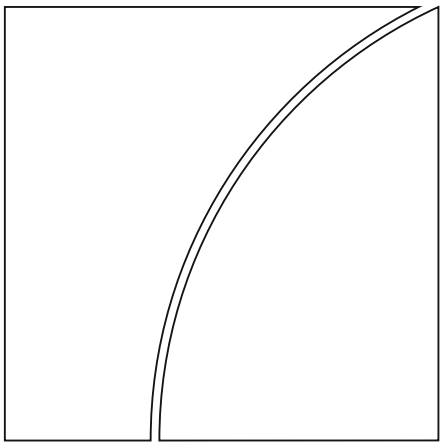
BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

March 2017



International banking and financial market developments

BIS Quarterly Review
Monetary and Economic Department

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Notations used in this Review

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

Differences in totals are due to rounding.

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

Abbreviations

Currencies

ARS	Argentine peso	LTL	Lithuanian litas
AUD	Australian dollar	LVL	Latvian lats
BGN	Bulgarian lev	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	KR	Korea
AU	Australia	LT	Lithuania
BG	Bulgaria	LV	Latvia
BH	Bahrain	MX	Mexico
BR	Brazil	MY	Malaysia
CA	Canada	NO	Norway
CH	Switzerland	NZ	New Zealand
CL	Chile	PE	Peru
CN	China	PH	Philippines
CO	Colombia	PL	Poland
CZ	Czech Republic	RO	Romania
DK	Denmark	RU	Russia
EA	Euro Area	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

Beyond swings in risk appetite

Many asset prices have traded sideways since the release of the previous BIS Quarterly Review in early December, while investors waited for clues on a number of sources of uncertainty. Market participants expected a change in the policy mix in the United States, with a greater role for fiscal policy, continued gradual tightening of monetary policy, a push for deregulation, and a more protectionist trade stance. However, the precise nature and timing of policy changes and their impact remained unclear. In February, stock markets rallied in the United States, while sovereign yields in a number of euro area countries came under pressure as investors shifted their focus towards political uncertainties in Europe.

More broadly, asset returns have become less correlated across classes, regions and sectors. The close co-movements that characterised markets during much of the period following the Great Financial Crisis (GFC) seem to have broken down. This suggests that, over the period under review, swings in investor risk appetite were less of a driver of overall valuations.

Stock prices were broadly supported by data confirming a general improvement in the macroeconomic outlook of advanced economies (AEs). Manufacturing and employment strengthened, while inflation edged up across the board, due in part to flattering base effects and rebounding commodity prices. The monetary policy stance of the major economies continued to diverge, in line with their central banks' assessment of country-specific circumstances. While the Federal Open Market Committee (FOMC) raised the target federal funds rate another quarter-point, and hinted at a somewhat quicker tightening pace, the ECB and the Bank of Japan (BoJ) stayed committed to sustaining "lower for longer". Core fixed income markets and exchange rates reflected this divergence.

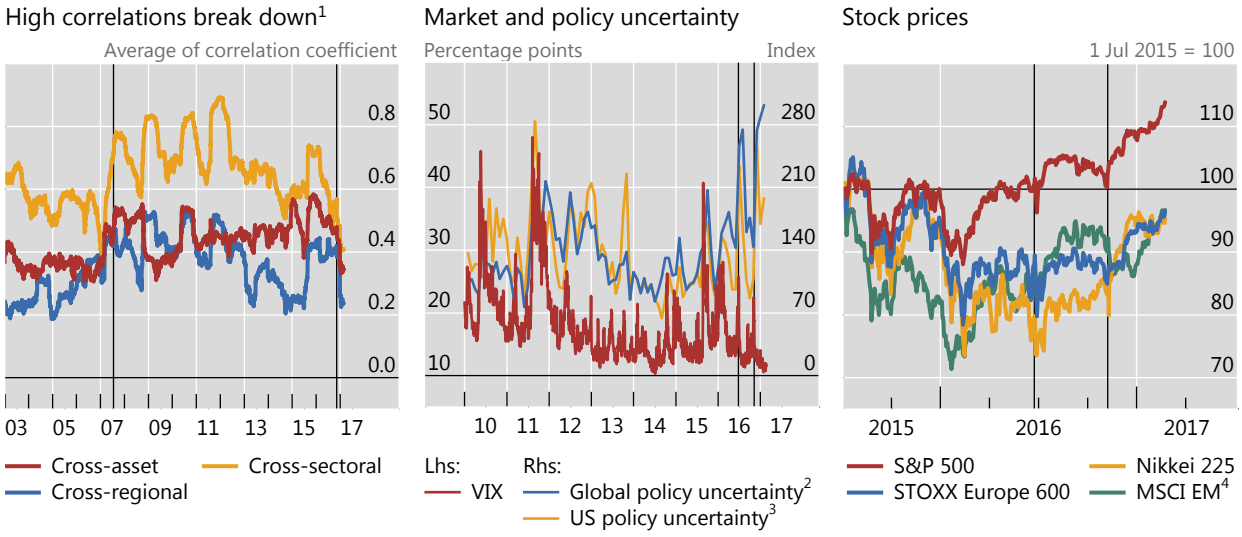
Asset prices also hinted at shifting perceptions of the challenges faced by emerging market economies (EMEs). While markets trimmed to a large extent the initial negative reactions that followed the US presidential election, relative valuations suggest that concerns persisted for some economies regarding their growth, trade and financing outlooks. Notably, some unusual volatility prevailed in Chinese FX and bond markets at the turn of the year as ebbing liquidity interacted with a less accommodating global financial environment.

The breakdown in correlations

A salient feature of recent market developments was the broad dispersion of returns across asset classes, economic sectors and geographical regions. Cross-asset correlations, which had gradually been declining since late 2015, plummeted after the US election in November (Graph 1, left-hand panel).[1] This contrasts with much of the period that followed the GFC when stock markets in advanced and emerging economies, EME sovereign spreads, AE long-term yields, the dollar, and corporate spreads in both advanced and emerging economies seemed to move in parallel. In a global environment devoid of growth but plentiful in liquidity, central bank decisions appeared to draw investors into common, successive phases of buying or selling risk. The recent collapse suggests that the common factors that had until recently been driving returns further weakened their grip on markets during the period under review.[2]

Returns became less correlated as policy uncertainty jumped to the foreground. Uncertainty persisted about the timing and quantum of a number of policy adjustments in the United States, even though the incoming administration reaffirmed its commitment to an agenda of deregulation, fiscal expansion and trade

Cross-asset correlations plunge as policy uncertainty rises — Graph 1



The vertical lines in the left-hand panel indicate 17 July 2007 (Bearn Stearns discloses the virtual demise of two of its mortgage-backed security funds) and 8 November 2016 (US presidential election); in the centre and right-hand panels, they indicate 23 June 2016 (Brexit referendum) and 8 November 2016 (US presidential election).

[1] Average of six-month rolling bilateral correlation coefficients of daily changes in the corresponding indices/assets included in each category; the sign of negative correlations is inverted. For "cross-regional", main stock indices for BR, CN, GB, HK, JP, KR, MX, PL, RU, TR, US and Europe; for "cross-sectoral", the S&P 500 level 1 sectoral sub-indices (11 sub-indices); for "cross-asset", MSCI Emerging Markets stock index, average return of stock indices and 10-year government rates of major advanced economies (DE, GB, JP and US), EMBI spread, DXY dollar index, high-yield and investment grade corporate bond indices for EMEs and AEs. [2] Global economic policy uncertainty index with PPP-adjusted GDP weights. [3] News-based policy uncertainty index for the United States. [4] MSCI Emerging Markets Index, in US dollars.

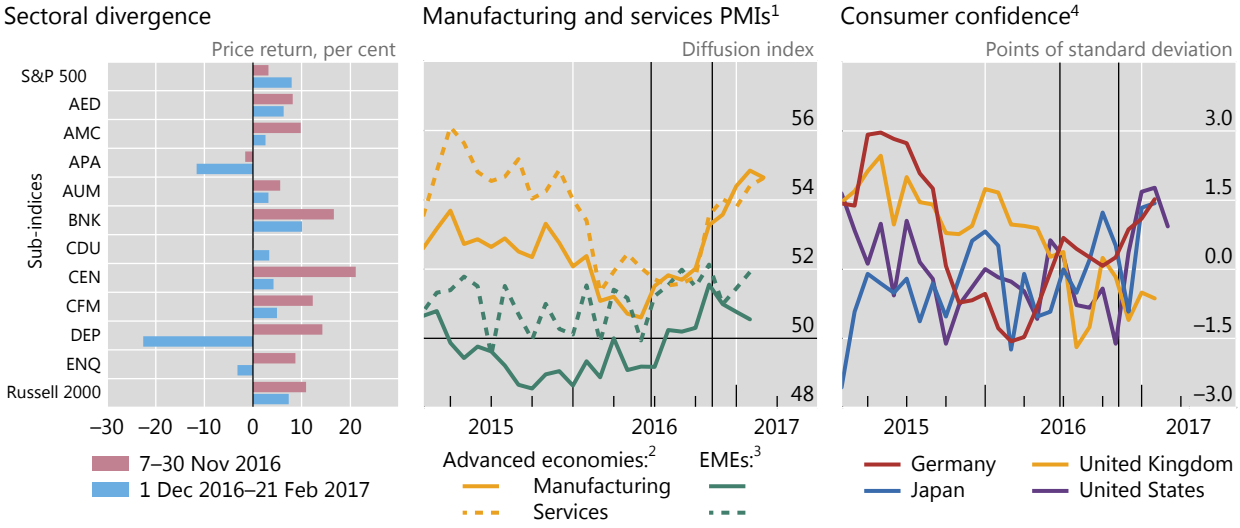
Sources: S Davis, *An index of global economic policy uncertainty*, www.PolicyUncertainty.com; Bloomberg; Datastream; BIS calculations.

[1] Comparable paths can be traced for cross-regional and cross-sectoral correlations.

[2] The review period ranges from late November 2016 to late February 2017.

Confidence and activity rebound, amid divergent sectoral performance

Graph 2



AED = aerospace and defence; AMC = asset management and custodian banking; APA = apparel and accessories; AUM = automobile manufactures; BNK = banks; CDU = consumer durables and appliances; CEN = construction and engineering; CFM = construction machine and heavy trucks; DEP = department stores; ENQ = energy equipment and services.

The vertical lines in the centre and right-hand panels indicate 23 June 2016 (UK referendum on EU membership) and 8 November 2016 (US presidential election).

[1] A value of 50 indicates that the number of firms reporting business expansion and contraction is equal; a value above 50 indicates expansion of economic activity. Weighted average based on GDP and PPP exchange rates of the economies listed. [2] EA, GB, JP and US. [3] AR, BR, CL, CN, CZ, HK, HU, ID, IN, KR, MX, MY, PE, PL, RU, SG, TH, TR and ZA. [4] Normalised data, measured as the difference between the indicator and its historical average (since January 2016).

Sources: Bloomberg; Datastream; BIS calculations.

deficit reduction. The range of possible policy outcomes also appeared to widen in the euro area as a busy electoral year got under way. All this contributed to a surge in indicators of policy uncertainty both in the United States and globally (Graph 1, centre panel).

Despite this uncertain backdrop, stock markets in AEs held the ground gained after the US election, and even moved upwards in February (Graph 1, right-hand panel). Volatility as priced by the market also stayed low as the VIX visited depths rarely seen since the start of the GFC. But significant differences across sectors and countries became apparent. In the United States, there were clear winners (defence, construction, financials, manufacturing, small firms) and losers (import-intensive sectors) even as the overall indices reached new highs (Graph 2, left-hand panel). In Europe and Japan, stock markets stayed relatively flatter throughout this period. In EMEs, equity valuations recovered substantially, offsetting and in many cases reversing the losses suffered in the immediate aftermath of 8 November. But the upturn was uneven across EME regions (see next section).

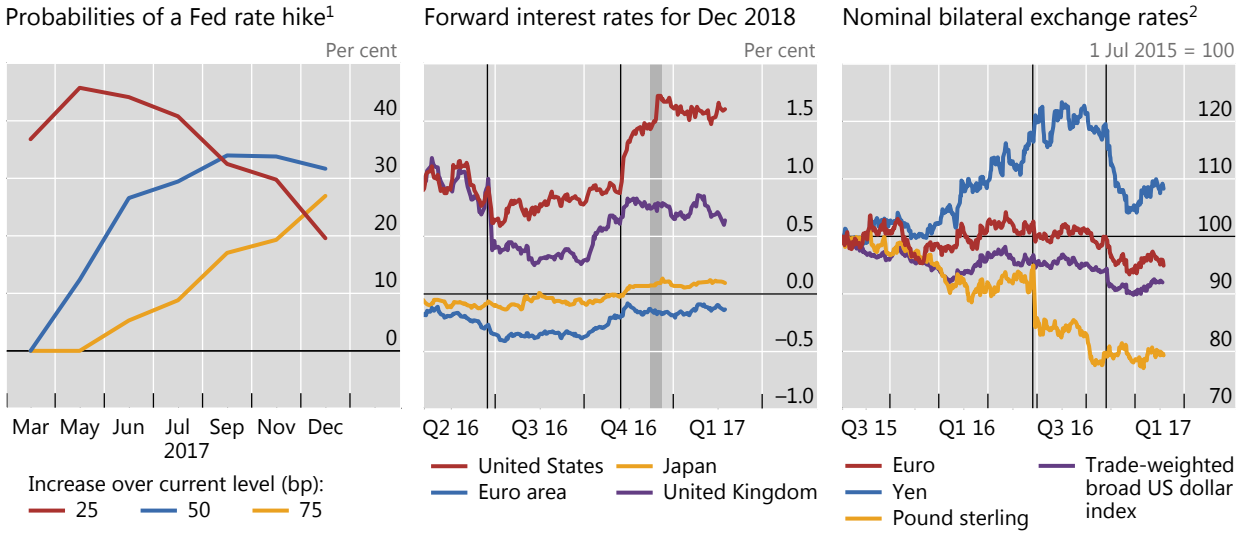
The solid performance of stock markets was buoyed by convincing signs of sustained improvement in the global economy. Manufacturing and services purchasing managers' indices (PMIs) in AEs recorded large gains as from the middle of last year, which accelerated in December (Graph 2, centre panel). Market sentiment indicators improved in major AEs following the US election.[3] This echoed

[3] See "A paradigm shift in markets?", *BIS Quarterly Review*, December 2016, pp 1–11.

strengthening consumer and business confidence, which in the United States reached levels not seen since late 2014, when the Fed was winding down its last programme of asset purchases amid market buoyancy (Graph 2, right-hand panel).[4] The improvement in confidence was more modest in other AEs, but it was enough to overcome the negative impact of Brexit. GDP surprised on the upside in several economies in the second half of 2016. In the United States and the euro area, strong private consumption lifted growth above the perceived potential.[5]

With an improved growth outlook, and as expectations of changes in fiscal and other policies took centre stage, monetary policy moved to the background. The FOMC increased the target range of the fed funds rate by 25 basis points in early December, while the "dot-plots" suggested that FOMC members anticipated three more 25 bp hikes during 2017. Investors seemed to expect one rise in the policy rate by May or June, followed possibly by a second in September, with a third remaining a distant prospect (Graph 3, left-hand panel). Meanwhile, the ECB and the BoJ stayed the course of "lower for longer". In mid-December, the ECB announced that, starting the following April, it would slow the pace of its asset purchases from €80 billion to €60 billion, but also extended the duration of its purchase programme until December 2017. The BoJ upgraded its assessment of the economy, but maintained all policy settings unchanged: a negative rate on excess bank reserves, a zero target for the 10-year Japanese government bond yield and purchases of ¥80 trillion per year. Short-term rates reflected the divergence in monetary policy expectations: the spread between the dollar's forward short-term rates and those of the euro and yen,

As market perceptions of policy divergence see-saw, so does the dollar — Graph 3



The vertical lines in the centre and right-hand panels indicate 23 June 2016 (UK referendum on EU membership) and 8 November 2016 (US presidential election). The shaded area in the centre panel indicates 8–20 December 2016 (ECB, Fed and BoJ monetary policy meetings).

[1] 15–21 February 2017 averages from Bloomberg WIRP function. [2] An increase indicates a depreciation of the US dollar.

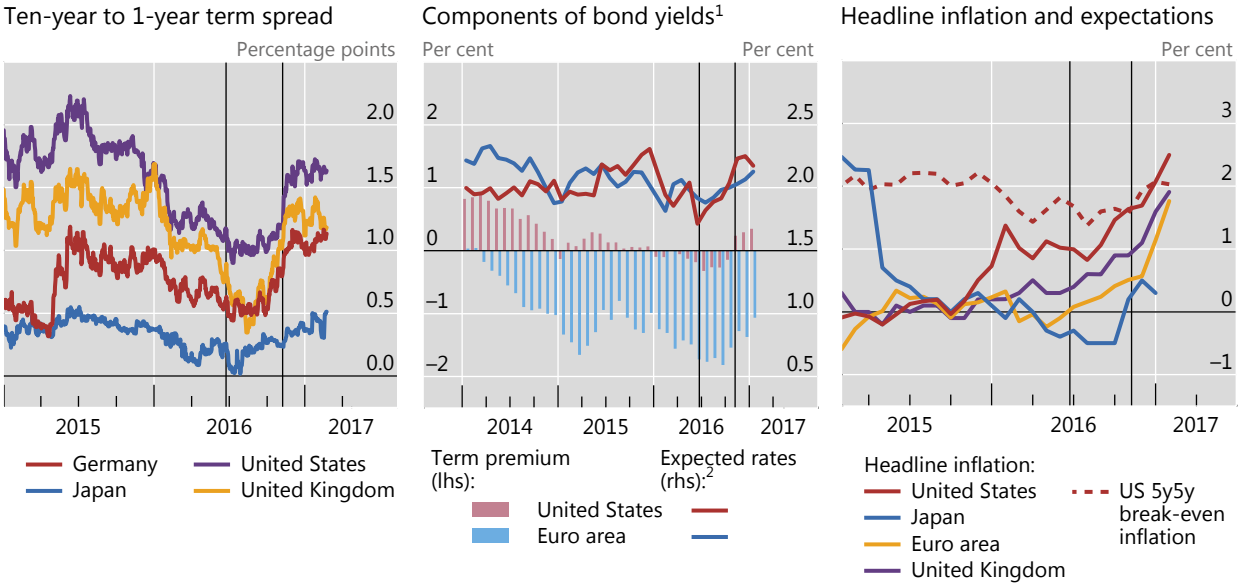
Sources: Board of Governors of the Federal Reserve System; Bloomberg; Datastream; national data; BIS calculations.

[4] See "Buoyant but fragile?", *BIS Quarterly Review*, December 2014, pp 1–12.

[5] On consumption-driven growth, see E Kharroubi and E Kohlscheen, "Consumption-led expansions", *BIS Quarterly Review*, March 2017, pp 25–37.

Fixed income markets stabilise after post-US election stir

Graph 4



The vertical lines indicate 23 June 2016 (UK referendum on EU membership) and 8 November 2016 (US presidential election).

[1] Decomposition of the 10-year nominal yield according to an estimated joint macroeconomic and term structure model; see P Hördahl and O Tristani, "Inflation risk premia in the euro area and the United States", *International Journal of Central Banking*, September 2014. Yields are expressed in zero coupon terms; for the euro area, French government bond data are used. [2] Difference between 10-year nominal zero coupon yield and 10-year estimated term premium.

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

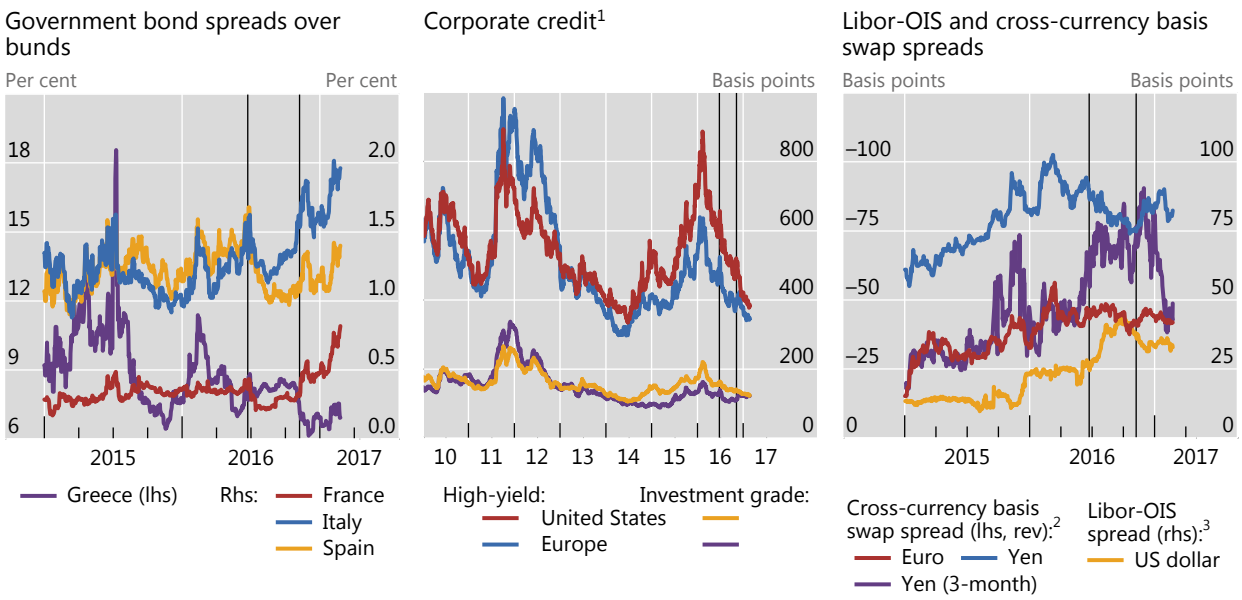
which had surged after the election, jumped again when the Fed increased its target range. Subsequently, the gap between the rates moderated (Graph 3, centre panel).

Core fixed income markets stabilised after their broad November rout. In Germany, the United Kingdom and the United States, the spread between 10-year and one-year yields see-sawed from December to February (Graph 4, left-hand panel). The initial increases in long-term rates were driven in large part by a decompression of the term premium, with the estimated premium returning to positive levels in the US and becoming less negative in the euro area. But increases in expected rates also played a role, pointing to both higher inflation expectations and the anticipated reaction of central banks (Graph 4, centre panel). Financial market-based measures of inflation compensation also rose in AEs, especially in the United States, against the backdrop of higher current inflation (Graph 4, right-hand panel). By January 2017, headline inflation exceeded 2% in the United States and neared 2% in the euro area and the United Kingdom, reflecting higher commodity prices as well as the "base effect" of a dip in inflation one year before, and in line with stronger global activity. After almost a year of zero or negative inflation, Japan saw consistently positive figures beginning in October (Graph 4, right-hand panel).

Some signals of tension resurfaced in the euro area sovereign bond markets. Spreads in government bond yields vis-à-vis German bunds widened sharply in the initial weeks of the year (Graph 5, left-hand panel). While there were heightened tensions about the implementation of the Greek adjustment programme, the pressure on sovereign spreads seemed more related to heightened political uncertainty. In particular, investors appeared unnerved by the possible policy implications of electoral contests in some euro area members in the year ahead. In this context, TARGET2 imbalances – which have been gradually growing since 2015 –

Tensions resurface in the euro area sovereign markets, calm elsewhere

Graph 5



The vertical lines indicate 23 June 2016 (UK referendum on EU membership) and 8 November 2016 (US presidential election).

[1] Option-adjusted spreads over government bonds. For Europe, euro-denominated corporate debt issued in euro domestic and eurobond markets. [2] Five-year basis swap spreads versus the US dollar. [3] Three-month spreads.

Sources: Bank of America Merrill Lynch; Bloomberg; BIS calculations.

received greater attention, but in fact they have so far been mainly a technical by-product of the ECB's asset purchase programme (Box A).

The US dollar, which had strengthened significantly in November and December, weakened on a broad basis in January despite the support provided by existing and expected interest rate differentials. The partial reversal seemed related to the impasse besetting the economic policy pipeline amid the political transition process. The Fed's concerns about the detrimental impact on the economy of a stronger dollar, as expressed in the minutes of the December FOMC meeting, may have played a role as well. Still, the US currency kept a large fraction of the gains made since the election, especially vis-à-vis the yen (Graph 3, right-hand panel). Sterling received a small boost from the strong performance of the UK economy towards the end of the year, and it seemed to benefit from greater clarity about the expected outcome of the Brexit process.

Equity market rallies in the large economies were matched by lower spreads in credit markets. After narrowing in November, the spreads of European and US corporate investment grade credit remained essentially unchanged thereafter (Graph 5, centre panel). High-yield spreads continued to fall throughout the review period, and US high-yields trimmed the differential with their European peers, to a large extent because of the improvement in credit spreads for firms in oil-related businesses.

Box A

What is driving the renewed increase in TARGET2 balances?

Raphael Auer and Bilyana Bogdanova

TARGET2 (T2) balances are again on the rise. Since early 2015, the T2 balances of euro area national central banks (NCBs) have risen steadily, in some cases exceeding the levels seen during the sovereign debt crisis (Graph A, left-hand panel). However, unlike then, record T2 balances should be viewed as a benign by-product of the decentralised implementation of the asset purchase programme (APP) rather than as a sign of renewed capital flight.

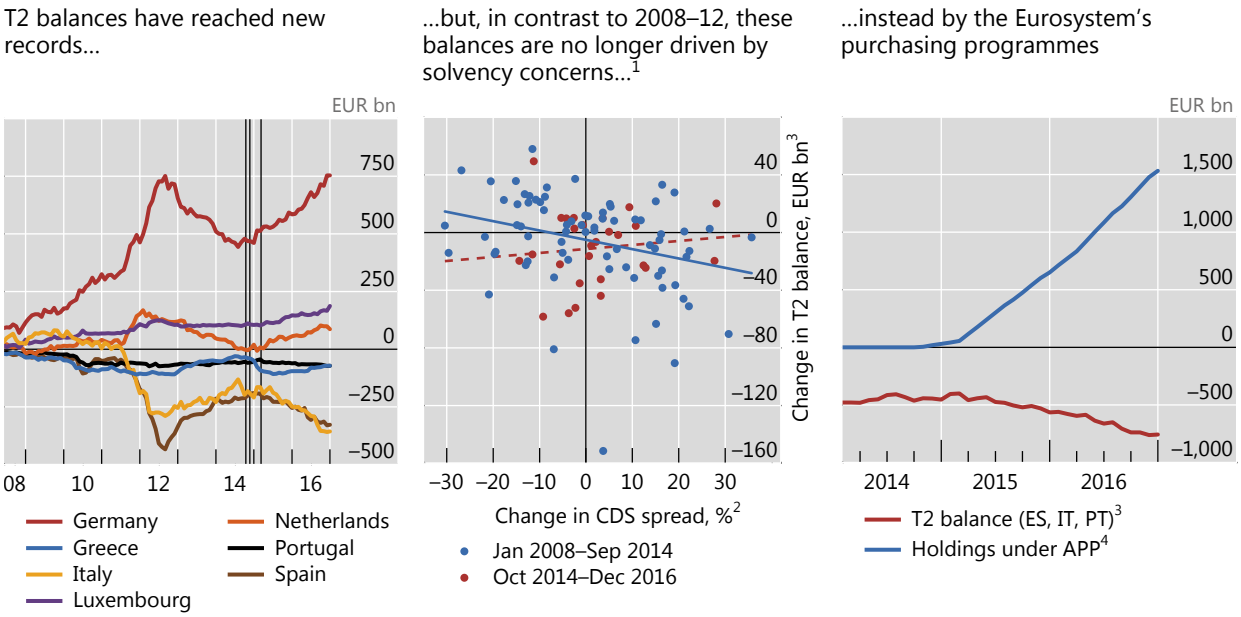
Because liquidity operations in the Eurosystem are decentralised, claims or liabilities of NCBs vis-à-vis the ECB can arise. Market operations are to a large extent implemented by the Eurosystem's NCBs rather than by the ECB. When an NCB disburses liquidity directly to commercial banks, it keeps the claims on those commercial banks on its own balance sheet. But the funds may end up in another commercial bank's account with a different NCB. As a consequence, the liquidity-providing NCB has a liability vis-à-vis the ECB, while the NCB receiving the reserves holds a claim on the ECB.

The net of such claims and liabilities is referred to as a "TARGET2 balance" because it is recorded as such in the main payment settlement system of the euro area, the second edition of the Trans-European Automated Real-time Gross Settlement Express Transfer System.①

In the period leading up to mid-2012, T2 balances grew strongly (Graph A, left-hand panel) due to intra-euro area capital flight. At the time, sovereign market strains spiked and redenomination risk came to the fore in parts of the euro area. Private capital fled from Ireland, Italy, Greece, Portugal and Spain into markets perceived to be safer, such as Germany, Luxembourg and the Netherlands.

New TARGET2 records are the benign result of decentralised APP implementation

Graph A



The vertical lines in the left-hand panel indicate 15 October 2014 (start of the third covered bond purchase programme), 21 November 2014 (asset-backed securities purchase programme) and 9 March 2015 (public sector purchase programme).

[1] The blue fitted line has a slope of –0.58 which is significant at the 1% level. The red fitted line has a slope of 0.28 which is insignificant. [2] Median credit default swap spread of ES, IT and PT. [3] Combined T2 balance of the countries listed, at month-end. [4] Holdings under the Eurosystem's asset purchase programme, at amortised cost, at month-end.

Sources: ECB; Markit; national data; authors' calculations.

Indeed, during that period, the rise in T2 balances seemed related to concerns about sovereign risk. The blue dots in the centre panel of Graph A show the close relationship between the sovereign credit default swap (CDS) spreads of Italy, Portugal and Spain and the evolution of their combined T2 balance from January 2008 to September 2014. Whenever the CDS spreads of those economies rose, the associated private capital outflows increased their T2 deficit. When the CDS spreads decreased after confidence in the euro area was restored in mid-2012, the capital outflows partly reversed, and T2 deficits dwindled.

In contrast, the current rise seems unrelated to concerns about the sustainability of public debt in the euro area. The red dots in the centre panel of Graph A show that, between October 2014 and December 2016, there was no relationship between the sovereign CDS spreads of Italy, Portugal and Spain and the evolution of their combined T2 balance.

The current rise in T2 imbalances seems to have a different cause: the Eurosystem's APP, which mechanically affects the evolution of these balances. Many APP purchases are conducted by NCBs via banks located in *other* countries. One example is where the Bank of Italy, as part of its implementation of the APP, buys securities from a London-based bank that connects to the T2 system via a correspondent bank located in Germany. The purchase amount is credited to the account of the German correspondent bank at the Deutsche Bundesbank, thus increasing the T2 surplus of the Bundesbank. Similarly, the Bank of Italy's T2 deficit widens.

Thus, T2 imbalances will increase whenever any T2-debtor NCB conducts an asset purchase with a counterparty that has a correspondent bank located in a T2-creditor NCB. This is very frequently the case. For example, whereas the Bundesbank itself purchases less than a quarter of the total APP purchases, 60% of all Eurosystem purchases under the APP are conducted via banks that connect to the T2 system via the Bundesbank.②

As the European interbank market is still fragmented, the liquidity does not circulate in the euro area and T2 imbalances grow as the total holdings under the APP accumulate. Indeed, the overall increase in T2 imbalances can be linked closely to the total purchases under the APP (Graph A, right-hand panel). A recent study, which takes into account the precise geography of the correspondent banks of each and every APP security purchase, shows that APP transactions can almost fully account for the re-emergence of T2 imbalances.③

This mechanical impact of the APP on T2 imbalances is also confirmed by the evolution of T2 balances vis-à-vis Greece. The country's sovereign bonds are not eligible for the APP, and consequently the Greek T2 deficit has actually been more or less stable during recent months (Graph A, left-hand panel).

① For a detailed description of this system and the origins of T2 imbalances during the European debt crisis, see R Auer, "What drives TARGET2 balances? Evidence from a panel analysis", *Economic Policy*, vol 29, no 77, 2014, pp 139–97; ECB, "TARGET balances and monetary policy operations", *Monthly Bulletin*, May 2013; and S Cecchetti, R McCauley and P McGuire, "Interpreting TARGET2 balances", *BIS Working Papers*, no 393, December 2012. ② See C-L Thiele, "Das Netz der Notenbanken", *Handelsblatt*, 7 February 2017. ③ See ECB, "TARGET balances and the asset purchase programme", *Monthly Bulletin*, November 2016.

Money markets also stabilised. As money market fund reform was implemented in the United States,[6] the Libor-OIS spread steadied around 35 bp, some 20 bp above the pre-reform level. The five-year euro/dollar cross-currency basis swap spread fluctuated around the 45 bp level, as it has since the end of Q1 2016 (Graph 5, right-hand panel). Funding conditions continued to be a bit more stretched in the yen market, where the longer-term basis reflected Japanese banks' structural need for cross-currency swaps to fund long-term dollar assets. In shorter tenors, however, the yen/dollar basis fell significantly, in part because of calendar effects.

[6] See I Aldasoro, T Ehlers, E Eren and R McCauley, "Non-US banks' global dollar funding grows despite US money market reform", *BIS Quarterly Review*, March 2017, pp 22–3.

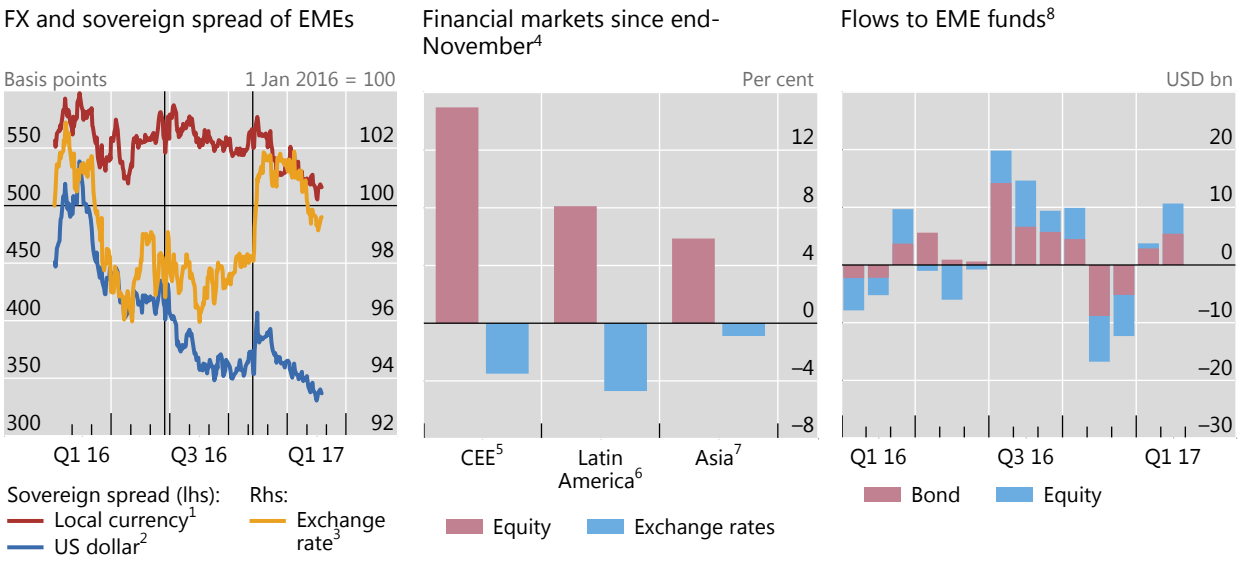
EMEs: between a rock and a hard place

Investor sentiment towards EME assets improved during the period under review, reversing the sell-off that followed the US presidential election. In line with the dispersion in asset returns discussed above, the extent of the reversal differed across major emerging market regions and countries, reflecting differentiated expected impacts from prospective US policies. Ultimately, however, many EMEs appeared caught between the prospects of heightened protectionism and the financial fallout of a significantly stronger dollar.

From late November, depreciation pressure on EME currencies eased and stock prices rebounded, while sovereign spreads narrowed, retracing all the increases posted in November (Graph 6, left-hand panel). Central and eastern European markets were least affected, due possibly to their limited trade and financial connections to the United States. Latin American countries – excluding Mexico – also did well, possibly benefiting from higher commodity prices. On the other hand, the currencies and equities of Asian countries, which have closer direct and indirect trade links with the US, did not improve as much (Graph 6, centre panel). Capital outflows moderated in December and turned to inflows in January and February, resulting in a net inflow of $14 billion into EME funds after two consecutive months of losses. The cumulative net outflow in the last two months of 2016 was slightly over $29 billion (Graph 6, right-hand panel).

Moderating movements in EME financial markets

Graph 6



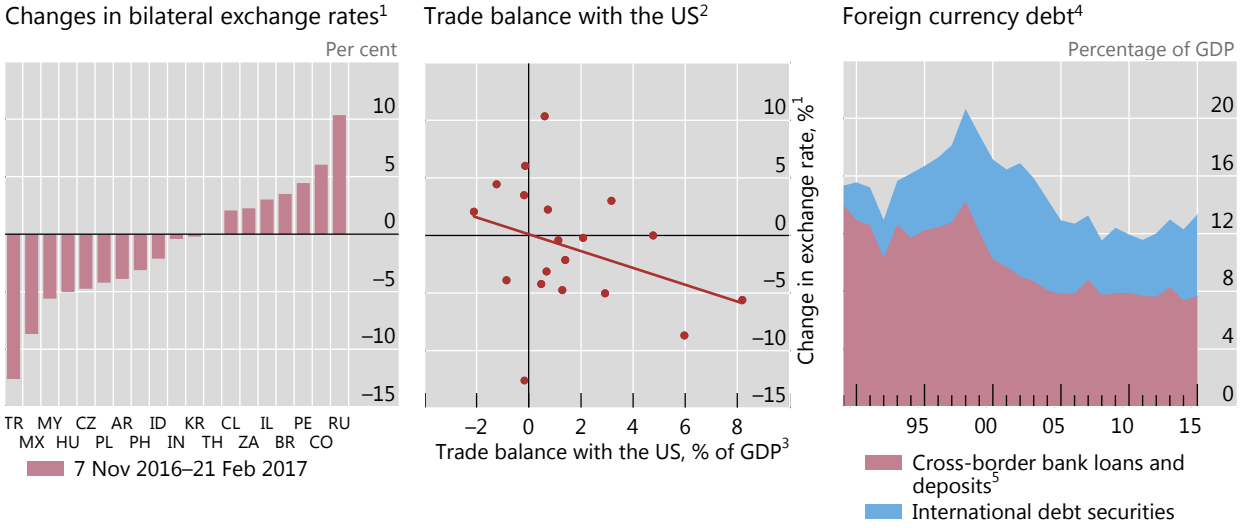
The vertical lines in the left-hand panel indicate 23 June 2016 (UK referendum on EU membership) and 8 November 2016 (US presidential election).

[1] JPMorgan GBI EM indices; spread over seven-year US Treasury securities. [2] JPMorgan EMBI Global indices; stripped spreads. [3] An increase indicates a depreciation of the local currency against the US dollar; simple average of EME currencies. [4] A negative value indicates an appreciation against the US dollar; simple average of the currencies of the countries listed. [5] Central and eastern Europe: CZ, HU, PL and RU. [6] AR, BR, CL, CO and PE. [7] HK, ID, IN, KR, MY, PH, SG and TH. [8] Monthly sums of weekly data up to 15 February 2017; a positive (negative) value indicates subscription (redemption).

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

Trade and financial concerns cloud the outlook for EMEs

Graph 7



[1] A negative value indicates a depreciation of the local currency against the US dollar. [2] The fitted line excludes Turkey (red dot at the very bottom). [3] For each country, defined as the trade balance with the United States divided by its own GDP; as of Q3 2016. A negative (positive) value indicates a deficit (surplus). [4] Amounts outstanding by residence, as a percentage of GDP; aggregates are weighted averages based on the GDP and PPP exchange rates of AR, BR, CL, CN, CO, CZ, HU, ID, IN, KR, MX, MY, PE, PH, PL, RU, TH, TR and ZA. [5] To/with bank and non-bank sectors, denominated in CHF, EUR, GBP, JPY and USD. Prior to Q4 1995, cross-border bank claims denominated in the foreign currencies listed.

Sources: IMF, *Direction of Trade*, *International Financial Statistics* and *World Economic Outlook*; national data; BIS debt securities statistics and locational banking statistics by residence; BIS calculations.

Judging from exchange rate movements (Graph 7, left-hand panel), market participants seemed to fear that a sharp reduction in international trade flows could bring heightened stress to some EMEs. The size of the bilateral trade surplus vis-à-vis the United States has been a relevant factor in explaining the difference in the recent depreciation of EME currencies vis-à-vis the dollar (Graph 7, centre panel). While large exporters to the US, such as China and Mexico, were in the spotlight, a shock to global trade could spread more widely through the disruption of global value chains.

Moreover, market developments reflected concerns that a stronger dollar and higher interest rates, on the expectation of fiscal stimulus and monetary normalisation in the United States, could put pressure on EME borrowers' balance sheets. The amount of outstanding US dollar-denominated securities issued by EMEs rose from $509 billion in 2008 to $1.25 trillion as of end-September 2016 on a residence basis. Around 40% of these were issued by non-financial corporations. Total US dollar debt (including bank loans) of EME non-bank borrowers stood at $3.6 trillion at end-September 2016. As a fraction of GDP, however, total EME debt denominated in foreign currency is still below the levels observed just before the Asian financial crisis (Graph 7, right-hand panel). And its composition has changed, as bank debt has been partially replaced by longer-term debt securities issuance. In addition, EMEs have in general much larger international reserve buffers now compared with the 1990s. Even so, the higher debt burden on the back of a stronger dollar and higher interest rates could turn into a financial headwind that could outweigh potential trade gains, especially if AEs became less open to trade.[7]

[7] J Kearns and N Patel, "Does the financial channel of exchange rate offset the trade channel?", *BIS Quarterly Review*, December 2016, pp 95–113, find that the financial channel of exchange rate

Big swings in Chinese financial markets as liquidity tightens

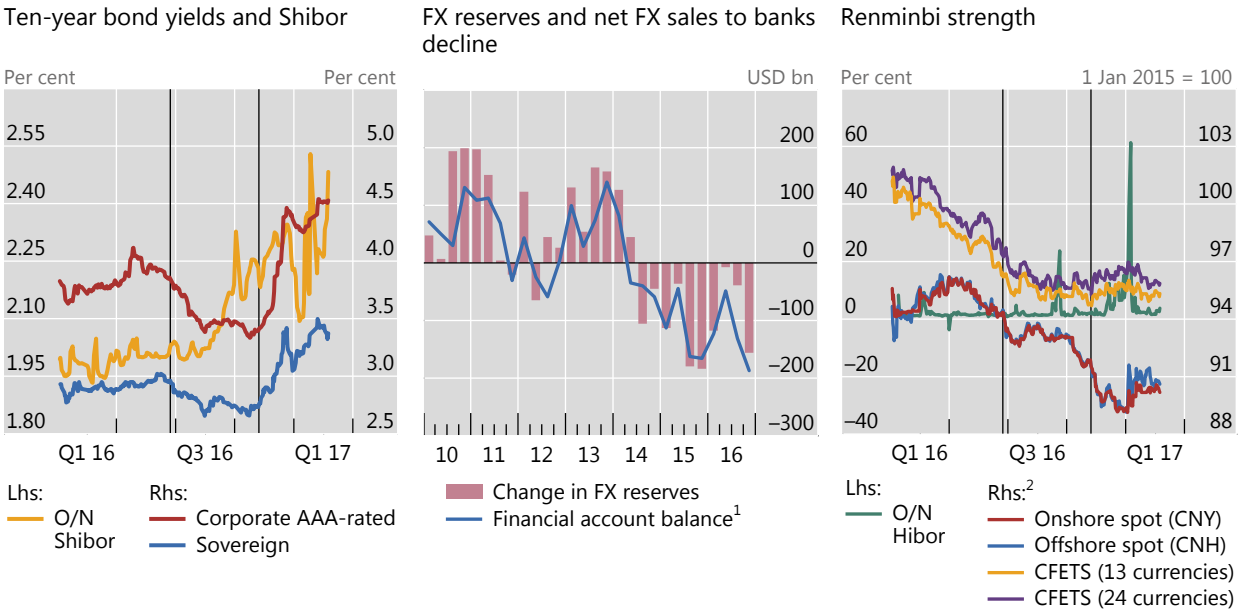
Chinese FX and bond markets went through substantial swings at the turn of the year. The gradual tightening of domestic financial conditions, amid continued capital outflows and depreciation pressures, sparked temporal dislocations in the provision of liquidity throughout the financial system.

Tight liquidity in onshore financial markets contributed to a sharp sell-off in domestic bonds in mid-December 2016. Liquidity had begun to gradually tighten in the third quarter. After largely stabilising at around 2% at the beginning of 2016, the Shanghai interbank offered rate (Shibor) benchmark rate had begun to edge higher starting in August and reached 2.20% in September. The upward path continued in the fourth quarter, with Shibor rising by another 15 bp between October and early December 2016 (Graph 8, left-hand panel). Tight liquidity conditions in the second half of 2016 in part reflected the measures taken by the People's Bank of China (PBC) to trim excessive leverage, such as diversifying the maturity structure of open market operations and introducing a tighter prudential treatment of off-balance sheet wealth management products (WMPs).

On the back of the tighter liquidity, as well as higher yields globally, 10-year Chinese government bond yields had risen by around 25 bp from the end of

Tightening liquidity shakes exchange rate and bond markets in China

Graph 8



The vertical lines in the left- and right-hand panels indicate 23 June 2016 (UK referendum on EU membership) and 8 November 2016 (US presidential election).

[1] Excluding reserves. [2] An increase indicates an appreciation against the US dollar.

Sources: IMF, *International Financial Statistics*; China State Administration of Foreign Exchange; Bloomberg; CEIC; Datastream; BIS calculations.

movements – the higher level and cost of foreign currency debt – partly offsets the trade channel for the average EME. They further find that both the trade and the financial channel are more prominent in Asia than in Latin America, and that the financial channel is stronger for EMEs that have issued more foreign currency debt.

September to the end of November 2016. The rise in yields accelerated in the first half of December. Reportedly, worries about the potential default of a mid-size brokerage firm on unregulated repurchase agreements triggered the December turmoil. The firm had funded its bond purchases with both WMPs and repurchase agreements, a common practice in the Chinese market (Box B). With the underlying bonds in the repos trading at a loss, concerns about a more widespread breakdown of similar deals froze the wholesale funding market. The ensuing liquidity squeeze in turn forced securities firms to conduct a fire sale of bonds in order to pay back their short-term loans. On 15 December, the 10-year government bond yield and corporate high-grade yields surged by around 15 bp (Graph 8, left-hand panel). The stress affected the futures market as well: trading in 10-year government bond futures was halted after hitting circuit breakers – the first such suspension since the relaunching of futures trading in 2013. Eventually, markets stabilised after the authorities injected liquidity through short- and medium-term lending facilities.

The renminbi had been subject to significant depreciation pressure against the dollar since September 2016, on the back of continued capital outflows. According to balance of payments data, 40% of the roughly $490 billion of outflows in 2016 took place during the fourth quarter (Graph 8, centre panel).[8] Other indicators suggest that outflows continued in January, albeit at a slower pace. In particular, foreign currency reserves shrank by $12 billion following a $52 billion average monthly decline in the previous quarter.

Despite this backdrop, both the onshore (CNY) and the offshore (CNH) renminbi rose sharply at the beginning of the year (Graph 8, right-hand panel). From 3 to 5 January, the CNH staged the largest two-day gain on record, with a 2.5% appreciation against the dollar. During the same period, the CNY went up 1.3%, the largest two-day appreciation since China de-pegged its currency in July 2005. The sudden jump of the renminbi reflected, in part, a liquidity squeeze in the offshore funding market against the backdrop of the PBC's measures to contain capital outflows and the waning of the dollar's post-election rally. This curtailed persistent depreciation expectations, with the CNH shifting from discount to premium vis-à-vis the CNY. Liquidity in CNH, already scarce, dried up further as investors scrambled for cash to close short positions. The Hong Kong interbank offered rate (Hibor) jumped from 17.8% on 3 January to more than 61% on 6 January, close to the highest level on record. However, despite the Chinese currency's high volatility against the dollar, the CFETS index (comprising a basket of renminbi exchange rates) remained quite stable.[9]

[8] Based on the preliminary balance of payments data release for Q4 2016.

[9] On 29 December, CFETS announced an adjustment of the renminbi index effective from 1 January 2017. Eleven currencies were added to the basket, accounting for a 21.09% weight in the index.

Box B

From wealth management products to the bond market

Over the past few years, banks' funding models in China have increasingly relied on wealth management products (WMPs) and corporate deposits (Graph B, left-hand panel). WMPs are saving products, issued by banks or other financial institutions, which offer relatively high returns compared with traditional bank deposits or Treasury bonds (centre panel). Some of these instruments carry principal and even return guarantees from the issuers, and are reported on-balance sheet. But the vast majority do not offer either, and are kept off the issuer's balance sheet. Despite carrying no explicit guarantees, the instruments are widely considered as safe by investors. As of end-June 2016, WMPs issued by banks totalled CNY 26.3 trillion, almost 40% of 2015 GDP. The proliferation of these instruments demonstrates that the traditional demarcations between banks and securities markets are not always clear-cut, and that any regulatory structure needs to take account of the connected nature of the system.

Banks are not only issuers but also buyers of WMPs. Reportedly, large banks often provide wholesale funding to small banks by purchasing their WMPs. Of the above total of CNY 26.3 trillion, about CNY 4 trillion was purchased by other banks. Moreover, large banks provide liquidity to small banks through interbank loans funded with the proceeds of their own issuance of WMPs. These loans made up the bulk of the 16% of money market instruments in the portfolio allocation of WMPs as of the first half of 2016 (Graph B, right-hand panel). These two channels could overlap, as the interbank loans sometimes involve the purchase of WMPs or the pledging of these as collateral.

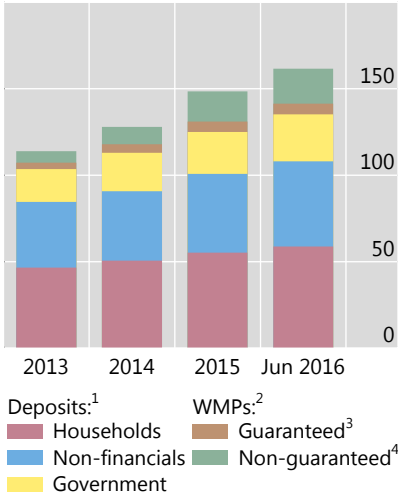
In order to be able to keep WMPs off their balance sheets, banks often turn to securities firms to manage the funds collected through WMPs. As of last June, around 40% of the aggregate WMP portfolio was invested in the bond market (Graph B, right-hand panel). In order to enhance capital returns, and on the back of ample liquidity, securities firms reportedly leverage up their bond investments by using repurchase agreements. A significant part of these repurchase agreements take place through informal verbal agreements between market players and are not regulated. The upshot is the proliferation of fixed income portfolios with high leverage ratios.

The unwinding of these leveraged portfolios while the wholesale funding market was frozen appears to have led to the bond market stress in mid-December. As bond prices fell while liquidity tightened, the securities firms were forced to sell bonds in order to pay back the small banks, which in turn were facing pressure to repay the loans from larger banks. This eventually led to bond prices falling further as the liquidity squeeze moved through the funding chain.

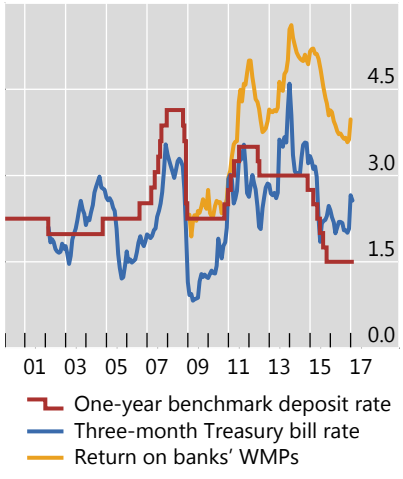
A profile of wealth management products (WMPs) in China

Graph B

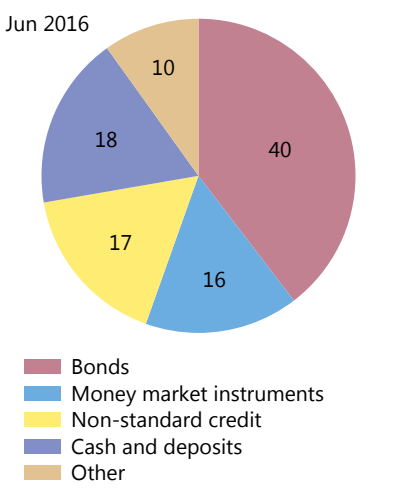
Funding sources of financial institutions (year-end)



Interest rates and WMP return



Asset allocation of WMPs



[1] Excluding deposits of non-bank financial institutions. [2] WMPs issued by banks. [3] WMPs with principal protected but floating return and WMPs with return guaranteed; reported on-balance sheet. [4] WMPs with principal not protected; reported off-balance sheet.

Sources: CEIC; China Central Depository & Clearing Co Ltd, www.chinawealth.com.cn; BIS calculations.

Highlights of global financial flows[1]

The BIS, in cooperation with central banks and monetary authorities worldwide, compiles and disseminates data on activity in international financial markets. It uses these data to compile indicators of global liquidity conditions and early warning indicators of financial stability risks. This chapter analyses recent trends in these indicators. It is based on the latest data for international banking markets, available up to September 2016, and for international debt securities, available up to December 2016.

Takeaways

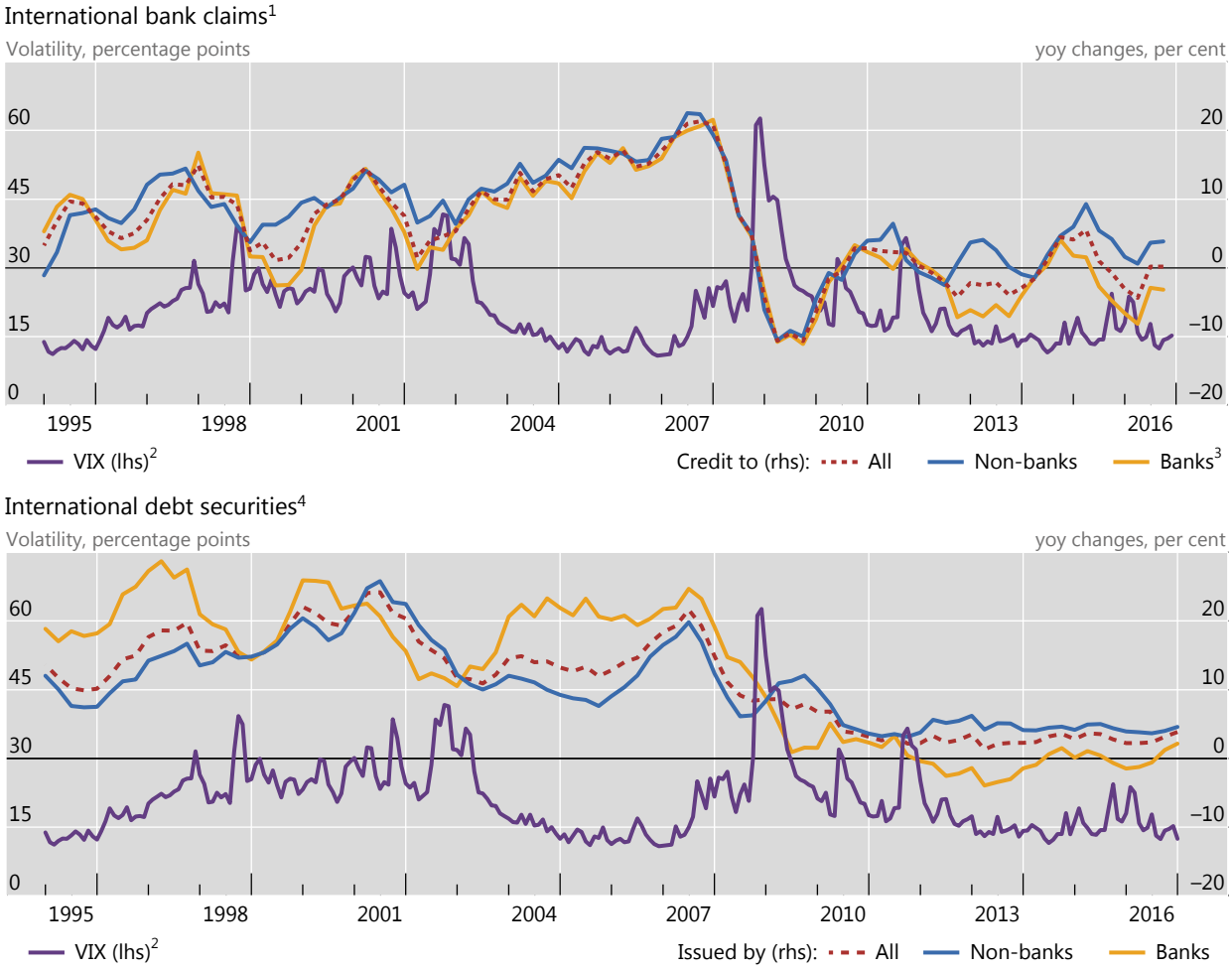
- Growth in international bank claims resumed in the second and third quarters of 2016, following year-on-year declines in late 2015 and early 2016. The recovery was led by 3.8% year-on-year growth in claims on the non-bank sector, while interbank claims contracted by 3.2% in Q3 2016.
- The stock of international debt securities grew steadily at the rate of 3.8% year on year in the fourth quarter of 2016, helped by a pickup in banks' net debt issuance to 2.2%. Net debt securities issuance by non-banks also increased slightly, as outstanding securities rose 4% year on year in Q3 2016 and 4.6% in Q4.
- US dollar credit to non-bank borrowers outside the United States grew by $420 billion between end-Q1 and end-Q3 2016. When newly reported data for credit extended by banks in China and Russia are included, the total outstanding amount at end-September 2016 stood at $10.5 trillion.
- US dollar credit to emerging market economy (EME) non-banks grew slightly. After including the newly reported data by banks in China and Russia, it stood at $3.6 trillion at end-Q3 2016.
- As a result of reforms to US money market funds, US dollar funding for non-US banks from prime funds fell by $555 billion from end-September 2015 to end-December 2016; this was partly offset by a $140 billion increase in funding from government funds (see box). Despite the cut, US dollar credit to non-US banks continued to grow, as these banks found funding from other sources.

[1] This article was prepared by Iñaki Aldasoro (Inaki.Aldasoro@bis.org) and Torsten Ehlers (Torsten.Ehlers@bis.org). Statistical support was provided by Kristina Bektyakova, Pamela Pogliani, and Matthias Loerch.

Global credit recovered in the second half of 2016

Global credit conditions, as measured by the aggregates tracked by the BIS global liquidity indicators (GLIs), recovered and strengthened somewhat in the second half of 2016.[2] The increase was driven by international bank claims (cross-border claims plus local claims in foreign currency),[3] which picked up in the second quarter of 2016 and fell only a small amount in the third quarter. Cumulated annual flows were small but positive in these two quarters, leading to moderate year-on-year increases of

International bank credit, international debt securities and volatility — Graph 1



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

[1] LBS-reporting banks' cross-border claims plus local claims in foreign currencies. [2] Chicago Board Options Exchange S&P 500 implied volatility index; standard deviation, in percentage points per annum. [3] Including intragroup transactions. [4] All instruments, all maturities, all countries. Immediate issuer basis.

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

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

[3] International bank credit as used in the BIS global liquidity indicators (GLIs) corresponds to the BIS locational banking statistics' definition. International bank credit captures banks' cross-border claims

0.2% in each case (Graph 1, top panel). Continuing a trend that started in the second quarter of 2015, global interbank credit decreased on a year-on-year basis. The pace of the decline, however, slowed in both Q2 and Q3 2016. By contrast, credit to non-banks picked up in those quarters, after a slight deceleration in Q1 2016. International bank claims on the non-bank sector rose for 10 consecutive quarters up to the third quarter of 2016, the latest observation available.

Net issuance of international debt securities[4] also picked up slightly in the second half of 2016 (Graph 1, bottom panel), with $229 billion net issuance in the third quarter alone. The stock of debt securities grew 3.8% from end-December 2015 to end-December 2016 – the largest four-quarter increase since Q3 2009–Q2 2010. Both banks and non-banks expanded their use of international bond markets: year-on-year growth in the stock of international debt securities by the banking sector was positive in Q3 2016 (1.2%, the first year-on-year expansion since Q2 2015), and picked up further in Q4 to 2.2%. Net debt securities issuance by non-banks also accelerated in the second half of 2016, as year-on-year growth in outstanding amounts advanced from 3.6% in Q2 2016 to 4% and 4.6% in the third and fourth quarters, respectively.

With the recovery in overall international bank credit and debt securities issuance, total foreign currency credit, in particular in US dollar and euros, also grew slightly faster in the second and third quarters of 2016 (Graph 2).

US dollar-denominated bank loans to the non-bank sector outside the US grew 2.4% in the third quarter of 2016 over the preceding year, compared with less than 1% in the first two quarters of 2016 (Graph 2, top panels). Outstanding amounts of US dollar-denominated debt securities by non-residents in the *non-financial sector* increased by 6.2% year on year in the third quarter, accelerating from 4% and 5.9% in the first and second quarters, respectively. Total outstanding US dollar credit (bank loans plus debt securities) to the non-financial sector outside the US rose from $8.1 trillion at end-March 2016 to $8.4 trillion at end-September 2016. During the same period, US dollar credit to non-banks rose from $10.1 trillion to $10.5 trillion.

The recent inclusion of China and Russia in the set of countries reporting to the BIS locational banking statistics (LBS) has made more detailed information on foreign currency credit available.[5] In particular, the estimates now include data for credit extended by banks in China and Russia. Without the newly available data, the estimate for the total amount of US dollar credit to non-banks outside the US would have been $10 trillion at end-September 2016 – about $500 billion lower than the current estimate. The effect of the additional data on the trend increase in outstanding amounts since Q1 2016, however, was minimal.

Supported by low euro area sovereign bond yields, the stock of euro-denominated debt securities issued by non-financials outside the euro area

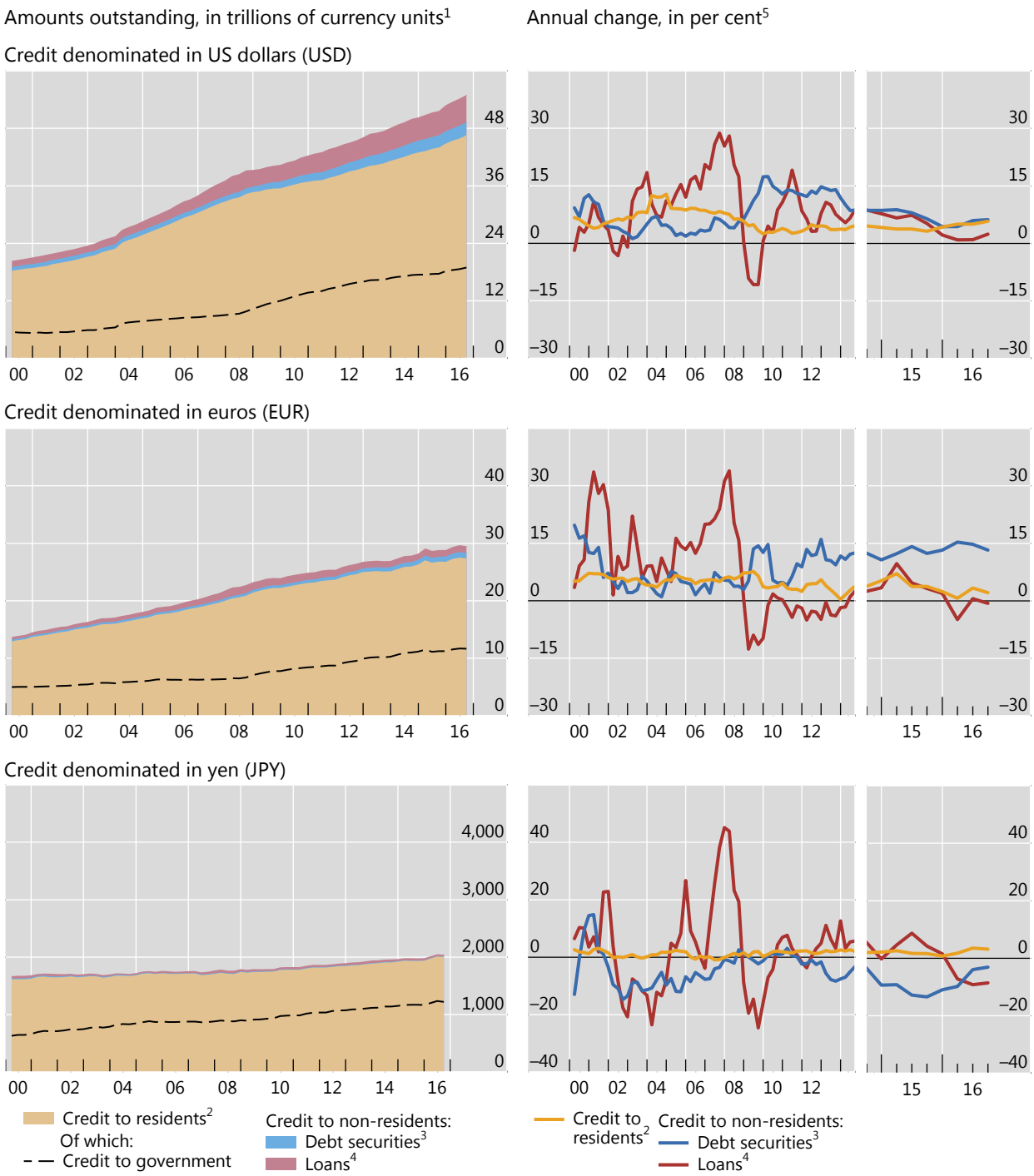
in all currencies and their local claims in foreign currencies, where local claims refer to credit extended by banks' affiliates located in the same country as the borrower. Quarterly changes are corrected for exchange rate effects and breaks in series.

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

[5] See K Goh and S Pradhan, "China and Russia join the BIS locational banking statistics", *BIS Quarterly Review*, December 2016, pp 25–6.

Global credit to the non-financial sector, by currency

Graph 2



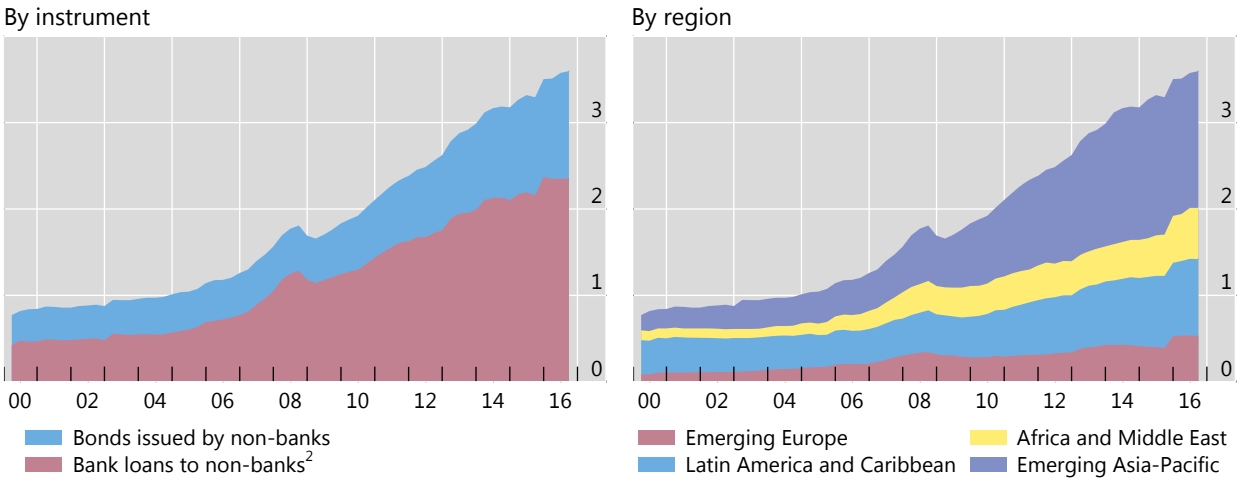
Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

[1] Amounts outstanding at quarter-end. [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 borrowers, including non-bank financial entities, comprise cross-border plus local loans. For countries that do not report local positions, local loans in USD/EUR/JPY are estimated as follows: for China, local loans in foreign currencies are from national data and are 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. [5] Geometric mean of quarterly break- and exchange rate-adjusted changes.

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

US dollar-denominated credit to non-banks in EMEs[1]

Amounts outstanding, in trillions of US dollars — Graph 3



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

[1] Non-banks comprise non-bank financial entities, non-financial corporations, governments, households and international organisations. [2] Loans by LBS-reporting banks to non-bank borrowers, including non-bank financial entities, comprise cross-border plus local loans. For countries that do not report local positions, 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.

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

continued to rise. Year-on-year growth was 13% up to the end of the third quarter of 2016 (Graph 2, centre panels), marking the 12th consecutive quarter of year-on-year growth exceeding 10%. In contrast, euro-denominated bank loans to non-residents were essentially flat in the second and third quarters of 2016, with 0.6% and –0.6% year-on-year growth, respectively. As a result, the overall amount of euro-denominated credit to non-financials outside the euro area increased by just €36 billion ($39 billion)[6] from end-March to end-September 2016, to reach a total of €2.2 trillion ($2.3 trillion).

Yen-denominated credit to non-residents in the non-financial sector, for which overall amounts are much smaller than those of credit denominated in dollars or euros (¥37 trillion or $311 billion at end-September 2016), continued to decline on an annual basis. Net international debt securities issuance in yen started to recover, but the stock of outstanding securities still fell by 3.1% year on year (Graph 2, bottom panels).

US dollar credit to *non-banks* in EMEs grew at a slow pace. While the turmoil in international financial markets in early 2016 led to a temporary decline in this aggregate in Q1 2016, the second and third quarters saw a combined increase of $87 billion, to $3.6 trillion at end-September 2016 (Graph 3, left-hand panel). Without the newly available data for China and Russia from the LBS, the total outstanding

[6] All currency conversions into US dollars are based on quarterly average exchange rates for the respective quarter.

Early warning indicators for stress in domestic banking systems[1]

Table 1

	Credit-to-GDP gap[2]	Property price gap[3]	Debt service ratio (DSR)[4]	DSR if interest rates rise by 250 bp[4, 5]
Asia[6]	15.6	5.5	2.0	4.3
Australia	1.3	3.7	1.4	5.3
Brazil	–2.4	–30.9	3.0	4.6
Canada	17.4	11.6	3.6	7.9
Central and eastern Europe[7]	–12.4	10.4	–0.5	0.9
China	26.3	0.8	5.4	8.8
France	1.6	–9.5	1.1	4.2
Germany	–4.2	15.6	–1.8	0.1
Greece	–16.3	11.8		
India	–4.7		1.4	2.5
Italy	–14.1	–14.2	–0.5	1.5
Japan	3.5	16.3	–2.2	0.5
Korea	2.3	5.4	–0.5	3.1
Mexico	8.9	7.7	0.8	1.5
Netherlands	–18.8	–11.4	0.8	5.6
Nordic countries[8]	–2.2	3.5	0.1	3.9
Portugal	–41.1	13.8	–1.6	1.6
South Africa	–2.0	–9.1	–0.3	1.1
Spain	–46.8	–15.2	–3.2	–0.4
Switzerland	8.2	7.8	0.0	3.2
Turkey	7.7		5.0	6.7
United Kingdom	–19.5	1.0	–1.2	1.7
United States	–7.8	5.1	–1.4	1.1
Legend	*Credit/GDP gap>10*	*Property gap>10*	*DSR>6*	*DSR>6*
	2≤Credit/GDP gap≤10		*4≤DSR≤6*	*4≤DSR≤6*

For the credit-to-GDP gap, the property price gap and the DSR, data up to Q3 2016.

[1] Thresholds for red cells are chosen by minimising false alarms conditional on capturing at least two thirds of the crises over a cumulative three-year horizon. A signal is correct if a crisis occurs in any of the three years ahead. The noise is measured by the wrong predictions outside this horizon. Beige cells for the credit-to-GDP gap are based on guidelines for countercyclical capital buffers under Basel III. Beige cells for the DSR are based on critical thresholds if a two-year forecast horizon is used. For a derivation of critical thresholds for credit-to-GDP gaps and property price gaps, see M Drehmann, C Borio and K Tsatsaronis, "Anchoring countercyclical capital buffers: the role of credit aggregates", *International Journal of Central Banking*, vol 7, no 4, 2011, pp 189–240. Country aggregates are simple averages. [2] Difference of the credit-to-GDP ratio from its long-run, real-time trend calculated with a one-sided HP filter using a smoothing factor of 400,000, in percentage points. [3] Deviations of real residential property prices from their long-run trend calculated with a one-sided HP filter using a smoothing factor of 400,000, in per cent. [4] For the DSR series and methodology, see www.bis.org/statistics/dsr/index.htm. Difference of DSRs for the private non-financial sector from country-specific long-run averages since 1999 or later depending on data availability and when five-year average inflation fell below 10%, in percentage points. Data may differ from those that are published on the BIS website due to data revisions in between updates of the data set. [5] Assuming that interest rates increase 2.50 percentage points and that all of the other components of the DSR stay fixed. [6] HK, ID, MY, PH, SG and TH; excluding PH and SG for the DSR and its forecast. [7] BG, CZ, EE, HU, LT, LV, PL, RO and RU; excluding CZ and RO for the real property price gap; excluding BG, EE, LT, LV and RO for DSR and its forecasts. [8] FI, NO and SE.

Sources: National data; BIS; BIS calculations.

amount would have been $3.3 trillion. The trend increase since Q1 2016 would be about the same.

The moderate rise in dollar credit to EME non-banks in Q2 and Q3 2016 was almost entirely driven by debt securities issuance, as outstanding US dollar bank loans stayed essentially flat. Countries in Africa and the Middle East contributed more than half ($48 billion) of the increase (Graph 3, right-hand panel), led by oil-exporting countries in the Middle East. More than a third ($30 billion) went to borrowers in Latin America, and less than 20% ($17 billion) to emerging Asia. US dollar credit to emerging Europe declined by $8 billion during the second and third quarters of 2016.

Early warning indicators for financial crises continue to signal vulnerabilities in several jurisdictions. Table 1 summarises the early warning indicators for domestic banking risks produced by the BIS, with data up to Q3 2016 for most countries.[7] Relative to previous readings,[8] the set of countries showing large and positive credit-to-GDP gaps remained the same (first column). The credit gap for China remained high at 26.3% of GDP, well above the threshold of 10%.[9] Canada, as well as a group of Asian countries, saw increases in the credit gap since September 2016. The size of the property price gap (second column) remains in line with historical trends in many jurisdictions, with the exception of Canada, Germany, Greece, Japan, Portugal and a group of central and eastern European countries, for which the gaps remain relatively large. However, a high reading need not indicate accelerating price growth – for Greece, Japan and Portugal, the high property price gap does not necessarily indicate vulnerabilities, as it is driven by property price growth returning to normal levels after long periods of decline.

The last two columns of Table 1 present two alternative measures of debt service ratios, which aim to capture aggregate principal and interest payments in relation to income for the total private non-financial sector. For most countries, debt service ratios stand at manageable levels under the assumption of no change in interest rates (third column). Under more stressed conditions – a 250 basis point increase in rates – and assuming 100% pass-through, the numbers point to potential risks in Canada, China and Turkey (fourth column). However, the figures are meant to be only indicative, and are not the outcome of a proper stress test: a rise in rates would take time to translate into higher debt service. The degree of pass-through depends on the share of debt at floating rates, debt maturities and possible changes in borrowing behaviour.

[7] These indicators aim to capture the potential for financial distress over the medium term. See "Highlights of global financing flows", *BIS Quarterly Review*, March 2016, p 28, for a discussion of the indicators and their interpretation.

[8] See eg "Highlights of global financing flows", *BIS Quarterly Review*, September 2016, p 23.

[9] In the past, two thirds of banking crises were preceded by credit-to-GDP gaps breaching this threshold during the three years before the event.

Non-US banks' global dollar funding grows despite US money market reform

Iñaki Aldasoro, Torsten Ehlers, Egemen Eren and Robert N McCauley

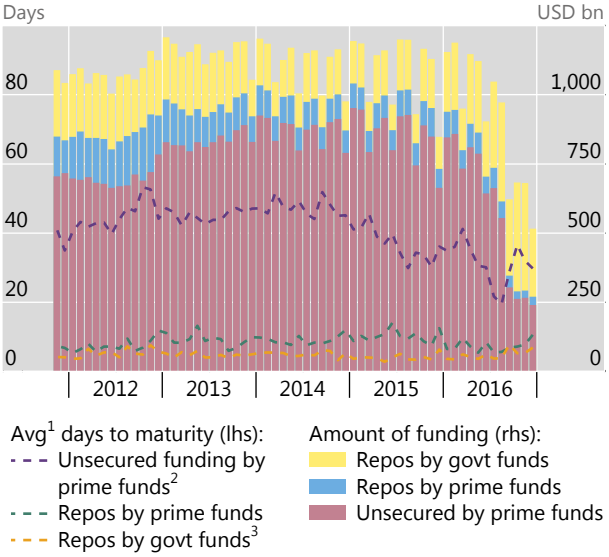
Despite the loss of dollar funding owing to money market mutual fund (MMMF) reform in the United States, non-US banks' aggregate US dollar funding rose to all-time highs in Q3 2016. In particular, deposits outside the United States have risen strongly, offsetting reduced funding from MMMFs. In aggregate at least, non-US banks are not suffering a dollar shortage as in 2008–09.

We estimate that the reform of institutional prime MMMFs, which formally took effect in October 2016, subtracted around $415 billion of dollar funding from non-US banks between September 2015 and December 2016. In some cases, including the largest institutional MMMF, *fund sponsors* converted such funds into "government-only" funds. In addition, *fund investors* switched from prime funds to existing government and Treasury-only funds. Both fund conversion and fund switching led to a shrinkage of prime funds' assets by $1.3 trillion over that period.① Not all of this came at the expense of non-US banks' funding, given prime funds' investments in US-chartered banks and government paper, and government funds' investment in repos with non-US banks. In the five quarters to end-December 2016, non-US banks lost around $555 billion of US dollar funding from prime MMMFs, but gained approximately $140 billion in repo funding from government MMMFs (Graph A1, left-hand panel). This switch reduced the maturity of non-US banks' MMMF funding.

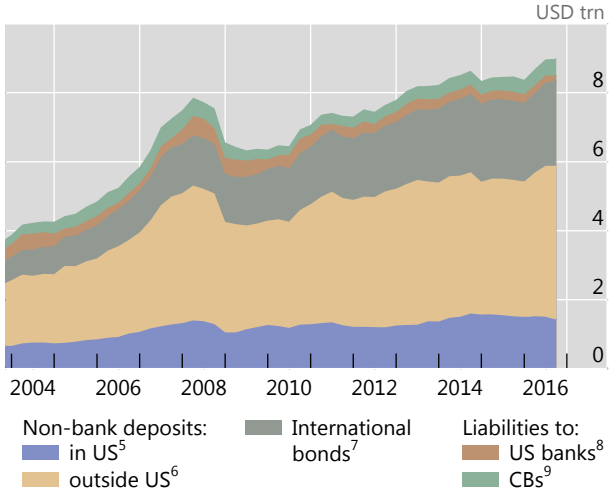
Based on this evidence, many analysts have concluded that non-US banks have suffered a shortage of dollar funding. However, taking a global perspective, up until Q3 2016, non-US banks saw a rise in their on-balance sheet dollar funding to $9.0 trillion (Graph A1, right-hand panel). (In addition to on-balance sheet funding, non-US banks also raise dollars by swapping foreign currency for dollars.) Despite the run-off of eurodollar deposits held by US MMMFs, offshore deposits in non-US banks actually rose by $531 billion to $4.5 trillion in the first three quarters of 2016. This is consistent with the $67 billion increase in customer deposits in foreign currency (mostly dollars) reported by Japanese banks in the seven months to end-October 2016.② The increase in bids for eurodollars widened both

Deposits from US MMMFs down, but eurodollars up at non-US banks — Graph A1

Funding by US money market funds to foreign banks



On-balance sheet dollar funding of non-US banks[4]



[1] Value weighted by notional amounts. [2] Unsecured funding = certificates of deposit, commercial paper and other funding. [3] Government and treasury funds. [4] Excluding positions reported by China and Russia, both of which started reporting to the LBS as from Q4 2015. [5] Deposit liabilities of foreign branches and agencies in the United States are from the Federal Reserve Financial Accounts, Table L.112. [6] Estimated deposit liabilities of non-US banks located outside the US. [7] Includes bonds, medium-term notes and money market instruments. [8] Dollar interbank claims of US banks. [9] US dollar-denominated liabilities to official monetary authorities (CBs) by non-US banks.

Sources: Board of Governors of the Federal Reserve System, Financial Accounts; Crane Data; BIS debt securities statistics and locational banking statistics (LBS) by residence and nationality.

the Treasury-eurodollar and the Libor-OIS spread, raising the cost of floating rate US dollar debt (see Graph 9 in "A paradigm shift in markets?", *BIS Quarterly Review*, December 2016). In addition, some well rated banks issued more long-term bonds in dollars. No aggregate dollar shortage is evident here.

The balance sheets of foreign branches and agencies in the United States shed further light on the adjustment of non-US banks to the funding shock. The loss of funding from US MMMFs shows up in the right-hand panel of Graph A2 as a decline of deposits and the net due to headquarters, the latter reflecting reduced eurodollar deposits by MMMFs in offshore branches, such as in the Cayman Islands. Foreign branches and agencies in the United States have by and large responded by running down their holdings of excess reserves at the Federal Reserve (Graph A2, left-hand panel). While cutting these low-yielding assets, foreign banks increased their more remunerative loans.③

As background, recall that non-US banks had built up disproportionately large holdings at the Fed after 2011, when the widening of the FDIC assessment base under the Dodd-Frank legislation imposed a balance sheet charge on US-chartered banks. Consequently, US-chartered banks left it largely to foreign branches to "arbitrage" by taking funds from those unable to earn interest on their Fed balances, such as Fannie Mae and Freddie Mac, and holding these funds as excess reserves at the Fed.④ Since the return on these transactions was modest, about 15 basis points, it was widely and correctly predicted that holdings at the Fed would feel the brunt of the lost dollar funding.

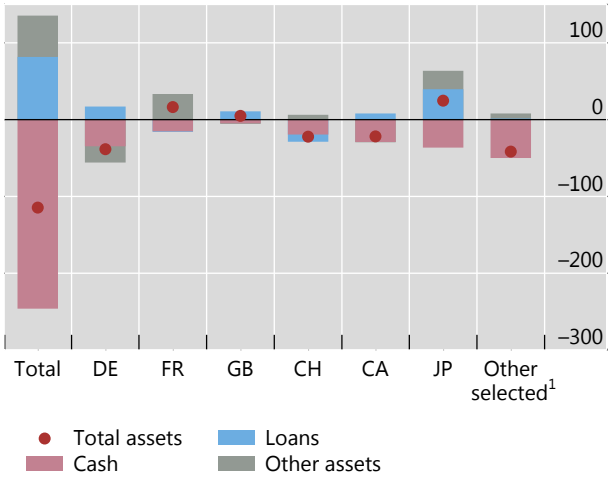
By nationality of bank, the largest losers of deposits were Canadian and Japanese banks (Graph A2, right-hand panel). As "federal funds arbitrageurs", the Canadian banks repaid the money market fund placements by running down their holdings at the Fed and by drawing on funding from affiliates outside the United States. Japanese bank branches added more to their loans and other assets than Canadian banks and drew more funding from their affiliates abroad. As noted above, the consolidated foreign currency balance sheet of Japanese banks suggests that the ultimate source of this affiliate funding was customer deposits.

Overall, we find that non-US banks offset their loss of funding due to US MMMF reform by raising dollar deposits at offices outside the United States and by drawing down excess reserves at the Fed. With less cash, rising loans and the shift to short-term repo funding from MMMFs, foreign branches and agencies in the United States have extended the maturity of their portfolios and taken on more credit risk. However, they collectively still held $630 billion in reserves at the Fed at end-September 2016, a third of the total.

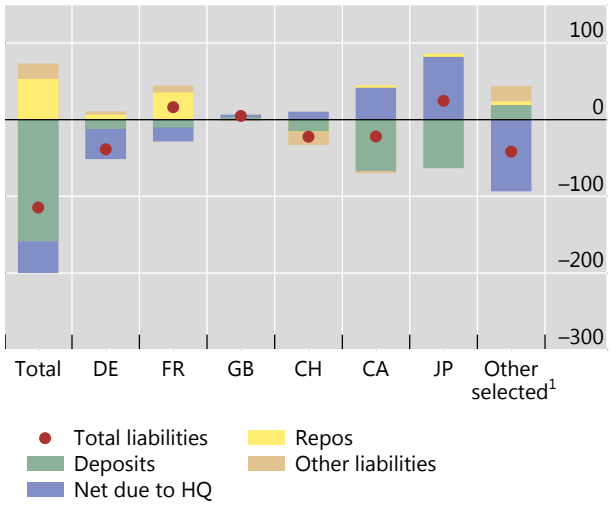
US foreign branches and agencies: deposits and reserves at the Fed both down

Year-on-year changes from end-Q3 2015 to end-Q3 2016 in billions of US dollars — Graph A2

Foreign branches and agencies in the US by nationality – changes in assets by category



Foreign branches and agencies in the US by nationality – changes in liabilities by category



[1] Other selected = AU, NL, NO and SE.

Source: US Federal Financial Institutions Examination Council, *Reports of Condition and Income*.

① See "A paradigm shift in markets?", *BIS Quarterly Review*, December 2016, p 10. ② See H Nakaso, "Monetary policy divergence and global financial stability: from the perspective of demand and supply of safe assets", speech to the International Bankers Association of Japan, 20 January 2017. ③ By contrast, see the decline in branch loans by European banks in R Correa, H Sapriza and A Zlate , "Liquidity shocks, dollar funding costs, and the bank lending channel during the European sovereign crisis", Board of Governors of the Federal Reserve System *International Finance Discussion Papers*, no 1059, 2012. ④ See R McCauley and P McGuire, "Non-US banks' claims on the Federal Reserve", *BIS Quarterly Review*, March 2014, pp 89–97.

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Consumption-led expansions[1]

GDP growth has increasingly been led by consumption. However, consumption-led expansions tend to be significantly weaker than when growth is driven by other components of aggregate demand, often because of the build-up of imbalances. We show that while factors such as credit growth and rising house prices can boost consumption in the short run, the incidence of consumption-led growth and rising debt service ratios significantly dampen growth in the medium to long run. Policies that address the build-up of imbalances and strengthen investment are therefore central to fostering durable growth.

JEL classification: E21, E32, E50, F43, O40.

Private consumption has been the key driver of demand growth in the past few years in many economies. In major advanced economies, consumption contributed up to 1 percentage point to GDP growth in 2015–16 (Graph 1, blue bars in left-hand panel). And in the current year, it is expected to remain a key driver of global growth.[2] This is also true of several major emerging market economies: for instance, in China the pace of consumption growth has exceeded that of GDP growth over the last three years (Table 1).

Growth patterns in previous expansions were often different. A striking feature of the most recent one is that investment has played a relatively minor role. Indeed, while it turned positive over 2013–14, investment's average contribution to growth was only around 0.3 percentage points over 2015–16, when the recovery was already well under way (Graph 1, red bars in left-hand panel). In contrast, during 2003–07 consumption and investment made very similar contributions (right-hand panel).

The current role of consumption growth raises a number of questions regarding its drivers and macroeconomic implications. What features characterise growth periods when private consumption rather than investment, government consumption or net exports take the lead? How secure are the foundations for sustained growth? This feature seeks to answer these questions.

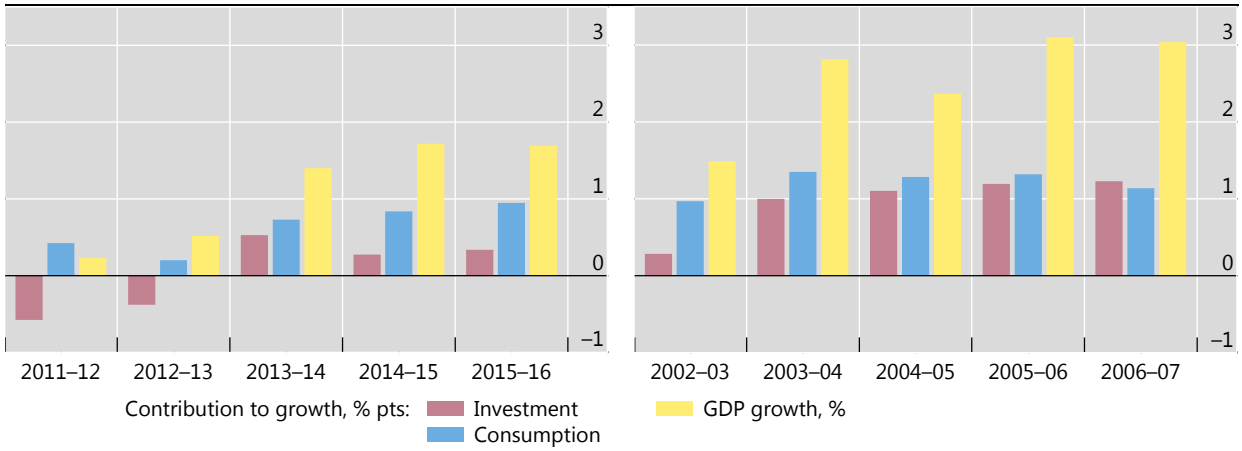
Overall, our analysis finds that during episodes of consumption-led growth GDP typically expands more slowly while investment and net exports are weak. Moreover, consumption-led expansions tend to be followed by weaker growth, even when

[1] This article expresses the views of the authors and not necessarily those of the BIS. We gratefully acknowledge contributions and comments by Claudio Borio, Ben Cohen, Dietrich Domanski, Dubravko Mihaljek and Hyun Song Shin, and research assistance from Emese Kuruc.

[2] The latest OECD, IMF and Consensus forecasts, for instance, suggest that private consumption growth will continue to exceed overall output growth in the United States in 2017.

Consumption has provided the main contribution to growth recently

Advanced economies;[1] growth and contribution to growth — Graph 1



[1] Simple average across AT, AU, BE, CA, CH, DE, DK, ES, FI, FR, GR, IT, JP, NL, NZ, PT, SE and US.

Sources: OECD, *Economic Outlook*; authors' calculations.

controlling for a number of factors. This finding is consistent with the view that a revival of investment is a precondition for a sustainable expansion.

The next section looks at the characteristics of consumption-led expansions, before we turn to their implications for subsequent GDP and consumption growth.

More countries have been experiencing consumption-led growth since 2012[1]

Table 1

	2010	2011	2012	2013	2014	2015	2016
Brazil		✓	✓	✓	✓		
Canada	✓		✓	✓	✓	✓	✓
China		✓	✓		✓	✓	✓
France					✓	✓	✓
Germany			✓	✓		✓	
India		✓		✓			✓
Italy					✓	✓	✓
Japan			✓	✓			
Russia	✓	✓	✓	✓	✓		
South Africa	✓	✓	✓			✓	✓
United Kingdom			✓			✓	✓
United States		✓			✓	✓	✓
Number of economies	*3*	*6*	*8*	*6*	*7*	*8*	*8*

[1] Growth is defined as consumption-led when the real growth rate of private consumption in a given year is higher than that of real GDP. Years with negative GDP growth are excluded. For 2016, OECD forecasts or BIS estimations.

Sources: OECD, *Economic Outlook*; World Bank; CEIC; national data; authors' calculations.

Characteristics of consumption-led growth

For our analysis, we define periods of consumption-led expansions as periods during which private consumption grows more quickly than GDP, either in nominal terms, so that the consumption-to-GDP ratio increases over time, or in real terms, so that real consumption growth exceeds real GDP growth.[3,4]

The number of countries experiencing such consumption-led expansions has increased over the last few years. For a sample of 18 advanced economies, it rose from seven in 2013–14 to 10 in 2015–16 (Graph 2, left-hand panel). Taking a somewhat longer time window to compute consumption and GDP growth rates provides a similar result: depending on the specific definition, eight or 12 countries experienced consumption-led growth over 2014–16, while the corresponding figures over 2012–14 were five and seven (right-hand panel).[5]

What are the main characteristics of consumption-led expansions? To answer this question, we start by simply comparing output growth across consumption- and non-consumption-led episodes. Specifically, we consider one- to three-year windows and compute the distribution of GDP growth rates for both regimes across our 18 advanced economies since 1991.

Before turning to the main patterns, it is worth recalling two important features of private consumption. First, consumption is the largest component of aggregate demand. For instance, in our sample it accounts for around 56% of GDP. Second, it is much stickier than other demand components.[6] Households try to smooth consumption over time, bridging periods of weak income growth or high unemployment by reducing saving. For this reason, recessions or periods of negative GDP growth are likely to witness an increase in the consumption-to-output ratio. Therefore, for the rest of this article we restrict our analysis to positive GDP growth periods so that we can confidently define consumption-led growth as periods of increasing consumption relative to output.

[3] The leading driver of GDP growth is usually defined as either the component that makes the largest contribution to GDP growth or the one growing faster than GDP. But if all GDP components grow at the same rate, the largest contribution will simply be that of the largest component. In other words, a drawback of focusing on growth contributions is that a large share in GDP could compensate for the low growth rate of a given component. The second definition also has its drawbacks. First, there may be more than one component growing faster than GDP, making it difficult to say which is leading growth. Second, growth rates often reflect the cyclical properties of demand components. For instance, investment is more cyclical than GDP, while private consumption is less so, implying that investment-led growth could be observed more often when the economy is growing quickly, and consumption-led when the economy is growing slowly. However, these two issues can easily be addressed. First, in advanced economies consumption is by far the largest component of GDP. Hence, when consumption grows faster than GDP, it also tends to have the largest contribution. Second, focusing on periods with positive GDP growth significantly alleviates the problem due to differences in GDP components' cyclical properties.

[4] The private consumption deflator tends to grow more slowly than the GDP deflator. As a result, real consumption can grow more quickly than real GDP even if the consumption-to-GDP ratio – which is computed using nominal values- is not necessarily increasing. Graph 2 therefore presents evidence using both alternative definitions. But the rest of the analysis focuses on consumption-led growth as periods of increasing consumption-to-output ratios, arguably a more restrictive definition.

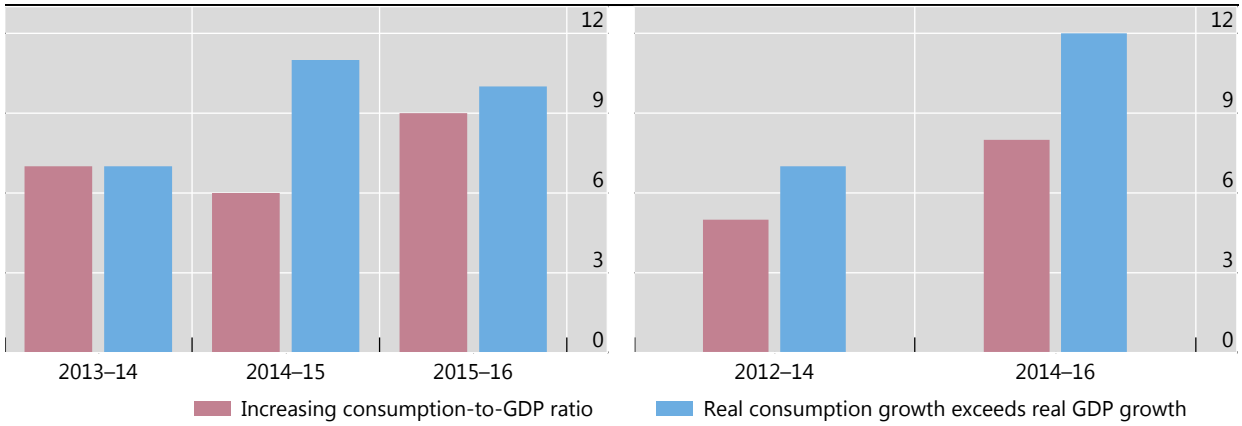
[5] The numbers in the right-hand panel of Graph 2 are based on two-year windows.

[6] Private consumption growth also tends to be stickier than total GDP growth, as the standard deviation of the former is 1.8%, versus 2.1% for the latter.

Advanced economies[1] experiencing consumption-led growth

Number of economies

Graph 2



[1] The sample includes AT, AU, BE, CA, CH, DE, DK, ES, FI, FR, GR, IT, JP, NL, NZ, PT, SE and US.

Sources: OECD, *Economic Outlook*; authors' calculations.

Some general patterns become clear at the outset. First, growth is weaker when it is consumption-led: the left-hand panel of Graph 3 shows that the distribution of GDP growth rates is tilted towards the right for non-consumption-led expansion. This holds whether one considers growth rates over one, two or three years. As noted above, this difference holds when we restrict our attention to periods of positive GDP growth: the difference in average annualised GDP growth is around 0.7 percentage points using a one-year window, 0.5 percentage points using a two-year window and

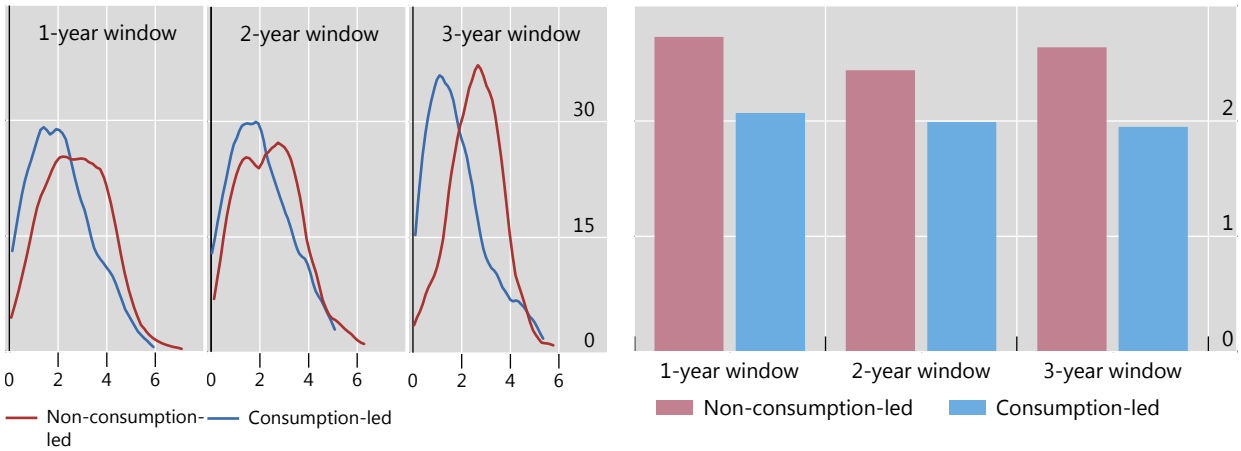
GDP growth under consumption- and non-consumption-led growth

Advanced economies,[1] 1991–2016; in per cent

Graph 3

GDP growth frequency distribution

Average annualised GDP growth



[1] The sample includes AT, AU, BE, CA, CH, DE, DK, ES, FI, FR, GR, IT, JP, NL, NZ, PT, SE and US. Restricted to positive GDP growth rates. Growth is consumption-led if the consumption-to-output ratio increases over the period considered.

Sources: OECD, *Economic Outlook*; authors' calculations.

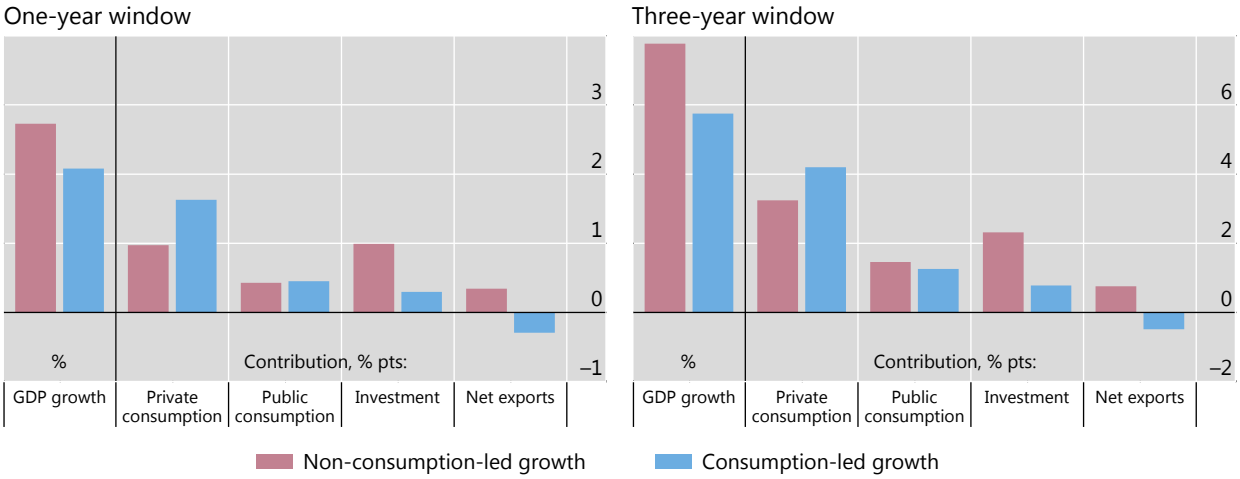
around 0.7 percentage points using a three-year window, with these differences being statistically significant in all three cases (Graph 3, right-hand panel).[7]

To understand why growth is systematically weaker when it is led by consumption, we decompose GDP by its demand components. As would be expected, consumption tends to contribute more to aggregate GDP growth when it is consumption-led: on average 1.6 percentage points versus 1 percentage point for non-consumption-led expansions (Graph 4, left-hand panel). Over a three-year window, the difference in the consumption contribution is around 1 percentage point, and therefore slightly lower on an annualised basis.

Public sector spending contributes about the same amount to GDP growth across both regimes, suggesting that differences between the two regimes are not related to differences in fiscal policy. Meanwhile, the respective contributions of investment and net exports to growth appear to be much weaker during consumption-led expansions, to an extent that this more than offsets the stronger contribution of private consumption. This finding suggests that the nexus between current consumption and investment is key for understanding the implications of consumption-led expansions.

Composition of GDP growth under consumption- and non-consumption-led growth

Advanced economies,[1] 1991–2016 Graph 4



[1] The sample includes AT, AU, BE, CA, CH, DE, DK, ES, FI, FR, GR, IT, JP, NL, NZ, PT, SE and US. Restricted to positive GDP growth rates. Growth is consumption-led if the consumption-to-output ratio increases over the window considered.

Sources: OECD, *Economic Outlook*; authors' calculations.

[7] Consumption being stickier than output, the consumption-to-output ratio tends to rise during recessions, ie episodes of negative GDP growth, while investment drops faster than GDP. This holds irrespective of the length of the window used to compute growth rates.

Implications of consumption-led expansions

The key question in assessing the implications of consumption-led expansions regards causality. Do such episodes cause lower overall GDP growth, or are they the consequence of a lack of growth opportunities? In other words, how secure are the foundations for sustained growth?

Strong consumption growth today could induce subsequent economic weakness through a number of possible mechanisms. First, if increased consumption is financed by debt, this may constrain spending in the future. Recent research (eg Jordà et al (2015) and Lombardi et al (2017)) has found that past credit growth tends to hinder future growth, either because a financial crisis occurs or simply because agents have over-borrowed relative to their repayment capabilities and need to deleverage. It could therefore be that a consumption-led expansion financed through borrowing ends up hurting future demand because households need to devote a larger fraction of their income to debt servicing.

Second, consumption-led growth may be driven by wealth effects, in particular housing wealth effects. When real house prices go up, property owners may decide to consume part of their capital gains, which boosts consumption and hence GDP. Yet if incomes do not grow in line with house prices, or if house price increases reverse, households have to cut back on consumption, thereby lowering GDP growth.

But consumption need not play a causal role. In particular, if there are few growth opportunities, then investment is weak. Weak investment would then be associated with low growth, which would, in turn, show up as consumption-led growth, not least since consumption is stickier than GDP.

Impact of consumption-led expansions on growth

Dependent variable: subsequent real GDP growth — Table 2

	Years ahead					
	1	2	3	4	5	5
Consumption-led growth	–0.169	–0.437*	–0.570***	–0.618**	–0.571*	–0.816**
	(0.155)	(0.252)	(0.275)	(0.304)	(0.342)	(0.319)
GDP growth	0.027	0.028	0.061	0.041	0.030	
	(0.054)	(0.082)	(0.098)	(0.118)	(0.130)	
Real house price growth	–0.002	–0.012	–0.031*	–0.037*	–0.042*	
	(0.010)	(0.015)	(0.020)	(0.022)	(0.022)	
Private credit-to-GDP growth	0.028*	0.069*	0.093**	0.073**	0.044	
	(0.010)	(0.030)	(0.038)	(0.041)	(0.043)	
Debt service ratio	–0.194***	–0.404***	–0.635***	–0.817***	–0.940***	
	(0.057)	(0.088)	(0.109)	(0.140)	(0.172)	
Number of observations	183	183	183	183	183	183
R-squared	0.800	0.803	0.814	0.821	0.838	0.787

The table reports the results of regressions where the dependent variable is GDP growth *h* years ahead and the independent variables are named at the beginning of each row. The sample includes AU, BE, CA, CH, DE, DK, ES, FI, FR, IT, JP, NL, SE and US; the estimation period is 2000–16. All estimations include country and time fixed effects. Robust standard errors in parentheses; ***/**/* denotes statistical significance at the 1/5/10% level.

Source: Authors' calculations.

We test the relevance of these mechanisms with a simple econometric exercise.[8] We estimate the relationship between the number of consumption-led growth years in a given period and the subsequent growth rate of GDP or consumption. The estimated coefficient for the consumption-led growth variable then quantifies the subsequent growth gain/loss in GDP or consumption stemming from an additional year of consumption-led growth. In parallel, we include the aforementioned mechanisms using private credit-to-GDP growth, real house price growth and the debt service ratio to tease out the channels through which consumption-led growth could harm subsequent output and consumption (see the box for details).

Table 2 presents the estimation results. The first five columns relate to different estimation horizons, *h*, from one to five years ahead; the sixth column shows results for the estimation horizon $h = 5$ without any control variables. Three main takeaways can be drawn from this exercise.

First, real house price growth has a weakly significant negative effect on subsequent GDP growth at horizons of three to five years. This is consistent with the view that households need to adjust their consumption downwards after having consumed part of the increase in their housing wealth. Another interpretation is that

Estimation of the effects of consumption-led expansions on subsequent GDP and consumption growth

Our econometric specification relates the growth rate of GDP (or the growth rate of private consumption) in country i between year t and $t+h$, denoted $Y_{t+h,i}$ to:

- A variable counting the number of years of consumption-led growth in country i between year t–3 and t, denoted $CL_{t,i}$, consumption-led growth years being defined as those over which the consumption-to-output ratio increases.

In addition, we add a number of control variables as follows:

- The growth rate of GDP between year t–3 and t, denoted $Y_{t,i}$. In this respect, if growth opportunities are correlated over time, having past GDP growth on the right-hand side can capture this autocorrelation in growth opportunities.
- The growth rate of private credit-to-GDP between year t–3 and t, denoted $PC_{t,i}$.
- The growth rate of real house prices between year t–3 and year t, denoted $HP_{t,i}$, with real house prices being computed by deflating nominal values with the CPI index.
- The debt service ratio in year t, denoted $DSR_{t,i}$, defined as the ratio of debt repayments to income.

Focusing on 16 advanced economies using annual data since 2000, we therefore estimate for each horizon $h=1,2,\ldots,5$ a separate regression following the specification:

$$Y_{t+h,i} = \alpha_{h,i} + \alpha_{h,t} + \beta_h CL_{t,i} + \gamma_h PC_{t,i} + \delta_h HP_{t,i} + \theta_h DSR_{t,i} + \lambda_h Y_{t,i} + \varepsilon_{t+h,i} \quad (1)$$

where $\alpha_{h,i}$ and $\alpha_{h,t}$ denote country and year fixed effects, respectively; β_h, γ_h, δ_h, θ_h and λ_h are parameters to be estimated and ε is a residual.

[8] Overall, we find that increases in the private consumption-to-GDP ratio tend to act as a drag on subsequent growth, rather than the long-term level of this ratio in any given country. We leave it to future research to determine which factors explain the substantial cross-country heterogeneity in this ratio.

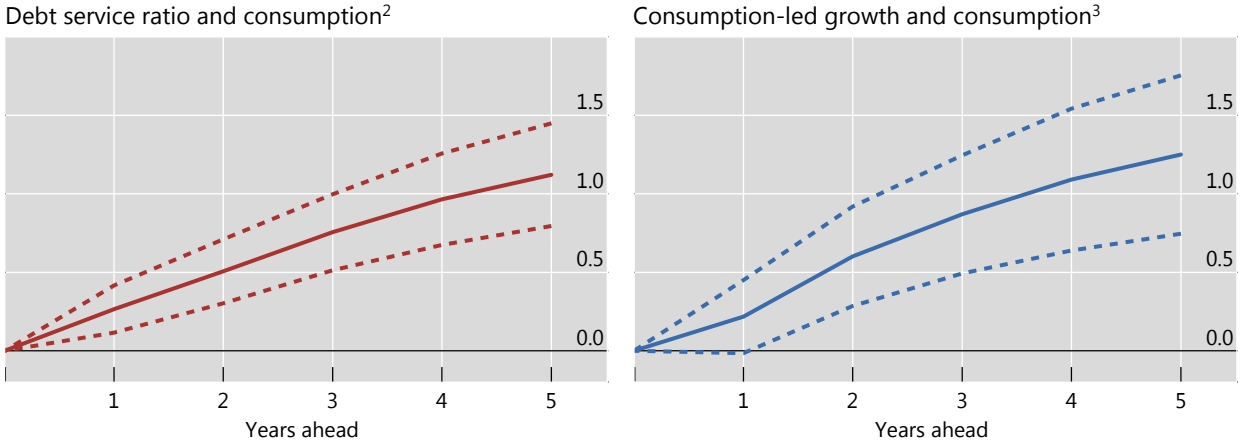
stronger house price growth, to the extent that it implies pouring more resources into housing, can act as a drag on resources that could be employed in more productive uses.

Second, past credit-to-GDP growth has a significant and positive effect on subsequent GDP growth at a three- to four-year horizon. Moreover, the debt service ratio has a strongly significant and persistent negative effect on subsequent GDP growth, which seems to last even at a five-year horizon. These two results are consistent with each other. If credit expands more quickly while the repayment burden is stable, then more credit is available to sustain aggregate demand, thereby lifting future GDP growth. Conversely, an increase in the repayment burden for a given credit-to-GDP increase means that the economy faces higher interest rates which ought to weigh on future growth. These results are consistent with a growing body of literature that highlights how credit extension can act as a drag on growth through a higher debt service ratio (Drehmann and Juselius (2012), Dynan (2012), Mian et al (2013), Juselius et al (2016) and Drehmann et al (2017).

To explore how these variables affect consumption, we carry out a similar exercise using subsequent real *consumption* growth as a dependent variable. We use the same independent variables as before, but replace past GDP growth with past consumption growth and private credit-to-GDP growth with household credit-to-GDP growth. This way, there is a closer relationship between the left-hand and right-hand side variables.[9,10]

Consumption-led growth, debt service ratio and subsequent consumption growth

Advanced economies;[1] consumption growth loss, in percentage points — Graph 5



[1] The sample includes AU, BE, CA, CH, DE, DK, ES, FI, FR, IT, JP, NL, SE and US; the estimation period is 2000–16. [2] The simulation represents the estimated effect on real private consumption of a one standard deviation increase in the debt service ratio based on the results from equation (1) in the box estimated for one to five years ahead. [3] The simulation represents the estimated effect on real private consumption of one additional year of consumption-led growth based on the results from equation (1) estimated for one to five years ahead.

Sources: OECD, *Economic Outlook*; BIS; authors' calculations.

[9] Unfortunately, due to data limitations we cannot use the household sector debt service ratio, which forces us to use the economy-wide debt service ratio.

[10] Adding household income growth to the specification does not change the results significantly, either qualitatively or quantitatively.

Qualitatively, the results are very similar (Table 3). The estimated coefficients for the number of consumption-led expansion years and the debt service ratio are both negative and statistically significant at most horizons. The estimated coefficients are lower (in absolute value) for the debt service ratio variable but larger for the consumption-led growth variable than in the GDP growth regression. Household credit growth also provides a significant boost to consumption over the one- to three-year horizon.

In contrast to the results for GDP growth, however, the other variables (past consumption growth, past real house price growth and past household credit-to-GDP growth) have little explanatory power. This suggests that the debt service ratio and the number of consumption-led growth years are strong determinants of subsequent consumption growth.

An additional year of consumption-led expansion (Graph 5, right-hand panel) or a one standard deviation increase in the debt service ratio (left-hand panel) have roughly the same estimated effect on consumption growth. In both cases, after five years consumption is between 1 and 1.2 percentage points lower that it would have been otherwise, or 0.2–0.24 percentage points per year.

While house prices do not generally have a significant effect on consumption over longer horizons, this is not always the case in the very short run. As one would expect, the effect of housing market conditions on consumption varies considerably across countries and over time. An analysis of the short-term effect confirms this view

Impact of consumption-led expansions on consumption

Dependent variable: subsequent real consumption growth — Table 3

	Years ahead					
	1	2	3	4	5	5
Consumption-led growth	–0.218	–0.602***	–0.869***	–1.090**	–1.253***	–1.374***
	(0.141)	(0.192)	(0.228)	(0.274)	(0.306)	(0.302)
Consumption growth	–0.053	–0.051	0.052	0.041	0.065	
	(0.055)	(0.075)	(0.089)	(0.107)	(0.120)	
Real house price growth	0.006	0.009	0.003	0.002	–0.013	
	(0.011)	(0.015)	(0.017)	(0.021)	(0.023)	
Household credit-to-GDP growth	0.047***	0.079***	0.061**	0.036	–0.001	
	(0.016)	(0.023)	(0.027)	(0.032)	(0.036)	
Debt service ratio	–0.175***	–0.333***	–0.497***	–0.635***	–0.738***	
	(0.060)	(0.082)	(0.097)	(0.116)	(0.130)	
Number of observations	180	180	180	180	180	180
R-squared	0.619	0.725	0.772	0.786	0.812	0.770

The table reports the results of regressions where the dependent variable is consumption growth *h* years ahead and the independent variables are named at the beginning of each row. The sample includes AU, BE, CA, CH, DE, DK, ES, FI, FR, IT, JP, NL, SE and US and the estimation period is 2000–16. All estimations include country and time fixed effects. Robust standard errors in parentheses; ***/** denotes statistical significance at the 1/5% level.

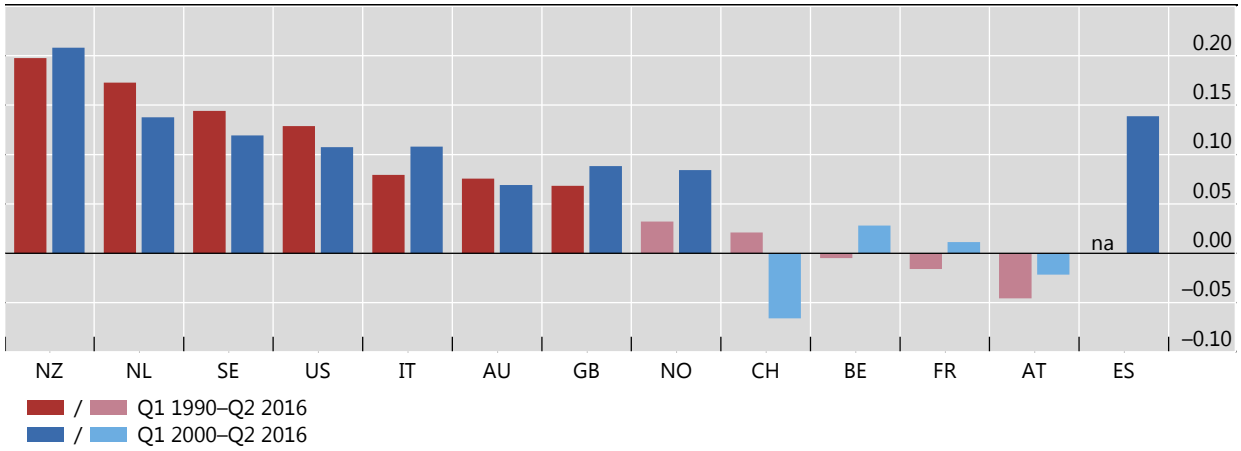
Source: Authors' calculations.

(Graph 6 and Table A1 in the Annex).[11] In nine of 13 countries, information on house price changes in a given quarter improves the prediction of consumption growth in the subsequent quarter in a way that is economically and statistically significant (in the post-2000 sample). The point estimates suggest that it would take an 8% increase in the respective house price indices (in real terms) to boost consumption by about 1 percentage point in the United States. The estimates also suggest that the short-term sensitivity of consumption to house prices has increased in some countries (eg Norway and the United Kingdom).

On the whole, the above association tends to be stronger in countries where mortgage refinancing and home equity extraction is more prevalent. Rising house prices may enable homeowners to take out larger loans, as the value of pledgeable collateral rises.[12] These loans may take the form of consumption or re-mortgaging lending (from which part of the gains may be consumed). Rising house prices also increase homeowners' net wealth, which may explain higher consumption. These channels tend to be stronger in the aggregate whenever the share of homeowners in the population is large. Indeed, there is a positive cross-country correlation (0.53) between the house price elasticity of short-run consumption and the home ownership rate.[13]

Short-term effect of housing market conditions on consumption[1]

Coefficient of house price growth in following-quarter consumption growth — Graph 6



The lighter bars denote coefficients that are not statistically significant at the 10% level.

[1] The bars refer to the coefficient of quarterly house price growth (deflated by CPI), in a quarterly consumption growth equation. The specification includes controls for changes in a proxy for permanent income, a risk indicator and the real interest rate (see Table A1).

Source: Authors' calculations.

[11] Control variables in these regressions include a proxy for changes in permanent income, where permanent income is computed by extrapolating the growth rate of income over the previous eight years (ie the moving average) into the future and applying a fixed discount rate of 5% (as in Aron et al (2012)). See also Muellbauer (2016).

[12] See Tsatsaronis and Zhu (2004), Scatigna et al (2014), BIS (2015) and Jordà et al (2015).

[13] While further refinement by the use of detailed micro-data analysis of this link is beyond the scope of this feature, several papers in the literature find confirmation of such channels. Campbell and Cocco (2007), for instance, find significant effects of house prices in the United States on the consumption of homeowners, but not of renters.

In contrast, when housing is obtained mostly through rental agreements, house prices are less likely to have first-order effects on aggregate consumption. Indeed, in several countries in continental Europe, the link between house prices and household consumption is not as evident. This is partly due to weaker incentives for households to take on leverage, which translate into low home ownership.[14]

The very short-term growth rate of consumption in several economies is affected by past house price developments, and house prices thus can be an important channel of monetary policy transmission. In the medium to long run, however, house price effects on consumption are typically superseded by the dynamics of the debt service ratio and investment.

Conclusion

All in all, the evidence suggests that the composition of growth matters for medium-term growth prospects. We find that increasing shares of private consumption in GDP can be a leading indicator of future growth slowdowns, particularly if consumption-led expansions come on the back of growing imbalances and rising debt burdens. High household debt service ratios tend to become a potent drag on economic growth, frequently leading to costly deleveraging processes.

The increasing prevalence of consumption-led growth since 2012 therefore presents new challenges for policymakers in several economies. Policies that address the build-up of imbalances and strengthen investment are thus central in fostering sustainable growth.

[14] In this regard, Schneider and Wagner (2015) document how the tax systems of Austria and Germany tend to favour renting over owning.

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Annex

Short-term consumption growth equations

Dependent variable: quarter-on-quarter log change in household consumption index Table A1

	Full sample			Post-2000			Sample period [number of observations]
	Change in house prices	R^2	Forecast standard error	Change in house prices	R^2	Forecast standard error	
Australia	0.076***	0.134	0.00513	0.069**	0.185	0.00467	Q3 1990–Q2 2016
	(2.85)			(2.19)			[104]
Austria	–0.045	0.089	0.00573	–0.022	0.085	0.00587	Q4 1996–Q2 2016
	(1.66)			(0.62)			[79]
Belgium	–0.005	0.055	0.00482	0.028	0.071	0.00401	Q3 1990–Q2 2016
	(0.69)			(0.46)			[104]
France	–0.016	0.070	0.00562	0.011	0.093	0.00421	Q3 1992–Q2 2016
	(0.74)			(0.36)			[96]
Italy	0.079*	0.186	0.00595	0.108**	0.337	0.00457	Q3 1990–Q2 2016
	(1.80)			(2.28)			[104]
Netherlands	0.173***	0.420	0.00559	0.137***	0.253	0.00545	Q4 1996–Q1 2016
	(4.54)			(4.23)			[78]
New Zealand	0.198***	0.267	0.00742	0.208***	0.297	0.00762	Q4 1996–Q2 2016
	(5.55)			(4.81)			[79]
Norway	0.032	0.071	0.00968	0.084**	0.078	0.00797	Q3 1992–Q2 2016
	(0.69)			(2.30)			[96]
Spain	…	.	.	0.139***	0.632	0.00585	Q4 2003–Q2 2016
	.			(3.81)			[51]
Sweden	0.144***	0.178	0.00800	0.119**	0.131	0.00623	Q3 1990–Q2 2016
	(2.65)			(2.48)			[104]
Switzerland	0.021	0.095	0.00316	–0.066	0.157	0.00286	Q3 1990–Q2 2016
	(0.74)			(1.42)			[104]
United Kingdom	0.068***	0.365	0.00620	0.088***	0.516	0.00517	Q3 1990–Q1 2016
	(2.88)			(3.12)			[103]
United States	0.129***	0.438	0.00398	0.107***	0.490	0.00354	Q3 1990–Q2 2016
	(3.85)			(3.01)			[104]

Variables are log changes and in real terms. *t*-statistics, in parentheses, are based on robust standard errors; ***/**/* denotes statistical significance at the 1/5/10% level. All equations include a constant and controls for changes in a proxy for permanent income, perceived risk (proxied by the VIX) and in the real interest rate.

Source: Authors' calculations.

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The new era of expected credit loss provisioning[1]

Following the Great Financial Crisis, accounting standard setters have required banks and other companies to provision against loans based on expected credit losses. While the rules adopted by the two main standard-setting bodies differ, banks must in both cases provision for expected credit losses from the time a loan is originated, rather than awaiting "trigger events" signalling imminent losses. In the short term, provisions may rise but the impact on regulatory capital is expected to be limited. However, the new rules are likely to alter the behaviour of banks in credit downturns, potentially dampening procyclicality. Banks, supervisors and market participants must prepare for their respective roles in implementing the new approach and assessing its impact.

JEL classification: G21, G28, M40, M48.

The Great Financial Crisis (GFC) of 2007–09 highlighted the systemic costs of delayed recognition of credit losses on the part of banks and other lenders. Pre-crisis, application of the prevailing standards was seen as having prevented banks from provisioning appropriately for credit losses likely to arise from emerging risks. These delays resulted in the recognition of credit losses that were widely regarded as "too little, too late". Furthermore, questions were raised about whether provisioning models, including the effect of provisioning on regulatory capital levels, contributed to procyclicality by spurring excessive lending during the boom and forcing a sharp reduction in the subsequent bust.

Following the crisis, the G20 Leaders, investors, regulatory bodies and prudential authorities called for action by accounting standard setters to improve loan loss provisioning standards and practices. In response, the International Accounting Standards Board (IASB) in 2014 published IFRS 9 *Financial Instruments*, which includes a new standard for loan loss provisioning based on "expected credit losses" (ECL).[2] For its part, the US Financial Accounting Standards Board (FASB) published its

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[2] IASB (2014a): IFRS 9 also includes new rules for classification and measurement of financial instruments and hedge accounting.

final provisioning standard based on "current expected credit losses" (CECL) in 2016.[3] The new standards will come into effect between 2018 and 2021.[4]

Under both IASB standards[5] and FASB standards, the current accounting model for recognising credit losses is commonly referred to as an "incurred loss model" because it requires the recording of credit losses that have been incurred as of the balance sheet date, rather than of probable future losses. Loss identification is based on the occurrence of "triggering" events supported by observable evidence (eg borrower loss of employment, decrease in collateral values, past-due status) combined with expert judgment. The new "expected credit loss" standards replace this with a more forward-looking approach that emphasises shifts to the probability of future credit losses, even if no such triggering events have yet occurred.

Section 1 looks more closely at the motivation for expected credit loss standards. Section 2 outlines the key features of the new standards, highlighting the main differences between the IASB and FASB approaches. Section 3 considers the transition, drawing on recent surveys by accounting firms and supervisors. Section 4 considers how the new standards might affect patterns of bank lending and procyclicality once they are in place. A concluding section examines the role of central banks, supervisors and other stakeholders in implementing the new regime.

Why provision for expected credit losses?

Borio and Lowe (2001) observe that, conceptually, if lending rates accurately reflected credit risks, banks would have no reason to set aside additional provisions at the initiation of a loan to cover *expected losses*. The higher interest margin on a risky loan would reflect the increased risk of non-payment, while a higher discount rate (reflecting greater risk) on the loan's cash flows would offset the higher interest margin in guiding the bank's lending decision. Of course, capital would still be needed to cover *unexpected* losses. Provisions would then be appropriate if the riskiness of the loan increases after initiation, to recognise the higher discount rate and reduced likelihood of repayment – or, equivalently, the value of the loan would be marked down as part of a fair value accounting approach. By the same token, a bank might even take "negative provisions" (an increase in asset values) if riskiness were to recede.

Why, then, should provisions be based on expected losses from the moment a loan is initiated? One answer is that loan pricing may not reflect the risks because of transitory market conditions. If past experience and sound modelling suggest that credit risks are not fully reflected in loan pricing decisions, prudent risk management would suggest supplementing market signals with additional evidence. A second set of explanations relate to capital. Peek and Rosengren (1995) and Dugan (2009) note that the need to maintain adequate capital (or rebuild deficient capital) is less likely

[3] FASB (2016): the FASB standard refers to its new provisioning approach as being based on "current expected credit losses" or "CECL".

[4] See Edwards (2014), who addressed key efforts of the G20, Financial Stability Board (FSB and its predecessor, the Financial Stability Forum, or FSF) and the BCBS to encourage the development of these new standards, summarised the IASB and FASB approaches (and why convergence was not achieved) and explored their potential impacts and implementation challenges before IFRS 9 was published.

[5] IASB standards are known as the International Financial Reporting Standards (IFRS).

to bind banks' decisions in good times than in bad, creating a bias to lend freely during upswings. Forward-looking provisioning essentially brings the capital cost of a lending decision forward in time, restoring (to some extent) the incentive value of capital for marginal lending decisions, even in times when the capital buffer itself is not a binding constraint.

Against this, some point to the danger that allowing too much judgment in setting provisions could enable banks to use provisioning to smooth earnings, reducing the transparency of financial accounts and hence their usefulness to investors and counterparties. To avoid this impression, provisioning standards need to set clear rules for when and how provisions are established and adjusted over time, along with transparency as to methodologies and assumptions.

Numerous studies have established that delayed or backward-looking provisioning practices contribute to the procyclicality of bank lending, while forward-looking provisioning reduces procyclicality. For example, Laeven and Majnoni (2003), looking at 1,419 banks in 45 countries in the 1988–99 period, find a positive relationship between provisions and pre-provision earnings, suggesting that banks use provisions to smooth income, and that a negative relationship holds between provisions and growth in lending and GDP, implying that provisions are procyclical. Beatty and Liao (2011), looking at quarterly data on 1,370 US banks in the 1993–2009 period, find that a longer delay in banks' loan-loss recognition increases the negative impact of recessions on bank lending. They find this result for several measures of delayed loss recognition at the bank level: a flow measure (the responsiveness of provisions to past non-performing loans (NPLs)), a stock measure (the ratio of loan loss allowances to contemporaneous NPLs) and a market measure (the link between a bank's current reported income and future equity returns). Bushman and Williams (2012) apply a similar approach to banks in 27 countries, measuring the relationship between banks' loan-loss provisions and their past and future NPLs. They find that banks' risk-taking discipline (the tendency to reduce leverage when asset volatility rises) is greater for banks that take provisions well ahead of actual loan losses.

Regulatory interventions can alter some of these effects. Jiménez et al (2013), study the "statistical provisioning" regime introduced by Spanish supervisory authorities in 2000, which was intended to introduce a more forward-looking element to Spanish banks' general provisions. They find that the initial strengthening of provisioning requirements dampened bank lending, and that subsequent policy adjustments that loosened the requirements spurred lending – but that these effects were stronger for banks where capital and provision levels were already high.[6]

In its April 2009 report on addressing procyclicality in the financial system,[7] the Financial Stability Forum (FSF) noted that "Earlier recognition of loan losses could have dampened cyclical moves in the current crisis," and argued that "earlier identification of credit losses is consistent both with financial statement users' needs for transparency regarding changes in credit trends and with prudential objectives of safety and soundness." The FSF report recommended: "The FASB and IASB should reconsider the incurred loss model by analysing alternative approaches for recognising and measuring loan losses that incorporate a broader range of available

[6] See Saurina and Trucharte (2017) for a review of the Spanish experience with statistical provisioning. In some other jurisdictions using IFRS standards, supervisors expected banks to use statistical provisioning approaches (Agénor and Pereira da Silva (2016)).

[7] Financial Stability Forum (2009).

credit information." These recommendations were endorsed by the G20 Leaders[8] and taken up by the IASB and FASB, with the input and encouragement of the newly formed Financial Stability Board (FSB), the Basel Committee on Banking Supervision (BCBS), key banking, insurance and securities regulators, and the IASB-FASB Financial Crisis Advisory Group, as well as investors and other stakeholders.[9]

Overview of the new standards

The IASB and FASB standards share a number of features. Both are designed to provide financial statement users with more useful information about a company's ECL on financial instruments that are not accounted for at fair value through profit or loss (eg trading portfolios). The impairment approach requires banks and other companies to recognise ECL and to update the amount of ECL recognised at each reporting date to reflect changes in the credit risk of financial assets. Both approaches are forward-looking and eliminate the threshold for the recognition of ECL, so that it is no longer necessary for a "trigger event" to have occurred before credit losses are reported. And both standards require companies to base their measurements of ECL on reasonable and supportable information that includes historical, current and – for the first time – forecast information. Thus, the effects of possible future credit loss events on ECL must be considered.[10]

Where the two standards differ is mainly in terms of the degree to which losses are recognised over an asset's lifetime. The FASB calls for a consideration of ECL over the life of a loan from the time of its origination whereas the IASB favours a staged approach.

More specifically, as summarised below and in Table 1, IFRS 9 requires banks and other companies to report ECL in three stages as the deterioration in credit quality takes place.[11] For Stage 1, they would report "12-month expected credit losses" and for Stages 2 and 3, full "lifetime expected credit losses".

In *Stage 1* under the IASB approach, which would begin as soon as a financial instrument is originated or purchased, 12-month ECL are recognised as an expense and a loss allowance is established. This serves as a proxy for the initial expectations of credit losses. For financial assets, interest revenue is calculated on the gross carrying amount (ie without adjustment for the loss allowance). Unless its credit quality changes, the same treatment will then apply every subsequent year until its maturity.

8 G20 Leaders (2009).

9 To be clear, the IASB and FASB published their standards because they believe their ECL approaches would provide better information for investors about credit losses; they did not seek to address procylicality issues. But, as the FSF noted, the earlier recognition of ECL should nonetheless help to mitigate procyclicality.

10 IFRS 9 applies the same impairment approach to all financial assets that are subject to impairment accounting, thus removing a source of current complexity. All banks and other companies that hold financial assets or commitments to extend credit that are not accounted for at fair value through profit or loss (eg trading portfolios) would be affected by IFRS 9's impairment rules. This includes trade receivables and lease receivables, loan commitments and financial guarantee contracts, and loans and other financial assets measured at amortised cost or that are reported at "fair value through other comprehensive income" (such as available-for-sale assets).

11 IASB (2014b).

Expected credit loss (ECL) measurement Table 1

	Performing assets	Underperforming assets (assets with a significant increase in credit risk)	Impaired assets
IASB	"Stage 1" 12-month ECL	"Stage 2" Lifetime ECL	"Stage 3" Lifetime ECL
FASB		Lifetime ECL	

Source: BCBS (2016c).

A bank or other lender would calculate 12-month ECL as the portion of lifetime ECL that may result from default events on a financial instrument within the 12 months after the reporting date. This is understood as the likely credit loss on an asset over its lifetime times the probability that the default will occur in the next 12 months.

If at inception a bank can identify assets or a portfolio of such assets that are expected to have a substantial default risk over the coming year, such assets would be more appropriately considered under Stages 2 or 3.

When credit quality is deemed to deteriorate significantly and is no longer considered to be "low credit risk", the asset would move into Stage 2. At this point, the full lifetime ECL would be reported. The resulting increase in the provisions is typically expected to be significant. As in Stage 1, interest income is calculated based on the gross carrying amount (ie without adjustment for ECL).

Under IFRS 9, lifetime ECL is the expected present value of losses that arise if borrowers default on their obligations at some time during the life of the financial asset. For a portfolio, ECL is the weighted average credit losses (loss-given-default) with the probability of default as the weight.[12] The relationship between lifetime and 12-month ECL will depend on many factors, including the loan's maturity as well as how default risks and recovery values are expected to evolve over the life of a loan.

Significant increases in credit risk may be assessed on a collective basis, for example on a group or subgroup of financial instruments. This should ensure that lifetime ECL are recognised when there is a significant increase in credit risk, even if evidence of that increase is not yet available on an individual asset level. IFRS 9 presumes that a loan has significant credit risk when it becomes 30 days past due and, thus, must be shown in Stage 2 or 3, where provisions are based on lifetime ECL.[13]

Stage 3 occurs when the credit quality of a financial asset deteriorates to the point that credit losses are incurred or the asset is credit-impaired. Lifetime ECL would continue to be reported for loans in this stage of credit deterioration but interest

[12] Since lifetime ECL consider the amount and timing of payments, a credit loss (ie a cash shortfall) arises even if the bank expects to be paid in full but later than due.

[13] IFRS 9 has a presumption that the credit risk on a financial asset has increased significantly since initial recognition when contractual payments are 30 days or more past due. While this 30-day threshold is not necessarily an absolute indicator for increased credit risk, it is presumed to be the latest point at which lifetime ECL should be recognised through a shift to Stage 2 or Stage 3.

revenue is calculated based on the lower net amortised cost carrying amount (ie the gross carrying amount adjusted for the loss allowance).

The FASB approach, by contrast, does not distinguish provisioning according to stages. Instead, the full lifetime ECL are recognised in provisions from the time of origination (Table 1).

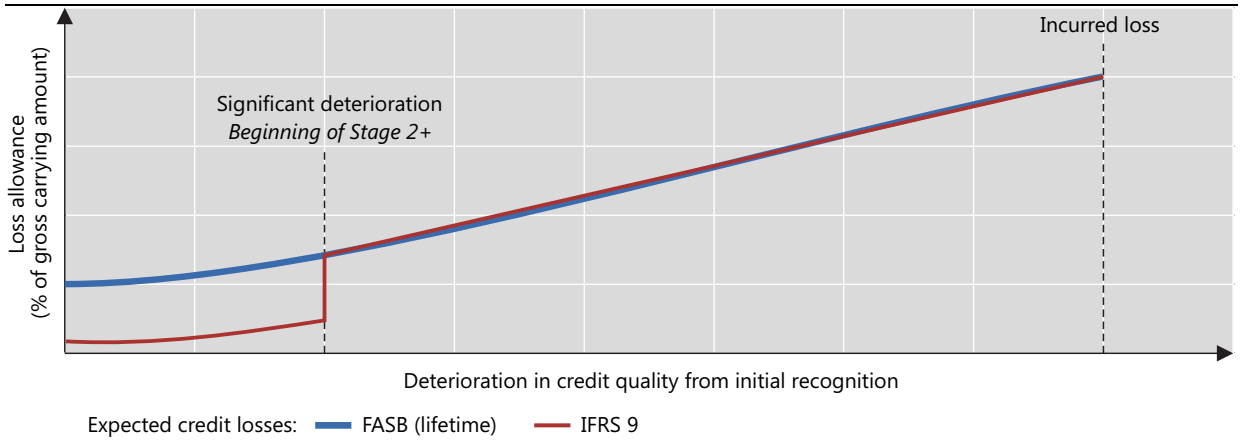
Since lifetime ECL are recorded for all exposures, the recognition of credit losses is expected to be earlier and more significant under the FASB approach, compared with the IASB approach, where only the 12-month ECL are recognised in Stage 1 (Graph 1).

This would result in lower provisions under the IASB standard for loans that have not yet suffered significant deterioration in credit quality (Stage 1). The two approaches converge in utilising lifetime credit losses only once significant credit deterioration occurs.

A second key IASB-FASB difference involves income recognition on problem loans. IFRS 9 continues to allow banks to book the accrual of interest income on non-performing loans even if the bank is not receiving some or all of the cash income due on the loan. By contrast, the FASB standard allows a bank or other creditor to use existing accounting methods for recording payments received on non-accrual assets, including a cash basis method, a cost recovery method or some combination of both. Since the accrued interest could be overstated and unreliable, the cash basis method and the cost recovery method are widely recognised as being more conservative

Cumulative loss allowance (ECL approach) and credit quality under IFRS 9 and FASB rules[1]

Graph 1



[1] Adapted from IASB (2013).

Source: IASB (2013).

Box A

Key aspects of the BCBS supervisory guidance, 2015

The BCBS supervisory guidance contains eight principles for banks on robust governance, methodologies, credit risk rating processes, experienced credit judgment and allowance adequacy, ECL model validation, common data and risk disclosures. The BCBS also has three principles calling for supervisors to adequately evaluate credit risk management, ECL measurement and capital adequacy.

In discussing the principles in the supervisory guidance, the BCBS highlights that banks must maintain sound corporate governance over their credit risk management and ECL estimation processes. Sound bank methodologies for assessing credit risk and estimating ECL should cover all lending exposures, including for restructured and credit impaired loans, should be subject to independent reviews, and must go beyond historical and current data to consider relevant forward-looking information. Clear roles and responsibilities for model validation are needed along with adequate independence and competence, sound documentation and independent process review.

The BCBS further stresses that supervisors should assess credit risk management, ECL measurement and factor these into their assessment of banks' capital adequacy. In doing so they may make use of the work performed by banks' internal and external auditors in reviewing banks' credit risk assessment and ECL measurement functions.

approaches to interest income recognition for non-performing loans.[14, 15] Some observers have expressed concern that allowing banks to continue to recognise income on non-performing loans, coupled with inadequate loan loss provisioning and delayed loan write-off practices, has provided disincentives for banks in countries following IFRS to reduce their excessive levels of non-performing loans.[16] In September 2016, these concerns prompted the European Central Bank (ECB) to propose including information on both accrued interest income on non-performing loans and the "cash interest income received" (similar to non-accrual treatment) for non-performing loans for supervisory reporting purposes as well as public disclosure.[17]

In December 2015, the BCBS published its final supervisory guidance to address how ECL accounting approaches should interact with a bank's overall credit risk management practices. It expresses the Committee's support for the use of ECL approaches and encourages their application in a manner that will provide incentives for banks to follow sound credit risk management and robust provisioning practices.[18] The guidance is intended to complement, not replace, the relevant

[14] Under the cash basis method, a bank would not accrue interest income for a non-performing loan but would instead record income only for interest payments received in cash from the borrower. Under the cost recovery method, typically all payments received by the bank would be applied to reduce the principal on the loan and, only after that has been fully repaid, would any further payments be reflected as interest income.

[15] IFRS 9 also includes more extensive guidance on write-offs than IAS 39 by requiring write-offs when the bank has no reasonable expectation of recovering a financial asset in its entirety or a portion thereof (and related disclosures), although it does not specify the number of days past due or other information often considered by banks as a basis for loan write-offs. Generally, the FASB CECL standard allows bank write-offs to continue to be made under banking practices for writing off uncollectible loans – practices that have been shaped in large part by US supervisory guidance and practice.

[16] For example, IMF (2015).

[17] European Central Bank (2016).

[18] BCBS (2015).

Differences between IASB and FASB ECL approaches and Basel capital models Table 2

Performing assets and underperforming assets (with a significant increase in credit risk)				
		IASB	FASB	Basel Committee
PD	Measurement period	12 months (Stage 1) Lifetime (Stages 2–3)	Lifetime	12 months
	Cycle sensitivity	Point-in-time, considering forward-looking information, including macroeconomic factors		Economic cycle
LGD/EAD	Measurement	Neutral estimate, considering forward-looking information, including macroeconomic factors		Downturn estimate

Source: BCBS (2016c).

accounting standards and it encourages robust implementation by banks and thorough supervisory review (see Box A).

The BCBS notes that banks may have well established regulatory capital models for the measurement of expected losses. However, while these models may be used as important starting points for estimating ECL for accounting purposes, regulatory capital models may not be directly usable without adjustment in the measurement of accounting ECL, given their different objectives and inputs (Table 2). For example, the Basel capital framework's expected loss calculation for regulatory capital differs from accounting ECL in that the Basel capital framework's probability of default (PD) may be "through the cycle" and is based on a 12-month time horizon. Another difference is that loss-given-default (LGD) in the Basel capital framework reflects downturn economic conditions, while in the accounting framework it is intended to be neutral to the business cycle.[19]

The transition: banks' progress in implementation

The IASB standard is mandatorily effective for annual periods beginning on or after 1 January 2018, although earlier adoption is permitted. The FASB rules become effective from 2020 for listed companies and 2021 for all other firms.

In 2016, global surveys by major accounting firms and other organisations noted that, despite progress by banks in implementing the IFRS 9 standard, considerable work remains. For example, Deloitte's Global Banking IFRS Survey captured the views of 91 banks – 15 from the Asia-Pacific region, seven from Canada, and 69 from Europe, the Middle East and Africa – including 16 global systemically important financial institutions (G-SIFIs).[20] Similar surveys were performed by

[19] Under both IASB and FASB ECL standards, the use of a PD/LGD method to measure ECL is not required and other methods can be used (eg a loss rate method).

[20] Deloitte (2016).

PricewaterhouseCoopers UK (PwC), which surveyed 43 institutions in 10 countries,[21] and Ernst and Young. In November 2016, the European Banking Authority (EBA) published its report on the IFRS 9 implementation progress of over 50 financial institutions across the European Economic Area.[22] Barclays (2017) estimated the impact of IFRS 9 on capital and provisions in Europe from a careful examination of disclosures by 28 large European banks.

One key finding was that many banks are still assessing the impact. In the Deloitte survey, 60% of banks either did not disclose or could not quantify the transition impact. In the PwC survey, 30% did not yet have an indication of the impact.

Of the banks who did estimate impacts, the majority in the Deloitte survey estimated that total loan loss provisions would increase by up to 25% across asset classes. In the PwC survey, 19% of respondents expect an increase of 0–10%, while 32% expect an increase between 10–30%. These were in line with the findings of the EBA, which estimated an increase of 18% on average and up to 30% for 86% of respondents. Barclays estimates an increase of about one third for the typical bank in its sample, mostly from the recognition of lifetime ECL for loans in Stage 2.

The estimated corresponding decrease in capital is relatively moderate. In the Deloitte survey, 70% of respondents anticipate a reduction of up to 50 bp in core Tier 1 capital ratios. However, most banks do not yet know how their regulators will incorporate the allowance estimates into regulatory capital definitions. The EBA reported that, while quantitative estimates provided by survey respondents were

Box B

Capital adequacy in the transition

While supporting ECL provisioning standards, the BCBS is considering the implications for regulatory capital.① One concern is that the impact of ECL provisioning could be significantly more material than currently expected and result in an unexpected decline in capital ratios. The two-year difference between the IASB and FASB implementation dates could also raise level-playing-field issues.②

With these concerns in mind, in October 2016, the BCBS released a consultative document that proposed to retain for an interim period the current regulatory expected loss (EL) treatment of provisions under the standardised and the internal ratings-based (IRB) capital approaches for credit risk. In addition, the BCBS requested comments on three possible transition approaches to allow banks time to adjust to the new ECL accounting standards.

- Approach 1: Day 1 impact on Common Equity Tier 1 (CET1) capital spread over a specified number of years;
- Approach 2: CET1 capital adjustment linked to Day 1 proportionate increase in provisions; or
- Approach 3: Phased prudential recognition of IFRS 9 Stage 1 and 2 provisions.

The BCBS mentioned that its current preference is for Approach 1 because it directly addresses a possible "capital shock" in a straightforward manner. Nevertheless, comments on Approaches 2 and 3 were encouraged because they consider the ongoing evolution of ECL provisions during the transition period and not just the impact at the date of adoption of ECL accounting on banks' provisions and CET1 capital. Once finalised, any transition approach would be accompanied by related Pillar 3 disclosure requirements.

① BCBS (2016c, 2016d). ② As previously mentioned, IFRS 9 will be effective in 2018 and the FASB's CECL standard will be effective starting in 2020 for listed companies and 2021 for all other firms.

[21] PricewaterhouseCoopers UK (2016).

[22] European Banking Authority (2016).

Box C

Enhanced risk disclosure needed during the transition period to IFRS 9

The importance to market confidence of useful disclosure by financial institutions of their risk exposures and risk management practices has been underscored during the GFC and its aftermath. At the FSB's request, the Enhanced Disclosure Task Force (EDTF) recommended disclosures to help market participants understand the upcoming changes to ECL approaches and to promote consistency and comparability.① The EDTF's report, published in December 2015, found that investors and other financial report users want to understand the specific reasons for any changes at transition in ECL loan loss provisions compared with the existing approach and the ongoing drivers of variability in credit losses.②

The EDTF recommended that a gradual and phased approach during the transition period would be most useful to users by giving them clearer insights, as implementation progresses, into the likely impacts of the new ECL standards and to allow users to make useful comparisons between banks. The initial focus should be on qualitative disclosures but quantitative disclosures – including the impact on earnings and capital of ECL approaches – should be added as soon as they can be practicably determined and are reliable but, at the latest, in 2017 annual reports for banks following IFRS. For example, the EDTF recommends banks following IFRS should provide:

- **qualitative disclosures** about general ECL concepts, differences from the current approach, and implementation strategy, starting with 2015 and 2016 annual reports;
- **qualitative disclosures** about detailed principles, governance organisation and capital planning impact starting with 2016 annual reports; and
- **disclosure of quantitative assessments** of the impact of adoption of the ECL approach starting when practicable and reliable but, at the latest, in 2017 annual reports.

In addition, the EDTF recommended that the granularity of disclosures should improve each year during this transition period. When IFRS 9 becomes effective, banks would provide the required ECL disclosures.③

① The FSB convened the EDTF in May 2012 to develop principles for improved bank disclosures and identify leading practice risk disclosures. The EDTF comprised senior officials and experts representing financial institutions, investors and analysts, credit rating agencies and external auditors. In October 2012, it reported recommendations to the FSB (EDTF (2012)), which were welcomed by the G20 Leaders, the FSB and the chairs of the IASB and FASB. ② EDTF (2015). ③ A similar approach, adjusted for the applicable transition period years, would be used for banks subject to US GAAP, including the FASB's CECL standard.

preliminary, CET1 and total capital ratios would fall, on average, by 59 bp and 45 bp respectively. CET1 and total capital ratios are estimated to fall by up to 75 bp for 79% of respondents. Barclays translates its increase in provisions to an average fall in capital of about 50 bp. Supervisors are exploring ways to ease the burden of adjustment as banks boost their capital ratios (Box B).

The surveys pointed to a need for further work on modelling, data and implementation. Overall data quality and the availability of the origination lifetime PD were the biggest data concerns for most banks. Total estimated programme budgets continued to increase. However, Deloitte found that more than three quarters of these budgets had yet to be spent, less than two years before the IFRS 9 effective date, and that almost half of surveyed banks did not have enough technical resources to complete the project. The EBA found that the involvement of some key stakeholders, which in general included senior credit risk experts, audit committees and the board of directors, seemed limited.

Deloitte asked its respondents how IFRS 9 would affect their pricing strategies for mortgages, corporate loans and other products. Most self-described "price makers" expect that it will have an impact on product pricing, while self-described "price takers" still think that this is unlikely. The divergent views suggest some scope for uncertainty and experimentation.

On disclosure, Ernst and Young, which surveyed 36 top-tier financial institutions worldwide in 2016, found that "most banks expect to disclose a first quantitative impact assessment to the markets during 2017." Of the 36 surveyed banks, 28 have already implemented the EDTF's 2012 recommendations but only 23 plan to implement the EDTF's recommended ECL disclosures. Despite IAS 8 requirements and the 2015 EDTF recommendations for improved ECL transition disclosures, over 40% of banks do not plan to disclose quantitative information before 2018.[23] See Box C for a further discussion.

The steady state: impact on the financial system

As discussed above, a number of academic studies have found that more prompt loss recognition, measured over a variety of data sets and indicators, reduces the procyclicality of bank lending. Would the new FASB and IASB approaches achieve this goal?

Some observers are sceptical. Barclays (2017), for example, suggests that a "typical" recession may reduce European bank CET1 ratios by an average 300 bp, which would probably lead to a cut-back in lending. The Barclays analysts focus on the "cliff effect" in the IFRS framework, where the shift from a one-year expected loss in Stage 1 to a lifetime loss in Stage 2 would force a sharp increase in provisions in the early stages of a downturn. By contrast, the incurred-loss approach, while delaying recognition to the later stages of a typical recession, would allow banks to accumulate an additional buffer stock of capital through retained earnings before the needed provisions are taken.

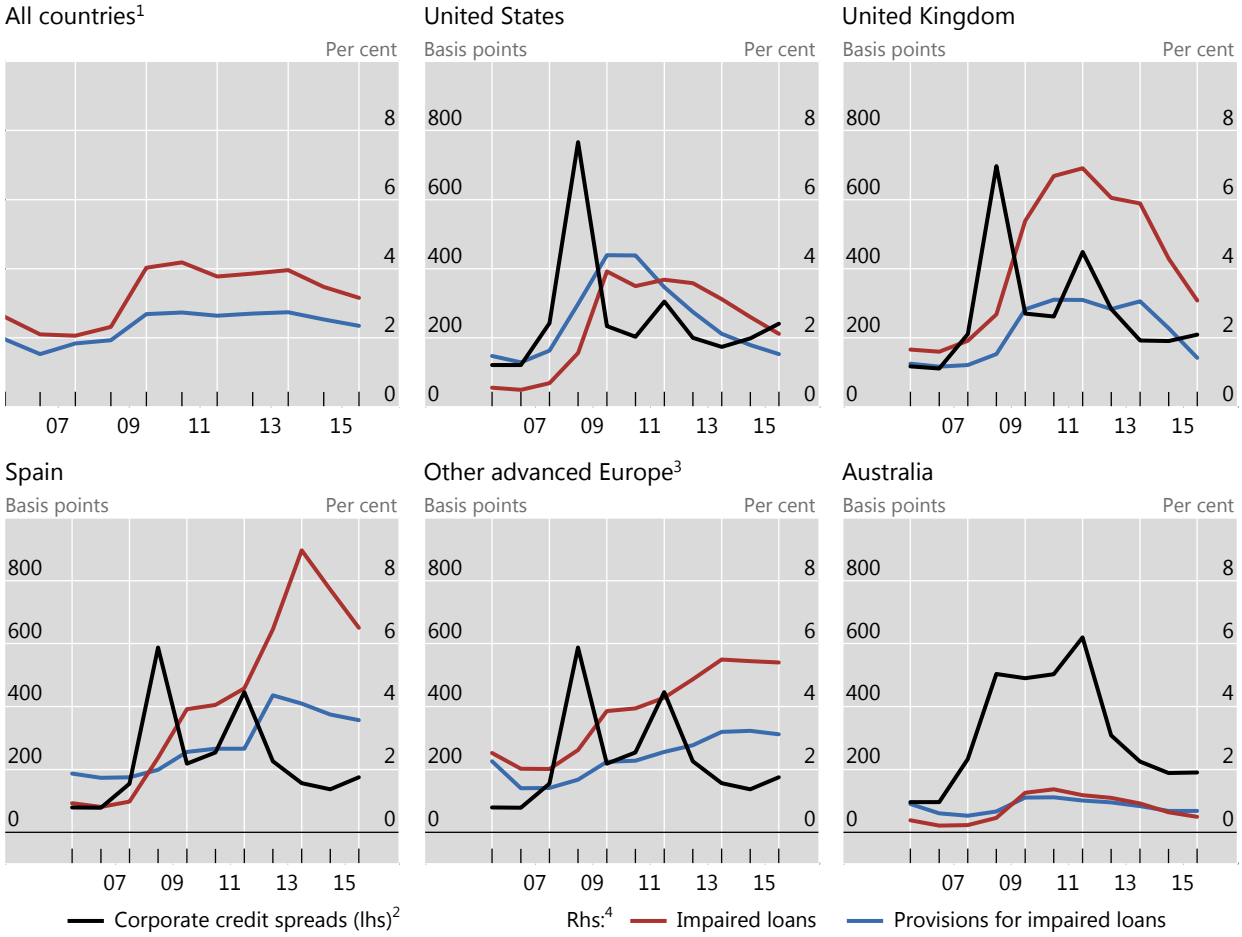
Against this, a number of points can be made. First, there is no guarantee that banks accumulate the needed provisions even as expected losses grow. Indeed, many banks continued to pay dividends throughout the GFC despite apparent capital shortfalls. Early loss recognition would accelerate the process of balance sheet clean-up so that banks are in a better position to support a recovery. Second, post-crisis regulatory efforts have focused on building capital buffers to the point that, even once they are reduced in a downturn, the bank would remain a going concern. According to BCBS (2016b), large ("Group 1") banks maintained fully phased-in Basel III CET1 ratios of 11.8% at end-December 2015, well above the target level (including the capital conservation buffer) of 7%. These buffers ought to be large enough to absorb shocks related to forward-looking provisioning; if they are not, this would call for capital buffers to be strengthened, not for provisioning to be delayed. And third, the provisioning rules (in combination with the strengthened regulatory and supervisory framework) are designed to reduce the build-up of loans in the upturn phase of the cycle. This should reduce the capital cost of an increase in provisions when the cycle starts to turn.

The experience of bank provisioning and impairments in the GFC and subsequent European sovereign debt crises offers some insight into these patterns (Graph 2). Across most countries and regions, both loan loss provisions (blue lines) and the stock of impaired loans (red lines) peaked a year or two after market signals of heightened credit risk (for example, the black lines that represent corporate credit

[23] Ernst & Young (2016).

Loan loss provisions and impaired loans as a share of gross loans

Graph 2



[1] All countries shown or listed, as well as BR, CA, CN, IN, JP, KR, MM, MX, MY, RU, SG, TW and ZA. [2] Option-adjusted spreads on an index of BBB-rated non-sovereign debt; end-year data. [3] AT, BE, CH, DE, DK, FR, GR, IE, IT, NL, NO, PT, SE and SI. [4] As a percentage of gross loans; asset-weighted averages.

Sources: Bank of America Merrill Lynch; Fitch Connect; authors' calculations.

spreads).[24] Provisions and impaired loans need not coincide – provisions are set against credit losses, which typically fall short of the full carrying value of the loan. For example, a bank might judge some portion of the impaired loans will be recovered, depending on the quality of the underlying assets and/or collateral. It is notable, however, that the relationship between loan loss provisions and impaired loans varies sharply across countries and regions. In Spain, for example, the statistical provisioning policy boosted provisions above impaired loans ahead of the two crises, but the subsequent rise in impaired loans was nevertheless well ahead of what had been set aside earlier.

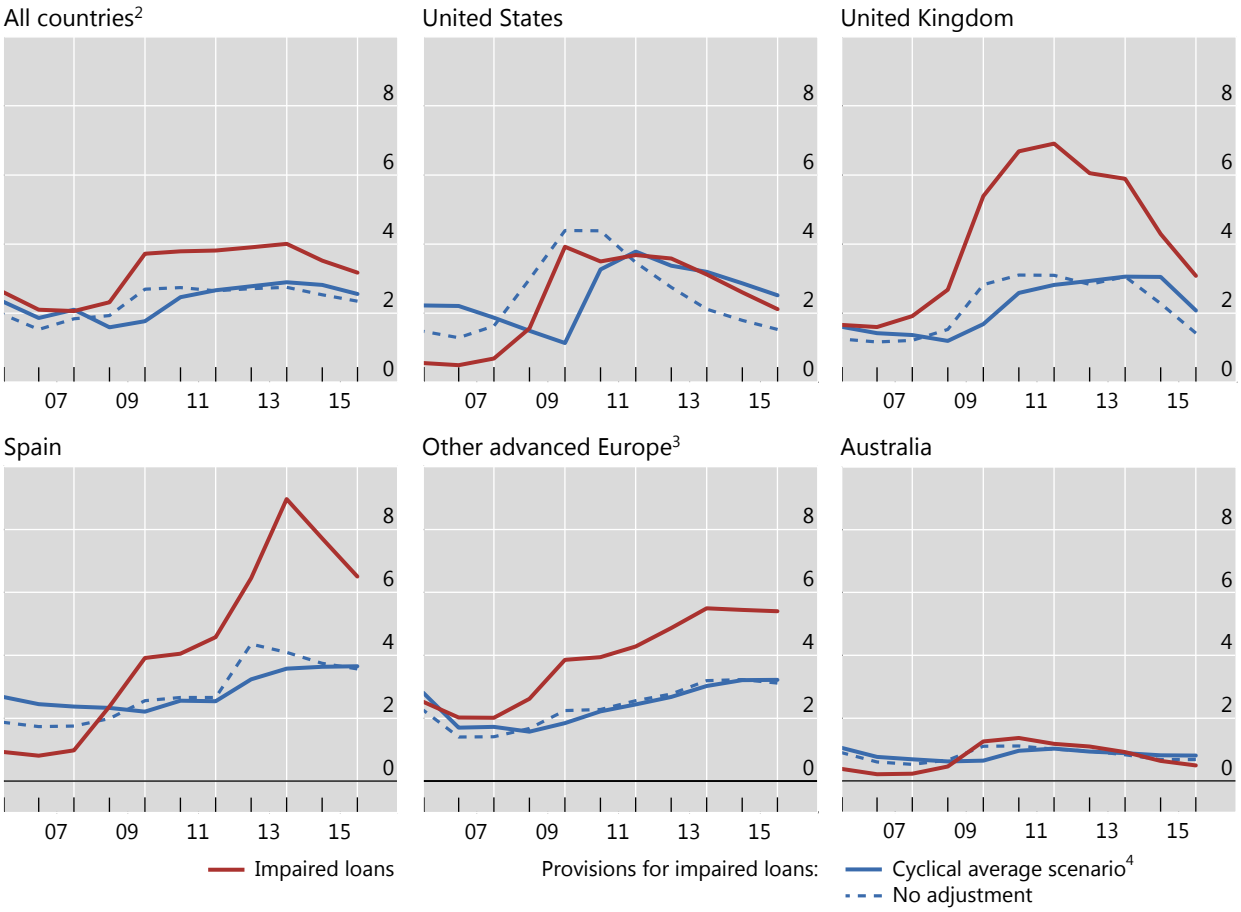
How would the picture have differed if more forward-looking provisioning rules had been in place? Graphs 3 and 4 illustrate the outcomes of two exercises that attempt, imperfectly, to answer this question.

[24] The graph shows ratios for a sample of roughly 100 large global banks from both advanced and emerging market economies, weighted by total assets. The sample was confined to institutions with more than $150 billion in total assets and where loans were at least 20% of assets.

Loan loss provisions and impaired loans as a share of gross loans[1] under a cyclical average scenario

In per cent

Graph 3



[1] Asset-weighted averages. [2] All countries shown or listed, as well as BR, CA, CN, IN, JP, KR, MM, MX, MY, RU, SG, TW and ZA. [3] AT, BE, CH, DE, DK, FR, GR, IE, IT, NL, NO, PT, SE and SI. [4] See text.

Sources: Bank of America Merrill Lynch; Fitch Connect; authors' calculations.

In Graph 3, we develop a "cyclical average" scenario. For each bank in our sample, we have calculated the average amount of provisions taken each year, as a share of loan growth, and we have then augmented (or reduced) each year's level of provisions by the difference between this average and those made in a given year. Thus, the annual impairment charge is reduced in years when provisions were high (namely those in the immediate aftermath of the crisis) and increased in years when provisions were low (namely the years preceding and well after the crisis). This is intended to produce a provisioning series resembling one that would have occurred had provisions been based on modelled ECL, where the behaviour of credit losses throughout the business cycle is accounted for in the relevant model.

The outcome is a revised series of provisions (blue lines in Graph 3). Loan loss provisions would have increased substantially ahead of the crisis for key countries under this scenario: for the US banks, for example, they would have risen from 1.3% of gross loans in 2006 to 2.2% – not a large increase, but a material one. Provisions under this scenario would have fallen from 4.4% of gross loans in 2009 to 1.1% of gross loans, possibly reducing the post–crisis "credit crunch". For the European banks,

provisions would have risen from 1.4% to 1.7% before the crisis, and would have fallen by a relatively small amount during the crisis years of 2008–09 and 2011–12.

A second scenario is illustrated in Graph 4. Here we have simply assumed that banks took provisions (as a share of gross loans) two years earlier than they did. The outcome is similar to the first exercise. For US banks, provisions rise even more sharply than in our "cyclical average" experiment, rising to 3.8% in 2006, corresponding to the sharp rise in provisions that instead took place immediately after the crisis. For other countries and regions, the impact is more muted.

The increased provisions likely would have resulted in lower lending ahead of the crisis. A number of studies (Bernanke and Lown (1991), Gambacorta and Shin (2016), Kishan and Opiela (2000, 2006), Cohen and Scatigna (2016)) have established that bank capitalisation has a significant impact on lending behaviour, suggesting that, to the extent that the provisions were taken out of capital, this would have dampened subsequent lending. The size of the estimated effect varies; a 1 percentage point increase in the common equity-to-assets ratio has been associated with subsequent

Loan loss provisions and impaired loans as a share of gross loans[1] under an early-provisioning scenario

In per cent

Graph 4

[1] Asset-weighted averages. [2] All countries shown or listed, as well as BR, CA, CN, IN, JP, KR, MM, MX, MY, RU, SG, TW and ZA. [3] AT, BE, CH, DE, DK, FR, GR, IE, IT, NL, NO, PT, SE and SI. [4] See text.

Sources: Bank of America Merrill Lynch; Fitch Connect; authors' calculations.

increases in lending growth of 0.6% (Gambacorta and Shin (2016)) to 0.9% (Cohen and Scatigna (2016)).[25] Beatty and Liao (2011) find an impact of 0.4% during economic expansions, rising to 1.1% during recessions, with the effects varying by bank size. A more rigorous analysis would be needed to understand how our scenarios for changed provisioning behaviour would have translated into changes in credit.

Both of these scenarios, of course, assume an unusually strong capacity for foresight among banks, almost all of which were caught unaware by the size of loan losses during the crisis. But the exercises illustrate how relatively small shifts in the timing of provisions can have a significant impact on the capacity of banks to absorb losses in crisis episodes, and can affect patterns of loan growth both before and after financial crises.

Conclusions

The new ECL provisioning standards are intended to induce a major change in how banks approach and manage credit risk. While provisions may increase significantly for some banks, the regulatory capital impacts in the transition to the new regime appear likely to be relatively limited (and may be further dampened by supervisors). In future, banks will be asked to examine the nature, likelihood and timing of the risks embedded in their lending decisions, and to reflect this assessment in their financial statements as soon as a loan is made. If this assessment is performed appropriately and with the full range of future risks in mind, this should reduce the procyclicality of the financial system.

The effectiveness of the new standards will depend not only on how banks implement them, but also on the contributions of central banks, supervisors and other stakeholders.[26] Based on their experience during financial crises, central banks and banking supervisors have a strong interest in promoting the use of sound credit risk and provisioning practices by banks. Supervisors also expect banks to provide useful public disclosures about credit risk exposures, credit risk management, provisioning and related matters to bring about a higher degree of transparency that facilitates market discipline and promotes market confidence.[27] Central banks and other prudential authorities can also play a very important role in promoting sound bank implementation practices through their banking supervisory activities in a manner that complements the efforts of accounting standard setters.[28]

At the same time, it will be necessary to consider how to achieve important transparency goals and prudential objectives while also reducing the regulatory

[25] More precisely, Cohen and Scatigna (2016) find that a 1 percentage point higher capital ratio for banks in their sample at end-2009 was associated with 2.83 percentage points faster asset growth over the subsequent three years.

[26] For a more extensive discussion of how central banks and other prudential authorities can encourage robust implementation practices, see Edwards (2016).

[27] BCBS (2015).

[28] These supervisory activities focus on encouraging *sound implementation practices* and not on developing accounting standards or interpretations. As such, they do not infringe on the roles and independence of accounting standard setters. In our experience, such carefully developed, sound activities focusing on enhanced practices are appreciated by accounting standard setters and securities regulators.

burden associated with ECL provisioning. At a time when the BCBS has been exploring ways to reduce undue dependence on models in the capital adequacy framework, ECL standards may require more use of models for accounting purposes.[29] The IASB, supervisors, banks and auditors should explore how to achieve the transparency principles underlying IFRS 9 and the robust credit risk management and provisioning practices desired by the BCBS, while at the same time reducing any unnecessary burden on banks, including smaller institutions.

The role of auditors will also be critical. Authorities can encourage auditors to achieve a greater understanding of IFRS 9 as well as related implementation efforts and supervisory guidance. Supervisors should gain a better understanding of auditor roles, meeting with them when appropriate. This could be helpful in encouraging an improvement in the quality of bank auditor practices.[30]

For these important stakeholders to perform their roles, the new provisioning frameworks will need to be fully assimilated and understood. Models will need to be validated and regularly reviewed. Complex data will need to be compiled and maintained. Disclosure practices will need to reinforce prudent risk measurement and management through market discipline. Survey results indicate a need for central banks and other prudential authorities to become more active in encouraging banks to devote more resources to implement ECL provisioning requirements in a more robust, consistent and transparent manner. New, forward-looking thinking will be needed for a new era.

[29] For example, a recent consultative document sets out the BCBS's proposed changes to the advanced internal ratings-based approach and the foundation internal ratings-based approach. The proposed changes envisage complementary measures, including the elimination of certain model-based approaches, that aim to (i) reduce the complexity of the regulatory framework and improve comparability; and (ii) address excessive variability in the capital requirements for credit risk (BCBS (2016a)).

[30] It is very important that auditors understand the accounting requirements and supervisory guidance, and that supervisors fully understand the role auditors play when determining whether they should "rely" on their work, in whole or in part. Key publications of the international audit standard setter (IAASB (2016)), the Basel Committee (BCBS (2012, 2014)) and the International Forum of Independent Audit Regulators (IFIAR (2016)) could help supervisors and auditors address these issues and promote improved auditor practices in this area.

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The quest for speed in payments[1]

This feature looks at technology in payment systems. It compares the diffusion of real-time gross settlement (RTGS) systems for wholesale payments with that of faster systems for retail payments (fast payments). RTGS systems emerged in the 1980s and were adopted globally within a span of 30 years. Fast payments followed in the early 2000s, offering instant payments on a 24-hour, seven-day basis. So far, the diffusion of fast payments mirrors that of RTGS, and it is primed to take off. Yet even while adoption of fast payments is under way, the next generation of payment systems, such as those based on distributed ledger technology, is under development.

JEL classification: E58, G20, O30.

Mankind has always been in pursuit of speed. In track and field, Jamaican superstar Usain Bolt rules the 100 metre sprint as the fastest man in the world. In the pool, American great Katie Ledecky continues to smash world records. In Formula One, Dutch sensation Max Verstappen is upending the established order and exciting fans with phenomenal speed.

A similar quest is evident in payments. Throughout history, people have worked to accelerate the speed of payments for finance and commerce through the adoption of new technologies, big and small. The use of a simple ledger in the Middle Ages allowed the transfer of credit on the books of a money changer – the precursor of deposit banks (Kohn (1999)). The introduction of the telegraph revolutionised communications and enabled financial institutions to communicate instantly. Electronification and digitalisation in the modern era allowed automation. Few may recall that, before the 1980s, credit card transactions required phone authorisation and imprinting of cards on paper slips.

This quest continues today. Real-time gross settlement (RTGS) systems emerged in the 1980s to speed up wholesale payments and are now the standard around the world. More recently, faster systems for retail payments (fast payments) have emerged. These systems generally allow payees to receive funds within seconds of the payer initiating the payment, anytime and anywhere. A day or more to pay another person used to be acceptable, but in today's fast-paced environment this seems like an eternity. Consumers, who are used to instant communication via e-mail and social media, now expect the same experience when it comes to payments.

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This article looks at two of the latest leaps forward in speed. Drawing in part on a recent report on fast payments by the Committee on Payments and Market Infrastructures (CPMI),[2] it compares how RTGS and fast payments have spread around the world. The pattern of diffusion of fast payments is remarkably similar to the move to RTGS for wholesale payments two decades earlier. Like RTGS, fast payments are primed for take-off 15 years after the first implementation. The feature also looks to the future of payments, drawing on two other CPMI reports on distributed ledger technology and digital currencies.

Emergence of fast (retail) payments

Payments are transfers of monetary value from payers to payees, usually in exchange for goods and services or to fulfil contractual obligations. They come in many forms and sizes. *Wholesale payments* are high-priority and typically large-value transfers that are made between financial institutions for their own accounts or on behalf of their customers. Wholesale payments are usually settled via dedicated interbank settlement systems. In contrast, *retail payments* are lower-value transactions between individuals, businesses and governments in such forms as cash, cheques, credit transfers, and debit and credit card transactions.

An important distinction between wholesale and retail payment systems has traditionally been the speed of settlement finality.[3] It typically took a day or more for a payee to receive funds using a traditional retail payment system, and for some systems payments were revocable within a certain period, adding an element of uncertainty. Hence, time-sensitive payments (even lower-value ones) were directed via the interbank payment system because of its ability to credit and debit accounts with real-time finality.

The speed of retail payments is now immediate in some countries thanks to improvements in information and communication technologies, including the ubiquity of smartphones and the internet. Fast payments provide retail funds transfer "in which the transmission of the payment message and the availability of 'final' funds to the payee occur in real-time or near real-time on as near to a 24/7 basis" (CPMI (2016b)). Further, this feature focuses on *open systems*, where end users can use any number of intermediaries, such as payment service providers (PSPs) and banks, to access the payment system.[4] (See the box for how fast payments work and examples of fast payment systems.)

[2] The CPMI is a BIS-based committee of senior central bank officials that promotes the safety and efficiency of payment, clearing, settlement and related arrangements (www.bis.org/cpmi/).

[3] *Settlement finality* is defined as the point when the irrevocable and unconditional transfer of an asset occurs.

[4] *Closed systems* provide payment services to only their customers, and credits and debits occur on their own books. Closed systems often have limitations on the coverage of users within a market or jurisdiction, which is a key element to the successful adoption of new payment services.

How do fast payment systems work?

A defining characteristic of a fast payment system is the ability to complete a payment almost immediately and at any time. To achieve this outcome, all fast payment systems require immediate clearing① between the payment service providers (PSPs) of the payer and payee. Funds settlements between the PSPs, however, do not necessarily need to occur immediately for each and every payment order. Payee funds availability and inter-PSP settlement can be either coupled (ie real-time settlement) or decoupled (ie deferred settlement).

In *real-time settlement*, payee funds availability and inter-PSP settlements are coupled, with inter-PSP settlements occurring in real time. In other words, the debiting and crediting of funds from the payer to the payee occur at the same time as associated debiting and crediting of the PSP in the fast payment system. In this model, credit risks between participating PSPs do not arise, but participating PSPs continuously require sufficient liquidity to support real-time settlements of fast payments. Therefore, a system is required to address the possible need for liquidity provision to the participant PSPs in the system, the adequacy of the settlement system's operating hours and associated liquidity facilities. Countries that use this model include Mexico and Sweden.

In *deferred settlement*, payee funds availability and inter-PSP settlements are decoupled, with inter-PSP settlements being deferred with batch settlement. That is, while payer and payee accounts are debited and credited in real time or near real time, the associated settlements between the PSPs are batched and executed at pre-specified times. In this model, credit risk inherently arises for PSPs, as the payee's PSP advances the funds to the payee before inter-PSP settlement takes place. A variety of tools can mitigate this risk, including prefunding of positions, a maximum limit on the net debit or credit position that can be established between PSPs, and collateralisation of debit positions. Countries that use this model include India and the United Kingdom.

Examples of fast payment systems

Mexico – The Sistema de Pagos Electrónicos Interbancarios (SPEI) is the Bank of Mexico's main payment system, providing both wholesale and retail payment services. SPEI was launched in 2004 and provided near real-time retail payments. As of November 2015, the service offers 24/7 availability. Funds are available to the payee in less than 15 seconds for mobile payments and less than 60 seconds for other online payments. Currently, 109 institutions (66 banks and 43 non-banks) participate in SPEI as direct members to provide their customers with fast payment services.

Sweden – BiR/Swish, introduced in 2012, is a real-time settlement system for mobile payments in Sweden. Being a privately owned special purpose institution that conducts settlement in commercial bank money, which in turn is fully backed by funding in central bank money, the system allows real-time settlement of fast payments even during times when other settlement facilities (eg the central bank real-time gross settlement system) are closed. The typical time between payment initiation and availability of final funds to the payee for a successful fast payment transaction is one to two seconds. More than half of the country's population uses the Swish mobile app to make fast payments

India – The Immediate Payment Service (IMPS) went live as a new instant mobile payment system in 2010. The system allows mobile phone subscribers and internet-connected devices to send and receive payments. Payees typically receive funds in less than 30 seconds. The service provides access to fast payments through 190 PSPs. In December 2016, IMPS processed 60.5 million transactions, which represented a 50% increase from the previous month – the largest monthly increase to date – likely driven by the Indian banknote demonetisation directive of November 2016 and the subsequent push from the government to get digital payments adopted nationwide.

United Kingdom – The Faster Payments Service (FPS) is a deferred net settlement system for credit transactions in the form of single, immediate payments, forward-dated payment, or standing orders for households and corporates. The service, which was launched in 2008, allows a payer to initiate a payment simply using the payee's mobile phone number. Funds are typically available to the payee within seconds of the payer initiating the payment transfer. FPS has 10 direct participants, who open up their customer channels to FPS. In December 2016, the service processed 125 million payments totalling £103 billion.

① CPMI (2016b) defines *clearing* as the process of transmitting, reconciling and, in some cases, confirming transactions prior to settlement, potentially including the netting of transactions and the establishment of final positions for settlement.

Sources: CPMI (2016b); publicly available information.

Fast payment systems in selected countries

Table 1

Year	Country	System	Year	Country	System
2001	Korea	Electronic Banking System	2013	Turkey	BKM Express
2003	Chinese Taipei	ATM, FXML and FEDI systems	2014	Denmark	Nets Real-time 24x7
	Iceland	CBI Retail Netting System (JK)		Italy	Jiffy – Cash in a flash
				Singapore	Fast And Secure Transfer
2006	Malaysia	Instant Transfer	2015	Mexico	SPEI
	South Africa	Real-Time Clearing		Switzerland	Twint
2007	Korea	CD/ATM System	2017p	Australia	New Payments Platform
2008	Chile	Transferencias en línea	2017/18p	Saudi Arabia	Future Ready ACH
	United Kingdom	Faster Payments Service	2018p	Hong Kong SAR	To be determined
2010	China	Internet Banking Payment System		Japan	Zengin System
	India	Immediate Payment Service	2019p	Hungary	Instant Payments
2011	Costa Rica	Transferencias de Fondos a Terceros del Sinpe		Netherlands	Instant Payments
2012	Ecuador	Pago Directo			
	Poland	Express ELIXIR			
	Sweden	BiR/Swish			

p = proposed implementation.

Sources: CPMI (2016b); FIS (2015); national central banks.

Fast payment systems began to emerge in the early 2000s. The first system to satisfy both the fast and continuous service availability requirements under the CPMI (2016b) definition was the Korean Electronic Banking System, which went live in 2001 (Table 1). Two other fast payment systems – in Chinese Taipei and Iceland – were implemented in 2003, and Malaysia and South Africa followed three years later. The two most populous countries in the world joined in 2010. Among the major advanced economies, the first to adopt a fast payment system was the United Kingdom in 2008, followed by Italy in 2014. Japan is planning to make its Zengin System, whose end-to-end speed is already real-time, available 24/7 in 2018.

Technology adoption and diffusion

Adoption is the decision to acquire and use a technology, and involves a weighing of costs and benefits. This is seldom straightforward; a significant part of the costs is incurred upfront, while the benefits tend to accrue over time. Moreover, it might be cheaper to adopt tomorrow rather than today, as the cost of technology tends to decrease over time. Matters are further complicated by the fact that the benefits may depend on the number of other adopters of the technology.

The process by which a new technology spreads is known as *diffusion*. According to Rogers (2003), diffusion is how a new technology (innovation) spreads over time and space among members of a social system through various channels. In other words, diffusion is the cumulative result of a series of adoption decisions, which are often implemented under uncertainty and with limited information. If diffusion passes

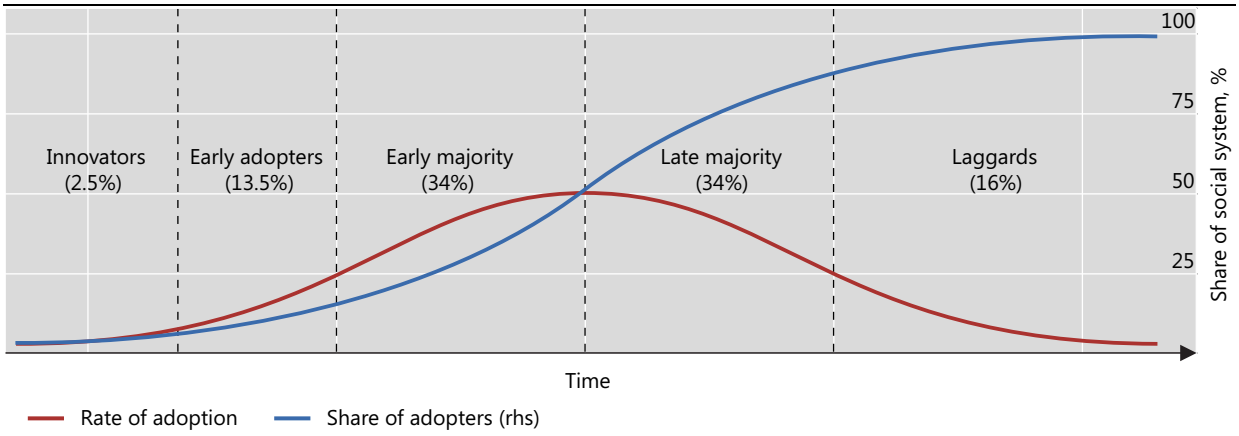
a certain threshold, or critical mass, then the technology is likely to take off and be widely adopted. Failure of a technology to take off is often due to either the inertia of an existing technology or the emergence of a superior one.

Empirical studies of diffusion suggest that the rate of adoption follows a predictable pattern over time (eg Griliches (1957)). The rate is generally slow at first and starts to accelerate if the technology gains traction within the social system. Rapid adoption continues until a substantial share of agents have shifted to the new technology. At this point, the rate of adoption levels off and eventually falls. That is, the rate of adoption tends to follow a bell curve over time and the share of adopters is a sigmoidal, or S-shaped, curve.

Rogers (2003) provides a simple framework to think about diffusion that builds on this stylised fact (Graph 1). It classifies members of the social system into five categories that reflect their "innovativeness", or predisposition to adopt a new technology, based on when they adopt relative to the median adopter. The first two categories are called *innovators* and *early adopters*, respectively. Innovators are enterprising and willing to take risk, and early adopters are often key opinion leaders. Early adopters are critical to whether or not the innovation spreads. In Rogers' framework, the adoption time of the last early adopter corresponds to the first inflection point of the bell curve, ie where the adoption of the technology takes off. The remaining categories are *early majority*, *late majority* and *laggards*.

Technology diffusion in payments is potentially different from other areas, as the adoption decision may involve more than profit maximisation. Payment systems often exhibit significant economies of scale and scope, so that they tend to be owned by either the central bank or an industry association/consortium. A central bank is likely to consider monetary and financial stability issues. And decision-making by an industry association or consortium is often complicated and time-consuming: it may require a catalyst or strong outside impetus.

Rogers' diffusion of innovation model — Graph 1



Source: Rogers (2003).

The diffusion of real-time gross settlement

Prior to the 1980s, wholesale payments typically accumulated over the business day and were settled by netting obligations on the central bank books either at the end of the day or the next morning. This method – known as deferred net settlement (DNS) – significantly reduces the amount of money that needs to change hands but also gives rise to potential settlement risk.[5] If a bank with a net amount due defaults, payments involving that bank may need to be unwound. This implies new net obligations for all other banks. Conceivably, some other bank – expecting incoming funds from the failed bank – may then not be able to meet its new net obligation and may thus fail, potentially setting off a cascade of failures.[6]

With wholesale payment values increasing in the 1980s, a number of central banks became more conscious of the settlement risk involved in large-value funds transfer and its potential financial stability implications. Driven by advances in information and communication technology, central banks shifted to RTGS, where payments are settled immediately one by one.[7] As payments are final and irrevocable, settlement risk is eliminated (eg Borio and Van den Bergh (1993)). In 1985, three central banks had RTGS systems; by 1990, the number was eight – including the Deutsche Bundesbank, the Bank of Japan, the Swiss National Bank and the Federal Reserve.

The adoption of RTGS took off in the mid-1990s in part because it was made a prerequisite for joining the Economic and Monetary Union of the European Union. This led to a flurry of new systems or upgrades to existing ones by eventual euro area members as well as prospective ones (Graph 2, left-hand panel).

Another factor contributing to the take-off was the guidance provided in a number of BIS committee reports that analysed the risks and benefits of netting and RTGS systems.[8] These reports later developed into a set of principles for the design of wholesale payment systems.[9] In turn, these Core Principles for Systemically Important Payment Systems became part of the toolkit of the Financial Sector Assessment Programs (FSAPs) and technical assistance programmes conducted by the International Monetary Fund and The World Bank Group. This supranational impetus – as well as lower implementation costs due to the emergence of several off-

[5] *Settlement risk* is the general term used to designate the risk that settlement in a funds or securities transfer system will not take place as expected. This risk may comprise both credit and liquidity risk. See CPMI (2016a).

[6] Humphreys (1986) found that the failure of a major participant in the New York-based Clearing House Inter-Bank Payments System (CHIPS) could, given the rules at the time, trigger a system-wide crisis. In 2001, CHIPS moved to a so-called "hybrid" settlement system which combines features of DNS and RTGS.

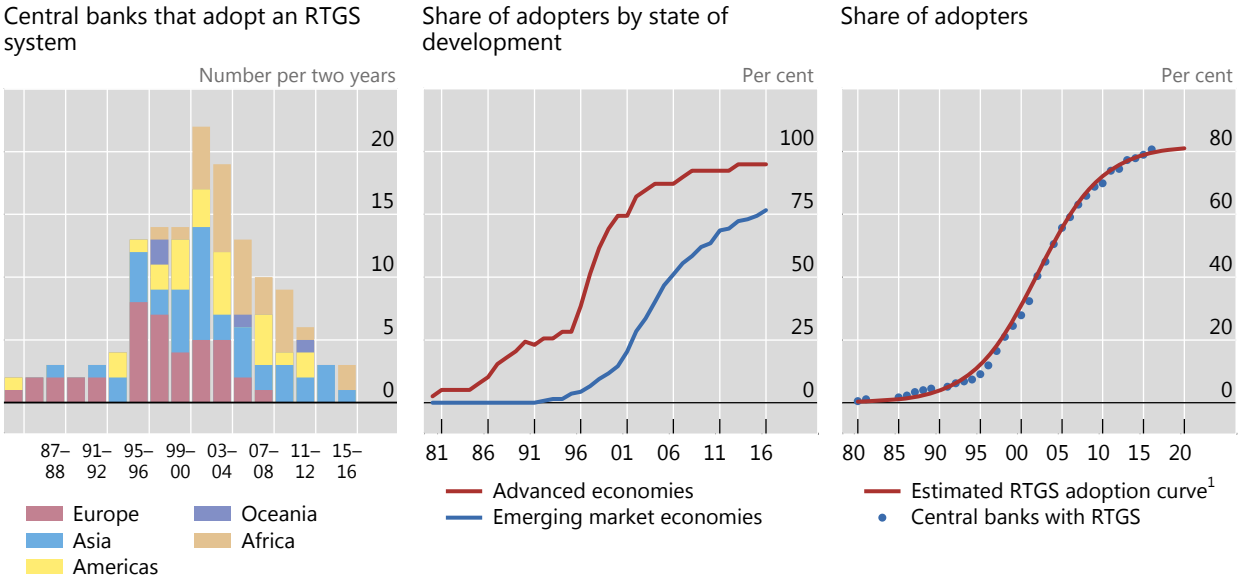
[7] The Federal Reserve's Fedwire Funds Service® is the world's oldest RTGS system. Its origins go back to 1918, when the Federal Reserve created a network of wire communications among the individual Federal Reserve Banks.

[8] Group of Experts on Payment Systems (1989), Committee on Interbank Netting Schemes (1990) and CPSS (1997).

[9] The Core Principles for Systemically Important Payment Systems were later replaced by the principles for financial market infrastructures (CPSS (2001) and CPSS-IOSCO (2012), respectively).

Diffusion of RTGS systems

Graph 2



[1] Using a generalised logistic model.

Sources: Bech and Hobijn (2007); Rogers (2003); national central banks; The World Bank Group; authors' calculations.

the-shelf RTGS solutions – led to the adoption of RTGS systems by emerging market economies from the late 1990s (Graph 2, centre panel).[10]

By 2000, 49 out of 176 central banks worldwide had RTGS systems; and by 2005, all advanced economy central banks had adopted RTGS with the exception of Canada.[11] At the end of 2016 (or some 35 years after "first" implementation), there are only a handful of late adopters (Graph 4). Consistent with models of technology diffusion, the rate of RTGS adoption by central banks followed a bell curve, and consequently the share of adopters takes the form of an S-curve (Graph 2, left- and right-hand panels).

The diffusion of fast payments

Comparing the diffusions of fast payments and RTGS reveals some interesting similarities and differences. Despite taking place about 20 years apart, for example, the diffusion of fast payments is so far surprisingly similar to that of RTGS (Graph 3, left-hand panel).[12] In fact, when put on the same time scale, the two diffusion curves are virtually identical (Graph 3, centre and right-hand panels). This also holds when projecting diffusion five years ahead based on systems under consideration or

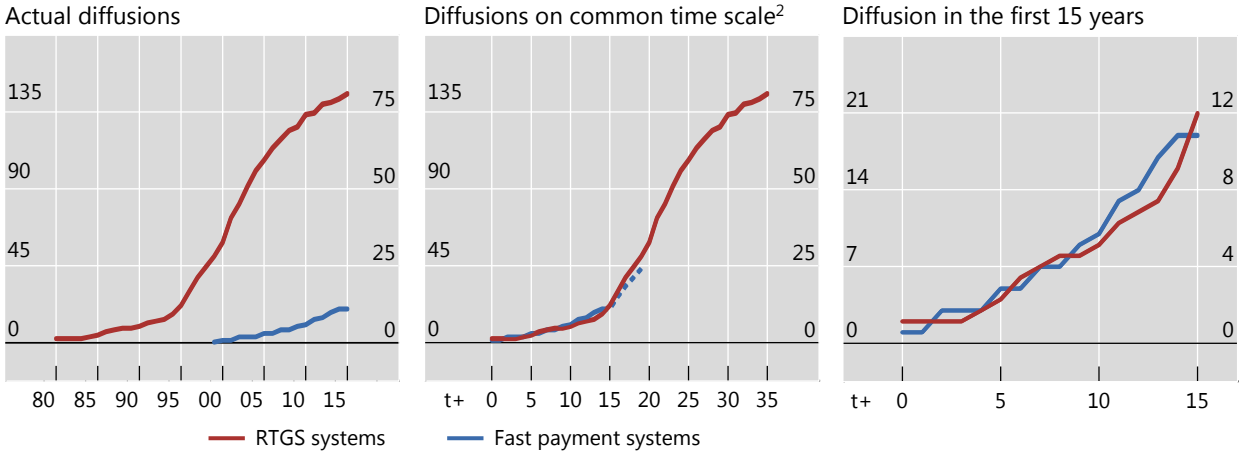
[10] Lester et al (2008) provide a theoretical model of RTGS adoption. They argue that deferred net settlement is less costly due to the higher information and communication technology costs associated with an RTGS environment. If these costs fall, then the settlement risk reduction achieved in an RTGS system may be enough to justify a switch from DNS.

[11] Canada opted for a hybrid system that is considered equivalent to RTGS in terms of settlement risk.

[12] This comparison does not include the US Fedwire Funds Service® that dates back to 1918 (see footnote 7).

Diffusion of fast payment and RTGS systems[1]

Graph 3



[1] Left-hand scale: number of central bank adopters; right-hand scale: adopters as a percentage of total number of central banks. [2] The dashed line corresponds to projected implementation based on public project announcements and assumptions that central banks currently considering a fast payment system would implement one within the next five years.

Sources: Bech and Hobijn (2007); CPMI (2016b); FIS (2015); national central banks; The World Bank Group; authors' calculations.

development. The implementation of fast payments is now at a similar stage to the implementation of RTGS in 1995.

This similarity is in itself somewhat surprising, however. It runs contrary to the perception that the general pace of technology adoption is speeding up (McGrath (2013)). One possible explanation is that adoption of a fast payment system is typically not solely an individual decision. Rather, it tends to be a decision that requires coordination and collective decision-making. This may be slowing diffusion in some cases, even if the technology itself has spread faster. In fact, a common challenge in many countries is to overcome potential coordination issues between different stakeholders.[13]

In contrast to the diffusion of RTGS, fast payment innovators and early adopters are not predominantly advanced economies, and indeed there is no discernible difference in the diffusion of fast payments between emerging market and advanced economies. A possible explanation as to why emerging market economies may be adopting fast payments at a similar rate to advanced economies is the lack of existing electronic retail payment infrastructures. This means that the net benefit of adoption is likely to be higher and the decision-making process may be easier in the absence of well established infrastructures.

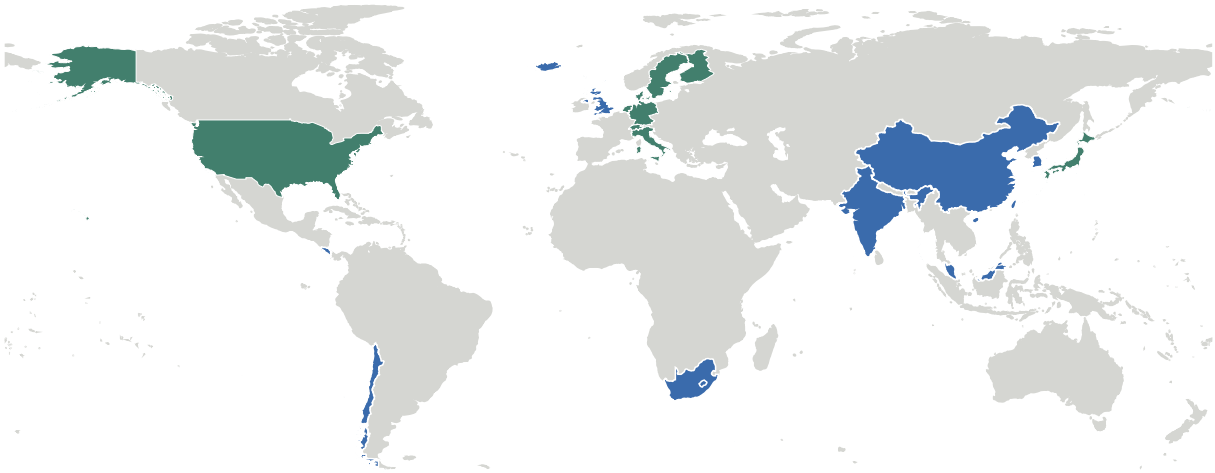
As of the end of 2016 (or 15 years after implementation of the first fast payment system), there were 20 such systems in operation meeting the CPMI (2016b) definition. The countries with these systems cover more than 40% of the world's population – twice that of RTGS systems at the same point in the diffusion of RTGS – and roughly 30% of global GDP – roughly half of where RTGS was.

[13] See CPMI (2016b, pp 27–8).

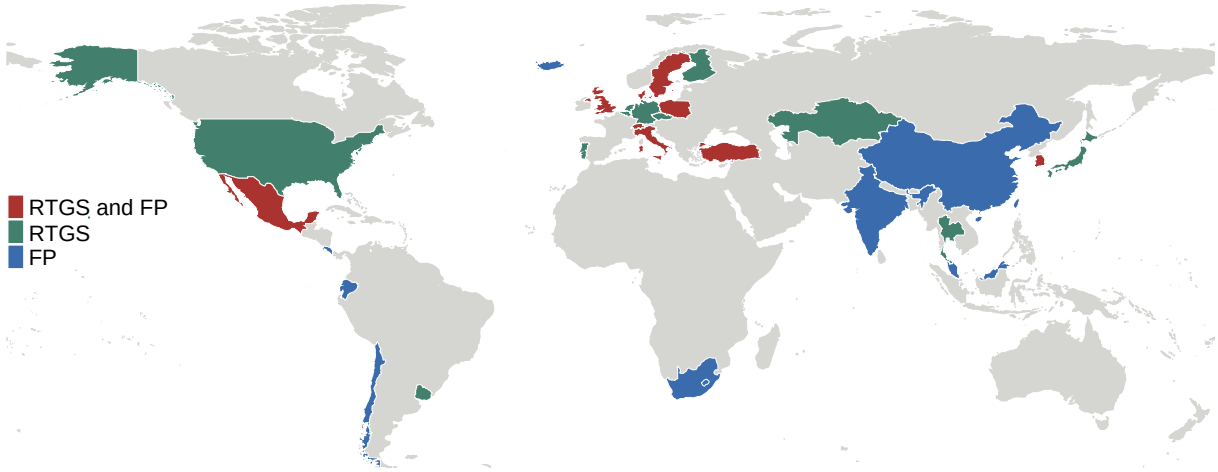
Diffusion of RTGS and fast payment (FP) systems across countries[1]

Graph 4

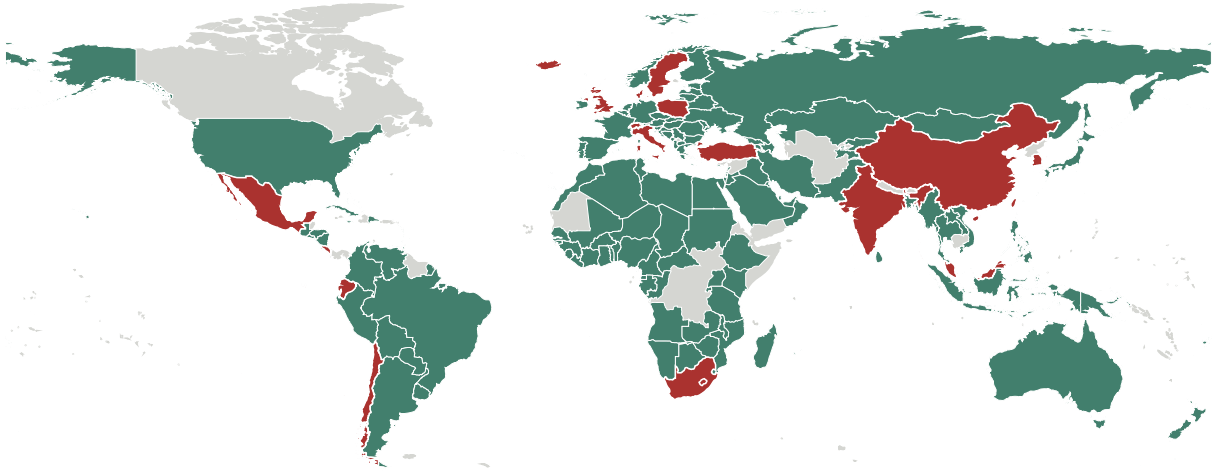
Ten years after implementation



Fifteen years after implementation



Thirty-five years after implementation



[1] For RTGS, 10, 15 and 35 years after implementation reflects 1991, 1996 and 2016, respectively. For fast payments, 10 and 15 years after implementation reflects 2011 and 2016, respectively.

Sources: Bech and Hobijn (2007); CPMI (2016b); FIS (2015); national central banks; The World Bank Group.

Continuing evolution of the payments landscape

As countries progress in implementing fast payments, work is under way to develop technologies and features to enhance the speed of certain types of payment. Unlike RTGS and fast payments, these efforts are not primarily driven by central banks or commercial banks but rather by entrepreneurs, technology firms and venture capitalists. Over the last couple of years, significant investment has gone into financial technology (fintech). A sizeable share has been directed towards payments-related projects – targeting all parts of the payment-processing chain, from user interfaces to clearing and settlement.

One particular technology that is receiving significant attention is *distributed ledger technology* (DLT) – commonly referred to as *blockchain* technology. DLT promises to streamline payment, clearing and settlement processes by, for example, reducing the number of intermediaries and eliminating the need for reconciliation among those that remain.[14] It allows participants in a payment system (or other arrangement) to jointly manage and update a synchronised, distributed ledger. This contrasts sharply with existing payment systems, where a single authority manages a central ledger. In DLT-based payment systems, participants can submit, validate and record transfers on the distributed ledger with little or no need for special intermediaries.

There are three areas where DLT could have a significant impact on the speed of payments. One is the payments associated with the settlement of securities. Today, it typically takes several days after the trade date for the security and the associated payment to change hands. If DLT arrangements could provide real-time or near real-time settlement of the securities and associated funds transfer on the trade date, the cost savings could be significant. It would reduce record-keeping and reconciliation costs, as well as settlement costs, by eg eliminating the use of collateral to guarantee the exchange of securities and cash.

The second area is cross-border payments, which are currently time-consuming. A cross-border payment typically involves the use of a local bank, a foreign bank and one or more correspondent banks. Other intermediaries involved may include financial services or communications companies such as SWIFT or Western Union. By using a distributed ledger, the sender and beneficiary could in principle settle cross-border funds transfers in real time without the need for financial intermediaries. Yet there may be significant barriers to implementing such a solution due to jurisdictional differences in the legal, regulatory and operational frameworks.

The third area is central bank-issued digital currencies. Sveriges Riksbank is studying the issuance of an e-krona as a complement to physical cash (Skingsley (2016)).[15] Several other central banks have also publicly announced internal efforts to study digital currencies for either retail payments or wholesale payments, or both (eg Mersch (2017)). If implemented, the impact would be significant: banks have traditionally played a central role in supporting payments, so that removing them from the centre of this system could reshape banking and, more broadly, the financial markets.

[14] See CPMI (2015) and CPMI (2017).

[15] Although digital currencies in the form of e-money have existed for decades, DLT is slightly different in that it could provide for the possibility of peer-to-peer payments in a decentralised network without the need for a financial intermediary (CPMI (2015)).

Conclusion

Payments are a dynamic, constantly evolving business. As the diffusion of RTGS ends, the implementation of fast payments is primed to take off. In fast payments, emerging market economies are likely to leapfrog advanced ones. Still, efforts are already under way to design the next-generation payment system. Blockchain and other distributed ledger technology holds great promise, but projects are currently only in the proof-of-concept phase. The first wide-scale use of distributed ledgers in payments is likely to be years away, as technological, legal and other hurdles will need to be overcome. Central banks and other authorities will continue to play a critical part in furthering greater efficiency and resilience of payments.[16]

[16] To assist in these efforts, the CPMI has developed an analytical framework to assess and analyse DLT-based projects in payment, clearing and settlement activities (CPMI (2017)).

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The bond benchmark continues to tip to swaps[1]

By the 1990s, basis risk had caused bond markets, like money markets before them, to start shifting from the use of government rates as benchmarks to the use of private ones. Developments since the Great Financial Crisis of 2007–09, including derivatives reforms and Libor scandals, had the potential to disrupt this shift. Yet BIS data on derivatives turnover indicate that interest rate swaps continue to gain on government bond futures for hedging and positioning at the long end of the yield curve. However, the ease of unwinding positions in futures may stop swap rates from completely displacing government bond rates as benchmarks.

JEL classification: G12, G15.

Money and bond markets function most efficiently when market participants agree on certain instruments that serve as references – or benchmarks – for the pricing of other securities. Historically, government securities played this role, yet in money markets they were displaced by private instruments as benchmarks as early as the 1980s. In bond markets, from the 1990s up until the 2007–09 Great Financial Crisis (GFC), evidence had accumulated that the benchmark was shifting from government to private rates, in particular interest rate swaps (IRS). Since then, several developments have had the potential to disrupt the shift. This feature examines what the latest BIS data show about the shift to private benchmarks, through the lens of the turnover of derivatives on long-term interest rates.

Since the GFC, one development that had the potential to undermine confidence in the use of swap rates as benchmarks was revelations of self-dealing in the setting of Libor and other interbank rates, which are the bases for the floating rate leg of IRS. Another was a greater dispersion of banks' creditworthiness, a development that could have increased the risk of idiosyncratic movements in interbank rates. A third noteworthy development was that negative rates in European and Japanese money markets might have reduced the effectiveness of IRS as hedges to the extent that banks could not pass on negative rates to depositors. Finally, the move of IRS to organised markets and central counterparties potentially increased their costs and so diminished their attractiveness.

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At the same time, countervailing factors may have made government bond rates less attractive as benchmarks. Periodic episodes of flight to quality led to sharp gapping in government and private interest rates. Such episodes made market participants acutely aware of basis risk – the risk of a divergence in the prices of two related instruments, such as a long position in a corporate bond hedged by a short position in a government bond future. Electronic trading and central clearing of swaps might have reduced the credit and collateral frictions in IRS and thereby undermined the corresponding advantages of the exchange-based trading of government bond futures relative to the over-the-counter (OTC) trading of IRS.

We find that, while the shift from government bond futures to swaps has slowed since 2007–09, it has not stopped. The role of basis risk in the shift from one benchmark to another is highlighted in the next section. We then explain why we use derivatives turnover to identify the benchmark and compare bond benchmarks around the world. The penultimate section examines data on bond derivatives for eight currencies over 21 years. The conclusion considers where the shift ends.

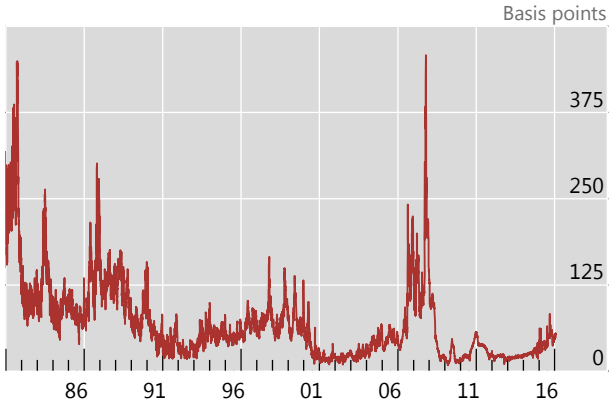
Benchmark tipping and the role of basis risk

"Tipping" refers to a social process whereby the self-reinforcing effect of individual choices causes the aggregate outcome to shift from the preponderance of one practice to another. The more people who adopt the new practice, the greater the incentive for any individual to adopt it as well (Schelling (1978)). In financial markets, a benchmark tips when market participants find it advantageous to switch from one instrument to another, in line with the preponderant choice of others. We argue that, in fixed income markets, basis risk in times of crisis sets off the tipping process.

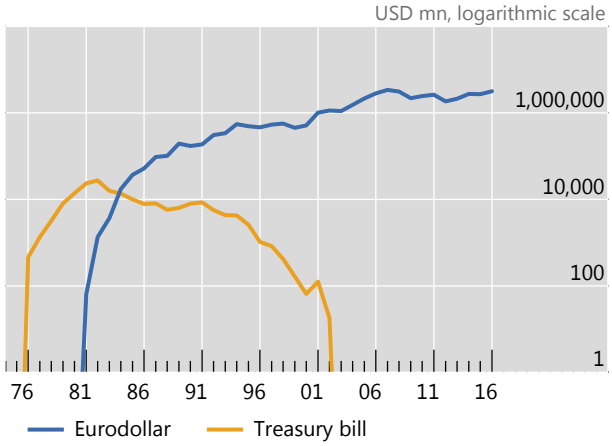
The tipping process is exemplified by the shift from Treasury bill to interbank rates in the US dollar money market in the 1980s and 1990s. Futures contracts on

Treasury bill benchmark tips to eurodollars — Graph 1

Spread between Treasury bill and eurodollar rates[1]



Turnover of money market futures and options[2]



[1] Three-month USD Libor (prior to 6 December 1984, Libid + 12.5 bp) minus three-month US Treasury bill rate; daily data. [2] Notional value of futures and options contracts traded on the Chicago Mercantile Exchange; daily average.

Sources: Federal Reserve Bank of St Louis; Bloomberg; Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics.

Treasury bill rates enjoyed a big head start over those on offshore (eurodollar) deposits. Yet eurodollar rates quickly supplanted Treasury bill rates as the benchmark when measured by the turnover of futures contracts (Graph 1, right-hand panel). The bill future died in 2003.

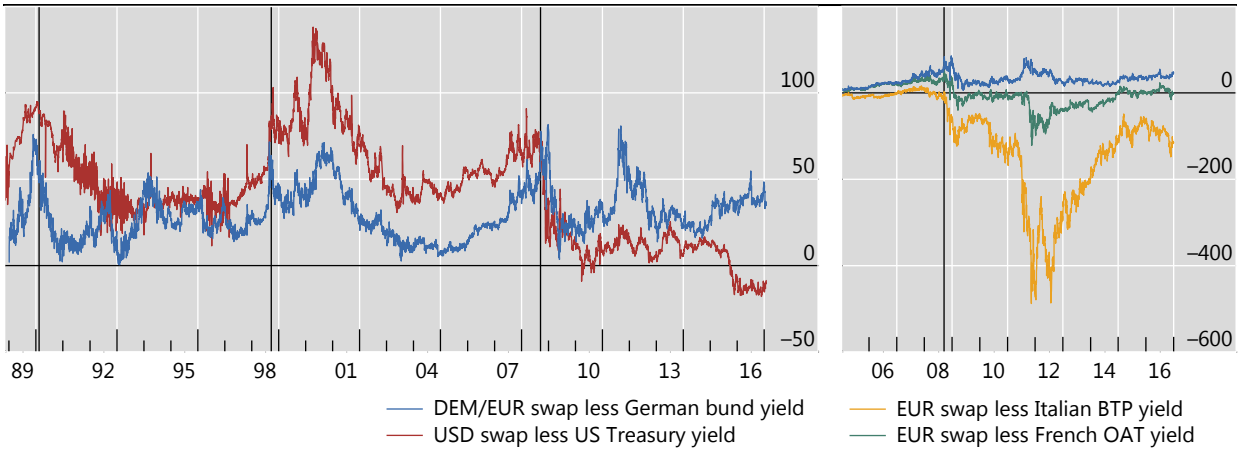
What encouraged market participants to abandon Treasury bill futures in favour of eurodollar futures was basis risk. In the US dollar money market, a key indicator of basis risk is the Treasury-eurodollar (TED) spread. As shown in the left-hand panel of Graph 1, the TED spread rose sharply during periods of market stress: for example, in August 1982, with the onset of the Latin American debt crisis; in May 1984, during the Continental Illinois crisis; in October 1987, when the stock market sold off; in late 1990, when US corporate defaults rose; and in August–September 1998, following Russia's default and the near collapse of Long-Term Capital Management (LTCM). On these occasions, hedges of Libor-based positions with Treasury bill futures proved to be ineffective, or worse. In the extreme, a flight to quality episode could inflict losses on both sides of the intended hedge, as long positions linked to Libor and short positions in US Treasury bill futures *both* lost value.

The more market participants who shifted, the more who were encouraged to do likewise in response to the ebb of liquidity out of Treasury bill futures and its flow into eurodollar futures. As liquidity ebbs, price changes may increasingly reflect order imbalances rather than new information, adding basis risk and so reinforcing the incentive to shift. The converse holds for those contracts gaining liquidity.

In bond markets, the equivalent of the TED spread is the swap spread: the difference between, say, the 10-year fixed rate on interest rate swaps and the 10-year government bond yield. Like the TED spread, US dollar and euro swap spreads have at times spiked, inflicting substantial losses on supposedly hedged portfolios. Spikes occurred at the time of Drexel Burnham Lambert's bankruptcy in early 1990, the US bond market sell-off of 1994, the Asian financial crisis of 1997, the Russian and LTCM events of August–September 1998, and corporate credit strains around the bursting of the tech bubble in 2000 (Graph 2, left-hand panel). Indeed, already by the early

Spread between government bonds and private yields

Based on 10-year interest rates, in basis points — Graph 2



The vertical lines indicate 13 February 1990 (Drexel Burnham Lambert bankruptcy), 23 September 1998 (Long-Term Capital Management recapitalisation) and 15 September 2008 (Lehman Brothers bankruptcy). BTP, OAT = government bonds.

Sources: Bloomberg; BIS calculations.

2000s, the frequency of spikes in swap spreads was pointing to the likelihood that the bond benchmark would tip from government rates to swaps (McCauley (2001, 2002), Remolona and Wooldridge (2003)).

Since 2007, recurring experience of basis risk strengthened the incentive for market participants to reconsider their choice of instrument for hedging and positioning. The GFC saw swap spreads widen on the back of an unprecedented loss of creditworthiness on the part of major swap dealers and flight to quality (Graph 2, left-hand panel). The European sovereign strains of 2011 led to sharp increases in euro swap spreads as well as a pronounced decoupling of spreads across countries (Graph 2, right-hand panel). And in 2015, the US dollar swap spread turned puzzlingly negative (Sundaresen and Sushko (2015), Ehlers and Eren (2016)).

Tracking the tipping process

To gauge the shift from one benchmark to another, our preferred measure is the turnover of interest rate derivatives. Trading activity directly reveals market participants' preferred instrument for hedging and positioning. Furthermore, turnover tends to be closely correlated with other measures of market liquidity: for example, high turnover often accompanies narrow bid-ask spreads (CGFS (1999a)).[2]

Ideally, the turnover of all relevant instruments should be compared, whether traded in cash markets or derivatives markets. However, the liquidity of derivatives can be seen as a proxy for the liquidity of the underlying instruments. Derivatives markets ease hedging and positioning, and therefore their development enhances the liquidity of related cash markets (CGFS (1999b)).

Furthermore, data on derivatives turnover are more readily available than data on cash transactions, as well as being more comparable across countries. The BIS compiles monthly data on the turnover of futures and options on organised exchanges (BIS (2015)). It also collects data on the turnover of OTC derivatives in the Triennial Central Bank Survey of foreign exchange and OTC derivatives markets (BIS (2016)). Unlike in money markets, where derivatives referencing interbank rates are traded heavily on exchanges, in bond markets derivatives referencing interbank rates are traded overwhelmingly over the counter. Almost without exception, bond derivatives traded on exchanges are referenced to a government rate.

The available data have two shortcomings, however. First, the Triennial Central Bank Survey is conducted only in April of every third year. Higher-frequency data would make it easier to distinguish between structural changes and short-term cyclical developments. That said, the cross section of currencies collected in the Triennial Survey helps to highlight global trends. A second shortcoming is that the OTC data are not available by maturity. IRS referencing long-term interest rates are grouped together with overnight index swaps (OIS) and other short-term swaps. Although OIS account for a sizeable share of total swap turnover, estimates for three currencies, including the euro and the US dollar, suggest that conclusions based on the reported swap data are robust to adjustments for OIS turnover (see box).

[2] Market liquidity has three dimensions: tightness, which is the difference between buying and selling prices; depth, which measures the size of trades possible without moving market prices; and resiliency, which denotes the speed at which prices return to normal following temporary order imbalances. Average turnover in a given time period indicates the order flow that a market typically accommodates and, as such, provides some indication of depth.

Bond benchmarks around the world

Looking around the world, the latest data point to swaps as the established benchmark for long-term interest rates. In April 2016, the daily average turnover of interest rate swaps and options was $2.0 trillion, compared with $0.5 trillion for government bond futures and options. Even if OIS account for as much as half of swap trading, aggregate turnover shows that bond derivatives are mainly referenced to swap rates.

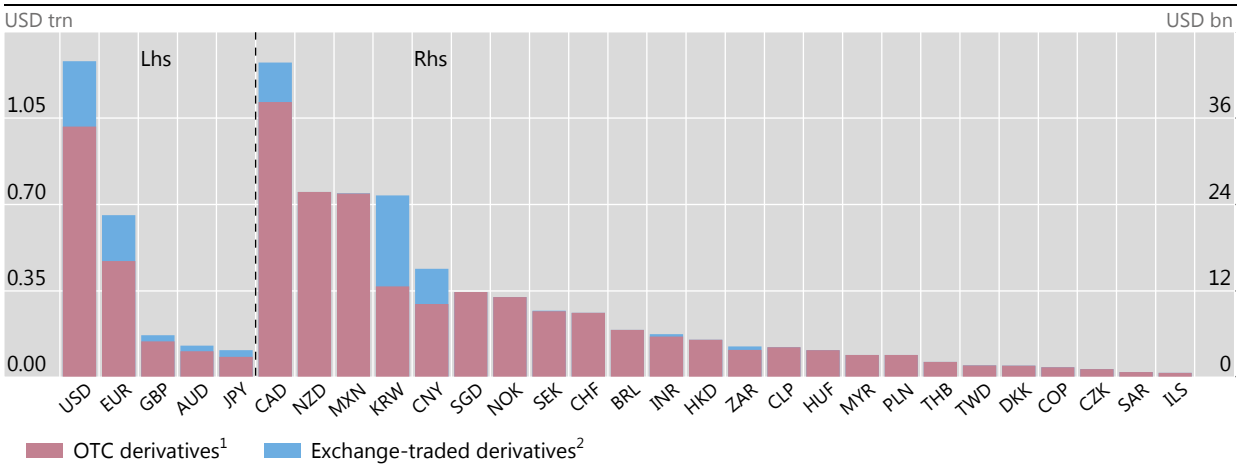
The dominance of IRS is even more evident in the disaggregated data. Whereas over 30 currencies have OTC markets for interest rate swaps, only 15 have government bond futures (Graph 3). If inactive markets are excluded, namely those where turnover averaged less than $1 billion per day in April 2016, then 27 currencies have active IRS markets but only eight have active bond futures. Notably, even for currencies with active bond futures, swaps predominate, as shown in Graph 4, which plots turnover in government futures and IRS to scale.

Since the year 2000, futures exchanges have launched contracts on a number of emerging market government bonds. However, only those for China and Korea are actively traded (Graph 5, left-hand panel). Futures on Indian government bonds have been launched no fewer than three times, but none has succeeded yet (Graph 5, right-hand panel, which shows the last of the three). Kreicher et al (2014) demonstrate that the absolute size of the bond market and per capita GDP explain which countries have active bond futures.

The most successful of the new government bond futures are reincarnations of previous contracts on French and Italian government bonds. Prior to the introduction of the single currency in 1999, both French and Italian bond futures, together with Spanish bond futures, traded actively in local markets. Once euro area bond yields

Turnover of bond derivatives, by currency

Daily average turnover in April 2016 — Graph 3



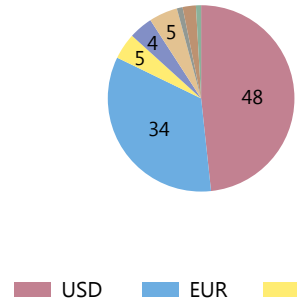
[1] Interest rate swaps and options, adjusted for local and cross-border inter-dealer double-counting, ie "net-net" basis. Excludes forward rate agreements but includes swaps referencing short-term interest rates (see box). [2] Futures and options that reference long-term interest rates (mainly government rates).

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

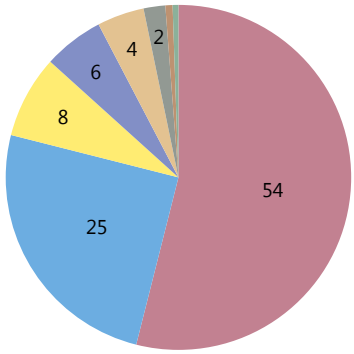
Bond derivatives turnover in April 2016

Share of total turnover, in per cent; size of pies reflects relative market size — Graph 4

Government bond futures and options



Interest rate swaps and options[1]



USD EUR GBP AUD JPY CAD KRW CNY

[1] Including turnover of swap futures.

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

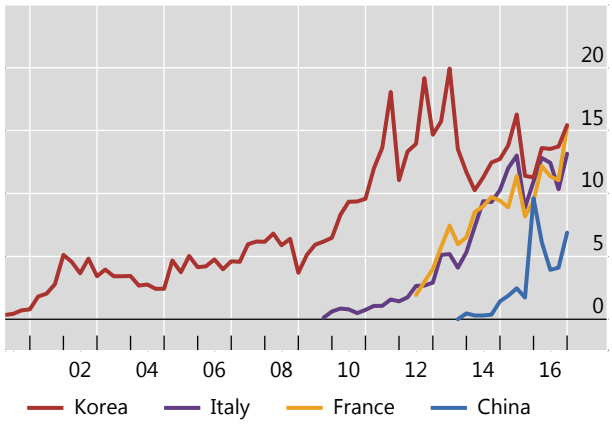
converged, the basis risk for French and Italian bonds converged to that for German bunds. Consequently, liquidity flowed to the more actively traded bund futures and, more so, to euro-denominated swaps.

Basis risk in the euro-denominated markets returned with a vengeance during the GFC and the 2011 European sovereign strains. Sovereign spreads widened against euro-denominated swaps and German bund yields (Graph 2, right-hand panel). This impaired the effectiveness of euro-denominated swaps and bunds for hedging and positioning in French and Italian debt: not only government bonds, but, owing to the sovereign-bank nexus, bank and corporate debt too. Eurex launched futures on Italian government bonds in 2009 and French ones in 2012, and they quickly joined the

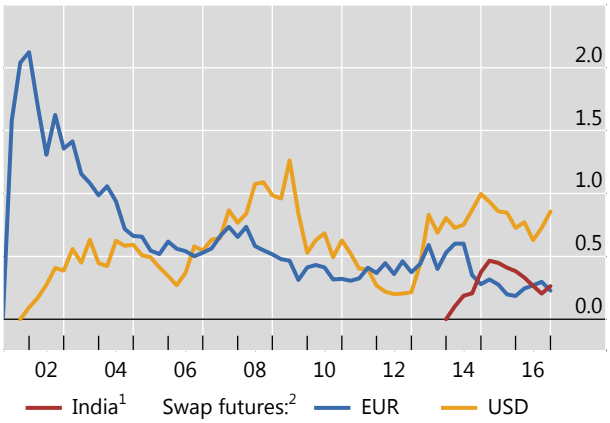
Bond and swap futures launched since 2000

Daily average turnover, in billions of US dollars — Graph 5

Most actively traded contracts[1]



Less actively traded contracts



Korea Italy France China India[1] Swap futures:[2] EUR USD

[1] Government bond futures. [2] Combined turnover of contracts of all maturities (from two to 10 years) traded on all exchanges.

Sources: Euromoney TRADEDATA; BIS derivatives statistics.

ranks of the most actively traded government bond futures (Graph 5, left-hand panel). That said, as of April 2016, their combined daily turnover remained a fraction of that of German government bond contracts: $20 billion equivalent, compared with $143 billion equivalent.

The shift from government futures to swaps: 1995–2016

Thus, the cross-sectional view confirms that, by 2016, swap rates were the preponderant choice for a bond benchmark. To test whether developments since the GFC have disrupted the tipping process, we focus on eight currency segments that have had active government bond futures, including the Swedish krona (which once had an active market) but excluding the renminbi (which was introduced only in 2013). For these, we observe turnover in OTC markets and organised exchanges as many as eight times from 1995 to 2016 (Table 1). Graph 6 plots the turnover of government bond futures and options as a share of the total turnover of all bond derivatives (exchange-traded and OTC; futures, swaps and options). The left-hand panel shows the government bond futures share for each of the eight currencies, and

Turnover of bond derivatives

Daily average turnover in the month of April, in billions of US dollars — Table 1

Currency	Market[1]	1995	1998	2001	2004	2007	2010	2013	2016
Total[2]	Government	199.5	234.7	283.1	517.4	655.7	650.6	635.0	543.3
	Swap	57.1	169.9	350.1	761.8	1,336.1	1,380.2	1,473.0	1,882.0
AUD	Government	3.3	3.7	5.1	9.0	12.2	13.0	26.3	22.6
	Swap	…	1.4	4.0	7.4	15.5	28.6	64.9	106.3
CAD	Government	0.2	0.4	0.4	0.7	2.2	2.0	3.9	5.5
	Swap	…	4.1	4.6	5.9	14.5	39.2	27.7	38.2
EUR[3]	Government	55.0	108.7	162.5	269.4	349.8	309.8	222.6	185.8
	Swap	8.3	83.1	184.0	344.9	589.3	631.8	737.9	471.1
GBP	Government	3.4	6.2	3.3	7.4	16.2	13.9	19.7	24.9
	Swap	…	9.0	24.9	65.1	130.4	160.3	98.8	145.9
JPY	Government	80.2	33.5	32.3	30.5	45.0	36.5	48.4	27.1
	Swap	25.3	23.8	18.6	45.7	132.8	121.8	69.0	83.1
KRW	Government	…	…	2.3	2.7	6.2	8.4	17.5	12.6
	Swap	…	…	0.04	0.3	4.5	16.0	12.0	12.7
SEK	Government	5.0	2.8	0.3	0.9	2.4	1.8	1.7	0.1
	Swap	…	0.4	1.3	4.1	14.5	10.6	16.8	9.2
USD	Government	52.4	79.5	76.9	196.7	221.7	265.2	294.9	264.7
	Swap	23.5	48.1	112.7	288.3	434.5	372.0	445.9	1,015.5

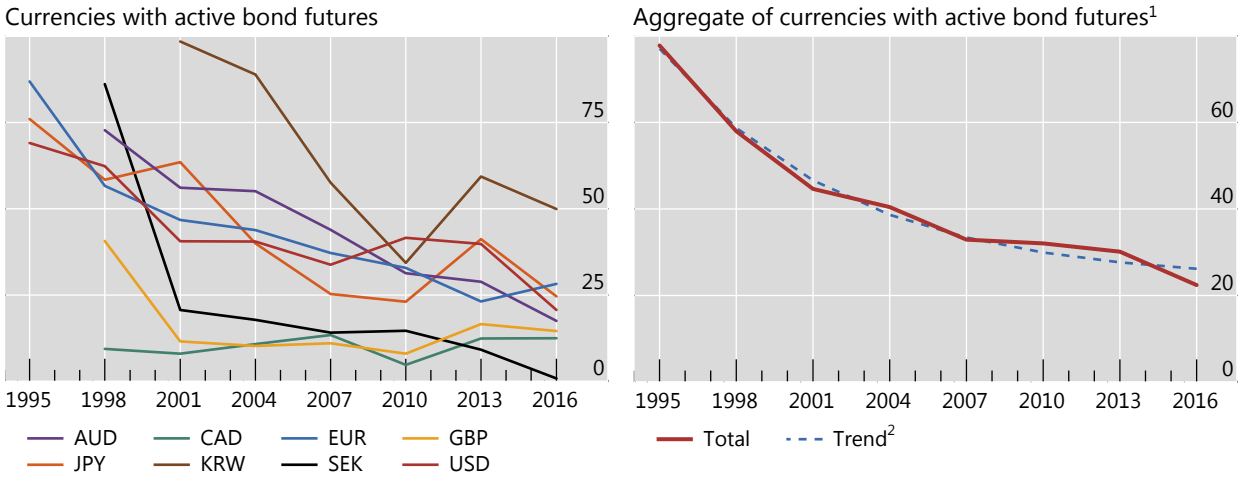
[1] "Government" refers to exchange-traded futures and options referencing government bond yields. "Swap" refers to interest rate swaps and options traded in OTC markets and on exchanges, excluding forward rate agreements but including OTC swaps referencing short-term interest rates (see box). [2] Sum of the eight currencies shown. [3] Prior to 1999, combined turnover of bond derivatives denominated in euro legacy currencies.

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

Government bond futures and options as a percentage of all bond derivatives

In per cent

Graph 6



[1] Sum of turnover in markets shown in the left-hand panel. [2] Estimated from an exponential decay function, where ratio = 0.2323 + 0.5385*$e^{-0.4165t}$, with adjusted R^2 = 0.97. The estimate implies an asymptotic ratio of 23%, compared with the April 2016 ratio of 22.4%.

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

the right-hand panel shows the aggregate share, calculated by summing the numerators and denominators across the eight currencies.

Overall, the declining government bond futures shares point to a continued shift to private benchmarks since the GFC. Evidently, the repeated experience of basis risk continued to drive the share of government bond futures and options lower. The most pronounced shift occurred in the Swedish krona market, where trading in government bond futures, which up to 2012 had exceeded that in Canadian government bond futures, died in 2016.

The overall trend suggests that neither the Libor scandal nor derivatives reforms following the GFC reduced the attractiveness of IRS as bond benchmarks. Revelations of self-dealing in setting Libor had the potential to undermine market participants' confidence in swap rates as measures of prevailing yields. However, the continued growth of swap trading is inconsistent with a loss of confidence; on the contrary, market participants appear to have taken reassurance from the reforms designed to reduce opportunities for abuse (FSB (2014)).

Likewise, whereas derivatives reforms had the potential to increase transaction costs in OTC markets, experience to date with swap futures indicates the opposite. Historically, exchanges had the advantage of centralised trading and, through their use of central counterparties, simpler counterparty risk management. Innovations in OTC markets since the GFC, such as central clearing, trade compression and swap execution facilities, have reformed them along the model of exchanges (Ehlers and Eren (2016), McCauley and Wooldridge (2016)). These changes, coupled with the advantage that OTC markets have in accommodating customised demands, have so far kept IRS trading from tipping from OTC markets to exchanges. Exchanges first introduced swap futures in 2001, when market participants were concerned about the shrinkage of government bond markets. Soon thereafter, the turnover of euro-denominated swap futures traded in London peaked at around $2 billion per day. By

2016, it had fallen to about $0.3 billion (Graph 5, right-hand panel). The creation of a dedicated swap exchange, Eris, in 2013 boosted the turnover of US dollar-denominated swap futures. Yet in 2016, it was still less than $1 billion per day.

Notwithstanding the overall downward trend in the share of government futures in bond derivatives, the shift has proceeded more slowly and unevenly since the GFC than it did over the 1995–2007 period. As shown in the left-hand panel of Graph 6, the tipping towards swaps temporarily reversed in the US dollar market in 2010; in the Canadian dollar, Korean won and sterling markets in 2013; and in the euro market in 2016. Considering the decoupling of European sovereign yields in recent years, and the associated multiplication of euro area bond futures offerings discussed above, the reversal of the share for the euro fits well with the explanation that the tipping process is driven by basis risk. But basis risk cannot explain all of the heterogeneity.[3]

The decline in banks' creditworthiness following the GFC may explain some. In particular, in the US dollar market in 2010, before derivatives reforms took effect, concerns about counterparty risk could plausibly have boosted the trading of government bond futures relative to bilateral OTC deals with and between banks.

The diversity of market participants is also a likely explanation of some of the heterogeneity. Some participants might prefer or be required to transact in particular markets, and their share of activity is likely to differ across currencies and over time. For example, the non-deliverability of the Korean won may segment liquidity between the onshore and offshore swap markets, and thereby boost the futures market. Yield-seeking international investors may have a larger influence on the evolution of trading in the Australian dollar market than in other markets.

In conclusion: the persistence of futures trading

Over a period of two decades, the benchmark in bond markets, as in money markets before them, has tipped from government rates to private swap rates. Developments since the Great Financial Crisis of 2007–09 slowed this shift but did not stop it.

The evidence also suggests that government bond futures may play a complementary role and find a floor that is not far below their current 23% share of all bond derivatives. Unlike in money markets, swaps have not completely displaced government bond futures. In the Canadian dollar and sterling markets, government bond futures have persisted for many years with a low share of total bond derivatives trading, although the same is not true of futures in the Swedish krona market.

Particular uses and market participants will tend to keep government bond futures alive. Government bond futures may remain useful to active asset managers as hedges for government bond portfolios and as tools for pure interest rate risk positioning. For market-makers, such futures may remain the most cost-effective hedge for transitory customer-driven positioning in bonds.

[3] The quality and completeness of data on turnover in OTC markets have improved over time, which may have contributed to the heterogeneity. For example, methodological changes in the 2013 Triennial Central Bank Survey ensured more complete coverage of activity in emerging market and other less traded currencies (BIS (2013)).

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Disentangling overnight index swaps from interest rate swaps

The BIS data on swap turnover comprise contracts referencing both short- and long-term interest rates. If short-term contracts were to account for a growing proportion of swap turnover, then it would cast doubt on our key finding that longer-term swaps are displacing government bonds as the benchmark. Using other sources to separate short- from long-term swaps, this box finds that the rise in swap trading is indeed driven by long-term, not short-term, contracts.

The Triennial Central Bank Survey does not identify the type or maturity of interest rate swaps (IRS). IRS thus include overnight index swaps (OIS), where a fixed rate is exchanged for the average value of an overnight rate, as well as basis swaps, where two floating rates are exchanged. Such swaps typically have very short maturities. According to ECB (2015) and Fleming et al (2012), almost all OIS mature within one year, although some have longer maturities.

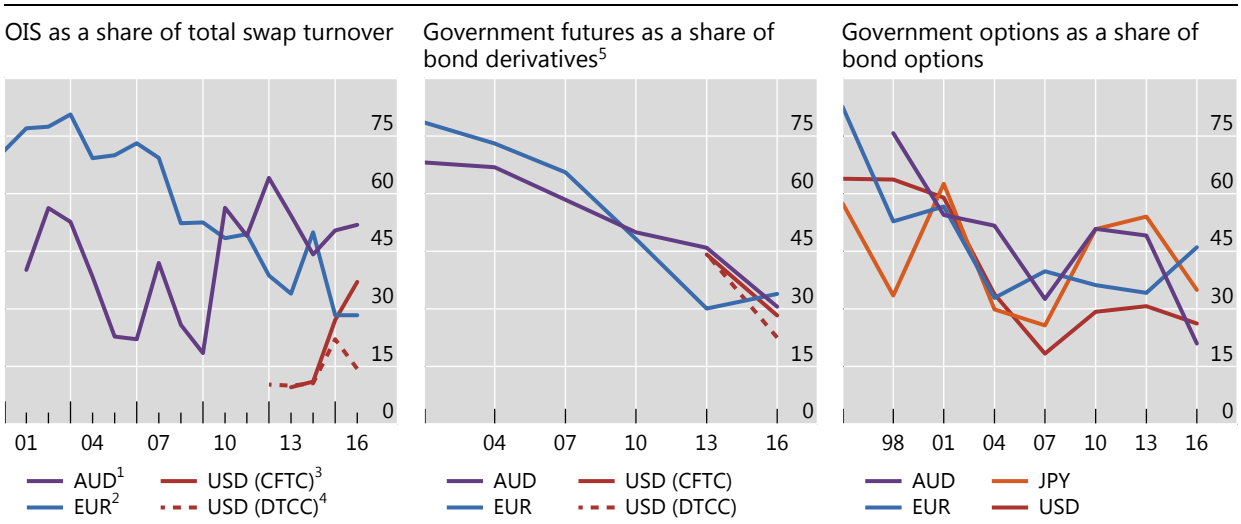
The OIS share of swap turnover varies (Graph A, left-hand panel). The share of OIS in Australian dollar-denominated swap turnover has fluctuated between 20 and 60% since 2000, with no trend. By contrast, that of euro-denominated OIS declined from a high of around 80% in 2003 to less than 30% in 2015, with a new survey from the ECB (2016) suggesting that turnover remains low. Data for the US dollar segment, available only since 2013's mandatory trade reporting and mainly covering US activity, show that the share increased from about 10% in 2013–14 to 15–35% in 2015–16, depending on the source.

When estimated OIS turnover is subtracted from total swap turnover, our finding that swaps are displacing government bonds as the benchmark for long-term rates remains intact. A trend decline in the share of government bond futures in the estimated turnover of bond derivatives is still evident (Graph A, centre panel). Between 2013 and 2016, this share fell from about 45% to 30% in the Australian dollar and US dollar markets, and stabilised at around 30% in the euro market.

Developments in options markets show a less clear picture. In OTC markets interest rate options typically reference long-term swap rates, while on exchanges they reference short-term rates. Therefore, OIS pose less of a problem to the interpretation of options data than swap data. The share of options referencing government rates fell sharply up to 2007 but then reversed (Graph A, right-hand panel). In 2016, the trend decline resumed, except for the euro.

Alternative measures of the share of government contracts in bond derivatives

In per cent — Graph A



[1] OIS and bills-OIS basis (BOB) swaps as a percentage of OIS, BOB, fixed/floating and tenor basis swaps; turnover in the 12 months to end-June. Data are from the *Australian Financial Markets Report*. [2] OIS as a percentage of OIS and other interest rate swaps; turnover in Q2. Data are from the *Euro Money Market Survey* (2016 is assumed to equal 2015). [3] OIS as a percentage of OIS and fixed/floating swaps; turnover in April (except 2013, in December). Data refer to all currencies, of which the USD accounts for about 60% and the EUR 15%. The share for all currencies is an upper bound for USD. Data are from the CFTC's *Weekly Swaps Report*. [4] OIS as a percentage of OIS and fixed/floating swaps; average notional amount outstanding in April (except 2012, in May). Shares referring to outstanding amounts provide a lower bound for shares referring to turnover. Data are from DTCC's Global Trade Repository. [5] Government bond futures as a percentage of bond futures and estimated IRS, excluding options; turnover in April. Long-term IRS are estimated as IRS turnover from the Triennial Survey minus OIS turnover, which is approximated as IRS turnover from the Triennial Survey multiplied by the shares shown in the left-hand panel.

Sources: ECB; Australian Financial Markets Association; Depository Trust & Clearing Corporation (DTCC); US Commodity Futures Trading Commission (CFTC); BIS Triennial Central Bank Survey; BIS derivatives statistics; 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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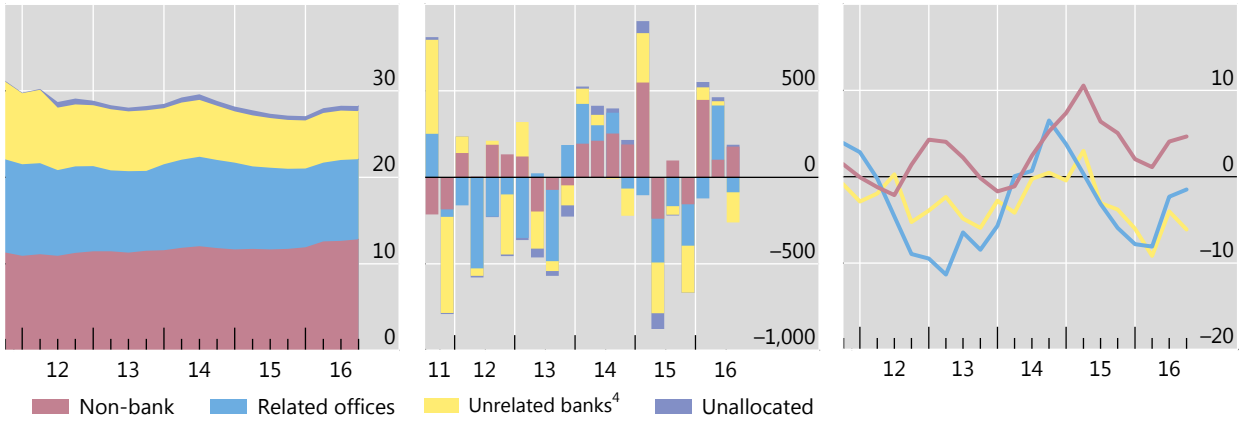
A Locational banking statistics

Cross-border claims, by sector, currency and instrument

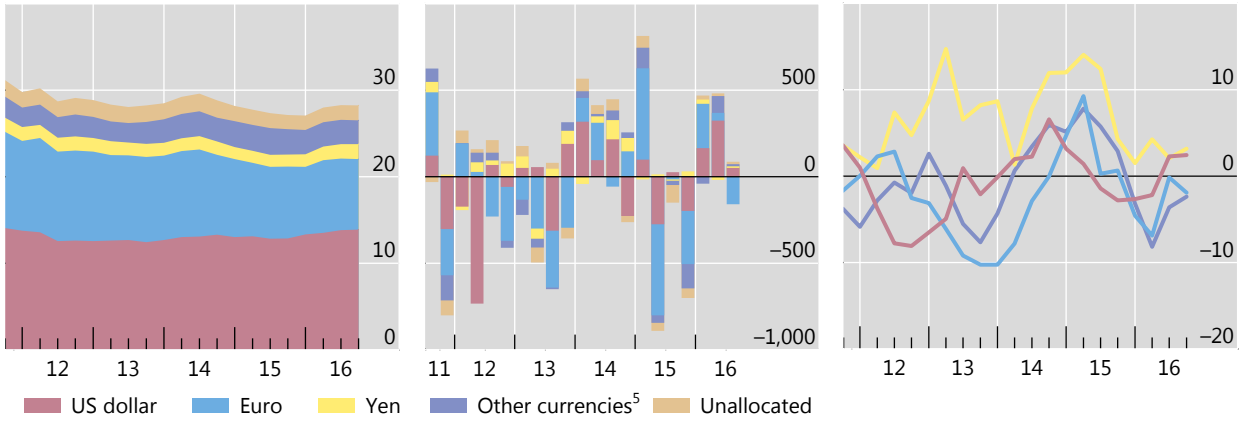
Graph A.1

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

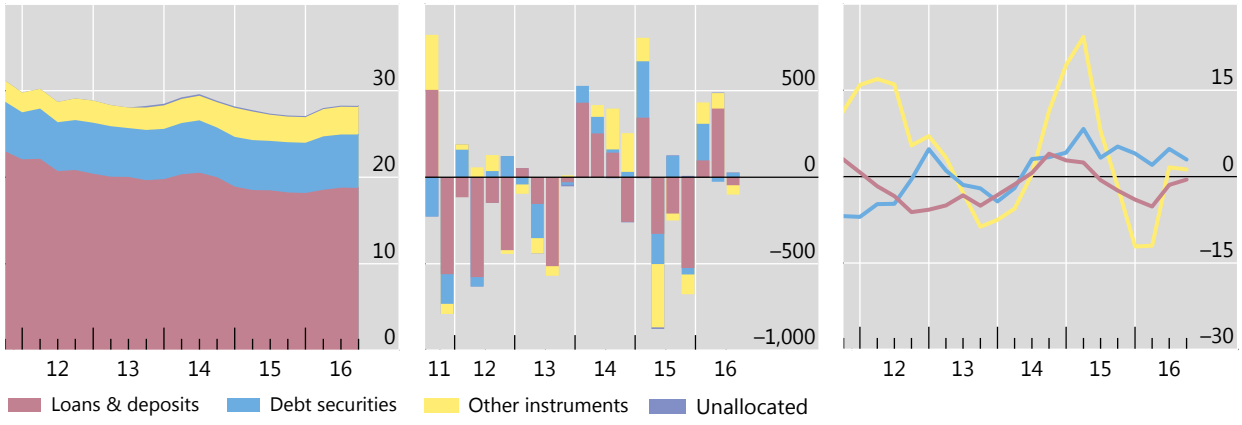
By sector of counterparty



By currency



By instrument



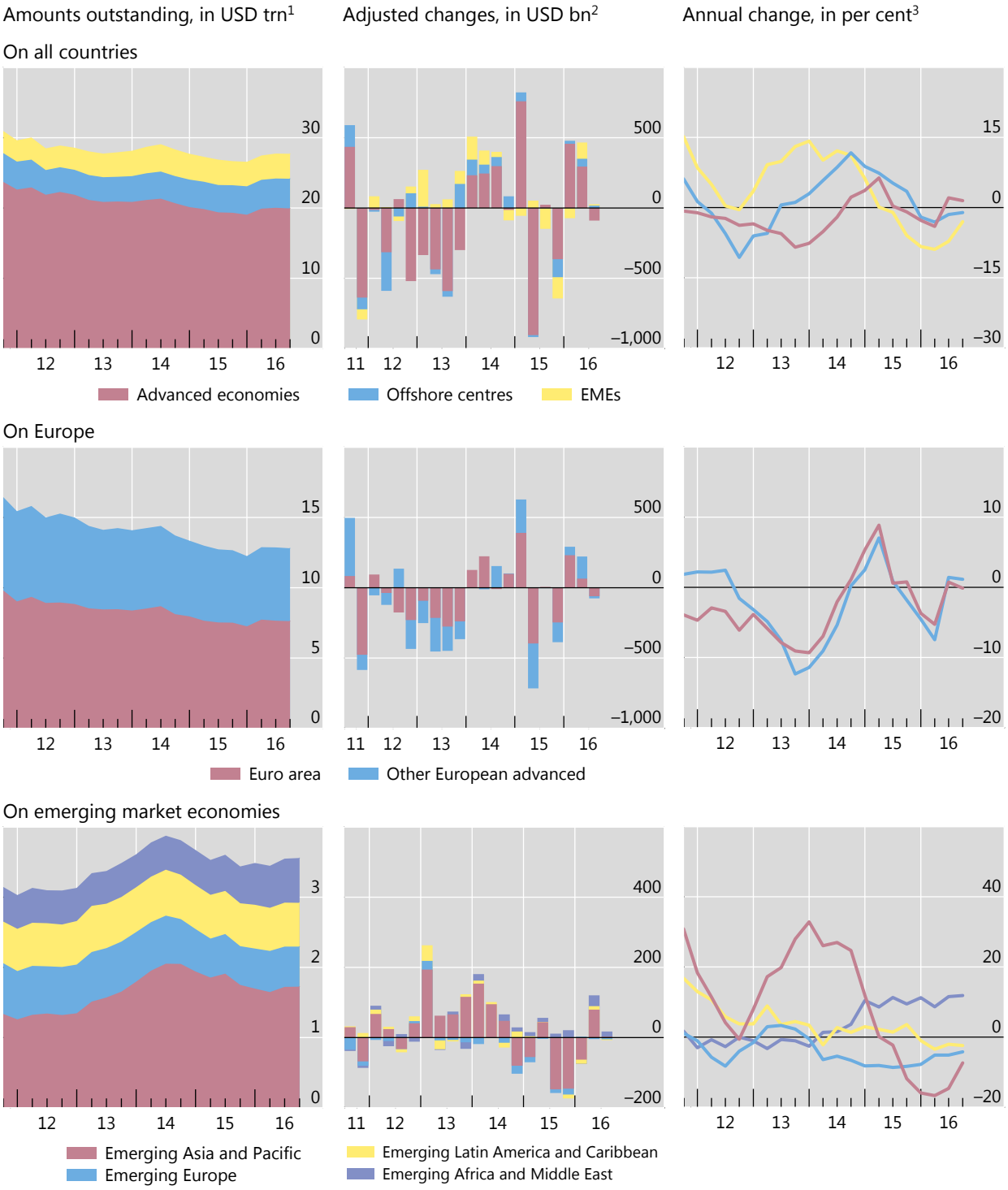
Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

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

Source: BIS locational banking statistics.

Cross-border claims, by borrowing region

Graph A.2



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

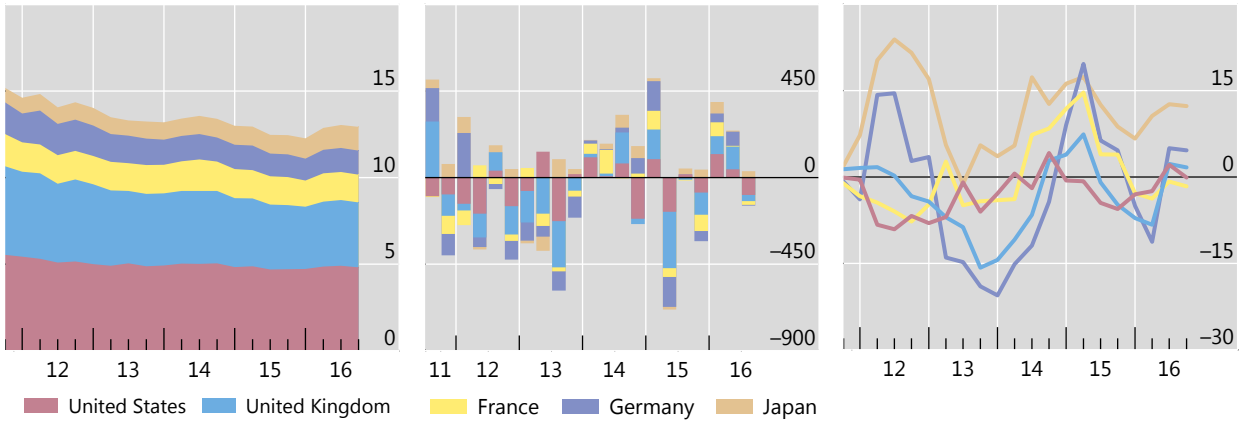
Source: BIS locational banking statistics.

Cross-border claims, by borrowing country

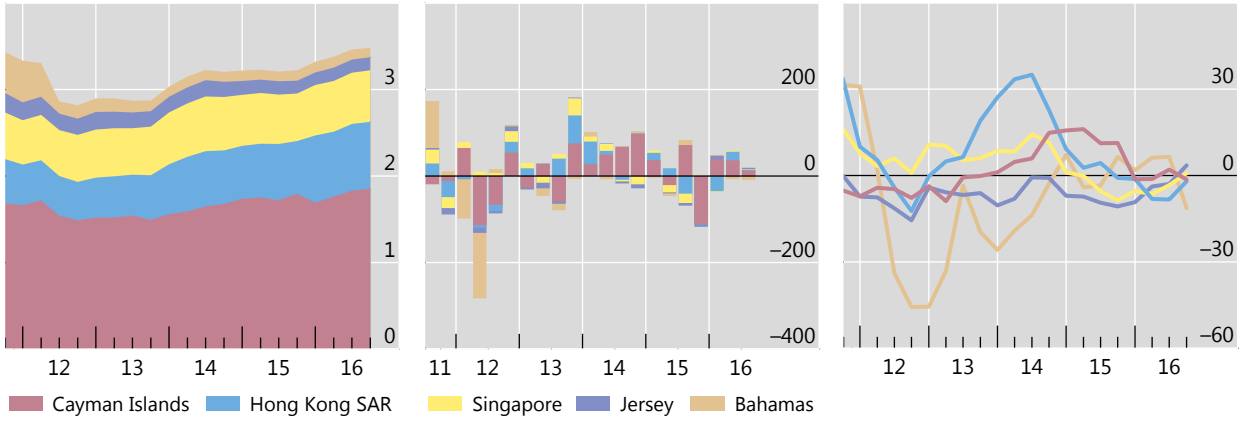
Graph A.3

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

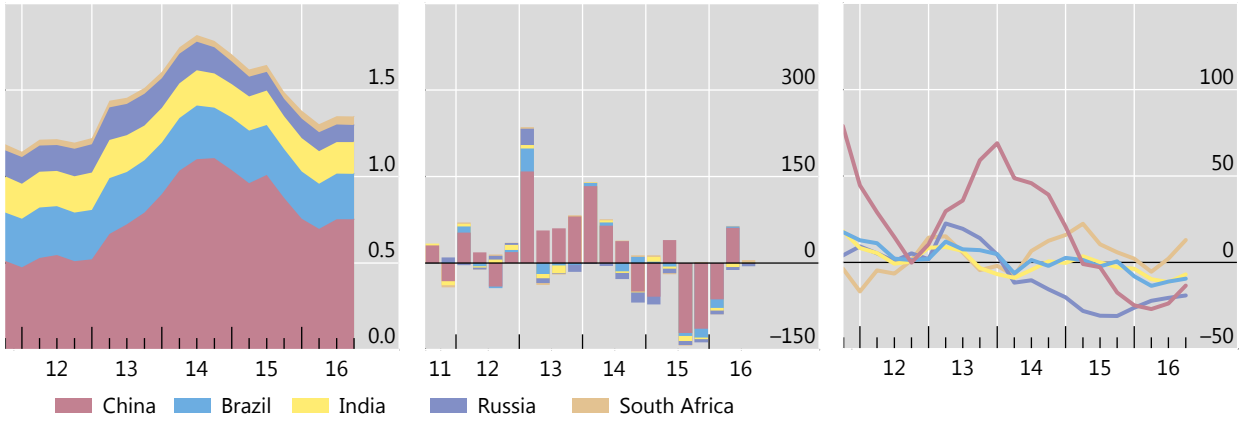
On selected advanced economies



On selected offshore centres



On selected emerging market economies



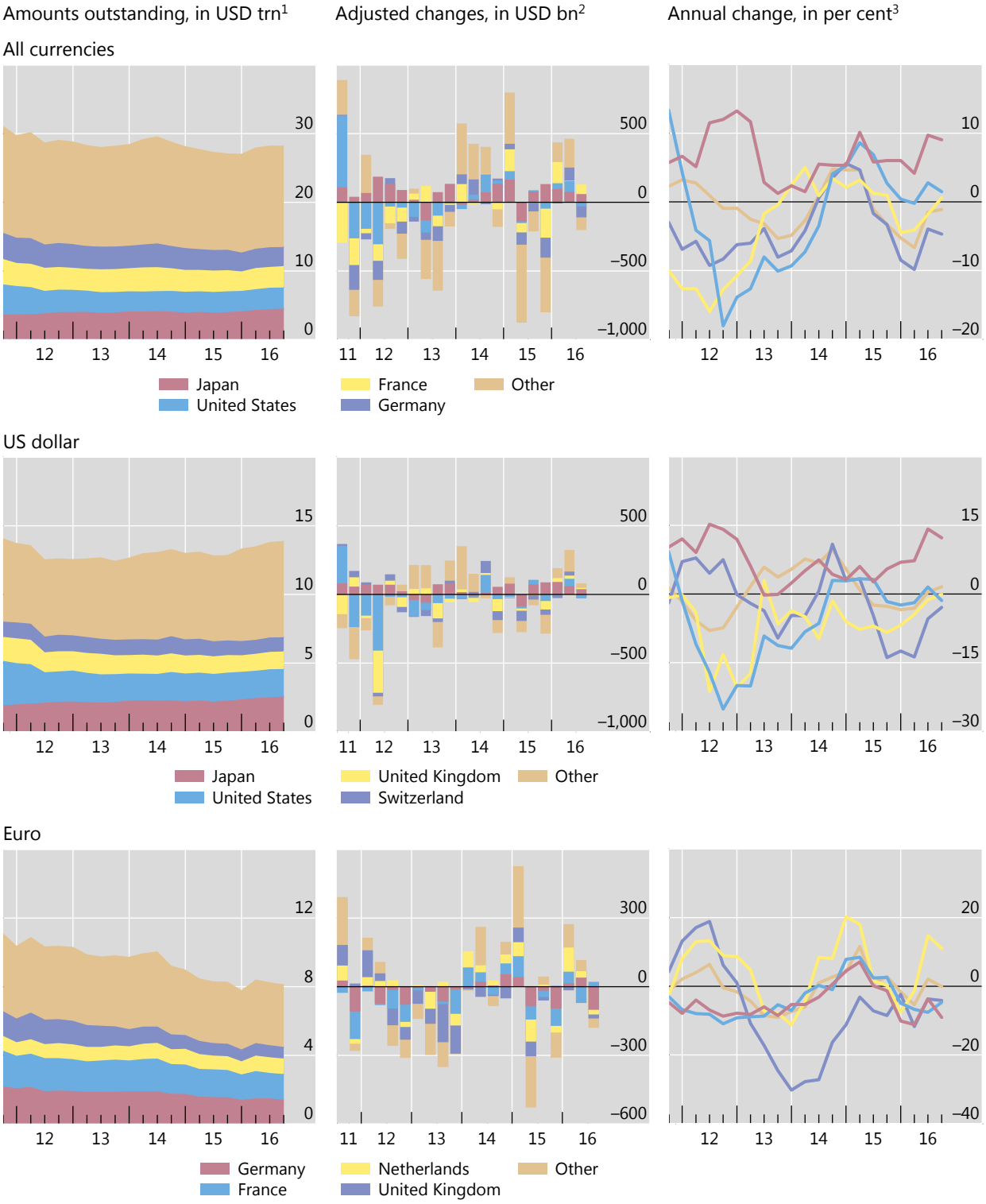
Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

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

Source: BIS locational banking statistics.

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

Graph A.4



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

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

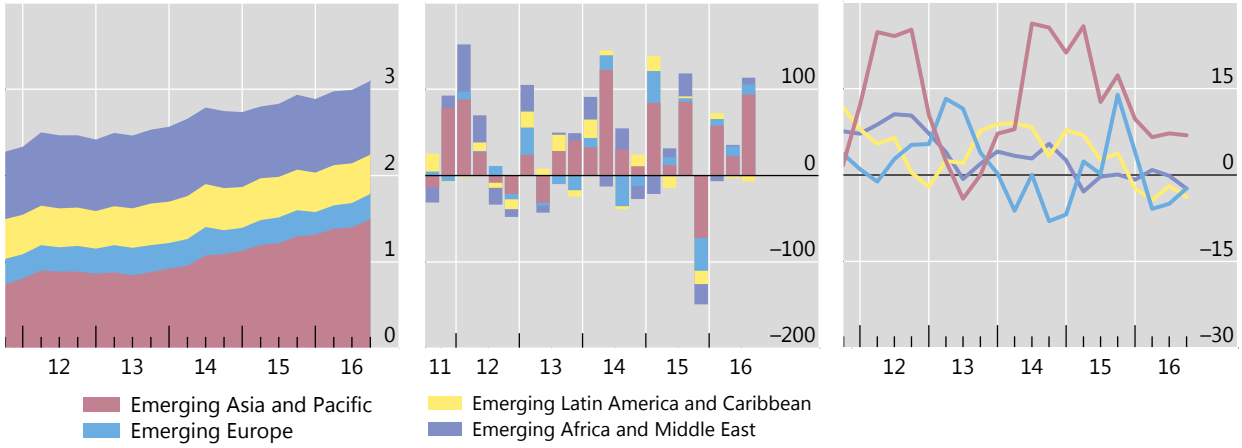
Source: BIS locational banking statistics.

Cross-border liabilities of reporting banks

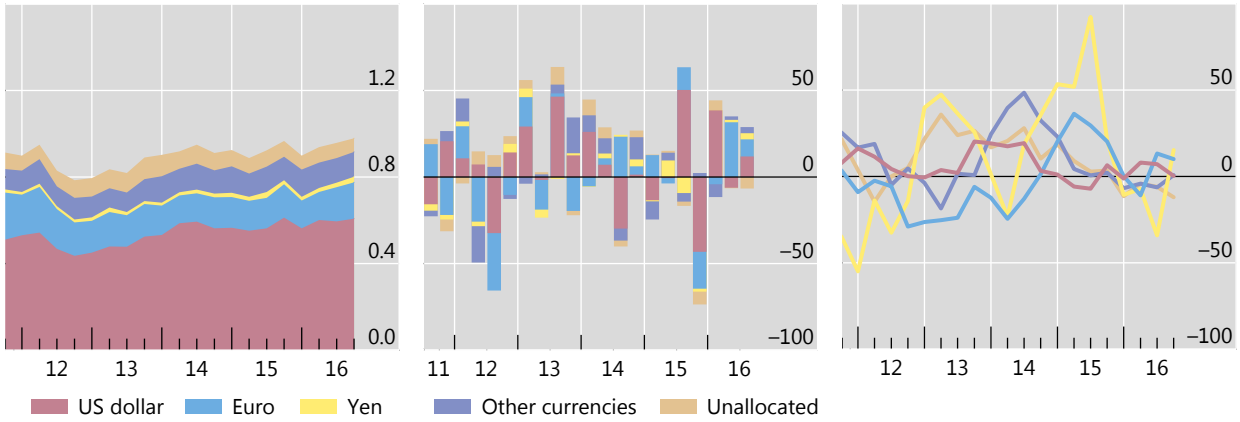
Graph A.5

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

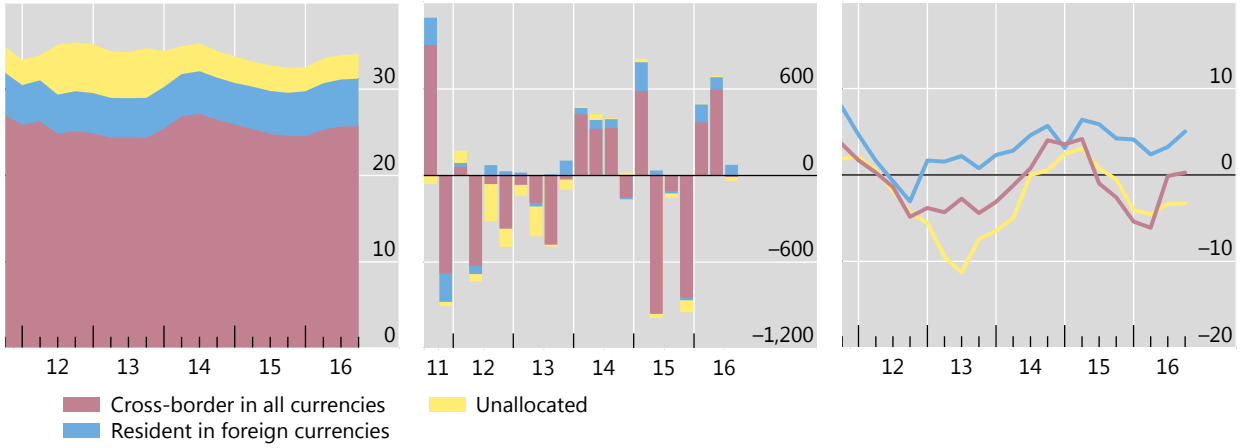
To emerging market economies



To central banks



By currency type and location



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

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

Source: BIS locational banking statistics.

B Consolidated banking statistics

Consolidated claims of reporting banks on advanced economies

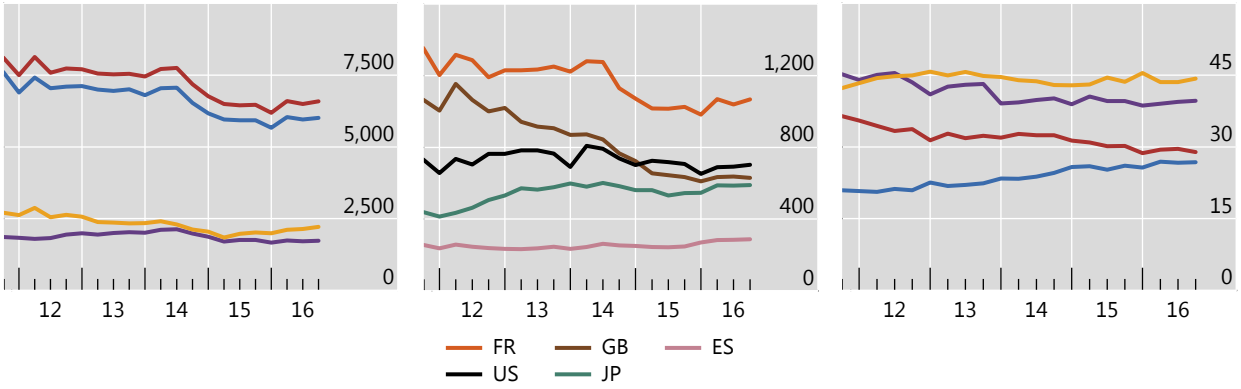
Graph B.1

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

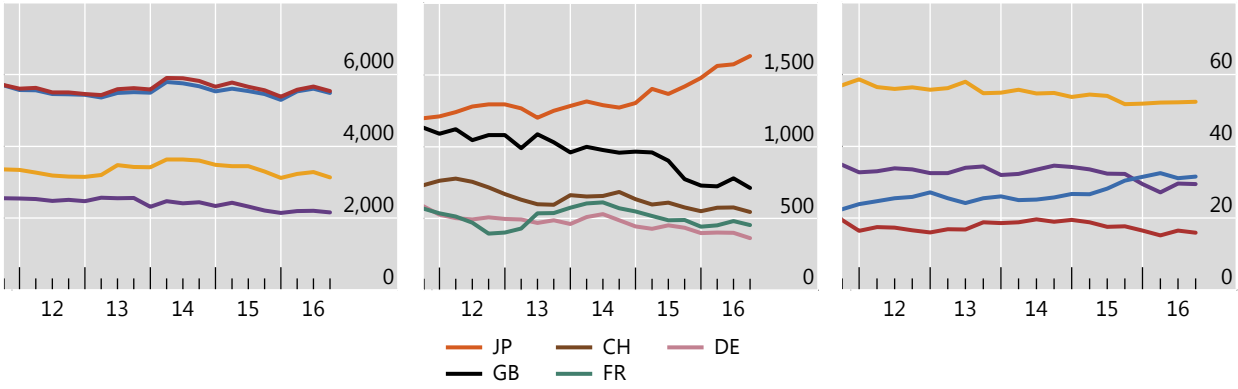
Foreign claims of selected creditors, in USD bn[1, 3]

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

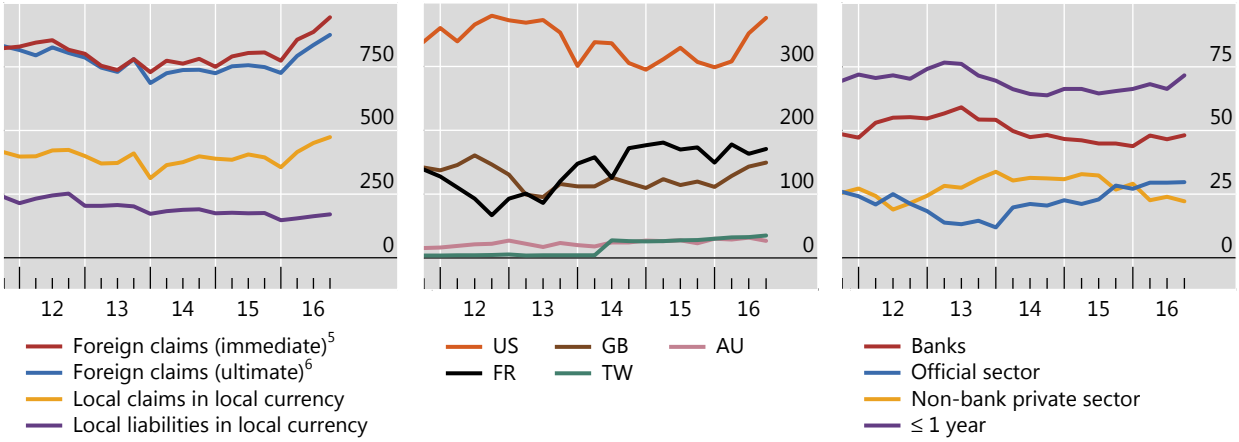
On the euro area



On the United States



On Japan



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

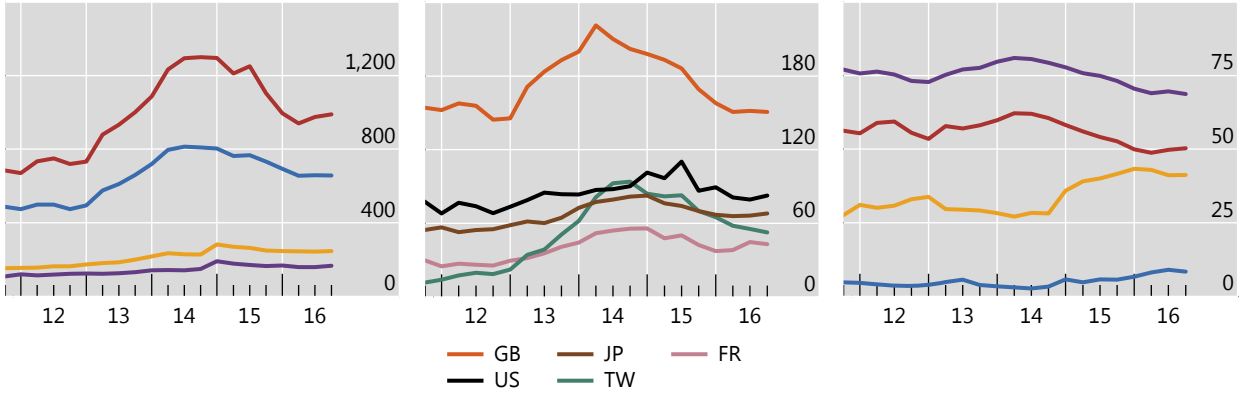
Graph B.2

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

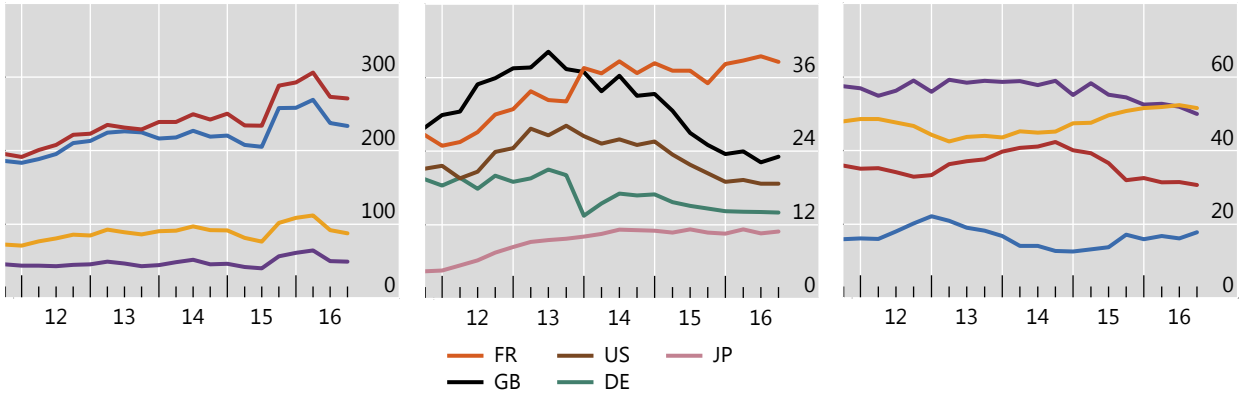
Foreign claims of selected creditors, in USD bn[1, 3]

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

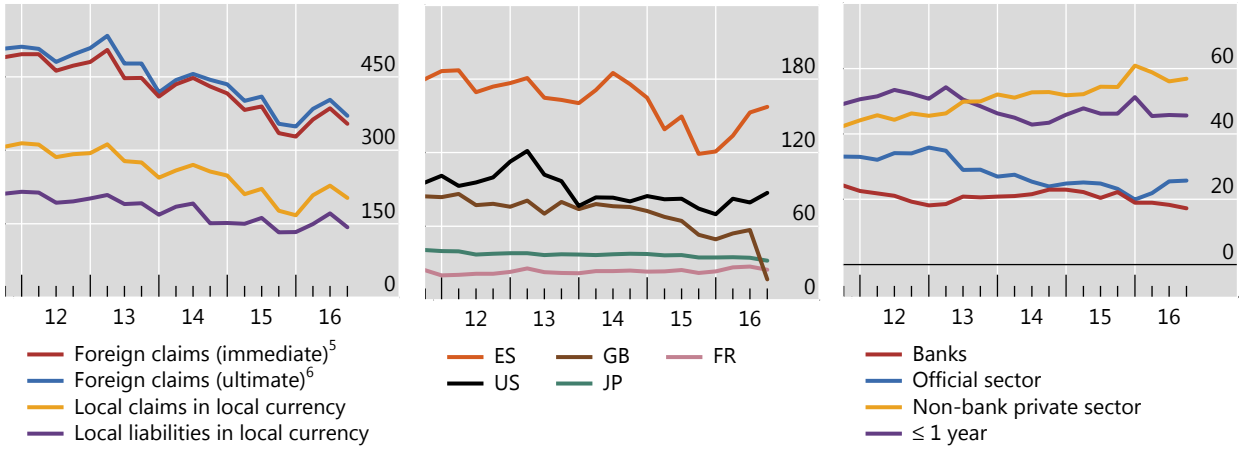
On China



On Turkey



On Brazil



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

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

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

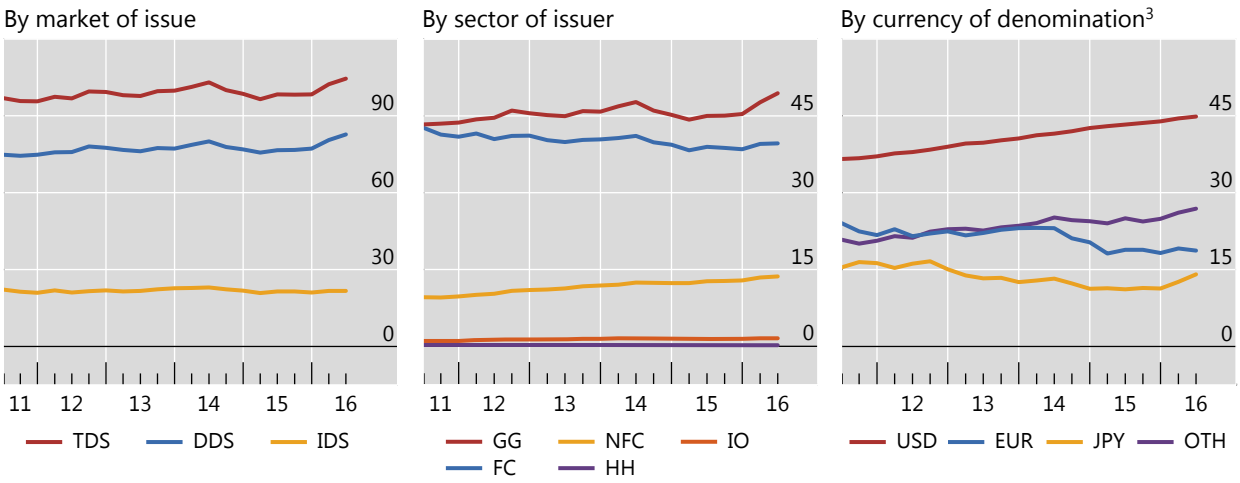
Source: BIS consolidated banking statistics (CBS).

C Debt securities statistics

Global debt securities markets[1]

Amounts outstanding, in trillions of US dollars[2]

Graph C.1



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

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

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.

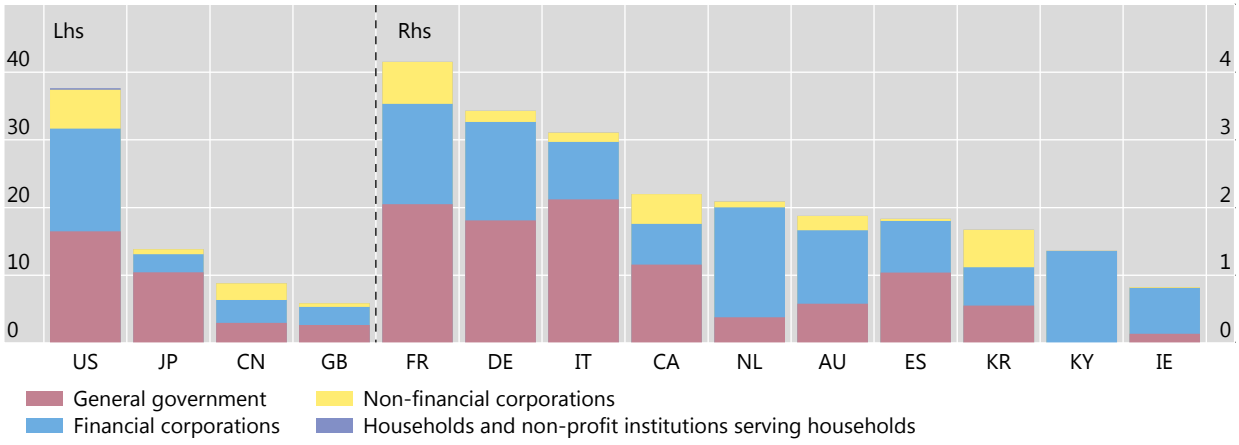
[1] Sample of countries varies across breakdowns shown. For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. For countries that do not report either TDS or DDS, data are estimated by the BIS as IDS. [2] At quarter-end. Amounts denominated in currencies other than the US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

Amounts outstanding at end-June 2016, in trillions of US dollars[2]

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.

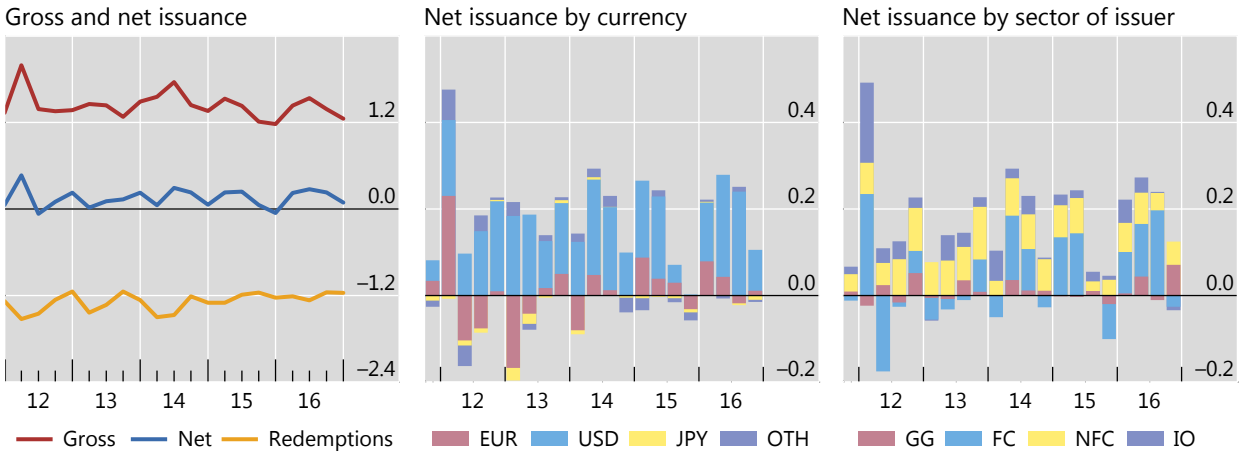
Further information on the BIS debt securities statistics is available at www.bis.org/statistics/secstats.htm.

[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.

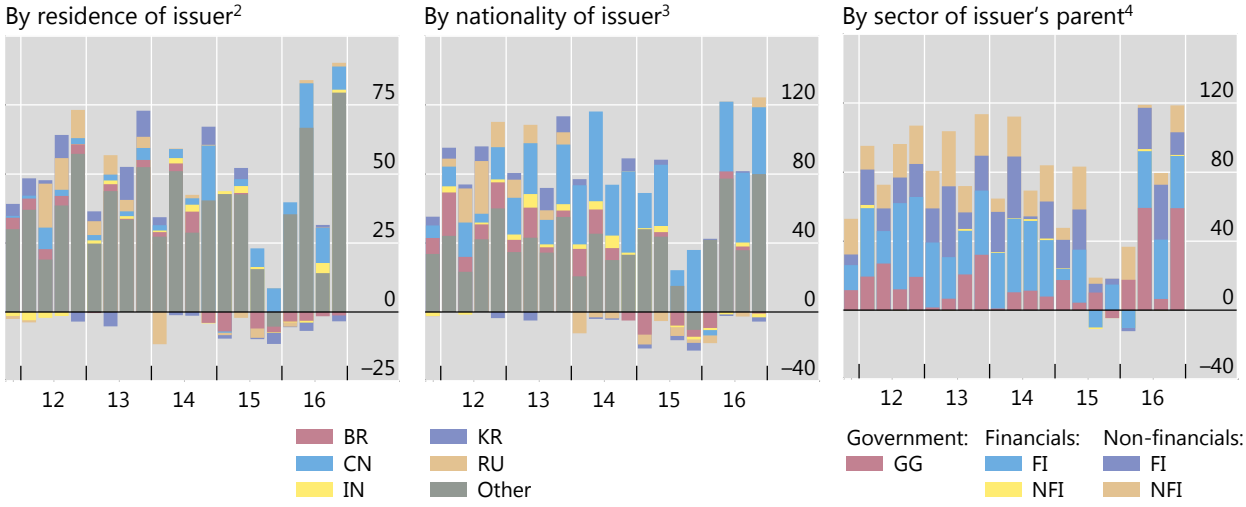
FC= financial corporations; GG = general government; IO = international organisations; NFC = non-financial corporations.

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 economies[1]

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

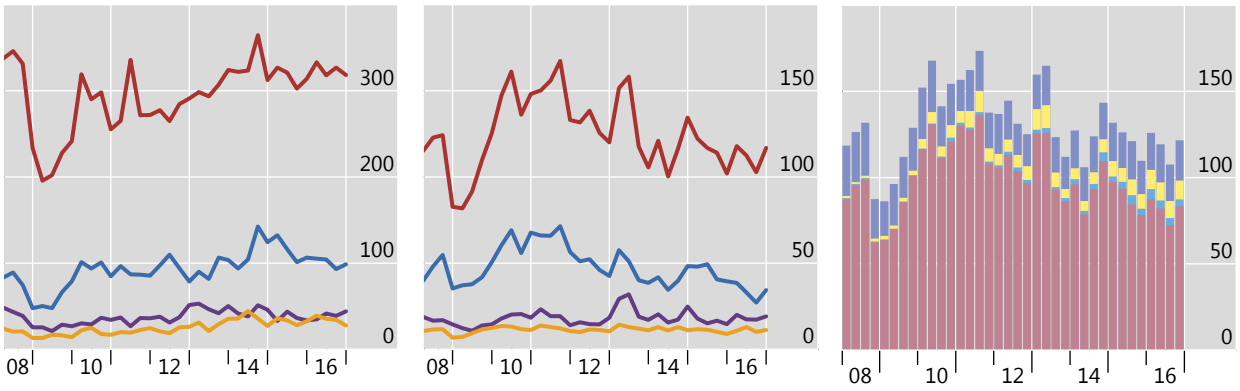
Graph D.1

Open interest, by currency[1]

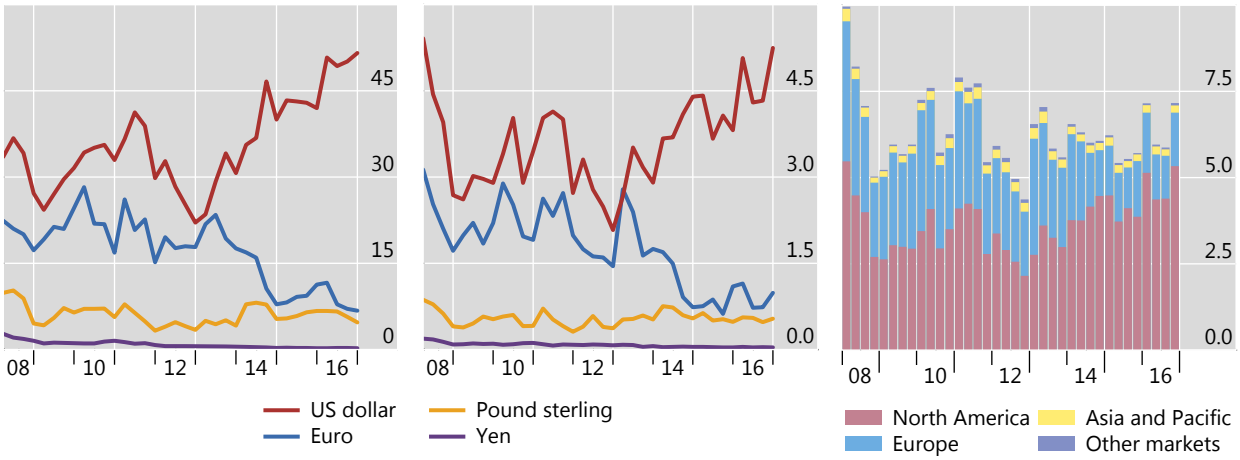
Daily average turnover, by currency[2]

Daily average turnover, by location of exchange[2]

Foreign exchange derivatives, USD bn[3]



Interest rate derivatives, USD trn[3]



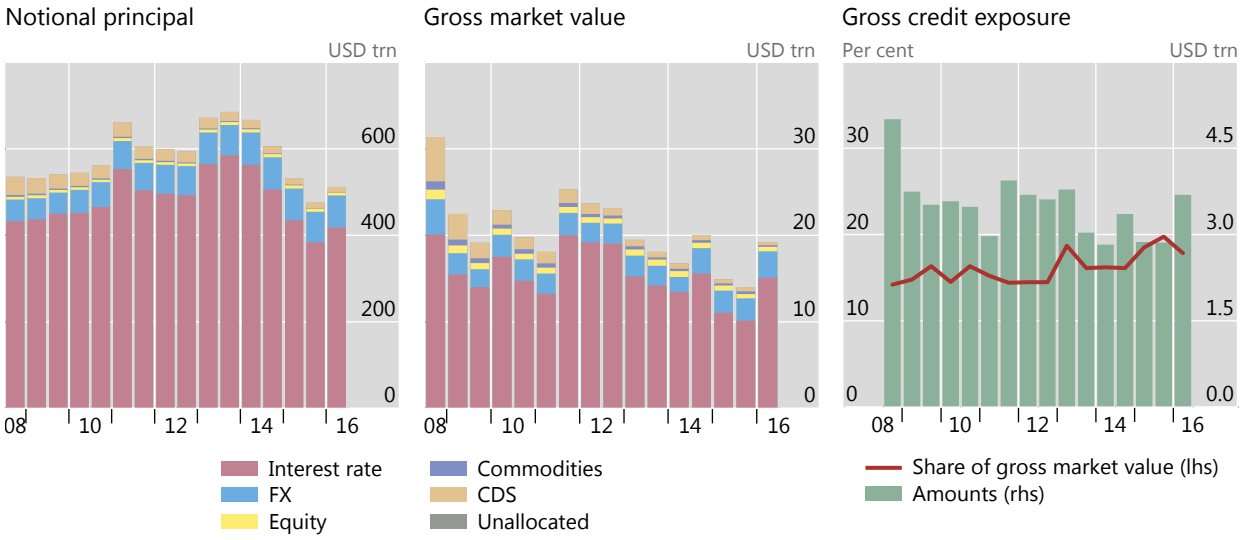
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/extderiv.htm.

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

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

Global OTC derivatives markets[1]

Graph D.2



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

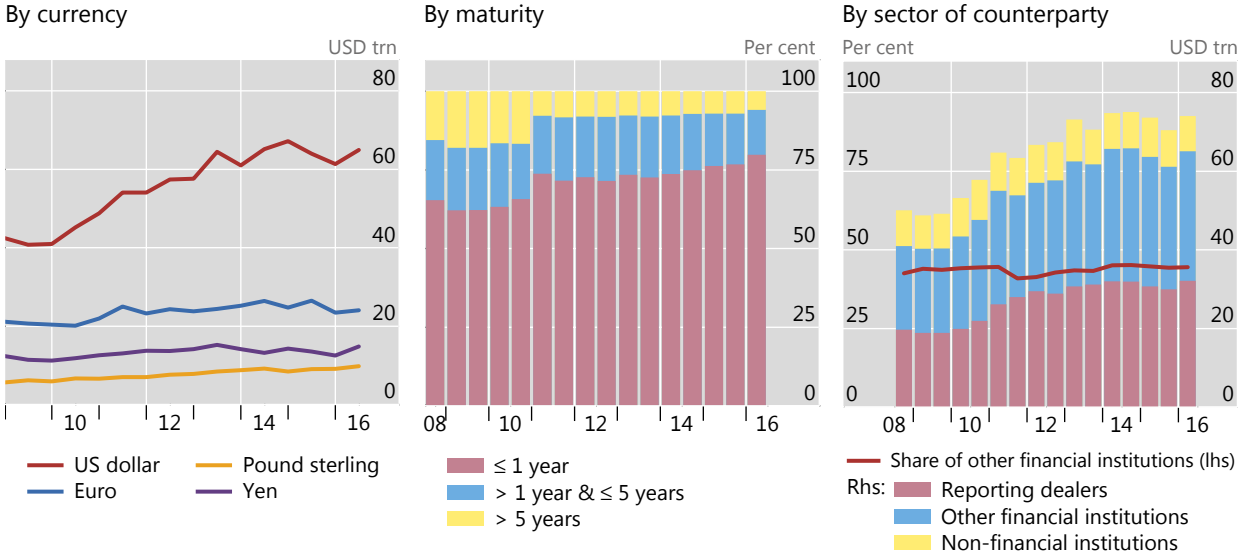
[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC foreign exchange derivatives

Notional principal[1]

Graph D.3



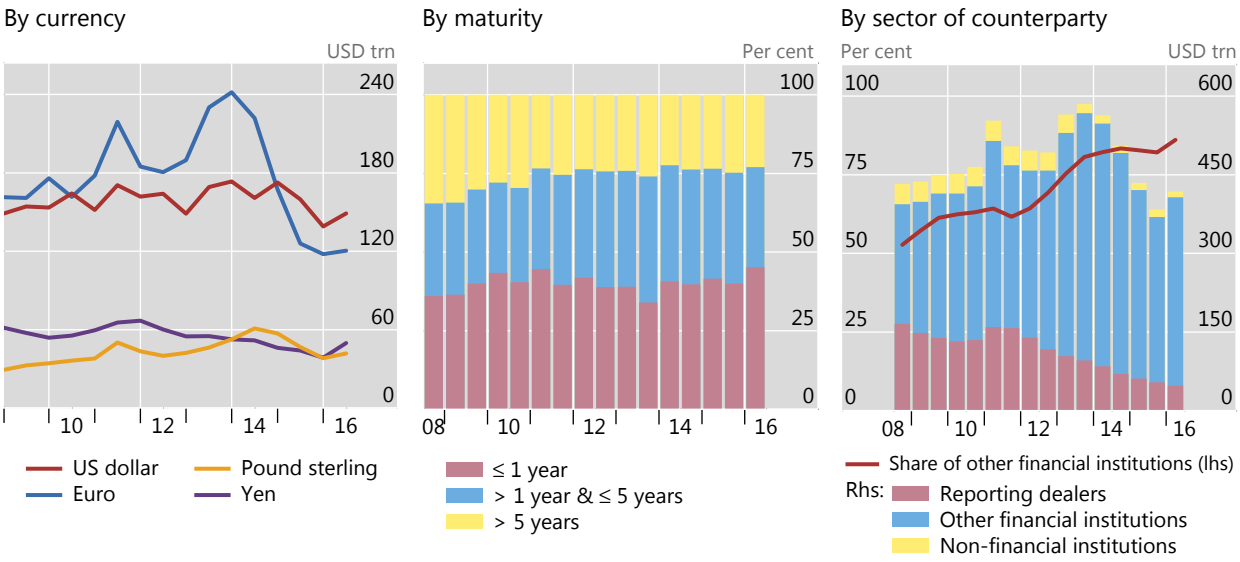
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

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

Source: BIS derivatives statistics.

OTC interest rate derivatives

Notional principal[1] Graph D.4



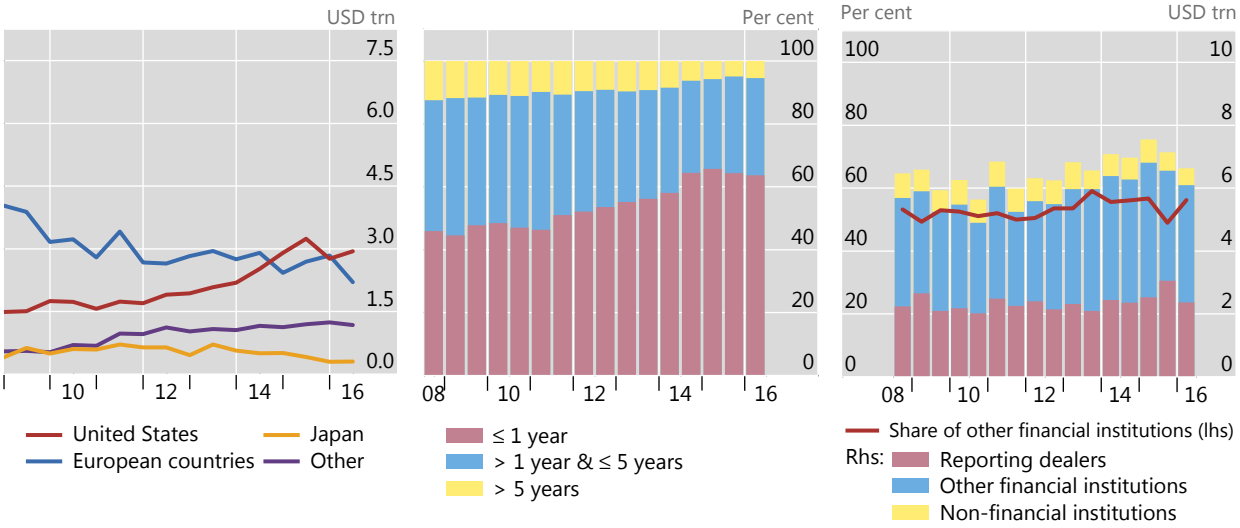
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

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

Source: BIS derivatives statistics.

OTC equity-linked derivatives

Notional principal[1] Graph D.5



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

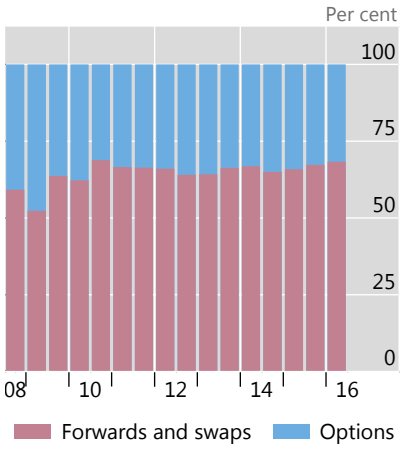
[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

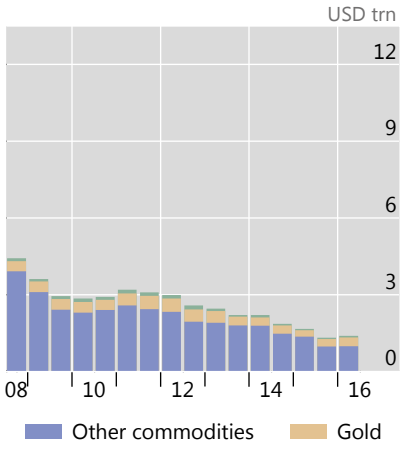
OTC commodity derivatives[1]

Graph D.6

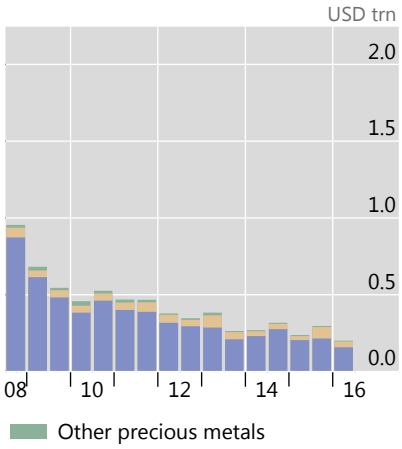
Notional principal, by instrument



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.

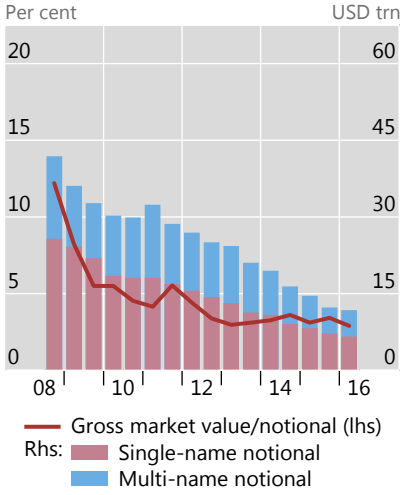
[1] At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

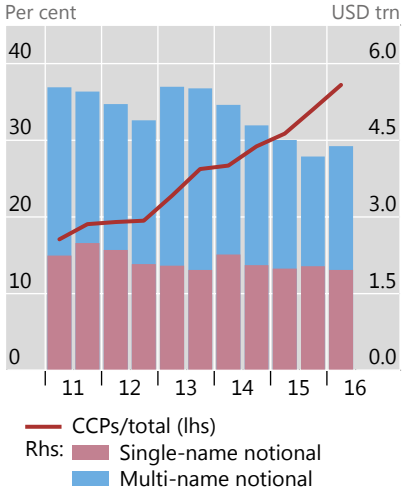
Credit default swaps[1]

Graph D.7

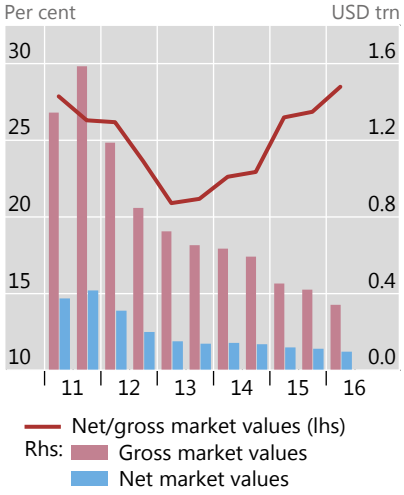
Notional principal



Notional principal with central counterparties (CCPs)



Impact of netting



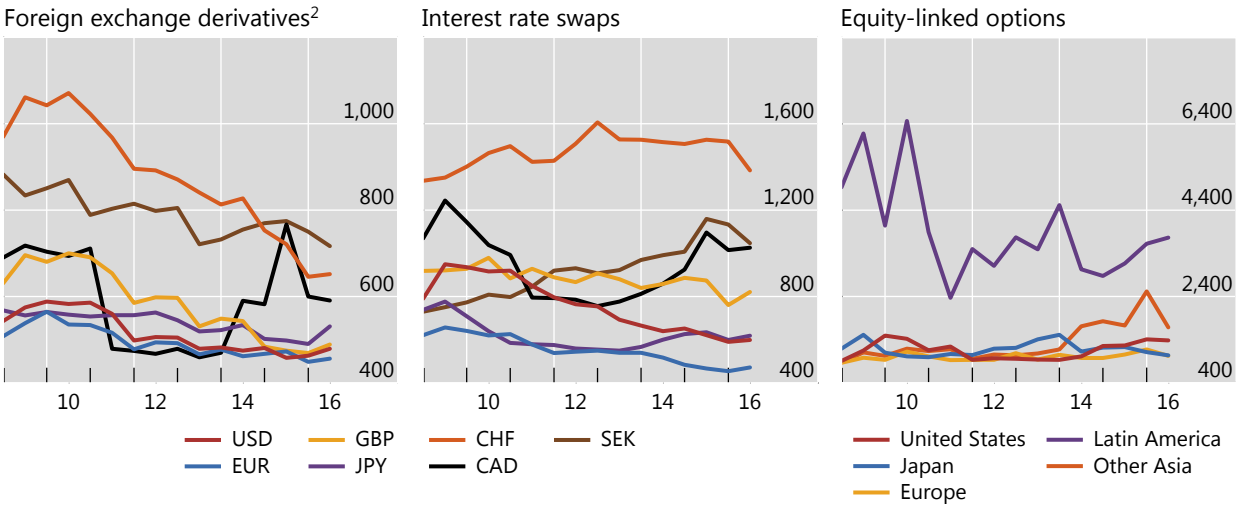
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

[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 index[1] 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.

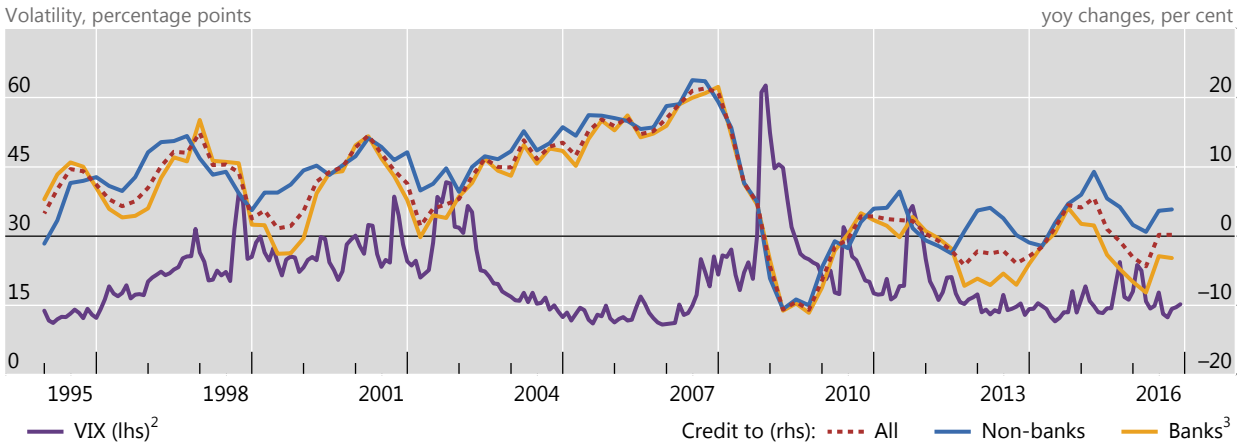
[1] The index ranges from 0 to 10,000, where a lower number indicates that there are many dealers with similar market shares (as measured by notional principal) and a higher number indicates that the market is dominated by a few reporting dealers. [2] Foreign exchange forwards, foreign exchange swaps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

Source: BIS derivatives statistics.

E Global liquidity indicators

Growth of international bank credit[1]

Graph E.1



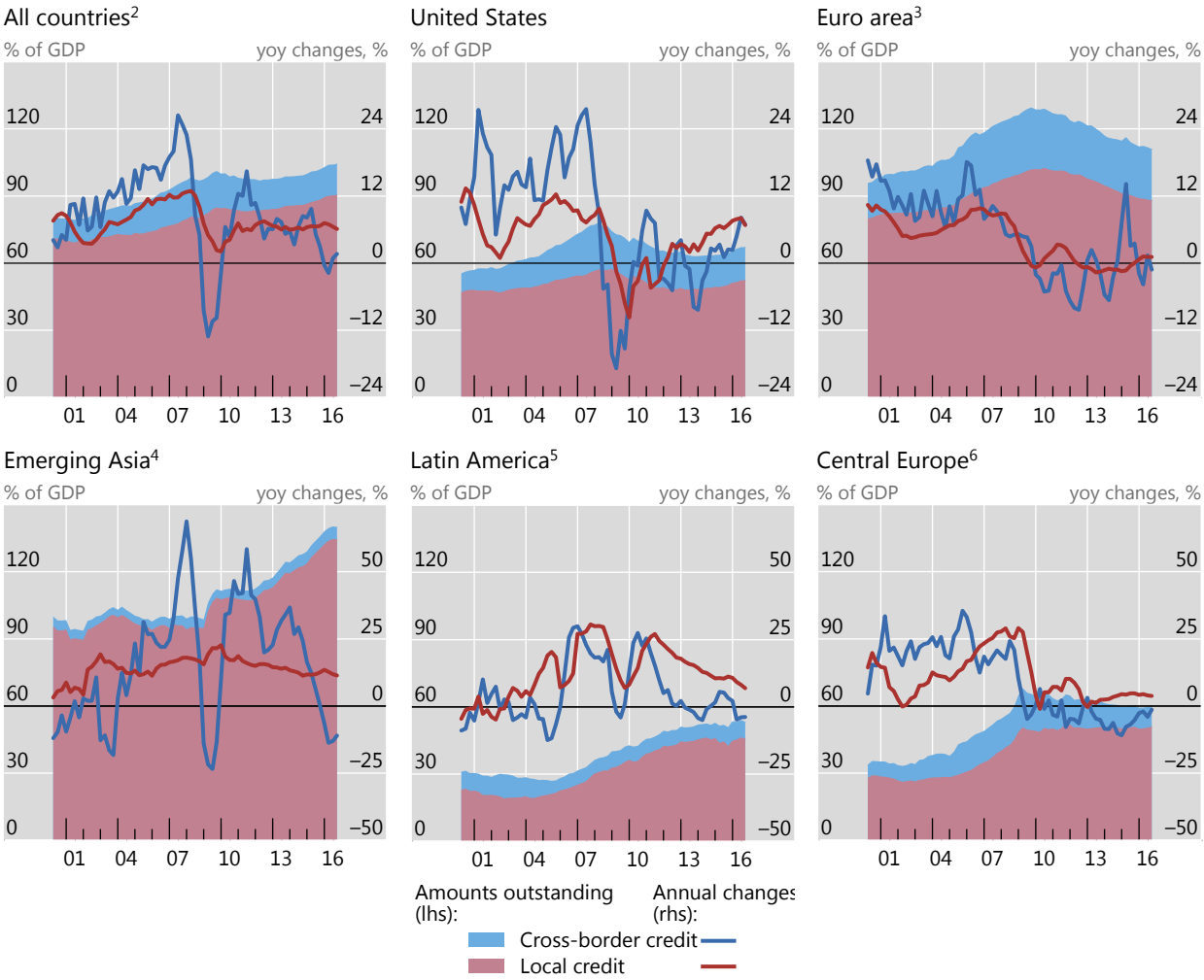
Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

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

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

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

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



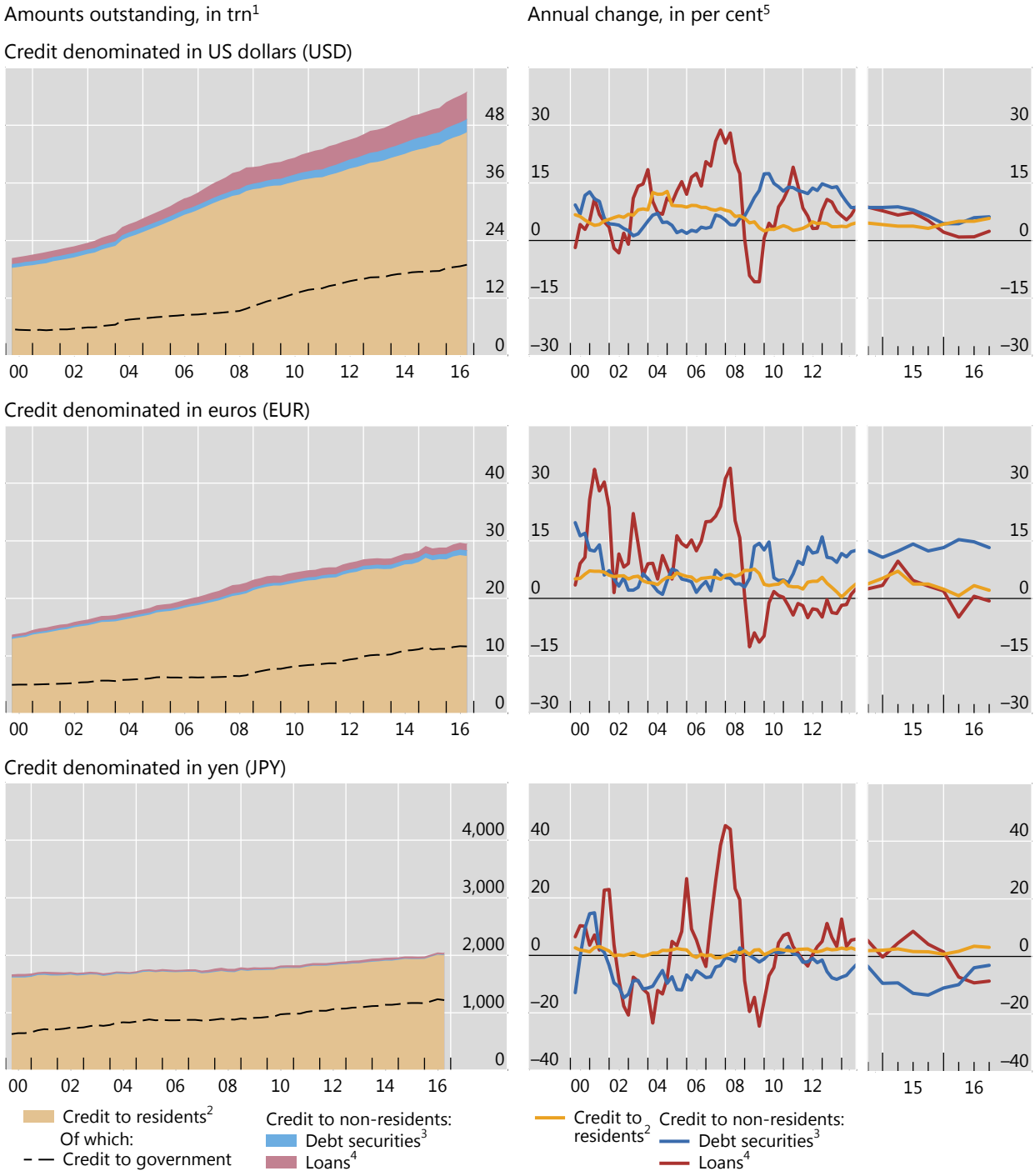
Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

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

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

Global credit to the non-financial sector, by currency

Graph E.3



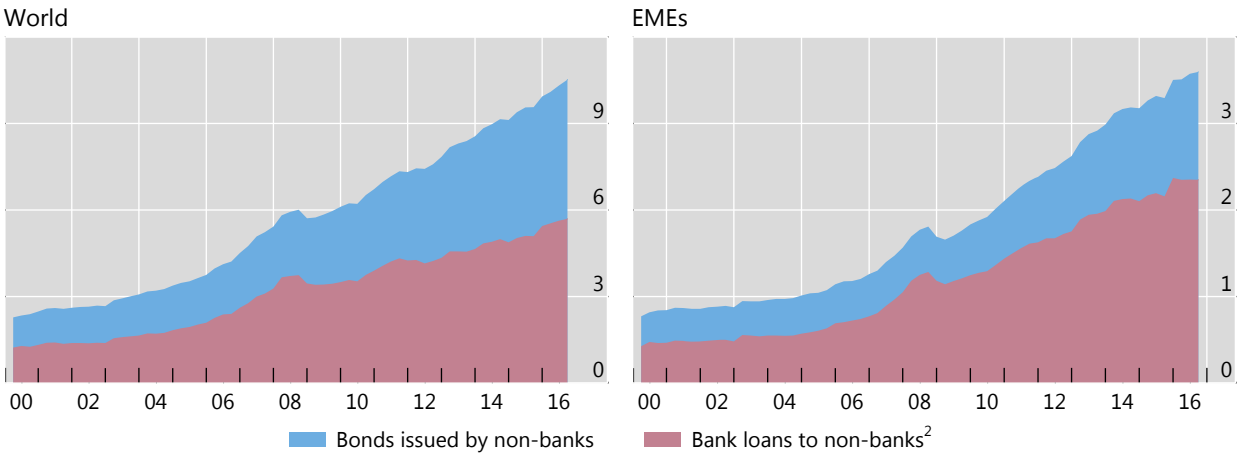
Further information on the BIS global liquidity indicators is available at www.bis.org/statistics/gli.htm.

[1] Amounts outstanding at quarter-end, in national currency. [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 borrowers, including non-bank financial entities, comprise cross-border plus local loans. For countries that do not report local positions, 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 onlent to non-banks. [5] Geometric mean of quarterly break- and exchange rate-adjusted changes.

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 States[1]

Amounts outstanding, in trillions of US dollars — Graph E.4



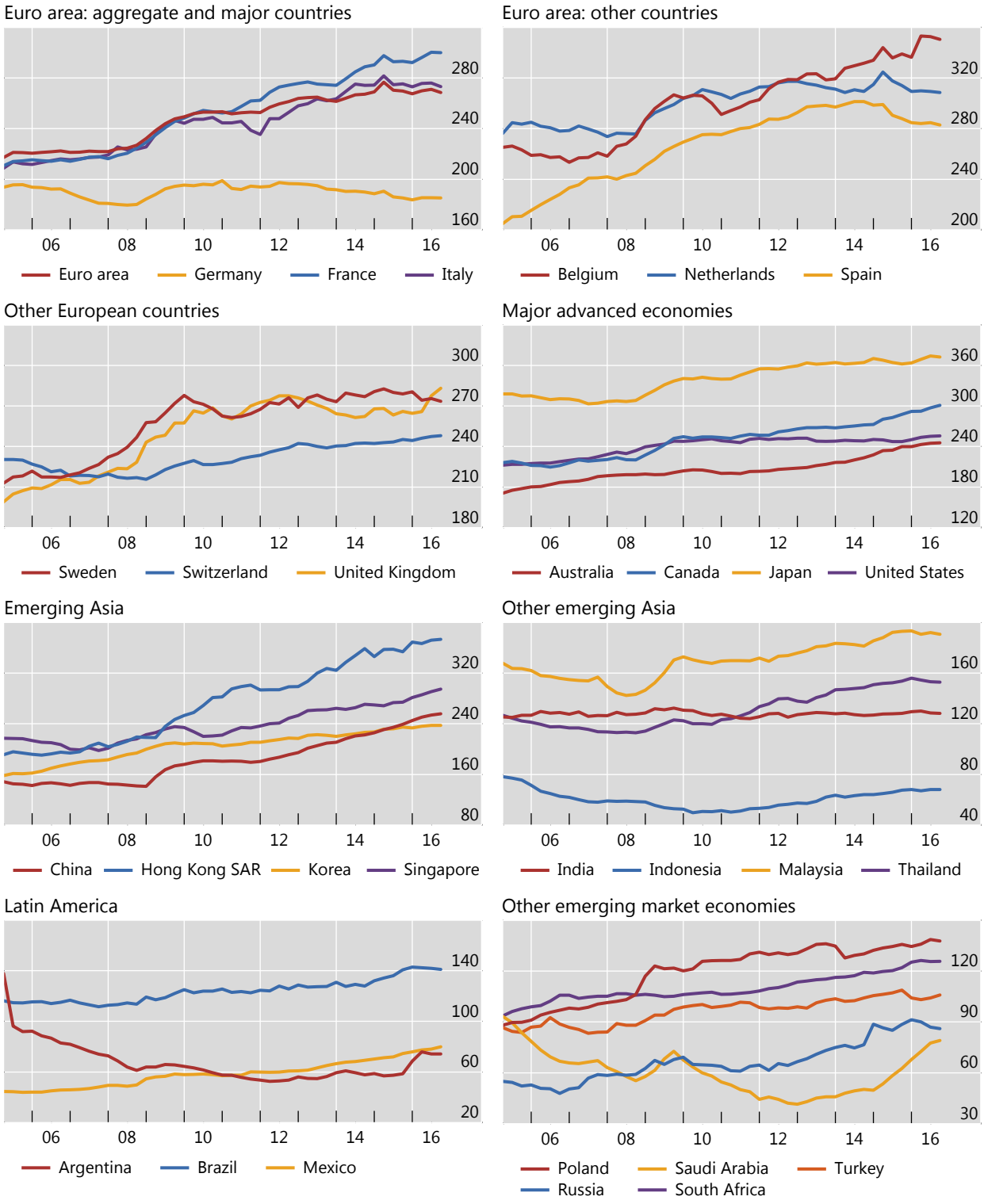
[1] Non-banks comprise non-bank financial entities, non-financial corporations, governments, households and international organisations. [2] Loans by LBS-reporting banks to non-bank borrowers, including non-bank financial entities, comprise cross-border plus local loans. For countries that do not report local positions, 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.

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

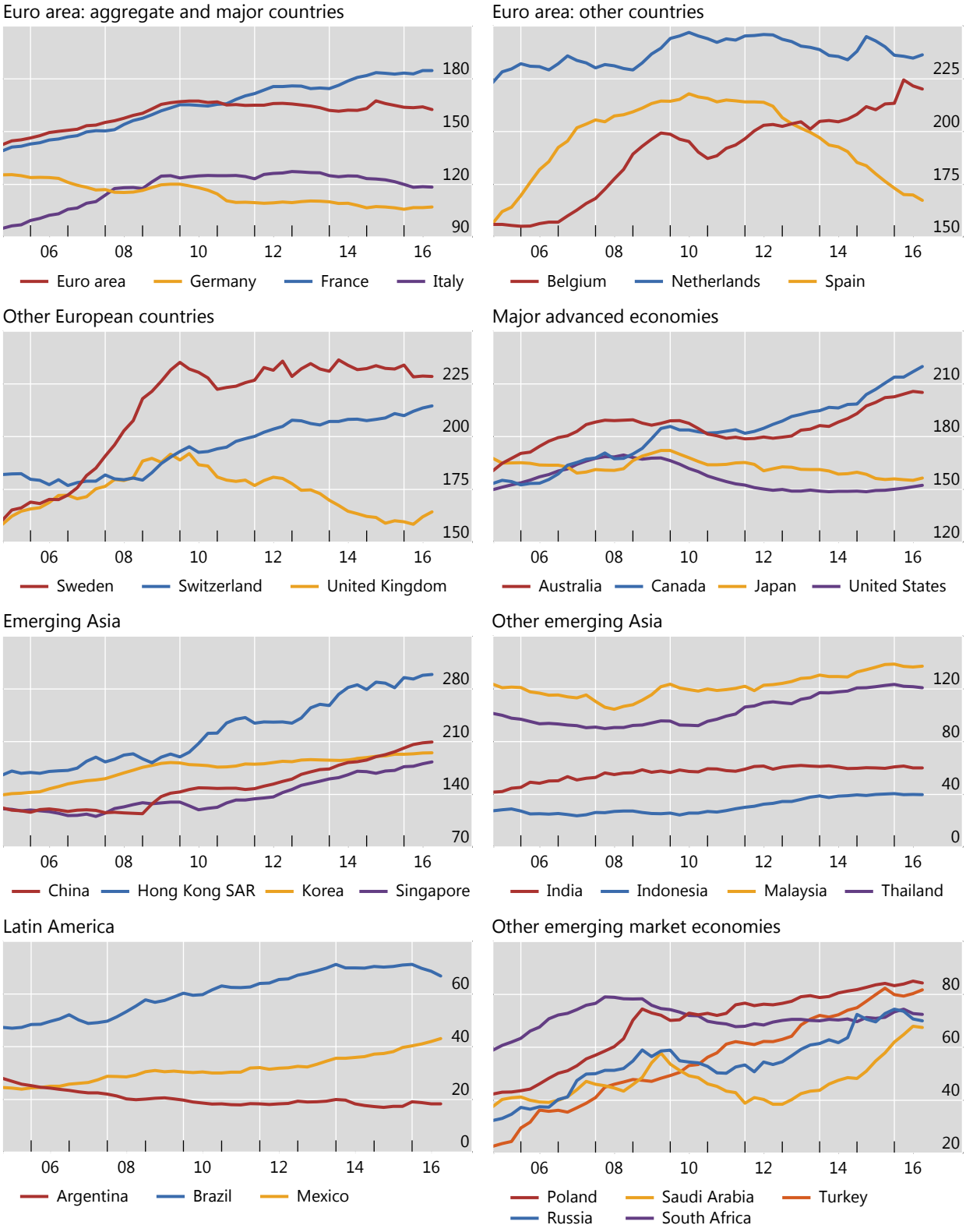


Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

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

As a percentage of GDP — Graph F.2



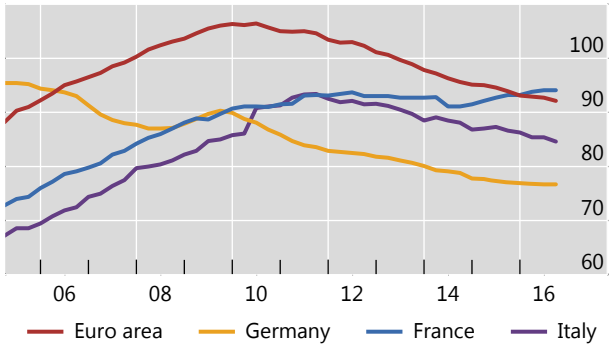
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

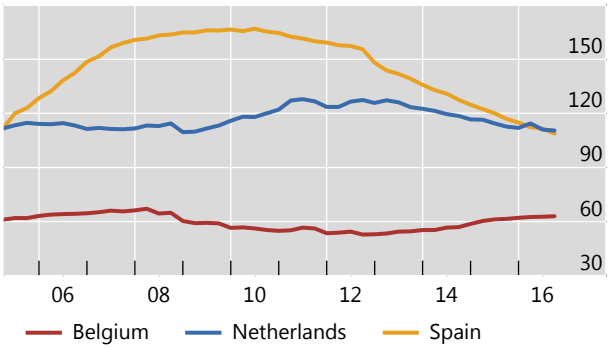
Bank credit to the private non-financial sector (core debt)

As a percentage of GDP — Graph F.3

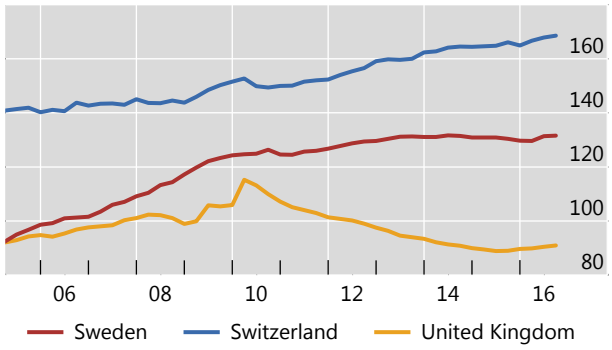
Euro area: aggregate and major countries



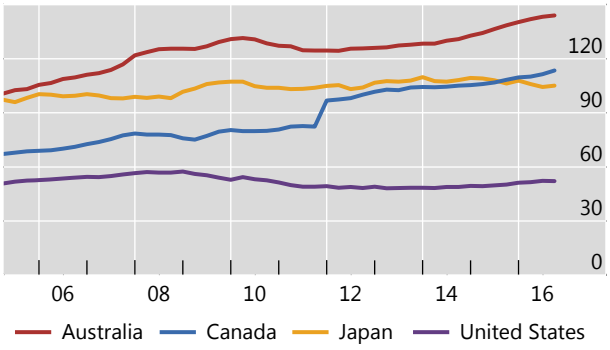
Euro area: other countries



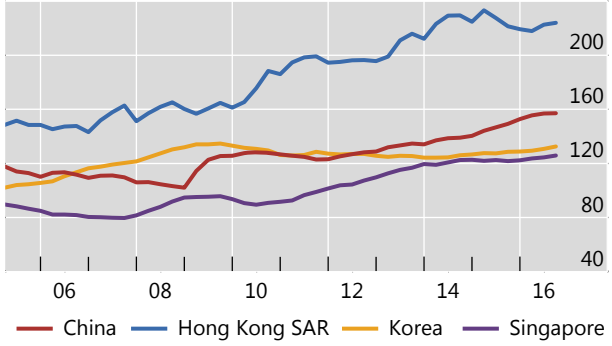
Other European countries



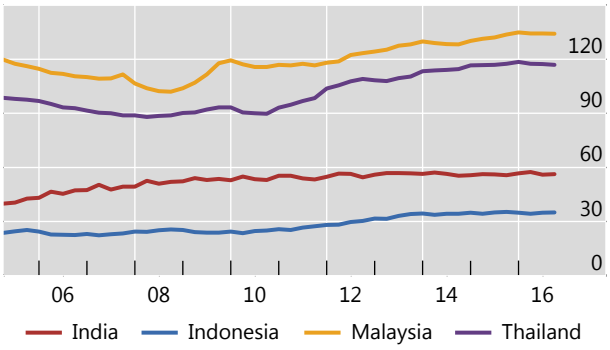
Major advanced economies



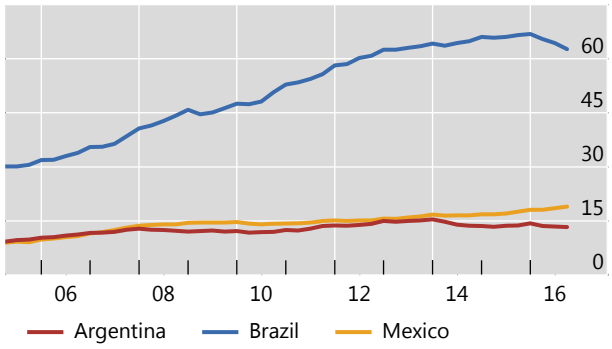
Emerging Asia



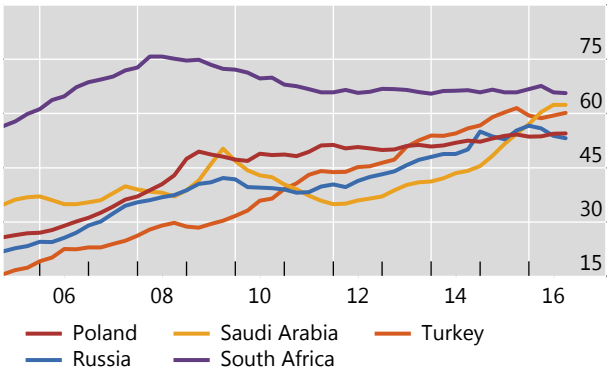
Other emerging Asia



Latin America



Other emerging market economies



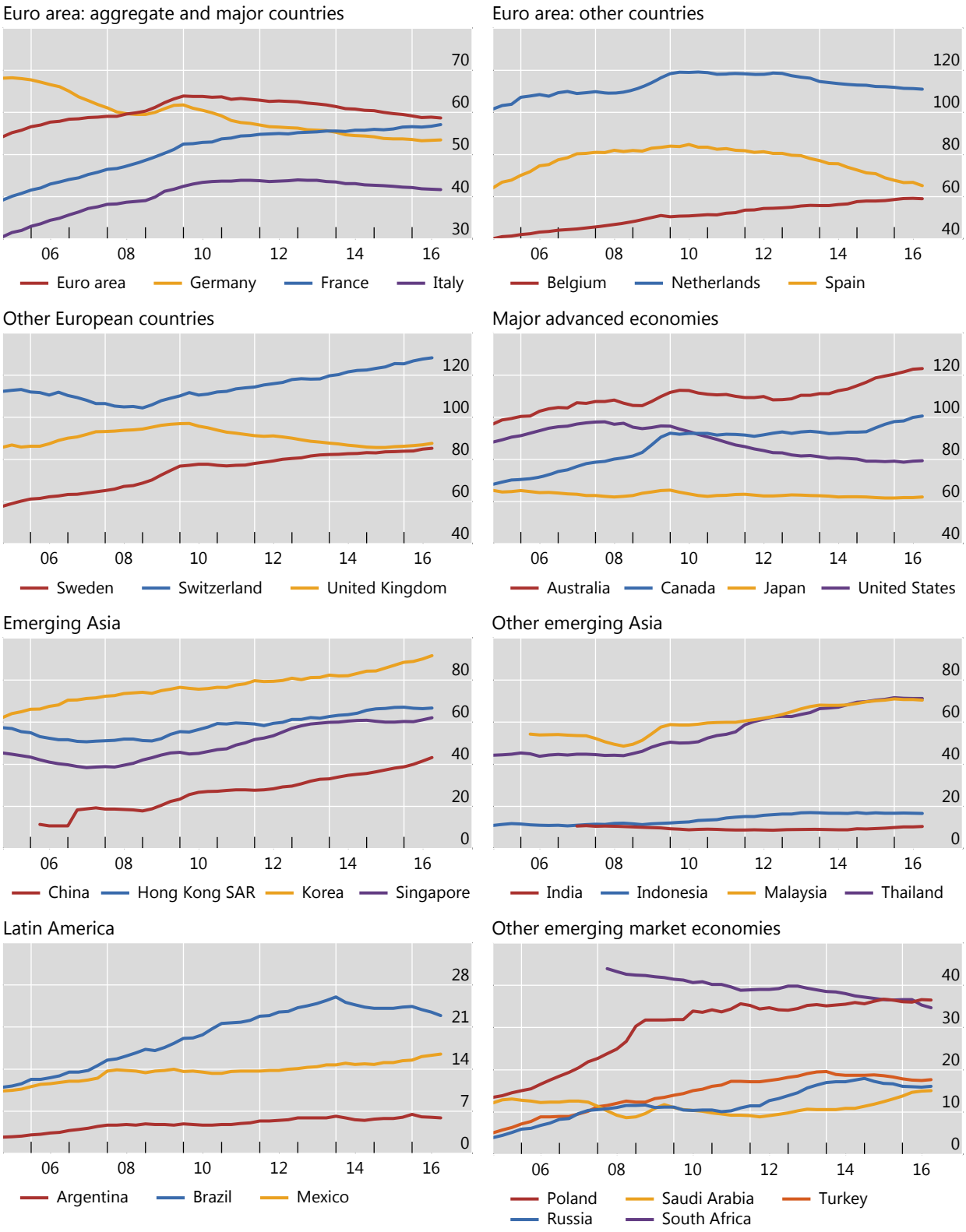
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

Total credit to households (core debt)

As a percentage of GDP

Graph F.4



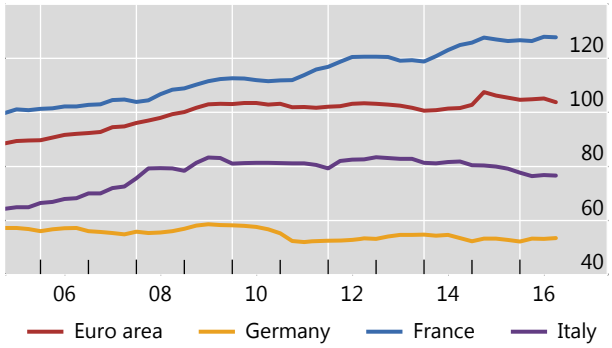
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

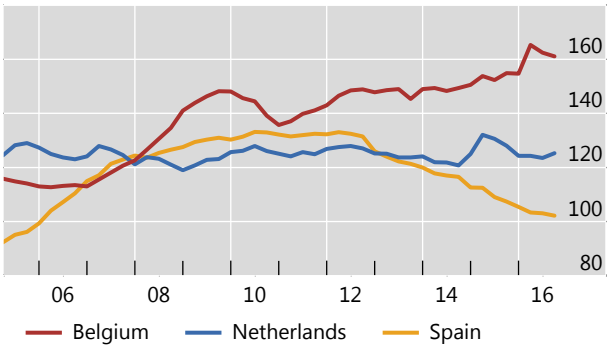
Total credit to non-financial corporations (core debt)

As a percentage of GDP — Graph F.5

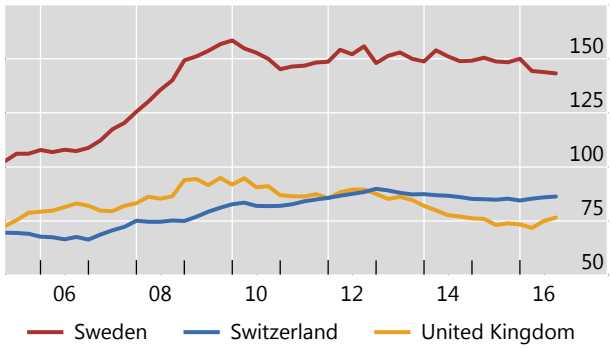
Euro area: aggregate and major countries



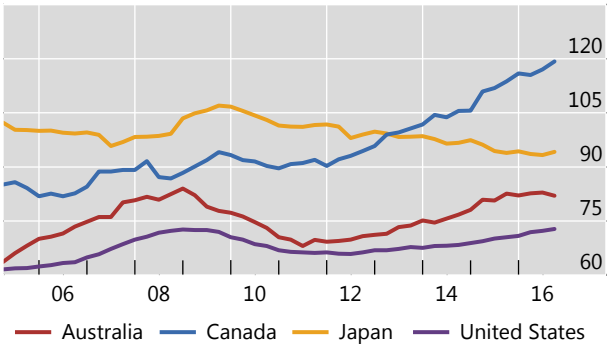
Euro area: other countries



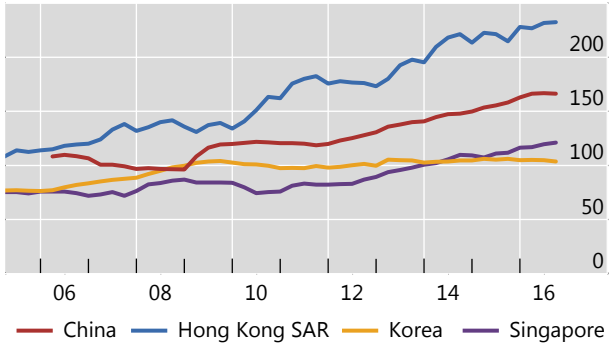
Other European countries



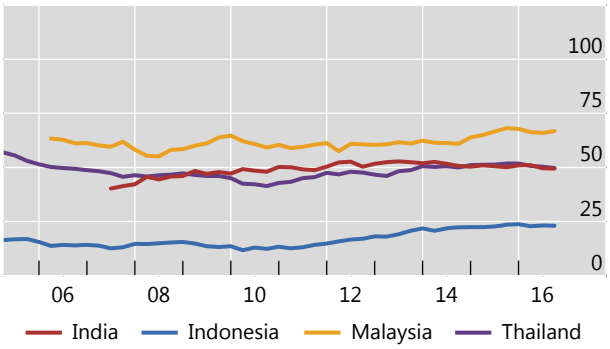
Major advanced economies



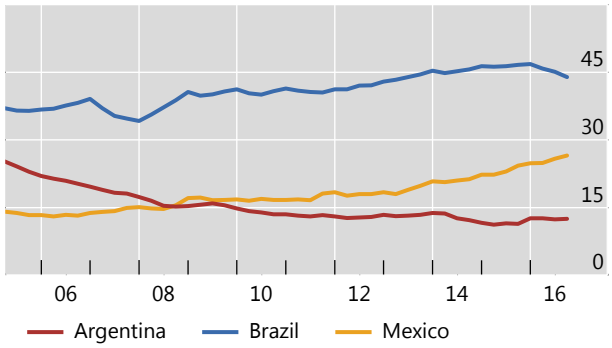
Emerging Asia



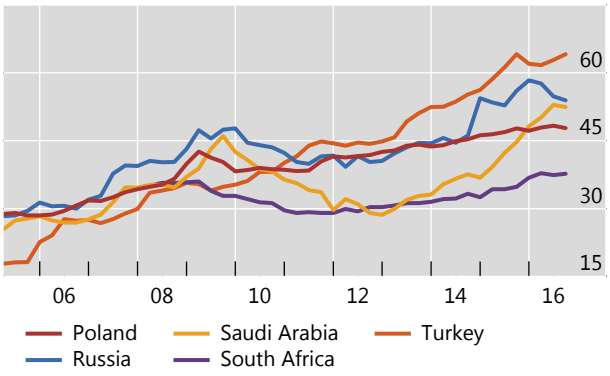
Other emerging Asia



Latin America



Other emerging market economies



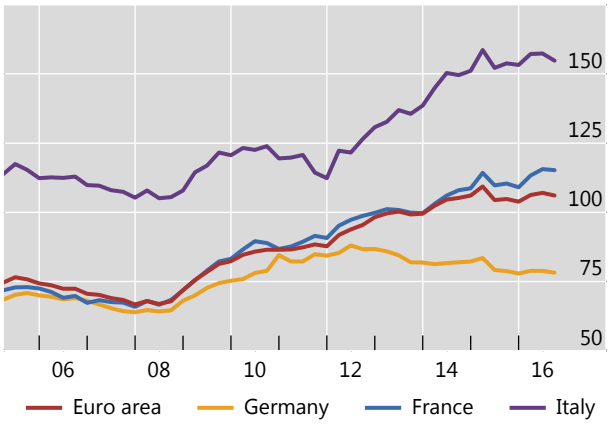
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

Source: BIS total credit statistics.

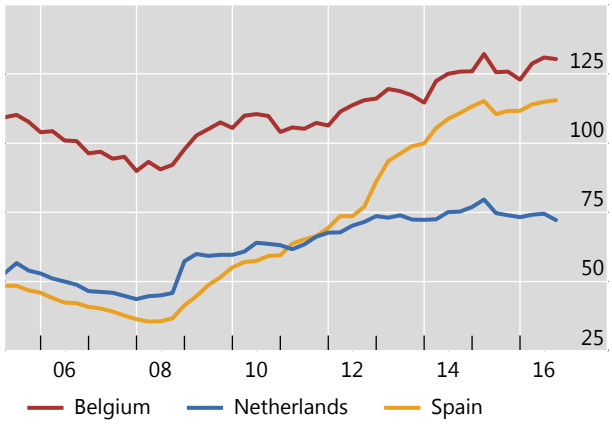
Total credit to the government sector at market value (core debt)[1]

As a percentage of GDP — Graph F.6

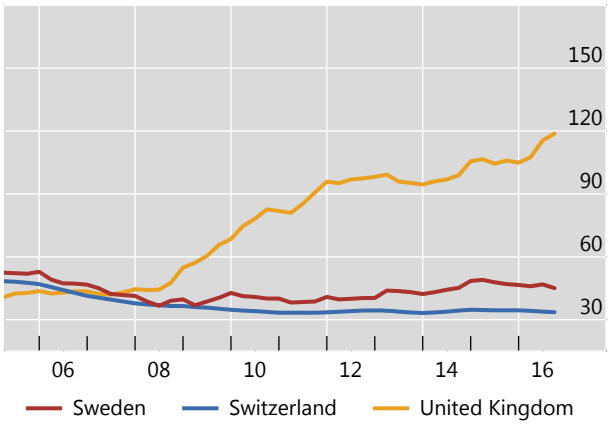
Euro area: aggregate and major countries



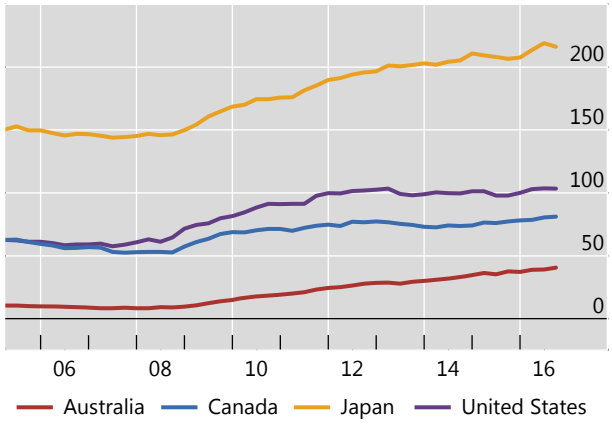
Euro area: other countries



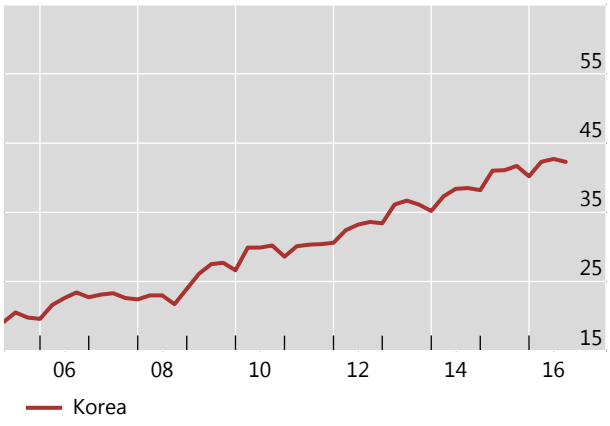
Other European countries



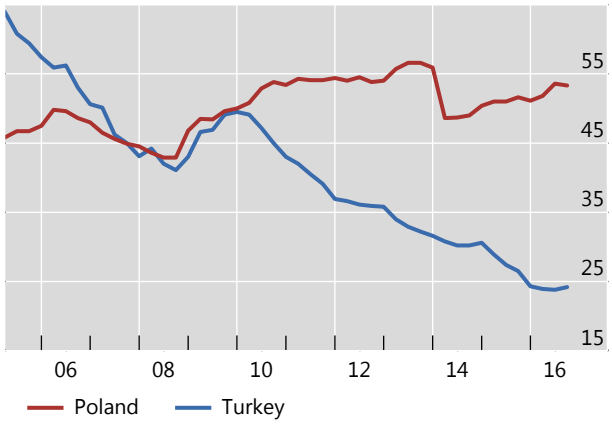
Major advanced economies



Emerging Asia



Other emerging market economies



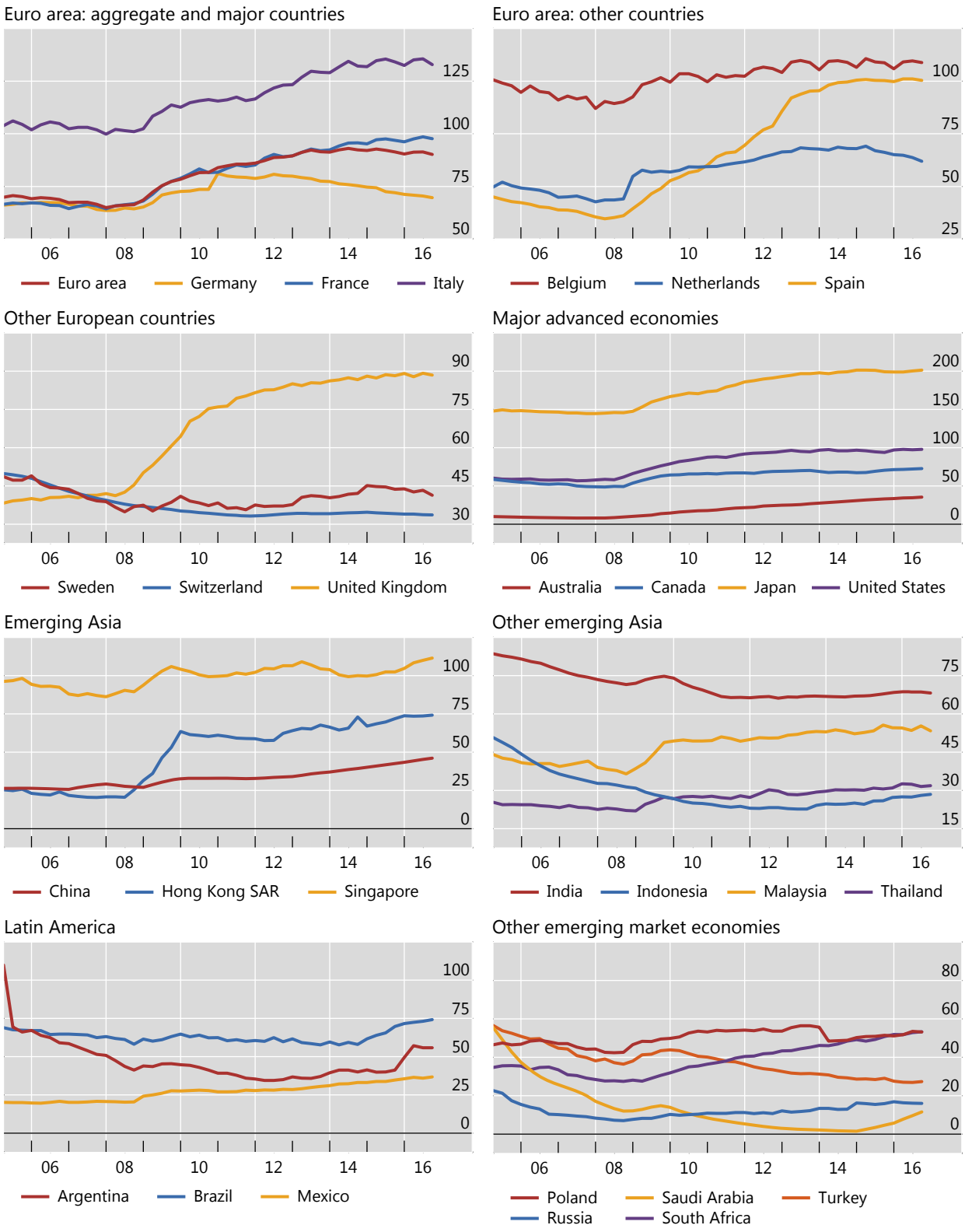
Further information on the BIS credit statistics is available at www.bis.org/statistics/totcredit.htm.

[1] Consolidated data for the general government sector.

Source: BIS total credit statistics.

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

As a percentage of GDP — Graph F.7



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

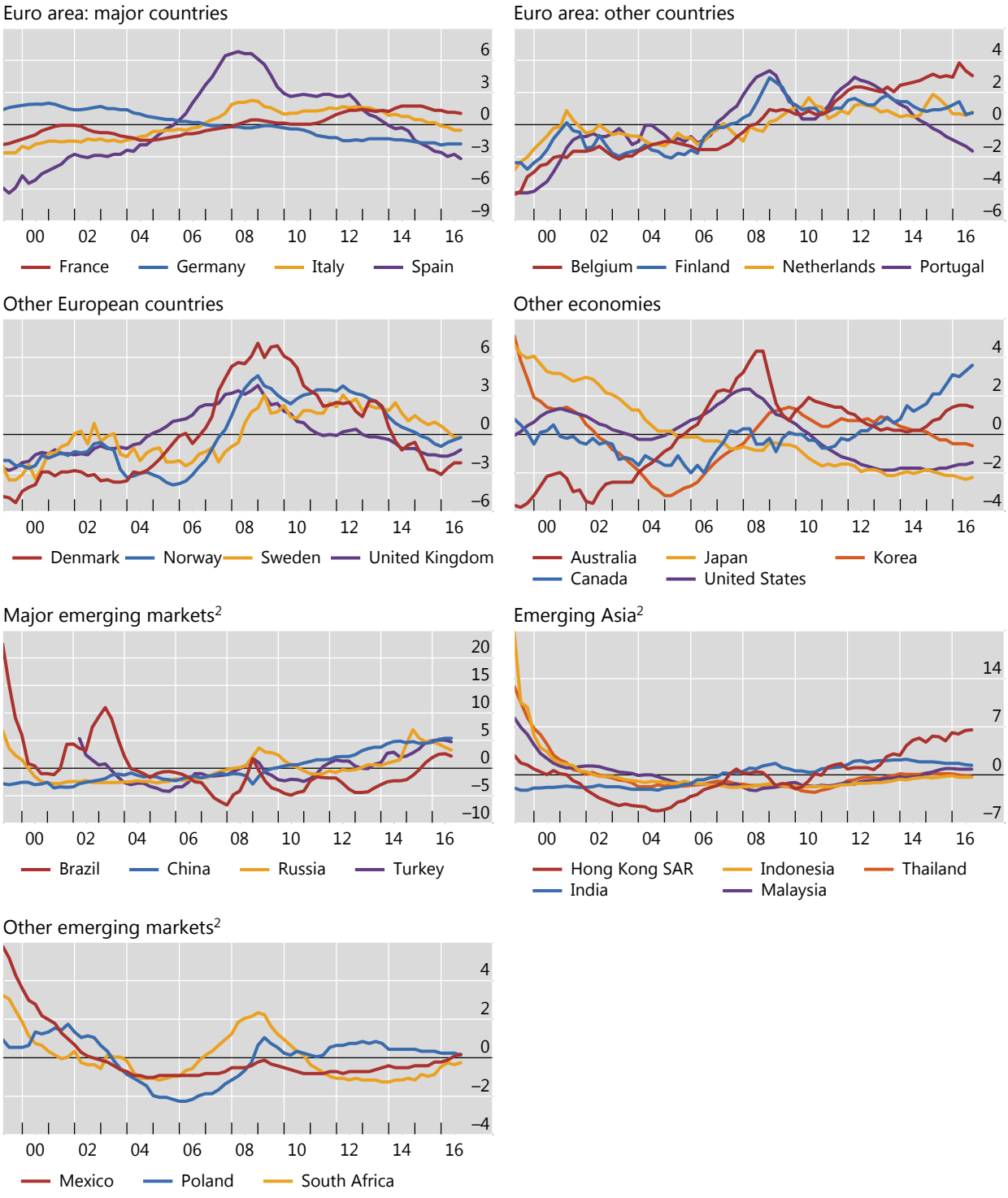
[1] Consolidated data for the general government sector; central government for Argentina, Indonesia, Malaysia, Mexico, Saudi Arabia and Thailand.

Source: BIS total credit statistics.

G Debt service ratios for the private non-financial sector

Debt service ratios of the private non-financial sector

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



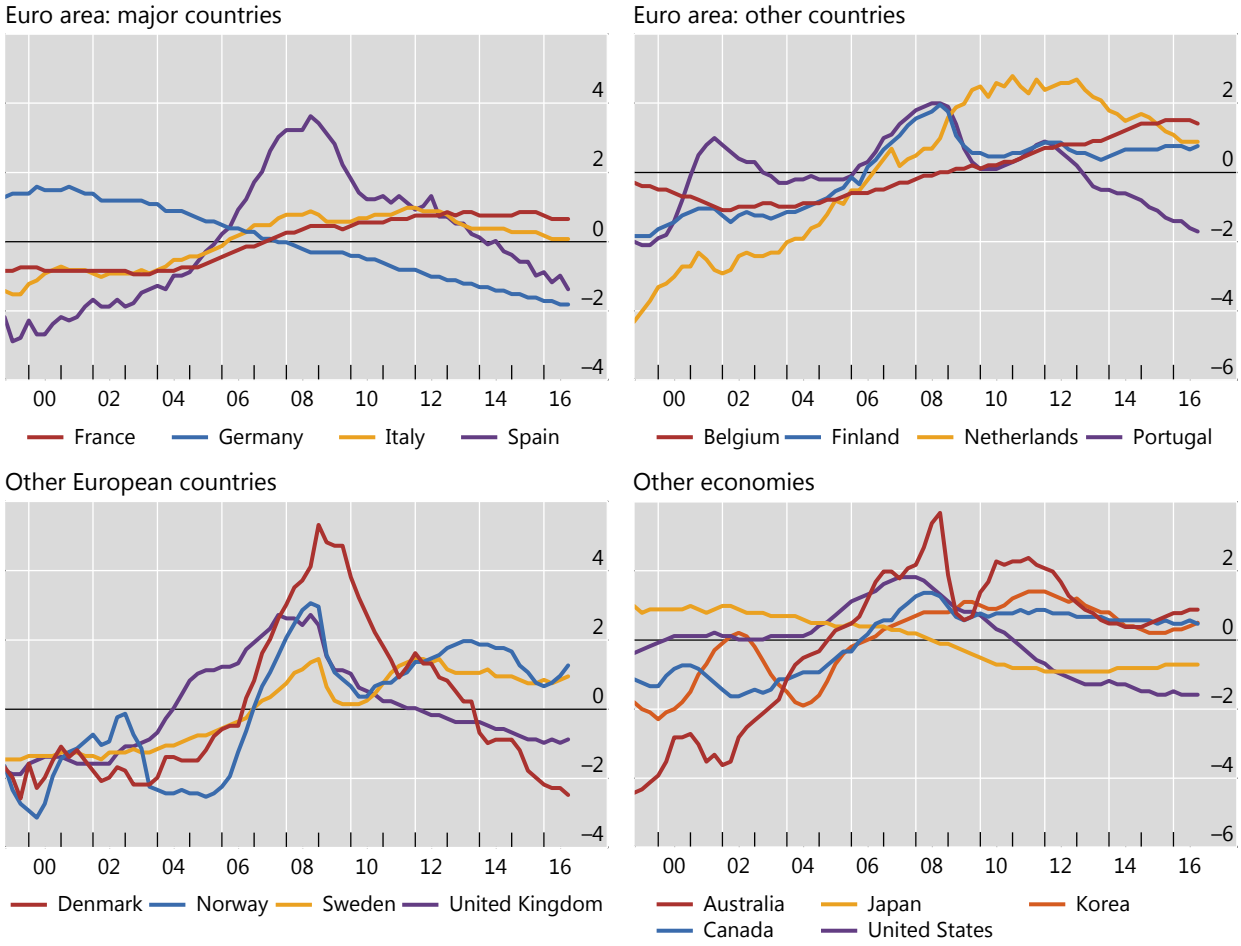
Further information on the BIS debt service ratio statistics is available at www.bis.org/statistics/dsr.htm.

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

Source: BIS debt service ratios statistics.

Debt service ratios of households

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



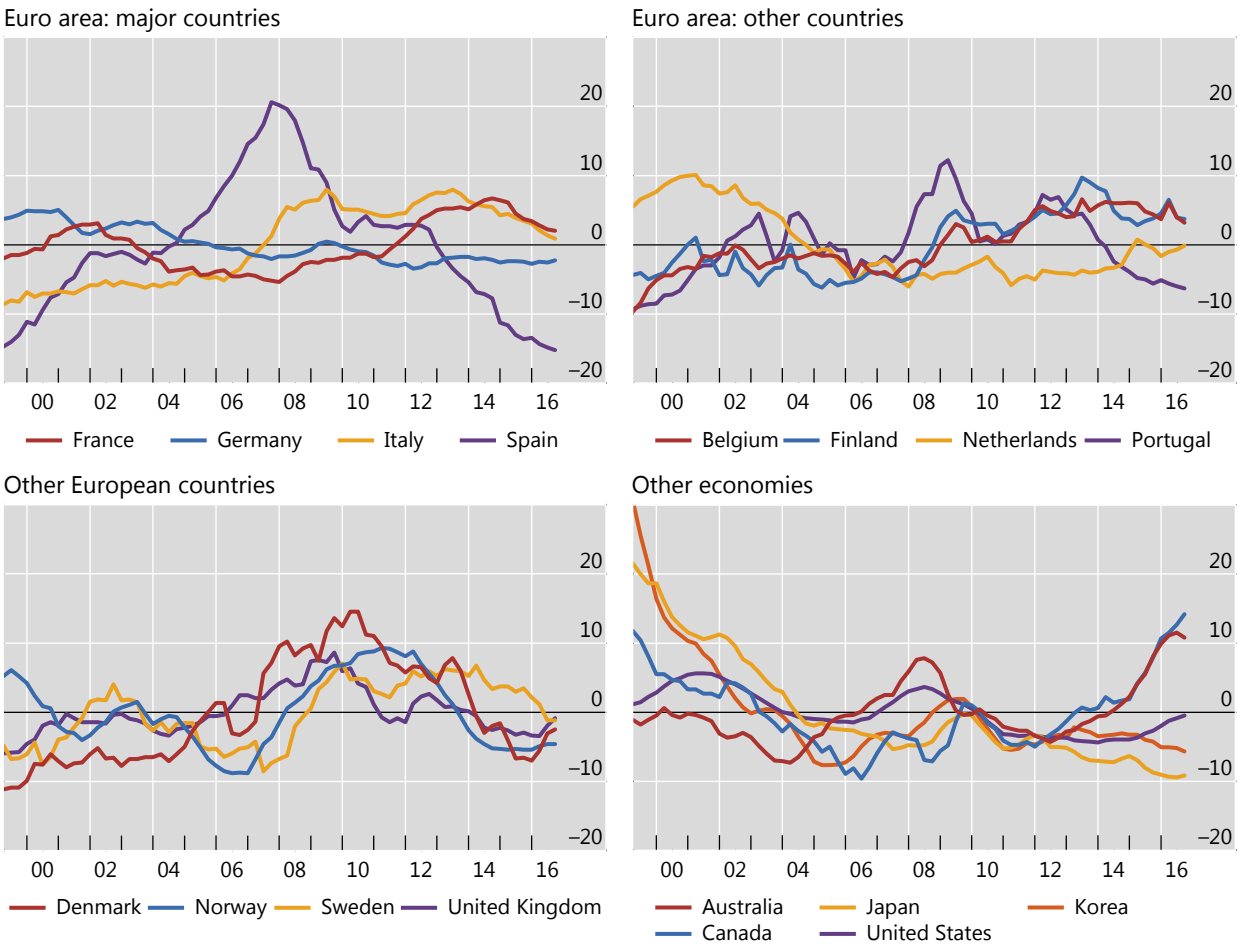
Further information on the BIS debt service ratio statistics is available at www.bis.org/statistics/dsr.htm.

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

Source: BIS debt service ratios statistics.

Debt service ratios of non-financial corporations

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



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

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

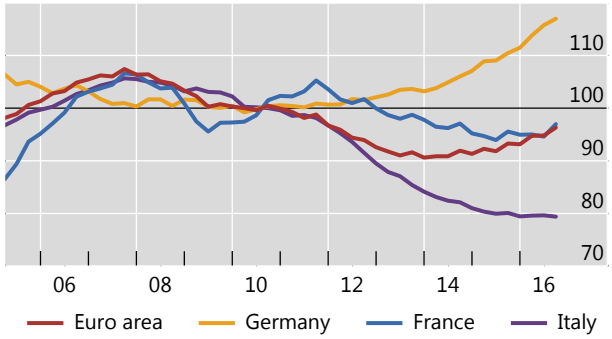
Source: BIS debt service ratios statistics.

H Property price statistics

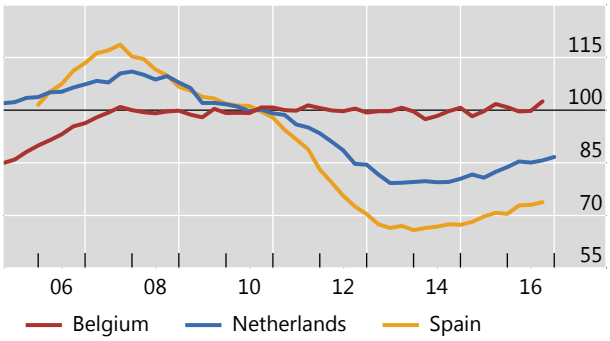
Real residential property prices

CPI-deflated, 2010 = 100 Graph H.1

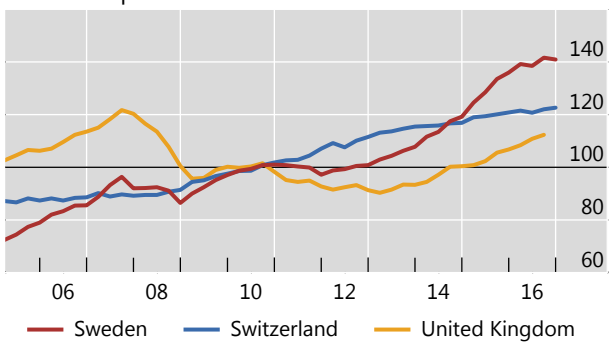
Euro area: aggregate and major countries



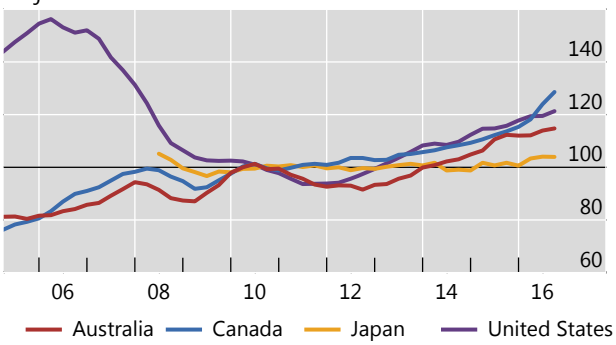
Euro area: other countries



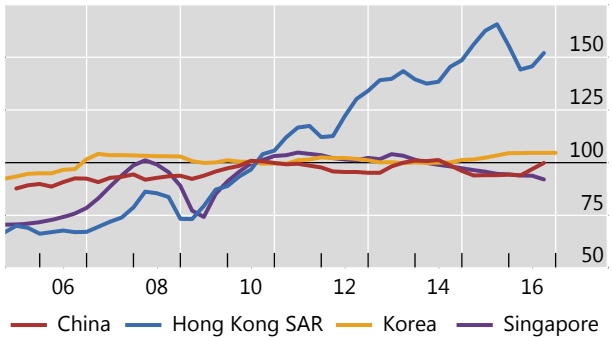
Other European countries



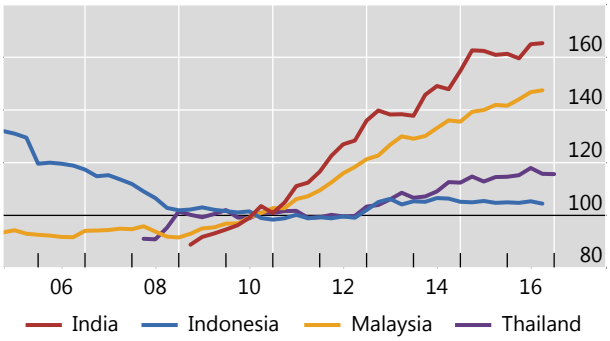
Major advanced economies



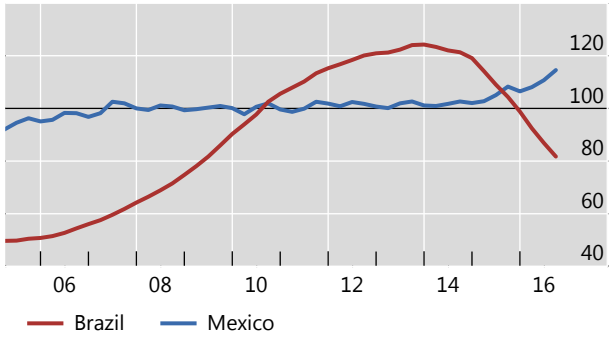
Emerging Asia



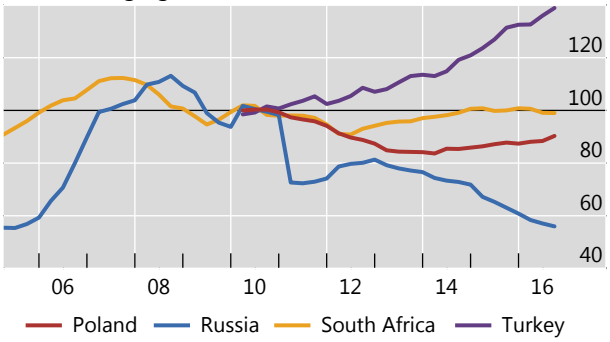
Other emerging Asia



Latin America



Other emerging market economies



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

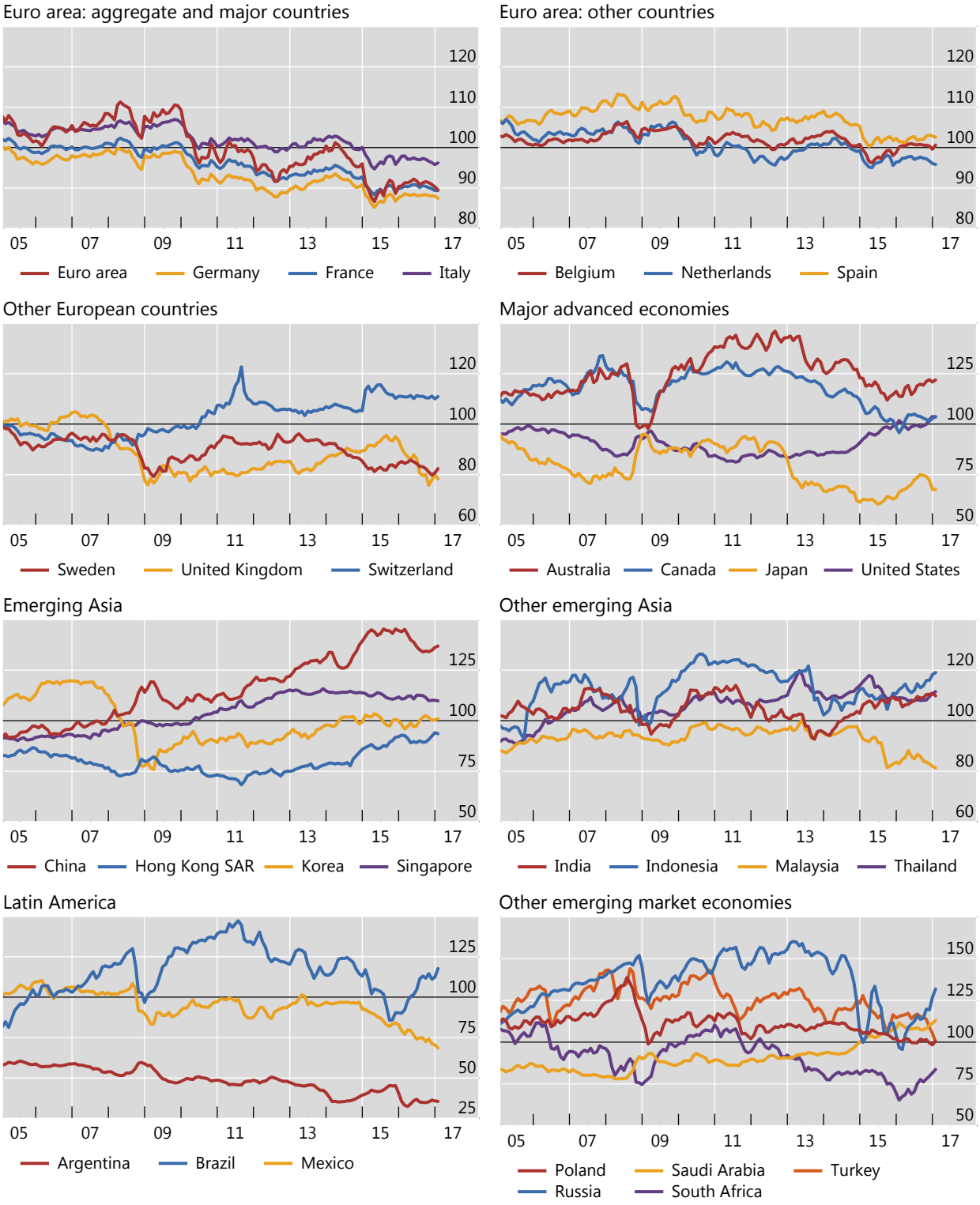
Source: BIS property prices statistics.

I Effective exchange rate statistics

Real effective exchange rates

CPI-based, 1995–2005 = 100[1]

Graph I.1



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

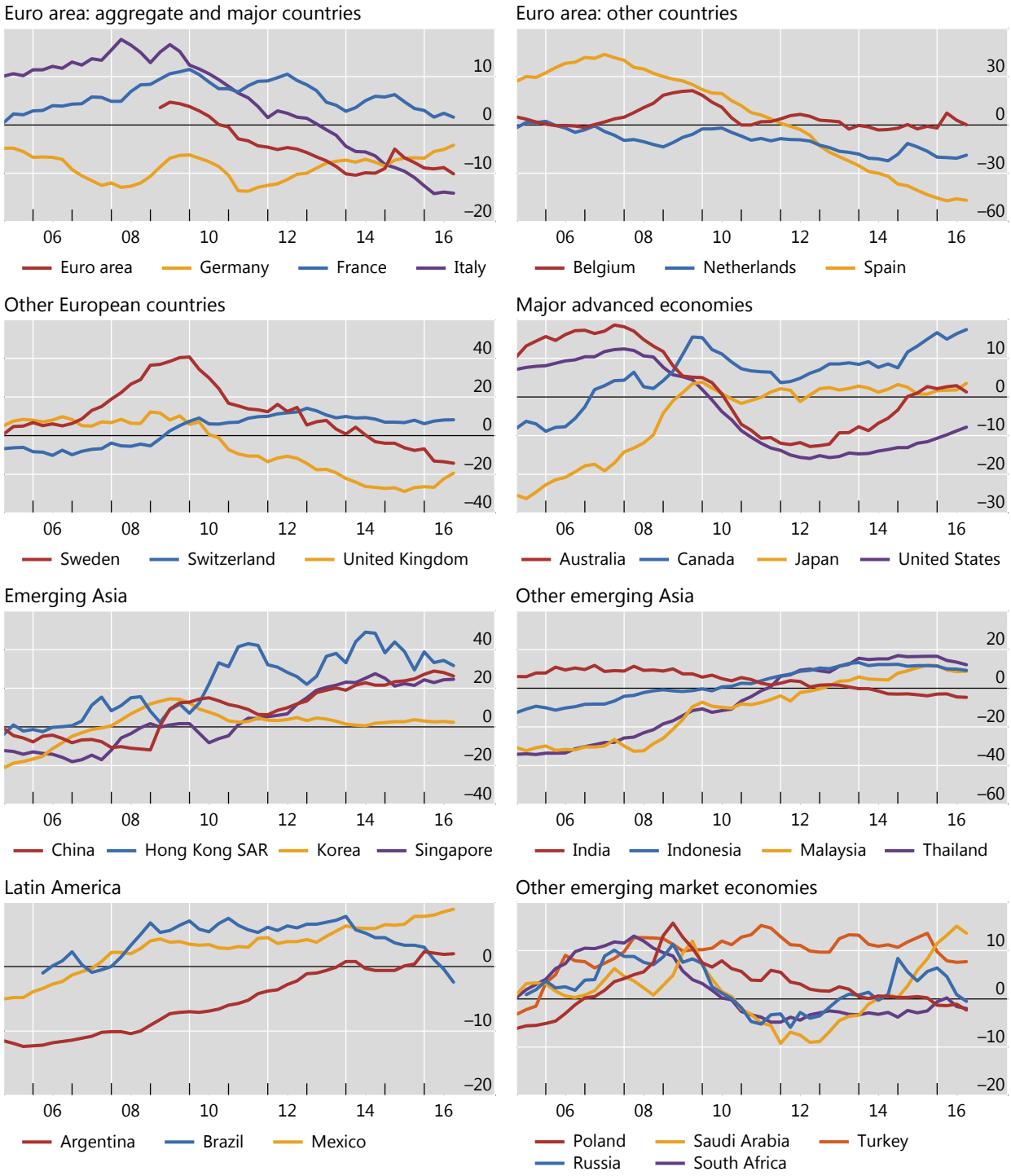
[1] An increase indicates a real-term appreciation of the local currency against a broad basket of currencies.

Source: BIS effective exchange rates statistics.

J Credit-to-GDP gaps

Credit-to-GDP gaps

In percentage points of GDP — Graph J.1



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

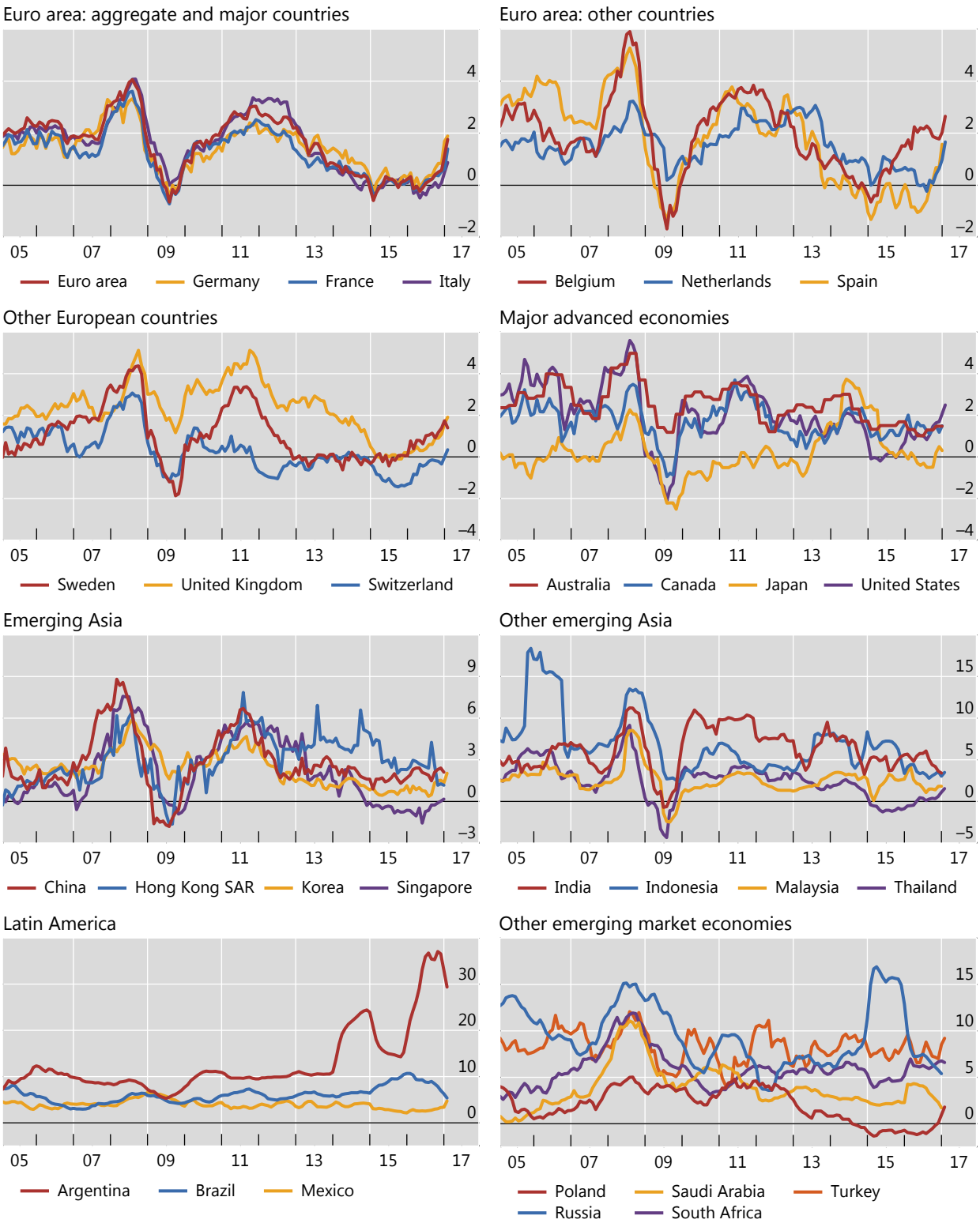
Source: BIS credit-to-GDP gaps statistics.

K Consumer prices

Consumer prices

Year-on-year percentage changes

Graph K.1



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

Source: BIS consumer price statistics.

Special features in the BIS Quarterly Review

December 2016	Downsized FX markets: causes and implications	Michael Moore, Andreas Schrimpf and Vladyslav Sushko
December 2016	The changing shape of interest rate derivatives markets	Torsten Ehlers & Egemen Eren
December 2016	Emerging derivatives markets?	Christian Upper & Marcos Valli
December 2016	Non-deliverable forwards: impact of currency internationalisation and derivatives reform	Robert McCauley & Chang Shu
December 2016	Does the financial channel of exchange rates offset the trade channel?	Jonathan Kerns & Nikhil Patel
September 2016	Covered interest parity lost: understanding the cross-currency basis	Claudio Borio, Robert McCauley, Patrick McGuire & Vladyslav Sushko
September 2016	Foreign exchange market intervention in EMEs: what has changed?	Dietrich Domanski, Emanuel Kohlscheen & Ramon Moreno
September 2016	Domestic financial markets and offshore bond financing	Jose Maria Serena & Ramon Moreno
September 2016	The ECB's QE and euro cross-border bank lending	Stefan Avdjiev, Agne Subelyte & Elod Takats
March 2016	How have central banks implemented negative policy rates?	Morten Bech & Aytek 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

Recent BIS publications[1]

BIS Working Papers

The effects of tax on bank liability structure
Leonardo Gambacorta, Giacomo Ricotti, Suresh Sundaresan and Zhenyu Wang
February 2017, No 611

This paper examines the effects of taxation on the liability structure of banks. We derive testable predictions from a dynamic model of optimal bank liability structure that incorporates bank runs, regulatory closure and endogenous default. Using the supervisory data provided by the Bank of Italy, we empirically test these predictions by exploiting exogenous variations of the Italian tax rates on productive activities (IRAP) across regions and over time (especially since the global financial crisis). We show that banks endogenously respond to a reduction in tax rates by reducing non-deposit liabilities more than deposits in addition to lowering leverage. The response on the asset side depends on the financial strength of the bank: well-capitalized banks respond to a reduction in tax rates by increasing their assets, but poorly-capitalized banks respond by cleaning up their balance sheet.

Global impact of US and euro area unconventional monetary policies: a comparison
Qianying Chen, Marco Jacopo Lombardi, Alex Ross and Feng Zhu Rungcharoenkitkul
February 2017, No 610

The paper analyses and compares the domestic and cross-border effects of US and euro area unconventional monetary policy measures on 24 major advanced and emerging economies, based on an estimated global vector error-correction model (GVECM). Unconventional monetary policies are measured using shadow interest rates developed by Lombardi and Zhu (2014). Monetary policy shocks are identified using sign restrictions. The GVECM impulse responses suggest that US unconventional monetary policy generally has stronger domestic and cross-border impacts than euro area non-standard measures. Its spillovers to other economies are estimated to be more sizeable and persistent, especially in terms of output growth and inflation. There is evidence of diverse responses in the emerging economies in terms of exchange rate pressures, credit growth as well as monetary policy. In addition, the strength of cross-border transmission channels to the emerging economies appears to differ for US and euro area policies.

Revisiting the commodity curse: a financial perspective
Enrique Alberola-Ila and Gianluca Benigno
February 2017, No 609

We study the response of a three-sector commodity-exporter small open economy to a commodity price boom. When the economy has access to international borrowing and lending, a temporary commodity price boom brings about the standard wealth effect that stimulates demand and has long-run implications on the sectoral allocation of labor. If dynamic productivity gains are concentrated in the traded goods sector, the commodity boom crowds out the traded sector and delays convergence to the world technology frontier. Financial openness by stimulating current demand, amplifies the crowding out effect and may even lead to a growth trap, in which no resources are allocated to the traded sector. From a normative point of view, our analysis suggests that capital account management policies could be welfare improving in those circumstances.

[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/).

Redemption risk and cash hoarding by asset managers
Stephen Morris, Ilhyock Shim and Hyun Song Shin
January 2017, No 608

Open-end mutual funds face redemptions by investors, but the sale of the underlying assets depends on the portfolio decision of asset managers. If asset managers use their cash holding as a buffer to meet redemptions, they can mitigate fire sales of the underlying asset. If they hoard cash in anticipation of redemptions, they will amplify fire sales. We present a global game model of investor runs and identify conditions under which asset managers hoard cash. In an empirical investigation of global bond mutual funds, we find that cash hoarding is the rule rather than the exception, and that less liquid bond funds display a greater tendency toward cash hoarding.

The real effects of household debt in the short and long run
Marco Jacopo Lombardi, Madhusudan Mohanty and Ilhyock Shim
January 2017, No 607

Household debt levels relative to GDP have risen rapidly in many countries over the past decade. We investigate the macroeconomic impact of such increases by employing a novel estimation technique proposed by Chudik et al (2016), which tackles the problem of endogeneity present in traditional regressions. Using data on 54 economies over 1990-2015, we show that household debt boosts consumption and GDP growth in the short run, mostly within one year. By contrast, a 1 percentage point increase in the household debt-to-GDP ratio tends to lower growth in the long run by 0.1 percentage point. Our results suggest that the negative long-run effects on consumption tend to intensify as the household debt-to-GDP ratio exceeds 60%. For GDP growth, that intensification seems to occur when the ratio exceeds 80%. Finally, we find that the degree of legal protection of creditors is able to account for the cross-country variation in the long-run impact.

Market volatility, monetary policy and the term premium
Sushanta K Mallick, Madhusudan Mohanty and Fabrizio Zampolli
January 2017, No 606

Based on empirical VAR models, we investigate the role of (option-implied) stock and bond market volatilities and monetary policy in the determination of the US 10-year term premium. Our preliminary findings are that an unexpected loosening of monetary policy - through a cut in the federal funds rate in the pre-crisis sample or an increase in bond purchases post-Lehman - typically leads to a decline in both expected stock and bond market volatilities and the term premium. However, while conventional monetary policy boosts economic activity in the precrisis period, bond purchases are found to have no statistically significant real effects postcrisis. Second, expected equity market volatility (VIX) is found to be more important than bond market volatility (MOVE). Pre-crisis, a shock to the VIX leads to a concomitant rise in the MOVE, a contraction of economic activity, a fall in broker-dealer leverage and a rise in the term premium, consistent with pro-cyclical swings in market liquidity. Post-crisis, an innovation to the VIX is instead associated with a drop in the term premium, suggesting the prevalence of flight to quality effects.

Wage and price setting: new evidence from Uruguayan firms
Fernando Borraz, Gerardo Licandro and Daniela Sola
January 2017, No 605

This paper presents new evidence on wage and price setting based on a survey of more than 300 Uruguayan firms in 2013. Most of the firms set prices considering costs and adding a profit margin; therefore, they have some degree of market power. The evidence indicates that price increases appear quite flexible in Uruguay (prices are downward rigid). Most of the firms adjust their prices without following a regular frequency which suggests that price changes in Uruguay are state-dependent, although wage changes are concentrated in January and July. Interestingly, the cost of credit is seen by companies as an irrelevant factor in explaining price increases. We also find that cost reduction is the principal strategy to a negative demand shock. Finally, the adjustment of prices to changes in wages is relatively fast.

Endogenous wage indexation and aggregate shocks
Julio A. Carrillo, Gert Peersman and Joris Wauters
January 2017, No 604

Empirical and institutional evidence finds considerable time variation in the degree of wage indexation to past inflation, a finding that is at odds with the assumption of constant indexation parameters in most New-Keynesian DSGE models. We build a DSGE model with endogenous wage indexation in which utility maximizing workers select a wage indexation rule in response to aggregate shocks and monetary policy. We show that workers index wages to past inflation when output fluctuations are driven by technology and permanent inflation-target shocks, whereas they index to trend inflation when aggregate demand shocks dominate output fluctuations. The model's equilibrium wage setting can explain the time variation in wage indexation found in post-WWII U.S. data.

Multiplex interbank networks and systemic importance - An application to European data
Iñaki Aldasoro and Ivan Alves
January 2017, No 603

Research on interbank networks and systemic importance is starting to recognise that the web of exposures linking banks' balance sheets is more complex than the single-layer-of-exposure approach suggests. We use data on exposures between large European banks, broken down by both maturity and instrument type, to characterise the main features of the multiplex (or multi-layered) structure of the network of large European banks. Banks that are well connected or important in one network, tend to also be well connected in other networks (i.e. the network features positively correlated multiplexity). The different layers exhibit a high degree of similarity, stemming both from standard similarity analyses as well as a core-periphery analyses at the layer level. We propose measures of systemic importance that fit the case in which banks are connected through an arbitrary number of layers (be it by instrument, maturity or a combination of both). Such measures allow for a decomposition of the global systemic importance index for any bank into the contributions of each of the sub-networks, providing a potentially useful tool for banking regulators and supervisors in identifying tailored policy responses. We use the dataset of exposures between large European banks to illustrate that both the methodology and the specific level of network aggregation may matter both in the determination of interconnectedness and in the policy making process.

The globalisation of inflation: the growing importance of global value chains
Raphael Auer, Claudio Borio and Andrew Filardo
January 2017, No 602

Greater international economic interconnectedness over recent decades has been changing inflation dynamics. This paper presents evidence that the expansion of global value chains (GVCs), ie cross-border trade in intermediate goods and services, is an important channel through which global economic slack influences domestic inflation. In particular, we document the extent to which the growth in GVCs explains the established empirical correlation between global economic slack and national inflation rates, both across countries and over time. Accounting for the role of GVCs, we also find that the conventional trade-based measures of openness used in previous studies are poor proxies for this transmission channel. The results support the hypothesis that as GVCs expand, direct and indirect competition among economies increases, making domestic inflation more sensitive to the global output gap. This can affect the trade-offs that central banks face when managing inflation.

Asymmetric information and the securitization of SME loans
Ugo Albertazzi, Margherita Bottero, Leonardo Gambacorta and Steven Ongena
January 2017, No 601

Using credit register data for loans to Italian firms we test for the presence of asymmetric information in the securitization market by looking at the correlation between the securitization (risk-transfer) and the default (accident) probability. We can disentangle the adverse selection from the moral hazard component for the many firms with multiple bank

relationships. We find that adverse selection is widespread but that moral hazard is confined to weak relationships, indicating that a strong relationship is a credible enough commitment to monitor after securitization. Importantly, the selection of which loans to securitize based on observables is such that it largely offsets the (negative) effects of asymmetric information, rendering the overall unconditional quality of securitized loans significantly better than that of non-securitized ones. Thus, despite the presence of asymmetric information, our results do not accord with the view that credit-risk transfer leads to lax credit standards.

The currency dimension of the bank lending channel in international monetary transmission
Előd Takáts and Judit Temesvary
December 2016, No 600

We investigate how the use of a currency transmits monetary policy shocks in the global banking system. We use newly available unique data on the bilateral crossborder lending flows of 27 BIS-reporting lending banking systems to over 50 borrowing countries, broken down by currency denomination (USD, EUR and JPY). We have three main findings. First, monetary shocks in a currency significantly affect cross-border lending flows in that currency, even when neither the lending banking system nor the borrowing country uses that currency as their own. Second, this transmission works mainly through lending to non-banks. Third, this currency dimension of the bank lending channel works similarly across the three currencies suggesting that the cross-border bank lending channel of liquidity shock transmission may not be unique to lending in USD.

Banking industry dynamics and size-dependent capital regulation
Tirupam Goel
December 2016, No 599

This paper presents a general equilibrium model with a dynamic banking sector to characterize optimal size-dependent bank capital regulation (CR). Bank leverage choices are subject to the risk-return trade-off: high leverage increases expected return on capital, but also increases return variance and bank failure risk. Financial frictions imply that bank leverage choices are socially inefficient, providing scope for a welfare-enhancing CR that imposes a cap on bank leverage. The optimal CR is tighter relative to the pre-crisis benchmark. Optimal CR is also bank specific, and tighter for large banks than for small banks. This is for three reasons. First, allowing small banks to take more leverage enables them to potentially grow faster, leading to a growth effect. Second, although more leverage by small banks results in a higher exit rate, these exits are by the less efficient banks, leading to a cleansing effect. Third, failures are more costly among large banks, because these are more efficient in equilibrium and intermediate more capital. Therefore, tighter regulation for large banks renders them less prone to failure, leading to a stabilization effect. In terms of industry dynamics, tighter CR results in a smaller bank exit rate and a larger equilibrium mass of better capitalized banks, even though physical capital stock and wages are lower. The calibrated model rationalizes various steady state moments of the US banking industry, and provides general support for the Basel III GSIB framework.

Did the founding of the Federal Reserve affect the vulnerability of the interbank system to contagion risk?
Mark A Carlson and David C Wheelock
December 2016, No 598

As a result of legal restrictions on branch banking, an extensive interbank system developed in the United States during the 19th century to facilitate interregional payments and flows of liquidity and credit. Vast sums moved through the interbank system to meet seasonal and other demands, but the system also transmitted shocks during banking panics. The Federal Reserve was established in 1914 to reduce reliance on the interbank market and correct other defects that caused banking system instability. Drawing on recent theoretical work on interbank networks, we examine how the Fed's establishment affected the system's resilience to solvency and liquidity shocks and whether these shocks might have been contagious. We find that the interbank system became more resilient to solvency shocks, but less resilient to liquidity shocks, as banks sharply reduced their liquidity after the Fed's founding. The

industry's response illustrates how the introduction of a lender of last resort can alter private behavior in a way that increases the likelihood that the lender may be needed.

Bank networks: contagion, systemic risk and prudential policy
Iñaki Aldasoro, Domenico Delli Gatti and Ester Faia
December 2016, No 597

We present a network model of the interbank market in which optimizing risk averse banks lend to each other and invest in non-liquid assets. Market clearing takes place through a tâtonnement process which yields the equilibrium price, while traded quantities are determined by means of an assortative matching process. Contagion occurs through liquidity hoarding, interbank interlinkages and fire sale externalities. The resulting network configuration exhibits a core-periphery structure, disassortative behavior and low density. Within this framework we analyse the effects of a stylized set of prudential policies on the stability/efficiency trade-off. Liquidity requirements unequivocally decrease systemic risk, but at the cost of lower efficiency (measured by aggregate investment in non-liquid assets). Equity requirements also tend to reduce risk (hence increase stability), though without reducing significantly overall investment. On this basis, our results provide general support for the Basel III approach based on complementary regulatory metrics.

Macroeconomics of bank capital and liquidity regulations
Frederic Boissay and Fabrice Collard
December 2016, No 596

We study the transmission mechanisms of liquidity and capital regulations as well as their effects on the economy and welfare. We propose a macro-economic model in which a regulator faces the following trade-off. On the one hand, banking regulations may reduce the aggregate supply of credit. On the other hand, they promote the allocation of credit to its best uses. Accordingly, in a regulated economy there is less, but more productive lending. Based on a version of the model calibrated on US data, we find that both liquidity and capital requirements are needed, and must be set relatively high. They also mutually reinforce each other, except when liquid assets are scarce. Our analysis thus provides broad support for Basel III's "multiple metrics" framework.

Bank lending and loan quality: the case of India
Pallavi Chavan and Leonardo Gambacorta
December 2016, No 595

This paper analyses how non-performing loans (NPLs) of Indian banks behave through the cycle. We find that a one-percentage point increase in loan growth is associated with an increase in NPLs over total advances (NPL ratio) of 4.3 per cent in the long run with the response being higher during expansionary phases. Furthermore, NPL ratios of banks are found to be sensitive to the interest rate environment and the overall growth of the economy. Notwithstanding differences in management and governance structures, there is a procyclical risk-taking response to credit growth in the case of both public and private banks with private banks being more reactive to changes in interest rate and business cycle conditions.

A quantitative case for leaning against the wind
Andrew Filardo and Phurichai Rungcharoenkitkul
December 2016, No 594

Should a monetary authority lean against the build-up of financial imbalances? We study this policy question in an environment in which there are recurring cycles of financial imbalances that develop over time and eventually collapse in a costly manner. The optimal policy reflects the trade-off between the short-run macroeconomic costs of leaning against the wind and the longer-run benefits of stabilising the financial cycle. We model the financial cycle as a nonlinear Markov regime-switching process, calibrate the model to US data and characterise the optimal monetary policy. Leaning systematically over the whole financial cycle is found to outperform policies of "benign neglect" and "late-in-the-cycle" discretionary interventions. This conclusion is robust to a wide range of alternative assumptions and supports an orientation shift in monetary policy frameworks away from narrow price stability to a joint consideration of price and financial stability.

The countercyclical capital buffer and the composition of bank lending
Raphael Auer and Steven Ongena
December 2016, No 593

Do macroprudential regulations on residential lending influence commercial lending behavior too? To answer this question, we identify the compositional changes in banks' supply of credit using the variation in their holdings of residential mortgages on which extra capital requirements were uniformly imposed by the countercyclical capital buffer (CCB) introduced in Switzerland in 2012. We find that the CCB's introduction led to higher growth in commercial lending, in particular to small firms, although this was unrelated to conditions in regional housing markets. The interest rates and fees charged to these firms concurrently increased. We rationalize these findings in a model featuring both private and firm-specific collateral. The corresponding imperfect substitutability between private and commercial credit for the entrepreneur's relationship bank is then shown to give rise to the compositional patterns we empirically document.

Basel Committee on Banking Supervision

Frequently asked questions on market risk capital requirements
January 2017

In January 2016, the Basel Committee on Banking Supervision published the standard Minimum capital requirements for market risk. To promote consistent global implementation of those requirements, the Committee has agreed to periodically review frequently asked questions (FAQs) and publish answers along with any technical elaboration of the standards text and interpretative guidance that may be necessary.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III risk-based capital regulations - Indonesia
December 2016

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

The RCAP Assessment Team was led by Ms Kerstin af Jochnick, First Deputy Governor of Sveriges Riksbank. The Assessment Team comprised eight technical experts drawn from France, Georgia, Germany, India, Mexico, the Philippines and South Africa (Annex 1). The main counterparts for the assessment were the Indonesia Financial Services Authority (OJK) and Bank Indonesia (BI). The overall work was coordinated by the Basel Committee Secretariat with support from staff from Sveriges Riksbank

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III LCR regulations - Indonesia
December 2016

This report presents the findings of the RCAP Assessment Team on the domestic adoption of the Basel Liquidity Coverage Ratio (LCR) standard in Indonesia and its consistency with the minimum requirements of the Basel III framework. The assessment focuses on the adoption of Basel standards applied to Indonesian banks that are internationally or regionally active and of significance to Indonesia's domestic financial stability.

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Regulatory Consistency Assessment Programme (RCAP) - Follow-up assessment of Basel III risk-based capital regulations - Japan
December 2016

This report summarises the findings of the RCAP Assessment Team on the domestic adoption of the Basel III loss absorbency and capital buffers standards in Japan. These standards were not assessed during the first assessment of risk-based capital standards in Japan, conducted in 2012, as they had not been implemented at that time. The report of that assessment1 recommended that these components be assessed in a follow-up assessment. This report describes that follow-up assessment and presents a revised assessment of Japan's overall compliance with the Basel risk-based capital standards. The Japanese regulations implementing these standards were revised in 2012 and 2015 and came into effect in 2013 and 2016.

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III LCR regulations - Japan
December 2016

This report presents the findings of the RCAP Assessment Team on the domestic adoption of the Basel This Liquidity Coverage Ratio (LCR) standard in Japan and its consistency with the minimum requirements of the Basel III framework. The assessment focuses on the adoption of Basel standards applied to the Japanese banks that are internationally active and of significance to domestic financial stability.

The RCAP Assessment Team was led by Mr Luigi Federico Signorini, Deputy Governor of the Bank of Italy. The Assessment Team comprised three technical experts drawn from Denmark, Malaysia and the United States (Annex 1). The main counterparties for the assessment were the Japanese Financial Services Agency (FSA) and the Bank of Japan. The overall work was coordinated by the Basel Committee Secretariat with support from staff from the Bank of Italy

Regulatory Consistency Assessment Programme (RCAP) - Assessment of Basel III LCR regulations -Singapore
December 2016

This report presents the findings of the RCAP Assessment Team on the domestic adoption of the Basel Liquidity Coverage Ratio (LCR) framework in Singapore and its consistency with the minimum requirements of this framework. The assessment focuses on the adoption of the Basel LCR standards applied to the Singapore banks that are internationally active and of significance to domestic financial stability.

The RCAP Assessment Team was led by Mr Stephen Bland, Director & Strategic Policy Advisor at the UK Prudential Regulation Authority. The Assessment Team comprised two technical experts drawn from Brazil and Sweden (Annex 1). The main counterpart of the assessment was the Monetary Authority of Singapore (MAS). The overall work was coordinated by the Basel Committee Secretariat.

Committee on Payments and Market Infrastructures

Payment, clearing and settlement systems in the Kingdom of Bahrain
January 2017 No 156

The Committee on Payments and Market Infrastructures (CPMI) publishes - under the aegis of the Bank for International Settlements (BIS) - reference works on payment systems and other financial market infrastructures in both CPMI member and non-member countries. These publications are widely known as Red Books.

The present volume, the first edition of the Red Book for the Kingdom of Bahrain is another step towards increasing our understanding of the way payment, clearing and settlement systems work in different countries.

Financial market infrastructures that are resilient and effective enhance the stability of the financial system. They also reduce transaction costs in the economy, promote the efficient use of financial resources, improve financial market liquidity and facilitate the conduct of monetary policy.

Central banks have a strong interest in promoting safety and improving efficiency in financial market infrastructures. They play a key role in domestic payment system development and, in many cases, operate large-value payment systems. Central banks in many countries have been influential in improving public understanding of financial market infrastructures in their countries and public awareness of the various policy issues they raise.

Statistics on payment, clearing and settlement systems in the CPMI countries - Figures for 2015
December 2016 No 155

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.

Markets Committee

The sterling 'flash event' of 7 October 2016
January 2017

This report investigates the events surrounding the so-called flash event in sterling during early Asian trading hours on October 7. Drawing on granular high-frequency data, it includes a forensic study of the event window, a comparison with similar historic episodes, and a discussion of the relevant policy implications.

The analysis points to a confluence of factors catalysing the move and places significant weight on the time of day and mechanistic amplifiers (including options-related hedging flows) as contributing factors. It notes that the 7 October event does not represent a new phenomenon, but rather a new data point in what appears to be a series of flash events that are now occurring in a broader range of markets than was previously the case. While such events have generally proved short-lived and without immediate consequences for financial stability, the report highlights the risk that flash events undermine confidence in financial markets and stresses the need for further analytical work in this area.

Market intelligence gathering at Central Banks
December 2016

'Market intelligence' (MI) refers to the information, primarily qualitative in nature, that central banks gather through direct interaction and dialogue with market participants. This descriptive paper seeks to increase understanding of the MI activities that are conducted by central banks. It demonstrates that MI gathering can be conducted via a number of different models dependent on the central bank, its remit, size and resources. The paper highlights the importance of market intelligence to central banks. A key focus of the paper is on the recent evolution of MI activity, both in terms of markets and institutions as well as in terms of the organisational models for the collection, synthesis and dissemination of MI. Furthermore, the paper describes what central banks do with the information they collect, including how it is recorded and distributed, as well as the treatment of sensitive or confidential information.

Speeches

International financial crises: new understandings, new data

Keynote speech by Mr Jaime Caruana, General Manager of the BIS, on the occasion of the launch of the book Alexandre Lamfalussy: selected essays at the National Bank of Belgium, Brussels, 6 February 2017.

Abstracts: Alexandre Lamfalussy championed better understanding of global financial vulnerabilities, better data collection to inform that understanding and, more generally, the macroprudential approach. This speech reviews the interaction between such understanding and data collection over the last 40 years. The 1982 international debt crisis demonstrated that governments do go bust, and the data collected on consolidated country exposures were subsequently improved. The Asian financial crisis demonstrated that not just government debt, but also that of overleveraged corporate sectors with currency and maturity mismatches could lead to crisis. Here too, the data were improved in response. The Great Financial Crisis of 2007-09 reminded us once more that private risk management is not enough, that low inflation is not enough and that prudent current accounts are not enough. And once more, the data were improved. As Lamfalussy emphasised, market participants often overlook data showing a build-up of stocks of debt that signal vulnerabilities. Nevertheless, production of data that allow market participants to recognise unsustainable developments remains an important macroprudential tool. This macroprudential perspective on financial statistics was strongly advocated by Lamfalussy throughout his career.

Rethinking development finance: towards a new "possible trinity" for growth?

Remarks by Mr Luiz Awazu Pereira da Silva, Deputy General Manager of the BIS, at the Atlantic Dialogues 2016, organised by OCP Policy Center and The German Marshall Fund of the United States, Marrakesh, December 2016.

Development finance is an issue that typically concerns developing countries where numerous, grave socio-economic problems persist, including - and not among the least - the need for stable development finance in higher quantity and of higher quality. However, development finance could also be used today as a growth-enhancing concept applicable to advanced economies, to boost their growth and help their social inclusion. It could contribute to rebalancing macroeconomic policies and move them towards a new "possible trinity": growth based on higher productivity, growth that favours stronger social inclusion and growth that is friendlier to the environment

Post-crisis financial safety net framework: lessons, responses and remaining challenges

Keynote address by Mr Jaime Caruana, General Manager of the BIS, at the FSI-IADI Conference on "Bank resolution, crisis management and deposit insurance issues", Basel, 6 December 2016.

Resolution arrangements: limiting the fallout from failures

Greater resilience can help banks withstand shocks, but one cannot rule out the possibility of failure. The question is: how well prepared are we for that?

Experience from the global financial crisis suggests that our preparedness on that front was also not as great as we would have liked. Many jurisdictions lacked the necessary powers and tools for resolving banks. They were left with the limited choice of either a disorderly liquidation or a bailout with public resources. The presence of systemically important banks, especially G-SIBs, posed special challenges for home and host authorities in terms of information and coordination. For their part, banks were also underprepared, with not enough loss-absorbing capacity to allow an orderly workout in case of failure and little advance planning on how to cope with such emergencies.

A key post-crisis response to these lessons was the development of the Financial Stability Board's Key Attributes of Effective Resolution Regimes for Financial Institutions.3 The Key Attributes set out the responsibilities, instruments and powers that national resolution regimes should have to enable orderly resolutions of failing financial firms, without exposing

the taxpayer. For global systemically important institutions, there are specific requirements for Crisis Management Groups (CMGs), institution-specific cross-border cooperation agreements between the home and host authorities, recovery and resolution planning, and resolvability assessments.

Complementing the Key Attributes is the new standard for G-SIBs on the adequacy of Total Loss- Absorbing Capacity - or TLAC, for short.4 It is designed to ensure that a failing G-SIB would have sufficient loss-absorbing and recapitalisation capacity available to implement a resolution that is orderly and avoids exposing public funds to loss.

How much of these have been put in place? The FSB's second annual report on the implementation of the agreed reforms notes that, as of end-August 2016, only a subset of the FSB membership - primarily the home jurisdictions of G-SIBs - has implemented bank resolution regimes with powers that are broadly in line with the Key Attributes. Elsewhere, there are considerable gaps in resolution regimes.

While there has been progress in reforming the resolution framework, there is scope for further refinements to ensure the legal certainty of resolution actions. Moreover, the new framework has not yet been tested.

CMGs have been established for all G-SIBs. But CMGs by themselves have no legal authority. Cross-border cooperation agreements still need to be put in place before the resolution plans can become operational.

Recovery and resolution planning processes are in place in many jurisdictions, but actually producing credible plans that are acceptable to supervisors is proving rather more challenging.6

Since the TLAC standard was released in November 2015, a majority of G-SIB home authorities have published policy proposals or consultation documents on TLAC implementation. Banks have issued substantial amounts of TLAC-eligible liabilities. The key question is: will TLAC instruments work as intended?

Observations from the market for contingent convertibles (CoCos) suggest some challenges on this front. CoCo instruments are meant to enhance loss absorption. Market tensions in early 2016 revealed that investors liked the fixed income component of these instruments but were not willing to sit still and take on losses. As soon as losses became a possibility, CoCo investors started hedging, undermining the value of banks' equity and increasing banks' costs of debt finance. Under market stress, such behaviour could generate a vicious spiral.7 Thus, with the improvements in loss-absorbing capacity, there are also new dynamics that we need to understand better.

Deposit insurance: protecting depositors and confidence

What about deposit insurance?

The global financial crisis illustrated the importance of maintaining depositor confidence and limiting contagion - and the key role that deposit protection plays in this regard. Indeed, one of the earliest and most widely adopted crisis responses in 2008 was the increase in deposit insurance coverage. In some jurisdictions, blanket guarantees were issued.

This experience also exposed some weaknesses in deposit insurance systems. These included depositors' limited understanding of the compensation schemes, delays in payment to depositors in some jurisdictions, and the lack of clear funding arrangements for the schemes.

To reflect the lessons from the crisis, the IADI Core Principles were revised in 2014.8 The revision strengthened several key areas, including speed of reimbursement, deposit insurance coverage, funding and governance.

Measures have also been taken to strengthen depositor protection in practice. Within the G20, almost all members have deposit insurance schemes in place. Two of the three FSB jurisdictions identified in the 2012 FSB peer review as not having such systems (China and Saudi Arabia) introduced them in 2015, while the third (South Africa) intends to follow suit in the near future. Outside the G20, new systems are being established, particularly in Africa.

These new systems are more aligned with the revised Core Principles, with explicit but limited coverage levels and financed by the industry through an ex ante premium.

Notwithstanding the progress, important challenges remain. In particular, the speed of payout needs to be accelerated in most jurisdictions. Currently, few systems can reimburse depositors within the seven-working-day objective recommended by the Core Principles. Emergency backup liquidity facilities, needed to ensure depositor confidence, can be enhanced and made more explicit. Finally, there is still room to strengthen the role of the deposit insurer in the safety net, especially as regards the communication and coordination with other authorities (prudential supervisors and resolution agencies) in the context of system-wide crisis preparedness and management.

Indeed, tackling these challenges in a focused manner is very much at the heart of the three current strategic priorities of IADI, namely: to promote compliance with the IADI Core Principles, to advance related research and policy development, and to support members with training and capacity building.

Closing thoughts on systemic risk: reasons to be cautious

To summarise, the global financial crisis exposed the gaps in our lines of defence. It is heartening to see the tremendous efforts made by both national and international authorities to apply the lessons learned. It is also encouraging to see the private sector on board to a great extent, even though tougher rules are understandably not what they like.

Much progress has indeed been made. But the task is big, and there is still a lot of pending work. Usually, we would finish here by emphasising that it is therefore crucial to complete the reform agenda and focus attention on implementation and monitoring.

But we should ask ourselves a deeper question: is the system as a whole safer now?

To address this question, we need a broader perspective. We need to look at stocks, in addition to flows. We need to look at balance sheets and incentives. Systemic risk is an elusive and dynamic concept. Since the crisis, financial intermediation has changed, balance sheets have changed, incentives have also changed. So where do we stand in terms of the whole system?

I will cite three reasons why we should be cautious and avoid being too sanguine.

Stocks of debt

One is that although banks have deleveraged since the crisis, the world as a whole is more leveraged today than when the crisis started in 2007.

We can think of the world as many interconnected balance sheets. This is how I think of the system. It goes well beyond the banking or even the financial system.

At a global level, credit extended to households, non-financial corporates and governments combined has been growing rapidly, though unevenly, since the crisis. As a consequence, the system of interconnected balance sheets I have just described has also grown rapidly.

The speed of credit growth has been shown to be a good indicator of risk, as it relates to the capacity of repayment of the whole economy and to the quality of the assets on the other side of the balance sheet.

As of mid-2016, the debt of households, non-financial corporates and governments as a percentage of GDP had reached 250%.

The reason to feel perturbed - or at least not be sanguine - is the combination of growing debt with the declining trend in productivity growth. This combination would indicate that there are some difficulties in generating sustainable income with which to repay the debt.

Persistent low rate environment

A second reason to be cautious is the persistent low interest rate environment. I would emphasise that my concern is about the persistence of low rates, rather than just low rates per se.

Interest rate is the cost of leverage; long periods of low rates could incentivise increased borrowing. The resulting accumulation of debt would render the whole system more sensitive to the future interest rate scenario, which affects the ability to repay or refinance the stock of debt. The longer that interest rates have stayed unusually low, the greater the risk of a sharp snapback of interest rates.

Low rates for long could also incentivise additional risk-taking through the search for yield. The valuation of financial assets would be boosted, flattering the assessment of their riskiness. This is often referred to as the risk-taking channel of monetary policy.9

Persistently low or even negative interest rates also make for a difficult environment for financial institutions, putting pressure on their earning capacity. Weaker profits would slow the build-up of equity over time, which would in turn affect banks' capacity to lend to the real economy. Indeed, pressure from the low rate environment is one of several challenges facing the banking sector in advanced economies. The relatively subdued performance of banks in capital markets reflects investor scepticism. For example, even with general stock market indices hitting all-time highs in recent years, the price-to-book ratios of European and Japanese banks are only at or below 0.5. This suggests that banks are still to varying extents burdened by unresolved issues in terms of asset quality, excess capacity, business model and profitability, making the return to normality more arduous than one would like.

Asset managers and search for yield

A third reason to be cautious is the changing nature of risks. With all the post-crisis efforts to improve the resilience of banks, it would not be a big stretch to conjecture that the next major crisis will originate not in the banking sector but somewhere else in the system.

Since the global financial crisis, bond market finance has surged, shifting international finance to non-bank intermediaries. This growth in market-based finance has partly filled the void left by declining international bank credit.

My colleague Hyun Song Shin refers to this as "the second phase of global liquidity", in which bond market finance dominates.10 In the first phase (roughly 2003 to 2008), the protagonists were global banks and the mechanism was leverage. In the second phase (starting from around 2010), the protagonists are asset managers and the search for yield is the driving force. And with the main action being in bond markets, movements in the term premium, ie the portion of bond yields not explained by the expected path of future short rates, play a key role in influencing the demand for bond financing.

There is much in this new phase that we do not yet understand well. There may be leverage-like behaviours that can create stress similar to that resulting from classic bank leverage. Specifically, even though asset managers are not themselves leveraged like banks, their lack of willingness or capacity to absorb temporary losses could still results in runs on capital markets. Recent policy initiatives - notably those coordinated by the FSB - are seeking an international response to these new sources of risk.11

Of course, shocks from capital markets could also affect banks at some point. In a complex financial system, how shocks are transmitted or amplified is hard to predict. Therefore, being prepared ex ante, strengthening all three lines of defence, is still recommended and necessary.

The slippery fiscal space

English translation of speech in Spanish by Mr Jaime Caruana, General Manager of the BIS, at a conference hosted by the BIS Representative Office for the Americas, Mexico City, 30 November 2016.

There have been recent calls for expansionary fiscal policy to boost economic growth, but some caution is required. In particular, policymakers must interpret existing measures of fiscal space with care as these estimates are highly uncertain and fiscal space can suddenly be reduced by shifts in market sentiment. Private debt can also interact with public debt in a way that could further reduce fiscal space. In this setting, fiscal policy - and accompanying

structural reforms - could be designed to increase productivity and growth over the medium and long term.

Monetary policy has been stretched to its limits

Original quotes from interview with Mr Claudio Borio, Head of the Monetary and Economic Department, in Süddeutsche Zeitung, conducted by Mr Markus Zydra and published on 30 November 2016.

Mr Borio, the world is facing many problems. What is the root cause?

We do not know for sure. The big questions in economics have not quite been solved. But let me start by saying that the rhetoric about the global economy is worse than the reality. In terms of global growth, we are not that far away from historical averages, especially if we adjust for demographics. Moreover, unemployment has been declining, and in several cases is close to historical norms or measures of full employment.

So everything is fine?

It is the medium term that is our concern - what we have called the "risky trilogy". The long-term decline in productivity growth has accelerated since the crisis, so that the prospects for long-term growth are not bright. Debt levels, both private and public, are historically high and have been increasing since the crisis. And, most critically, the room for policy manoeuvre, both monetary and fiscal, is limited.

But can central banks help out?

Monetary policy has been stretched to its limits. In inflation-adjusted terms, interest rates have never been negative for so long and they are lower now than in the midst of the financial crisis, which is odd since the situation has improved. If you came from Mars and they told you that policymakers were struggling to reach price stability, you might be surprised, as inflation is not far from measures of stable prices. But since many central banks have inflation targets set at 2%, there is a lot at stake.

Why do we have low inflation?

We do not fully understand this. But I think we have underestimated the long-lasting impact of the globalisation of the real economy, notably the entry of China and former communist states into the world trading system. There has been persistent downward pressure on wages and prices, as competition has greatly increased, helped also by technological change. The pricing power of producers and, in particular, the bargaining power of workers have declined, making the wage-price spirals of the past less likely.

The ECB and other central banks fear deflation.

Building on previous work, we have analysed deflation across many countries since the 1870s. There is only a very weak link between deflation and slow growth. That finding has not received the attention it deserves.

What should central banks be doing?

The idea is to look carefully at what is driving disinflation and use all the flexibility available in the mandate to reach the 2% inflation target. To form a judgment is not easy, but is always necessary. Whether deflation is costly or not depends on its drivers. For instance, to the extent that it is globalisation, it is not costly, as it is supply-driven rather than the reflection of weak demand.

Where is the danger?

Around 2003, policymakers were also concerned with deflation, and as a result kept interest rates very low. But this contributed to a credit and property price boom that sowed the seeds of the bust that did so much damage later on. In the crisis years after 2008, it was essential to loosen monetary policy. But since then, monetary policy has been overburdened. On balance, too little has been done to repair balance sheets and to raise sustainable growth through structural reforms, such as by making markets more flexible and promoting entrepreneurship and innovation.

And more fiscal spending?

Only where there is room. Public debt in relation to GDP has never been so high in so many countries during peacetime. Fiscal space should not be overestimated. It is all too easy to end up with an even larger pile of debt.

The global debt is around $90 trillion, and it is rising. How should one reduce it?

How to manage the debt burden is the hardest question. The best way, of course, is to grow out of it, which is why structural reforms are so important. Other forms are more painful.

Do you fear political populism?

I fear a return to trade and financial protectionism. We are seeing some worrying signs. The open global economy order has been remarkably resilient to the financial crisis; but it might not so easily survive another one. At that point, we could see a historic rupture. That is an endgame we should do all we can to avoid.

There are academics and politicians advocating the abolition of cash. What do you think of that?

Negative nominal interest rates, especially if persistent, are already problematic. Quite apart from the problems they generate for the financial system, they can be perceived as a desperate measure, paradoxically undermining confidence. Getting rid of cash would take all this one big step further, as it would signal that there is no limit to how far into negative territory nominal interest rates could be pushed. That would risk undermining the very essence of our monetary economy. It would be playing with fire. Also, it would be quite a challenge for communication, even in simply economic terms. It would be like saying: "We want to abolish cash in order to tax you with lower negative rates in order to - tax you even more in the future."

Why?

Because the reason for doing this would be to raise inflation - which is perceived as an unjust tax on savings. This would require people to have faith in the "model" which policymakers use to steer the economy. Quite a challenge!