

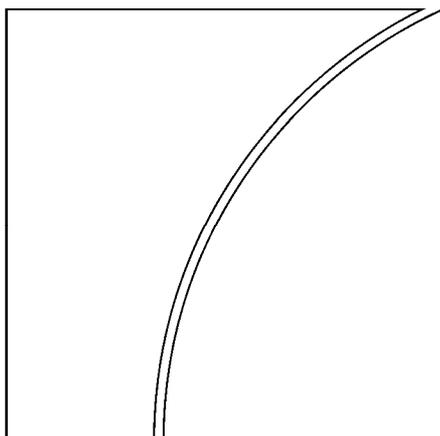


BANK FOR INTERNATIONAL SETTLEMENTS

## **BIS Quarterly Review**

March 2011

International banking  
and financial market  
developments



BIS Quarterly Review  
Monetary and Economic Department

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# BIS Quarterly Review

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## Notations used in this Review

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

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.

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## Inflation pressures rise with commodity prices<sup>1</sup>

In the period from the beginning of December 2010 to the last week of February 2011, investors priced in a strengthening of economic activity in major mature economies and a growing likelihood that the recovery had finally reached escape velocity. This improved growth outlook had a visible impact on financial markets: equity prices rose and credit spreads tightened in major advanced economies. Government bond yields also increased significantly, reflecting both higher expected real yields due to anticipated monetary policy tightening and higher expected inflation. During the last week of February, however, investor sentiment suffered a marked setback as concerns mounted about the repercussions of the political unrest in North Africa and the Middle East.

The rise in inflation expectations, especially in the near term, was due not only to the stronger growth outlook but also to rapidly rising prices for agricultural and other commodities, in particular food. Worries about global demand for food outpacing supply in several key markets are likely to have been an important factor in these increases. The surging prices prompted renewed concerns among investors and policymakers about the inflationary impact of higher commodity prices across the globe and possible second-round effects. Accelerating oil price increases in the wake of escalating political tensions in North Africa and the Middle East added further to these concerns.

While asset prices in mature economies were primarily driven by continued signs of a self-sustaining recovery, equity and bond prices in a number of emerging economies began to reflect increasing investor concerns about the impact of policy tightening in response to rising inflation. Moreover, the changing global outlook led investors to rebalance their portfolios geographically. This resulted in outflows from equity markets in Asia and Latin America and inflows into developed economy equity markets.

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<sup>1</sup> This article was produced by the BIS Monetary and Economic Department. The analysis covers the period until 3 March 2011. Questions about the article can be addressed to [jacob.gyntelberg@bis.org](mailto:jacob.gyntelberg@bis.org) or [peter.hoerdahl@bis.org](mailto:peter.hoerdahl@bis.org). Questions about data and graphs should be addressed to [magdalena.erdem@bis.org](mailto:magdalena.erdem@bis.org) or [garry.tang@bis.org](mailto:garry.tang@bis.org).

## Recovery optimism versus political unrest

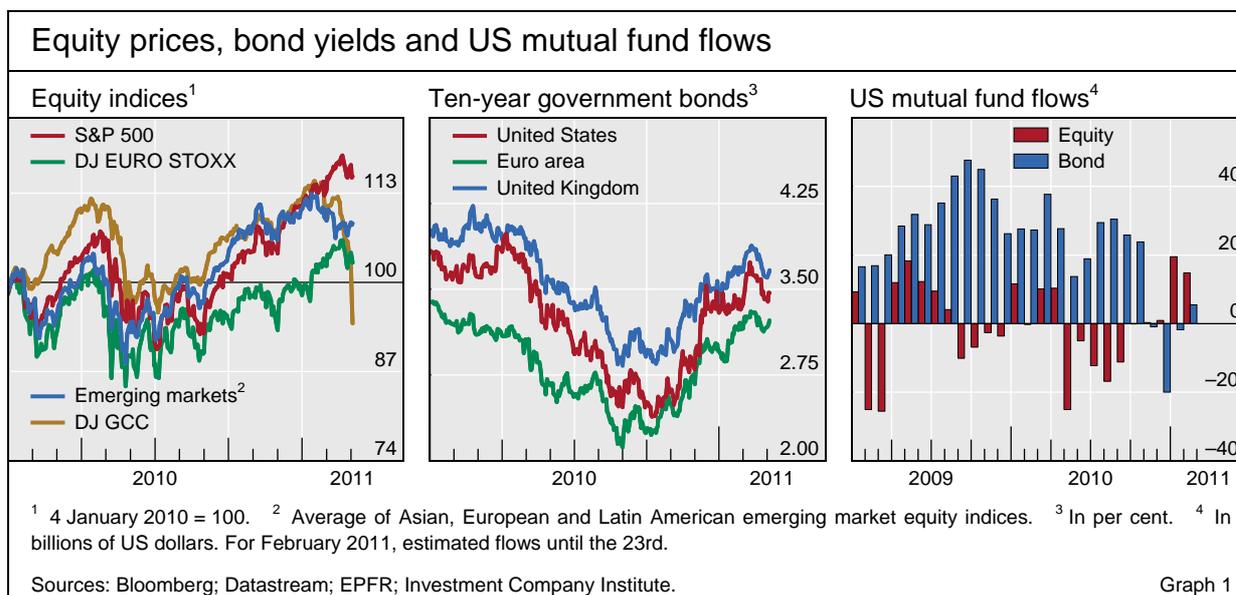
From early December until the last week of February both equity and bond market developments suggested that investors were beginning to price in an improved growth outlook for major advanced economies. A steady trickle of positive data releases continued to indicate that a recovery was taking hold in the advanced economies, particularly in Japan and the United States. This growing optimism resulted in significant increases in equity prices in major economies over the period under review (Graph 1, left-hand panel). Similarly, corporate credit spreads continued to tighten and longer-term government bond yields rose (Graph 1, centre panel). The increase in bond yields reflected a combination of higher expected inflation and expectations of higher real yields (see below). The change in investor sentiment in favour of equities over bonds was clearly visible in US mutual fund flows, with bond market funds experiencing outflows in December, as investors rebalanced their portfolios towards equities (Graph 1, right-hand panel).

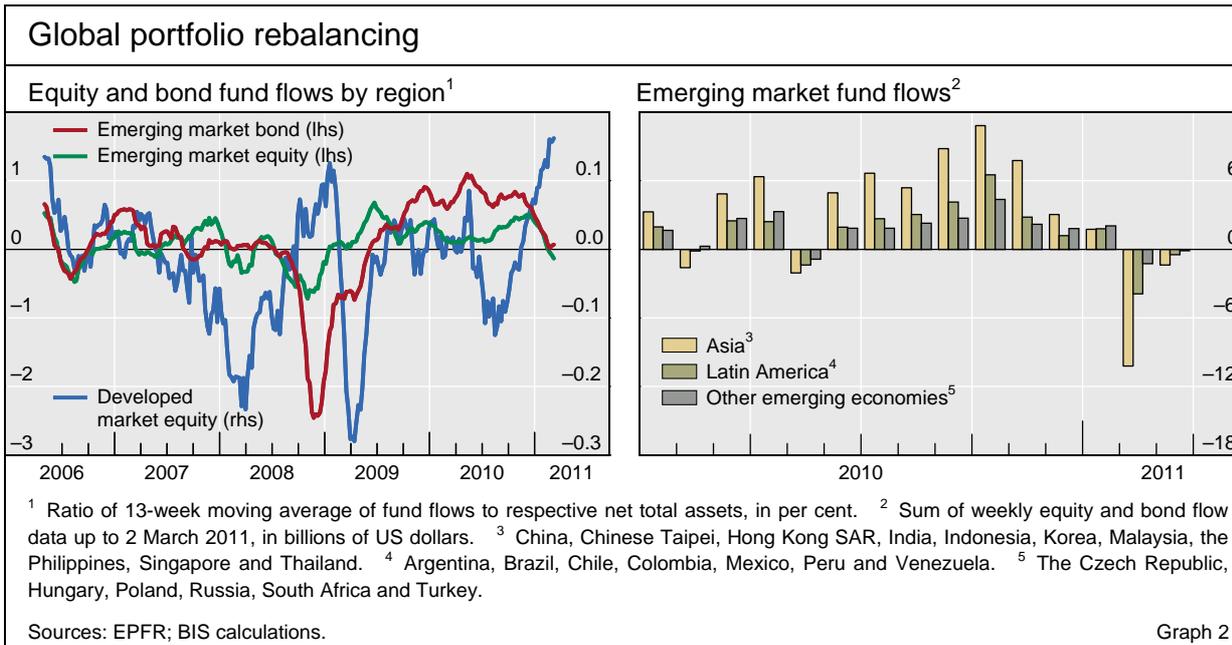
Equities rise and bonds drop in advanced economies as the recovery takes hold ...

In emerging market economies, investors focused on the impact of future policy tightening in response to the growing inflation momentum in a number of countries. The changed outlook caused equity prices in several emerging markets to decline starting in December (Graph 1, left-hand panel). It was also reflected in outflows from US mutual funds targeting emerging markets and inflows into developed economy equity market funds (Graph 2, left-hand panel). This signalled the end to a period with high capital inflows into Asia and Latin America: in February all emerging market focused funds saw net outflows (Graph 2, right-hand panel).

...while inflation worries weigh on emerging markets

Sentiment suffered a notable setback during the last week of February, as concerns about the impact of political unrest in North Africa and the Middle East led to oil price spikes. This change was clearly seen across global markets. Safe haven flows caused the Swiss franc to appreciate against the US dollar, and global equity prices declined. Implied equity option volatilities – an often-used

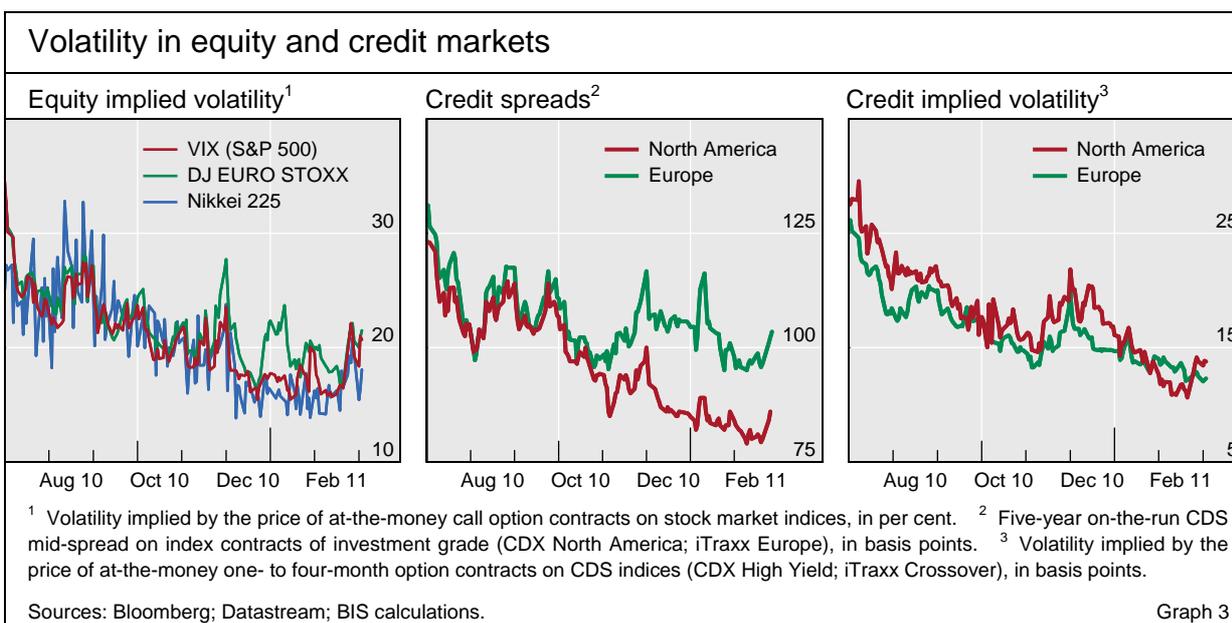


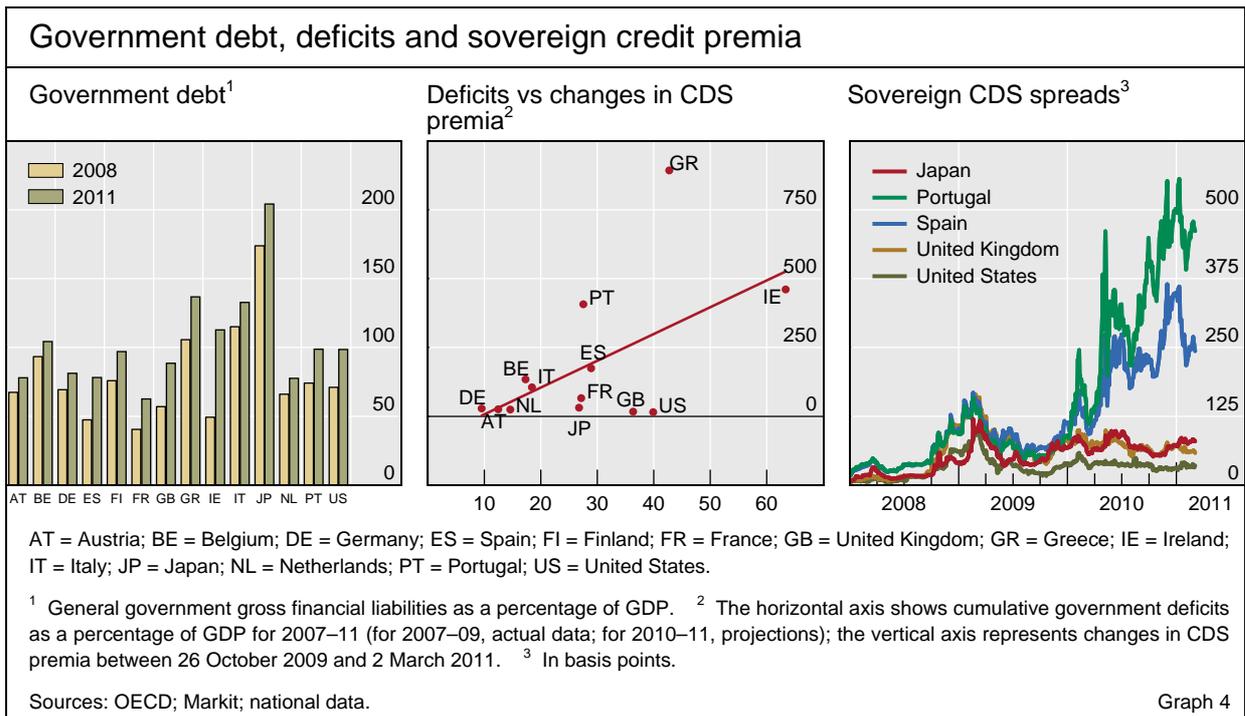


indicator of investor risk perceptions – jumped by around two thirds (Graph 3, left-hand panel). In credit markets, spreads widened substantially in a matter of days while implied credit volatilities reversed their downward trend (Graph 3, centre and right-hand panel).

#### *Fiscal outlook still a focus area*

Investors remained focused on public debt levels and fiscal developments in mature economies. Japanese sovereign debt was downgraded by Standard & Poor's in late January and put on negative credit outlook by Moody's in late February, in part due to the expected increase in the debt-to-GDP ratio (Graph 4, left-hand panel). Equity markets appeared to react negatively to the rating changes, but the response in bond markets was hardly noticeable,





possibly owing to the high percentage of Japanese government bonds held by domestic investors. Sovereign credit spread developments for a number of other countries continued to reflect their uncertain fiscal outlook (Graph 4, centre panel).

Concerns about the fiscal situation in Spain and Portugal continued to linger. After the rescue package for Ireland, investors' focus turned to the sustainability of Portugal's fiscal situation as yields on Portuguese debt continued to reach new highs. As a result, the possibility that Portugal might tap the European Financial Stability Facility was seen by many as increasing over the period. Starting on 10 January a gradual decline in sovereign credit spreads provided signs of a slight easing of investor concerns (Graph 4, right-hand panel). The improved sentiment was in part driven by lower budget deficits and fiscal austerity initiatives in Spain as well as the successful issuance of EU bonds in early January. The EU bond issues were oversubscribed, benefiting from a Japanese pledge to buy 25% of the bonds. The lower spreads may also have reflected a decline in the number of short positions in both credit and currency markets as investor sentiment improved. This improvement also resulted in higher European bank equity prices while bank credit spreads narrowed. During January and February developments in Spanish bank bond and equity prices also reflected the release of more detailed information about property sector exposures as well as the introduction of stricter capital requirements.

Fiscal concerns continue to linger

### Food, oil and other commodity prices increase

Commodity prices surged over the period under review, with food and oil prices seeing the largest increases (Graph 5, left-hand panel). The significant food price increases in part reflected concerns about future supply, driven by weather-

Commodity prices soar

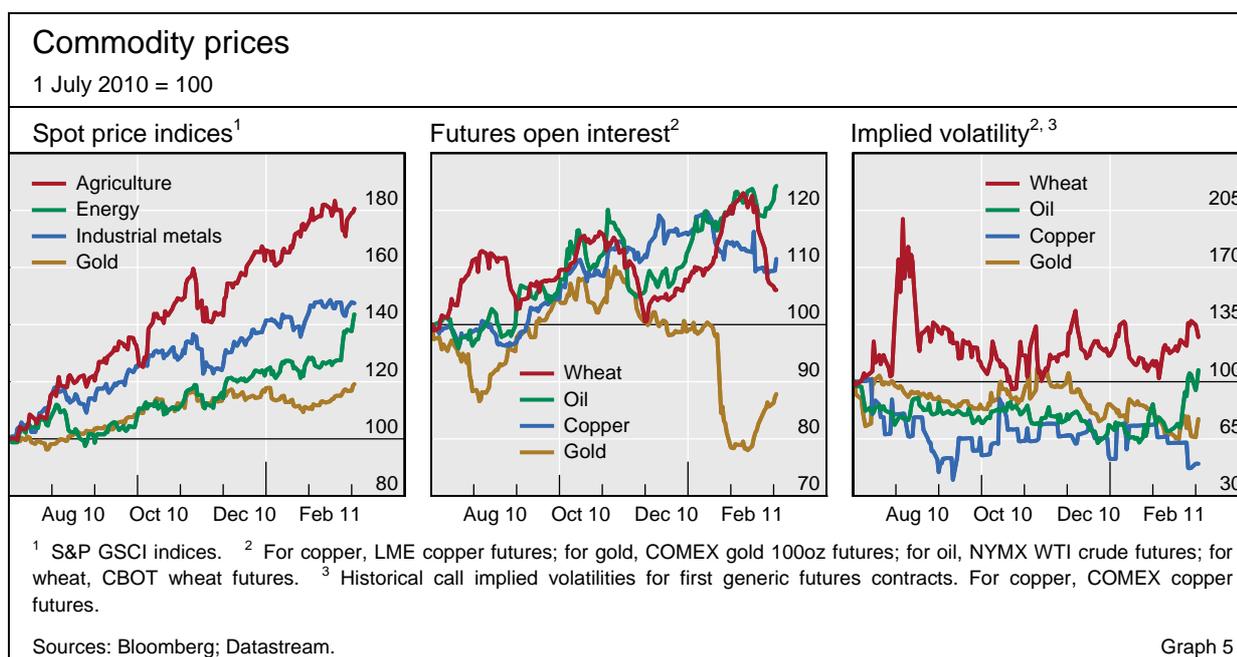
related declines in global production. The surge in prices led some policymakers and commentators to express concerns about the possible political and inflationary impact of higher food prices in emerging and developing economies.

The factors behind increasing prices for food and other commodities differed somewhat. In the case of food, prices were mainly driven by concerns about low future supply due to flooding in Australia and disappointing harvests as a result of bad weather in Ukraine, Russia, China and Pakistan. For several commodities, low inventories added to the price pressures. The most visible impact was on wheat, which is one of the commodities most affected by supply concerns. However, futures prices indicated that food supply is expected to increase and that prices may stabilise later this year. In contrast to food prices, the rise in energy and metal prices seemed to be driven by longer-run demand pressures stemming from the expected path of global growth.

The rapid rise in food prices was accompanied by significant increases in open interest positions in futures markets (Graph 5, centre panel). The futures markets for wheat, maize (corn) and soybeans saw the largest and most rapid increases, reflecting lower inventories and greater concerns about future demand outstripping supply. Despite the increase in futures positions, it is unclear to what extent financial factors were a key driver of spot prices. In particular, price increases in a number of markets preceded the rise in futures positions. Also, financial investments linked to commodity price indices, another possible driver of commodity prices, do not appear to have grown much over the period. Consistent with a tight but predictable supply/demand situation, several commodity markets have seen declines in implied option volatilities (Graph 5, right-hand panel) as well as a steepening of futures price curves.

Libyan unrest adds further pressure on oil

Oil prices soared in the last week of February in the wake of mounting concerns that the political unrest in Libya could spread to other major oil producers in the region and disrupt global oil production. Assurance from the oil producers' cartel that they stood ready to increase supply to avoid shortages



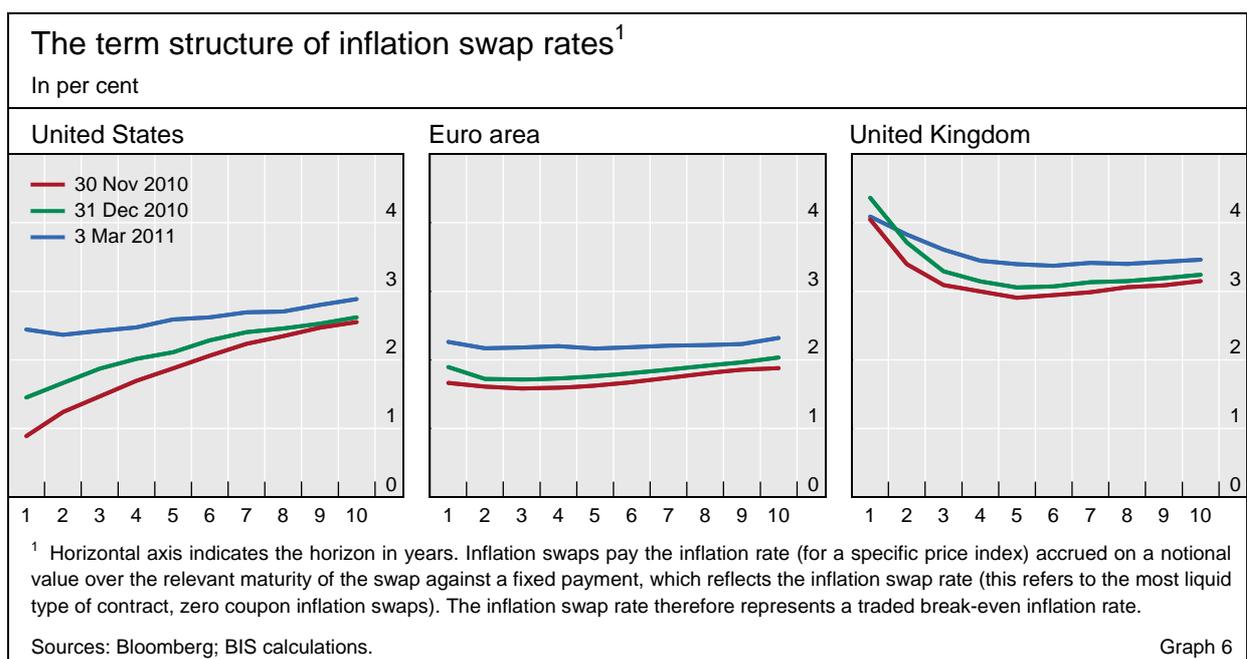
had little impact. The deteriorating political situation in Libya led to more than half of the country's oil production being shut down. This resulted in sizeable jumps in oil spot and futures prices, with the spot price reaching levels not seen for two years. The surge in oil prices was seen as a threat to global growth, causing non-energy commodity spot prices to decline and implied option volatilities for oil and other commodities to shoot up.

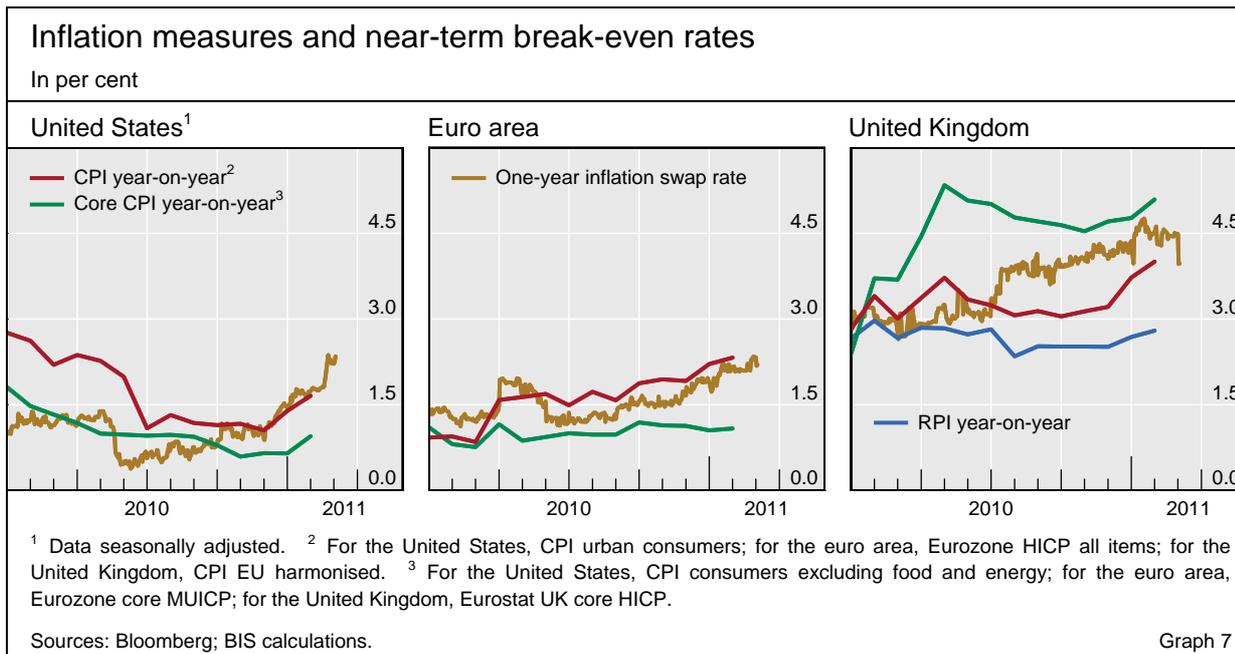
### Monetary policy in focus as inflation pressures mount

With food and commodity prices surging and headline inflation picking up, investors began pricing in higher inflation rates in major mature economies, particularly in the near term. Inflation swap rates (ie break-even inflation rates traded in swap markets) shifted gradually upwards in recent months. While these movements were largely uniform across maturities for euro area and UK inflation swap curves, the US curve shifted upwards substantially more at the short than at the long end (Graph 6). With inflation pressures rising, investors increasingly focused on the likelihood and timing of monetary policy tightening.

Investors price in higher inflation ...

The rise in inflation swap rates coincided with upticks in headline inflation measures in the United States and the euro area, even as core inflation remained considerably lower and more stable (Graph 7). This was no surprise, as inflation swaps are indexed to headline consumer price indices (the retail price index (RPI) for the United Kingdom), and consumer prices tend to react relatively quickly to swings in prices of commodities and food. Core price indices, on the other hand, tend to take out food and energy prices, ie precisely those components which have experienced the most rapid increases. The greater stability of longer-dated US inflation swap rates suggests that, at least for now, much of the recent rise in headline inflation rates was perceived by investors as largely a one-off increase, rather than the beginning of a





persistent rise in US inflation.<sup>2</sup> It remains to be seen whether these expectations turn out to be justified.

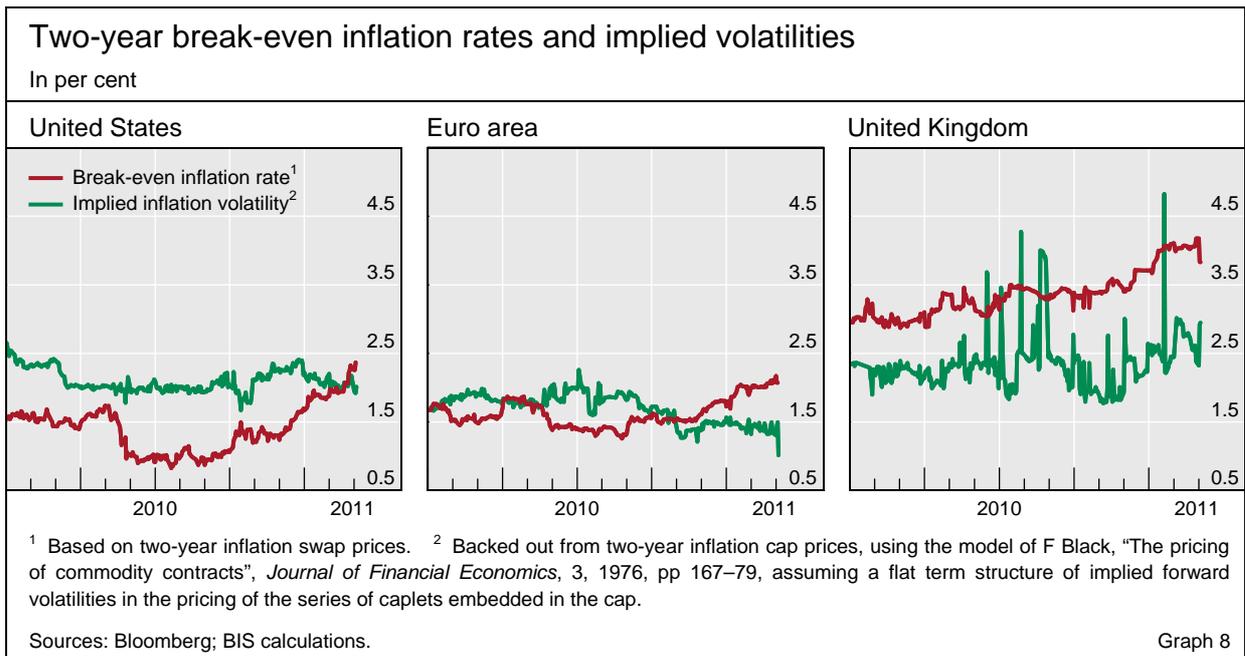
The recent indications of rising short-term inflation expectations were generally not accompanied by signs of higher uncertainty about near-term inflation developments. Implied inflation volatility, backed out from two-year options on inflation, remained broadly stable for the United States and the euro area, even as two-year inflation swap rates rose markedly (Graph 8, left-hand and centre panels).<sup>3</sup> The United Kingdom was an exception, with signs of rising implied volatility in recent months indicating that investors were becoming more uncertain about the likely path of inflation over the next couple of years (Graph 8, right-hand panel).<sup>4</sup> This coincided with a gradual rise in the two-year UK inflation swap rate to above 4%, and with the release of data showing UK CPI inflation rising to 3.7% in December 2010.<sup>5</sup> Although a non-trivial part of this increase was due to the recent VAT hike, the heightened near-term uncertainty may suggest investor wariness of a persistent overshoot of the 2% CPI inflation target. News that the UK economy unexpectedly

<sup>2</sup> See also the article by Gerlach et al in this issue of the *Quarterly Review*, which examines various measures of inflation expectations since the financial crisis, but only up to January 2011.

<sup>3</sup> Longer-term implied inflation volatilities have also remained fairly stable in recent months; see the article by Gerlach et al in this issue of the *Quarterly Review*.

<sup>4</sup> It also appears that UK implied inflation volatility is more volatile than US or euro area implied volatility. This may, however, reflect greater illiquidity in the UK segment of the inflation derivative market rather than structurally higher volatility of volatility.

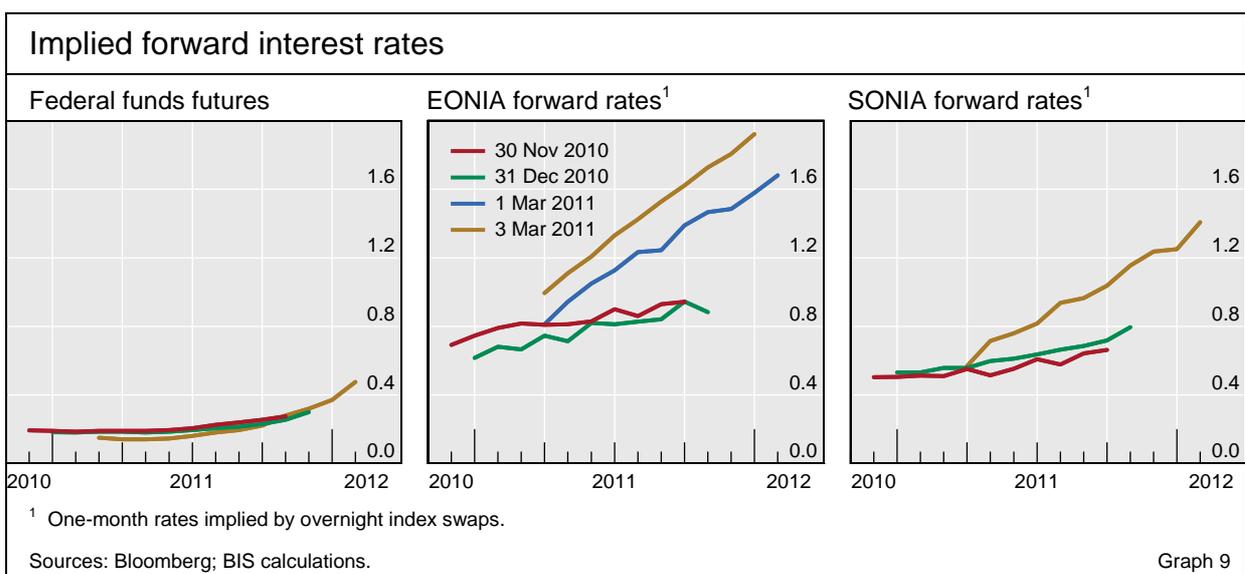
<sup>5</sup> The RPI, which has a different coverage from the CPI, including with respect to mortgage and housing costs, rose to 4.8% in December.



contracted by 0.5% in the fourth quarter of 2010 further complicated the monetary policy outlook.<sup>6</sup>

In line with signs that the recovery was gaining traction and with expectations of rising inflation in advanced economies, investors began to bring forward expected increases in policy interest rates, at least for the euro area and the United Kingdom (Graph 9, centre and right-hand panels). This contrasted with developments throughout much of 2010, when the expected timing of first rate hikes had repeatedly been pushed further into the future. By late February, implied forward interest rates indicated that the first UK and euro area tightening moves were expected around mid-2011, whereas in late 2010 they had pointed to first rate hikes only in 2012. This shift was consistent with

... and tightening of monetary policy ...



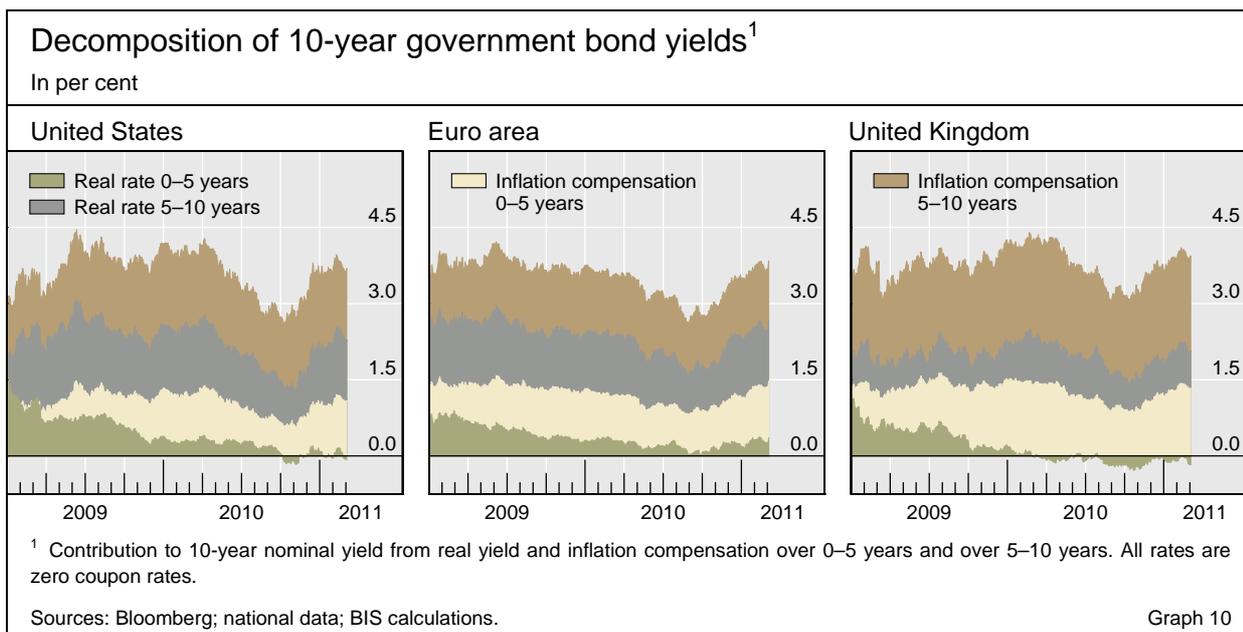
<sup>6</sup> The contraction was partly due to negative shocks to construction and services as a result of severe winter weather conditions in late 2010.

the recent rapid widening of the gap between consumer price indices and the price stability objectives of the ECB and the Bank of England. Implied euro area forward rates shifted further upwards on 3 March, as ECB President Trichet unexpectedly hinted that a rate hike was close at hand (Graph 9, centre panel). Meanwhile, US policy rates were, as before, priced in to start rising in the first half of 2012 (Graph 9, left-hand panel).

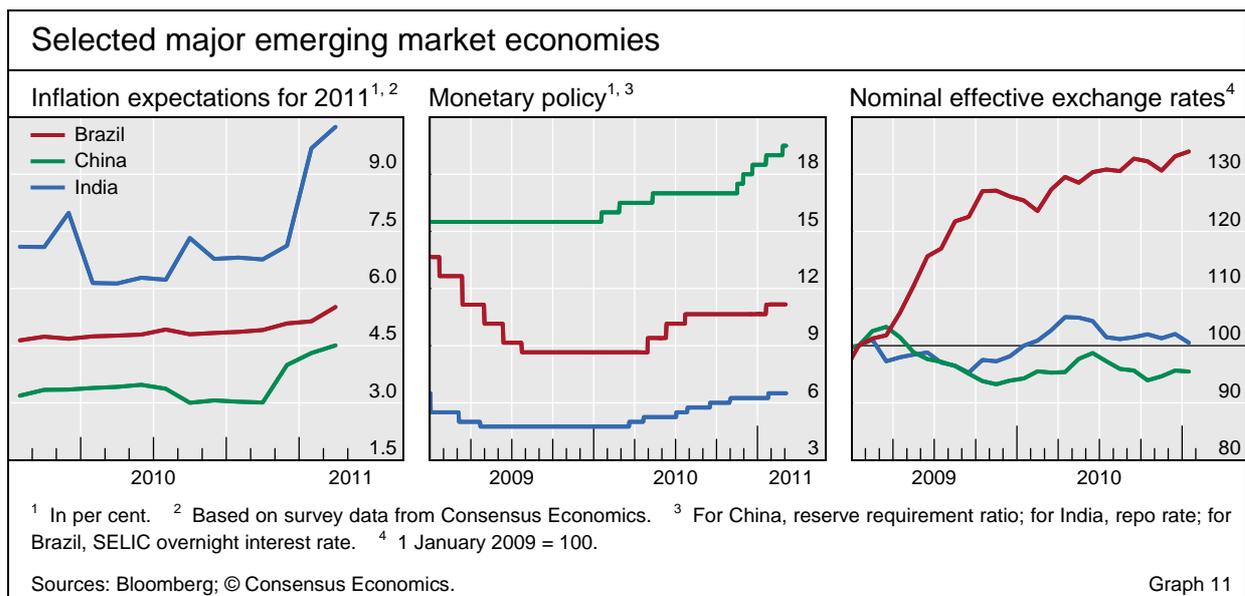
... thus driving up bond yields

The combination of a stronger recovery, rising inflation expectations, and a resulting pickup in the anticipated pace of monetary policy tightening pushed long-term government bond yields higher across major mature economies. Between end-November 2010 and early March 2011, 10-year nominal bond yields (zero coupon) rose by around 55 basis points in the euro area,<sup>7</sup> by almost 50 basis points in the United Kingdom and by 65 basis points in the United States. In line with the evidence from inflation swap markets, a large part of these increases was due to rising inflation compensation, especially in the near-to-medium term – up to five years ahead – while the component due to inflation compensation between five and 10 years ahead was smaller (Graph 10). For the United States, this longer-term inflation component was actually negative, albeit small. The increase in the US 10-year yield was due in roughly equal parts to inflation compensation up to five years ahead and to rising real yields between 5 and 10 years ahead. This was in line with the perceived pickup in economic activity and with investors pricing in higher real yields in anticipation of only a very gradual normalisation of US monetary policy rates. The fact that the real rate rise was seen in the five- to 10-year segment suggests that this process was expected to take some time.

In late February, flight-to-safety flows resulting from political unrest in North Africa and the Middle East put some downward pressure on bond yields in major mature economies.



<sup>7</sup> This refers to French government bond yields.



Meanwhile, authorities in major emerging market economies continued to take gradual steps to tighten monetary policy as inflationary pressures there intensified. These pressures resulted both from the brisk pace of economic growth – much higher than in mature economies – and from the greater importance of rising food and commodity prices for consumer price inflation in emerging economies. Among the largest economies, inflation expectations rose notably in China, and climbed further in India (Graph 11, left-hand panel). In response, the People’s Bank of China hiked the reserve requirement by 50 basis points in January and again in February. These increases represented the seventh and eighth tightening moves since the beginning of 2010, bringing the ratio to 19.5% (Graph 11, centre panel). The bank also raised key policy rates by 25 basis points in December 2010 and February 2011. Citing the “unacceptably high” rate of inflation, the Reserve Bank of India raised the repo rate by a further 25 basis points to 6.5%, making the cumulative increase 175 basis points since March 2010. The Central Bank of Brazil tightened policy too, increasing the SELIC interest rate to 11.25% in January to try to bring inflation towards the bank’s target. These interest rate hikes in major emerging market economies have also resulted in higher real policy rates over the past few months (at least as proxied by nominal policy rates less actual, contemporaneous inflation). However, while the Brazilian real rate is relatively high (around 5%), real policy rates in China and India are still negative.

Further policy tightening in emerging markets

With interest rates on the rise, exchange rates continued to be subject to upward pressure in major emerging economies (Graph 11, right-hand panel). Many countries continued to rely on reserve accumulation in order to resist rapid nominal exchange rate appreciation.

## Highlights of the BIS international statistics

*The BIS, in cooperation with central banks and monetary authorities worldwide, compiles and disseminates several datasets on activity in international banking and financial markets. The latest available data on the international banking market refer to the third quarter of 2010. The discussion on international debt securities and exchange-traded derivatives draws on data for the fourth quarter of 2010.*

### The international banking market in the third quarter of 2010<sup>1</sup>

Cross-border lending<sup>2</sup> by BIS reporting banks returned to positive growth in the third quarter of 2010. Claims denominated in all major currencies except the euro increased during the period. Internationally active banks expanded their claims on residents of all four major emerging market regions for the first time since the collapse of Lehman Brothers. The exchange rate-adjusted foreign claims<sup>3</sup> of BIS reporting banks on Greece, Ireland, Portugal and Spain fell slightly during the period. As of September 2010, the exposures of all major national banking systems to the Middle East and North Africa were fairly small relative to their aggregate foreign exposures.

#### *Cross-border lending picks up<sup>4</sup>*

The aggregate cross-border claims of BIS reporting banks recorded a sizeable expansion in the third quarter of 2010. The \$650 billion (2.3%) rise brought the stock to \$31 trillion, approximately \$5 trillion below the peak of \$36 trillion reached at the end of March 2008. The overall increase was led by a \$372 billion (3.6%) rise in lending to non-banks (Graph 1, left-hand panel). At \$11 trillion, these claims represent slightly more than a third of the aggregate

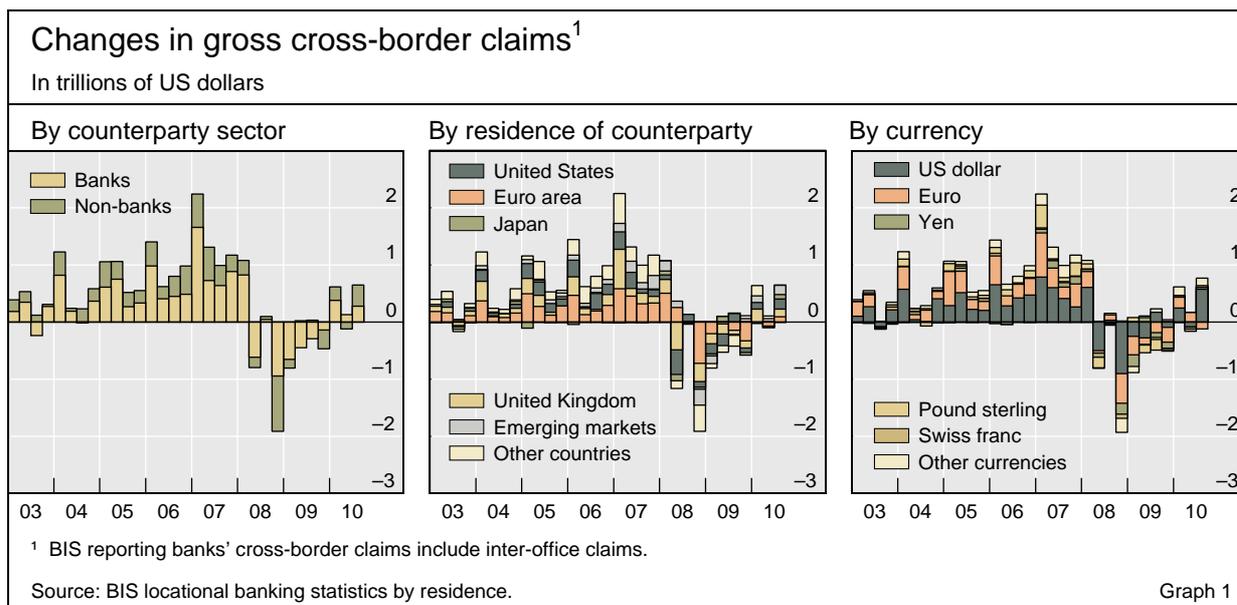
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<sup>1</sup> Queries concerning the banking statistics should be addressed to Stefan Avdjiev.

<sup>2</sup> Cross-border lending is defined as lending to entities located in a country other than the country of residence of the reporting banking office (balance of payments basis).

<sup>3</sup> Foreign claims are defined as the sum of cross-border claims and local claims of foreign affiliates.

<sup>4</sup> The analysis in this and the following subsection is based on the BIS locational banking statistics by residence. In this dataset, creditors and debtors are classified according to their residence (as in the balance of payments statistics), not according to their nationality. All reported flows in cross-border claims have been adjusted for exchange rate fluctuation and breaks in series.



stock of cross-border claims and are normally less volatile than their interbank counterparts, which went up by \$278 billion (1.5%) during the third quarter of 2010.

BIS reporting banks simultaneously increased their cross-border claims on all major advanced economies for the first time since the start of 2008 (Graph 1, centre panel). Cross-border claims on residents of the United States recorded their largest rise (\$176 billion or 3.4%) since the second quarter of 2007. Most of that growth was due to a \$142 billion (5.7%) increase in claims on non-banks in the country. Cross-border claims on the euro area went up for the first time in two years (by \$93 billion or 1.0%). More than three quarters of the increase was due to a \$73 billion rise in claims booked by banks located outside the euro zone. Claims on residents of the United Kingdom and Japan also rose during the period (by \$135 billion or 2.9% and by \$80 billion or 11.6%, respectively).

Banks expand cross-border lending to developed economies ...

Cross-border claims denominated in all major currencies except the euro increased during the quarter (Graph 1, right-hand panel). Cross-border claims denominated in US dollars surged by \$575 billion (4.8%). Claims denominated in yen and sterling also went up (by \$35 billion or 3.2% and by \$25 billion or 1.6%, respectively). By contrast, euro-denominated claims contracted (by \$122 billion or 1.2%) following two consecutive quarterly expansions.

#### *Broad-based expansion in cross-border claims on emerging markets*

The growth rate of BIS reporting banks' cross-border claims on residents of emerging market economies increased during the third quarter of 2010 (Graph 2). The \$160 billion (6.3%) rise was the sixth in a row and larger than any of the preceding five. It was also the first since the failure of Lehman Brothers to encompass all four major emerging market regions.

... and to emerging market economies

More than half of the overall increase was directed towards the buoyant economies of the Asia-Pacific region (Graph 2, bottom right-hand panel). The \$84 billion (9.2%) expansion was the result of a \$44 billion (7.6%) rise in interbank claims and a \$40 billion (12%) increase in claims on non-banks.

Strong growth in claims on China ...

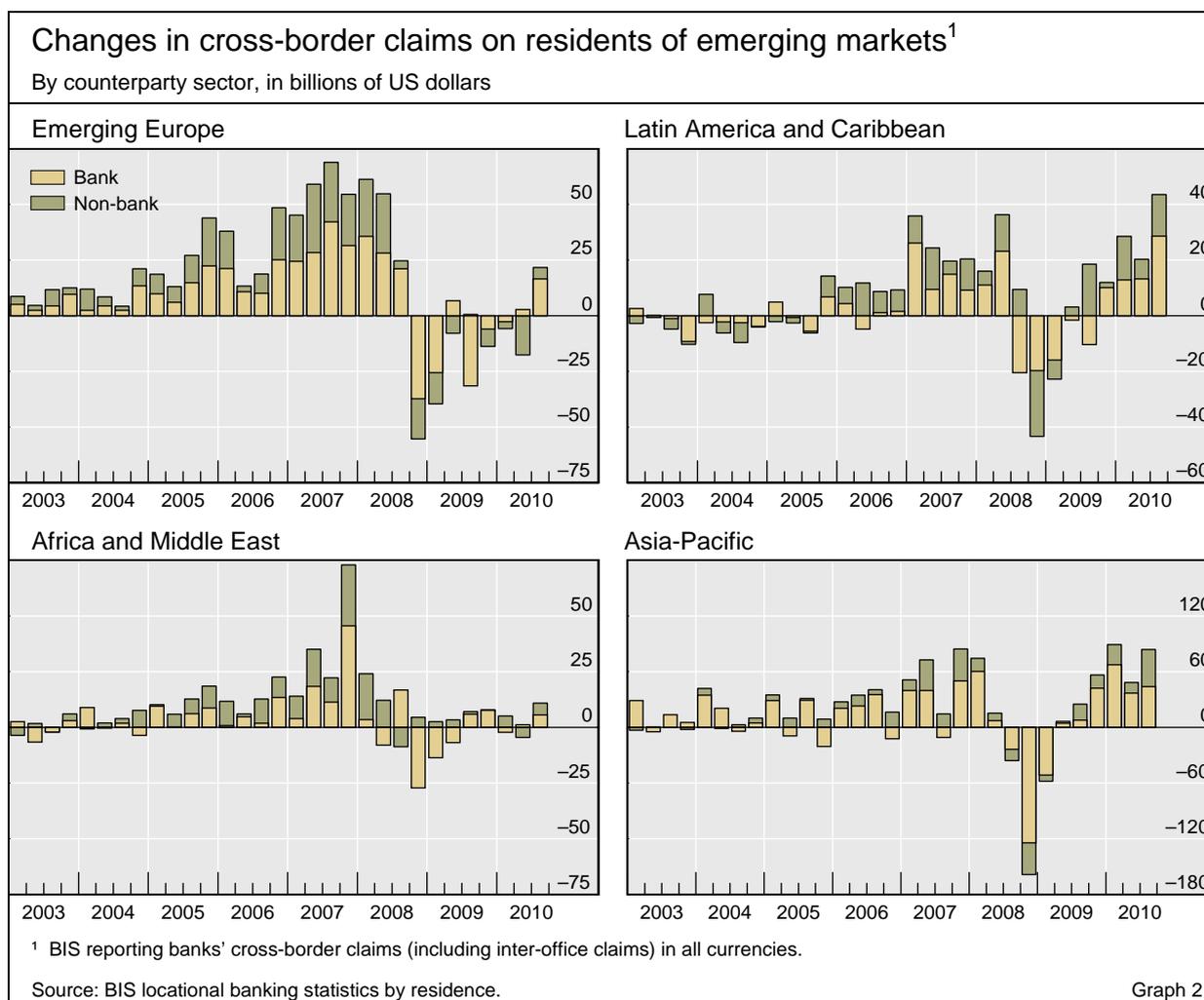
Once again, the emerging market country that saw the largest growth in cross-border lending was China (\$37 billion or 15%). This brought the stock of BIS reporting banks' cross-border claims on that country to \$285 billion, which accounted for over 10% of all claims on emerging market economies (\$2.779 trillion) and more than a quarter of all those on the Asia-Pacific region (\$1.015 trillion). Claims on India and Chinese Taipei also recorded solid gains during the quarter, increasing by \$13 billion (8.0%) and \$11 billion (17%), respectively. By contrast, claims on Korea declined by \$2.6 billion (1.2%).

... and Brazil

Cross-border claims on residents of the Latin America-Caribbean region grew at an unprecedented pace during the third quarter of 2010 (Graph 2, top right-hand panel). In absolute terms, the \$44 billion (9.6%) increase was the largest on record. Approximately two thirds of that amount (\$28 billion or 14%) was directed towards Brazil. Ahead of the October 2010 presidential election, claims on banks located in the country soared by \$17 billion (21%), while those on non-banks expanded by \$11 billion (8.5%). In the meantime, cross-border claims on Peru surged by \$4.6 billion (32%) amidst very strong (mainly export-led) economic growth in the country. Reporting banks also increased their claims on Mexico (\$4.1 billion or 4.0%) and Chile (by \$3.4 billion or 7.5%).

Cross-border lending to emerging Europe grows again

BIS reporting banks expanded their cross-border lending to emerging Europe for the first time in the last eight quarters (Graph 2, top left-hand



panel). Claims on the region went up by \$22 billion (3.1%) during the period. Not surprisingly, internationally active banks chose to direct most of their funds towards the more vibrant economies of the area. Claims on Poland, the only country in the region that did not experience a recession during the financial crisis, rose by \$8.7 billion (7.8%). Banks also continued to expand their cross-border lending to Turkey (by \$5.0 billion or 3.7%), while the country's economy recorded its sixth quarter of positive growth. In the meantime, cross-border lending to Russia, whose economy had expanded for three consecutive quarters, increased (by \$10.1 billion or 8.0%) for the first time after seven consecutive declines. Nevertheless, not all countries in the region experienced inflows. Banks cut their lending to Hungary (by \$2.3 billion or 2.7%) as details emerged about some unorthodox features of the government's plan to deal with the country's fiscal situation. Claims on Croatia also fell considerably (by \$1.6 billion or 4.3%).

BIS reporting banks increased their cross-border lending to Africa and the Middle East for the fourth time in the last five quarters (Graph 2, bottom left-hand panel). The \$10.8 billion (2.4%) increase in claims was the result of a \$5.5 billion (3.1%) expansion in interbank lending and a \$5.2 billion (1.9%) rise in claims on non-banks. The largest inflows were experienced by Saudi Arabia (\$7.1 billion or 9.9%), South Africa (\$2.8 billion or 8.5%) and Qatar (\$2.4 billion or 4.7%).

#### *BIS reporting banks' foreign exposures to Greece, Ireland, Portugal and Spain<sup>5</sup>*

As of the end of the third quarter of 2010, the total *consolidated* foreign exposures<sup>6</sup> (on an *ultimate risk* basis) of BIS reporting banks to Greece, Ireland, Portugal and Spain stood at \$2,512 billion (Table 1). At \$1,756 billion, foreign claims were equal to approximately 70% of that amount. The remaining \$756 billion was accounted for by *other exposures* (ie the positive market value of derivatives contracts, guarantees extended and credit commitments).

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<sup>5</sup> The analysis in this and the following subsection is based on the BIS consolidated international banking statistics on an ultimate risk basis. In this dataset, the exposures of reporting banks are classified according to the nationality of banks (ie according to the location of banks' headquarters), not according to the location of the office in which they are booked. In addition, the classification of counterparties takes into account risk transfers between countries and sectors (see box on page 16 for a more detailed discussion and examples of risk transfers).

<sup>6</sup> *Total foreign exposures* consist of two main components: *foreign claims* and *other exposures*. In turn, *foreign claims* consist of cross-border claims (ie claims on entities located in a country other than the country of residence of the reporting banking office) and local claims (ie claims on entities located in the country of residence of the reporting banking office) of foreign affiliates (ie branches and subsidiaries located outside the country in which the bank is headquartered); *other exposures* consist of the positive market value of derivatives contracts, guarantees extended and credit commitments.

## Foreign exposures to Greece, Ireland, Portugal and Spain, by bank nationality

End-Q3 2010; in billions of US dollars

		Bank nationality									
Exposures to	Type of exposure	DE <sup>1</sup>	ES <sup>2</sup>	FR <sup>3</sup>	IT	OEA <sup>2</sup>	GB	JP	US	ROW	Total
Greece	Public sector	26.3	0.6	19.8	2.6	15.7	3.2	0.5	1.8	1.5	72.0
	+ Banks	3.9	0.0	1.4	0.3	1.3	4.3	0.5	0.5	1.3	13.6
	+ Non-bank private	10.1	0.5	42.1	1.9	13.3	7.5	0.9	4.7	4.2	85.0
	+ Unallocated sector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	= Foreign claims	40.3	1.1	63.3	4.7	30.4	15.1	1.9	6.9	7.1	170.7
	+ Other exposures <sup>4</sup>	29.2	0.4	28.7	1.7	3.1	5.3	0.1	36.2	2.4	107.2
	= Total exposures	69.4	1.5	92.0	6.5	33.5	20.4	2.0	43.1	9.5	277.9
Ireland	Public sector	3.4	0.3	6.6	0.8	3.7	6.6	1.5	1.5	0.7	25.1
	+ Banks	57.8	3.3	16.8	3.3	7.3	37.4	1.8	17.9	10.6	156.3
	+ Non-bank private	92.8	9.4	21.2	10.9	47.4	116.1	17.7	40.3	25.0	381.0
	+ Unallocated sector	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.8	1.3
	= Foreign claims	154.1	13.0	44.7	15.3	58.6	160.2	21.0	59.7	37.1	563.7
	+ Other exposures <sup>4</sup>	54.3	4.5	33.4	9.1	8.6	64.4	1.5	54.2	20.2	250.1
	= Total exposures	208.3	17.5	78.1	24.4	67.2	224.6	22.5	113.9	57.3	813.7
Portugal	Public sector	8.4	8.8	16.1	0.9	7.8	2.6	1.3	1.6	1.5	49.0
	+ Banks	18.1	6.1	6.5	2.3	4.6	6.2	0.3	1.4	0.9	46.2
	+ Non-bank private	13.6	70.3	14.8	1.5	7.5	16.5	0.8	1.5	1.8	128.3
	+ Unallocated sector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	= Foreign claims	40.0	85.2	37.4	4.7	19.8	25.3	2.4	4.5	4.2	223.5
	+ Other exposures <sup>4</sup>	8.5	23.4	8.1	3.2	2.1	8.5	0.4	42.6	1.5	98.3
	= Total exposures	48.5	108.6	45.6	7.9	22.0	33.7	2.8	47.1	5.8	321.8
Spain	Public sector	29.4	.	46.0	3.3	16.9	10.0	9.7	4.7	3.0	123.0
	+ Banks	85.8	.	55.8	9.0	49.1	34.0	4.5	20.6	11.0	269.7
	+ Non-bank private	85.7	.	81.3	16.2	98.5	72.4	10.2	26.3	14.7	405.3
	+ Unallocated sector	0.0	.	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.4
	= Foreign claims	200.9	.	183.1	28.7	164.6	116.3	24.4	51.6	28.9	798.5
	+ Other exposures <sup>4</sup>	41.4	.	41.6	13.1	15.0	36.1	4.8	136.0	12.4	300.3
	= Total exposures	242.4	.	224.7	41.8	179.6	152.4	29.2	187.5	41.3	1,098.8

DE = Germany; ES = Spain; FR = France; IT = Italy; OEA = other euro area; GB = United Kingdom; JP = Japan; US = United States; ROW = rest of the world.

<sup>1</sup> Claims of German banks on the four countries are on an immediate borrower basis. <sup>2</sup> Exposures of banks headquartered in the respective country are not included, as these are not foreign exposures. <sup>3</sup> Claims of French banks on the four countries are currently under review and are subject to revisions. <sup>4</sup> Positive market value of derivatives contracts, guarantees extended and credit commitments.

Source: BIS consolidated banking statistics (ultimate risk basis).

Table 1

## What the BIS banking statistics say (and what they do not) about banking systems' exposures to particular countries and sectors

The BIS consolidated international banking statistics provide a unique perspective on the exposures of national banking systems to particular countries and sectors. The statistics provide information on the total foreign exposures (ie *foreign claims* plus *other exposures*) of banks headquartered in a particular jurisdiction on a worldwide consolidated basis (ie including the exposures of consolidated foreign branches and subsidiaries and netting out inter-office positions). The BIS *consolidated* banking statistics offer a more useful measure of the total risk exposure of a banking system than do the BIS *locational* banking statistics, which are based on the residence (rather than on the nationality of ownership) of the reporting banking unit.

The BIS consolidated banking statistics are reported on both an *ultimate risk* and an *immediate borrower* basis. In the former case, the statistics are adjusted for net risk transfers between countries and sectors, while in the latter they are not. Chart A shows three examples of risk transfers that would generate differences between figures reported, respectively, on an ultimate risk and on an immediate borrower basis.

Several important caveats should be kept in mind when analysing figures obtained from the BIS consolidated banking statistics. The first is that the statistics capture the foreign exposures of reporting banking systems to given countries, not the expected losses that those banking systems would suffer as a result of a large negative shock to their assets in those countries. For example, if the foreign exposures of banks headquartered in country X to country Y amounted to \$60 billion and an event inflicted losses of 25% on all foreign-owned assets in country Y, banks from country X would sustain losses of \$15 billion (not \$60 billion). Furthermore, the BIS consolidated banking statistics focus exclusively on assets and provide no information on liabilities to the same debtor.

Second, in the BIS consolidated banking statistics, the holdings of various banking units are assigned to a given national jurisdiction according to the nationality of the highest-level *banking affiliate* in the chain of ownership, not according to the nationality of the ultimate parent. For example, the claims of a bank that is incorporated in country X and is owned by a non-bank financial company headquartered in country Y would be reported as a part of the claims of the banking sector of X (and not of Y). As a result, the set of banks that report to the BIS consolidated banking statistics as a part of the banking population of country X and the set of banks that are regulated and/or guaranteed by the government of country X do not necessarily overlap.

Third, the BIS consolidated banking statistics do not include a currency breakdown. Furthermore, no information is available on which claims are marked to market and which are held to maturity. As a result, it is difficult to interpret changes in the stocks of foreign claims because it is impossible to know exactly how much of a given change was caused by currency fluctuations, how much of it occurred as a result of adjustments in the mark to market values of claims and how much was due to banks actively changing the quantities of these claims that they own (ie buying and selling claims). The most that can be done in that dimension is to obtain estimates of exchange rate-adjusted changes in foreign claims based on assumptions about their currency composition.

While the BIS consolidated banking statistics are very useful in answering certain questions, they cannot be used to address all issues related to a given topic. For example, the BIS consolidated banking statistics *can* be used to answer a question such as:

*What are the exposures of banks headquartered in country X to country Y?*

However, they *cannot* be used to answer a question such as:

*How much would banks headquartered in country X lose in the event of a sovereign restructuring in country Y?*

Similarly, the BIS consolidated banking statistics *can* be used to answer a question such as:

*What are the overall foreign exposures of banks headquartered in country X?*

However, they *cannot* be used to answer a question such as:

*What are the overall foreign exposures of banks that have an explicit (or an implicit) guarantee by the government of country X?*

The BIS consolidated banking statistics *can* also be used to answer a question such as:

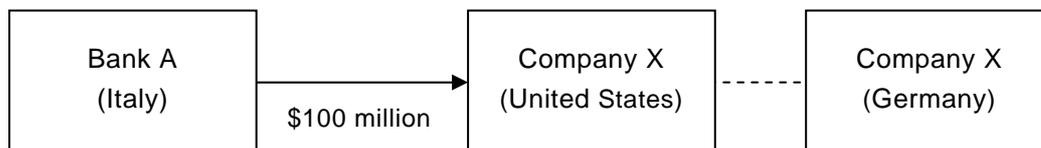
*What were the foreign claims of banks headquartered in country X on country Y at a given point in time?*

However, they *cannot* be used to answer a question such as:

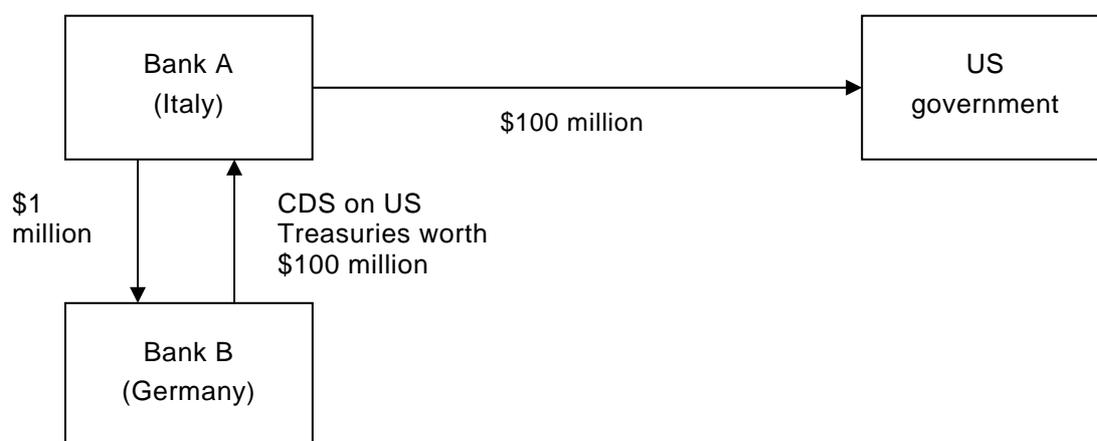
*How much of the change in foreign claims of banks headquartered in country X on country Y during a given period was due to banks actively changing the quantities of these claims that they own and how much was caused by fluctuations in the market values of the claims?*

### Ultimate risk versus immediate borrower (some hypothetical examples)

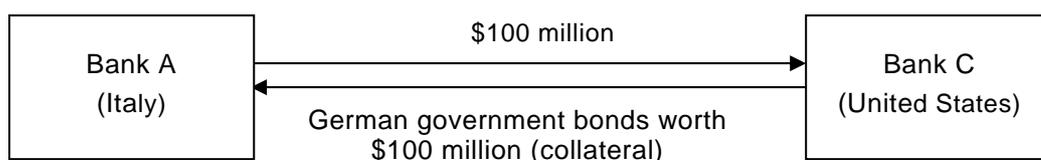
1. Bank A (headquartered in Italy) extends a \$100 million loan to the US subsidiary of Company X, which is guaranteed by Company X's headquarters in Germany.



2. Bank A (headquartered in Italy) buys US Treasuries worth \$100 million and then pays \$1 million to buy a CDS on the whole amount from Bank B (headquartered in Germany).



3. Bank A (headquartered in Italy) extends a \$100 million loan to Bank C (headquartered in the United States) and receives German government bonds worth \$100 million as collateral.



All three of the hypothetical transactions described above would result in:

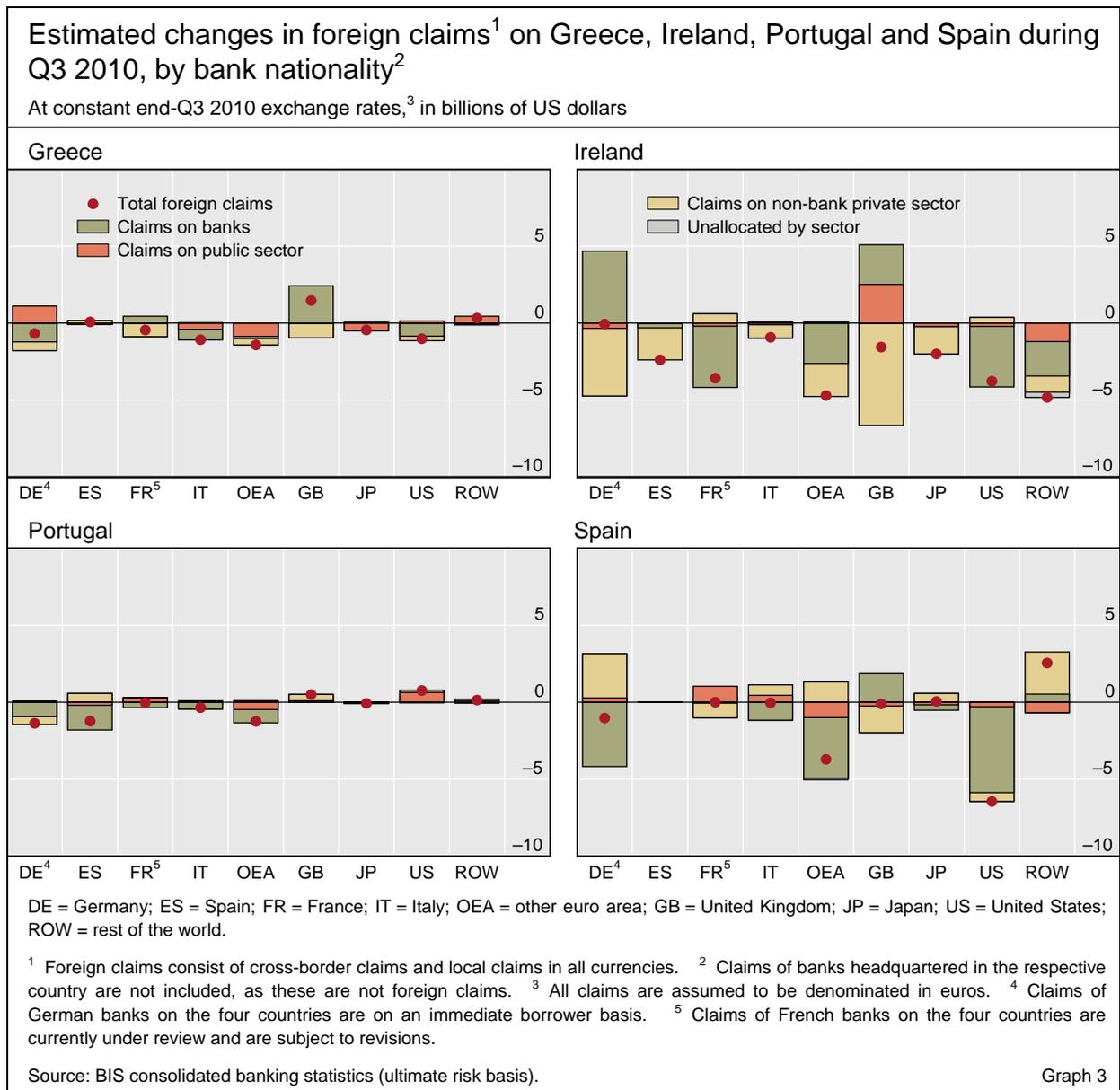
1. A \$100 million increase in the claims of *Italian banks on the United States* on an *immediate borrower* basis.
2. A \$100 million increase in the claims of *Italian banks on Germany* on an *ultimate risk* basis.

Chart A

Our rough estimates indicate that, at constant exchange rates,<sup>7</sup> the foreign claims of BIS reporting banks on the above four countries fell slightly during the third quarter of 2010 (Graph 3). Most of the exchange rate-adjusted decline of \$39 billion (2.4%) was due to a \$23 billion (5.0%) drop in interbank claims. Foreign claims on the non-bank private sector also contracted (by \$15 billion or 1.7%). By contrast, foreign claims on the public sector remained virtually unchanged.

Foreign claims on each of the above countries shrank on an exchange rate-adjusted basis during the third quarter of 2010. Nevertheless, the sectoral composition differed. The \$3.2 billion (2.0%) reduction in foreign claims on Greece and the \$24 billion (4.5%) decrease in foreign claims on Ireland were primarily caused by falls in BIS reporting banks' claims on the non-bank private

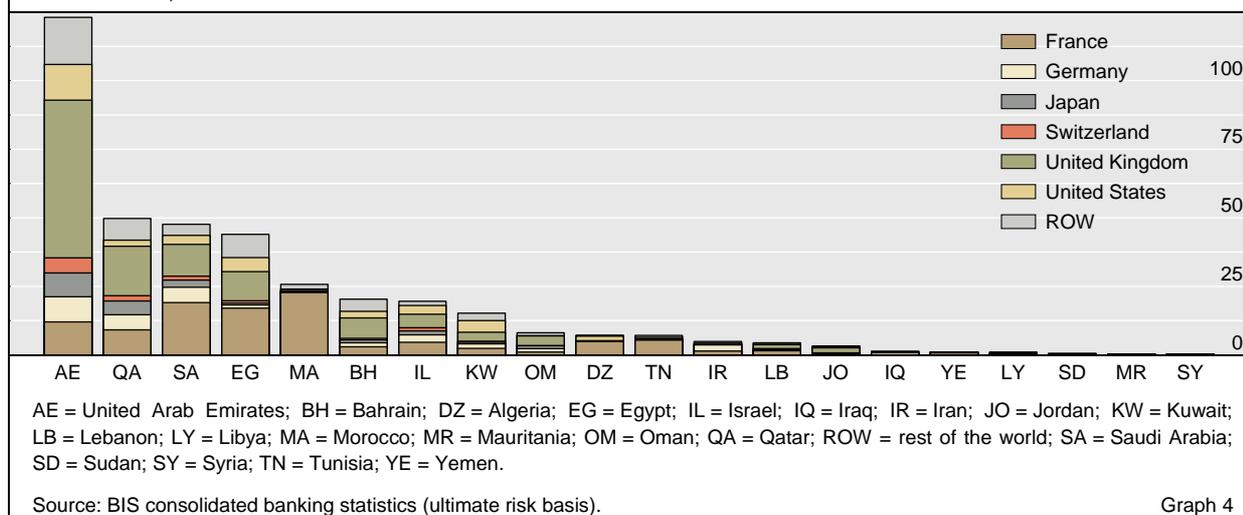
Exchange rate-adjusted foreign claims on Greece, Ireland, Portugal and Spain decline slightly



<sup>7</sup> The consolidated banking statistics do not include a currency breakdown. That is why, in order to adjust for the currency fluctuations that took place during the period, we make the

## Foreign claims on countries in the Middle East and North Africa, by bank nationality

End-Q3 2010, in billions of US dollars



sector. By contrast, the interbank component was the main driver of the declines in foreign claims on Spain (\$8.8 billion or 1.2%) and Portugal (\$2.9 billion or 1.4%).

Most major banking systems reported small decreases in their exchange rate-adjusted foreign claims on Greece, Ireland, Portugal and Spain. US banks saw their foreign claims on that group of countries fall by more than those of any other major banking system (by \$10 billion or 8.7%), mainly as a result of a contraction in their claims on banks located in Spain and Ireland. The exchange rate-adjusted foreign claims of French and German banks on the four countries also declined slightly (by \$4.0 billion or 1.4% and by \$3.1 billion or 0.8%, respectively).

### *BIS reporting banks' foreign claims on the Middle East and North Africa*

The sociopolitical turmoil experienced by a number of countries in the Middle East and North Africa region in 2011 has generated interest in the size of internationally active banks' exposures to the area. Graph 4 displays a breakdown of the foreign claims of the six national banking systems with the largest presence<sup>8</sup> in the region as of the end of the third quarter of 2010.<sup>9</sup>

According to the BIS consolidated banking statistics on an ultimate risk basis, the exposures of all major BIS reporting national banking systems to the

Foreign exposures to the Middle East and North Africa are relatively small

(admittedly imperfect) assumption that all foreign claims on Greece, Ireland, Portugal and Spain are denominated in euros.

<sup>8</sup> The six national banking systems whose foreign claims on the countries in the Middle East and North Africa are displayed in Graph 4 accounted for approximately 87% of all BIS reporting banks' foreign claims on the region as of the end of September 2010.

<sup>9</sup> The full details of the data on BIS reporting banks' foreign claims on the countries in the Middle East and North Africa can be found in Table 9D of *Detailed tables on provisional locational and consolidated banking statistics at the end-September 2010* ([www.bis.org/statistics/consstats.htm](http://www.bis.org/statistics/consstats.htm)).

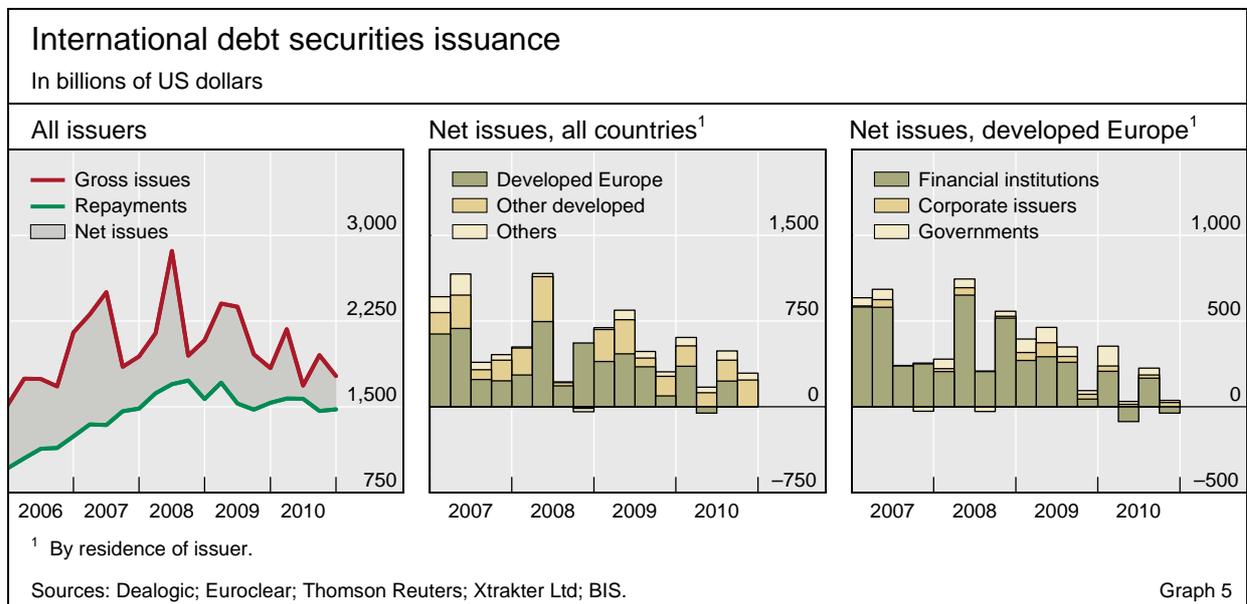
area are fairly small relative to their aggregate foreign exposures.<sup>10</sup> As of the end of September 2010, the foreign claims of UK and French banks on the region (\$122 billion and \$107 billion, respectively) amounted to only 3.1% and 3.0%, respectively, of their worldwide foreign claims. All other major national banking systems had less than 2% of their aggregate foreign claims ultimately exposed to the area.

BIS reporting banks had much smaller exposures to the countries that have gone through sociopolitical unrest in 2011. Their combined foreign claims on Egypt (\$44 billion) accounted for only 0.17% of their aggregate global foreign claims (\$26 trillion). Their foreign claims on Tunisia (\$7 billion) and Libya (\$1 billion) represented even smaller fractions of their consolidated global foreign portfolio (0.03% and 0.004%, respectively).

### International debt securities issuance in the fourth quarter of 2010<sup>11</sup>

Activity in the primary market for international debt securities slowed in the fourth quarter of 2010, reverting to the seasonal pattern observed before the financial crisis.<sup>12</sup> Completed gross issuance fell by 9% quarter on quarter to \$1,707 billion between October and December (Graph 5, left-hand panel). With stable repayments, net issuance dropped to \$293 billion, from \$489 billion in the third quarter.

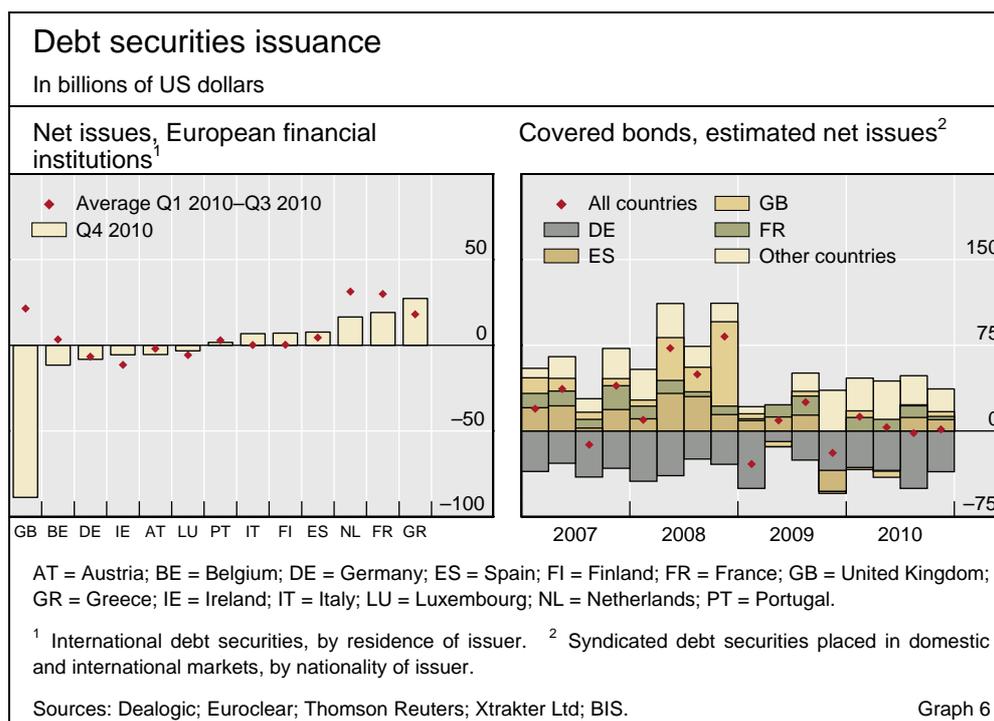
Falling issuance in the international debt securities market ...



<sup>10</sup> Note that the latest available data on BIS reporting banks' foreign claims on the countries in the Middle East and North Africa refer to the end of September 2010, several months before the unrest began.

<sup>11</sup> Queries concerning international debt securities should be directed to Christian Upper.

<sup>12</sup> See J Amato and J Sobrun, "Seasonality in international bond and note issuance", *BIS Quarterly Review*, September 2005, pp 36–9 ([www.bis.org/publ/qtrpdf/r\\_qt0509c.pdf](http://www.bis.org/publ/qtrpdf/r_qt0509c.pdf)).



... particularly in developed European economies

The decline in net issuance masks large variations across regions. Very low net issuance by residents in the developed European economies (\$0.9 billion, after \$225 billion in the third quarter) contrasted with an increase of 28% or \$234 billion in the amounts raised by residents in other advanced economies (Graph 5, centre panel). Emerging market borrowers raised \$39 billion, unchanged from the previous quarter.

European financial institutions raise less funding ...

Financial institutions located in Europe reacted to the renewed concerns about sovereign risk by curtailing their funding programmes. Completed gross issuance by European financial institutions fell by 12% to \$928 billion. With somewhat higher redemptions, this resulted in net repayments of \$36 billion, after net issuance of \$167 billion in the third quarter. That said, the net redemptions of the fourth quarter were much smaller than the net repayments of \$86 billion in the second quarter, during the first bout of the European sovereign debt crisis. Institutions resident in the United Kingdom saw particularly large net repayments (\$89 billion; Graph 6, left-hand panel). Between July and September, they had raised \$69 billion in the international market.

... in response to adverse market conditions

The drop in European financial issuance was less the result of banks' inability to borrow than a response to apparently unfavourable market conditions. Accordingly, banks in the countries most affected by the tensions were able to issue in the international market. Greek financial institutions borrowed \$27 billion, well above the \$8 billion of the third quarter but short of the \$43 billion in the second quarter. Irish financial institutions, including some of the large banks facing severe problems, raised \$84 billion through the sale of new securities, but this fell short of the \$90 billion of scheduled repayments.

Covered bond issuance (including domestic issues) fell in the final quarter of the year. Gross issuance dropped from \$103 billion in the third quarter to \$70 billion in the fourth, the lowest amount since late 2009. Net issuance of

covered bonds stood at \$1.3 billion, after net redemptions of \$1.9 billion between July and September (Graph 6, right-hand panel). German banks repaid Pfandbriefe worth \$36 billion (net), continuing a trend of several years. By contrast, Spanish, Swedish, Italian and UK banks raised new funding to the tune of \$10 billion, \$7 billion, \$5 billion and \$4 billion, respectively.

Issuance by non-financial corporations resident in the advanced European economies was much more resilient than that by financial institutions. Non-financial enterprises resident in the advanced European economies increased their borrowings in the international market by 34%, to \$25 billion. French firms accounted for the bulk of new issuance (\$15 billion). Irish firms borrowed \$2.4 billion, the largest amount since late 2008.

Activity in the primary market for debt securities issued by residents of non-European advanced economies was much less affected by the turbulence. Financial institutions located in the United States placed \$62 billion in the international market, 78% more than in the previous three months. International issuance by US non-financial corporates reached a new high at \$136 billion (22% higher than in the third quarter). Issuance by Canadian residents rebounded to \$28 billion, largely offsetting the drop in the third quarter.

Issuance by residents in developing economies was stable at \$39 billion. Borrowers from emerging Europe raised \$4.4 billion, 60% less than in the third quarter. However, this was offset by a doubling in issuance by residents in Asia-Pacific (\$11 billion). Residents in Latin America-Caribbean and Africa-Middle East tapped the market to the tune of \$19 billion (+9%) and \$5 billion (-11%).

Strong issuance by European non-financial corporates ...

... and in developed economies outside Europe

Stable borrowing by emerging market borrowers

### Exchange-traded derivatives in the fourth quarter of 2010<sup>13</sup>

The volume of trade on international derivatives exchanges was higher in the fourth quarter of 2010 than in the previous one. Turnover, measured as the notional amount of traded derivatives contracts, rose by 9% in dollar terms. The bulk of this increase (7.8 percentage points) corresponds to a surge in the turnover of short-term dollar interest rate futures. This rose by 29%, reflecting particularly strong trading in November, when the Federal Reserve Board announced its second round of US Treasury bond purchases. A further notable portion of the increase in derivatives turnover (1.4 percentage points) is due to a 38% rise in trading of Korean equity index options. This was partly offset (-1.3 percentage points) by lower trading of short-term euro interest rate options, which declined by 16%.<sup>14</sup>

Higher turnover on derivatives exchanges ...

Despite the overall increase in turnover on derivatives exchanges, open interest, measured as the notional amount of outstanding contracts, declined by 13%. More than one third of this reduction is explained by a decline in short-term euro interest rate options, and almost a further one third by declines in short-term interest rate options on both dollar and sterling interest rates

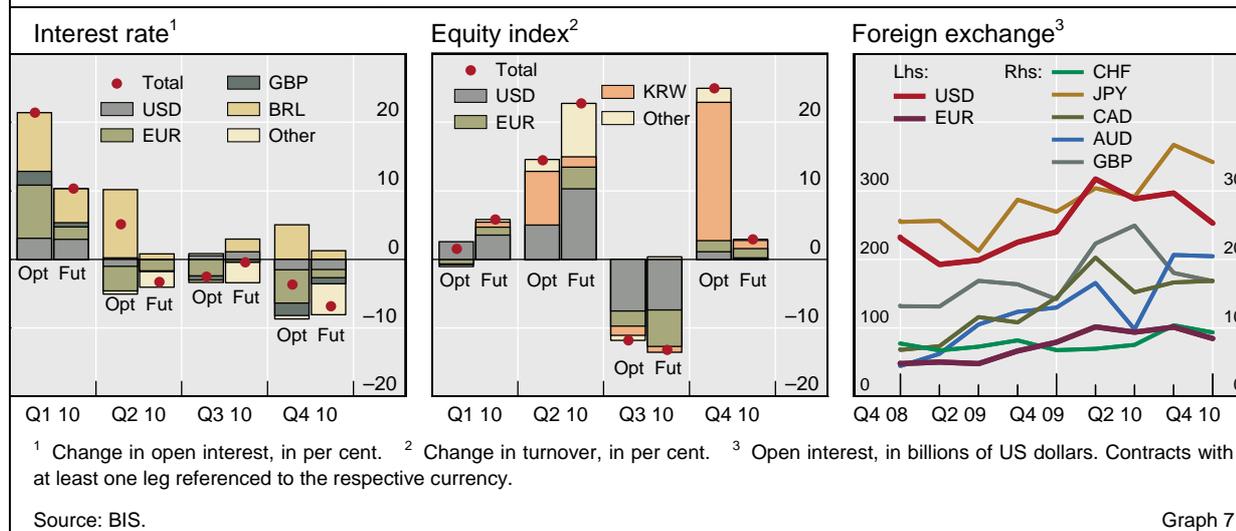
... but smaller open positions

<sup>13</sup> Queries concerning the exchange-traded derivatives statistics should be addressed to Nicholas Vause.

<sup>14</sup> This was despite the euro being 5% weaker against the dollar during the fourth quarter of 2010.

## Exchange-traded derivatives

Notional amounts of futures and options contracts



(Graph 7, left-hand panel). This may reflect decisions by some market participants to shed protection against near-term increases in major-currency interest rates, as expectations of such moves were pushed further into the future during the fourth quarter of 2010.

In interest rate derivatives markets, higher turnover in futures (+14%) contrasted with weaker trading in options (–5%). The rise in futures turnover was driven by the large increase in trading of short-term dollar contracts. In contrast, trading of long-term dollar futures was little changed, despite a marked increase in US Treasury bond futures turnover in November. The fall in options turnover reflects declines in trading of euro and sterling short-dated options of 16% and 19%, respectively.

Heavy trading on Asian exchanges boosted turnover of equity index derivatives (up 15%). In addition to the rise in turnover of Korean equity index options (Graph 7, centre panel) to 59% of total equity index options turnover, trading of Hong Kong and Indian equity index options also expanded rapidly, by 45% and 33%, respectively. Trading of equity index futures on the same regions increased by 15%, 26% and 20%, respectively.<sup>15</sup> Open interest in equity index derivatives fell by 11%, mainly reflecting a 23% decline in open interest in euro area stock index options.

Activity in the market for foreign exchange derivatives increased as higher trading in contracts on the euro more than offset weaker trading in the dollar and sterling. Overall turnover increased by 9%. Trading of both euro futures and options increased by around 20%. In contrast, trading of dollar and sterling options declined by 22% and 26%, respectively. Open interest in foreign exchange derivatives declined by 15%, reflecting widespread falls in contracts linked to major currencies (Graph 7, right-hand panel).

<sup>15</sup> The dollar value of Korean, Hong Kong and Indian equities increased by 11%, 2% and 0%, respectively, during the fourth quarter of 2010, so the growth rates in this paragraph do, in fact, reflect changes principally in trading volumes.

Heavy trading on Chinese exchanges in derivatives on agricultural products contributed strongly to an overall increase of 11% in turnover of commodity derivatives. Turnover in agricultural contracts listed on Chinese exchanges went up by 46%, and that in agricultural contracts worldwide by 33%.<sup>16</sup> The surge in trading of agricultural contracts contrasted with declining volumes in other types of commodities. Turnover in derivatives on energy products and precious metals fell by 2% and 5%, respectively, while trading in contracts on non-precious metals declined by 17%.

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<sup>16</sup> Turnover of commodity contracts is measured by the number of contracts traded, since notional amounts are not available. Note that Chinese contracts tend to be significantly smaller in value than those traded on other exchanges. As a result, growth in contract volumes that is led by Chinese exchanges can overstate increases in activity.

## Systemic importance: some simple indicators<sup>1</sup>

*Are there simple yet reliable indicators of banks' systemic importance? In addressing this question, this article explores three model-based measures of systemic importance and finds that bank size helps approximate each of them. A bank's total interbank lending and borrowing provide useful complementary information.*

*JEL classification: G20, G28, L14.*

A pressing policy objective is to finalise and implement a regulatory framework for systemically important financial institutions. Meeting this objective calls for measures of systemic importance. The recent academic literature has proposed a number of such measures, underpinned by sophisticated economic and statistical techniques. Despite their intellectual appeal, these measures pose serious challenges for practitioners. They are demanding on data, computationally intensive and difficult to communicate to the general public. In addition, given that the measures require detailed system-level information, individual institutions would not be able to use these measures directly in order to assess and manage their own degree of systemic importance. This prompts the question whether there are simple, readily available indicators that are reliable proxies for the more sophisticated measures.

In this article, we address this question empirically. We use data on 20 large internationally active banks to test the relationship between three sophisticated, model-based measures of systemic importance and three simple indicators. Given the multifaceted nature of systemic importance, we consider both top-down and bottom-up measures. The top-down measures first derive systemic (ie system-wide) risk and then allocate it to individual institutions. We explore two such measures that differ in terms of their perspective on systemic importance and, consequently, in the way in which they allocate system-wide risk. We also consider one bottom-up measure, which first assumes distress in a particular institution and then evaluates the level of system-wide risk associated with that event. We then compare each of these measures to simple indicators that are

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<sup>1</sup> The views expressed are those of the authors and do not necessarily reflect those of the BIS. Jörg Urban and Marek Hlaváček provided excellent research assistance. Claudio Borio, Stephen Cecchetti, Robert McCauley, Kostas Tsatsaronis and Christian Upper provided helpful comments on earlier drafts of the article.

based on readily available and well understood characteristics of individual banks: size, total interbank lending and total interbank borrowing.

We find that the simple indicators approximate the model-based measures of systemic importance quite well. Under each of these measures, bank size is highly significant in both statistical and economic terms. In comparison, the link between interbank activity and measured systemic importance is weaker. And the strength of this link varies across the alternative measures of systemic importance, in line with the economic logic underlying each of them.

We perform the analysis in three steps. We start with a specific definition of system-wide risk, which is necessary for constructing any measure of systemic importance. We then outline three such measures, highlighting the different perspectives on systemic importance they incorporate. Finally, after describing our empirical setup, we evaluate the explanatory power and economic significance of the simple indicators for each of the three rigorous measures.

## A measure of systemic risk

Systemic risk is an elusive concept: it can have significant economic consequences and is quantitatively important, yet there is no clear consensus on how it should be measured. In this article, we associate systemic risk with losses in the financial system exceeding a high threshold with a small probability. We regard such losses as indicating systemic events, which are also characterised by a disruption to financial services and potentially serious harm to the real economy (FSB, IMF, BIS (2009)).

A popular measure  
of systemic risk ...

In measuring systemic risk, we only consider losses incurred by banks' *non-bank* creditors as opposed to bank equity holders and interbank creditors. Thus, our perspective is that of an insurer of banks' debt whose concern is solely about system-wide losses vis-à-vis the rest of the economy. By abstracting from losses to equity holders, we treat equity as fully loss-absorbing. In other words, a positive equity value, no matter how small, ensures the smooth functioning of a bank and does not imply any systemic repercussions.<sup>2</sup> In turn, by abstracting from losses to interbank creditors, we avoid double-counting. Since the interbank liabilities of one bank are the interbank assets of another, losses to the interbank creditors of one bank are losses incurred by the equity holders or non-bank creditors of one or more other banks in the system.

Concretely, we measure systemic risk as the expected *aggregate* loss to non-bank creditors, conditional on such a loss exceeding the 99th percentile of the underlying probability distribution. This measure is often referred to as the expected shortfall at the 99% confidence level.

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<sup>2</sup> Admittedly this is a strong assumption, given that the recent financial crisis showed that banks' strategic behaviour at positive but low equity values can have adverse systemic consequences. The assumption also abstracts from informational frictions associated with losses on interbank positions or the possibility that banks have cross-shareholdings. That said, postulating that equity is a true loss absorber only above a certain level would increase the magnitude of measured losses but would not change the main messages of this article.

Expected shortfall (ES) is the most popular measure of systemic risk. Its popularity stems from the fact that, unlike most of its alternatives, it provides an informative summary of the severity of extreme events that occur with a small probability but can have system-wide consequences. Recent studies by Acharya et al (2009), Webber and Willison (2011) and Huang et al (2010) apply ES to the analysis of systemic risk in a variety of settings.

## Measures of systemic importance

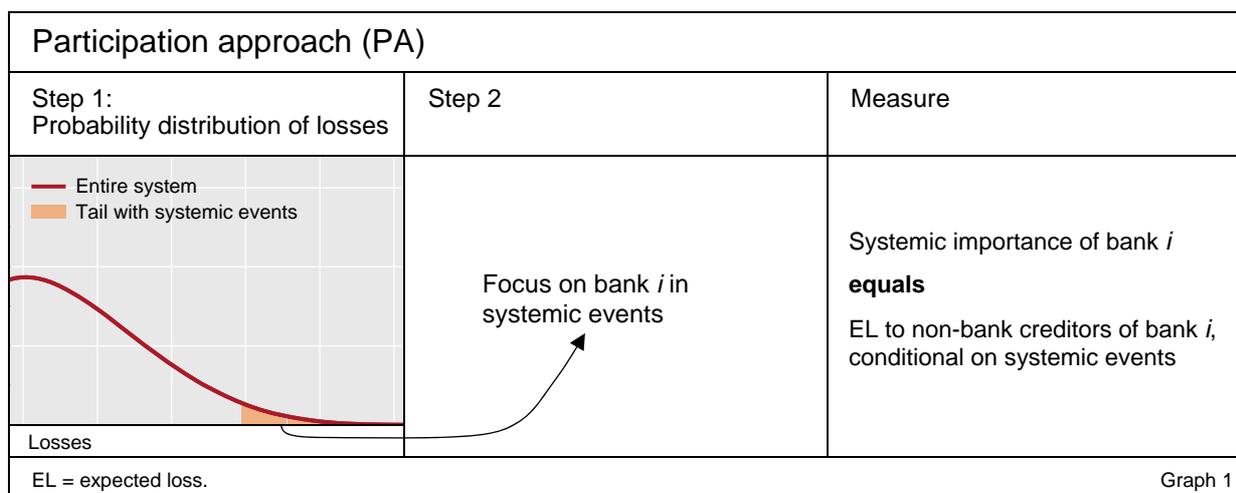
... underpins three rigorous measures of systemic importance

A bank's systemic importance can be measured from different angles. Like slicing a pie into pieces, top-down measures start with the risk of the system and allocate it to individual institutions. By contrast, bottom-up measures start with distress at a particular institution and then compute the associated level of system-wide distress. Even when based on the same measure of systemic risk, as is the case here, these alternative measures of banks' systemic importance typically deliver different conclusions. It is thus useful to explain the intuition behind the underlying approaches.

### Top-down measures

The literature has proposed two approaches to allocate systemic risk across banks in a top-down fashion. The first, the participation approach (PA), considers the expected participation of each bank in systemic events. As illustrated by Graph 1, PA first focuses on systemic events (shaded area in the left-hand panel). It then measures the systemic importance of a bank, say bank  $i$ , as the expected losses incurred by its non-bank creditors in these events. Economically, PA equals the actuarially fair premium that the bank would have to pay to a provider of insurance against losses it may incur in a systemic event.<sup>3</sup>

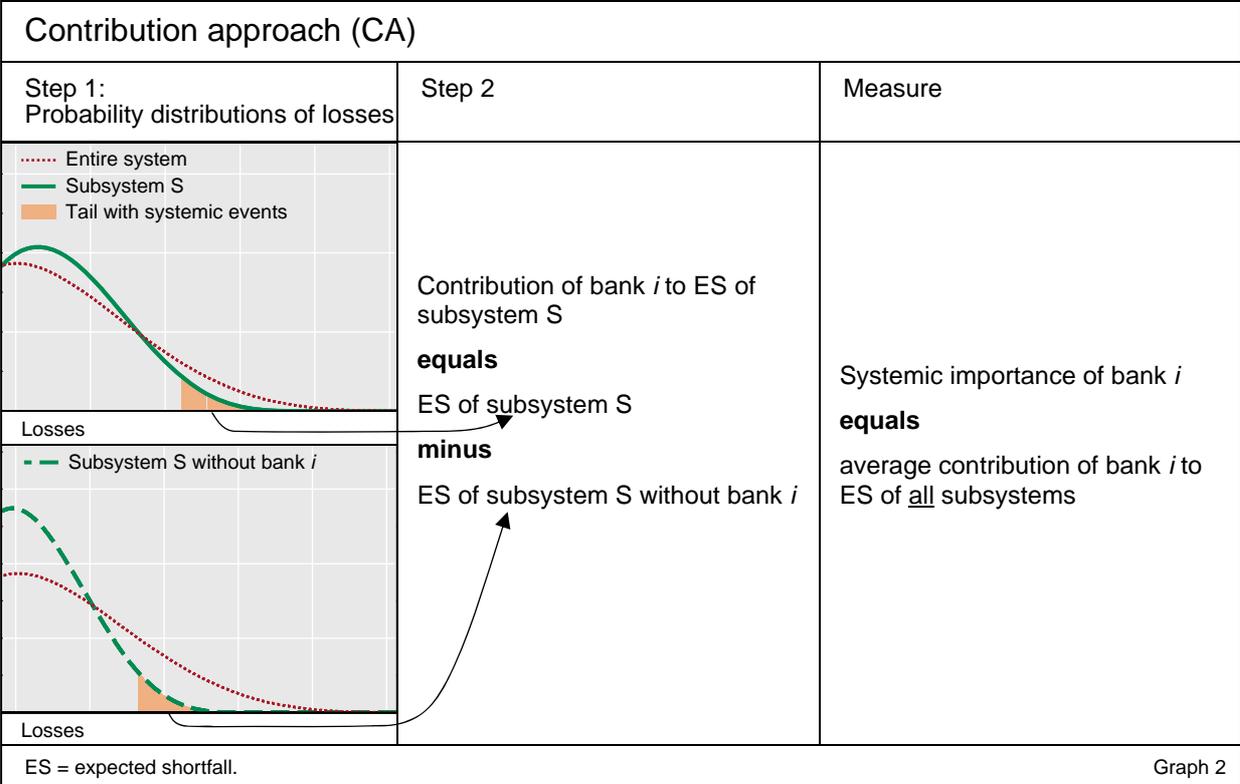
As argued in Tarashev et al (2010) and Drehmann and Tarashev (2011), however, the extent to which a bank participates in systemic events typically differs from the extent to which it *contributes* to these events. To see why,



<sup>3</sup> PA has been implemented in various ways and with different datasets by Acharya et al (2009), Huang et al (2010), Brownlees and Engle (2010), Tarashev et al (2010) and Drehmann and Tarashev (2011).

consider a bank with small debt liabilities to non-banks but with large positions on the interbank market. Since the failure of this bank in a systemic event would impose small losses on non-banks, we say that it participates little in systemic events. But the bank may contribute materially to these events by transmitting distress from one bank in the system to another. Such cases are captured by the second top-down approach: the contribution approach (CA). CA accounts explicitly for the fact that a bank contributes to systemic risk through its exposure to exogenous shocks, by propagating shocks through the system, and by being itself vulnerable to propagated shocks.<sup>4</sup>

CA is rooted in a methodology first proposed by Shapley (1953) for the allocation across individual players of the value created in a cooperative game. The intuition behind this methodology is quite simple. We could use the level of risk an individual bank generates in isolation as a measure of systemic importance. But such an approach would miss the contribution of each bank to the risk of others. Similarly, it is not enough to consider only the marginal-risk contribution of a single bank, calculated as the difference between the system-wide risk with and without the bank. The reason is that this calculation ignores the complexity of bilateral relationships, which is especially pronounced when interbank exposures can propagate shocks within the system through a potentially long chain of market participants. The Shapley methodology accounts fully for such interactions by ascribing to individual institutions a weighted average of the marginal contributions each makes to the risk in each



<sup>4</sup> The contribution approach was originally suggested by Tarashev et al (2010). It has been subsequently implemented by Gauthier et al (2010), Liu and Staum (2010) and Drehmann and Tarashev (2011) in a way that takes interbank links explicitly into account.

Bottom-up approach (BA)		
Step 1	Step 2: Probability distribution of losses	Measure
Bank <i>i</i> defaults		Systemic importance of bank <i>i</i> <b>equals</b> ES of entire system, conditional on bank <i>i</i> defaulting
ES = expected shortfall.		Graph 3

possible subsystem. The derivation of such a marginal contribution for a given subsystem *S* is illustrated in Graph 2.<sup>5</sup>

#### *Bottom-up measure*

The bottom-up approach (BA) reverses the logic of the PA. Namely, it measures the systemic importance of a bank by the ES of the whole system, conditional on this particular bank being in default. This is shown in Graph 3.<sup>6</sup>

Bottom-up measures have been implemented frequently in the literature. For example, conditional on the default of a bank, Elsinger et al (2006) measure the ES of all other banks, whereas Segoviano and Goodhart (2009) derive the probability that at least one more bank defaults. Similar measures have also been popular in network analysis (for an overview, see Allen and Babus (2009) or Upper (2011)). More recently, Adrian and Brunnermeier (2010) suggest using CoVaR, ie the system-wide value-at-risk (VaR), conditional on an institution being in distress.

#### Empirical setup

The empirical analysis ...

There are two key building blocks of our empirical analysis. The first is a probability distribution of losses to banks' non-bank creditors, which is the basis of our measure of system-wide risk and each of the three alternative measures of individual banks' systemic importance. The second building block is a set of simple indicator variables that could proxy for the more sophisticated measures of systemic importance.

<sup>5</sup> For a more technical discussion, see Tarashev et al (2010).

<sup>6</sup> Our objective is to make the *conditional* ES, from the bottom-up measure, comparable to the *unconditional* ES at the 99% confidence level, which underpins the top-down measures. To meet this objective, we seek to align the systemic events over which the conditional and unconditional ES take expectations. It turns out that this is attained (on average across banks) for a conditional ES at the 75% confidence level.

### *Losses to non-bank creditors*

Systemic risk in our setup, ie risk to non-bank creditors, stems exclusively from bank defaults. In turn, a default occurs if losses on a bank's assets wipe out its equity cushion. Such losses can arise from two sources. On the one hand, banks can experience losses on their non-bank exposures, which, if sufficiently large, trigger first-round defaults. On the other hand, credit losses on interbank exposures can cause additional bank failures, or second-round defaults.<sup>7</sup>

Several inputs, which we describe at some length in the box on page 31, play a key role in our derivation of first- and second-round defaults. One is the probability that each bank in our sample defaults. Our premise is that this probability is influenced by prudential rules that set capital requirements on the basis of bank-level information. The second input is data on the correlation of exogenous shocks. The higher this correlation, the more likely it is that, when one bank experiences a first-round default, other banks also default or have their balance sheets weakened. And a bank with a weaker balance sheet is more likely to experience a second-round default if it is exposed to a defaulted bank. We capture the size of interbank exposures through estimates of bilateral interbank positions.

We derive default probabilities, asset correlations and interbank exposures for a system of 20 large internationally active banks on the basis of data from 2006–09. Then, we simulate exogenous shocks to the claims of the banks in this system on non-banks. This ultimately delivers the joint probability distribution of losses to non-bank creditors. Based on this distribution, we derive the system's expected shortfall as our measure of systemic risk and implement the three alternative approaches to systemic importance as outlined above. For more detail on the implementation, see Drehmann and Tarashev (2011).

### *Simple indicators*

It is unlikely that a prudential authority will *directly* employ any of the sophisticated measures delivered by the alternative approaches to systemic importance. Instead, the authority may derive these measures only to approximate them with simple and reliable bank-specific indicators. Basing actual policy on such indicators, authorities would trade precision of the assessment for transparency and ease of communication. Furthermore, authorities would also allow banks that do not have system-wide information to assess and manage their own systemic importance.

We examine the information in three indicators of systemic importance. All come directly from banks' financial statements. The first is *bank size*. Given our focus on non-bank creditors, we measure size as a bank's liabilities to non-banks. The other two indicators relate to linkages across banks. One of them is *interbank lending (IL)*. This provides information on the degree to which a bank is exposed to risks stemming from the interbank market. The other one –

... employs data on  
20 large banks ...

... in order to  
compare the  
rigorous  
measures ...

... to simple  
indicators of  
systemic  
importance

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<sup>7</sup> "Second-round defaults" refers to failures induced through direct interlinkages but also failures resulting from longer domino-type default cascades.

## Data and calibration<sup>①</sup>

We analyse a system of 20 large banks on the basis of two sets of data.<sup>②</sup> The first comprises estimated correlations of asset returns between 2006 and 2009. We use these estimates to generate correlated shocks to banks' claims on non-banks. The second dataset refers to banks' balance sheets at end-2009 (for our main analysis) and end-2006 (for a robustness check). We divide the assets side of each bank's balance sheet into interbank claims (precisely, loans and advances to banks) and claims on non-banks (total assets minus interbank claims). In turn, we divide the liabilities side into: interbank debt liabilities (deposits from banks), equity capital and debt liabilities to non-banks (total liabilities minus interbank debt liabilities minus equity capital).<sup>③</sup>

In order to simulate the probability distribution of losses in the system, we need information on each bank's probability of default (PD). We start with the premise that prudential authorities do not take a system-wide perspective. They set capital requirements based on bank-level information that does not reflect fully the complexity of counterparty exposures and system-level interbank linkages. In order to work in a straightforward setup, we then assume that each bank's probability of a first-round default is fixed at 0.1% but banks' different interbank exposures lead to different probabilities of second-round defaults and, thus, to different overall PDs.<sup>④</sup> We implement this assumption by adjusting the marginal probability distribution of the exogenous shocks to each bank's claims on non-banks.

For second-round defaults, we need information on the bilateral linkages across the 20 banks in our sample.<sup>⑤</sup> Since our data reveal only the total interbank positions on the balance sheet of each bank, we need to make certain assumptions. First, we assume that interbank linkages are fully captured by balance sheet data, thus excluding for instance securitised assets and derivative exposures. Second, we follow the literature in constructing a network of bilateral interbank linkages on the assumption that each bank in our sample spreads its entire interbank positions as evenly as possible across the other banks in the sample (Upper (2011)). Third, as in any empirical setting, our system is not truly closed in the sense that aggregate interbank assets are not exactly equal to aggregate interbank liabilities. Following the literature, we close the system by introducing a hypothetical "sink" bank.

The default of a bank, irrespective of whether it is first- or second-round, imposes losses on the bank's non-bank creditors. The magnitude of these losses depends on the level of the defaulted bank's assets and on bankruptcy costs. We assume that bankruptcy costs wipe out 20% of the bank's assets at default.

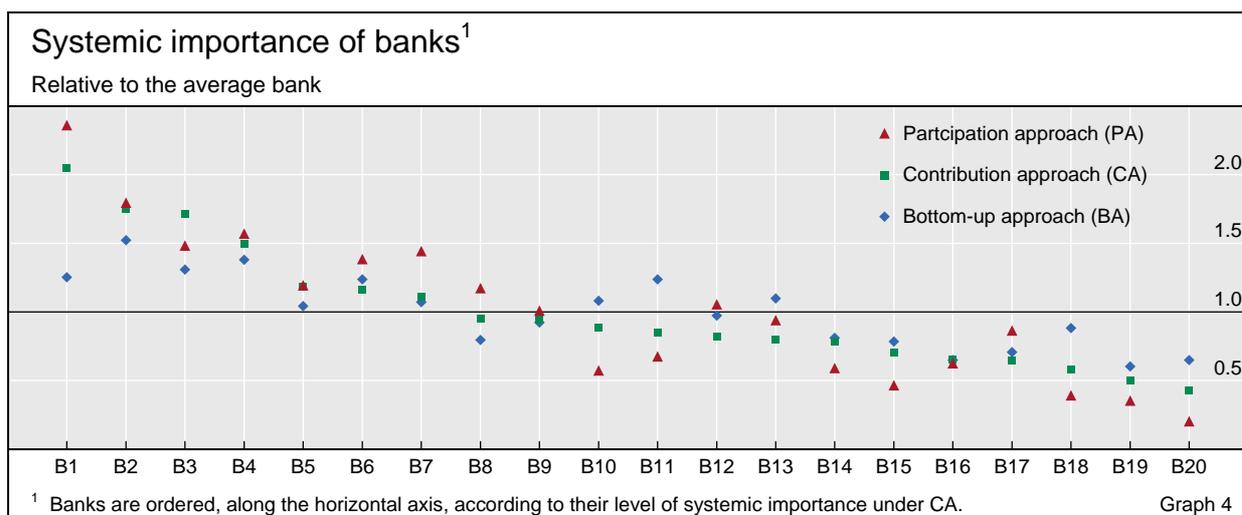
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<sup>①</sup> For further detail, see Drehmann and Tarashev (2011). <sup>②</sup> These banks are: Bank of America, Barclays, BNP Paribas, Citigroup, Commerzbank, Crédit Agricole, Credit Suisse, Deutsche Bank, HSBC, ING, JPMorgan, Lloyds, Mizuho, Royal Bank of Scotland, Santander, Société Générale, Sumitomo Mitsui, UBS, UniCredit and Wells Fargo. <sup>③</sup> Our data sources are Moody's KMV and Bankscope. <sup>④</sup> As a robustness check, we assess the empirical performance of the indicators under the assumption that supervisors can control a bank's overall PD, stemming from first- and second-round defaults. This setup leaves our conclusions broadly unchanged. <sup>⑤</sup> In principle, the correlations of banks' asset returns reflect both common exposures to non-banks and interbank linkages. Background analysis reveals, however, that interbank linkages affect the tail of the distribution of asset returns and, thus, have a negligible impact on asset return correlations, which are related mainly to the centre of this distribution. We abstract from this impact in our calibration of the banking system.

*interbank borrowing (IB)* – captures the extent to which a bank imposes credit risk on other banks and, thus, can propagate shocks through the system.

## Empirical results

In this section, we report and discuss the results of our empirical analysis. We start with a comparison of the three model-based measures of systemic importance. We then examine the performance of our simple indicators as proxies for the three measures.



### *Differences across measures of systemic importance*

Since they have different conceptual underpinnings, the alternative model-based measures of systemic importance can be expected to deliver different results. We examine differences across measures on the basis of the implied levels of systemic importance reported in Graph 4. In this graph, banks are ordered according to their systemic importance under CA (green squares), so that bank 1 is the most systemically important bank under this approach. The red triangles plot systemic importance under PA, and the blue diamonds under BA.

Indeed, there is a pronounced variation in the measured levels of systemic importance. On average, the absolute difference between the PA and CA measures is roughly 20% of CA measures. Furthermore, for nearly a third of the banks in our sample, these differences are between 30 and 50%. Similar discrepancies exist between BA and either PA or CA measures.

Such differences between alternative measures of systemic importance have important policy implications. For example, they indicate that capital requirements calibrated to the levels of systemic importance could depend materially on the approach chosen. This underscores that policymakers need to be careful in picking a measure that is aligned with their own perspective on systemic importance. But it also raises the question whether prudential policy should be based on just one measure or whether it should be guided by simple indicators. We turn to this question next.

Despite differences across measures of systemic importance ...

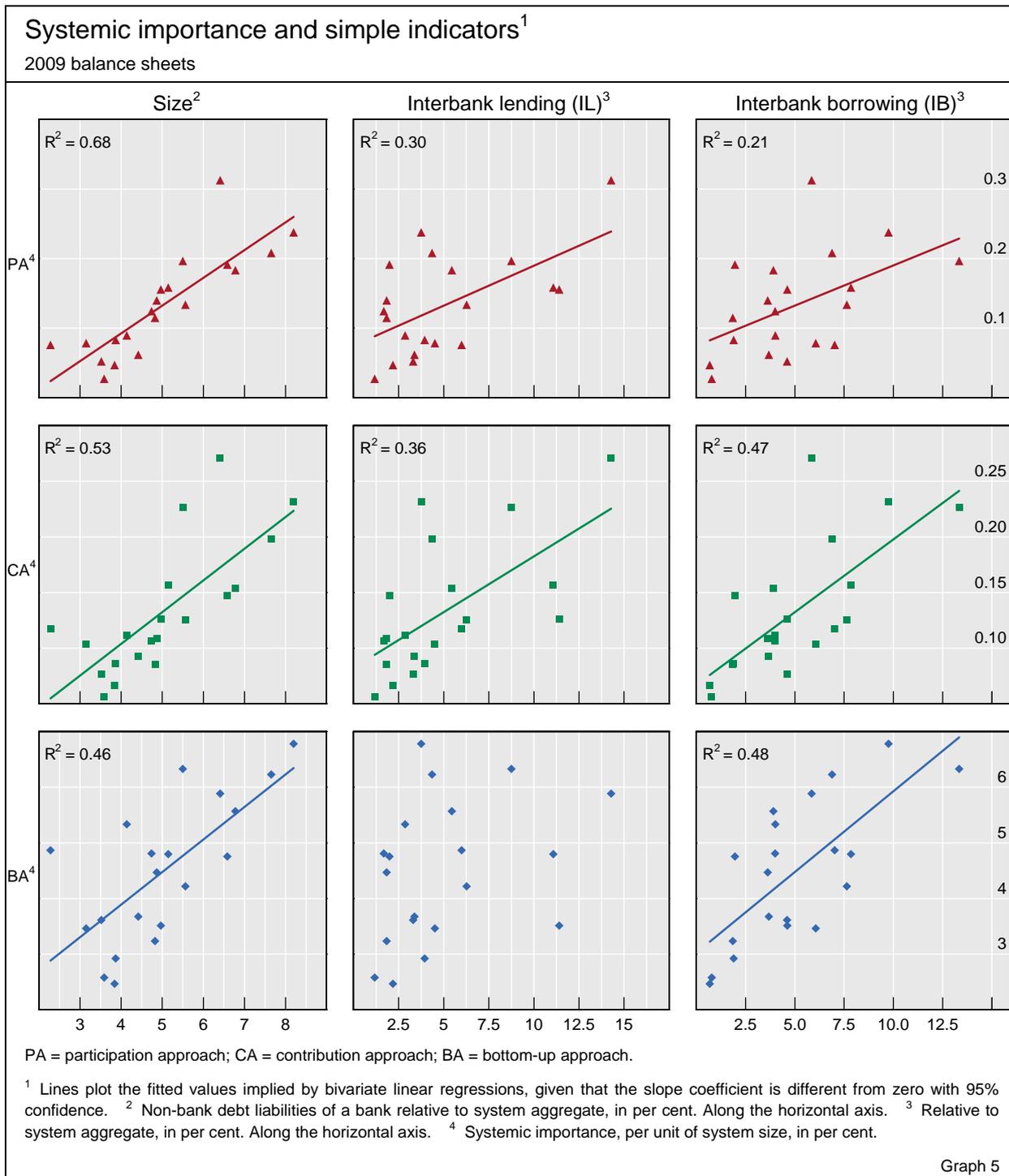
### *Explanatory power of the simple indicators*

Given the differences across the three approaches, how should we expect them to relate to our simple indicators? Under any approach, measured systemic importance should be expected to increase in size because the default of a bank that has borrowed more leads to larger losses. By contrast, the three measures of systemic importance are likely to differ in the way they relate to the interbank market indicators, IL and IB.

Drehmann and Tarashev (2011) discuss why interbank positions are captured differently by CA and PA. If a portion of systemic risk is associated with a particular interbank link, then CA splits this portion equally between the

interbank lender and borrower. In this sense, CA provides a “fair” attribution of systemic risk. By contrast, PA focuses squarely on the losses that a bank could impose on *its own* non-bank creditors. All else equal, the risk of such losses is higher in the case of an interbank lender, who is vulnerable to shocks from the interbank market. Thus, PA attributes most of the risk of an interbank transaction to the lender.

BA treats interbank positions in the opposite way to PA. By considering systemic risk when a particular bank defaults, BA attributes a higher level of systemic importance to a bank whose default poses risk to other banks. This is



Regression results <sup>1</sup>													
	Participation approach (PA)				Contribution approach (CA)				Bottom-up approach (BA)				
2009 balance sheets													
Size	4.0***		3.5***		2.9***		2.1***		58.6***		43.4***		
IL	10.4***		7.3***		9.0***		4.8***		106.6		-20.3		
IB			10.6**		0.8		12.0***		5.8***		267.4***		214.4**
R <sup>2</sup>	0.68	0.30	0.21	0.85	0.53	0.36	0.47	0.84	0.46	0.07	0.48	0.70	
2006 balance sheets													
Size	5.1***		3.9***		4.0***		1.9***		67.8***		53.9***		
IL	15.1***		9.5***		18.5***		12.4***		177.8**		97.3		
IB			15.9***		1.8		18.8***		6.1*		198.7***		30.1
R <sup>2</sup>	0.66	0.50	0.48	0.89	0.34	0.72	0.64	0.86	0.45	0.25	0.28	0.51	
The dependent variable, systemic importance under alternative approaches, is in tens of millions of US dollars. Size = non-bank liabilities; IL (interbank lending) = total interbank assets; IB (interbank borrowing) = total interbank liabilities (all in billions of US dollars).													
<sup>1</sup> Constants are included in all regressions but not reported for brevity. ***/**/* indicates that the coefficient is significant at the 1%/5%/10% level, respectively. Adjusted R <sup>2</sup> s are reported.													

Table 1

the case for a large interbank borrower. As a result, BA assigns a higher level of systemic importance to this bank than to another similarly sized bank which is primarily an interbank lender.

In summary, we would expect the following relationship between the three simple indicators and the three measures of systemic importance. First, size should be important for all measures. Second, interbank lending (IL) should have strong explanatory power for measures obtained under CA and PA, whereas interbank borrowing (IB) should help to predict CA and BA.

Graph 5 visualises the relationship between the simple indicators and the model-based measures of systemic importance. A row in this graph corresponds to a particular measure (PA, CA or BA) and a column to a particular indicator (size, IL or IB). The bivariate regression lines show the estimated relationship between a simple indicator and a more rigorous measure, if it is statistically significant at the 95% confidence level (all regression results are reported in Table 1).

... bank size helps explain each of them

As expected, size (first row) is a robust indicator across all measures. And it consistently exhibits the highest explanatory power (as captured by the goodness of fit statistic R<sup>2</sup>). The effects of interbank lending (second row) are also in line with the earlier discussion: a larger IL is associated with a higher level of systemic importance under PA and CA but not under BA. Likewise, being a large interbank borrower typically leads to high levels of measured systemic importance (third row).

Graph 5 also highlights that different indicators carry complementary information about systemic importance. For instance, the bank with the highest level of systemic importance under PA and CA is not the largest bank in the sample. But it is the most active lender in the interbank market. Similarly, the

Indicators of interbank activity ...

seventh largest bank attains the third highest level of systemic importance under CA as well as BA because it is the largest interbank market borrower.

... provide complementary information

Simple multivariate regressions indicate the degree to which different indicators carry complementary information (Table 1, upper panels).<sup>8</sup> Size remains statistically significant once all indicator variables are included. By contrast, the performance of interbank borrowing and lending (IB and IL) does depend on the approach underlying the model-based measure of systemic importance. Fully in line with the above discussion, IB is not an important driver of systemic importance under PA, which attributes the risk associated with an interbank link mainly to the lending counterparty. Likewise, since BA assigns this risk mainly to the interbank borrower, it tends to render IL uninformative. Only under CA are borrowers and lenders treated equally. Thus, both IL and IB help to explain CA measures of systemic importance.

In order to verify the robustness of the above results, we rerun the linear regressions after recalculating the alternative measures and indicators on the basis of 2006, instead of 2009, balance sheet data. The new results (reported in the lower panels in Table 1) confirm our previous conclusions about the explanatory power of size as well as the lending and borrowing indicators.<sup>9</sup>

#### *Economic significance of the simple indicators*

Indicators' economic significance ...

What do these results mean for the economic significance of each indicator? This is not fully apparent from the regression results in Table 1, as the top-down and bottom-up approaches measure systemic importance from different perspectives, thus impairing the comparability of regression coefficients. For each approach, we therefore calculate the predicted level of

Economic impact <sup>1</sup>				
	PA	CA	BA	Average
Size	12.24	6.14	4.88	7.75
IL	3.33	2.85	0.00	2.06
IB	0.00	2.27	1.27	1.18

PA = participation approach; CA = contribution approach; BA = bottom-up approach; IL = interbank lending; IB = interbank borrowing. For definitions, see Table 1.

<sup>1</sup> Economic impact is measured by the ratio of predicted systemic importance if an indicator is increased by 10% relative to the predicted level of systemic importance for a bank with average size and the average level of interbank lending and interbank borrowing. Predicted levels of systemic importance are based on the regression results shown in Table 1, setting insignificant coefficients to zero and averaging across 2006 and 2009 results. In per cent. Table 2

<sup>8</sup> We consider linear regressions in order to study the explanatory power of the indicators under a simple specification. In general, the true relationship between an indicator and a measure of systemic importance would be non-linear. Tarashev et al (2010) derive this formally in the case of bank size.

<sup>9</sup> The weakening of IB's explanatory power for CA and BA is the result of multicollinearity. IB exhibits significant explanatory power on a standalone basis. However, it loses its explanatory power in a regression with all three indicators because it is highly correlated with IL (a correlation coefficient of 71%).

systemic importance for a bank of average size and average levels of interbank lending and interbank borrowing.<sup>10</sup> Then, we increase each indicator by 10% and recalculate the predicted level of systemic importance under PA, CA and BA (Table 2).

Taking the results at face value, we conclude that the economic significance of size is much larger than that of the other two indicators. Concretely, increasing size by 10% has a two to four times greater impact on systemic importance than increasing IL or IB by 10%. In turn, it seems that IL is economically more significant than IB.

Table 2 also shows that the economic significance of each indicator depends materially on the measure of systemic importance. As in the case of regression results, this is in line with the different economic logic underlying the three measures of systemic importance. The policy implication of the finding is that, even when simple indicators are used, regulators should have a clear understanding of their preferred perspective on systemic importance.

... differs across measures of systemic importance

## Conclusion

In this article, we investigate whether simple indicators can approximate more complex measures of a bank's systemic importance. And since systemic importance itself is a multifaceted concept, we measure it from three different perspectives, based on top-down or bottom-up approaches.

We find that bank size is a reliable proxy of systemic importance, regardless of the perspective chosen. Interbank lending or borrowing provides additional useful information for some measures but not for others. This result is not surprising as it is fully in line with the economic logic underlying each measurement approach.

Taken together, our results highlight that simple indicators do help to assess the degree of banks' systemic importance. Given the complexities of implementing and communicating more rigorous model-based measures of systemic importance, these results suggest that an indicator approach may be the most suitable route for practical purposes. It would also allow banks with limited system-level information to measure and manage their own systemic importance.

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<sup>10</sup> For this calculation, we set all insignificant coefficients to zero and average across the regression results of 2006 and 2009.

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## Inflation expectations and the great recession<sup>1</sup>

*This article examines whether short-run inflation expectations and indicators of long-term credibility have been affected by the great recession and by the policies to counter it. Measures of short-run expectations dropped in the crisis, particularly in advanced economies, but have since rebounded. Measures of long-run inflation expectations have in general fluctuated around a relatively stable level, suggesting continued central bank credibility. At the same time, dispersion and uncertainty measures of long-term inflation expectations are somewhat higher than before the crisis, raising questions about how firmly expectations are anchored.*

*JEL classification: E31, E52.*

This article examines two questions. The first is whether, in the aftermath of the great recession, short-term inflation expectations have signalled risks for price stability in the near term. A still fragile economic recovery and low realised inflation in some advanced countries could be associated with risks of price level declines. By contrast, rising commodity prices, large capital inflows and pressures on resource utilisation have driven inflation up in many emerging market economies. If such pressures on consumer prices significantly affect expectations, this could have important consequences for the economy more broadly. After all, short-term inflation expectations, together with expectations about the near-term path of central bank policy rates, not only affect ex ante real interest rates and thus households' and firms' spending decisions, but also influence wage negotiations and price setting.

The second question is whether there is any sign that the credibility of central banks' commitment to price stability has suffered as a result of the great recession and associated policy measures. Long-run inflation expectations reflect the credibility of monetary policy and are crucial for anchoring inflation: price shocks, such as oil or food price rises, have limited impact on actual inflation if the public believes that the central bank can meet its price stability objective in the long run. In this regard, measures of dispersion and uncertainty about long-term inflation developments may provide some indication of how firmly expectations are anchored.

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<sup>1</sup> The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. The authors would like to thank Claudio Borio, Stephen Cecchetti and Christian Upper for helpful comments, and Emir Emiray and Gert Schnabel for research assistance. The analysis in this feature is based on data until late January 2011.

We find that short-term survey expectations of inflation have rebounded, although they remain low in most of the major advanced economies. Short-run inflation forecasts in major emerging market economies have returned to, and for some countries surpassed, pre-crisis levels. Moreover, the dispersion of emerging market inflation forecasts has generally been greater than in advanced economies, possibly reflecting uncertainty about the impact of strongly rising food and commodity prices. Measures of long-term inflation expectations far ahead into the future have in most cases remained close to a stable pre-crisis level, suggesting continued high central bank credibility. However, measures of dispersion and uncertainty of long-term inflation expectations are somewhat higher than prior to the crisis. This could raise questions about how firmly expectations are anchored.

The next section examines how indicators of short-run inflation expectations have developed during and after the great recession. It also discusses to what extent disagreement about such expectations has changed. The following section turns to measures of long-term inflation expectations and associated uncertainty indicators, and discusses central bank credibility. The final section concludes.

## Rebounding short-run inflation expectations

This section reviews recent developments in short-run inflation expectations. Short-run inflation expectations matter because they affect – for a given path of nominal policy interest rates – short-term real interest rates and thereby influence the path of expected real income. By reducing the level of short-term real interest rates, a rise in short-term inflation expectations can strengthen the impact on real activity of a policy commitment when nominal interest rates are at the zero lower bound. At the same time, higher inflation expectations can signal pressure on wages and a need to tighten policy, as is the case in many emerging economies today.

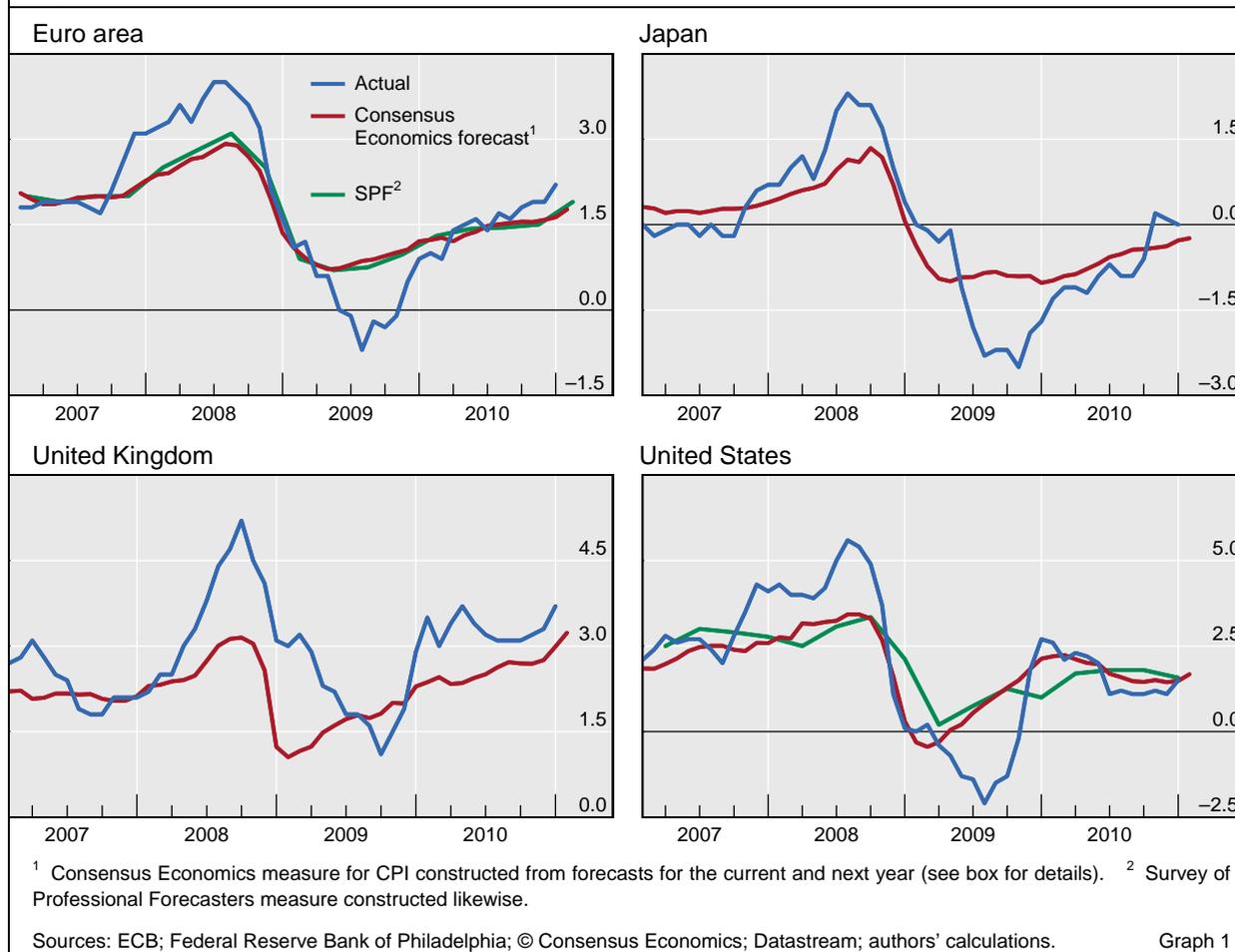
Measures of short-term inflation expectations are available for consumers and professional forecasters. While consumer surveys offer respondents categories of answers that can be rather vague, professional forecasters provide point estimates, summaries of which are published by firms such as Consensus Economics. Some central banks also publish surveys.

In line with the economic recovery, short-term inflation expectations of professional forecasters for the major advanced economies have risen since the worst of the crisis (Graph 1). Consumer price inflation rates decreased sharply over the year 2009 and have since rebounded. Inflation expectations followed the same pattern, albeit with smaller amplitude. That said, expectations have not increased uniformly. In the euro area, Consensus Economics forecasts for the year ahead have recently edged up to 1.8%, although they remain in line with actual inflation, at 2.2%, and the ECB's definition of price stability of consumer price inflation of close to, but below, 2%. The ECB's Survey of Professional Forecasters measure suggests an expected euro area inflation rate of 1.9%. In Japan, professional forecasters' inflation expectations continue to point to deflation, standing at –0.2%. In the

Strength of rebound varies across advanced economies

## Measures of actual and expected short-run inflation in advanced economies

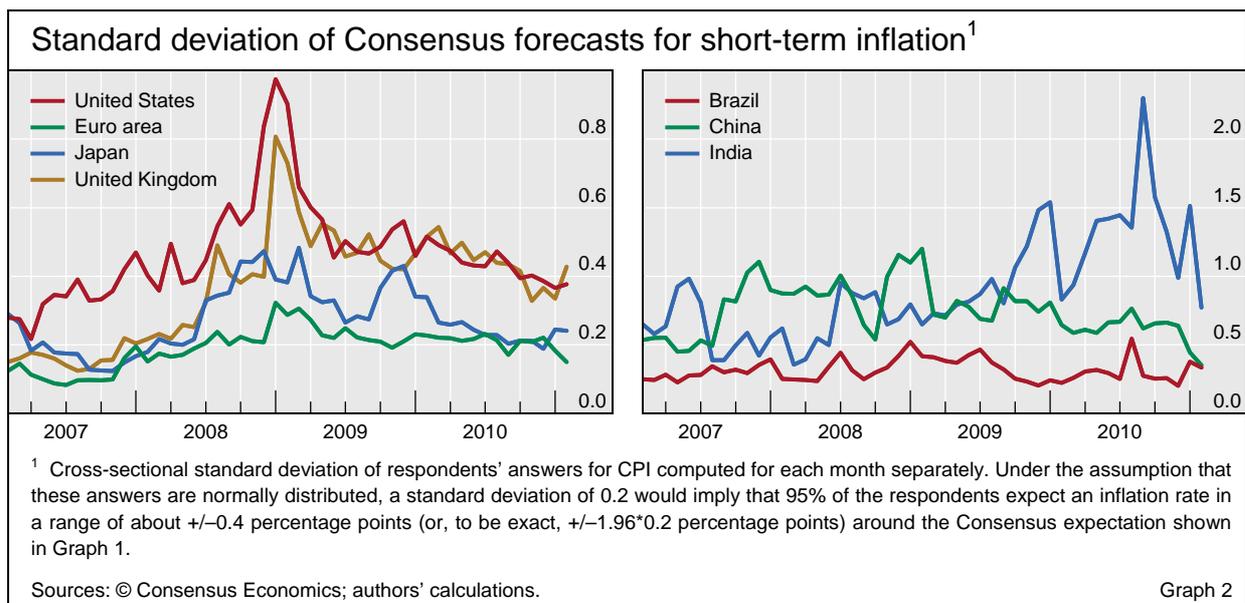
In per cent



United Kingdom, expectations and actual inflation today exceed the Bank of England's inflation target of 2%, with current values at 3.2% and 3.7%, respectively.<sup>2</sup> And in the United States, inflation expectations have recently been declining slightly, standing at 1.7% for the Consensus measure and 1.6% for the Survey of Professional Forecasters; actual consumer price inflation is 1.5%. US core inflation has decreased to 0.6%, and survey respondents seem to be pushing their expected timing for this measure's recovery further and further into the future. For several quarters now, they have predicted core inflation to be low in the quarter of the survey and to increase to around 1.5% over the subsequent year. There is a risk that low headline inflation expectations may become entrenched in the United States.

The dispersion of economic forecasters' inflation expectations, as measured by the standard deviation of the answers underlying the Consensus

<sup>2</sup> The VAT rate in the United Kingdom rose in January 2011 by 2.5 percentage points. The Bank of England (2010) expects that this might increase CPI inflation by as much as 1.5 percentage points.



Economics forecast, peaked at the end of 2008 (Graph 2).<sup>3</sup> Under the assumption that respondents' answers are normally distributed, the value of almost one for the standard deviation for the United States at the end of 2008 suggests that 95% of the forecasters expected inflation over the year 2009 to lie somewhere in the range of  $-2\%$  to  $2\%$ .<sup>4</sup> With the exception of the United Kingdom, disagreement about the inflation outlook has declined to pre-crisis levels since late 2008. High dispersion merits monitoring because it implies adjustment costs for a large number of individuals once actual inflation turns out to deviate from their initial expectations.

Actual and expected inflation in major emerging economies also dropped during the crisis, though often less sharply than in advanced economies (Graph 3). In Brazil and China, consumer prices are currently rising again, by 5.9% and 4.6% a year, and Consensus Economics expectations have returned to the peaks of 2008, standing at 5.1% and 4.2%, respectively. In India, the latest values for actual and expected CPI inflation are 8.3% and 9.3%, respectively. Wholesale prices, which may be more representative in India than the consumer price index, are currently rising by 18.4% a year. These rises in actual and expected inflation probably reflect the fast and strong economic recovery in emerging economies. Aggregate demand effects from earlier large-scale capital inflows are also likely to be filtering through, as are increases in international commodity prices, which fell sharply in late 2008 but have risen strongly since mid-2010 (Graph 4). The increase has affected all major classes of commodities, including energy, metals and food, and is likely to largely reflect

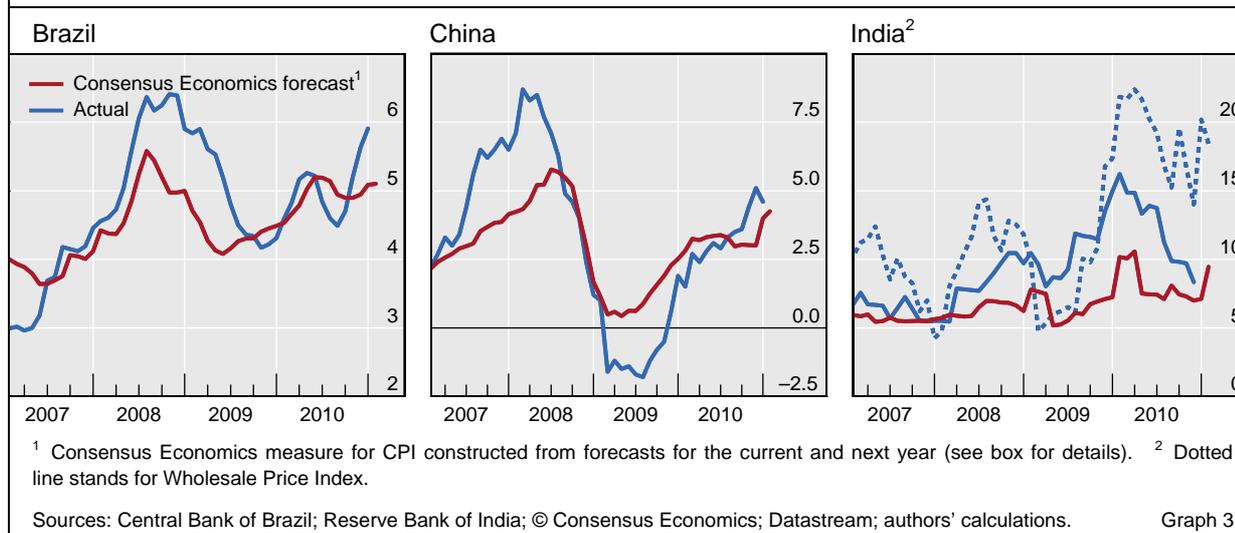
In emerging market economies, food prices reinforce the rebound

<sup>3</sup> Bruine de Bruin et al (2009) show that such dispersion in views is correlated with, but not identical to, individuals' uncertainty about the inflation outlook. See also Capistran and Timmermann (2009).

<sup>4</sup> Graph 1 shows an average expected US inflation rate at the end of 2008 of essentially zero. For a normal distribution, one obtains the upper (lower) edge of the 95% confidence band by multiplying the standard deviation by 1.96 and adding (subtracting) the resulting value to (from) the mean of the distribution.

## Measures of actual and expected short-run inflation in emerging market economies

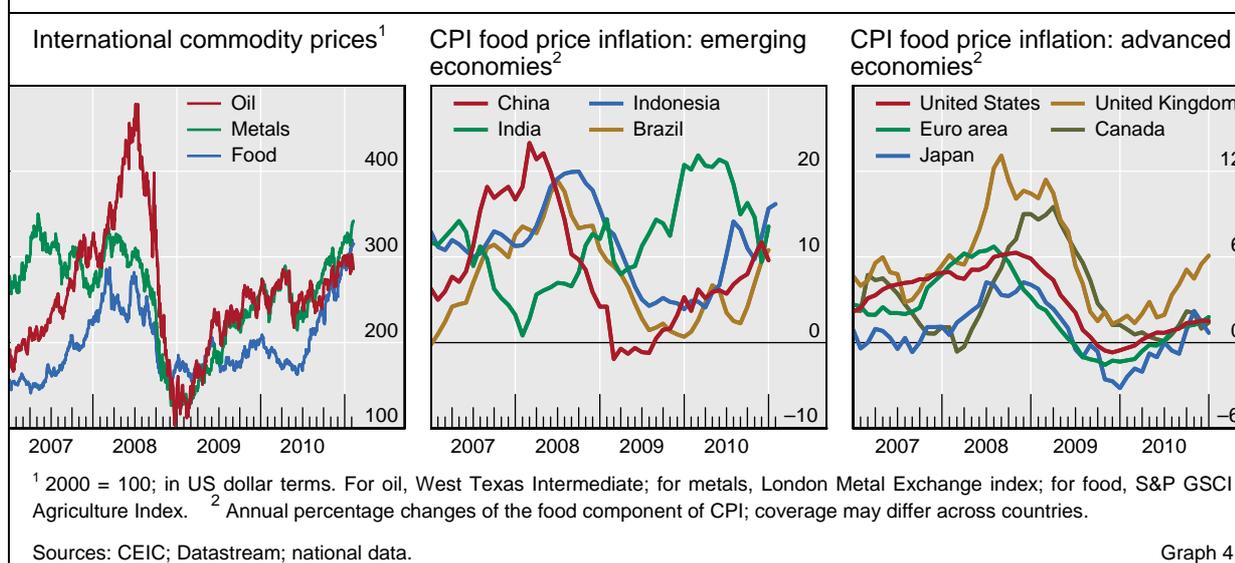
In per cent



strong demand from emerging economies. In addition, supply factors are also likely to have played a role in pushing up food prices, in particular bad weather conditions including floods in Pakistan and droughts in Russia.

Food prices seem to affect inflation expectations in emerging economies more strongly than in advanced economies (see box). One reason is that food prices in the consumer price index have generally risen more strongly in emerging economies than in advanced economies. Moreover, food accounts for a higher proportion of the total household consumption expenditure basket in economies with lower income per capita. The weight of food in the total CPI is correspondingly higher for these economies, at around 30% on average for emerging economies, compared with around 13% for industrial countries (IMF (2007), Cecchetti and Moessner (2008)). It is noteworthy that the latest spikes in the dispersion of short-run inflation expectations in emerging economies, and especially in India, have coincided with recent increases in commodity prices.

## Commodity and food prices



## Has there been a change in the formation of inflation expectations?

Changes in the expectations formation process can affect the dynamics of inflation itself. For monetary policymakers who seek to stabilise inflation two to three years out, such a change might signal the need to adjust the way in which they react to shocks.

There are a number of ways in which the financial crisis could have affected how inflation expectations are formed. The public may have changed its understanding of how monetary policy works. The deep recession in major advanced economies could have changed assessments of the growth rate of potential output. Or rapid real growth in emerging markets may have altered the dynamics of commodity and food prices, changing the way in which agents form their inflation expectations.

Galati et al (2009) analyse how *long-run* inflation expectations changed during the financial crisis. Using bond- and swap-based expectations measures, they find that expectations in the euro area, the United Kingdom and the United States have started responding more strongly to macroeconomic news. In principle, such news should have no impact if long-run inflation expectations are well anchored.

### Formation of short-run inflation expectations as captured by Consensus Economics

	Emerging markets		Advanced economies		Inflation target		No inflation target	
	Pre-Lehman	Post-Lehman	Pre-Lehman	Post-Lehman	Pre-Lehman	Post-Lehman	Pre-Lehman	Post-Lehman
<i>c</i>	0.240***	0.792***	0.150***	0.271***	0.283***	0.557***	0.078***	0.270***
<i>c<sub>exp,1</sub></i>	1.108***	1.023***	1.071***	1.144***	1.101***	1.186***	1.114***	0.936***
<i>c<sub>exp,2</sub></i>	-0.088*	-0.147*	-0.104**	-0.139	-0.074	-0.317***	-0.147**	0.151
<i>c<sub>exp,3</sub></i>	-0.118***	-0.125**	-0.081**	-0.182***	-0.140***	-0.050	-0.054	-0.299***
<i>c<sub>core,1</sub></i>	0.036***	0.038**	0.019	0.070**	0.031**	0.009	0.036***	0.053***
<i>c<sub>core,2</sub></i>	0.042***	0.006	0.054***	0.021	0.073***	0.052*	0.011	-0.016
<i>c<sub>core,3</sub></i>	-0.051***	-0.032*	-0.040***	-0.072***	-0.079***	-0.054***	-0.014	-0.040**
<i>c<sub>energy,1</sub></i>	0.005*	0.007***	0.003***	0.004*	0.008***	0.010***	-0.001	0.007***
<i>c<sub>energy,2</sub></i>	0.003	-0.004	0.001	-0.003	-0.003	-0.008**	0.007***	-0.006**
<i>c<sub>energy,3</sub></i>	-0.004	0.000	-0.004***	-0.003	-0.001	-0.001	-0.004**	-0.000
<i>c<sub>food,1</sub></i>	0.052***	0.031***	-0.001	-0.020*	0.035***	0.021**	0.011*	-0.013
<i>c<sub>food,2</sub></i>	-0.033***	-0.016	0.010**	0.023	-0.0167**	-0.009	0.002	0.010
<i>c<sub>food,3</sub></i>	-0.014*	-0.008	-0.003	-0.021**	-0.013**	-0.012	0.000	0.001
<i>c<sub>ugap,1</sub></i>	-0.003	-0.039	-0.001	0.037	-0.002	-0.028	-0.003*	-0.092
<i>c<sub>ugap,2</sub></i>	0.002	-0.059	0.000	0.007	0.001	-0.014	0.005***	-0.116
<i>c<sub>ugap,3</sub></i>	-0.000	0.026	-0.001	-0.016	0.000	-0.005	-0.003***	0.210***
Average expected inflation								
	4.444	3.768	1.676	0.881	4.070	3.363	1.847	1.378

Panel estimates with country- and time-fixed effects of

$$\pi_{j,t}^{exp} = c + c_j + c_t + c_{exp,k} \pi_{j,t-k}^{exp} + c_{core,k} \pi_{j,t-k}^{core} + c_{energy,k} \pi_{j,t-k}^{energy} + c_{food,k} \pi_{j,t-k}^{food} + c_{ugap,k} ugap_{j,t-k} + \varepsilon_{j,t}$$

with  $k = 1, 2, 3$ , pre-Lehman April 2000 to September 2008, post-Lehman October 2008 to November 2010. \*\*\*/\*\*/\* indicate significance at the 10/5/1% level. Average expected inflation is computed as

$$(c + \sum_{k=1}^3 c_{core,k} \mu_{core} + \sum_{k=1}^3 c_{energy,k} \mu_{energy} + \sum_{k=1}^3 c_{food,k} \mu_{food} + \sum_{k=1}^3 c_{ugap,k} \mu_{ugap}) / (1 - \sum_{k=1}^3 c_{exp,k})$$

with  $\mu$  the mean over the entire sample period. Economies included are Australia, Brazil, Canada, the Czech Republic, Denmark, the euro area, Hong Kong SAR, Hungary, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Norway, the Philippines, Poland, Singapore, South Africa, Sweden, Switzerland, Thailand, Turkey, the United Kingdom and the United States. Emerging market dummies for whole sample for Brazil, the Czech Republic, Hong Kong SAR, Hungary, Indonesia, Korea, Malaysia, Mexico, the Philippines, Poland, Singapore, South Africa, Thailand and Turkey. IT dummy = 1 from first quarter of the year in which inflation target was adopted (true at the end of the sample for Australia, Brazil, Canada, the Czech Republic, Hungary, Indonesia, Korea, Mexico, New Zealand, Norway, the Philippines, Poland, South Africa, Sweden, Thailand, Turkey and the United Kingdom). The CPI food price series is defined as food and non-alcoholic beverages (COICOP 01) or the closest available series; the CPI energy price series is defined as electricity, gas and other fuels (COICOP 04.5) plus fuels and lubricants for personal transport equipment (COICOP 07.2.2), or the closest available series. The Classification of Individual Consumption by Purpose (COICOP) is a reference classification published by the United Nations Statistics Division. CPI data for OECD countries from the OECD; for some emerging market countries, the closest available series are used. Unemployment gaps are constructed using the Hodrick-Prescott filter on deseasonalised data.

Sources: National central bank websites; OECD; CEIC; Datastream; BIS; authors' calculations.

Table A

Table A presents a simple econometric analysis of the formation process of *short-run* inflation expectations. The analysis uses monthly data on expectations for the year ahead from 25 countries from 2000 onwards.<sup>Ⓢ</sup> The table provides a breakdown between emerging and advanced economies, on the one hand, and between inflation targeting nations and other economies, on the other hand, since it seems likely that the average rate of inflation differs between these groups. For all breakdowns, estimates are reported for before and during the great recession.

Before the crisis, inflation expectations evolved in similar ways in the different country groups. Consensus Economics inflation forecasts seemed to be autocorrelated and to depend on lagged core, energy and food price inflation.<sup>Ⓢ</sup> Average inflation expectations appeared lower in advanced economies and countries without an inflation target, and they seemed to follow a hump-shaped pattern in response to shocks. Core, energy and food price inflation tended to increase inflation expectations initially but to reduce them after two to three months. Thus, it appeared that changes in the rate of food and energy price inflation, rather than their rate of inflation itself, affected expectations. The impact of food prices was particularly large in emerging markets. Finally, inflation expectations in non-inflation targeting countries seemed to depend on the unemployment gap: when unemployment increased above its long-term trend, inflation expectations tended to decline.<sup>Ⓢ</sup>

Since the onset of the great recession, average inflation expectations have apparently decreased across the board, a result that seems largely driven by the reduced impact of food price inflation. This weaker response of inflation expectations may in turn be a reaction to the increase in the volatility of food price inflation in recent years. Further, in economies without an inflation target, inflation expectations seem to have stopped following a hump-shaped response to shocks. This may suggest that forecasters have started to view inflation itself as less sluggish than before the crisis. Alternatively, they may today rely more on new economic information when forming inflation expectations and less on their own past forecasts. It remains to be seen if these changes in the formation of inflation expectations have modified the dynamics of inflation itself.

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<sup>Ⓢ</sup> Consensus Economics provides forecasts for the current calendar year and the coming one. In January 2011, expectations for the year ahead are simply given by the Consensus 2011 forecast. In February 2011, expectations for the year ahead are computed as a weighted average of the Consensus 2011 and 2012 forecasts, with the former assigned a weight of 11/12 and the latter a weight of 1/12. These weights shift as the year progresses: in December, they are 1/12 and 11/12, respectively. <sup>Ⓢ</sup> The analysis uses three lags. Further lags were generally insignificant. Contemporaneous data for the right-hand side variables have been excluded to account for data collection and reporting lags. A level specification is chosen since it seems implausible to assume non-stationary inflation expectations over the relevant period. <sup>Ⓢ</sup> Output gaps do not appear to affect inflation expectations. Since monetary regimes differ widely across the economies considered, policy rates are not included in the analysis. The effect of quantitative easing measures is not examined due to the small number of observations.

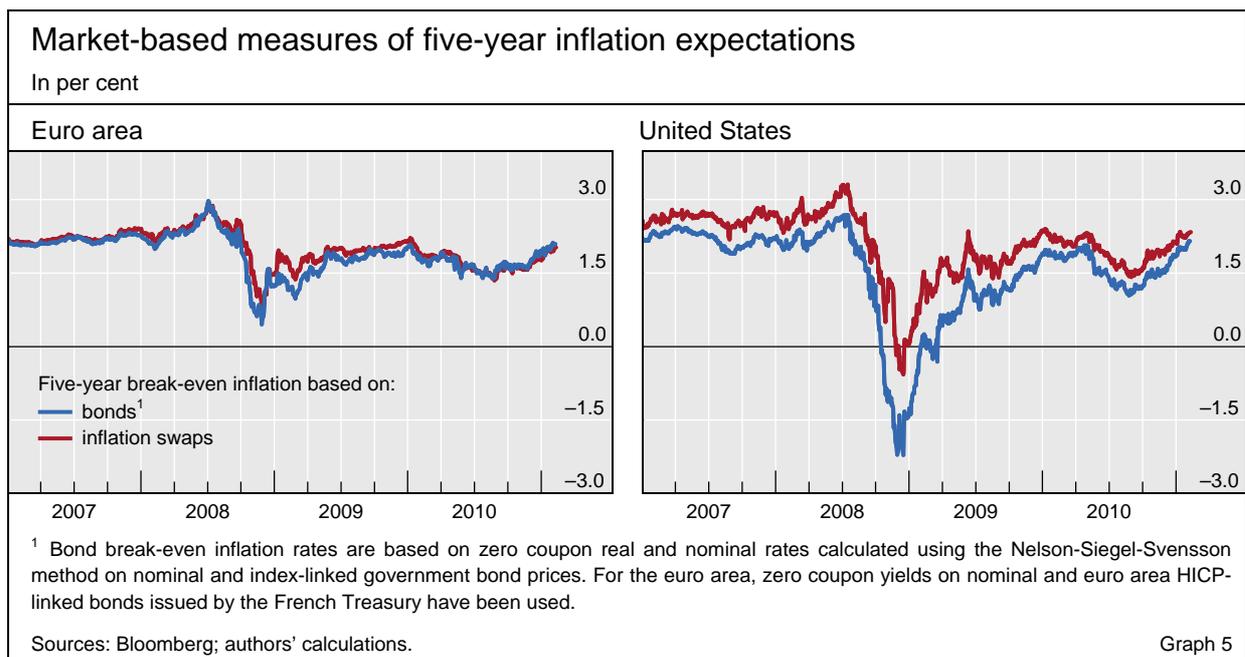
## Long-run inflation expectations and central bank credibility

Financial market prices provide timely ...

Long-run inflation expectations reflect the credibility of monetary policy with respect to its inflation objective, and are therefore crucial for anchoring inflation. Information on longer-term inflation expectations can be obtained from surveys and financial market prices. Timeliness and richness of information across a wide range of horizons make market-based measures particularly useful. For instance, break-even inflation rates can be derived from the difference between nominal bond yields and corresponding index-linked real yields, and are available every day.

... although imperfect information on inflation expectations

However, market-based measures do not represent pure measures of inflation expectations. Break-even inflation rates contain premia for inflation risk as well as for differential liquidity risk in nominal and index-linked bonds that muddy the waters. Moreover, the information content of break-even rates may be relatively low in times of market stress. During the height of the financial crisis, for example, they exhibited sharp swings not closely related to



changes in the outlook for inflation. Break-even inflation rates plunged in the aftermath of the Lehman collapse, with the five-year US break-even rate falling below  $-2\%$  (Graph 5). While this decline may have reflected expectations that average inflation would decrease over the next few years, other factors were arguably more important. Intense flight-to-liquidity flows during the market turmoil resulted in strong demand for nominal government bonds. This pushed down nominal yields to extremely low levels, which in turn placed severe downward pressure on break-even rates. At the same time, the liquidity premium in the less liquid index-linked market segment almost certainly rose, pushing real yields up and depressing break-even rates further. This was reinforced by rapid unwinding of inflation-linked bond positions in response to collapsing break-even rates, which further added to the drop in these rates.

More recently, the question arises whether central bank bond purchase programmes might have distorted break-even inflation rates, especially in the United States. In the recent \$600 billion expansion of the Federal Reserve's Large-Scale Asset Purchase (LSAP) programme, 97% of the purchases were earmarked for the nominal Treasury market, and only 3% for the index-linked Treasury Inflation-Protected Securities (TIPS) market. By comparison, nominal Treasuries make up around 89% of the entire US Treasury market, with the remaining 11% consisting of TIPS. With the Fed making heavier purchases in the nominal sector compared to its share of the total market, it is conceivable that this would generate relatively more downward pressure on nominal bond yields relative to real yields.

There is little evidence for such an effect, though. Following the first LSAP announcement by the Federal Open Market Committee on 18 March 2009, long-term US break-even rates rose by almost 20 basis points within two days (Guidolin and Neely (2010)). The 3 November 2010 announcement of a second round of LSAPs was widely anticipated by markets, and the effects on yields and break-even rates were seen weeks before the actual announcement. In

particular, investors became confident that the LSAPs would be expanded following Federal Reserve Chairman Bernanke's Jackson Hole speech on 27 August. From the day before this speech until the ultimate announcement on 3 November, the five-year US break-even rate rose by around 40 basis points, suggesting growing expectations of easier US monetary policy. Hence, if LSAPs were going to have distorting effects on break-even rates, one might anticipate that this would have resulted in downward pressure on such rates. Instead, break-even rates rose as investors priced in expectations of additional LSAPs.

Prices of inflation swaps also suggest that bond market-specific factors had little to do with the movements of break-even rates around LSAP announcements. Inflation swap prices continued to move in parallel with bond-based break-even inflation rates, even as investors reacted to news about Fed purchases of bonds (Graph 5, right-hand panel). Inflation swaps pay the CPI inflation rate accrued on a notional value over the relevant maturity of the swap against a fixed payment, which reflects the inflation swap price.<sup>5</sup> While the limited depth of inflation swap markets suggests caution is advisable in interpreting their price movements, they nevertheless provide useful information to complement bond break-even rates. Inflation swaps are not affected by differential liquidity conditions in nominal and index-linked bond markets and, at least in principle, they should not be directly influenced by other bond market-specific factors.

Forward break-even rates can measure credibility ...

Implied forward break-even inflation rates far ahead are often used as measures of central bank credibility: if the central bank's commitment to maintaining price stability is fully credible, expected inflation in the distant future should remain at a level consistent with the central bank's inflation objective. Distant forward rates, such as the five-year forward break-even rate five years ahead, are seen as providing a cleaner indication of long-horizon inflation expectations than spot break-even rates because, at least in principle, they should be unaffected by purely near-term inflation expectations and policy actions.

... and have remained stable ...

Such forward rates have fluctuated somewhat since the crisis, but they have not exhibited the upward trend that would suggest concerns about central banks' long-term credibility (Graph 6, left-hand and centre panels). Correcting the forward break-even rates for estimated forward inflation risk premia does not change the overall picture (although it suggests that euro forward break-even rates consistently overestimate survey inflation expectations).<sup>6</sup>

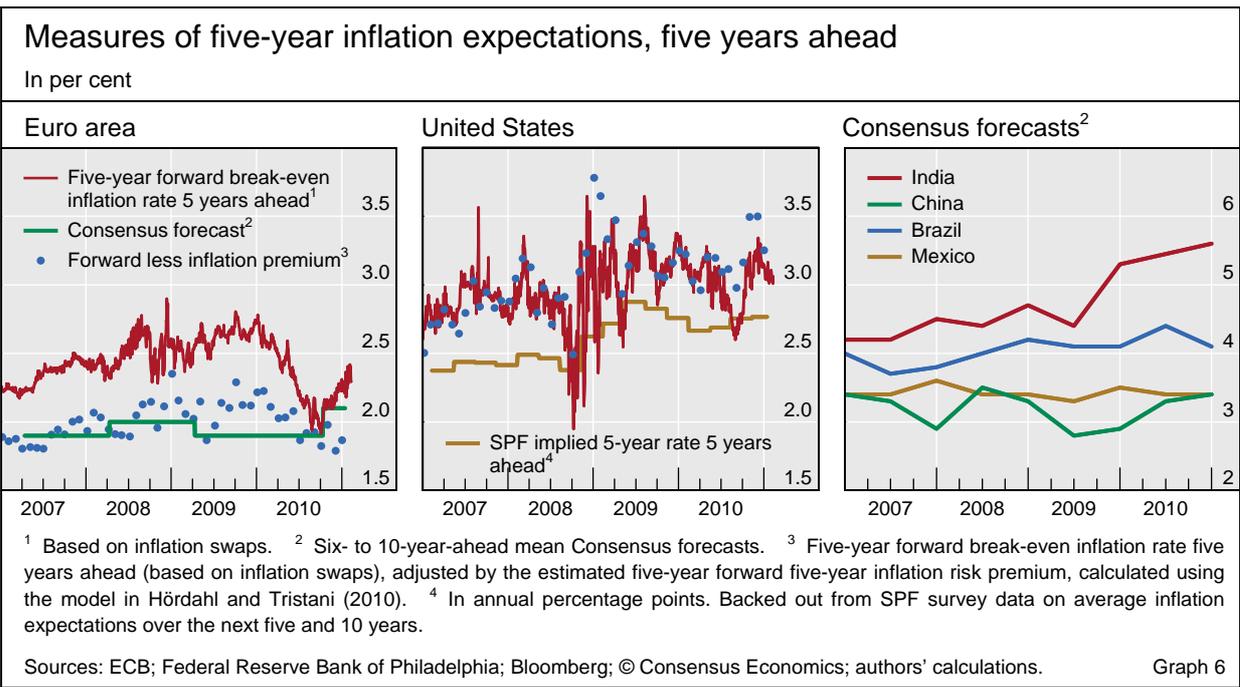
... as have long-term survey forecasts

Nor have professional forecasters' expectations of long-run inflation moved significantly in the aftermath of the crisis. Consensus Economics' data show that the forecast for average five-year euro area inflation five years ahead has stayed very close to 2%, consistent with the ECB's objective (Graph 6, left-hand panel). In the United States, forecasts for average five-year

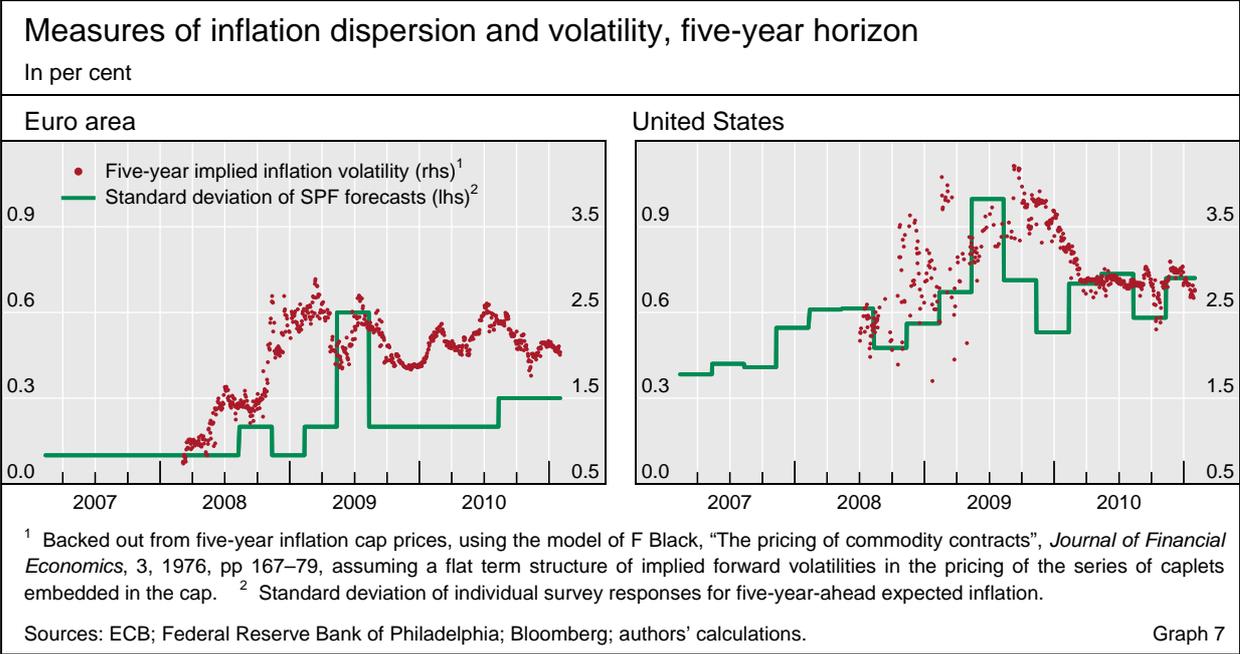
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<sup>5</sup> This refers to zero coupon inflation swaps, which are the most liquid type of inflation swap.

<sup>6</sup> This correction is based on inflation premia estimated using a macro-finance dynamic term structure model; see Hördaahl and Tristani (2010) for details.



inflation five years ahead, as measured by the Survey of Professional Forecasters, rose by around 45 basis points from Q3 2008 to Q3 2009, as the crisis first intensified and was then met by an array of policy responses (Graph 6, centre panel). Since late 2009, this measure has come down somewhat, but remains above its pre-crisis level. Meanwhile, in major emerging market countries, where the impact of the crisis was much more muted and policy responses less aggressive, expectations of inflation six to 10 years ahead have also remained quite stable both during and after the crisis (Graph 6, right-hand panel). There are exceptions, however. In the case of India, for example, this measure of long-term inflation expectations has been rising in the recent past.

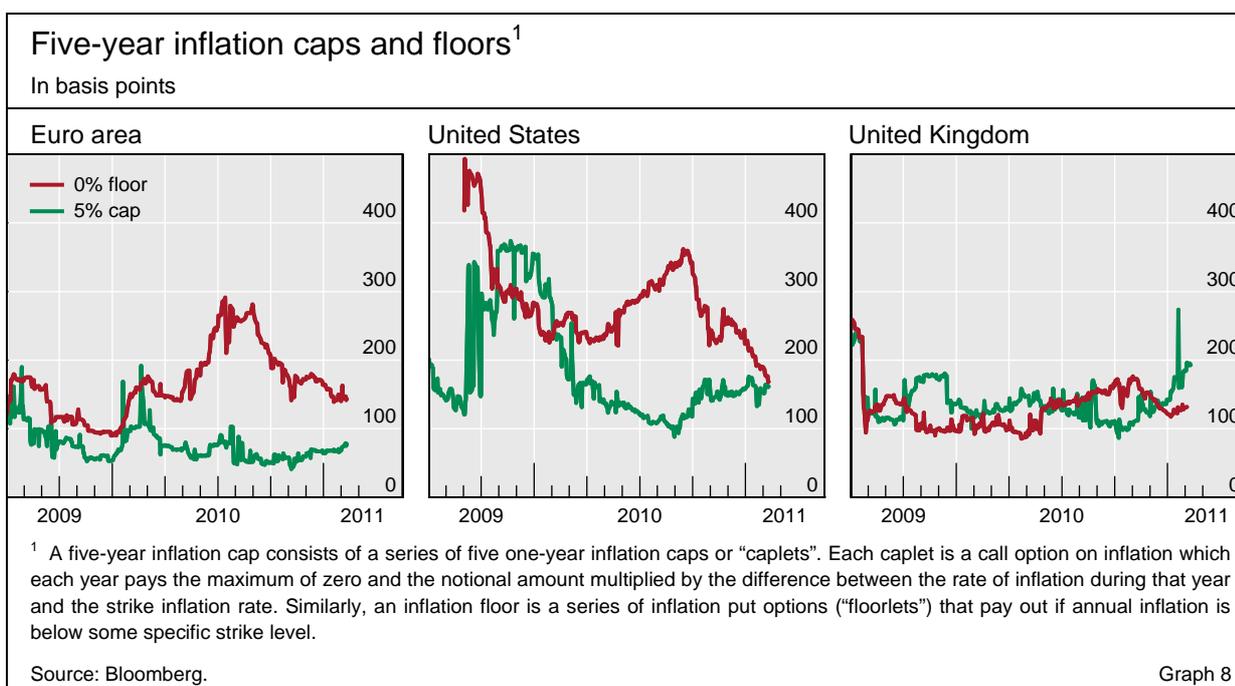


Long-term uncertainty measures are higher than before the crisis ...

Both survey-based and market-based measures of long-term uncertainty about future inflation are currently somewhat higher than prior to the crisis. While this could reflect greater macroeconomic uncertainty in general, it could also suggest that expectations may be less firmly anchored than they used to be (see also the discussion in the box relating to findings by Galati et al (2009)). The dispersion of professionals' forecasts of five-year inflation, measured by the standard deviation of individual survey responses, peaked in early 2009 in the euro area and the United States, shortly after the height of the financial turmoil (Graph 7). Although the degree of disagreement retreated relatively quickly, it did not return to pre-crisis levels. The introduction of various unconventional monetary policy measures may have played a role here. Another measure of long-term uncertainty, implied inflation volatilities backed out from prices on options on inflation, has followed a similar pattern. These volatilities have also retreated from their crisis peaks, but have since remained higher than before the crisis.<sup>7</sup>

... but tail risks do not seem to have increased

Still, developments in prices of traded inflation derivative instruments have provided little cause for concern with respect to how investors perceive "tail risks" to price stability. Inflation derivatives allow investors to hedge against or bet on such tail risks, including deflation or inflation outcomes substantially above the central bank's explicit or implicit price stability objective. A five-year inflation floor with a strike price of 0%, for example, pays the buyer the rate of deflation on a notional amount during any of the next five years in which prices fall on average. In the recent past, when such instruments have become more liquid, inflation floor prices have risen in the United States and the euro area as the economic recovery seemed to be losing steam, as in the first half of 2010 (Graph 8, left-hand and centre panels). In general, however, there is no



<sup>7</sup> For the United States, data are available only as of mid-2008, as the US inflation derivatives market has been slower to develop than the corresponding euro area market.

indication of an upward trend that would suggest that investors have adjusted upwards the perceived likelihood of such downward tail risks. The same can be said with respect to upward tail risks. Prices of five-year 5% inflation caps, which pay off if inflation exceeds 5% in any of the next five years, have fluctuated but not trended higher. Interestingly, the recent higher than expected UK inflation figures resulted in a spike in UK inflation cap prices, suggesting increased concerns about high inflation outcomes there (Graph 8, right-hand panel).

## Concluding remarks

Measures of short- and long-term inflation expectations plunged during the financial crisis, in line with realised inflation. Since then, expectations have rebounded, albeit at an uneven pace. Short-run inflation expectations in major emerging market economies have returned to pre-crisis levels, and in some cases surpassed them. Inflation expectations in the mature economies have been slower to rebound, even as recent headline inflation rates have picked up notably in some cases. This might reflect much more stable core inflation developments, or the fact that the economic recovery in mature economies has tended to be substantially less brisk than in most emerging market economies.

As for long-term inflation expectations, both market-based and survey measures suggest that such expectations have remained quite stable thus far. In this regard, central bank credibility seems to remain high. Nevertheless, this could change if policymakers are seen to be slow in responding to unexpected increases in inflation, which in turn could trigger rapid upward revisions of inflation expectations. At the same time, in many mature economies, any premature tightening could jeopardise the economic recovery and risk sparking expectations of deflation. The fact that measures of dispersion and uncertainty of long-term inflation expectations are somewhat higher than before the crisis could indicate that such expectations are less firmly anchored than at first sight, and therefore vulnerable to policy mistakes.

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## The use of reserve requirements as a policy instrument in Latin America<sup>1</sup>

*In recent years, some central banks in Latin America and other emerging market regions have used reserve requirements to pursue monetary or financial stability goals. In the past decade, they have raised reserve requirements in the expansion phase of the cycle to tighten monetary conditions without attracting capital inflows. After the bankruptcy of Lehman Brothers, they lowered them sharply, helping to restore market functioning. In some cases, the use of reserve requirements can complement the policy rate in the conduct of monetary policy. However, there are trade-offs in the use of this instrument.*

*JEL classification: E51, E52, E43.*

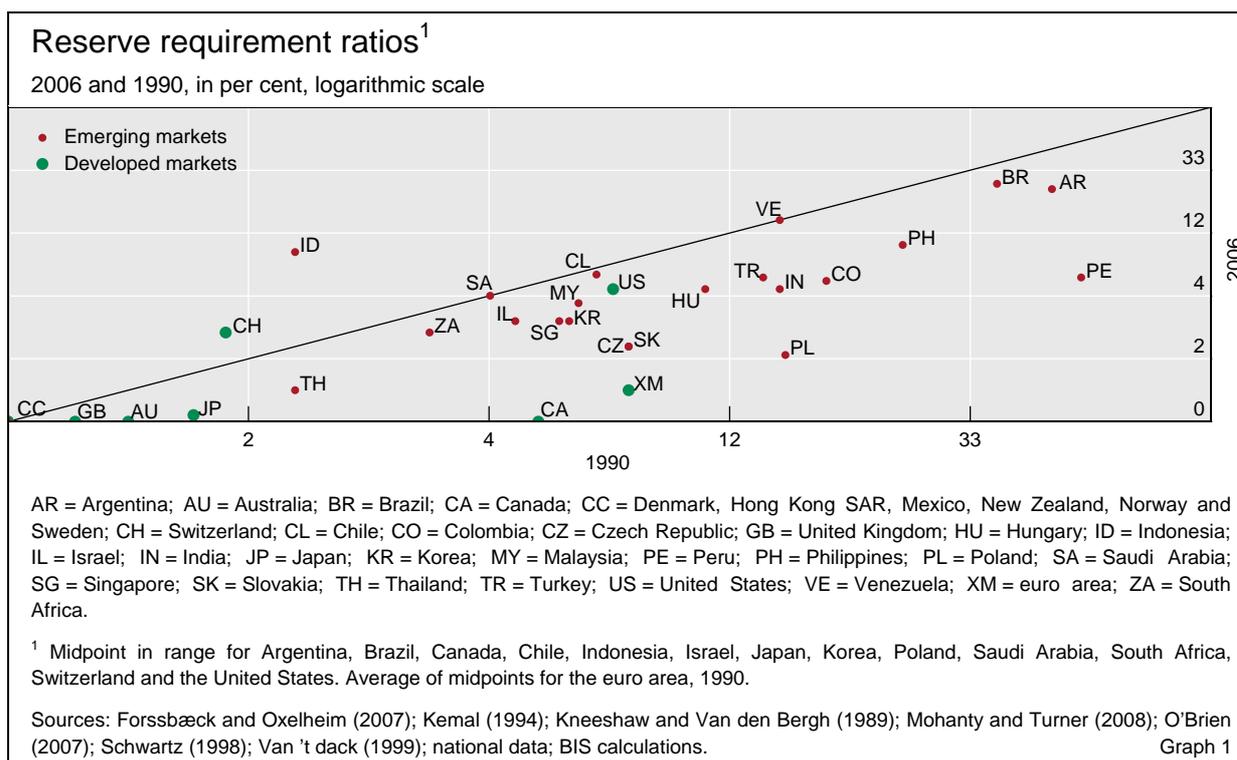
This article explores the use of reserve requirements in three inflation targeting Latin American countries (Brazil, Colombia and Peru) in recent years. For a variety of reasons, reserve requirements have fallen out of favour with most policymakers in the past quarter of a century.<sup>2</sup> As a result, reserve requirements fell in many economies between 1990 and 2006. This is illustrated in a scatter diagram of reserve requirements (Graph 1) which shows much lower reserve requirements in 2006 (most points in the graph were well below the diagonal line) and rates that were particularly low – close to zero – in many advanced economies. This trend notwithstanding, monetary authorities in several emerging market economies (EMEs) in Latin America and other regions<sup>3</sup> have continued to use reserve requirements as a supplement to (and in some cases a substitute for) the policy rate in pursuing monetary or financial stability aims.

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<sup>1</sup> The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. We would like to thank Claudio Borio, Stephen Cecchetti, Corrinne Ho and Christian Upper for helpful comments. We also thank – without implicating – officials from the central banks of Brazil, Colombia and Peru for useful information or comments that have been used in the preparation of this paper. Alan Villegas provided excellent research assistance.

<sup>2</sup> Central banks have shifted the focus of their operating procedures from controlling reserves or monetary aggregates to short-term interest rates. They have also become more aware of the potential costs imposed by reserve requirements on financial intermediation. Lastly, financial innovations have reduced the effectiveness of this policy tool.

<sup>3</sup> For discussions on the use of reserve requirements in Asian economies, see Borio and Shim (2007) and Ho (2008).



The article is structured as follows. We begin with a short discussion of the policy dilemmas faced by the three countries, before looking at the rationale for the use of reserve requirements and assessing their effectiveness as a policy instrument. This experience suggests that the use of reserve requirements can help to offset tighter financing conditions for banks during periods of financial stress and to smooth credit growth in less developed financial markets. Lastly, we describe some of the costs associated with the use of reserve requirements.

## Policy dilemmas

Prior to the Lehman Brothers bankruptcy in September 2008, Brazil, Colombia and Peru faced a combination of high capital inflows and economic overheating. Headline inflation was above or close to the upper target bound, reflecting pressures on productive capacity and the effects of a commodity price boom. Also, credit was growing at annual real rates of more than 20% (Graph 2, centre panel). Policymakers faced a dilemma: if they raised interest rates to control headline inflation and credit growth, they risked attracting even more capital inflows. As a source of cheap financing, such inflows could be expansionary even if they generated appreciation pressure. Furthermore, they might stimulate credit growth and push up asset prices, with adverse implications for financial stability.<sup>4</sup>

Dilemmas from capital inflows and overheating ...

<sup>4</sup> Policymakers have addressed this dilemma in various ways. Some central banks have raised interest rates by less than they otherwise might have done. Outside the region, some have responded by lowering interest rates (eg the Czech National Bank in 2002 and the Central Bank of the Republic of Turkey in 2011 – which also simultaneously increased reserve requirements).

... followed by a fall in inflows and persistent inflation ...

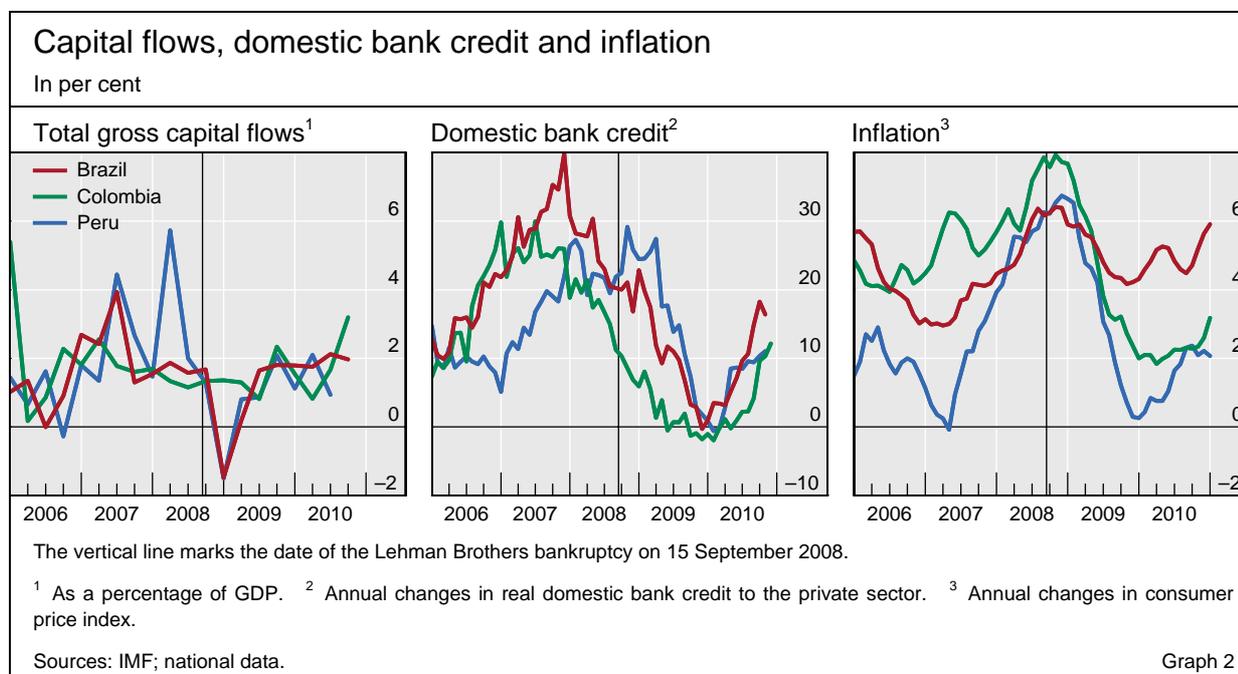
... were addressed by adjusting reserve requirements and the policy rate

Central banks raised reserve requirements during expansion phase ...

Events after the Lehman bankruptcy led to yet another dilemma. Gross capital inflows to EMEs contracted sharply and financing conditions tightened, in both foreign exchange and domestic markets.<sup>5</sup> Inflation remained high, though, so that policymakers needed to stabilise financial markets and counter the sharp contraction in external demand while also ensuring that inflation expectations remained stable.

In general, policymakers in the three countries addressed these dilemmas by adjusting reserve requirements as well as the policy rate (see box on page 56 for a discussion of how reserve requirements were implemented in these countries). They raised reserve requirements in the expansion phase of the cycle and lowered them after the Lehman bankruptcy. For example, in the second quarter of 2007 when credit growth was still strong and inflation was picking up (Graph 2, centre and right-hand panels), Colombia's Bank of the Republic imposed a marginal reserve requirement of 27% on savings and current accounts and increased average reserve requirements on savings accounts (Graph 3, centre panel).<sup>6</sup> Over this period, policy rates rose from 8.25% to 9%. In June 2008, when credit growth was slowing (Graph 2, centre panel), the Colombian central bank reduced the effective reserve requirement by setting marginal reserve requirements to zero while simultaneously increasing average reserve requirements. Only half a year later, on 19 December, did it lower the policy rate.

Similarly, the Central Reserve Bank of Peru increased average and marginal reserve requirements<sup>7</sup> between the first and second quarters of 2008,



<sup>5</sup> As shown in Graph 2, however, the capital inflow reversal was much more muted in Colombia.

<sup>6</sup> During the same period, it also reduced the average reserve requirement on current accounts to 4.7%; however, the overall effect was to increase the effective reserve requirement.

<sup>7</sup> In both domestic and foreign currency.

## Operating procedures for reserve requirements

Reserve requirements can have different effects on the banking system, depending on how they are structured. Table A presents the main features of reserve requirements for the three Latin American countries discussed in this paper and (for reference) Argentina and Chile. Mexico does not impose reserve requirements.<sup>①</sup>

All three countries fulfil their reserve requirements on an average basis (column 1) during the maintenance period (the period for which the corresponding required reserves must be held; see Borio (1997, p 47)). The maintenance period ranges from one week to one month (column 4). Brazil and Colombia have lagged reserve accounting frameworks, while Peru maintains a contemporaneous system. In lagged systems, the calculation period precedes the maintenance period. In semi- or half-lagged systems these periods partly overlap, and in contemporaneous frameworks the ends of both periods coincide. The advantage of lagged reserve accounting is that the amount of required reserves is known with certainty, whereas in contemporaneous frameworks data collection lags create an incentive for banks to over-provision in order to meet reserve requirements.

Required reserves tend to be lower today than in early 2007, reflecting sharp reductions in response to the crisis. Also, they vary greatly across countries, ranging from as low as zero (in Colombia, for certificates of deposit with maturity longer than 18 months) to 43% (in Brazil, for demand deposits).<sup>②</sup> In many cases, reserve requirements are remunerated at below-market rates, which partly reduce their distortionary tax effect but also lessen the impact of changes in the reserve requirement rate on the banking system. It also means that the central bank assumes some cost when raising reserve requirements. Colombia does not remunerate reserves from July 2009, Brazil remunerates only required reserves, and Peru remunerates excess reserves.

Certain other characteristics can also influence the effectiveness of reserve requirements as a policy instrument. For example, changes in reserve requirements will have a smaller impact if the amount of deposits subject to reserve requirements relative to domestic bank credit is small. In Brazil, Colombia and Peru, these ratios were, respectively, 0.6, 1.1 and 1.1 in October 2010. Also, the impact will vary over time if the changes are made through the level or through the marginal reserve requirement. When the reserve requirement level is changed, the effect is almost immediate. In contrast, a change in the marginal reserve requirement has a small effect at the beginning that increases over time. As shown in Graph 3 in the main text, Colombia and Peru adjusted both marginal and average reserve requirements, while Brazil only adjusted average reserve requirements.

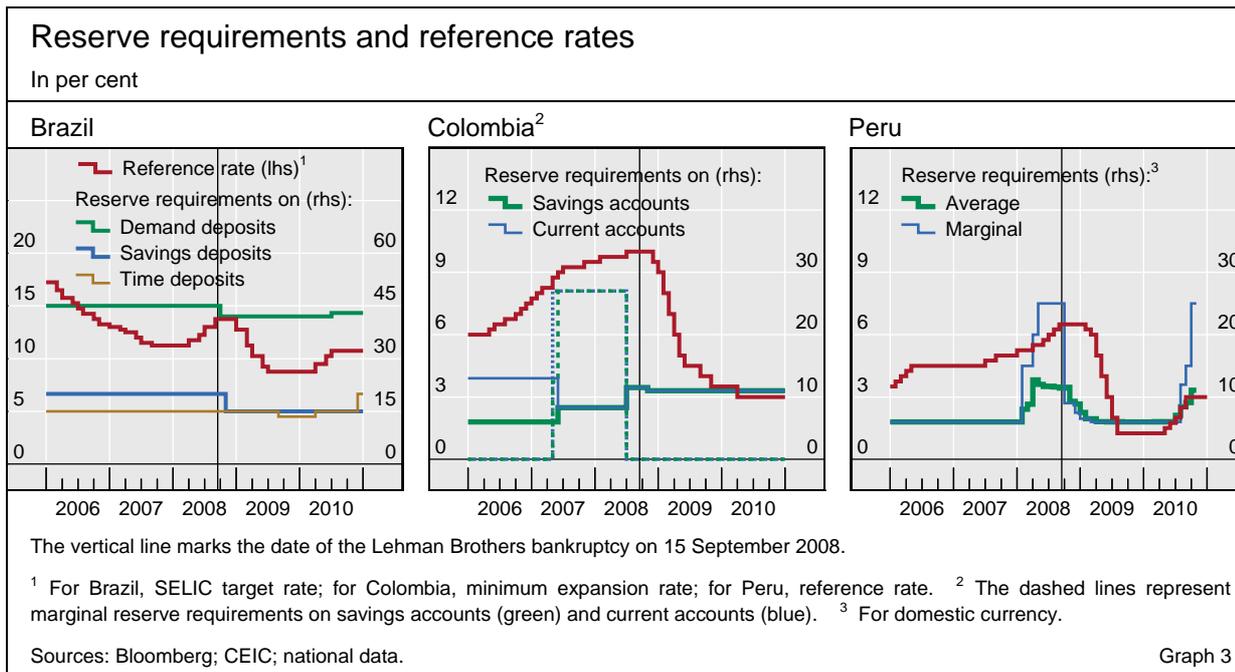
<sup>①</sup> Ho (2008, Table 2) describes the main features of reserve requirements in a sample of Asian and other economies. <sup>②</sup> Peru also has reserve requirements in foreign currency, although these are outside the scope of this article. In Peru, a dollarised economy where around 50% of credit is in US dollars, reserve requirements in foreign currency are set at a high level to reduce the risks of sudden reversals in the flows of foreign currency deposits or foreign credit lines (Quizpe and Rossini (2010)).

### Main features and key ratios (as of December 2010)

	Averaging	Accounting	Main-tenance period	Requirements on:				Remuneration
				domestic currency	foreign currency	domestic currency	foreign currency	
				(as of March 2007)		(as of December 2010)		
Brazil	Yes	Half-lagged, lagged <sup>1</sup>	1–2 weeks <sup>2</sup>	4–45%		10–43%		Yes <sup>3,4</sup>
Colombia	Yes	Lagged	2 weeks	0–13%		0–11%		No <sup>5</sup>
Peru	Yes	Contemporaneous	1 month	6%	30%	9–25%	9–55%	Yes <sup>6,7</sup>
<i>Memo:</i>								
<i>Argentina</i>	Yes	<i>Contemporaneous</i>	<i>1 month</i>	<i>0–35%</i>	<i>0–40%</i>	<i>0–19%</i>	<i>0–20%</i>	Yes <sup>3,6</sup>
<i>Chile</i>	Yes	<i>Lagged</i>	<i>1 month</i>	<i>0–9%</i>	<i>0–9%</i>	<i>0–9%</i>	<i>0–9%</i>	Yes <sup>6,8</sup>

<sup>1</sup> For demand deposits, half-lagged; for time deposits, savings accounts and "additional requirements", lagged. <sup>2</sup> For demand deposits, two weeks; for time deposits, savings accounts and "additional requirements", one week. <sup>3</sup> Only non-excess reserves. <sup>4</sup> Only for time deposits (invested 40% in federal securities) and for "additional requirements" (all invested in federal securities). <sup>5</sup> Remuneration was eliminated on 24 July 2009. <sup>6</sup> Below-market. <sup>7</sup> Only excess reserves. <sup>8</sup> Only domestic currency time deposits.

Table A



and raised policy rates from 5% up to 6.5% in September 2008. Over this period, gross capital inflows in Peru were both higher and much more volatile than in Colombia (or Brazil), while domestic credit growth and inflation had yet to peak. The Peruvian central bank then reduced reserve requirements starting in October 2008 and continuing up to the first quarter of 2009 (Graph 3, right-hand panel). As in Colombia, there was also a lag before the policy rate was lowered; the first cut occurred on 2 February 2009.

... and lowered them ahead of the policy rate during the downturn

In contrast, the Brazilian central bank did not increase reserve requirements during the expansion phase of the cycle although it raised the policy rate. However, in the last quarter of 2008 it reduced its reserve requirements on demand and savings deposits (Graph 3, left-hand panel). In December 2008, Brazilian authorities also granted to large and liquid banks reductions on their reserve requirements if they extended financing to small and illiquid banks. Once again, the policy rate cuts followed later, starting on 21 January 2009.<sup>8</sup>

### Why use reserve requirements?

At least three explanations may be offered for the recent reliance on reserve requirements in the Latin American economies in our sample: (i) raising reserve requirements is less likely to attract capital inflows than is an increase in policy rates; (ii) reserve requirements may strengthen the effectiveness of interest rate policy; and (iii) reserve requirements can be used to meet financial stability objectives, or support the use of macroprudential tools.

<sup>8</sup> The effect of reserve requirements depends on differences in the way they are imposed. See box for a comparison of operating procedures in Latin American countries.

### *Less likely to attract capital inflows*

As reserve requirements resemble a tax on financial intermediation, raising them tends to reduce bank profits, other things being equal. Banks can partly compensate by increasing their net interest margins through adjustments in deposit or lending rates. Higher reserve requirements can tighten domestic financing conditions without attracting more capital inflows if they induce banks to raise lending rates while keeping deposit rates stable or lowering them (the latter are more relevant for foreign investors).<sup>9</sup> In contrast, a policy rate rise would increase both deposit and lending rates, which could have a contractionary effect on economic activity while also attracting more capital inflows.<sup>10</sup> We discuss the effects of reserve requirements on deposit and lending rates below.

Raising reserve requirements is less likely to attract capital inflows

### *Strengthening the effectiveness of monetary policy*

Reserve requirements may serve to complement monetary policy when it would be too costly to rely solely on open market operations to achieve an interest rate target or when a change in the interest rate would not be sufficient to maintain price (or financial) stability.<sup>11</sup> For example, a central bank seeking to mop up excess liquidity may find it cheaper to do so by raising reserve requirements (which are not fully remunerated at market rates) than through open market operations. However, as noted below, the cost is then assumed by the banking system. As another example, during periods of rising inflation or rapid credit growth, even very sharp increases in interest rates over a short period of time may fail to constrain bank lending behaviour. In such cases, raising reserve requirements may be more effective, since they directly affect the supply of credit. This is especially true when financial markets are less developed and the pass-through from the policy rate to market rates and the impact of the latter on credit (the credit channel) are smaller. This seems to be the case in a number of EMEs (Moreno (2008)).<sup>12</sup>

Reserve requirements may be particularly effective ...

Reserve requirements may be particularly useful during periods of financial stress. During such periods, higher risk aversion blocks the transmission channel of the policy rate, reducing its signalling power and impairing the functioning of the money market (Quizpe and Rossini (2010)). In this case, lowering reserve requirements can directly offset credit supply

... during periods of financial stress ...

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<sup>9</sup> This holds true when competition in the lending market is greater than in the deposit market. Vargas et al (2010, p 135) note that deposit rates will fall when reserve requirements are raised if central bank credit is a close substitute for deposits as a source of funds for the banks.

<sup>10</sup> As confirmed empirically by Herrmann and Mihaljek (2010), capital flows respond to relative return differentials and expected income growth. Herrmann and Mihaljek also found that interest rate differentials are particularly significant drivers of capital flows in Asia and Latin America, but not in central and eastern Europe.

<sup>11</sup> See Mesquita and Toros (2010), Vargas et al (2010) and Quizpe and Rossini (2010) on the rationale for the use of reserve requirements in Brazil, Colombia and Peru, respectively.

<sup>12</sup> The reasons include less bank competition, less credible monetary policy regimes and more government intervention in the financial system. The credit supply effects of reserve requirements are also more important in less developed financial markets because borrowers cannot easily switch to (wholesale) borrowing from financial markets.

disruptions, providing liquidity relief to banks and thus helping restore the operation of the monetary transmission mechanism.<sup>13</sup> This effect may be larger than the effect of a change in the policy rate when financial markets – including the price discovery mechanism – are impaired. When policy rates are close to zero, lowering the policy rate may be ineffective unless the central bank supplies credit directly. Lowering reserve requirements may then provide an alternative policy instrument, because the effect does not depend on the market’s response to policy rate reductions, but directly affects bank profit margins.

... when policymakers are reluctant to change the policy rate

Moreover, the use of reserve requirements as an additional policy instrument could help resolve conflicting objectives. For instance, policymakers may be reluctant to lower the policy rate in response to an economic slowdown if inflation is still relatively high. They may instead prefer to lower reserve requirements to ease monetary conditions, if they believe that inflation expectations will be less affected by changes in reserve requirements than by changes in the policy rate. As noted earlier, this is broadly in line with how policymakers responded in the aftermath of the Lehman bankruptcy – reserve requirements were lowered first, followed by interest rates.

#### *Reserve requirements and financial stability*

Reserve requirements can restrain credit growth ...

Reserve requirements could have two implications for financial stability. First, raising reserve requirements could prevent financial imbalances by restraining credit growth (and, by extension, asset price increases) in the upswing of the business cycle. Second, lowering reserve requirements during a downturn can deploy the cushion of reserves built up during the expansion. In this manner, reserve requirements can potentially act countercyclically, smoothing out liquidity fluctuations in the financial system over time.

... and are an instrument typically available to central banks

There may also be institutional advantages to using reserve requirements as an instrument for financial stability, including: (i) they are available to most central banks – indeed, they may be the only instrument (other than the policy rate) that central banks can use when banking supervision and regulation are housed in a different institution; (ii) they provide liquidity using the banking system’s own balance sheet, so that the central bank does not directly incur any costs or risks, although the extent to which it is desirable to transfer such costs to the banking system may vary;<sup>14</sup> and (iii) unlike the rediscount window, the use of reserve requirements does not depend on banks owning low-risk assets as collateral.

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<sup>13</sup> Montoro and Tovar (2010) show that if banks face financing constraints that reduce their ability to supply credit during periods of financial stress, lowering reserve requirements can provide liquidity to the banking system that helps restore the proper functioning of the interbank market.

<sup>14</sup> In contrast, the central bank can assume significant risks when using unconventional monetary policy measures such as buying a wider range of assets including illiquid ones. Losses could then threaten its independence.

## How effective are reserve requirements?

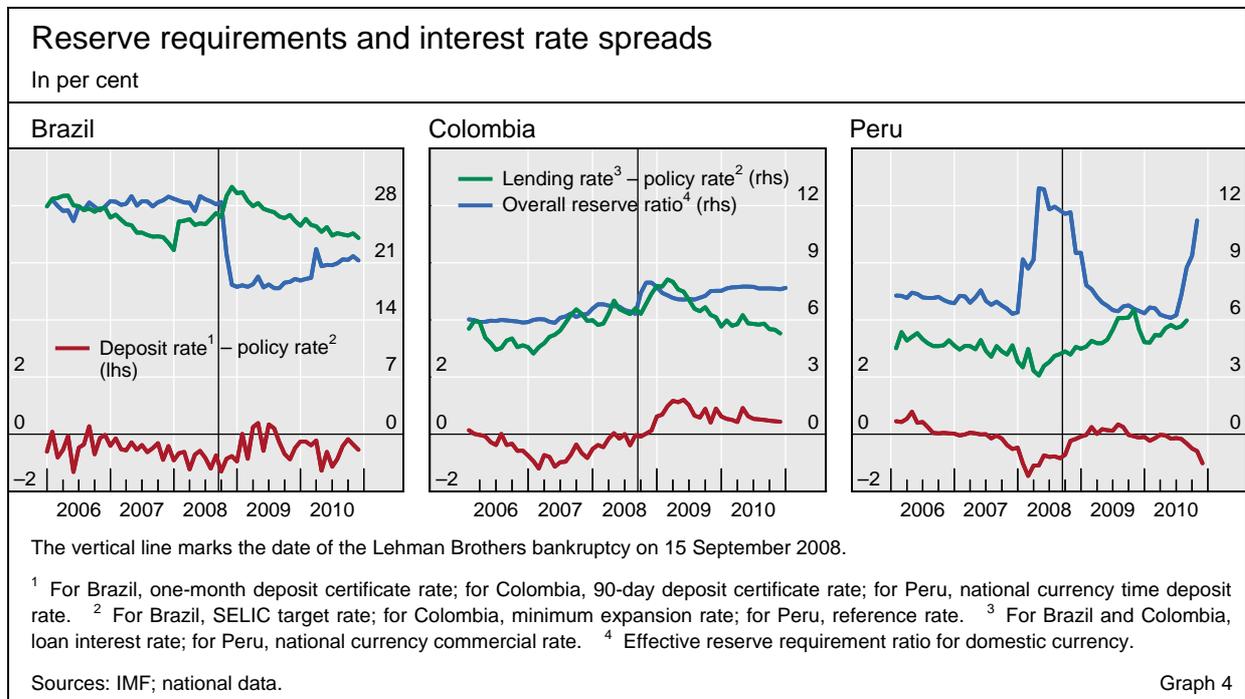
The effectiveness of reserve requirements may be assessed through their effects on market rates and on domestic credit to the private sector.

Turning first to the effects on market rates, there is some evidence that adjustments in reserve requirements helped policymakers stabilise the interbank market and meet their policy rate targets. For example, in 2007–08 in Peru, interbank lending rates fell for a time by up to 475 basis points below the policy rate before reserve requirements were increased, reflecting excess liquidity. The rise in reserve requirements reversed this condition, helping restore monetary control.

Reserve requirements helped stabilise interbank markets ...

In some cases, adjustments in reserve requirements may also have helped stabilise capital flows, because of the impact on bank rates. Graph 4 shows movements in reserve requirements and in deposit and lending rates (relative to the policy rate) in recent years. In Peru, the spread between the deposit rate and the policy rate<sup>15</sup> did not just remain stable, but fell around the time when reserve requirements increased in 2008, and rose around the time when reserve requirements declined (following the Lehman bankruptcy as identified by the vertical line in Graph 4). In Brazil, deposit rates increased relative to the policy rate following a sharp decline in the reserve requirement in the aftermath of the Lehman Brothers bankruptcy. Broadly in line with the findings of Vargas et al (2010), the effects are not as clear in the case of Colombia, but this may reflect the fact that reserve requirements there changed less than in the other two countries and because we are not controlling for other factors.

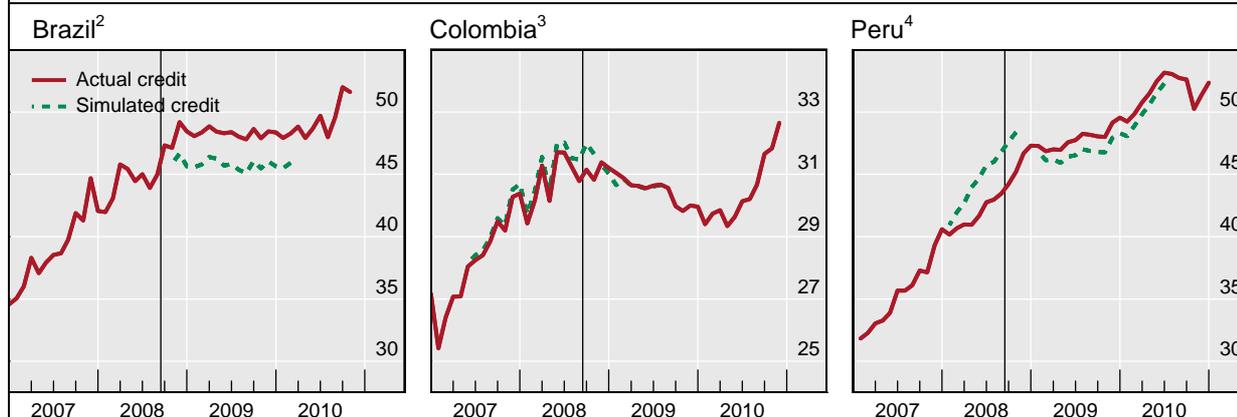
... influencing bank rates in ways that moderated capital flows



<sup>15</sup> We discuss adjustment relative to the policy rate to give a sense of how much deposit or lending rates changed, abstracting from policy rate changes. However, for the experiment to be clean, we would need policy rates to be stable, as the spread between these rates is not normally constant.

## Counterfactual effects of reserve requirements on credit

As a percentage of GDP<sup>1</sup>



The vertical line marks the date of the Lehman Brothers bankruptcy on 15 September 2008.

<sup>1</sup> Four-quarter moving average. <sup>2</sup> Domestic bank credit to the private sector corresponding to national currency. Credit between October 2008 and February 2010 is simulated with counterfactual effective reserve requirement rates corresponding to the average of the last two years. <sup>3</sup> Domestic bank credit to the private sector is simulated with counterfactual effective remuneration-adjusted reserve requirement rates (between May 2007 and October 2008, the average of the last two years, 4.7%; between November 2008 and July 2009, the pre-change rate, 7.3%). <sup>4</sup> Domestic bank credit to the private sector comprises national and foreign currencies. Credit is simulated with counterfactual effective pre-change reserve requirement rates (between January and October 2008, 6% and 28.8% for national and foreign currencies, respectively; between January 2009 and June 2010, 11.5% and 33.2%, respectively). The average exchange rate for the March 2008–March 2010 period was used.

Source: IMF: national data.

Graph 5

An event analysis provides additional perspective. Following the Lehman bankruptcy, Brazil, Peru and Colombia reduced their effective reserve requirements ratios<sup>16</sup> by a respective 10, 5 and 1 percentage points. Other things being equal, this would tend to increase the profitability of banks and allow them to reduce their net intermediation margins by raising deposit rates and/or lowering loan rates. However, while deposit rates increased relative to policy rates, lending rates rose by even more. As a result, until the first half of 2009, the spread between lending and deposit rates remained at least as high as before the Lehman bankruptcy. It increased in Brazil (by 300 basis points) but was unchanged in Peru. Other shocks appear to have masked the effects of lower reserve requirements; in particular, a very sharp rise in risk aversion may have reduced bank credit supply. This effect is illustrated by the case of Colombia, where the change in reserve requirements was relatively small and the spread rose by 200 basis points.

Some additional empirical evidence suggests that an increase in reserve requirements tends to raise lending rates and to reduce deposit rates, although precisely by how much varies across countries (Reinhart and Reinhart (1999)).<sup>17</sup>

<sup>16</sup> Measured by the ratio of reserve requirements held by banks over deposits, subject to reserve requirements. For Colombia, this is adjusted by the effect of the remuneration of reserve requirements (Vargas et al (2010)).

<sup>17</sup> For instance, in Brazil, higher unremunerated reserve requirements have been found to increase the mean of the lending rates (De Souza-Rodrigues and Takeda (2004)). There is also evidence that reserve requirements are important long-run determinants of lending rates in Colombia (Vargas et al (2010)). In contrast, they affect both lending and deposit rates in Peru in the short run, but not in the long run (Condor (2010)).

The resources released or retained through changes in reserve requirements may have helped smooth credit growth. This may explain why credit showed resilience in the three countries even during the most difficult part of the crisis in 2009. Graph 5 presents an illustrative exercise comparing the path of credit with the possible (counterfactual) path of credit if reserve requirements had not changed, assuming that all the resources released or withdrawn by the change in reserve requirements directly affected credit on a one-to-one basis, which can be seen as an upper bound estimate of the effects on credit.<sup>18</sup> For Peru, we estimate that the increase in reserve requirements in late 2007 and early 2008 (in response to rising inflation) may have reduced credit by around 4% of GDP. Similarly, the reduction in reserve requirements in response to the spread of the crisis was possibly around the same order of magnitude, ie about 3–4% of GDP in Brazil and Peru. As noted earlier, in the case of Colombia, the changes in reserve requirements were much smaller (between 2.6 and 1.2 percentage points in effective rates), as were the estimated effects on credit, which were between 2.8 and 0.4% of GDP for each episode.

Reserve requirements can help smooth credit growth ...

Furthermore, in Brazil the above-mentioned reductions in reserve requirements conditional on lending to small and illiquid banks helped to restore financing to smaller Brazilian financial institutions that were vulnerable to the domestic liquidity squeeze (Mesquita and Toros (2010)).

## Side effects of reserve requirements

Many central banks have reduced their reliance on reserve requirements as a policy instrument in recent decades because they impose significant costs. Reserve requirements compel banks to deposit a portion of their assets with the central bank, which generally offers a lower yield than other investments. Such requirements therefore act as a tax on the financial sector, putting depository institutions at a competitive disadvantage to other financial institutions.<sup>19</sup> One result is a larger spread between lending and deposit rates, which increases the cost of credit and tends to reduce the level of financial intermediation. In particular, reserve requirements create an incentive for borrowers to look for other sources of funding, for example from abroad or from the unregulated financial sector.

... but also impose costs on the financial sector

As illustrated in Graph 6, in a cross section of countries, financial intermediation (measured by the ratios of M2 to GDP and of domestic credit to GDP) indeed tends to be lower when the level of reserve requirements is higher, although the direction of causality needs to be investigated further. Also, the net interest margin tends to be larger when reserve requirements are higher.

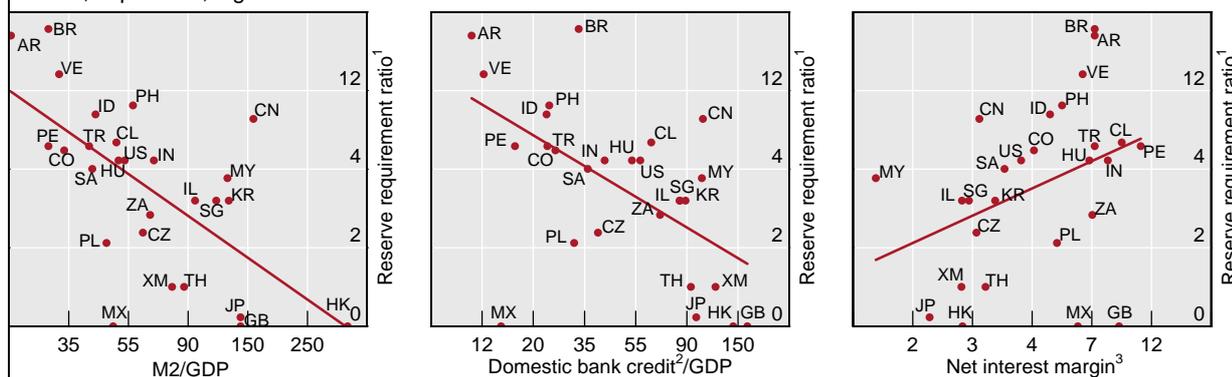
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<sup>18</sup> More precisely, simulated credit is then equal to actual credit less (plus) the resources released (withdrawn) by the decrease (increase) in reserve requirements.

<sup>19</sup> On the other hand, some central bank services, such as the discount window, are unavailable to institutions that are not subject to reserve requirements. In this light, the taxatory element of reserve requirements could be seen as a service charge.

## Reserve requirements, M2, domestic bank credit and net interest margin

2006, in per cent, logarithmic scale



AR = Argentina; BR = Brazil; CL = Chile; CN = China; CO = Colombia; CZ = Czech Republic; GB = United Kingdom; HK = Hong Kong SAR; HU = Hungary; ID = Indonesia; IL = Israel; IN = India; JP = Japan; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; PL = Poland; SA = Saudi Arabia; SG = Singapore; TH = Thailand; TR = Turkey; US = United States; VE = Venezuela; XM = euro area; ZA = South Africa.

<sup>1</sup> Midpoint in range for Argentina, Brazil, Chile, the euro area, Indonesia, Israel, Japan, Korea, Poland, Saudi Arabia and the United States. <sup>2</sup> Domestic bank credit to private sector. <sup>3</sup> Net interest revenue/average earning assets.

Sources: Mohanty and Turner (2008); IMF; Bankscope; national data; BIS calculations.

Graph 6

In order to avoid these effects and promote financial development, many central banks have shifted towards market-based instruments for monetary control, such as open market operations using repos.

### Concluding remarks

In Latin America, reserve requirements have been used to: (i) resolve policy dilemmas associated with capital inflows; (ii) enhance the effectiveness of monetary control or strengthen monetary policy transmission; (iii) restore the transmission mechanism of monetary policy during periods of stress, possibly serving as an alternative to quantitative easing or large-scale asset purchases; and (iv) counter financial imbalances associated with excessive credit growth.

The recent experience of three Latin American economies suggests that adjustments in reserve requirements may have helped to stabilise interbank rates and influence market rates in a way that moderated capital flows. They may also have helped to smooth credit growth during the expansionary and contractionary phases of the economic and financial cycle.

That said, there are trade-offs in the use of reserve requirements, which can give rise to distortions in the financial system that increase the cost of credit and reduce financial intermediation.

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## Foreign exchange trading in emerging currencies: more financial, more offshore<sup>1</sup>

*Foreign exchange turnover evolves in a predictable fashion with increasing income. As income per capita rises, currency trading cuts loose from underlying current account transactions. In parallel, an increasing share of trading in the currency takes place outside the home country. At given income levels, moreover, currencies with either high or very low yields attract more trading, consistent with their role as target and funding currencies in carry trades.*

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

The 2010 central bank survey of foreign exchange market activity showed rapid growth in turnover in emerging market currencies. In particular, global central banks reported that some up-and-coming currencies traded outside their home market to a much greater extent than market participants had estimated. Where one had put Chinese renminbi offshore trading at \$3 billion, for example, the central banks found \$22 billion. Similarly, offshore trading of \$17 billion in the Indian rupee surprised market participants, who had taken into account rupee trading in Singapore but not that in London or New York.<sup>2</sup>

Confronted every three years with the survey results, policymakers and market participants alike seek benchmarks for perspective. In this special feature, we provide simple benchmarks for turnover and location, and highlight some important cases that deviate from those benchmarks. In doing so, we widen and update the work of Ho et al (2005) and McCauley (2010).

We show that, as income per capita rises, a currency trades in ever greater multiples of the home economy's underlying international trade ("financialisation") and trades to a greater extent outside its home market ("internationalisation"). In April 2010, for example, the Australian dollar turned over 80 times more than Australia's imports and exports of goods and services. At the same time, 78% of this trading took place outside Australia. This first

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<sup>1</sup> 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, Stephen Cecchetti, Corrinne Ho and Christian Upper for comments and to Carlos Mallo for help with the triennial data.

<sup>2</sup> HSBC (2009, p 10), Philipose (2010), BIS (2010b). The HSBC estimate, it may be noted, was published several months before the April 2010 survey; see King and Mallo (2010).

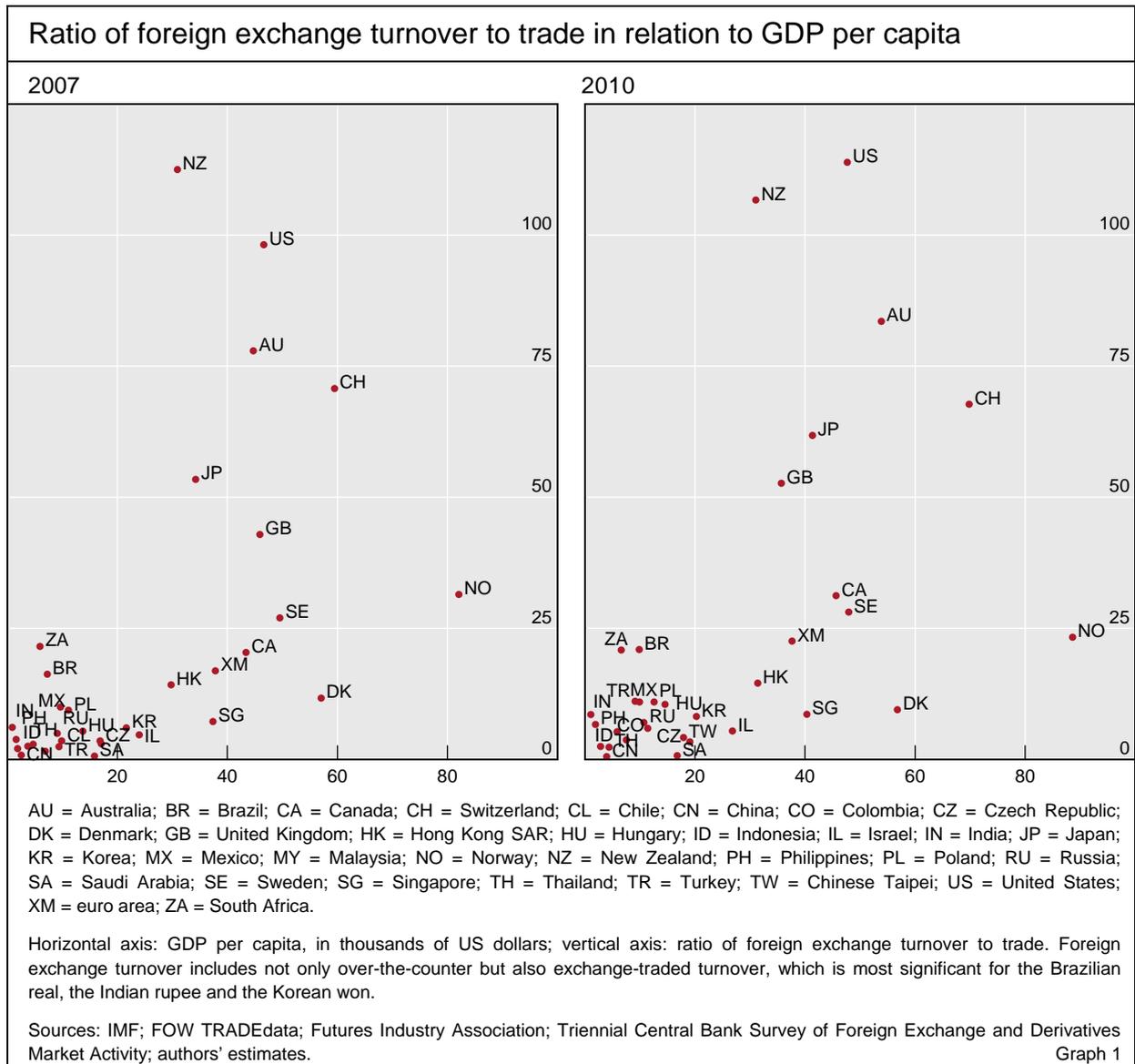
factor, income per capita, proxies for a number of related aspects, such as financial depth and complexity, and creditworthiness.

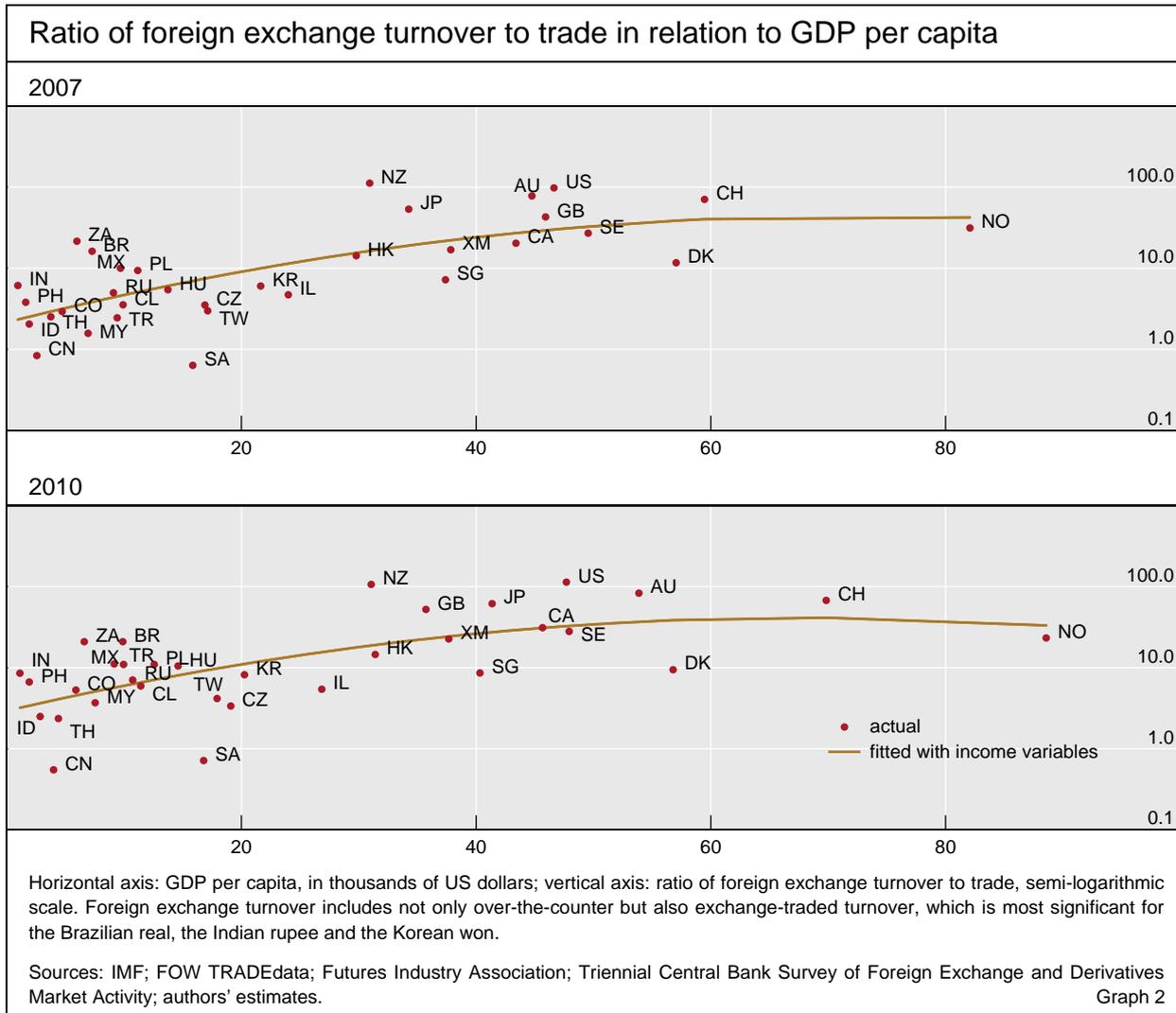
A second factor that is increasingly influencing the cross section of global turnover is the level of yields: higher-yielding and lower-yielding currencies turn over more. This may reflect the growing importance of carry trades that in effect borrow in low-yielding currencies to fund holdings of high-yielding ones.

### Financial trading

For some currencies, international trade drives turnover; for others, financial transactions predominate. If one divides foreign exchange turnover in a given currency by underlying exports plus imports of goods and services of the currency's home country, the resulting ratio ranges widely (Graph 1). Here we employ an inclusive definition of foreign exchange trading, including spot, forward, futures, swap and option trading, both over the counter and on

Trading becomes more financial ...





organised exchanges, both deliverable and non-deliverable. For example, the renminbi trades in daily amounts that are similar to daily Chinese exports and imports of goods and services – a ratio of around 1. Other currencies, such as the US dollar or Japanese yen, trade in amounts closer to 100 times the value of corresponding international trade transactions.

... as economies develop ...

What accounts for such dispersion? As economies develop, trading of their currencies grows faster than their current account transactions. To analyse this relationship, we re-plot this simple relationship, putting the ratio on a logarithmic scale (Graph 2). With this transformation, the relationship is nearly linear, with some evidence of a plateau at higher income levels. Real income and its square can explain half (in 2007) or two fifths (in 2010) of the ratios of foreign exchange to trade (Table 1, column 1).

This relationship between turnover and income held quite consistently from the April 2007 to the April 2010 survey. Thus, currencies trade more actively in relation to flows of goods and services (in Graph 2, they move out the curve) as their respective economies develop.

On this view of the data, the US dollar does not trade much more actively relative to the international benchmark than the yen. Indeed, it is relatively less

Regression analysis of foreign exchange turnover as a ratio of trade								
	Dependent variable: log (FX turnover/trade)							
	2007				2010			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
GDP per capita	0.036 (3.241)***	0.044 (3.913)***	0.041 (3.135)***	0.043 (3.155)***	0.034 (3.116)***	0.050 (4.749)***	0.050 (3.987)***	0.041 (3.360)***
GDP per capita squared	-2.4E-07 (-1.559)	-2.9E-07 (-1.925)*	-2.7E-07 (-1.655)*	-3.2E-07 (-1.924)*	-2.4E-07 (-1.750)*	-3.7E-07 (-2.917)**	-3.7E-07 (-2.634)**	-3.3E-07 (-2.274)**
Interest rates		0.041 (2.151)**	0.041 (2.073)**			0.123 (3.327)***	0.123 (3.242)***	
Interest rate: absolute deviation/median				0.194 (1.922)*				0.285 (2.676)**
Non-deliverable forward dummy			-0.061 (-0.761)	-0.082 (-0.411)			-0.004 (-0.024)	0.013 (0.066)
Adj R <sup>2</sup>	0.48	0.54	0.52	0.51	0.39	0.54	0.52	0.48

Cross section of the currencies of the 33 economies listed in Graph 1. T-statistics in parenthesis; \*\*\*, \*\* and \* denote 1%, 5% and 10% significance, respectively. Non-deliverable forward dummy takes value 1 for the currencies of the following economies: Brazil, Chile, China, Chinese Taipei, Colombia, India, Indonesia, Korea, Malaysia, the Philippines and Russia.

Sources: IMF; FOW TRADEdata; Futures Industry Association; Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity; authors' estimates.

Table 1

active than the New Zealand dollar. This is surprising, given the dollar's unparalleled role in the foreign exchange swap market, in which funding in one currency is briefly exchanged for funding in another currency.<sup>3</sup>

On the basis of the relationship between turnover and income, some currencies do stand out. While the global turnover figures for the Chinese renminbi and the Indian rupee were quite close, at a respective \$34 billion and \$38 billion, the currencies are outliers in opposite directions with respect to underlying trade and income.<sup>4</sup> Recall that the Chinese economy is both larger and more open than that of India, so the similar dollar amounts translate into ratios that differ by an order of magnitude. Thus, the renminbi trades less than China's trade and income would suggest, while the rupee trades more than India's trade and income would seem to warrant. Part of the difference may arise from the contrast between the large outright foreign investment in India's equity market and the restriction of most foreign investment to Chinese shares listed offshore ("H shares" and "N shares"). If, relative to China's trade and income, renminbi turnover were to reach rupee-like levels, the case for including the renminbi in the SDR would strengthen.<sup>5</sup>

... although some currencies stand out

Given the relationship between income and turnover, multivariate regressions show that foreign exchange turnover is higher for currencies with

High yields also raise turnover

<sup>3</sup> For instance, the recent financial crisis highlighted the role of dollar swap transactions in affording Hungarian and Polish banks access to Swiss franc funding (BIS (2010a, pp 57–8)).

<sup>4</sup> The difference may be overstated if Chinese customer trades are underreported. See Ho et al (2005, p 53) for a possible source of underreporting.

<sup>5</sup> See the discussion of the renminbi in IMF (2010, pp 11 and 31–5).

relatively high yields (Table 1, columns 2 and 3). Turnover of high-yielding currencies benefits from activity undertaken in pursuit of strategies in which positions in high-yielding currencies are funded with lower-yielding currencies (“carry trades”).<sup>6</sup> Many such trades occur in forward markets (both deliverable and non-deliverable) and futures (Galati et al (2007)).

From another perspective, interest rate differentials exert a remarkably similar effect on trading as reported in the two surveys. This is evident in column 4 of Table 1, where the extremity of yields is measured with the absolute value of the yield deviation from the international median as a ratio of that median. Here the measured effect is consistent as between 2007 and 2010. This would imply that the 2010 Brazilian yield of 8.7%, at more than four times the median of 2%, attracted more turnover than the 2007 yield of 12.5%, which was less than three times the median then. Globally low yields force international investors to redefine what constitutes a high-yielding currency.

There is no evidence that restrictions on a currency’s international use systematically influence turnover (Table 1, columns 3 and 4). Such controls lead to offshore trading in the form of non-deliverable forwards that are split from onshore trading, which can impair liquidity (Tsuyuguchi and Wooldridge (2007)). At the same time, such restrictions also create arbitrage opportunities that can encourage trading. It appears that these opposing effects leave currencies that trade in non-deliverable form neither more nor less traded than one would predict from income and yields.

## Offshore trading

Trading more  
offshore ...

Currencies also show a wide dispersion in the geography of trading. The central bank survey defines the location of a trade (and hence one of the counterparties) by the location of the sales desk of the reporting dealer. Some currencies trade largely in their home market, either between two residents (“strictly domestic” trading) or between a resident and a non-resident (“onshore-offshore” trading). Others trade for the most part outside the home market between two non-residents (“strictly offshore” trading). For instance, trading in the Brazilian real, the Indian rupee, the Korean won and the Russian rouble occurs mostly at home, or at least involves a resident, while other currencies are overwhelmingly traded outside the home market (Graph 3).

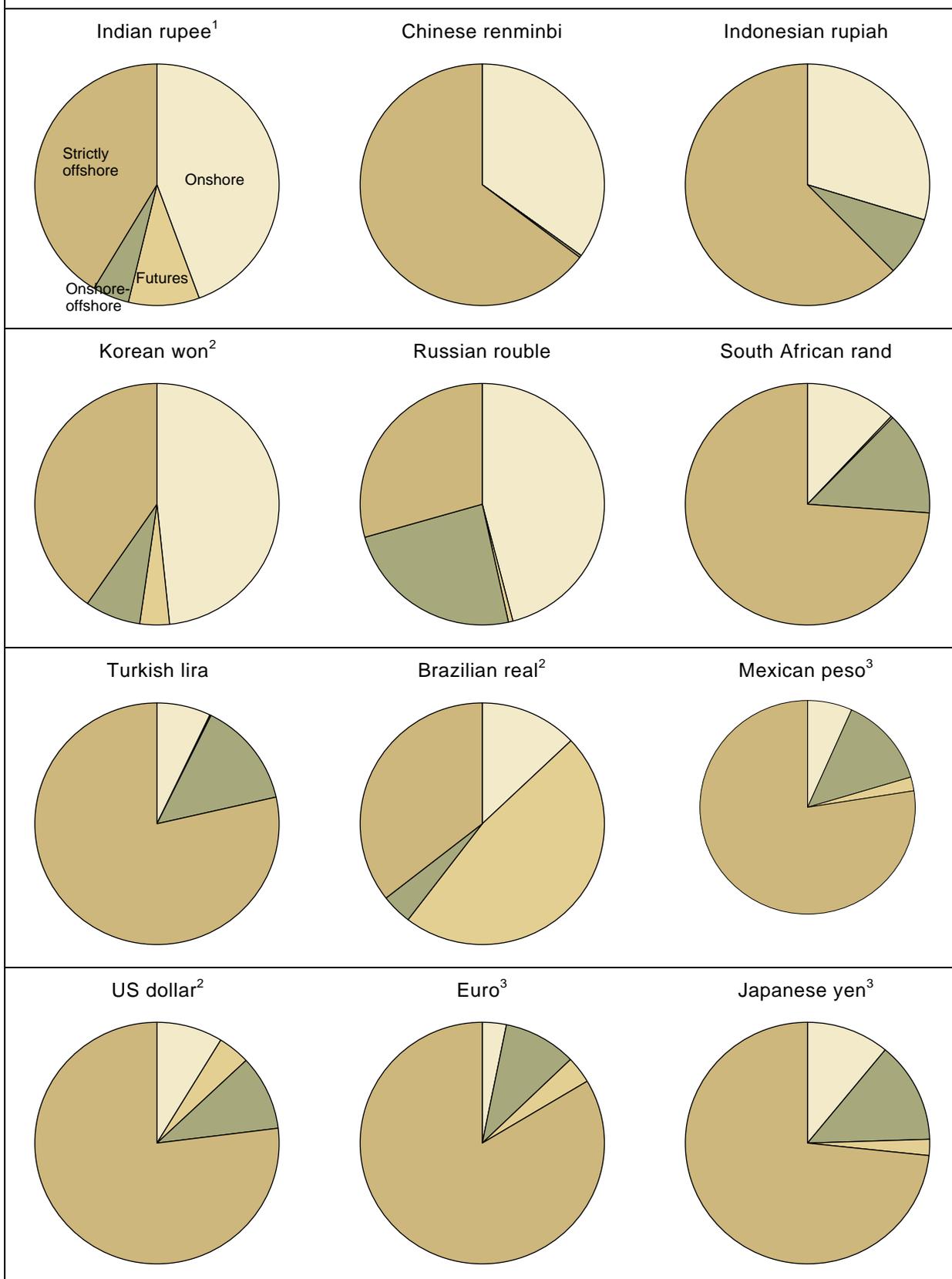
... as economies  
develop ...

The benchmark for the geography of currency trading is similar to that for financial trading. Currencies of higher-income countries also tend to trade more

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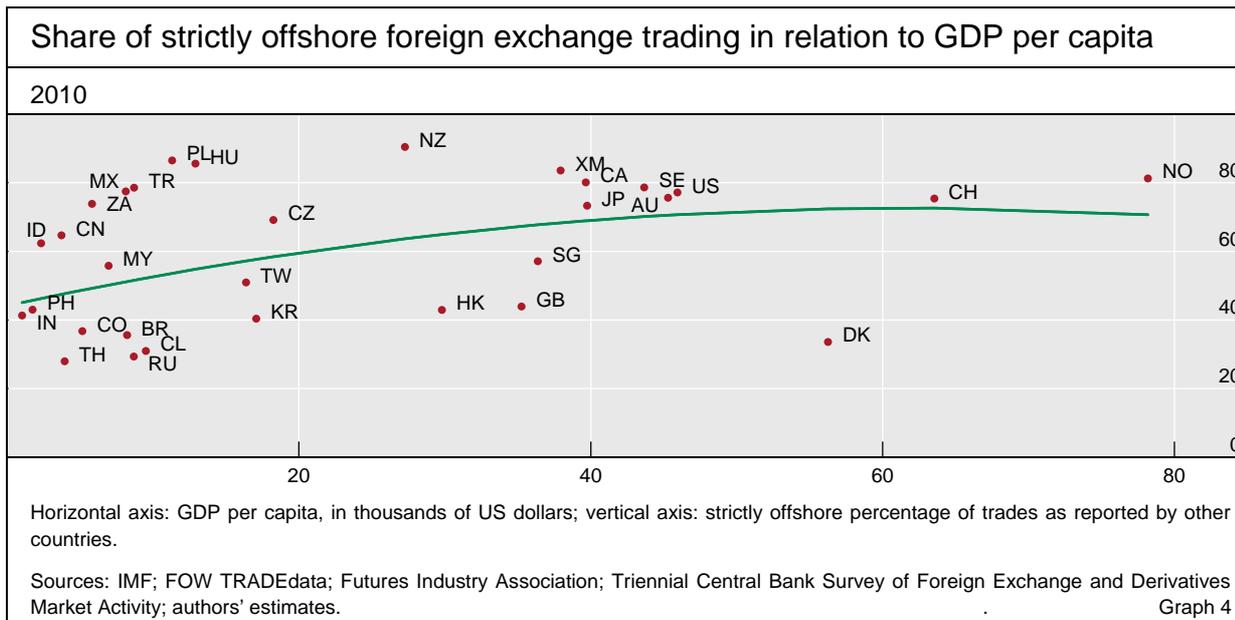
<sup>6</sup> The specification in columns 2 and 3 posits that the target currency, but not the funding currency, trades more in relation to income. If target currencies typically trade considerably less than the big currencies used for funding, the effect would be more readily measured on the high-yield side. (Long Australian dollar against short Swiss franc positions would be an exception, since these currencies have comparable turnover.) The specification in column 4 tests for higher turnover in high-yielding or low-yielding currencies, given income. The ratio of the absolute deviation of yields from the median to that median, rather than the arithmetic difference, makes sense if creditors pay attention to the carry trader’s ratio of interest paid to cash flow. As leverage rises, the interest-to-cash flow ratio approaches the ratio of the yield on funding currencies to the yield on target currencies.

### Geography of currency trading: distribution of turnover in April 2010



<sup>1</sup> Futures are traded onshore between residents. <sup>2</sup> Futures, mostly onshore exchange, are traded among residents and non-residents. <sup>3</sup> Futures, mostly offshore exchange, are traded among non-residents and residents.

Sources: IMF; FOW TRADEdata; Futures Industry Association; Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity; authors' estimates. Graph 3



outside the home jurisdiction. In Graph 4, we plot the simple percentage of strictly offshore trading on the vertical axis, again against income per capita on the horizontal axis. Turnover of the most actively traded bonds in major currencies outside home market hours, for instance, generates offshore foreign exchange transactions. In many emerging market currencies, controls push trading offshore into non-deliverable forwards, resulting in high proportions of forward transactions offshore (Mihaljek and Packer (2010, p 54)).

International financial centres tend to concentrate trading in their own currencies as well as in others' currencies. Thus, we allow the Hong Kong and Singapore dollars as well as sterling and the Swiss franc a lower offshore share (through a financial centre dummy that cuts 17–18% from the estimated offshore share), which improves the fit (Table 2, columns 2 to 4).

Beyond the currencies based in financial centres, this simple benchmark fits most currencies of high-income countries fairly well. Among the big three currencies, the euro has a higher ratio of offshore transactions, especially in London, than do the US dollar or yen. The New Zealand dollar, with its comparatively high yields, stands out as highly internationalised. Dr Alan Bollard, Governor of the Reserve Bank, once described it as an international standard of value that just happens to be used by a small country as its money.

The currencies of many low- to medium-income countries trade offshore to a greater or lesser extent than the norm. Offshore trading of the Indian rupee lines up with India's income, especially when account is taken of the strictly onshore rupee futures trading that has developed in Mumbai over the last several years (Graph 3). Strictly offshore trading bulks large for the Indonesian rupiah and the Chinese renminbi, both in non-deliverable form. The high share of offshore trading, the paucity of onshore-offshore trading, and rapid development of the deliverable renminbi market in Hong Kong SAR reflect the gap between the world's interest in the renminbi and its access to it. At moderate income levels, the South African rand, the Mexican peso and the

... although some currencies stand out

Regression analysis of the strictly offshore foreign exchange turnover								
	Dependent variable: share of offshore trading							
	2007				2010			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
GDP per capita	1.381 (3.068)***	1.681 (3.704)***	1.781 (3.547)***	1.223 (1.741)*	0.917 (2.102)**	1.207 (2.983)***	1.407 (2.909)***	1.002 (1.378)
GDP per capita squared	-1.1E-05 (-1.840)*	-1.4E-05 (-2.506)**	-1.5E-05 (-2.425)**	-1.0E-05 (-1.424)	-7.4E-06 (-1.248)	-1.0E-05 (-2.024)*	-1.2E-05 (-2.132)**	-8.2E-06 (-1.145)
Financial centre		-17.692 (-2.109)**	-17.543 (-1.993)*	-18.518 (-2.101)*		-18.106 (-2.296)**	-16.735 (-2.099)**	-17.729 (-2.142)**
Interest rates			0.709 (0.802)	0.578 (0.790)			1.559 (0.637)	1.104 (0.426)
Non-deliverable forward dummy				-21.077 (-1.771)*				-12.168 (-1.116)
Adj R <sup>2</sup>	0.26	0.27	0.26	0.34	0.13	0.16	0.16	0.18

Cross section of the currencies of the 33 economies listed in Graph 1. T-statistics in parenthesis; \*\*\*, \*\* and \* denote 1%, 5% and 10% significance, respectively. Non-deliverable forward dummy takes value 1 for the currencies of the following economies: Brazil, Chile, China, Chinese Taipei, Colombia, India, Indonesia, Korea, Malaysia, the Philippines and Russia. Financial centre is a dummy variable that takes value 1 for Hong Kong SAR, Singapore, Switzerland and the United Kingdom.

Sources: IMF; FOW TRADEdata; Futures Industry Association; Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity; authors' estimates.

Table 2

Turkish lira all trade heavily offshore, while the Thai baht, the Russian rouble and the Korean won all appear low for their incomes.

In contrast to the overall turnover analysis above, and despite the case of New Zealand, higher yields are not systematically associated with higher proportions of offshore trading (Table 2, column 3). Furthermore, non-deliverability of the currency offshore unsurprisingly seems to limit offshore trading, but this relationship does not rise to conventional levels of statistical significance (column 4). In general, the benchmark relationship fits overall turnover in relation to trade better than the geography of currency trading.

## Conclusions

Foreign exchange turnover evolves in a predictable fashion with rising income, which augments financial depth, complexity and openness. Using income per capita to set a benchmark for both the ratio of turnover to underlying current account transactions and the proportion of offshore turnover can help policymakers discern what is usual and what is unusual in the trading of their currencies. The association of higher interest rates with higher turnover suggests that relatively high inflation, among other causes of relatively high nominal yields, can attract perhaps unwanted attention in a world with low yields in the main economies.

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