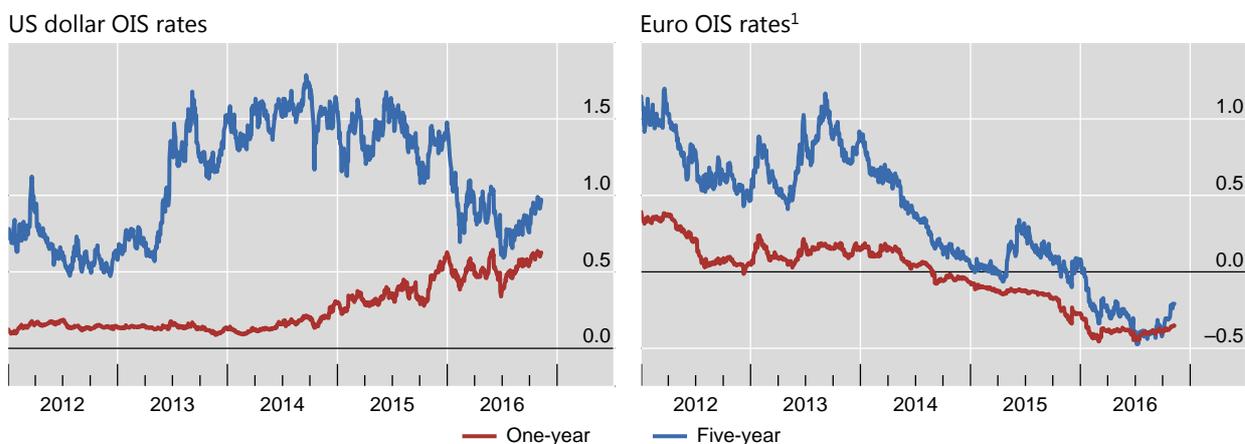
The impact of monetary policy is corroborated by the timing of the reactions observed in derivatives markets. In the United States, the gross notional amounts outstanding of swaps increased around the mid-2013 “taper tantrum”. At the same time, rates for OIS with longer maturities increased, while the rates for OIS with shorter maturities remained virtually unchanged (Graph 5, left-hand panel). This suggests that market participants expected rates to rise in the future, albeit not in the forthcoming year. Gross notional amounts outstanding for OIS and swaps increased sharply immediately following the end of bond purchases by the Federal Reserve in October 2014. This affected short-term expectations of rate rises but left long-term rate expectations virtually unchanged. The turmoil in global financial markets in 2016 (BIS (2016a)) brought about a downward revision of expectations for longer-term rates (Graph 5, left-hand panel), as well as a decline in OIS outstanding amounts (Graph 4, left-hand panel).

Gross notional amounts outstanding of euro-denominated contracts also experienced short-lived spikes around some of the monetary policy events in the United States, perhaps due to potential spillover effects. However, both OIS and interest rate swaps decreased overall – especially following the ECB’s announcements of new asset purchase programmes (Graph 4, centre and right-hand panels).

Expectations of future policy rates

In per cent

Graph 5



¹ EONIA rate.

Source: Bloomberg.

Negative interest rates in the euro zone may have been another factor dampening the demand for euro-denominated interest rate derivatives. Negative rates imply an additional cost of holding euro-denominated derivatives, as any cash deposited for margin requirements incurs a negative return.

Indeed, the Triennial Survey data show that other currencies with negative short-term interest rates also saw declines in turnover. This was the case for the Swedish krona (–46% change, to \$19.4 billion, from April 2013 to April 2016), the Swiss franc (–5.1%, to \$14 billion) and the Danish krone (–57%, to \$1.7 billion). Turnover in yen-denominated contracts, however, picked up by 20%, to \$83 billion. But, this was still substantially below turnover volumes in earlier surveys.

GSEs and US dollar interest rate swap markets

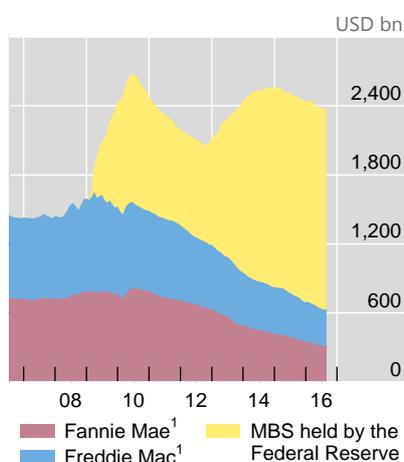
In contrast to the OIS market, activity in long-term US dollar swaps was not boosted by an expected tightening of US monetary policy (Graph 4, right-hand panel). We argue that the lack of activity in longer-term US dollar swaps reflects a structural shift in the hedging activities of GSEs.

If anything, natural demand for receiving fixed rates should have increased with rising corporate bond issuance. Corporate hedgers were joined by pension funds and insurance companies in using the fixed rate payments of long-maturity swaps to match the typically shorter duration of their assets with the longer duration of their liabilities (Klinger and Sundaresan (2016)).

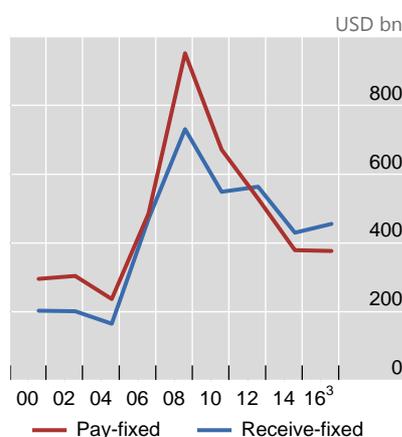
On the other side of the market, GSEs are natural hedgers paying fixed rates. In this way, they can hedge their large portfolios of fixed income securities, particularly when short-term rates are expected to rise. In the previous monetary tightening cycle of 2004–07, notional amounts of fixed-paying interest rate swaps in the portfolios of GSEs rose markedly (Graph 6, centre panel).

Since quantitative easing started in the United States, however, the mortgage portfolios of the GSEs have fallen substantially, while that of the Federal Reserve has grown to around \$1.5 trillion (Graph 6, left-hand panel). Furthermore, the notional

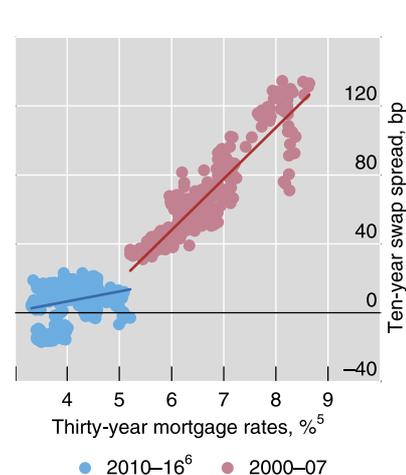
Mortgage portfolios held by GSEs and MBS holdings of the Federal Reserve



Interest rate swaps held by GSEs,² notional amounts outstanding



Mortgage rates and swap spreads⁴



GSE = government-sponsored enterprise; MBS = mortgage-backed securities.

¹ Includes MBS held in own portfolio, non-agency MBS and mortgage loans. ² Fannie Mae and Freddie Mac; fiscal year-end ³ Data up to end-September 2016. ⁴ See Goldman Sachs (2015). ⁵ Thirty-year fixed rate average in the United States. ⁶ Data up to 20 October 2016.

Sources: Board of Governors of the Federal Reserve System; Fannie Mae; Freddie Mac; Bloomberg.

amounts of swaps for which GSEs pay fixed rates have declined substantially (Graph 6, centre panel). As the Federal Reserve does not hedge its portfolio of mortgage securities, this change may also help explain why the link between mortgage rates and swap spreads has virtually disappeared (Graph 6, right-hand panel).

The key factors behind the subdued activity in longer-maturity swaps are likely to have included the absence of hedging activity by the Federal Reserve, the strongly reduced mortgage and swap portfolios of GSEs, and balance sheet constraints on swap dealers due to tightened regulation.

In the absence of natural hedgers wishing to pay fixed rates, greater demand from corporate issuers, pension funds and insurance companies for receiving fixed rates, and reduced activity by swap dealers due to regulatory pressures, prices adjust downwards – to an equilibrium where other speculators are willing to take positions. Accordingly, swap spreads have fallen for longer maturities (Clark and Mann (2016)).

Conclusions

Amid low and stable interest rates across the globe, trading in OTC and exchange-traded interest rate derivatives markets has grown moderately. The structure of those markets, however, has changed shape, owing to a shift in the currency composition of contracts and to regulatory reforms.

We argue that monetary policy has been an important driver of the shift in the currency composition of activity from the euro to the US dollar. In the euro-denominated market segment, the expected persistence of stable and negative interest rates has reduced demand for swaps, while the rise in the turnover of short-term swaps in the United States is consistent with expectations of increasing short-term rates. We also suggest that the reduced demand for swaps by the GSEs in the

United States has been a key factor behind the subdued activity observed in long-term swaps.

Several reforms on the G20 agenda have had an impact on the structure of OTC interest rate derivatives markets. More than 70% of notional values are now centrally cleared in all major currency segments, reducing counterparty credit risk. Electronic trading platforms, including swap execution facilities, have made inroads, improving market liquidity and transparency. OTC markets have adapted to regulatory changes by increasing their recourse to services, such as portfolio compression, that lower capital charges by reducing notional amounts, while keeping net exposures unchanged. The full impact of the recent introduction of margining requirements for non-centrally cleared contracts on OTC markets may lead to further structural changes.

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Emerging derivatives markets?¹

Only 10% of global derivatives turnover is in contracts denominated in the currency of an emerging market economy (EME), much lower than the share of these economies in global GDP or world trade. Derivatives in EME currencies also tend to be less complex and more likely to be traded outside the home economy than those in advanced economy currencies. Differences persist even if we control for key drivers of derivatives turnover such as the size of the bond market, the openness of the capital account, the amount of foreign trade and the size of external liabilities. Instead, the small size of EME derivatives markets appears to reflect differences in per capita income. Large external asset holdings by residents of a country go hand in hand with lower turnover, perhaps because they are used as a hedge against country risk.

JEL classification: F31, G12, G23.

The economies and financial markets of emerging market economies (EMEs) tend (with some exceptions) to be more volatile than those of advanced economies. This is true whether one looks at output growth, exchange rates, interest rates or capital flows. Given this volatility, one would expect hedging markets in EMEs to be well developed. But this does not seem to be the case. EMEs make up about one third of the global economy when measured at market exchange rates and just under one half when measured at purchasing power parity. Their share in global trade is 36%. Still, derivatives referencing their currencies or interest rates account for only 10% of the global turnover of such contracts, despite notable growth in some cases in recent years.

But the desire to hedge need not result in liquid markets unless there is somebody willing to take the other side. For idiosyncratic risks that are easily diversifiable, a financial intermediary could sell the appropriate insurance. But creating a market for macroeconomic risks, such as exchange rate and interest rate risk, is much more difficult unless there are agents who are exposed to such risk in opposite ways.

Consider the example of an EME with a volatile exchange rate. Residents and foreign investors alike will probably be interested in protecting themselves against a depreciation in the exchange rate, but it is less obvious who would be willing to take the other side. Of course, foreign financial institutions with no particular interest in gaining exposure to the currency could offer such protection, but they would

¹ The views expressed here are those of the authors and do not necessarily reflect those of the BIS. We are grateful to Claudio Borio, Ben Cohen, Ramon Moreno, Hyun Song Shin and Phil Wooldridge for helpful comments and suggestions. Diego Urbina provided excellent research support; we are grateful for his patience and dedication. The authors of Box A would like to acknowledge the help of Steven Kong, Jimmy Shek, Tsvetana Spasova and Agne Subelyte. See the Glossary (BIS (2016)) for definitions of relevant technical terms.

probably charge a very high price. More attractive terms could be obtained from market participants wanting to protect themselves against an *appreciation* – for instance, domestic holders of foreign assets or foreigners issuing domestic currency debt.

This article uses the latest vintage of the BIS Triennial Central Bank Survey to examine how derivatives trading on EME exchange rates and interest rates has evolved and why it remains lower than for advanced economies. Our focus is on the ability to trade EME risks rather than on trading derivatives locally, so we focus on derivatives on EME currencies and interest rates (including those traded offshore) and not just on contracts traded domestically *in* EMEs. Given the focus of the Triennial Survey, we limit ourselves to exchange rate and interest rate contracts and do not discuss other risk categories such as equities and commodities, despite their importance for both EME residents and foreign investors.

The article is divided into two parts. In the first part, we compare derivatives markets in EMEs with those in the advanced economies using data from the Triennial Survey. In the second part, we look at the factors that explain cross-country differences in the development of these markets.

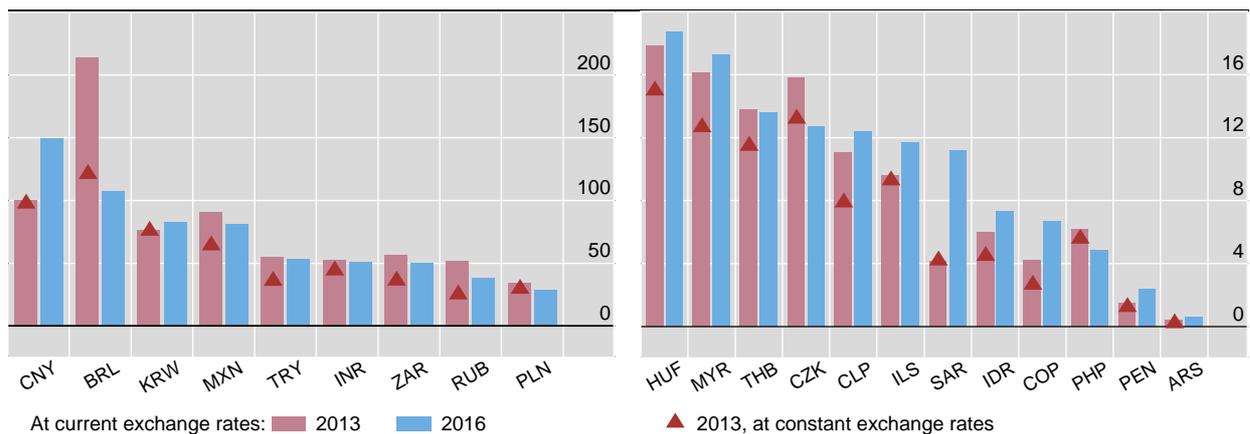
Derivatives markets in emerging and advanced economies

The sharp movements in exchange rates during the past few years masked a solid increase in activity in EME derivatives. Average daily turnover in FX and interest rate derivatives denominated in EME currencies stood at \$0.8 trillion in April 2016, almost

Growing underlying activity offset by exchange rate movements

Average daily turnover in April, "net-net" basis;¹ in billions of US dollars

Graph 1



¹ Over-the-counter (excluding spot transactions) and exchange-traded derivatives.

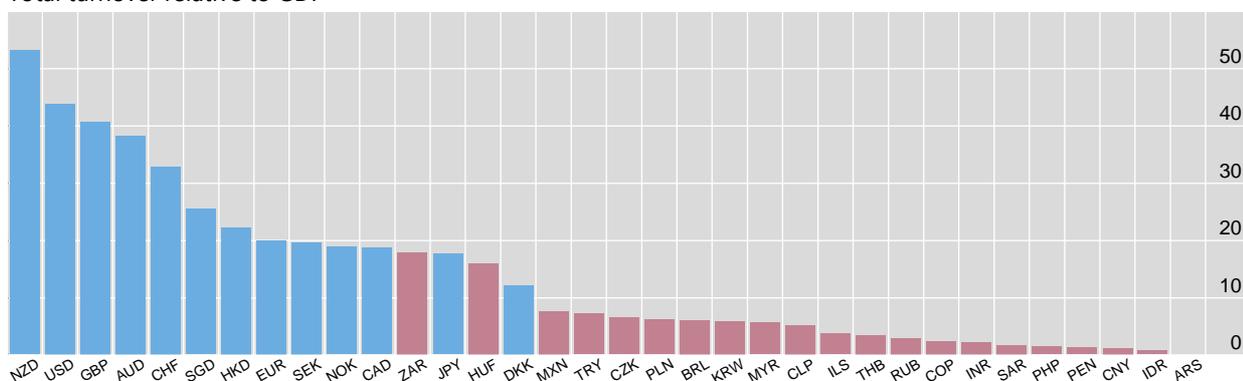
Sources: Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics and Triennial Central Bank Survey.

EMEs have smaller markets

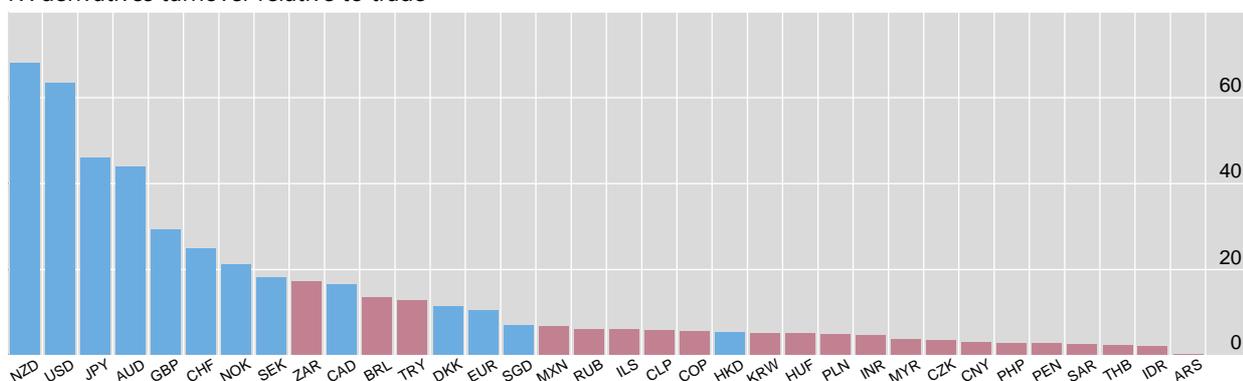
Average daily turnover in April 2016, “net-net” basis;¹ in per cent

Graph 2

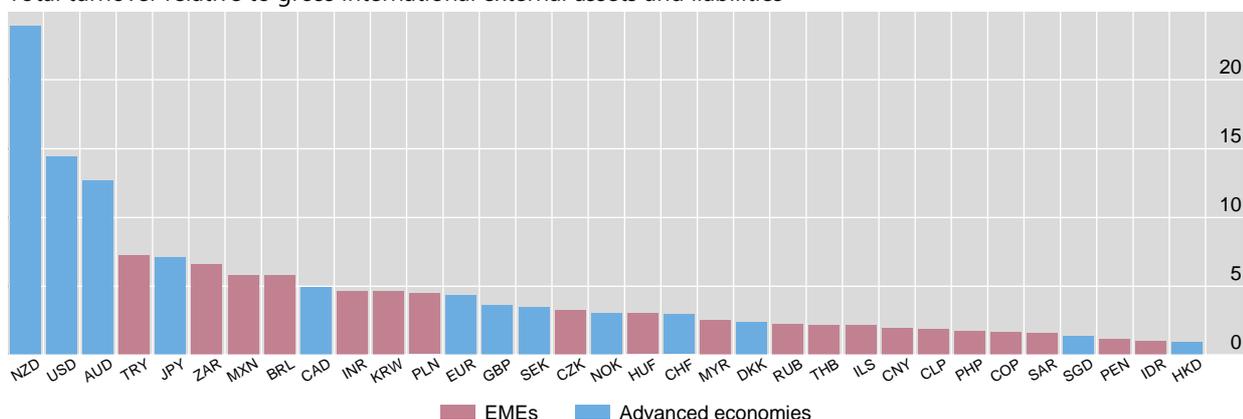
Total turnover relative to GDP



FX derivatives turnover relative to trade²



Total turnover relative to gross international external assets and liabilities³



¹ Over-the-counter (excluding spot transactions) and exchange-traded derivatives. ² Exports plus imports of goods and services. ³ Assets exclude reserve assets.

Sources: IMF, *Balance of Payments Statistics* and *World Economic Outlook*; Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics and Triennial Central Bank Survey.

the same as in April 2013, on the cusp of the bout of sharp market moves that started a month later (the so-called taper tantrum).² But this apparent stagnation paints a

² Includes all contracts in the Argentine peso (ARS), Bulgarian lev (BGN), Bahraini dinar (BHD), Brazilian real (BRL), Chilean peso (CLP), Chinese renminbi (CNY), Colombian peso (COP), Czech koruna (CZK), Hungarian forint (HUF), Indonesian rupiah (IDR), Israeli new shekel (ILS), Indian rupee (INR), Korean

misleading picture of the underlying dynamics of the market, as the sharp depreciation of many EME exchange rates between the last two Triennial Surveys depressed volumes measured in US dollars. Measured in local currencies, turnover actually expanded by 25%, albeit with large differences across currencies (Graph 1).

The size and depth of derivatives markets vary considerably across currencies. The largest and most rapidly growing market is the one for contracts on the Chinese exchange rate and Chinese interest rates. Its activity grew by 50% between the 2013 and 2016 surveys (55% when measured in local currency) to reach \$150 billion a day in April 2016. This makes the Chinese renminbi the eighth most traded currency in the global derivatives market in 2016, overtaking the Brazilian real (\$108 billion), Korean won (\$83 billion) and Mexican peso (\$81 billion). The rapid growth of the renminbi market is part of a broader internationalisation of the currency (see “The rise and financialisation of the renminbi” in Moore et al (2016), and Box A). Other EME currencies with significant market activity are the Turkish lira, the Indian rupee and the South African rand with just over \$50 billion turnover a day each.

Large as they may seem, these numbers are relatively modest when set against GDP or proxies for hedging needs, as measured by international trade or investment. On all those measures, even EMEs with relatively developed and deep derivatives markets sustain lower turnover than most advanced economies. Median EME derivatives turnover is roughly 5% of annual GDP, well below the median for advanced economies, which is close to 20%. Even advanced economies that are neither financial centres nor issuers of a reserve currency, such as Australia, Canada, New Zealand, Norway and Sweden, have much higher turnover-to-GDP ratios than any EME (Graph 2, top panel). The only EME currencies coming close to the advanced economy median are the South African rand and the Hungarian forint, with ratios of 15–20%. The picture does not change much when derivatives turnover (FX contracts only, as interest rate contracts are unlikely to be used in this context) is set against foreign trade (middle panel). On both measures, CNY contracts rank close to the bottom of the distribution. When derivatives volumes are compared with cross-border investment positions, the differences between advanced and emerging economies are less stark (bottom panel).

The low ratios of FX derivatives turnover to foreign trade in EMEs could indicate that exporters and importers in these countries still find it relatively difficult to hedge the exchange rate risk associated with their transactions, although one cannot say this for sure in the absence of detailed data on their use of derivatives.

Derivatives trading in EMEs is heavily geared towards FX contracts, which account for 75–90% of turnover in most cases (Graph 3, first panel). FX contracts also outweigh interest rate contracts in advanced economies, though by a smaller margin. Currencies with relatively low FX shares are the Brazilian real (with a share of 56%), Hungarian forint (59%), Chilean peso (66%), South African rand (67%) and Mexican peso (68%).

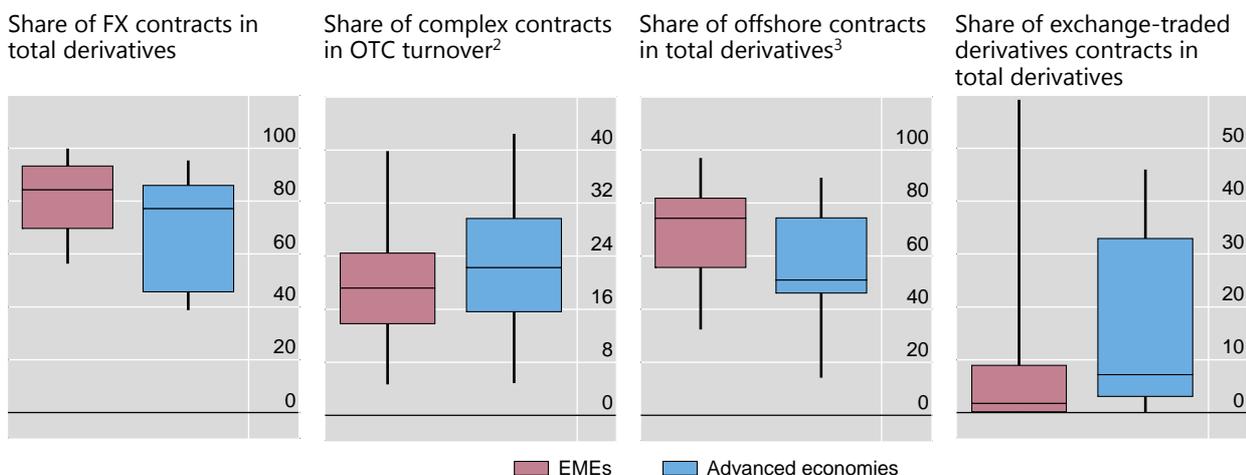
EME derivatives markets are not only smaller than their advanced economy counterparts, they also feature less complex contracts. At least this is the message from the relatively coarse instrument breakdown of the Triennial Survey. More sophisticated contracts, such as cross-currency swaps, FX options, interest rate swaps and interest rate options, account for a lower share in total turnover in emerging than

won (KRW), Mexican peso (MXN), Malaysian ringgit (MYR), Peruvian sol (PEN), Philippine peso (PHP), Polish zloty (PLN), Romanian leu (RON), Russian rouble (RUB), Saudi riyal (SAR), Thai baht (THB), Turkish lira (TRY), New Taiwan dollar (TWD) and South African rand (ZAR). Data are subject to change.

Market structure

Average daily turnover in April 2016,¹ in per cent

Graph 3



The box plots show the maximum, 75th percentile, median, 25th percentile and minimum of the variables shown.

¹ Excluding spot transactions. ² Cross-currency swaps, FX options, and interest rate swaps and options. ³ Offshore (over-the-counter) defined as local currency with reporting organisation and location of counterparty in all countries ("net-net" basis) minus onshore in local currency ("net-gross" basis); offshore (exchange-traded derivatives) is calculated as local currency in all exchanges minus onshore (local currency on local exchanges).

Sources: Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics and Triennial Central Bank Survey.

in advanced economy derivatives markets (Graph 3, second panel). But there are signs that such contracts are becoming more common in some EMEs. For example, Mexico and South Africa have comparatively liquid cross-currency swap markets. In the interest rate segment, many economies have developed active over-the-counter (OTC) markets for options.

Another feature that sets some, albeit not all, EME derivatives markets apart is the prevalence of non-deliverable contracts. Three quarters of Brazilian real FX forwards and swaps and two thirds of Korean won contracts are non-deliverable in the sense that they are settled in a single currency. The other markets with a significant share of non-deliverable contracts are the New Taiwan dollar (56%) and the Indian rupee (47%). The prevalence of non-deliverable contracts reflects the presence of restrictions on currency convertibility, which hinder the development of contracts settled in two currencies. That said, non-deliverable markets may continue to exist well after controls have been lifted. Developments in the non-deliverable FX market are discussed in McCauley and Shu (2016); for background on the Brazilian market, see Box B.

With some notable exceptions, EME FX and interest rate derivatives are mostly traded outside the home economy, usually in a major global financial centre such as New York, London, Hong Kong and Singapore (Graph 3, third panel). Very few EMEs have onshore markets that come close, in terms of activity, to the offshore market. Only in the Brazilian real, Russian rouble and Korean won does onshore OTC turnover exceed offshore turnover, although the Indian rupee, Israeli new shekel and South African rand come close. Offshore trading tends to take place in the same time zone. For instance, Latin American currencies tend to be traded in New York, central and eastern European currencies in London, and Asian currencies in Hong Kong and Singapore. Box A compares on- and offshore renminbi markets.

The changing landscape of renminbi offshore and onshore markets

Torsten Ehlert, Frank Packer and Feng Zhu

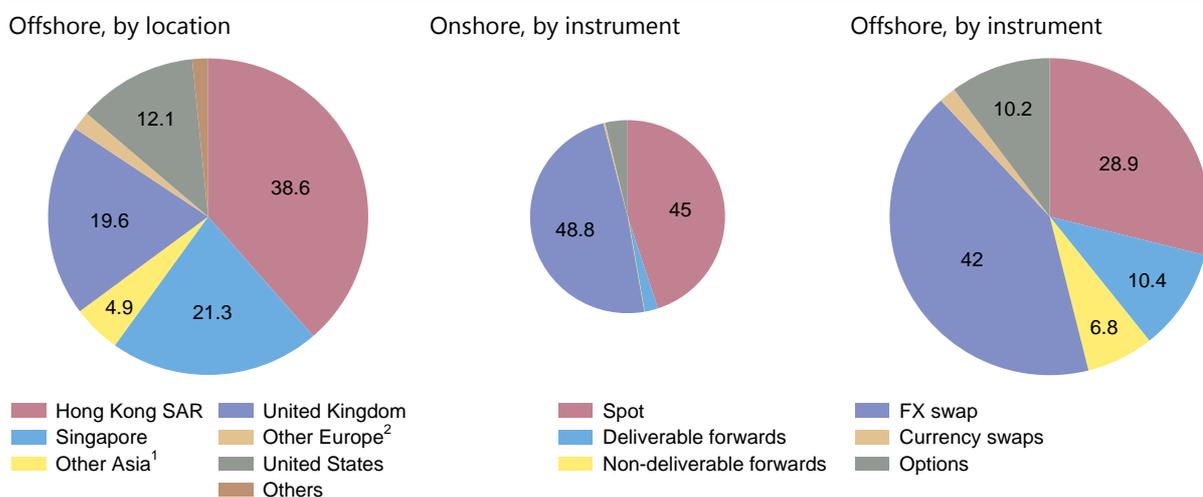
Encouraging the growing international use of the renminbi (RMB) has been a long-standing element of China's FX liberalisation strategy. As part of this strategy, many new instruments are permitted first to develop in the offshore RMB market. RMB offshore trading in non-deliverable forwards (NDFs) first emerged in Hong Kong SAR in 1996 and then in Singapore, where the offshore RMB business was subsequently mostly concentrated. The 2016 Triennial Central Bank Survey revealed that the already exceptionally large offshore share of over-the-counter (OTC) derivatives turnover in RMB had risen to 73%. That said, there have been significant changes in the composition of offshore trading by instrument and nationality that have reflected policy shifts and the dynamic nature of the RMB's internationalisation. There has been convergence between on- and offshore trading patterns in some, but not all, respects. And there have also been very significant developments since 2013 in the offshore trading of exchange-traded derivatives.

Cross-border RMB demand has increased through a number of channels. First, starting in July 2009, China allowed the use of the RMB in the settlement of its cross-border trade, which in terms of both imports and exports grew rapidly to CNY 7.23 trillion (ie to nearly 30% of trade) in 2015 before falling somewhat in 2016. Second, both outward and inward direct investment have grown rapidly, with RMB outward direct investment reaching CNY 736.2 billion in 2015. Third, offshore RMB can also serve as a vehicle for portfolio investment in China. Channels for such investment include dim sum bond issuance (offshore RMB-denominated bond issuance) and the RMB Qualified Foreign Institutional Investor (RQFII) scheme, which allows the RMB funds raised in Hong Kong by the subsidiaries of domestic fund management companies and securities companies to be invested in the mainland securities market. The RQFII scheme had 169 participants and an approved quota of CNY 511.34 billion by the end of September 2016.

Renminbi onshore and offshore FX trading in 2016

Share of total turnover volume, in per cent

Graph A1



The sizes of the centre and right-hand pies reflect the relative volumes of on- and offshore trading.

¹ Chinese Taipei, Hong Kong SAR, India, Japan, Korea, Malaysia, the Philippines and Thailand. ² Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Norway, Portugal, Spain, Sweden and Switzerland.

Source: BIS Triennial Central Bank Survey.

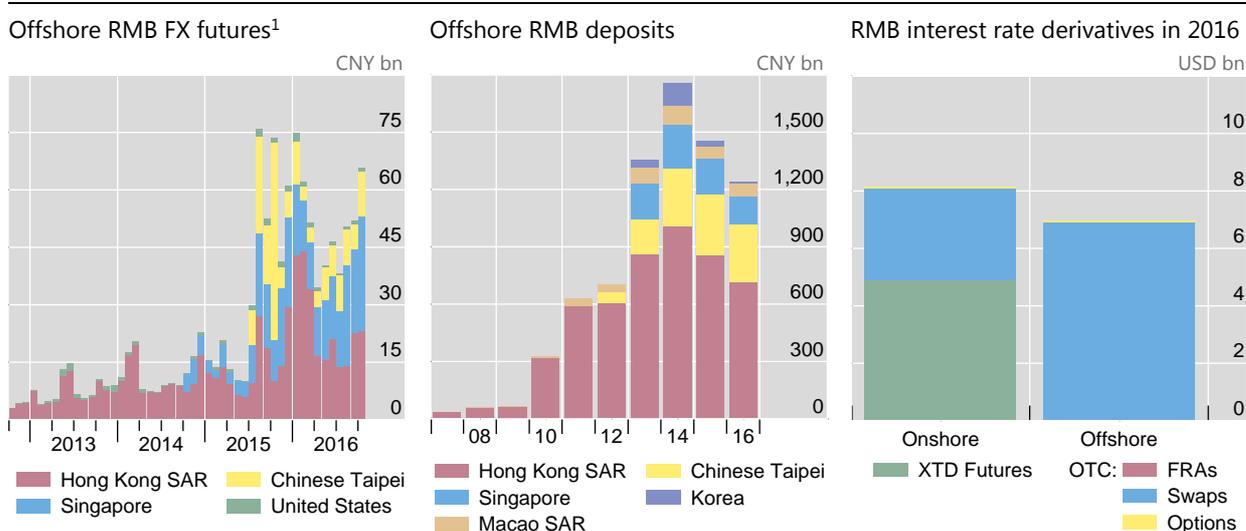
Looking at the location of offshore activity, the RMB is still traded mostly within the Asian region, but also spans a wider international dimension than before. The share of turnover in Hong Kong declined from 43% to 39% of total RMB offshore trading, although it is still much larger than in 2013 in absolute terms. At the same time, trading in Singapore and other Asian economies has increased, so that the share of total offshore trading taking place in Asia

summed to 65% (Graph A1, left-hand pie). Offshore RMB trading outside Asia has also grown; while trading in the United Kingdom edged down from 21% to 20%, the share of RMB offshore turnover occurring in the United States rose from 7% to 12% in 2016.

In terms of instruments used in RMB trading, there has been some convergence between the off- and onshore markets since the preceding Triennial Survey in 2013 (Graph A1, centre and right-hand pies). This is particularly noticeable in the case of spot trading, which fell as a share of the onshore market from 60% to 45%, while it rose from 16% to 29% in the offshore market. At the same time, NDFs, which had accounted for nearly one fifth of all offshore trading in 2013, constituted only 7% of activity in 2016, a development examined by McCauley and Shu (2016). Offshore option trading also declined significantly. The one significant exception to the trend of convergence was deliverable forward transactions, which showed slightly larger shares of overseas trades (11% vs 10%) but collapsed in the onshore market (from 8% to 2%). Diminished turnover in onshore forwards may have been related to reserve requirements on forward transactions, which were instituted in August 2015 to discourage speculation in the RMB after a period of exceptional volatility.

Renminbi offshore products and interest rate derivatives

Graph A2



FRAs = forward rate agreements; OTC = over-the-counter (from BIS Triennial Central Bank Survey); XTD = exchange-traded.

¹ Exchange-traded, monthly data.

Sources: Monetary Authority of Macao; Bloomberg; CEIC; Wind; BIS exchange-traded derivatives statistics and Triennial Central Bank Survey; authors' calculations.

The rapid growth of the offshore market for the RMB and related derivatives is not limited to OTC FX market transactions covered by the Triennial Survey. Futures turnover grew strongly on the exchanges of Singapore and Chinese Taipei, in addition to Hong Kong (Graph A2, left-hand panel). RMB futures products, first offered more than 10 years ago on the Chicago Mercantile Exchange, were launched on the Hong Kong Exchange in September 2012, and in Singapore and Chinese Taipei in October 2014 and July 2015, respectively (as well as in Brazil in August 2011, South Africa in May 2013 and Korea in October 2015). The growth in these instruments, while still relatively small, has paralleled the growth of RMB deposits outside China, another component of China's capital account liberalisation (Graph A2, centre panel).

Both on- and offshore, RMB interest rate derivatives markets remain less developed than their FX counterparts. Average daily turnover in OTC and exchange-traded markets increased slightly, by \$0.6 billion to \$15 billion, between 2013 and 2016. The increase was entirely driven by onshore futures contracts, whereas turnover in OTC markets – mainly swaps – declined by \$4 billion to \$10 billion (Graph A2, right-hand panel). In comparison with the markets in advanced economies, the depth of the interest rate derivatives market remains very limited (Ehlers and Eren (2016)). While net bond issuance by Chinese residents has been similar to that by US residents in recent years, total RMB interest rate derivatives turnover in April 2016 was less than 1/300 of turnover in US dollar contracts. This suggests that the issuers and holders of RMB bonds, mainly Chinese residents, may not be actively hedging the underlying interest rate risks. In contrast to the key role of offshore markets in the rapid expansion of RMB FX markets, opportunities to hedge RMB interest rate risk may depend on developments in onshore markets – not least because most RMB bonds are held by domestic investors.

Finally, EME derivatives are disproportionately traded over the counter (Graph 3, fourth panel). OTC trading exceeds exchange-based trading by a factor of three, with Brazil being the only major market in which derivatives exchanges account for a large fraction of turnover (Box B). Many other EMEs have active futures exchanges, but these tend to concentrate on stock index and commodity contracts rather than FX and interest rate instruments. For example, only 2.5 million of the close to 1 billion contracts traded on Chinese derivatives exchanges in the first quarter of 2016 referenced interest rates. According to Euromoney TRADEDATA, there are no listed contracts on exchange rates in China. And even in Brazil, equity contracts account for 50% of total turnover (measured by the number of contracts); interest rate contracts follow with 28% of turnover and FX contracts with 11%.

Why is EME derivatives turnover so low?

What explains the comparatively low level of activity in EME currency derivatives? In the introduction, we argued that the development of a liquid derivatives market – of any market, in fact – requires the existence of regular two-way flows. So, what explains the existence of such flows, and thus the size of the market? In this section, we aim to address these questions by estimating the determinants of activity in derivatives markets across a wide range of economies – emerging and advanced – on proxies for the hedging needs of different investor types. Our sample comprises 34 economies (24 emerging and 10 advanced economies)³ and the data from the Triennial Survey responses in April 2013 and April 2016. Unfortunately, the incomplete currency breakdown in earlier surveys precludes us from going back further.

The first, and most obvious, hedging motive derives from international trade, which we proxy by summing the exports and imports of the home economy.

The second motive concerns the hedging of financial exposures. We proxy those exposures by the size of the bond market in domestic currency. Investors in this market may want to hedge the interest rate risk associated with these bonds, so we would expect a larger market to go hand in hand with higher turnover in the interest rate segment. Foreign investors in particular may also want to hedge the currency risk associated with their bond holdings, so we would expect bond market size to be related to turnover in the FX segment too. Unfortunately, we do not have data on the currency composition of domestically issued bonds, so we limit our attention to international issues. Since investors, even those who hold securities until maturity, tend to follow overlay strategies when hedging interest rate and currency risks, we look at amounts outstanding rather than new issuance.

The third motive is related to the level of integration with global markets as measured by the size of external assets and liabilities. We would expect high external liabilities to be associated with a high demand for (FX) hedging instruments on the part of domestic borrowers and thus larger turnover. The impact of large external assets on turnover is more ambiguous. On the one hand, the holders of these assets

³ The number of economies is constrained by the availability of data on international investment positions.

Derivatives markets in Brazil

Virtually alone among emerging economies, Brazil boasts relatively large and well developed onshore derivatives exchanges that trade FX and interest rate contracts in addition to stock and commodity instruments. Brazilian FX futures and options are non-deliverable, in that they are settled in domestic currency. A particular combination of factors gave rise to such a large derivatives market, where exchange-traded, both onshore and non-deliverable, transactions predominate.

The instability of the Brazilian economy has created strong demand for hedging instruments, contributing to the development of a large derivatives market. High and volatile inflation, in particular at the end of the 1980s and beginning of the 1990s, led to widespread inflation-indexing and volatile real interest rates, which fostered the demand for instruments to manage inflation and interest rate risks. In the second half of the 1990s, after the “Real Plan” succeeded in reducing inflation and stabilising the exchange rate, the private sector made greater use of lower-cost foreign currency borrowing. The resulting exposure to foreign debt incentivised the use of FX futures for hedging.

The Brazilian legal and regulatory framework puts constraints on over-the-counter (OTC) trading, thus encouraging the migration of trading to exchanges. Taxes levied on revenues and cash flows rather than income or value added create a bias towards a system in which profits and losses of individual contracts can be netted, thus reducing the tax burden.^① This is the case on exchanges, where purchases and sales of the same contract can be offset against each other, but not in most OTC markets, where positions are closed by offsetting outstanding trades.^②

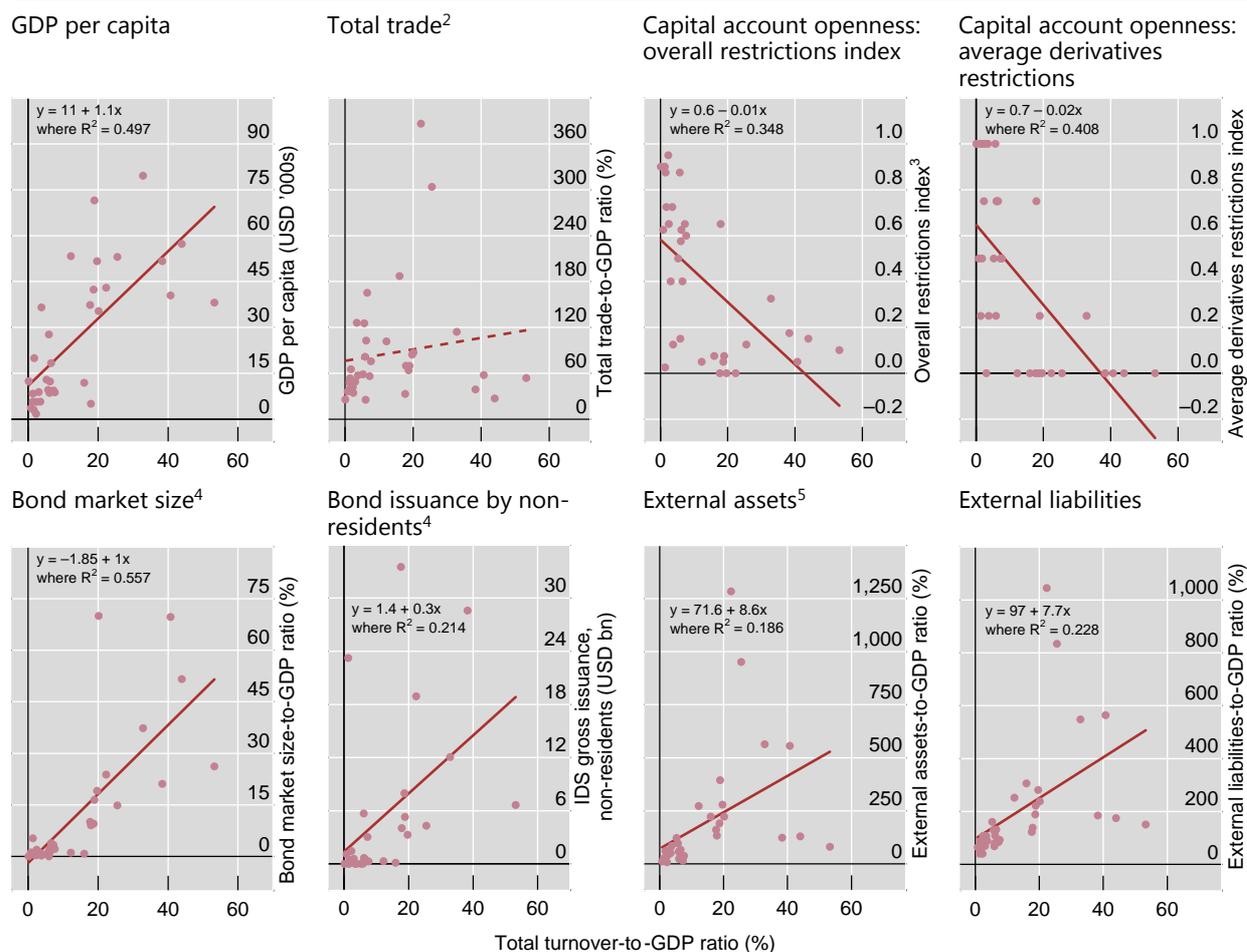
Restrictions on the use and trading of foreign currencies provide a further incentive for the use of derivatives as a substitute for cash transactions, while also explaining the preference for non-deliverable instruments settled in local currency. Access to the FX spot market is highly restricted, since only chartered banks have such authorisation. Also, local banks are not allowed to take deposits in foreign currency. In addition, the Brazilian real is not fully convertible and cannot be delivered outside the country, which precludes the development of a liquid (deliverable) offshore market.

Given its high liquidity, the FX futures market in Brazil is considered more developed than the spot market. The demand for hedges against exchange rate exposures is concentrated in the futures market, which in effect provides price discovery for the spot exchange rate.^③ The link between those two markets is established via “synthetic” operations, known as “casado” or “differential” transactions, which are used to match positions between them. In such operations, it is possible to buy or sell dollars in the spot market while simultaneously selling or buying the same amount of dollar/real futures.

The liquidity of FX derivatives markets has encouraged central bank intervention in these markets, which has in turn spurred further development of these markets. During the 1990s, when the real followed a crawling peg, the central bank intervened by selling US dollar futures through state-owned commercial banks as intermediaries.^④ Since 1999, when the floating regime was introduced, auctions of domestic non-deliverable currency swaps (the “swap cambial”) to dealer banks have been very prominent. Another important intervention instrument has been the FX repo, which has been used to deal with liquidity shortages of FX cash, for example after the Great Financial Crisis. Derivatives-based interventions aim at providing liquidity in FX cash (eg repo) or a hedge (eg non-deliverable currency swap) to the private sector, without drawing, at least not definitively, on official FX reserves.

Owing to its depth and high level of development, the Brazilian derivatives market has been innovative and resilient to financial distress. During many episodes of financial turbulence, including the East Asian financial crisis (1997), the Russian debt moratorium (1998), the abandonment of the real peg (1999), the Argentine default (2001), the Great Financial Crisis (2007–09) and the recent fiscal and political crisis in Brazil (2015), the Brazilian derivatives market arguably helped prevent more serious financial distress or a credit crunch. It did so by providing low-cost, transparent and liquid trading vehicles for a wide range of customers (Dodd and Griffith-Jones (2007)). In particular, dealers, rather than taking market and counterparty risks on their own balance sheets, have been using the exchanges. The exchanges have maintained their prominent role by investing in efficiency improvements and have endeavoured to adopt international best practices. For example, they recently implemented a multimarket architecture that allows integrated risk management across a range of asset classes and contracts, as well as a post-trade integrated clearing house framework. This improves the netting of market risks and reduces the need for dealers to provide guarantees.

^① For more details, see Kohlscheen and Andrade (2014). ^② Or are terminated; see Ehlers and Eren (2016). ^③ For details about price discovery in Brazilian FX markets, see Garcia, Medeiros and Santos (2014). ^④ For more about FX interventions in Brazil, see Garcia and Volpon (2014).



A solid (dashed) red line denotes a significant (insignificant) independent variable coefficient.

¹ Average daily turnover in April 2016, "net-net" basis; over-the-counter (excluding spot transactions) and exchange-traded derivatives. ² Exports plus imports of goods and services. ³ All asset categories, average bond restrictions only from 1997 onwards. ⁴ International debt securities (IDS); all countries excluding residents vis-à-vis all countries excluding residents, by currency. ⁵ Assets exclude reserve assets.

Sources: Fernández et al (2015); IMF, *Balance of Payments Statistics* and *World Economic Outlook*; Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics, international banking statistics and Triennial Central Bank Survey.

may want to hedge the associated exchange rate risk in derivatives markets,⁴ thus providing a natural counterpart to external borrowers. On the other hand, external assets may provide a natural hedge against currency fluctuations, thus dampening derivatives turnover. Since these effects centre on FX exposures, ideally we would like to separate each of these variables further, into domestic currency- and foreign currency-denominated assets and liabilities. Unfortunately, data availability precludes us from doing so for a large enough sample of countries.

The fourth financial variable is the gross issuance of domestic currency bonds by non-residents. Several international financial institutions, such as the World Bank and

⁴ This might be because of having liabilities in domestic currency. Such a mechanism appears to be in place in Chile, where domestic pension funds hedge their foreign currency assets back into domestic currency (Avalos and Moreno (2013)).

the European Investment Bank, as well as other public and private entities issue bonds in EME currencies and swap the proceeds into their base currency. In contrast to the previous variables, this one does not refer to a stock but to a flow. This is because associated derivatives trades tend to be one-off transactions, often with tenors equal to the maturity of the underlying bond. We proxy these hedging needs with the gross issuance of local currency bonds by non-residents in the first half of the year.

In addition, we include measures for capital account controls and restrictions on cross-border derivatives transactions. Both are taken from Fernández et al (2015) and correspond to de jure restrictions, irrespective of how tightly they are enforced. Finally, we include GDP per capita of the home economy to control for income level.

Simple bivariate regressions suggest that per capita GDP, capital account openness and bond market size are better predictors of market development than trade (Graph 4). This is in contrast with earlier work by Mihaljek and Packer (2010), who found a close association between (FX) derivatives turnover and trade. Non-resident bond issuance and large external assets and liabilities are also correlated with higher turnover, although their explanatory power is weaker.

These results are largely confirmed by multivariate regressions (Table 1). International trade remains insignificant regardless of the specification. By contrast, many of the financial variables turn out to be highly significant.

Explaining EME derivatives turnover ¹						Table 1
Dependent variable	Total turnover		Foreign exchange		Interest rates	
	(i)	(ii)	(i)	(ii)	(i)	(ii)
Constant	-1.01 (3.06)	-1.18 (1.73)	-3.35 (2.62)	-2.08 (1.33)	2.34 (1.67)	0.74 (0.47)
Bond market size	0.19 (0.12)	0.27*** (0.07)	0.05 (0.10)		0.13** (0.06)	0.19*** (0.03)
Issuance by non-residents	0.01** (0.00)	0.01** (0.00)	0.00 (0.00)		0.01*** (0.00)	0.01*** (0.00)
External liabilities	0.07*** (0.03)	0.06*** (0.02)	0.05** (0.02)	0.06*** (0.01)	0.02 (0.01)	
External assets	-0.05** (0.02)	-0.04** (0.02)	-0.03** (0.02)	-0.04*** (0.01)	-0.01 (0.01)	
GDP per capita	0.22*** (0.06)	0.20*** (0.05)	0.21*** (0.05)	0.22*** (0.03)	0.01 (0.03)	
Total trade	-0.02 (0.03)		0.00 (0.02)		-0.03* (0.02)	
Capital account controls	5.20 (5.30)		6.78 (4.55)		-1.59 (2.89)	
Restrictions on cross-border derivatives transactions	-4.31 (4.35)		-3.94 (3.74)		-0.37 (2.38)	
Adjusted R ²	0.81	0.81	0.69	0.69	0.75	0.73
Number of observations	58	58	58	58	58	58

Standard errors in parentheses; ***/**/* denotes statistical significance at the 1/5/10% level.

¹ Including all countries for which international investment position data are available.

Source: Authors' estimations.

The total stock of bonds outstanding in a particular currency is an important driver of both interest rate and total derivatives turnover but is insignificant for FX turnover. Raising the stock of bonds outstanding to GDP by 1 percentage point is on average associated with a 0.3 percentage point higher ratio of derivatives turnover to GDP.

Large external liabilities are associated with significantly higher turnover in both FX and total derivatives, although the elasticity is smaller than for bond market size. High non-resident issuance in domestic currency is also associated with higher derivatives turnover, especially in the interest rate segment. Finally, economies with large external asset holdings tend to have lower derivatives turnover.

It is important to note that our results reflect correlations, not necessarily causality. While we measure all variables (except non-resident issuance) during or at the end of the previous year, this does not entirely eliminate endogeneity since the variables are mostly quite persistent. For instance, the negative coefficient on external assets could indicate that holders of external assets do not need to hedge their exposure to foreign currency; or, quite the contrary, that the limited ability to hedge through derivatives makes residents hold more external foreign currency assets. But in either case, there is little support for the notion that residents with external asset holdings provide a natural counterparty to those wanting to insure against currency fluctuations. The experience of Chile, where pension funds convert their external asset holdings into domestic currency and, in the process, serve as natural counterparts to residents wanting to hedge their foreign currency liabilities, appears to be the exception rather than the rule.

Controlling for such financial factors, the differences between advanced and emerging economy derivatives markets appear to reflect mainly differences in income. The level of per capita GDP is highly significant, both statistically and economically, whereas a dummy variable that takes the value of one if a country is an EME and zero otherwise turns out to be insignificant. Variables measuring capital account controls and restrictions on cross-border derivatives transactions also turn out to be insignificant. It is worthy of note that GDP per capita is significant for determining only turnover in the foreign exchange market, not that of interest rate contracts.⁵ This is quite puzzling because only relatively rich economies have sizeable interest rate derivatives markets.

Conclusions

Derivatives markets for EME currencies and interest rates tend to be much smaller than their advanced economy counterparts, in relation to both GDP and trade. EME derivatives markets are also limited to a narrower set of instruments, and a disproportionate part of trading takes place over the counter. While simple activity indicators such as the ones used in this article are only loosely related to market liquidity or trading costs, especially in the short term, there is reason to believe that residents of and investors in EMEs find it more difficult and more costly to hedge their exposures than their peers in advanced economies.

⁵ McCauley and Scatigna (2011, 2013) find that FX turnover (including both spot and derivatives) increases with GDP per capita.

Our regression results suggest that the weaker turnover in EME reflects several factors, including a lower level of financial development (as measured by the size of the bond market in domestic currency), less integration in the global economy (as measured by the size of international liabilities) and lower per capita income. They also suggest that EME residents use their external asset holdings as a substitute for derivatives to hedge currency risk.

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Non-deliverable forwards: impact of currency internationalisation and derivatives reform¹

Global turnover in non-deliverable forwards (NDFs) continues to rise in aggregate. But the paths of NDF markets have diverged across currencies: renminbi internationalisation has led to rapid displacement of NDFs by deliverable forwards, while the NDF market has retained or even gained in importance in other emerging market economy currencies. Policy reforms to reduce systemic risk in derivatives markets are changing the microstructure of the NDF market.

JEL classification: F31, G15, G18.

The 2016 BIS Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity (“the Triennial”) gathered, for a second time, global data on non-deliverable forwards (NDFs), shedding light on an active, yet little studied, segment of foreign exchange (FX) markets. NDFs are contracts for the difference between an agreed exchange rate and the actual spot rate at maturity, settled with a single payment for one counterparty’s profit. They allow hedging and speculation in a currency without providing or requiring funding in it. Investors thereby circumvent limits on home market (“onshore”) trading and on delivery of the home currency offshore.

The Triennial Survey shows that NDF turnover grew by 5.3% in dollar terms between April 2013 and April 2016. This growth is remarkable in that three currencies with large NDF markets – the Brazilian real (BRL), the Indian rupee (INR) and the Russian rouble (RUB) – depreciated notably vis-à-vis the US dollar during the period. It is also remarkable given the sharp drop in turnover in the renminbi (CNY) NDF.

Divergent trends in NDF trading among the six emerging market economy (EME) currencies identified in the Triennial highlight three distinct paths of FX market development. In a path exemplified by the Korean won (KRW), NDFs gained in importance in a policy regime with restrictions on offshore deliverability. In a second, represented by the liberalised rouble, the NDF maintained its minor role amid financial sanctions and policy uncertainty. China has taken a unique, third path of currency internationalisation within capital controls. For the renminbi, deliverable forwards (DFs) have been displacing NDFs offshore.

¹ The authors thank Iñaki Aldasoro, Claudio Borio, Benjamin Cohen, Emanuel Kohlscheen, Guonan Ma, Hyun Song Shin, Christian Upper, Laurence White and Philip Wooldridge for discussions, and Norma Abou-Rizk, Kristina Bektyakova, Denis Pêtre, Jimmy Shek, Tsvetana Spasova, José María Vidal Pastor and Alan Villegas for research assistance. The views expressed are those of the authors and not necessarily those of the BIS. See the Glossary (BIS (2016b)) for definitions of relevant technical terms.

The microstructure of NDF trading is evolving under the global force of legal and regulatory reforms of derivatives markets. NDFs have started the transition from a decentralised, bilateral microstructure to centralised trading, disclosure and clearing. Disclosure of derivatives transactions (including NDFs) has become mandatory in many jurisdictions (CPMI-IOSCO (2015), FSB (2016)). Centralised NDF clearing took off in September 2016 when US, Japanese and Canadian banks began to post higher required margins for uncleared derivatives. A shift to centralised trading is also evident.

Reform allows us to assess NDF turnover spillovers from surprises like the adjustment in the renminbi exchange rate regime in August 2015. We supplement data from the Triennial and a similar survey for FX trading in London with higher-frequency data from central banks, a clearing house (LCH) and a trading registration system (the Depository Trust & Clearing Corporation (DTCC)). With this combination of sources, we find that, ironically, liberalisation of the renminbi is boosting other Asian NDFs even as it strangles the CNY NDF.

This analysis should interest policymakers concerned about spillovers from an offshore NDF market to the onshore market. In addition, for observers of capital account liberalisation, the diversity in policy choices and NDF market developments offer a natural experiment on paths of currency internationalisation. Finally, this analysis helps policymakers to assess progress in derivatives reforms.

This article is in three parts. Developments in NDF turnover, counterparties and location during 2013–16 are discussed first. The second part maps paths for NDF market development, drawing implications for currency internationalisation. The third assesses changing NDF trading, disclosure and trading, given derivatives reforms.

NDF developments in 2013–16

According to the 2016 Triennial, global NDF turnover amounted to \$134 billion in April 2016, up 5.3% since April 2013 (Table 1). Expansion of the NDF market is consistent with the overall growth of markets for EME currencies (BIS (2016a)). The NDF share in the categories reported to the Triennial has stayed broadly stable over

Global NDF turnover

Average daily turnover in millions of US dollars, on a net-net basis,¹ April 2013 and April 2016

Table 1

	USD vis-à-vis								Other currency pairs	Grand total
	BRL	CNY	INR	KRW	RUB	TWD	Six currencies	Total		
2013	15,894	17,083	17,204	19,565	4,118	8,856	82,720	119,178	8,131	127,309
2016	18,653	10,359	16,427	30,075	2,926	11,504	89,945	130,224	3,787	134,011
<i>Memo: % change</i>										
<i>Unadjusted</i>	17.4	-39.4	-4.5	53.7	-28.9	29.9	8.7	9.3	-53.4	5.3
<i>FX-adjusted</i>	108.9	-37.1	16.7	57.2	51.3	40.8	30.9			

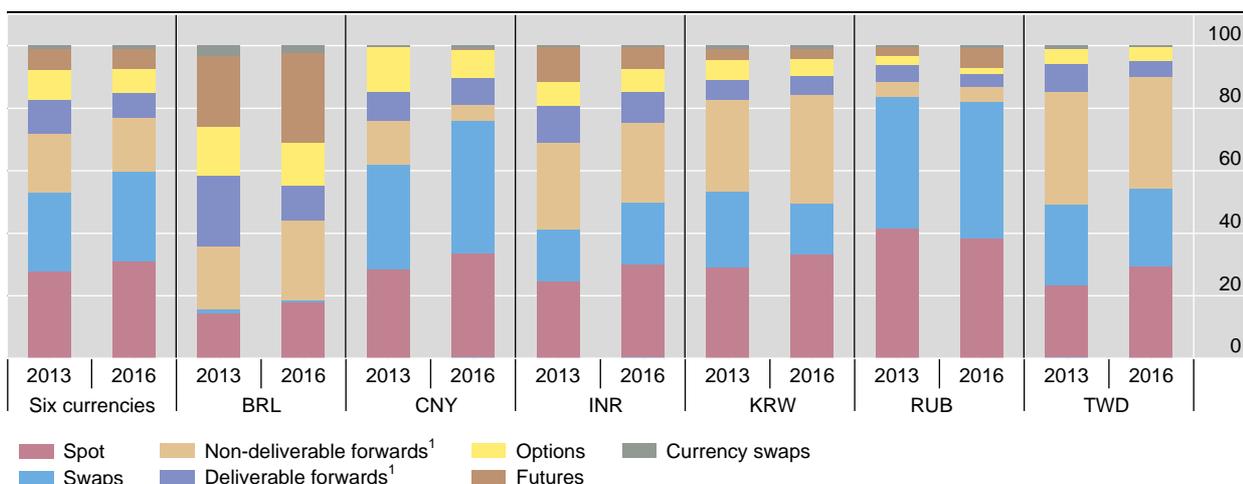
¹ Adjusted for local and cross-border inter-dealer double-counting.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

EME currency global trading composition by instrument: 2013 and 2016

In per cent

Graph 1



¹ NDF turnover is against the US dollar only (thus understating total NDFs by an average of 3%); deliverable forwards are outright forwards less US dollar NDFs and are correspondingly overstated.

Sources: Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics and Triennial Central Bank Survey; authors' calculations.

the last three years: NDFs continue to represent about a fifth (19%) of outright forward trading, and about a 40th (2.6%) of overall FX trading. The Triennial did not collect data on non-deliverable options and currency swaps, which might have grown faster. NDFs written against the US dollar accounted for 97% of the total, an even higher share than for EME FX generally.

In the six currencies singled out by the Triennial, which account for two thirds of all NDFs, turnover increased at a faster pace, by 8.7%. Growth was much stronger in exchange rate-adjusted terms (30.9%, Table 1) than in current dollar terms, owing to depreciation against the dollar of the real, rupee and rouble. Indeed, BRL NDF turnover would have doubled in the absence of BRL depreciation. By contrast, the substantial decline in CNY NDFs and the rapid growth of KRW and Taiwan dollar (TWD) turnover owed little to movements against the US dollar. Apart from the six surveyed currency pairs, NDF markets are active in a number of other currencies. The DTCC data (see below) show that the Indonesian rupiah, Malaysian ringgit, and Chilean and Colombian pesos also have sizeable NDF trading.

Apart from the renminbi, NDFs grew in line with turnover in EME currencies. As a hedging market, they grew along with the increased trading of swaps and forwards in the broader global FX market (Moore et al (2016)).

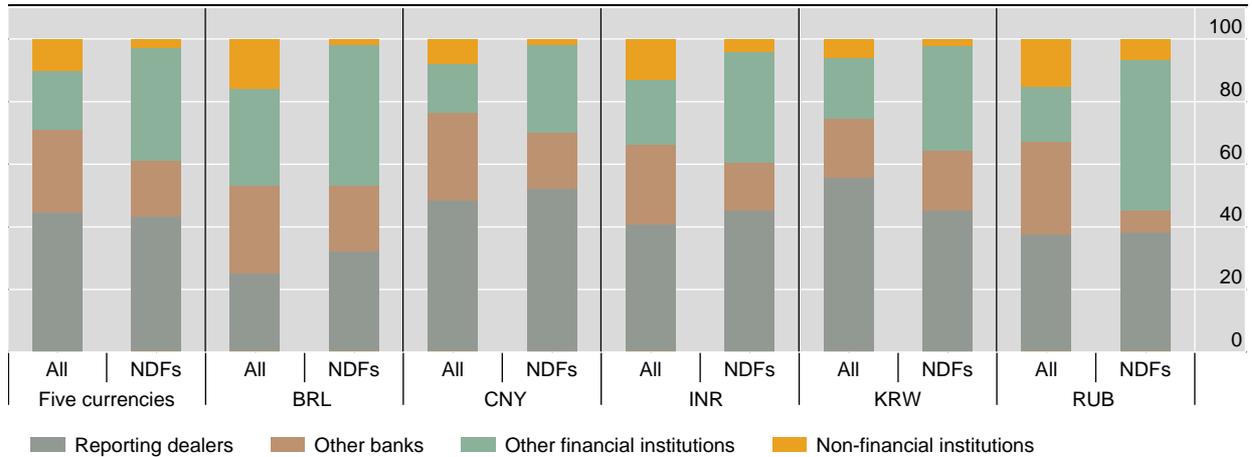
In aggregate, the share of NDFs in currency trading has declined relative to spot trading and swaps (Graph 1, two left-hand bars), but this is due entirely to the renminbi. Apart from it, NDFs actually gained share in BRL and KRW trading, and retained their share in the other three currency pairs. (These data on instruments combine data from the Triennial and futures exchanges. The Annex table gives the underlying dollar amounts and growth rates of the instrument breakdown.)

Compared with other FX instruments, NDF counterparties are skewed towards non-bank financial firms (Graph 2). This category includes not only institutional investors hedging their holdings but also leveraged accounts. The London Foreign

EME currency trading composition by counterparties: all instruments vs NDFs¹

In per cent

Graph 2



¹ NDF turnover is against the US dollar only (thus understating total NDFs by an average of 3%); deliverable forwards are outright forwards less US dollar NDFs and are correspondingly overstated.

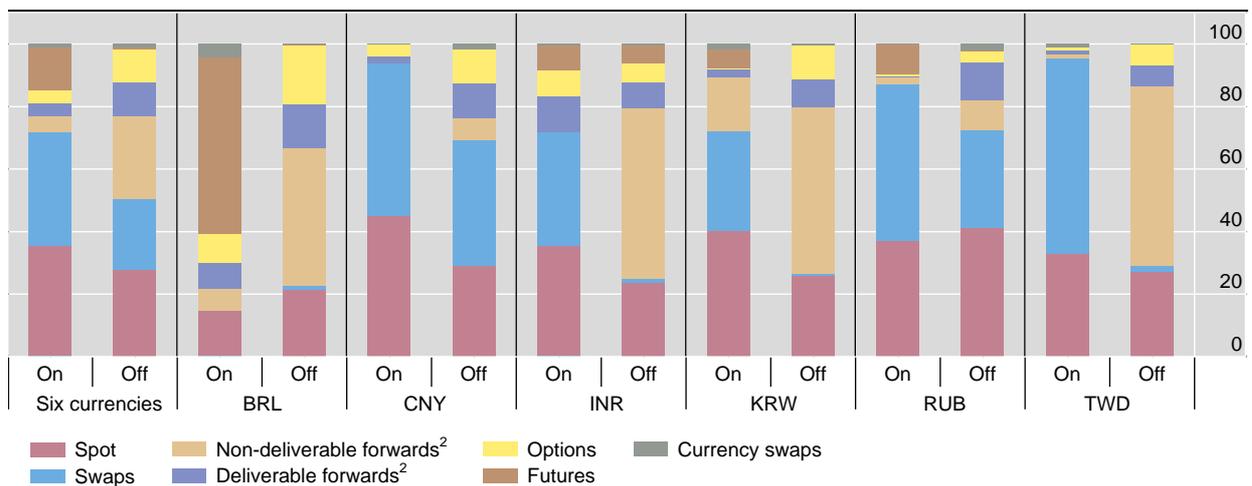
Sources: London Foreign Exchange Joint Standing Committee; BIS Triennial Central Bank Survey; authors' calculations.

Exchange Joint Standing Committee, a Bank of England-hosted group, reports more prime broker customers – mainly hedge funds and the like – for NDFs than for DFs, including FX swaps. The role of such traders may have contributed to the suspicion with which some policymakers are said to view NDFs (IGIDR Finance Research Group (2016); see also Ibrahim (2016)).

EME currency global trading composition by instrument: onshore vs offshore¹

In per cent

Graph 3



On = onshore; Off = offshore.

¹ Onshore is defined as all trades executed in the jurisdiction where a currency is issued on a "net-gross" basis (ie adjusted for local inter-dealer double-counting). Offshore is calculated as the difference between total for the currency on a "net-net" basis (ie adjusted for local and cross-border inter-dealer double-counting) and onshore transactions. ² NDF turnover is against the US dollar only (thus understating total NDFs by an average of 3%); deliverable forwards are outright forwards less US dollar NDFs and are correspondingly overstated.

Sources: Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics and Triennial Central Bank Survey; authors' calculations.

The NDF is a key instrument in EME currencies' offshore, but not onshore, trading (Graph 3; see Ehlers et al (2016) for an analysis of CNY on- and offshore trading). For a full picture of FX instrument composition, we again add exchange-traded turnover to the over-the-counter turnover collected in the Triennial. NDFs trade onshore to some extent in the real, won, rouble and New Taiwan dollar.² Outside Brazil, the modal domestic trade is a swap, as in the global FX market.³ By contrast, NDFs are over 40% of offshore FX trades in the real, rupee, won and New Taiwan dollar.

DFs (including FX swaps) tend to trade onshore and NDFs offshore. As shown in the top panels of Table 2, offshore NDFs account for 29.5% of total forward trading, higher than the 21.1% share that would hold if the deliverable/non-deliverable split were the same onshore and offshore. Similarly, DFs trade disproportionately onshore.⁴ The lower six panels of Table 2 show that the strength of the relationship,

Trade location and deliverability of forwards¹

Average daily turnover in millions of US dollars, April 2016

Table 2

Six currencies²	DFs	NDFs	Total	Memo: Share (%)³	DFs	NDFs	Total
Onshore	88,277	10,851	99,129	<i>Onshore</i>	32.9	4.0	37.0
Offshore	89,821	79,093	168,914	<i>Offshore</i>	33.5	29.5	63.0
Total	178,098	89,945	268,043	Total	66.4	33.6	100.0
Brazilian real				Chinese renminbi			
Onshore	3,036	2,527	5,563	Onshore	28,064	8	28,072
Offshore	2,810	16,126	18,936	Offshore	72,187	10,350	82,538
Total	5,846	18,653	24,499	Total	100,252	10,359	110,610
Indian rupee				Korean won			
Onshore	16,305	0	16,305	Onshore	14,454	7,357	21,811
Offshore	2,208	16,427	18,635	Offshore	2,985	22,718	25,703
Total	18,513	16,427	34,940	Total	17,439	30,075	47,515
Russian rouble				New Taiwan dollar			
Onshore	18,645	828	19,472	Onshore	7,773	131	7,905
Offshore	8,199	2,099	10,298	Offshore	1,430	11,373	12,804
Total	26,844	2,926	29,770	Total	9,204	11,504	20,708

DFs = deliverable forwards and FX swaps; NDFs = non-deliverable forwards.

¹ NDF turnover is against the US dollar only (thus understating total NDFs by an average of 3%); deliverable forwards are outright forwards and FX swaps less US dollar NDFs and are correspondingly overstated. Currency totals are reported on a "net-net" basis, ie adjusted for local and cross-border inter-dealer double-counting. Onshore is defined as all trades executed in the jurisdiction where a currency is issued on a "net-gross" basis (ie adjusted for local inter-dealer double-counting); offshore is calculated as the difference between total for the currency on a net-net basis and onshore transactions. ² Brazilian real, Chinese renminbi, Indian rupee, Korean won, Russian rouble and New Taiwan dollar. ³ Six currencies onshore and offshore percentage shares.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

² Some NDFs traded in Brazil settle in reais (Garcia and Volpon (2014); Kohlscheen and Andrade (2014)).

³ For the real, futures trading dominates onshore. See Upper and Valli (2016).

⁴ The share of offshore NDF trading (29.5%) is over 8 percentage points higher than in the case of the same DF and NDF split onshore and offshore (33.6% * 63.0% = 21.1%). Similarly, DFs' onshore share (32.9%) is higher than expected (37.0% * 66.4% = 24.6%). A chi-squared test strongly rejects the independence of trading location and deliverability (Table 3).

though uniformly highly significant in statistical terms, varies across the six currency pairs. Segmentation is strongest in the rupee, for which NDFs do not trade onshore at all and DFs trade predominantly onshore, followed by the New Taiwan dollar, won, renminbi, real and rouble. In India, the sense that onshore markets had lost market share led the Ministry of Finance to commission a group of experts (Standing Council on International Competitiveness of the Indian Financial System (2015)). Supporting the Standing Council in its investigation of markets, the Indira Gandhi Institute of Development Research Finance Research Group (2016, p 29) suggested that domestic banks in India be allowed to participate in the NDF market.

NDFs and paths of foreign exchange liberalisation

The divergent trends across currencies point to three stylised paths for the development of FX markets, from a starting point where restrictions on foreign participation in the domestic FX markets and offshore deliverability have fostered the emergence of an NDF market. One is a sudden liberalisation of FX trading and the capital account. The second is market development around an entrenched NDF market. And the third is a controlled opening up of the FX market within a regime that retains effective capital controls.

The rouble has followed the first path.⁵ It was made fully convertible in mid-2006 amid current account surpluses, large foreign exchange reserves and official ambitions for its international use. Among our six currencies, the rouble NDF has the smallest share among the different instruments used for RUB trading (Graph 1). Bloomberg stopped publishing a separate exchange rate series for the rouble NDF in 2014, citing its price convergence with the deliverable forwards.

Still, the rouble NDF has lingered for 10 years and even enjoyed a modest revival recently. One interpretation of the revival is that credit and legal concerns since 2014 have prolonged the life of the rouble NDF. In 2013, the concentration of liquidity in offshore markets (including the NDF) was ascribed to concerns about the enforceability of collateral arrangements in Russia (HSBC (2013)). In early 2014, a series of financial sanctions on certain Russian individuals, defence firms, energy firms and banks were reported to have led non-financial firms to use NDFs rather than DFs (Becker (2014)). In September 2014, sanctions were extended to Russia's largest bank. The share of NDFs in RUB forward trades in London bottomed out in October 2014, and has since risen slightly in the three subsequent semiannual London surveys (Graph 4, left-hand panel).

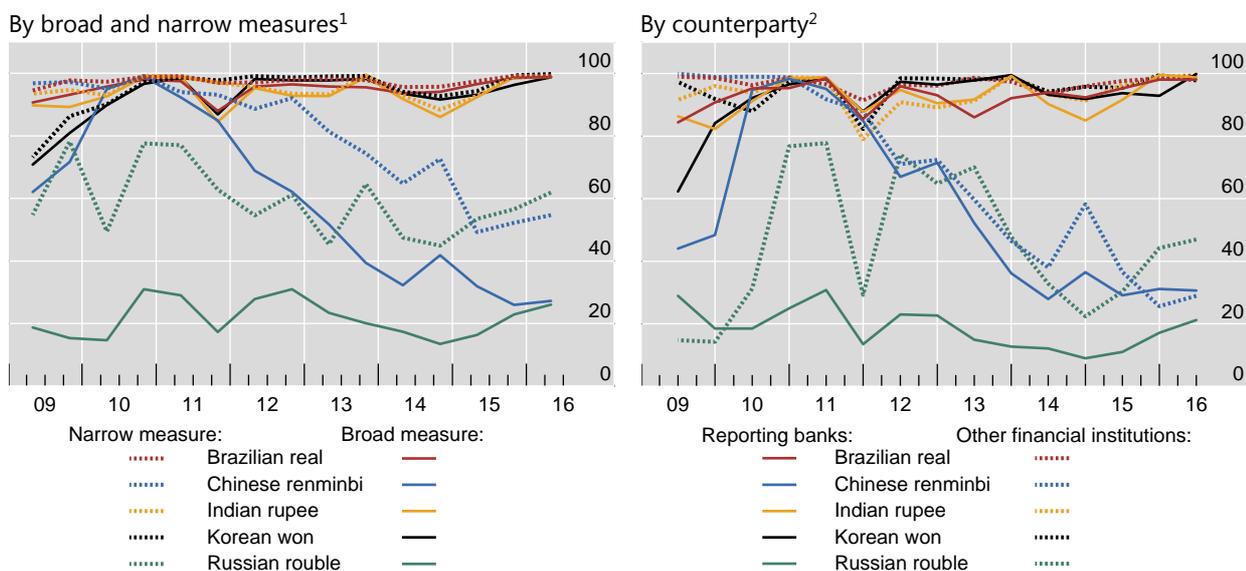
The won exemplifies the second path, in which the foreign exchange market develops around an entrenched NDF. While having a generally open capital account, Korea still limits non-residents' won borrowing from banks in Korea in the DF market. As a result, the NDF has the lion's share of forward won trading in London (Graph 4). However, Korean banks can arbitrage between the onshore forward and NDF markets, and various interest rate and currency derivatives trade actively in the non-deliverable form. The KRW/USD pair is now by far the most traded NDF globally, and KRW NDF turnover expanded by over half between 2013 and 2016, even faster than

⁵ In the early 1980s, the Australian dollar also followed this first path. The domestically traded and domestic currency-settled NDF market disappeared four years after liberalisation in 1983 (Debelle et al (2006)).

Share of NDFs in forward trading

In per cent

Graph 4



¹ Narrow measure includes deliverable forwards only; broad measure includes (deliverable) swaps as well. ² Using broad measure.

Sources: London Foreign Exchange Joint Standing Committee; authors' calculations.

the strong growth of KRW spot and forward trading (Table 1). It is possible that market developments associated with derivatives reforms have contributed to the rise in the turnover in the KRW NDF (see below).

The renminbi's internationalisation has taken the third path. Under China's capital controls, residents have access to offshore markets, and non-residents have access to onshore markets, generally only through administered channels. Non-residents do not generally enjoy access to onshore DFs and therefore cannot use them to borrow renminbi from banks in China. Instead, the authorities have permitted, within still effective (although leaky) capital controls, a pool of offshore renminbi that can be freely traded and delivered (Shu et al (2015)). The renminbi forward market is thus split into three: an offshore NDF market (starting in the 1990s), an onshore DF market (since 2007) and an offshore DF market, known as the CNH market (since mid-2010).

The progress of deliverable renminbi at the expense of the NDF is very evident in London trading (Graph 4, left hand panel). By mid-2016 the NDF share of forward trading in London had declined to that of the rouble (25%). The NDF's share declined sharply between 2011 and 2014 across all counterparties (Graph 4, right-hand panel). Before the August 2015 reform of the onshore renminbi fixing mechanism, the NDF was a problematic hedge, with a gap as wide as 2% between its settlement rate and the renminbi's actual trading level (McCauley et al (2014)).⁶

⁶ Since the reform, the gap has narrowed, as the "fixing rate" used for settlement – set every morning at 9.30 am in the China Foreign Exchange Trade System – is not far from the previous day's close. The reduced "basis risk" from the convergence between the NDF's settlement rate and the market rate made the NDF more useful, but came too late: liquidity had already tipped to DFs.

Segmentation of onshore and offshore markets,¹ April 2013 and April 2016

Chi-squared test statistics for the independence of trade location and deliverability of forwards²

Table 3

	BRL	CNY	INR	KRW	RUB	TWD	Total ³
2013	1,933	5,452	21,961	14,653	5,760	9,997	46,083
2016	1,848	3,732	26,061	13,734	1,829	14,461	33,652

¹ Using the broad measure of forwards, which includes deliverable forwards and (deliverable) swaps. ² The critical value for the chi-squared distribution at $p = 0.001$ is 10.8. ³ Total for the six currencies.

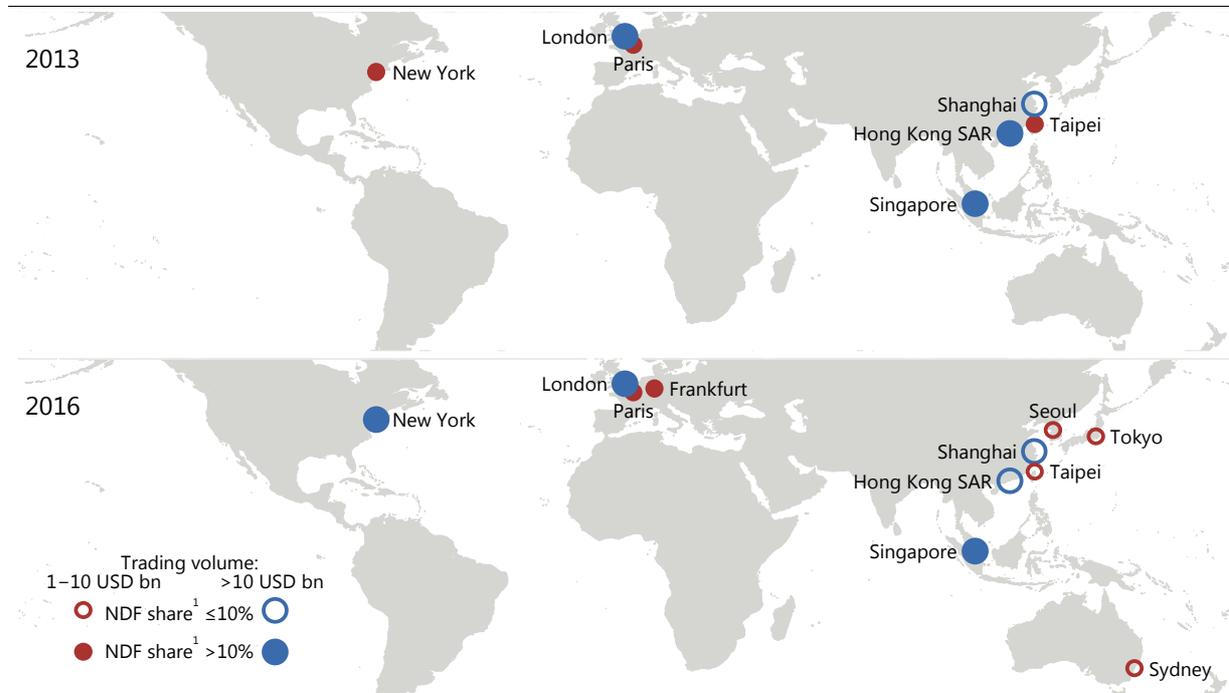
Sources: BIS Triennial Central Bank Survey; authors' calculations.

The renminbi and rouble stand out from the other four owing not only to the declining share of NDFs in forward turnover, but also to the declining segmentation between onshore and offshore markets. For the renminbi, the relationship between deliverability and location has weakened – a drop in the chi-squared statistic from 5,452 to 3,732 (Table 3) – as offshore deliverable CNY trades doubled and offshore NDF trades shrank. Likewise, the increase in NDF trading in Moscow reduced the segmentation between onshore and offshore rouble markets.

The displacement of the renminbi NDF by deliverable CNY trades has progressed furthest in the offshore centres that have traded the renminbi the longest. Asian centres enjoyed an early lead in renminbi trading under the strategy of renminbi internationalisation. Graph 5 shows that, as of April 2016, the Asian centres traded a mix of forwards that was very light in NDFs, compared with April 2013. NDFs still have a higher share in European and US CNY trading.

Renminbi trading volumes and deliverability by trading centre, 2013 and 2016

Graph 5



¹ NDFs as a percentage of deliverable forwards and FX swaps.

Sources: BIS Triennial Central Bank Survey; authors' calculations.

NDFs and derivatives reform

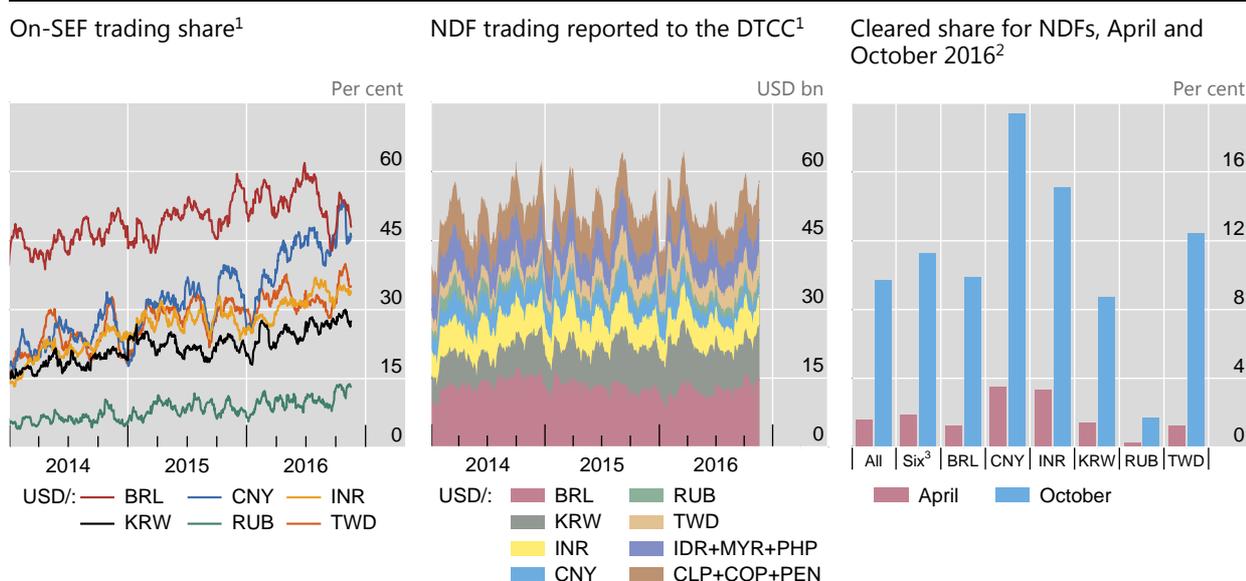
International regulatory initiatives have begun to transform NDF markets, as they have other derivatives markets. Policymakers concluded from the events of 2008–09 that the opacity and decentralisation of derivatives markets posed systemic risks. Measures to reduce such risks include promotion of trading on electronic platforms, mandatory trade reporting and centralised clearing. As a result, NDFs, along with other derivatives (particularly interest rate derivatives; see Ehlers and Eren (2016)), have started the transition from a decentralised, bilateral microstructure to centralised trading platforms and clearing with mandatory disclosure.

According to the DTCC data (see below), trading of NDFs on electronic platforms has risen considerably in the last few years. The share of NDF trading on swap execution facilities (SEFs) reached 15% for the rouble, about 30% for the rupee, won and New Taiwan dollar, and 45% for the real and renminbi in September 2016 (Graph 6, left-hand panel). This increase in centralised NDF trading occurred without a requirement that FX products be traded on such platforms (FSB (2016)).

A large number of jurisdictions now require public trade reporting for NDFs and other derivatives (FSB (2016)). Volumes of NDFs reported to the DTCC involving US counterparties amounted to 40% of the total trading of our six currencies in April 2016. In particular, about a third of NDF trades in the renminbi, rupee, won and New Taiwan dollar were reported for April 2016, and 60% of trades in the real and rouble.

NDFs in DTCC and LCH data

Graph 6



¹ Twenty-day moving average. SEF = swap execution facility. ² DTCC change between April and October 2016 is applied to Triennial Survey turnover (Table 1). ³ Six currencies: BRL, CNY, INR, KRW, RUB and TWD.

Sources: Clarus Financial Technology; DTCC; LCH; BIS Triennial Central Bank Survey; authors' calculations.

NDF trading during the August 2015 renminbi volatility

Using DTCC and Triennial data, this box explores how renminbi market developments in August 2015 spilled over into emerging FX markets. This analysis using newly available turnover data sheds new light on international spillovers from China's currency markets, heretofore identified through prices (Shu et al (2016)).

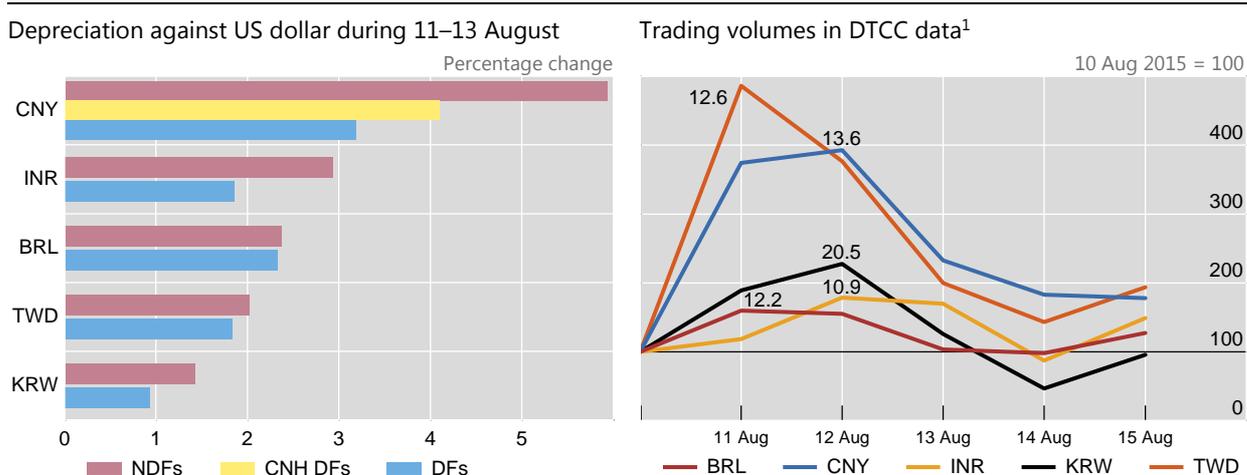
On 11–12 August 2015, the renminbi daily fixing was set successively 1.9% and then 1.6% lower than the previous day, and fears of a steep CNY depreciation led to widespread pressure on forwards of EME currencies (Graph A, left-hand panel). The INR three-month NDF and DF depreciated by 2.9% and 1.9% against the US dollar, respectively, in three days. The BRL DF and NDF both depreciated by 2.3–2.4%. The Korean won and New Taiwan dollar depreciated less, but, like the rupee, moves were larger for NDFs than DFs. These two currencies' NDF rates switched from implying a smaller depreciation than their DF counterparts before 11 August, to a greater depreciation after.

The volume response was bigger in the currencies of China's neighbouring economies. The DTCC data show that KRW and TWD NDF trading involving US counterparties saw larger rises in volumes, even though the INR and BRL rates depreciated more (Graph A, right-hand panel). On 11 August, renminbi NDF trading almost quadrupled to \$13 billion. Given the ratio of DTCC turnover to global turnover in April, this implies around \$40 billion in global CNY NDF turnover, four times the April 2016 level. CNY NDF turnover rose further on the following day before falling back. TWD NDF trading surged even more on 11 August, to 486% of the previous day's volume, or an estimated 3.7 times the April volume. While KRW NDF turnover only doubled, its increase of \$10 billion was the largest response of the five currencies. In terms of volume, the responses of the INR and BRL NDFs were the smallest. Similar increases in NDF trading occurred during a bout of CNY turbulence in January 2016. On this evidence, it appears that, even though the CNY NDF turnover is fading, renminbi developments are boosting Asian NDFs.

Observations for three countries with daily data on domestic trading suggest that the NDF's share of trading increased in China and India in this episode, but not in Brazil. For the renminbi, the daily onshore spot trading through the China Foreign Exchange Trade System (CFETS) rose by 50% on average in the five days after 11 August, a modest increase compared with that of NDF trading registered with the DTCC. On 11 August when NDF trading peaked, the ratio of NDF trading in DTCC data to onshore spot trading (CFETS) rose to 50%, well above the ratio of 42% for the *global* NDF trading to onshore spot trading reported by the April 2016 Triennial. Data from the Reserve Bank of India show that increases in spot trading volumes in the initial days after the devaluation were comparable to those of the NDF trading reported in the DTCC data, but onshore DFs showed lower increases. Spot trading rose by more than that of NDFs over a five-day period in the case of the real, according to the Central Bank of Brazil.

DF and NDF developments after 11 August 2015

Graph A



NDFs = non-deliverable forwards; CNH DFs = offshore Chinese renminbi deliverable forwards; DFs = deliverable forwards.

¹ The numbers shown in the panel indicate the trading volume peak for each currency, in billions of US dollars.

Sources: Bloomberg; Clarus Financial Technology; DTCC; authors' calculations.

Data made available through mandatory disclosure have made it possible to study NDF market dynamics at a high frequency. For example, DTCC data suggest that NDFs experienced peak volumes in August 2015 (Graph 6, centre panel). This timing points to the influence of the changes to the renminbi's exchange rate management on NDF volumes, not only in the renminbi but also in other Asian currencies (see box).

In almost all jurisdictions, central clearing of NDFs, though not legally mandated, is being encouraged by higher margins for non-cleared NDFs. From September 2016, large banks in the United States, Japan and Canada must post both initial and maintenance margins for NDFs and higher margins for those not centrally cleared.

When these rules came into effect, cleared NDF trades immediately surged, and rose to a record high in October. We estimate that the share of cleared NDF trades quintupled to about 10% in October 2016 from the low base of April 2016 (Graph 6, right-hand panel; see Barnes (2016) for method). The Triennial and clearing house data suggest that in April 2016, before the new rules, just 1–2% of global NDFs were centrally cleared. The cleared share ranged from practically zero for the rouble and 1–2% for the real, won and New Taiwan dollar to 3–4% for the renminbi and rupee. The imposition of higher margin requirements saw the share of cleared CNY, INR and TWD NDFs rise by over 10 percentage points.⁷

Conclusions

The NDF market has maintained its share globally in overall FX trading, despite shrinkage of CNY NDF turnover in recent years. It remains a particularly important offshore FX instrument for many EMEs. This market's resilience reflects hedging and position-taking demand for currencies subject to restrictions on non-resident use.

Nonetheless, different policies towards such restrictions have led to different paths in NDF market development. The Korean won NDF bulks large in trading in that currency owing to official constraints, and its turnover may be spurred by renminbi developments while its liquidity gains from ongoing market centralisation. The rouble NDF is lingering with a low market share despite full convertibility of the currency, possibly due to credit constraints and political developments. At the same time, renminbi DFs are displacing the NDF, thanks to currency internationalisation.

The corner of the foreign exchange market represented by NDFs also opens a window for assessing the progress of derivatives reforms. Trading of NDFs has begun to shift to centralised platforms, and higher margin requirements for non-cleared derivatives trades implemented in September saw centralised clearing of NDFs jump. Disclosure of trades has become mandatory in a number of jurisdictions, and the resulting increased transparency can inform a better understanding of market dynamics.

⁷ See Wooldridge (2016) for further discussion on central clearing of OTC derivatives.

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Annex

Global turnover in six currencies with NDFs,¹ in April 2016

Average daily turnover in billions of US dollars

Table A1

	OTC spot	OTC FX swaps	OTC NDFs ¹	OTC DFs	Options ²	Futures	OTC currency swaps	Total
Brazilian real								
Onshore	5.4	0.1	2.6	3.1	3.4	21.1	1.6	37.3
Offshore	7.9	0.4	16.1	5.2	6.8	0.1	0.1	36.7
Total	13.3	0.5	18.7	8.3	10.2	21.2	1.7	74.0
<i>% change, 2013–16</i>	16.5	-34.4	17.1	-53.3	-17.3	19.4	-33.7	-5.9
Chinese renminbi								
Onshore	24.9	27.0	0.0	1.3	2.0	0.0	0.2	55.4
Offshore	42.7	59.0	10.4	16.4	15.8	0.3	2.5	147.0
Total	67.6	86.0	10.4	17.6	17.9	0.3	2.6	202.4
<i>% change, 2013–16</i>	99.0	115.5	-39.4	60.0	4.6	578.4	413.9	69.2
Indian rupee								
Onshore	12.2	12.6	0.0	3.9	2.8	2.8	0.1	34.5
Offshore	7.1	0.3	16.5	2.5	1.8	1.7	0.2	30.1
Total	19.3	12.9	16.5	6.4	4.7	4.5	0.3	64.6
<i>% change, 2013–16</i>	26.9	27.9	-4.7	-9.7	0.7	-34.9	-0.8	4.8
Korean won								
Onshore	17.6	14.0	7.5	1.1	0.2	2.7	0.7	43.8
Offshore	11.1	0.2	22.8	3.8	4.5	0.0	0.3	42.7
Total	28.6	14.3	30.3	4.9	4.7	2.7	1.0	86.5
<i>% change, 2013–16</i>	47.4	-10.6	54.3	15.6	11.0	10.7	50.2	29.9
Russian rouble								
Onshore	15.0	20.3	0.9	0.1	0.3	3.9	0.0	40.6
Offshore	8.9	6.7	2.1	2.6	0.8	0.0	0.5	21.6
Total	23.9	27.1	3.0	2.7	1.1	4.0	0.5	62.2
<i>% change, 2013–16</i>	-34.6	-26.9	-28.0	-43.3	-60.2	69.9	10.6	-29.3
New Taiwan dollar								
Onshore	4.0	7.6	0.1	0.2	0.1	0.0	0.2	12.2
Offshore	5.4	0.4	11.4	1.4	1.4	0.0	0.0	19.9
Total	9.4	8.0	11.5	1.5	1.5	0.0	0.2	32.1
<i>% change, 2013–16</i>	66.0	27.0	29.9	-28.4	22.1	0.0	-28.8	31.4

DFs = deliverable forwards; NDFs = non-deliverable forwards. Currency totals are reported on a “net-net” basis, ie adjusted for local and cross-border inter-dealer double-counting. Onshore is defined as all trades executed in the jurisdiction where a currency is issued on a “net-gross” basis (ie adjusted for local inter-dealer double-counting); offshore is calculated as the difference between the total for the currency on a net-net basis and onshore transactions.

¹ NDF turnover is against all currencies. ² OTC options plus exchange-traded options.

Sources: Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics and Triennial Central Bank Survey; authors’ calculations.

Does the financial channel of exchange rates offset the trade channel?¹

While the trade channel indicates that an exchange rate depreciation will stimulate domestic economic activity, the financial channel can have the opposite effect. When banks and non-banks have foreign currency liabilities, an exchange rate depreciation has valuation effects that can lead to a tightening in domestic financial conditions. Using trade-weighted exchange rates and new BIS-constructed debt-weighted exchange rates to separate these influences, this article finds that the financial channel partly offsets the trade channel for emerging market economies but the effect is weaker for advanced economies.

JEL classification: F31, F41, F43, G15.

The trade channel, or demand substitution channel, underpins the effect of the exchange rate on economic activity. An exchange rate appreciation raises the international cost of exports, reducing both export demand and the domestic cost of imports, leading to substitution away from domestic production. Thus, an appreciation is contractionary for domestic economic activity, while a depreciation is expansionary.

However, the links between economies go beyond trade. Extensive financial connections, and in particular the large stock of foreign currency borrowing, provide another crucial means by which external conditions can affect an economy. An appreciation of the local currency can strengthen the balance sheets of domestic borrowers in foreign currency, easing domestic financial conditions. This "financial channel" of exchange rates can act as a potential offset to the trade channel, in that an exchange rate appreciation boosts domestic economic activity through easier financial conditions. Conversely, a depreciation could negatively affect the economy by weakening domestic balance sheets. In this article we use the term financial channel interchangeably with "risk-taking channel", which is also sometimes used to describe this mechanism. There could also be some offsetting economic consequences from the exchange rate valuation effects of foreign currency assets. However, we expect the effects of exchange rate changes through foreign currency liabilities to predominate over those through foreign currency assets. Foreign currency assets are often held by "long-term" investors, such as pension funds, or foreign exchange reserves managers, from which valuation changes are likely to elicit

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smaller changes in spending. In addition, in much the same way as an interest rate cut can stimulate the economy by transferring income from savers to borrowers, an appreciation can stimulate the economy through the transfer of net wealth from foreign currency savers to borrowers.

Whether an exchange rate appreciation is contractionary or expansionary rests on whether the trade or financial channel predominates. The strength of the trade channel depends on the nature of trade flows, while the intensity of the financial channel depends on the sensitivity of domestic balance sheets to the exchange rate and the amount of foreign borrowing. The intensity of both of these channels can differ across countries for a range of reasons. So an appreciation may be contractionary for some countries but expansionary for others.

This article extends BIS (2016a) to consider empirically the relative strength of the trade and financial channels, taking into account differences between countries and providing some insight into the mechanisms at work by examining the response of GDP components. We find evidence that the financial channel partly offsets the trade channel for emerging market economies (EMEs) but that it is weaker for advanced economies. Investment is found to be particularly sensitive to the financial channel.

We first review the relevant empirical literature on the trade and financial channels. We then describe our empirical approach to examining the two channels. This involves the use of the trade-weighted exchange rate to capture the trade channel and the debt-weighted exchange rate to capture the financial channel. The construction of the latter, which draws on BIS debt statistics, is outlined in a box. We then present our results, first for GDP and then for GDP components.

The trade channel

The trade channel of exchange rates links changes in exchange rates to export and import volumes via the prices of traded goods. If export prices are fixed in domestic currency, then the full effect of an exchange rate depreciation will “pass through” to lower export prices as measured in the foreign currency. Foreign demand for exports typically increases as their foreign currency price falls, and so a depreciation will raise export volumes. Equivalently, a depreciation is typically passed through to higher domestic prices for imports, which will generally result in a lower volume of imports. Both import and export effects imply that an exchange rate depreciation increases net exports, while an appreciation reduces them.

However, pass-through to export and import prices may be incomplete, meaning that the change in foreign currency export prices and domestic currency import prices may be smaller than the change in the exchange rate. A range of factors influences the extent of exchange rate pass-through into trade prices as well as the response of trade volumes to the prices of traded goods. The strength of the trade channel can then differ widely across countries.

One important factor is the nature of trade. For example, if a country exports generic goods, such as commodities, for which there is a world price, there will likely be no pass-through of exchange rate changes to the export price, and domestic currency export prices will therefore fully reflect the exchange rate change. Conversely, for a specialised good, or one for which the exporting country is a major producer, the exporting country will generally have some influence over the world

price, meaning there will be partial pass-through. Equivalently the degree of pass-through to import prices will depend on whether these prices are set in the local currency or the producer's currency.

Further, traded goods prices may not be invoiced in the currency of the importer or exporter, but in a specific "invoicing currency" such as the US dollar. In this case the exchange rate against this invoicing currency will be the one relevant for traded goods price and volume effects.²

An exchange rate depreciation can stimulate economic activity through exports even if there is no pass-through to foreign currency export prices. If foreign currency export prices are unchanged with a depreciation, then the domestic currency price of exports will rise. The increased profits resulting from higher prices can stimulate investment through greater retained earnings, or consumption through higher payments to the owners of exporting firms. Through the same mechanism, an appreciation can depress economic activity.

Researchers have documented several ways in which the composition of a country's trade flows can influence the observed aggregate pass-through. Service prices have been found to be more responsive to exchange rates in the short run (Cole and Nightingale (2016)), while more specialised goods tend to have variable markups and so their prices are less sensitive to exchange rate movements (Burstein and Gopinath (2014)). Pass-through can depend not only on the type of export but also the characteristics of the exporting firm. Amiti et al (2014) show that, while pass-through is nearly complete for small non-importing firms, for large import-intensive exporters it is only half so. Berman et al (2012) find that highly productive firms vary their markup and so have less pass-through in response to exchange rate movements. Trade elasticities can also be influenced by country-level factors. Bussière et al (2014) find that export price elasticities are higher in EMEs than in advanced economies, primarily because of macroeconomic factors. Indeed, they find that export and import price elasticities are correlated across countries.

The extent of pass-through can also vary over time, for structural and cyclical reasons. Campa and Goldberg (2005) showed that much of the change in exchange rate pass-through had resulted from shifts in the composition of countries' imports. Pass-through can also decline because of growing trade integration (Gust et al (2010)) and in particular because of the increasing role of global value chains (see Ahmed et al (2015) and Kharroubi (2011) on how this also influences trade balances). Cyclically, the extent of pass-through can also depend on a range of factors including the strength of external demand (Bussière et al (2013)) and the level of interest rates (Alessandria et al (2013)). Moreover, pass-through can also vary depending on the nature of shocks hitting the economy, as shown by Forbes et al (2015).

Overall, the strength of the trade channel for an economy will depend not only on the responsiveness of traded goods prices and volumes to the exchange rate but also on the share of exports and imports in economic activity (the trade share). Hence it is not surprising that the strength of this channel is typically found to differ markedly across countries. Auboin and Ruta (2011) and Leigh et al (2015) provide more detailed surveys of the extensive literature on the relationship between the exchange rate and trade.

² Gopinath (2015) shows that countries with more trade invoiced in their local currency generally have lower pass-through to import prices. Other studies find equivalent results for individual countries, including Gopinath et al (2010), and Gillitzer and Moore (2016). See also Casas et al (2016).

The financial channel

The financial channel of exchange rates, sometimes also referred to as the risk-taking channel, works in the opposite direction to the trade channel. The financial channel describes how exchange rate movements influence the supply and cost of foreign funding, and hence domestic economic activity.³

The risk-taking channel is present whenever borrowers' balance sheets are sensitive to exchange rate changes. This sensitivity can result from an imbalance in the currency denomination of a firm's assets and liabilities or in the relationship of net cash flows to the exchange rate. The simplest case is when there is an unhedged currency mismatch, for example when a non-financial corporate borrows in foreign currency to finance domestic currency assets such as real estate. Also, if a bank makes foreign currency loans to domestic firms, currency fluctuations will ultimately affect the bank's credit quality, and hence lending and funding decisions. If a borrower has local currency assets but foreign currency borrowing, then its net worth rises with an appreciation of the local currency. Similarly, firms' cash flows may rise with the local currency; for example, the price of oil tends to be inversely related to the strength of the dollar and so non-US oil producers' revenue can rise with a dollar depreciation.

There can be both a price and quantity aspect to the financial channel. The improved creditworthiness of borrowers that comes with a local currency appreciation can lift the supply of foreign currency lending.⁴ Bruno and Shin (2015a) find that a depreciation of the dollar, from expansionary US monetary policy, results in an increase in cross-border banking capital flows and a rise in the leverage of international banks. Bruno and Shin (2015b) find empirical support for their model in which local currency appreciation is associated with higher leverage of the domestic banking sector through its interaction with global banks. Indeed, BIS (2016b) shows that a 1% depreciation of the dollar is associated with a 0.6 percentage point increase in the quarterly growth rate of dollar-denominated cross-border lending. In addition, if an appreciation results in an apparently lower risk profile for foreign currency borrowers, this may reduce their risk spreads and hence their borrowing costs. But this effect only seems to be present for appreciation vis-à-vis the funding currency: Hofmann et al (forthcoming) find that risk spreads decline as EME currencies appreciate against the dollar but not if they appreciate against other currencies.

The financial channel can thus lead to a cycle through which appreciation against global funding currencies increases the supply, and reduces the cost, of foreign lending. This will boost interest-sensitive domestic spending. Conversely, a contraction in financial conditions and economic activity will follow a local currency depreciation. These effects will generally be more potent in EMEs, where unhedged foreign currency exposures are more likely to be present, in part because of less-developed financial systems. However, advanced economies may be affected too.

³ The financial channel relates to the broader risk-taking channel of monetary policy, as outlined in Borio and Zhu (2012). The financial channel has been described in Shin (2015, 2016) and BIS (2016b). It also relates to the broad literature on the implications of foreign currency debt and currency mismatches in EMEs, see eg Cespedes et al (2004) and Bordo et al (2010).

⁴ For example, Shin (2015) notes that foreign lenders with a fixed exposure limit, say resulting from a value-at-risk (VaR) constraint, can increase the supply of lending as local currency appreciation strengthens balance sheets. See also Bruno and Shin (2015a,b).

Rey (2015) finds that US monetary policy shocks are transmitted internationally even to countries with developed financial markets and flexible exchange rates.

Importantly, the relevant exchange rate for the financial channel is the one against international funding currencies, predominantly the US dollar and increasingly the euro, but also the yen, Swiss franc and pound sterling. In contrast, the trade channel is sensitive to the trade-weighted exchange rate, ie the weighted exchange rate against countries with which the country trades and competes in global markets.⁵

Data and methodology

To test empirically the relative importance of the trade and financial channels, we estimate models of GDP growth and its components with the trade-weighted and debt-weighted exchange rates as key explanatory variables. The nominal effective exchange rate (NEER, which is trade-weighted) should capture the trade channel, while the BIS-constructed debt-weighted exchange rate (DWER) proxies for the financial channel.⁶ The DWER uses the shares of foreign currency debt to weight a country's bilateral exchange rates, as described in Box A.

We use a univariate autoregressive distributed lag (ARDL) model to compute the short- and long-run elasticity of GDP and its components with respect to the two exchange rate variables. In principle, both GDP and exchange rates could be driven by a common (unmodelled) factor, or the causality may run from GDP growth to exchange rates. For instance, financial booms can coincide with exchange rate appreciations. We take two steps to limit such concerns. First, we include control variables to account for domestic and foreign factors that could influence the relationship between exchange rates, and GDP and its components. Second, acknowledging the autocorrelation in the data given the quarterly frequency, we include lags of both the dependent and the independent variables. The lagged dependent variables are particularly useful in mitigating the consequences of model misspecification in quarterly data.

The model is given by Equation (1):

$$\Delta y_t = \sum_{i=1}^4 \gamma_i \Delta y_{t-i} + \sum_{i=0}^4 \zeta_i \Delta DWER_{t-i} + \sum_{i=0}^4 \delta_i \Delta NEER_{t-i} + \theta X_t + \varepsilon_t \quad (1)$$

where the dependent variable Δy_t is the growth of quarterly GDP (or its components):

⁵ In general, in addition to the trade-weighted exchange rate, the trade channel is also likely to be particularly sensitive to the exchange rate against currencies used in trade invoicing. However, incomplete data on the currency of invoicing prevent us from exploring this question.

⁶ While the trade channel is typically quantified through the real effective exchange rate (REER), we use the NEER to make the comparison with the debt-weighted exchange rate (which is a nominal measure) more meaningful. That said, the REER and NEER are highly correlated, with the correlation of quarterly changes in the two variables averaging 0.8 for our sample of countries.

Debt-weighted exchange rate indices

Bat-el Berger

There are several possible ways of calculating debt-weighted exchange rate (DWER) indices, depending on what measure of debt is used to weight bilateral exchange rates. More concretely, the debt measure could vary along two main dimensions: the currency of denomination and the residence of lenders (Table A).

Debt-weighted exchange rates, available weighting options

Table A

Residence of lenders:	Currency of denomination:	
	Foreign currency	All currencies
External debt	A	C
Total debt	B	D

The first possible debt measure is foreign currency-denominated external debt (cell A in Table A). This is the narrowest of the four possible measures. It does not take into account the importance of external debt in total debt and the importance of domestic currency debt in external debt. Consequently, for countries whose foreign currency-denominated external debt is a modest share of total debt (eg the United States), even large swings of the index would have a minor impact on domestic financial conditions.

The second potential debt measure is total foreign currency-denominated debt (cell B in Table A). This is a more complete measure than the one in cell A since it incorporates local debt denominated in foreign currencies. That said, it still suffers from the problem that total foreign currency debt could be a relatively small share of total debt for certain economies (eg China).

The third possible debt measure is external debt denominated in all currencies (cell C in Table A). This measure, which is conceptually very close to the one constructed by Bénétrix et al (2015), is more complete than the one in cell B since it also incorporates information on external debt denominated in the local currency of the borrowing country. Nevertheless, it ignores any local debt, including local debt denominated in foreign currencies. Therefore, it could provide a misleading picture for countries in which a large portion of the domestic debt is denominated in foreign currencies (eg the Czech Republic, Hungary and Poland).

The final potential debt measure is total debt denominated in all currencies (cell D in Table A). This is the most comprehensive of the four measures since it includes total debt and a weight is given to debt in domestic currencies. Nevertheless, this measure tends to be too broad for addressing a large number of questions. For example, the value of the index is likely to be very close to 1 for countries in which the share of domestic debt in domestic currency is large (eg China). In theory, the “total debt” used for the construction of DWER indices should encompass the debt of only those entities that can actually choose their financing currency. In practice, however, this perimeter is not easily identifiable.

We opt to construct our benchmark DWER indices using the weights based on foreign currency-denominated total debt (ie cell B in Table A). While none of the above four measures is perfect, we select that particular one because it strikes the optimal balance between conceptual comprehensiveness and computability. Furthermore, it is the most direct counterpart to the trade-weighted exchange rate (NEER and REER) indices that are typically used in the existing empirical literature. That is, it captures the distribution of the foreign currency components of total debt (regardless of how large foreign currency debt is relative to debt in all currencies) in the same way that trade-weighted exchange rate indices capture the distribution of the foreign trade component of GDP (regardless of how large foreign trade is relative to GDP).

In more concrete terms, the DWER that we construct for each country is the geometric average of its bilateral exchange rates against each of the five major global funding currencies (US dollar, euro, Japanese yen, pound sterling and Swiss franc), weighted by the shares of these global funding currencies in that country’s foreign currency debt. The weight of currency j at quarter t in the DWER index for country i is calculated using the following formula:

$$weight_{i,t}^j = \frac{XBL_{i,t}^j + IDS_{i,t}^j + LL_{i,t}^j}{\sum_j (XBL_{i,t}^j + IDS_{i,t}^j + LL_{i,t}^j)}$$

where: *XBL* = cross-border loans to non-banks denominated in foreign currencies (BIS LBS[Ⓢ] data)

IDS = international debt securities statistics denominated in foreign currencies, issued by non-banks (BIS IDSS[Ⓢ] data)

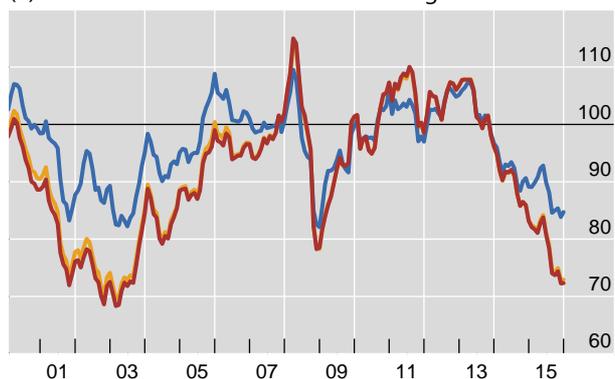
LL = local loans to non-banks denominated in foreign currencies (BIS LBS data)

Comparison of three alternative exchange rates

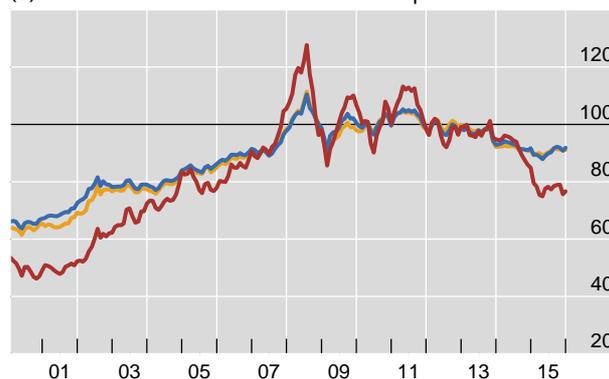
2010 = 100

Graph A

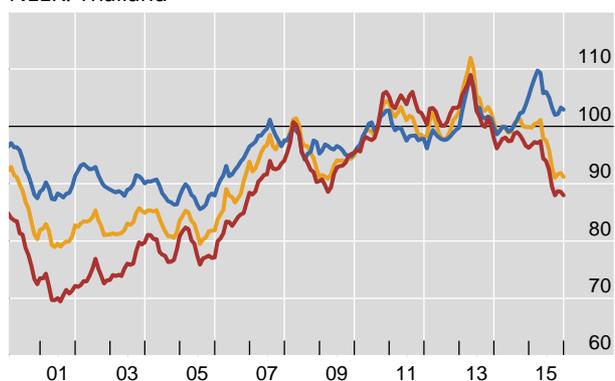
(1) DWER close to bilateral USD exchange rate: Chile



(2) DWER close to NEER: the Czech Republic



(3) DWER in between bilateral USD exchange rate and NEER: Thailand



(4) DWER close to both the bilateral USD exchange rate and the NEER: Canada



— Bilateral USD exchange rate — Trade-weighted NEER — Debt-weighted exchange rate

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; national data; BIS effective exchange rates indices and locational banking statistics; BIS calculations.

Weights are calculated on a quarterly basis. For all days in a quarter, the end-of-quarter weights of the preceding quarter are applied (eg using end-Q3 2015 weights for all days in Q4 2015). When one of the five currencies is the home currency of a given country (eg the yen in Japan), only the remaining four currencies are used to calculate the DWER weights for the respective country. For countries that joined the euro after the currency's launch, the euro is treated as a foreign currency until the quarter in which the country joined the euro. For example, in the case of Estonia, the euro is treated as a foreign currency until Q1 2011.

The *XBL* and the *LL* series are taken directly from the BIS locational banking statistics (LBS). The *IDS* series are taken directly from the BIS international debt securities statistics data. When not available, we use one of the three following estimates:

- For countries which do not report data to the BIS LBS, local loans in foreign currency j are proxied by cross-border loans denominated in currency j to banks in the respective country. Since the United States does not report local loans in foreign currencies, this estimate is used for the United States as well.
- For countries that started reporting local loans in foreign currency after the sample period started, LL in currency j are proxied by multiplying cross-border loans to banks (in currency j) by the maximum of 1 and the average of the ratio of reported local claims on non-banks to cross-border claims on banks for the first eight reported quarters. When the ratio exceeds 1, the new-reporter estimate follows the same methodology as that of the non-reporter estimate.
- For China, local loans in foreign currencies are taken from national data and are assumed to comprise 80% USD, 10% EUR, 10% JPY, 0% GBP and 0% CHF, following a methodology similar to the one used by McCauley et al (2015).

The 61 countries for which debt-weighted exchange rate indices were calculated can be roughly split into four groups:

1. Countries for which the DWER closely follows the bilateral US dollar exchange rate. This is, for example, the case for most Latin American countries, as illustrated by Chile in the upper left-hand panel of Graph A above. About 25% of the countries in the sample fall in this category.
2. Countries for which the DWER and the trade-weighted NEER index (as measured by the BIS effective exchange rate indices) are very similar. This is the case for several emerging European countries, as can be seen for the Czech Republic in the upper right-hand panel of graph A, but is not very common in general (less than 10% of the sample falls into this category).
3. Countries for which the DWER falls between the bilateral US dollar exchange rate and the trade-weighted index. This is the case for more than half of the countries in the sample and is most prominent among euro area countries and several countries in emerging Asia. An example is Thailand, whose exchange rate is shown in the lower left-hand panel of Graph A.
4. Countries for which the DWER, the bilateral US dollar exchange rate and the trade-weighted NEER index are virtually the same, which is the case for slightly more than 10% of the sample. Often this involves countries that trade heavily with the United States, as Canada illustrates in the bottom right-hand panel of Graph A (the average trade weight of the United States in the NEER index for Canada was 62.6% between 1999 and 2013).

① BIS locational banking statistics. ② BIS international debt securities statistics.

investment, private consumption, government consumption, exports and imports) and $\Delta DWER$ and $\Delta NEER$ are the exchange rate variables. For each country, we estimate the regressions using the first differences of the log of each variable and include contemporaneous values as well as four lags of the exchange rate variables, and four lags of the dependent variable. The control variables, X_t , are: changes in domestic prices (measured by the GDP deflator); the policy rate; a global commodity price index; a foreign producer price index and a measure of foreign demand (measured respectively as the export-weighted change in the foreign producer price index and foreign GDP); a dummy variable for financial crisis (which takes the value 1 for years 2008 and 2009) and the financial crisis dummy interacted with the foreign demand variable.⁷ A time trend is also included in all regressions. In addition, the regressions for exports and imports also include domestic absorption (measured as the sum of private consumption, government consumption and investment) to

⁷ The financial crisis dummy is included to acknowledge the unusual response of trade to changes in demand during the crisis – what has been dubbed the “Great trade collapse”. See Leigh et al (2015) for a similar approach.

control for domestic demand.⁸ While the exchange rate can be expected to affect aggregate economic activity through its impact on absorption, in the import and export regressions we include absorption as a control variable in order to see if there is an additional effect on trade volumes through the financial channel, given that tradeable sectors are particularly exposed to exchange rate movements.

Our sample consists of 44 countries: 22 advanced economies and 22 EMEs. The full list of countries along with the country group classifications and sample periods is shown in the Appendix. The full sample runs until Q3 2016 and starts as early as Q1 1990 for some countries. However, for most countries, it is constrained by data availability to start in the mid-1990s.

Results and discussion

In order to allow for heterogeneity across countries, we analyse results from time series regressions that are run separately on each country and report medians across different country groups. As a complement to this analysis and to check for robustness and statistical significance, we also conduct panel regressions, which are reported in Appendix Tables A2 and A3.

GDP

Table 1 summarises the results for GDP growth, reporting the medians across country groups of short-run and long-run elasticities with respect to the two exchange rate measures.⁹ The estimates provide strong support in favour of the existence of both the financial and the trade channels for EMEs.

Elasticity of GDP with respect to debt-weighted (DWER) and nominal effective (NEER) exchange rates

Table 1

	DWER		NEER	
	Short-run	Long-run	Short-run	Long-run
Advanced economies	0.02	0.06	-0.09	-0.17
Emerging market economies	0.11	0.12	-0.14	-0.01
Emerging Asia	0.23	0.21	-0.23	-0.21
Latin America	0.12	0.13	-0.10	0.01
Emerging Europe	-0.03	-0.19	0.04	0.13

The table reports median elasticities across the different country groups. A list of countries (including their classification into the different groups) as well as other details of the sample are available in the Appendix.

Source: Authors' calculations.

⁸ Four-quarter changes are used for all variables except for the two exchange rate variables, instead of multiple lags, in order to preserve degrees of freedom.

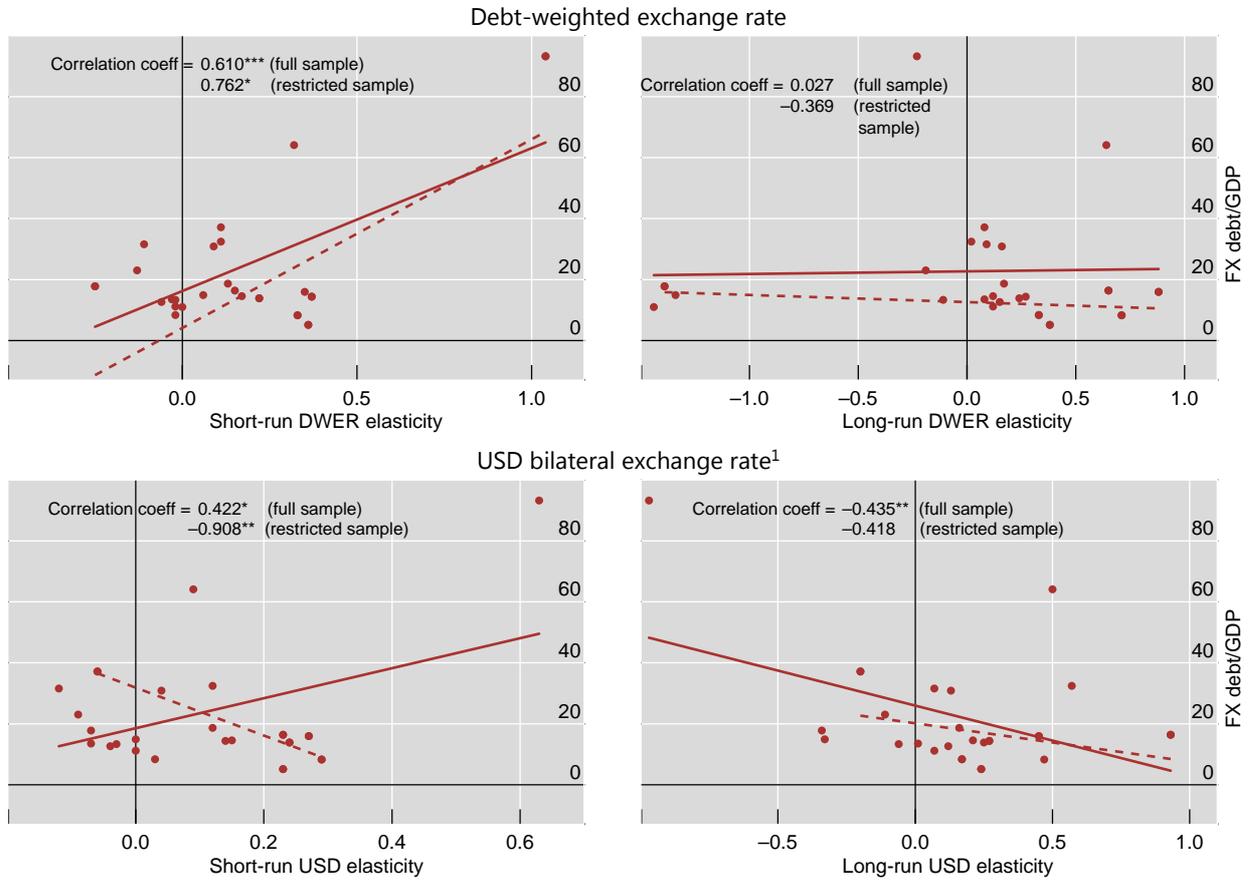
⁹ This model includes both exchange rates simultaneously in the regression. As a robustness check (Appendix Table A1), we first regress changes in the DWER on the NEEER and include the residuals (ie the component of DWER that is orthogonal to NEER) in the second stage regression instead of the DWER itself. The results are similar.

Cross-country correlations between foreign currency debt and the exchange rate elasticity of GDP for EMEs

Graph 1

Short-run elasticity vs foreign currency debt

Long-run elasticity vs foreign currency debt



***/**/* denotes statistical significance at the 1/5/10% level. The solid (dashed) lines are the regression lines for the full (restricted) samples. In the restricted sample, only individual country estimates that are statistically significantly different from zero at a 10% level or less are retained. FX debt refers to foreign currency debt.

¹ Saudi Arabia has been removed from the bottom panels, since it was a significant outlier due to limited data availability and the peg to the US dollar. The unrestricted correlation between foreign currency debt and US dollar exchange rate elasticity actually turns negative in the short run (-0.091) if this one single observation is included, further strengthening the results in favour of the DWER.

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; national data; BIS locational banking statistics; BIS calculations; authors' calculations.

The positive elasticity for the DWER indicates that an appreciation tends to raise growth, while the negative elasticity for the NEER indicates that an appreciation tends to reduce growth. For the median EME, a 1% appreciation of the debt-weighted exchange rate leads to an increase in quarterly GDP growth of 0.1% in both the short and long run.¹⁰ Indeed, for 13 out of 22 EMEs, the sum of the DWER and NEER elasticities is positive, indicating that an equal appreciation of both measures would be expansionary. The coefficient estimates are statistically significant for many, but

¹⁰ While the short-run elasticity measures the contemporaneous impact of a one-time change in the exchange rate variable in the immediate aftermath of the change, the long-run elasticity measures the contemporaneous impact in a new equilibrium characterised by a persistent change in the exchange rate. Mathematically, the short-run elasticity of DWER is given by ζ_0 , and the long-run elasticity is given by $\sum_{i=0}^4 \zeta_i / (1 - \sum_{i=1}^4 \gamma_i)$. The corresponding short-run and long-run elasticities for NEER are given by δ_0 and $\sum_{i=0}^4 \delta_i / (1 - \sum_{i=1}^4 \gamma_i)$, respectively.

not all, of the individual countries. An alternative approach, using a panel that imposes identical elasticities for all EMEs, also implies that the trade and financial channels are both important with statistically significant positive and negative elasticities on the DWER and NEER, respectively, in both the short and long run (Appendix Tables A2 and A3). For advanced economies, while evidence for the trade channel is also strong, evidence for the financial channel is weaker, with the median elasticity with respect to the DWER being small. For only five out of 23 advanced economies is the sum of the DWER and NEER elasticities positive. These results are in line with estimates from panel regressions in BIS (2016a) that did not consider country heterogeneity

Both the trade and financial channels are more prominent in Asia than in Latin America. The DWER elasticity is twice as large in Asia as in Latin America, and the difference in NEER elasticity is even starker. Interestingly, and somewhat surprisingly, we do not find any evidence of a financial channel for European EMEs.¹¹

The financial channel is stronger for EMEs with more foreign currency debt. Specifically, in the EME sample there is a positive, and statistically significant, relationship across countries between the DWER elasticity and foreign currency debt as a fraction of GDP in the short run (Graph 1).¹² This positive relationship exists for the full sample of EME countries and is also present for those with a statistically significant relationship between GDP and the DWER.

The natural alternative to our DWER measure for capturing the financial channel is the US dollar. Rey (2016) has argued that the dollar exchange rate is the main driver of the global financial cycle through its link to US monetary policy. To evaluate the strength of this alternative, we re-estimate our benchmark model by replacing the DWER with the bilateral nominal dollar exchange rate. It is noteworthy that the positive cross-correlation between the DWER elasticity and the share of foreign currency debt to GDP across EMEs is weaker in the short run when the DWER is replaced by the dollar exchange rate. In fact, it is negative when based only on those

Comparison of elasticity of GDP with respect to debt-weighted exchange rate (DWER) and US dollar bilateral exchange rate (USD)

Table 2

Short-run elasticity			Long-run elasticity		
DWER	USD	Difference	DWER	USD	Difference
0.29**	0.07	0.22***	0.91*	0.19	0.72**
(0.02)	(0.10)	(0.00)	(0.09)	(0.32)	(0.05)

***/**/* denotes statistical significance at the 1/5/10% level. The R² for the DWER model is 0.27 and the R² for the USD model is 0.23. The DWER model is preferred to the USD model according to the Quang (1989) test for non-nested models (with p-value ~0.001).

Source: Authors' calculations.

¹¹ Although estimates in Table 1 do not provide evidence even in favour of the trade channel for European EMEs, this result is not robust to changes in the specification. In particular, if we include the NEER and the component of DWER that is uncorrelated with (orthogonal to) NEER, then the trade channel clearly shows up, as is evident in Appendix Table A1.

¹² This pattern is not observed for advanced economies, for which the elasticities are themselves negligibly small. Note that lack of sufficient variation in the level of foreign currency debt-to-GDP ratios within countries across the sample period prevents us from uncovering this relationship explicitly in the regressions by employing interaction terms. However, with sufficient cross-sectional variation, the scatter plot indicates that there is a strong relationship.

countries with a statistically significant relationship between GDP growth and the bilateral dollar exchange rate (Graph 1, lower panel).¹³ The DWER is seemingly a better measure of the financial impact of exchange rates, as it can explain the differences in the strength of the financial channel across countries.

To further compare the ability of the DWER and dollar exchange rate to uncover the financial channel, we conduct panel regressions. These use the same specification above for the five EMEs for which the correlation between quarterly changes in the DWER and dollar exchange rate is lowest (less than 0.85). As shown in Table 2, the model with the DWER outperforms the model with the dollar based on a model comparison test (the test for non-nested models from Quang (1989)). In addition, the elasticity on the DWER is significantly higher than the equivalent elasticity on the dollar in both the short and long run.

In order to provide some indication of how the financial channel affects output growth, Equation (1) is estimated for imports, exports and other components of GDP. These results follow.

Exports

Just as for GDP growth, country regressions for export growth suggest that the financial and trade channels are both evident for EMEs, whereas for advanced economies the financial channel is weak (Table 3). Moreover, both channels are stronger for Asian EMEs than for Latin American economies, which is also confirmed by our panel regression results as reported in the Appendix. While the signs of these elasticities are generally confirmed by alternative panel models, only the trade channel is found to be statistically significant (Appendix Tables A2 and A3). Overall, while the export elasticities indicate that the trade channel has a significant effect on GDP growth through exports, there is tentative evidence of an offsetting impact through the financial channel.

Elasticity of exports with respect to debt-weighted (DWER) and nominal effective (NEER) exchange rates

Table 3

	DWER		NEER	
	Short-run	Long-run	Short-run	Long-run
Advanced economies	-0.08	0.05	-0.17	-0.30
Emerging market economies	0.12	0.20	-0.25	-0.36
Emerging Asia	0.23	0.50	-0.47	-0.78
Latin America	-0.01	0.40	-0.07	-0.37
Emerging Europe	0.12	-0.05	-0.25	-0.25

The table reports median elasticities across the different country groups. A list of countries (including their classification into the different groups) as well as other details of the sample are available in the Appendix.

Source: Authors' calculations.

¹³ This is based on excluding Saudi Arabia which is a notable outlier. Including Saudi Arabia, the correlation based on the dollar is essentially zero.

Imports

Unlike in the case of GDP and export growth, the theoretical implications of the financial channel for imports are ambiguous. An improvement in financial conditions can lead to an increase in imports because of easier access to trade finance for importers or increases in net wealth resulting from a currency mismatch in assets and liabilities (including households with foreign currency mortgages). This would imply a positive elasticity of imports with respect to the DWER. Alternatively, easier financial conditions could enhance the competitiveness of domestically produced import substitutes that may reduce the demand for imports, implying a negative elasticity of imports with respect to the DWER. In contrast, the implications for imports through the trade channel are clear: an appreciation boosts the import of cheaper foreign goods and services.

In order to capture the trade channel for imports, we replace the NEER with import prices measured in local currency, which is a better measure of the competitiveness of imports vis-à-vis domestic production.¹⁴ The results in Table 4 show that for advanced economies and EMEs (with the exception of those in Europe) the trade channel is apparent in the negative elasticities on import prices (implying that a fall in import prices leads to a rise in imports).

In contrast, the results for the financial channel vary across countries. For EMEs in Latin America and Europe, the elasticity of the DWER is positive, indicating that the effect of the cost of funding for imports dominates, with an exchange rate appreciation boosting imports. In contrast, for Asian EMEs and advanced economies, the DWER elasticity is negative, indicating that an appreciation reduces imports, possibly because it boosts import-competing industries through the financial channel. As was the case for exports, alternative panel models suggest that the impact through the trade channel is statistically significant, but that through the financial channel is not (Appendix, Tables A2 and A3).

Elasticity of imports with respect to debt-weighted (DWER) and import prices

Table 4

	DWER		Import prices	
	Short-run	Long-run	Short-run	Long-run
Advanced economies	-0.55	-0.03	-0.02	-0.03
Emerging market economies	-0.07	-0.14	-0.05	-0.34
Emerging Asia	-0.46	-0.58	-0.43	-0.56
Latin America	0.10	0.12	0.02	-0.30
Emerging Europe	0.08	0.17	0.03	0.17

The table reports median elasticities across the different country groups. A list of countries (including their classification into the different groups) as well as other details of the sample are available in the Appendix.

Source: Authors' calculations.

¹⁴ While replacing the NEER with trade prices improves the identification of the trade channel for imports, the same is not true when export prices are used in the exports regression. Unlike in the case of imports, the competitiveness of exports is not captured by export prices in local currency (or any other individual currency). Instead, their competitiveness is best captured by export prices in a synthetic export-weighted currency, which is closely related to the NEER itself. Hence we make the switch from the NEER to trade prices only when the dependent variable is imports.

Median elasticity of DWER for components of aggregate demand

Table 5

	GDP		Consumption		Investment		Government expenditure	
	SR	LR	SR	LR	SR	LR	SR	LR
Advanced economies	0.02	0.06	-0.02	-0.03	-0.06	0.02	-0.05	-0.06
Emerging market economies	0.11	0.12	0.01	0.17	0.21	0.64	0.04	0.08
Emerging Asia	0.23	0.21	0.10	-0.01	0.19	0.37	-0.25	-0.17
Latin America	0.12	0.14	0.14	0.41	0.42	1.16	0.18	0.12
Emerging Europe	-0.03	-0.19	-0.07	-0.28	0.24	0.44	0.24	-0.16

SR = short-run; LR = long-run.

The table reports median elasticities across the different country groups. A list of countries (including their classification into the different groups) as well as other details of the sample are available in the Appendix.

Source: Authors' calculations.

Domestic absorption: investment and private and public consumption

Examining the components of GDP suggests that the financial channel of exchange rates operates strongly through investment, a finance-intensive form of spending. The exchange rate elasticities for investment (gross fixed capital formation), private consumption and government consumption are shown in Table 5. For EMEs, the elasticities of investment with respect to the DWER are substantially higher than those of the other components of aggregate demand, in particular private consumption. The relative magnitudes and statistical significance are also confirmed in panel regressions (Appendix Tables A2 and A3). These results are consistent with the view that financial frictions matter more for investment than they do for consumption. This is especially so in EMEs, where the corporate sector often has more unhedged foreign currency debt.

Conclusion

Our evidence suggests that the trade channel is not the only determinant of how economies respond to exchange rate movements; the financial channel also matters. We find that the financial channel can be a significant offset to the trade channel at the macroeconomy level, particularly for EMEs. Our results suggest that the BIS debt-weighted exchange rate is an improvement over the alternative of using the bilateral US dollar exchange rate to capture the financial effects of exchange rates. Among the components of GDP, the financial channel is seemingly present for exports, pointing to a link between financial conditions and trade competitiveness. The financial channel is also stronger for investment than for private consumption. Since investment is more reliant on foreign currency debt than is consumption, especially in EMEs, these findings provide further support for the presence of a risk-taking channel that amplifies the financial cycle.

By showing how the financial channel can substantially offset the impact of the traditional trade channel, these results outline the challenges faced by policymakers in countries where the financial channel of exchange rates is prominent. For instance,

in an economy requiring a stimulus because of an adverse demand shock, if the trade and financial channels are likely to offset each other, then exchange rate devaluation would fail to provide the desired stimulus, and in some cases could even be contractionary. The onus then falls on other demand management policies.

This article offers a first attempt at quantifying the extent of the offset between the trade and financial channels of exchange rates. It also opens up several avenues for future exploration. Our exercise focuses on the dynamic elasticities of GDP and its components to exchange rates. Thus, studying dynamic responses to specific episodes of large exchange rate changes would be a natural complement to our analysis. Moreover, our focus is on cross-country comparisons. A complementary approach would be to examine potential non-linearities in the relationships we document and to look at changes in the strength of the two channels over time by considering longer samples for selected countries.¹⁵

¹⁵ See Jasova et al (2016) for evidence of change in the pass-through of exchange rates to inflation over time in EMEs.

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Appendix:

Sample

Quarterly: ending Q2 2016, with the start date varying by country according to data availability.

Countries (beginning of sample is given in parenthesis):

- Advanced economies (22):
 - Austria (Q1 1993), Australia (Q1 1993), Belgium (Q1 1994), Canada (Q1 1993), Switzerland (Q1 1999), Germany (Q1 1993), Denmark (Q1 1993), Spain (Q1 1994), Finland (Q1 1993), France (Q1 1993), United Kingdom (Q1 1993), Greece (Q1 1994), Ireland (Q1 1996), Italy (Q1 1993), Japan (Q1 1993), Luxembourg (Q1 1994), Netherlands (Q1 1993), Norway (Q1 1993), New Zealand (Q1 1998), Portugal (Q1 1994), Sweden (Q1 1993), United States (Q1 1993).
- EMEs – Asian (10):
 - China (Q1 1999), Hong Kong SAR (Q1 1998), Indonesia (Q1 1995), India (Q1 1999), Korea (Q1 1993), Malaysia (Q1 1994), Philippines (Q1 1997), Saudi Arabia (Q1 2009), Singapore (Q1 1993), Thailand (Q1 1999).
- EMEs – Latin American (five):
 - Argentina (Q1 1994), Brazil (Q1 1994), Chile (Q1 1996), Colombia (Q1 1996), Peru (Q1 1999).
- EMEs – European (five):
 - Czech Rep. (Q1 1995), Hungary (Q1 1994), Israel (Q1 1995), Poland (Q1 1994), Turkey (Q1 2001).
- EMEs – Other (two)
 - Russia (Q1 1994), South Africa (Q1 1993).

Dependent variable: GDP exogenous DWER model

Table A1

	Exo-DWER		NEER	
	SR	LR	SR	LR
Advanced economies	0.02	0.06	-0.015	-0.03
Emerging market economies	0.11	0.12	-0.01	0.05
Emerging Asia	0.24	0.22	-0.04	0.03
Latin America	0.12	0.14	0.01	0.14
Emerging Europe	-0.03	-0.19	-0.02	-0.10

The median short-run (SR) and long-run (LR) estimates are reported across the different country groups. Exo-DWER is created by regressing DWER on the NEER (both in first differences) and taking the residual in the regression instead of the DWER itself.

Source: Authors' calculations.

Panel regressions

Tables A2 and A3 display results from estimation of Equation (1) for different GDP components for a panel on EMEs and advanced economies separately. Country fixed effects are included in each regression.

Panel regressions: emerging market economies (EMEs)							Table A2
	GDP	Exports	Exports (Asia)	Imports ¹	C	I	G
Short-run elasticities							
DWER	0.17*** (0.03)	0.04 (0.10)	0.45** (0.16)	0.02 (0.09)	0.16*** (0.04)	0.52*** (0.13)	0.08 (0.08)
NEER	-0.16*** (0.03)	-0.18 (0.08)	-0.79*** (0.17)	-0.30** (0.11)	-0.09** (0.04)	-0.46*** (0.13)	-0.04 (0.08)
Long-run elasticities							
DWER	0.34*** (0.01)	0.07 (0.12)	0.50** (0.21)	-0.11* (0.10)	0.34*** (0.12)	1.17*** (0.36)	0.20*** (0.08)
NEER	-0.31*** (0.08)	-0.22** (0.12)	-0.58*** (0.28)	-0.42*** (0.12)	-0.21** (0.11)	-1.00*** (0.36)	-0.16*** (0.08)
Observations	1,378	1,289	505	1,272	1,288	1,288	1,296
R-squared	0.23	0.21	0.40	0.33	0.19	0.16	0.30

C = private consumption; I = private fixed investment; G = government consumption. Robust standard errors in parentheses. Country fixed effects included. ***/**/* denotes statistical significance at the 1/5/10% level.

¹ Import prices are used instead of NEER as explained in the main text.

Source: Authors' calculations.

Panel regressions: advanced economies							Table A3
	GDP	Exports	Imports ¹	C	I	G	
Short-run elasticities							
DWER	0.02 (0.02)	0.08 (0.04)	-0.02 (0.03)	-0.01 (0.01)	-0.13*** (0.04)	-0.00 (0.01)	
NEER	-0.06** (0.03)	-0.30*** (0.07)	0.00 (0.08)	0.02 (0.02)	0.14** (0.06)	-0.00 (0.02)	
Long-run elasticities							
DWER	-0.06** (0.03)	-0.02 (0.09)	-0.03 (0.04)	-0.04** (0.02)	-0.03 (0.10)	-0.04** (0.02)	
NEER	0.03 (0.05)	-0.32 (0.13)	-0.11 (0.12)	0.10*** (0.03)	0.22* (0.18)	0.06** (0.04)	
Observations	1,400	1,400	1,384	1,400	1,400	1,400	
R-squared	0.21	0.16	0.25	0.22	0.11	0.13	

C = private consumption; I = private fixed investment; G = government consumption. Robust standard errors in parentheses. Country fixed effects included. ***/**/* denotes statistical significance at the 1/5/10% level.

¹ Import prices are used instead of NEER as explained in the main text.

Source: Authors' calculations.

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

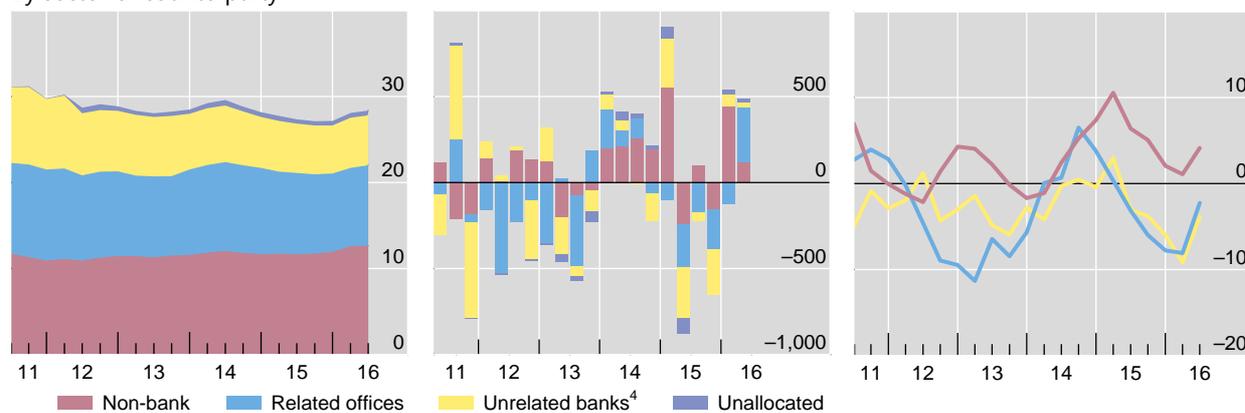
Graph A.1

Amounts outstanding, in USD trn¹

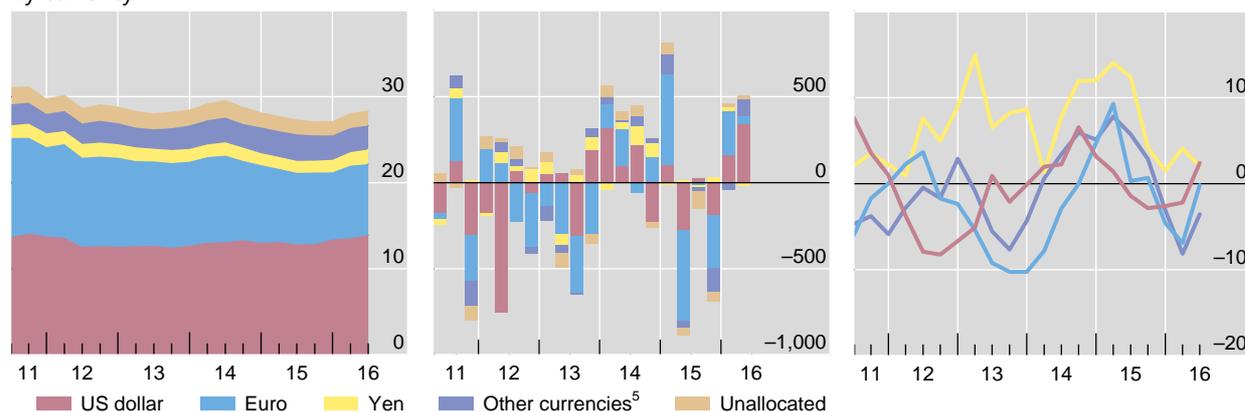
Adjusted changes, in USD bn²

Annual change, in per cent³

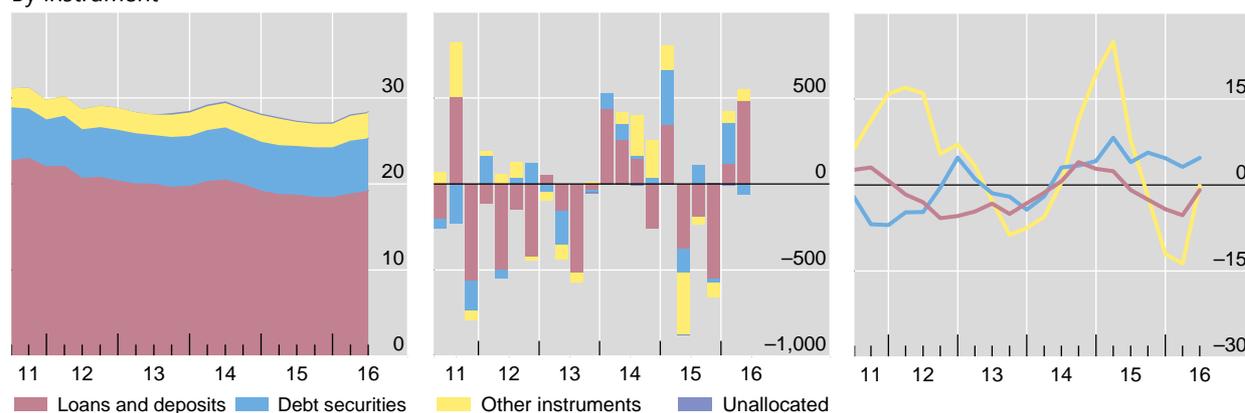
By sector of counterparty



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

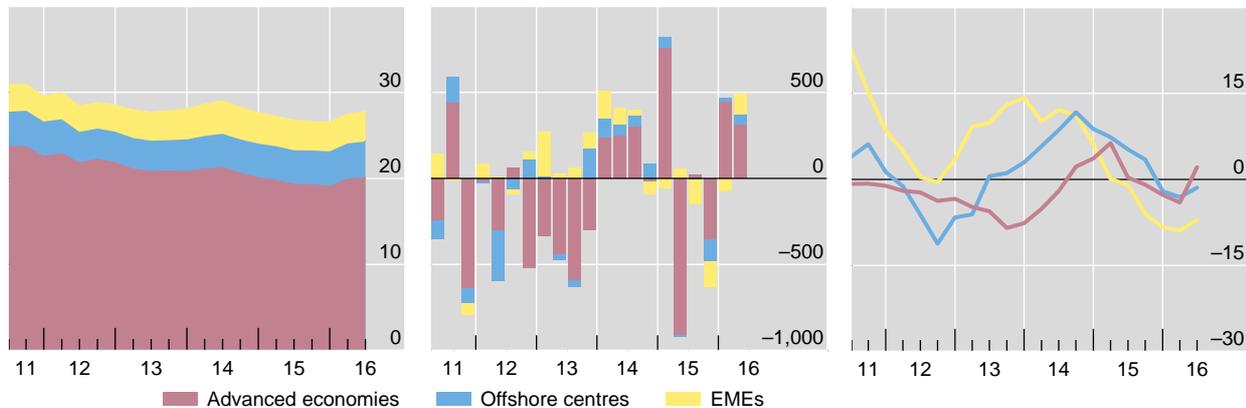
Graph A.2

Amounts outstanding, in USD trn¹

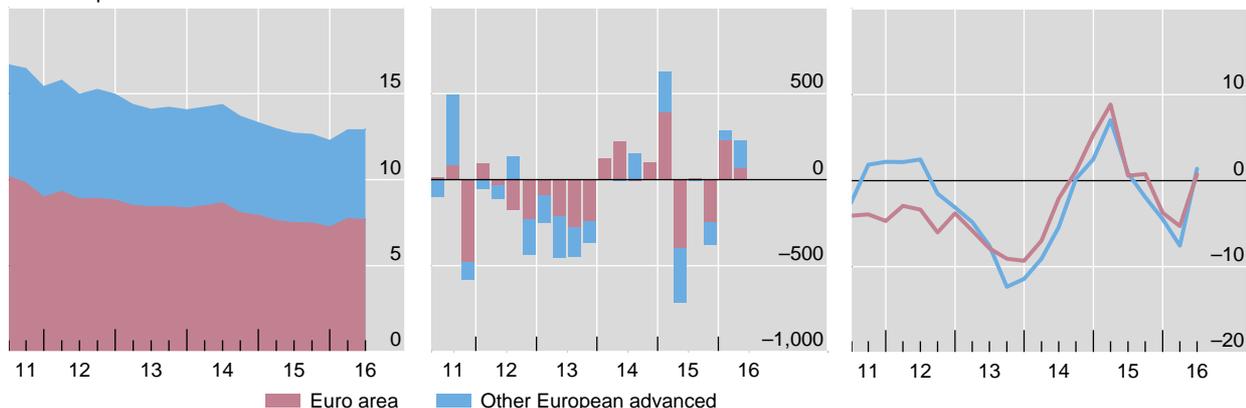
Adjusted changes, in USD bn²

Annual change, in per cent³

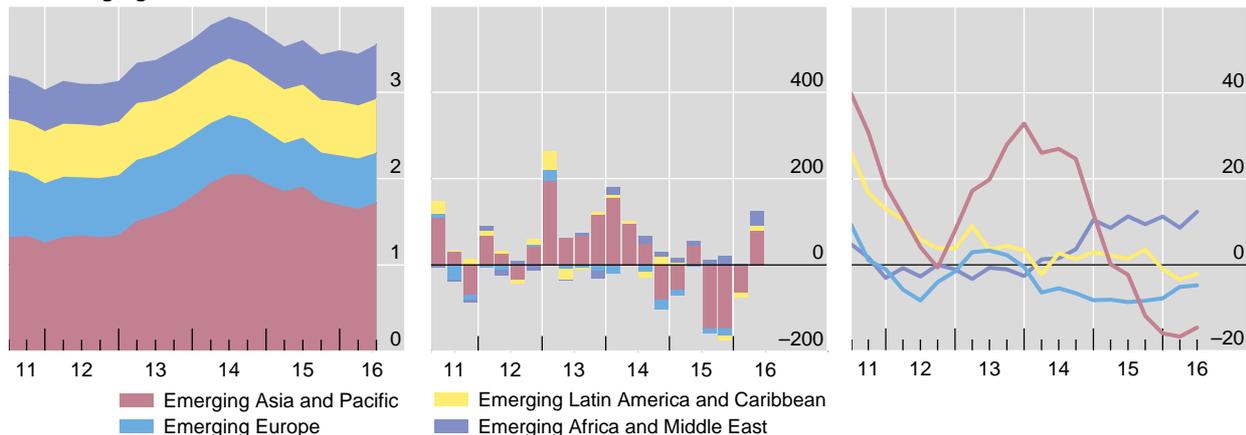
On all countries



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

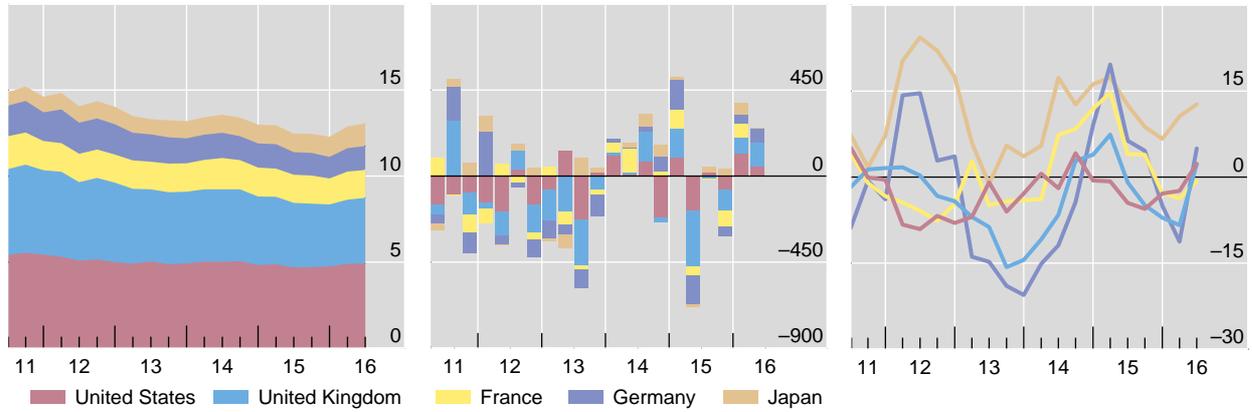
Graph A.3

Amounts outstanding, in USD trn¹

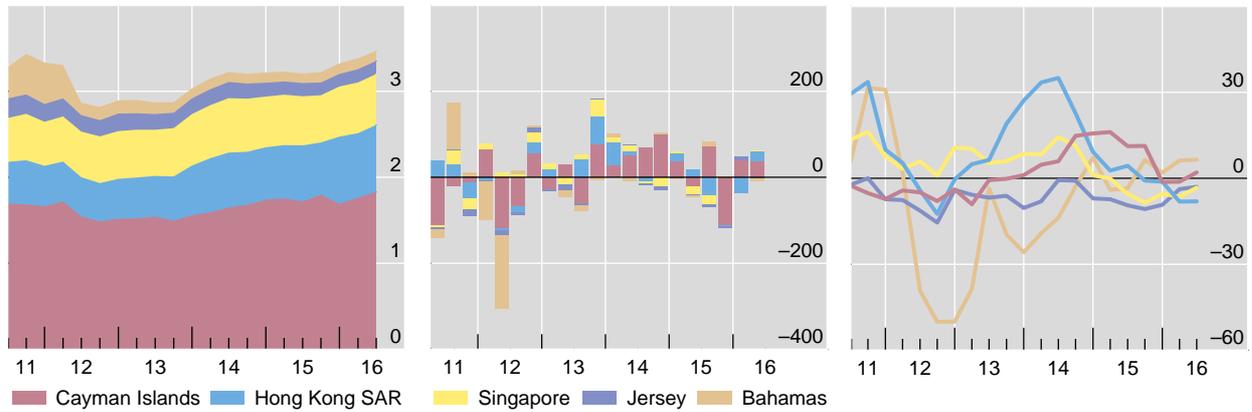
Adjusted changes, in USD bn²

Annual change, in per cent³

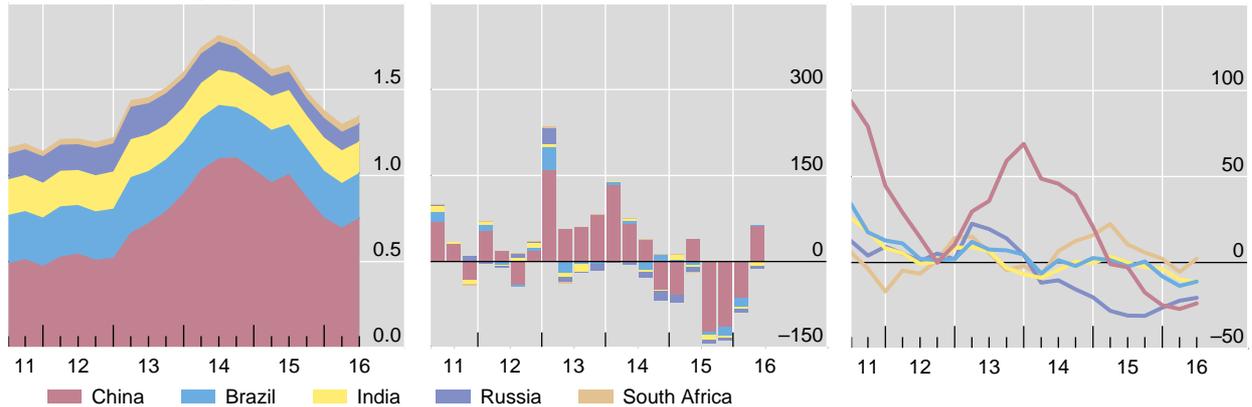
On selected advanced economies



On selected offshore centres



On selected emerging market economies

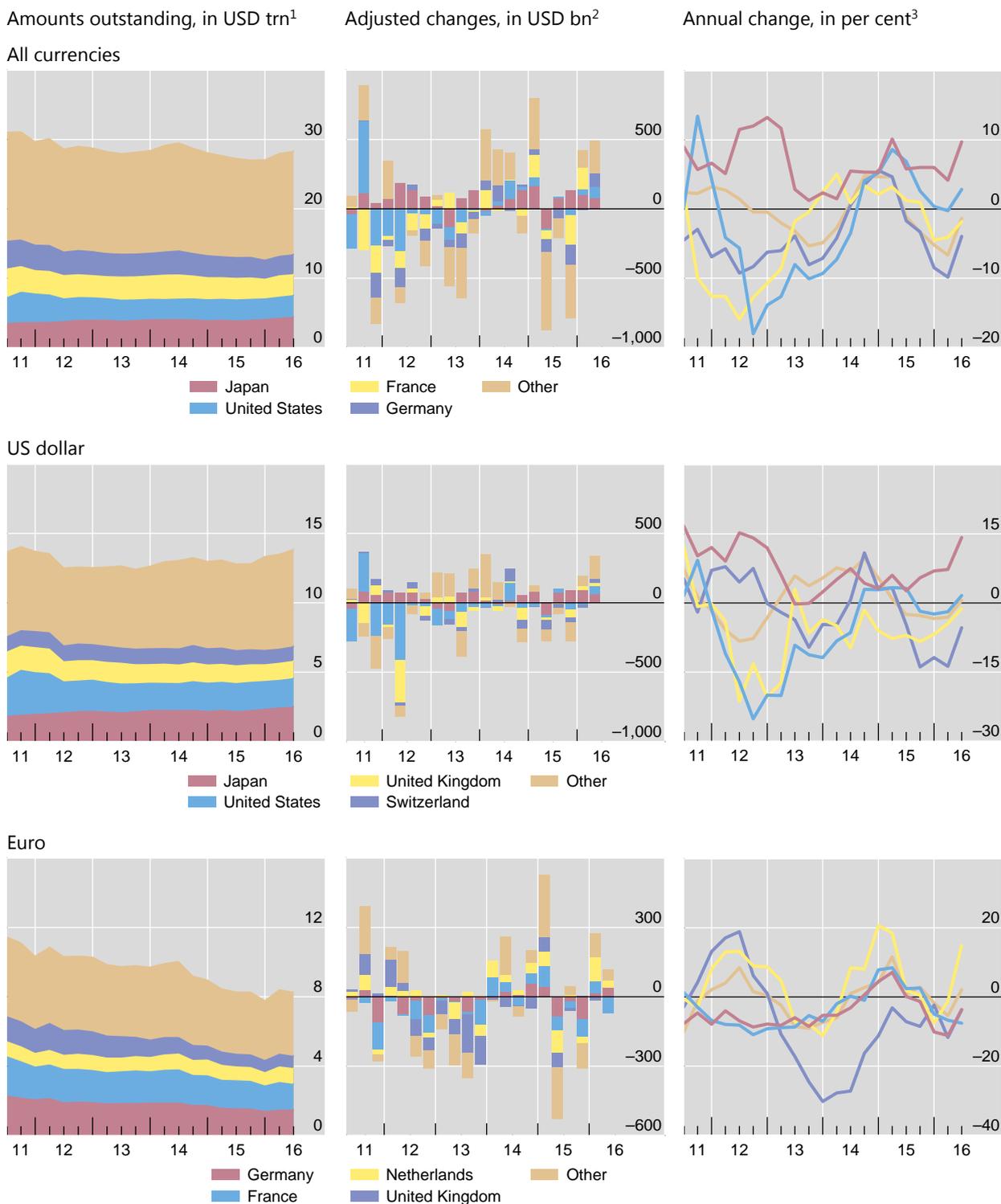


Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

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

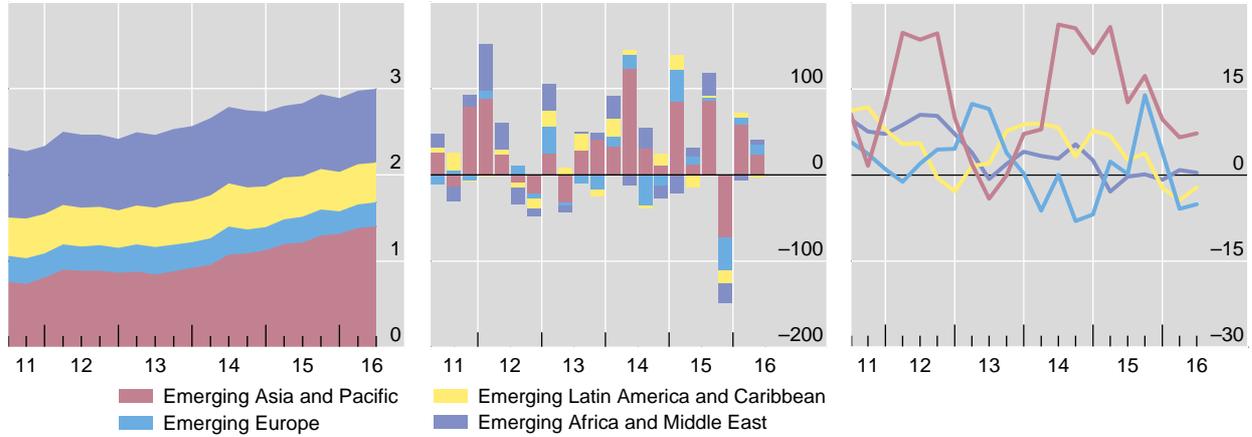
Graph A.5

Amounts outstanding, in USD trn¹

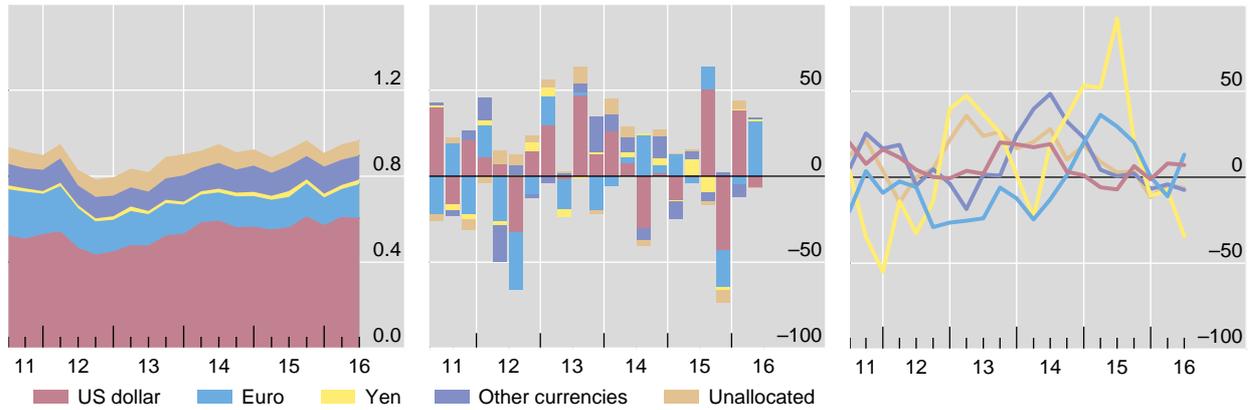
Adjusted changes, in USD bn²

Annual change, in per cent³

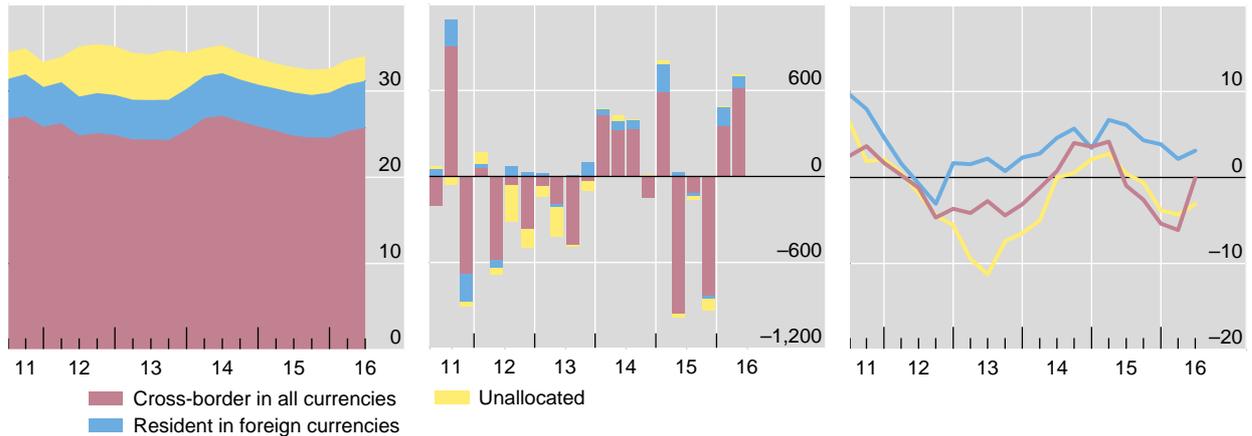
To emerging market economies



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

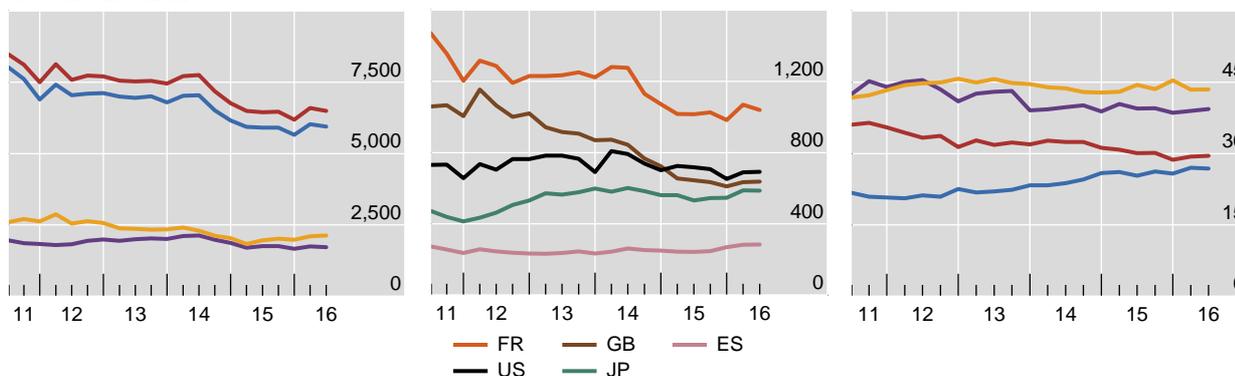
Graph B.1

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

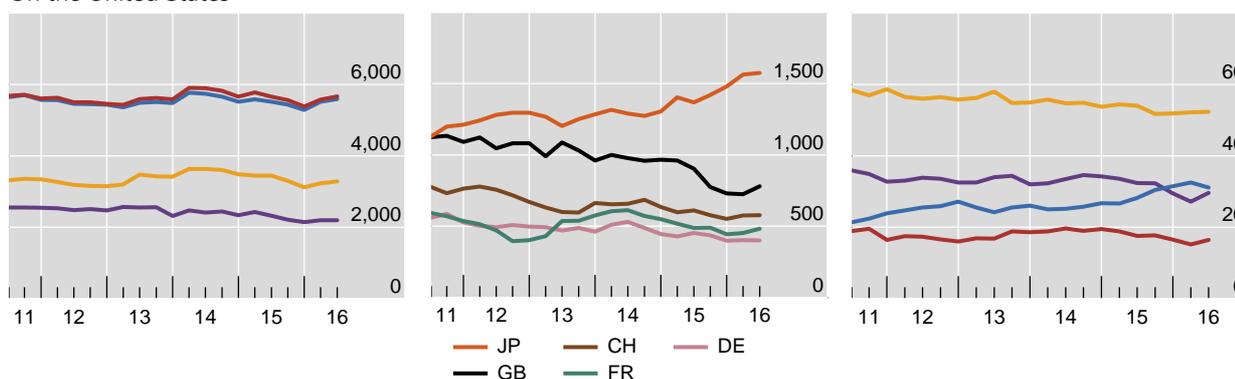
Foreign claims of selected creditors, in USD bn^{1,3}

International claims, by sector and maturity, in per cent⁴

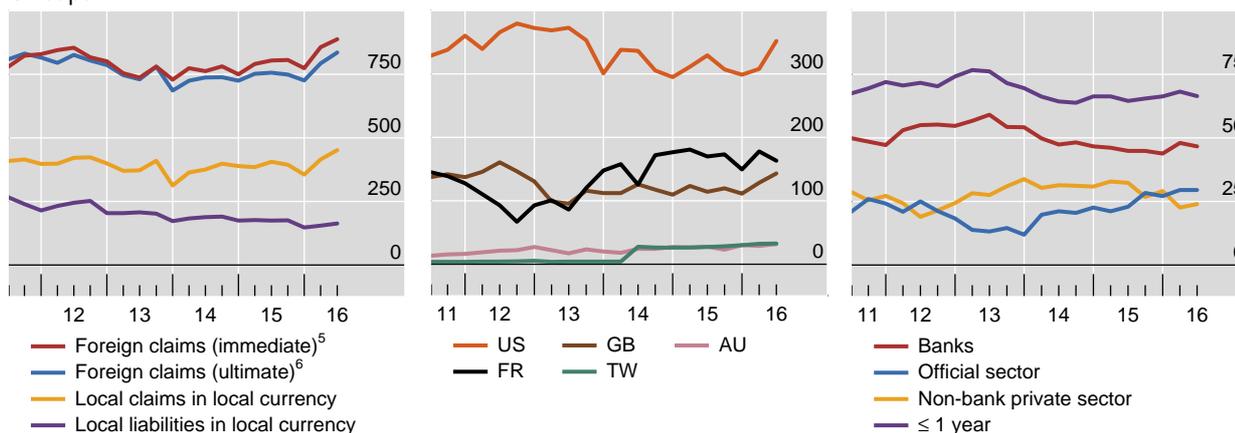
On the euro area



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

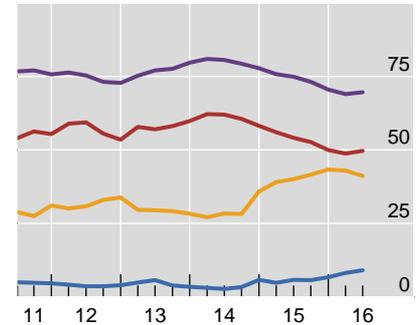
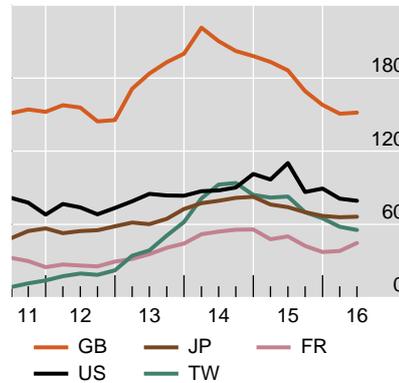
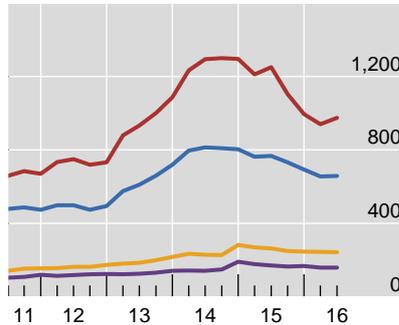
Graph B.2

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

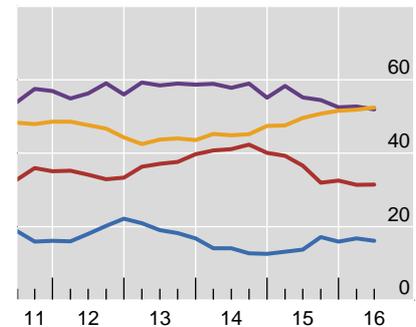
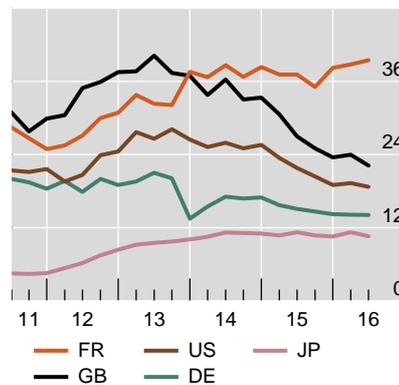
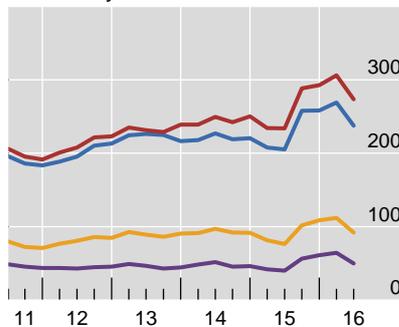
Foreign claims of selected creditors, in USD bn^{1,3}

International claims, by sector and maturity, in per cent⁴

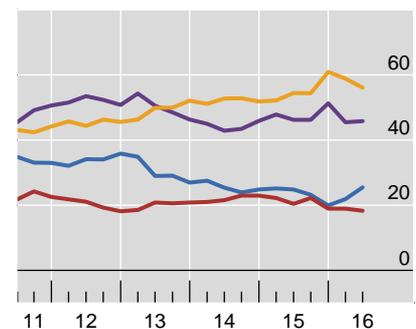
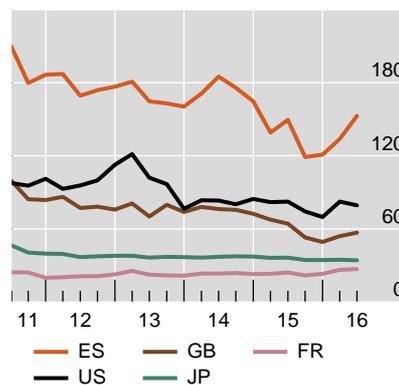
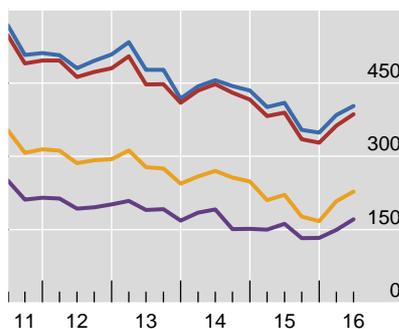
On China



On Turkey



On Brazil



— Foreign claims (immediate)⁵
 — Foreign claims (ultimate)⁶
 — Local claims in local currency
 — Local liabilities in local currency

— ES — GB — FR
 — US — JP

— Banks
 — Official sector
 — Non-bank private sector
 — ≤ 1 year

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.

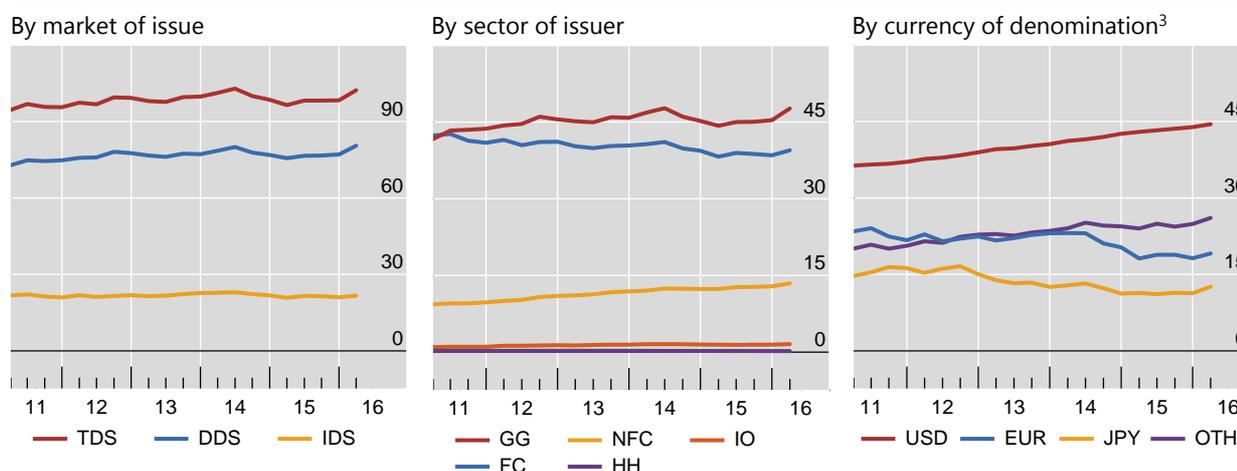
Source: BIS consolidated banking statistics (CBS).

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.

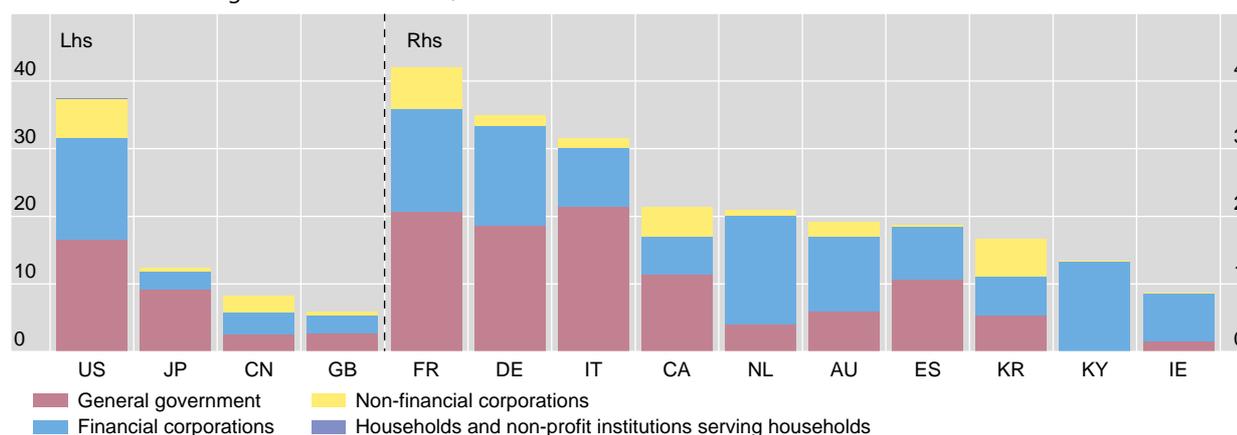
¹ Sample of countries varies across breakdowns shown. For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. For countries that do not report either TDS or DDS, data are estimated by the BIS as IDS. ² At quarter-end. Amounts denominated in currencies other than the US dollar 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-March 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.

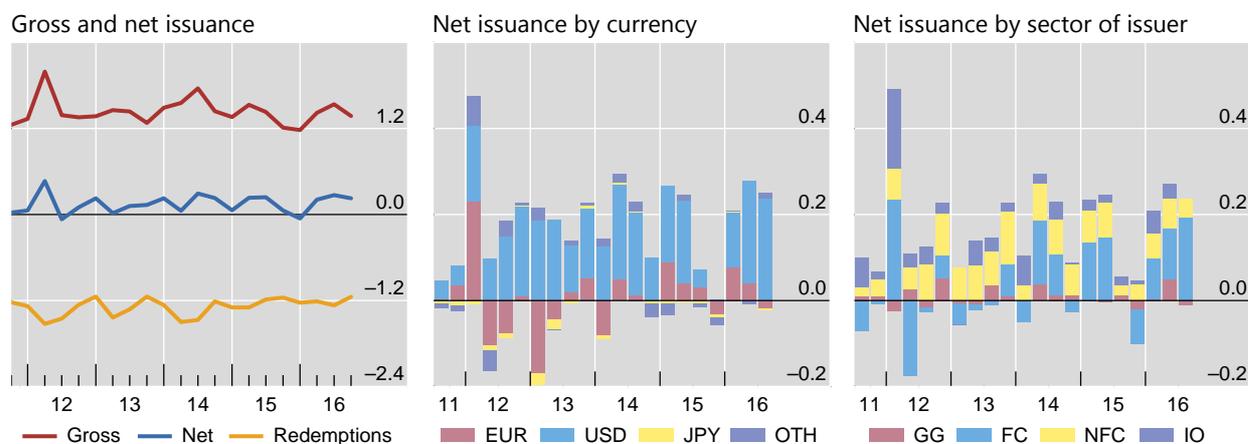
¹ For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. ² Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

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.

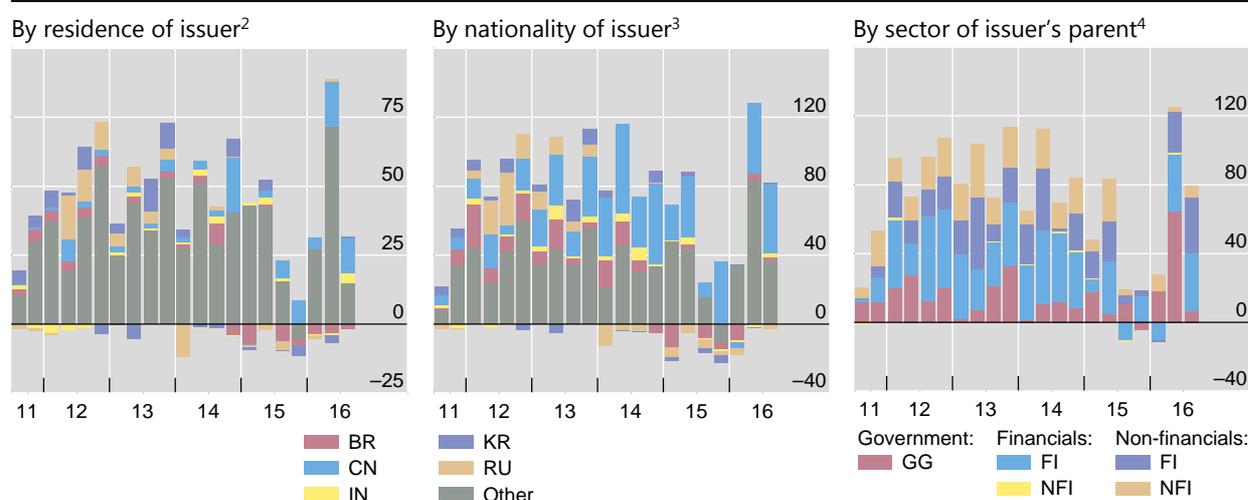
Further information on the BIS debt securities statistics is available at www.bis.org/statistics/secstats.htm.

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

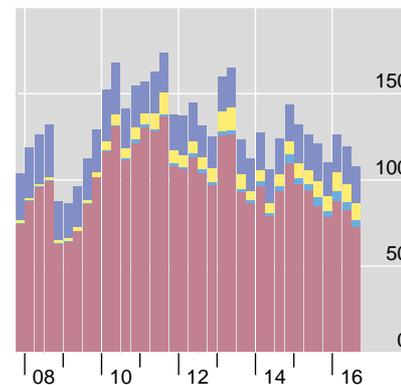
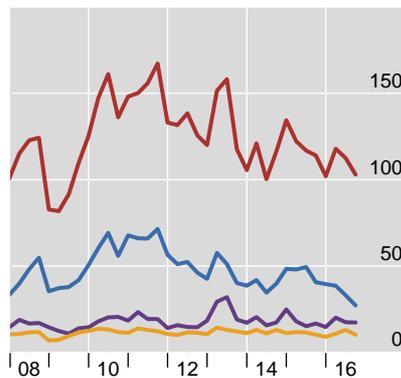
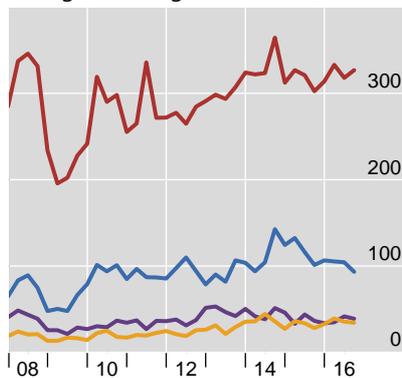
Graph D.1

Open interest, by currency¹

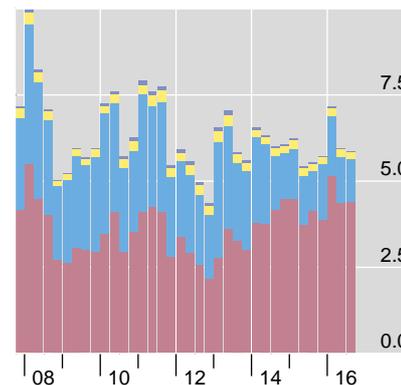
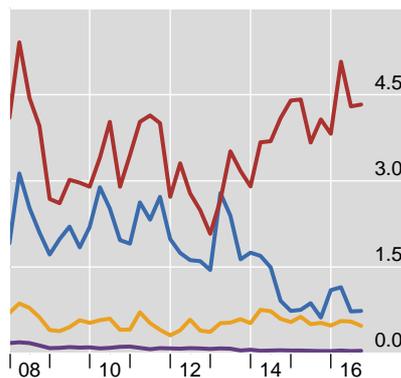
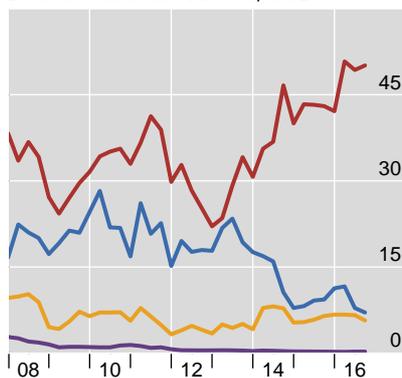
Daily average turnover, by currency²

Daily average turnover, by location of exchange²

Foreign exchange derivatives, USD bn³



Interest rate derivatives, USD trn³



— US dollar — Pound sterling
— Euro — Yen

— North America — Asia and Pacific
— Europe — Other markets

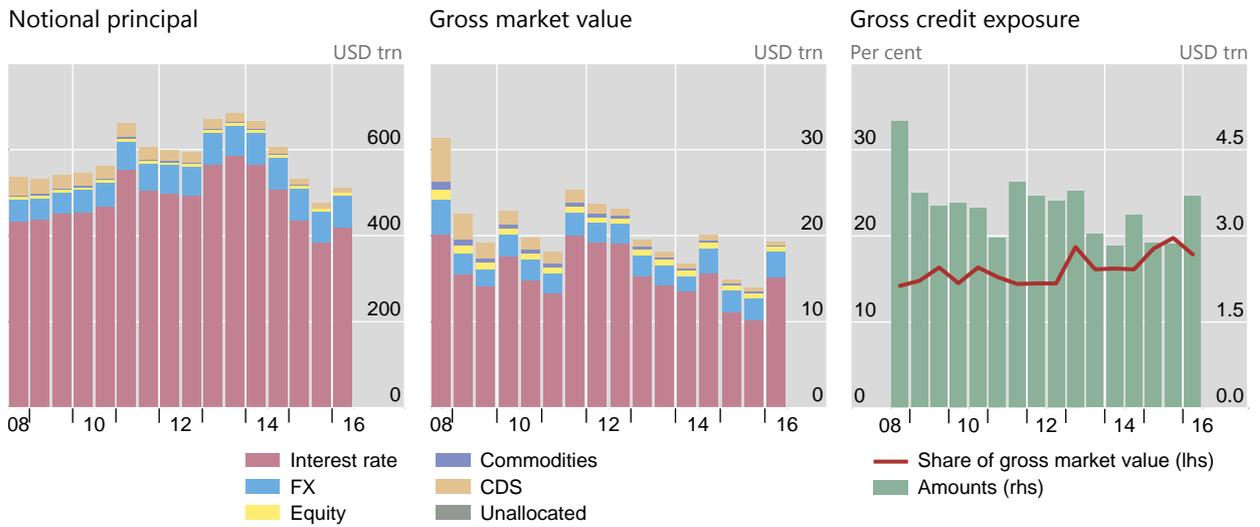
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/extderiv.htm.

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.

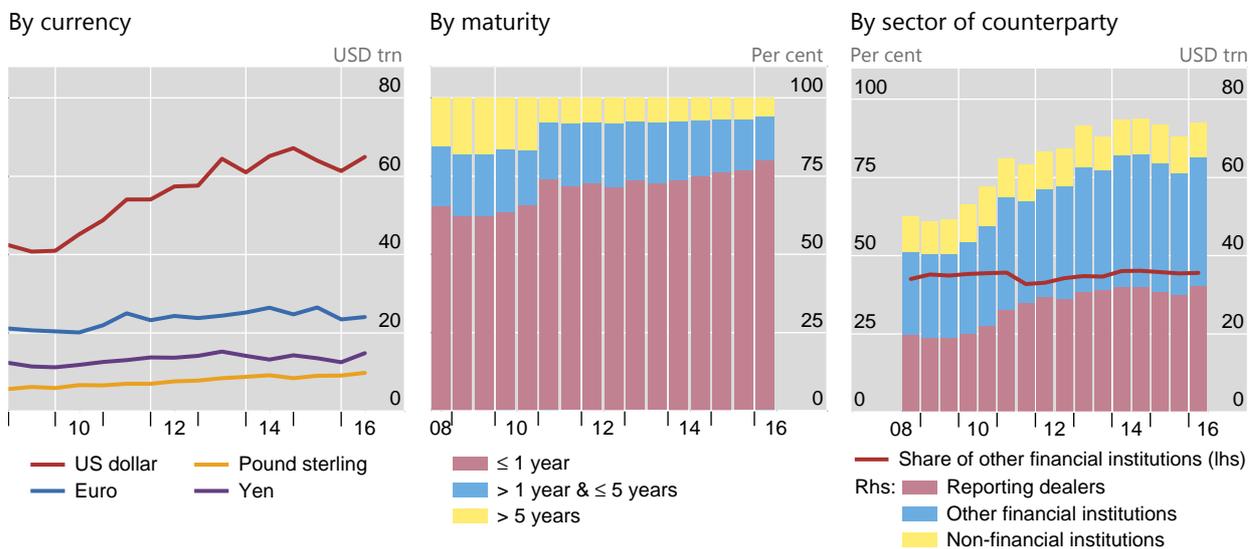
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

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.

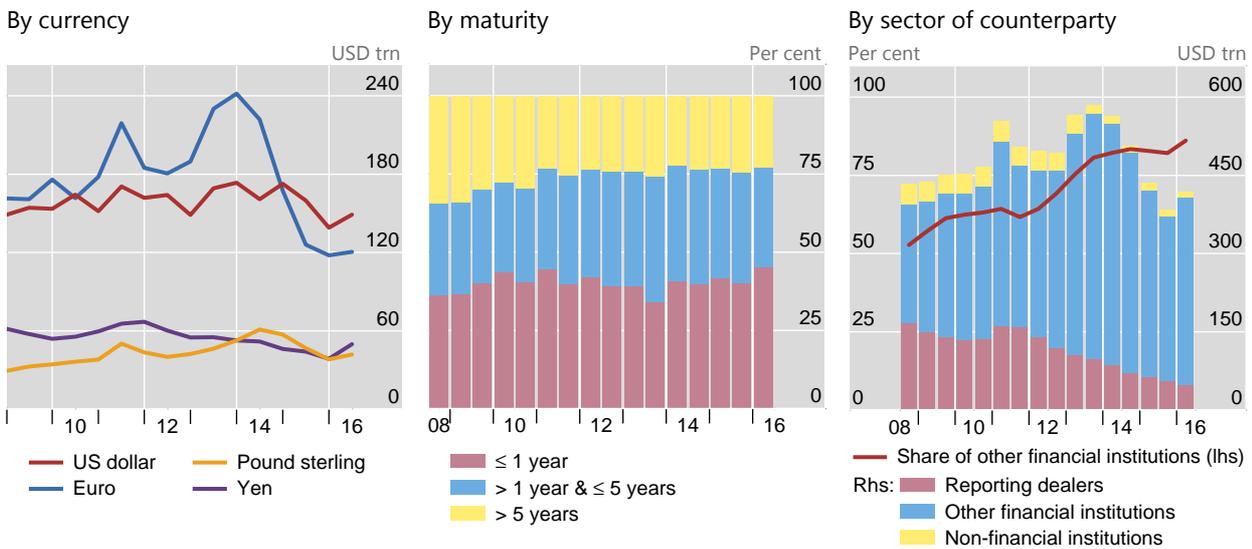
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

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.

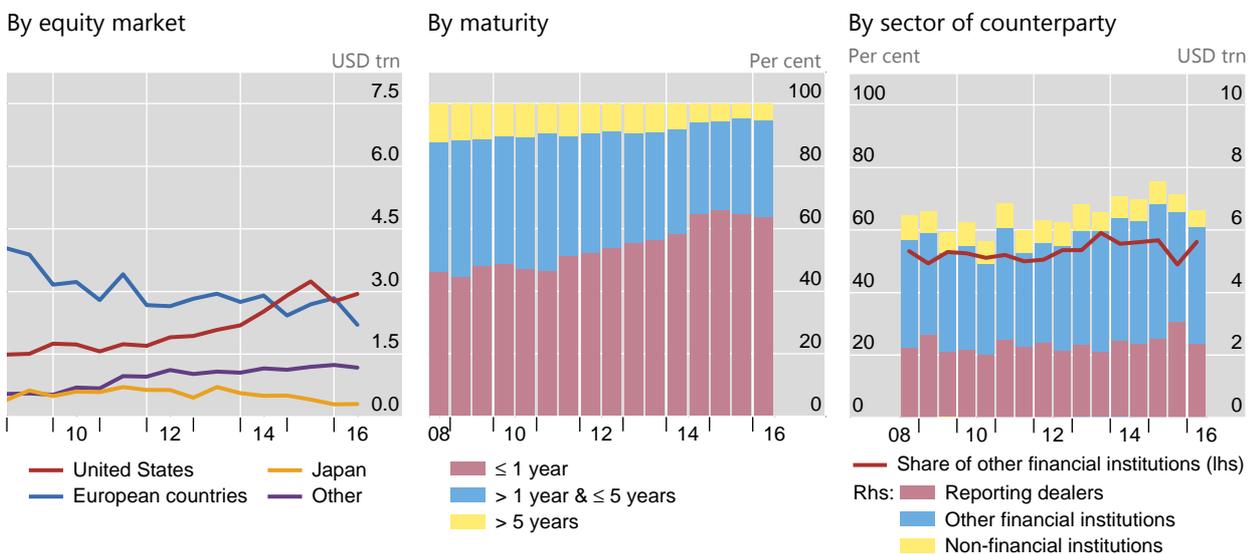
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

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.

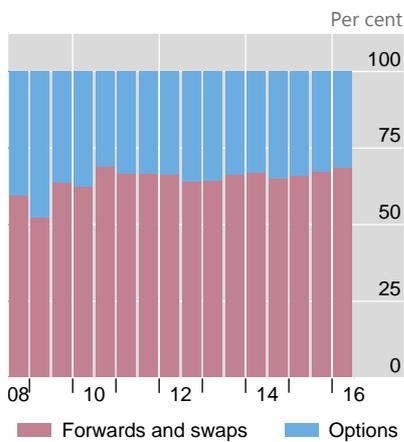
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

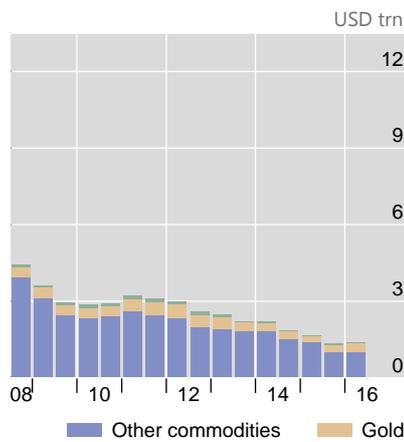
OTC commodity derivatives¹

Graph D.6

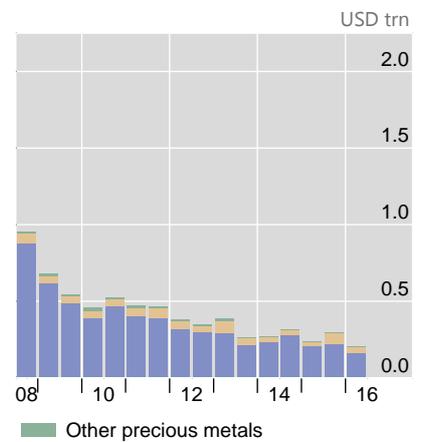
Notional principal, by instrument



Notional principal, by commodity



Gross market value, by commodity



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

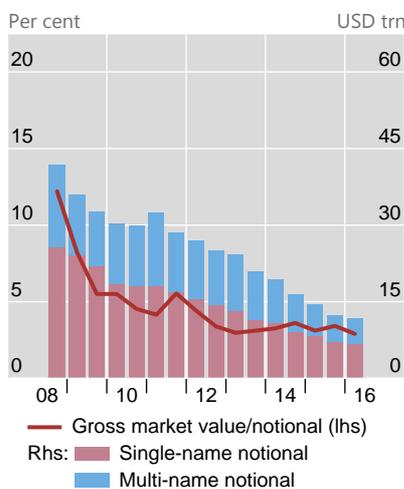
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

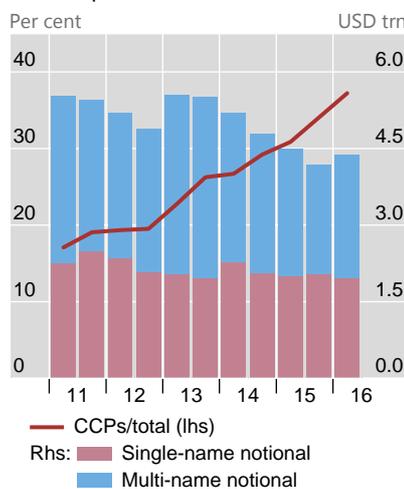
Credit default swaps¹

Graph D.7

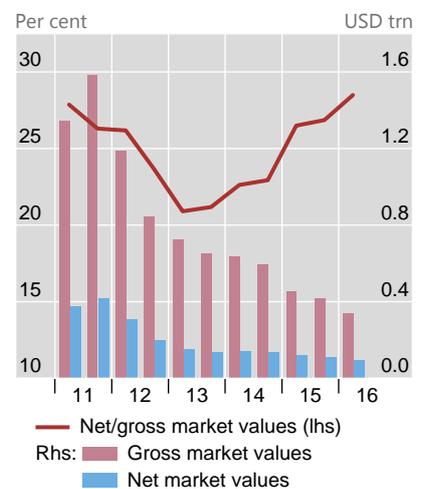
Notional principal



Notional principal with central counterparties (CCPs)



Impact of netting



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

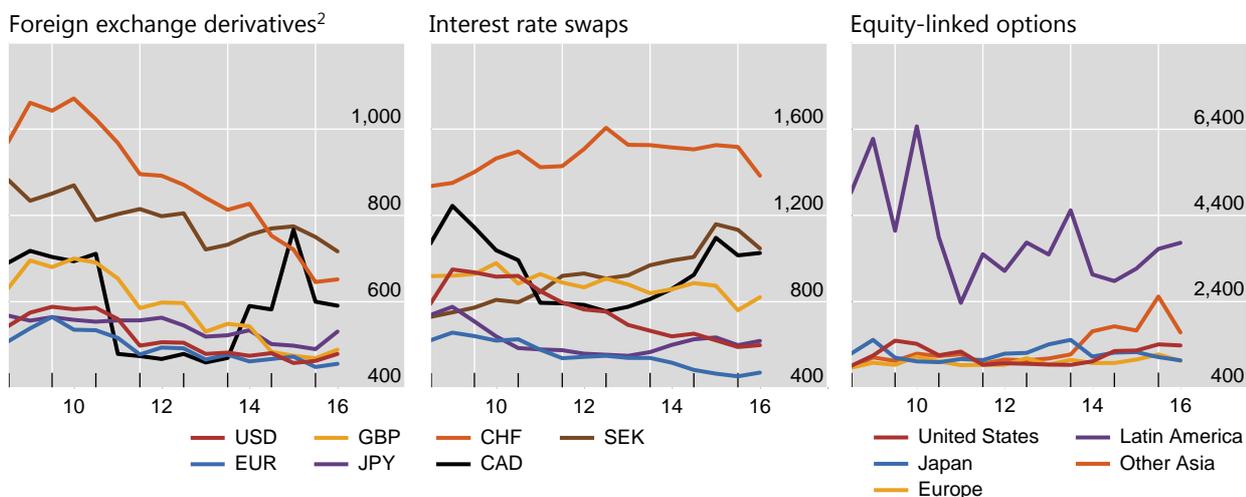
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

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.

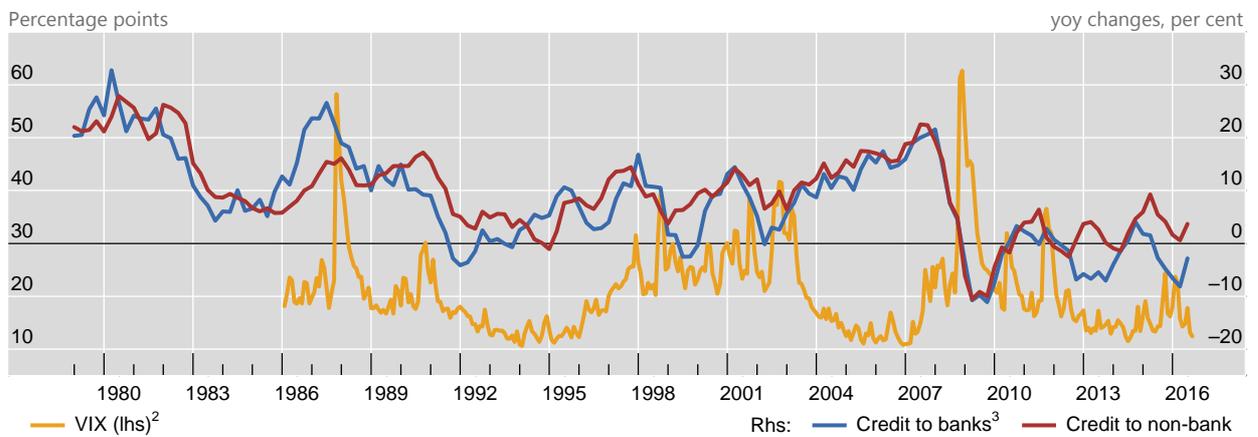
¹ The index ranges from 0 to 10,000, where a lower number indicates that there are many dealers with similar market shares (as measured by notional principal) and a higher number indicates that the market is dominated by a few reporting dealers. ² Foreign exchange forwards, foreign exchange swaps and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

Source: BIS derivatives statistics.

E Global liquidity indicators

Growth of international bank credit¹

Graph E.1



In June 2016, the presentation of data in this graph was revised to show the year-on-year changes in credit, instead of the contribution to growth, and to exclude credit unallocated by sector, which was previously included in credit to banks.

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

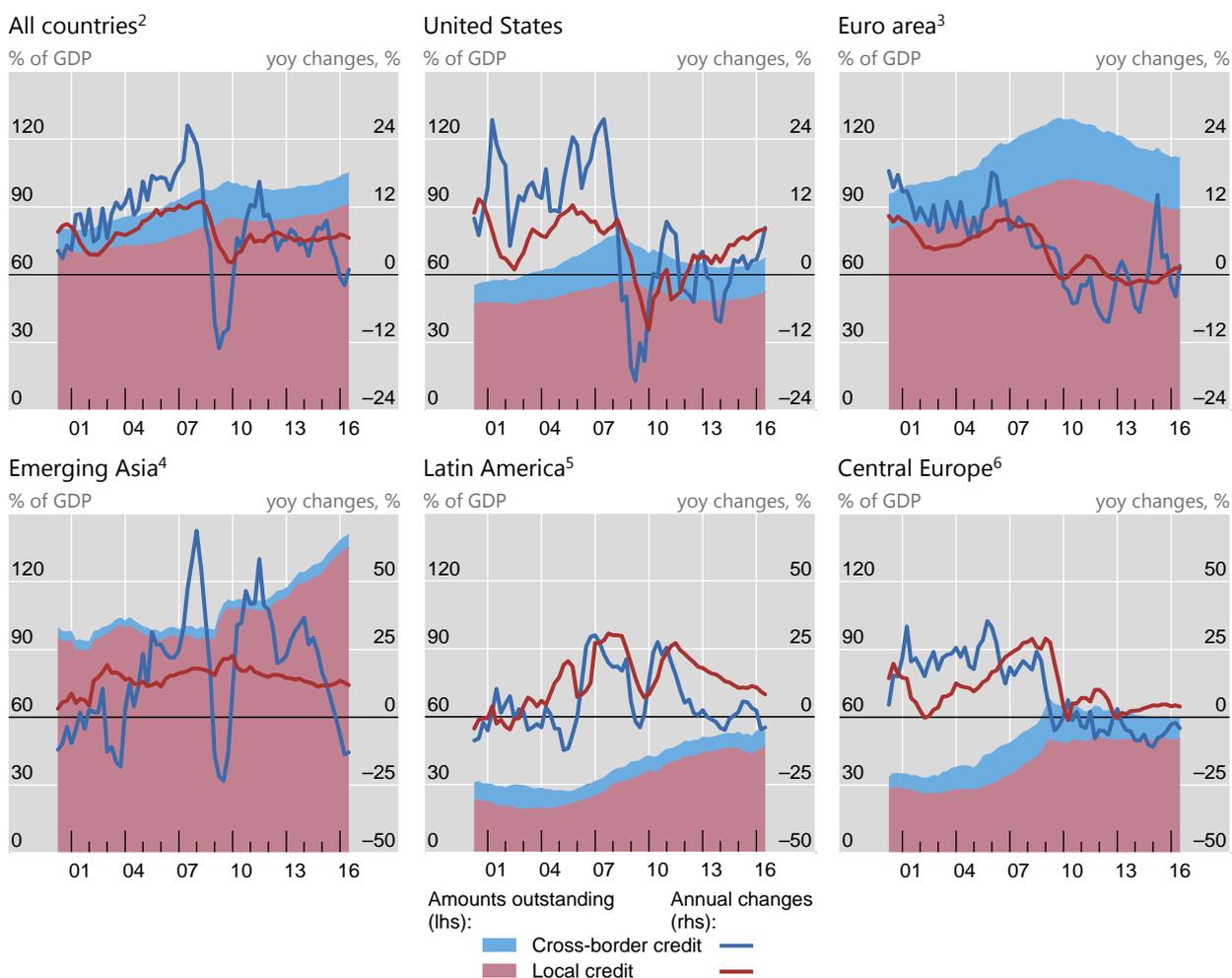
¹ LBS-reporting banks' cross-border claims plus local claims in foreign currencies. ² Chicago Board Options Exchange S&P 500 implied volatility index; standard deviation, in percentage points per annum. ³ Including intragroup transactions.

Sources: Bloomberg; BIS locational banking statistics (LBS).

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.

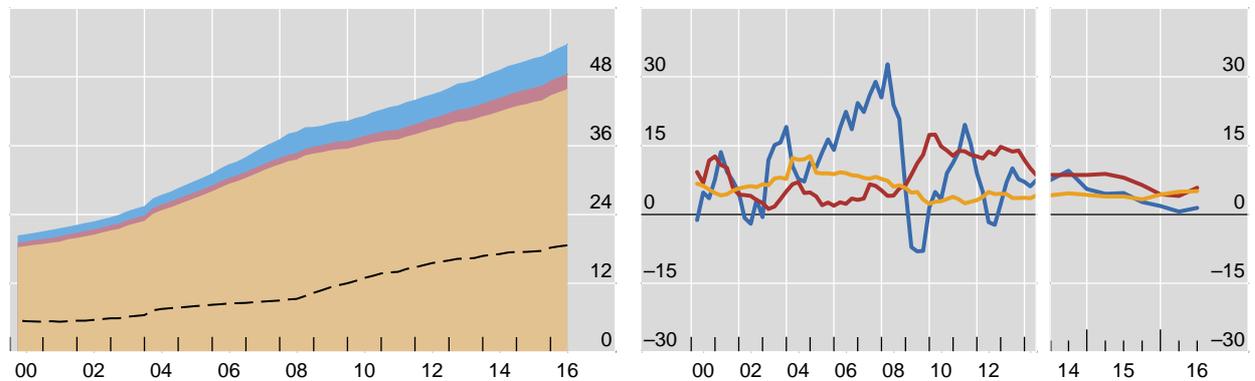
¹ Cross-border claims of LBS reporting banks to the non-bank sector plus local claims of all banks to the private non-financial sector. Weighted averages of the economies listed, based on four-quarter moving sums of GDP. ² Australia, Canada, Denmark, Japan, New Zealand, Norway, Russia, Saudi Arabia, 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 and locational banking statistics (LBS); BIS calculations.

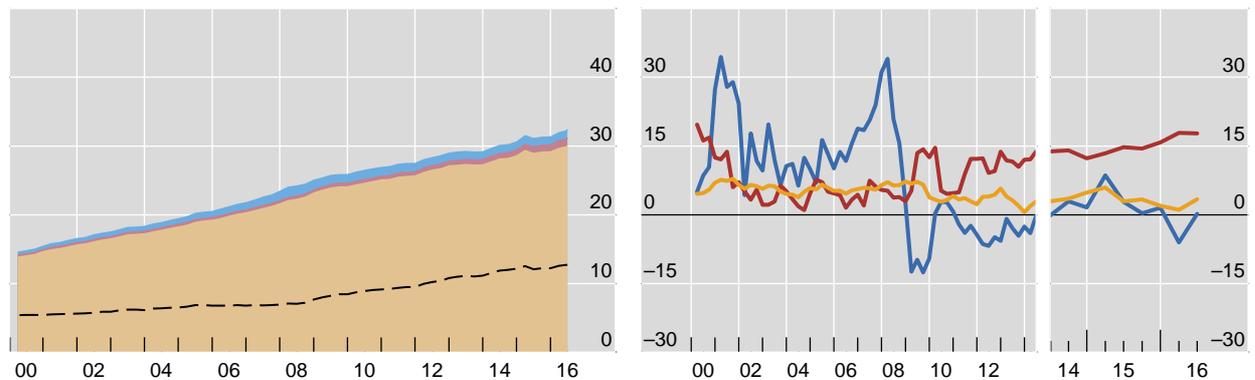
Amounts outstanding, in USD trn¹

Annual change, in per cent

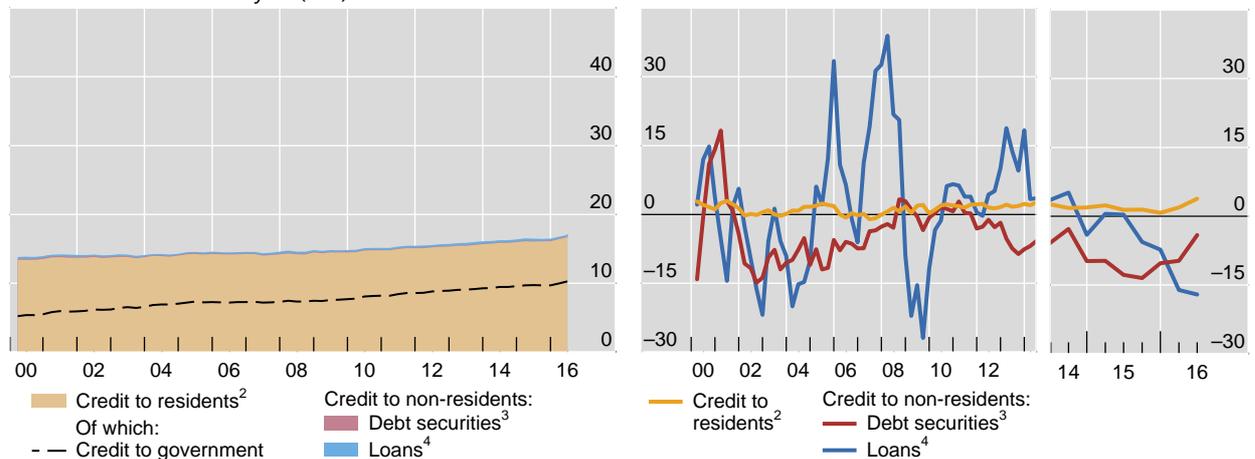
Credit denominated in US dollars (USD)



Credit denominated in euros (EUR)



Credit denominated in yen (JPY)



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

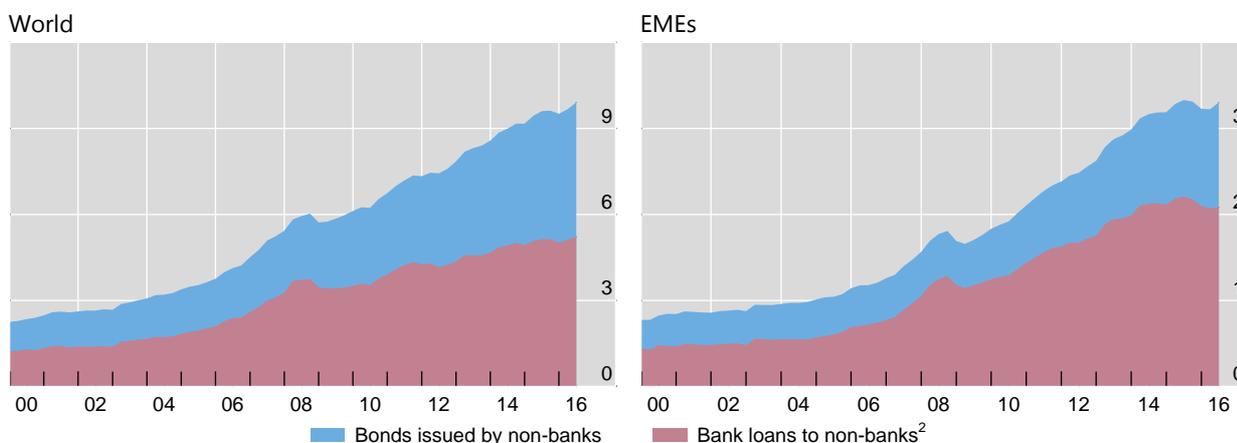
¹ Amounts outstanding at quarter-end. Amounts denominated in currencies other than USD are converted to USD at the exchange rate prevailing at end-December 2015. ² Credit to non-financial borrowers residing in the United States/euro area/Japan. National financial accounts are adjusted using BIS banking and securities statistics to exclude credit denominated in non-local currencies. ³ 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. ⁴ Loans by LBS-reporting banks to non-bank financial entities, including non-bank financial entities, comprise cross-border plus local loans. For countries that are not LBS-reporting countries, local loans in USD/EUR/JPY are estimated as follows: for China, local loans in foreign currencies are from national data and assumed to be composed of 80% USD, 10% EUR and 10% JPY; for other non-reporting countries, local loans to non-banks are set equal to LBS-reporting banks' cross-border loans to banks in the country (denominated in USD/EUR/JPY), on the assumption that these funds are lent to non-banks. For the purpose of the "global liquidity: total credit by currency of denomination" series, LBS-reporting countries exclude China and Russia.

Sources: IMF, *International Financial Statistics*; Datastream; BIS debt securities statistics and locational banking statistics (LBS).

US dollar-denominated credit to non-banks outside the United States¹

Amounts outstanding, in trillions of US dollars

Graph E.4



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. For countries that are not LBS-reporting countries, local loans in USD are estimated as follows: for China, local loans in foreign currencies are from national data and are assumed to be composed of 80% USD; for other non-reporting countries, local loans to non-banks are set equal to LBS-reporting banks' cross-border loans to banks in the country (denominated in USD), on the assumption that these funds are onlent to non-banks. For the purpose of the "global liquidity: total credit by currency of denomination" series, LBS-reporting countries exclude China and Russia.

Sources: Datastream; BIS debt securities statistics and locational banking statistics (LBS).

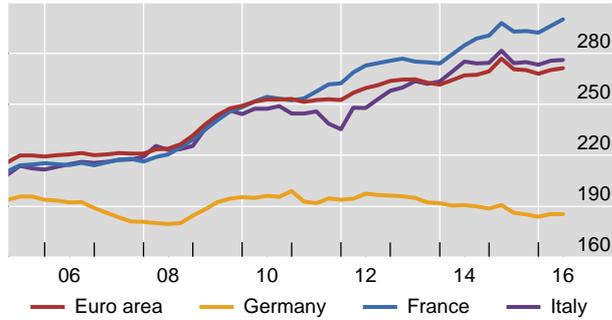
F Statistics on total credit to the non-financial sector

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

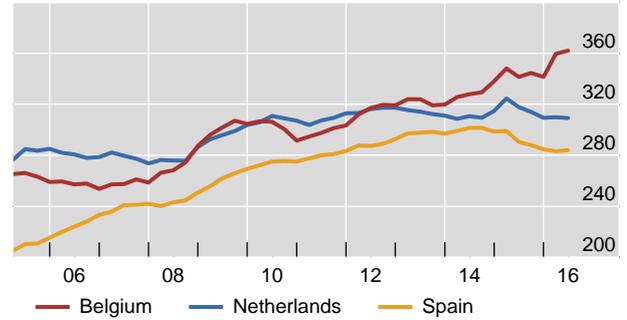
As a percentage of GDP

Graph F.1

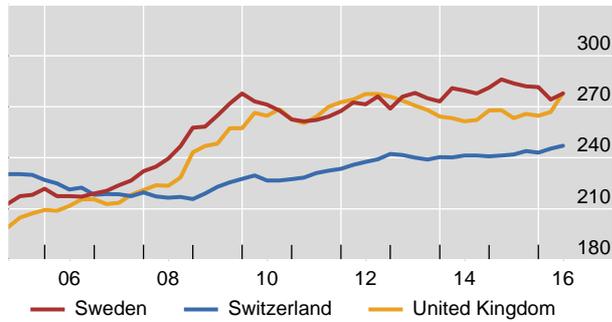
Euro area: aggregate and major countries



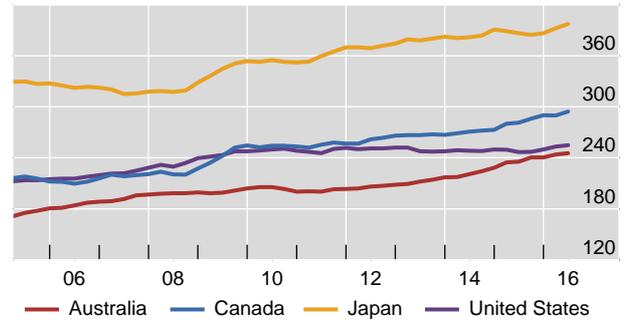
Euro area: other countries



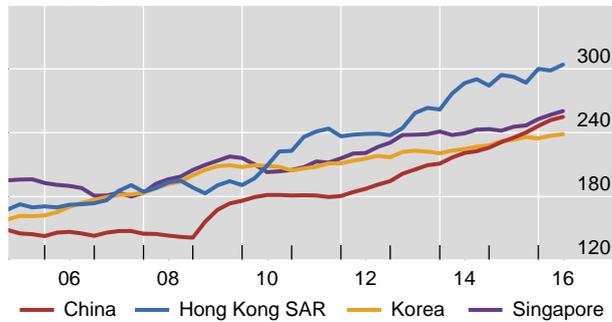
Other European countries



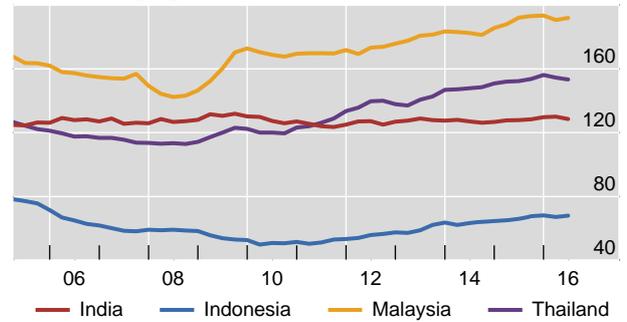
Major advanced economies



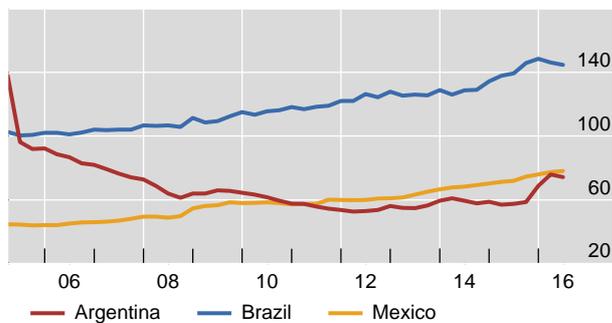
Emerging Asia



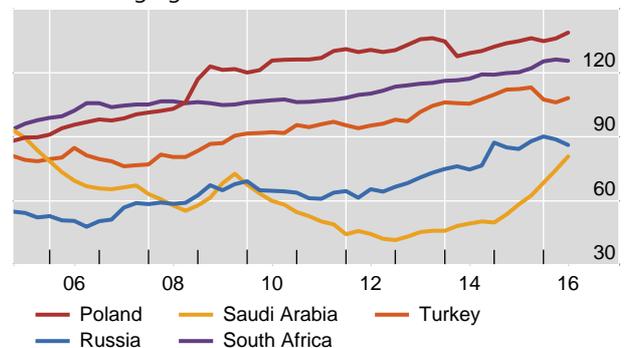
Other emerging Asia



Latin America



Other emerging market economies



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

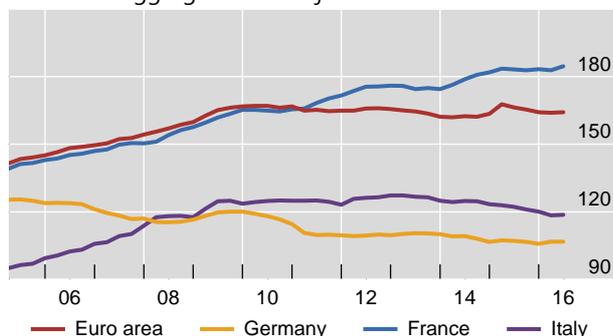
Source: BIS total credit statistics.

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

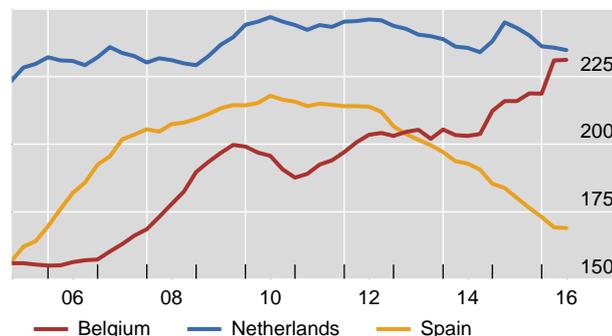
As a percentage of GDP

Graph F.2

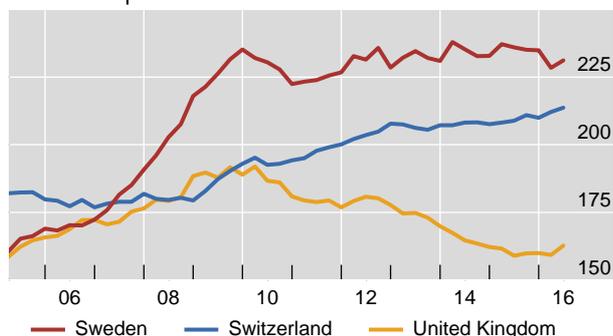
Euro area: aggregate and major countries



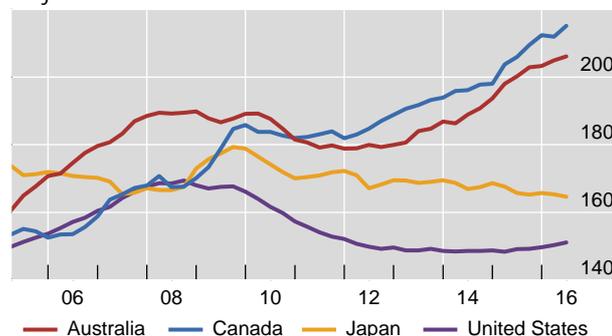
Euro area: other countries



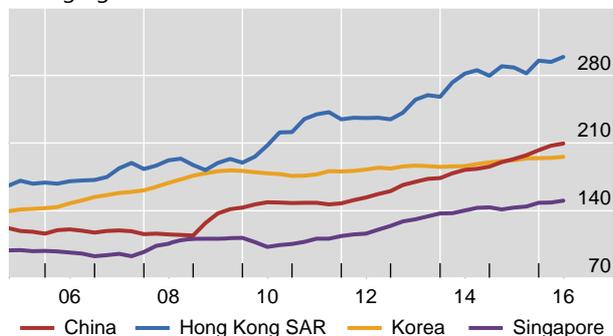
Other European countries



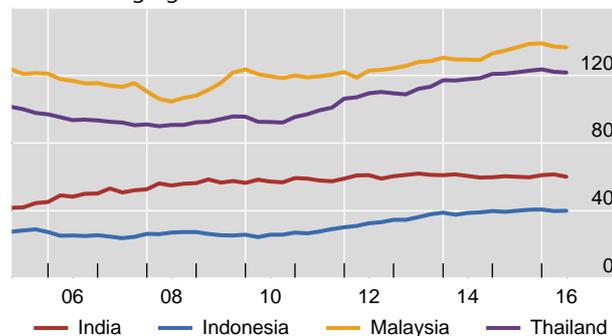
Major advanced economies



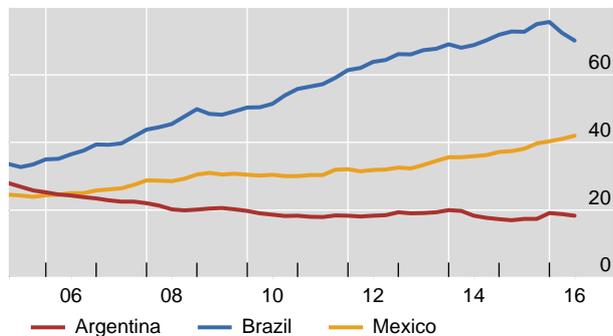
Emerging Asia



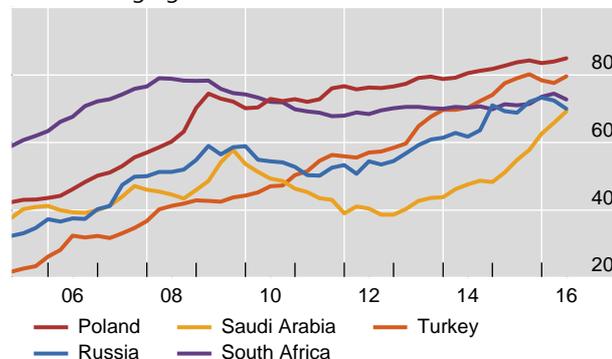
Other emerging Asia



Latin America



Other emerging market economies



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

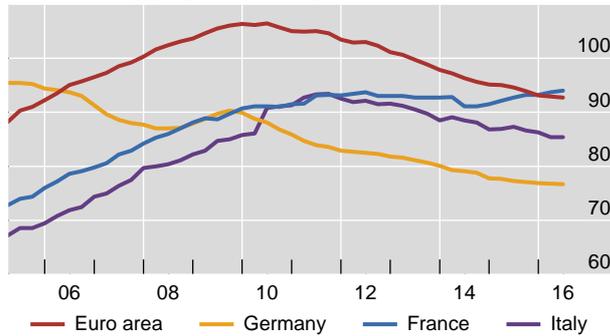
Source: BIS total credit statistics.

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

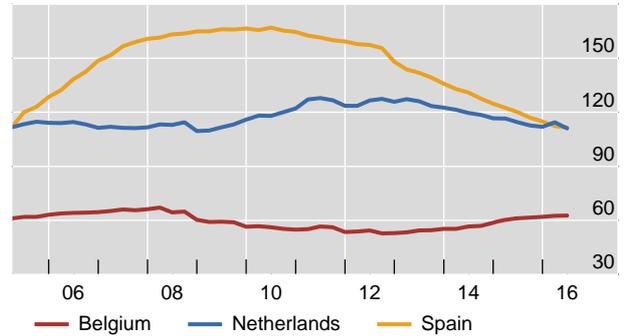
As a percentage of GDP

Graph F.3

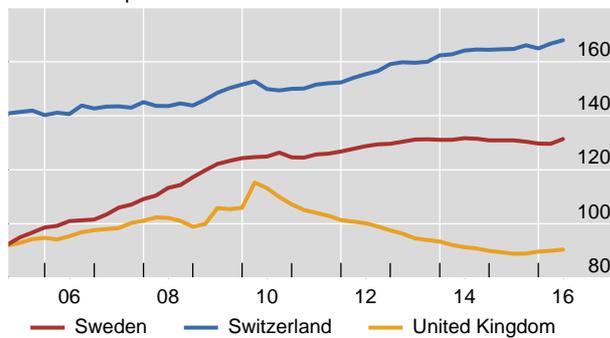
Euro area: aggregate and major countries



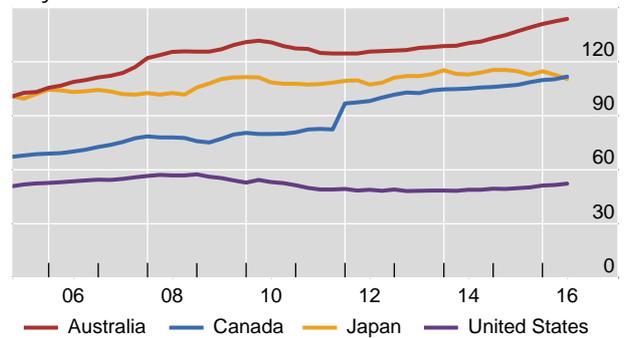
Euro area: other countries



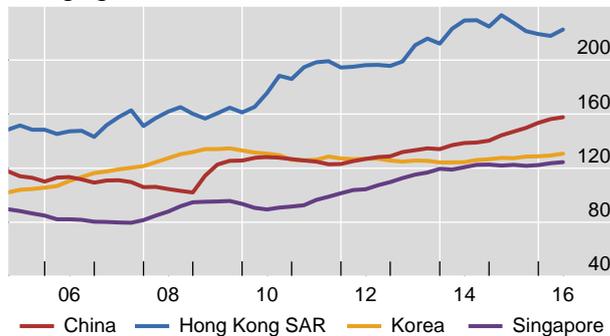
Other European countries



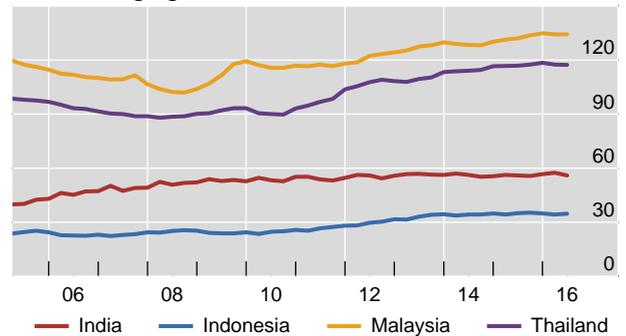
Major advanced economies



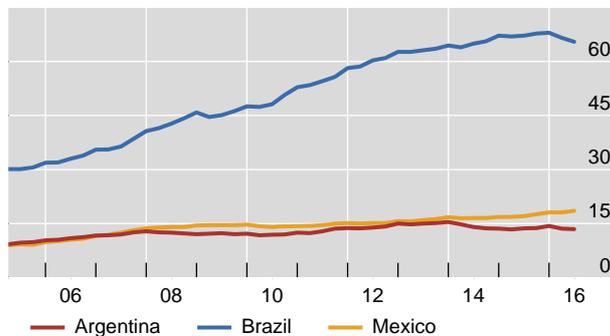
Emerging Asia



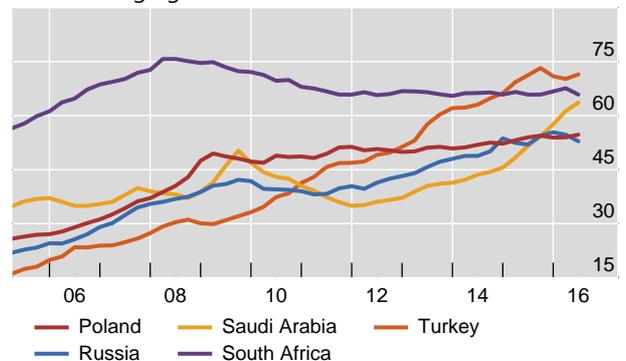
Other emerging Asia



Latin America



Other emerging market economies



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

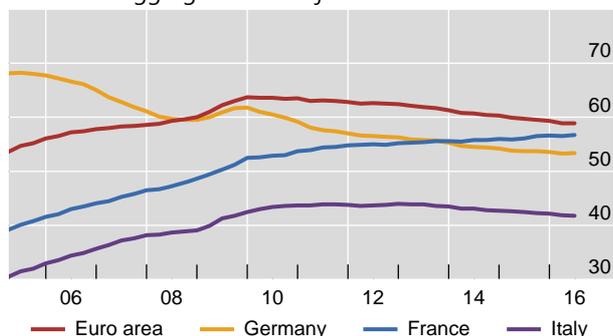
Source: BIS total credit statistics.

Total credit to households (core debt)

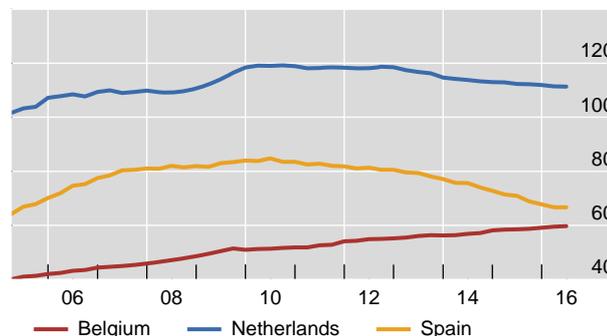
As a percentage of GDP

Graph F.4

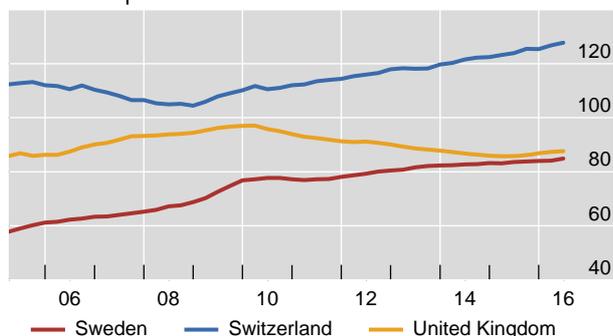
Euro area: aggregate and major countries



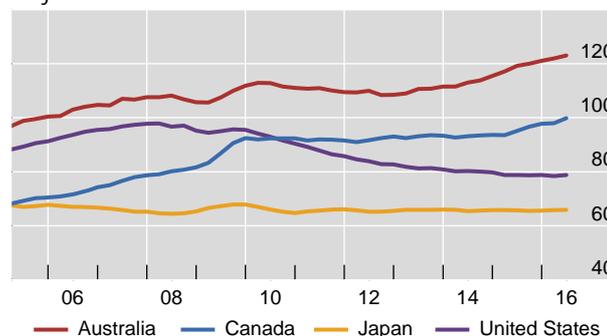
Euro area: other countries



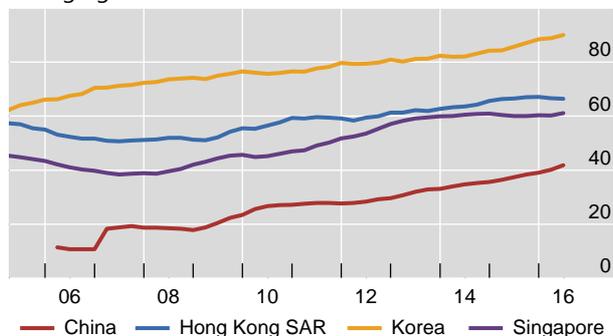
Other European countries



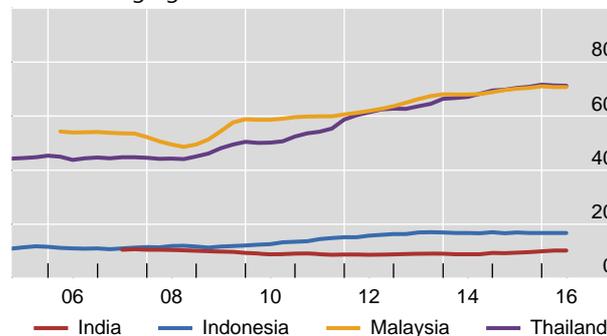
Major advanced economies



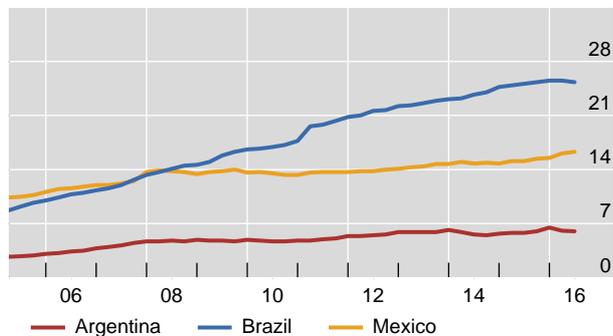
Emerging Asia



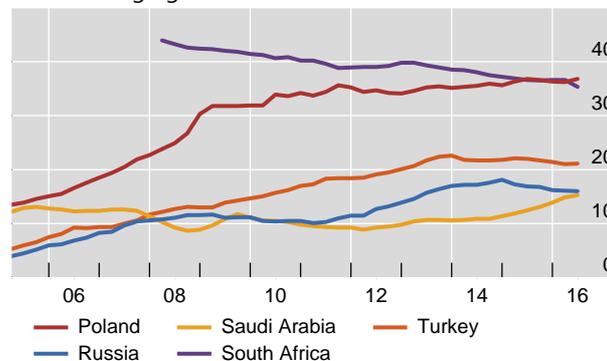
Other emerging Asia



Latin America



Other emerging market economies



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

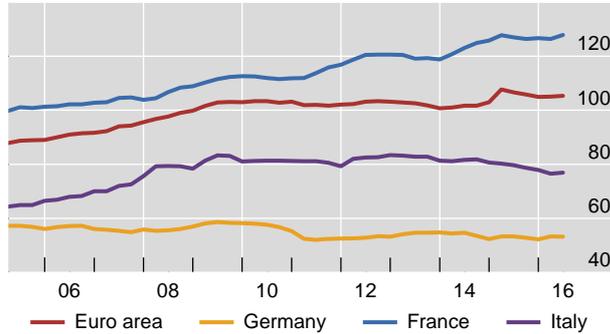
Source: BIS total credit statistics.

Total credit to non-financial corporations (core debt)

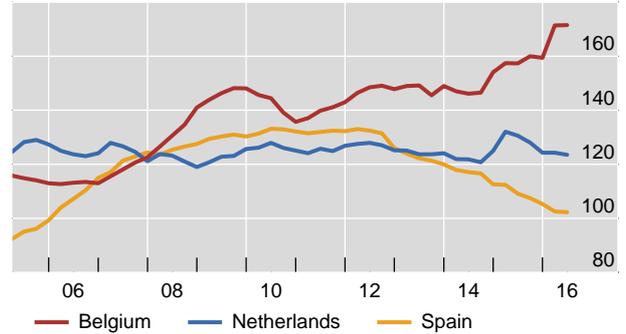
As a percentage of GDP

Graph F.5

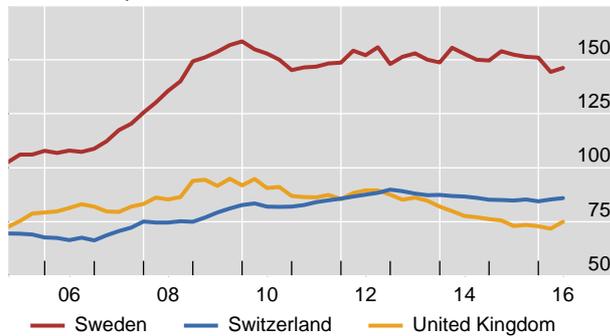
Euro area: aggregate and major countries



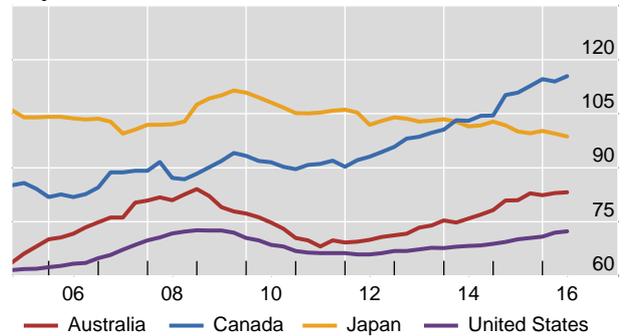
Euro area: other countries



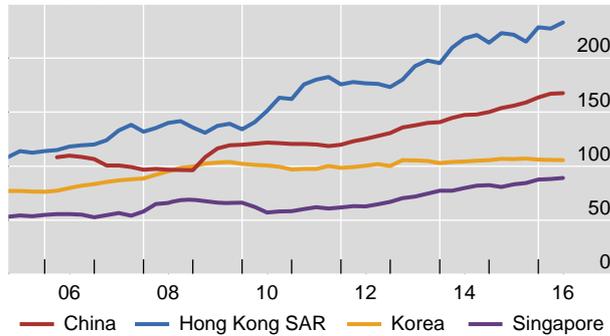
Other European countries



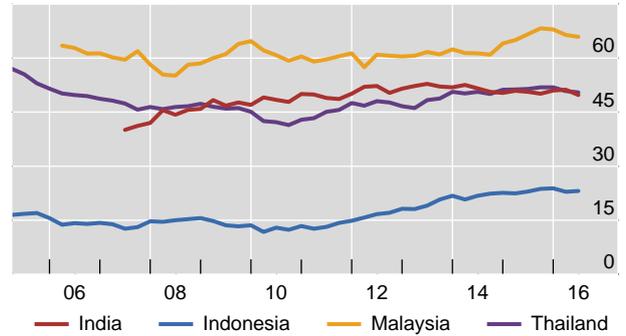
Major advanced economies



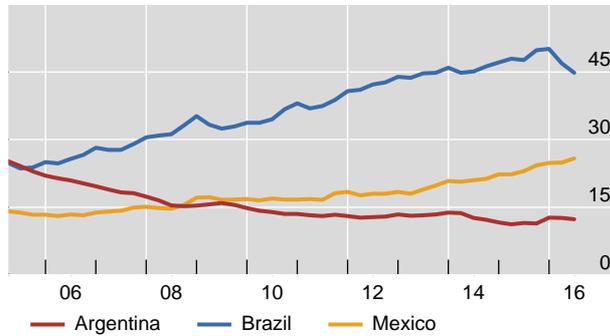
Emerging Asia



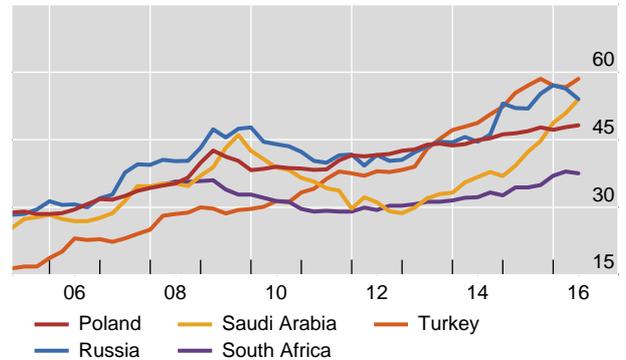
Other emerging Asia



Latin America



Other emerging market economies



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

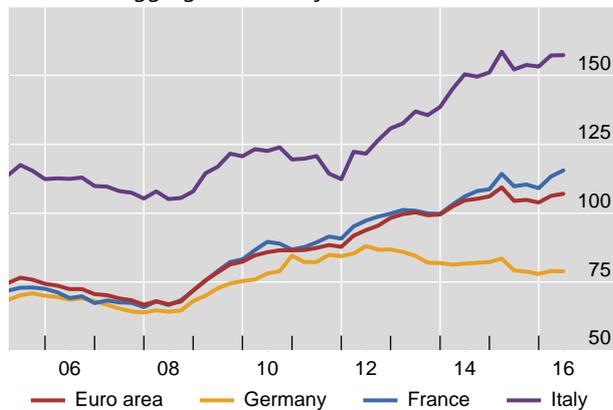
Source: BIS total credit statistics.

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

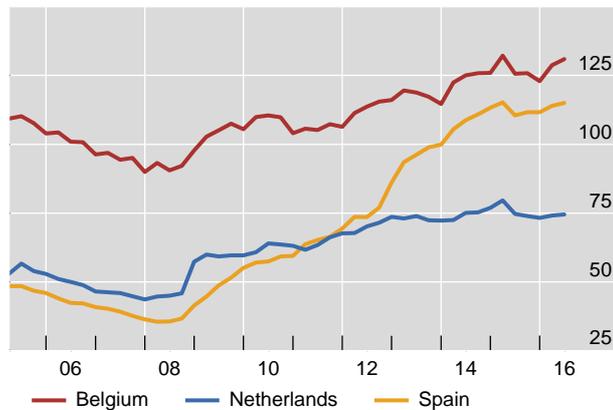
As a percentage of GDP

Graph F.6

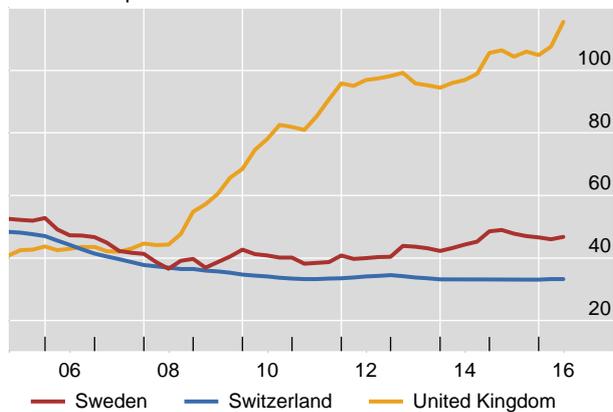
Euro area: aggregate and major countries



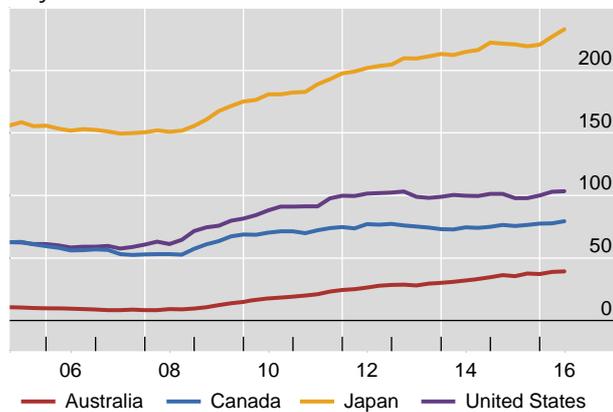
Euro area: other countries



Other European countries



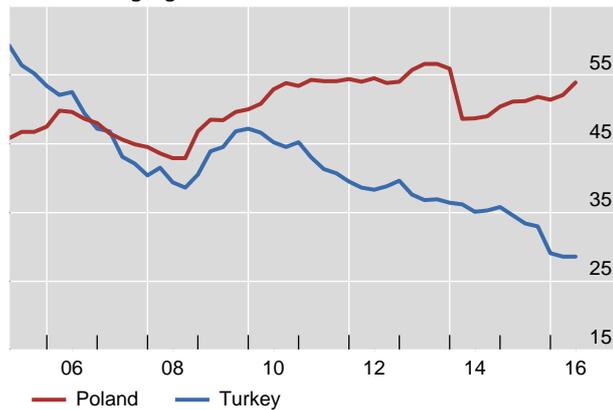
Major advanced economies



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.

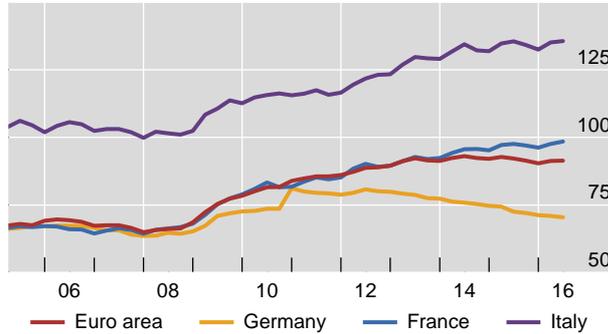
Source: BIS total credit statistics.

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

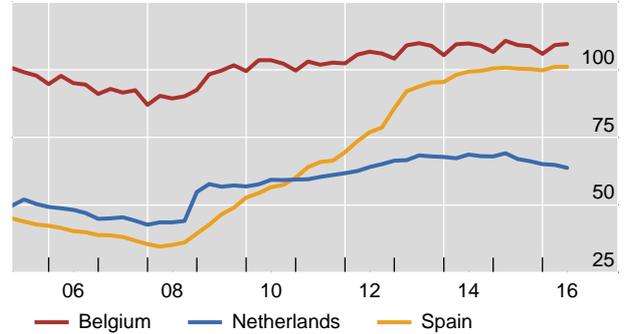
As a percentage of GDP

Graph F.7

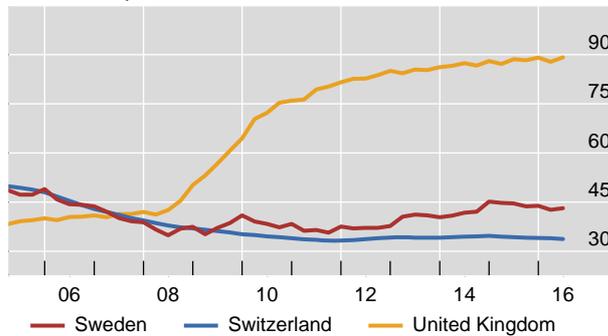
Euro area: aggregate and major countries



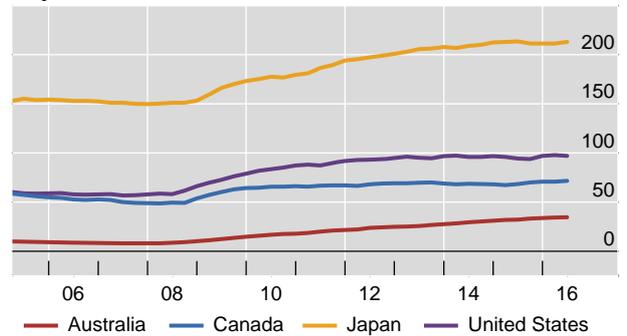
Euro area: other countries



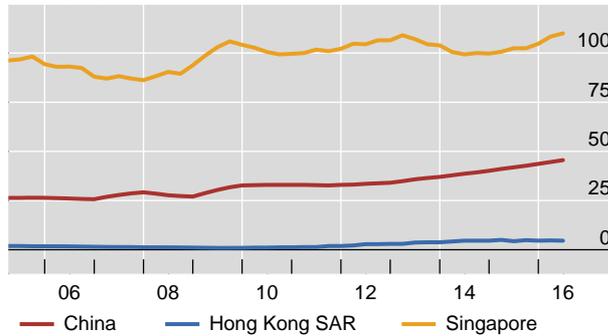
Other European countries



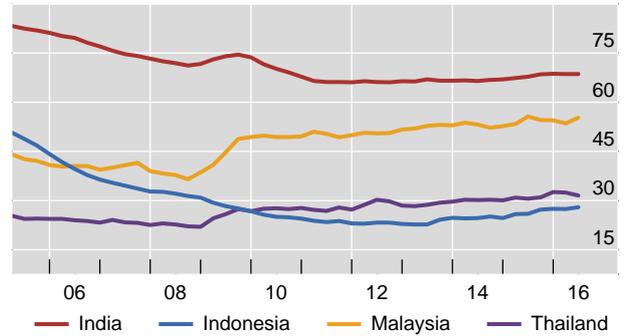
Major advanced economies



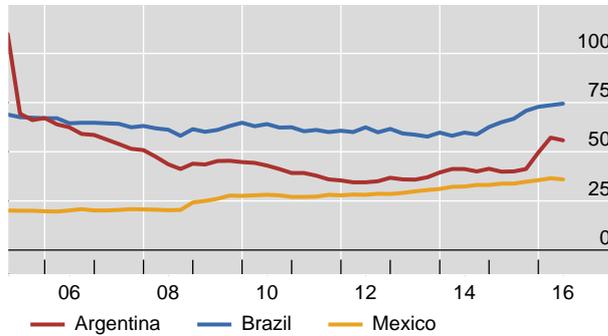
Emerging Asia



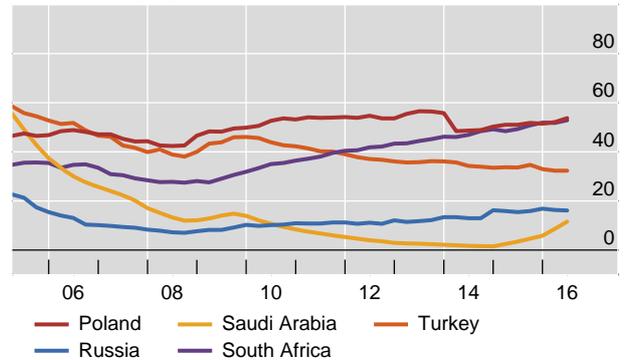
Other emerging Asia



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.

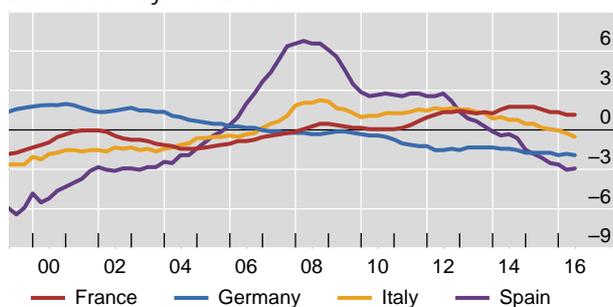
G Debt service ratios for the private non-financial sector

Debt service ratios of the private non-financial sector

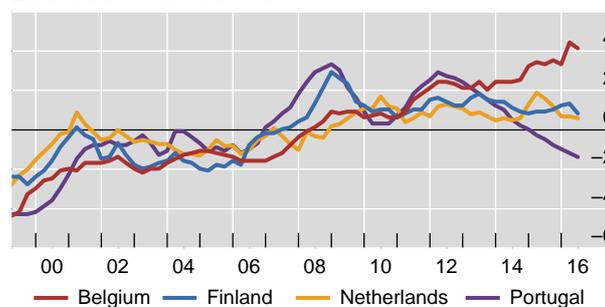
Deviation from country-specific mean, in percentage points¹

Graph G.1

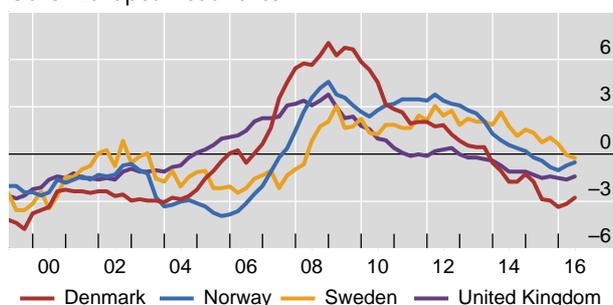
Euro area: major countries



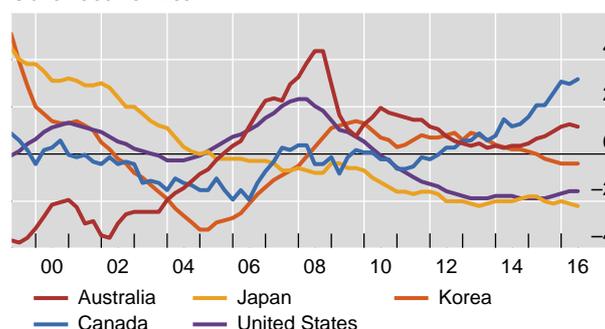
Euro area: other countries



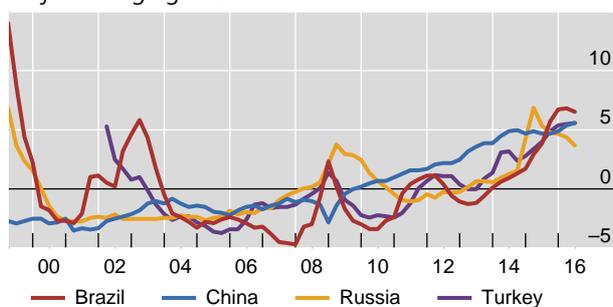
Other European countries



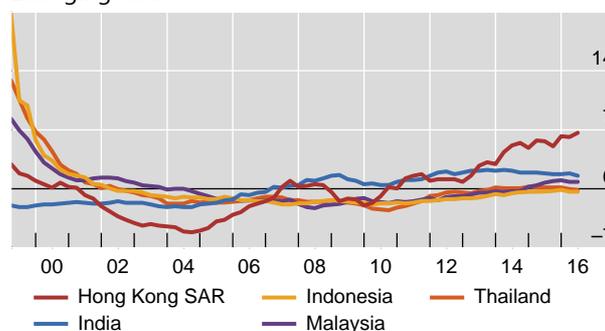
Other economies



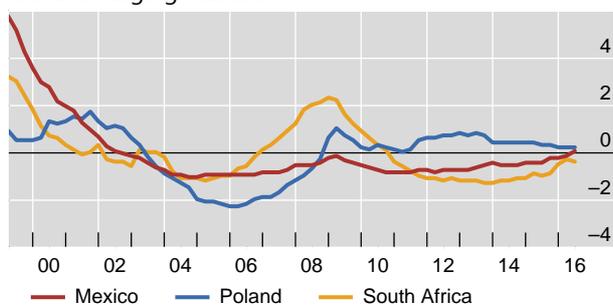
Major emerging markets²



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.

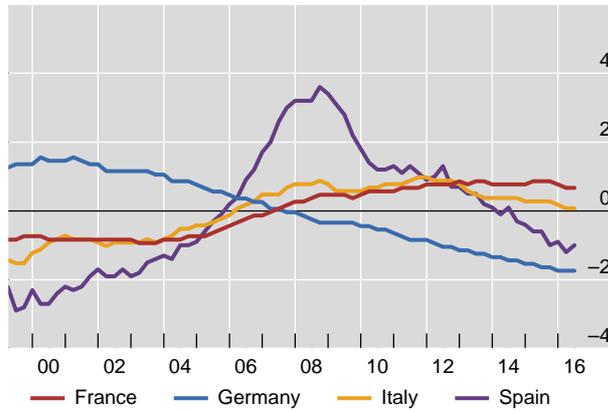
Source: BIS debt service ratios statistics.

Debt service ratios of households

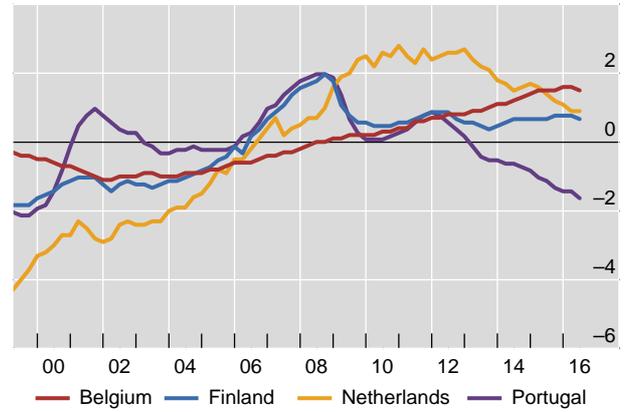
Deviation from country-specific mean, in percentage points¹

Graph G.2

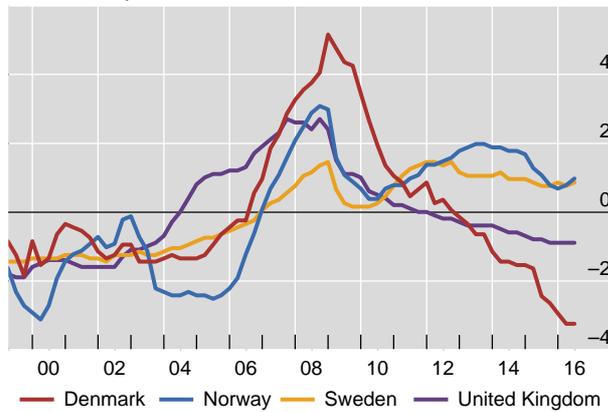
Euro area: major countries



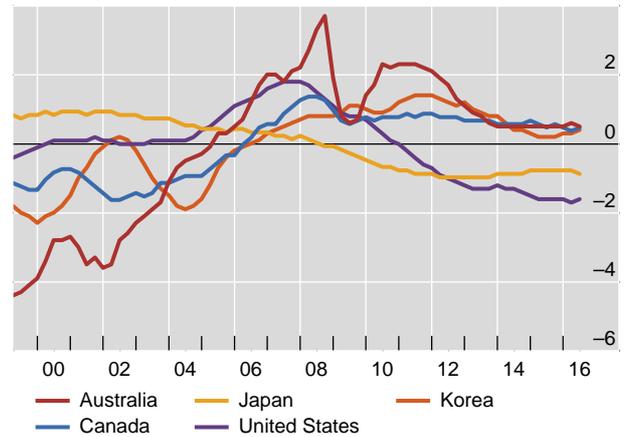
Euro area: other countries



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.

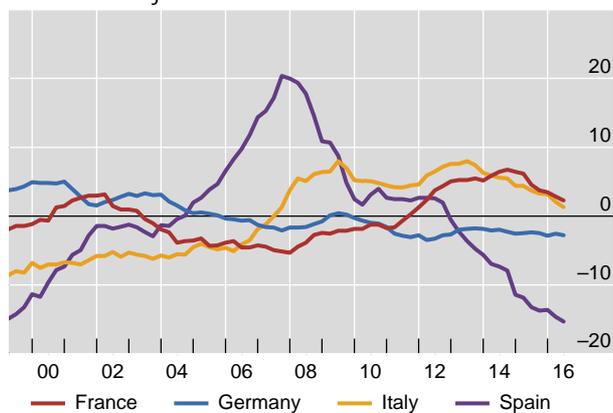
Source: BIS debt service ratios statistics.

Debt service ratios of non-financial corporations

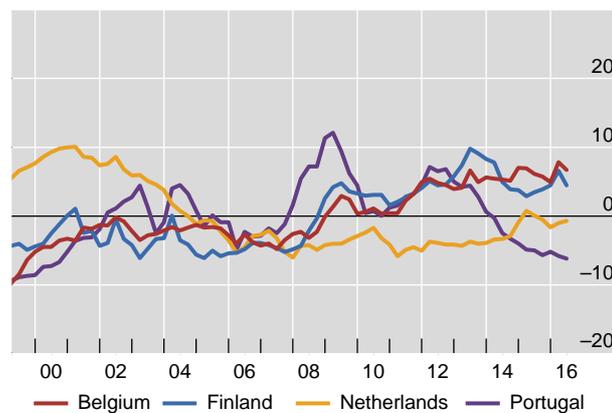
Deviation from country-specific mean, in percentage points¹

Graph G.3

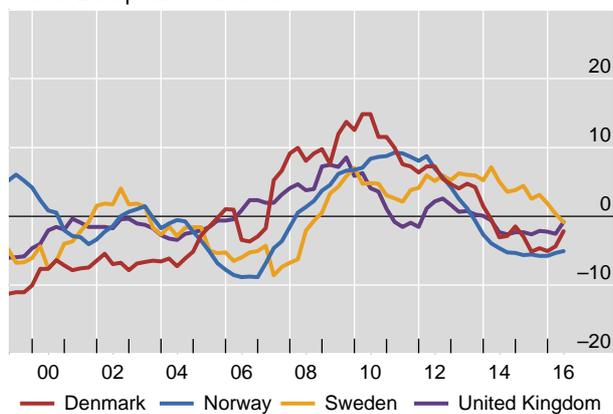
Euro area: major countries



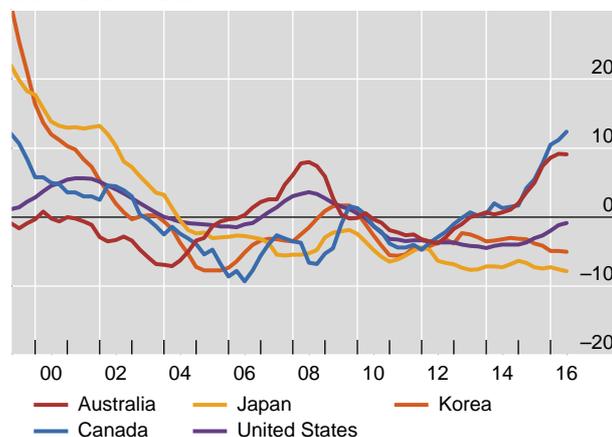
Euro area: other countries



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.

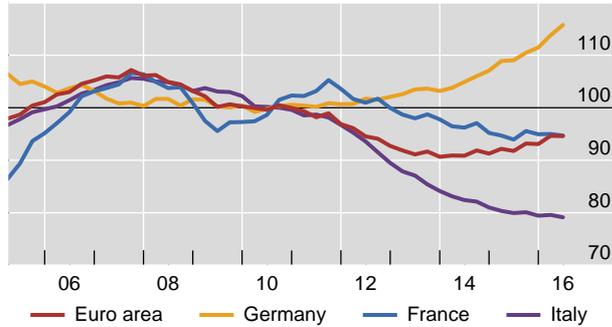
H Property price statistics

Real residential property prices

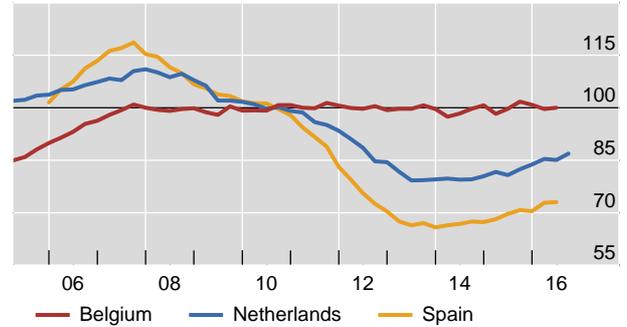
CPI-deflated, 2010 = 100

Graph H.1

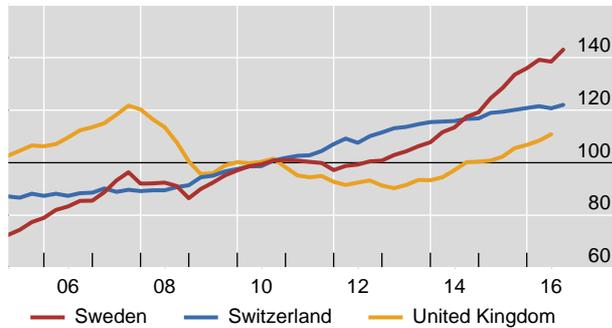
Euro area: aggregate and major countries



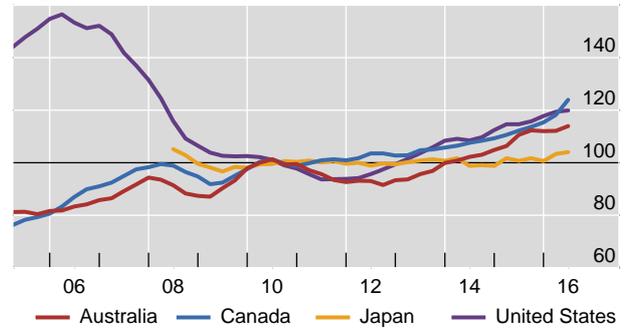
Euro area: other countries



Other European countries



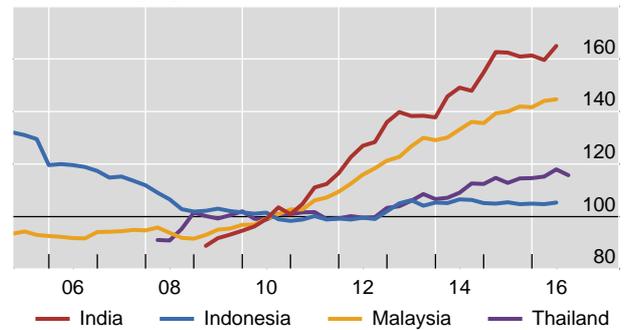
Major advanced economies



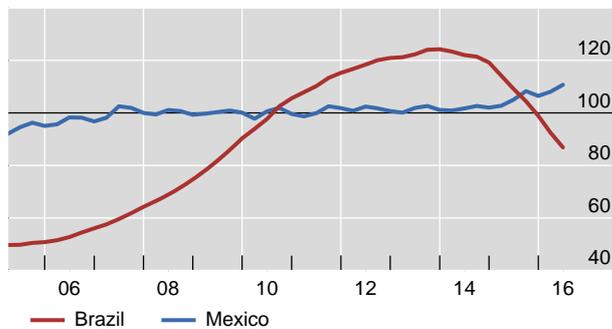
Emerging Asia



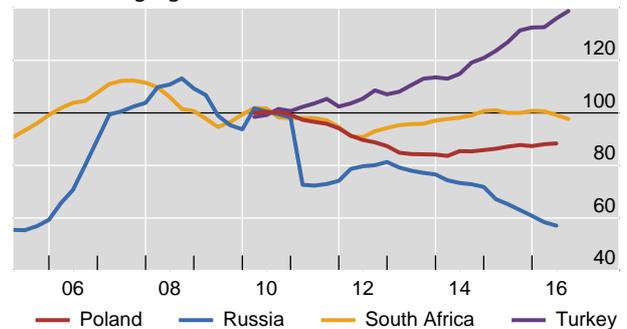
Other emerging Asia



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.

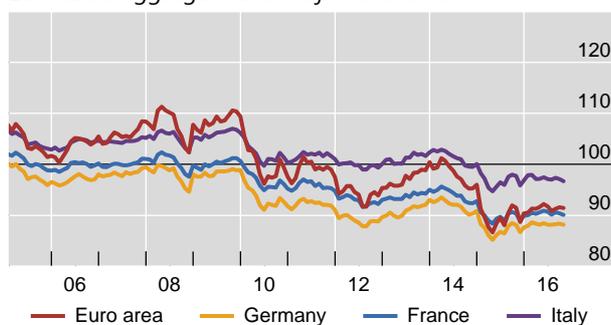
I Effective exchange rate statistics

Real effective exchange rates

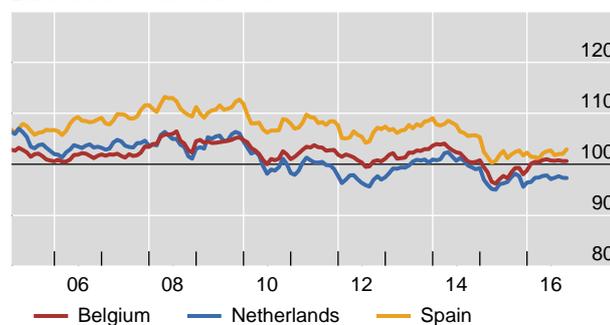
CPI-based, 1995–2005 = 100¹

Graph I.1

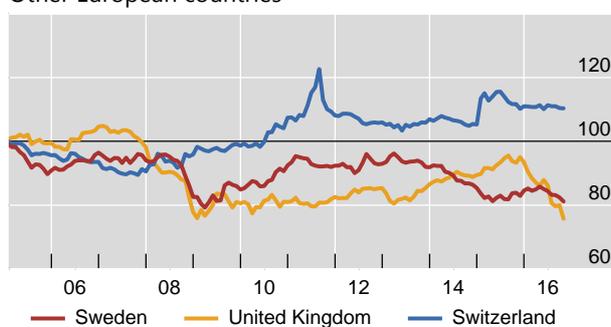
Euro area: aggregate and major countries



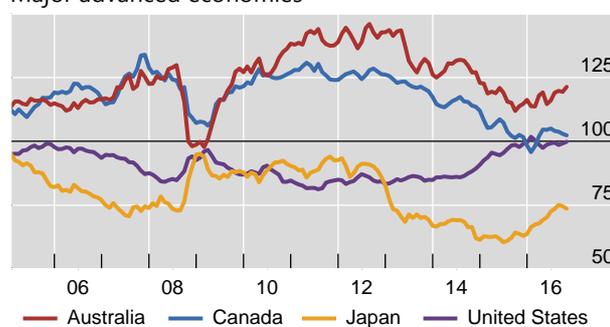
Euro area: other countries



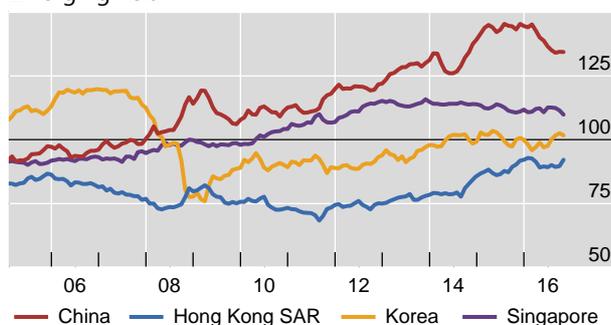
Other European countries



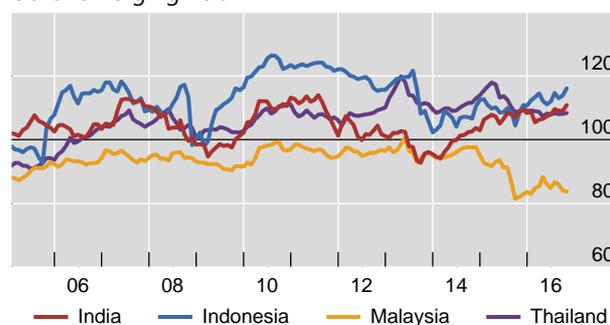
Major advanced economies



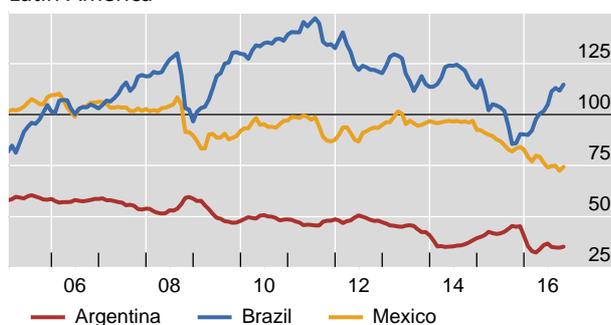
Emerging Asia



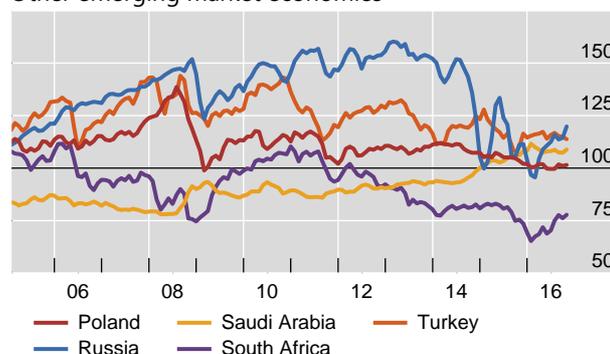
Other emerging Asia



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.

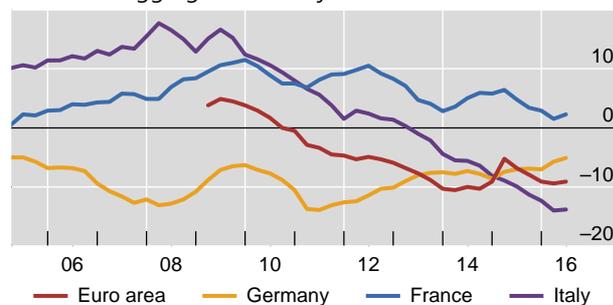
J Credit-to-GDP gaps

Credit-to-GDP gaps

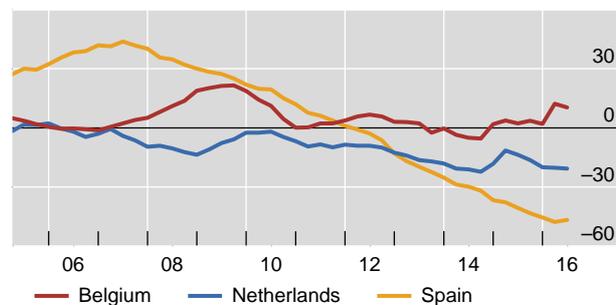
In percentage points of GDP

Graph J.1

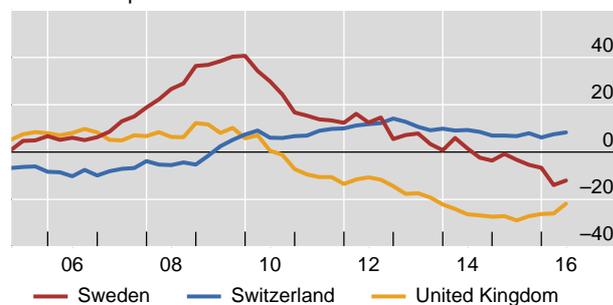
Euro area: aggregate and major countries



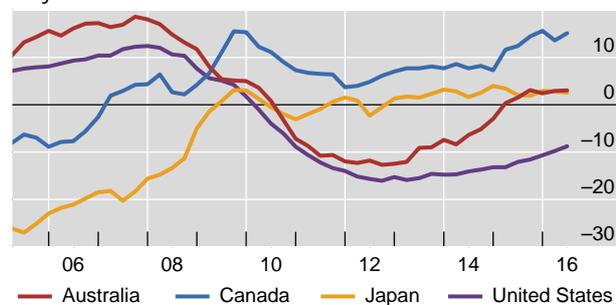
Euro area: other countries



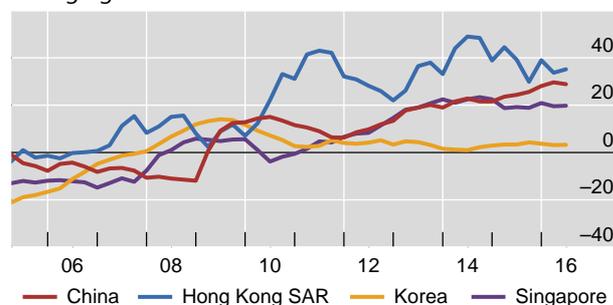
Other European countries



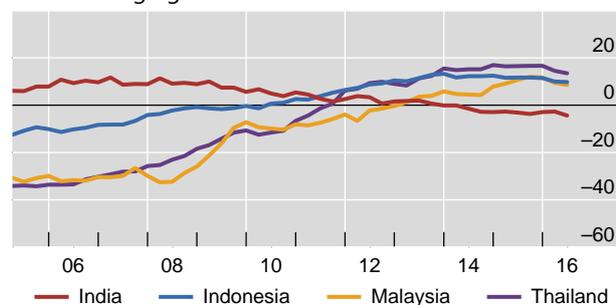
Major advanced economies



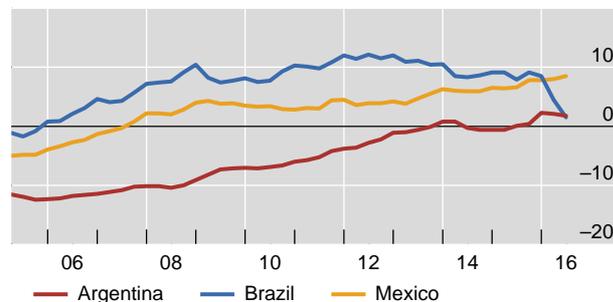
Emerging Asia



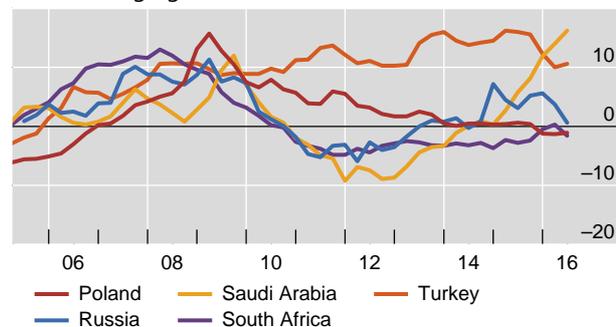
Other emerging Asia



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.

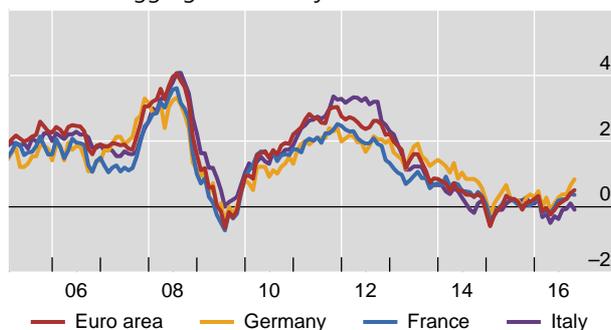
K Consumer prices

Consumer prices

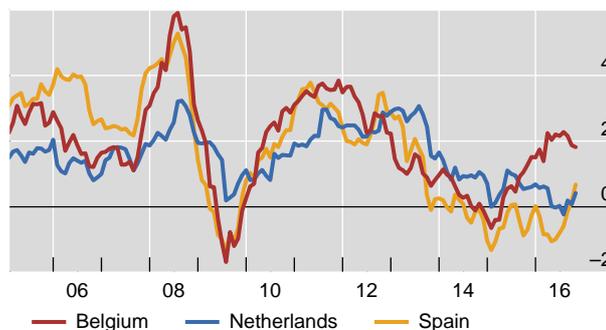
Year-on-year percentage changes

Graph K.1

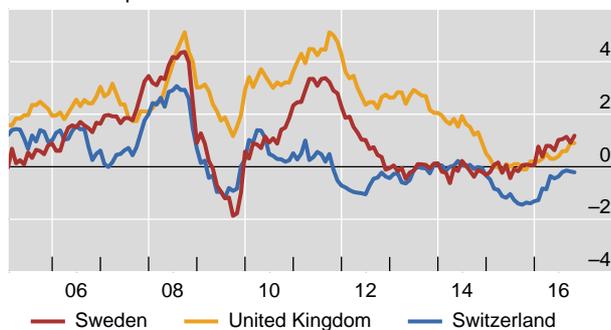
Euro area: aggregate and major countries



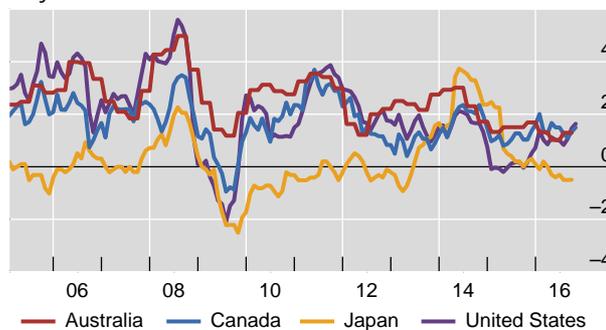
Euro area: other countries



Other European countries



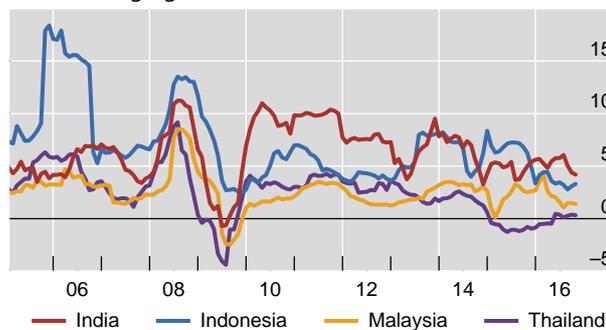
Major advanced economies



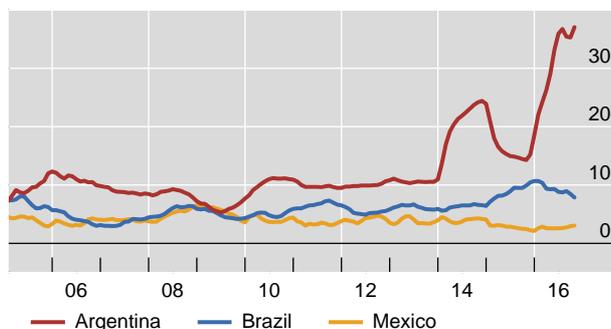
Emerging Asia



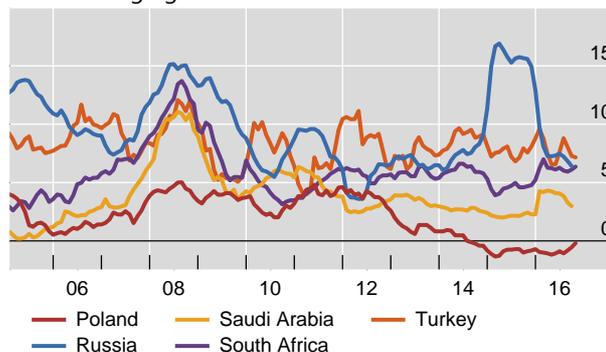
Other emerging Asia



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.

Special features in the BIS Quarterly Review

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
March 2016	How have central banks implemented negative policy rates?	Morten Bech & Aytel Malkhozov
March 2016	Wealth inequality and monetary policy	Dietrich Domanski, Michela Scatigna & Anna Zabai
March 2016	The resilience of banks' international operations	Patrick McGuire & Goetz Von Peter
March 2016	Hanging up the phone – electronic trading in fixed income markets and its implications	Morten Bech, Anamaria Illes, Ulf Lewrick & Andreas Schrimpf
December 2015	Dollar credit to emerging market economies	Robert Neil McCauley, Patrick McGuire & Vladyslav Sushko
December 2015	Calibrating the leverage ratio	Ingo Fender & Ulf Lewrick
December 2015	Central clearing: trends and current issues	Dietrich Domanski, Leonardo Gambacorta & Cristina Picillo
December 2015	Sovereign ratings of advanced and emerging economies after the crisis	Marlene Amstad & Frank Packer

Recent BIS publications¹

BIS Papers

Inflation mechanisms, expectations and monetary policy

BIS Papers No 89, November 2016

Inflation has been off-target for some time in many economies, both advanced and emerging. Whereas advanced economies have mostly been experiencing inflation below target, the experience among emerging market economies has been more mixed. Inflation has been below target in several EMEs in Asia and Central and Eastern Europe, but above target in some Latin American economies as well as in Russia, South Africa and Turkey. This volume explores the reasons behind this diverse inflation performance in EMEs and analyses possible changes to the inflation mechanism

Expanding the boundaries of monetary policy in Asia and the Pacific

BIS Papers No 88, October 2016

The Bank Indonesia and the Bank for International Settlements (BIS) co-hosted a research conference on "Expanding the boundaries of monetary policy in Asia and the Pacific" on 20-21 August 2015 in Jakarta. The event was the wrap-up conference of a research programme of the BIS Representative Office for Asia and the Pacific that had been approved by the Asian Consultative Council of central bank Governors in February 2014.

The topic was motivated by the increased importance of financial stability in the conduct of monetary policy and the expanding set of monetary policy tools being employed. Within this overall theme, the following issues for the Asia-Pacific region were identified: (i) monetary policy objectives and strategies; (ii) instruments to manage monetary conditions; (iii) the assessment of monetary conditions; and (iv) transmission mechanisms.

The conference brought together senior officials and researchers from central banks, international organisations and academia. This volume is a collection of the speeches, papers and prepared discussant remarks from the conference. This foreword summarises the contents of the conference and provides a synopsis of the discussions for time-constrained readers.

Challenges of low commodity prices for Africa

BIS Papers No 87, September 2016

The impressive growth of many African economies during the past decade was highly dependent on booming commodity markets and strong capital inflows, often related to commodities. With commodity prices falling and market expectations pointing to little reversal in the foreseeable future, macroeconomic policies have been put to a serious test. Growth has already weakened substantially in commodity exporters. The fiscal space for pursuing countercyclical policies has largely been eroded since the onset of the Great Financial Crisis (GFC) - except in some commodity exporters that had managed to build up financial buffers. Even such precautionary policies provide only temporary insulation. Should the commodity price decline be of a long-term duration, as projected by most analysts, further measures would be needed. Moreover, access to external financing has become more difficult and costly, and African countries have drawn down their external deposits with international banks. Meanwhile aid flows from advanced countries have been constrained by

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/>).

the currently weak economic situation. This suggests that African countries will have to rely primarily on domestic policies and financing in dealing with the slowdown in growth.

Macroprudential policy

BIS Papers No 86, September 2016

This volume contains 17 papers presented at the joint Central Bank of the Republic of Turkey (CBRT) - Bank for International Settlements (BIS) - International Monetary Fund (IMF) conference on "Macroprudential policy: effectiveness and implementation challenges" held in Istanbul, Turkey, during Turkey's presidency of the G20. They address the history, the theory and the practical implementation of macroprudential policies.

They analyse, inter alia: the nature of interactions with other policies (notably monetary policy and microprudential regulation); how macroprudential policies can cope with external shocks and what cross-border spillover effects arise; and the effectiveness of various macroprudential policy tools. Several country case studies are presented.

BIS Working Papers

The dollar, bank leverage and the deviation from covered interest parity

Chang Shu, Stefan Avdjiev, Wenxin Du, Catherine Koch and Hyun Song Shin

November 2016, No 592

We document the triangular relationship formed by the strength of the US dollar, cross-border bank lending in dollars and deviations from covered interest parity (CIP). A stronger dollar goes hand-in-hand with bigger deviations from CIP and contractions of cross-border bank lending in dollars. Differential sensitivity of CIP deviations to the strength of the dollar can explain cross-sectional variations in CIP arbitrage profits. Underpinning the triangle is the role of the dollar as proxy for the shadow price of bank leverage.

Adding it all up: the macroeconomic impact of Basel III and outstanding reform issues

Ingo Fender and Ulf Lewrick

November 2016, No 591

As the Basel III package nears completion, the emphasis is shifting to monitoring its implementation and assessing the impact of the reforms. This paper presents a simple conceptual framework to assess the macroeconomic impact of the core Basel III reforms, including the leverage ratio surcharge that is being considered for global systemically important banks (G-SIBs). We use historical data for a large sample of major banks to generate a conservative approximation of the additional amount of capital that banks would need to raise to meet the new regulatory requirements, taking the potential impact of current efforts to enhance G-SIBs' total loss-absorbing capacity into account. To provide a high-level proxy for the effect of changes in capital allocation and bank business models on the estimated net benefits of regulatory reform, we simulate the effect of banks converging towards the "critical" average risk weights (or "density ratios") implied by the combined risk-weighted and leverage ratio-based capital requirements. While keeping in mind that quantifying the regulatory impact remains subject to caveats, the results suggest that Basel III can be expected to generate sizeable macroeconomic net benefits even after the implied changes to bank business models have been taken into account.

The failure of covered interest parity: FX hedging demand and costly balance sheets

Vladyslav Sushko, Claudio Borio, Robert Neil McCauley and Patrick McGuire

October 2016, No 590

The failure of covered interest parity (CIP), or, equivalently, the persistence of the cross currency basis, in tranquil markets has presented a puzzle. Focusing on the basis against the US dollar (USD), we show that the CIP deviations that are not due to transaction costs or bank credit risk can be explained by the demand to hedge USD forward. Fluctuations in FX hedging demand matter because committing the balance sheet to arbitrage is costly. With limits to arbitrage, CIP arbitrageurs charge a premium in the forward markets for taking the

other side of FX hedgers' demand. We find that measures of FX hedging demand, combined with proxies for the risks associated with CIP arbitrage, improve the explanatory power of standard regressions.

International prudential policy spillovers: a global perspective

Stefan Avdjiev, Catherine Koch, Patrick McGuire and Goetz von Peter
October 2016, No 589

We combine the BIS international banking statistics with the IBRN prudential instruments database in a global study analyzing the effect of prudential measures on international lending. Our bilateral setting, which features multiple home and destination countries, allows us to simultaneously estimate both the international transmission and the local effects of such measures. We find that changes in macroprudential policy via loan-to-value limits and local currency reserve requirements have a significant impact on international bank lending. Balance sheet characteristics play an important role in determining the strength of these effects, with better capitalized banking systems and those with more liquid assets and less core deposits reacting more. Overall, our results suggest that the tightening of these macroprudential measures can be associated with international spillovers.

Macroprudential policies, the long-term interest rate and the exchange rate

Philip Turner
October 2016, No 588

The Bernanke-Blinder closed economy model suggests that macroprudential policies aimed at bank lending will affect the domestic long-term interest rate. In an open economy, domestic shocks to long-term rates are likely to influence capital flows and the exchange rate. Currency movements feed back into domestic credit through several channels, which will be influenced by balance sheet positions and not only by income flows. Macroprudential policies aimed at domestic credit and at foreign currency borrowing may be the best option open to small countries facing very low global interest rates and risky domestic credit expansion.

Globalisation and financial stability risks: is the residency-based approach of the national accounts old-fashioned?

Bruno Tissot
October 2016, No 587

The Great Financial Crisis of 2007-09 and its aftermath have emphasised the need for a global approach when assessing financial stability risks. One difficulty is that the traditional apparatus, especially the System of National Accounts (SNA), relies on the criterion of residency to capture statistical information within countries' boundaries. This paper analyses how to collect meaningful data to assess consolidated risk exposures. In particular, it argues that data collected along the residency-based SNA concept can be usefully complemented by a nationality-based, global approach. This requires the establishment of a framework for assessing financial positions on a so-called "nationality-basis", that is, at a globally consolidated level.

Leverage and risk weighted capital requirements

Leonardo Gambacorta and Sudipto Karmakar
September 2016, No 586

The global financial crisis has highlighted the limitations of risk-sensitive bank capital ratios. To tackle this problem, the Basel III regulatory framework has introduced a minimum leverage ratio, defined as a banks Tier 1 capital over an exposure measure, which is independent of risk assessment. Using a medium sized DSGE model that features a banking sector, financial frictions and various economic agents with differing degrees of creditworthiness, we seek to answer three questions: 1) How does the leverage ratio behave over the cycle compared with the risk-weighted asset ratio? 2) What are the costs and the benefits of introducing a leverage ratio, in terms of the levels and volatilities of some key macro variables of interest? 3) What can we learn about the interaction of the two regulatory ratios in the long run? The main answers are the following: 1) The leverage ratio acts as a backstop to the risk-sensitive capital requirement: it is a tight constraint during a boom and a soft constraint in a bust; 2) the net benefits of introducing the leverage ratio could be

substantial; 3) the steady state value of the regulatory minima for the two ratios strongly depends on the riskiness and the composition of bank lending portfolios.

The effects of a central bank's inflation forecasts on private sector forecasts: Recent evidence from Japan

Masazumi Hattori, Steven Kong, Frank Packer and Toshitaka Sekine
September 2016, No 585

How central banks can best communicate to the market is an increasingly important topic in the central banking literature. With ever greater frequency, central banks communicate to the market through the forecasts of prices and output with the purposes of reducing uncertainty; at the same time, central banks generally rely on a publicly stated medium-term inflation target to help anchor expectations. This paper aims to document how much the release of the forecasts of one major central bank, the Bank of Japan (BOJ), has influenced private sector expectations of inflation, and whether the degree of influence depends to any degree on the adoption of an inflation target (IT). Consistent with earlier studies, we find the central bank's forecasts to be quite influential on private sector forecasts. In the case of next year forecasts, their impact continues into the IT regime. Thus, the difficulties of aiming at an inflation target from below do not necessarily diminish the influence of the central bank's inflation forecasts.

Intuitive and reliable estimates of the output gap from a Beveridge-Nelson filter

Güneş Kamber, James Morley and Benjamin Wong
September 2016, No. 584

The Beveridge-Nelson (BN) trend-cycle decomposition based on autoregressive forecasting models of U.S. quarterly real GDP growth produces estimates of the output gap that are strongly at odds with widely-held beliefs about the amplitude, persistence, and even sign of transitory movements in economic activity. These antithetical attributes are related to the autoregressive coefficient estimates implying a very high signal-to-noise ratio in terms of the variance of trend shocks as a fraction of the overall quarterly forecast error variance. When we impose a lower signal-to-noise ratio, the resulting BN decomposition, which we label the "BN filter", produces a more intuitive estimate of the output gap that is large in amplitude, highly persistent, and typically positive in expansions and negative in recessions. Real-time estimates from the BN filter are also reliable in the sense that they are subject to smaller revisions and predict future output growth and inflation better than for other methods of trend-cycle decomposition that also impose a low signal-to-noise ratio, including deterministic detrending, the Hodrick-Prescott filter, and the bandpass filter.

Exchange rate pass-through: What has changed since the crisis?

Martina Jašová, Richhild Moessner and Előd Takáts
September 2016 No 583

We study how exchange rate pass-through to CPI inflation has changed since the global financial crisis. We have three main findings. First, exchange rate pass-through in emerging economies decreased after the financial crisis, while exchange rate pass-through in advanced economies has remained relatively low and stable over time. Second, we show that the declining pass-through in emerging markets is related to declining inflation. Third, we show that it is important to control for non-linearities when estimating exchange rate pass-through. These results hold for both short-run and long-run pass-through and remain robust to extensive changes in the specifications.

Global inflation forecasts

Jonathan Kearns
September 2016 No 582

Inflation co-moves across countries and several papers have shown that lags of this common inflation can help to forecast country inflation. This paper constructs forecasts of common (or 'global') inflation using survey forecasts of country inflation. These forecasts of global inflation have predictive power for global inflation at a medium horizon (12 months) but not at a longer horizon. Global inflation forecasts, and forecast errors, are correlated with survey forecasts and errors of oil and food prices, and global GDP growth, but not financial variables. For some countries, forecasts of global inflation improve the accuracy of

forecasting regressions that include survey forecasts of country inflation. In-sample fit and out-of-sample forecasting exercises suggest that forecasts of global inflation generally contain more information for forecasting country inflation than do lags of global inflation. However, for most countries, lagged or forecast global inflation does not improve the accuracy of survey forecasts of country inflation. Whatever information global inflation may include about country inflation, for most countries it seems that survey forecasts of country inflation have historically already incorporated that information.

Near-money premiums, monetary policy, and the integration of money markets: lessons from deregulation

Mark A Carlson and David C Wheelock

September 2016 No 581

The 1960s and 1970s witnessed rapid growth in the markets for new money market instruments, such as negotiable certificates of deposit (CDs) and Eurodollar deposits, as banks and investors sought ways around various regulations affecting funding markets. In this paper, we investigate the impacts of the deregulation and integration of the money markets. We find that the pricing and volume of negotiable CDs and Eurodollars issued were influenced by the availability of other short-term safe assets, especially Treasury bills. Banks appear to have issued these money market instruments as substitutes for other types of funding. The integration of money markets and ability of banks to raise funds using a greater variety of substitutable instruments has implications for monetary policy. We find that, when deregulation reduced money market segmentation, larger open market operations were required to produce a given change in the federal funds rate, but that the pass through of changes in the funds rate to other market rates was also greater.

Bank capital and dividend externalities

Viral Acharya, Hanh Le and Hyun Song Shin

September 2016 No 580

Dividend payouts affect the relative value of claims within a firm. When firms have contingent claims on each other, as in the banking sector, dividend payouts can shift the relative value of stakeholders' claims across firms. Through this channel, one bank's capital policy affects the equity value and risk of default of other banks. In a model where such externalities are strong, bank capital takes on the attribute of a public good, where the private equilibrium features excessive dividends and inefficient recapitalization relative to the efficient policy that maximizes banking sector equity. We compare the implications of the model with observed bank behavior during the crisis of 2007-09.

Basel Committee on Banking Supervision

Risk weight for the International Development Association (IDA)

November 2016

The Basel Committee on Banking Supervision has agreed that supervisors may allow banks to apply a 0% risk weight to claims on the International Development Association (IDA) in accordance with paragraph 59 of the document International Convergence of Capital Measurement and Capital Standards: a Revised Framework, June 2004 (Basel II Framework). IDA will be included in the list of multilateral development banks as set out in footnote 24 to paragraph 59 of the Basel II Framework.

Revisions to the annex on correspondent banking

November 2016

The Basel Committee is consulting on proposed Revisions to the annex on correspondent banking . The proposals 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 proposed 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. The proposed revisions also clarify supervisors' expectations regarding the quality of payment messages as well as conditions for using Know Your Customer (KYC) utilities.

Eleventh progress report on adoption of the Basel regulatory framework October 2016

This updated Progress report on adoption of the Basel regulatory framework provides a high-level view of Basel Committee members' progress in adopting Basel III standards as of end-September 2016.

The report focuses on the status of adoption of all Basel III standards (which will become effective by 2019) to ensure that the Basel standards are transformed into national law or regulation according to the internationally agreed timeframes. The report is based on information provided by individual members as part of the Committee's Regulatory Consistency Assessment Programme (RCAP). The report includes the status of adoption of the Basel III risk-based capital standards, the leverage ratio, the liquidity coverage ratio (LCR), the net stable funding ratio (NSFR), the standards for global and domestic systemically important banks (SIBs), Pillar 3 disclosure requirements, and the large exposure framework.

In addition to periodically reporting on the status of adoption, all Committee members undergo an assessment of the consistency of their domestic rules with the Basel standards.

TLAC holdings standard October 2016

This document is the final standard on the regulatory capital treatment of banks' investments in instruments that comprise total loss-absorbing capacity (TLAC) for global systemically important banks (G-SIBs).

The standard also reflects changes to Basel III to specify how G-SIBs must take account of the TLAC requirement when calculating their regulatory capital buffers.

The standard will take effect at the same time as the minimum TLAC requirements for each G-SIB. These requirements are set out in the Financial Stability Board's TLAC standard for G-SIBs. They take effect on 1 January 2019 for most G-SIBs, but later for those whose headquarters are in emerging market economies.

Regulatory treatment of accounting provisions - interim approach and transitional arrangements - consultative document & discussion document October 2016

The Basel Committee on Banking Supervision today released a consultative document and a discussion paper on the policy considerations related to the regulatory treatment of accounting provisions under the Basel III regulatory capital framework.

The International Accounting Standards Board (IASB) and the US Financial Accounting Standards Board (FASB) have adopted provisioning standards that require use of expected credit loss (ECL) models rather than incurred loss models.

The new accounting standards modify provisioning standards to incorporate forward-looking assessments in the estimation of credit losses. The consultative document released today sets out the Committee's proposal to retain, for an interim period, the current regulatory treatment of provisions under the standardised and the internal ratings-based approaches. In addition, the Committee is seeking comments on whether any transitional arrangement is warranted to allow banks time to adjust to the new ECL accounting standards.

Frequently asked questions on the supervisory framework for measuring and controlling large exposures
October 2016

The Basel Committee today issued frequently asked questions on the global supervisory framework for measuring and controlling large exposures. When the Committee published the revised Supervisory framework for measuring and controlling large exposures in April 2014, it noted that by 2016 it would review the appropriateness of setting a large exposure limit for exposures to qualifying central counterparties (QCCPs) related to clearing activities and the need for a specific treatment for interbank exposures. After completing the observation period, the Committee has decided not to modify the framework. As a result, the framework, which will take effect from 1 January 2019, will: (1) exempt from the large exposure limit exposures to QCCPs related to central clearing; and (2) apply the large exposure limit to interbank exposures (ie no exemption will apply).

The publication also includes clarifications on some paragraphs of the standard, pursuant to the Committee's objective of promoting consistent global implementation of the requirements.

Guidance on the application of the Core Principles for Effective Banking Supervision to the regulation and supervision of institutions relevant to financial inclusion
September 2016

This document reflects comments received during a consultation period and builds on past work by the Committee to elaborate additional guidance in the application of the Committee's Core principles for effective banking supervision to the supervision of financial institutions engaged in serving the financially unserved and underserved. This includes a report of the Range of practice in the regulation and supervision of institutions relevant to financial inclusion, and expands on Microfinance activities and the Core Principles for Effective Banking Supervision.

The Guidance identifies 19 of the total 29 Core Principles where additional guidance is needed, and both Essential Criteria and Additional Criteria which have specific relevance to the financial inclusion context. Many of the unserved and underserved customers reside in countries that are not BCBS members. In recognition of this, the Guidance is intended to be useful to both BCBS member and non-member jurisdictions, including those jurisdictions in which supervisors are striving to comply with the Core Principles and who may implement this Guidance gradually over time.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III risk-based capital regulations – Argentina

This report presents the findings of the RCAP Assessment Team (the Assessment Team) on the domestic adoption of the Basel risk-based capital standards in Argentina and their consistency with the Basel Committee standards. The team was led by Édouard Fernandez-Bollo, Secretary General of the French Prudential Supervisory and Resolution Authority, and comprised five technical experts. The assessment was carried out in 2016 using information available as of 30 December 2015. The counterparty for the assessment was the Central Bank of Argentina (BCRA), which published Basel III risk-based capital regulations in November 2013 and brought them into force on 1 February 2013. The BCRA published additional regulations in November 2015 to implement the capital conservation and countercyclical buffers that came into force on 1 January 2016.

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

This report presents the findings of the RCAP Assessment Team (the Assessment Team) on the domestic adoption of the Basel Liquidity Coverage Ratio (LCR) standards in Argentina.¹ The assessment focuses on the regulatory adoption of Basel LCR standards as applied to Argentinian banks that are internationally or regionally active and of significance to its domestic financial stability.

The RCAP LCR assessment was based primarily on the LCR rules that were issued by the Central Bank of Argentina (BCRA) in 2015. In the course of the assessment, the BCRA made a number of minor revisions to the rules based on issues identified by the Assessment Team. This report has been updated where relevant, to reflect the progress made by the BCRA to further align the regulations with the Basel LCR standards.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III risk-based capital regulations – Korea

This report presents the findings of the RCAP Assessment Team on the domestic adoption of the Basel risk-based capital standards in Korea and its consistency with the minimum requirements of the Basel III framework.¹ The assessment focuses on the adoption of Basel standards applied to the Korean banks that are internationally or regionally active and of significance to Korea's domestic financial stability.

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

This report presents the findings of the RCAP Assessment Team (the Assessment Team) on the domestic adoption of the Basel Liquidity Coverage Ratio (LCR) standards in Korea.¹ The assessment focuses on the regulatory adoption of Basel LCR standards applied to Korean banks that are internationally or regionally active and of significance to its domestic financial stability.

The RCAP LCR assessment was based primarily on the LCR rules that were issued by the Korean authorities² in December 2014. In the course of the assessment, the authorities made a number of revisions to the rules based on issues identified by the Assessment Team. This report has been updated where relevant, to reflect the progress made by Korean authorities to align the regulations with Basel LCR standards.

Basel III Monitoring Report

The Basel Committee today published the results of its latest Basel III monitoring exercise . . . The Committee established a rigorous reporting process to regularly review the implications of the Basel III standards for banks and it has published the results of previous exercises since 2012.

Data have been provided for a total of 228 banks, comprising 100 large internationally active banks ("Group 1 banks", defined as internationally active banks that have Tier 1 capital of more than €3 billion) and 128 "Group 2 banks" (ie representative of all other banks).

On a fully phased-in basis, data as of 31 December 2015 show that all large internationally active banks meet the Basel III risk-based capital minimum Common Equity Tier 1 (CET1) requirements as well as the target level of 7.0% (plus the surcharges on global systemically important banks - G-SIBs - as applicable). Between 30 June and 31 December 2015, Group 1 banks continued to reduce their capital shortfalls relative to the higher Tier 1 and Total capital target levels; in particular, the Tier 2 capital shortfall has decreased from €12.8 billion to €5.5 billion. As a point of reference, the sum of after-tax profits prior to distributions across the same sample of Group 1 banks for the six-month period ending 31 December 2015 was €206.8 billion.

Under the same assumptions, there is no capital shortfall for Group 2 banks included in the sample for the CET1 minimum of 4.5%. For a CET1 target level of 7.0%, the shortfall remained constant at €0.2 billion since the previous period.

The monitoring reports also collect bank data on Basel III's liquidity requirements. Basel III's Liquidity Coverage Ratio (LCR) was set at 60% in 2015, increased to 70% in 2016 and will continue to rise in equal annual steps to reach 100% in 2019. The weighted average LCR for the Group 1 bank sample was 125.2% on 31 December 2015, slightly up from 123.6% six months earlier. For Group 2 banks, the weighted average LCR was 148.1%, up from 140.1% six months earlier. Of the banks in the LCR sample, 85.6% of the Group 1 banks and 82.9% of the Group 2 banks reported an LCR that met or exceeded 100%, while all banks except for

one bank each in Group 1 and Group 2 reported an LCR at or above the 60% minimum requirement that was in place for 2015.

Basel III also includes a longer-term structural liquidity standard - the Net Stable Funding Ratio (NSFR). The weighted average NSFR for the Group 1 bank sample was 113.7%, while for Group 2 banks the average NSFR was 115.9%. As of December 2015, 79.6% of the Group 1 banks and 87.0% of the Group 2 banks in the NSFR sample reported a ratio that met or exceeded 100%, while 95.9% of the Group 1 banks and 97.2% of the Group 2 banks reported an NSFR at or above 90%.

The results of the monitoring exercise assume that the final Basel III package is fully in force, based on data as of 31 December 2015. That is, they do not take account of the transitional arrangements set out in the Basel III framework, such as the gradual phase-in of deductions from regulatory capital. No assumptions were made about bank profitability or behavioural responses, such as changes in bank capital or balance sheet composition. For that reason, the results of the study may not be comparable with industry estimates. The report presents the findings of the RCAP Assessment Team (the Assessment Team) on the domestic adoption of the Basel Liquidity Coverage Ratio (LCR) standards in Korea.¹ The assessment focuses on the regulatory adoption of Basel LCR standards applied to Korean banks that are internationally or regionally active and of significance to its domestic financial stability.

The RCAP LCR assessment was based primarily on the LCR rules that were issued by the Korean authorities² in December 2014. In the course of the assessment, the authorities made a number of revisions to the rules based on issues identified by the Assessment Team. This report has been updated where relevant, to reflect the progress made by Korean authorities to align the regulations with Basel LCR standards.

Committee on the Global Financial Systems

Objective-setting and communication of macroprudential policies November 2016 No 57

Macroprudential policy faces a range of challenges that stem from the difficulty to quantify its principal objective, financial stability, and from the absence of an established analytical paradigm to guide its conduct. These challenges are particularly relevant when appraising policy (see CGFS Publications, no 56) and, as discussed here, when setting objectives and communicating policy.

This report argues that adopting a systematic policy framework that channels policymaking through a set of predictable procedures can help address these challenges. A key element of an effective policy framework is a communication strategy that clearly explains how macroprudential actions can contribute to achieving financial stability. The report provides an overview of how objectives are set in macroprudential policy and how policy is communicated in practice. The main part of the report discusses the role that communication can play in macroprudential policy, both in terms of helping to anchor stakeholders' expectations but also in influencing stakeholders' behaviour. One of the report's messages is that perhaps more than in other policy areas, a greater effort is required to explain the macroprudential policy framework and to ensure that the goal of maintaining financial stability is valued by the wider public. Such an appreciation facilitates policy actions early on in the cycle, when instruments may be more effective and adjustment less costly.

Committee on Payments and Market Infrastructures

Fast payments - Enhancing the speed and availability of retail payments

November 2016 No 154

The Committee on Payments and Market Infrastructures has issued a report on Fast payments . So-called fast payment services make funds immediately available to the payee and can be used around-the-clock, on a 24/7 basis. As such, they overcome the limitations of traditional retail payment services, namely that usually the funds reach the beneficiary one or more days after the funds are debited in the payer's account, and that these can be initiated only in certain places at certain times.

The report sets out key characteristics of fast payments, takes stock of different initiatives in CPMI jurisdictions, analyses supply and demand factors that may foster or hinder their development, sets out the benefits and risks and, finally, examines the potential implications for different stakeholders, particularly central banks.

Harmonisation of critical OTC derivatives data elements (other than UTI and UPI) - second batch, consultative report

October 2016 No 153

The 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 as well as the consultative report on Harmonisation of the Unique Transaction Identifier and two consultative reports on Harmonisation of the Unique Product Identifier¹. The Harmonisation Group also plans to issue consultative reports on further batches of key data elements (other than UTI and UPI) in the coming months.

Statistics on payment, clearing and settlement systems in the CPMI countries - Figures for 2015 - preliminary release

September 2016 No 152

This is an annual publication that provides data on payments and payment, clearing and settlement systems in the CPMI countries.

This version of the statistical update contains data for 2015 and earlier years. There are detailed tables for each individual country as well as a number of comparative tables.

Speeches

Monetary policy for financial stability

Keynote speech by Mr Jaime Caruana, General Manager of the BIS, at the 52nd SEACEN Governors' Conference, Naypyidaw, 26 November 2016.

Some widely cited models find that tightening monetary policy to reduce the probability of financial crisis ("leaning against the wind") has near-term macro costs that appreciably exceed the long-term output gains. However, these models make assumptions that tend to underestimate the net benefits of such a policy. Relaxing some of these strict assumptions

suggests that leaning early as part of a systematic response from monetary policy over the whole financial cycle can yield significant economic benefits.

The banking industry: struggling to move on

Keynote speech by Claudio Borio, Head of the Monetary and Economic Department of the BIS, at the Fifth EBA Research Workshop on "Competition in banking: implications for financial regulation and supervision", London, 28-29 November 2016.

Almost one decade on since the Great Financial Crisis, pressing questions linger about the banking industry's state and prospects. In some important respects, notably capitalisation, banks are stronger than they were pre-crisis. Even so, there is widespread market scepticism about their strength and profit outlook. This reflects a poisonous mix of legacy problems and a hostile economic environment, notably persistently ultra-low interest rates. What can be done? Banks need to pursue sustainable profits, avoiding pre-crisis mistakes, by choosing the right business models; cost cutting and reductions of excess capacity are an inevitable part of the solution. Prudential authorities need to complete the financial reforms without delay, notably Basel III, to resist the pressure to dilute standards and to redouble efforts to repair balance sheets. Policymakers more generally need to work in concert with prudential supervisors to facilitate the necessary adjustment, not least by addressing the "exit problem" that characterises the industry and entrenches excess capacity.

What are capital markets telling us about the banking sector?

Speech by Mr Jaime Caruana, General Manager of the BIS, at the IESE Business School conference on "Challenges for the future of banking: regulation, governance and stability", London, 17 November 2016.

Many banks already hold better-quality capital that significantly exceeds the new regulatory requirements. Yet the sector is still some way from recovering trust. Market pressures - not just regulations - have prompted banks to be more conservative with their balance sheets. Low price-to-book ratios of banks, a persistently wide cross-currency basis and continued deleveraging are signs that creditors and investors are now much more ready to sanction banks that are deemed not well capitalised. Therefore, dialling back the post-crisis regulatory reforms is not a convincing strategy to help banks overcome these pressures. Rather, banks can help themselves regain market participants' trust - and better serve the real economy - by cleaning up balance sheets and strengthening capital.

The bank/capital markets nexus goes global

Speech by Mr Hyun Song Shin, Economic Adviser and Head of Research of the BIS, at the London School of Economics and Political Science, 15 November 2016.

Banks borrow in order to lend, and so their lending capacity depends on their ability to borrow. When wholesale funding is the margin of adjustment for bank leverage, capital market conditions exert a large impact on bank lending capacity. The VIX index had previously served as the barometer of the appetite for leverage, but this is no longer true. Instead, the dollar has emerged as a barometer of that appetite for leverage. When the dollar is strong, banks' risk appetite is subdued and market anomalies, such as the breakdown in covered interest parity, become more pronounced. This phenomenon has implications both for financial stability and for the real economy. If banks are reluctant to lend during largely tranquil times, what will happen when volatility picks up? The effects of the strong dollar on funding costs may also shed light on aspects of the real economy, such as the slowdown in international trade.

Low global bond yields: low growth, monetary policy, market dynamics

Keynote speech by Mr Jaime Caruana, General Manager of the BIS, at the Crédit Agricole CIB Asset Managers Summit, London, 14 November 2016.

For asset managers, the appropriate interpretation of the signals coming from the bond market is a key call. In understanding low global bond yields, it is easy to overstate the influence of slow growth fundamentals and to understate the role of central bank actions and internal market dynamics.

How should prudential and monetary policies in open economies react to "current global conditions"?

Intervention by Mr Luiz Awazu Pereira da Silva, Deputy General Manager of the BIS, at the BoE-HKMA-IMF Joint Conference on "Monetary, Financial and Prudential Policy Interaction in the Post-Crisis World", Hong Kong, 24-25 October 2016.

In a global environment characterised by the implementation and the consequences of unconventional monetary policies (ultra-low rates, exchange rate volatility, large capital flows, etc), how should policy frameworks of small open and emerging market economies react? How should those economies lean against the wind and with what instruments? Apart from monetary policy, what combination of macroprudential tools should this include? We illustrate the results of leaning against the wind with a combination of macroprudential and monetary policies that complement each other and help to achieve both price and financial stability. More specifically, calling this an integrated inflation targeting (IIT) framework, we show the need to coordinate and jointly calibrate both instruments. Nevertheless, we acknowledge that there is a need to continue to explore a research agenda on how, when and with what combination of complementary tools we can best lean against the wind.

Financial inclusion and the fintech revolution: implications for supervision and oversight

Welcoming remarks by Mr Jaime Caruana, General Manager of the BIS, at the Third GPMI-FSI Conference on Standard-Setting Bodies and Innovative Financial Inclusion - "New frontiers in the supervision and oversight of digital financial services", Basel, 26 October 2016.

Ladies and gentlemen, it is my great pleasure to welcome you to this Third GPMI-FSI Conference on Global Standard-Setting and Innovative Financial Inclusion. I would like to thank the Global Partnership for Financial Inclusion (GPMI) and our Financial Stability Institute (FSI) for once again bringing together representatives from standard-setting bodies, multilateral organisations and national authorities for this biennial event. The theme this year is "New frontiers in the supervision and oversight of digital financial services".

When I opened our previous gathering in October 2014, I expressed amazement at the pace of change. I cited, as an example, the growth of digital financial services resulting from the wider availability of mobile phones. Looking back, the 2014 conference marked the first time we used the term "digital financial inclusion". It was also the first time most of the organisations present in this room came together to consider the shifting risks posed by the spread of digital transactional platforms designed to bring much needed services to the world's financially under-served - then estimated at 2.5 billion.¹

Now, just two years later, the pace of change seems only to be increasing - as does the urgent need for collective action, a theme to which I shall come back. The forces shaping and accelerating this change challenge us to revisit fundamental questions about the role of finance, the responsibilities of public authorities, and the power of private actors - including outsiders to traditional finance.

Towards an integrated inflation targeting framework in middle-income countries: a research agenda

Keynote speech by Mr Luiz Awazu Pereira da Silva, Deputy General Manager of the BIS, at the 2nd ECBN Policy Research Conference on "Macroprudential Instruments and Financial Cycles", Ljubljana, 29 September 2016.

The damage inflicted by the recent Global Financial Crisis (GFC) changed the terms of the old debate about "leaning before" versus "cleaning up after" a financial crisis. Easy monetary conditions in advanced economies and large capital flows to middle income countries add to the complexity of the discussion. A proposed integrated inflation targeting framework (IIT regime) that comprises monetary, fiscal and macroprudential policies would be best suited to achieve price and financial stability in this context. But the complexity and interconnectedness of these policies means that the development of this framework will require substantial research effort by all interested parties in academia and policymaking.

Issues faced by emerging market economies in the evolving international monetary and financial system: what has the global financial crisis revealed?

Speech by Mr Luiz Awazu Pereira da Silva, Deputy General Manager of the BIS, at the City Lectures, Official Monetary and Financial Institutions Forum, London, 19 September 2016.

The Global Financial Crisis (GFC) revealed larger than anticipated interconnected weaknesses in our international monetary and financial system (IMFS), in our regulatory framework and in the local macro framework used by emerging market economies (EMEs). Thus advanced economies (AEs) and EMEs need to work on strengthening their domestic macro framework and putting their "house in order" from a macro-financial perspective; and the global regulatory framework needs to be strengthened to contribute to reinforcing the disciplinary dimension of the IMFS, especially given the current potential volatility that monetary policy divergence and unconventional monetary policy have created. The coordination of macroprudential policy across AEs and EMEs could be a potential win-win for the IMFS. This could offer a progressive way out of the policy stance prevailing in this phase of the GFC.

The OeNB at 200: continuity and change in central banking

Opening remarks by Mr Jaime Caruana, General Manager of the BIS, at the conference on the occasion of the 200th anniversary of the Oesterreichische Nationalbank (OeNB): "Central banking in times of change", Vienna, 13 September 2016.

Ladies and gentlemen, it is a great pleasure and privilege for the BIS to co-organise this conference celebrating the 200th anniversary of the Oesterreichische Nationalbank. We congratulate our host on being one of the oldest central banks in the world. It is both amazing and humbling to see how the Austrian central bank has been able to navigate through some extremely changing circumstances - including times of war and peace, of wealth and poverty, of inflation and deflation, as well as currency reforms.

At a mere 86 years of age, the BIS is much younger. But our two institutions have worked closely ever since the BIS was established in 1930. Today, we continue to cooperate on many of the same issues of monetary and financial stability as in the early 1930s - which was also a challenging time.

The theme of our conference is precisely that of continuity and change. To set the scene, let me highlight two aspects of continuity and two aspects of change that have shaped our thinking about central banking over time.

Towards a financial stability-oriented monetary policy framework? OeNB at 200: continuity and change in central banking

Presentation by Mr Claudio Borio, Head of the Monetary and Economic Department of the BIS, at the "Central banking in times of change" - conference on the occasion of the 200th anniversary of the Central Bank of the Republic of Austria, Vienna, 13-14 September 2016.

There has been intense debate during the last decade or so over whether monetary policy should take financial stability into account rather than focus exclusively on price stability. Drawing on recent BIS research, this presentation argues that a shift towards a financial stability-oriented monetary policy framework could yield benefits. For this to be the case, the framework would need to allow for a systematic response of monetary policy to the financial cycle in addition to output and inflation. It would be imprudent to follow a policy of selective attention, whereby monetary policy leaned against financial imbalances only when signs of their emergence became evident. Such a framework would call for refinements designed to allow sufficient flexibility in the pursuit of inflation targets.