

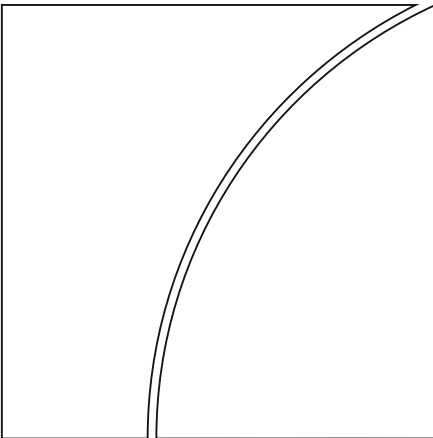


BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

March 2018

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

Countries

AE	United Arab Emirates	GT	Guatemala
AO	Angola	HK	Hong Kong SAR
AR	Argentina	HR	Croatia
AT	Austria	HU	Hungary
AU	Australia	ID	Indonesia
AZ	Azerbaijan	IE	Ireland
BD	Bangladesh	IL	Israel
BE	Belgium	IN	India
BG	Bulgaria	IQ	Iraq
BH	Bahrain	IR	Iran
BM	Bermuda	IS	Iceland
BR	Brazil	IT	Italy
BY	Belarus	JP	Japan
CA	Canada	KE	Kenya
CH	Switzerland	KR	Korea
CL	Chile	KW	Kuwait
CN	China	KY	Cayman Islands
CO	Colombia	KZ	Kazakhstan
CR	Costa Rica	LB	Lebanon
CY	Cyprus	LK	Sri Lanka
CZ	Czech Republic	LT	Lithuania
DE	Germany	LU	Luxembourg
DK	Denmark	LV	Latvia
DO	Dominican Republic	MA	Morocco
DZ	Algeria	MM	Myanmar
EA	euro area	MO	Macao SAR
EC	Ecuador	MT	Malta
EE	Estonia	MU	Mauritius
EG	Egypt	MX	Mexico
ES	Spain	MY	Malaysia
ET	Ethiopia	NG	Nigeria
FI	Finland	NL	Netherlands
FO	Faeroe Islands	NO	Norway
FR	France	NZ	New Zealand
GB	United Kingdom	OM	Oman
GR	Greece	PE	Peru

Countries (cont)

PH	Philippines	TH	Thailand
PK	Pakistan	TR	Turkey
PL	Poland	TW	Chinese Taipei
PT	Portugal	UA	Ukraine
RO	Romania	US	United States
RS	Serbia	UY	Uruguay
RU	Russia	VE	Venezuela
SA	Saudi Arabia	VG	British Virgin Islands
SD	Sudan	VN	Vietnam
SE	Sweden	ZA	South Africa
SG	Singapore	AE	advanced economy
SK	Slovakia	EME	emerging market economy
SI	Slovenia		

Volatility is back

Stock markets across the globe underwent a sharp correction in late January and early February. After a steady rally that had lasted several months, capped by the strongest January since the 1990s, the release of a labour market report showing higher than expected US wage growth heralded a burst of heightened activity. Equity valuations fell, rebounded and fell again, amid unusual levels of intraday volatility. This correction coincided with higher volatility in government bond markets. Long-term Treasury yields had been gradually rising since mid-December, as investors seemed increasingly concerned about inflation risks as well as the macroeconomic impact of US tax reform. A sudden spurt in yields at the very end of January preceded the stock market drop in the United States and subsequently in other advanced economies (AEs). Government bond yields also increased in several other AEs, as the synchronised upswing in global growth led investors to price in a less gradual than previously expected exit from unconventional policies.

Throughout the period under review, which started in late November, market participants remained very sensitive to any perceived changes in central banks' messages. As expected, the Federal Reserve raised the federal funds target range by 25 basis points in December, and its balance sheet reduction moved forward largely as planned. Across the Atlantic, the ECB maintained its policy stance and left its forward guidance unaltered, including an open-ended date for the termination of its asset purchase programme (APP). The Bank of Japan responded to an uptick in long-term yields, which appeared to test its yield curve control policy, with an offer to buy an unlimited amount of long-term government bonds.

The market tremors occurred within a general context of protracted US dollar weakness for most of the period, continued loosening of credit conditions, and undaunted risk-taking in most asset classes. A brief flight-to-safety event associated with the peak of the stock market turbulence provided only limited support for the dollar. Neither the Fed's steady tightening nor the recent equity sell-off coincided with wider corporate credit spreads, which remained at record lows. The appetite for emerging market economy (EME) assets also stayed strong. Stock markets soon stabilised and trimmed their losses. At the same time, bond investors appeared to struggle in assessing the overall impact of an evolving inflationary outlook and the uncertain size of the future net supply of securities with longer tenors.

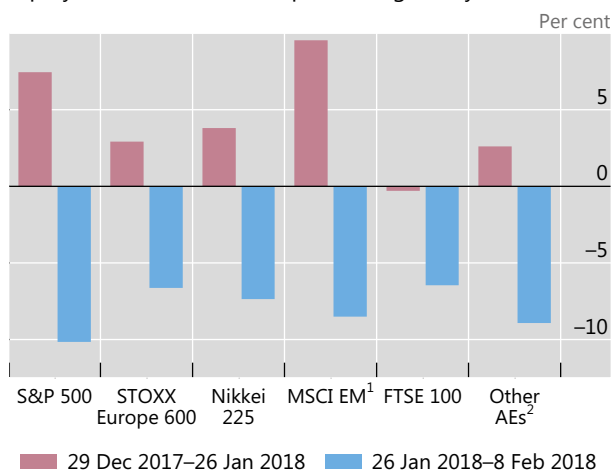
Equity market correction triggered by inflation concerns

Equity prices rallied globally after the seasonal Christmas lull. During the first few weeks of January, the S&P 500 rose more than 6%, in one of the strongest starts to the year since the late 1990s. In those weeks, the Nikkei 225 jumped 4%, EME stock markets rose almost 10% and European stocks went up more than 3% (Graph 1, top left-hand panel). At the end of the month, the rosy picture changed abruptly. On

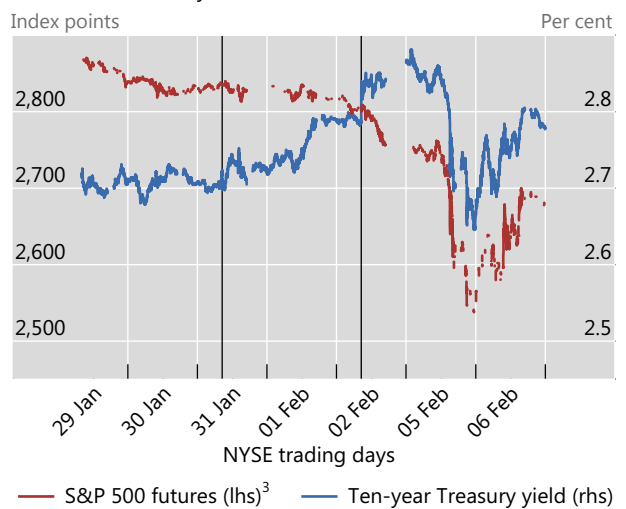
US labour market report triggers stock market sell-off

Graph 1

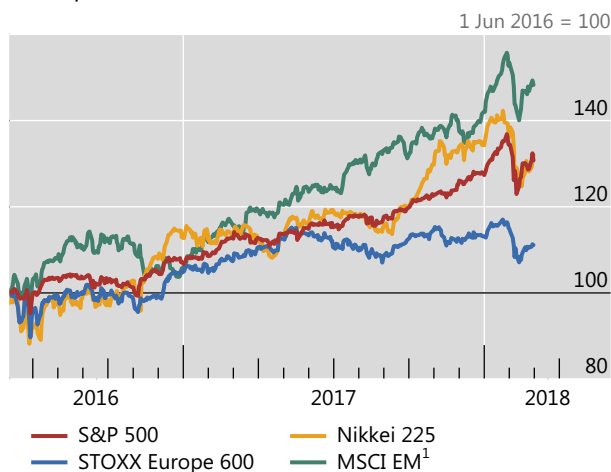
Equity market turbulence spills over globally



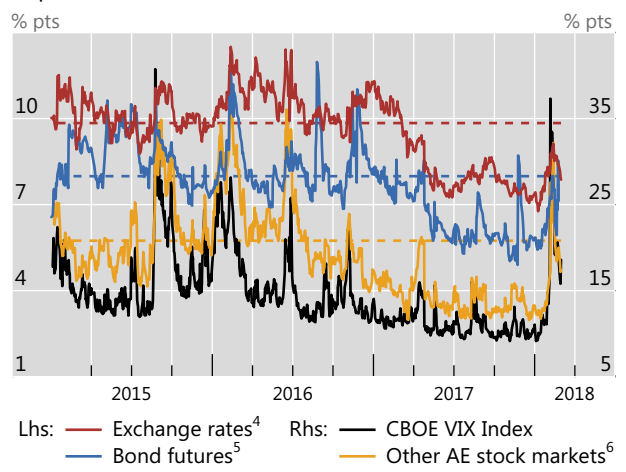
News and intraday market moves



Stock prices



Implied volatilities



The vertical lines in the top right-hand panel indicate 08:30 (EST) on 31 January 2018 (release of US Treasury quarterly refunding documents) and 2 February 2018 (release of US labour market report).

The dashed lines in the bottom right-hand panel indicate simple averages over the period 1 January 2010–27 February 2018.

¹ MSCI Emerging Markets Index, in US dollars. ² Stock prices of AU, CA, CH, DK, NO, NZ and SE; weighted average based on market capitalisation. ³ Current contract. ⁴ JPMorgan VXY Global index, a turnover-weighted index of the implied volatility of three-month at-the-money options on 23 USD currency pairs. ⁵ Implied volatility of at-the-money options on the long-term bond futures of DE, GB, JP and US; weighted average based on GDP and PPP exchange rates. ⁶ Implied volatility of the EURO STOXX 50, FTSE 100 and Nikkei 225 indices; weighted average based on market capitalisation.

Sources: Bloomberg; Datastream; BIS calculations.

2 February, a stronger than expected US labour market report – stating that non-farm payrolls had risen 200,000 in January, while wages had increased 2.9% year on year – seemed to stoke market participants’ concerns about a firming inflationary outlook. The payroll figures were above analysts’ expectations, and were accompanied by news that job creation during 2017 had been revised upwards. But it was the large annualised increase in hourly earnings that received the most press coverage, being the highest rise in wages since the end of the recession in mid-2009. The figure was widely perceived as increasing the chances of a faster pace of monetary policy tightening by the Federal Reserve.

Global stock markets fell sharply in the wake of the report (Graph 1, top right-hand panel). During the week following its release, stock indices gave away the year’s gains, and more, with the S&P 500 falling by further than 10%, the Nikkei by 7%, EME stock markets 8% and euro area stock markets 7% (top left-hand panel). There were indications that forced sales by commodity trading advisers and other momentum traders, in response to accumulated losses on their cross-asset positions, had helped amplify initial short-term market movements. Stock markets stabilised subsequently, and added moderate gains up to the end of February (bottom left-hand panel).

The declines in stock markets were accompanied – and possibly exacerbated – by a spike in volatility. Equity and exchange rate volatility – both realised and implied – had been falling for a while and had touched new all-time lows early in the new year (Graph 1, bottom right-hand panel). When the market indices started turning down, stock market implied volatilities skyrocketed, especially for the S&P 500, approaching levels last seen in August 2015, when markets were roiled by changes to China’s foreign exchange policy. Implied volatilities in bond and foreign exchange markets jumped too, though staying within range of their post-Great Financial Crisis (GFC) averages. Volatility dynamics appear to have been accentuated intraday by trading patterns related to rapid adjustments in positions in complex financial products that had been used to bet on persistent low market volatility (Box A).

Bond yields rise, but financial conditions stay loose

A sharp increase in long-term US bond yields heralded the stock market stress. Bond yields, which had steadily increased by about 35 basis points from mid-December, rose sharply over the first two days of February. Prior to the surprising strength of the US labour market report on 2 February, which boosted 10-year yields by about 5 basis points, bond investors had already been rattled by the US Treasury’s quarterly refunding plan, released on the morning of 31 January (Graph 1, top right-hand panel). The plan featured unexpected, albeit modest, increases in the auction size of all coupon-bearing nominal securities, including the benchmark 10- and 30-year bonds.

The rise in long-term yields steepened the US term structure, which had been flattening for most of last year. Short-term yields had been increasing from early September 2017, as the beginning of the Federal Reserve’s balance sheet reduction process appeared imminent. The two-year yield rose by almost 100 basis points between September and the end of January, clearly surpassing the flat plateau that had prevailed during the first half of last year (Graph 2, left-hand panel). Meanwhile, long-term yields significantly trailed the shorter tenors, staying essentially flat until

The equity market turbulence of 5 February – the role of exchange-traded volatility products

Vladyslav Sushko and Grant Turner

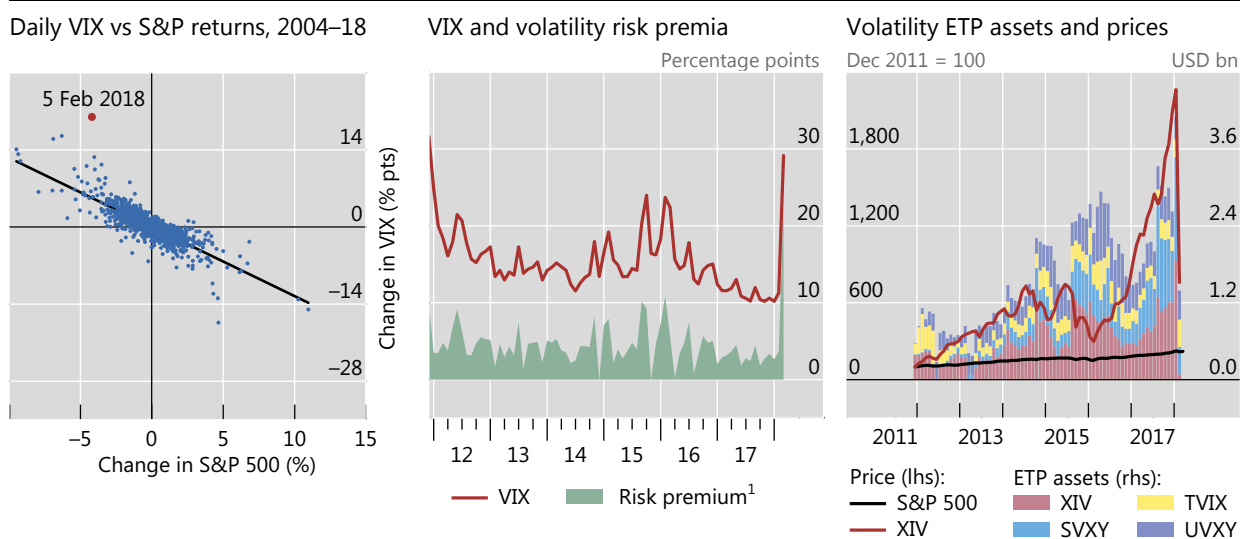
On Monday 5 February, the S&P 500 index fell 4% while the VIX – a measure of volatility implied by equity option prices – jumped 20 points. Historically, falls in equity prices tend to be associated with higher volatility and thus a rise in the VIX. But the increase in the VIX on that day significantly exceeded what would be expected based on the historical relationship (Graph A1, left-hand panel). In fact, it was the largest daily increase in the VIX since the 1987 stock market crash.

The VIX is an index of one-month implied volatility constructed from S&P 500 option prices across a range of strike prices. Market participants can use equity options or VIX futures to hedge their market positions, or to take risky exposures to volatility itself. Trading in both types of derivative instrument can affect the level of the VIX.

Because it is derived from option prices, theoretically the VIX is the sum of expected future volatility and the volatility risk premium. Model estimates indicate that the rise in the VIX on 5 February far exceeded the change in expectations about future volatility (Graph A1, centre panel). The magnitude of the risk premium (ie the model residual) suggests that the VIX spike was largely due to internal dynamics in equity options or VIX futures markets. Indeed, the considerable expansion in the VIX futures market – market size (ie total open interest) rose from a daily average of about 180,000 contracts in 2011 to 590,000 in 2017 – means such dynamics are likely to have had a growing impact on the level of the VIX.

Volatility snapback risk: assets and returns of complex volatility ETPs

Graph A1



SVXY = ProShares Short VIX Short-Term Futures (short vol/short term); TVIX = VelocityShares Daily 2x VIX Short-Term ETN (leveraged long vol/short term); UVXY = ProShares Ultra VIX Short-Term Futures (leveraged long vol/short term); VIX = CBOE VIX Index; XIV = VelocityShares Daily Inverse VIX Short-Term ETN (short vol/short term).

¹ Difference between implied and projected realised volatility; for details, see G Bekaert, M Hoerova and M Lo Duca, "Risk, uncertainty and monetary policy", *Journal of Monetary Economics*, vol 60, no 7, 2013, pp 771–88.

Sources: US Commodity Futures Trading Commission; Bloomberg; Chicago Board Options Exchange; Oxford-Man Institute; BIS calculations.

Among the growing users of VIX futures are issuers of volatility exchange-traded products (ETPs). These products allow investors to trade volatility for hedging or speculative purposes. Issuers of leveraged volatility ETPs take long positions in VIX futures to magnify returns relative to the VIX – for example, a 2X VIX ETP with \$200 million in assets would double the daily gains or losses for its investors by using leverage to build a \$400 million notional position in VIX futures. Inverse volatility ETPs take short positions in VIX futures so as to allow investors to bet on lower volatility.

To maintain target exposure, issuers of leveraged and inverse ETPs rebalance portfolios on a daily basis by trading VIX-related derivatives, usually in the last hour of the trading day.

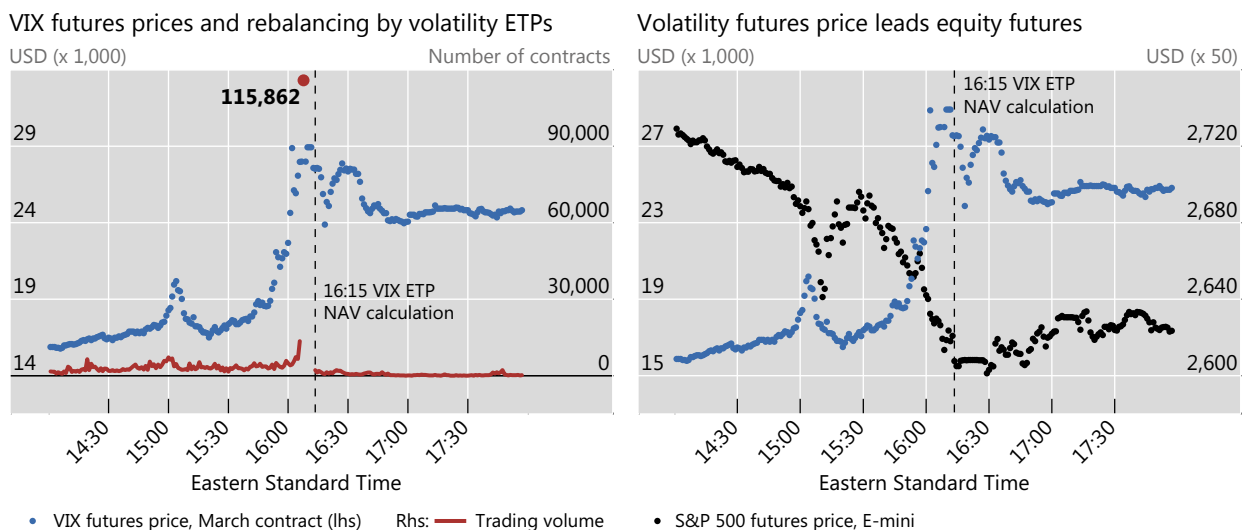
The assets of select leveraged and inverse volatility ETPs have expanded sharply over recent years, reaching about \$4 billion at end-2017 (Graph A1, right-hand panel).^① Although marketed as short-term hedging products to investors, many market participants use these products to make long-term bets on volatility remaining low or becoming lower. Given the historical tendency of volatility increases to be rather sharp, such strategies can amount to “collecting pennies in front of a steamroller”.

Even though the aggregate positions in these instruments are relatively small, systematic trading strategies of the issuers of leveraged and inverse volatility ETPs appear to have been a key factor behind the volatility spike that occurred on the afternoon of 5 February.^② Given the rise in the VIX earlier in the day, market participants could expect leveraged long volatility ETPs to rebalance their holdings by buying more VIX futures at the end of the day to maintain their target daily exposure (eg twice or three times their assets). They also knew that inverse volatility ETPs would have to buy VIX futures to cover the losses on their short position in VIX futures. So, both long and short volatility ETPs had to buy VIX futures. The rebalancing by both types of funds takes place right before 16:15, when they publish their daily net asset value. Hence, because the VIX had already been rising since the previous trading day, market participants knew that both types of ETP would be positioned on the same side of the VIX futures market right after New York equity market close. The scene was set.

There were signs that other market participants began bidding up VIX futures prices at around 15:30 in anticipation of the end-of-day rebalancing by volatility ETPs (Graph A2, left-hand panel). Due to the mechanical nature of the rebalancing, a higher VIX futures price necessitated even greater VIX futures purchases by the ETPs, creating a feedback loop. Transaction data show a spike in trading volume to 115,862 VIX futures contracts, or roughly one quarter of the entire market, and at highly inflated prices, within one minute at 16:08. The value of one of the inverse volatility ETPs, XIV, fell 84% and the product was subsequently terminated.^③

Developments in the VIX futures market and spillovers to equity futures, 5 February

Graph A2



Sources: Thomson Reuters Tick History; BIS calculations.

Spillovers back to the equity market on that day were also evident. For example, peaks and troughs in VIX futures prices led those of S&P (E-mini) futures (Graph A2, right-hand panel). One transmission channel worked via VIX futures dealers that hedged their exposure from selling VIX futures to the ETPs by shorting E-mini futures, thus putting further downward pressure on equity prices. In addition, normal algorithmic arbitrage strategies between ETFs, futures and cash markets kept the related market dynamics tightly linked. For the day as a whole, the S&P 500 index fell 4.2%, a 3.8 standard deviation daily move.

Overall, market developments on 5 February were another illustration of how synthetic leveraged structures can create and amplify market jumps, even if the core players themselves are relatively small. For investors, this was also a stark reminder of the outsize risks involved in speculative strategies using complex derivatives.

① The four products shown include exchange-traded funds (ETFs), which give investors exposure to market risk, and exchange-traded notes (ETNs), which are debt securities backed by the credit of the issuers and expose investors to both market and credit risk. ② Neither the size nor the complex strategies of leveraged and inverse volatility ETPs are representative of the broader ETP market; see V Sushko and G Turner, “What risks do exchange-traded funds pose?”, Bank of France, *Financial Stability Review*, forthcoming. ③ As is common with debt securities, ETNs often come with an issuer call option to protect the issuer from losses. In the case of XIV, conditions of termination (called “acceleration” in the prospectus) include a loss of 80% or more from previous daily indicative closing value.

last December. The subsequent boost to longer yields coincided with the approval by the US Congress of a major tax reform package, which was seen as likely to spur a significant fiscal expansion (Graph 2, centre panel).

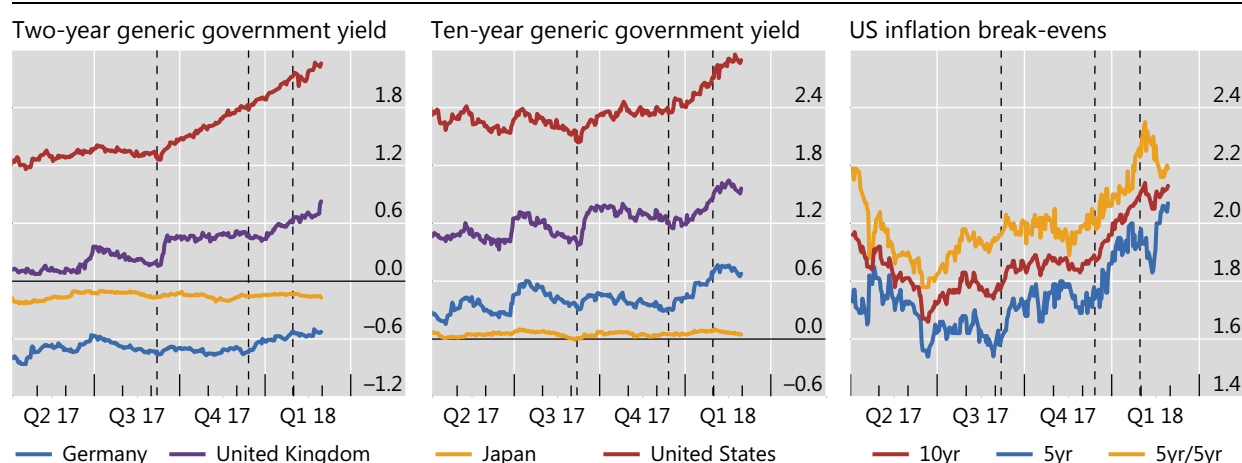
A firming inflationary outlook was at the root of the increase in US long-term yields during the period under review. US inflation stayed low in the backward-looking monthly figures, and survey-based measures of inflation expectations remained stable. But a stronger than expected CPI reading in mid-February highlighted market participants’ nervousness about upward inflation risks, as the news was followed by yet another bout of yield increases and stock market softness.

Market-based measures of inflation compensation have increased materially since mid-December. The 10-year break-even rate derived from US Treasury Inflation-Protected Securities (TIPS) crossed the 2% threshold soon after the turn of the year, and continued rising. Other gauges followed comparable paths (Graph 2, right-hand panel). The market-based inflation compensation measures decreased in the wake of the market turbulence. That drop was most likely related to the compression of nominal yields, as investors’ flight to safety temporarily overwhelmed fixed income markets. Although the inflation break-evens rebounded as market volatility eased, by

Long-term bond yields rise as inflation break-evens widen

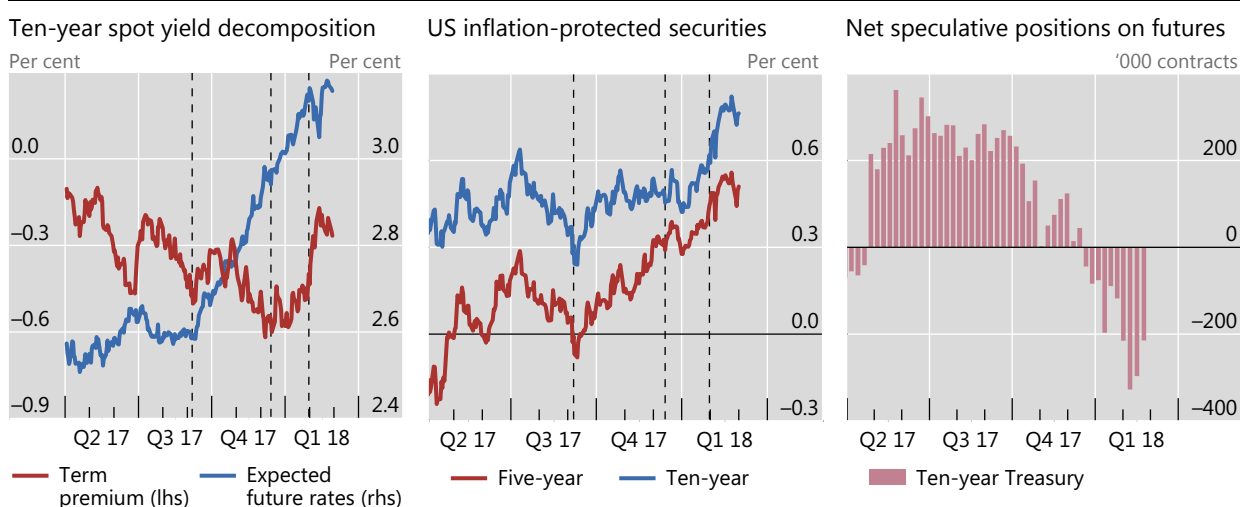
In per cent

Graph 2



The dashed lines indicate 7 September 2017 (William Dudley’s speech at New York University), 14 December 2017 (US congressional conference committee reaches deal on tax reform) and 31 January 2018 (release of US Treasury quarterly refunding documents and Federal Open Market Committee meeting).

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



The dashed lines in the left-hand and centre panels indicate 7 September 2017 (William Dudley's speech at New York University), 14 December 2017 (US congressional conference committee reaches deal on tax reform) and 31 January 2018 (release of US Treasury quarterly refunding documents and Federal Open Market Committee meeting).

Sources: T Adrian, R Crump and E Moench, "Pricing the term structure with linear regressions", *Journal of Financial Economics*, October 2013, pp 110–38; www.newyorkfed.org/research/data_indicators/term_premia.html; US Commodity Futures Trading Commission; Bloomberg.

the end of February they were back around the levels immediately predating the turbulence.

The expected path of future interest rates has also steepened substantially in recent months. In consonance with the gradual expected path of monetary policy tightening, the estimated expected future rate component of the 10-year zero coupon yield increased steadily from early September (Graph 3, left-hand panel). Similar developments across the maturity spectrum underlay increases in the shorter tenors of US Treasury securities.

The recent rise in long TIPS rates themselves (which should reflect real yields) may point towards the contribution of rising term premia to higher long-term nominal yields, in particular after the market turmoil. The 10-year TIPS yield had been slow to react to the Fed's balance sheet normalisation announcement in September, closing its spread over the five-year TIPS (Graph 3, centre panel). But after this spread stabilised in December, it rose again in the wake of the market moves of early February. This is consistent with the path followed by some estimates of the 10-year term premium. Such estimates must always be regarded with caution, as they may swing greatly depending on the features of the underlying model.¹ Nevertheless, they suggest that while the term premium had been flat or declining from September to December, it started rising in January before jumping in early February (left-hand panel).

¹ The proper methodology and actual reliability of such estimates are a topic of discussion as well as the object of active research. Here, we rely on the daily estimates provided by the Federal Reserve Bank of New York, based on the methodology in T Adrian, R Crump and E Moench, "Pricing the term structure with linear regressions", *Journal of Financial Economics*, vol 110, no 1, October 2013, pp 110–38. This has become a common market barometer, as it is freely available at daily and monthly frequencies. See also BIS, "Term premia: concepts, models and estimates", *87th Annual Report*, June 2017, pp 29–30.

In other words, a sudden and persistent decompression of the term premium at the beginning of February, while inflation break-evens stabilised, pushed nominal and real yields higher. This suggests that inflation expectations largely drove yields until late January, with the term premium the driver of yields thereafter. The timing of the term premium decompression, following the release of the quarterly refunding plan, suggests that investors' reckoning of its implications for the future net supply of long-term securities may have played a role. In the short run, however, the large short position recently built by speculative investors may give way to additional volatility and occasional falls in long-term benchmarks in the event of "short squeezes" (Graph 3, right-hand panel).

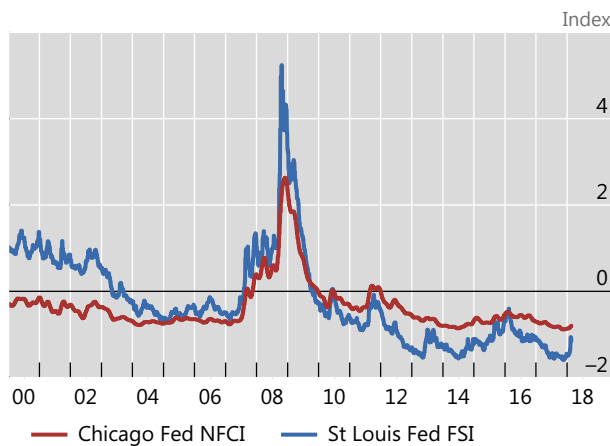
Government bond yields also increased elsewhere, but mostly in the longer tenors. The synchronised strengthening of the global economy was seen as supportive of higher rates, especially at the long end, as investors seemed to anticipate a quicker exit from unconventional policies. Ten-year German bund yields rose to almost 0.80%, double the levels prevailing in mid-December (Graph 2, centre panel). Most of that increase occurred before the stock market turbulence, after which German long yields flattened. Short-term yields increased less (left-hand panel), with the result that the German term structure steepened over the period as a whole. The term structure remained roughly constant in Japan, where long yields barely moved at all, due in part to the forceful response of the Bank of Japan to upward pressure on yields in February.

Despite equity market turbulence and higher yields, financial conditions remained very accommodative in the United States, with minimal signs of overall stress (Graph 4, left-hand panel). In fact, global credit markets were largely unfazed by these events. For instance, US and European corporate high-yield spreads had narrowed and stabilised after hitting their own bump in late November. When the

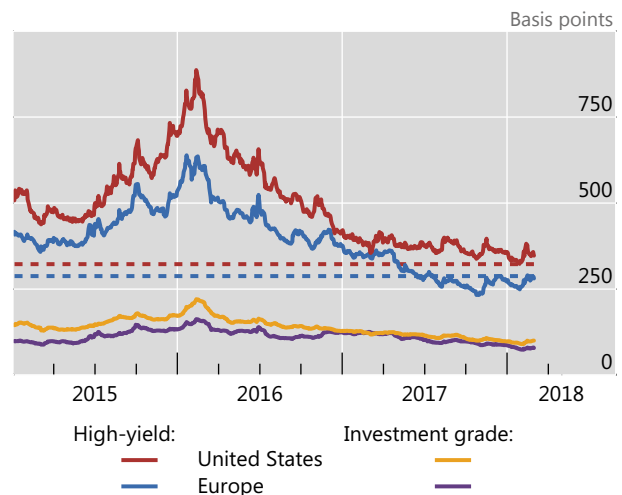
Credit conditions stay loose

Graph 4

US financial conditions¹



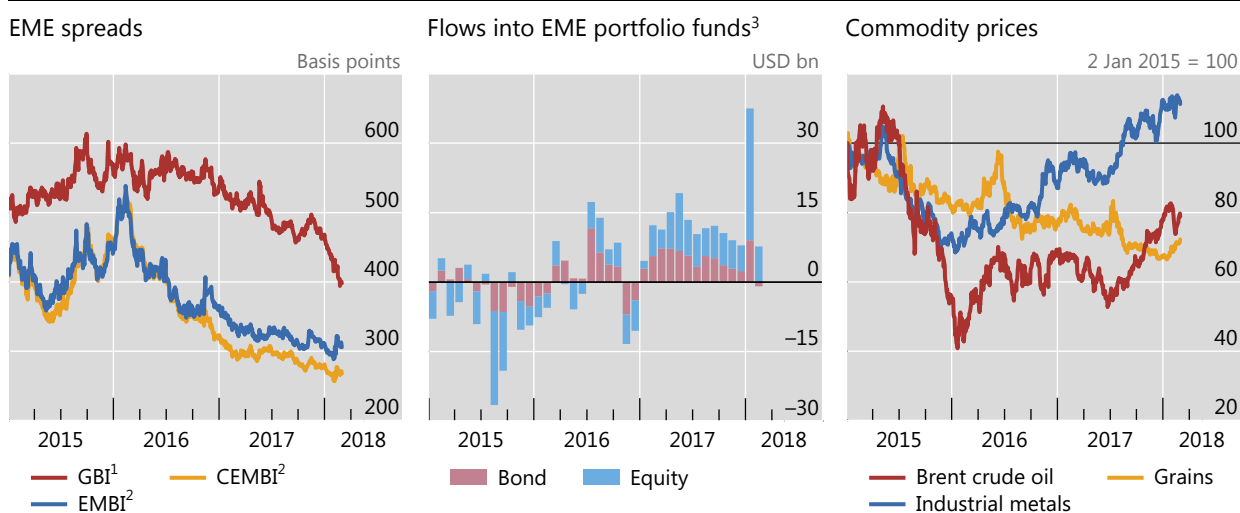
Corporate spreads²



The dashed lines in the right-hand panel indicate simple averages over the period June 2005–June 2007.

¹ Positive/negative values of the Chicago Fed National Financial Conditions Index (NFCI) indicate financial conditions that are tighter/looser than average. Positive/negative values of the St Louis Fed Financial Stress Index (FSI) indicate above/below-average financial market stress. ² Option-adjusted spread.

Sources: Datastream; ICE; BIS calculations.



¹ For JPMorgan GBI index, spread over seven-year US Treasury securities. ² For JPMorgan EMBI Global and CEMBI indices, stripped spread. ³ Monthly sums of weekly data across major EMEs up to 21 February 2018. Data cover net portfolio flows (adjusted for exchange rate changes) to dedicated funds for individual EMEs and to EME funds with country/regional decomposition

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

turbulence struck in early February, they surrendered their January gains, but still ended up fluctuating around levels very close to their pre-GFC record lows (right-hand panel). Corporate investment grade spreads swung mildly, and eventually narrowed further.

The financial outlook remained strong in emerging market economies as well. EME sovereign spreads compressed further, especially in the local currency segment: throughout the period, local currency spreads fell by 80 basis points on average vis-à-vis a decrease of 5 basis points in EMBI Global spreads (Graph 5, left-hand panel). Corporate EMBI spreads narrowed by about 10 basis points during the period under review. The strong performance of EME bond markets was underpinned by steady capital inflows, which reached a multi-year record high in January, after continued positive net inflows throughout 2017. Inflows to EME equity funds were more contained in February, whereas bond funds faced small redemptions (centre panel). There were no indications that appetite for EME debt and lending to other less established borrowers has waned. Finally, oil and other commodity prices saw some volatility during the equity market wobble, possibly because of de-risking by commodity trading advisers that exacerbated intraday movements. But all commodity indices ended with net gains by the end of the period (right-hand panel).²

² Trading in credit and commodity markets was stable despite longstanding concerns that post-crisis regulations affecting market-making activity could reduce market resilience. Box B discusses how foreign banks in the United States, a number of which play an important role as market-makers, have responded to some of these new regulations.

The new US intermediate holding companies: reducing or shifting assets?

Lawrence L Kreicher and Robert N McCauley

Recent volatility in the US bond market recalls long-standing concerns about market-making capacity, especially for corporate bonds.^① This box examines how the balance sheets of foreign banking organisations (FBOs) with big US broker-dealers have responded to the implementation of the Dodd-Frank Act. Despite their reduction of assets subject to new US capital requirements, their market-making capacity in US corporate and agency bonds has not suffered.

This law required the Federal Reserve to enhance prudential standards for bank holding companies (BHCs) with assets over \$50 billion, including through stress tests, capital plans and living wills.^② On the principle of “national treatment”, the Fed required FBOs with \$50 billion or more in US subsidiary (also known as “non-branch”) assets to put all their US subsidiaries under an intermediate holding company (IHC) by 1 July 2016.

Foreign banks changed their operations and legal structures in response to this IHC requirement in several ways. Some squeezed subsidiaries’ assets enough to avoid the IHC requirement altogether. Others already had separately capitalised BHCs, converted them into IHCs, and maintained or grew assets. Since these (“old”) IHCs had largely adapted their operations to host capital requirements, we take them as a control group. Finally, five FBOs with Fed primary dealers, who had to set up *new* IHCs, have since reduced IHC assets (Table B) and appear to have also shifted assets to their offshore and US bank branches not subject to the US capital requirements.

Five banks on a 2014 Federal Reserve “illustrative list” of 17 banks^③ that might have needed to set up IHCs ended up with subsidiary assets low enough *not* to do so. One of the five, Royal Bank of Scotland, had committed to its main owner, the UK Treasury, to downsize irrespective of the IHC threshold. Of the others, Société Générale had subsidiary assets over \$50 billion as late as 30 June 2015 but managed them below the threshold by year-end.^④

Deutsche Bank established an IHC, but only after cutting its US subsidiary assets very substantially. Its former US BHC, named Taunus, had \$355 billion in assets at end-2011 before it relinquished its BHC status in early 2012.^⑤ Its new IHC reported assets at end-Q3 2016 of just \$203 billion. Other FBOs may also have cut subsidiary assets before setting up new IHCs in 2016, again with the effect of limiting US capital charges, but data are lacking.

Since establishment, every new IHC has reduced its assets and therefore its required capital. Between Q3 2016 and Q3 2017, the new IHCs shrank their total assets by about \$100 billion or 10% (Graph B, left-hand panel, either quarter-average or end-of-quarter). In contrast, FBOs with pre-existing BHCs (“old IHCs”) kept their total US assets unchanged at \$1.3 trillion. The new IHCs shrank their trading assets by \$50 billion, moving or cutting Treasury securities but keeping agency and corporate bonds roughly unchanged. Trading asset levels at the old IHCs were stable.

Intermediate holding companies of foreign banks in the United States Table B

New	Assets \$bn Q3 17	Change vs Q3 16 avg	Primary dealer?	G-SIB ¹ 11/17?	Old	Assets \$bn Q3 17	Change vs Q3 16 avg	Primary dealer?	G-SIB ¹ 11/17?
Credit Suisse	220	-9.0%	Y	1	Toronto Dominion	374	11.7%	Y	
Barclays	175	-29.4%	Y	1	HSBC	286	-6.9%	Y	3
Deutsche Bank	165	-33.6%	Y	3	MUFG	155	3.7%		2
UBS	146	-23.4%	Y	3	Royal Bank of Canada	138	-5.6%	Y	1
BNP	146	-5.7%	Y	2	Santander	132	-5.7%		1
<i>Subtotal</i>	852			<i>Avg = 2</i>	Bank of Montreal	131	1.8%	Y	
					BBVA	86	-5.7%		
Grand total	2,154				<i>Subtotal</i>	1,302			<i>Avg = 1</i>

¹ For G-SIBs, numbers indicate buckets, which correspond to the following extra capital required: 3 = 2% more; 2 = 1½% more; 1 = 1% more. Sources: Board of Governors of the Federal Reserve System, FR Y-9C; Federal Reserve Bank of New York; Financial Stability Board, *2017 list of global systemically important banks (G-SIBs)*, 21 November.

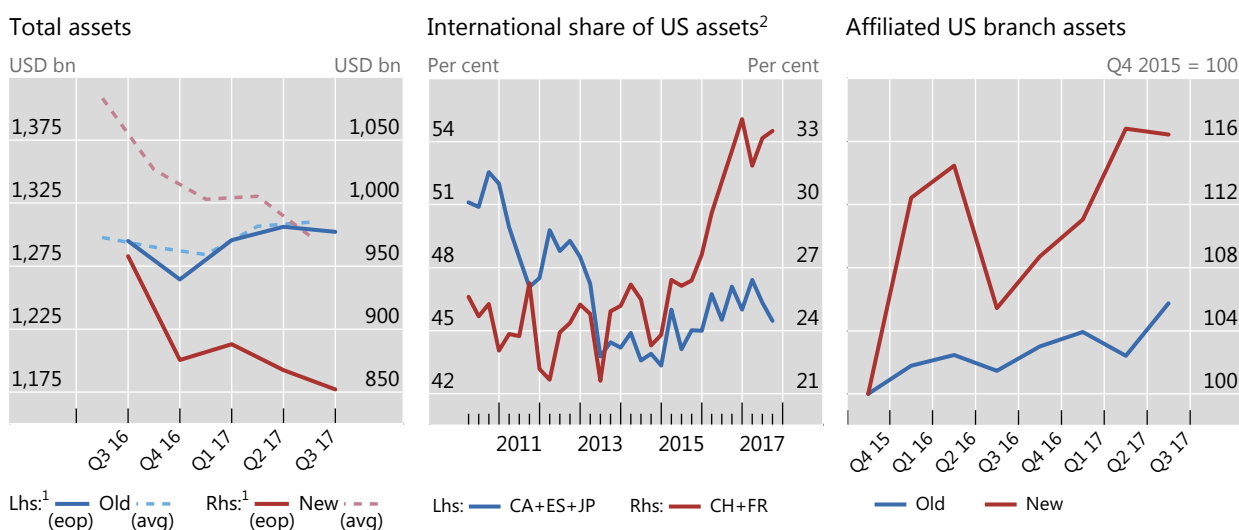
If the new IHCs have shed assets in their US subsidiaries, did they also *shift assets offshore*? FBOs could do so either by rebooking existing assets or by booking new assets offshore. BIS consolidated international banking data are consistent with such a shift. In particular, Swiss and French banks have indeed grown (mostly offshore) international claims on US residents faster than locally booked claims on US residents (Graph B, centre panel). From a pre-IHC trough of 24% in 2014, the ratio of international claims on US residents of banks headquartered in these new IHC countries to their total US claims increased to 33% in the third quarter of 2017, an increase of 9 percentage points at the margin and a share increase of more than a third. In contrast, the ratio for the countries with banks operating with old IHCs barely increased, from 43% to 45%.

The FBOs with the new IHCs look to have *shifted assets to US branches* as well (Graph B, right-hand panel). From end-2015 to September 2017, US branch assets for FBOs with new IHCs increased by 16%. By contrast, during that same time, US branches of FBOs with old IHCs increased by 6%. If the branches affiliated with new IHCs had shown similar asset growth, their assets would have been \$58 billion less. As with shifts of assets to foreign branches, operational, transfer accounting and legal constraints presumably limited the shifts from IHCs to their respective US branches.

We conclude that foreign banks facing the IHC requirement did not sit still. At least one FBO avoided the IHC mandate by shrinking assets while another cut assets significantly before the IHC deadline. All the new IHCs have subsequently reduced their footprints. Asset shifts within FBOs from IHCs to offshore or US bank branches would have reduced the specific US capital charges. One caveat is the limitation of our natural experiment: our control group with pre-existing BHCs has a greater weight of banking in their business models and, relatedly, a lower capital surcharge for consolidated size, interconnectedness, substitutability, span and complexity (Table B, “G-SIB?” column).

Any shrinkage of trading books by foreign-owned primary dealers could worsen the perceived disproportion between the huge stock of US corporate bonds outstanding and dealer inventory. Thus far, however, the new IHCs’ asset reduction has spared their trading book of agency and corporate bonds.

Total assets, international share and affiliated US branch assets: new vs old IHCs Graph B



¹ As defined in Table B; eop = end of period; avg = quarterly average. ² Immediate borrower basis; German banks’ non-bank subsidiary assets not reported to BIS.

Sources: Board of Governors of the Federal Reserve System, FR Y-9C and “Structure and share data for US banking offices of foreign entities”; BIS consolidated international banking statistics; authors’ calculations.

① Committee on the Global Financial System, “Fixed income market liquidity”, *CGFS Papers*, no 55, January 2016. ② US Treasury, *A financial system that creates economic opportunities: banks and credit unions*, June 2017, suggests a higher threshold. ③ “Factbox: Fed lists foreign banks that may fall under new rule”, Reuters, 20 February 2014. ④ Letters from the Board of Governors to Sheldon Goldfarb, General Counsel, RBS Americas, 11 December 2014, and to Slawomir Krupa, CEO, Société Générale Americas, 6 July 2016. Another of the five banks, Mizuho, expected to set up an IHC in the future according to the Board letter to Frank Carellini, Deputy General Manager, Mizuho Bank (USA), 18 February 2016. ⑤ Deutsche Bank, *Annual Report*, 2011 and 2012, notes on subsidiaries; S Nasiripour and B Masters, “Bank regulators edge towards ‘protectionism’”, *Financial Times*, 12 December 2012.

Continued dollar weakness

The stock and bond market developments took place against the broad backdrop of US dollar weakness. The dollar had been depreciating against most currencies since the beginning of 2017. The slide had been briefly arrested by last September's announcement of the start of the Federal Reserve's balance sheet run-off, but it resumed in December. The stock market correction interrupted it only briefly, in part because of the short-lived flight to safety that followed. By the end of February, the currency was down 1% from the beginning of the year, as measured by the broad trade-weighted index (Graph 6, left-hand panel).

The persistent weakness of the dollar is, in many respects, hard to reconcile with developments in monetary policy. Gradualism and predictability notwithstanding, the Federal Reserve has been steadily tightening its stance since December 2016. The central bank again raised the fed funds target range by 25 basis points in December 2017, and the future path of policy rates, as depicted by the "dot plot" of forecasts by members of the Federal Open Market Committee, stayed mostly unchanged. In contrast, the ECB did not set a termination date for its APP, and expected its key policy rates to remain unchanged long past the programme's horizon. The Bank of Japan signalled that qualitative and quantitative easing would continue. As a result, spreads between future expected short-term rates in the United States, on one side, and the euro area and Japan, on the other, continued to widen (Graph 6, right-hand panel).

That said, dollar weakness during a period of Fed policy tightening is not unusual. The dollar had also depreciated during the Federal Reserve's two previous tightening cycles in 1994 and 2004. In the course of the first 15 months of the current cycle, the

Dollar weakens despite Fed tightening

Graph 6

USD exchange rates¹



Overnight index swap spreads²

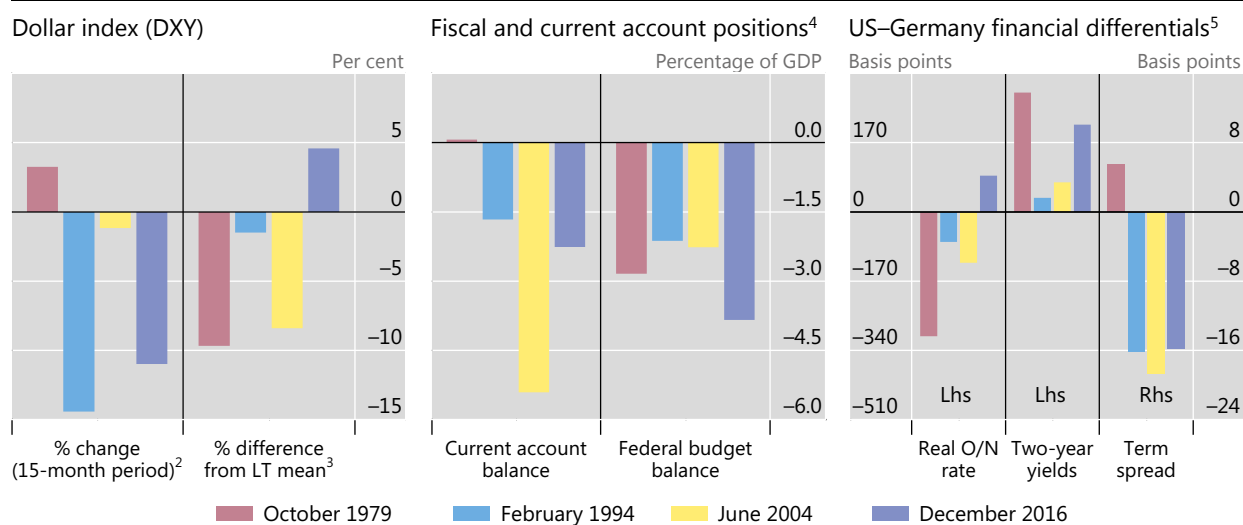


The dashed vertical lines in the left-hand panel indicate 27 June 2017 (opening of ECB forum in Sintra), 14 December 2017 (US congressional conference committee reaches deal on tax reform) and 11 January 2018 (release of minutes of ECB December meeting).

The dashed horizontal lines in the left-hand panel indicate the long-term average for JPY (2 January 1987–27 February 2018) and EUR (4 January 1999–27 February 2018).

¹ An increase indicates an appreciation of the US dollar. ² Difference between the one-year US dollar overnight index swap (OIS) and the one-year euro OIS or one-year yen OIS.

Sources: Bloomberg; national data; BIS calculations.



¹ For each tightening episode, the start date is shown in the legend and the end date is 15 months later. ² A positive value indicates appreciation of the US dollar. ³ Percentage difference from the long-term mean (1970–latest) at the start of each tightening episode. ⁴ The bars show averages over the indicated periods based on quarterly data. ⁵ The real rate is defined as the difference between the overnight rate and headline inflation. The term spread is defined as the difference between the 10-year and two-year government bond yields (pre-1989 Germany, two-year government bond yield proxied by the overnight rate).

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

dollar has depreciated by 11% against other AE currencies, as measured by the DXY dollar index. Over a similar time span, the dollar had depreciated by about 14% during the relatively stronger 1994 tightening, and by only 1% during the more gradual 2004 episode (Graph 7, left-hand panel), in each case as indicated by changes in the DXY index. However, the dollar had indeed appreciated, albeit moderately (3%), during the comparable window of the 1979 tightening. Both in 1979 and 1994, the bulk of the dollar appreciation occurred after the tightening cycle had finished.

The position of the dollar at the beginning of the tightening vis-à-vis its long-term average value does not explain these exchange rate moves. Market commentary has emphasised that the relatively strong initial position of the dollar at the beginning of the current tightening cycle was a factor explaining its subsequent weakness. And in fact, in December 2016 the dollar was almost 5% above the average value of its index, computed for the full sample (Graph 7, left-hand panel). But the finding does not carry over to the other events. Both in 2004 (when the depreciation was small) and in 1979 (when the appreciation was moderate), the currency had entered the policy tightening episode 8–10% below its long-term average. In contrast, a dollar that was slightly below its mean in 1994 went on to depreciate almost 15% in the following months.

Similarly, market observers' emphasis on the role of the "twin deficits" (fiscal and external) is not clearly borne out by the data. True, the current account was slightly positive in 1979 (when the dollar appreciated) and negative in the other three events (when the dollar depreciated). But the external deficit in 2004 was more than double the one observed during 1994 and 2016 (Graph 7, centre panel), and yet the dollar depreciated much less in 2004. On the fiscal side, the average deficit-to-GDP ratio was roughly similar in the first three episodes, and higher in the current one. But fiscal consolidation was actually on the march in 1994, when the dollar depreciated most, while fiscal deficits were expected to increase during the other episodes because of

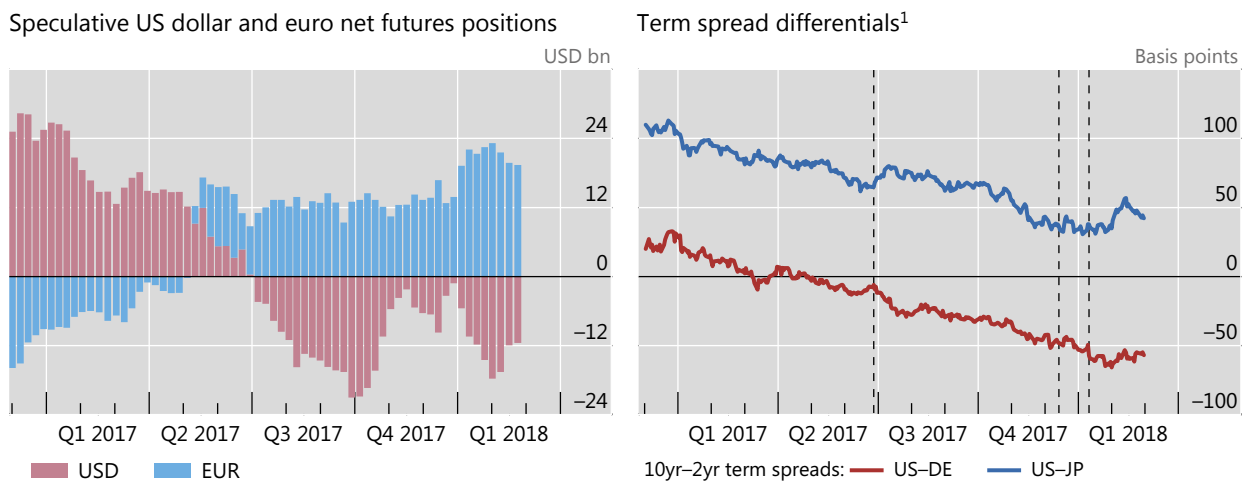
significant tax cuts.³ While it is hard to find a clear link between the external deficits and the exchange rate in the data, protectionist rhetoric in the United States may have indeed played a role in the dollar's recent weakness, as well as statements by high-ranking officials that were understood to be aimed towards "talking down the currency".

Term spread differentials did exhibit patterns consistent with the exchange rate moves observed in these four incidents. Empirical research has shown that the term spread differential between two countries helps to forecast their currencies' exchange rate moves. The right-hand panel of Graph 7 suggests a simple "stylised fact": the dollar has depreciated whenever the term spread differential on average favoured other currencies, in this example Germany's. In other words, when the term spread tended to be higher in Germany than in the United States (even if the rates themselves were lower), the dollar depreciated, and vice versa. A causal explanation is not warranted, but the sign of the carry is likely to have played a role in supporting the appreciating currency. Other financial spreads typically examined by the exchange rate literature did not show consistent patterns across these four tightening episodes.

The dollar's depreciation has not been uniform across all currencies. In particular, the euro has proved especially strong. Since December 2016, the euro has appreciated by about 14% against the dollar. In contrast, during the same time span the yen has appreciated by 6% and other currencies by just under 6%. As the euro area economy continued to strengthen throughout last year, investors were increasingly pricing in a sooner than previously expected end to unconventional monetary policies, adding support for the currency. The ECB forum in Sintra in late June 2017 appeared to mark one of the main turning points (Graph 6, left-hand panel). The euro had been moving roughly in tandem with the yen and other

Market sentiment and carry trade support the euro

Graph 8



The dashed lines in the right-hand panel indicate 27 June 2017 (opening of ECB forum in Sintra), 14 December 2017 (US congressional conference committee reaches deal on tax reform) and 11 January 2018 (release of minutes of ECB December meeting).

¹ Based on government bond yields.

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

³ This comparison should be interpreted with caution, as the timing of the various measures differed. In particular, the fiscal measures were adopted at different stages of the respective tightening cycles.

currencies till then. Afterwards, it separated from the others, strengthening markedly and quickly converging towards its long-term average parity with the dollar, before the latter started depreciating further last December. The dollar's slide since December has appeared relatively broad-based; even the yen, which until then had been trading within a 5% range below its December 2016 level, also strengthened to stand well above its 30-year average parity.

Market positioning and carry trades, at least in the short run, have been helping the euro. Investors' longstanding speculative net short euro position has been falling continuously since late 2016, and it turned into a net long position as of last June. Long euro positions spiked once again late last year (Graph 8, left-hand panel). Exactly the opposite happened on the dollar side. Moreover, as the term structure of US Treasuries flattened while that of German bunds gradually steepened, the term spread in Germany became consistently higher than the US term spread for the first time since the GFC (Graph 8, right-hand panel). The relative gap favouring German bonds and those of other core European economies reached almost 60 basis points in late February, despite some narrowing as turbulence took hold of markets.

Common lenders in emerging Asia: their changing roles in three crises¹

The “common lender channel” is a mechanism that facilitates the spread of financial shocks around the globe. Creditor banks withdraw from previously unaffected countries when highly exposed to the epicentre of a crisis. At the time of the Asian financial crisis in 1997, Japanese banks dominated lending to emerging Asia. When Japanese banks cut their credit sharply, less exposed European banks took over as leading lenders. When the Great Financial Crisis of 2007–09 and the European sovereign debt crisis of 2010 struck, it was euro area lenders’ turn to pull back from Asia owing to their extensive exposures. By contrast, less exposed Japanese banks expanded their lending. Today, Chinese banks have a sizeable and growing global footprint. In the face of future shocks at home or abroad, they are likely to take their turn as important common lenders.

JEL classification: F34, F36, G21.

Several recent financial crises have exhibited a *common lender channel*. This is the tendency for crisis conditions to spread from one country to another as creditor banks pull back from previously unaffected countries because of a shock they have suffered in a crisis-hit country.

The common lender channel played an especially important role in the Asian financial crisis (AFC) of 1997–98, when a series of countries suffered severe financial stress with significant real consequences. In this highlights feature, we analyse the ebb and flow of international bank credit in emerging Asia around the time of the AFC as well as around the Great Financial Crisis (GFC) of 2007–09 and the European sovereign debt crisis of 2010–12. The composition of creditor banks in the region has changed in important ways over the past two decades (McGuire and van Rixtel (2012)). These episodes thus present three different patterns of lending countries’ exposures to crisis-stricken countries, and three different examples of how the common lender channel can affect credit to emerging market economies (EMEs).

After briefly setting out the concepts underlying the common lending channel, we explore how this channel operated in emerging Asia during the three crisis episodes. The AFC stands as a polar case, featuring shocks to both the demand and the supply of credit. The GFC gives a mixed picture. The demand for credit within Asia hardly changed, while the supply effects differed across creditor banks. During the

¹ We thank Stefan Avdjiev, Claudio Borio, Stijn Claessens, Benjamin Cohen, Robert McCauley, Patrick McGuire, Swapan-Kumar Pradhan, Hyun Song Shin and Philip Wooldridge for helpful comments and suggestions. We also thank Zuzana Filková and José María Vidal Pastor for excellent statistical assistance. The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS.

European sovereign debt crisis, demand effects in Asia were also mild, while supply effects again paint a more nuanced picture. Finally, we examine the current composition of lenders in the region, including the growing global footprint of Chinese banks.

Lenders and borrowers in emerging Asia

The common lender channel

When several countries borrow from just a few big international banks, these borrowers face the risk of what is called the “common lender channel”. Unexpected losses in one country may induce banks to withdraw from other borrower countries as banks restructure their asset portfolio in an attempt to rebalance overall risks and satisfy regulatory constraints (Kaminsky and Reinhart (1999)). Contagious spillovers can thereby spread the turmoil around the globe. Researchers have tended to lay particular emphasis on the transmission of shocks emanating from the common lenders’ home countries.

The rich dimensionality structure of the BIS international banking statistics allows us to examine more complex relationships involving several borrower and lender countries. For example, we can look at how shocks in a given borrower country might affect how exposed banks in a lending country choose to alter their lending to other, unaffected countries. This allows us to study how the dynamics of the common lender channel play out across different relative exposures of the creditor banks.

The borrowers

The two decades since the AFC have seen a broad rise in international credit to EME borrowers in Asia. According to the BIS locational banking statistics,² cross-border claims of BIS reporting banks more than quadrupled, totalling \$2 trillion in 2017. Among the Asian EMEs, we restrict our focus to Indonesia, Korea, Malaysia, the Philippines and Thailand, the countries at the epicentre of the AFC. We will refer to them as “emerging Asia”. Together, these five countries accounted for 69% of the region’s total cross-border credit in Q2 1997, and 24% in Q3 2017. The considerable decline in their regional share reflects the emergence of China as the largest borrower in the region from BIS reporting banks.

When taking local positions in foreign currency into account, consolidated³ international claims⁴ on emerging Asia reached 21% of these borrowers’ combined GDP on the eve of the AFC in mid-1997. In absolute amounts international credit has

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

³ The consolidated banking statistics are structured according to the nationality of reporting banks and are reported on a worldwide consolidated basis, ie excluding positions between affiliates of the same banking group. Banks consolidate their inter-office positions and report only their claims on unrelated borrowers.

⁴ International bank claims are the sum of banks’ cross-border claims and their local claims denominated in foreign currencies.

risen by two thirds over the past 20 years, while relative to GDP it has ebbed and flowed (Graph 1, left-hand panel). As of Q3 2017, international claims of creditors reporting to the BIS consolidated banking statistics fell to 11% of emerging Asia's GDP, suggesting that the sensitivity of these countries to a sudden withdrawal by international lenders has declined over the past two decades. It should be noted that these data do not include credit granted by banks headquartered in countries that do not report to the BIS consolidated banking statistics, even if the claims have been intermediated through BIS reporting locations.

The lenders

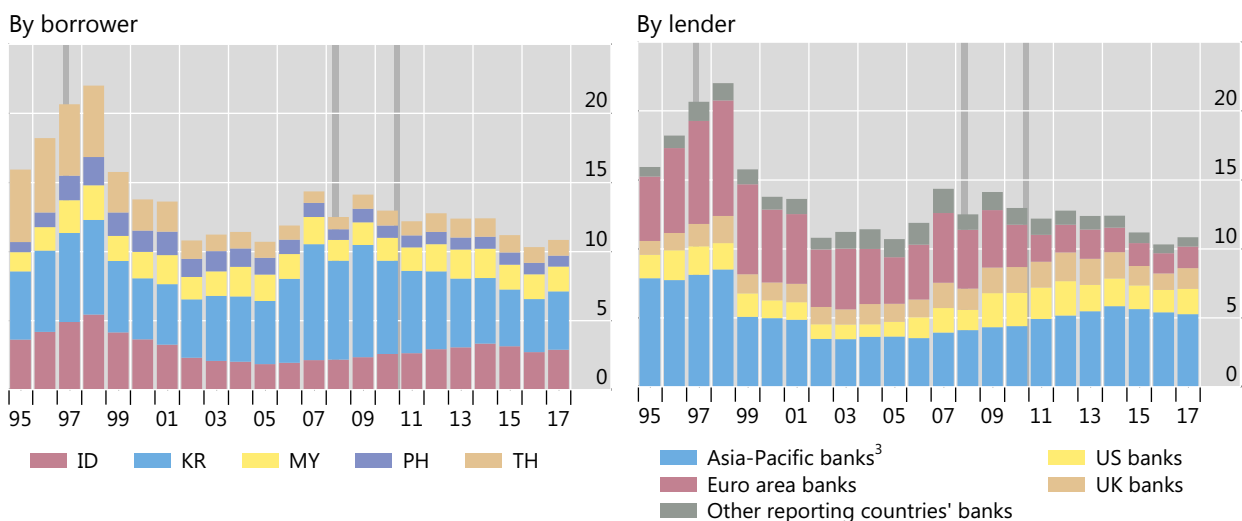
Different countries and regions have taken turns as home to the leading bank lenders to emerging Asia (Graph 1, right-hand panel). Exactly whose turn it was depended on the adjustments made in response to each successive crisis. Japanese banks assumed the role of leading lenders in 1997, reporting about 42% of all international consolidated claims⁵ on the five AFC countries we focus on (Graph 2, left-hand panel). Slightly behind them, euro area banks held 36%, with German and French banks accounting for the bulk thereof and UK banks for 7%.

In the aftermath of the AFC, the dominance of Japanese banks was increasingly challenged by European banks. By mid-2008, Japanese banks held 15% of international claims, while euro area (35%) and UK (14%) banks jointly held almost

Credit to emerging Asia:¹ a consolidated view

International claims, as a percentage of GDP²

Graph 1



The grey bars indicate the start of the crises.

¹ Emerging Asia is limited to the countries at the epicentre of the AFC: Indonesia, Korea, Malaysia, the Philippines and Thailand. ² International claims (defined as the sum of cross-border claims and locally extended claims in foreign currency) on all sectors; immediate borrower basis. The series plotted in both panels are scaled by the sum of the nominal GDP of the five emerging Asia countries listed. ³ Item consists of reporting regional banking systems: Australia (joined as a reporter in Q4 2003), Chinese Taipei (Q4 2000), India (Q4 2001), Japan (Q4 1983), Korea (Q4 2011), Hong Kong SAR (Q4 1997) and Singapore (Q4 2000).

Sources: National data; BIS consolidated banking statistics and US dollar exchange rate statistics.

⁵ In fact, as of 1997 Japan was the only country in the region reporting consolidated data.

half of all claims. The changes in the composition of the lenders within the Asia-Pacific region itself were also significant. Banks headquartered in Australia, Hong Kong SAR and Singapore accounted for about 11% of all regional claims.⁶

With the onset of the European sovereign debt crisis in 2010, other banks from the Asia-Pacific region found opportunities to make inroads. As of end-2010, the combined share of Japanese banks plus regional banks from offshore centres and EMEs in Asia accounted for almost 32% of all international claims. By that time, the shares of euro area and UK banks amounted to 24% and 15%, respectively.

Incomplete data and changing reporting standards of the consolidated banking statistics make it difficult to track all lenders over time. Hence, we limit our analysis of the three crisis episodes to the roles of the major global banks headquartered in the euro area, Japan, the United Kingdom and the United States. It should also be noted that in what follows, reflecting the structure of the BIS banking statistics, we look at borrowing and lending exposures at the level of national banking systems rather than that of individual banks. There was of course significant variation across banks, including banks from the same country, in how they adjusted their borrowing and lending positions throughout this period.

The Asian financial crisis

The AFC was triggered by speculative attacks in July 1997 on the currencies of Indonesia, Malaysia, the Philippines and Thailand.⁷ These four countries saw sharp currency depreciations, losses of foreign exchange reserves and stock market collapses. In November, the crisis spread to Korea. What made this crisis so severe, among other factors, was the contagion that ensued (Glick and Rose (1999)). Shifts in investor sentiment also contributed to these contagion effects (Cohen and Remolona (2008a)).

The five crisis-hit countries had borrowed most heavily from Japanese banks. These creditor banks, in turn, were significantly exposed to the epicentre of the crisis. On the eve of the AFC, borrowers in emerging Asia owed 42% of their international bank debt to Japan (Graph 2, left-hand panel). The five crisis-stricken countries had also borrowed heavily from euro area banks, which held 36% of the claims. Banks from the United States and the United Kingdom accounted for 10% and 7% of international credit to emerging Asia, respectively. Japanese claims on emerging Asia represented 9% of their global portfolio (Graph 2, right-hand panel). This was higher than the 6% ratio reported by US and UK banks, respectively, and the 4% ratio reported by euro area banks.

The crisis came at a particularly unfortunate time for Japanese banks. In 1997, these banks were still struggling from the effects of the end-1980s Japanese financial bubble, which left them with a large stock of weak or non-performing domestic corporate and real estate loans (Ueda (2000)). Hence, they were not in a good position

⁶ In addition, some loans to emerging Asia were extended by banks that did not report to the BIS banking statistics, as their headquarters were located outside the BIS reporting countries. McGuire and van Rixtel (2012) suggest that these were mainly Chinese banks located in Asian offshore centres. In the current setup, this part of credit to emerging Asia falls outside the scope of our analysis.

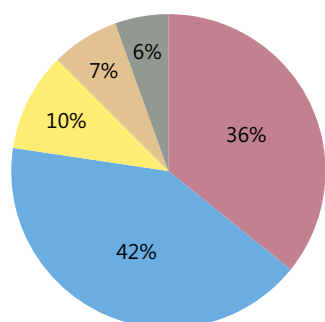
⁷ See Moreno et al (1998) for a review.

The Asian financial crisis: main creditors and their relative exposures

International claims, as of Q2 1997, by lending bank nationality¹

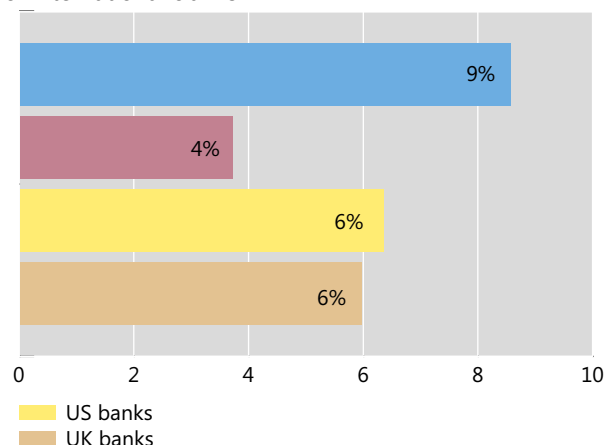
Graph 2

Claims on emerging Asia relative to all creditors



Legend for pie chart:
 ■ Other reporting countries' banks (grey)
 ■ JP banks (blue)
 ■ EA banks (red)
 ■ US banks (yellow)
 ■ UK banks (orange)

Claims on crisis countries, as a share of global portfolio of international claims²



¹ International claims on emerging Asia, which is limited to the countries at the epicentre of the AFC: Indonesia, Korea, Malaysia, the Philippines and Thailand. ² As of Q2 1997, the BIS consolidated banking statistics did not capture claims on advanced economies. For this reason, we scale the international claims by the total of cross-border claims of the particular parent country from the BIS locational banking statistics by nationality. In order to approximate consolidated data, we subtract claims on the interbank sector from all-sector claims.

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

to bear additional losses. As McCauley and Yeaple (1994) pointed out, even before the crisis Japanese banks had changed course, making room for other banks, especially in the interbank market. Reflecting this, the pace of Japanese banks' expansion in the five crisis countries slowed relative to that of other global lenders (Graph 3, left-hand panel). With the onset of the crisis, lending by Japanese banks to emerging Asia fell by up to 72% over seven years. Japanese banks also cut the credit they provided to other EMEs, such as those in Africa and the Middle East, Latin America and Europe, by up to 36% as of Q3 2002 (right-hand panel, blue line). While Japanese banks' credit to emerging Asia started to recover only in 2004, their lending to other EMEs reached pre-crisis levels in 2005. The pattern of Japanese banks' lending to non-Asian EMEs in the aftermath of the AFC thus points to the presence of spillover effects as described by the common lender channel.

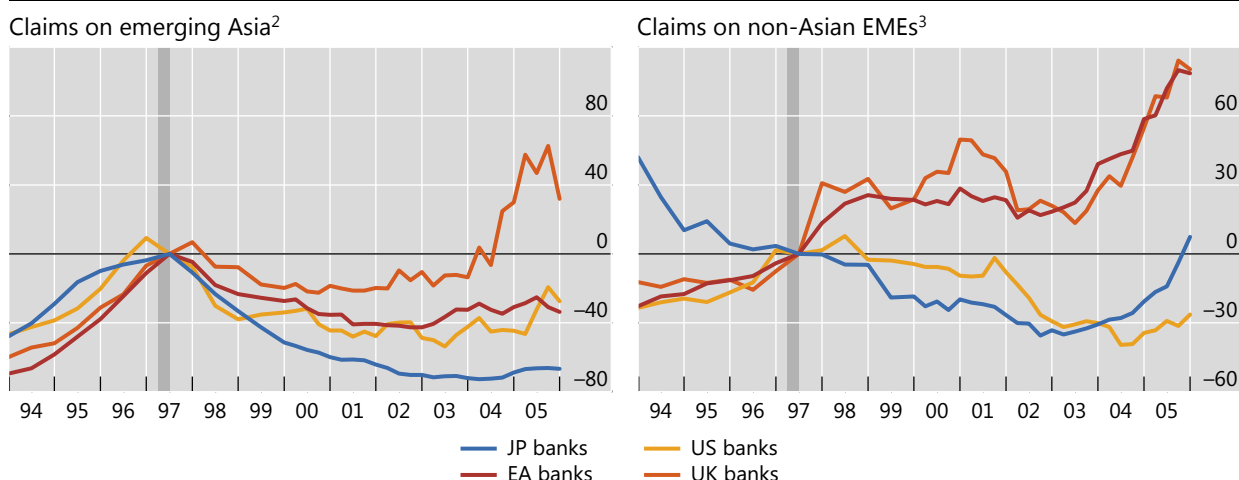
The adjustment patterns to the AFC exhibited by other major lenders differ substantially, but were in general not as sharp as in the case of Japanese banks. Lending by US banks to emerging Asia also dropped by about 50% over the six years following the AFC (Graph 3, yellow lines). However, in contrast to Japanese banks, their international lending to other EMEs after 1997 remained almost unchanged initially, although they tended to reduce their EME credit significantly after 2001. Euro area banks' lending to emerging Asia declined by up to 43% by end-2002, but started to rebound in 2003 (red lines). Despite their more severe exposure to the crisis-hit borrowers, UK banks actually withdrew the least and had fully recovered by 2004 (orange lines). In contrast to their US and Japanese counterparts, euro area and UK banks never cut their exposure to other EMEs in the wake of the AFC, and in fact increased it, especially from 2003 onwards.

As a result of these shifts, the composition of creditor banks in emerging Asia changed fundamentally in the decade following the AFC. Euro area and UK banks made inroads in this market, and US banks partly followed suit. By contrast, Japanese

The common lender channel in the Asian financial crisis

International claims on EMEs, by lending bank nationality, Q2 1997 = 0¹

Graph 3



The grey bar indicates the start of the crisis.

¹ Percentage changes relative to the start of the AFC. ² Emerging Asia is limited to the countries at the epicentre of the AFC: Indonesia, Korea, Malaysia, the Philippines and Thailand. ³ Emerging market economies in Africa and Middle East, Latin America and Europe.

Sources: BIS consolidated banking statistics; authors' calculations.

banks lost market share. In June 2008, on the eve of the GFC, the leading bank creditors of emerging Asia were now the banks from Europe. Banks from the euro area and the United Kingdom jointly held almost 50% of the international consolidated claims on the five Asian countries, while Japanese banks accounted for only 15%.

The Great Financial Crisis

Triggered by defaults in subprime mortgages in the United States, the GFC was amplified by runs in the US repo market and defaults on collateralised debt obligations (Cohen and Remolona (2008b)). In August 2008, the interbank market in Europe froze and the ECB had to step in and provide liquidity. In September, Lehman Brothers and Washington Mutual collapsed and a number of other institutions were absorbed by competitors or received aid from the official sector. The crisis was centred on the United States, but affected global banks worldwide. For many non-US banks, the crisis manifested itself partly in the form of a dollar shortage that was related to problems in the interbank market (McGuire and von Peter (2009)).

In contrast to the AFC, the top lenders to emerging Asia ahead of the GFC were not at the same time the most exposed lenders to the epicentre of the crisis, the United States. Japanese banks reported the highest overall exposure, with 28% of their international assets being invested in the US. For UK banks, borrowers in the US accounted for 22% of their international claims; for euro area banks, only 10% (Graph 4, left-hand panel). Once we take into account the claims in local currency of these banks' US-based affiliates, the exposure of Japanese creditor banks to the

United States rises to 32% of their global portfolio, while that of UK and euro area banks climbs to 30% and 15%, respectively.⁸

However, some banks' positions led to higher losses than others'. European banks' exposures were heavily tilted towards assets that immediately suffered when the US subprime bubble burst. By contrast, the exposure of Japanese banks to US borrowers was concentrated in safe assets such as US Treasury securities. As argued by Amiti et al (2017), Japanese banks had never succumbed to the structured finance boom. Between 2002 and 2007, they were busy restructuring their balance sheets after taking huge write-offs in the early 2000s.⁹

Facing large and growing losses on their US exposures, euro area and UK banks cut back on their lending to Asian borrowers, again reflecting the common lender channel at work. Over two quarters, UK banks' international credit to emerging Asia saw a decline of about 32%. However, it bounced back in early 2009 and returned to its 2008 level in mid-2010 (Graph 4, right-hand panel). Banks from the euro area also withdrew from emerging Asia. Within three quarters, their outstanding claims fell by 29%, and then remained relatively constant until the outbreak of the European sovereign debt crisis.

By contrast, Japanese creditor banks barely reduced their lending to emerging Asia. As one of the few major banking systems with sufficiently sound balance sheets, they actually expanded internationally. Within a year and a half, these banks' claims

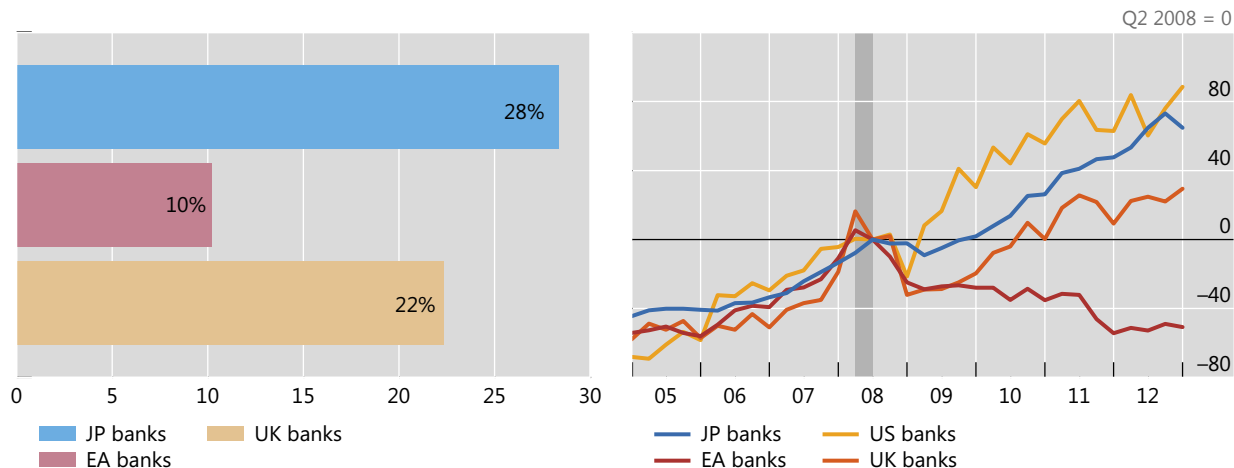
The Great Financial Crisis: main creditors' exposures and their responses in Asia

International claims, by lending bank nationality

Graph 4

Claims on the US, as a share of global portfolio of international claims, as of Q2 2008

Claims on emerging Asia¹



The grey bar indicates the start of the crisis.

¹ International claims on emerging Asia, which is limited to the countries at the epicentre of the AFC: Indonesia, Korea, Malaysia, the Philippines and Thailand. Percentage changes relative to the start of the Great Financial Crisis.

Sources: BIS consolidated banking statistics; authors' calculations.

⁸ In the BIS international banking statistics, this broader aggregate is labelled "foreign claims". This category comprises cross-border claims and local claims, where local claims refer to credit extended by foreign banks' affiliates located in the same country as the borrower.

⁹ For a discussion of Japanese bank reforms, see McGuire (2002).

were back to where they had stood in mid-2008 and had started growing strongly (Graph 4, right-hand panel).

As in 1997, the composition of creditor banks lending to emerging Asia changed in the aftermath of the crisis. While European banks remained the leading lenders to emerging Asia, their position was not as dominant as before. At the end of 2010, European creditors (comprising euro area and UK banks) jointly accounted for slightly less than 40% of all international claims on emerging Asia. Japanese and US banks remained important creditors, with market shares of roughly 20% each.

The European sovereign debt crisis

Compared with the Asian crisis, the European sovereign debt crisis was a slow-burner. Greece lost its access to the bond market in May 2010, but at first other European countries were not affected. Ireland would lose market access in November 2010 and Portugal in April 2011. Eventually, Italy and Spain would also face difficulties in raising funds. For our purposes, we date the start of the crisis to the last quarter of 2010. The choice of the precise start date does not affect our findings.

In terms of exposures to the crisis countries – which we define as Greece, Ireland, Italy, Portugal and Spain – euro area banks obviously stand out. Their claims on these five crisis countries made up 15% of all their international claims (Graph 5, left-hand panel). UK and US creditor banks were also quite exposed, with a share of 10% and 7%, respectively. Much less exposed this time were Japanese banks, with a ratio of only 4%.

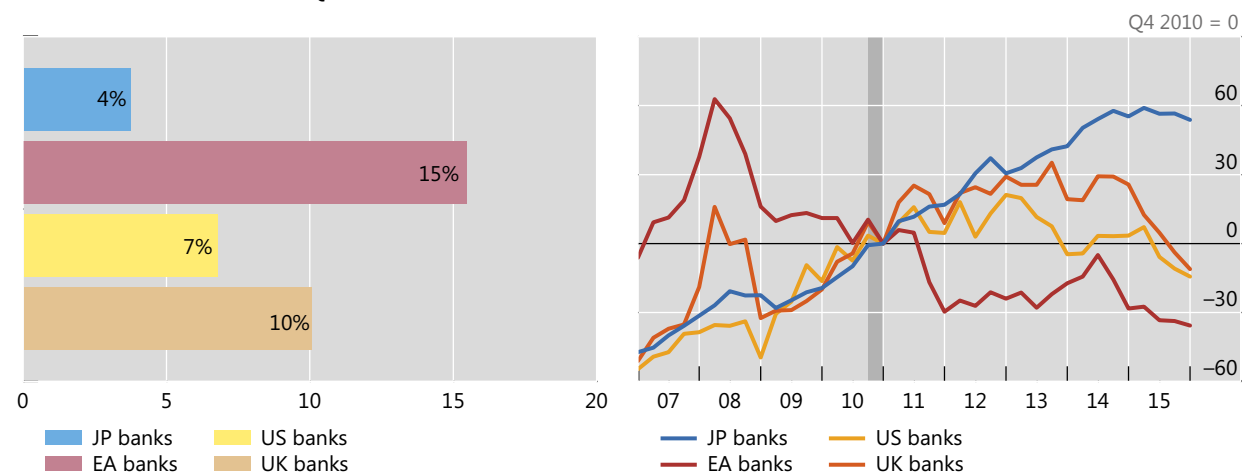
The European debt crisis: main creditors' exposures and their responses in Asia

International claims, by lending bank nationality

Graph 5

Claims on crisis countries,¹ as a share of global portfolio of international claims as of Q4 2010

Claims on emerging Asia²



The grey bar indicates the start of the crisis.

¹ Greece, Ireland, Italy, Portugal and Spain ² International claims on emerging Asia, which is limited to the countries at the epicentre of the AFC: Indonesia, Korea, Malaysia, the Philippines and Thailand. Percentage changes relative to the start of the European sovereign debt crisis.

Sources: BIS consolidated banking statistics; authors' calculations.

Credit adjustment patterns in emerging Asia in response to the shock from Europe again point to the presence of a common lender channel. The most exposed banks withdrew, while the less exposed banks stepped in. With the epicentre of the crisis so far away, emerging Asia was unlikely to see a strong contraction of its own demand for credit. Instead, any declines in credit flows are likely to have been due to supply side effects triggered by the common lender channel.

Just as Japanese banks with significant exposures in their home region had cut back on lending elsewhere during the AFC, euro area banks cut their lending to distant borrowers in EMEs the most. Claims held by euro area banks fell by about 30% within one year (Graph 5, right-hand panel).

At the same time, claims held by other major banking systems on emerging Asia grew. UK banks' lending surged initially by around 20% and then stayed above its pre-crisis level for about five years. While Japanese banks' claims on emerging Asia rose rather steadily, by about two thirds over two years, US banks' lending turned out to be more volatile over the same period.

Where emerging Asia finds itself today

At first sight, the common lender risks that emerging Asia faces today seem much less worrisome than before. Relative to regional GDP, emerging Asia is now borrowing much less internationally than it did two decades ago. In 1997, international consolidated claims of BIS reporting banks on the five Asian borrower countries we focus on reached 21% of their total GDP. As of the third quarter of 2017, such claims had shrunk to merely 11% (Graph 1).

In terms of exposures, traditional creditors' claims on emerging Asia have dropped significantly as a share of their global portfolios over the past two decades. As of Q3 2017, international claims on emerging Asia represented about 3% for banks from the UK, the US and Japan, respectively (Graph 6, right-hand panel). In the case of Japanese banks, this share declined to a mere third of its 1997 level; for US and UK banks, it essentially halved. Over the same period, euro area banks cut their exposure from 4% to 1%.

Moreover, emerging Asia seems to be borrowing from a more diversified set of lenders whose market shares have become more evenly distributed. The region still relies on Japan for about a quarter of its international borrowing (Graph 6, left-hand panel). However, about 17% of international claims are held by US banks, while the euro area and the United Kingdom remain important creditors, with market shares of roughly 14% each.

The reduction in shares held by traditional lenders has been mirrored by a rise in the share of banks from "Other reporting" countries. As Remolona and Shim (2015) point out, the push for regional bank integration by the member countries of ASEAN is likely to lead to even greater intraregional lending. McGuire and van Rixtel (2012) also argue that Chinese banks located in offshore centres like Hong Kong SAR contribute significantly to these new lenders' international credit business in emerging Asia.

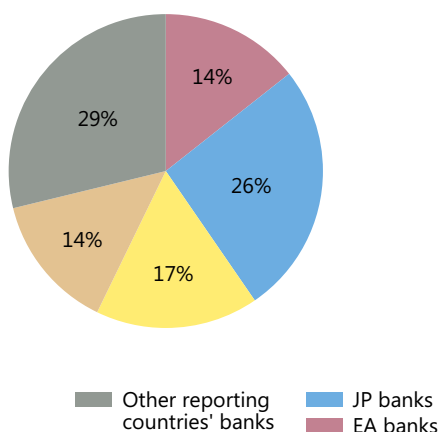
Chinese banks have become an increasingly important provider of international bank credit, to borrowers both within and outside Asia. At the moment, China does not report consolidated banking claims. Relying only on the BIS locational data by

Emerging Asia¹ today: market shares and exposures of the main creditors

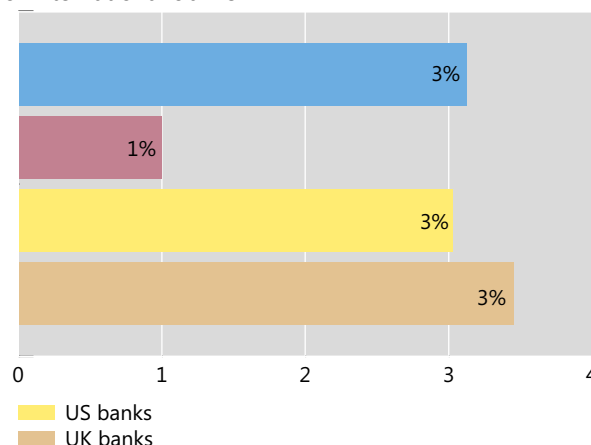
International claims, as of Q3 2017, by lending bank nationality

Graph 6

Claims on emerging Asia relative to all creditors



Claims on emerging Asia, as a share of global portfolio of international claims



¹ Emerging Asia is limited to the countries at the epicentre of the AFC: Indonesia, Korea, Malaysia, the Philippines and Thailand.

Sources: BIS consolidated banking statistics; authors' calculations.

nationality, which it does report, gives an incomplete picture of the banks' global footprint. Nonetheless, based on the BIS locational banking statistics as of Q3 2017, with cross-border financial assets worth about \$2.0 trillion, Chinese banks now rank as the sixth largest international creditor group worldwide. As pointed out by Hu and Wooldridge (2016), Chinese banks are net creditors in the international banking system. Further, when lending abroad, Chinese banks do so largely in US dollars. In absolute terms, Chinese banks are now the third largest provider of US dollars to the international banking system.

Looking forward, the common lender channel would pose its greatest risk to emerging Asia if the shock were to come from Asian borrowers themselves, as it did during the AFC, and if the largest lenders to the region were at the same time highly exposed to the region relative to their broader global portfolios. Among all banks headquartered in advanced economies, Japanese banks do still loom large in terms of these exposures. Over time, however, as the new group of Asian lenders continues to expand both their lending to the region and their global footprint in EMEs, the common lender channel may start to reassert itself through this new group of creditors as a potential mechanism of contagion.

Conclusions

Like in a game of musical chairs, the banks that have dominated the business of lending to emerging Asia have been changing places over the last two decades. Changes in the composition of bank creditors alter how contagion effects from the common lender channel play out during a crisis.

We find that spillovers from the common lender channel have played a role in shaping international banking flows to emerging Asia and the composition of creditor banks in the region over the last 20 years. Empirical evidence suggests that this

channel was a source of contagion during the 1997–98 Asian financial crisis, particularly with respect to lending to EMEs outside the Asian region. During the Great Financial Crisis a decade later, euro area banks' toxic exposure to the United States induced them to pull back from lending to Asia. The European sovereign debt crisis of 2010 reinforced their retreat.

Recent years have seen a return of regional banking in Asia. Japanese banks have become significant players again, but they do not dominate this lending business to the same extent as they did before 1997. Now, another major group of lenders from the region has emerged. This group includes Chinese banks and possibly other banks located, but not headquartered, in the offshore centres of Hong Kong and Singapore. Most likely, these new lenders will continue to expand in the future.

In the face of shocks, Chinese banks have the potential to play an important role as common lenders. As the sixth largest group of international creditors worldwide, their global footprint encompasses not just emerging market economies, but also advanced economies and offshore centres worldwide.

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Early warning indicators of banking crises: expanding the family¹

Household and international debt (cross-border or in foreign currency) are a potential source of vulnerabilities that could eventually lead to banking crises. We explore this issue formally by assessing the performance of these debt categories as early warning indicators (EWIs) for systemic banking crises. We find that they do contain useful information. In fact, over the more recent subsample, for household and cross-border debt indicators the information is similar to that of the more commonly used aggregate credit variables regularly monitored by the BIS. Confirming previous work, combining these indicators with property prices improves performance. An analysis of current global conditions based on this richer information set points to the build-up of vulnerabilities in several countries.

JEL classification: E37, E44, F34, G21.

Early warning indicators (EWIs) of banking crises are typically based on the notion that crises take root in disruptive financial cycles. The basic intuition is that outsize financial booms can generate the conditions for future banking distress. The narrative of financial booms is well understood: risk appetite is high, asset prices soar and credit surges. Yet it is difficult to detect the build-up of financial booms in real time and with reasonable confidence. It is here that EWIs come in. Many studies, including at the BIS, have found that one can identify such unsustainable booms reasonably well based on, say, deviations of credit and asset prices from long-run trends (“gaps”) breaching certain critical thresholds.

In order to detect the build-up of vulnerabilities around the globe, in recent years the BIS has regularly published credit-to-GDP gaps, economy-wide debt service ratios (DSRs) and, less frequently, property price gaps. While these aggregate indicators are useful, research has pointed to the importance of specific subcategories of debt as a source of vulnerabilities, especially household debt and cross-border and/or foreign currency debt (international debt for short).

Against this backdrop, in this special feature we do two things. First, we assess the EWI performance of both household and international debt. Here, we draw extensively on BIS statistics, notably the international banking and securities statistics as well as sectoral credit data and DSRs. Second, we map the statistical analysis into

¹ The authors would like to thank Stefan Avdjiev, Stijn Claessens, Ben Cohen, Ingo Fender, Mikael Juselius and Pat McGuire for helpful comments and Bat-el Berger, Anamaria Illes, Matthias Lörch, Kristina Micic and Taejin Park for excellent research assistance. The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS.

current conditions, taking into account also the information from aggregate indicators. In the process, we take the opportunity to clarify some common misconceptions about the interpretation of EWIs.

We come up with three main findings. First, indicators based on household and international, in particular cross-border, debt do contain useful information about future banking distress. The household sector DSRs perform especially well. Second, as might be expected, it is possible to further improve performance by combining individual indicators. Confirming previous work, we find that combining debt variables with property prices is especially helpful. Finally, the indicators currently point to the build-up of risks in several economies.

The feature is structured as follows. The first section reviews the rationale behind EWIs and provides a first look at the behaviour of selected candidate indicator variables around crises. The second formally evaluates their EWI performance. We first compare indicators on a standalone basis and then show the gains in predictive power from combining them. The third section draws on these findings to discuss current vulnerabilities. A box provides a short guide on how to interpret indicators. A final section concludes.

The rationale behind EWIs

EWIs typically capture booms in the financial cycle in a stylised way. The notion of the financial cycle refers to the self-perpetuating sequence of financial expansions and contractions that can amplify business fluctuations (Minsky (1982), Kindleberger (2000), Borio (2014)). And outsize financial booms can lead to stress and even financial crises. While progress has been made, measuring the financial cycle remains challenging: the underlying theoretical modelling is scant and there is no single aggregate measure of financial activity. That said, a consensus has started to emerge that credit aggregates and asset prices, especially property prices, play an important role (Terrones et al (2011), Drehmann et al (2012)).

The existing BIS EWIs translate the intuitive notion of a financial boom into simple and transparent measures. The BIS has regularly published and monitored aggregate private sector credit-to-GDP gaps, residential property price gaps and DSRs for the private non-financial sector. The credit-to-GDP gap is calculated as the difference between the credit-to-GDP ratio and its (one-sided) long-term trend.² Detrending is designed to remove the impact of benign, long-term changes in the underlying series, for example those that result from financial development. The gap opens up if the increase in the credit-to-GDP ratio strongly outpaces the trend for some time, pointing to a possible financial imbalance. The property price gap is the equivalent measure, defined as the deviation of inflation-adjusted property prices from their trend. DSRs measure interest payments and amortisations relative to income.³ As

² The credit-to-GDP gap is the difference between the ratio of total non-financial sector credit to GDP and its trend based on a one-sided Hodrick-Prescott (HP) filter with the smoothing parameter equal to 400,000. Such a high value ensures a very slowly moving trend. The residential property price gap is the deviation of inflation-adjusted residential property prices from a similarly constructed trend. For a discussion of the appropriateness of this trend measure in this specific context, see Drehmann and Tsatsaronis (2014).

³ Since most countries do not compile data on amortisation payments, these are estimated using information from debt maturities, interest rates and outstanding debt stocks (Drehmann et al (2015)).

high credit growth feeds into higher debt service down the road, DSRs rise during credit booms (Drehmann et al (2017)). And since they take into account interest payments, they could perform better than the credit gap or credit growth when debt builds up continuously but more slowly over time, making balance sheets vulnerable to increases in interest rates.

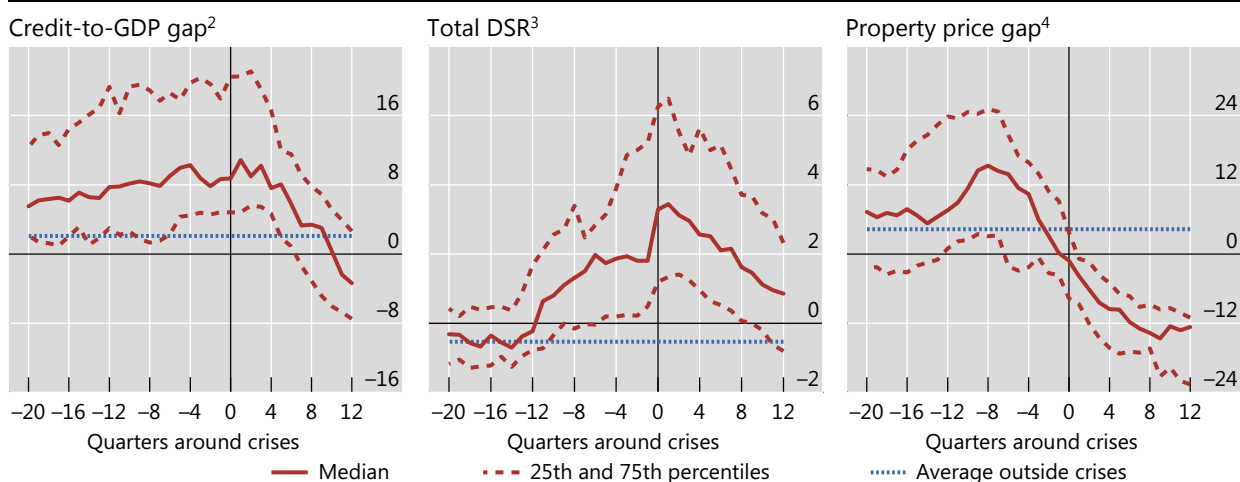
It is thus unsurprising that credit, DSRs and property price gaps were comparatively high before past crises (Graph 1). For much the same reason, they perform well as EWIs on a standalone basis, and even better if combined (Borio and Lowe (2002a), Drehmann et al (2011), Drehmann and Juselius (2012), Detken et al (2014)).⁴

In addition to the aggregate credit developments covered by the current BIS EWIs, recent research has highlighted the importance of the household sector specifically. While higher household debt boosts consumption and output growth in the short run, too much of it can lower output growth in the medium to long term (eg Mian et al (2017), Lombardi et al (2017), Zabai (2017)). Excessive household debt has also been found to herald banking crises (eg Jordà et al (2016), IMF (2017), Drehmann et al (2017)). As such, indicators assessing household debt developments feature prominently in many central bank financial stability reports (eg Bank of Canada (2017), ECB (2017), Bank of England (2017)).

We consider two household sector indicators. The first is the household credit-to-GDP gap – an exact analogue of the total credit-to-GDP gap but using only credit

Evolution of existing BIS EWI variables around past banking crises¹

Graph 1



¹ The vertical line indicates time = 0. The historical dispersion (median, 25th and 75th percentiles) of the relevant variable is taken at the specific quarter across all crisis episodes available for the respective indicator. ² Difference of the credit-to-GDP ratio from its long-run trend computed with a one-sided HP filter. ³ Difference of the total DSR from country-specific 20-year rolling averages. ⁴ Deviation of real property prices from their long-run trend computed with a one-sided HP filter.

Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector and property price statistics; authors' calculations.

⁴ The credit gap was first proposed by Borio and Lowe (2002a), and the literature has found broadly similar EWI performance for slightly different measures, such as five-year growth rates in the credit-to-GDP ratio (eg Schularick and Taylor (2012)). The credit-to-GDP gap has been incorporated into the policy process as the trigger variable for the imposition of a countercyclical capital buffer on supervised banks (BCBS (2010)).

to households in the numerator.⁵ The second is the difference between the household sector DSR and its 20-year rolling average (Drehmann et al (2017)).⁶ By normalising with a one-sided trend or a rolling average, we try to mimic the real-time environment policymakers face: the indicators are only based on past information, available at the time decisions are made.

Policymakers have also long focused on foreign currency and/or cross-border debt as a source of financial stability risks (Bruno and Shin (2015), Chui et al (2014), BIS (2017), Borio et al (2011), Avdjiev et al (2012)). In part because of data limitations, the EWI literature has operationalised this by looking at current account deficits (eg Lo Duca and Peltonen (2013)) or exchange rate developments (eg Borio and Lowe (2002b) and Gourinchas and Obstfeld (2012)).⁷

Drawing on the BIS international banking and debt statistics, we go one step further and explicitly evaluate cross-border borrowing as well as foreign currency debt, issued across borders and at home. In order to normalise by country size and to tease out medium-term developments, we take the three-year growth rates in the corresponding ratios to GDP.⁸ The foreign currency debt is that of non-banks. For cross-border claims we take a broader perspective that captures lending to non-banks and banks.⁹ We do so as indirect cross-border credit, ie cross-border credit that banks lend on to non-banks, is a frequent enabler of domestic credit expansions (Avdjiev et al (2012)).¹⁰

Data coverage differs across indicators.¹¹ We have credit-to-GDP gaps and cross-border credit for 42 jurisdictions, often from the first quarter of 1980 to the second quarter of 2017.¹² Data are most limited for the household DSR, which is only

⁵ We also assessed the three- or five-year growth rate of the household credit-to-GDP ratio. This did not have a statistically significantly different performance from the household credit-to-GDP gap.

⁶ As there are country-specific differences in the level, it is important to remove the long-run trend (Drehmann et al (2015)).

⁷ We also considered exchange rates and current account balances as indicators. But as they underperformed cross-border credit indicators, we exclude them from the reported results.

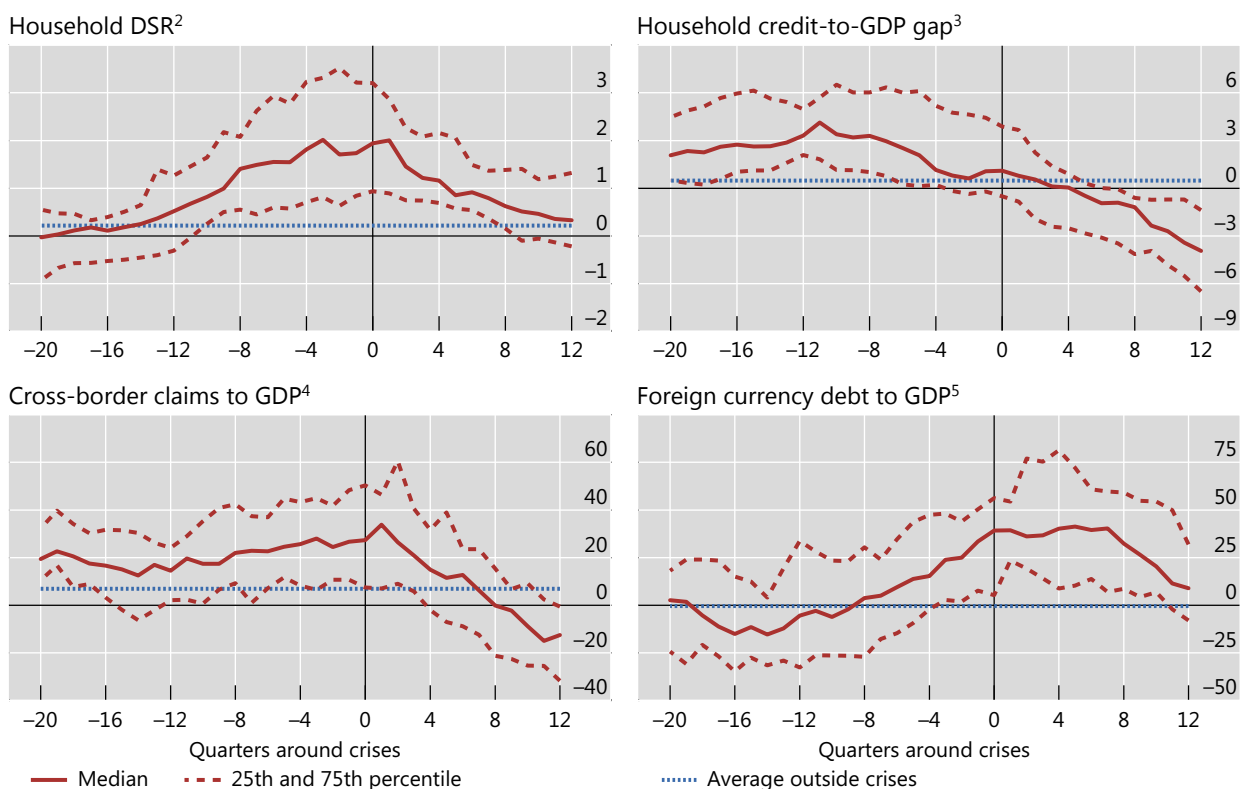
⁸ Foreign currency debt is composed of the sum of US dollar-, euro-, yen-, sterling- and Swiss franc-denominated debt in the form of cross-border loans to non-banks, international debt securities issued by non-banks and, where reported, local loans in foreign currency to non-banks. The series start in 1995, and we extend them backwards by applying the change in cross-border claims on non-banks from the BIS locational banking statistics. Our indicator on cross-border claims comprises lending in all instruments and currencies, to both banks and non-banks, as reported in the locational banking statistics. For both series we take the stocks and adjust them for breaks due to methodological or coverage changes. Given large breaks prior to 1984, we start from that point. See also the [Online Appendix](#).

⁹ In addition to the growth rate in the *gross* claims relative to GDP, we also assessed the performance of a corresponding net indicator (claims minus liabilities). This is likely to be a better measure of the credit that remains within the country. That said, this variable did not perform as well as its gross counterpart.

¹⁰ Indirect credit is not included in the foreign currency debt series as we would run into problems of double-counting. For instance, a bank may borrow in foreign currency from abroad to lend domestically (also in foreign currency).

¹¹ Coverage and sources are discussed in detail in the [Online Appendix](#).

¹² Our broadest sample includes Argentina, Austria, Australia, Belgium, Brazil, Canada, Chile, China, Colombia, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Malaysia, Mexico, the Netherlands, Norway, New Zealand, Poland, Portugal, Russia, Saudi Arabia, Singapore, Spain, South Africa, Sweden, Switzerland, Thailand, Turkey, the United Kingdom and the United States.



¹ The vertical line indicates time = 0. The historical dispersion (median, 25th and 75th percentiles) of the relevant variable is taken at the specific quarter across all crisis episodes available for the respective indicator. ² Difference of the household DSR from country-specific 20-year rolling averages. ³ Difference of the household credit-to-GDP ratio from its long-run trend computed with a one-sided HP filter. ⁴ Twelve-quarter growth rate in the cross-border claims-to-GDP ratio. ⁵ Twelve-quarter growth rate in the foreign currency debt-to-GDP ratio.

Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector, debt securities, locational banking and property price statistics; authors' calculations.

available for 27 jurisdictions and often starts only in the mid-1990s. For crisis dating, we rely on the new European Systemic Risk Board crisis data set (Lo Duca et al (2017)) for European countries and on Drehmann et al (2010) for the rest.¹³

A first glance at the data indicates that household debt may provide useful signals of the build-up of vulnerabilities (Graph 2). The household sector DSR (top row, left-hand panel) has been unusually high in the run-up to crises. The household credit-to-GDP gap (top row, right-hand panel) has also tended to be above normal levels during those phases.

The same holds for the international debt indicators (Graph 2, bottom row). The growth rate of the foreign currency debt-to-GDP ratio increases strongly pre-crisis, though it exhibits relatively high variation across countries (dashed lines). That of the cross-border debt-to-GDP ratio is also markedly higher but less variable.

¹³ We exclude crises related to transitioning economies or that were imported from abroad based on Lo Duca et al (2017). In addition, we classify the crisis in 2008 in Switzerland as imported. For the statistical analysis we drop post-crisis periods as identified in Lo Duca et al (2017) and Laeven and Valencia (2012) for non-European countries.

Evaluating EWIs

When formally evaluating the performance of the EWIs, one would ideally like to know how policymakers assess the trade-off between missed crisis calls (type I errors) and false alarms (type II errors). However, this cannot be done with any precision, not least due to the limited experience from which to estimate expected costs and benefits (CGFS (2012)).

Absent well specified trade-offs, one way to assess the performance of EWIs is to consider the full mapping between type I and type II errors. This mapping is called the receiver operating characteristic (ROC) curve (see Box A for details). The area under the curve (AUC) is a convenient and interpretable summary measure of the signalling quality of a binary (yes/no) signal. A completely uninformative indicator has an AUC of 0.5. Correspondingly, the AUC for the perfect indicator equals 1. The AUC of an informative indicator falls in between and is statistically different from 0.5.

The AUC is a useful starting point, but it does not provide any information about the critical thresholds that, if breached, should raise concerns about financial stability risks. These ultimately depend on policymakers' preferences. To derive the thresholds, we assume that policymakers choose one that minimises the noise-to-signal ratio (the ratio of false alarms to correctly predicted events) while capturing at least two thirds of the crises, as in Borio and Drehmann (2009). (Box A discusses the link between this criterion and the ROC curve).

To be useful for policy, EWIs should not only have statistical forecasting power and rely on real-time information, but also satisfy three additional requirements (Drehmann and Juselius (2014)): timing, stability and ease of interpretation.

Having the right timing means that the indicators' signals should arrive early enough so that policy measures can be implemented and have an impact. That said, signals that arrive too early can be problematic (eg Caruana (2010)). We focus on a 12-quarter forecast horizon.¹⁴ Employing a multi-year horizon also recognises that the indicators may help identify the build-up of vulnerabilities, but cannot be expected to pinpoint the specific timing of a crisis.

EWIs should also provide stable signals. Policymakers prefer to react to persistent movements, given the uncertainties involved. Stability requires that the forecast performance should not decrease as crises approach. This is a problem for residential property prices (Drehmann and Juselius (2012)), for which growth tends to slow or even become negative closer to crises (Graph 1, left-hand panel). This makes it hard to discern in real time whether the slowdown reflects the typical pre-crisis behaviour of property prices or a welcome correction.

Finally, unless EWIs are easy to interpret intuitively, their signals are likely to be ignored (eg Önköl et al (2002), Lawrence et al (2006)). This is why our EWIs are simple, transparent and based on the financial cycle logic. Their simple structure may also reduce the risk of overfitting associated with more sophisticated techniques.

¹⁴ Strictly speaking, one could drop the year that precedes the crisis, on the grounds that by then it would be too late to take major preventive steps.

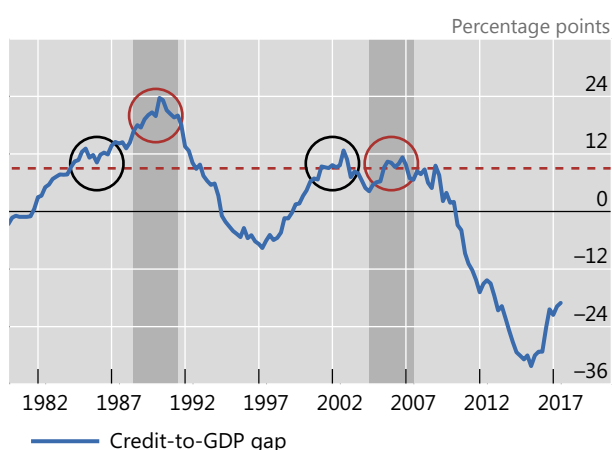
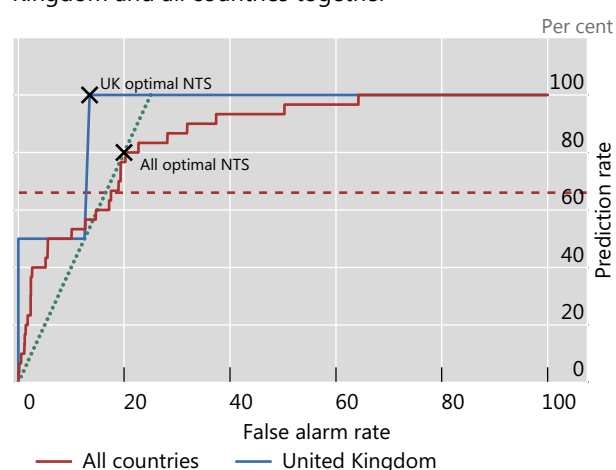
Evaluating EWIs: ROC curves, noise-to-signal ratios and critical thresholds

Selecting an early warning indicator (EWI) involves making a choice about the trade-off between the rate of correct predictions and the rate of false alarms. There are four possible value combinations of a binary signal (“on” or “off”) and subsequent event realisations (“occurrence” or “non-occurrence”). The perfect indicator signals “on” ahead and only ahead of all occurrences; an uninformative one has an equal probability of being right or wrong, like a coin toss.

It is possible to illustrate the trade-off between correct event predictions (as a share of all events) and false alarms (as a share of all normal periods) when choosing a threshold in the case of the credit-to-GDP gap for the United Kingdom. The left-hand panel of Graph A shows the evolution of the gap since 1980. The shaded areas highlight the three years before the crises in 1991 and 2007, the period when we would like to see a signal based on the assumed three-year prediction horizon. The dashed red horizontal line indicates a credit-to-GDP gap of 9 – the optimal threshold given our analysis (Table 2). In both pre-crisis periods, the gap exceeded 9, so the prediction rate is 100% (red circles). Yet there are also false alarms (black circles). Increasing the threshold above 9 reduces the number of false calls. But once the threshold exceeds 11.5, the crisis in 2007 is no longer predicted, so that the prediction rate falls to 50%. Conversely, lowering the threshold from 9 does not increase the prediction rate and leads only to more false alarms.

Correct calls, false alarms and the mapping between ROC curves and thresholds

Graph A

UK credit-to-GDP gap relative to critical threshold¹ROC curves for the credit-to-GDP gap in the United Kingdom and all countries together²

¹ The horizontal line at value 9 indicates the critical threshold for the credit-to-GDP gap obtained in Table 2. The shaded periods indicate the 12 quarters prior to crises – the prediction horizon. The black circles indicate periods in which the credit-to-GDP gap exceeded the critical threshold yet no crisis materialised within the prediction horizon. The red circles indicate periods in which the credit-to-GDP gap exceeded the critical threshold during the prediction horizon. ² The horizontal line indicates a crisis prediction rate of 66%. The black crosses show the points on the ROC curves with the optimal noise-to-signal ratios. The green dotted line is the steepest line from the origin that touches a corner point on the portion of the ROC curve that is at or above the 66% prediction rate, identifying the point with the lowest noise-to-signal ratios.

Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector statistics; authors' calculations.

The receiver operating characteristic (ROC) curve captures this trade-off between correct predictions and false alarms for all thresholds. For the United Kingdom, the prediction rate can only be 100%, 50% and 0% (Graph A, right-hand panel, blue line), with false alarm rates decreasing as the threshold increases. The solid red line depicts the ROC curve for the credit-to-GDP gap based on all the available data in our sample. We can see that the credit-to-GDP gap is an informative indicator but is not perfect. For a perfect indicator we would find at least one threshold with a prediction rate of 100% and a false alarm rate of 0%. At the other end of the spectrum, a completely uninformative indicator would have an ROC curve that equalled the 45° line for every threshold, ie the same rate of correct and false calls.

The area under the ROC curve (AUC) provides a summary measure of the signalling quality of an indicator. Intuitively, it captures the average gain over the uninformed case (the 45° line) across all possible threshold combinations. The uninformative indicator has an AUC equal to 0.5 (ie the area under the 45° line equals 0.5), while that for the fully informative indicator is equal to 1. The intermediate cases have values in between.

While the ROC maps the full set of trade-offs, the policymaker may weigh missed crisis calls and false alarms differently. Unfortunately, these preferences are not known. As discussed in the main text, we therefore assume that policymakers choose a threshold that minimises the noise-to-signal ratio (the ratio of false alarms to correctly predicted events), while capturing at least two thirds of the crises.

It is possible to find the points on the ROC curve that correspond to the optimal thresholds for the United Kingdom and the more general case (black crosses). The UK case is especially intuitive. One picks the part of the ROC curve that identifies a prediction rate of at least 66% of crises – here the only possible one is 100%. Next one moves on that line as far as left as possible, thereby minimising false alarms, ie one chooses the leftmost corner. The more general case is slightly more complicated, although the procedure is the same. One picks the steepest line from the origin (dotted green line) that touches a corner point on the portion of the ROC curve that is at or above the 66% prediction rate (red dashed line). This works because the slope of such a line equals the signal-to-noise ratio of the threshold associated with the corner point on the ROC curve. And as the signal-to-noise ratio is the inverse of the noise-to-signal ratio, the steepest line finds the point on the ROC curve with the lowest noise-to-signal ratio.

Standalone indicators

To evaluate and compare the performance of the indicators on a standalone basis, we proceed in two steps. Initially, to assess their general information content, we use the AUC criterion. We then evaluate the indicators from an operational perspective by analysing optimal thresholds based on specific preferences.

We do so using two different samples: the full sample available for each indicator, and the much smaller common sample. The common sample allows a comparison of like with like, but it reduces our sample size considerably. We therefore also use the full sample available for each indicator as a comparison.

Although we try to collect as much data as possible, predicting crises inevitably means predicting rare events. Data coverage is best for the credit-to-GDP gap. But even then, we only cover 30 crises. The common sample covers 19 episodes, 12 of which are related to the Great Financial Crisis (GFC). In addition, the data set is tilted towards advanced economies. Thus, the use of the full sample available for each indicator is important for robustness. For brevity, we only report this for the threshold analysis. In addition, we did robustness checks, not reported here, running the statistical tests on pre-and post-2000 subsamples to ensure that the GFC does not drive the results. While all these robustness checks underpin the insights of this paper, we cannot escape the underlying (fortunate) problem that crises are rare. Results therefore have to be interpreted with some caution.

These formal statistical tests confirm the insights from the raw data and previous work.

The total DSR and the credit-to-GDP gap, two indicators traditionally used as BIS EWIs, have the highest AUCs across all forecast horizons (Table 1, top two rows). While there is no statistically significant difference between their information content, the aggregate DSR has the highest AUC for the short horizon and the credit-to-GDP gap the highest AUC for the longer one. This confirms earlier findings (Drehmann and Juselius (2012)). In line with the results from Graph 1, the property price gap performs

A comparison of the predictive power of single EWIs using the AUC

Table 1

EWI	Horizon (quarters)											
	1	2	3	4	5	6	7	8	9	10	11	12
Credit-to-GDP gap	0.80*	0.80*	0.81*	0.80*	0.79*	0.78*	0.75*	0.78*	0.77*	0.78*	0.76*	0.77*
Total DSR	0.84*	0.83*	0.82*	0.79*	0.77*	0.76*	0.74*	0.75*	0.74*	0.71*	0.69*	0.69*
Property price	0.43	0.49	0.54	0.61	0.64	0.67*	0.68*	0.72*	0.71*	0.70*	0.69*	0.68*
Household DSR	0.82*	0.81*	0.80*	0.79*	0.77*	0.76*	0.73*	0.76*	0.75*	0.72*	0.69*	0.67*
Household credit-to-GDP gap	0.60	0.60	0.61	0.65*	0.66*	0.67*	0.70*	0.74*	0.75*	0.76*	0.76*	0.76*
Foreign currency debt to GDP	0.73*	0.71*	0.71*	0.67*	0.64	0.60	0.52	0.47	0.49	0.46	0.46	0.45
Cross-border claims to GDP	0.75*	0.75*	0.77*	0.74*	0.73*	0.71*	0.67*	0.66*	0.65*	0.63*	0.60	0.58

An asterisk denotes that the estimated AUC is statistically significantly higher than 0.5. The numbers in bold indicate the highest AUC for each horizon. Numbers in green indicate that the AUC is not statistically significantly different from the highest one at this horizon.

Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector, debt securities, locational banking and property price statistics; authors' calculations.

particularly well around two years before crises, but it becomes uninformative in the pre-crisis year, when it tends to decline or close.

Household debt indicators, in particular the household DSR, are also informative (Table 1, fourth and fifth rows). Based on the AUC point estimates, the household DSR performs even slightly better than the aggregate credit gap in the pre-crisis year. It also outperforms the household credit-to-GDP gap, which we will therefore not consider in the rest of this article.¹⁵

Confirming what policymakers have long stressed, international debt also contains useful information (Table 1, last two rows), although on balance not as much as the aggregate and household debt indicators. AUCs for the cross-border claims indicator are statistically significant but lower than those of the top-performing indicator, even though statistically it is hard to distinguish between the two. The foreign currency debt indicator does not perform as well as the traditional indicators throughout. To simplify the analysis, in what follows we retain only the indicator based on cross-border claims.

We next operationalise the indicators for policymaking, based on the chosen threshold criteria (Table 2). We show the values of the noise-to-signal ratio for different indicators subject to predicting correctly two thirds of the crises. The left- and right-hand panels show the EWIs' performance over the longest available sample and over a smaller common sample, respectively.¹⁶

The analysis confirms that the household DSR adds value. It has the lowest noise-to-signal ratio across all indicators and samples. A 1.4 percentage point positive deviation of the household DSR from its long-run average captures around 70% of crises with a noise-to-signal ratio of roughly 20% across the two samples, ie one false crisis call for every five correct ones. This result is not only driven by the GFC: the

¹⁵ Strictly speaking, the household credit-to-GDP gap performs marginally better than the household DSR for quarters 10 to 12. These differences are not statistically significant. Still, we drop the household credit-to-GDP gap because it becomes uninformative in the pre-crisis year.

¹⁶ Tables A2–A6 in the [Online Appendix](#) show the results from a broader range of thresholds in addition to the one that minimises the noise-to-signal ratio subject to predicting 66% of crisis.

Optimal signalling thresholds for standalone EWIs

Table 2

EWI	All available data ¹				Common sample ²			
	Threshold ³	Predicted ⁴	NTS ⁵	# crises ⁶	Threshold ³	Predicted ⁴	NTS ⁵	# crises ⁶
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	At least 66% of the crises predicted							
Household DSR	1.4	68.4	18.7	19	1.4	68.4	22.7	19
Total DSR	1.8	67.9	22.4	28	1.8	68.4	24.2	19
Credit-to-GDP gap	9.0	80.0	25.7	30	9.0	78.9	32.6	19
Cross-border claims to GDP	34.0	72.4	27.3	29	34.0	68.4	31.2	19

¹ Results are based on the broadest data coverage for each indicator. ² Results are based on a common sample, when all four indicators are available. ³ Optimal EWI threshold that minimises the noise-to-signal ratio while capturing at least 66% of the crises. In percentage points. ⁴ Percentage of correctly predicted crises. A crisis is judged to be correctly predicted if the indicator variable breaches the critical threshold (column 1 or 5) anytime within a three-year horizon before a crisis. ⁵ Noise-to-signal (NTS) ratio; fraction of type II errors (the threshold is breached but no crisis occurs within the next three years) divided by the fraction of correctly predicted crises (column 2 or 6). ⁶ Number of crises included in the analysis.

Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector, debt securities and locational banking statistics; authors' calculations.

household sector DSR also exceeded this threshold in four out of the six crises before 2000.

In terms of noise-to-signal ratio, the performance of the cross-border claims indicator is roughly equivalent to that of the credit-to-GDP gap, regardless of the sample considered. However, the credit-to-GDP gap predicts a larger percentage of crises.

The comparison of noise-to-signal ratios should not, however, be overemphasised. For instance, the somewhat higher noise-to-signal ratio of the credit-to-GDP gap is mainly due to its tending to signal crises very early, some five to seven years ahead of the event (Drehmann et al (2011)). While these are "wrong" signals according to our formal criteria, they nevertheless still correctly identify the build-up of vulnerabilities.¹⁷

Table 2 also highlights the EWIs' robustness. Despite large differences in sample size between the longest and the smaller common sample (left-hand panel versus right-hand panel), the thresholds for each indicator are identical in both cases. This shows that the results are not solely due to advanced economies or crises related to the GFC – two key features of the common sample. The main insights from the table are also robust to performing bivariate comparisons for each possible pair of indicators.

Combined indicators

Previous work has shown that combining information from credit and asset markets into composite indicators can improve performance. This is intuitive as financial booms feature both exuberant credit growth and buoyant asset prices. Given the role

¹⁷ Regardless of the sample, Table 2 identifies a critical threshold for the credit-to-GDP gap equal to 9 for the requirement of predicting at least 66% of the crises. This is fully in line with previous findings. It is also consistent with the Basel III calibration, which suggests that the countercyclical capital buffer should be at its maximum if the credit to GDP gap exceeds 10 (BCBS (2010)).

of housing as collateral, the literature has highlighted in particular how residential property prices amplify the financial cycle, despite their inferior performance as standalone indicators (Table 1).

Thus, we next derive optimal thresholds for combinations of debt variables and property prices. We follow the same logic as before. But for a warning signal to be issued we now require that (i) the debt indicator has breached the threshold and (ii) the property price gap was above 11 within the 12 quarters preceding the breach. We choose 11 because it is the standalone critical threshold obtained for this variable based on predicting at least two thirds of the crises.¹⁸

The condition for property prices is deliberately backward-looking. As discussed above, property price growth tends to slow from very high rates ahead of crises, so that the gap closes (Graph 1, right-hand panel).¹⁹ If we were to require that both credit and property price gaps exceed critical thresholds simultaneously, the combined signal would start to “switch off” in the late stages of the boom.

Combining information from credit and property markets improves the EWIs’ precision considerably (Table 3). Noise-to-signal ratios fall below 21%, to as low as 11.8%.

Optimal signalling thresholds of combined EWIs: credit and residential property prices

Table 3

EWI	Threshold ¹	Predicted ²	NTS ³
	(1)	(2)	(3)
	With property price gap at 11 ⁴		
Household DSR	0.5	68.8	12.1
Credit-to-GDP gap	4.0	68.2	20.9
Total DSR	0.4	66.7	11.8
Cross-border claims to GDP	19.0	70.0	19.0

¹ Optimal threshold that minimises the noise-to-signal ratio while capturing at least 66% of crises. In percentage points. ² Percentage of correctly predicted crises. ³ Noise-to-signal (NTS) ratio; fraction of type II errors (the EWI signals a crisis but no crisis occurs within the next three years) divided by the fraction of correctly predicted crises (column 2). ⁴ The percentage of correctly predicted crises and the noise-to-signal ratio are based on joint signals that also incorporate information from property price gaps. A crisis is judged to be correctly predicted if (i) the debt indicator variable breaches the critical threshold (column 1) anytime within a three-year horizon before a crisis and (ii) the property price gap exceeds 11 at some point in the 12 quarters preceding the breach of the debt indicator variable.

Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector, locational banking and property price statistics; authors’ calculations.

¹⁸ Simultaneously changing thresholds for the debt indicators and property price gaps leads to even lower noise-to-signal ratios. But it complicates the interpretation across debt indicators for vulnerability assessments such as Table 4. As an alternative method to ensure a common property price gap across the debt indicators, we also searched for the optimal threshold for the property price gap if we minimise the average noise-to-signal ratios of the combined indicators, conditional on a common property price gap threshold for all of them. This does not deliver significantly different results.

¹⁹ We also tried to capture the intuition from the graph by requiring not only that the property price gap is above the critical threshold in any of the previous three years but also that its current change is negative. This did not modify the forecast performance much.

The combined EWIs also lead to lower critical thresholds for the debt indicators. This is intuitive, since the information contained in property prices underscores the signal issued by rapid credit expansion, so that the threshold can be lower.

Assessing current vulnerabilities

What do the EWIs suggest about current vulnerabilities? Table 4 takes a closer look at the status of the various indicators as of June 2017, while Box B provides a short discussion of how to use and interpret EWIs more generally.

The colour coding is based on the standalone indicators (Table 2). Cells are marked in red if the indicator has breached the threshold for predicting at least two thirds of the crises. Those marked in amber correspond to the lower threshold required to predict at least 90% of the crises.²⁰ This avoids a false sense of precision and captures the very gradual build-up in vulnerabilities. Asterisks indicate that the corresponding combined credit-cum-property price indicator (from Table 3) has breached its critical threshold.

The picture that emerges is a varied one.

Aggregate credit indicators point to vulnerabilities in several jurisdictions (Table 4, first two columns). Canada, China and Hong Kong SAR stand out, with both the credit-to-GDP gap and the DSR flashing red. For Canada and Hong Kong, these signals are reinforced by property price developments. The credit-to-GDP gap also flashes red in Switzerland, whereas the total DSR flashes red in Russia and Turkey. Credit conditions are also quite buoyant elsewhere. Credit-to-GDP gaps and/or the total DSR send amber signals in some advanced economies, such as France, Japan and Switzerland, as well as in several emerging market economies (EMEs). In Indonesia, Malaysia and Thailand, as well as some other countries, property price gaps underscore this signal.

Some jurisdictions also exhibit some signs of high household sector vulnerabilities. In Korea, Russia and Thailand, the household sector DSR flashes red (Table 4, third column). In Thailand, the red signal for the household DSR is underlined by the property price indicator. Property prices have also been elevated in Sweden and Canada, which exhibit an amber signal for the household DSR.

The cross-border claims indicator supports the risk assessment for several countries and flags some potential external vulnerabilities for others (Table 4, fourth column). The indicator flashes red for Norway, and is amber for a number of economies.

While providing a general sense of where policymakers may wish to be especially vigilant, these indicators need to be interpreted with considerable caution (see also Box B). As always, they have been calibrated based on past experience, and cannot take account of broader institutional and economic changes that have taken place since previous crises. For example, the much more active use of macroprudential measures should have strengthened the resilience of the financial system to a financial bust, even if it may not have prevented the build-up of the usual signs of vulnerabilities. Similarly, the large increase in foreign currency reserves in several EMEs should help buffer strains. The indicators should be seen not as a definitive

²⁰ See Tables A2–A6 in the [Online Appendix](#) for details.

warning but only as a first step in a broader analysis – a tool to help guide a more drilled down and granular assessment of financial vulnerabilities. And they may also point to broader macroeconomic vulnerabilities, providing a sense of the potential slowdown in output from financial cycle developments should the outlook deteriorate.

Early warning indicators for stress in domestic banking systems

Table 4

	Credit-to-GDP gap	Debt service ratio (DSR)	Household DSR	Cross-border claims to GDP
Australia	-8.1	1.0	1.0	21.3
Brazil	-6.4	-0.9	...	0.5
Canada	9.6*	2.9*	0.7*	33.1*
Central and eastern Europe ¹	-12.5	-1.9	...	11.4*
China	16.7	5.1	...	-27.9
Finland	-5.2	0.9	0.8	-22.4
France	4.0	1.6	0.5	2.7
Germany	-2.1	-1.6	-1.9	6.9
Hong Kong SAR	30.7*	6.9*	...	-12.3
India	-7.8	0.5	...	-30.6
Indonesia	6.9*	0.5*	...	-10.9
Italy	-18.0	-1.2	0.0	-10.8
Japan	7.6*	-1.8	-1.0	20.5*
Korea	-1.3	0.1	1.7	-13.9
Malaysia	4.0*	0.4*	...	-1.6
Mexico	6.2	1.1	...	17.9
Norway	-1.0	-0.3	1.1	34.4
Russia	-4.6	1.8	1.8	-24.9
South Africa	-2.2	0.0	-0.3	22.1
Spain	-50.7	-3.6	-1.6	-19.5
Sweden	-11.2	-0.4	1.1*	-1.9
Switzerland	10.0*	0.7*	...	7.5
Thailand	6.7*	-0.6	2.8*	-16.6
Turkey	5.4	6.1	...	-1.2
United Kingdom	-17.7	-1.3	-0.8	0.6
United States	-6.9	-1.1	-1.5	-15.2
<i>Legend</i>	<i>Credit/GDP gap ≥ 9</i>	<i>DSR ≥ 1.8</i>	<i>DSR ≥ 1.4</i>	<i>XB claims ≥ 34</i>
	<i>4 ≤ Credit/GDP gap < 9</i>	<i>0.1 ≤ DSR < 1.8</i>	<i>0.6 ≤ DSR < 1.4</i>	<i>18 ≤ XB claims < 34</i>

The threshold for red (amber) cells minimises false alarms conditional on capturing at least two thirds (90%) of historical crises with a cumulative three-year prediction horizon (see Table 2 and Tables A2–A6 in the [Online Appendix](#)). Asterisks highlight a signal of the combined indicator when property price gaps were above 11 at some point during the last three years (see Table 3).

¹ Simple average of CZ, HU and PL.

Sources: IMF, *International Financial Statistics*; national data; BIS credit to the non-financial sector, locational banking and property price statistics; authors' calculations.

What do EWIs tell us?

This box explains how to read the table that assesses current vulnerabilities based on the set of early warning indicators (EWIs). Then it explains the limitations of those indicators in the context of a broader analysis of vulnerabilities,

To interpret the table entries, it helps to understand the methodology used to derive the critical thresholds that – if crossed – lead to a warning signal. For any indicator, we start off with a large sample spanning countries and time that ideally contains as many crises and non-crisis periods as possible. After checking whether the indicator has more EWI power than a coin toss,^① we search over a range of potential thresholds that, when breached, issue a warning signal. We judge a crisis as correctly predicted if there is a warning signal at least once in the 12 quarters preceding the crisis, ie if the crisis occurs anytime within the three years following the breach. If a signal is issued but no crisis occurs within that time frame, we count this as a false alarm.

We choose two different thresholds to identify amber and red “alert zones”. In both cases the calibration, drawing on historical experience, minimises the ratio of false alarms to correct warning signals (the “noise-to-signal ratio”). But one threshold is chosen so as to predict at least two thirds of the crises (red), and the other at least 90% (amber). The red threshold is more stringent (higher) in the sense that it is exceeded less often.

The cells also include asterisks (*). These refer to instances in which the combined behaviour of the corresponding debt and property price indicators signal vulnerabilities. For this debt-cum-property price combined indicator we follow a similar logic to the one above. We keep the property price gap threshold constant at its optimal standalone value and then optimise over the debt indicator threshold, so as to capture at least 66% of crises while minimising the noise-to-signal ratio. In other words, for a warning signal to be issued, we require that (i) the debt indicator breached the critical threshold *and* (ii) the property price gap was above 11 (the red threshold for the property price gap on its own) within the three years before the breach.^② When this happens, we add an asterisk to the relevant EWI.

To interpret these signals correctly from a statistical viewpoint, a few points are worth recalling:

- Over the calibration period, there were naturally many instances in which the indicators breached the thresholds (corresponding to signals denoted by the amber, red and * identifiers) but crises did not materialise within the following three years. The more often this happens, the higher the noise-to-signal ratio.
- This may happen because crises do not materialise at all: the indicator subsequently switches off and imbalances correct themselves. Alternatively, it may happen because the signals may occur “too early” (eg five or six years before a crisis), with the indicator correctly continuing to signal risks until the crisis breaks out.^③ In general, even when the indicators identify the risk of crises correctly, it is unrealistic to expect them to identify the timing with any precision.
- Noisy signals also mean that the statement “66% of crises were preceded by a breach of the EWI threshold” is not equivalent to “the crisis probability is 66% once the threshold is breached”. Or putting it differently, the former statement says that “given that a crisis has occurred, the threshold was breached in 66% of the cases”; the latter means “given that the threshold is breached, a crisis occurs in 66% of the cases”. The reason the two statements are not equivalent is that some breaches do not herald crises, ie the noise-to-signal ratio is higher than zero. In fact, in our sample and as a rule of thumb, the likelihood of a crisis emerging once the threshold for an indicator is breached is around 50%.^④

More generally, certain caveats need to be borne in mind:

- EWIs have only two settings: “on” or “off”. They do not reflect the gradual intensification of a financial boom. (The use of two thresholds is designed to capture this to some extent.)
- The exact thresholds should not be overemphasised. We have run a battery of checks and drawn on other research to make sure our economic insights are as robust as possible. But the exact optimal thresholds identified can vary by a few percentage points across specifications. Given these uncertainties, whether an indicator is just above or below a threshold is not a first-order issue for monitoring purposes.

- EWIs are based on historical relationships. Thus, structural breaks may reduce their predictive power, eg as a result of increased use of macroprudential measures or changes in prudential regulation more broadly. This is only partly mitigated by evidence indicating that similar variables have displayed consistent predictive power going back to at least the 1870s (eg Schularick and Taylor (2012)).
- EWI thresholds are common across countries. Thus, they cannot take into account country-specific features. This is inevitable: as crises are rare events, it is not possible to calibrate the indicators with any statistical confidence based on the experience of any individual country.
- The EWIs displayed in the table are specifically designed to capture only vulnerabilities linked to the financial cycle. Other vulnerabilities that could lead to banking crises are not considered (eg sovereign crises owing to unsustainable fiscal positions).

Taken together, these caveats suggest that EWIs cannot be analysed in isolation. They are best seen as a useful starting point for a more granular assessment of vulnerabilities.

① Formally, we test whether the AUC is statistically significantly different from 0.5. ② We use backward-looking information for residential property prices, as the associated gaps tend to close ahead of crises (Graph 1). ③ For instance, this is the case for the credit-to-GDP gap (Drehmann et al (2011)). ④ The derivation of how likely a crisis is given an EWI signal is much more sample-dependent than the thresholds shown in Table 2 because of small sample issues.

Conclusion

This special feature has formally assessed the performance of household and international debt as EWIs for banking distress. These variables are found to contain useful information about banking system vulnerabilities, similar to that of their more widely used counterparts based on aggregate debt. Within the group of household-based indicators, the household debt service ratio stands out. Within that of international debt indicators, cross-border claims perform better than foreign currency debt.

At the same time, in assessing these results it is also important to take into account data limitations. Crises are rare events even in samples where data coverage is good. And they become “rarer” for samples over which we can consider household or foreign currency debt. This prevents a more detailed, robust analysis of EMEs in particular. More definite comparisons and inferences would require overcoming these limitations. Thus, improving the data is an area that deserves greater attention.

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Tracking the international footprints of global firms¹

As the global economy becomes more integrated, there is a growing tension between the nature of economic activity and the measurement system that attempts to keep up with it. Many policies are still determined by measuring economic activity at the national level. Since the typical unit of analysis is the economic area (the “island”), economic activity is measured within the island and in terms of transactions between islands. But, increasingly, companies and their ownership are global, with economic activity taking place in a geographically dispersed way. We analyse several important issues created by this tension, show how they manifest themselves in the data and draw lessons from them.

JEL classification: E01, F20, F40, F62.

Our existing measurement framework for economic activity in national accounts and the balance of payments is based on an “islands” view of the global economy. Taking the economic area (the “island”) as their unit of survey, analysts measure economic activity within the island and the transactions between islands.² In the simplest case, the workers, production processes, headquarters, management and owners of firms are all located in the same economic area, typically defined by a national boundary.

The key concept in national accounts is that of *residence*. National accounts convey information on the activities of residents on the island. In simple cases, residence is clear-cut. For a firm producing goods in a plant located on a single island, employing workers from the same island and owned by residents on the island, the notion of “residence” for the firm is straightforward. It coincides with the physical

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² The national accounting framework comprises the suite of macroeconomic and financial statistics on the evolution of flows and stocks for an economy and its institutional sectors, as well as their interactions with residents and non-residents. For an introduction to the system of national accounts see Lequiller and Blades (2014).

location of the firm on the island. If such a firm exports goods, then the goods will cross the boundary of the island into another island. Thus, exports will show up in the customs data for the island.

However, “residence” is a legal concept denoting the relationship between an entity and a location. For a person, travelling through another country does not make the person a resident of that country. For a firm, residence is defined as “the economic territory with which it has the strongest connection, expressed as its centre of predominant economic interest”.³ But a firm resident on island A can operate elsewhere. For example, it could enter into a contract manufacturing agreement with a firm in island B, and sell the output in island C. The good is shipped from B to C, and never touches the shores of island A. The sale would nevertheless be counted as an export of island A, and would enter its trade and GDP statistics. Island A’s GDP would go up even if no workers are employed on the island.

Closely related to the notion of residence is that of *domicile*, which indicates greater permanence. For a person, domicile is a legal concept similar to residence, but which carries additional implications as a place of origin and permanent place of residence. For firms, the term is often used to denote the location of the headquarters. However, there are far-reaching implications from the designation of a particular location as its domicile, as the firm’s relationship with its subsidiaries, branches, offices and subcontractors all make reference to the domicile. When a firm moves its domicile, a cascade of other changes follow. The firm’s place in the world undergoes fundamental alterations, as its relationship with other jurisdictions is rearranged. The redomiciling of a firm is not just a relabelling, but involves a long list of changes in bilateral relationships between jurisdictions that flow from the alteration in domicile.

In a global context, we can think of the above two perspectives, the residency view and the domicile view, as two distinct but integrated frameworks from an accounting, statistical, legal and regulatory angle. In the international statistical framework, the islands view allocates economic agents to the country in which they are deemed to reside. An alternative approach is to take a *consolidated* view, which assigns economic entities to the country of headquarters of the parent institution (Avdjiev et al (2016), Bénétrix et al (2017), McCauley et al (2017)). This latter approach is, therefore, more closely aligned with notion of domicile.⁴ In a consolidated framework, the entire corporate group is assigned to the country of headquarters, no matter where its constituent operating units may reside.⁵

Since the national accounting framework was developed in the 1930s and 1940s, the activities of global firms and the structure of the global economy have undergone profound changes. Balance of payments accounting has adapted to changes in economic reality, with the latest standard being the sixth edition of the IMF’s balance of payments manual (known as BPM6), published in 2009 (IMF (2009)). However, the pace of globalisation has arguably outstripped the pace of innovation in the

³ IMF (2009, p 70). According to the international statistical framework, residency is expressed as the centre of predominant economic interest. Each institutional unit is a resident of only one economic territory. An institutional unit is defined as households, corporations, non-profit institutions, government units, legal or social entities recognised by law or society, or other entities that may own or control them.

⁴ Strictly speaking, there are several different ways to consolidate group-level information, depending on whether one adopts a supervisory, statistical or business accounting viewpoint (IAG (2015)).

⁵ The country in which economic decisions are taken may be different from both the country of residence and the country of headquarters.

measurement rules, increasing the tension between the nature of economic activity and the measurement system that strives to keep up with it. Increasingly, companies are global, as is their ownership, with economic activity taking place in a geographically dispersed way. Understanding the impact of macroeconomic developments, financial price movements or public policies on corporate decisions requires the rearrangement of institutional units dispersed across the world into corporate groups on the basis of ownership and control. And yet measurement is still largely residence-based, classifying institutional units by attributing a location of “predominant economic interest” to each entity.⁶

As corporate activity increasingly straddles national borders, it takes place through many separate legal entities that together span the globe. A manufacturing operation and its workers can be sited far from the headquarters of the firm, and far from its other operations, such as marketing, sales, or research and development. Ownership is also global, since the investors of a listed firm are spread around the world. The jurisdiction in which a company is headquartered (its domicile) may reflect the firm’s origin and history, or simply tax or corporate governance considerations. Domicile applies to a firm’s assets, which need not be only physical capital but can include intellectual property used to create value.

In this article, we go over a number of the key issues raised by the tension between the traditional residence-based measurement system and the evolving nature of globalisation. In many instances, the consolidated approach has the potential to provide a useful alternative perspective. That said, given the increasingly complex nature of the global economy, there are no straightforward ways to comprehensively address many important economic questions using a single measurement framework. Instead, one needs to extract information from multiple frameworks, using an approach tailored to the specific question at hand.

The remainder of the article is organised as follows. In the next section, we discuss several important measurement issues associated with the way in which the activities of global firms are recorded under current national accounting rules. Next, we investigate how some of those issues manifest themselves in the data. We conclude by drawing lessons from the above issues.

National accounts and global firms: measurement issues

As multinational firms, with their complex corporate structures, distribute their activities across traditional borders, they complicate the task of capturing economic activity within traditional national accounts (Tissot (2016)). A growing body of evidence suggests that the activities of global firms have outgrown some features of the existing national accounting framework (see box on next page).⁷

It is now well understood that *net* concepts such as the current account do not adequately reveal the underlying linkages across countries, which are likely to reflect *gross* flows to and from different national sectors. As a consequence of their growing

⁶ There are several data sets that represent notable exceptions to the above pattern. We discuss those in the last section of this article.

⁷ Lane (2015, 2017), Forbes et al (2017), Guvenen et al (2017).

A broad overview of the national accounting framework

This box provides a review of national income measures and their relationship with balance of payments categories.

Gross domestic product (*GDP*), the best-known measure of a country's economic activity, comprises the sum of all final goods and services produced in the economy in a given period. *GDP* measured on an expenditure basis can be decomposed into:

$$GDP_t = C_t + G_t + I_t + NX_t \quad (1)$$

where *C* and *G* are respectively the private sector and public sector consumption of goods and services, *I* represents investment, and *NX* describes the net exports (exports minus imports) of goods and services.

Gross national income (*GNI*) is the total income earned by the residents of an economy in a given period, including that which is generated abroad. Its relation to *GDP* is given by the identity:

$$GNI_t = GDP_t + NPI_t \quad (2)$$

where *NPI* denotes net primary income, which is the difference between income inflows (credits) from non-residents to domestic residents and income outflows (debits) by domestic residents to non-residents.

NX and *NPI* are components of the current account (*CA*), which measures the trade in merchandise and services, income inflows and outflows and current transfers of an economy's residents vis-à-vis non-residents in a given period.

Formally the current account can be described as:

$$CA_t = NX_t + NPI_t + NSI_t \quad (3)$$

where *NSI* is net secondary income, which accounts for unreciprocated payments and receipts (for example, transfers between governments and international organisations such as emergency aid and technical assistance). Primary income can be decomposed further into compensation of employees, investment income and other income (rent and taxes and subsidies on products and production). The investment income category is related to the income generated on international financial assets and liabilities.

The *CA* balance is also associated with the net acquisitions and sales of foreign assets and liabilities. The relation between a country's current account (*CA*) and the net international investment position (*NIIP*) is:

$$NIIP_t - NIIP_{t-1} = CA_t + SFA_t \quad (4)$$

where *SFA* is the stock flow adjustment term.^① This item reflects not only valuation effects due to asset price changes and exchange rate fluctuations but also the reallocation of the ownership of intangible capital assets and financial assets across borders.^②

The *NIIP* and related investment income – recorded in primary income – comprise five broad functional categories: (i) direct investment; (ii) portfolio investment; (iii) other investment; (iv) reserve assets; and (v) financial derivatives.

Direct investment (*DI*) is a form of international investment that reflects the lasting interest of an entity (direct investor) resident in one economy in an enterprise (direct investment enterprise) located in another economy.^③ A direct investment relation is deemed to exist when a direct investor acquires 10% or more of the voting shares/power of a direct investment enterprise, or owns less than 10% and still maintains an effective voice in management of the direct investment enterprise. The initial transaction between the direct investor and the direct investment enterprise is recorded as *DI*, as are all subsequent transactions between them.

Equity holdings worth less than 10% of the voting shares/power of an enterprise are classified as portfolio investment, along with holdings of tradable securities, such as debt securities (bonds and notes) and money market instruments.

The other investment component of the *NIIP* comprises external assets and liabilities not recorded under direct investment or portfolio investment, namely: loans, currency, deposits, trade credits, derivatives and other accounts receivable and payable.

Reserve assets include Special Drawing Rights, monetary gold, a country's IMF position, foreign exchange assets and other claims.

Financial derivatives covers a range of products including over-the-counter and exchange-traded contracts (options, futures, forwards and swaps).

The residency concept states that the residence of each institutional unit is the economic territory with which it has the strongest connection (expressed as its centre of predominant economic interest). Each unit is a resident of only one economic territory (IMF (2009), UN-EC-IMF-OECD-WB (2009)).^④ The residency approach is consistent with the concept that production and economic activity operate within a boundary or rather on an "island".

The complexity of the global activities and corporate structures of multinational firms gives rise to diverging measurements of direct investment by official national statistical compilers. Two primary approaches to measuring direct investment co-exist in the international statistical framework: measurement on the basis of "immediate counterpart" and "ultimate host and source" (OECD (2008), IMF (2009)). Differences across national statistical agencies in their measurement of direct investment between these approaches, coupled with the persistent rise and increasing complexity of globalisation, have given rise to asymmetries in the mirror direct investment data between countries (CSO (2016)). An IMF initiative, the IMF Coordinated Direct Investment Survey (CDIS) Project on Bilateral Asymmetries, commenced in 2010 with the aim of addressing quality concerns in direct investment statistics (IMF (2015)).

① For simplicity it is assumed that net errors and omissions and the Capital Account are zero. The Capital Account covers transfers of capital and gross transactions of non-produced non-financial assets (for example, bailouts and debt forgiveness). ② Data revisions are also included in the SFA component. ③ The notion of a lasting interest implies that there will be a long-term strategic commitment between the enterprises, with capital flows arising from this relationship being classified as direct investment. ④ According to these international statistical standards collectively termed "the 2008 SNA", an institutional unit is defined as a household, corporation, non-profit institution, government unit, legal or social entity recognised by law or society or another entity that may own or control them.

size and complexity, gross capital flows increasingly affect the current account through their impact on primary income. That is why it is necessary to analyse the composition of both gross and net flows, by functional component and sector, even within the confines of the existing residence-based accounting framework (Lane (2013)).

In the context of international banking flows, this has already been well documented in the existing literature. For example, several authors have argued that current account balances did not reveal underlying vulnerabilities created by European banks' large-scale reinvestment of funds raised from US money market funds into US mortgage-backed securities before the 2007–09 Great Financial Crisis (GFC).⁸

In this section, we provide three hypothetical examples to illustrate some consequences of globalisation. We start with the "classical" measurement issues associated with global firms, illustrating how offshoring affects national accounts. Second, we highlight additional conceptual and measurement challenges associated with the redomiciling of global firms – that is, the change of legal domicile of a firm to another location. Third, we describe issues raised by the cross-border mobility of corporate assets, in particular intangible assets such as intellectual property. While we provide three separate examples for simplicity, these phenomena can interact in practice, further complicating the interpretation of balance of payments data.

⁸ Obstfeld (2012), Borio and Disyatat (2011), Lane (2013), Shin (2012).

Classical measurement problems

Perhaps the first form of globalisation that comes to mind in popular discussions is “offshoring”, where business processes are moved to another jurisdiction, either through the firm’s own foreign subsidiary or to an unrelated firm through a contract agreement.⁹ Offshoring can apply to manufacturing or to support services, such as accounting or back office functions. When the offshoring takes place through an arm’s length contract, the offshoring is combined with “outsourcing”.

Consider an example where the residents of a given country (Country A) produce goods domestically and sell them to the rest of the world. In our hypothetical example, Country A manufactures and exports goods worth 110, using inputs worth 60 that it imports from the rest of the world. Country A thus has a positive trade balance of 50 and a current account surplus of equal size (Table 1).

Now, suppose that the firm offshores the production of its goods to Country C by establishing a foreign subsidiary.¹⁰ In this case, the imports and exports of goods

Effect of offshoring Table 1

Pre-offshoring				
	A HQ	B	C Manufacturer	D Rest of the world
Exports	110	0	0	60
Imports	60	0	0	110
<i>Trade balance</i>	+50	0	0	-50
Current account balance	+50	0	0	-50
Post-offshoring				
	A HQ	B	C Manufacturer	D Rest of the world
Exports	0	0	110	60
Imports	0	0	60	110
<i>Trade balance</i>	0	0	+50	-50
Primary income credit	50	0	0	0
Primary income debit	0	0	50	0
<i>Net primary income</i>	+50	0	-50	0
Current account balance	+50	0	0	-50

Imports and exports in this example refer to goods. The imports and exports of services are assumed to be zero. Primary income reflects income related to direct investment only. Compensation of employees, portfolio investment and other investment income, and net secondary income (NSI) are assumed to be zero. Local (labour-related and other) costs of the subsidiary in country C are assumed to be zero. +/- sign indicates a positive/negative balance in the trade account, a surplus/deficit balance for the current account and net receipts and net payments on the primary income account, respectively.

⁹ Contract manufacturing occurs when a firm in a domestic economy engages another firm abroad to manufacture products on its behalf. The ownership of these manufacturing inputs is retained by the firm in the domestic economy, and the contract manufacturing is accounted for as a service in the current account framework.

¹⁰ Offshoring in this example assumes a direct investment relation between Country A and Country C. In practice, offshoring does not necessarily have to be performed by a foreign subsidiary (ie it can be performed by an unrelated party).

no longer show up in Country A. Instead, Country C imports and exports goods vis-à-vis the rest of the world. For simplicity, we assume that local (labour-related and other) costs are zero, so that the profit of the subsidiary in Country C is the difference (50) between the exported final goods (110) and the imported inputs (60). That profit of 50 is channelled from Country C to Country A through the primary income component of the current account.

In this way, offshoring transforms the original trade surplus of Country A into primary income net receipts of the same magnitude. The current account balances of both countries, however, remain unchanged relative to their respective pre-offshoring values (at a surplus of 50 for Country A and a balance of 0 for Country C).

Transfer pricing represents another classical measurement issue in international finance. This article does not cover transfer pricing in depth since that subject has been extensively covered by a voluminous literature.¹¹ Suffice it to say that transfer pricing washes out in the current account. Choosing transfer prices to understate domestic profits and overstate foreign profits means that exports are underreported by exactly the same amount that overseas investment income is overreported (abstracting from any resulting tax effects). As a result, the measured trade balance and the measured net investment income are both “inaccurate”, but in exactly offsetting ways.

Recently, more significant than classical transfer pricing practices has been the practice of optimising the location of global firms’ profits by selecting the location of their headquarters and the location of their mobile capital assets. We cover those issues below.¹²

Redomiciliation

Redomiciliation is a type of financial engineering that is associated with changing the location of the headquarters. It poses challenges in the measurement of the investment income component of the current account.¹³ Drawing on Lane (2015), we use the post-offshoring world from the simple stylised example described in the bottom panel of Table 1 as a starting point to demonstrate how redomiciling affects the current accounts of the countries involved.¹⁴

Suppose that Country A is the historical home of Firm ABC (Table 2, top panel). The shareholders (portfolio investors) of Firm ABC are also resident in Country A.¹⁵ Suppose that firm ABC decides to redomicile its headquarters to Country B (Table 2, bottom panel). Through redomiciliation, the firm relocates its legal incorporation to Country B, but does not generate any additional real economic activity in Country B.

¹¹ See among others Hines (2000), Bernard et al (2006) and Curcuru et al (2013).

¹² For the impact of corporate tax strategies on the US balance of payments, see Setser (2017, 2018).

¹³ The increase in redomiciliation is most likely motivated by the tax planning activities of global firms when faced with the prospect of changes in the tax regime in some jurisdictions (Fitzgerald (2015), Lane (2015), Voget (2011), Gravelle and Marples (2014)).

¹⁴ In practice, global firms are likely to have many foreign subsidiaries across numerous countries. This example focuses on a two-country restructuring to provide an overview of redomiciliation. As in the example presented in Table 1, we assume that local (labour-related and other) costs of the subsidiary in Country C are zero.

¹⁵ In practice, the ownership structure of global firms is both complex and global in nature.

Effect of redomiciliation

Table 2

Pre-redomiciliation				
	A	B	C	D
	Original HQ	New HQ	Manufacturer	Rest of the world
Exports	0	0	110	60
Imports	0	0	60	110
<i>Trade balance</i>	0	0	+50	-50
Direct investment income credit	50	0	0	0
Direct investment income debit	0	0	50	0
Portfolio investment income credit	0	0	0	0
Portfolio investment income debit	0	0	0	0
<i>Net primary income</i>	+50	0	-50	0
Current account balance	+50	0	0	-50
Post-redomiciliation				
	A	B	C	D
	Original HQ	New HQ	Manufacturer	Rest of the world
Exports	0	0	110	60
Imports	0	0	60	110
<i>Trade balance</i>	0	0	+50	-50
Direct investment income credit	0	50	0	0
Direct investment income debit	0	0	50	0
Portfolio investment income credit	10	0	0	0
Portfolio investment income debit	0	10	0	0
<i>Net primary income</i>	+10	+40	-50	0
Current account balance	+10	+40	0	-50

Imports and exports in this example refer to goods. The imports and exports of services are assumed to be zero; compensation of employees, other investment income, and NSI are assumed to be zero. Local (labour-related and other) costs of the subsidiary in country C are assumed to be zero. +/- sign indicates a positive/negative balance in the trade account, a surplus/deficit balance for the current account and net receipts and net payments on the primary income account, respectively.

Nothing fundamental has changed in terms of economic activity. Nevertheless, there are large consequences for the current account balances of both countries involved due to the asymmetry between the accounting treatment of direct investment (DI) income and portfolio investment (PI) income. DI income is measured on an accrual basis, meaning that income is recognised in the accounting period in which profits are earned. In contrast, PI income is recognised only on the actual payout of dividends or interest. This accounting treatment asymmetry distorts measures of Gross National Income (GNI) and the current account balance.¹⁶

The shareholders of Firm ABC continue to reside in Country A, but their original claim on a domestic firm has been transformed into portfolio investment assets of Country A on Country B.¹⁷ Country A had previously booked all of Firm ABC's foreign

¹⁶ Retained earnings boost the value of direct investment liabilities, so that the increase in the measured current account balance should be matched by an increase in the stock-flow adjustment term in the stock of direct investment liabilities.

¹⁷ The above example assumes that no single shareholder owns more than 10% in Firm ABC.

earnings as DI income receipts since its operations in Country C counted as DI. Now, since the foreign assets are held as a portfolio investment, it only receives investment income on the share of income paid out as dividends. This reduces the current account balance for Country A, as some of the firm's profits are held back and added to retained earnings.

The converse effect is reported for Country B. It now receives all of the investment income generated by the direct investment assets it has vis-à-vis Country C, but the offsetting entry related to the portfolio equity holdings of shareholders in Country A is only recorded when dividends are paid out. Since the firm keeps back some profit, this boosts the current account of Country B.

In this example, the financial account is the mirror image to the measured current account balances. The international balance sheet of Country A records an increase in portfolio equity assets and that of Country B records an increase in portfolio equity liabilities. Therefore, in purely economic terms, the two countries are in much the same situation as before the redomiciliation. Thus, despite the impact on the current account, which is likely to dominate headlines, the financial account and the international balance sheet are not affected in the same way.¹⁸

These effects are not only theoretical possibilities. The effect of corporate globalisation on the national accounts of a number of small open economies has been well known for some time (Beusch et al (2017)). More recently, substantial measurement challenges have also emerged for several large advanced economies.

For example, the significant presence of multinational firms in Switzerland is associated with a substantial measured current account surplus (Jordan (2017)). This is in part due to the profits earned abroad by multinational enterprises resident in Switzerland being attributed to that country despite the owners of those firms residing outside Switzerland. Dividend payments to the ultimate owners dissipate some of the profits that flow to the headquarters, but only partially (due to the asymmetrical accounting treatment of DI income and PI income, described above).

Furthermore, in the past decade, a number of UK and US firms have relocated their headquarters to Ireland, leading to an upward shift in Ireland's receipts of investment income. This development has led to an overstatement of the recording of net primary income for Ireland and consequently of its measured current account.¹⁹

Conversely, since 2011 the United Kingdom has experienced a deterioration in its net primary income, predominantly reflecting a decline in receipts of investment income inflows (Lane (2015), ONS (2016), Burgess and Shanbhogue (2017)). This has consequences for the interpretation of the evolution of the UK current account, particularly in the light of the increased correlation between the current account and investment income since the early 2000s (Forbes et al (2017)).

Mobility of intangible assets across countries

The rise of the knowledge economy and the use of intellectual property (IP) as capital assets in the production of technology have also had a critical impact on the

¹⁸ See Borio et al (2014) for a detailed discussion of the relation between the current account and financial account in the balance of payments.

¹⁹ While net primary income is overstated, it continues to be negative on a net basis, reflecting the investment income payments to parents of multinational firms with subsidiaries resident in Ireland. For more detail, see Everett (2012), Fitzgerald (2013), Lane (2015), and CSO (2015).

measurement and interpretation of GDP and balance of payments statistics. IP is a type of intangible asset and includes research and development, copyright and computer software.²⁰ According to the 2008 System of National Accounts (SNA) framework, the booking of exports and imports depends on the economic ownership of IP.²¹ As a consequence, the relocation of IP across countries, typically motivated by the tax planning activities of global firms, can change the geographical location where exports and imports are recorded. The relocation of mobile capital assets can also affect measured GDP and GNI, via its impact on depreciation. This form of financial engineering is no longer predominantly channelled through offshore financial centres, but also affects the national accounts of advanced economies (for example Ireland, Switzerland, the United Kingdom and the United States).

In what follows, we use another hypothetical example to illustrate how (i) the role of trade in services and (ii) the relocation of IP across countries affect the trade balance and the current accounts of the relevant countries.²²

Once again, we use the post-offshoring world from the simple stylised example described in the bottom panel of Table 1 as a starting point. We enrich the example in two ways. First, we now assume that production uses IP inputs. Second, in contrast to the previous examples, we now allow for the existence of local (labour-related and other) costs.

Reflecting the first additional assumption, Country A exports IP services (required to manufacture the product) to Country C and receives a royalty service fee of 10 (Table 3, top panel). Country A also pays a (contract manufacturing) service fee of 20 to the manufacturer in Country C, which in turn has to pay local (labour-related and other) costs of 5 in addition to the above royalty service fee of 10. The profits of the manufacturer in Country C (equalling 5, that is the service fee of 20, minus the royalty fee of 10 and the local costs of 5) are transferred back to Country A as primary income. Country A also records imports (80) and exports (110) of goods. Thus, the product, which is manufactured in Country C and sold to the rest of the world, boosts the exports of Country A, even though it never physically crosses A's border.²³

Now, suppose the firm relocates its IP assets from Country A to Country B (Table 3, bottom panel). The physical production process remains unchanged, but the relocation of IP assets has implications for the trade balances of A and B. The parent firm in Country A is no longer exporting services related to its intangible assets – this income (to the extent it comes from a third country) is now earned by the subsidiary in Country B, which is now the economic owner of the IP. The subsidiary in Country B is now (i) exporting IP services to the manufacturer in Country C (the subsidiary in B receives a royalty service fee of 10 from the manufacturer in C) and (ii) importing contract manufacturing services from the manufacturer in Country C (the subsidiary

²⁰ IP is formally defined in the current international statistical framework as “the result of research, development, investigation or innovation leading to knowledge that the developers can market or use to their own benefit in production because use of the knowledge is restricted by means of legal or other protection” (paragraph 10.98 of UN-EC-IMF-OECD-WB (2009)).

²¹ The 2008 SNA framework distinguishes between legal ownership and economic ownership (see paragraph 2.47 in UN-EC-IMF-OECD-WB (2009)).

²² For a detailed discussion see Stapel-Weber and Verrinder (2016).

²³ The production inputs of goods under a contract manufacturing arrangement remain under the economic ownership of Country A. Country C is providing a manufacturing service as part of this subcontracting production process.

Effect of external manufacturing and capital asset relocation

Table 3

Pre-relocation of capital asset				
	A	B	C	D
	HQ	New location of IP	Manufacturer	Rest of the world
Goods exports	110	0	0	80
Goods imports	80	0	0	110
Services exports	10	0	20	0
Services imports	20	0	10	0
<i>Trade balance</i>	+20	0	+10	-30
Primary income credit	5	0	0	0
Primary income debit	0	0	5	0
<i>Net primary income</i>	+5	0	-5	0
Current account balance	+25	0	+5	-30
Post-relocation of capital asset				
	A	B	C	D
	HQ	New location of IP	Manufacturer	Rest of the world
Goods exports	0	110	0	80
Goods imports	0	80	0	110
Services exports	0	10	20	0
Services imports	0	20	10	0
<i>Trade balance</i>	0	+20	+10	-30
Primary income credit	25	0	0	0
Primary income debit	0	20	5	0
<i>Net primary income</i>	+25	-20	-5	0
Current account balance	+25	0	+5	-30

Compensation of employees, other investment income, and NSI are assumed to be zero. +/- sign indicates a positive/negative balance in the trade account, a surplus/deficit balance for the current account and net receipts and net payments on the primary income account, respectively.

in B pays a fee of 20 to the manufacturer in C).²⁴ Furthermore, the exports (110) and imports (80) of goods, which were previously booked by Country A, are now booked by Country B, where the economic ownership of the IP assets now resides.²⁵ Country A receives primary income of 25, comprising 20 from the relocated IP in Country B and 5 from the profits of the manufacturer in Country C.

So far, we have focused on the trade balance. In a baseline scenario, there should be no impact on current account balances, because of the offsetting impact on net primary income. For Country A, the decline in net exports should be exactly offset by the increase in investment income receipts, since the parent in Country A is still the ultimate owner. Similarly, the profits earned by the subsidiary in Country B from

²⁴ In practice, there will also be a negative effect on the net profits of the foreign subsidiary through the recording of depreciation on the capital stock. For simplicity, the explicit treatment of depreciation is not included in this stylised setup. See Lane (2017) for detailed information on the effects of depreciation on the current account when the domestic capital is owned by a foreign investor.

²⁵ A change in economic ownership takes place when the final goods are sold by Country B to the rest of the world.

exporting IP services to Country C and goods to the rest of the world will be exactly offset by an accrued increase in DI income flowing to Country A.

The relocation of IP assets across countries also has implications for international balance sheets. In the scenario we have been discussing here, there will be a shift increase in the external liabilities of country B and the external assets of country A by the corresponding value of the IP relocated, reflected in the stock flow adjustment (SFA) component of the net international investment position (NIIP) (see equation 4 in the box). This is due to the intra-group accounting treatment of the relocation of the IP, which is recorded as an increase in the IP assets of the foreign subsidiary resident in Country B, coupled with a simultaneous increase in the (external) liabilities of the subsidiary to its parent firm in Country A (or some related subsidiary). This will be reflected in a corresponding increase in the external assets (direct investment component) of Country A through the SFA component.

The latter two phenomena were recently experienced by Ireland. The relocation of the corporate structures of global firms to Ireland, combined with relocation of intangible assets (in the form of IP) and the increased globalisation of production processes (including contract manufacturing and aircraft leasing), has significantly affected its national accounts. In July 2016, the National Income and Expenditure 2015 results for Ireland reported real GDP growth of 26% and real GNI growth of 19%.²⁶ Following the recommendation of a domestic Economic Statistics Review Group, the Central Statistics Office, Ireland's national statistical agency, published a number of modified economic indicators that account for the distortions arising from the globalised nature of the Irish economy. One example of the modified indicators is GNI*, which excludes the investment income flows related to redomiciled global firms, the depreciation of intellectual property products and distortionary effects related to aircraft leasing (Lane (2017)).

This section has offered stylised examples of how globalisation in its many complex and dynamic forms has increased the complexity of accounting for the activities of global firms in the international statistical framework, and therefore the interpretation of a key economic indicator and its components. In the next section, we examine the quantitative importance of these restructuring developments.

Quantitative importance

Financialisation of the current account

The post-World War II increase in global external financial openness accelerated sharply between the mid-1990s and the GFC.²⁷ Spurred by financial liberalisation and innovation, external assets and liabilities surged from a combined total of less than 150% of GDP in 1995 to over 400% in 2007 (Lane and Milesi-Ferretti (2018)). The GFC seemingly brought to a halt the rapid rise in external financial openness, with the

²⁶ The relocation of IP to Ireland boosted GDP through (i) a one-time increase in investment and (ii) an increase in contract manufacturing, which gave rise to greater trade in goods and services. It also led to a significant increase in the recording of depreciation, due to the increased stock of capital (ultimately legally owned by a foreign parent), which positively affected GNI.

²⁷ The post-World War II increase in external financial openness was a part of the second major wave of globalisation. The first major globalisation wave, which lasted from the early 1800s to World War I, also saw a substantial increase in both real and financial cross-border linkages.

global stock of external assets and liabilities contracting to slightly under 400% of GDP in 2015 (BIS (2017b)).

Given the expansion in gross assets and liabilities, a focus on the trade balance when measuring external imbalances ignores the dynamics of international trade in financial assets (Lane (2015), Lane and Milesi-Ferretti (2018), Forbes et al (2017)). The importance of gross primary income flows (relative to gross trade flows) rose steadily between the mid-1990s and the GFC. This largely reflected the rapid pre-crisis expansion of the stocks of cross-border financial assets and liabilities (discussed above). This trend was most pronounced for financial centres (FCs), where the ratio of gross primary income flows to gross trade flows more than quadrupled from 14% in 1995 to 65% in 2007. The relative importance of primary income flows also rose considerably for (non-FC) advanced economies (AEs) – from 12% in 1995 to 23% in 2007.

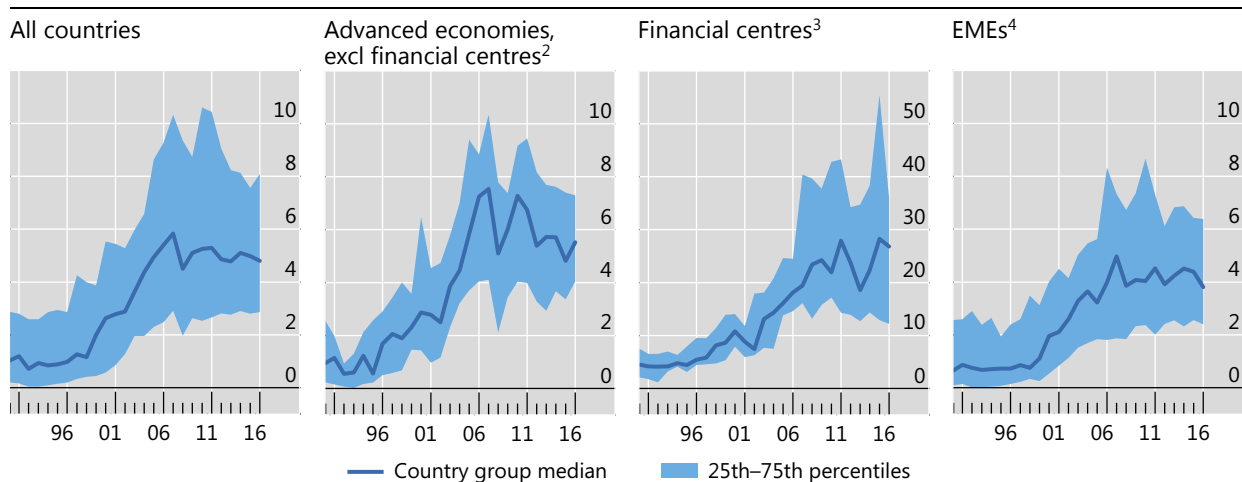
The post-GFC pullback in gross external financial positions (together with the low interest rate environment) reversed this trend, but only partially. The 2015 level of the ratio of gross primary income flows to gross trade flows was still roughly three times that in 1995 for FCs. By contrast, the respective ratio remained relatively flat for EMEs both before and after the GFC.

Delving deeper into the main components of primary income flows reveals that the relative importance of direct investment income has increased sharply since the 1990s (Graph 1). This is the case not only at the global level, but also for all major country groups. The rise is especially notable in the case of FCs. The increase was primarily driven by the growth of offshoring.

Some country experiences highlight the incidence of these trends (Graph 2). In the case of the United States, the growing (positive) net primary income component of the current account has partially offset its trade balance component (Graph 2, left-hand panel). As a result, it has driven a considerable wedge between the current account balance and the trade balance during the post-crisis period. By way of contrast, as documented by Lane (2015), Forbes et al (2017) and Burgess and

Gross direct investment income flows as a percentage of gross trade flows¹

Graph 1



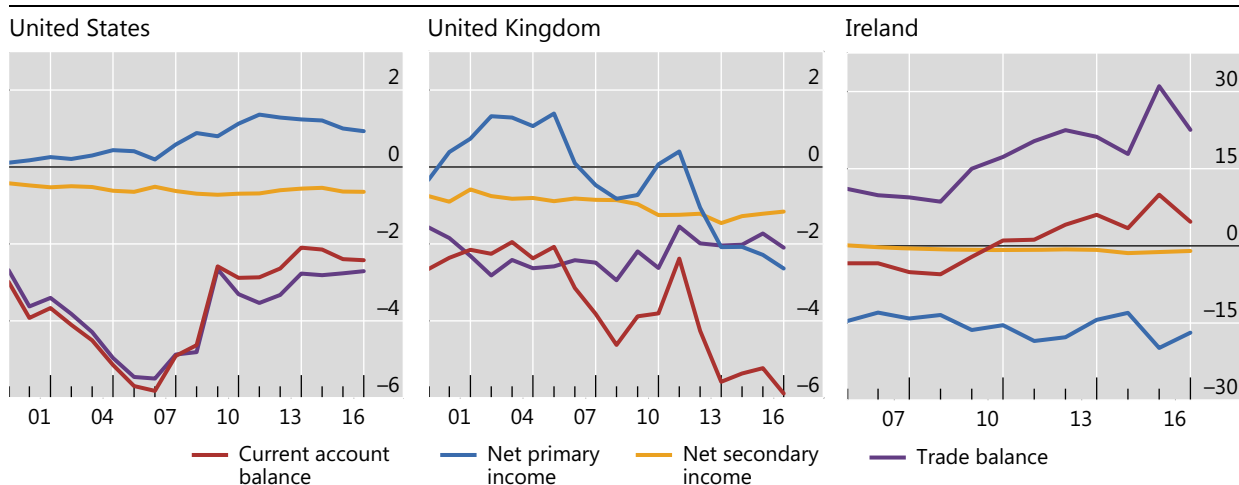
¹ (Direct investment income, debit + direct investment income, credit) / (exports + imports). ² AT, AU, CA, DE, DK, EE, ES, FI, FO, FR, GR, IS, IT, JP, LT, LV, NO, NZ, PT, SE, SI, SK and US. ³ BE, CH, CY, GB, IE, LU, MT and NL. ⁴ AO, AR, AZ, BD, BG, BR, BY, CL, CN, CO, CR, CZ, DO, DZ, EC, EG, ET, GT, HR, HU, ID, IL, IN, IQ, IR, KE, KR, KW, KZ, LK, MA, MM, MX, MY, NG, OM, PE, PH, PK, PL, RO, RU, SA, SD, TH, TR, UA, UY, VE and ZA.

Sources: Lane and Milesi-Ferretti (2018); IMF, *Balance of Payments Statistics*.

Decomposing the evolution of the current account

Selected countries' balance of payments components, as a percentage of GDP

Graph 2



Sources: IMF, *Balance of Payments Statistics* and *World Economic Outlook*.

Shanbhogue (2017), the primary income component has played a substantial role in the post-crisis deterioration of the current account balance of the United Kingdom (Graph 2, centre panel). In the case of Ireland, the primary income component of the current account is close to a mirror image of its trade balance component (Graph 2, right-hand panel). Interestingly, the contribution of primary income to the Irish current account balance exceeded that of net exports of goods and services even before the GFC, reflecting the presence of significant multinational corporate activity.

Tracking corporate profits and cash holdings

The increased relative importance of direct investment income (DII) flows (illustrated in Graph 1 above) suggests that global firms' foreign profits merit special attention. Conceptually, there are three types of corporate profits that could affect the measurement of domestic and national income for a given country (Table 4). First, the profits of domestically headquartered corporates operating in the home country are recorded as part of both domestic and national income. The profits of corporates in that group do not affect the current account (top left-hand cell). Second, the profits of domestically headquartered corporates operating abroad contribute to national income, but are not a part of domestic income. These are recorded as DII-credits and boost the current account (bottom left-hand cell). Third, the profits of foreign-owned corporates operating in the home country contribute to domestic income, but are not a part of national income. They are recorded as DII-debits and have a negative impact on the current account (top right-hand cell).

Thus, DII reduces the current account of the country in which it is generated and boosts those of (i) the country in which the company is headquartered and (ii) the countries in which the company's shareholders reside. In economic terms, all the benefits (abstracting from labour income) accrue to the countries in which the shareholders reside. In accounting terms, however, the positive current account impact is split between the countries in groups (i) and (ii) above because of the asymmetrical treatment of DII relative to portfolio investment income (PII) in the existing balance of payments framework (discussed above). The split depends on the

Classification of corporate profits

Table 4

Country of operations:	Country of headquarters:	
	Home	Rest of the world
Home	<i>Domestic profits</i>	<i>Direct investment income (debit)</i>
Rest of the world	<i>Direct investment income (credit)</i>	.

proportion of DII which is not distributed to shareholders. Such “undistributed profits” could take the form of either DII reinvested earnings (DII_RE) or dividends paid from an affiliate to a parent, which are added to the corporate cash pile rather than paid out to shareholders.²⁸

As a consequence, one can expect to find the following empirical relationships in the data. First, for countries (such as FCs) in which global firms tend to be headquartered, there should be a *positive* correlation between the current account balance and the portion of direct investment income that is not paid out to shareholders, measured as the difference between *DII (credit)* and *PII (debit)*. Second, for countries (such as AEs) in which the shareholders of global firms tend to reside, there should be a *positive* correlation between the current account balance and *PII (credit)*. Finally, for countries (such as EMEs) that tend to host the operations of global firms, there should be a *negative* correlation between the current account balance and *DII (debit)*.

Graph 3 presents evidence for the existence of the above relationships. The top panels reveal that there is a strong positive correlation between the portion of direct investment income that is not paid out to shareholders and the current account balances of three FCs (the Netherlands, Switzerland and the United Kingdom) that host the headquarters of internationally active corporates. Similarly, there is a strong positive correlation between the PII (credit) flows and the current account balances of three AEs (Germany, Sweden and Denmark) in which the shareholders of many global firms tend to reside (middle panels). Conversely, there is a strong negative correlation between the DII (debit) flows and the current account balances of three EMEs (South Africa, Turkey and Brazil) that host the operations of global firms (bottom panels).

The increase in the undistributed profits of global corporates has manifested itself not only in the current account balances of a number of countries, but also in the evolution of the cash holdings of large multinational non-financial corporates (Graph 4). Those cash holdings have risen sharply since the GFC (Graph 4, left-hand panel) and account for an increasing share of corporate assets (Graph 4, centre panel).

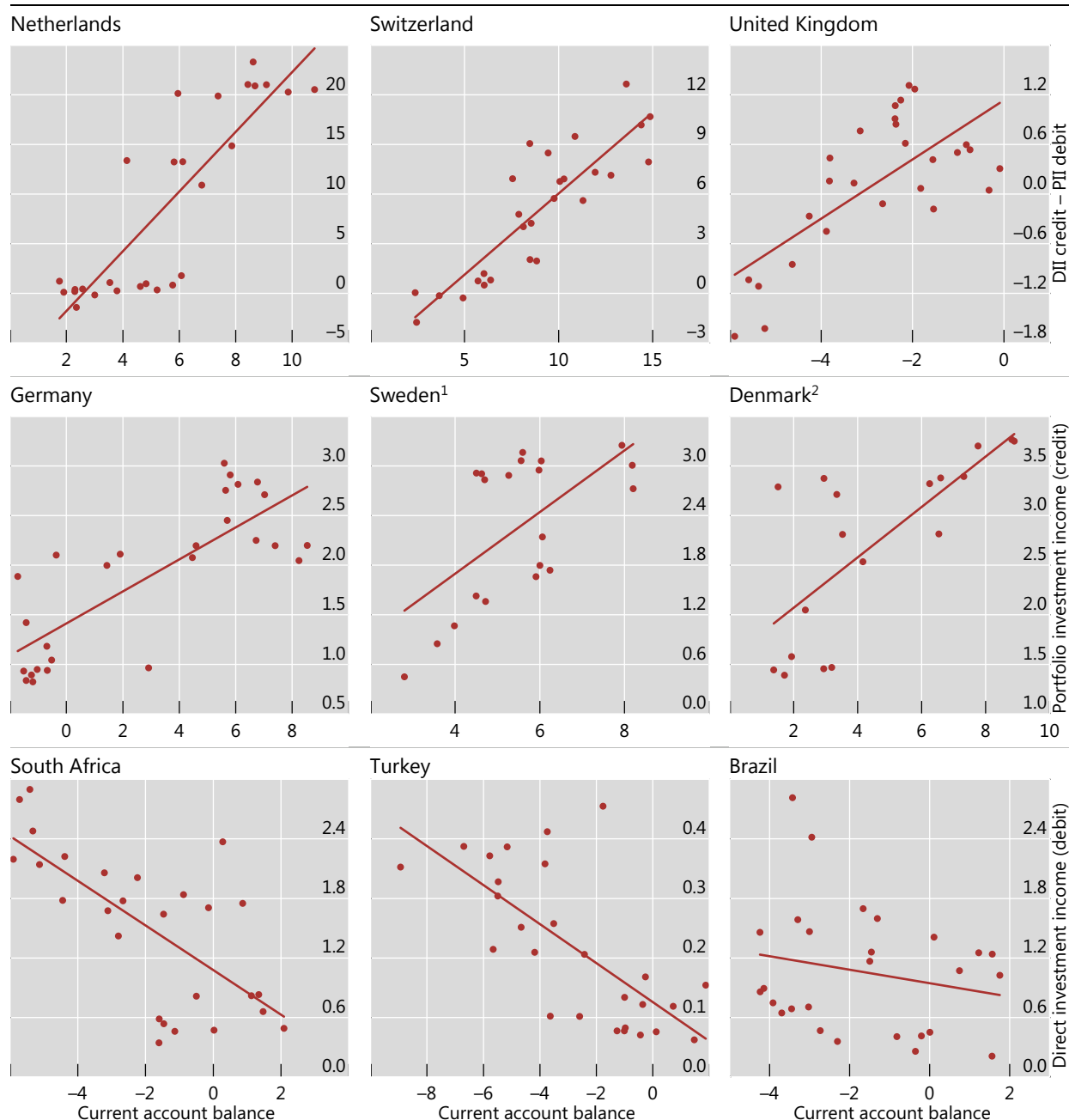
As a result, the conventional notion of non-financial corporates (NFCs) acting exclusively as borrowers in international financial markets has become increasingly outdated. NFCs have grown to become important lenders to a number of major sectors. For instance, NFCs provide credit to sovereigns and corporates via their bond purchases.

²⁸ As discussed earlier, these undistributed profits should be captured in the financial account of the balance of payments under the reinvested earnings component of direct investment and affect the dynamics of the net international investment position (since, all else equal, the value of portfolio equity liabilities should rise in proportion to the scale of retained earnings). The net international investment position, however, receives less attention than the traditional current account balance.

Investment income and current account balances

Annual values 1990–2016, as a percentage of GDP

Graph 3

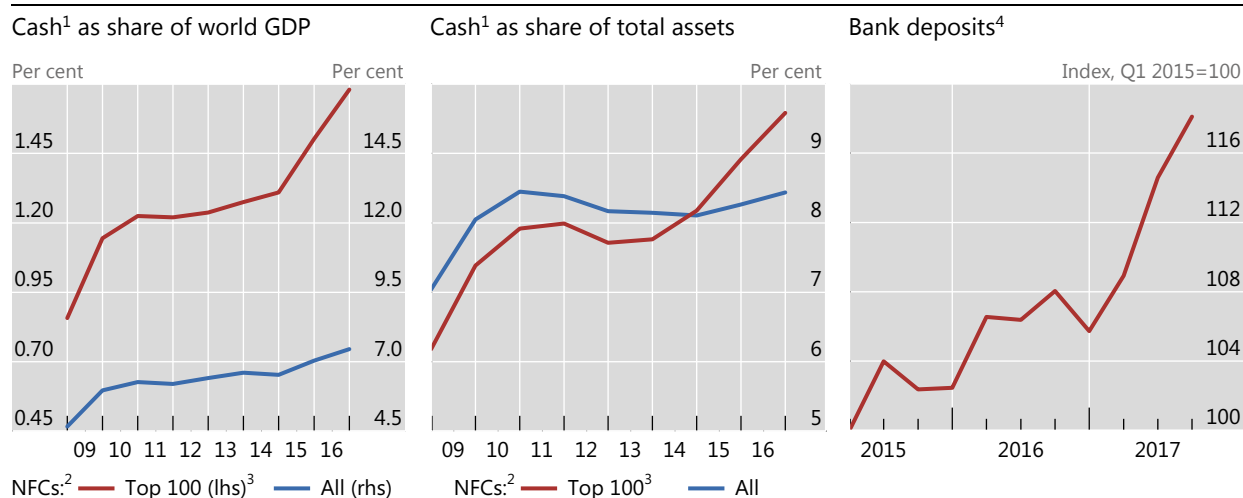


DII = direct investment income; PII = portfolio investment income.

¹ Due to data availability constraints, annual values for 1997–2016. ² Due to data availability constraints, annual values for 1999–2016.

Sources: IMF, *Balance of Payments Statistics* and *World Economic Outlook*.

NFCs are also important providers of funding to banks. As illustrated by Aldasoro et al (2017), banks outside the United States have reported considerable increases in their US dollar-denominated deposits from non-banks since the GFC. This source of funding has more than offset the run-off of eurodollar deposits by US money market funds that took place in 2016 (BIS (2017a)). The recently enhanced counterparty



¹ Cash and cash equivalents, defined as readily convertible deposits, securities and other instruments having maturities of less than three months at the time of purchase. ² Public non-financial corporations (NFCs). ³ The top 100 public NFCs (ranked according to the US dollar value of their cash holdings as of end-2016) for which data are available from 2007 onward. ⁴ Internationally active banks' deposit liabilities to non-financial corporations for the 22 countries that report an enhanced counterparty sector breakdown (going at least as far back as Q1 2015) to the BIS locational banking statistics.

Sources: IMF, *World Economic Outlook*; Capital IQ; BIS locational banking statistics.

sector dimension of the BIS locational banking statistics reveals that NFCs' deposits in BIS reporting banks have grown by nearly 20% between end-March 2015 and end-September 2017 (Graph 4, right-hand panel). Thus, the undistributed profits of NFCs have contributed to keeping global liquidity conditions relatively loose, despite a number of factors pulling in the opposite direction.

Conclusions

Given the measurement issues discussed in this special feature, policymakers should exercise caution when using rules of thumb developed for a bygone era. For example, debt/GDP and credit/GDP ratios may not be good measures of financial system vulnerabilities for some countries, as the denominator does not adequately capture the size of the domestic economy. Unfortunately, the current national accounting framework creates obstacles to the accurate interpretation of key economic indicators by stakeholders including the official sector, financial market participants and researchers. The complexity of global firms indicates that additional measures are necessary. Such measures should augment the traditional national accounting framework by looking through the "islands" with the ultimate goal of creating consolidated national accounts.

A number of data initiatives now under way point to progress in addressing these problems, as recognised in the G20 Data Gaps Initiative. These include the Legal Entity Identifier initiative to identify distinct legal entities and link them to the ultimate parent group;²⁹ the various data sets collected by the BIS on a consolidated basis – eg the consolidated banking statistics, the G-SIB data hub collection and the

²⁹ www.lei.org/.

international debt securities; Ireland's concept of GNI*, which strips the depreciation of foreign-owned capital assets from the measurement of domestic income; and the foreign affiliate trade statistics.

The residence-based and the consolidated accounting frameworks should be considered complementary rather than mutually exclusive. The consolidated accounting framework, while newer and more suited to addressing some of the measurement issues discussed here, is not unconditionally superior to the residence-based framework along all dimensions. Instead, its real benefit would be in providing a useful supplementary perspective, whose relevance would naturally depend on the question that is under investigation.

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Payments are a-changin' but cash still rules¹

Retail payment systems continue to become faster and more convenient. Yet, despite increased use of electronic payments around the world, there is scant evidence of a shift away from cash. As the appetite for cash remains unabated, few societies are close to “cashless” or even “less-cash”. In fact, demand for cash has risen in most advanced economies since the start of the Great Financial Crisis. This resurgence appears to be driven by store-of-value motives (reflecting lower opportunity cost of holding cash) rather than by payment needs.

JEL classification: E40, E41, E42.

Like “the times” in Bob Dylan’s song, the ways we pay are a-changin’. In most advanced countries, cheques have disappeared or are dying a slow death. Credit or debit cards are now accepted by all but a few merchants. New electronic payment (e-payment) services are emerging around the world and are increasingly instant, ubiquitous and available around the clock (CPMI (2016), Bech et al (2017)).

Many types of payment usually done with cash are going electronic. In Denmark, for example, church collection boxes and street performers now accept mobile payments. In China, fast food can be bought using “smile to pay” facial recognition technology. In the United States, college students pay for pizza and beers using apps that broadcast the purchases to their social media friends.

In general, innovations are putting the traditional bank-based payment system under pressure both within and across borders (CPMI (2015)). The proliferation of mobile phones has, in some developing countries, allowed payment systems to leapfrog those in more advanced economies. For example, in Kenya and other places, mobile payments flow without bank accounts.² Going forward, cryptocurrencies as well as fintech applications – the subject of feverish innovation by both small startups

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² Some mobile money services (eg Kenya’s M-PESA) do not require users to have a bank account. However, aggregate balances within the service are typically held by the operator in trust in a bank account. See Dittus and Klein (2011) for a discussion of mobile payments and financial inclusion.

and large firms – will likely further disrupt existing business models. In addition, some central banks are considering the need to issue a digital version of cash (eg Sveriges Riksbank (2017b)).

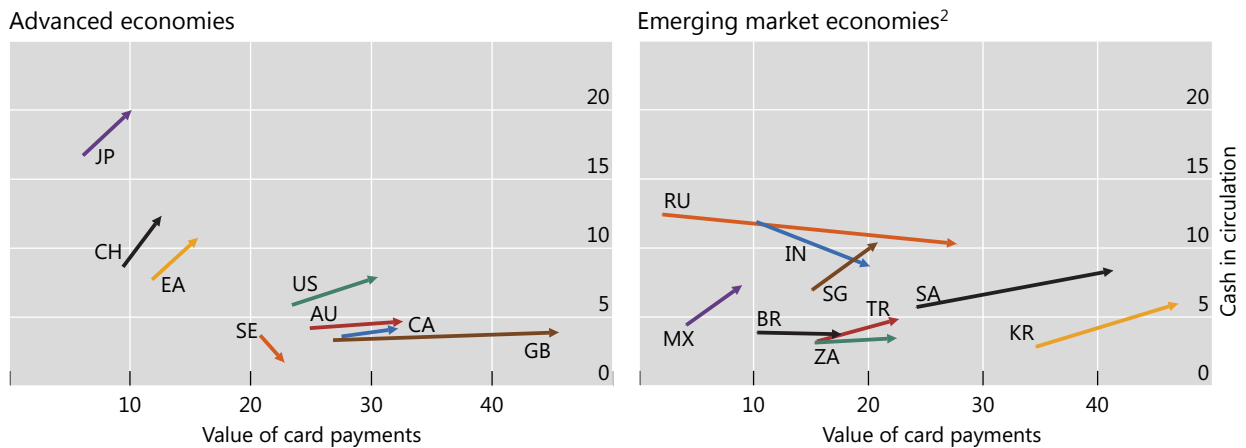
On the face of it, all this points to a shift away from cash (ie notes and coins). However, the data, so far, say otherwise. Based on the “Red Book” statistics³ on payment, clearing and settlement systems collected by the Committee on Payments and Market Infrastructures (CPMI),⁴ cash in circulation and card payments (a proxy for e-payments) have both increased since 2007.⁵ Only Russia and Sweden show evidence of substitution between cards and cash (Graph 1).⁶

Why is the demand for both cash and card payments rising? And, in particular, why has the demand for cash remained so robust? To seek answers to these questions, we look at recent trends in e-payments and demand for cash across countries.

Card payments and cash demand have generally increased since 2007¹

As a percentage of GDP

Graph 1



¹ 2007–16 changes. The start/end of an arrow represents 2007/2016, respectively. ² For South Africa, 2009–16 change. Data for China are not comparable with other jurisdictions and thus are not shown. Data are not available for Hong Kong SAR.

Sources: CPMI (2017b); authors’ calculations.

³ Like the US Federal Reserve’s “Beige Book”, the “Red Book” got its name because of the colour of its cover when it was first published in 1985. The Red Book gives an overview of the transactional flows through payment, clearing and settlement systems (ie for retail and wholesale payments, central counterparties and securities settlement systems). Among other things, the data include the value of cash in circulation (by denomination), the number and value of card payments and information on point-of-sale terminals and automated teller machines. The most recent edition, covering data for 2016, was published in December 2017 (CPMI (2017b)).

⁴ The 24 CPMI jurisdictions are: AU, BE, BR, CA, CN, EA, FR, DE, HK, IN, IT, JP, KR, MX, NL, RU, SA, SG, ZA, SE, CH, TR, GB and US.

⁵ Cash in circulation (a stock measure) is obviously not equivalent to the use of cash for payments (a flow measure). However, comparable cross-country data on cash use are not available and cash in circulation is often used as a proxy.

⁶ The arrow for India also indicates substitution between cards and cash. However, towards the end of 2016, the Indian government announced the removal of all INR 500 and 1,000 banknotes (ie demonetisation) and the issuance of new INR 500 and 2,000 banknotes. Cash in circulation dropped by more than 40% between 1 November and 31 December 2016. Latest data from the Reserve Bank of India show that cash in circulation in February 2018 was almost back to its November 2016 level.

We find that people are using cards for payments more frequently and for ever-smaller transactions. This is driven, in part, by more people holding cards (in emerging market economies(EMEs)) and greater availability of point-of-sale (PoS) terminals (in both emerging and advanced economies). Nevertheless, the demand for cash remains robust around the world, except notably in some Nordic countries. Furthermore, many jurisdictions have seen an increased affinity for cash following the Great Financial Crisis (GFC). Digging a bit deeper and differentiating between “means-of-payment” and “store-of-value” demand for cash, we provide evidence that the increasing demand for cash is driven, in part, by the lower interest rates (hence a lower opportunity cost of holding cash) that have characterised the post-crisis period.

The feature starts by analysing the use of card payments. The second section examines trends in cash demand. The third explores the drivers of cash demand, while the concluding one outlines some policy issues.

Card payments are a-booming...

Around the world people are relying more and more on e-payments. Data on card payments (defined as e-payments made with a plastic card at a PoS terminal)⁷ are currently the most comparable and consistent cross-country data on e-payments in the Red Book.⁸

The value of card payments for CPMI member countries increased from 13% of GDP in 2000 to 25% in 2016 (Graph 2, left-hand panel and Annex Table A). Not surprisingly, card use varies significantly across countries but there is no apparent difference between EMEs and advanced economies. The value of card payments (relative to GDP) is only around 10% in Germany, Japan and Mexico, but is over 40% in Korea, Saudi Arabia and the United Kingdom (centre panel).

People hold more cards and use them more often. The average number of payment cards (eg credit and debit cards) per person in CPMI member countries rose from 1.1 to 2.5 in the 2007–16 period. Cards issued in EMEs drove this increase, as cards per person were little changed in most advanced economies. The frequency of card use increased from around 60 transactions per person on average in 2000 to close to 85 in 2016. In Australia, Korea, Sweden and the United States, the average person uses a card more than 300 times per year while in India and Mexico the number is less than 25 times a year (Graph 2, right-hand panel).

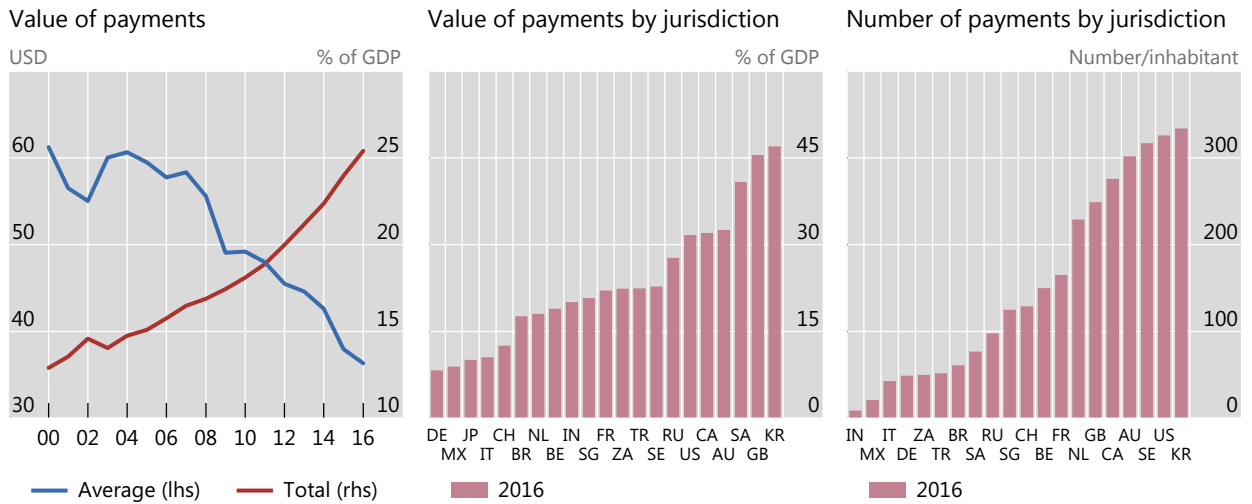
At the same time, the value of a typical card payment has declined. Over the last decade and a half, the average value of a card payment (in nominal terms) has dropped from above \$60 to less than \$40. This decline has been most pronounced in

⁷ Includes cards with credit features, debit features or both. Card payments made on the internet or using a smartphone app are not included in the current measure.

⁸ The scope of the data collected by the Red Book is updated from time to time to reflect and track the latest trends. Starting with 2018 version, the Red Book will be revamped, partly in order to capture more aspects of e-payments, such as online and contactless methods. The upcoming changes are detailed in CPMI (2017a).

Card payments are increasing everywhere but usage varies¹

Graph 2



¹ Data for China are not comparable with other jurisdictions and thus are not shown.

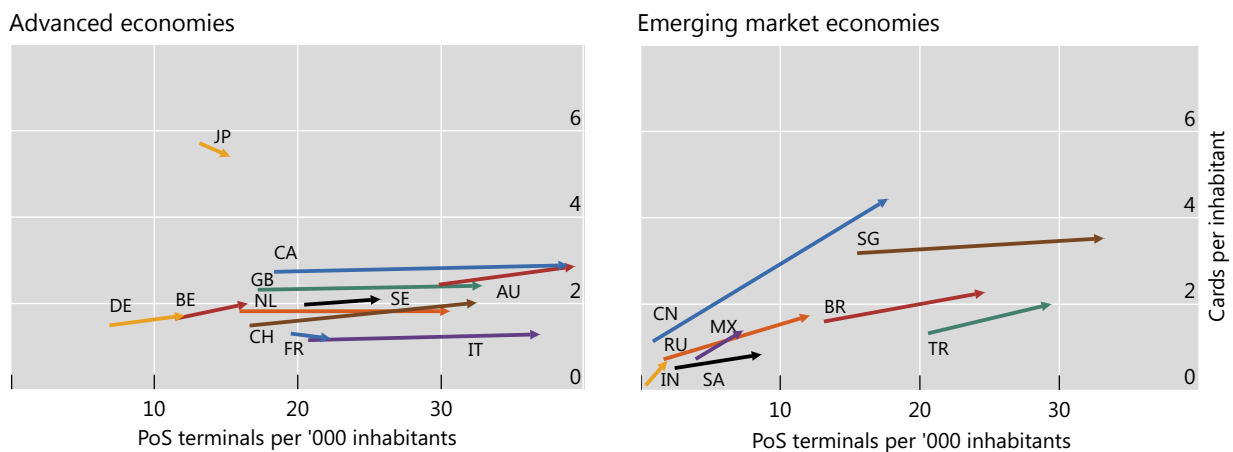
Sources: CPMI (2017b); authors' calculations.

Brazil, Korea and Russia.⁹ In 2016, the smallest average value of a card payment was around \$8, in Brazil and Russia.

One reason why cards are being used for an increasing number of ever smaller payments is better and more widespread infrastructure. PoS terminals used to be fixed terminals installed on counters but they have increasingly been replaced by

Infrastructure supporting card payments is expanding¹

Graph 3



¹ 2007–16 changes. The start/end of an arrow represents 2007/2016, respectively. Data are not available for Hong Kong SAR, Korea, South Africa and the United States. For the Netherlands, 2009–16 change.

Sources: CPMI (2017b); authors' calculations.

⁹ In Russia, this may, in part, reflect new policies during the sample period. In October 2013, the Russian Ministry of Finance introduced regulation that directed retailers with annual sales of over RUB 60 million (around \$1 million) to install PoS terminals to accept card payments.

more convenient mobile terminals. Lately, lower-cost smartphone or tablet-based PoS terminals have emerged, encouraging even smaller businesses to invest in them.

The density of PoS terminals has correspondingly risen. In CPMI countries, their density has doubled between 2007 and 2016 to 13 per thousand inhabitants. Density went up for all jurisdictions but the largest increases were in Canada and China (Graph 3). On average, there are 27 PoS terminals per thousand people in advanced economies and 11 in EMEs.

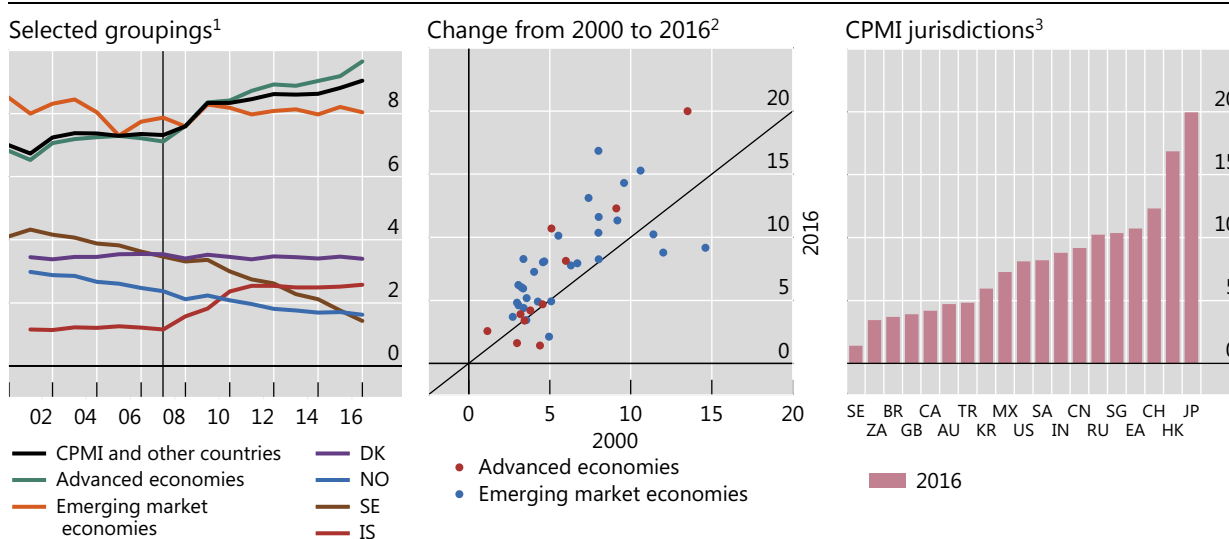
...but cash still rules in many places

Cash in circulation (scaled by GDP) is frequently used as a proxy for cash demand (eg Amromin and Chakravorti (2007), Williams and Wang (2017)). Since 2000, cash in circulation is up from 7% to 9% of GDP (on average) in a sample comprising CPMI members and 22 additional countries (Graph 4, left-hand panel).¹⁰ The increase is primarily due to an uptick in advanced economies following the GFC.¹¹ Overall, a majority of countries saw higher cash in circulation (centre panel), with the largest increases occurring in Hong Kong SAR and Japan (by 9 and 7 percentage points of

Cash demand varies across countries

As a percentage of GDP

Graph 4



¹ Includes CPMI and other countries (AE, BG, CL, CO, CZ, DK, HR, HU, ID, IL, IS, KW, MY, NG, NO, PH, PL, RO, RS, TH, UA and UY). Data start in 2002 for India, 2004 for Mexico, Turkey, South Africa and 2005 for Russia. The vertical line indicates the start of the GFC in 2007. ² For countries with no data available in 2000, the first data point available is used for the x-axis value. For the euro area, 2002 data. ³ For China, 2015 data from the People's Bank of China webpage. Data for Russia include banknotes and coins in the vaults of the Central Bank of the Russian Federation. Data for Singapore include Brunei notes and coins held at banks.

Sources: People's Bank of China; IMF, *International Financial Statistics*; CPMI (2017b); authors' calculations.

¹⁰ The 22 additional countries report data on cash in circulation to the IMF's *International Financial Statistics*. These include: DK, NO, IS, CL, CO, UY, IL, KW, AE, ID, MY, PH, TH, NG, BG, UA, CZ, RS, HU, HR, PL, and RO. For BE, DE, FR, IT and NL, cash in circulation is measured at the euro area level.

¹¹ The Wald test confirms the presence of a structural break in cash demand in 2007–08 for advanced market economies, but we find no such break for EMEs.

GDP, respectively). In contrast, in China cash demand declined by 5 percentage points of GDP.¹²

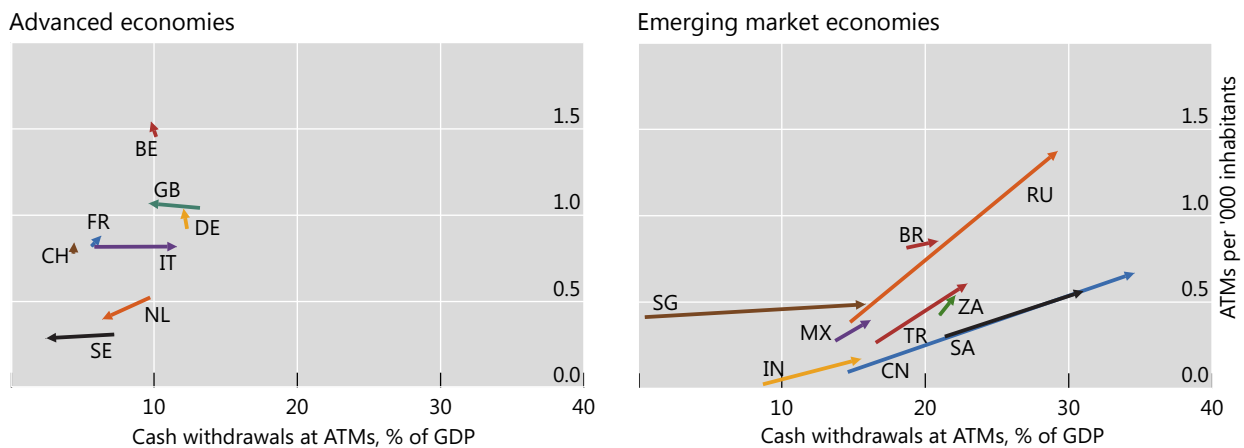
As noted by other studies (eg Jobst and Stix (2017)), cash demand varies considerably across countries (Graph 4, right-hand panel). While one might expect EMEs to have higher cash demand, no such pattern is evident from the data. According to the latest Red Book, for 2016, cash in circulation is below 2% of GDP in Sweden, but 10 times larger in Japan at 20%. Demand even differs among countries that are otherwise similar in terms of economic and social characteristics. One such example is the Nordic region. At the start of the 2000s, Iceland’s cash-to-GDP ratio was as low as 1.2%, while Denmark, Norway and Sweden were clustered at around 3–4% (Graph 4, left-hand panel).¹³ Since then, cash demand has shown a secular decline in Sweden and Norway, while in Denmark it has remained stable at around 3.5%. However, in Iceland, cash demand has more than doubled since its banking crisis, and now exceeds that of Norway and Sweden.

As with cards, the infrastructure supporting cash has improved. Since their debut in 1967, automated teller machines (ATMs) have become the key means through which people access cash. Like PoS terminals, ATMs have also evolved; most ATMs now accept cash deposits and some also provide other banking services such as bill payments.

The number of ATM terminals per thousand inhabitants has surged over time. In CPMI countries it has risen by 50% since 2007, from 0.4 per thousand people in 2007 to above 0.6 in 2016. Over the same period, the amount of cash withdrawn rose from 12% to 20% of GDP. These increases were driven by rapid growth in EMEs, where the number of ATMs as well as the amounts withdrawn rose significantly (Graph 5). In contrast, for advanced economies ATM density is, in general, little changed since 2007. An interesting case is the Netherlands, where the density of ATMs declined, in part, because of a shift towards using the “cashback” option at the point of sale

ATM density increasing in emerging markets but flat in advanced economies¹

Graph 5



¹ 2007–16 changes. The start/end of an arrow represents 2007/2016, respectively. Data are not available for Australia, Canada, Hong Kong SAR, Japan, Korea and the United States. For South Africa, 2009–16 change.

Sources: CPMI (2017b); authors’ calculations.

¹² The rapid rise in the mobile payment solutions in China (eg AliPay and WeChat) has likely contributed to this decline in cash demand.

¹³ Finland was slightly above 2% of GDP before the changeover to the euro.

(Netherlands Bank (2017)). Lastly, the value of ATM withdrawals in advanced economies saw disparate trends. Withdrawals as a share of GDP fell for the Netherlands, Sweden and the United Kingdom, stayed unchanged for Belgium, France, Germany and Switzerland, and increased for Italy.

The relationship between ATMs and cash demand is not straightforward (Graph 5). ATMs can both boost and constrain cash demand. On the one hand, by facilitating easy access, ATMs increase cash demand. On the other hand, wider distribution of ATMs can reduce the amount of cash consumers hold, since they can withdraw it as needed. Moreover, it can be difficult to determine whether higher cash demand leads to a greater supply of ATMs or vice versa.

What is driving cash demand?

“Money is what money does” (Hicks (1969)). And cash, like other forms of money, is used both as a means of payment and a store of value. Banknotes sewn into a mattress are likely held for store-of-value purposes but it is harder to tell whether a banknote in a wallet is held for one or the other motive. One way to get to at this distinction is to ask people to keep diaries of how they pay (eg Esselink and Hernández (2017), Greene and Schuh (2017)). However, such surveys are costly to run and differences in methodology complicate the comparison of data across countries. In addition, people keeping diaries often underreport smaller-value (mainly cash) transactions (Ilyés and Varga (2017)). For these reasons, a common way to try and disentangle the two types of cash demand is to assume that larger-denomination notes are mostly held as a store of value and smaller ones for payments (Amromin and Chakravorti (2007)).

Of course, what constitutes a “large” note is in the eye of the holder. The most valuable notes currently issued by CPMI members are Switzerland’s CHF 1,000 (~\$1,060)¹⁴ and Singapore’s SGD 1,000 (~\$760) notes.¹⁵ In contrast, countries whose largest-denomination notes have the smallest value are China (CNY 100, ~\$16) and South Africa (ZAR 200, ~\$17) (Graph 6, left-hand panel).

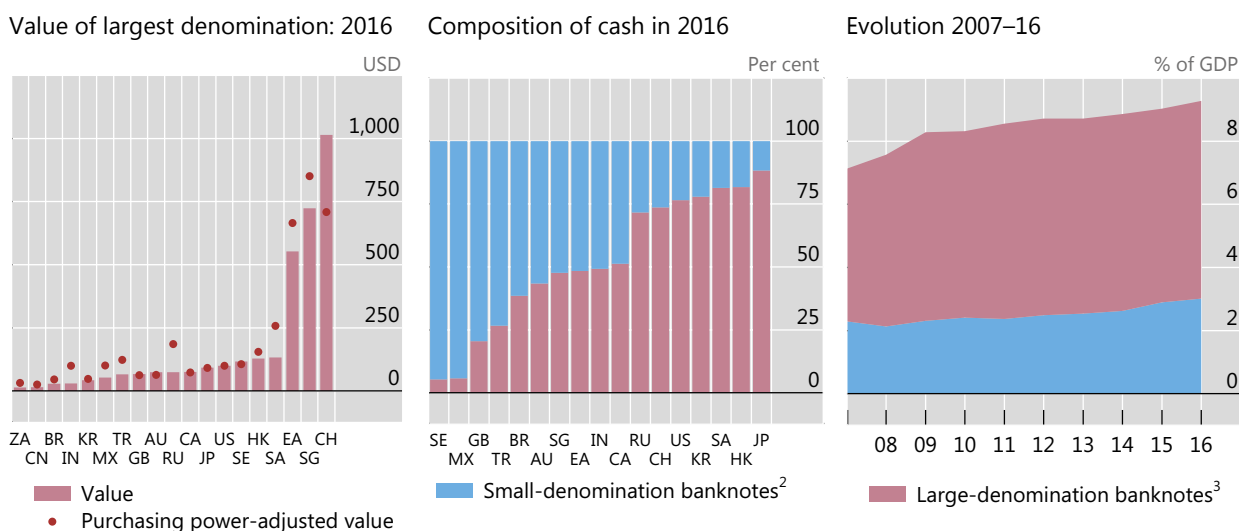
Here we use a uniform threshold across countries of \$75 (purchasing power-adjusted) to distinguish the two components of cash demand.¹⁶ We find that the relative share of total cash in circulation accounted for by large notes varies greatly across the CPMI countries. For Mexico and Sweden, the large-denomination notes comprise less than 10% of the outstanding stock of cash in circulation while in Hong Kong SAR, Japan and Saudi Arabia, these notes constitute more than 75% of the total (centre panel).¹⁷

¹⁴ Based on the end-February 2018 exchange rate.

¹⁵ The most valuable note still in circulation (but no longer issued) is the SGD 10,000, which at end-February 2018 was worth a cool \$7,600. The issuance of the CAD 1,000 bill was stopped in 2000 and the ECB plans to stop the issuance of the EUR 500 banknote at the end of 2018.

¹⁶ The purchasing power parity adjustment is based on World Bank estimates. While the choice of the value of the threshold is somewhat arbitrary, varying the value does not materially change the analysis.

¹⁷ For countries where all notes are below the \$75 threshold, the highest-denomination notes are treated as the “large” notes.



¹ Banknotes no longer being issued are not included in the calculations. Data for China and South Africa are not included because a breakdown of cash denominations is not available. Data for Russia include banknotes and coins in the vaults of the Central Bank of the Russian Federation. ² Less than \$75. ³ Greater than or equal to \$75.

Sources: World Bank; CPI (2017b); authors' calculations.

The evolution of large- and small-denomination notes suggests that cash is being increasingly used as a store of value rather than for payments. Over the last decade, the demand for large-denomination notes has outpaced that for smaller denominations (Graph 6, right-hand panel). In fact, a handful of countries (eg Korea and Russia) saw the demand for smaller-denomination notes decline and that for larger-denomination ones increase. Sweden is again an outlier: demand for all notes has decreased since 2007.¹⁸

Regression analysis

Panel data analysis can help shed further light on factors driving cash demand. Following Keynes (1936), we focus on three motives for holding cash: transactionary, precautionary and speculative (or portfolio). However, the small size of our data set (fewer than 20 countries, and annual data for 16 years) requires a parsimonious approach.

The econometric model is as follows:

$$Y_{i,t} = \beta \text{OpportunityCost}_{i,t} + \pi \text{Uncertainty}_{i,t} + \gamma \text{Age}_{i,t} + \delta \text{GDPPerCapita}_{i,t} + \theta_i + \varepsilon_{i,t} \quad (1)$$

where three different measures of the dependent variable are used: total cash demand, demand for small notes (transactionary), and demand for large notes (store-of-value or speculative).

¹⁸ Cash demand is expected to continue declining in Sweden, in part, as it is not compulsory for businesses and retailers in Sweden to accept cash as payment (Sveriges Riksbank (2017a)). Handelsrådet (2018) estimates that 25% of Swedish merchants will cease to accept cash by 2020 and the figure is expected to rise to 50% by 2025.

$OpportunityCost_{i,t}$ is proxied by the central bank policy rate.¹⁹ Other things equal, we expect store-of-value demand to fall when the forgone interest of holding cash increases. In contrast, transactionary demand is expected to be less sensitive to movements in the policy rate. $Uncertainty_{i,t}$ represents country-specific financial and economic uncertainty.²⁰ Higher levels of uncertainty may increase the demand for cash due to a number of precautionary motives, including diminished trust in financial intermediaries and less clarity about future payment needs. If so, $Uncertainty_{i,t}$ would be positively related to cash demand, especially for the smaller banknotes. In addition to country fixed effects, we control for $Age_{i,t}$ (average age of the population) and $GDPPerCapita_{i,t}$.²¹ Everything else equal, cash demand is expected to be higher when the average age of the population increases (affinity for cash among older people) and to be lower as GDP per capita increases (lower cash use as countries become richer over time).

The regression results generally confirm our priors for the explanatory variables (Table 1).²² Conditional on unobserved country characteristics, the average age of the population is positively related to the total and transactionary demand for cash (columns I and II). This is consistent with survey evidence which shows that younger people are more likely to use electronic means of payments, whereas older generations tend to be more attached to cash for payments (eg Stavins (2001), Esselink and Hernández (2017)). Both the total and transactionary demand for cash (columns I and II) is also inversely related to $GDPPerCapita_{i,t}$.

Interestingly, we do not find a statistically significant effect of uncertainty in our regressions.²³ There could be a number of reasons for this. For example, our coefficient estimates reflect an unweighted average across countries. This implies that, even if uncertainty is positively related to cash demand in some large countries, it may not be captured in the average estimate across countries. In addition, some of the currencies in the sample have a non-trivial component related to global demand for cash, which could be affected more by foreign rather than by domestic uncertainty.²⁴ Finally, our uncertainty measure may not fully capture uncertainty related to payment needs.

¹⁹ Other options for the opportunity cost of cash (eg overnight deposit and three-month interbank rates) were also considered. The regression results are generally robust to these alternative variables, but overall perform somewhat better with the policy rate.

²⁰ The measure is based on Öztürk and Sheng (2017) and is expressed as an index bound by 0 to 2. It is based on subjective forecasts of market participants and reflects their perceived financial and economic uncertainty. Higher values of the measure correspond to higher uncertainty.

²¹ The country-level fixed effects account for about 40% of the variability in cash demand; this is not shown in the adjusted R^2 in Table 1. The country effects likely reflect cultural factors, the black economy, tax evasion characteristics etc that the explanatory variables cannot capture.

²² The panel regression is not weighted, so the coefficient estimates reflect an average impact across countries.

²³ The results are similar when using other measures of economic or financial uncertainty such as the implied volatility in stock options.

²⁴ For example, Banegas et al (2015) show that US cash shipments were correlated with domestic uncertainty before the GFC but with global uncertainty afterwards.

Regression results¹

Table 1

Explanatory variables	Dependent variable		
	Total cash to GDP	Small-denomination banknotes to GDP ²	Large-denomination banknotes to GDP ³
	(I)	(II)	(III)
Monetary policy rate	-0.113** (0.043)	0.013 (0.024)	-0.125** (0.053)
Macroeconomic uncertainty	0.152 (0.395)	0.597 (0.341)	-0.448 (0.463)
Average age of population	0.599*** (0.196)	0.192* (0.104)	0.406 (0.272)
GDP per capita (log)	-1.652*** (0.512)	-0.8462* (0.439)	-0.796 (0.878)
Country fixed effects	Yes	Yes	Yes
Number of observations	199	199	199
Number of countries	16	16	16
R ²	0.401	0.140	0.302

¹ Panel regression with country fixed effects. Robust standard errors in parentheses; ***/** denotes statistical significance at the 10/5/1% level. The R² reflects the variance explained by the regressors but not the variance explained by the fixed effects. ² Value less than \$75. ³ Value greater than or equal to \$75.

Source: Authors' calculations.

Importantly, the regression analysis suggests that cash demand increases as the opportunity cost decreases.²⁵ The impact of $OpportunityCost_{i,t}$ is statistically significant for total demand and for large notes (columns I and III), but not for small ones (column II). This is in line with our expectations.

An important caveat is that the strength of our findings is limited by the small sample size.²⁶ For example, in order to keep the model parsimonious, other variables such as the density of ATMs, measures of corruption and tax evasion (eg Drehmann et al (2002)), and unobserved time effects were not incorporated.

Conclusions

Not only are payments arguably the origin of central banking (eg Quinn and Roberds (2007), Schnabel and Shin (2018)), but they have historically been the channel through which technological innovations first affected the financial system. They might even be the area where innovation brings the most benefits: Paul Volcker once quipped that the ATM was the only financial innovation that had improved society (Volcker (2010)).

²⁵ Our results suggest that the policy rate can account for one third of the variability in total cash demand over time (average across all countries), and 12% of the variability across countries (average over time).

²⁶ Also, a full range of robustness checks was infeasible given the limited degrees of freedom. For example, estimating the equations country by country could have helped to identify misspecification.

Payments are currently seeing another period of rapid innovation and transformation. The use of e-payments is booming and technology companies as well as financial institutions are investing heavily to be the payment providers of tomorrow. Yet, despite continuing digitalisation, “reports of the death of cash are greatly exaggerated” (Williams and Wang (2017)). Cash in circulation is, in fact, not dropping for most countries. The continuing demand for cash has been especially noticeable in advanced economies since the start of the GFC, and is likely driven by store-of-value motives rather than payment needs.

Cash is an evergreen topic for central bankers. In the light of the current debate around digital currencies (Carstens (2018)), including those potentially issued by a central bank (eg Skingsley (2016), Bech and Garratt (2017), Mersch (2017), CPMI-Markets Committee (2018)), understanding the costs and drivers of demand is more important than ever.²⁷ For such analysis, more timely, comprehensive and comparable data on the use of cash and e-payments are needed. The upcoming improvements in the Red Book are a step in this direction. However, further efforts are needed to collect more detailed data at the jurisdictional level and to ensure that these data are comparable across countries. With better data, we might be able to finally answer the question of whether notes and coins will continue to stay with us and, if so, for how long.

²⁷ As the total cost of using cash is difficult to estimate, cross-country data are relatively sparse and often not directly comparable. Krüger and Seitz (2014) provide an overview of these issues. They note that, while estimates of the cost of cash range between 0.2 and 0.7% of GDP for selected advanced economies, these figures are not really comparable. This is due to differences in methodologies, assumptions about the value of time and the opportunity cost (interest rate), and the point in time when the estimates were calculated.

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Annex

Payments data for CPMI jurisdictions

Table A

	Card				Cash ¹			ATM		PoS terminals
	Value of payments (% of GDP)		Payments per inhabitant		Value (% of GDP)		Value of largest note in circulation ²	Number per '000 inhabitants	Withdrawals (% of GDP)	Number per '000 inhabitants
	2000	2016	2000	2016	2000	2016	2016	2016	2016	2016
Australia	13.5	32.5	64	302	4.6	4.7	64	1.4	...	39.3
Belgium	10.3	18.9	44	150	.	.	.	1.5	9.8	16.5
Brazil	5.5 ³	17.6	7 ³	62	2.7	3.7	46	0.8	20.9	24.7
Canada	19.6	32.1	105	276	3.8	4.2	74	1.9	...	38.9
China	8.6 ^{4,5}	75.7 ⁵	14 ⁵	28 ⁵	14.6	9.2 ⁶	26	0.7	34.5	17.7
Euro area	7.8	15.6	60	105	5.1 ⁷	10.7	666	0.8	9.8	22.8
France	10.6	22.1	54	165	.	.	.	0.9	6.3	22.3
Germany	5.3	8.3	18	49	.	.	.	1.0	12.1	12.2
Hong Kong SAR	...	...	...	...	8.0	16.9	155	...	...	...
India	8.3 ⁴	20.1	1 ⁸	9	12.0 ⁸	8.8	100	0.2	15.5	1.9
Italy	4.2	10.6	10	43	.	.	.	0.8	11.5	36.9
Japan	4.4 ⁹	10.1	16 ⁹	...	13.5	20.0	92	1.1	...	...
Korea	29.9 ⁹	47.0	40 ⁹	334	3.4	5.9	48 ¹⁰	2.4	...	...
Mexico	3.3 ⁸	8.9	4 ⁸	21	4.0 ⁸	7.3	100	0.4	16.2	7.4
Netherlands	10.5	18.1	53	229	.	.	.	0.4	6.4	30.6
Russia	1.5 ⁸	27.7	1 ⁸	98	11.4 ⁴	10.2	186	1.4	29.2	12.1
Saudi Arabia	17.8	40.9	9	77	8.0	8.2	258	0.6	30.7	8.7
Singapore	10.9	20.8	21	125	8.0	10.4	852	0.5	15.8	33.2
South Africa	14.7 ¹¹	22.4	17 ¹¹	50	3.6	3.4	32	0.5	22.1	7.3
Sweden	9.6	22.8	36	317	4.4	1.4	106	0.3	2.5	25.8
Switzerland	10.6	12.6	36	129	9.1	12.3	709	0.8	4.4	32.5
Turkey	11.6 ⁸	22.5	19 ⁸	52	3.0 ⁸	4.8	124	0.6	22.8	29.4
United Kingdom	16.9	45.5	65	249	3.2	3.9	63	1.1	9.7	32.9
United States	15.8	31.7	86	326	6.0	8.1	100	...	...	...
<i>Memo:</i>										
<i>CPMI jurisdictions</i> ¹²	12.8 ¹³	25.3 ¹³	61 ¹³	83 ¹³	6.8	9.4	.	0.6	20.1	13.1
<i>Advanced economies</i> ^{12, 14}	12.8	25.4	63	200	6.7	9.7	.	1.1	9.2	27.4
<i>EMEs</i> ^{12, 15}	15.4 ¹³	25.0 ¹³	11 ¹³	34 ¹³	7.2	8.0	.	0.5	28.7	11.4

¹ For BE, FR, DE, IT and NL, see figures for the EA. ² Banknotes that are no longer being issued are not included. Purchasing power-adjusted. ³ 2001 figures. ⁴ 2006 figures. ⁵ Data also include online payments. ⁶ 2015 figures. ⁷ 2002 figures. ⁸ 2005 figures. ⁹ 2003 figures. ¹⁰ Until 2009, Korea was the jurisdiction with the lowest-value large-denomination note (KRW 10,000 corresponding to USD 9). The Bank of Korea introduced the KRW 50,000 note in 2009. ¹¹ 2009 figures. ¹² Averages are based on country data available for the year. ¹³ China is not included in the calculations. ¹⁴ AU, BE, CA, DE, EA, FR, IT, JP, NL, SE, CH, GB and US. ¹⁵ BR, CN, HK, IN, KR, MX, RU, SA, SG, ZA and TR.

Sources: World Bank; CPMI (2017b); authors' calculations.

The ABCs of bank PBRs¹

Price-to-book ratios have been unusually low for many banks since the Great Financial Crisis. Ratios below one, in particular, have been seen as reflecting market concerns about banks' health and profitability as well as the need for shifts in business models. But what drives these valuations globally? What explains consistently low levels for some banks and jurisdictions? This special feature proposes an empirical valuation methodology based on the intangible value attached to bank assets and liabilities. Our model fits the data well across time and banks, suggesting that measures targeting traditional drivers of profitability, such as the proactive management of non-performing loans, remain essential in enhancing bank valuations.

JEL classification: G21, G28, G3.

Banks have gone through difficult times. Following the Great Financial Crisis (GFC), profitability has been hamstrung by a protracted period of tepid economic growth, muted demand for banking services, unusually low interest rates and flat yield curves. Now that near-term economic prospects have brightened substantially, the outlook for banks' bottom line is finally improving. Client demand is rising and intermediation margins are starting to widen, supporting revenue growth. As a result, following the recent finalisation of the Basel III package of regulatory reforms (BCBS (2017a)) and given the progress that has already been made in complying with the new capital and liquidity requirements (BCBS (2017b)), a window of opportunity is opening up for banks to finalise their adjustment to the new post-crisis environment (BIS (2017)).

Despite this improved outlook, however, price-to-book ratios (PBRs) remain low for many banks, especially in Europe. The PBR is the ratio of the market value of a bank's equity to its accounting, or book, value. On this basis, PBRs are often thought of as a yardstick of franchise value – that is, investors' expectations of how much shareholder value the company's management will be able to create from a given stock of assets and liabilities. As such, PBRs are also an indicator of banks' health and their ability to support economic activity. What explains these stubbornly low valuations, and what – if anything – can be done about them? Are the sources of post-crisis bank valuation much different from the pre-crisis ones? And, if so, could tighter bank regulation be responsible for the lower post-crisis valuations?

This special feature seeks to answer these questions by analysing the drivers of bank PBRs. We find that, while current bank PBRs are indeed rather low, they are not

¹ The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. We are grateful to Claudio Borio, Stijn Claessens, Benjamin Cohen, Gerald Edwards, Leonardo Gambacorta and Hyun Song Shin for comments and suggestions.

generally out of line with what would be predicted from our valuation model, which is estimated on a sample based on both pre-and post-GFC data. With some of the key drivers under direct management control, this suggests that banks are well placed to improve their valuations through time-tested measures, such as the proactive management of non-performing loans (NPLs) and tight control of non-interest expenses. As such, with key drivers that are unrelated to regulatory reform explaining much of the observed change in PBRs, our findings cast some doubt on explanations that assign a large role to regulation as a source of low current bank PBRs (eg Chousakos and Gorton (2017)).

In terms of methodology, we apply a bank valuation model based on earnings and intangibles, as described in Calomiris and Nissim (2014), to an international sample of banks. On the one hand, our valuation equation (VE) proxies expected cash flow via banks' return-on-equity (ROE) and other bank income measures. On the other hand, our VE assumes that bank value derives in part from the intangible value created by banks' core loan and deposit relationships. We capture this through various accounting metrics derived from bank balance sheets and income statements.

The remainder of the paper is organised as follows. The second section introduces the PBR concept and reviews recent trends in bank valuations. The third section undertakes the econometric analysis and estimates the valuation equation. The fourth discusses the implications of the results, followed by various robustness checks. The final section concludes, with policy-relevant implications.

Recent trends

Our variable of interest is bank value, as measured by PBRs. A bank's PBR is defined as the ratio of the market value of equity to its book value.² Use of PBRs in the assessment of bank valuations emphasises the intangible value created by banks' core loan and deposit relationships as a driver of investor behaviour – enabling banks to earn profits above and beyond what would have been possible strictly based on banks' book value alone (see box). This suggests that, in order to understand the drivers of PBRs, one should start from observed book values and then examine the degree to which various measures of bank activity contribute to a market premium above (or discount from) these book values. In PBR terms, values above one would suggest positive market premia from intangibles (eg from the funding advantage afforded by stable and relatively cheap deposit funding and related cross-selling of services), while values below one would suggest discounts (eg due to delayed loss recognition in the recorded book value of bank assets).

As measured by PBRs, bank values have been subject to a number of broad global trends that a satisfactory bank valuation approach would have to capture. First, there was a widespread decline in bank valuations during the GFC (Graph 1, left-hand panel). Average bank PBRs hovered around a level of two times book value right before the GFC, indicating large valuation premia. They then plummeted to values below one in 2008–09, and recovered only recently – while remaining below their pre-

² This is similar in spirit to Tobin's q , which is defined as market value over replacement cost (Tobin and Brainard (1976), Chung and Pruitt (1994)). For stable prices, both measures are essentially identical. Values above one thus incentivise firms to raise more capital in order to invest the proceeds.

Bank valuation and price-to-book ratios (PBRs)

What's special about valuing banks? One key factor is regulation, which is much more stringent for banks than for corporates. Specifically, banks are typically required to maintain predefined regulatory capital adequacy ratios based on their book value of equity. More importantly, however, the accounting treatment of banks and their activities can differ substantially from that of non-financial corporates. As a result, book values are often more meaningful measures of value for financial firms than for non-financial ones.^①

Accounting for bank assets. Accounting practices are important for bank valuations for two reasons. First, the assets held by banks are typically in the form of financial instruments (loans, bonds and other securities as well as derivatives) that have well defined cash flows. The majority of bank assets (loans, investments and other assets) are reported at amortised cost. However, for larger banks many financial instruments are traded in relatively liquid markets, at least under normal conditions, or are substantially similar to traded assets. This is why marking traded and, in some cases, non-traded assets to market has long been established practice among banks. With a significant portion of assets on banks' balance sheets treated in this way, book values are much closer to market values than is the case for non-financial corporates, where most of the assets are carried at amortised cost. Similarly, depreciation, which can be a key driver of book values for corporates, tends to be much less important for banks, which hold relatively few real assets.

Second, it is natural for bank assets to be subject to credit and other risks that can imply the potential for large, possibly abrupt losses, with loss provisions being made to report estimated credit losses as an allowance reducing the value of the loan portfolio and reported earnings. In practice, banks have discretion in setting their provisioning policies. For a given loan portfolio, conservative banks will set aside more for loan losses, implying lower profits during good times than those generated by their more aggressive peers. Indeed, the literature suggests that delayed loss recognition (or "purposeful understatement of losses"; Huizinga and Laeven (2012)) has been a significant factor for US banks during the recent financial crisis, especially in the context of their mortgage market exposures. Expected credit loss accounting, due to be implemented globally during 2018–21, is intended to improve the incorporation of forward-looking credit risks into book asset valuations and earnings.^② Against this background, depressed PBRs would tend to reflect the effect of accounting rules on recognised book values as well as attempts by bank managers to preserve their institutions' (book) capital positions.

Implications for bank valuation metrics. For banks and other financial firms, therefore, combining book- and market-based valuation metrics can provide useful information. In particular, price-to-book ratios (PBRs) above one – which have tended to prevail under normal market conditions – will tend to be driven by the market value of intangible assets and liabilities, which in turn may be affected by market developments and the competitive environment in ways that are not reflected in their book values.

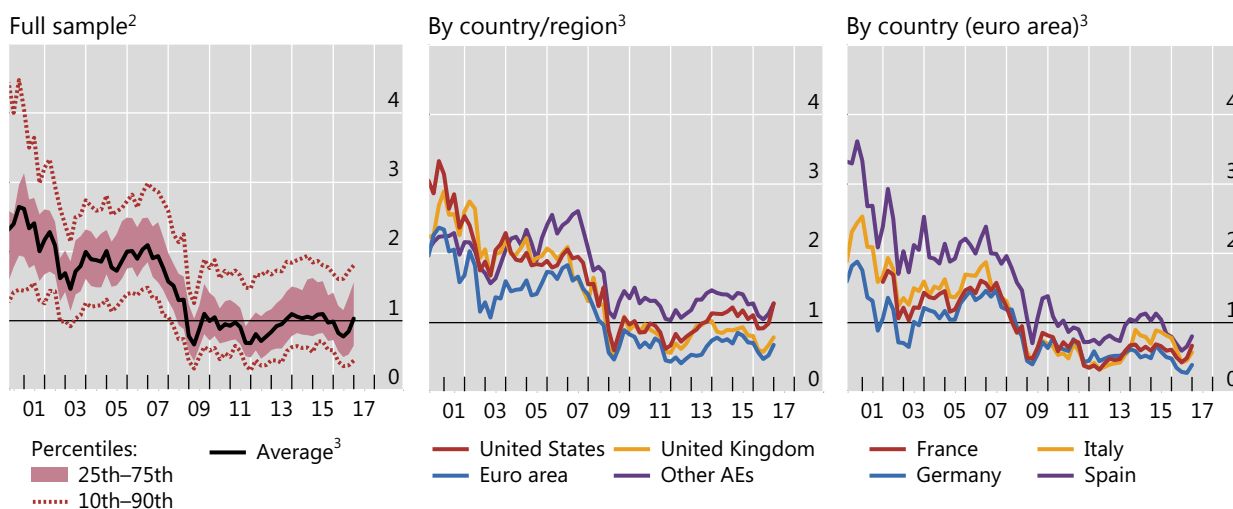
Changing economic conditions would thus be expected to affect PBRs largely via their effect on intangibles, on both the asset (eg Diamond (1984)) and liability sides (Gorton and Pennacchi (1990)) of the balance sheet. For example, if interest rates are low for an extended period, having a stable base of core deposits may be less valuable to banks, to the extent that they are unable to reprice deposit rates in line with rates earned on the asset side of their balance sheets (BIS (2016)). Similarly, loan relationships may lose value if the economic environment implies a lower ability for banks to benefit from the cross-selling of services.

^① For a more detailed discussion, see Damodaran (2009) and Calomiris and Nissim (2014). ^② See Cohen and Edwards (2017).

crisis levels.³ Importantly, valuations in the higher and lower percentiles exhibit very similar trends, highlighting that average PBR performance has not been skewed by outliers.

Second, while advanced economy banks shared the crisis-induced decline and subsequent partial recovery, cross-country differences have been substantial. Euro area banks, in particular, stand out, with valuations underperforming those of many

³ This adds to a longer-term downward trend in bank PBRs that is well documented in the literature. See, for example, Keeley (1990) and Demsetz et al (1996), who highlight deregulation and competition as key drivers of bank franchise values.



¹ End of quarter. ² The sample covers 72 banks in advanced economies (AT, AU, BE, CA, CH, DE, ES, FR, GB, IT, JP, NL, SE and US). ³ Asset-weighted averages across countries/regions/full sample).

Sources: Datastream; authors' calculations.

of their international peers (Graph 1, centre panel). A closer look at the euro area data, in turn, suggests that the evolution of bank valuations there reflected more than just the effects of the 2010–12 euro area sovereign debt crisis (Graph 1, right-hand panel). Most euro area banks' valuations have yet to recover from their collapse during the GFC, but cross-country differences remain, for instance between German and Spanish banks. This suggests that important banking system-level drivers, including – but not limited to – home market macroeconomic performance, have been at play.

Modelling bank valuations

Analytical setup

We investigate observed bank PBRs by way of a panel regression framework. Our approach is based on a bank valuation model emphasising the value created by banks' core loan and deposit relationships (Calomiris and Nissim (2014)); in addition to investors' earnings expectations, as proxied by the return-on-equity (ROE). In this setting, PBRs would be driven by the market value of intangibles and other drivers of future earnings (Gordon (1962), Damodaran (2009)), to the extent that these are not already reflected in observed book values (see box). Our approach thus investigates the cross-sectional and time series relationship between bank PBRs and a variety of indicators measuring the intensity of different banking activities, based on accounting metrics derived from bank balance sheet and income statement information.

This approach yields our baseline regression, which is estimated for a sample of 72 banks from 14 jurisdictions using annual data over the 2000–16 period (the stock exchange-listed banks from the Brei and Gambacorta (2014) database). Formally, it is set up as follows:

$$\begin{aligned}
PBR_{ict} = & \alpha + \sum_c \beta_c NPL_{ict} + \gamma_1 LOANS_{ict} + \gamma_2 PLL_{ict} + \gamma_3 COREDEPO_{ict} \\
& + \gamma_4 NONINTDEPO_{ict} + \gamma_5 NONINTEXPENSE_{ict} + \gamma_6 RNONINTINC_{ict} \\
& + \gamma_7 TNONINTINC_{ict} + \gamma_8 ROE_{ict} + \gamma_9 TEQT_{ict} + \gamma_{10} ASSETS_{ict} \\
& + \gamma_{11} DIVIDEND_{ict} + \gamma_{12} INTGAP_{ict}
\end{aligned}$$

There are four sets of explanatory variables, which can affect PBRs through both economic and signalling effects:⁴ (i) loans (LOANS) and related indicators of asset quality, such as non-performing loans (denoted NPL) and provisions (PLL); (ii) core (COREDEPO) and non-interest-bearing deposits (NONINTDEPO); (iii) profit-and-loss variables, namely non-interest expenses (NONINTEXP), recurring non-interest income (RNONINTINC), transitory non-interest rate income (TNONINTINC) and return-on-equity (ROE); (iv) other metrics capturing bank characteristics, such as balance sheet leverage (tangible book equity over tangible total assets; TEQT), asset size (ASSETS), dividends paid (DIVIDEND) and the difference between interest-earning assets and interest-bearing liabilities (INTGAP; a measure of interest rate risk). All variables are expressed as ratios to book equity, except for ASSETS (which are in logarithms of US dollar amounts) and leverage (as defined above). We cluster the standard errors across both banks and time. (See the discussion below for more detail on the various variables.) When extending the analysis, we add macroeconomic and macro-financial data to capture drivers such as the business cycle (via the output gap) and the financial cycle (via the credit-to-GDP gap).

A key extension of our approach relative to earlier work, such as Calomiris and Nissim (2014), is the multi-country setup; most previous research has focused on US banks. This requires that we restrict ourselves to explanatory variables that are consistently available for a broad international sample of banks. In addition, given our focus on the time series variation in bank valuations, we deviate from Calomiris and Nissim (2014) by not including time fixed effects in our baseline specification, and by adding (current) ROE as a proxy for investors' return expectations.

Given our multi-country approach, legal and accounting differences can affect some of the standard accounting metrics used in our empirical approach. The definition of NPLs, in particular, is known to differ substantially across jurisdictions, including among euro area economies (where more standardised definitions were phased in only during the later stages of our sample period; see EBA (2016)). In addition, differences in workout procedures imply that even identically defined NPLs can have a different meaning economically (eg Fitch Ratings (2016)). We account for these effects by allowing for country-level variation in NPL coefficients.

Main results

The estimated coefficients from our baseline VE are mostly statistically significant and have the economically expected sign (Table 1, Model 1). Specifically, NPLs generally depress bank PBRs, indicating that investors penalise banks for asset quality problems, more than the book value of NPLs – which is covered also by our LOANS metric – would suggest. Provisioning levels (relative to book equity) show up positively once NPLs are controlled for, highlighting that investors seem to value attempts by banks to address asset quality issues in a proactive fashion. While income

⁴ Our main analysis relies on annual financial data (eg bank equity prices) and corresponding bank balance sheet and income statement items. Details can be found in Appendix Table A.

Estimating bank valuations

Dependent variable: bank price-to-book ratio

Table 1

	2000–08	2009–16	Time FE	Country FE	Time and country FE	
	(1)	(2)	(3)	(4)	(5)	(6)
Loans ¹	-0.01	-0.04**	0.02	0.00	-0.01	-0.01
Average NPL ^{1, 2}	-0.59***	-0.63***	0.05***	-0.24***	-0.76***	-0.40***
Provisions for loan losses ¹	1.06***	0.90**	0.05	0.08	1.14***	0.13
Core deposits ¹	0.00	0.02	0.01	0.03**	0.00	0.03**
Non-interest deposits ¹	0.00	0.01	-0.01	-0.01	0.01	-0.01
Recurrent non-interest income ¹	0.76*	0.06	0.99*	0.55	0.41	0.26
Transitory non-interest income ¹	0.54***	-0.01	0.91***	0.28**	0.31	0.07
Non-interest expense ¹	-0.30	-0.04	-0.77*	-0.63***	-0.02	-0.43**
Dividends ¹	2.83***	3.06***	3.40**	2.79***	2.34***	2.28***
Interest rate gap ¹	-0.01	-0.03	0.01	-0.02	-0.01	-0.02
Return on equity	3.62***	4.59***	1.11***	2.02***	3.55***	1.89***
Tangible common equity ³	-0.28	0.08	6.79***	2.20	-1.25	2.88
Total assets (log)	-0.11***	-0.12**	0.03	-0.02	-0.13***	-0.02
<i>Number of observations</i>	1,047	499	548	1,047	1,047	1,047
<i>R</i> ²	0.52	0.43	0.59	0.68	0.56	0.72

The t-statistics are calculated using two-way (bank and time) clustered standard errors (Cameron et al (2011)). */**/** indicates statistical significance at the 10/5/1% levels, respectively.

¹ Share of tangible common equity. ² Average of country-specific coefficients on NPL; test for joint significance of the country-specific NPL coefficients is based on χ^2 test. ³ Share of total assets.

Source: Authors' calculations.

measures generally enhance value, higher non-interest rate expenses depress it, underlining the value of cost reductions, or their signals, for market valuations. In line with basic discounted cash flow logic, ROE and dividend ratios both increase PBRs, even after controlling for net non-interest income. Lower leverage (ie higher tangible common equity) and larger balance sheets, in turn, appear to reduce valuations, though the leverage effect is not statistically significant. The effects of size and leverage are discussed in more detail in the robustness section below.

Overall, fitted values for bank PBRs from our baseline specification appear to match the actual values reasonably well across the entire sample. The R^2 is 0.52, a rather high value for an international panel setting. Both the crisis decline and muted post-crisis recovery in PBRs are present in the fitted estimates (Graph 2, left-hand and centre panels). This is true not only for the whole sample or the relatively large US subsample (red and blues lines, respectively, in left-hand panel), but also – though to a smaller extent – for headquarter jurisdictions hit by the euro area sovereign debt crisis, such as Italy or Spain (centre panel, yellow and green lines).

Despite the relatively large number of explanatory variables in our baseline specification, around three quarters of the VE-implied change in bank PBRs between 2007 and 2015 is explained by only four drivers. NPLs and ROE are the most important ones, while dividends and non-interest expenses also play a role (Graph 2, right-hand panel). This comes on top of the ROE effect, likely reflecting the signalling value of

dividend payments and cost reductions for bank investors. VE-implied valuations (blue dots), in turn, align reasonably well with the observed change in PBRs across the various subsamples over the observation period (red dots).

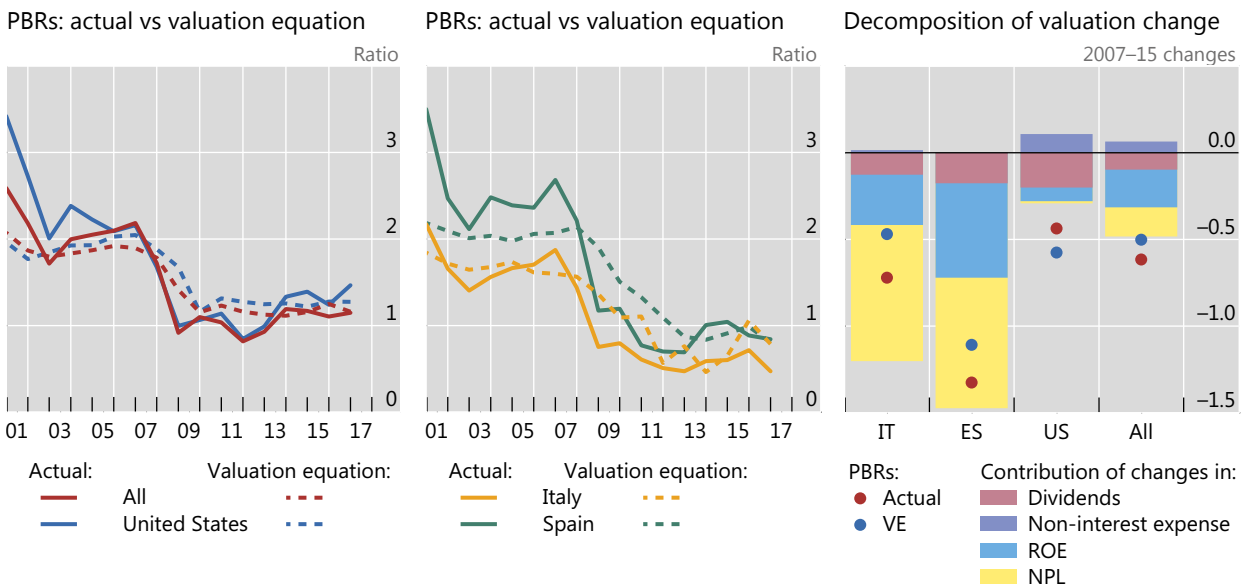
Extensions and robustness across time

One key question is the stability of our results across time, particularly around the GFC: did the GFC change how the market values banks? To answer this question and assess the robustness of our findings, we proceed in three steps.⁵

First, we run our VE on pre- and post-crisis subsamples to test for meaningful changes in the effect of the various explanatory variables (Table 1, Models 2 and 3). While most coefficient estimates remain broadly unchanged in terms of significance and directionality, there are two important exceptions.⁶ One concerns the effect of tangible common equity, ie balance sheet leverage, which shifts from insignificant in the pre-crisis period to significantly positive afterwards. That is, post-GFC, higher capitalisation levels relative to total assets (lower leverage) are associated with higher PBR values, with ROE-related leverage effects already controlled for. This suggests changing investor attitudes about leverage-implied risks. Investors appear to have

Price-to-book ratio (PBR) values are closely approximated by the valuation equation¹

Graph 2

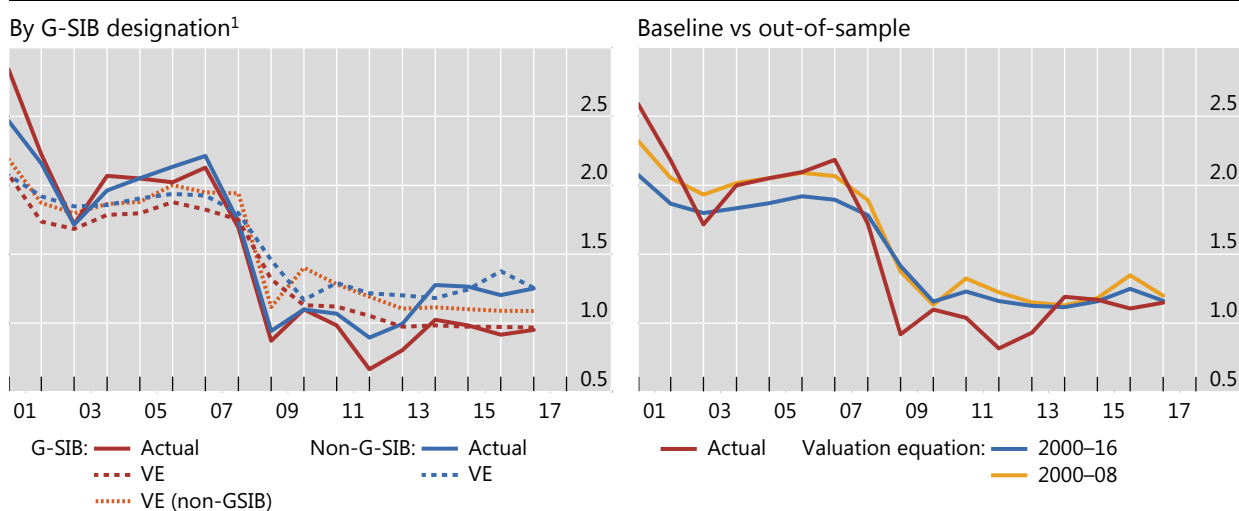


¹ Fitted values use coefficients estimated in the baseline VE specification (see Table 1, column 1).

Sources: Datastream; Fitch Solutions; authors' calculations.

⁵ In addition, by adding a number of additional control variables, we examine the extent to which our results may be affected by omitted variable bias. See the Appendix for the results.

⁶ A third exception concerns the estimate of the average NPL coefficient, which switches to a positive sign in the post-crisis subsample. We find, however, that the average is driven by a single country-level outlier and that it turns negative once country fixed effects are added. In addition, most countries have negative NPL coefficients and all significant individual coefficients are negative.



¹ Based on the baseline specification estimated over the full sample 2000–16. VE refers to the predicted PBRs of G-SIBs based on estimations of the baseline equation over a subsample of non-GSIBs; G-SIB designation is based on FSB (2017).

Sources: Datastream; Fitch Solutions; authors' calculations.

shifted from viewing leverage as a mechanism primarily for increasing ROE, thereby boosting valuations, to a greater focus on ways in which excessive leverage can threaten solvency and thereby longer-term profitability. This conforms to other research findings that point to changes in investor attitudes towards leverage in the aftermath of the crisis (eg Aiyar et al (2014), Calomiris and Nissim (2014)).

The other major change across the two subsamples concerns the impact of bank size, ie the sign of the coefficient on total assets. While larger banks were generally valued less, on average, than smaller banks before the crisis, this size effect became statistically insignificant afterwards. Furthermore, even the pre-crisis size estimates, while being statistically significant, suggest only limited economic significance.⁷

Importantly, the bank size results do not seem to be associated with the designation of global systemically important banks (G-SIBs). G-SIBs were valued at broadly similar levels, on average, to non-GSIBs pre-crisis; and several points lower post-crisis (Graph 3, left-hand panel, red and blue lines, respectively). Yet, both pre- and post-crisis, observed valuations (solid lines) are fairly closely matched by our full-sample VE estimates (dotted lines). In addition, the basic valuation drivers of G-SIBs and non-G-SIBs do not seem to materially differ. To see this, we approximate the valuation of G-SIBs based on the coefficients from the non-G-SIB subsample (orange dotted line): the resulting values are rather close to those based on the G-SIB sample (red dotted line) and also close to actual G-SIB PBRs (red solid line). This suggests that, in our sample of large banks,⁸ investors' approach to G-SIB valuation does not

⁷ For the pre-crisis estimate (Table 1, Model 2), the coefficient estimate of -0.12 on bank asset size implies that the valuation difference between a median-sized bank (assets of \$276 billion) and a bank in the 75th percentile (assets of \$580 billion, ie more than twice as large) is around 0.089 in PBR terms.

⁸ As almost all the banks in our sample are systemically important in their home jurisdictions, we should not interpret these results as describing effects related to systemic importance per se.

seem to systematically differ from that for other banks, even after controlling for various other bank characteristics.

Second, in order to understand the economic significance of these pre-/post-GFC changes, we use the pre-crisis coefficient estimates (Model 2) to conduct an out-of-sample estimation (Graph 3, right-hand panel). The results point to a remarkable similarity between the out-of-sample (yellow line) and full-sample (red line) valuation estimates. Both, in turn, are very close also to observed bank PBRs in most years (red line). Hence, while the difference between pre- and post-crisis coefficient estimates might be statistically significant in some instances, as highlighted above, we conclude that these differences do not materially affect the VE's overall fit.

Third, we apply time fixed effects to confirm the significance and directionality of our estimated baseline coefficients (Table 1, Model 4). We find that most coefficient estimates remain stable and that valuations are not unduly driven by the effects of outlier years, such as during the GFC. Time fixed effects should also capture any developments that would tend to affect banks similarly at the same time, such as the impact of global macro-financial conditions. Similarly, our main results also remain robust to allowing for country-specific variation in bank valuation. Specifically, they are broadly unchanged when adding country fixed effects (Model 5), even in combination with time fixed effects (Model 6).⁹

Conclusion

PBRs are well explained by traditional valuation factors, especially the return on equity, NPLs, and factors linked to the intangible components of a bank's activities. Our baseline estimates, which use these factors to estimate PBRs for 72 banks from 14 jurisdictions, capture both the crisis-induced decline and muted post-crisis recovery in PBRs as well as jurisdictional differences, such as those between US and euro area banks in the context of the sovereign debt crisis. As such, they provide a useful benchmark for bank PBRs across countries and time.

Our findings offer at least three closely related policy implications. First, there does not seem to be a major break in the factors driving bank valuations after the GFC. Indeed, even though current PBRs are compressed relative to their pre-crisis levels, they are not generally out of line with our model estimates based on the full pre- and post-crisis sample: neither for the aggregate, nor at the country level. By way of analogy: effectively, bank analysts seem to be using their pre-crisis "valuation spreadsheets" also after the GFC. Hence, one should be careful not to overemphasise the effect of the crisis and of crisis-related policies for how banks are valued in the post-crisis environment.

Second, these findings also suggest that traditional tools, such as the proactive management of NPLs and tight control of non-interest expenses, remain useful in enhancing bank valuations also in the post-crisis period. The crucial role of NPLs, in particular, underscores the value of various policy measures recently taken in Europe, where observed levels of NPLs have remained stubbornly high in some jurisdictions (EBA (2016), Carpinelli et al (2016)). This includes efforts to tighten banks' provisioning

⁹ This should capture the effect of any country-specific differences in accounting standards that might otherwise affect the valuation impact of individual balance sheet items, ie when comparing US and non-US institutions (Hoenig (2017)).

policies (such as via asset quality reviews and stress tests) as well as measures tackling legal impediments to the timely workout of NPLs, which are now being actively pursued in countries such as Italy. Our results also align with earlier evidence showing that the proactive tackling of NPLs (including via the use of public sector funds) can be an effective catalyst of banking sector recovery in post-crisis environments (Borio et al (2010)).

Third, given the presence of key valuation drivers – such as NPLs – that are unrelated to regulatory reform, our findings cast some doubt on explanations that assign a large role to regulation as a source of low current bank valuations. While there are tentative signs of changing post-crisis valuations for G-SIBs relative to their non-G-SIB peers, our baseline VE serves as a valid bank valuation benchmark during both the pre- and post-crisis periods, and for G-SIBs as well as non-G-SIBs. Out-of-sample forecasts based on pre-crisis estimates produce valuations that are very close to observed values. Thus, while regulation is among the various possible drivers of bank value, it is not needed to explain post-crisis PBRs.

These results would support the view that bank managements should take advantage of the current favourable macroeconomic environment to use the traditional tools at their disposal to complete balance sheet repair and return their institutions to sustained profitability.

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Appendix

Data sources

Our empirical analysis relies on annual financial data (bank equity prices) as well as bank balance sheet and income statement items. As part of our robustness checks, we then extend the analysis by adding macroeconomic and macro-financial data, such as measures of output and credit-to-GDP gaps (Table A).

Additional controls

To ensure that our results are not materially affected by omitted variable bias, we consider a variety of potential additional explanatory variables.

We start by extending our baseline equation with a set of macroeconomic controls. Based on our basic model setup, one would expect macroeconomic developments – both in banks' home market and internationally – to influence PBRs mainly indirectly (eg via explanatory variables such as NPLs or ROE), but not directly (ie not once these other factors are controlled for). And, indeed, neither the business cycle (Table B, Model a) nor the financial cycle (Model b) seems to directly affect bank valuations significantly.

We also estimate alternative specifications of our VE to investigate the impact of longer-term growth potential (Table B, Model c). The results suggest that banks headquartered in countries with the strongest economic growth prospects, as measured by longer-term consensus growth forecasts, are valued somewhat more highly, to a statistically significant degree, than banks from home jurisdictions judged as slower-growing. This likely reflects the impact of higher growth potential in the home market, combined with the presence of significant home bias in banks' activities.

Conversely, we do not find any significant impact of macroeconomic policy uncertainty on bank valuations that would not already be accounted for in the baseline VE (Table B, Model d). Similarly, measures of banks' intermediation margin (as proxied by the term spread, ie the difference between long- and short-term interest rates) and of banks' competitive environment (as proxied by the concentration ratio and by the number of branches per home country population) turn out to be insignificant, both statistically and economically, as drivers of bank valuation (Table B, Models e, f and g, respectively).

Data sources			Table A
Variable name	Description	Frequency	Source
Price-to-book ratio (PBR)	Market value / Book value of equity	End of year	Thomson Reuters Worldscope
Non-performing loans (NPL)	Impaired loans & Advances to customers + Impaired loans & Advances to banks	End of financial year	Fitch Solutions
Loans (LOANS)	Residential mortgage loans + Other mortgage loans + Other consumer/retail loans + Corporate & commercial loans + Other loans	End of financial year	Fitch Solutions
Provisions for loan losses (PLL)	Reserves for non-performing loans	End of financial year	Fitch Solutions
Core deposits (COREDEPO)	Total customer deposits	End of financial year	Fitch Solutions
Non-interest deposits (NONINTDEPO)	Customer deposit accounts, which can be withdrawn on demand or at short notice	End of financial year	Fitch Solutions
Non-interest expense (NONINTEXPENSE)	Personnel expenses + Other operating expenses	End of financial year	Fitch Solutions
Recurrent non-interest income (RNONINTINC)	Net insurance income + Net fees and commissions + Other operating income	End of financial year	Fitch Solutions
Transitory non-interest income (TNONINTINC)	Net gains (losses) on trading and derivatives + Net gains (losses) on other securities + Net gains (losses) on assets at fair value through income statement	End of financial year	Fitch Solutions
Return-on-equity (ROE)	Net income / Average equity	End of financial year	Fitch Solutions
Tangible common equity (TEQT)	Total equity less Goodwill less Other intangibles less Deferred tax assets to be deducted from core capital	End of financial year	Fitch Solutions
Total assets (ASSETS)	Total assets – Banks	End of financial year	Fitch Solutions
Dividends (DIVIDEND)	Dividend provided for or paid for	End of financial year	Thomson Reuters Worldscope

Data sources (cont)				Table A
Description	Frequency	Description	Frequency	
Interest rate gap (INTGAP)	Average earning assets less Average interest-bearing liabilities	End of financial year	Fitch Solutions	
Output gap	Percentage of potential output	Annual	IMF, WEO	
Credit-to-GDP gap	Total credit-to-GDP gap	End of year	BIS	
Long-term growth forecast	Six- to 10-year-ahead forecast	Annual	Consensus Economics	
Term spread	Ten-year government bond yield less Three-month rate	End of year	Bloomberg	
Policy uncertainty index	Index based on Öztürk and Sheng (2017)	Annual	IMF	
Concentration ratio	Top five as a share of total assets	Annual	World Bank	
Branches per population	Number per 100,000	Annual	CGFS (2018)	

Adding additional controls								Table B
	Output gap	Credit-to-GDP gap	Long-term growth forecast	Policy uncertainty index ⁴	Term spread ⁴	Concentration ratio ⁴	Branches per population ⁴	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	
Loans ¹	-0.01	-0.01	-0.02	-0.01	-0.01	0.00	0.00	
Average NPL ^{1, 2}	-0.58***	-0.54***	-0.57***	-0.54***	-0.56***	-0.55***	-0.68***	
Provisions for loan losses ¹	1.06***	1.03***	0.70**	1.14***	1.04***	1.09***	1.12***	
Core deposits ¹	0.00	0.00	0.01	0.00	0.00	0.00	0.00	
Non-interest deposits ¹	0.00	0.00	0.01	0.00	0.00	0.00	0.00	
Recurrent non-interest income ¹	0.77*	0.75	0.13	0.83*	0.79*	0.58	0.73	
Transitory non-interest income ¹	0.54***	0.53***	0.30	0.61***	0.56***	0.47***	0.53***	
Non-interest expense ¹	-0.30	-0.31	-0.02	-0.34	-0.29	-0.23	-0.25	
Dividends ¹	2.82***	2.77***	2.57***	2.88***	2.66***	2.85***	2.74***	
Interest rate gap ¹	-0.01	0.00	-0.02	-0.02	-0.01	-0.01	-0.01	
Return on equity	3.58***	3.60***	3.32***	3.47***	3.47***	3.65***	3.63***	
Control variable (see head of column)	0.01	0.00	0.46***	-0.84	-0.04	0.00	0.00	
Tangible common equity ³	-0.31	-0.08	-1.01	-0.54	-0.04	-2.04	-0.58	
Total assets (log)	-0.11***	-0.11***	-0.09***	-0.12***	-0.11***	-0.11***	-0.11***	
<i>Number of observations</i>	<i>1,047</i>	<i>1,047</i>	<i>1,018</i>	<i>949</i>	<i>1,047</i>	<i>1,047</i>	<i>1,047</i>	
<i>R²</i>	<i>0.52</i>	<i>0.52</i>	<i>0.57</i>	<i>0.52</i>	<i>0.52</i>	<i>0.53</i>	<i>0.52</i>	

The t-statistics are calculated using two-way (bank and time) clustered standard errors (Cameron et al (2011)). */**/** indicates statistical significance at the 10/5/1% levels, respectively.

¹ Share of tangible common equity. ² Average country-specific coefficients on NPL; test for joint significance of the country-specific NPL coefficients is based on χ^2 test. ³ Share of total assets. ⁴ See Table A for definitions.

Source: Authors' calculations.

Mortgages, developers and property prices¹

This special feature studies the risks posed by the rapid rise in property developer debt in several Asian economies in recent years. Gradually, the firms involved are shifting away from traditional bank loans and choosing to issue debt securities, often in foreign currency. So far indebtedness has tended to be low for most firms, but weak profitability and declining interest coverage ratios give cause for concern. The firms are thus vulnerable to shocks, such as increases in interest rates, falling property prices or local currency depreciations. Even if outright defaults can be avoided, the weakening fundamentals of the sector could spill over to other parts of the economy through lower house prices.

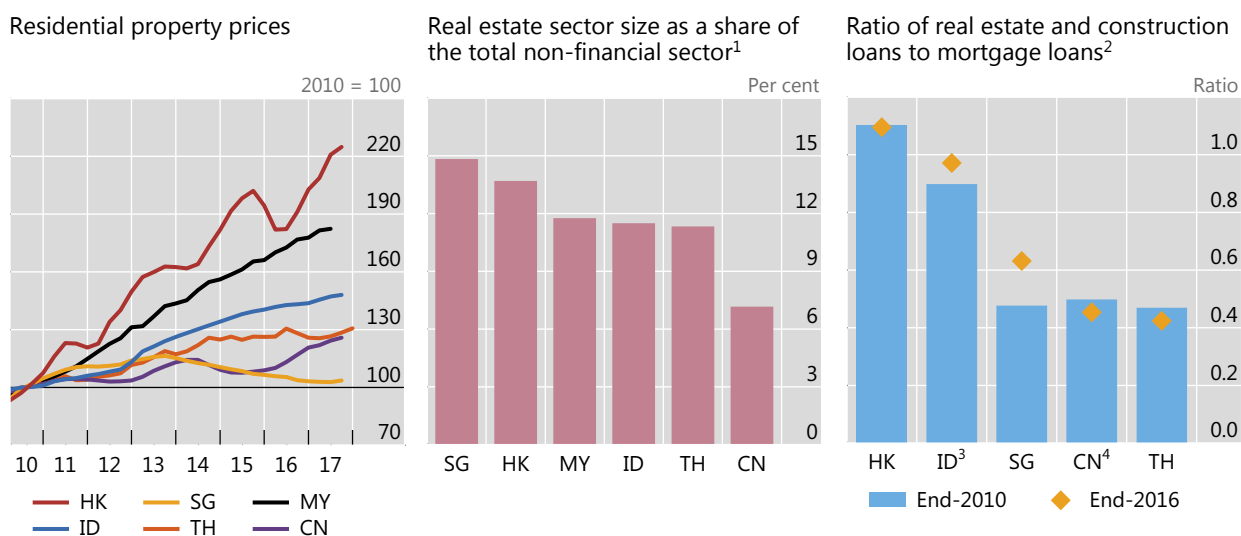
JEL classification: E40, F20, F30, F34, F41, F65, L85.

On 5 February 1997, Somprasong Land, a Thai property developer, failed to meet a scheduled interest payment. Many consider this the first event of the Asian financial crisis, which would shake one emerging economy after another over the following two years (IMF (1998)). As in many advanced and emerging market economy crises before and since, excessive leverage linked to property markets was a key source of weakness that would end up imposing significant costs on the financial system, the real economy and the population at large.

Twenty years on, much has changed in emerging Asia. Policy frameworks have been revised in light of the crisis, exchange rates are (more) flexible and foreign exchange reserves ample. Financial regulation has been strengthened. Yet in recent years, despite a tightening of macroprudential measures and a slowdown in credit growth, property prices have continued to go up in several jurisdictions (Graph 1, left-hand panel).

In some economies, rapid property price growth has coincided with a pickup in property developers' borrowing through loans and securities. As in the mid-1990s, a sizeable part of this debt is in foreign currencies. However, while most of the foreign currency debt was in the form of bank loans in the earlier episode, international bond issuance, especially by subsidiaries domiciled in a different economy from the one where the firm is headquartered, has dominated in recent years. In both episodes, a large part of the debt has been either unhedged or only partly hedged against exchange rate movements.

¹ The authors would like to thank Claudio Borio, Benjamin Cohen and Hyun Song Shin for helpful comments. The views expressed are those of the authors and do not necessarily reflect those of the BIS.



¹ Real estate sector size calculated as the sum of the 2016 market capitalisation of the individual real estate and construction firms for each country. Total non-financial sector size defined as the 2016 market capitalisation of the exchange minus the financial sector market capitalisation. ² Type of loan by industry or purpose based on national aggregated data; for China, data based on a sample of 22 banks. ³ Data from June 2016 to June 2017. ⁴ Data from end-2014 to end-2015.

Sources: Individual banks' annual reports; Thomson Reuters Eikon; World Federation of Exchanges; national data; BIS calculations.

Despite its importance during the Asian crisis, the Great Financial Crisis (GFC) of 2007–09 and the subsequent European debt crisis, developer debt is often neglected in the analysis of financial stability risks.² This limited attention is surprising, for two reasons.

First, developer debt is large. Even though real estate firms account for no more than 15% of the total market capitalisation of non-financial companies in most Asian economies (Graph 1, centre panel), their borrowing from banks is significant. For example, in Hong Kong SAR and Indonesia, loans to property developers and construction companies are as large as the aggregate mortgage debt of households (Graph 1, right-hand panel). In the past, high and rising developer debt has often signalled an unsustainable property boom and sometimes been accompanied by a bout of banking stress. For instance, in Spain developer debt rose sixfold between 2000 and the beginning of the GFC in 2007, peaking at 43% of GDP in early 2009. By contrast, mortgage lending to Spanish households rose by “only” 250% over the same period, peaking at approximately 62% of GDP (Bank of Spain (2017)). Meanwhile in Ireland, developer lending exceeded mortgages (Whelan (2014)).

Second, default rates are very sensitive to house price developments, potentially amplifying procyclicality in the financial system.³ Credit-fuelled increases in property

² Research on the Asian crisis focuses mainly on issues such as currency speculation, “overlending” and contagion (eg Corsetti et al (1999), Chang and Velasco (2000)). Quigley (2001) is a notable exception and concludes that “part of the debacle [the Asian financial crisis] can be attributed to the combination of outmoded banking practices and an immature market for real property”.

³ The Bank of Thailand (2018) warns that once many large-scale property projects are completed in four to five years' time, house prices could adjust sharply because of an oversupply of condominiums. Under such circumstances, the central bank argues, financial pressures on property developers could spread to the banking sector, as bank loans have been the main funding source of these firms.

prices drive up the value of developers' inventories and provide room for even more debt.⁴ But when property prices drop, developers have to revalue their assets. This drives up leverage, which not only limits their ability to take on new loans for new investments, but could also lead to a violation of debt covenants, allowing lenders to call the debt. Such forced deleveraging could oblige developers to sell off assets and result in a downward spiral of deleveraging and falling asset prices (Bernanke et al (1999)) – just when reduced credit quality and forced deleveraging are likely to be plaguing other parts of the system. In the case of Spain, almost 40% of all loans to the construction and real estate sectors became non-performing during the GFC, compared with approximately 6% of mortgages (IMF (2017)). At the height of the crisis, 700,000 to 1.1 million finished properties remained unsold (Maza and Peñalosa (2010)), which put significant pressure on property prices and housing-related employment.

In this special feature, we analyse the debt issued by Asian property developers in more detail. We find that large developers have increased their leverage over the past few years, with bond issuance being the main driver of rising debt. New borrowing in the form of medium- or long-term bonds should reduce rollover risk, but if a large proportion is denominated in foreign currencies, then issuers could be facing increased risk of currency mismatches, unless the proceeds are used to acquire corresponding foreign currency assets or the debts are adequately hedged financially. In addition, the profitability of developers has declined in recent years, with some firms reporting returns on assets that are either outright negative or fall short of their debt costs. Worsening credit quality may also make it harder to roll over the debt.

In the next section, we present data on the debt of property developers in six Asian economies. We then focus in on two factors that could result in both financial stability and macroeconomic risks: the borrowers' leverage and profitability, and currency mismatches.

Developer debt in Asia

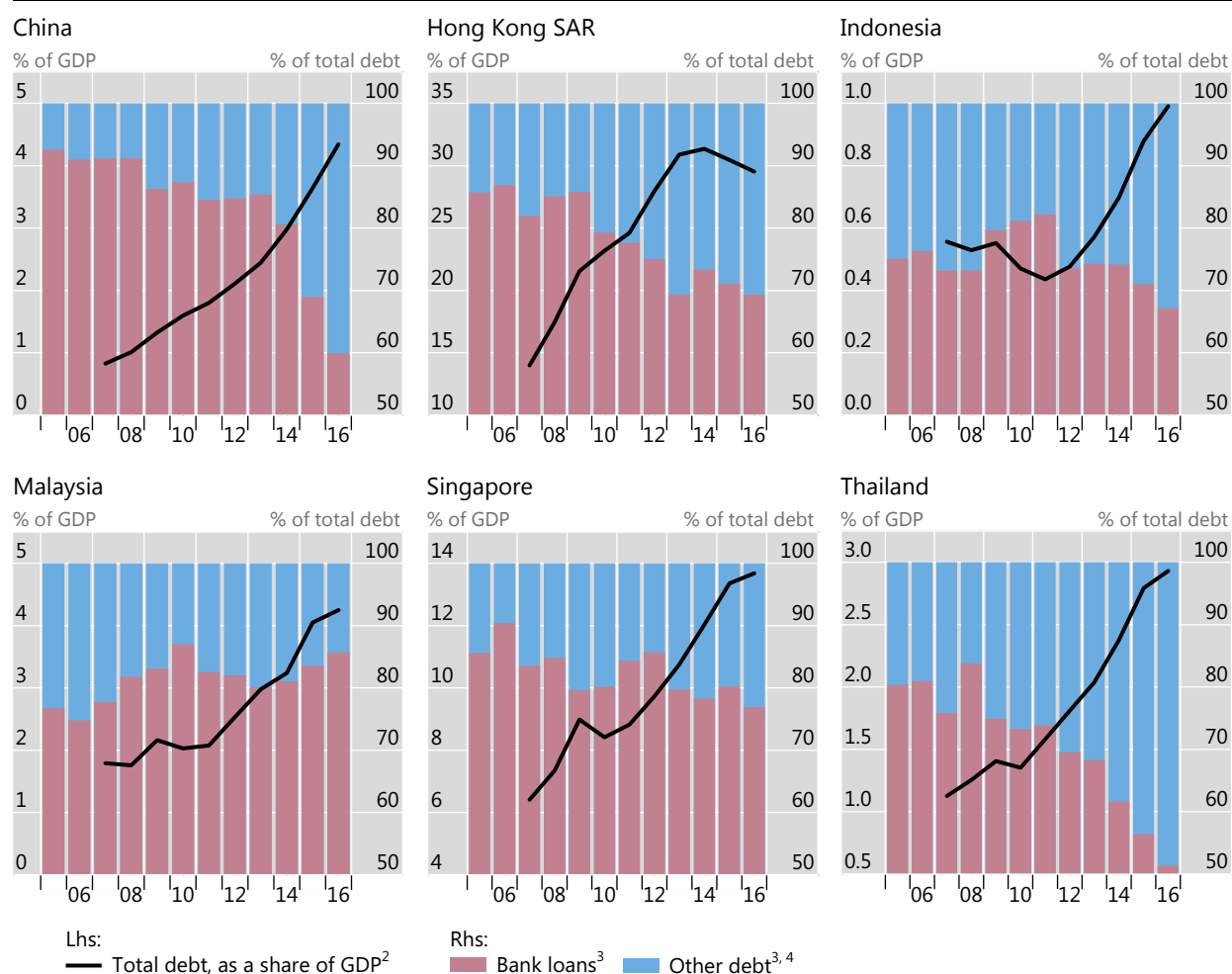
Since comprehensive data on property developer debt in Asia are not easily available, we base our analysis of developer debt on a sample constructed from firm-level information that combines information from Capital IQ and Thomson Reuters Eikon (see Appendix). We define property developers as listed firms belonging to the real estate or construction and engineering sectors. We aggregate the firm-level data to analyse the sector-wide balance sheets in China, Hong Kong, Indonesia, Malaysia, Singapore and Thailand from 2006 to 2016. We also compile detailed debt issuance data to examine the risk of currency mismatch. To focus on the ultimate country risk, regardless of where that debt is being issued, we consolidate as far as possible and classify companies by the country in which the parent is incorporated. This means, for example, that a company listed in Hong Kong but headquartered in China is counted as a Chinese company. Although our sample may not cover all developers in each economy, it includes the top players and should give a good overview of the sector.

Debt of the property developers in our sample has increased significantly since the late 2000s (Graph 2). In all six economies, developer debt has grown strongly over

⁴ When real estate is the dominant form of collateral, there is an added incentive for a company to build in an appreciating market in order to borrow funds to expand (Quigley (2001)).

Debt structure of property developers¹ shifts away from bank loans

Graph 2



¹ Defined as firms in the real estate and construction sectors. ² Total debt calculated as sum of the total debt of each firm in the sample each year; share is percentage of GDP based on the three-year rolling average of total debt. ³ Average value across all firms. ⁴ Calculated as total debt minus bank loans; excludes companies where bank loans are larger than total debt.

Sources: Capital IQ; BIS calculations.

the past decade. Only in Hong Kong, where developer debt peaked as a share of GDP in 2014, did this growth slow in the last few years.

The weight of the large developers in the economy where they are incorporated varies greatly across jurisdictions. In our data, the ratio of their debt to GDP ranges from 1% in Indonesia to around 30% in Hong Kong. But since our data set is limited, the true figure for all developers is likely to be much higher. For example, national data indicate that in Hong Kong bank lending to the developer sector reached approximately 50% of GDP at end-2016, about twice the bank debt of the firms in our sample. In Singapore, bank debt of resident property firms is 29% of GDP, compared with just under 15% in our sample; in Indonesia, 2.7% versus 1.0%; and in Thailand, 5.6% versus 3%. In Malaysia, lending to construction firms (real estate activities are bundled together with lending to households) stood at 3.8% at end-2016, about the same as our figures.

The share of debt from sources other than banks⁵ (blue bars in Graph 2), which includes bonds, increased considerably in recent years in China, Hong Kong and Thailand. In China and Hong Kong, the other debt category continued to grow rapidly well after bank lending had slowed. Both economies introduced a series of macroprudential measures to slow bank lending to real estate activities but were much less effective in curtailing bond market borrowing (HKMA (2017)).

Risks and vulnerabilities

Bond finance by property developers generates less rollover risk than bank loans because of the bonds' longer maturity. However, declining profitability (in some cases masked by rising leverage) and currency mismatches could make developers fragile. And even if the immediate financial stability risks are manageable, problems in this sector could lead to lower house prices, forcing developers to lay off staff and curtail investment. This could have a sizeable impact on economic activity. For example, investment in residential properties in the United States peaked at 6.6% of GDP in 2005, only to fall to just 2.5% in 2010.

Profitability and leverage

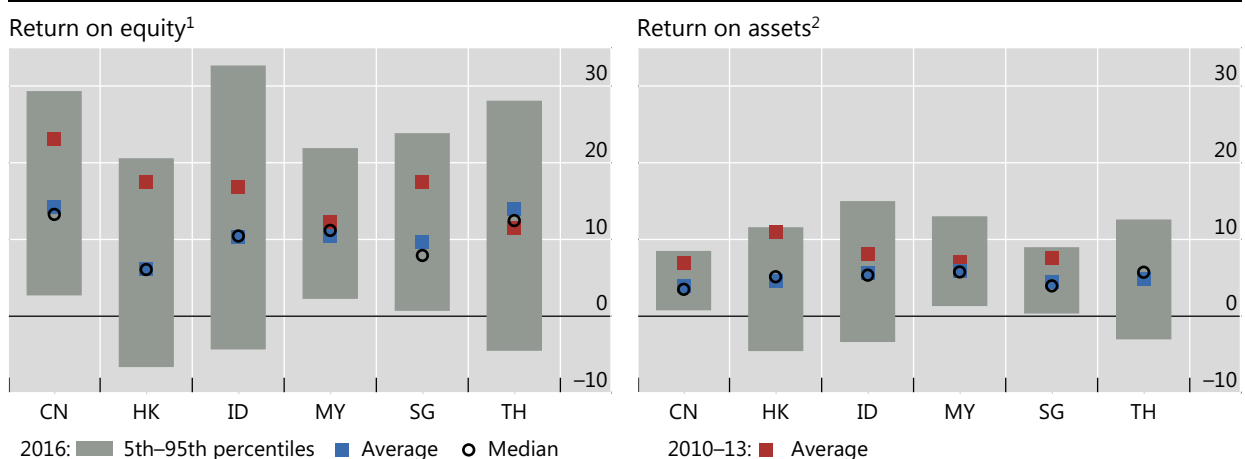
The financial health of property developers varies greatly across jurisdictions as well as across firms within a jurisdiction. That said, a few developments stand out.

First, property developers in all economies except Thailand have become less profitable in recent years. In 2016, returns on the equity of the median firm ranged from just over 6% in Hong Kong to almost 15% in China (Graph 3, left-hand panel).

Profitability of property developers declines

In per cent

Graph 3



¹ Pre-tax profit divided by average total equity. ² Pre-tax profit divided by average total assets.

Sources: Capital IQ; BIS calculations.

⁵ Calculated by subtracting bank debt from total debt. Note that the exclusion of Chinese developers listed in Hong Kong from our sample could contribute to the difference.

Leverage indicators for property developers

Median across firms

Table 1

	2010	2011	2012	2013	2014	2015	2016
Debt as a share of total assets, in per cent							
China	31.5	31.9	30.2	33.4	34.9	36.8	37.2
Hong Kong SAR	20.8	17.0	16.8	17.2	14.6	14.2	14.9
Indonesia	16.8	14.3	17.9	18.0	19.6	19.4	20.5
Malaysia	20.2	22.3	22.6	20.1	23.9	23.3	24.7
Singapore	33.8	32.1	35.8	33.9	37.6	35.0	35.6
Thailand	36.8	40.3	39.6	38.0	36.8	41.7	38.1
Interest coverage ratio ¹							
China	11.3	9.9	9.1	8.1	6.6	3.9	5.7
Hong Kong SAR	12.1	8.1	11.0	9.9	9.6	9.7	12.2
Indonesia	4.9	5.9	7.1	6.3	6.3	4.6	3.4
Malaysia	5.4	5.8	6.7	9.0	7.7	6.9	7.1
Singapore	10.5	13.0	9.5	11.7	6.1	4.4	3.7
Thailand	7.4	8.0	7.8	7.8	6.7	6.4	5.6
Inventories as a share of total assets, in per cent							
China	50.4	57.2	59.6	57.5	58.3	54.4	48.9
Hong Kong SAR	11.4	9.9	6.7	10.2	13.3	12.9	12.1
Indonesia	21.3	18.0	12.5	11.3	16.5	14.1	14.6
Malaysia	18.2	16.1	16.2	21.7	16.3	21.0	21.8
Singapore	21.8	6.0	13.6	21.9	18.4	18.7	18.0
Thailand	66.4	62.2	61.2	63.5	61.4	56.9	53.2

¹ EBITDA divided by interest expense.

Sources: Capital IQ; BIS calculations.

And the median returns were more than 5 percentage points lower than the averages between 2010 and 2013 in most economies except Malaysia and Thailand, which were broadly unchanged.

Second, returns on assets of the median firms also fell in all six economies except Thailand. In 2016, the median developers earned 4–6% on their assets. With corporate bond yields fluctuating around 4% in recent years, it seems that the median firms are just about to earning their cost of debt.

Yet these averages hide substantial variation across firms. In particular, there is a large “tail” of firms that do not make any profits at all. In Hong Kong and Indonesia, around 10% of firms reported negative returns on assets in 2016. And in Thailand, this share was 15%.

Third, in most economies the increase in property developers’ lending coincided with an increase in their leverage. Debt-to-assets ratios of the median firm increased between 2010 and 2016 in all economies except Hong Kong (Table 1). That said, debt ratios are still relatively low. Debt accounts for less than one third of the total assets of the median developer in all the economies studied except China, Singapore and Thailand, where the ratios are just below 40%. The relatively low leverage helps explain why developers have so far not had major difficulties in servicing their debt,

despite low asset returns. Interest coverage ratios – defined as earnings before interest, taxes, depreciation and amortisation (EBITDA) divided by interest expense – have been gradually decreasing in all economies except Hong Kong and Malaysia, but tended to remain well above critical levels in 2016.

Low leverage and still comfortable interest coverage ratios could be taken as an indication that developers have significant buffers with which to withstand adverse shocks without having to default. But past episodes have shown that developers' financial health tends to be very sensitive to property prices, interest rates and, possibly, exchange rates. This effect can be quite immediate, as a drop in prices may force developers to revalue their inventories of unsold housing. Such inventories are quite large in the case of Chinese and Thai firms, with a median inventory of around 50% of assets at the end of 2016 (Table 1). Second, higher interest rates could result in higher debt service costs, especially for firms with variable rate or short-maturity debt. Hofmann and Peersman (2017) find that an increase in policy rates would have a significant and lasting effect on the effective lending rate, which in turn would increase the debt service ratio for the private non-financial sector. Finally, both the leverage and debt service costs of firms with currency mismatches are very sensitive to the exchange rate. Since property prices, interest rates and exchange rate movements are closely interlinked, all three effects could occur simultaneously, resulting in a severe deterioration in the financial health of developers.

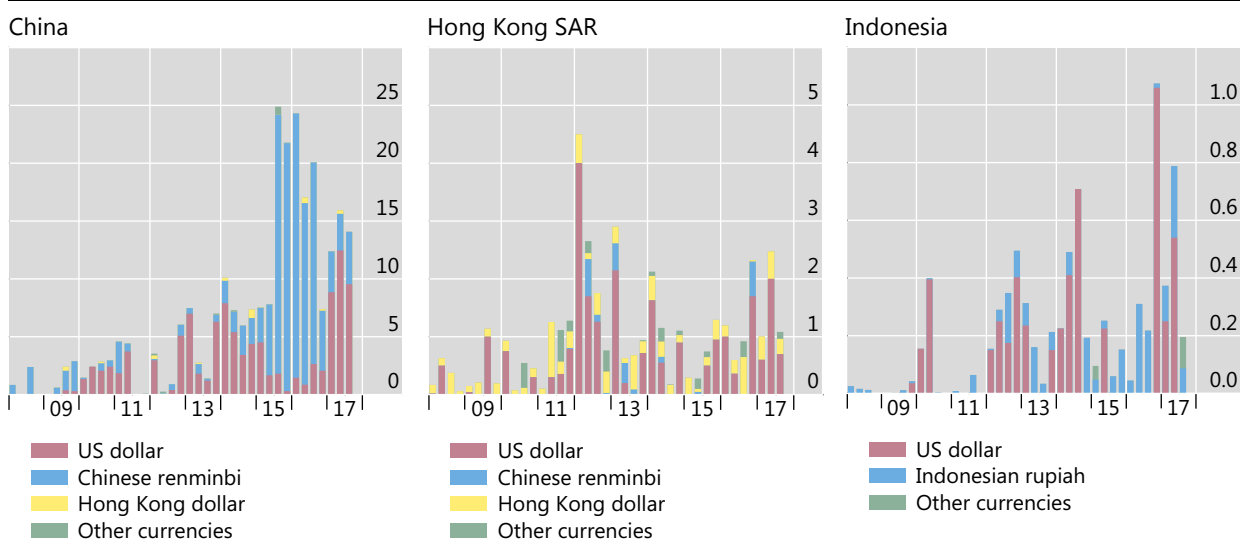
Currency mismatches

In some countries, low profitability is accompanied by substantial currency mismatches. These arise if debt is denominated in foreign currency and used to finance local currency assets, unless the resulting mismatches are hedged with foreign currency assets or derivatives. Large currency mismatches in balance sheets

Property developers in some jurisdictions rely on dollar bond issuance...

In billions of US dollars

Graph 4

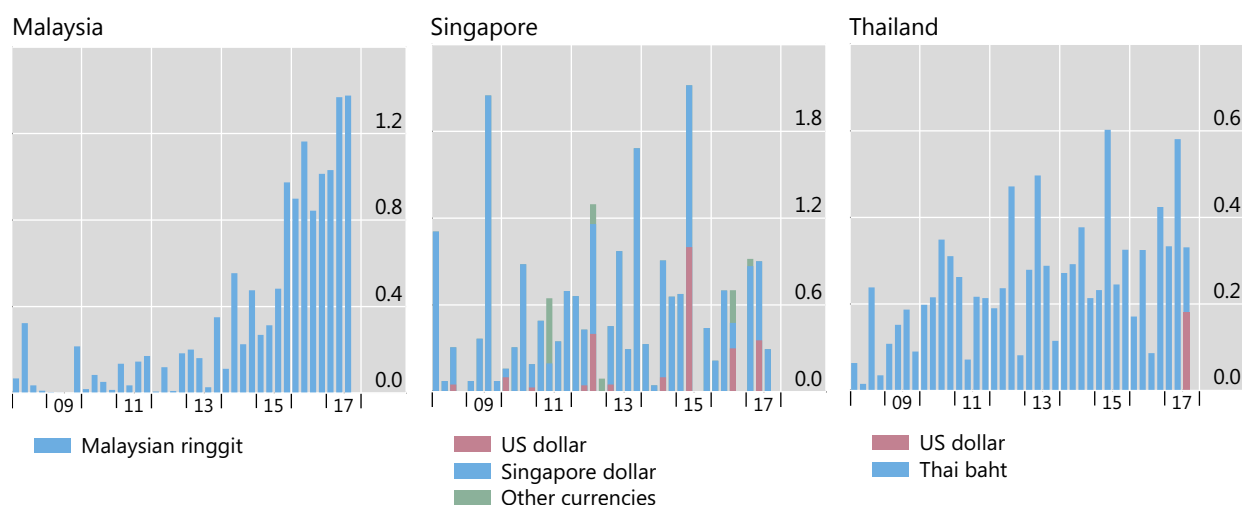


Sources: Thomson Reuters Eikon; BIS calculations.

...while other property developers depend on local currency bond issuance

In billions of US dollars

Graph 5



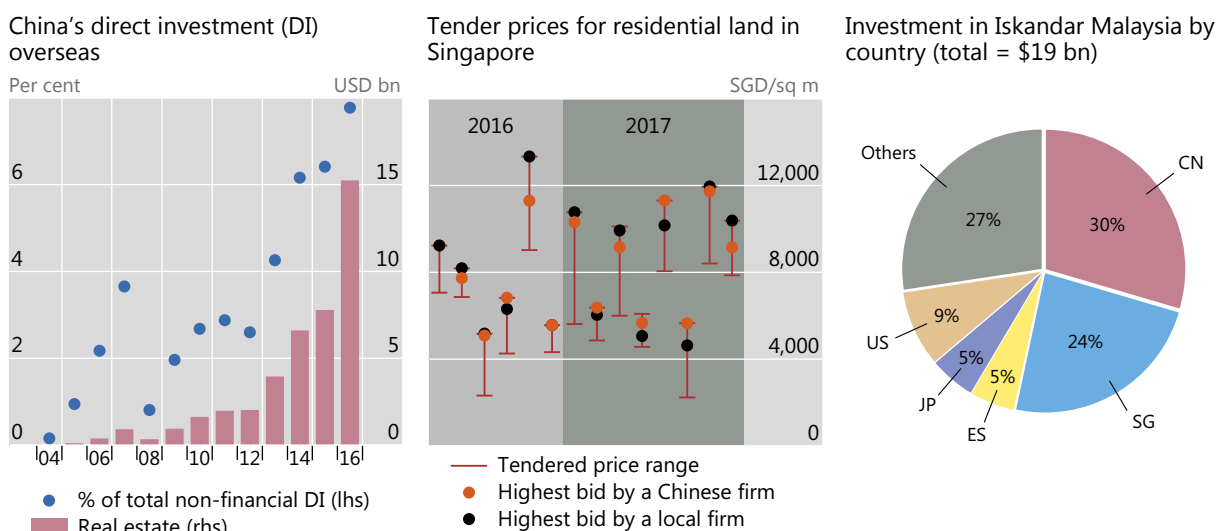
Sources: Thomson Reuters Eikon; BIS calculations.

can increase the effect on economic activity of exchange rate fluctuations through the risk-taking channel (Hofmann et al (2017)).

Dollar-denominated developer debt appears to be rising overall, although the trend varies across countries. While in Malaysia, Singapore and Thailand companies have mostly issued bonds in domestic currencies, those in China, Hong Kong and Indonesia have issued considerable amounts of US dollar-denominated bonds (Graphs 4 and 5). Foreign currency bond issuance often takes place in waves, with phases of positive market sentiment alternating with periods when investors are not so receptive. This is especially important for emerging market economies, which are subject to episodes such as the May–June 2013 “taper tantrum”, when sentiment deteriorates rapidly, exchange rate volatility rises and market access falls. In addition, banks may have other debt, not least bank loans, denominated in foreign currency.

Some of the US dollar borrowing has funded activities in foreign currencies – for example, the strong expansion of Chinese developers outside China. Chinese residents’ outstanding foreign direct investment in the real estate sector doubled in 2016 to \$16 billion, accounting for around 8% of Chinese direct investment in all non-financial sectors (Graph 6, left-hand panel). Chinese property developers and their subsidiaries have been particularly active in other Asian economies. In Singapore, Chinese companies have bid aggressively in residential land auctions (Graph 6, centre panel). In Malaysia, they accounted for almost 30% of the funding of Iskandar Malaysia, a large real estate project in the region neighbouring Singapore (Graph 6, right-hand panel). When completed, the project was intended to establish around 336,000 new private residential units – more than the entire existing stock of private homes in Singapore. While these projects could bring in foreign currency revenues, these may not necessarily be in the same currencies as the debt that finances them.⁶

⁶ There are exceptions: for example, an Indonesian firm issued a US dollar bond in Singapore to finance the purchase of a service apartment block targeting expatriate families. Since the rents were charged in US dollars, the prospective income streams provided some natural hedge to the investment, although mismatches remained as purchases were priced in Singapore dollars. However, it should



Sources: Iskandar Regional Development Authority, Malaysia; Singapore Urban Development Authority; WIND.

Property developers can also hedge their liabilities through derivatives contracts. While detailed information on corporate hedging activities is generally scarce, it appears that some firms do not hedge their foreign currency exposures at all. Only 12 of the 34 Hong Kong-listed Chinese real estate companies that had issued foreign currency-denominated bonds over the past few decades reported hedging their exposures. But financial hedges may not be complete. Financial statements of the few firms that provide detailed information on their hedging strategies show that, in order to economise on hedging costs, they often resort to contracts that limit the amount of protection in case of very large currency movements. Any losses that exceed this amount are incurred by the borrower. Moreover, firms tend to use strategies that require them to regularly roll over hedging contracts. If liquidity in the derivatives markets evaporates, seemingly hedged positions could thus suddenly become unhedged.

The rest reported that they had not hedged, or some said they would consider hedging if the need arose. Interestingly, the debt maturity profiles of “hedgers” and “non-hedgers” are roughly similar, as are their leverage patterns (Graph 7). Furthermore, non-hedgers commonly point to the high cost of buying derivatives on emerging market currencies as a reason for not hedging.

At least for Chinese firms, the risk of sharp losses from currency mismatches from their bond borrowings in case of a depreciation appears to have decreased in recent years. This is because of a shift towards renminbi-denominated bonds. Simulations based on bond issuance data for the 22 Chinese firms that do not hedge their FX exposures show that a 20% depreciation of the renminbi against all foreign currencies would raise scheduled repayments on their outstanding bonds by 13% in 2019 and less than that in the subsequent three years, when most of the debt on the firm’s balance sheet today is coming due (Graph 8, left-hand panel).

also be noted that Singapore dollar- and Malaysian ringgit-denominated bond issuance by Chinese firms has been negligible over the past few years, despite Chinese firms’ extensive activities in both countries.

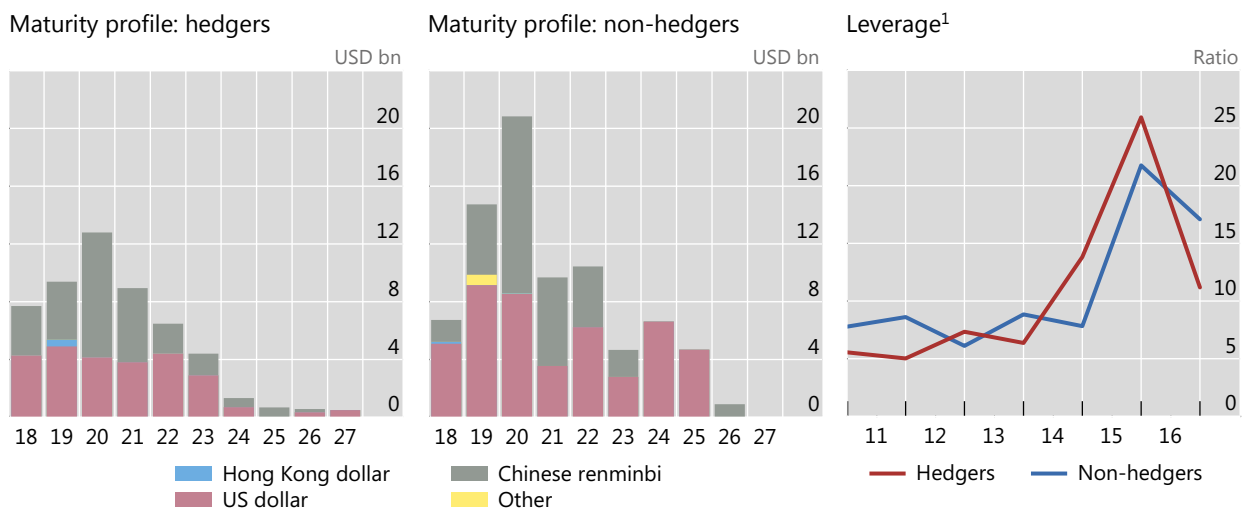
A more comprehensive stress test would require information on the currency composition of assets as well as liabilities. For example, if a Chinese developer issues a Hong Kong dollar bond and uses the proceeds to purchase a property in Hong Kong, there is no exchange rate risk. Since this information is not available, we consider two scenarios: a lower bound where all Hong Kong dollar borrowings carry no currency risk, and an upper bound where all Hong Kong dollar-denominated debts carry the same exchange rate risk as that in US dollars and other foreign currencies. Crucially, we assume that EBITDA and domestic assets and liabilities remain unchanged.

When the same exercise takes into consideration firm-level data on the total debt of the non-hedgers – where total debt includes bank loans, securities and other forms of debt – the results suggest that a 20% depreciation of the local currency would have only a minor impact on firms’ fundamentals, irrespective of our assumptions as to what assets back Hong Kong dollar debt. Leverage as measured by the debt-to-assets ratio would remain almost unchanged, although the interest coverage ratio would drop even further (Graph 8, right-hand panel). While the mean and median of the distribution would remain fairly stable, a depreciation could have more important effects on the firms in both tails. In particular, more firms would see their interest coverage ratio drop below one, meaning that they would no longer earn enough to service their debt.

Unfortunately, missing data on the interest rates paid on the debt outstanding preclude us from doing a similar exercise for the impact of higher interest rates on developers’ cash flows. The available information suggests that interest shocks would not affect firms immediately, since a large part of their debt pays a fixed rate. But maturities of bank loans are often fairly short, so higher market rates may affect developers’ interest coverage ratios relatively quickly.

Maturity and leverage decisions are independent of hedging strategy

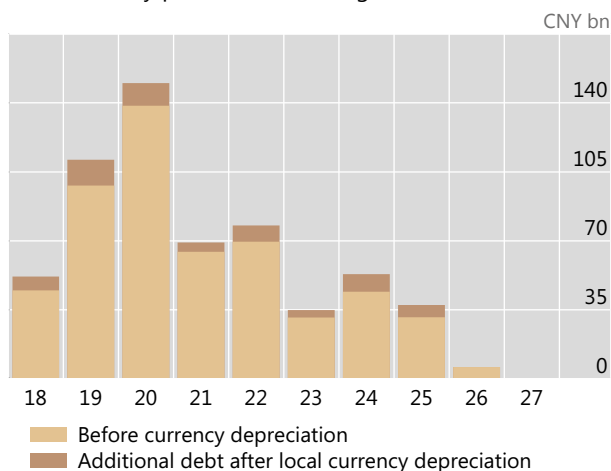
Graph 7



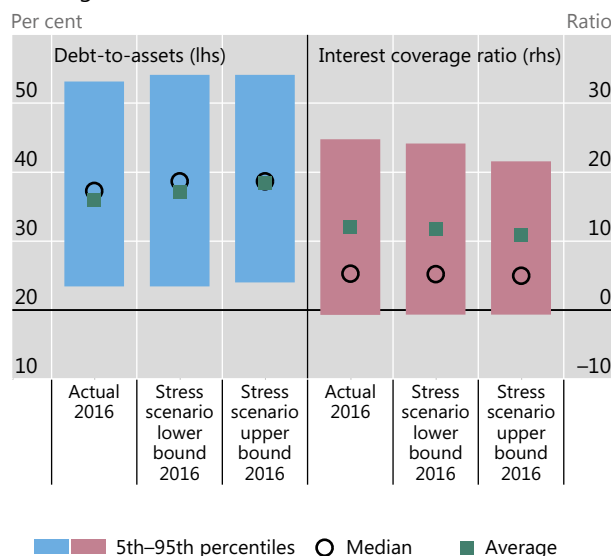
¹ Calculated as the simple average of the ratio of total debt divided by EBITDA.

Sources: Capital IQ; Thomson Reuters Eikon; BIS calculations.

Debt maturity profile of non-hedgers²



Leverage and interest ratio³



¹ Assumes a 20% depreciation in local currency against all other currency pairs for the 22 Chinese firms not hedging their FX liabilities. See text for further discussion. ² Based on Thomson Reuters Eikon bond issuance data. ³ Based on Capital IQ capital structure details in 2016. For the stress scenario lower bound, both Chinese renminbi- and Hong Kong dollar-denominated debt are treated as local currency debt; for the higher bound, renminbi-denominated debt is treated as local currency debt and Hong Kong dollar-denominated debt as foreign currency debt.

Sources: Capital IQ; Thomson Reuters Eikon; BIS calculations.

Conclusions

Large Asian property developers substantially increased their indebtedness during the property booms that followed the GFC. The near-term financial stability risks associated with this debt appear to be limited. While debt levels of property developers are quite high in some economies, approaching 30% of GDP at end-2016 in Hong Kong, 15% in Singapore and 5% in China, leverage looks modest and interest coverage ratios are above critical levels. At the same time, from a longer-term perspective, the sector’s deteriorating fundamentals give reason for concern. Profitability has declined since the boom years at the beginning of the decade, and many firms’ returns on assets are below their costs of debt. This also means that leverage has been rising and interest coverage ratios falling.

Such weakened fundamentals make developers more vulnerable to shocks – for instance, higher interest rates or lower property prices. Since most of the developers’ debt is in the form of bank loans, which tend to pay floating rates, higher market rates could quickly push up debt costs. Their impact could be compounded by valuation losses if higher interest rates are accompanied by a drop in property prices, which would push up leverage. Exchange rate depreciation could add to the woes, given non-negligible currency mismatches. The experience of past crises has shown that higher interest rates, drops in property prices and exchange rate depreciation often occur concurrently, and that fundamentals can deteriorate quickly.

A deterioration of the developers' financial health can have significant economic repercussions. The financial accelerator works in both directions. While easy financing conditions in the aftermath of the GFC have arguably added fuel to the property booms in many economies, a tightening in the years ahead could force firms to sell off inventory, driving down prices. Firms may also be forced to lay off workers.

Moreover, falling returns on assets and declining interest coverage ratios could pose problems even in the absence of external shocks. At the very least, they could hinder developers' ability to grow further, which could in turn affect property prices and employment.

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Appendix

Data sources and methodology

Data sources. Our analysis uses both aggregate bank lending and firm-level data. First, bank loans to the real estate sector (defined as those to property developers and construction firms) are compared with mortgage loans to gauge the relative importance of developers to households as borrowers. Second, we extract firm-level balance sheet and debt issuance data from S&P Capital IQ and Thomson Reuters Eikon, respectively. Security-by-security issuance data from Eikon allow us to build an aggregate debt profile by currency for each economy. Information about whether a company has hedged its foreign currency risk or not is extracted from the company's financial reports.

Sample selection. Our first-pass filter is to select listed companies that are constituents of property-related stock indices. Then we exclude all real estate investment trusts and those firms specialising in hotels/rentals, but add those "non-developer" companies that reported a significant proportion of total revenues (>50%) from their property development business. On this basis, our sample has 233 companies: 104 in China (69 listed in China + 34 listed in Hong Kong), 43 in Thailand, 34 in Hong Kong, 32 in Malaysia and 20 in Singapore.

Financial items definitions/compilations¹

Table A1

	Our sample	Capital IQ	Thomson Reuters Eikon
Operating income / operating profit	HKD 17.1 bn = Revenues – direct costs of revenues – selling/admin expenses	HKD 17.1 bn [Defined as operating income]	HKD 17.1 bn [Defined as operating profit]
EBITDA	HKD 18.4 bn = Operating income/profit + interest + depreciation + amortisation	HKD 18.4 bn	HKD 18.5 bn
Pre-tax profit	HKD 25.8 bn = EBITDA – unusual expense – non-operating interest expense – investment losses	HKD 25.8 bn [EBT including unusual items]	HKD 25.8 bn
Return on average equity (ROE) ²	8.3% = Pre-tax profit / average total equity	6.7% = (Pre-tax profit – income tax expense) / average total equity	8.3% = Pre-tax profit / average total equity
Return on average assets (ROA) ²	5.8% = Pre-tax profit / average total assets	2.4% = Operating income / average total assets × 0.625 ³	5.8% = Pre-tax profit / average total assets
Interest coverage	16.8 = EBITDA / total interest expense	16.8 = EBITDA / total interest expense	10.7 = EBIT / interest expense [Defined as times interest earned]

¹ Figures are examples for a Hong Kong-based developer. Entries in square brackets are the terminology used by the respective data providers. ² Average total equity = (total equity at the end of the current year + total equity at the end of the previous year) / 2. ³ Capital IQ uses a common factor of 0.625 to derive post-tax ROA, ie by assuming a corporate tax rate of 37.5%.

Sources: Capital IQ; Thomson Reuters Eikon; BIS calculations.

Data definition. Data providers employ slightly different definitions in reporting key financial ratios to allow for peer group or international comparison. Consequently, an apparently identical financial ratio of a company provided by different data providers could vary. Thus, we derive our own financial ratios from raw balance sheet data. Table A1 summarises our data for a Hong Kong-based developer and compares them with those reported by Capital IQ and Eikon.

The implications of passive investing for securities markets¹

The popularity of passive investing through index mutual funds and exchange-traded funds (ETFs) has grown substantially over recent years, displacing higher-cost active investment styles. A shift towards passive investing could affect securities markets in two key ways. First, it could result in higher correlation of returns and less security-specific price information. Second, it could affect aggregate investment fund flows and market price dynamics. In this context, active mutual funds exhibited persistent outflows in recent stress periods, whereas passive mutual fund flows were fairly stable. ETF flows were relatively volatile, although their link with underlying prices is less straightforward than for other fund types.

JEL classification: G11, G12, G14, G23.

Passive portfolio management (or passive investing) is a strategy that tracks the returns of a price index, such as an established market benchmark. It is typically implemented by holding each of the indices' constituent securities in line with their representation in the index. Maintaining a passive investment strategy requires no trading in the absence of changes in index composition.

Passively managed funds are investment vehicles that offer diversified and low-fee portfolios. This contrasts with actively managed funds, which seek to earn higher returns than their chosen benchmark through discretionary security selection or trading in anticipation of market turning points. Doing so generates trading costs and requires compensation to active managers and investment in relevant information, which go hand in hand with higher fees.

Aside from the issue of the potential benefits and costs for individual investors, rapid growth of passively managed portfolios has generated debate about their possible impact on securities markets. One concern is that the mechanical investment rules of passive investing may give rise to distortions in the pricing of individual securities. At the aggregate level, there is also the question of whether it might add to destabilising price dynamics by amplifying investors' trading patterns.

¹ This special feature draws on material prepared for the Committee on the Global Financial System in consultation with Kevin Henry (Federal Reserve Bank of New York), Fuminori Niwa (Bank of Japan), Edith Siermann (Netherlands Bank) and Jonathan Witmer (Bank of Canada). The authors also thank Claudio Borio, Benjamin Cohen, Stijn Claessens, Hyun Song Shin and Kostas Tsatsaronis for valuable comments, and Giulio Cornelli and Tania Romero for excellent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the BIS.

This special feature provides a conceptual and empirical discussion of these issues. A key observation is that, despite their rapid growth, passive funds account for a relatively small fraction of outstanding securities. Even so, the available empirical evidence suggests that portfolio-wide trading of passive funds can still contribute to correlation across individual security prices. The mechanical way that passive funds manage their portfolios implies that their impact on aggregate security price dynamics will depend mostly on how end investors behave.² Here, it is important to distinguish between the two main types of passive fund: index mutual funds and exchange-traded funds (ETFs). In this respect, we observe that investors in index mutual funds exerted a stabilising influence in recent periods of market stress relative to those using active mutual funds, while flows in and out of ETFs were relatively volatile.

The remainder of this feature is organised as follows. The first section provides an overview of the growth in passive funds across asset classes and countries. The second outlines the theoretical grounds for passive investing, and the third discusses factors behind its recent growth. The fourth considers the implications of greater passive investing for security prices and issuers, while the fifth examines the impact on aggregate fund flows and market price dynamics.

Recent growth in the passive fund industry

Passive fund assets have expanded rapidly over recent years and now represent a significant portion of the global investment fund universe. Measuring industry size by assets under management, passive funds managed about \$8 trillion or 20% of aggregate investment fund assets as of June 2017, up from 8% a decade earlier (Graph 1, left-hand panel). Passive (or index) mutual funds, the traditional passive portfolio product, grew sharply over this period. ETFs, which allow intraday trading of shares in passive portfolios on a secondary market, grew even faster (Box B).³ ETFs' share of passive fund assets exceeded 40% in June 2017, compared with around 30% in 2007.

Growth in passive funds has been rapid for both equity and bond asset classes (centre panel). The rising popularity of passive equity funds has displaced investment in their active counterparts, which experienced outflows over the past decade (right-hand panel). Net outflows from active bond funds were concentrated in 2013 and 2015 – periods of bond market turbulence. Most of the remaining passive funds specialise in commodities.

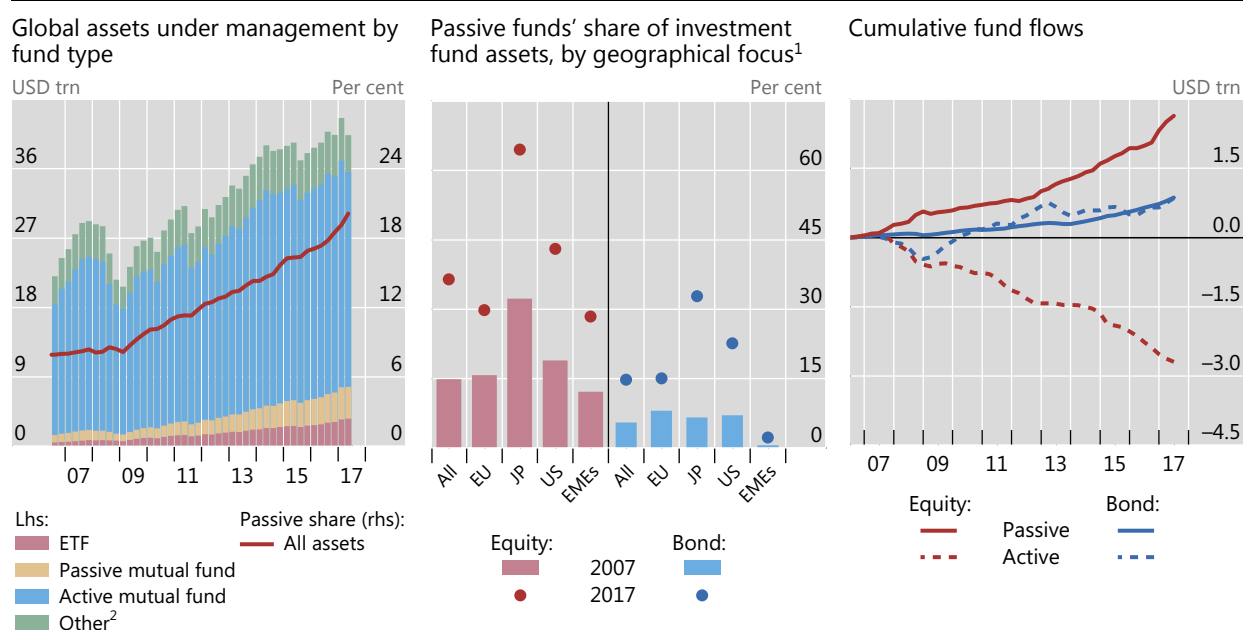
Despite the rapid growth of passive bond funds, the majority of passive portfolios remain focused on equities. To some degree, this reflects the greater liquidity and exchange-traded nature of equities. In addition, constructing and tracking indices of equities is easier because they are perpetual securities, while the

² Indeed, it is important to emphasise that the “passive” or “active” designation refers to the investment approach of the *fund manager* that acts as an agent for end investors. The investment strategies of end investors can differ from that of the fund manager. As a result, there may be significant variation in the stability of balances across investors in a given passive or active fund.

³ Around 2% of total ETF assets do not seek to track an index, but rather offer investors an active investment strategy designed to deliver absolute returns or high returns relative to a benchmark. Given the small share of active ETFs, we treat all ETFs as passive funds in this special feature.

Passive funds' share of the fund management sector rises

Graph 1



¹ As of end-June for each year. ² Includes investment fund assets of closed-end funds, hedge funds, insurance funds, investment trusts and pension funds.

Sources: Lipper; authors' calculations.

high correlation of interest rates may make holding broad market index bond portfolios less attractive (Fender (2003)).

Across countries, passive funds have gained most prominence in US equities. There, they have expanded to more than \$4 trillion, or 43% of total US equity fund assets (Graph 1, centre panel). Although starting from a much lower base, passive funds have gained even more traction among Japanese equity funds, supported by the Bank of Japan's ETF purchases and the Government Pension Investment Fund's increased allocation towards equities over recent years.⁴ Sharp rises in the proportion of passive funds have also occurred for European and emerging market economy (EME) equity funds.

While passive funds have made substantial inroads into the universe of investment vehicles available to end investors, their holdings as a share of total outstanding securities remain at a relatively low level due to the sizeable holdings of other (non-fund) investors (Table 1). The share of securities held by passive fund portfolios is highest for the US equity market, but it still amounts to only around 15% of the total. Shares of passive funds in other equity markets are lower, at about 5% or less. The proportion of passive bond funds has risen to almost 5% of the US bond market.

Using assets managed by index tracking funds is a simple approach to measuring the extent of passive investing, but it is not without shortcomings. In practice, the distinction between passive and active fund strategies is fuzzy. The risk of outflows if

⁴ The Bank of Japan holds approximately 60% of outstanding Japanese equity ETFs as part of its asset purchase programme (Fueda-Samikawa and Takano (2017)), while the share of the Government Pension Investment Fund (GPIF) equity investment allocation to passive investment vehicles exceeded 80% by 2016, according to published GPIF data.

Passive funds' estimated share of outstanding market volumes¹

In per cent

Table 1

Securities market	2007	2017
Equities ²		
Europe	2.3	3.3
Japan	2.0	5.5
United States	6.0	14.7
EMEs	1.2	2.3
Bonds ³		
Europe	1.0	0.9
United States	1.2	4.5

¹ End-June data for each year. ² Equity market capitalisation (denominator) based on Bloomberg World Market Capitalization indices (WCAUJAPA for Japan, WCAUUS for US, and constituent countries for Europe and EMEs). ³ Bond market capitalisation (denominator) based on Bloomberg Barclays Pan-European Aggregate, Bloomberg Barclays Pan-European High Yield, Bloomberg Barclays US Corporate High Yield and US Aggregate Bond Indices (LP06TREU, LP01TREU, LF98TRUU and LBUSTRUU, respectively).

Sources: Bloomberg; Lipper; authors' calculations.

they underperform their benchmark leads many active funds to avoid portfolios that deviate substantially from those of the market index. Cremers et al (2016) find that in many countries the share of "closet indexing" (where weights of securities in equity fund portfolios are not substantially different from those of the benchmark) is more or less the same as that of "explicit indexing", if not higher. Closet indexing is also prevalent among actively managed bond funds, particularly those investing in EMEs (Miyajima and Shim (2014)). Furthermore, other investors, such as pension funds and insurance companies, may implement passive investment strategies in their portfolios managed in-house or through investment vehicles other than mutual funds and ETFs. The rise of "smart beta" ETFs further blurs the distinction between passive and active fund management. Rather than track traditional market value-weighted indices, smart beta ETFs implement factor-weighting index strategies (such as those for value, volatility and dividend yield), the construction of which can be considered active in nature (Blackrock (2017)).

In sum, ascertaining the true extent of passive investing is challenging. Nonetheless, it seems clear that over recent years there has been a substantial shift towards passive portfolio management globally.

Theoretical grounds for passive investing

The end users' choice of investment vehicle depends on not only the track record of the fund manager but also how the manager's style accords with their preferences and risk appetite. There are several general considerations for individual investors in deciding whether or not to adopt a passive investment strategy (market-wide considerations are discussed further below).

From a theoretical perspective, the rationale for individual investors adopting a passive investment strategy is grounded in the notion of efficient markets. This theory holds that security prices rapidly incorporate all available information, implying that

(excess) future returns are not predictable.⁵ A natural corollary is that there is limited room, if any at all, for active investment strategies to generate returns above those of the market. Limited scope for systematic outperformance raises doubt about the rationale of incurring management fees in excess of those necessary to maintain a diversified market portfolio.

Even if one rejects the notion of market efficiency (and thus the inability of managers to produce above-market returns over time), passive investing can still be considered an optimal strategy to the extent that outperformance of the market benchmark is a “zero sum game” (Sharpe (1991), Malkiel (2003)). Since passive investors’ average return before costs should, by construction, equal the market return, the average return across all active investors must also equal the market return. Given that active investors are attempting to beat the market, any gains for some of these investors must be offset by the losses of others. Thus, after trading costs, the average return for active investors will be less than for passive ones.

In principle, investors could earn superior returns by selecting those active funds that outperform. But identifying such funds can be difficult in practice because it requires ex ante information about the incentives and skill of a manager. Adopting a strict index-based investment strategy therefore circumvents the main asymmetric information and agency problems arising from delegating authority for investment decisions to a fund manager (Vayanos and Woolley (2016)).

Notwithstanding the above arguments, there may still be a strong theoretical case for active management. First, informed active managers can earn above-market returns to the extent that the investor universe also includes active but uninformed investors whose aggregate portfolio underperforms the market. Second, while the zero sum game argument holds for a constant market portfolio, in reality passive fund managers must trade (albeit not frequently) to manage investor inflows and outflows and because indices themselves are not static (Pedersen (2018)). This means that, on average, informed active investors could outperform the benchmark by taking advantage of passive managers’ predictable trading patterns, such as by trading in anticipation of adjustment to index membership or ahead of initial public offerings.

Drivers of recent growth in passive investing

Various factors have contributed to the growing investor preference for passive funds in recent years. A key one has been the better performance record of passive funds over actively managed funds.

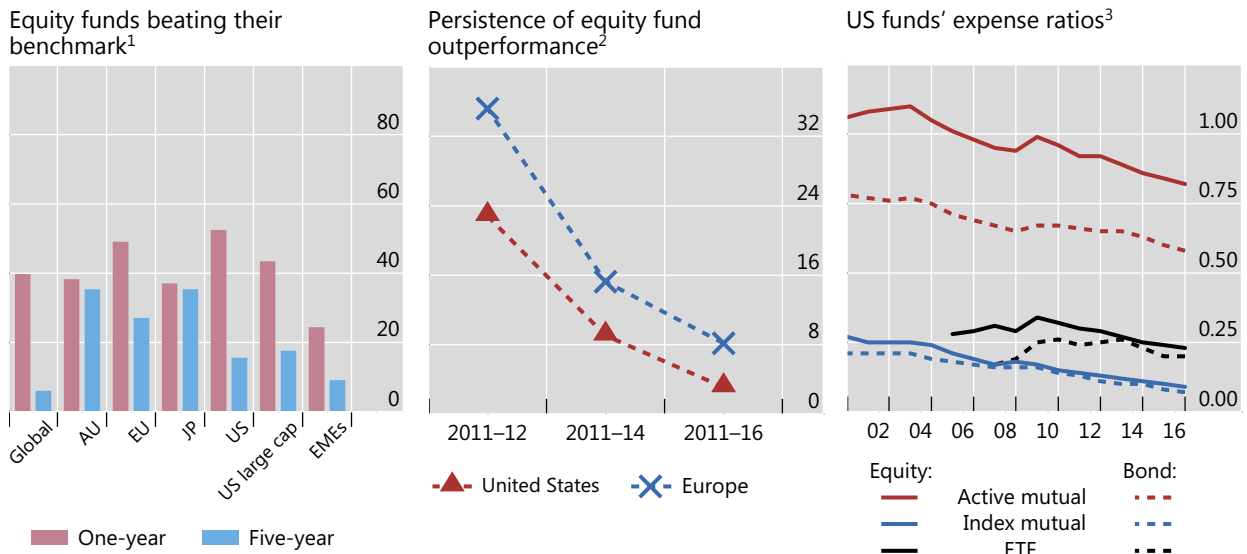
After fees and expenses, most active equity funds have failed to outperform the market benchmark in recent years (Graph 2, left-hand panel). Moreover, at least in major markets, funds that outperformed their benchmark have not done so consistently. For example, 35% of European equity funds outperformed during 2011–12, but only 8% outperformed over a longer horizon of six years (Graph 2, centre panel).

⁵ There are several versions of the efficient markets hypothesis that differ in the strength of their assumptions around “all available information”. The relevant version here is the semi-strong form, which states that the stock price includes all publicly available information regarding the prospects of the firm issuing it.

Active funds have failed to outperform their benchmark

In per cent

Graph 2



¹ For Global, S&P Global 1200; for AU, S&P/ASX 200; for EU, S&P Europe 350; for JP, S&P Japan 500; for US, S&P Composite 1500; for US large cap, S&P 500; for EMEs, S&P/IFCI. For illustrative purposes only; individual active funds may have different benchmarks. Data as of 30 June 2017. ² Share of active funds outperforming their benchmark during the corresponding periods. ³ Asset-weighted averages.

Sources: Investment Company Institute; Lipper; S&P Dow Jones Indices; authors' calculations.

By and large, the findings of the empirical literature accord with recent experience; after fees and expenses, the average active equity fund underperforms the market portfolio over long horizons (eg Jensen (1968), Carhart (1997), Fama and French (2010), Busse et al (2014)). Although the literature is much less extensive, there are comparable findings of underperformance by active bond funds, on average, after adjusting for the riskiness of fund portfolios relative to the market benchmark (Blake et al (1993), Cici and Gibson (2012)).

The recent popularity of lower-cost passive funds has been supported by structural shifts in the financial advisory industry. These include: the rise of the so-called "robo advisors" (platforms offering low-fee automated investment management services); the introduction of fiduciary duty requirements; and a move away from commission-based remuneration. Regulators' greater focus on fee transparency has also played a role in some jurisdictions.⁶

The bulk of money flowing into passive funds over recent years has been directed to the largest fund managers, which tend to offer the lowest-cost funds. Since 2010, the three largest passive fund managers have received around 70% of cumulative inflows. This pattern of inflows can set in motion scale economies that help compress fees (Graph 2, right-hand panel).⁷ Greater fund size mechanically reduces funds' expense ratios and allows managers to further invest in cost reductions and new products, in turn helping them to attract more inflows. It also enables greater netting

⁶ A recent example is the transparency-driven regulations embodied within the Markets in Financial Instruments Directive (MiFID II) that came into effect in the European Union in January of this year.

⁷ Active funds' expense ratios have also been declining in recent years, at least in the United States.

of inflows and outflows, as well as the negotiation of more favourable trading fees from brokers, thus reducing trading costs.

Greater use of information and computational technology is another factor underlying the development of the index industry and the rise of passive investing. There has been a marked expansion in the range of indices beyond traditional broad market benchmarks, opening up investment and diversification opportunities previously inaccessible to many investors.⁸

Lastly, the recent period of low volatility and associated high correlations within asset classes might have reduced the rewards to active security selection.

Implications for security pricing and issuers

The discussion in the previous two sections provided an individual-investor perspective on the rise of passive investing. The adoption of passive strategies by an increasing share of investors also has implications for security prices and issuers.

The efficiency of security price formation

Passive fund investment decisions are made at the portfolio level and not at the level of individual securities. Passive fund managers and investors naturally place emphasis on systematic (or common) factors affecting portfolio returns, such as expectations about monetary policy, inflation and other macroeconomic factors.

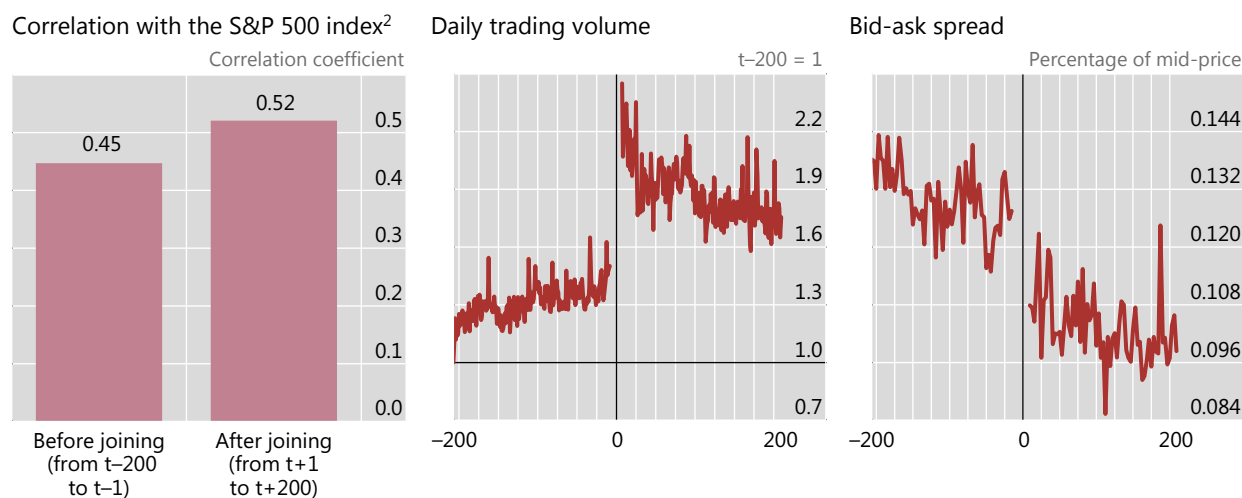
By contrast, passive portfolio managers have scant interest in the idiosyncratic attributes of individual securities in an index. They do not devote resources to seeking out and using security-specific information relevant for valuing individual securities. In effect, they free-ride on the efforts of active investors in this regard. Hence, an increase in the share of passive portfolios might reduce the amount of information embedded in prices, and contribute to pricing inefficiency and the misallocation of capital.⁹

An increase in passively managed portfolios could also affect the pricing of securities through greater portfolio-wide trading in the market. Passive managers buy and sell the entire basket of index constituents in response to fund inflows and outflows. This trading pattern can induce higher co-movement in the prices of the constituents of the index.¹⁰ It might also magnify any pricing differences with securities not included in the index (Wurgler (2010)).

⁸ The proliferation of indices is evident in the fact that, as of early February 2018, around 350,000 equity indices and 80,000 bond indices were covered by Thomson Reuters Datastream.

⁹ It is possible that a rise in passive investing could lead to more resources being devoted to market-wide pricing factors. But efficiency might still deteriorate; there is an argument that pricing is less efficient for the market as a whole than for individual securities (Samuelson (1998)). Jung and Shiller (2005) provide supporting evidence, showing that individual US firms' price/dividend ratios have predictive power for future growth rates in real dividends, but when the firms are aggregated into an index the predictive power disappears or obtains a wrong sign.

¹⁰ Greater co-movement of securities in an index implies a reduction in the potential benefit of holding the diversified portfolio.



¹ Sample based on 462 stocks joining the S&P 500 between January 2000 and September 2017. Stocks subject to mergers and acquisitions, stocks with poor data availability and those that have left the index during the first 30 days after the inclusion date are excluded. t=0 is the index inclusion date specific to each stock. ² Correlation of daily returns with the S&P 500 index.

Sources: Bloomberg; Thomson Reuters Eikon; authors' calculations.

Numerous academic studies across a range of equity markets have identified co-movement, price pressures and other trading effects as securities are added to a benchmark index (eg Barberis et al (2005), Kaul et al (2002), Claessens and Yafen (2013)). Discernible effects are evident when individual stocks are included in the S&P 500 index: their correlation with the index increases, trading volume jumps and bid-ask spreads narrow (Graph 3). Research lends support to the view that index inclusion effects reflect “non-fundamental” investor demand shocks (Pruitt and Wei (1989), Greenwood (2008), Claessens and Yafen (2013)).¹¹ The most obvious reason is the correlated behaviour of passive investors tracking an index, compounded by the behaviour of active investors that benchmark against an index. For ETFs specifically, there is recent evidence that trading and arbitrage activity contributes to the co-movement of S&P 500 stocks (Da and Shive (2018), Leippold et al (2016)).

It should be noted, however, that these effects also create counterbalancing forces. At some point, greater anomalies in individual security prices would be expected to increase the gains from informed analysis and active trading, and thus spur more active investment strategies.¹² The ultimate balance between active and passive styles would depend on securities market characteristics, such as information costs, accessibility and overall market efficiency (Cremers et al (2016)). Thus, in markets that are already deep and efficient, the returns to active investors' information gathering should be relatively low and returns to scale from passive investing relatively high, all else equal. Evidence in support of this view might be

¹¹ A different interpretation of the price pressures and increased stock co-movement is that they reflect better diffusion of available information (Barberis et al (2005)). For example, common return factors may be more quickly incorporated into prices given lower trading costs and higher liquidity for securities included in indices. In this case, greater passive investing would not reduce pricing efficiency.

¹² The need for incentives to informed active investing underpins the argument of Grossman and Stiglitz (1980) that markets are likely to be mostly, but not completely, efficient.

found in the fact that passive funds have been able to secure a higher share of equity market capitalisation in advanced economies (AEs) than in EMEs (Table 1).

The perspective of security issuers

Going beyond the impact on the prices of individual securities, growth in passive funds might also influence the decisions and profile of security issuers.

A general consideration is that passive investing may alter the relationship between issuers and investors. By design, passive funds invest in all securities included in the index they track. Unlike active investors, they cannot express their disagreement with the decisions of individual issuers by selling their holdings. A higher share of passive investors could therefore weaken market discipline and alter the incentives of corporate and sovereign issuers to act in the interest of investors.¹³

Growth of passive bond funds, specifically, might encourage leverage by borrowers. Because inclusion in bond indices is based on the market value of outstanding bonds (that is, the face value of bond debt times its price), the largest issuers tend to be more heavily represented in bond indices. As passive bond funds mechanically replicate the index weights in their portfolios, their growth will generate demand for the debt of the larger, and potentially more leveraged, issuers. From a financial stability perspective, there is a concern that this can act procyclically and encourage aggregate leverage. The analysis presented in Box A, which is based on a major global corporate bond index, suggests that passive bond funds do indeed obtain greater exposure to firm leverage than to firm size.

As passive funds grow, the mechanical trading impact of index inclusion or exclusion is likely to become more important for issuers. For instance, the higher the share of portfolios tracking an investment grade bond index, the larger the selling effect when a bond is removed from an index because of a credit rating downgrade.

Decisions around the country composition of indices can potentially have relatively large financial effects, given that they involve the combined weight of all securities from that country in the index. This is more so for smaller countries because the size of the fund asset base can be much larger than the underlying securities market. One example of a significant mechanical country trading effect is the reclassification in 2010 of Israel from emerging to developed market status by MSCI, an important provider of global benchmark equity indices. This reclassification resulted in about \$2 billion of net equity fund outflows from Israel during the month in which the change came into effect. This occurred because Israel's new weight in the developed equities index was smaller than its previous weight in the emerging equities index, and the value of fund assets tracking these two indices was not very different (Raddatz et al (2017)). Reclassification could also result in spillovers to other countries if the country being removed (or added) has a large index weight, obliging index funds to rebalance their portfolios to accommodate the change.¹⁴

¹³ Of course, there are potentially other ways in which passive funds can influence issuer behaviour, such as through their voting on board composition and executive remuneration. Concentration among passive fund providers might be a factor increasing the influence of individual passive funds.

¹⁴ Raddatz et al (2017) also examine the impact of the removal of Qatar and the United Arab Emirates from the MSCI Frontier Markets Index in 2014. These two countries together represented 40% of that index, so their removal resulted in large passive equity fund inflows to the smaller remaining countries, as their portfolio weights rose.

Corporate leverage and representation in a major bond index

This box examines the relationship between a firm's leverage and its weight in a major corporate bond index, the Bank of America Merrill Lynch Global Broad Market Corporate Index. Data on corporate debt are matched with issuers in the index. A firm's weight in the index is then calculated as the sum of the market value of its individual bonds, divided by the market value for all issues where there is matching firm data.^①

Regression results confirm that there is a statistically significant positive relationship between a company's weight in the index and its leverage (based on either total debt or just bond debt; Table A, columns (1) and (2)), conditioned on the bond price. Although larger companies would be expected to have more outstanding debt, the coefficient on debt is about four times larger and more significant than the coefficient on total assets (column (4)). Specifically, a 1% increase in company debt is associated with a 0.025 percentage point increase in its weight in the index, compared with a 0.005 percentage point higher weight from a 1% increase in total assets.^②

Relationship between leverage and a firm's weight in a bond index

Based on constituents of Bank of America Merrill Lynch Global Broad Market Corporate Index

Table A

Independent variables:	Dependent variable: index weight			
	(1)	(2)	(3)	(4)
Total debt/total assets	0.026** (0.012)			
Bond debt/total assets		0.042*** (0.013)		
Log total debt			0.029*** (0.001)	0.025*** (0.003)
Log total assets				0.005** (0.003)
Log price	0.02 (0.042)	0.012 (0.042)	0.025 (0.032)	0.024 (0.032)
Number of observations	1,341	1,341	1,358	1,338
R-squared	0.003	0.008	0.425	0.425

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

As of 27 March 2017; 1,341 of the 1,938 bond issuers matched with balance sheet data for Q1 2017. Index constituents for which balance sheet data were not available are excluded from the weights calculation. Bond debt proxied by total debt less total commercial paper and bank debt outstanding. Constant omitted for brevity.

Sources: Bank of America Merrill Lynch; S&P Capital IQ; authors' calculations.

^① Lack of data for some bond issuers could bias results if their leverage differs systematically from the average of the other issuers in the index. ^② Since firm index weights are not normally distributed, we also run regressions using the log of the weight: the results are essentially the same.

Despite the above-mentioned concerns, the availability of benchmark indices may reduce issuance costs and improve issuance opportunities by supporting securities market development. For example, the development of a set of local currency bond indices in several major Asia-Pacific economies and the associated growth in passive funds have helped broaden and deepen Asian regional and local bond markets. Specific effects include the rise in bond issuance, increased market

liquidity, institutional investors' greater participation, and lower barriers to non-resident investors (Chan et al (2012)).

Fund flows and aggregate price dynamics

The growth in passively managed portfolios also has implications for security price dynamics. A key question is whether passive funds have a stabilising or destabilising influence on aggregate prices.

Passive fund managers could exert a stabilising influence on prices in the *absence* of fund inflows and outflows. By design, the value of passive portfolios automatically rebalances in line with the index, and passive fund managers do not need to trade unless they receive investment or redemption orders from investors. In contrast, active fund managers have the discretion to adjust portfolio allocations in response to market events. For these reasons, passive funds might provide an offsetting force to any procyclical investment decisions of active funds.

On the other hand, passive funds could conceivably contribute to price overshooting if their fund flows are sizeable. As indices are typically weighted according to market values, the share of overvalued stocks or bonds in them tends to increase in a rising market and decline in a falling market (CGFS (2003)). Large flows into and out of passive funds could exacerbate these investment trends.

Given these considerations, the impact of passive fund growth on aggregate price dynamics will depend on two sets of factors. The first is how passive investment vehicles influence end investor fund flows. The stickiness of investor flows in times of market stress is an important aspect of this issue. The second is the strength of transmission from investor flows and trading to security prices. In assessing these factors, it is important to distinguish between the different types of passive funds, index mutual funds and ETFs, as their structures will have different implications.

Investor behaviour and fund flows

There are several reasons why index-tracking funds may be used by investors that themselves behave in a stable (or "passive") way with respect to their investments. For one, passive funds appear to be optimal vehicles for "buy-and-hold" investors seeking to minimise trading costs and fees. Second, the trading activity of some institutional investors, such as pension funds, can be limited by rigid asset allocation mandates and tax efficiency objectives. Third, the absence of fund manager discretion might make some investors less likely to shift their money in and out of the fund in response to fund performance.

At the same time, the unique structures of ETFs might allow, or even encourage, less stable investment behaviour by owners of these products. ETFs enable investors to trade index portfolios on an intraday basis at a transparent secondary market price. This contrasts with mutual funds, where trading usually occurs at the close of the trading day (Box B). The ability to trade ETFs frequently could attract high-turnover

Trading mechanisms of ETFs compared with other fund types

Like passive (index) mutual funds, exchange-traded funds (ETFs) seek to track the returns of a benchmark index. The key innovation of ETFs is a trading process that combines the characteristics of open-end mutual funds with those of closed-end funds. Variation in the number of ETF units arising from inflows or redemptions resembles the design of open-end mutual funds, while the ability to trade ETF shares throughout the day on a secondary market at a transparent price is a feature shared with closed-end funds. Trading of ETF shares on an exchange also allows market participants to place market, limit or stop orders, as well as to engage in short selling, which further boosts the ETFs' market liquidity.

ETFs' unique primary-secondary market trading mechanism is facilitated by registered intermediaries known as authorised participants (APs), typically broker-dealers or market-makers in the underlying securities. APs may trade the ETF shares on the secondary market like other investors, but they can also create and redeem ETF shares (known as "creation units") through direct transactions with the ETF sponsor at the current net asset value of the portfolio. The ability of APs to transact in both the primary and the secondary market incentivises profitable arbitrage of the ETF share price and the underlying assets.^① This, together with arbitrage by other market participants solely in the secondary market, underpins a key value proposition of ETFs for investors – near-immediate liquidity at a share price close to the value of assets underlying the price index. This can be contrasted with open-end mutual funds, where investors buy or redeem units directly at the fund's end-of-day net asset value.

Trading mechanism of funds

Table B

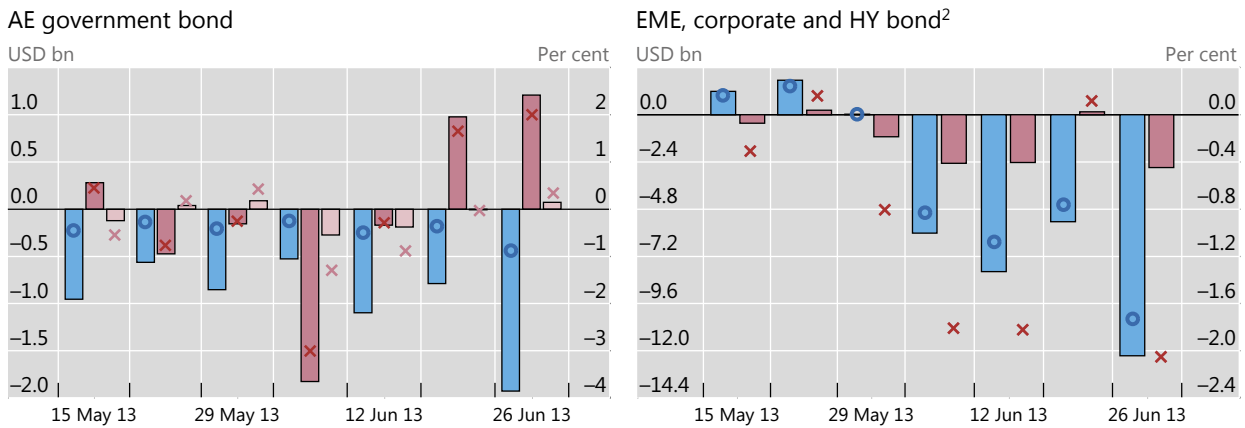
Fund type	Primary market	Secondary market	Link between end investor trading and underlying security prices
Closed-end funds	Initial and seasoned public offerings of shares to investors	Investor trading of fund shares on market	Arbitrage of fund share prices and security prices in secondary markets
Open-end mutual funds	Issuance and redemption of fund units by end investor	...	Fund transactions generate securities market transactions (unless there is a rundown of fund cash buffers in response to redemptions)
ETFs	Creation and redemption of units between ETF sponsor and APs	Investor trading of fund shares on market	Arbitrage of fund share prices and security prices in secondary markets Arbitrage by APs in the primary ETF market (unless they decide to warehouse securities or use existing securities inventories)

^① For example, in the case of a material decline in the price of ETF shares below the value of the underlying assets, APs could purchase ETF shares and redeem these with the ETF sponsor in exchange for the underlying securities, which they then may sell on the market.

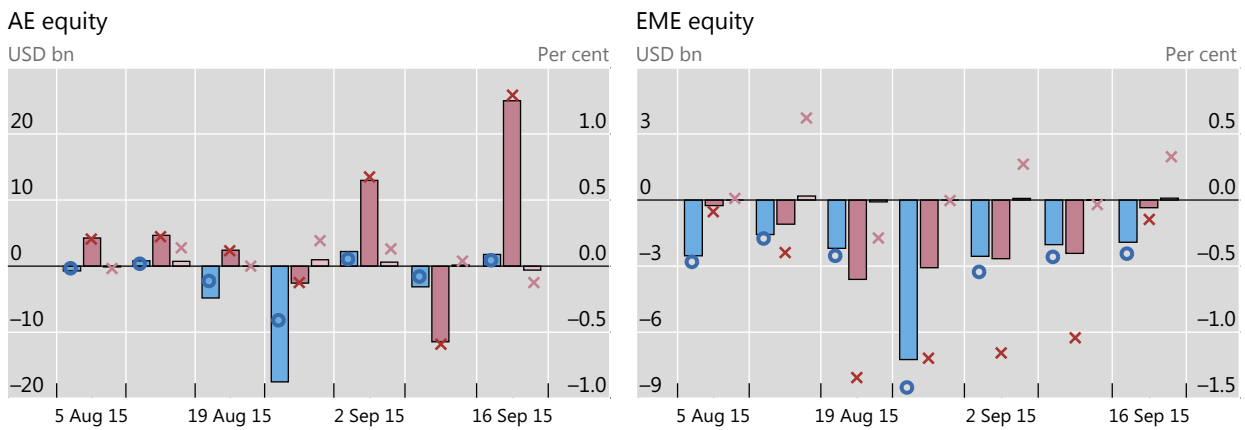
Fund flows vary across fund types during recent stress episodes¹

Graph 4

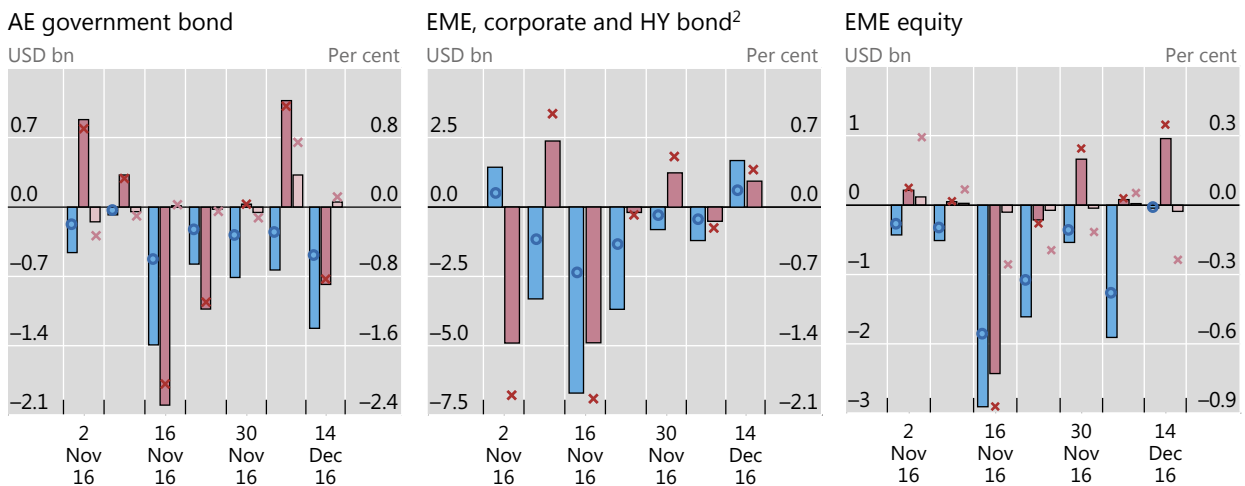
2013 taper tantrum



2015 equity market volatility



2016 US presidential election



Net flows (lhs):
 Active mutual funds (blue bar)
 ETFs (red bar)
 Passive mutual funds (grey bar)

Net flows/total net assets (rhs):
 Active mutual funds (blue dot)
 ETFs (red cross)
 Passive mutual funds (grey cross)

¹ Based on weekly data. ² HY = high-yield. Passive mutual funds have been excluded given the small size of total net assets invested in these asset classes.

Sources: EPFR; authors' calculations.

investors and investors pursuing shorter-term investment strategies, such as high-frequency trading (HFT) or dynamic market hedging. Based on this, one might expect ETF flows to be more volatile compared with those of index mutual funds.¹⁵

An analysis of recent stress episodes compares the stability of fund flows across passive fund types (index mutual funds and ETFs) and active mutual funds. We focus on three recent periods of stress: the 2013 taper tantrum (bond funds only); the 2015 bout of equity market turbulence (equity funds only); and the turbulence surrounding the 2016 US presidential election (bond funds and EME equity funds).¹⁶ Graph 4 shows weekly net flows for active mutual funds, passive mutual funds and ETFs in US dollar terms (absolute flows) on the left-hand scale, and net flows as a percentage of total assets (relative flows) on the right-hand scale.

Several patterns stand out. First, passive mutual funds' flows were the least volatile, in both absolute and relative terms, compared with those of both ETFs and active mutual funds. On this basis, index mutual fund investors do not appear to "rush for the exit" in times of stress.

Second, ETFs exhibited the largest inflows and outflows (ie fund flow volatility) relative to their asset size, although in some cases their flows offset each other over the weeks within an episode. The fact that fund flows were more volatile for ETFs than for passive mutual funds (and even active mutual funds in some instances) is consistent with ETFs being associated more with a wider array of investment and trading strategies.

Third, compared with both index mutual funds and ETFs, active mutual funds exhibited the most persistent outflows across asset classes in all three episodes. This tallies with well known active mutual fund procyclical effects arising from investor sensitivity to poor fund performance, as well as fund managers' discretionary sales (Shek et al (2018)).¹⁷ Active mutual fund flows also tend to be largest in terms of absolute dollar amounts, reflecting the sheer size of the assets managed by those funds.

¹⁵ While not the focus of this article, ETF flow volatility could also stem from investor expectations of high liquidity and a possible impairment of authorised participant intermediation in times of stress. For a discussion of this issue and other risks posed by ETFs, see Sushko and Turner (2018).

¹⁶ The period May–June 2013 was characterised by a broad decline in fixed income markets as investors responded to expectations of monetary policy tightening by the US Federal Reserve. In August 2015, global equity markets experienced falling prices and bouts of volatility as investors focused on growing EME vulnerabilities following a plunge in China's equity prices. November 2016 was characterised by a sell-off in fixed income and EME assets as investors revised their expectations following the outcome of the US presidential election. For an overview of market developments during these episodes, see, for example, the Overview chapter in the September 2013, September 2015 and December 2016 issues of the *BIS Quarterly Review*.

¹⁷ Because investor redemptions from mutual funds affect the next-period net asset value of remaining investors' holdings, they can create a first-mover advantage. This effect is more pressing for less liquid asset classes, such as corporate bond funds (Goldstein et al (2017)). Feroli et al (2014) find evidence of such feedback outflows by fixed income mutual fund investors during the 2013 taper tantrum, when global bond markets were unusually turbulent.

Fund flows and trading in underlying securities

Variation in fund flow patterns during recent stress episodes points to a differential impact on securities market prices across fund types.

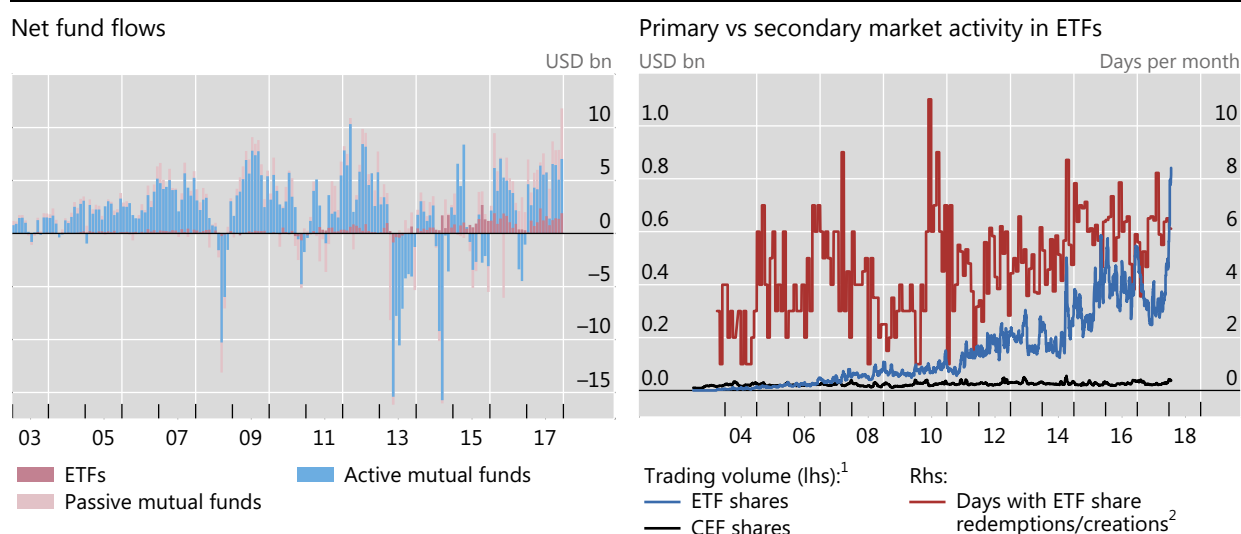
An examination of mutual funds and ETFs benchmarked to a major advanced economy bond index provides some evidence on the link between fund flows and security prices.¹⁸ Given their large size, active mutual fund flows should be important for the price dynamics of this index (Graph 5, left-hand panel). This is confirmed by the significant relationship of active mutual fund flows with the “abnormal returns” to the index – the component of index returns not explained by fundamental drivers (Table 2, column (1)).¹⁹ The regression results do not show a similar relationship for either index mutual fund or ETF flows.

The direct link between security prices and the flows of active mutual funds may also arise from the fact that mutual fund investors transact directly with the fund, which, in turn, trades directly in the underlying securities. For this reason, the buying

Fund flows and trading in fund shares

Based on funds benchmarked to the Barclays US Aggregate Bond Index

Graph 5



¹ Daily trading volume in the secondary market for exchange-traded fund (ETF) shares and closed-end fund (CEF) shares, 22-day moving average. ² Number of days in each month in which an ETF exhibited redemptions or creations in the primary market based on the average of the 12 ETFs with the index as their benchmark.

Sources: Bloomberg; Lipper; authors' calculations.

¹⁸ We focus on the Barclays US Aggregate Bond Index, which is shown to have been the advanced economy bond benchmark most widely used by fund managers (Miyajima and Shim (2014)). The index represents about 8,200 fixed income securities with a total value of about \$20 trillion, or more than 40% of the total US bond market.

¹⁹ The dependent variable is the “abnormal return” on the index, defined as the residual from the regression of the index log return on the change in the 10- to two-year term spread, the log of the MOVE index (a measure of bond market volatility) and the Citigroup Economic Surprise Index.

Fund flows, fund share trading volumes and index returns

Based on funds benchmarked to the Barclays US Aggregate Bond Index

Table 2

Independent variables:	Dependent variable:	
	Abnormal index returns (1)	Absolute abnormal index returns (2)
Primary market		
ETF net flows/index mkt cap	-12.455 (21.518)	
Passive MF net flows/index mkt cap	-17.102 (15.684)	
Active MF net flows/index mkt cap	7.402*** (2.353)	
Secondary market		
% change ETF share trading volume		0.004** (0.001)
% change CEF share trading volume		-0.002 (0.002)
Constant	-0.001 (0.001)	0.006*** (0.000)
Number of observations	177	169
R-squared	0.055	0.036

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

February 2003 to November 2017 monthly sample. Sample comprises a total of 12 exchange-traded funds (ETFs), 21 closed-end funds (CEFs), 465 active mutual funds (MFs), and 19 passive open-end MFs (including those tracking the float-adjusted version of the index). The dependent variable is "abnormal return" to the index, based on the residual from the regression of the index logarithm return on the change in the 10- to two-year term spread, the logarithm of the MOVE index, and the Citigroup Economic Surprise Index.

Sources: Bloomberg; Lipper; authors' calculations.

or selling of fund shares by investors should be expected to result in the buying or selling of the underlying securities by the fund manager.²⁰

By contrast, ETF investors trade fund shares in the secondary market with each other (similar to investors in closed-end funds). As a consequence, market-clearing prices in the secondary market will adjust to any demand/supply imbalances for ETF shares. In such a setting, the pass-through to the prices of the underlying securities will depend on arbitrage activity by various players in the secondary market for ETFs and in the underlying securities market – that is, investors taking long and short positions in the ETF shares and underlying securities portfolio. The importance of secondary market trading in ETFs for aggregate prices is confirmed by the result of a regression of the absolute value of the abnormal bond index return on ETF share trading volume (Table 2, column (2)).

²⁰ Although funds could meet redemptions by first drawing on any cash (or liquid asset) buffers, studies conclude that cash holdings of mutual funds are not sufficiently large to mitigate the price impact of fund flows (eg Chernenko and Sunderam (2016)). There is also evidence that fund managers increase cash hoarding in response to redemptions, which would amplify fire sales (Morris et al (2017)).

Direct transactions with an ETF (ie fund flows) may be undertaken only by so-called authorised participants (APs; Box B), which can operate in both the primary and the secondary ETF market. But such ETF share creation and redemption appears to be fairly infrequent (Graph 5, right-hand panel). This is consistent with evidence that the vast bulk of ETF trading across various equity and bond classes clears in the secondary market (ICI (2015)). In addition, in the case of ETFs, the fund does not transact directly in the underlying securities, but rather relies on the AP. This too could dampen the effects of fund flows on securities markets. For example, after redeeming the ETF shares, APs can potentially warehouse the securities instead of immediately selling them in the secondary market (Box B, Table B). These two factors may help explain why ETF flows may have less of an impact on security prices than do active mutual funds flows.

In sum, the above analysis suggests that while active mutual fund flows have a direct impact on prices, ETF investor trading exerts a greater impact on underlying asset prices by generating the conditions for secondary market arbitrage.

Conclusion

The implications of the rapid expansion of passively managed funds have been hotly debated. At this point, the relatively small share of passive fund portfolios in total securities market holdings suggests that any effect on security prices and issuers may not be large. However, the effects could become significant if the passive fund management industry continues to expand.

This special feature discusses a number of possible securities market effects that warrant further consideration. Three issues are worth highlighting. First, it seems plausible that the portfolio-wide investing and trading of passive funds could bring about greater correlation of index securities and reduce the security-specific information contained in prices. Second, at an aggregate level, fund flow dynamics may change. In this respect, we observe that investors in index mutual funds exhibited a stabilising influence in recent stress episodes relative to active mutual funds. ETF flows were more volatile, in line with investors' ability to frequently trade these products. Third, the link between ETF trading and underlying security prices deserves further study. In particular, secondary market arbitrage of ETF shares appears to constitute an additional (and potentially more important) transmission channel to prices compared with that which works through fund flows.

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Annexes

BIS Statistics: Charts

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

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

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A Locational banking statistics

Cross-border claims, by sector, currency and instrument

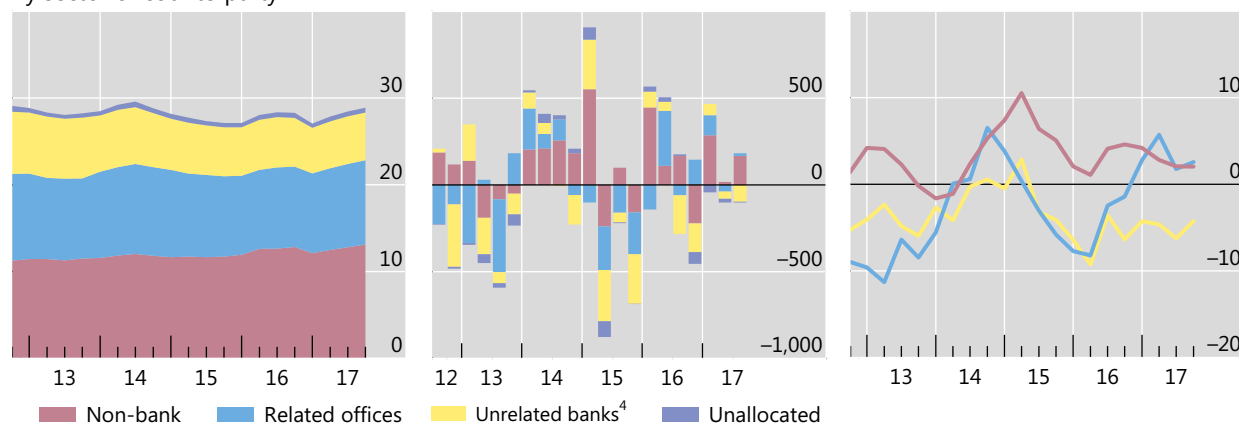
Graph A.1

Amounts outstanding, in USD trn¹

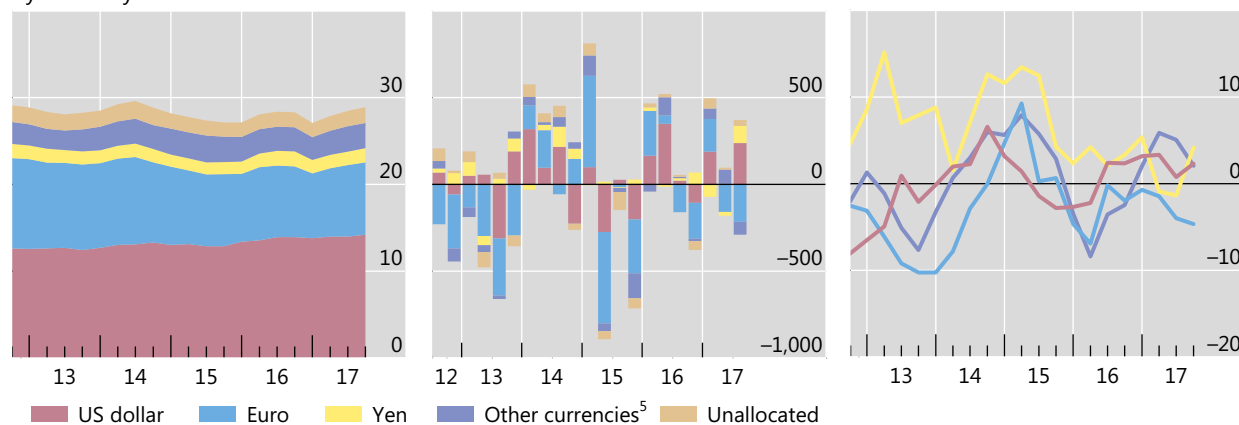
Adjusted changes, in USD bn²

Annual change, in per cent³

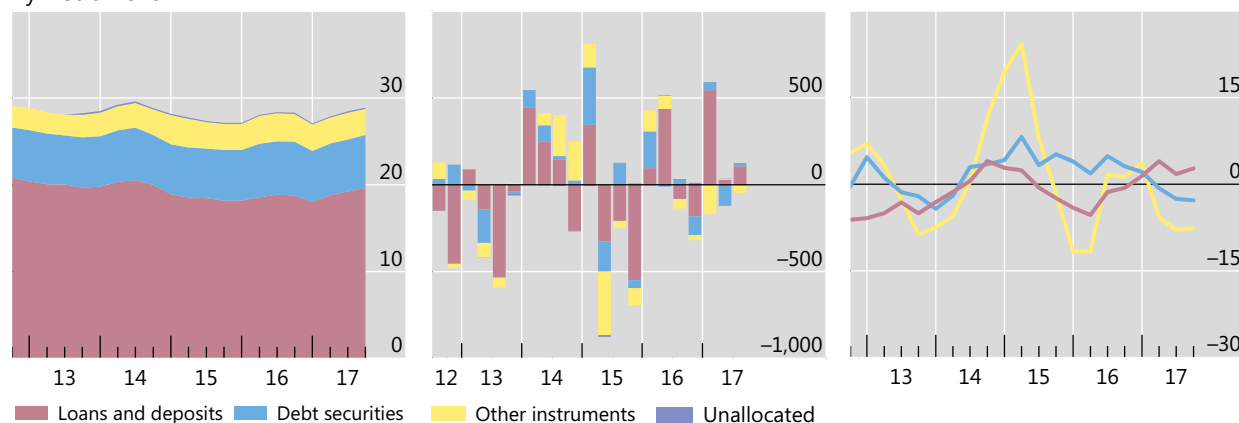
By sector of counterparty



By currency



By instrument



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

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

Source: BIS locational banking statistics.

Cross-border claims, by borrowing region

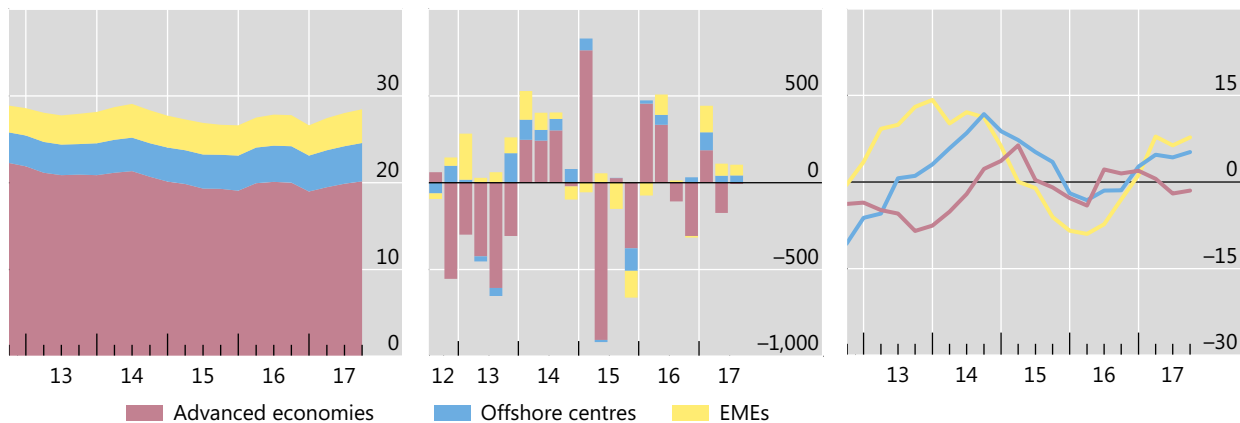
Graph A.2

Amounts outstanding, in USD trn¹

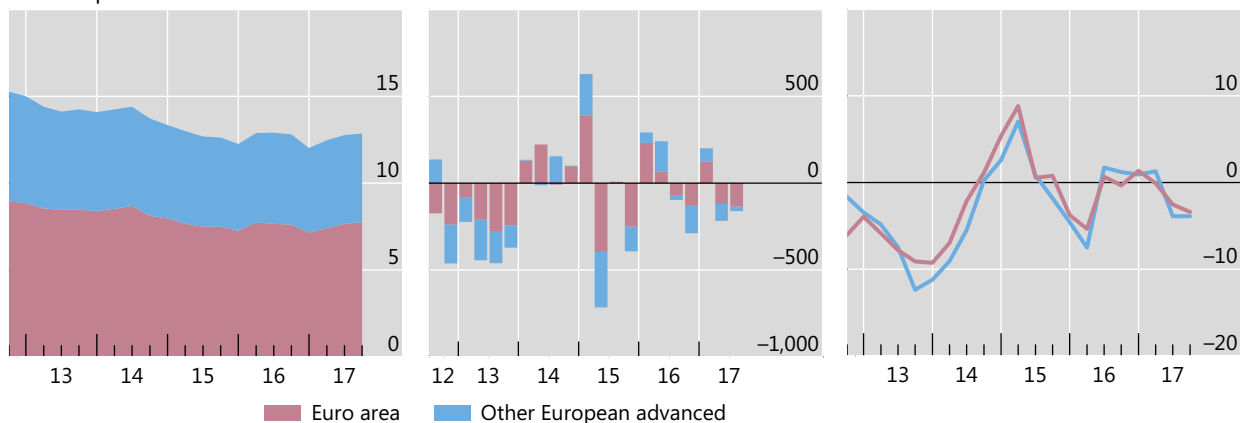
Adjusted changes, in USD bn²

Annual change, in per cent³

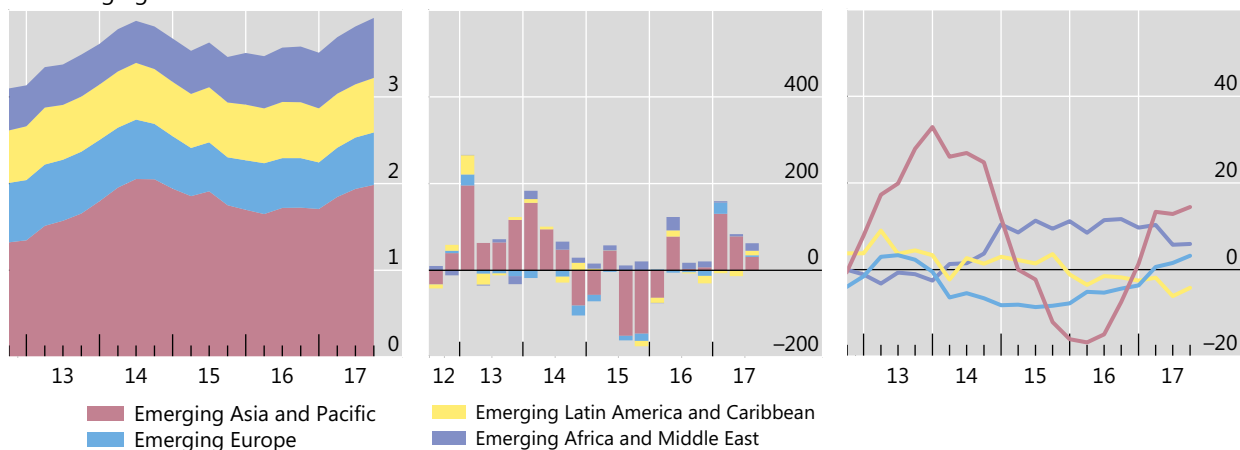
On all countries



On Europe



On emerging market economies



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

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

Source: BIS locational banking statistics.

Cross-border claims, by borrowing country

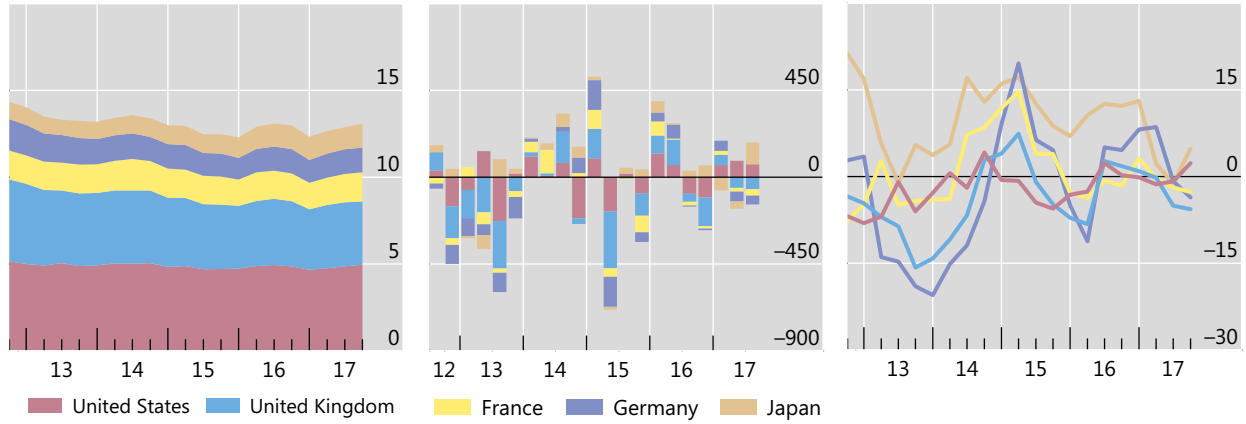
Graph A.3

Amounts outstanding, in USD trn¹

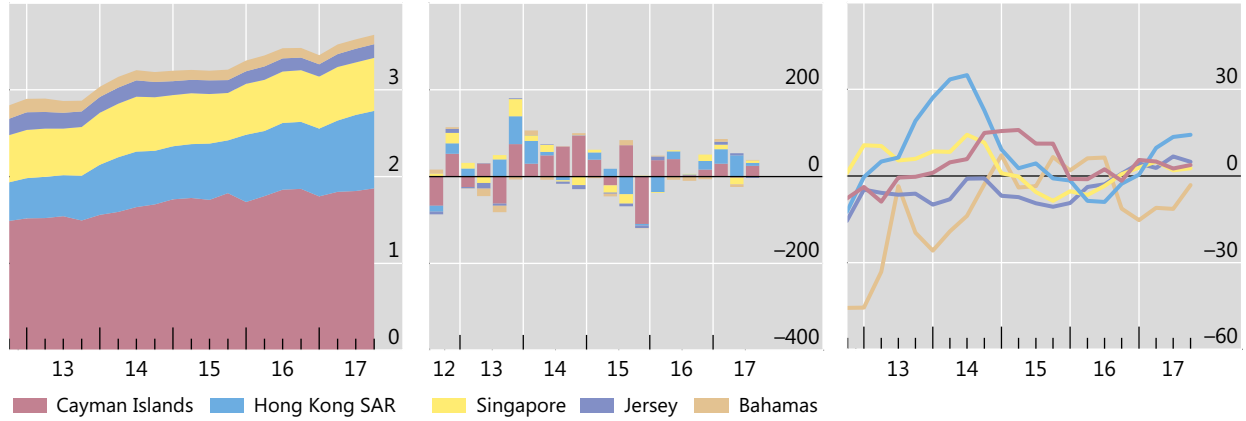
Adjusted changes, in USD bn²

Annual change, in per cent³

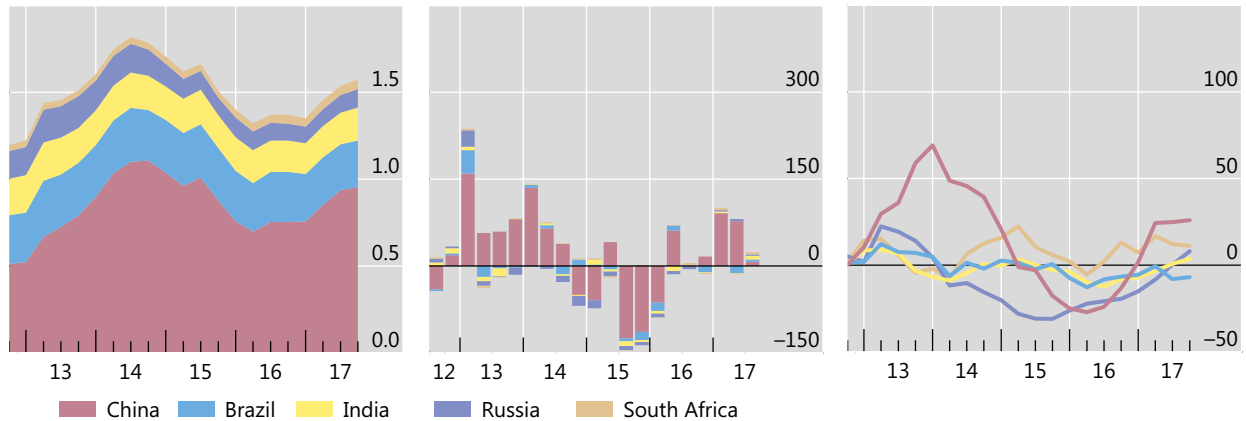
On selected advanced economies



On selected offshore centres



On selected emerging market economies

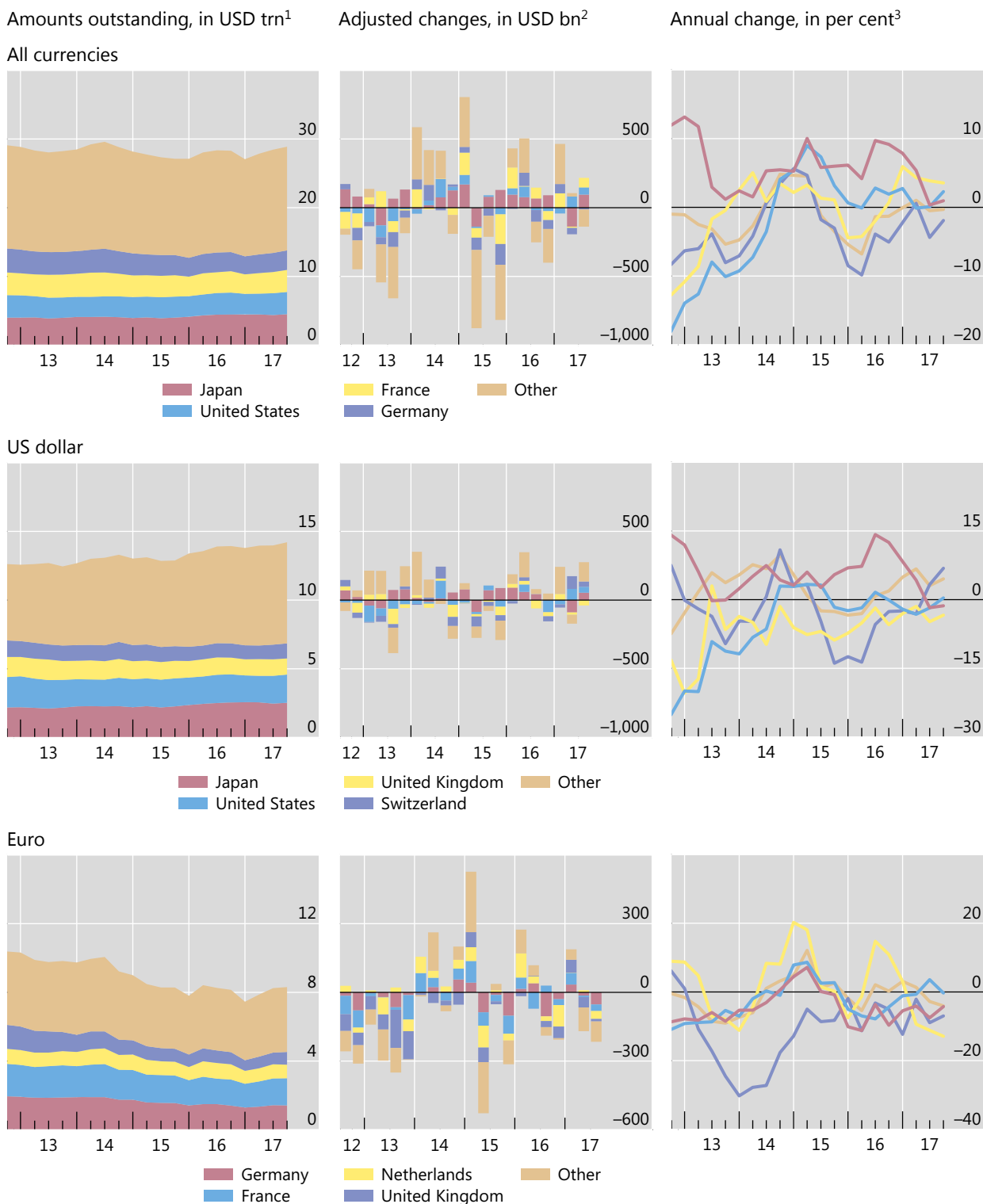


Further information on the BIS locational banking statistics is available at www.bis.org/statistics/bankstats.htm.

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

Source: BIS locational banking statistics.

Cross-border claims, by nationality of reporting bank and currency of denomination Graph A.4



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

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

Source: BIS locational banking statistics.

Cross-border liabilities of reporting banks

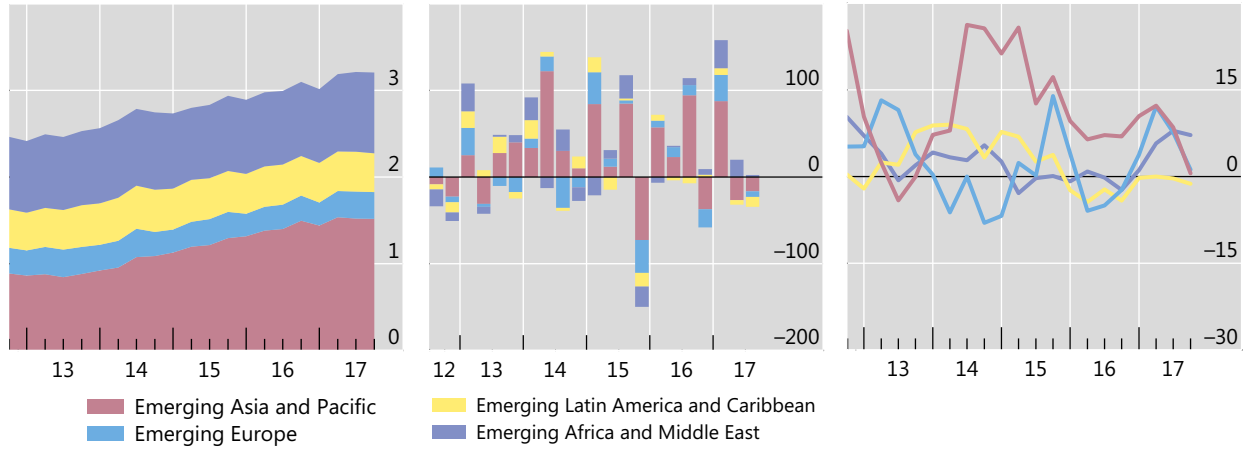
Graph A.5

Amounts outstanding, in USD trn¹

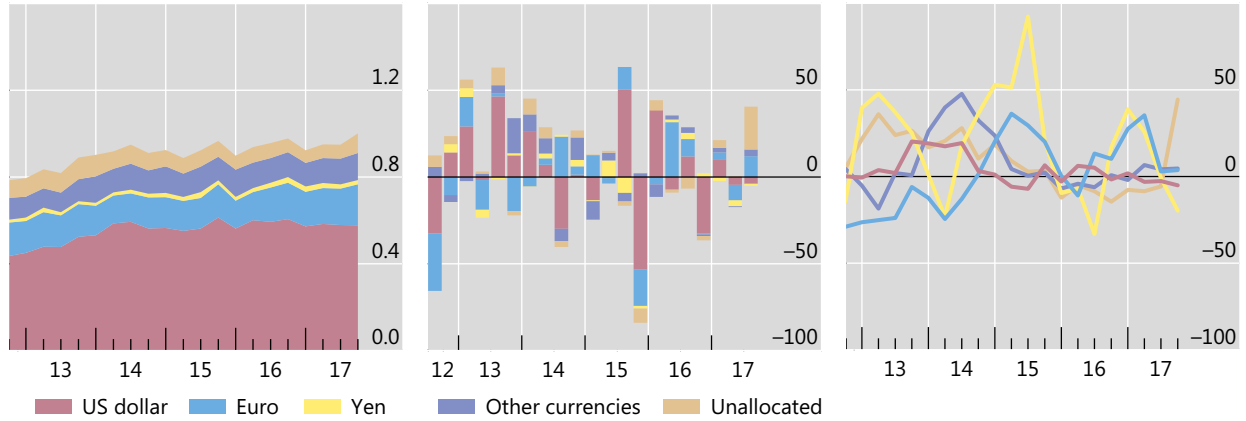
Adjusted changes, in USD bn²

Annual change, in per cent³

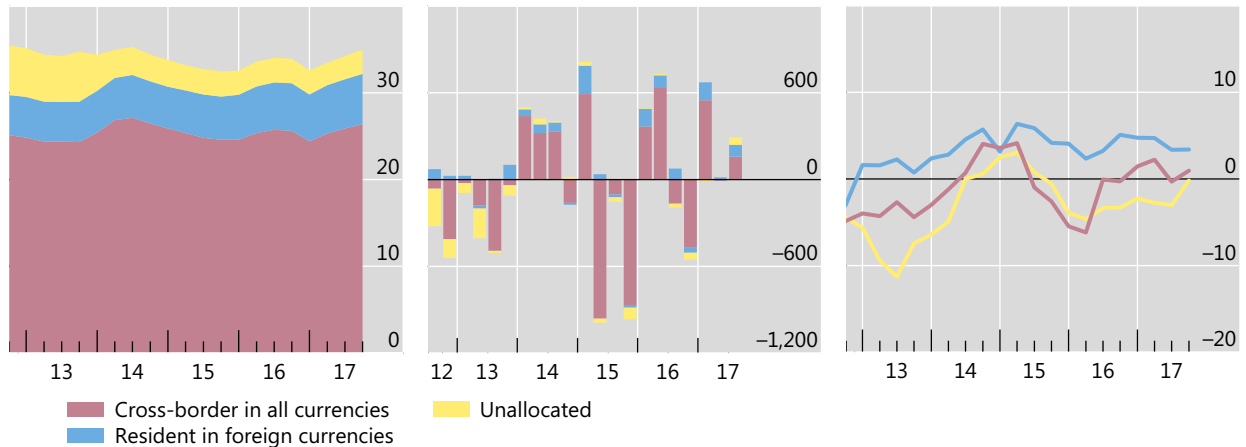
To emerging market economies



To central banks



By currency type and location



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

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

Source: BIS locational banking statistics.

B Consolidated banking statistics

Consolidated claims of reporting banks on advanced economies

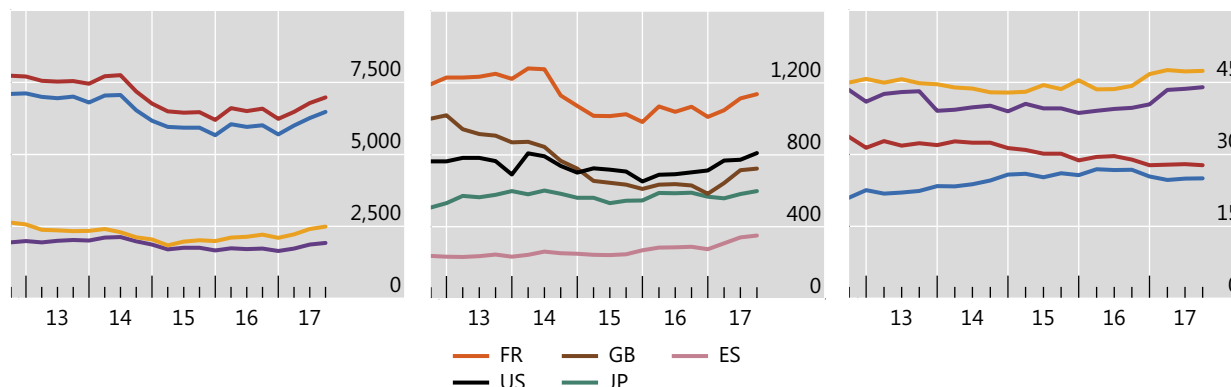
Graph B.1

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

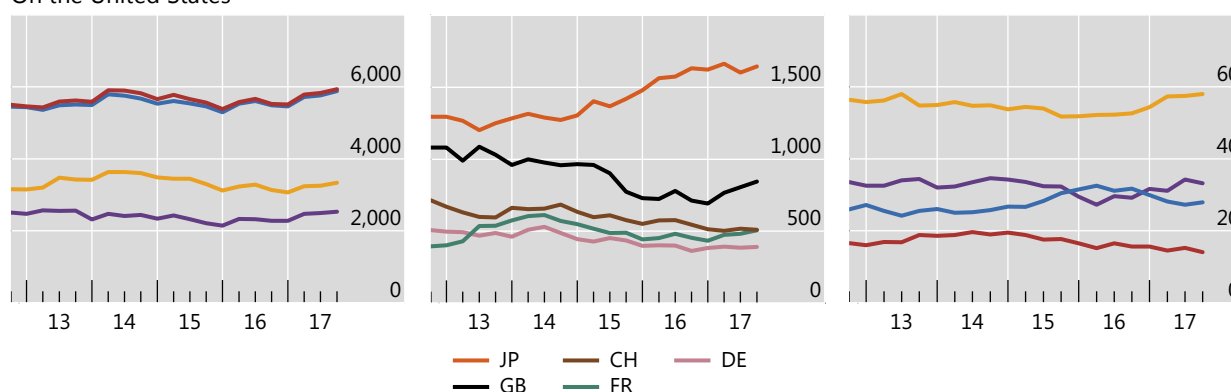
Foreign claims of selected creditors, in USD bn^{1,3}

International claims, by sector and maturity, in per cent⁴

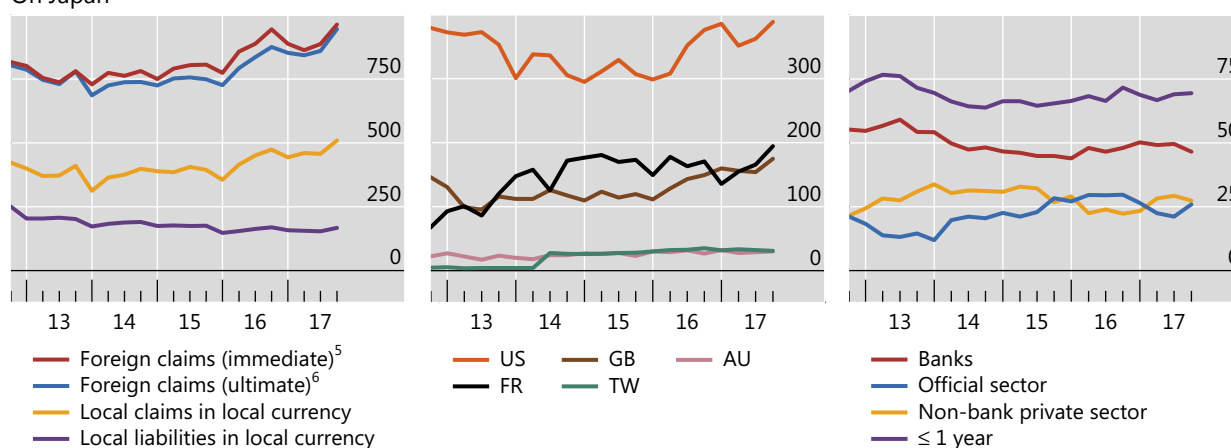
On the euro area



On the United States



On Japan



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

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

Source: BIS consolidated banking statistics (CBS).

Consolidated claims of reporting banks on emerging market economies

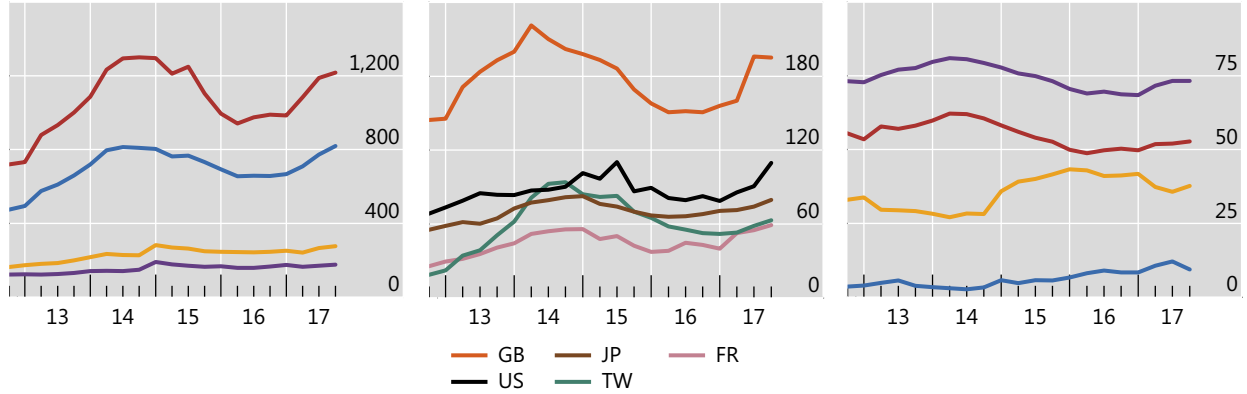
Graph B.2

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

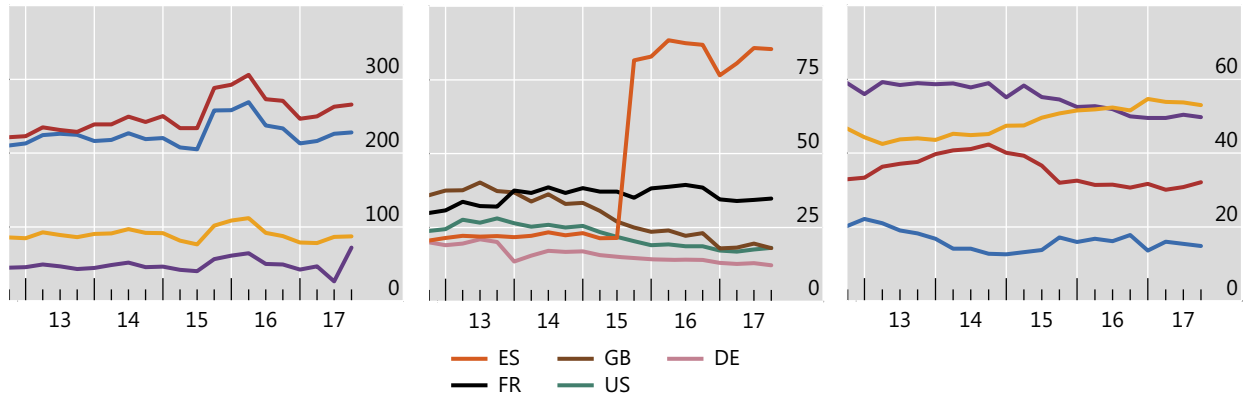
Foreign claims of selected creditors, in USD bn^{1,3}

International claims, by sector and maturity, in per cent⁴

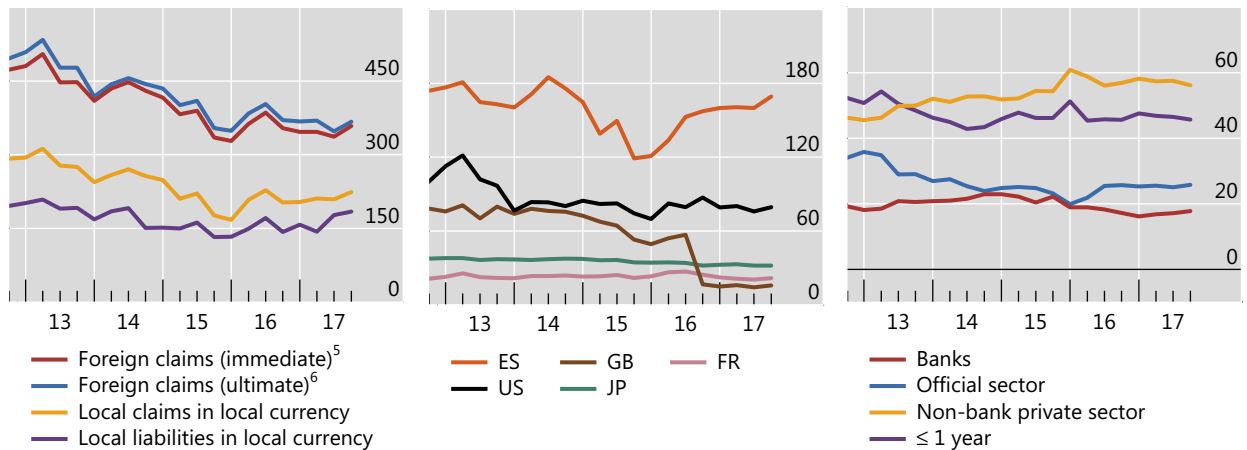
On China



On Turkey



On Brazil



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

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

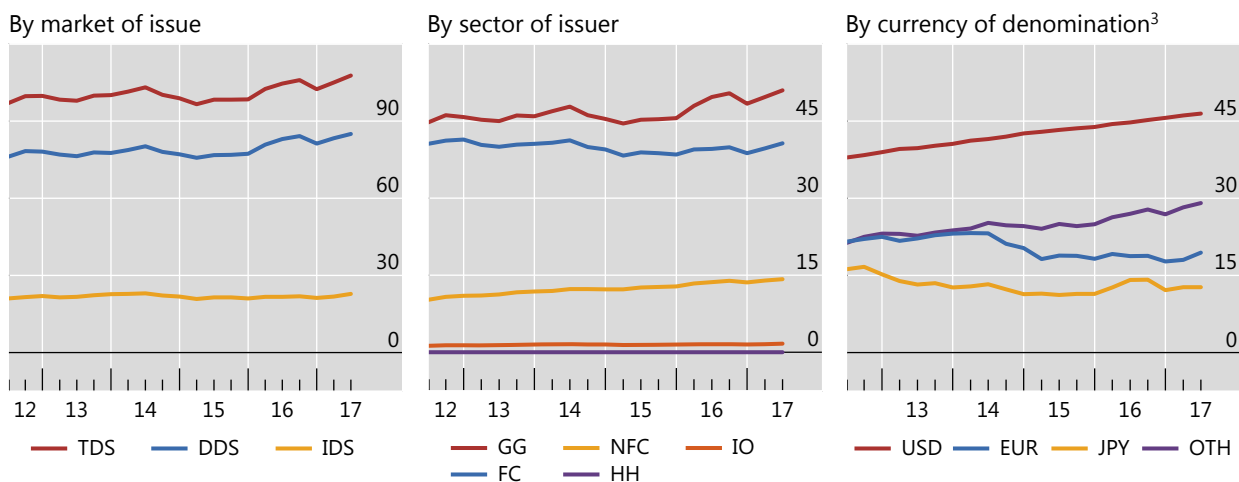
Source: BIS consolidated banking statistics (CBS).

C Debt securities statistics

Global debt securities markets¹

Amounts outstanding, in trillions of US dollars²

Graph C.1



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

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

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

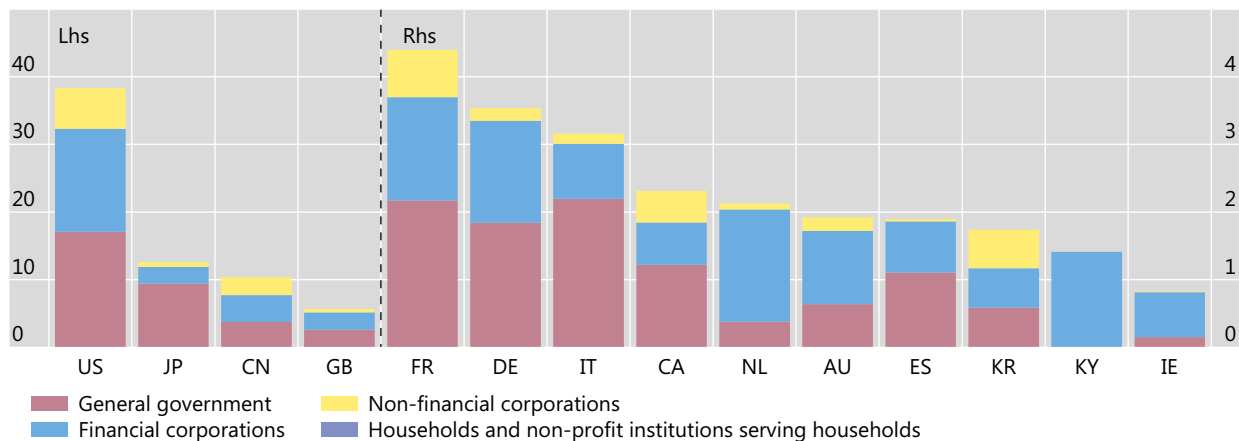
¹ Sample of countries varies across breakdowns shown. For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. For countries that do not report either TDS or DDS, data are estimated by the BIS as IDS. ² At quarter-end. Amounts denominated in currencies other than the US dollar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

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

Total debt securities, by residence and sector of issuer¹

Amounts outstanding at end-June 2017, in trillions of US dollars²

Graph C.2



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

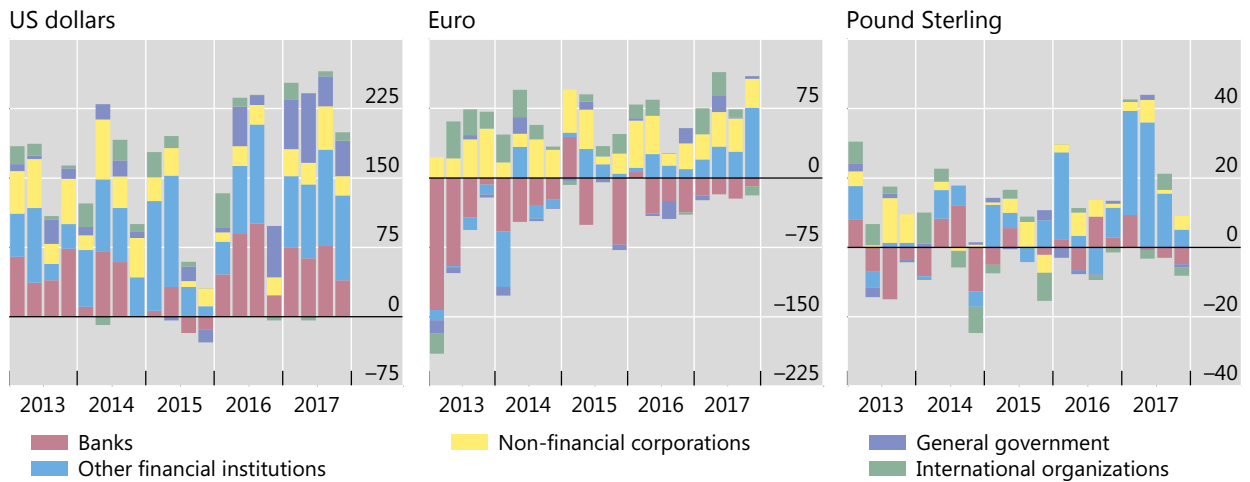
¹ For countries that do not report TDS, data are estimated by the BIS as DDS plus IDS. ² Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Sources: National data; BIS debt securities statistics.

Net issuance of international debt securities

By issuer sector and currency of denomination, in billions of US dollars

Graph C.3



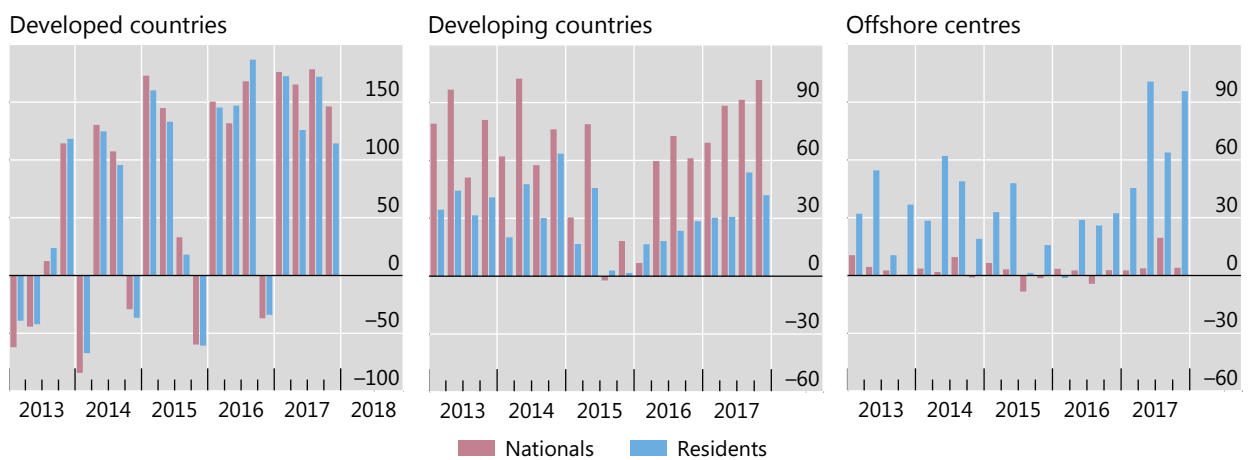
Further information is available at www.bis.org/statistics/secstats.htm.

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

International debt securities issued by financial and non-financial corporations¹

Net issuance by region, in billions of US dollars²

Graph C.4



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

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

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

D Derivatives statistics

Exchange-traded derivatives

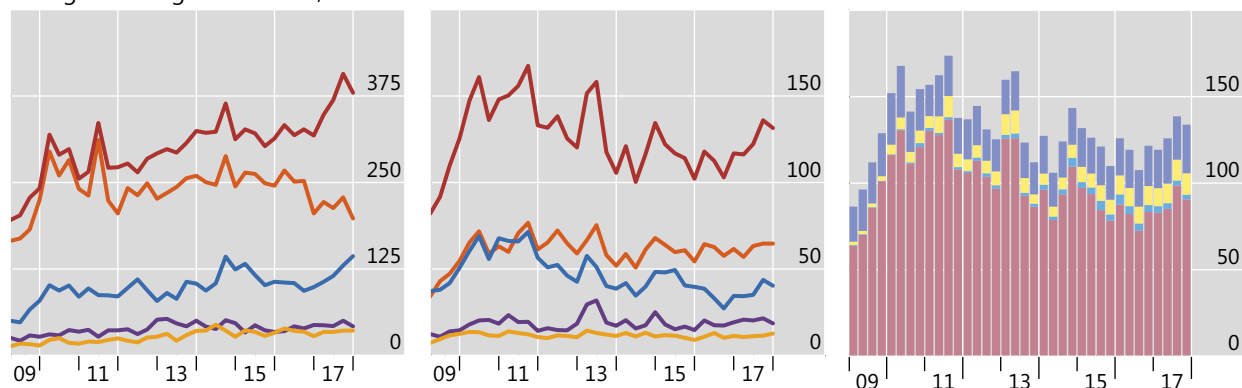
Graph D.1

Open interest, by currency¹

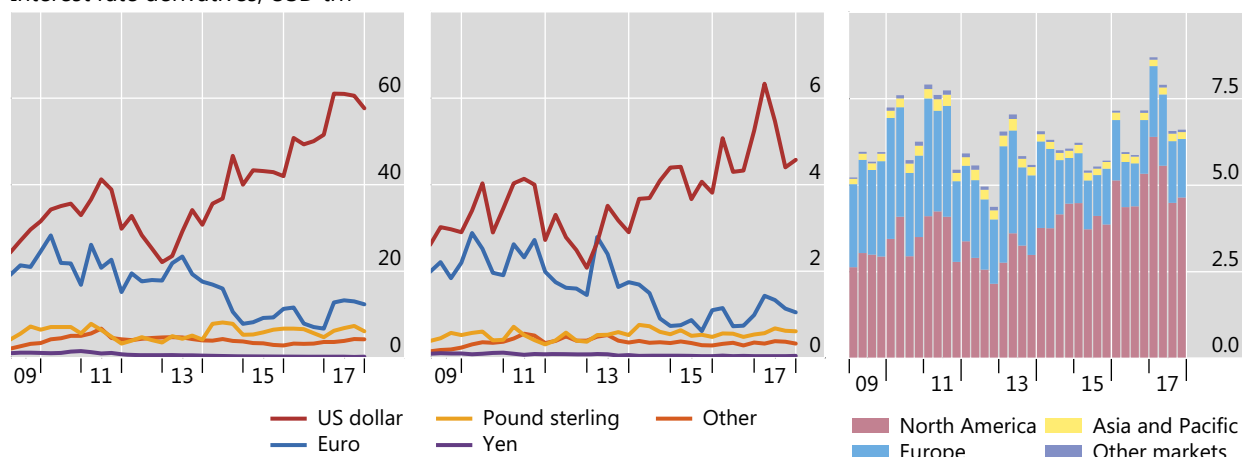
Daily average turnover, by currency²

Daily average turnover, by location of exchange²

Foreign exchange derivatives, USD bn³



Interest rate derivatives, USD trn³



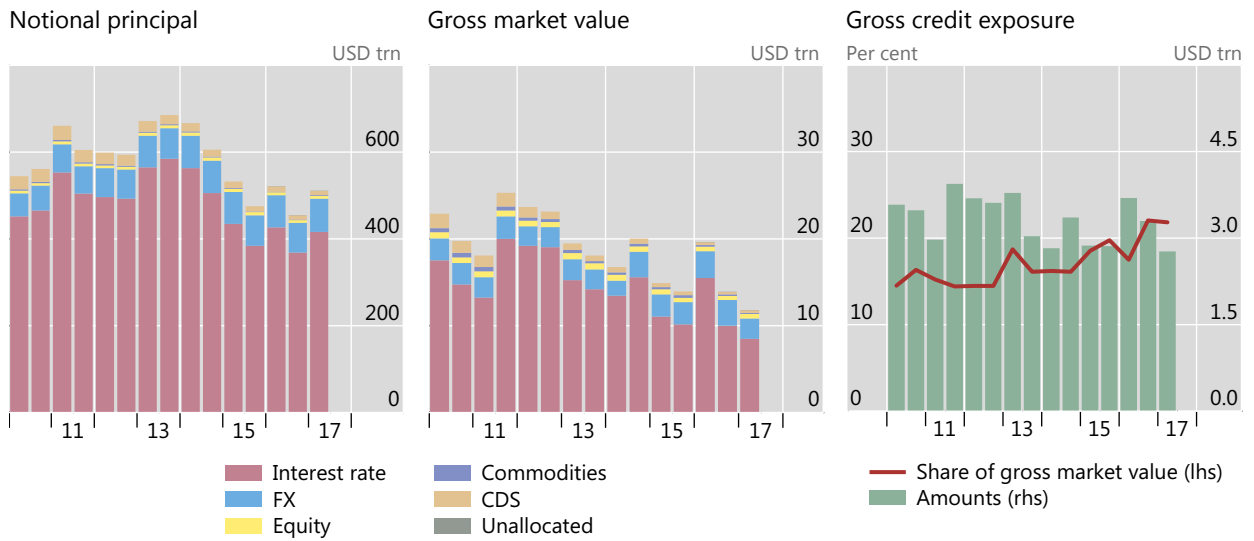
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/extderiv.htm.

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

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

Global OTC derivatives markets¹

Graph D.2



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

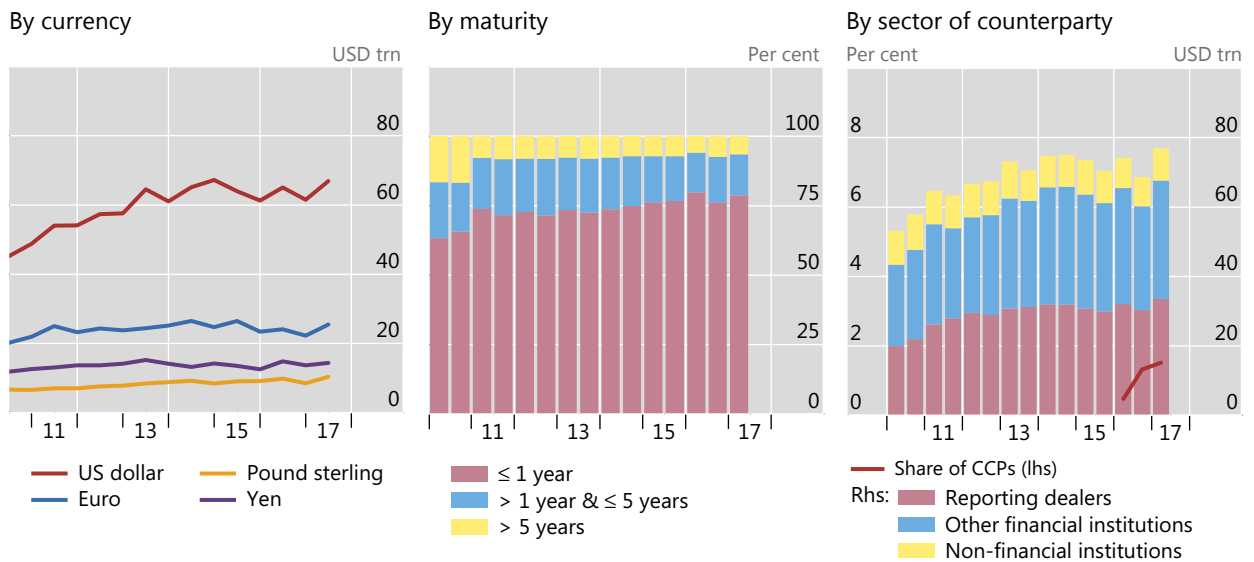
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC foreign exchange derivatives

Notional principal¹

Graph D.3



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

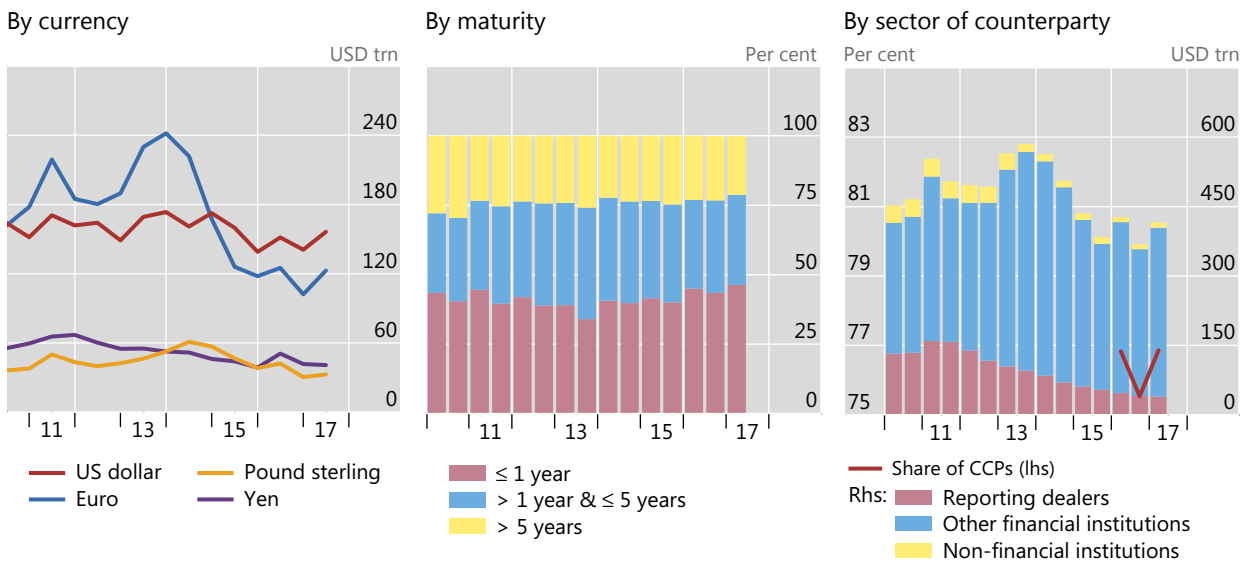
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC interest rate derivatives

Notional principal¹

Graph D.4



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

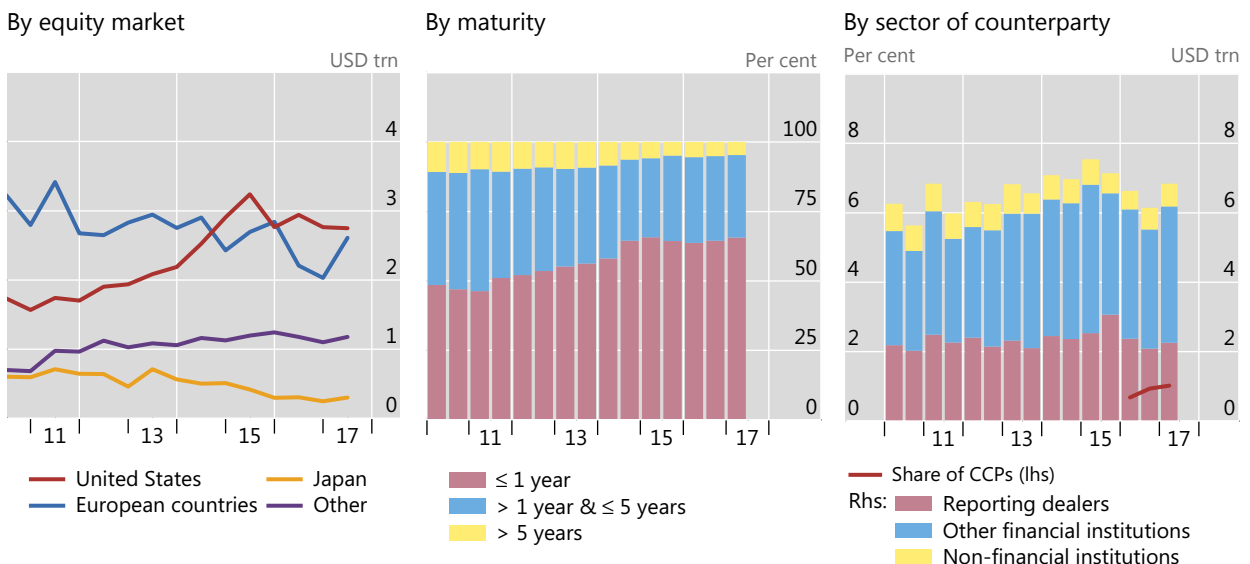
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

OTC equity-linked derivatives

Notional principal¹

Graph D.5



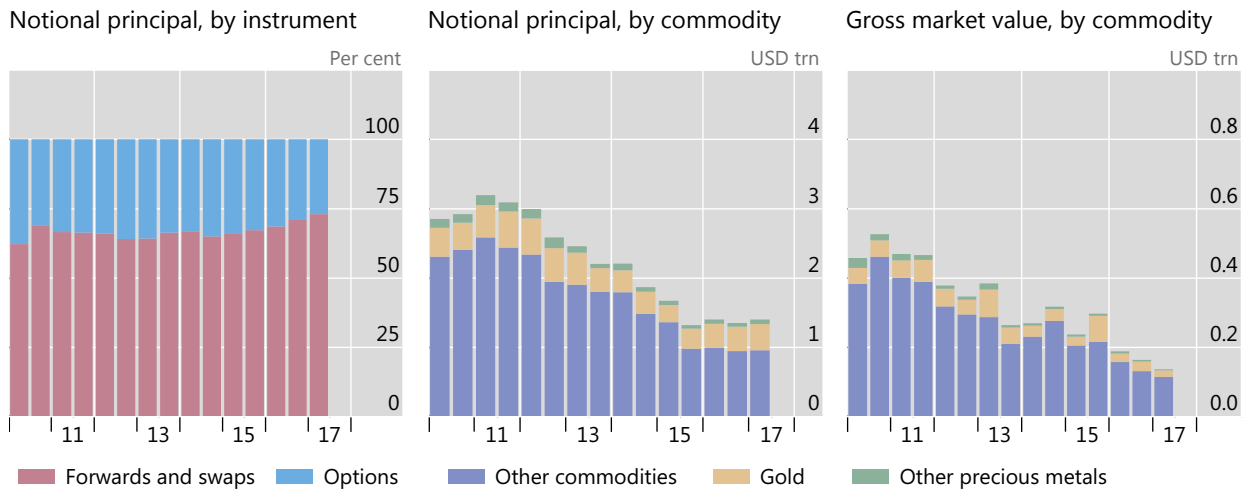
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

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

Source: BIS derivatives statistics.

OTC commodity derivatives¹

Graph D.6



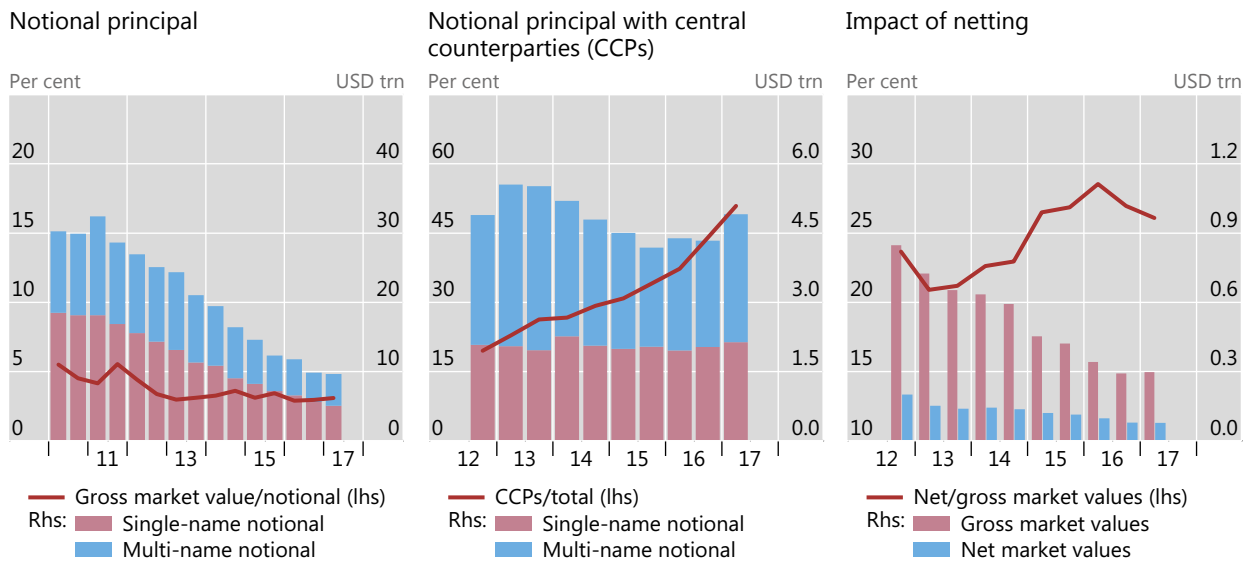
Further information on the BIS derivatives statistics is available at www.bis.org/statistics/derstats.htm.

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

Source: BIS derivatives statistics.

Credit default swaps¹

Graph D.7



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

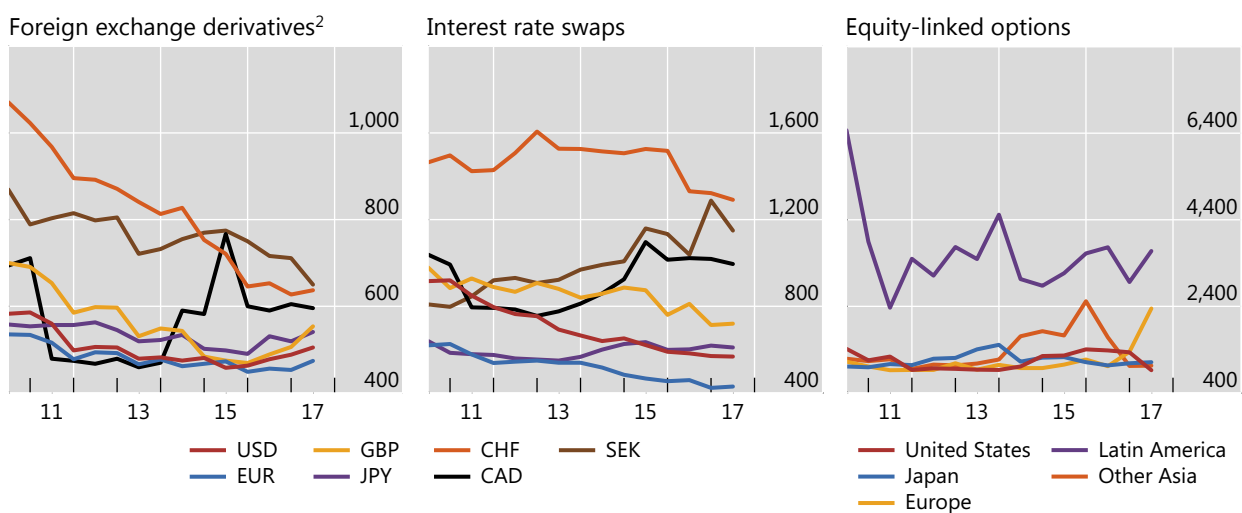
¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS derivatives statistics.

Concentration in global OTC derivatives markets

Herfindahl index¹

Graph D.8



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

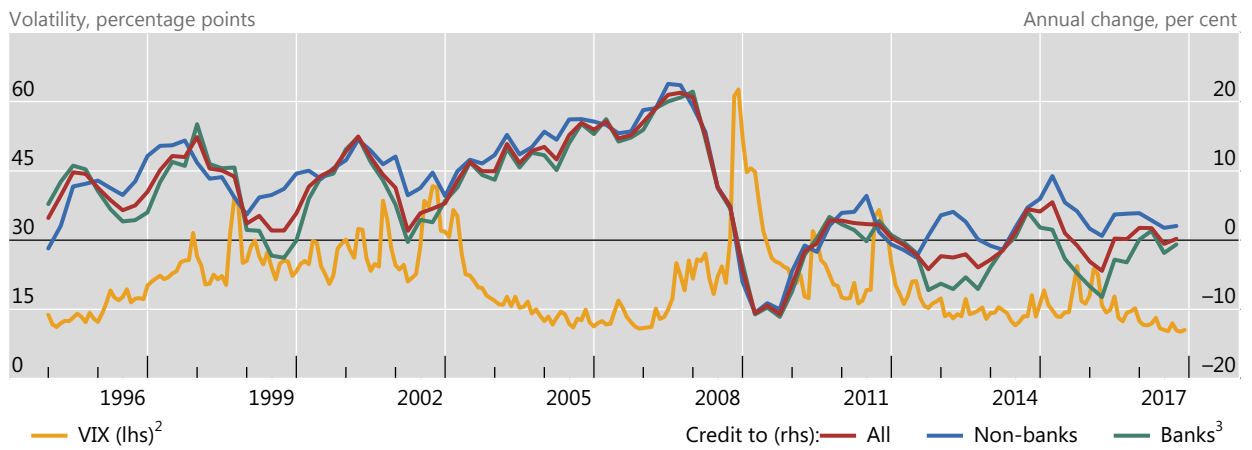
¹ The index ranges from 0 to 10,000, where a lower number indicates that there are many dealers with similar market shares (as measured by notional principal) and a higher number indicates that the market is dominated by a few reporting dealers. ² Foreign exchange forwards, foreign exchange swaps and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

Source: BIS derivatives statistics.

E Global liquidity indicators

Growth of international bank credit¹

Graph E.1



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

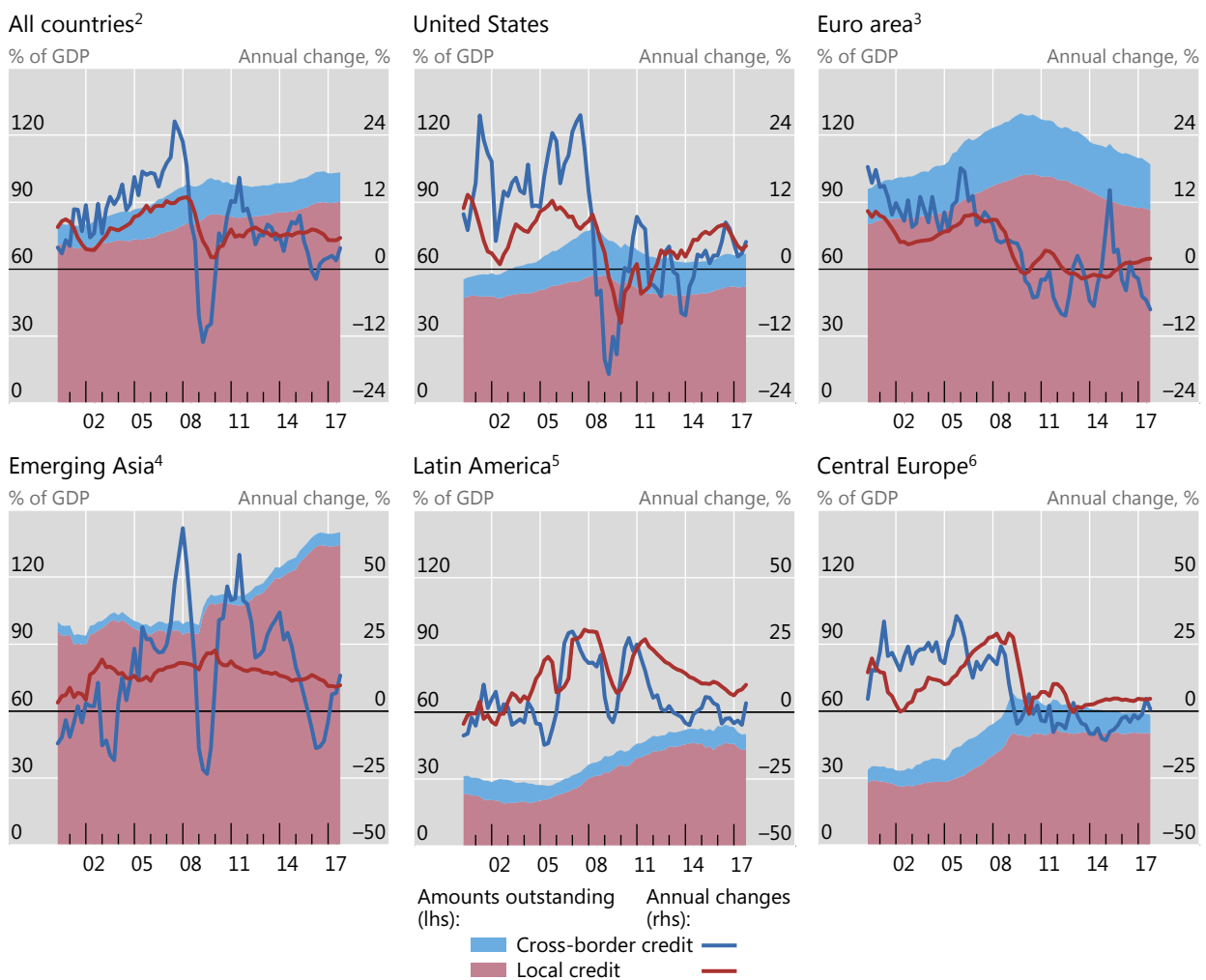
¹ LBS-reporting banks' cross-border claims plus local claims in foreign currencies. ² Chicago Board Options Exchange S&P 500 implied volatility index; standard deviation, in percentage points per annum. ³ Including intragroup transactions.

Sources: Bloomberg; BIS locational banking statistics.

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

Banks' cross-border credit plus local credit in all currencies¹

Graph E.2



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

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

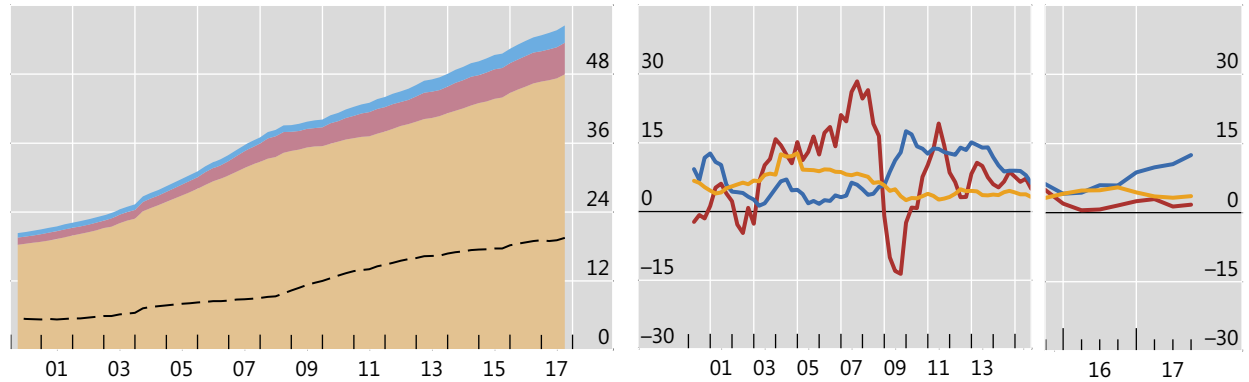
Global credit to the non-financial sector, by currency

Graph E.3

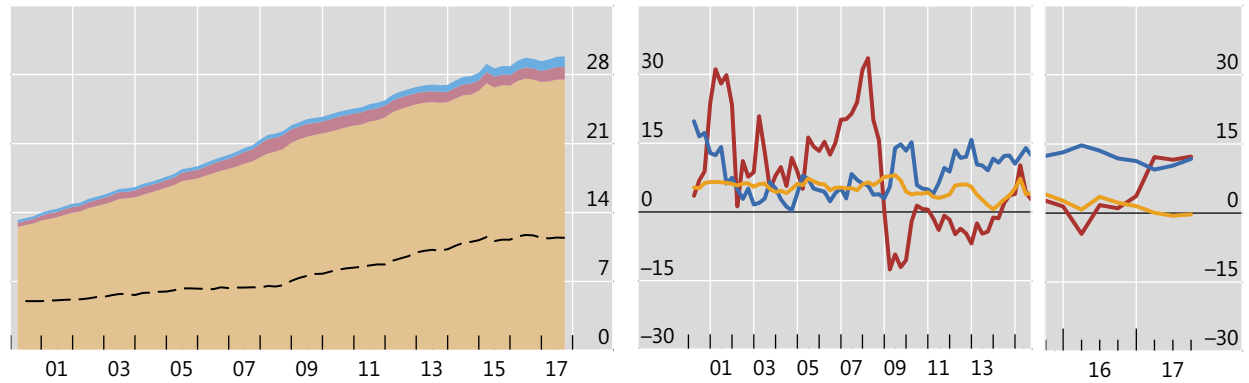
Amounts outstanding, in trillions of currency units¹

Annual change, in per cent²

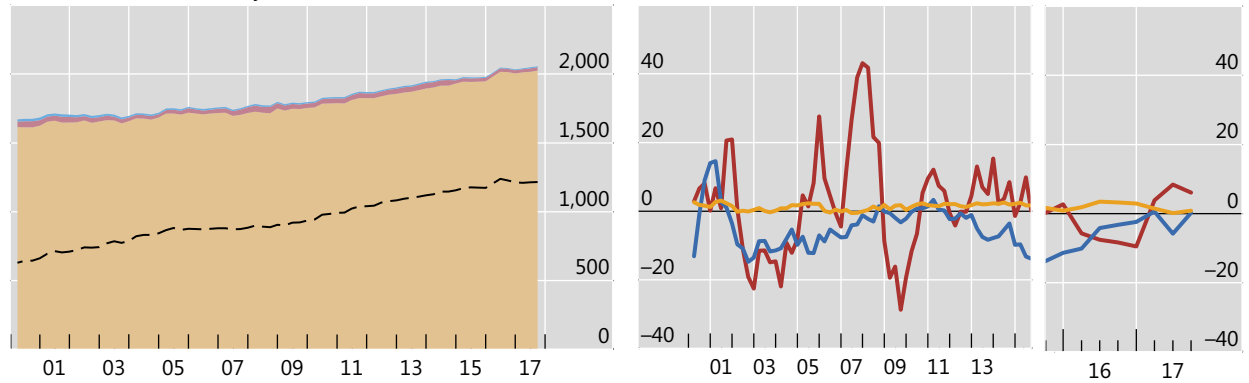
Credit denominated in US dollars (USD)



Credit denominated in euros (EUR)



Credit denominated in yen (JPY)



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

Credit to government

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

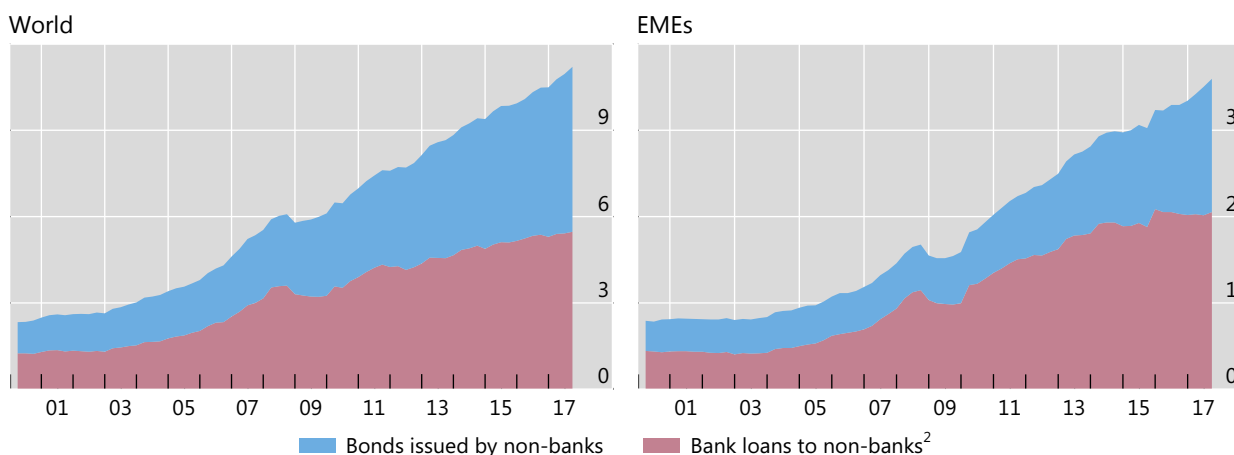
¹ Amounts outstanding at quarter-end. ² Based on quarterly break- and exchange rate-adjusted changes. ³ Credit to non-financial borrowers residing in the United States/euro area/Japan. National financial accounts are adjusted using BIS banking and securities statistics to exclude credit denominated in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

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

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

Amounts outstanding, in trillions of US dollars

Graph E.4



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

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

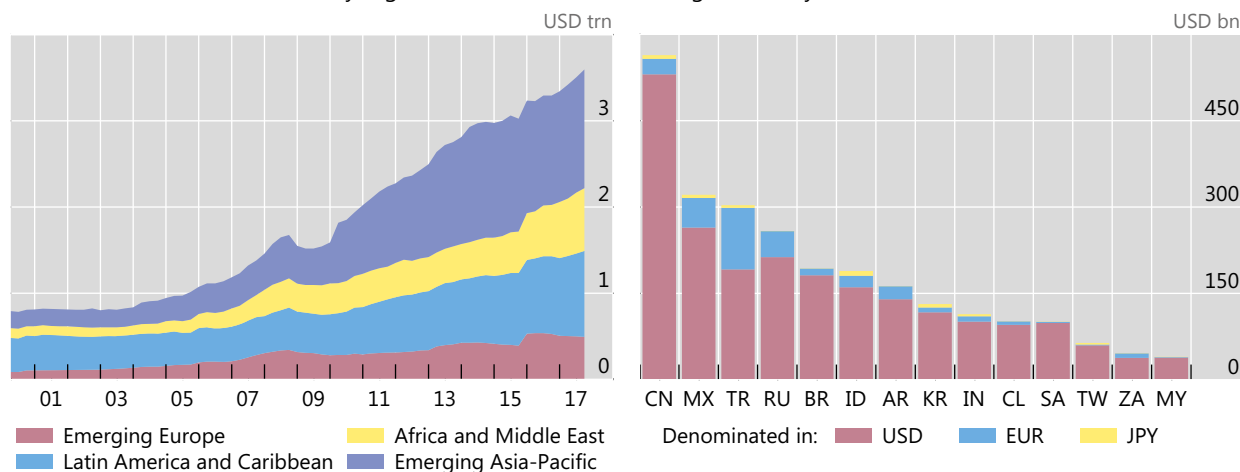
Sources: Datastream; Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; national data; BIS locational banking statistics (LBS); BIS calculations.

Foreign currency credit to non-banks in EMEs

Graph E.5

US dollar-denominated credit by region

Foreign currency credit to selected EMEs¹



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

¹ Amounts outstanding for the latest available data.

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

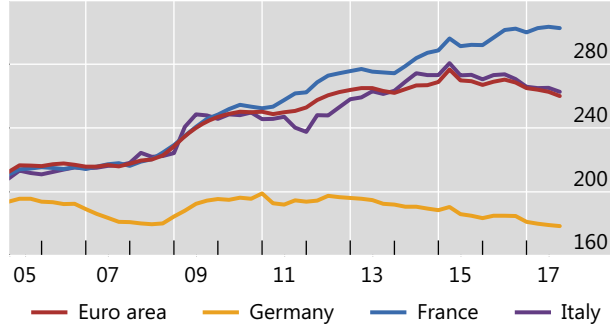
F Statistics on total credit to the non-financial sector

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

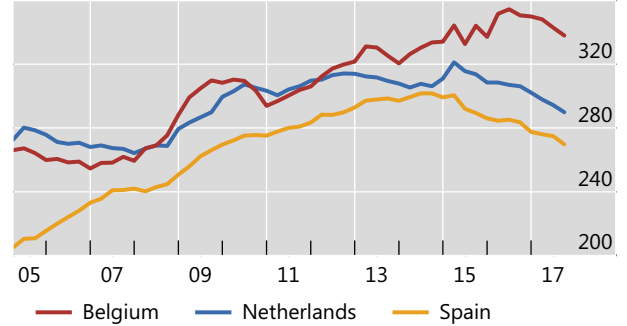
As a percentage of GDP

Graph F.1

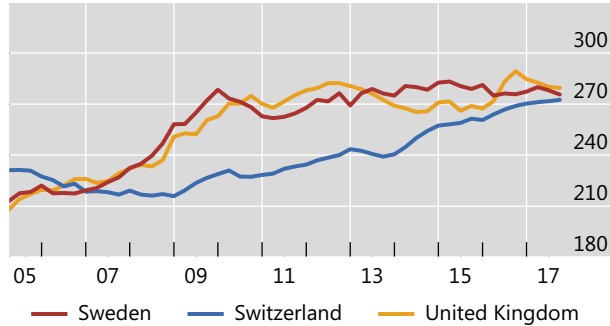
Euro area: aggregate and major countries



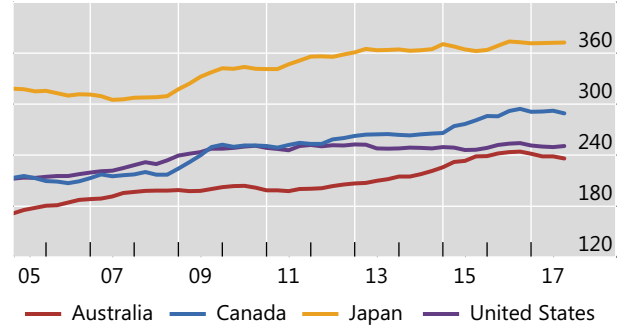
Euro area: other countries



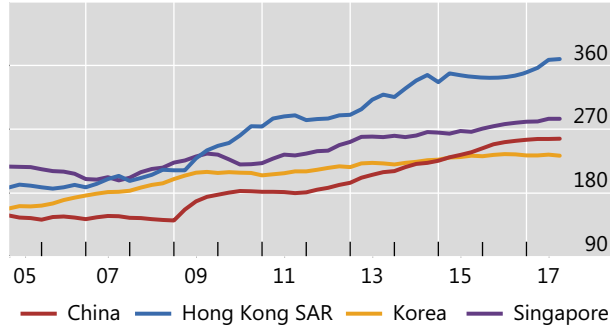
Other European countries



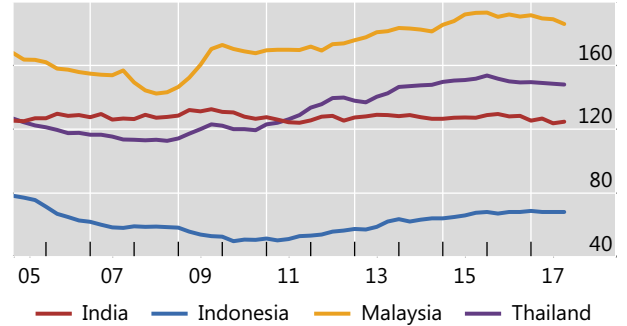
Major advanced economies



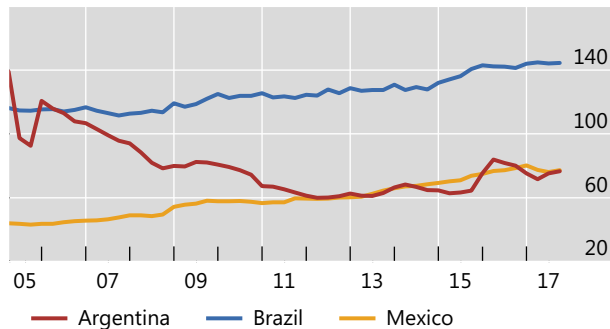
Emerging Asia



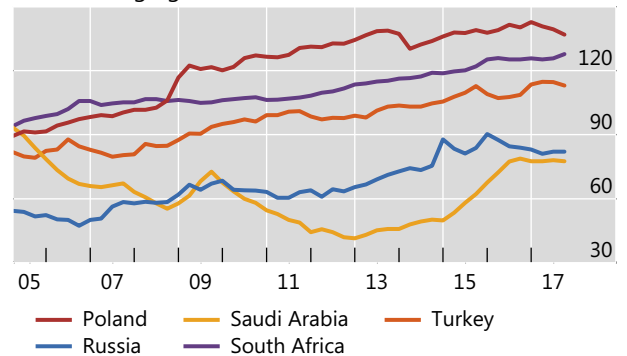
Other emerging Asia



Latin America



Other emerging market economies



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

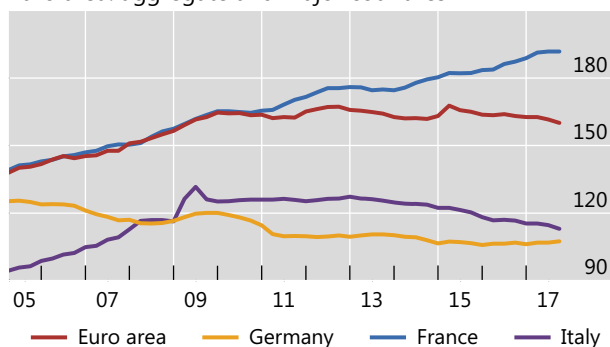
Source: BIS total credit statistics.

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

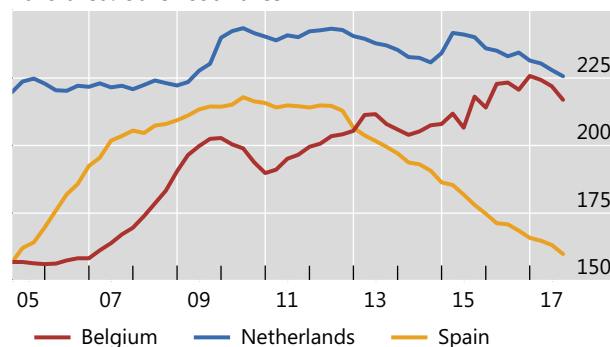
As a percentage of GDP

Graph F.2

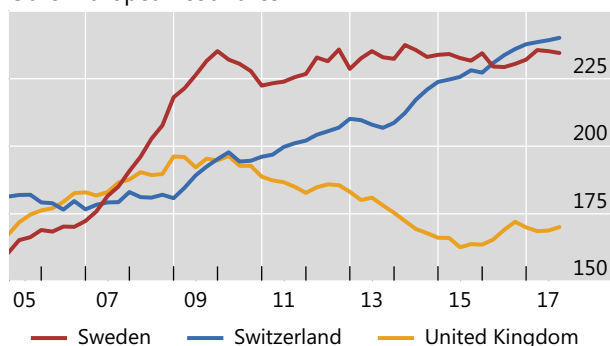
Euro area: aggregate and major countries



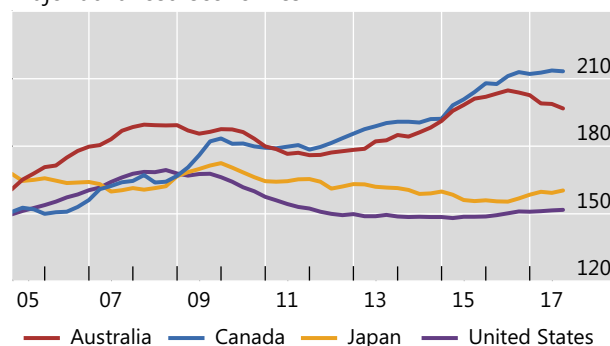
Euro area: other countries



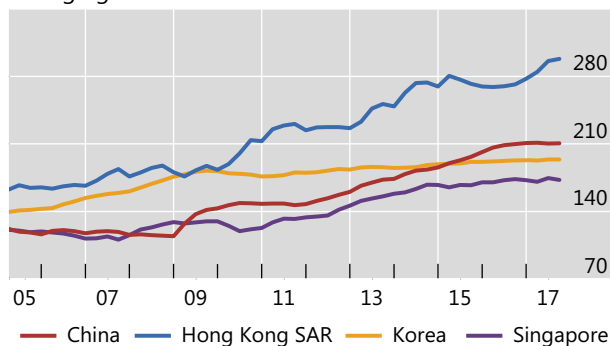
Other European countries



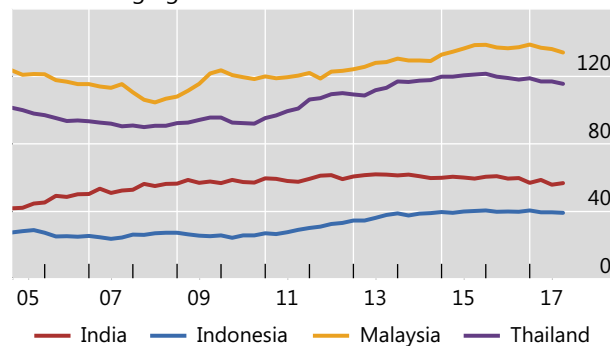
Major advanced economies



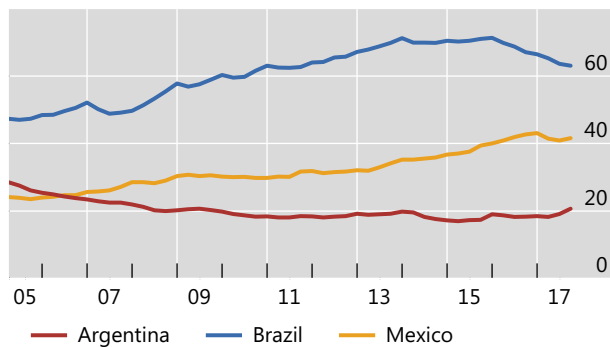
Emerging Asia



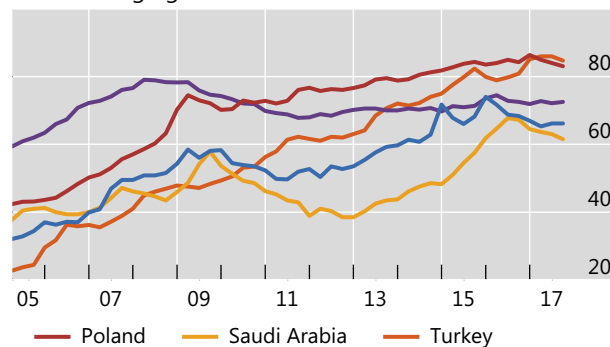
Other emerging Asia



Latin America



Other emerging market economies



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

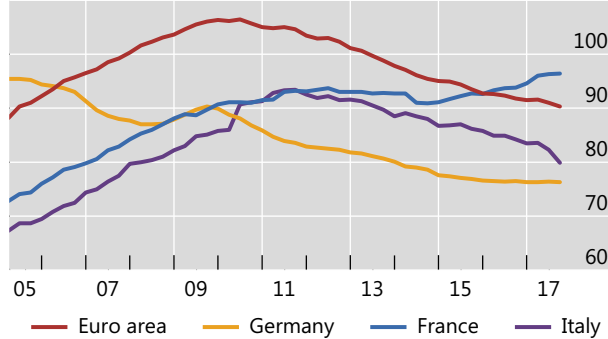
Source: BIS total credit statistics.

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

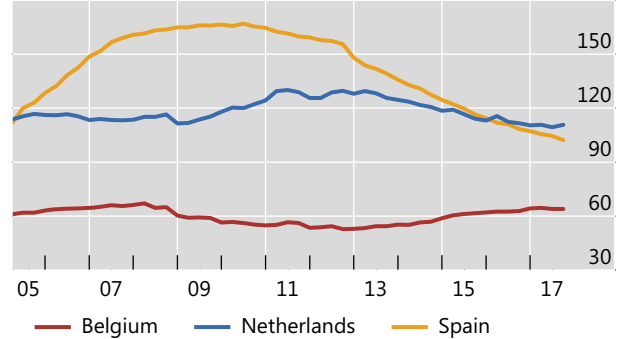
As a percentage of GDP

Graph F.3

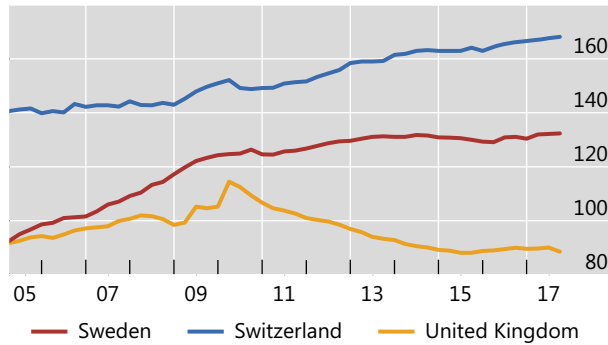
Euro area: aggregate and major countries



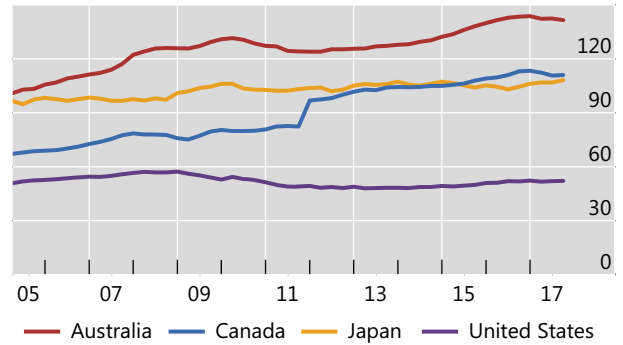
Euro area: other countries



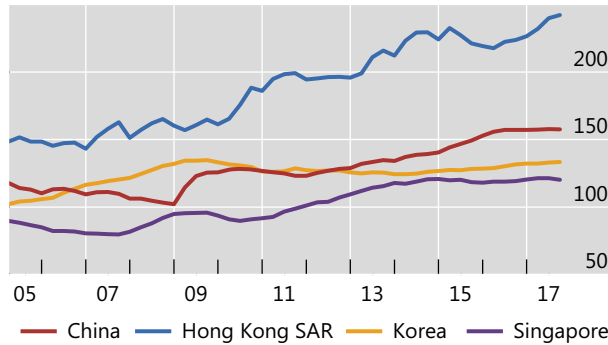
Other European countries



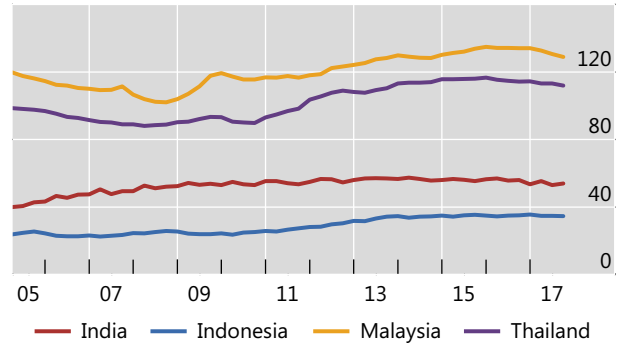
Major advanced economies



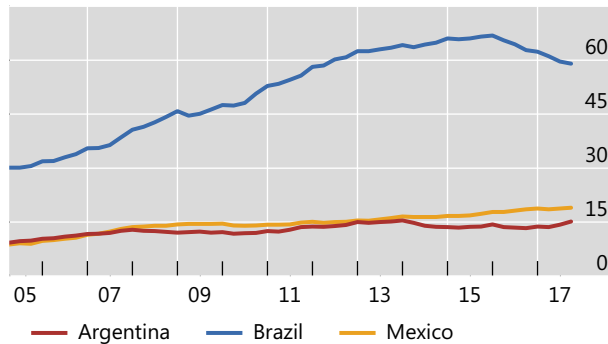
Emerging Asia



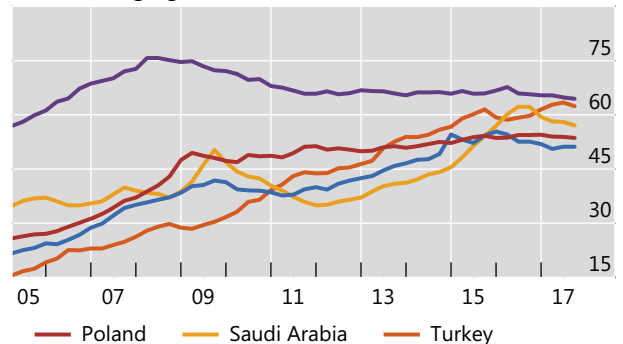
Other emerging Asia



Latin America



Other emerging market economies



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

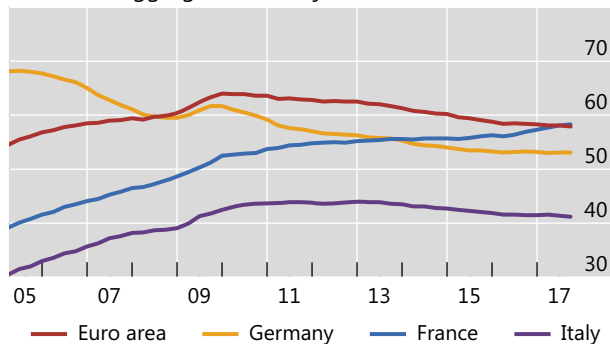
Source: BIS total credit statistics.

Total credit to households (core debt)

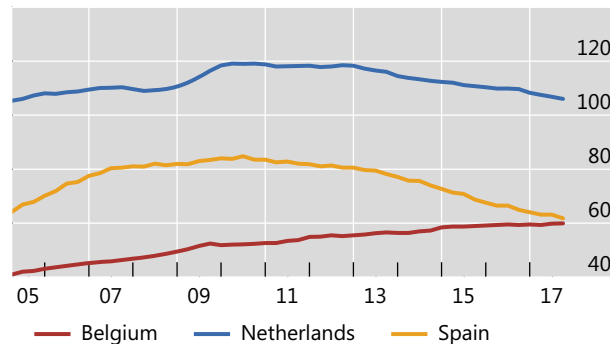
As a percentage of GDP

Graph F.4

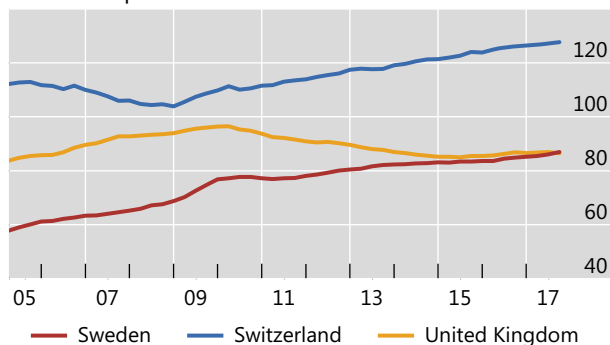
Euro area: aggregate and major countries



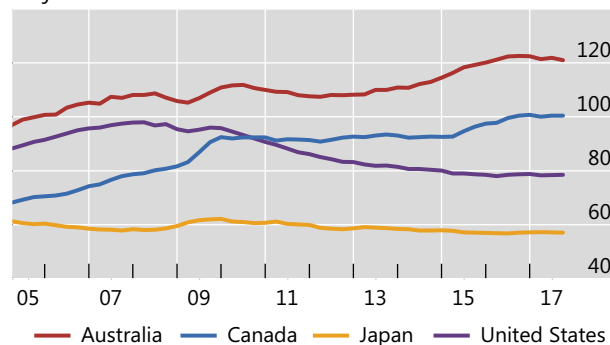
Euro area: other countries



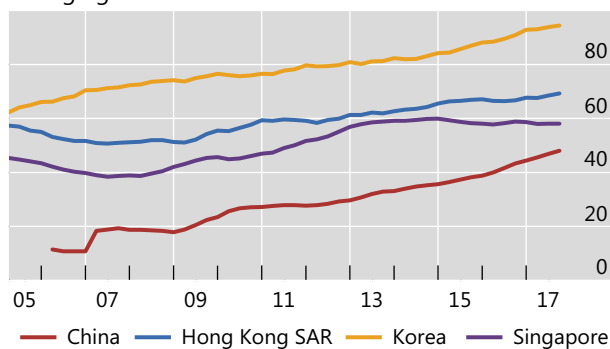
Other European countries



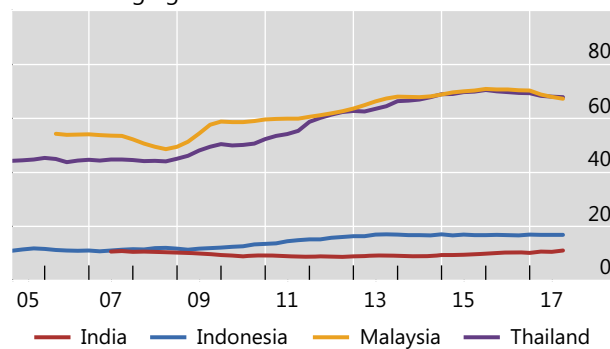
Major advanced economies



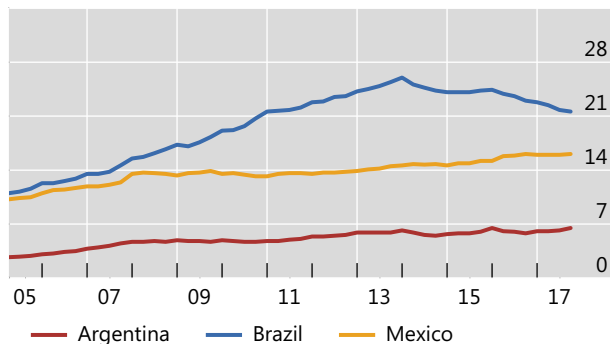
Emerging Asia



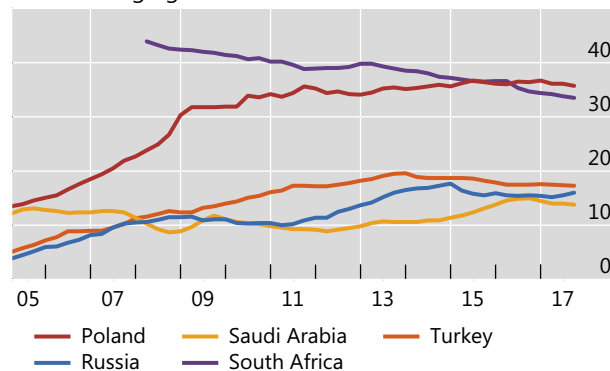
Other emerging Asia



Latin America



Other emerging market economies



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

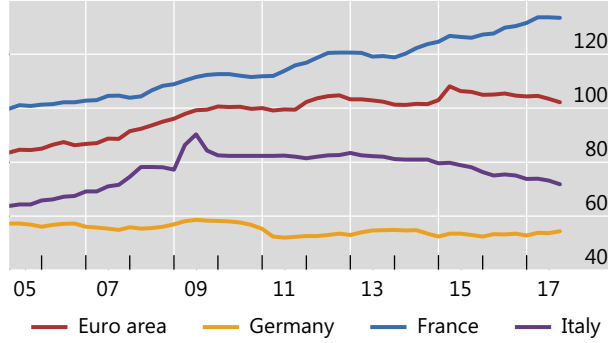
Source: BIS total credit statistics.

Total credit to non-financial corporations (core debt)

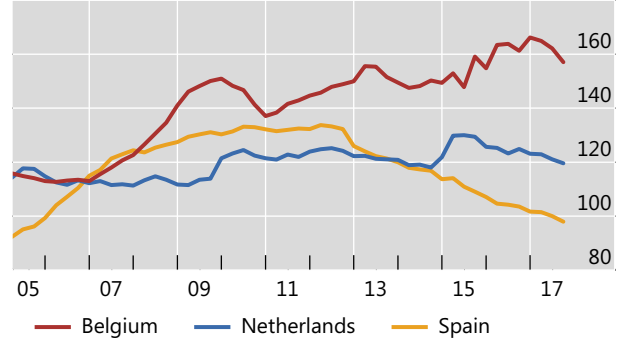
As a percentage of GDP

Graph F.5

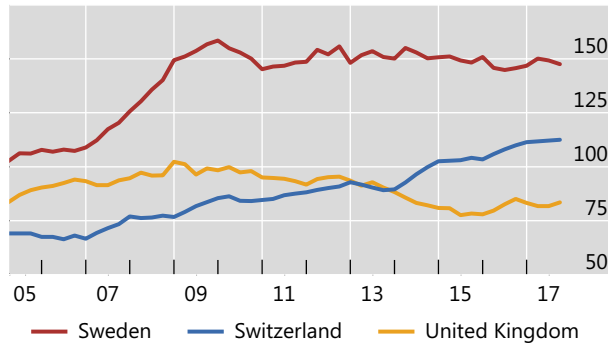
Euro area: aggregate and major countries



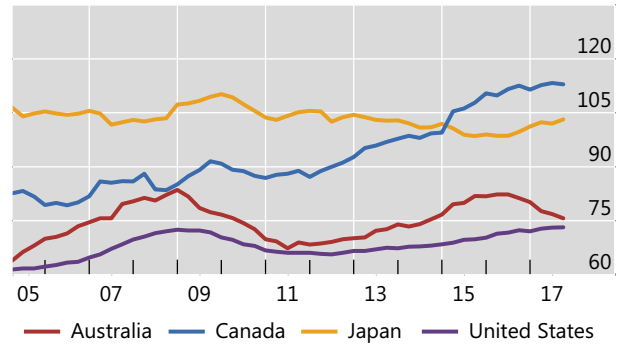
Euro area: other countries



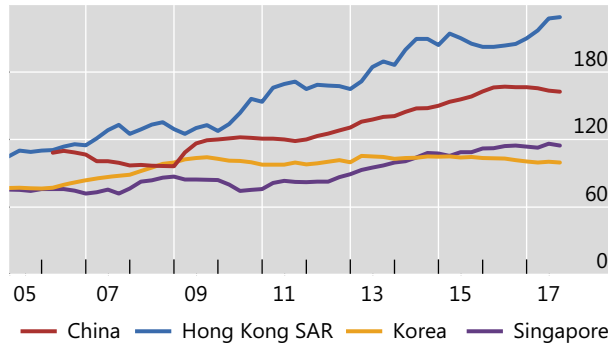
Other European countries



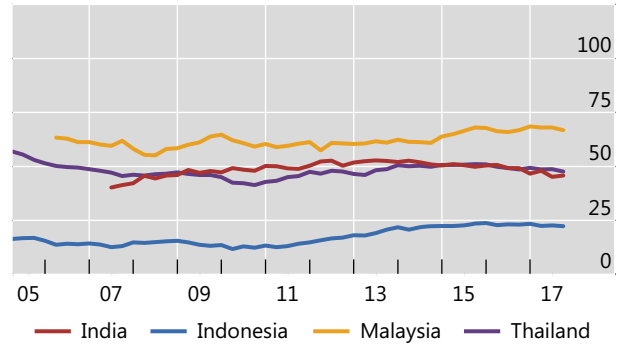
Major advanced economies



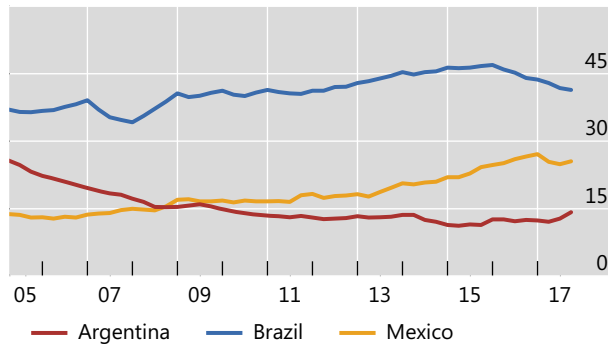
Emerging Asia



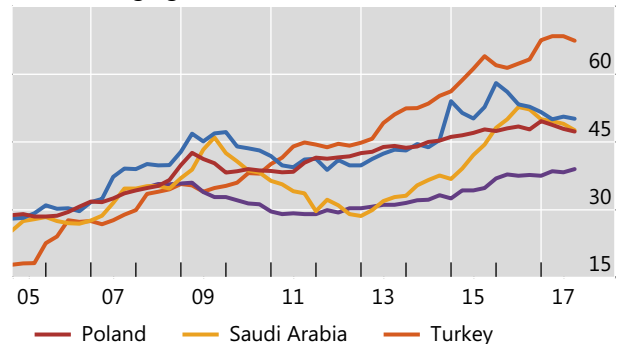
Other emerging Asia



Latin America



Other emerging market economies



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

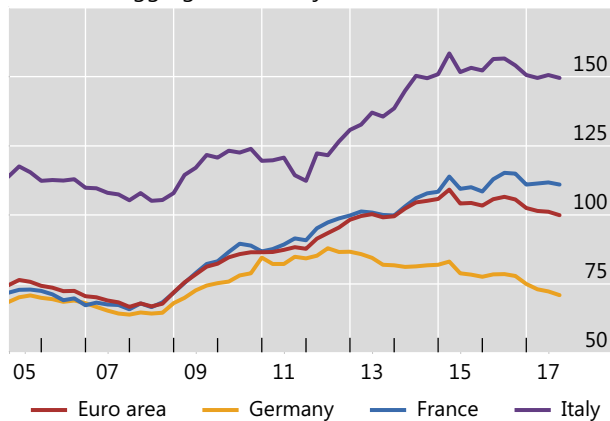
Source: BIS total credit statistics.

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

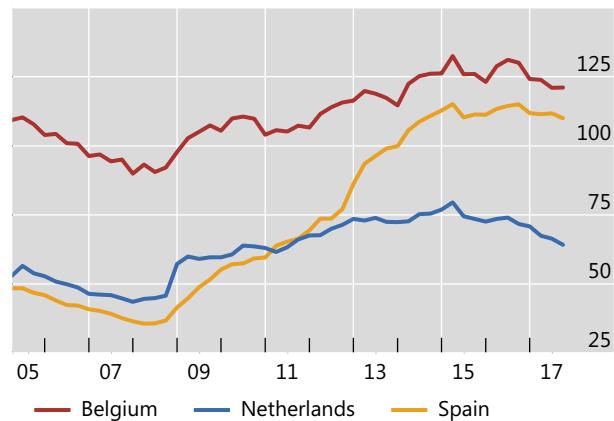
As a percentage of GDP

Graph F.6

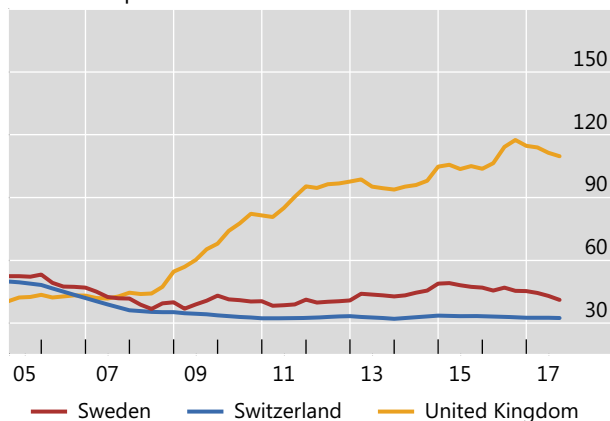
Euro area: aggregate and major countries



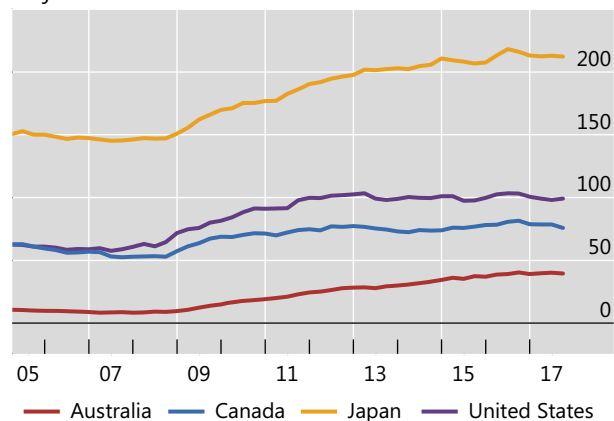
Euro area: other countries



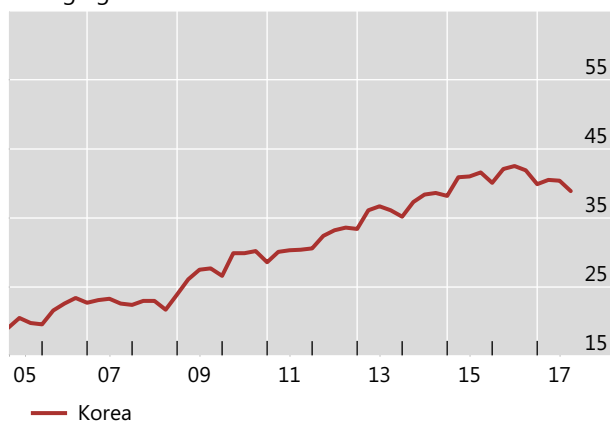
Other European countries



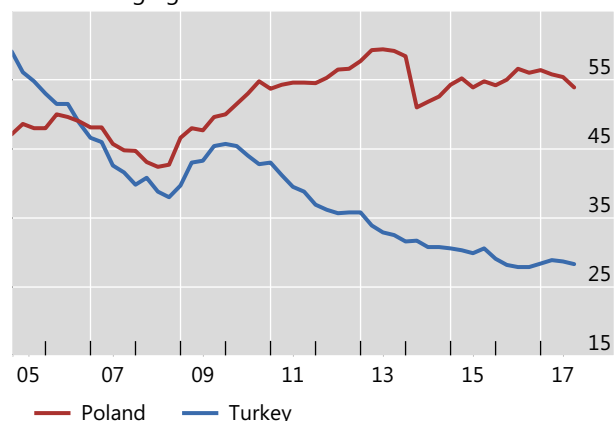
Major advanced economies



Emerging Asia



Other emerging market economies



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

¹ Consolidated data for the general government sector.

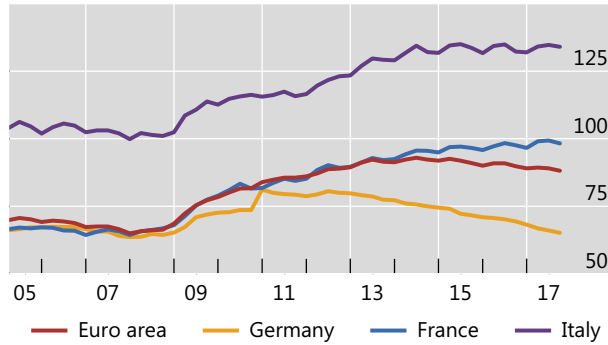
Source: BIS total credit statistics.

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

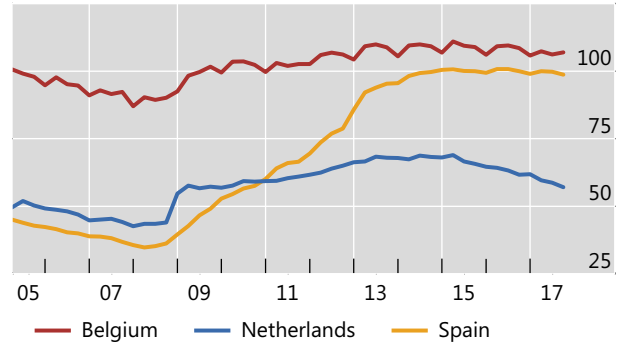
As a percentage of GDP

Graph F.7

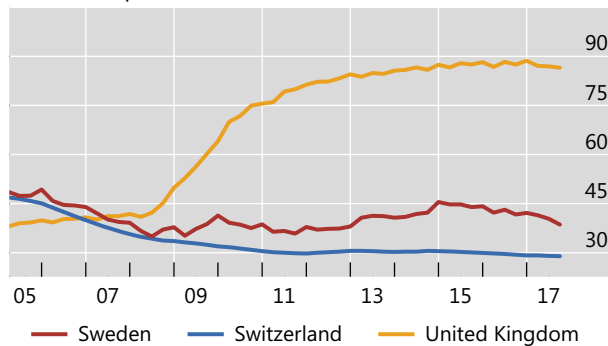
Euro area: aggregate and major countries



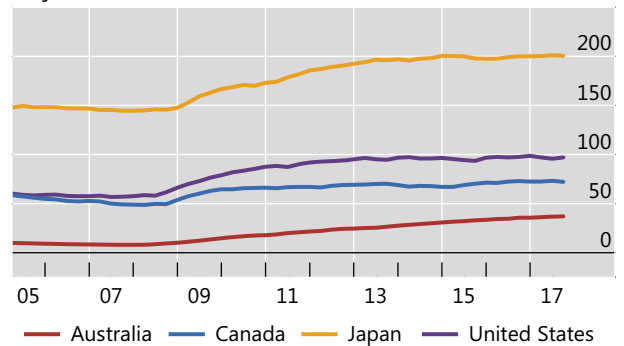
Euro area: other countries



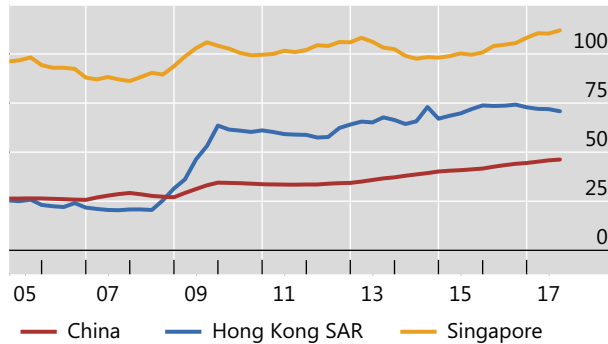
Other European countries



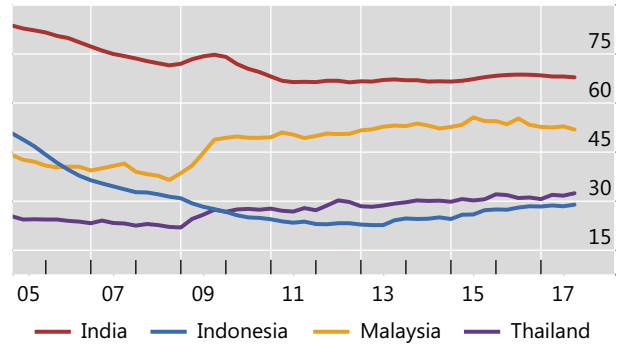
Major advanced economies



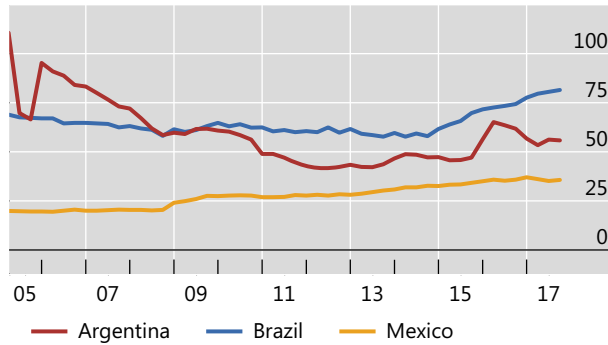
Emerging Asia



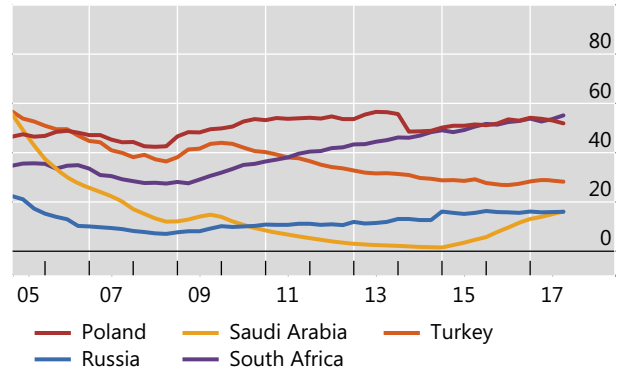
Other emerging Asia



Latin America



Other emerging market economies



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

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

Source: BIS total credit statistics.

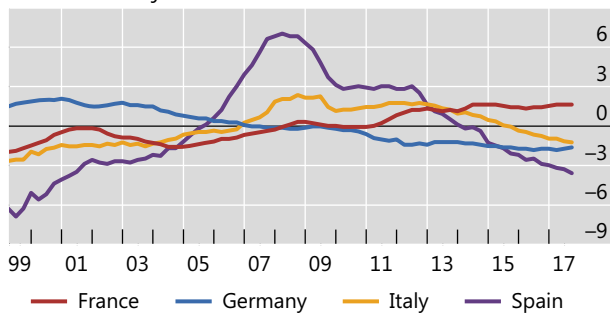
G Debt service ratios for the private non-financial sector

Debt service ratios of the private non-financial sector

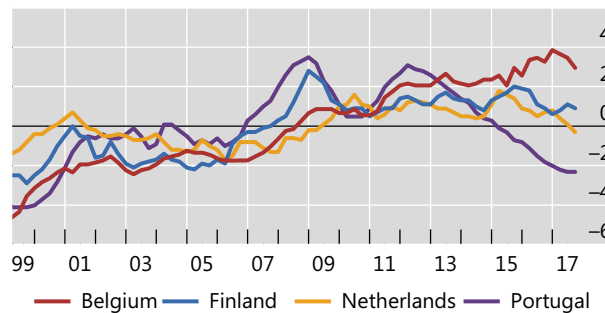
Deviation from country-specific mean, in percentage points¹

Graph G.1

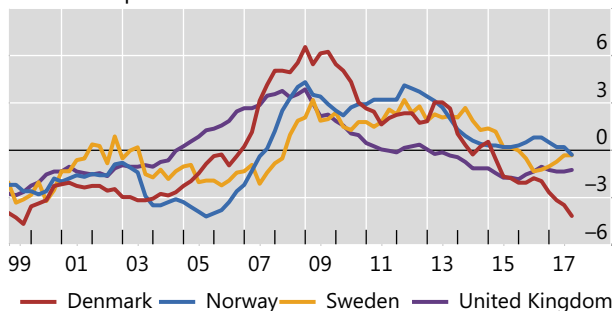
Euro area: major countries



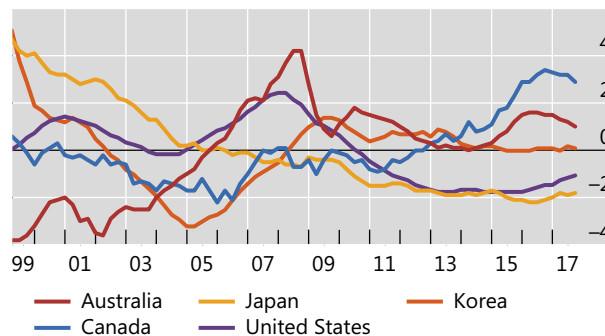
Euro area: other countries



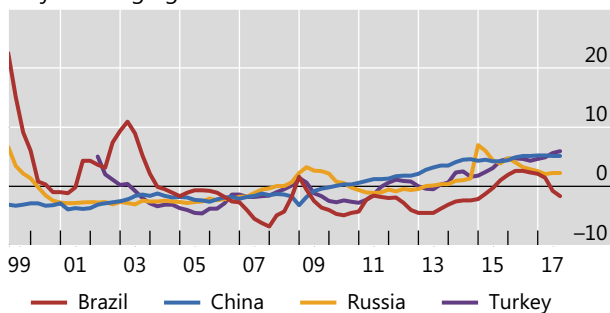
Other European countries



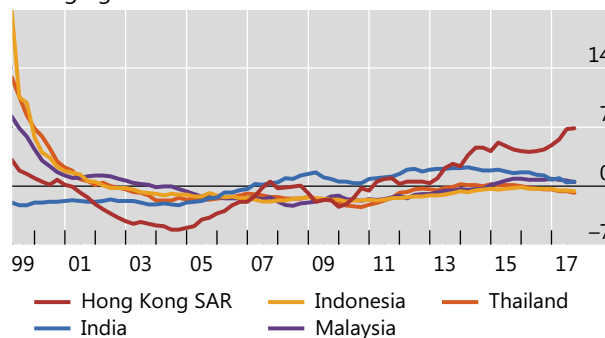
Other economies



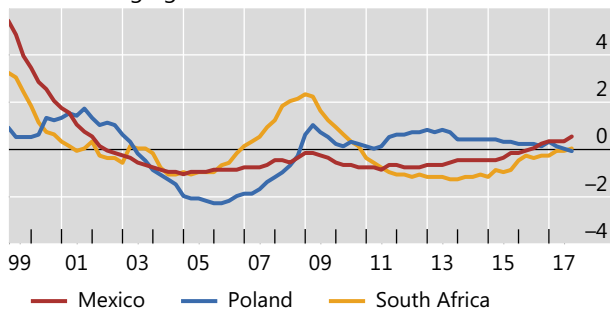
Major emerging markets²



Emerging Asia²



Other emerging markets²



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

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

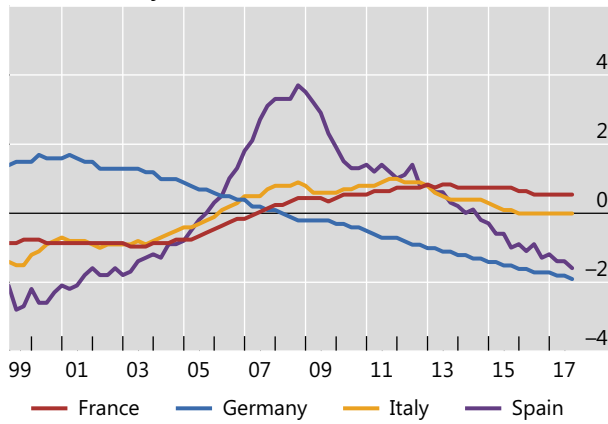
Source: BIS debt service ratios statistics.

Debt service ratios of households

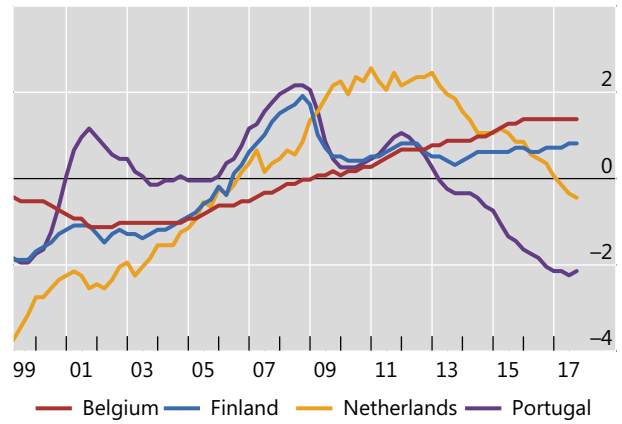
Deviation from country-specific mean, in percentage points¹

Graph G.2

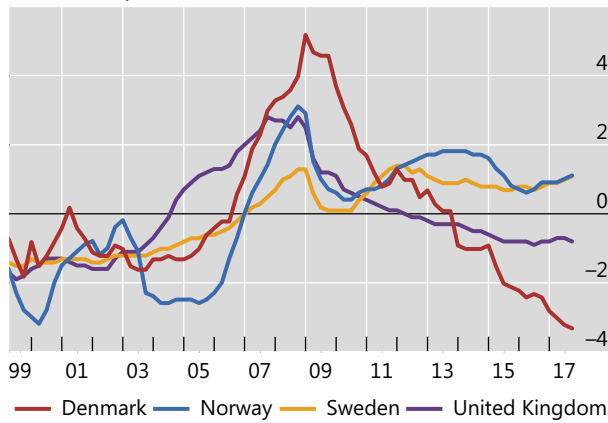
Euro area: major countries



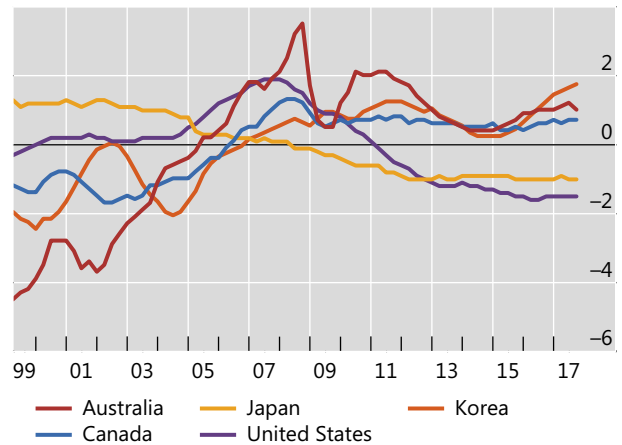
Euro area: other countries



Other European countries



Other economies



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

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

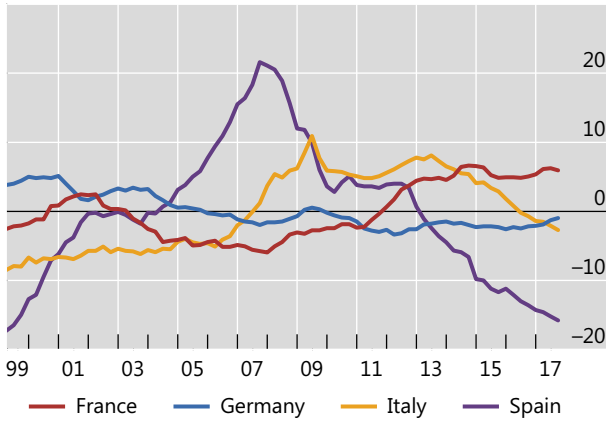
Source: BIS debt service ratios statistics.

Debt service ratios of non-financial corporations

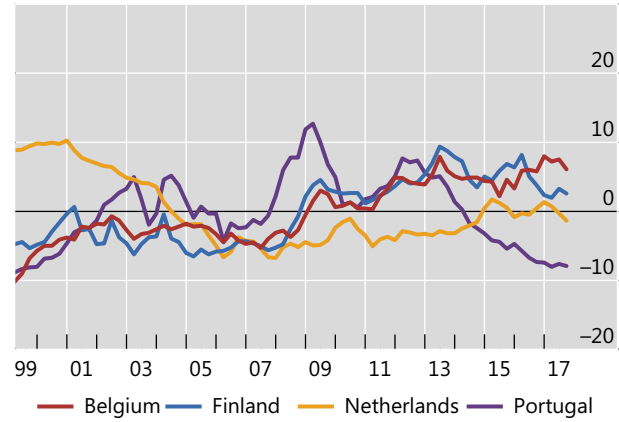
Deviation from country-specific mean, in percentage points¹

Graph G.3

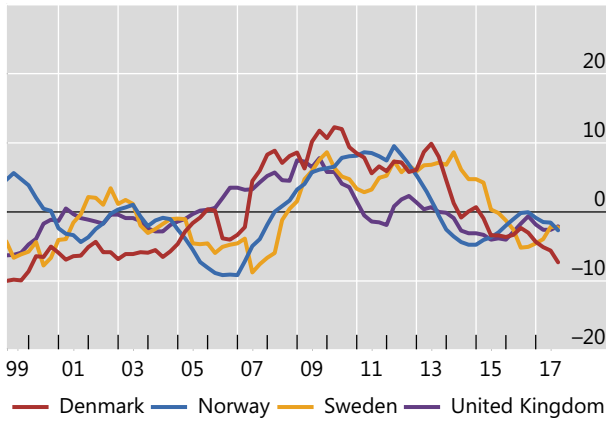
Euro area: major countries



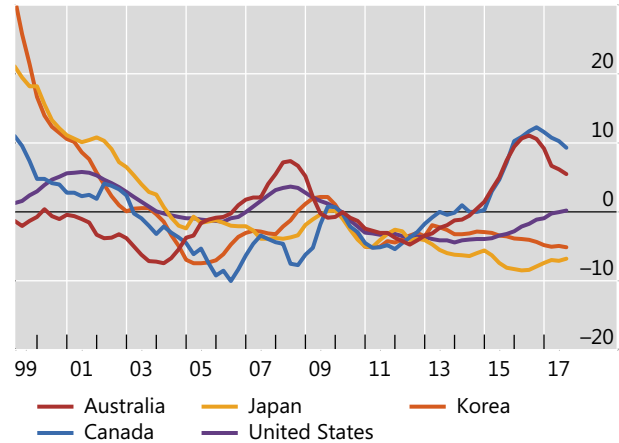
Euro area: other countries



Other European countries



Other economies



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

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

Source: BIS debt service ratios statistics.

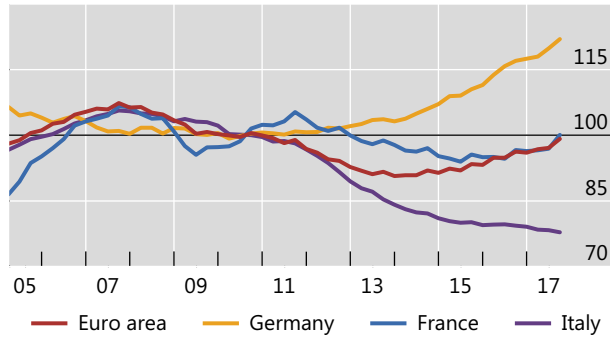
H Property price statistics

Real residential property prices

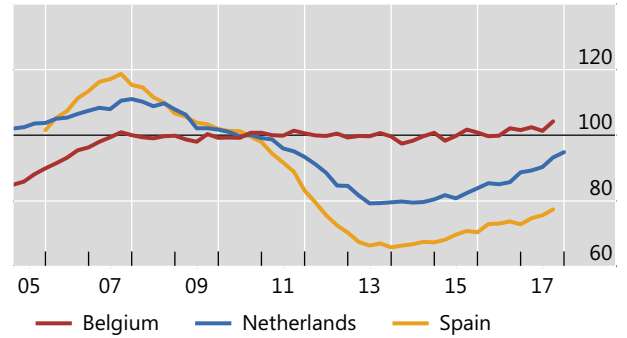
CPI-deflated, 2010 = 100

Graph H.1

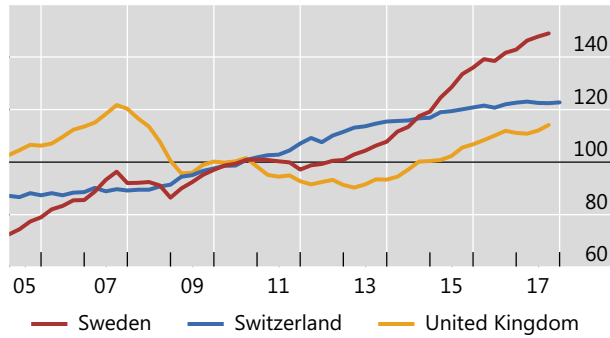
Euro area: aggregate and major countries



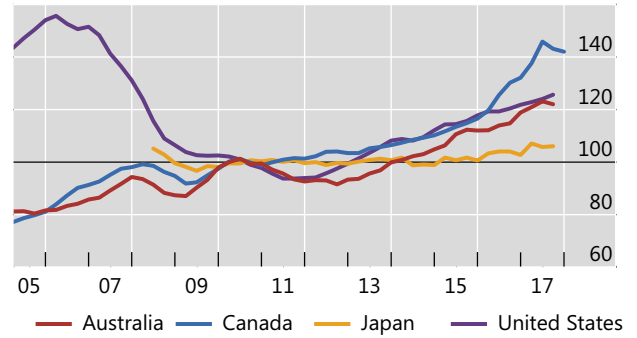
Euro area: other countries



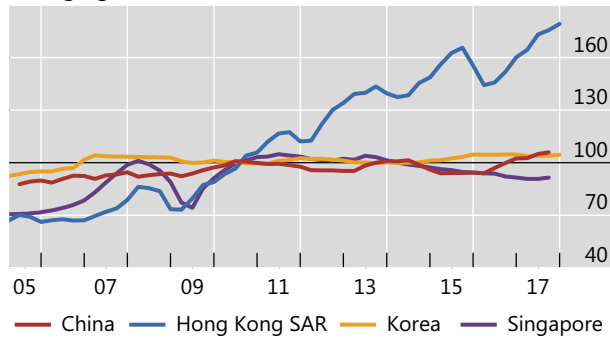
Other European countries



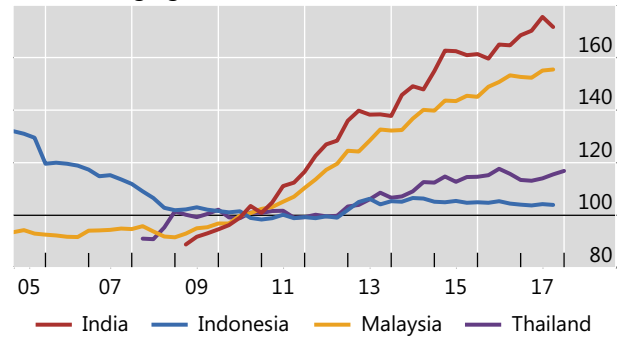
Major advanced economies



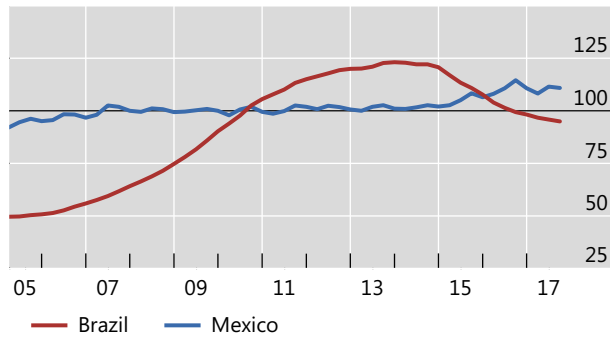
Emerging Asia



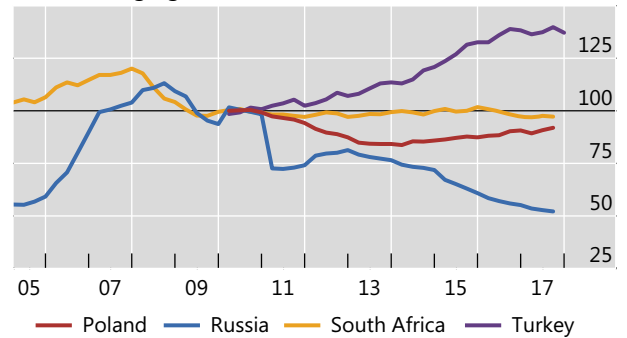
Other emerging Asia



Latin America



Other emerging market economies



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

Source: BIS property prices statistics.

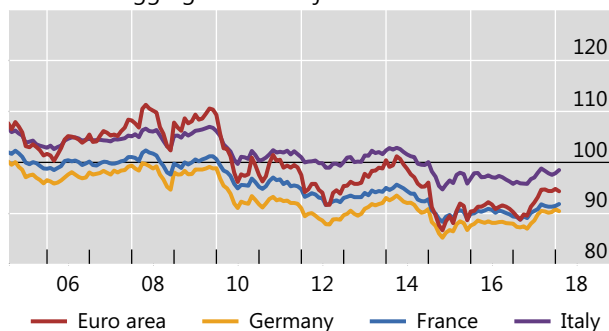
I Effective and US dollar exchange rate statistics

Real effective exchange rates

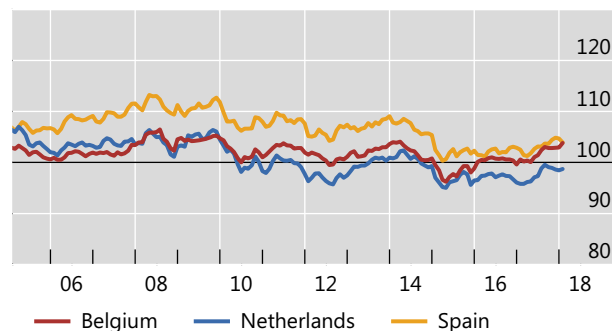
CPI-based, 1995–2005 = 100¹

Graph I.1

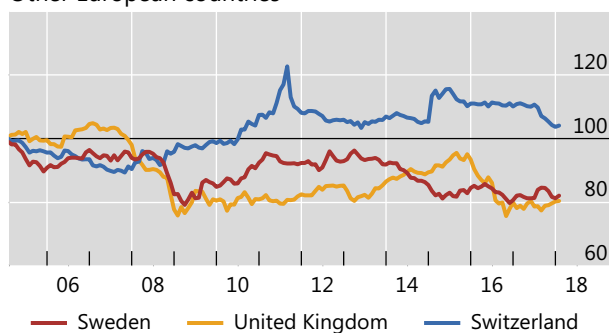
Euro area: aggregate and major countries



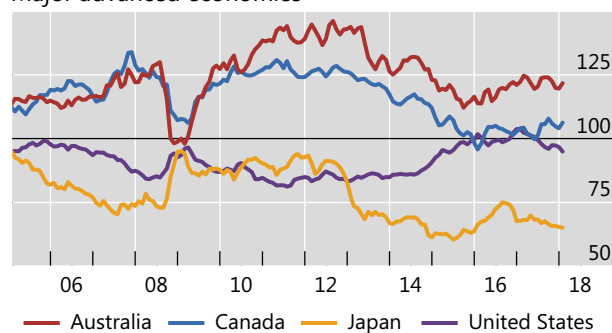
Euro area: other countries



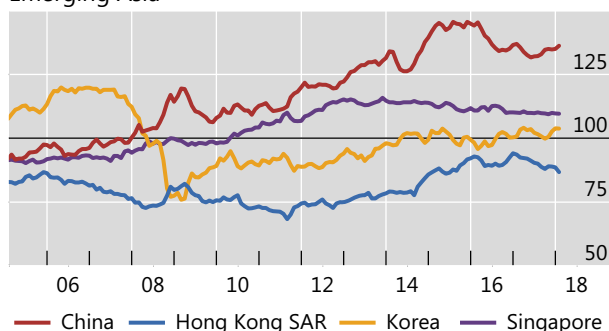
Other European countries



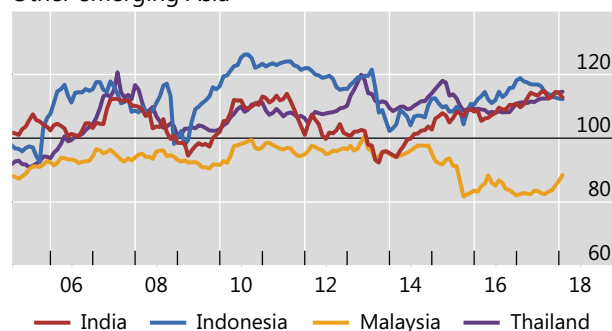
Major advanced economies



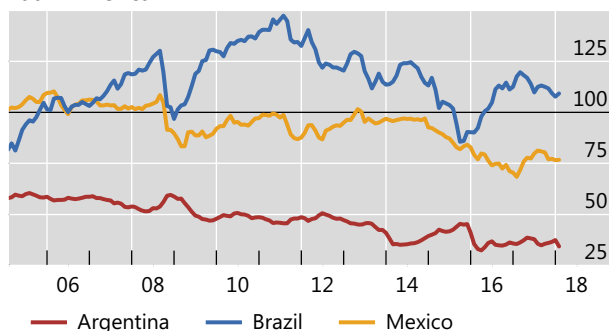
Emerging Asia



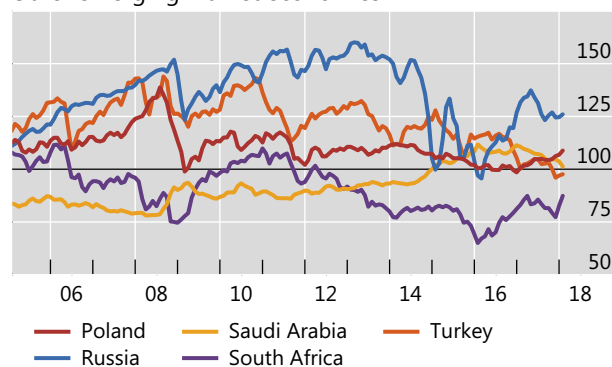
Other emerging Asia



Latin America



Other emerging market economies



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

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

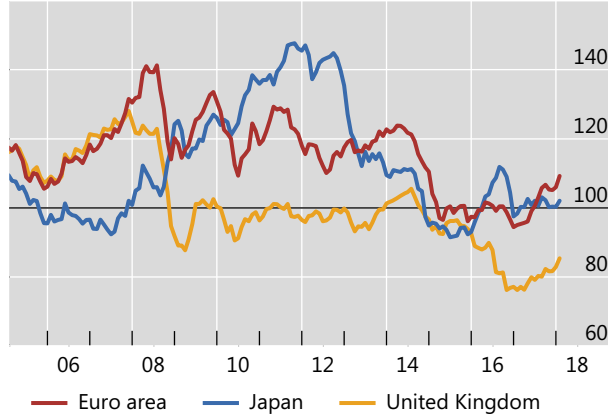
Source: BIS effective exchange rates statistics.

US dollar exchange rates

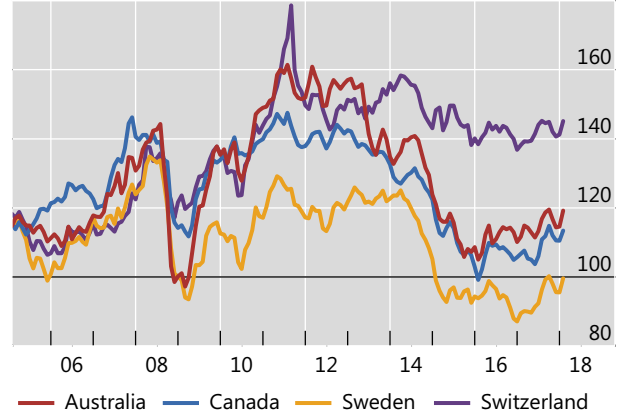
Indices, 1995–2005 = 100¹

Graph I.2

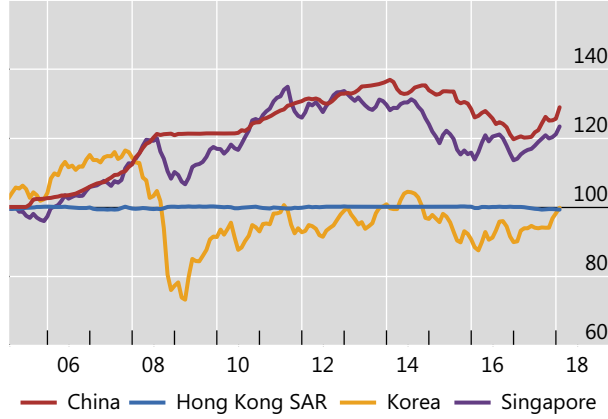
Major advanced economies



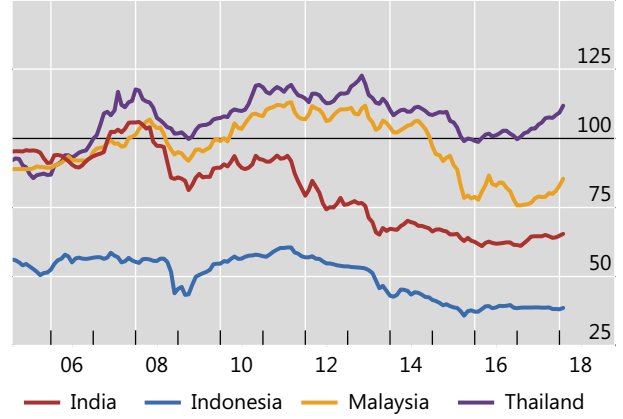
Other advanced economies



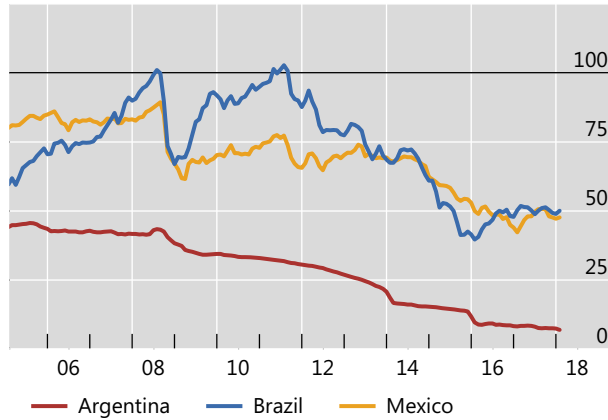
Emerging Asia



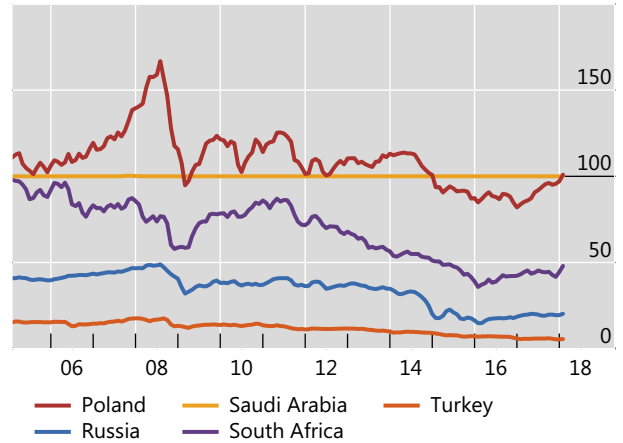
Other emerging Asia



Latin America



Other emerging market economies



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

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

Source: BIS US dollar exchange rates statistics.

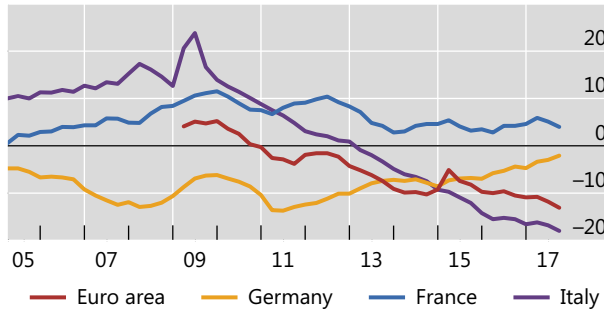
J Credit-to-GDP gaps

Credit-to-GDP gaps

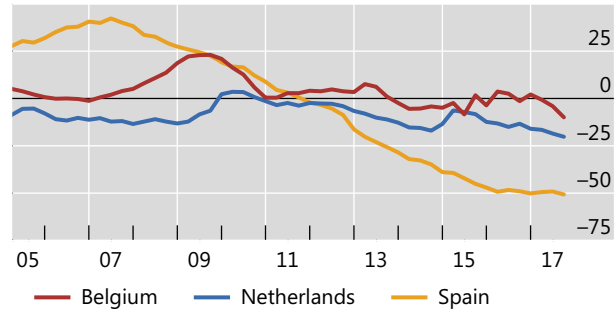
In percentage points of GDP

Graph J.1

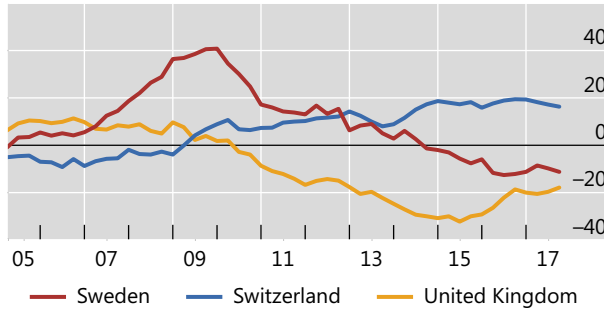
Euro area: aggregate and major countries



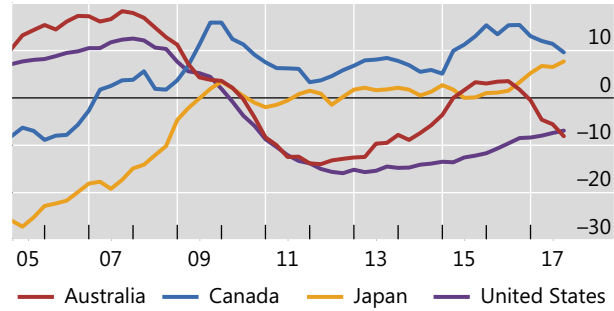
Euro area: other countries



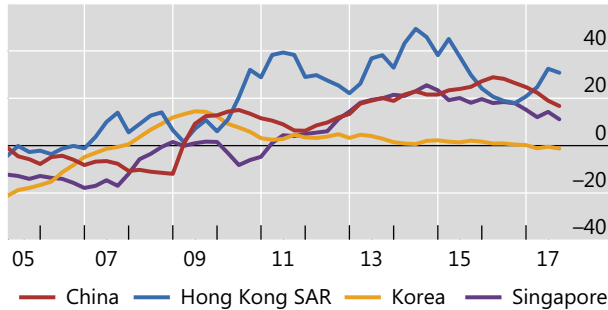
Other European countries



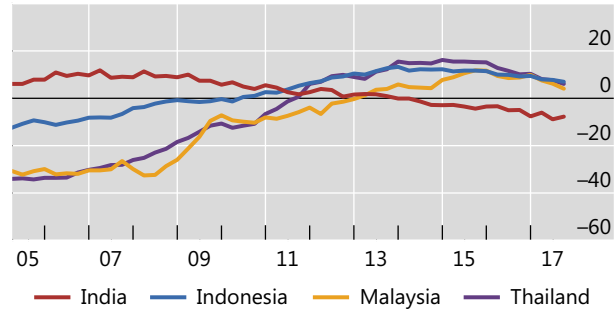
Major advanced economies



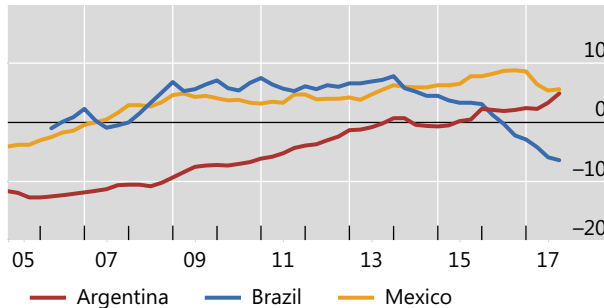
Emerging Asia



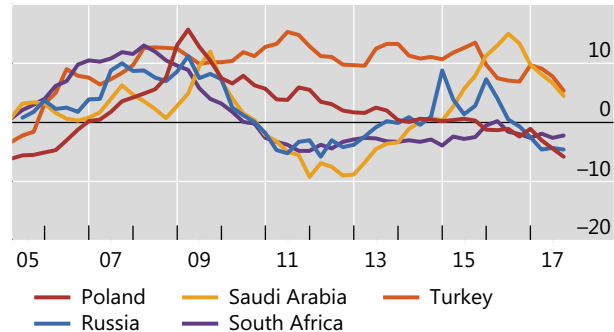
Other emerging Asia



Latin America



Other emerging market economies



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

Source: BIS credit-to-GDP gaps statistics.

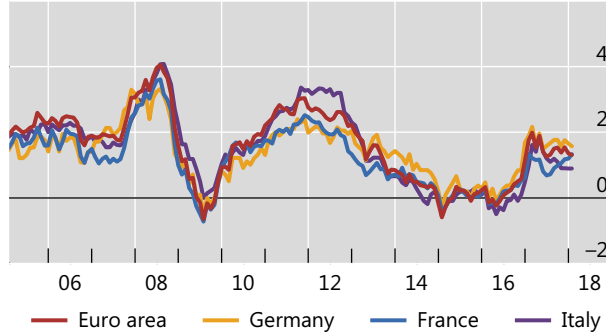
K Consumer prices

Consumer prices

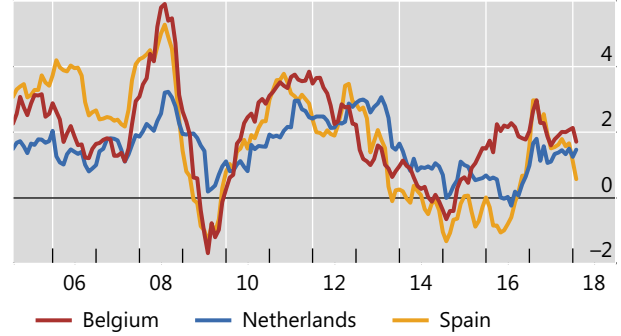
Year-on-year percentage changes

Graph K.1

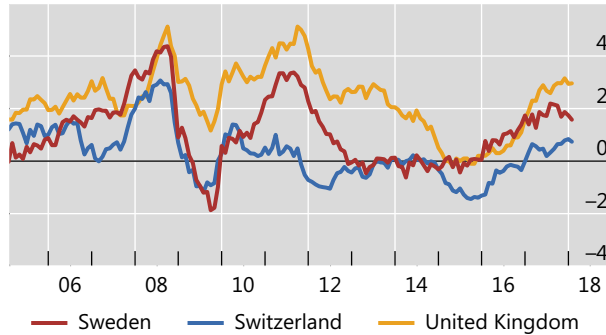
Euro area: aggregate and major countries



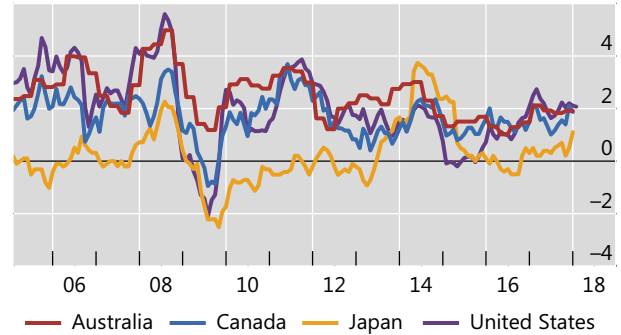
Euro area: other countries



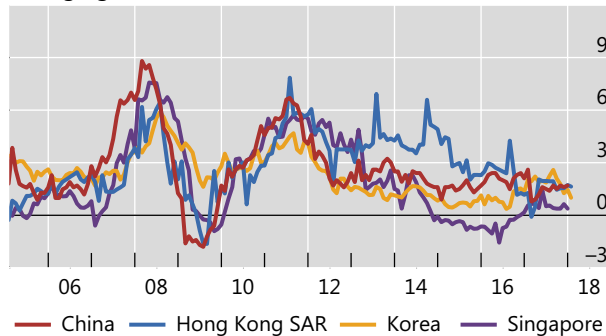
Other European countries



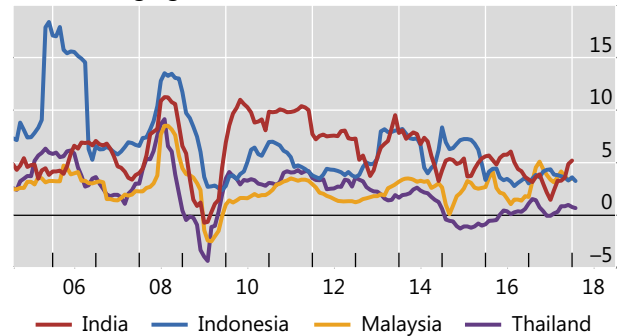
Major advanced economies



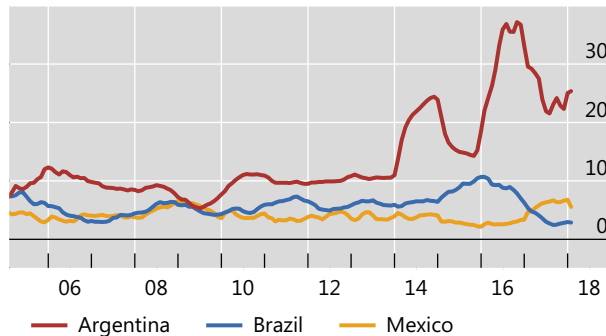
Emerging Asia



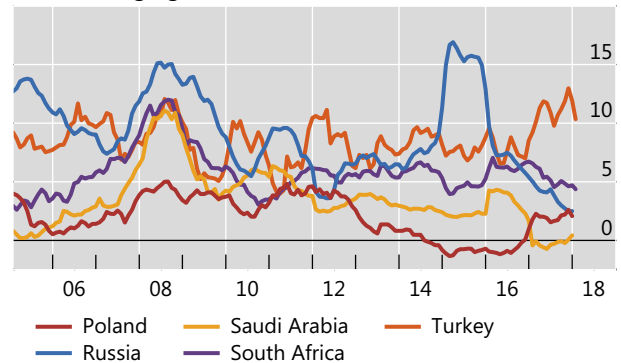
Other emerging Asia



Latin America



Other emerging market economies



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

Source: BIS consumer price statistics.

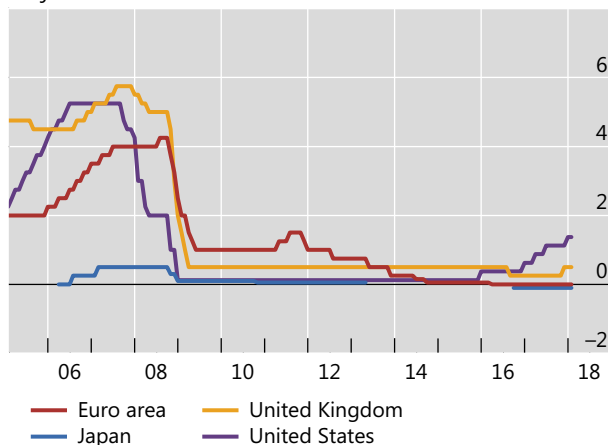
L Central bank policy rates

Central bank policy or representative rates

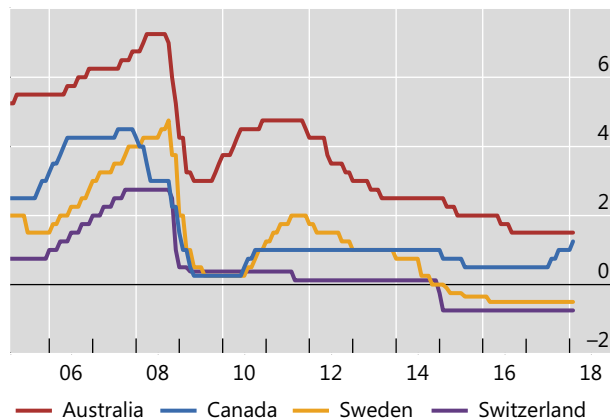
Month-end; in per cent

Graph L.1

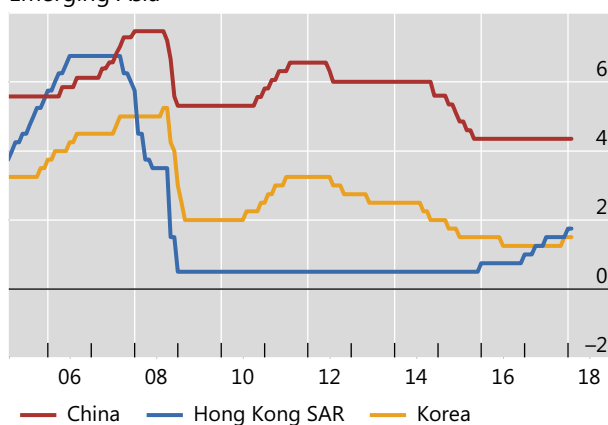
Major advanced economies



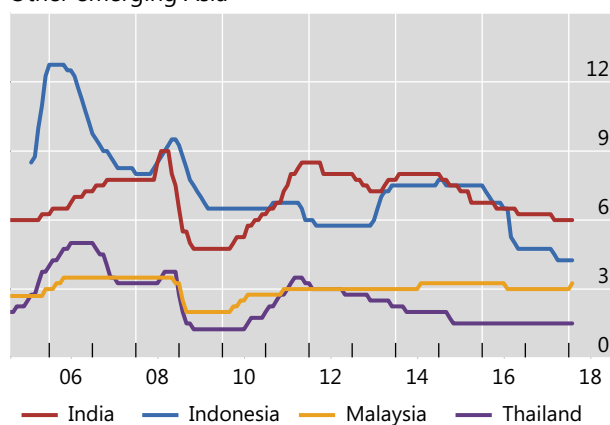
Other advanced economies



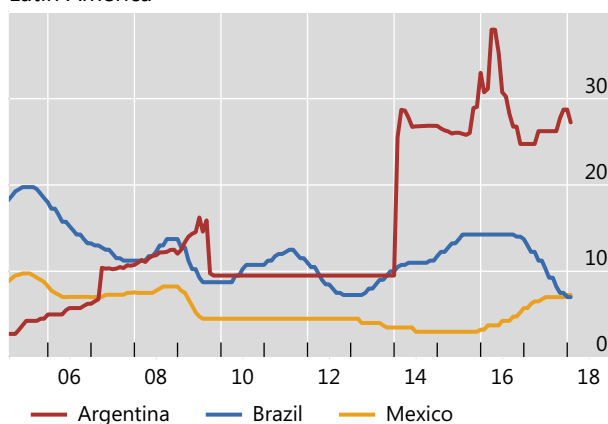
Emerging Asia



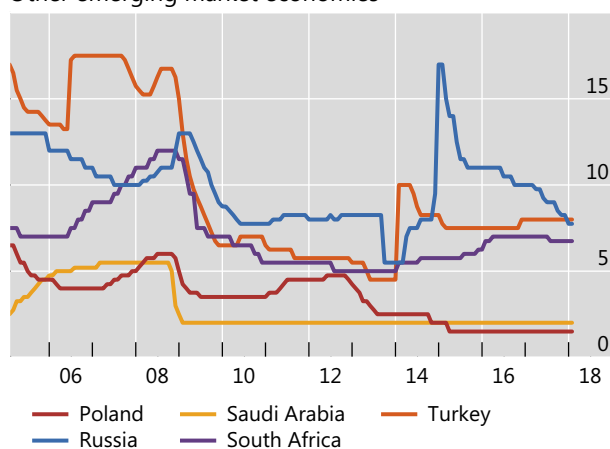
Other emerging Asia



Latin America



Other emerging market economies



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

Source: BIS policy rates statistics.

Special features in the BIS Quarterly Review

December 2017	Is there a debt service channel of monetary transmission?	Boris Hofmann & Gert Peersman
December 2017	Household debt: recent developments and challenges	Anna Zabai
September 2017	FX swaps and forwards: missing global debt?	Claudio Borio, Robert McCauley & Patrick McGuire
September 2017	Central bank cryptocurrencies	Morten Bech & Rodney Garratt
September 2017	What are the effects of macroprudential policies on macroeconomic performance?	Codruta Boar, Leonardo Gambacorta, Giovanni Lombardo & Luiz Pereira da Silva
September 2017	Green bond finance and certification	Torsten Ehlers & Frank Packer
March 2017	Consumption-led expansions	Enisse Kharroubi & Emanuel Kohlscheen
March 2017	The new era of expected credit loss provisioning	Benjamin Cohen & Gerald Edwards Jr
March 2017	The quest for speed in payments	Morten Bech, Yuuki Shimizu and Paul Wong
March 2017	The bond benchmark continues to tip to swaps	Lawrence Kreicher, Robert McCauley & Philip Wooldridge

Recent BIS publications¹

BIS Papers

Frontiers of macrofinancial linkages

BIS Papers No 95, January 2018

The Great Financial Crisis of 2007-09 confirmed the vital importance of advancing our understanding of macrofinancial linkages, the two-way interactions between the real economy and the financial sector. The crisis was a bitter reminder of how sharp fluctuations in asset prices, credit and capital flows can have dramatic impact on the financial positions of households, corporations and sovereign nations. As fluctuations were amplified, the global financial system was brought to the brink of collapse and the deepest contraction in world output in more than half a century followed. Moreover, unprecedented challenges for fiscal, monetary and financial regulatory policies resulted.

The crisis revived an old debate in the economics profession about the importance of macrofinancial linkages. Some argue that the crisis was a painful reminder of our limited knowledge of these linkages. Others claim that the profession had already made substantial progress in understanding them but that there was too much emphasis on narrow approaches and modelling choices. Yet, most also recognise that the absence of a unifying framework to study these two-way interactions has limited the practical applications of existing knowledge and impeded the formulation of policies.

With these observations in mind, this paper presents a systematic review of the rapidly expanding literature on macrofinancial linkages. It first surveys the literature on the linkages between asset prices and macroeconomic outcomes. It then reviews the literature on the macroeconomic implications of financial imperfections. It also examines the global dimensions of macrofinancial linkages and documents the main stylized facts about the linkages between the real economy and the financial sector. The topic of macrofinancial linkages promises to remain an exciting area of research, given the many open questions and significant policy interest. The paper concludes with a discussion of possible directions for future research, stressing the need for richer theoretical models, more robust empirical work and better quality data so as to advance knowledge and help guide policymakers going forward.

Macroprudential frameworks, implementation and relationship with other policies

BIS Papers No 94, December 2017

Papers in this volume were prepared for a meeting of senior officials from central banks held at the Bank for International Settlements.

Emerging market central banks have a long history of using macroprudential instruments. But while most central banks carry a heavy responsibility for financial stability, legal objectives are generally vague, do not define success or failure, and say nothing about competing objectives. This complicates both accountability and the communication of macroprudential decisions.

Participants drew several lessons from their experience with implementing macroprudential instruments. First, macroprudential authorities need to act early if they want to address systemic risk effectively. Second, building buffers or shifting the composition of credit is easier than managing the cycle. Third, macroprudential measures tend to be better at

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/>).

constraining booms than at dampening busts. Fourth, although macroprudential tools could, in principle, be targeted very precisely, circumvention by lenders and borrowers require more broad-based approaches. Fifth, macroprudential measures and monetary policy can reinforce each other when used in the same direction. Sixth, the jury is still out whether macroprudential instruments could be used effectively to address regional disparities within economies.

This volume collects the background papers of a meeting of Deputy Governors of central banks from emerging market economies to exchange their experience with designing macroprudential frameworks and implementing macroprudential instruments.

BIS Working Papers

Monetary policy in the grip of a pincer movement

Claudio Borio, Piti Disyatat, Mikael Juselius and Phurichai Rungcharoenkitkul

February 2018, No 706

Monetary policy has been in the grip of a pincer movement, caught between growing financial cycles, on the one hand, and an inflation process that has become quite insensitive to domestic slack, on the other. This two-pronged attack has laid bare some of the limitations of prevailing monetary policy frameworks, particularly in the analytical notions that have guided much of its practice. We argue that the natural rate of interest as a guidepost for monetary policy has a couple of limitations: the concept, as traditionally conceived, neglects the state of the financial cycle in the definition of equilibrium; in addition, it underestimates the role that monetary policy regimes may play in persistent real interest rate movements. These limitations may expose monetary policy to blindsiding by the collateral damage that comes from an unhinged financial cycle. We propose a more balanced approach that recognises the difficulties monetary policy has in fine-tuning inflation and responds more systematically to the financial cycle.

An explanation of negative swap spreads: demand for duration from underfunded pension plans

Sven Klingler and Suresh Sundaresan

February 2018, No 705

The 30-year U.S. swap spreads have been negative since September 2008. We offer a novel explanation for this persistent anomaly. Through an illustrative model, we show that underfunded pension plans optimally use swaps for duration hedging. Combined with dealer banks' balance sheet constraints, this demand can drive swap spreads to become negative. Empirically, we construct a measure of the aggregate funding status of Defined Benefit pension plans and show that this measure is a significant explanatory variable of 30-year swap spreads. We find a similar link between pension funds' underfunding and swap spreads for two other regions.

Are credit rating agencies discredited? Measuring market price effects from agency sovereign debt announcements

Mahir Binici, Michael M Hutchison and Evan Weicheng Miao

February 2018, No 704

This paper investigates whether the price response to credit rating agency (CRA) announcements on sovereign bonds has diminished since the Global Financial Crisis (GFC). We characterize credit rating events more precisely than previous work, controlling agency announcements for the prior credit state - outlook, watch/review, or stable status as well as the level of the credit rating. Emphasizing the transition from one state to another allows us to distinguish between different types of announcement (rating changes, watch and outlook events) and their price effects. We employ an event study methodology and gauge market response by standardized cumulative abnormal returns (SCAR) and directional change statistics in daily credit default swap (CDS) spreads. We find that rating announcements provide a rich and varied set of information on how credit rating agencies influence market perceptions of sovereign default risk. CRA announcements continued to have significant

effects on CDS spreads after the GFC, but the magnitude of the responses generally fell. Moreover, we find that accurate measurement of these effects depends on conditioning for the prior credit state of the sovereign bond.

The negative interest rate policy and the yield curve

Dora Xia and Jing Cynthia Wu

February 2018, No 703

We extract the market's expectations about the ECB's negative interest rate policy from the euro area's yield curve and study its impact on the yield curve. To capture the rich dynamics taking place at the short end of the yield curve, we introduce two policy indicators that summarise the immediate and longer-horizon future monetary policy stances. The ECB has cut interest rates four times under zero. We find that the June 2014 and December 2015 cuts were expected one month ahead but that the September 2014 cut was unanticipated. Most interestingly, the March 2016 cut was expected four months ahead of the actual cut.

Cross-stock market spillovers through variance risk premiums and equity flows

Masazumi Hattori, Ilhyock Shim and Yoshihiko Sugihara

February 2018, No 702

We estimate variance risk premiums (VRPs) in the stock markets of major advanced economies (AEs) and emerging market economies (EMEs) over 2007–15 and decompose the VRP into variance-diffusive risk premium (DRP) and variance-jump risk premium (JRP). Daily VAR analysis reveals significant spillovers from the VRPs of the United States and eurozone's AEs to the VRPs of other economic areas, especially during the post-Global Financial Crisis (GFC) period. We also find that during the post-GFC period, shocks to the DRPs of the United States and the eurozone's AEs have relatively strong and long-lived positive effects on the VRPs of other economic areas whereas shocks to their JRPs have relatively weak and short-lived positive effects. In addition, we show that increases in the size of US VRP, DRP and JRP tend to significantly reduce weekly equity fund flows to all other AEs and some EMEs during the post-GFC period. Finally, US DRP plays a more important role than US JRP in the determination of equity fund flows to all other AEs and some EMEs after the GFC, while the opposite holds true for equity fund flows to all other AEs during the GFC. Such results indicate the possibility of equity fund flows working as a channel of cross-market VRP spillovers.

Mapping shadow banking in China: structure and dynamics

Torsten Ehlers, Steven Kong and Feng Zhu

February 2018, No 701

We develop a stylised shadow banking map for China with the aim of providing a coherent picture of its structure and the associated financial system interlinkages. Five key characteristics emerge. One defining feature of the shadow banking system in China is the dominant role of commercial banks, true to the adage that shadow banking in China is the "shadow of the banks". Moreover, it differs from shadow banking in the United States in that securitisation and market-based instruments play only a limited role. With a series of maps we show that the size and dynamics of shadow banking in China have been changing rapidly. This reveals a marked shift in the relative importance of different shadow banking activities. New and more complex "structured" shadow credit intermediation has emerged and quickly reached a large scale, while the bond market has become highly dependent on funding channelled through wealth management products. As a result, the structure of shadow banking in China is growing more complex.

The perils of approximating fixed-horizon inflation forecasts with fixed-event forecasts

James Yetman

February 2018, No 700

A common practice in studies using inflation forecasts is to approximate fixed-horizon forecasts with fixed-event ones. Here we show that this may be problematic. In a panel of US inflation forecast data that allows us to compare the two, the approximation results in a mean absolute approximation error of around 0.2–0.3 percentage points (around 10% of the level of inflation), and statistically significant differences in both the variances and persistence of the approximate inflation forecasts relative to the actual forecasts. To reduce these problems,

we propose an adjustment to the approximation, consistent with a model where longer-horizon forecasts are more heavily "anchored", while shorter-horizon forecasts more closely reflect current inflation levels.

Deflation expectations

Ryan Niladri Banerjee and Aaron Mehrotra
February 2018, No 699

We analyse the behaviour of inflation expectations during periods of deflation, using a large cross-country data set of individual professional forecasters' expectations. We find some evidence that expectations become less well anchored during deflations. Deflations are associated with a downward shift in inflation expectations and a somewhat higher backward-lookingness of those expectations. We also find that deflations are correlated with greater forecast disagreement. Delving deeper into such disagreement, we find that deflations are associated with movements in the lefthand tail of the distribution. Econometric evidence indicates that such shifts may have consequences for real activity.

Money and trust: lessons from the 1620s for money in the digital age

Isabel Schnabel and Hyun Song Shin
February 2018, No 698

Money is a social convention where one party accepts it as payment in the expectation that others will do so too. Over the ages, various forms of private money have come and gone, giving way to central bank money. The reasons for the resilience of central bank money are of particular interest given current debates about cryptocurrencies and how far they will supplant central bank money. We draw lessons from the role of public deposit banks in the 1600s, which quelled the hyperinflation in Europe during the Thirty Years War (1618–1648). As the precursors of modern central banks, public deposit banks established trust in monetary exchange by making the value of money common knowledge.

Are banks opaque? Evidence from insider trading

Fabrizio Spargoli and Christian Upper
February 2018, No 697

We use trades by US corporate insiders to investigate bank opacity, both in absolute terms and relative to other firms. On average, bank insider sales do not earn an abnormal return and do not predict stock returns. By contrast, bank insider purchases do, even though less than other firms. Our within-banking sector and over-time analyses also fail to provide evidence of greater opacity of banks vis-à-vis other firms. These results challenge conventional wisdom and suggest that, to assess bank opacity, the type of benchmark (transparency vs. other firms) and transaction/information (purchase/positive vs. sale/negative) are crucial.

Monetary policy spillovers, global commodity prices and cooperation

Andrew Filardo, Marco Jacopo Lombardi, Carlos Montoro and Massimo Ferrari
January 2018, No 696

Commodity price swings are key drivers of inflation and naturally factor into monetary policy decisions. Our paper assesses the soundness of the conventional wisdom that central banks should largely ignore the initial impact of commodity prices on headline inflation. This approach is based on the 1970s experience, when commodity prices soared because of supply shortages. Now, demand plays a more prominent role. Trying to distinguish between demand and supply, however, raises the risk of misdiagnosing commodity price falls as being driven primarily by external supply shocks, such as new discoveries of oil reserves, when they are in fact driven by global demand shocks, such as a fall in consumer confidence. We look at how misdiagnoses may affect the stability of the global business cycle.

The dollar exchange rate as a global risk factor: evidence from investment

Stefan Avdjiev, Valentina Bruno, Catherine Koch and Hyun Song Shin
January 2018, No 695

Exchange rate fluctuations influence economic activity not only via the standard trade channel, but also through a financial channel, which operates through the impact of exchange rate fluctuations on borrowers' balance sheets and lenders' risk-taking capacity.

This paper explores the "triangular" relationship between (i) the strength of the US dollar, (ii) cross-border bank flows and (iii) real investment. We conduct two sets of empirical exercises – a macro (country-level) study and a micro (firm-level) study. We find that a stronger dollar is associated with lower growth in dollar-denominated cross-border bank flows and lower real investment in emerging market economies. An important policy implication of our findings is that a stronger dollar has real macroeconomic effects that go in the opposite direction to the standard trade channel.

Exchange rates and the working capital channel of trade fluctuations

Valentina Bruno, Se-Jik Kim and Hyun Song Shin

January 2018, No 694

Our paper provides a fresh take on the way the US dollar exchange rate influences the volume of global trade. We take as our starting point the substantial financing needs of the long supply chains, or global value chains (GVCs), that underpin trade in manufactured goods. These financial needs make GVCs susceptible to fluctuations in the supply of dollar-denominated trade credit. As a stronger dollar goes hand-in-hand with tighter dollar credit supply, the impact of a strong dollar can run counter to the traditional understanding of the impact of exchange rates on trade.

Family first? Nepotism and corporate investment

Gianpaolo Parise, Fabrizio Leone and Carlo Sommavilla

January 2018, No 693

Nepotism emerges in a multiplicity of contexts from political assignments to firm hiring decisions, but what are its real effects on the economy? This paper explores how nepotism affects corporate investment. To measure nepotism, we build a unique dataset of family connections among individuals employed in strategic positions by the same firm. We address endogeneity concerns by exploiting the heterogeneity in ancestries across U.S. counties to construct a measure of inherited family values. We find that firms headquartered in counties where locals inherited strong family values exhibit more nepotism. Using this measure and the percentage of family households in the county as instrumental variables, we provide evidence that nepotism hinders investment. Overall, our results suggest that underinvestment in these firms is driven by both lower quality of hired workers and lower incentive to exert effort.

Central bank forward guidance and the signal value of market prices

Stephen Morris and Hyun Song Shin

January 2018, No 692

The paper examines the relationship between monetary policy and market prices through the lens of central bank communication. Central bankers use forward guidance to steer market expectations of future monetary policy moves. At the same time, they rely on market prices to gauge the likely path of the economy and the appropriate stance of monetary policy. This two-way flow between market prices and forward guidance can create a circularity, and raises questions on how best to read market signals without distorting those same prices.

Effectiveness of unconventional monetary policies in a low interest rate environment

Andrew Filardo and Jouchi Nakajima

January 2018, No 691

Have unconventional monetary policies (UMPs) become less effective at stimulating economies in persistently low interest rate environments? This paper examines that question with a time-varying parameter VAR for the United States, the United Kingdom, the euro area and Japan. One advantage of our approach is the ability to measure an economy's evolving interest rate sensitivity during the post-GFC macroeconomy. Another advantage is the ability to capture time variation in the "natural", or steady state, rate of interest, which allows us to separate interest rate movements that are associated with changes in the stance of monetary policy from those that are not.

Nonlinear state and shock dependence of exchange rate pass through on prices

Hernán Rincón-Castro and Norberto Rodríguez-Niño

January 2018, No 690

This paper examines the nature of the pass-through of exchange rate shocks on prices along the distribution chain, and estimates its short and long-term path. It uses monthly data from a small open economy and a smooth transition auto-regressive vector model estimated by Bayesian methods. The main finding is that exchange rate pass-through is nonlinear and state and shock dependent. There are two main policy implications of these findings. First, models used by central banks for policymaking should take into account the nonlinear and endogenous nature of the pass-through. Second, a specific rule on pass-through for monetary policy decisions should be avoided.

Estimating unknown arbitrage costs: evidence from a three-regime threshold vector error correction model

Kristyna Ters and Jörg Urban

January 2018, No 689

We present a methodology for estimating a 3-regime threshold vector error correction model (TVECM) with an unknown cointegrating vector based on a new dynamic grid evaluation. This model is particularly suited to estimating deviations from parity conditions such as unknown arbitrage costs in markets with a persistent non-zero basis between two similar financial market instruments traded in the spot and the derivative markets. Our proposed 3-regime TVECM can estimate the area where arbitrageurs have no incentives for trading. Only when the basis exceeds a critical threshold, where the potential gain from the basis trade exceeds the overall transaction costs, do we expect arbitrageurs to step in and carry out the respective trade. This leads to non-linear adjustment dynamics and regimes with different characteristics. The overall transaction costs for the basis trades can be inferred from the estimated no-arbitrage regime. Our methodology allows us to quantify overall transaction costs for an arbitrage trade in markets where trading costs are opaque or unknown, as in credit risk or index arbitrage trading. The key contributions of this paper are the further development of the 2-threshold VECM, together with the numerical evaluation of the model through numerous simulations to prove its robustness. We present two short applications of the model in arbitrage trades in the palladium market and index trading for the S&P 500.

Global factors and trend inflation

Güneş Kamber and Benjamin Wong

January 2018, No 688

We develop a model to empirically study the influence of global factors in driving trend inflation and the inflation gap. We apply our model to five established inflation targeters and a group of heterogeneous Asian economies. Our results suggest that while global factors can have a sizeable influence on the inflation gap, they play only a marginal role in driving trend inflation. Much of the influence of global factors in the inflation gap may be reflecting commodity price shocks. We also find global factors have a greater influence on inflation, and especially trend inflation, for the group of Asian economies relative to the established inflation targeters. A possible interpretation is that inflation targeting may have reduced the influence of global factors on inflation, and especially so on trend inflation.

Searching for yield abroad: risk-taking through foreign investment in U.S. bonds

John Ammer, Stijn Claessens, Alexandra Tabova and Caleb Wroblewski

January 2018, No 687

The risk-taking effects of low interest rates, now prevailing in many advanced countries, ("search-for-yield") are hard to analyze due to both a paucity of data and challenges in identification. Unique, security-level data on portfolio investment into the United States allow us to overcome both problems. Analyzing holdings of investors from 36 countries in close to 15,000 unique U.S. corporate bonds between 2003 and 2016, we show that declining home-country interest rates lead investors to shift their international bond portfolios toward riskier U.S. corporate bonds, consistent with "search-for-yield". We estimate even stronger effects

when home interest rates reach a low level, suggesting that risk-taking in securities accelerates as rates decline.

Determinants of bank profitability in emerging markets

Emanuel Kohlscheen, Andrés Murcia Pabón and Julieta Contreras

January 2018, No 686

We analyse key determinants of bank profitability based on the evolution of balance sheets of 534 banks from 19 emerging market economies. We find that higher long-term interest rates tend to boost profitability, while higher short-term rates reduce profits by raising funding costs. We also find that in normal times credit growth tends to be more important for bank profitability than GDP growth. The financial cycle thus appears to predict bank profitability better than the business cycle. We also show that increases in sovereign risk premia reduce bank profits in a significant way, underscoring the role of credible fiscal frameworks in supporting the overall financial stability.

Why so low for so long? A long-term view of real interest rates

Claudio Borio, Piti Disyatat, Mikael Juselius and Phurichai Rungcharoenkitkul

December 2017, No 685

Prevailing explanations of the decline in real interest rates since the early 1980s are premised on the notion that real interest rates are driven by variations in desired saving and investment. But based on data stretching back to 1870 for 19 countries, our systematic analysis casts doubt on this view. The link between real interest rates and saving-investment determinants appears tenuous. While it is possible to find some relationships consistent with the theory in some periods, particularly over the last 30 years, they do not survive over the extended sample. This holds both at the national and global level. By contrast, we find evidence that persistent shifts in real interest rates coincide with changes in monetary regimes. Moreover, external influences on countries' real interest rates appear to reflect idiosyncratic variations in interest rates of countries that dominate global monetary and financial conditions rather than common movements in global saving and investment. All this points to an underrated role of monetary policy in determining real interest rates over long horizons.

Triffin: dilemma or myth?

Michael Bordo and Robert N McCauley

December 2017, No 684

Triffin gained enormous influence by reviving the interwar story that gold scarcity threatened deflation. In particular, he held that central banks needed to accumulate claims on the United States to back money growth. But the claims would eventually surpass the US gold stock and then central banks would inevitably stage a run on it. He feared that the resulting high US interest rates would cause global deflation. However, we show that the US gold position after WWII was no worse than the UK position in 1900. Yet it took WWI to break sterling's gold link. And better and feasible US policies could have kept Bretton Woods going.

This history serves as a backdrop to our critical review of two later extensions of Triffin. One holds that the dollar's reserve role required US current account deficits. This current account Triffin is popular, but anachronistic, and flawed in logic and fact. Nevertheless, it pops up in debates over the euro's and the renminbi's reserve roles. A fiscal Triffin holds that global demand for safe assets will either remain dangerously unsatisfied, or force excessive US fiscal debt. Less flawed, this story posits implausibly inflexible demand for and supply of safe assets. Thus, these stories do not convince in their own terms. Moreover, each lacks Triffin's clear cross-over point from a stable system to an unstable one.

Triffin's seeming predictive success leads economists to wrap his brand around dissimilar stories. Yet Triffin's dilemma in its most general form correctly points to the conflicts and difficulties that arise when a national currency plays a role as an international public good.

Can macroprudential measures make cross-border lending more resilient?

Előd Takáts and Judit Temesváry

December 2017, No 683

We study the effect of macroprudential measures on cross-border lending during the taper tantrum, which saw a strong slowdown in cross-border bank lending to some jurisdictions. We use a novel dataset combining the BIS Stage 1 enhanced banking statistics on bilateral cross-border lending flows with the IBRN's macroprudential database. Our results suggest that macroprudential measures implemented in borrowers' host countries prior to the taper tantrum significantly reduced the negative effect of the tantrum on cross-border lending growth. The shock-mitigating effect of host country macroprudential rules are present both in lending to banks and non-banks, and are strongest for lending flows to borrowers in advanced economies and to the non-bank sector in general. Source (lending) banking system measures do not affect bilateral lending flows, nor do they enhance the effect of host country macroprudential measures. Our results imply that policymakers may consider applying macroprudential tools to mitigate international shock transmission through cross-border bank lending.

Bank business models: popularity and performance

Nikola Tarashev, Kostas Tsatsaronis and Alan Villegas

December 2017, No 682

We allocate banks to distinct business models by experimenting with various combinations of balance sheet characteristics as inputs in cluster analysis. Using a panel of 178 banks for the period 2005-15, we identify a retail-funded and a wholesale-funded commercial banking model that are robust to the choice of inputs. In comparison, a model emphasising trading activities and a universal banking model are less robustly identified. Both commercial banking models exhibit lower cost-to-income ratios and more stable return-on-equity than the trading model. In a reversal of a pre-crisis trend, the crisis aftermath witnessed mainly switches away from wholesale-funded and into retail-funded banking. Over the entire sample period, banks that switched into the retail-funded model saw their return-on-equity improve by 2.5 percentage points on average relative to non-switchers. By contrast, the relative performance of banks switching into the wholesale-funded model deteriorated by 5 percentage points on average.

Corporate leverage in EMEs: did the global financial crisis change the determinants?

Snehal S Herwadkar

December 2017, No 681

This paper evaluates whether the GFC was instrumental in changing the determinants of corporate leverage in EMEs. This issue is addressed using a panel-GMM framework and quantile analysis with a database comprising more than 2,000 firms in 10 EMEs over a 19-year period. We find that, post-GFC, global financial market and macroeconomic conditions facilitated build-up of corporate leverage. Specifically, global factors, such as the growth of world GDP and the FED shadow rate, have assumed centre stage as determinants of leverage in EMEs. At the same time, some traditional drivers, such as domestic growth and firm-specific factors, have become less important.

The macroeconomic effects of asset purchases revisited

Henning Hesse, Boris Hofmann and James Weber

December 2017, No 680

This paper revisits the macroeconomic effects of the large-scale asset purchase programmes launched by the Federal Reserve and the Bank of England from 2008. Using a Bayesian VAR, we investigate the macroeconomic impact of shocks to asset purchase announcements and assess changes in their effectiveness based on subsample analysis. The results suggest that the early asset purchase programmes had significant positive macroeconomic effects, while those of the subsequent ones were weaker and in part not significantly different from zero. The reduced effectiveness seems to reflect in part better anticipation of asset purchase programmes over time, since we find significant positive macroeconomic effects when we consider shocks to survey expectations of the Federal Reserve's last asset purchase

programme. Finally, in all estimations we find a significant and persistent positive impact of asset purchase shocks on stock prices.

Syndicated loans and CDS positioning

Iñaki Aldasoro and Andreas Barth

December 2017, No 679

This paper analyzes banks' usage of CDS. Combining bank-firm syndicated loan data with a unique EU-wide dataset on bilateral CDS positions, we find that stronger banks in terms of capital, funding and profitability tend to hedge more. We find no evidence of banks using the CDS market for capital relief. Banks are more likely to hedge exposures to relatively riskier borrowers and less likely to sell CDS protection on domestic firms. Lead arrangers tend to buy more protection, potentially exacerbating asymmetric information problems. Dealer banks seem insensitive to firm risk, and hedge more than non-dealers when they are more profitable. These results allow for a better understanding of banks' credit risk management.

Basel Committee on Banking Supervision

Pillar 3 disclosure requirements - updated framework (consultative document)

February 2018

The Basel Committee on Banking Supervision has today issued for consultation Pillar 3 disclosure requirements - updated framework. Pillar 3 of the Basel framework seeks to promote market discipline through regulatory disclosure requirements. Many of the proposed disclosure requirements published today are related to the finalisation of the Basel III post-crisis regulatory reforms in December 2017 and include new or revised requirements:

for credit risk (including provisions for prudential treatment of assets), operational risk, the leverage ratio and credit valuation adjustment (CVA);

that would benchmark a bank's risk-weighted assets (RWA) as calculated by its internal models with RWA calculated according to the standardised approaches; and

that provide an overview of risk management, key prudential metrics and RWA.

In addition, today's publication proposes new disclosure requirements on asset encumbrance and capital distribution constraints.

Separately, the Committee is seeking feedback on the scope of application of the disclosure requirement on the composition of regulatory capital that was introduced in March 2017.

Together with the first phase and second phase of the revised Pillar 3 disclosure requirements issued in January 2015 and March 2017 respectively, the proposed disclosure requirements would comprise the single Pillar 3 framework.

Sound Practices: implications of fintech developments for banks and bank supervisors

February 2018

This paper therefore combines historical research, analysis of current media and industry periodicals, fintech product analysis and scenario analysis as well as surveys on BCBS members' activities, to provide a forward-looking perspective on fintech and its potential impact on the banking industry and bank supervision. Based on this work, the BCBS has identified 10 key implications and related considerations for banks and bank supervisors. The BCBS will continue to monitor fintech developments and assess whether and how these implications and considerations should be updated as appropriate.

Progress report on the implementation of principles for effective supervisory colleges

December 2017

Supervisory colleges play a valuable role in the supervision of internationally active banks by helping their members to develop a more comprehensive understanding of a banking group's risk profile globally and they provide a framework for addressing topics that are

relevant to the group's supervision. Home and host supervisors are responsible for assessing the bank's risks in their respective jurisdictions, while activities organised in the supervisory colleges serve as important contributions to these assessments.

Although they started out as a tool for addressing cross-border supervisory coordination issues related to Basel implementation, supervisory colleges now serve the broader objectives of supervisory cooperation and coordination. Given the evolution in the use and functioning of colleges, they will continue to play a key role in fostering international cooperation among supervisors to promote effective supervision of cross-border banking groups.

Basel III: Treatment of extraordinary monetary policy operations in the Net Stable Funding Ratio - consultative version
December 2017

The Committee today released its first technical amendment, which is related to the treatment of extraordinary monetary policy operations in the Net Stable Funding Ratio. To provide greater flexibility in the treatment of extraordinary central bank liquidity-absorbing monetary policy operations, the technical amendment proposes to allow for reduced required stable funding factors for central bank claims with maturity of more than 6 months.

Technical amendments are defined as changes in standards that are not substantial in nature but that cannot be unambiguously resolved based on the current text.

The Committee invites comments on the proposed amendment by 5 February 2018. All comments will be published on the website of the Bank for International Settlements unless a respondent specifically requests confidential treatment.

Stress testing principles - consultative document
December 2017

The Basel Committee on Banking Supervision has released a consultative document on stress testing principles • in which it proposes to replace the existing principles published in May 2009.

The existing principles were designed to address key weaknesses in stress testing practices that were highlighted by the global financial crisis. Since then, the role of stress testing has rapidly evolved and grown in importance in many jurisdictions. Stress testing is now a critical element of risk management for banks and a core tool for banking supervisors and macroprudential authorities.

The increasing importance of stress testing, combined with a significant range of approaches adopted by supervisory authorities and banks, highlights the continued need for a set of principles to govern stress testing frameworks. These factors also suggest that the principles themselves should be stated at a sufficiently high level to avoid impeding innovation in this rapidly evolving area.

During the course of 2017, the Committee undertook a review of its current set of stress testing principles. As a result of this review it proposes to replace the existing set of principles with a new streamlined version that states the principles at a high enough level to be applicable across many banks and jurisdictions and remain relevant as stress testing practices continue to develop. National authorities may wish to use the principles in designing their own stress testing rules, guidance or frameworks.

The Committee welcomes comments on all aspects of the proposed new principles. Comments should be uploaded here by 23 March 2018. All comments will be published on the website of the Bank for International Settlements (BIS) unless a respondent specifically requests confidential treatment.

Supervisory and bank stress testing: range of practices
December 2017

This range of practices report • describes and compares supervisory and bank stress testing practices and highlights areas of evolution. The report finds that, in recent years, both banks and authorities have made significant advances in stress testing methodologies and

infrastructure. Stress testing is now a critical element of risk management for banks and a core tool for banking supervisors and macroprudential authorities.

The report draws primarily on the results of two surveys, completed respectively by Basel Committee member authorities and by banks (54 respondent banks from across 24 countries, including 20 global systemically important banks). The survey results are supplemented by case studies and other supervisory findings. A stress testing taxonomy is included with a common set of definitions for stress testing terms to aid the dialogue among banks and supervisors.

Basel III: Finalising post-crisis reforms December 2017

The Basel III framework is a central element of the Basel Committee's response to the global financial crisis. It addresses shortcomings of the pre-crisis regulatory framework and provides a regulatory foundation for a resilient banking system that supports the real economy.

A key objective of the revisions incorporated into the framework is to reduce excessive variability of risk-weighted assets (RWA). At the peak of the global financial crisis, a wide range of stakeholders lost faith in banks' reported risk-weighted capital ratios. The Committee's own empirical analyses also highlighted a worrying degree of variability in banks' calculation of RWA. The revisions to the regulatory framework will help restore credibility in the calculation of RWA by:

enhancing the robustness and risk sensitivity of the standardised approaches for credit risk and operational risk, which will facilitate the comparability of banks' capital ratios

constraining the use of internally modelled approaches

complementing the risk-weighted capital ratio with a finalised leverage ratio and a revised and robust capital floor.

Basel III Monitoring Report - Results of the cumulative quantitative impact study December 2017

Alongside the finalisation of the Basel III post-crisis reforms, the Basel Committee published the results of a cumulative quantitative impact study (QIS) conducted while developing the standards. The Committee believes that the information contained in the report will provide relevant stakeholders with a useful benchmark for analysis and provide an estimated impact of the Committee's finalisation of the Basel III reforms.

The QIS is based on end-2015 data provided by 248 banks that participated in the exercise. The QIS did not take into account any transitional arrangements, nor make any assumptions about banks' profitability or behavioural responses. The report also does not reflect any additional capital requirements under Pillar 2 of the Basel II framework, any higher loss absorbency requirements for domestic systemically important banks or any countercyclical capital buffer requirements. Such factors may result in the report overstating the actual impact. On that basis, the report shows that the finalisation of Basel III results in no significant increase in overall capital requirements, although effects vary among banks.

The regulatory treatment of sovereign exposures - discussion paper December 2017

In January 2015, the Basel Committee on Banking Supervision set up a high-level Task Force on Sovereign Exposures to review the regulatory treatment of sovereign exposures and recommend potential policy options. The Task Force's report analysed issues concerning the regulatory treatment of sovereign exposures in the Basel framework. This discussion paper is derived from the Task Force's report.

The Committee's view is that the issues raised by the Task Force and the ideas outlined in this paper are important, and could benefit from a broader discussion. However, at this stage the Committee has not reached a consensus to make any changes to the treatment of sovereign exposures, and has therefore decided not to consult on the ideas presented in this paper.

The views of interested stakeholders will nevertheless be useful in informing the Committee's longer-term thinking on this issue. The Committee welcomes comments, which should be uploaded here by Friday 9 March 2018. All comments will be published on the website of the Bank for International Settlements unless a respondent specifically requests confidential treatment.

Committee on the Global Financial System

Structural changes in banking after the crisis **January 2018 No 60**

Report prepared by a Working Group established by the Committee on the Global Financial System. The Group was chaired by Claudia Buch (Deutsche Bundesbank) and B Gerard Dages (Federal Reserve Bank of New York).

The experience of the global financial crisis, the post-crisis market environment and changes to regulatory frameworks have had a marked impact on the banking sector globally. The CGFS Working Group examined trends in bank business models, performance and market structure over the past decade, and assessed their implications for the stability and efficiency of banking markets.

The report contains several key observations on structural changes in the banking sector after the crisis. First, while many large advanced economy banks have moved away from trading and cross-border activities, there does not appear to be clear evidence of a systemic retrenchment from core credit provision. Second, bank return on equity has declined across countries, and individual banks have experienced persistently weak earnings and poor investor sentiment, suggesting a need for further cost cutting and structural adjustments. Third, in line with the intended direction of the regulatory reforms, banks have significantly enhanced their balance sheet and funding resilience and curbed their involvement in certain complex activities.

The report also provides a comprehensive country-level dataset encompassing indicators of market structure, balance sheet composition, capitalisation and performance. The data, covering 21 countries over the 2000–2016 period, are provided in the annex tables of the report and in a data file for ease of use.

Committee on Payments and Market Infrastructure

Cross-border retail payments **February 2018 No 173**

There is room to improve the infrastructure for payments made by individuals, firms and government agencies that cross borders, according to a report by the Committee on Payments and Market Infrastructures (CPMI), the global standard setter for payment, clearing and settlement services.

Innovations such as mobile or e-banking have made cross-border payments more convenient but the key to making these payments faster and cheaper is better choice and diversity of clearing and settlement arrangements.

Speeches

Supervision in a post-Basel III world

Keynote address by Mr Agustín Carstens, General Manager of the BIS, at the 13th Asia-Pacific High-level Meeting on Banking Supervision, Singapore, 28 February 2018.

Three key messages:

First, completion of the Basel III reforms is a significant milestone and provides much needed regulatory certainty to the banking sector.

Second, effective supervision continues to be an important, but sometimes forgotten, element of the post-crisis reforms. It provides context to, and reinforces, Basel III. In a post-crisis world, supervisors will need to stay focused on traditional risks such as asset quality. At the same time, they must keep an eye on emerging risks, such as the evolving fintech landscape and the way it can transform our traditional approaches to identifying and assessing risk. In both cases, they will need to utilise new forward-looking assessment tools and to better employ existing ones to identify and resolve problems at an early stage.

And third, although it may not be sufficiently emphasised, perhaps the most powerful countercyclical tool available to prudential authorities is their army of front-line supervisors. They are the eyes and ears of policymakers and they see first-hand the impact of, for instance, monetary policy decisions on bank behaviour and risk-taking. Working in concert with risk managers at banks, supervisors are best positioned to say "no", even when society and indeed some governments are saying "yes".

With these considerations in mind, I believe that our Financial Stability Institute (FSI) can play a key role in advancing the supervisory agenda. Through its publications and outreach events such as this High-level Meeting, the FSI facilitates the exchange of supervisory experiences and approaches on a range of prudential issues. It also contributes to capacity-building for supervisors around the world.

The post-crisis regulatory agenda: What is missing?

English translation of speech in Spanish by Mr Fernando Restoy, Chairman, Financial Stability Institute, Bank for International Settlements, to Círculo Financiero La Caixa, Barcelona, Spain, 19 February 2018.

At the beginning of these remarks, I told you that, despite the significant progress that has been made, the regulatory community still has a lot of work to do. The tasks ahead are derived not only from the various sources of risk that affect the international financial system, but from the need to rigorously translate international principles into the regulations and supervisory practices of each jurisdiction. As I have said, this means adopting specific policies when international guidelines are not prescriptive enough - as in the case of identifying and measuring non-performing loans. It also means accurately defining the scope of application of the international standards, aiming for careful application of the principle of proportionality. Finally, it entails designing complementary measures that maximise the benefits and reduce the risks associated with the practical application of the international principles - such as those required by the new powers to resolve credit institutions.

All these tasks should be carried out by national authorities (or European ones in the case of the EU). Still, experience shows that in this area of implementation cooperation between supervisors can add significant value rooted in the exchange of experiences, mutual learning and the identification of effective ways of overcoming challenges. This is precisely the area of focus of the FSI.

How to transition out of a "Goldilocks economy" without creating a new "Minsky moment"?

Remarks by Mr Luiz Awazu Pereira da Silva, Deputy General Manager of the BIS, and Mr Jochen Schanz, Senior Economist, on the occasion of the joint conference by the National Bank of the

Republic of Macedonia and the Reinventing Bretton Woods Committee on "Monetary policy and asset management", Skopje, 16 February 2018.

A long episode of very calm markets appears to have come to an end. During the first eight days of February 2018, concerns about the joint impact on inflation of rising wage pressures against the backdrop of the US fiscal expansion and dollar depreciation challenged investors' complacency about inflation risks. Yield curves shifted up, apparently driven mostly by higher inflation expectations. The S&P 500 fell by 10%, the first sharp decline since January 2016 when market participants reacted with alarm to events in China. The VIX, a measure of expected stock market volatility, reached levels unseen since August 2015. For a moment, the risk appeared to emerge that the Goldilocks economy, with robust growth, low unemployment, and low inflation, could come to an abrupt end, giving rise to a "Minsky moment" in which speculative positions are unwound quickly, asset prices fall and the economy plunges into recession.

The policy life cycle and capacity-building needs of financial sector authorities

Keynote address by Mr Agustín Carstens, General Manager of the BIS, at the BIS-IMF symposium on "Capacity-building in financial sector regulation and supervision", Basel, 8 February 2018.

Money in the digital age: what role for central banks?

Lecture by Mr Agustín Carstens, General Manager of the BIS, at the House of Finance, Goethe University, Frankfurt, 6 February 2018.

Reviewing the economic functions and historical foundations of money, this lecture asks whether new technology fundamentally alters the advantages of central banks being the ultimate issuer. The inquiry sheds light on current policy questions surrounding cryptocurrencies. It concludes that authorities should focus on the ties linking cryptocurrencies to the conventional financial system and apply the level playing field principle of "same risk, same regulation".

Post-crisis bank resolution: what are the main challenges now?

Concluding remarks by Mr Agustín Carstens, General Manager of the BIS, at the 8th FSI-IADI conference on "Bank resolution, crisis management and deposit insurance", Basel, 2 February 2018.

This conference has provided an overview of the standards in crisis management and resolution as well as of the challenges so far and those to come.

A lot of ground has been covered, but we clearly need to road-test the new standards and requirements. Time will tell which ones work best.

In the meantime, implementation of the standards will continue to teach us important lessons, and it is key that authorities carry forward their cooperation, nationally and internationally, and further strengthen their resolution frameworks.

Events like today's conference convened by the IAID and the FSI can only help to support the development of best practices, so allow me to congratulate both bodies on the success of this occasion.

A level playing field in banking

Keynote address by Mr Agustín Carstens, General Manager of the BIS, at the Institute of International Finance Board of Directors dinner, Zurich, 21 January 2018.

A blind spot in today's macroeconomics?

Panel remarks by Mr Claudio Borio, Head of the Monetary and Economic Department of the BIS, at the BIS-IMF-OECD Joint Conference on "Weak productivity: the role of financial factors and policies", Paris, 10-11 January 2018.

A standard presumption in today's macroeconomics is that when making sense of first-order macroeconomic outcomes we can treat the economy as if its output were a single good

produced by a single firm. This means that issues of resource misallocation can be safely ignored. But the link between resource misallocations and macroeconomic outcomes may well be tighter than we think. This speech illustrates the point with reference to two examples that highlight the link between finance and macroeconomics: the impact of resource misallocations induced by financial booms and busts on productivity growth, and an intriguingly close relationship between the growing incidence of "zombie" firms and declining interest rates since the 1980s.

Fernando Restoy's intervention before the Spanish Parliament

Intervention of Mr Fernando Restoy, Chairman of the Financial Stability Institute, before the Spanish Parliament's Committee of Inquiry about the financial crisis in Spain and the financial assistance programme, Madrid, 20 December 2017.

The nature of evolving risks to financial stability

Keynote address by Mr Agustín Carstens, General Manager of the BIS, at the 53rd SEACEN Governors' Conference/High-level Seminar and 37th Meeting of the SEACEN Board of Governors, Bangkok, 15 December 2017.

While the risks I have outlined above are significant, they are by no means unmanageable. We can learn from previous tightening episodes and prepare ourselves for the risk of sharp snapbacks in the level of interest rates. We can do a better job in both spreading and selling to the body politic the benefits of economic and financial integration. Globalisation is not off the rails; it is just in need of maintenance.

We should continue to enhance our capacity to respond to the challenges posed by some disruptive innovations in financial services. At the same time, we should not allow for the revolution in IT and innovation to blur the distinction between money and virtual currencies.

And let's also continue to buttress domestic policies with international cooperation that monitors and addresses global linkages - through both global bodies such as the BIS, the IMF and the FSB, and regional ones such as ASEAN and SEACEN. Not least, let's fully implement the internationally agreed financial reforms - such as Basel III - in a timely and consistent manner to ensure the resilience of our financial systems.

