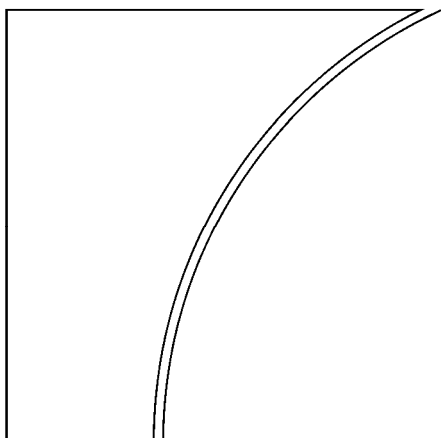BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

December 2009

International banking and financial market developments

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Special features

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.

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Overview: continued record low rates spur markets

From early September to late November, a steady stream of mostly positive macroeconomic news reassured investors that the global economy had in fact turned around, but investor confidence remained fragile. This was clearly illustrated towards the end of the period under review, when prices of risky assets dropped sharply as investors reacted nervously to news that government-owned Dubai World had asked for a delay in some payments on its debt.

Market participants expected the recovery to continue, but at times grew wary about its pace and shape due to uncertainty about the timing and speed of withdrawal of monetary and fiscal stimulus as well as the associated risks to future economic activity. The unease was compounded by the unevenness of the recovery among different regions of the world, which in turn was seen as increasing the risk that harmful imbalances could build, thereby adding to challenges for policymakers.

In this environment, market developments continued to be driven to a significant degree by ongoing and expected policy stimulus, and in particular by expansionary monetary policy. As investors priced in expectations that interest rates in major advanced economies would remain low (Graph 1, left-hand

Policy rates, equity prices and exchange rates

Policy rates[1,2]

- Euro area
- Japan
- United Kingdom
- United States

Equity prices[3]

- Advanced economies[4]
- Emerging markets[5]

Nominal effective exchange rates[3]

- Brazilian real
- South African rand
- Korean won
- Russian rouble
- Euro

[1] In per cent.   [2] For the ECB, minimum bid rate on the main refinancing operations; for the Bank of Japan, uncollateralised target rate; for the Federal Reserve, federal funds target rate; for the Bank of England, bank rate.   [3] 3 March 2009 = 100.   [4] Average of S&P 500, DJ EURO STOXX, TOPIX and FTSE 100 indices.   [5] Average of Asian, European and Latin American emerging markets equity indices.

Sources: Bloomberg; Datastream.   Graph 1

panel), prices of risky assets continued to go up. Equity prices generally rose, in particular in emerging markets (Graph 1, centre panel). Investment grade credit spreads were little changed, while sub-investment grade spreads narrowed further. Meanwhile, both market- and survey-based indicators continued to suggest that price pressures in the largest advanced economies were expected to remain well contained. This, combined with expectations of a prolonged period of low policy rates, contributed to keeping long-term government bond yields down, as did low term premia.

The low interest rates in the advanced economies, combined with the earlier and stronger recovery in a number of emerging economies, continued to drive significant capital inflows into emerging markets, particularly in Asia and the Pacific. Although difficult to quantify, a related development was increasing FX carry trade activity funded in US dollars and other low interest rate currencies. The result was rapid asset price increases in several emerging economies as well as substantial exchange rate appreciation with respect to the US dollar (Graph 1, right-hand panel).

Rates in major advanced economies remain near zero

Investors remained firmly focused on the progress and prospects of the global economic recovery from early September to late November. Although the outlook remained uncertain, there were clear signs that the global economy had turned around. Preliminary data on US third quarter GDP growth showed that the longest and deepest US recession since World War II had come to an end. Likewise, in the third quarter the euro area economy grew for the first time since early 2008, while that of Japan expanded for a second consecutive quarter. With sizeable monetary and fiscal stimulus gaining traction, analysts' forecasts showed that the G3 economies were expected to grow in 2010 and to remain on steady growth trajectories of around 2–3% in coming years (Graph 2, left-hand panel).

The recession comes to an end …

GDP growth[1]

Annual changes, in per cent

United States
Euro area
Japan

China
India
Brazil

[1] Growth rates until latest available; annual year-end growth forecasts (year-on-year) thereafter based on survey data from Consensus Economics' October 2009 long-term forecasts.

Sources: © Consensus Economics; national data.   Graph 2
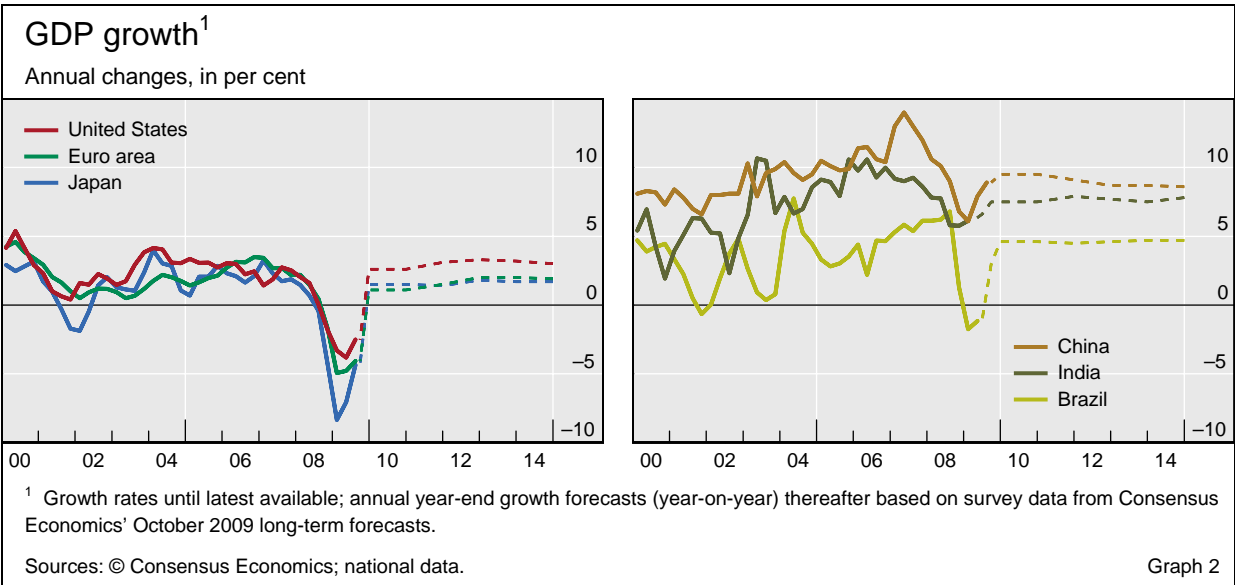
Importantly, major emerging markets, such as China, India and Brazil, whose growth rates had fallen significantly less than those of advanced economies during the crisis, recovered much more quickly and were expected to expand at a substantially more rapid pace in the next five years (Graph 2, right-hand panel). Brisk economic activity in emerging markets could support demand for goods in developed economies, hence raising the likelihood of a sustained recovery also in major advanced economies.

Although recovery remained the central scenario of investors, they were still uncertain about its future shape and strength in the case of advanced economies. Speculation about the timing and pace at which authorities would begin withdrawing stimulus measures added to this uncertainty. Fiscal support has contributed importantly to growth so far in 2009, so there was some anxiety that withdrawal of such stimulus could significantly restrain future economic growth. Moreover, the bifurcation in economic growth between the largest advanced economies and other economies – including major emerging markets – fuelled concerns that this could lead to a build-up of imbalances that might prove unsustainable in the future, as the uneven recovery could also complicate the issue of the timing and speed of withdrawal of fiscal and monetary stimulus. Despite a more rapid turnaround in many emerging economies, investors anticipated that monetary policy would remain accommodative in those countries until recovery was assured in major advanced economies too.

With available data pointing to an ongoing, albeit uneven, recovery, investors' attention turned from the spectre of rising inflation. In the light of record low policy interest rates, widespread unconventional monetary policy measures and outsize fiscal stimulus, some market participants voiced concerns about inflationary risks down the road. However, indicators of long-

Break-even inflation rates and survey inflation expectations[1]

In per cent

United States

Euro area
- Ten-year break-even rate
- Adjusted for inflation premium[2]
- Long-term inflation expectations[3]

Forward break-even rates[4]
- United States
- Euro area

[1] All break-even inflation rates are based on zero coupon real and nominal rates calculated using the Nelson-Siegel-Svensson method on nominal and index-linked government bond prices; end-of-month data. [2] Ten-year break-even inflation rate less the estimated 10-year inflation risk premium. [3] Survey expectations of inflation during the next 10 years (for the United States) and five years ahead (for the euro area), as reported in the Survey of Professional Forecasters of the Federal Reserve Bank of Philadelphia and the ECB, respectively. [4] Five-year-ahead five-year forward rates.

Sources: ECB; Federal Reserve Bank of Philadelphia; Bloomberg; BIS calculations.   Graph 3

term inflation expectations suggested that this was not the main scenario. Indeed, investors expected price pressures to remain contained in the largest advanced economies. In late November, 10-year break-even inflation rates stood at close to 2% in the United Sta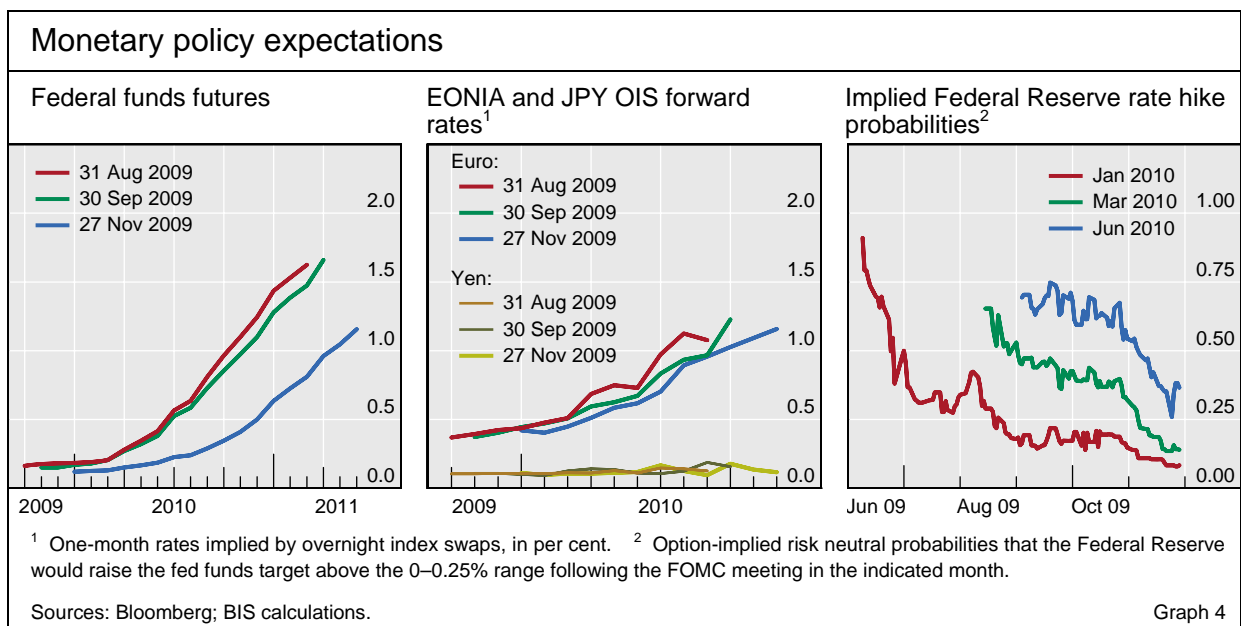tes and the euro area (Graph 3, left-hand and centre panels). Moreover, the corresponding break-even rates adjusted for estimated inflation premia were very close to long-term average inflation expectations obtained from surveys. These survey expectations, in turn, remained steady at the levels seen in the past few years. Five-year forward break-even rates five years ahead, which eliminate effects due to expectations of low short-term price pressures, were steady in the euro area while they rose somewhat in the United States (Graph 3, right-hand panel).

With the economic recovery still in its early stages, at least in major advanced economies, and inflation seeming contained there, investors did not foresee any tightening of monetary policy for some time. Indeed, expectations about the future path of policy rates in the three largest advanced economies, as proxied by implied forward interest rates, pointed to continued low rates well into 2010 (Graph 4, left-hand and centre panels). Supporting these expectations, major central banks signalled that near-term rate hikes were not in the cards. Notably, in mid-November the Chairman of the US Federal Reserve pointed out that headwinds were preventing the economic expansion from being as robust as hoped, and that these conditions would be likely to warrant "exceptionally low levels of the federal funds rate for an extended period". Following these remarks, US bond yields dropped by 4–8 basis points across the maturity spectrum, sending two-year yields to their lowest levels since January. Moreover, the pricing of options on federal funds futures contracts indicated that the (risk neutral) probability that the Federal Reserve would raise its target from the 0–0.25% range in the first half of 2010 had plunged following the Chairman's remarks (Graph 4, right-hand panel).

Monetary policy expectations

Federal funds futures

- 31 Aug 2009
- 30 Sep 2009
- 27 Nov 2009

EONIA and JPY OIS forward rates[1]

Euro:
- 31 Aug 2009
- 30 Sep 2009
- 27 Nov 2009

Yen:
- 31 Aug 2009
- 30 Sep 2009
- 27 Nov 2009

Implied Federal Reserve rate hike probabilities[2]

- Jan 2010
- Mar 2010
- Jun 2010

[1] One-month rates implied by overnight index swaps, in per cent. [2] Option-implied risk neutral probabilities that the Federal Reserve would raise the fed funds target above the 0–0.25% range following the FOMC meeting in the indicated month.

Sources: Bloomberg; BIS calculations.   Graph 4

Implied interest rate volatility and term premia

| Swaption volatilities[1] | Implied volatility for 7% caps[2] | Ten-year nominal term premia[3] |

[1] Three-month swaption volatility, 10-year rate, in basis points.   [2] Volatility on three-year interest rate caps with strike rate 7%. Interest rate caps are derivative instruments that pay the holder if some underlying interest rate (eg a Libor rate) exceeds a specific level (the strike rate).   [3] Nominal term premia, in per cent, based on estimates from a modified version of the term structure model in P Hördahl and O Tristani, "Inflation risk premia in the term structure of interest rates", *BIS Working Papers*, no 228, May 2007.

Sources: Bloomberg; BIS calculations.   Graph 5

Interest rate
uncertainty remains
high …

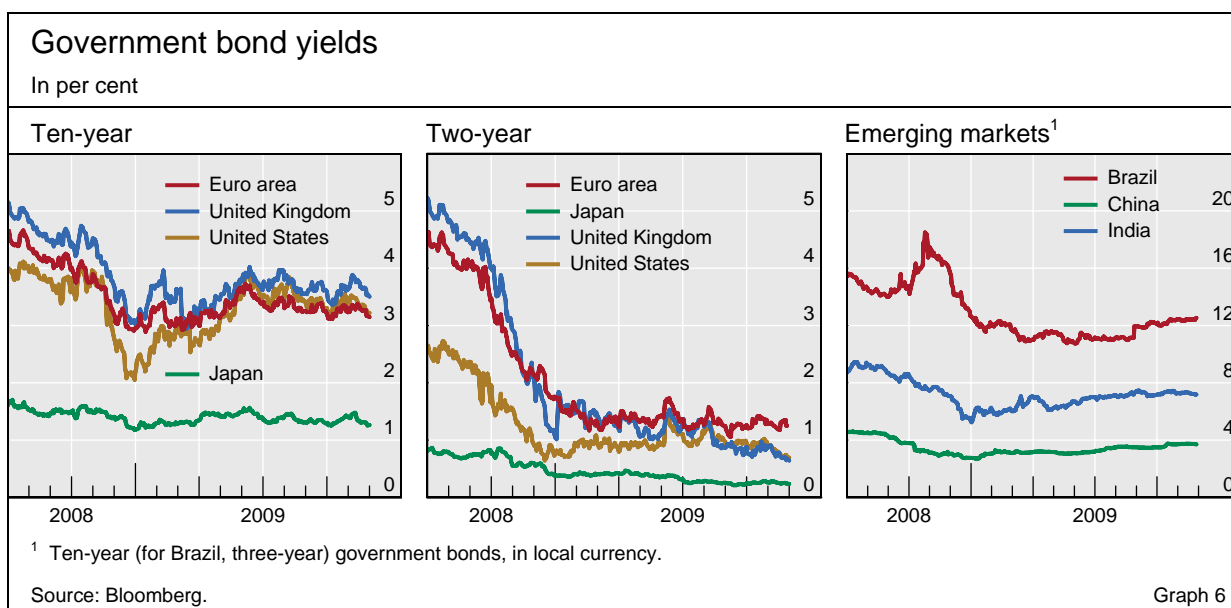While uncertainty about the near-term evolution of short-term interest rates appeared relatively low, the picture with respect to long-term interest rates differed to some extent. Although considerably down from the peaks reached at the height of the crisis, implied volatilities on swaptions (ie options on swaps) remained somewhat above past averages (Graph 5, left-hand panel). This probably reflected a continued high degree of uncertainty about the shape and pace of the economic recovery, as well as associated risks to the long-term inflation outlook, both of which are key elements in determining long-term interest rates. Questions about the possible impact of exit from unconventional monetary policy measures, including programmes for outright purchases of government bonds, probably added to the uncertainty in a few markets.

… especially on the
upside …

In particular, there was some concern among market participants about the risk of substantially higher yields as a result of a combination of reduced demand for and increased supply of bonds, in particular for some major advanced economies. Demand for government bonds was seen as likely to decline as central banks and private banks were set to scale down their purchases of such assets, which so far in 2009 have been sizeable. Meanwhile, the supply of government debt was expected to reach record levels in some economies following massive fiscal stimulus coupled with falling tax revenues. This was compounded by perceptions that the risk of sharply higher interest rates was on the rise. Specifically, there were concerns among some investors that central banks might find it necessary to raise policy rates considerably more than currently expected if prices in asset and goods markets turned out to increase at an unsustainably rapid pace. Signs that investors were hedging themselves against such adverse scenarios were evident in the pricing of interest rate derivatives. For example, implied volatilities of out-of-the-money caps – ie options that pay out if interest rates exceed some specific

Government bond yields

In per cent

Ten-year	Two-year	Emerging markets[1]

Legends:
- Ten-year: Euro area, United Kingdom, United States, Japan
- Two-year: Euro area, Japan, United Kingdom, United States
- Emerging markets: Brazil, China, India

[1] Ten-year (for Brazil, three-year) government bonds, in local currency.

Source: Bloomberg.   Graph 6

level well above the current one – continued to rise for US rates and remained relatively high in the case of euro rates (Graph 5, centre panel).

Despite much uncertainty about future long-term interest rates, estimated term premia in long-term bond yields stayed quite low when compared to levels in past years (Graph 5, right-hand panel). While term premia typically can be expected to be elevated in an environment of high uncertainty, they generally tend to decline as economic activity picks up. Moreover, other forces seemed to have compressed estimated premia – for example, continued high demand for government securities by banks, as they acted to offset lower lending volumes and reduce the riskiness of their assets. In some countries, this effect was probably reinforced by central bank purchases of government bonds. On top of this, demand for safe government bonds continued to push term premia down from time to time, most notably following the announcement by Dubai World in late November that it sought to delay payments on its substantial debt (see below).

… but term premia stay low

Taken together, the above-mentioned factors all contributed to keeping long-term bond yields in major advanced economies low and relatively stable between early September and late November (Graph 6, left-hand panel). Bond yields, which represent expected average future short-term interest rates (plus term premia), remained down as monetary policy rates were expected to be very low for some time. This effect was particularly evident at the short end of the yield curve (Graph 6, centre panel). At the long end, forces holding down term premia contributed further. Meanwhile, government bond yields in major emerging markets also remained fairly stable, albeit at levels higher than those in major advanced economies (Graph 6, right-hand panel).
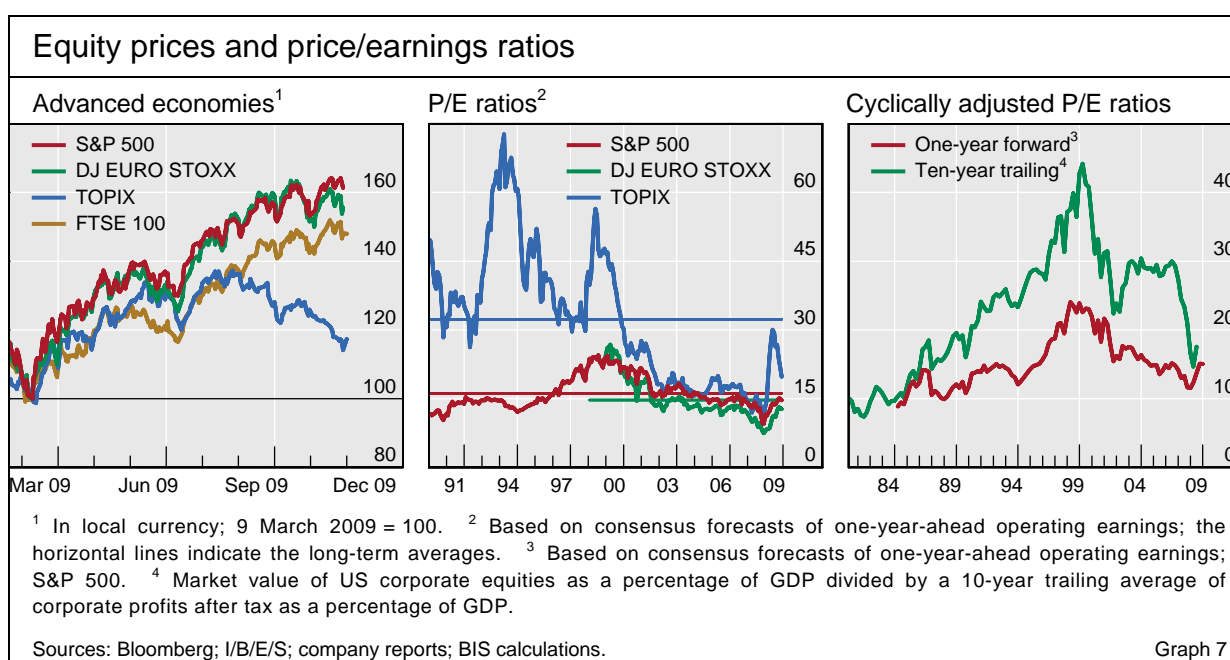
Equity market rebound continues

Developments in global equity and credit markets between early September and late November clearly reflected continued global monetary and fiscal stimulus. However, market volatility increased for short periods following

macroeconomic data releases and statements by policymakers about policy paths, suggesting that despite the recovery there was continued investor uncertainty about the impact of the withdrawal of monetary and fiscal stimulus on global economic growth.

In this environment, markets reacted with alarm when at the end of November Dubai World, one of Dubai's three government strategic investment vehicles, unexpectedly announced that it was seeking a standstill on its debt payments during negotiations to extend debt maturities. Most equity markets initially dropped several percentage points, with a more pronounced reaction in emerging markets. Equity prices also fell sharply for banks and companies thought to be more exposed to Dubai and the Middle East. The five-year sovereign credit default swap (CDS) premium for Dubai debt increased more than 300 basis points, to over 640 basis points, and sovereign CDS premia across the Middle East also rose sharply.

Low rates continue to drive equity rebound

The combination of economic growth recovery, exceptionally low policy rates across the globe and fiscal stimulus in the major advanced economies continued to drive the post-crisis rebound in global equity markets, although at a slower pace than previously (Graph 7, left-hand panel). The S&P 500 rose by more than 9%, the Dow Jones EURO STOXX by almost 5% and the FTSE 100 by 9% during the period. The Japanese market remained an important exception to this global pattern, with the TOPIX ending the period under review almost 17% lower. The decline in Japanese equity prices was driven by declining exports and weaker than expected corporate earnings. The latter concern was reflected in earnings revisions for Japanese companies becoming less optimistic starting in September. Price/earnings ratios for Japanese stocks remained well above the levels seen during the last five to 10 years. (Graph 7, centre panel). In contrast, equity valuations in the US and European markets still appear to be in line with longer-term levels, and in the case of the United

---

Equity prices and price/earnings ratios

Advanced economies[1]	P/E ratios[2]	Cyclically adjusted P/E ratios
S&P 500	S&P 500	One-year forward[3]
DJ EURO STOXX	DJ EURO STOXX	Ten-year trailing[4]
TOPIX	TOPIX	
FTSE 100		

[1] In local currency; 9 March 2009 = 100.   [2] Based on consensus forecasts of one-year-ahead operating earnings; the horizontal lines indicate the long-term averages.   [3] Based on consensus forecasts of one-year-ahead operating earnings; S&P 500.   [4] Market value of US corporate equities as a percentage of GDP divided by a 10-year trailing average of corporate profits after tax as a percentage of GDP.

Sources: Bloomberg; I/B/E/S; company reports; BIS calculations.   Graph 7

States, also more in line with cyclically adjusted price/earnings ratios (Graph 7, right-hand panel).

Equity market investors continued to focus on macroeconomic data releases, and equity prices increased on the steady stream of macroeconomic news confirming that the major economies had returned to positive growth in the third quarter. They also rose after statements in mid-November by the Federal Reserve Chairman suggesting that policy rates were likely to remain low for some time. However, there were also negative reactions to disappointing data releases, some of which raised concerns about the impact of higher unemployment, consumption and households' ability to service their mortgages. These reaction patterns were consistent with market commentary during the period, which suggested that investors were becoming more and more uneasy about the possible impact of tighter global monetary and fiscal policies.
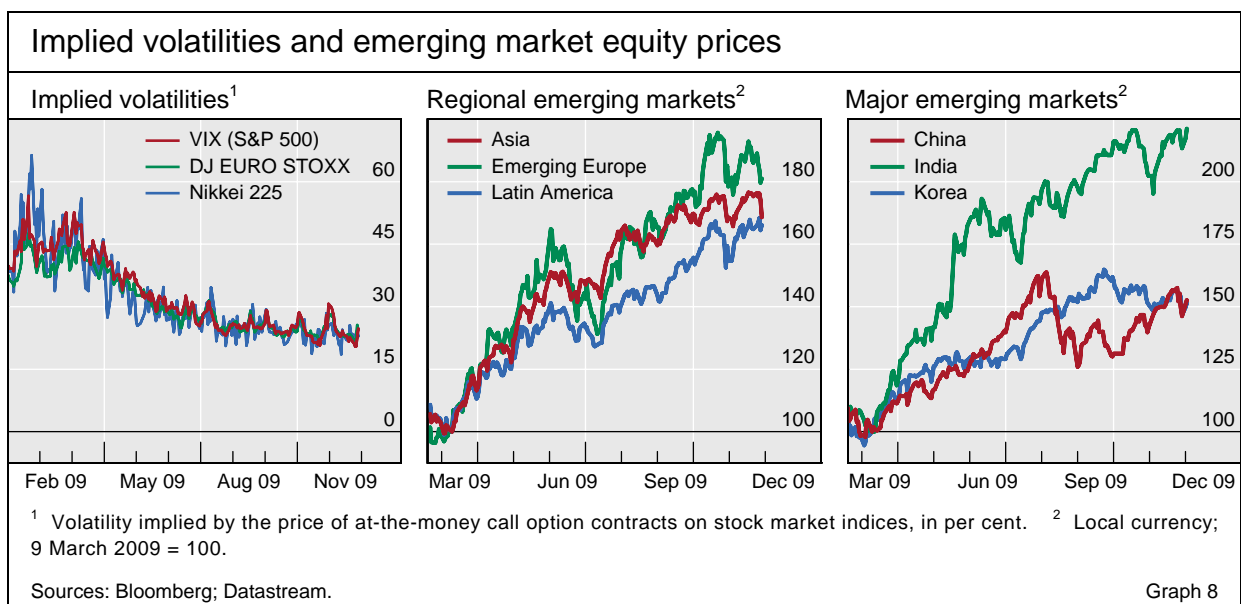
Uncertainty about the robustness of the recovery in the major advanced economies was also reflected in implied volatilities for equity options. After a long period of decline from the all-time highs during the crisis, implied volatilities rose briefly towards the end of October as investors faced a mix of positive earnings news and negative news related to the US housing and job markets (Graph 8, left-hand panel). Volatilities decreased after a statement by G20 finance ministers and central bank Governors in early November, in which they "agreed to maintain support for the recovery until it is assured".

Record low policy rates in the major advanced economies and the divergence in economic growth patterns between emerging and advanced economies continued to encourage positive capital inflows into emerging markets. As a result, equity prices in emerging economies increased even more than in the advanced economies (Graph 8, centre and right-hand panels). Increasing commodity prices also contributed to the significant rise in emerging market equity prices. Between early September and end-November, Asian equity prices grew by almost 5% on average, with increases well above 15% in Chinese equity markets. Prices in emerging Europe also rose by nearly 10%

Implied volatilities and emerging market equity prices

Implied volatilities[1]	Regional emerging markets[2]	Major emerging markets[2]
VIX (S&P 500) / DJ EURO STOXX / Nikkei 225	Asia / Emerging Europe / Latin America	China / India / Korea

[1] Volatility implied by the price of at-the-money call option contracts on stock market indices, in per cent.   [2] Local currency; 9 March 2009 = 100.

Sources: Bloomberg; Datastream.   Graph 8

Price/earnings ratios, capital inflows and exchange rate returns

Emerging market P/E ratios[1]	Flows to emerging market equity funds[2]	FX returns against US dollar[3]

Emerging market P/E ratios[1]

Asia
Eastern Europe
Latin America

20
15
10
5
0

2001 2003 2005 2007 2009

Flows to emerging market equity funds[2]

Asia ex Japan
Latin America
EMEA

10
5
0
−5
−10
−15

2007 2008 2009

FX returns against US dollar[3]

Asia
Latin America
Emerging Europe
Euro area

16
12
8
4
0

Mar 09– May 09   Jun 09– Aug 09   Sept 09– Nov 09

Asia = China, India, Indonesia, Korea and Singapore; Latin America = Argentina, Brazil, Chile and Mexico; emerging Europe = the Czech Republic, Hungary, Poland, Russia and Turkey.

[1] Based on consensus forecasts of one-year-ahead operating earnings; the horizontal lines indicate the long-term averages.   [2] In billions of US dollars.   [3] Simple average of changes in the US dollar spot exchange rate, in per cent. A positive value indicates an appreciation against the US dollar.

Sources: Bloomberg; Dealogic; EPFR Global.   Graph 9

during the period, and those in Russia by more than 15%. Latin American equity prices ended around 17% higher. Despite the rapid increase in equity prices, however, higher earnings meant that price/earnings ratios for many emerging market equities remained in line with longer-term levels (Graph 9, left-hand panel).
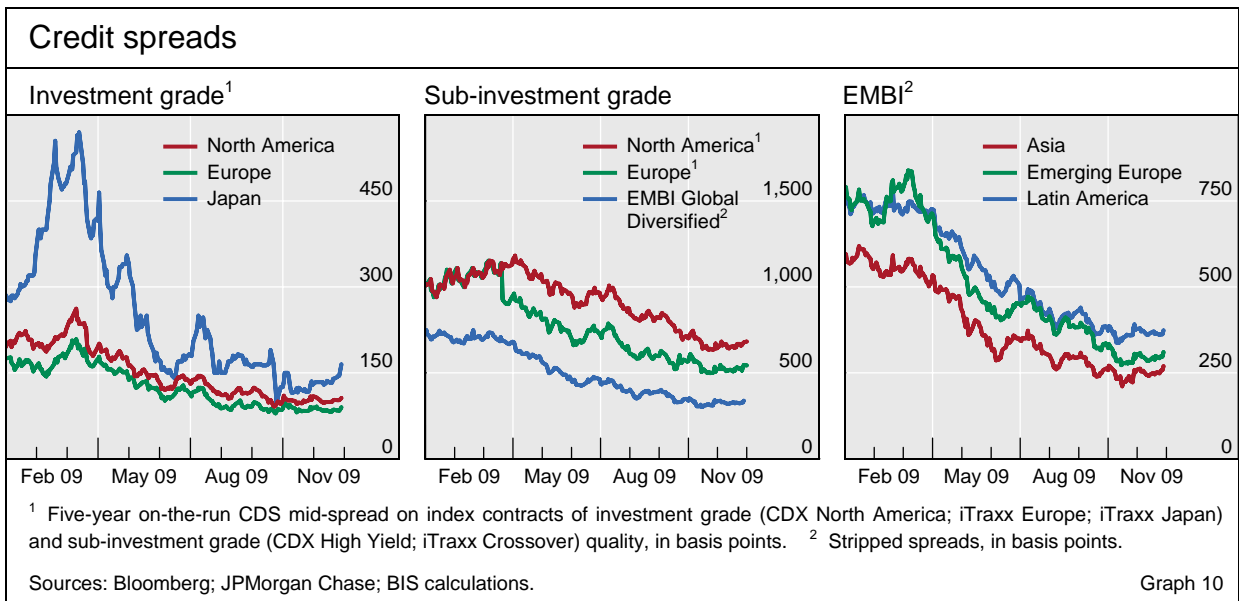
Capital inflows drive appreciation and asset price increases

Record low policy rates in the major advanced economies encouraged not only capital inflows into emerging economies but also FX carry trades. The result was substantial exchange rate appreciation and asset price increases in a number of emerging economies (Graph 9). In recent months, this became a significant source of concern with regard to both exports and financial stability. In the case of Brazil, these concerns led to the introduction of a 2% tax on foreign portfolio investments. In a number of other countries, including India, Indonesia, Korea and Chinese Taipei, policymakers hinted that they would consider measures to limit capital inflows. Towards the end of November, the Indonesian rupiah dropped on statements from Bank Indonesia that it was considering measures to curb foreign investment in short-term government debt in order to douse speculative inflows. This reaction points to investors' concerns about the extent to which policymakers in emerging markets might be willing and able to limit capital inflows to prevent further exchange rate appreciation and asset price inflation.

Credit markets normalise further
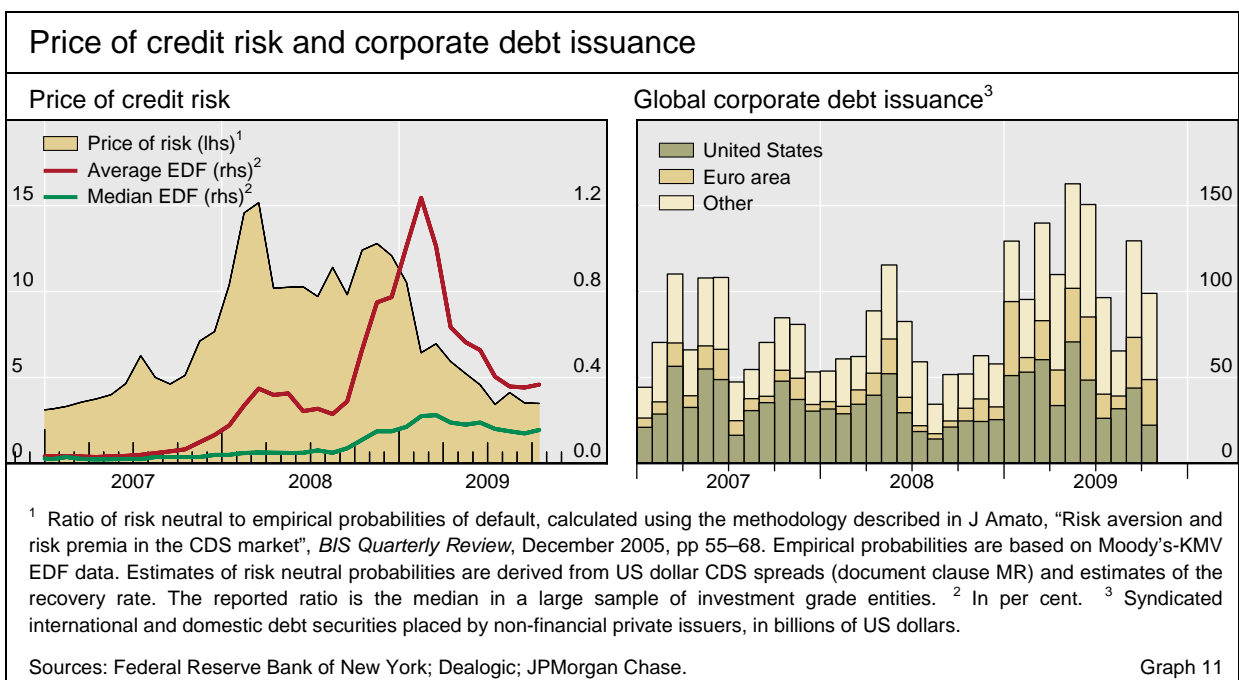
Credit markets continue to normalise ...

Credit markets continued to normalise and investment grade credit spreads in the advanced economies were fairly stable. US spreads narrowed 25 basis points, while European and Japanese spreads were little changed (Graph 10, left-hand panel). Sub-investment grade spreads, however, continued to tighten: US spreads by around 140 basis points, European spreads by 70 basis points and the EMBI Global diversified spread by about 55 basis points (Graph 10,

Credit spreads

Investment grade[1]

- North America
- Europe
- Japan

450
300
150
0

Feb 09   May 09   Aug 09   Nov 09

Sub-investment grade

- North America[1]
- Europe[1]
- EMBI Global Diversified[2]

1,500
1,000
500
0

Feb 09   May 09   Aug 09   Nov 09

EMBI[2]

- Asia
- Emerging Europe
- Latin America

750
500
250
0

Feb 09   May 09   Aug 09   Nov 09

[1] Five-year on-the-run CDS mid-spread on index contracts of investment grade (CDX North America; iTraxx Europe; iTraxx Japan) and sub-investment grade (CDX High Yield; iTraxx Crossover) quality, in basis points. [2] Stripped spreads, in basis points.

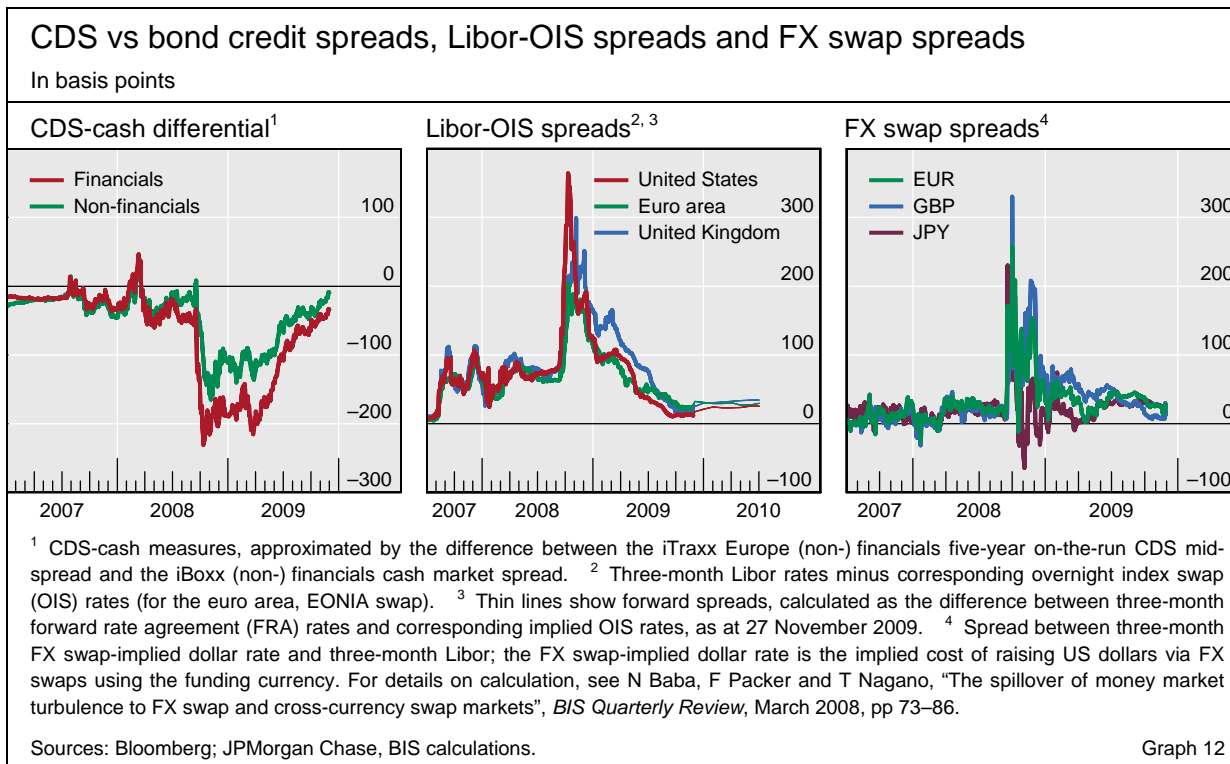Sources: Bloomberg; JPMorgan Chase; BIS calculations.   Graph 10

centre panel). Emerging market credit spreads also continued to narrow, with Asian spreads declining by almost 30 basis points, emerging European spreads by about 75 basis points and Latin American spreads by more than 60 basis points (Graph 10, right-hand panel). Similarly, the market-implied price of credit risk also continued its downward trend, but to its pre-crisis level (Graph 11, left-hand panel).

The return to more normal credit market conditions was also reflected in corporate bond issuance (Graph 11, right-hand panel, and Highlights section). Higher issuance of commercial paper by US financials also pointed to improved credit market conditions. In contrast, bank lending to non-financial firms continued to contract in the United Kingdom, the United States and the euro area. In the euro area, the improved credit market conditions led to several ECB Council members indicating that the unlimited 12-month loan auctions

... as market conditions improve

Price of credit risk and corporate debt issuance

Price of credit risk

- Price of risk (lhs)[1]
- Average EDF (rhs)[2]
- Median EDF (rhs)[2]

15
10
5
0

1.2
0.8
0.4
0.0

2007   2008   2009

Global corporate debt issuance[3]

- United States
- Euro area
- Other

150
100
50
0

2007   2008   2009

[1] Ratio of risk neutral to empirical probabilities of default, calculated using the methodology described in J Amato, "Risk aversion and risk premia in the CDS market", *BIS Quarterly Review*, December 2005, pp 55–68. Empirical probabilities are based on Moody's-KMV EDF data. Estimates of risk neutral probabilities are derived from US dollar CDS spreads (document clause MR) and estimates of the recovery rate. The reported ratio is the median in a large sample of investment grade entities. [2] In per cent. [3] Syndicated international and domestic debt securities placed by non-financial private issuers, in billions of US dollars.

Sources: Federal Reserve Bank of New York; Dealogic; JPMorgan Chase.   Graph 11

CDS vs bond credit spreads, Libor-OIS spreads and FX swap spreads
In basis points

CDS-cash differential[1]	Libor-OIS spreads[2, 3]	FX swap spreads[4]
Financials	United States	EUR
Non-financials	Euro area	GBP
	United Kingdom	JPY

[1] CDS-cash measures, approximated by the difference between the iTraxx Europe (non-) financials five-year on-the-run CDS mid-spread and the iBoxx (non-) financials cash market spread.   [2] Three-month Libor rates minus corresponding overnight index swap (OIS) rates (for the euro area, EONIA swap).   [3] Thin lines show forward spreads, calculated as the difference between three-month forward rate agreement (FRA) rates and corresponding implied OIS rates, as at 27 November 2009.   [4] Spread between three-month FX swap-implied dollar rate and three-month Libor; the FX swap-implied dollar rate is the implied cost of raising US dollars via FX swaps using the funding currency. For details on calculation, see N Baba, F Packer and T Nagano, "The spillover of money market turbulence to FX swap and cross-currency swap markets", *BIS Quarterly Review*, March 2008, pp 73–86.

Sources: Bloomberg; JPMorgan Chase, BIS calculations.   Graph 12

introduced during the crisis could soon be phased out as part of efforts to gradually withdraw emergency liquidity measures. The ECB also announced that from March 2011 it will require at least two ratings from an accepted external credit assessment institution for all asset-backed securities used as collateral, where the second best rating must be at least single-A.

There were also clear indications that the dysfunctions seen in global credit markets during the crisis had more or less disappeared by end-November. The spread differentials between cash and CDS prices had essentially returned to pre-crisis levels, at least for non-financial borrowers (Graph 12, left-hand panel). Libor-OIS spreads, a frequently used indicator of short-term credit market stress, had gone back to levels only slightly above their pre-crisis levels (Graph 12, centre panel). Finally, FX swap spreads had declined to their pre-crisis levels by end-November (Graph 12, right-hand panel).
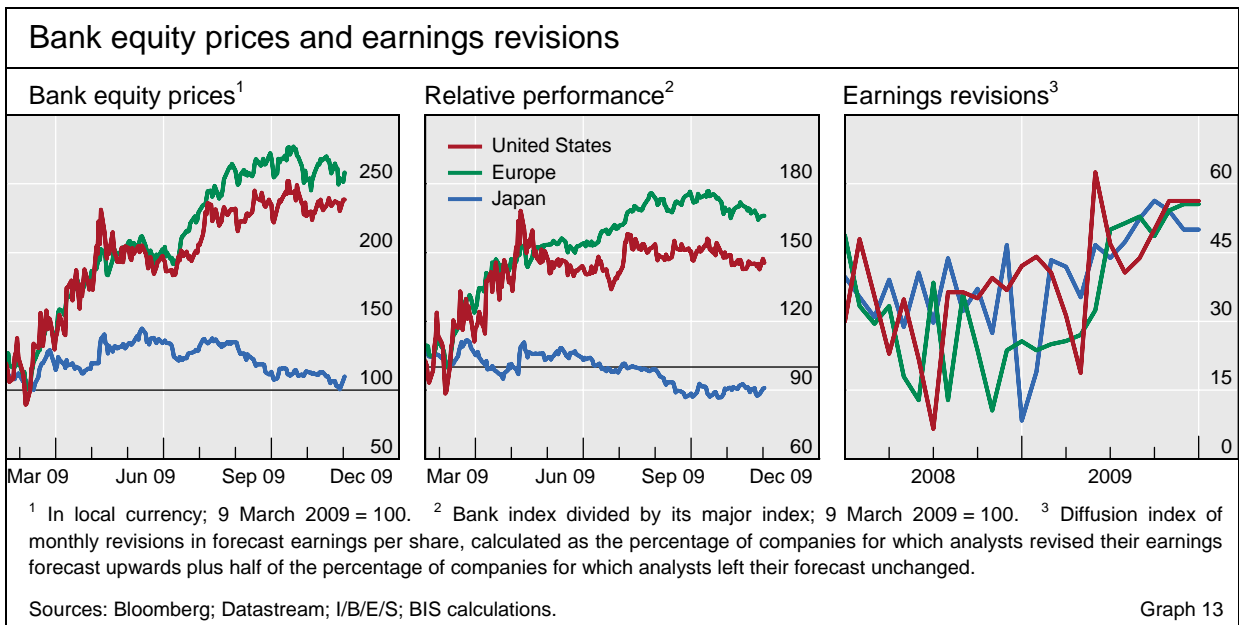
Banks continue to repair balance sheets
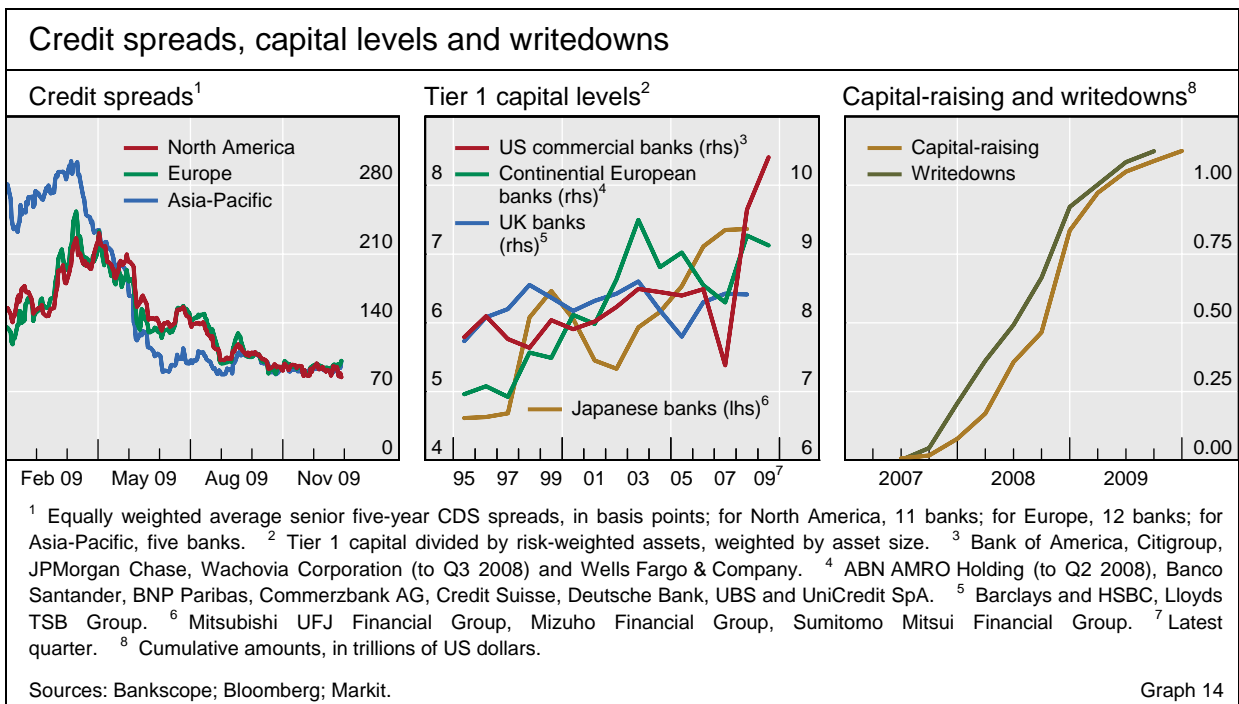
Bank equity prices move with market

Bank stocks posted further gains during the period under review, at least in Europe and the United States (Graph 13, left-hand panel). Even so, bank equity prices in these two economies fell relative to the broader market and remained well below their pre-crisis levels. Japanese equity prices dropped slightly in recent months, both in absolute terms and relative to the broader market (Graph 13, centre panel).

Bank credit spreads tighten as banks continue to repair balance sheets

Following overall market developments, bank credit spreads tightened further, reflecting improved earnings and continued efforts to strengthen banks' capital positions (Graph 14, left-hand and centre panel). Following large equity issues by US banks in the first half of the year, many European banks also

Bank equity prices and earnings revisions

Graph 13

Bank equity prices[1]	Relative performance[2]	Earnings revisions[3]

[1] In local currency; 9 March 2009 = 100. [2] Bank index divided by its major index; 9 March 2009 = 100. [3] Diffusion index of monthly revisions in forecast earnings per share, calculated as the percentage of companies for which analysts revised their earnings forecast upwards plus half of the percentage of companies for which analysts left their forecast unchanged.

Sources: Bloomberg; Datastream; I/B/E/S; BIS calculations.

raised new capital. As a consequence, the total amount of capital raised finally caught up with writedowns (Graph 14, right-hand panel). Tier 1 capital ratios increased by around 1 percentage point in the first 11 months of 2009. Particularly noteworthy in this context was a large rights issue by Lloyds Banking Group in late November. Lloyds, whose balance sheet had suffered due to the firm's takeover of HBOS last year, issued new shares at a discount of almost 60% compared to the market price, to raise £13.5 billion. In addition, it was the first bank to issue contingent convertible bonds (CoCo bonds or enhanced capital notes), convertible debt securities that are automatically turned into equity if the Tier 1 ratio falls below a specific level. The concept of such contingent capital has received much attention in recent months, but it remains to be seen if other banks will issue similar types of securities.

Credit spreads, capital levels and writedowns

Graph 14

Credit spreads[1]	Tier 1 capital levels[2]	Capital-raising and writedowns[8]

[1] Equally weighted average senior five-year CDS spreads, in basis points; for North America, 11 banks; for Europe, 12 banks; for Asia-Pacific, five banks. [2] Tier 1 capital divided by risk-weighted assets, weighted by asset size. [3] Bank of America, Citigroup, JPMorgan Chase, Wachovia Corporation (to Q3 2008) and Wells Fargo & Company. [4] ABN AMRO Holding (to Q2 2008), Banco Santander, BNP Paribas, Commerzbank AG, Credit Suisse, Deutsche Bank, UBS and UniCredit SpA. [5] Barclays and HSBC, Lloyds TSB Group. [6] Mitsubishi UFJ Financial Group, Mizuho Financial Group, Sumitomo Mitsui Financial Group. [7] Latest quarter. [8] Cumulative amounts, in trillions of US dollars.

Sources: Bankscope; Bloomberg; Markit.

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Highlights of international banking and financial market activity[1]

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 *second* quarter of 2009. The discussion on international debt securities and exchange-traded derivatives draws on data for the *third* quarter of 2009. Data on the over-the-counter derivatives market are available for the end of June 2009. The analysis of the BIS statistics is complemented by two boxes. The first box discusses bank lending in China; the second compares BIS data on OTC derivatives with those produced by the Depository Trust & Clearing Corporation.

The international banking market

Banks' international balance sheets continued to contract during the second quarter of 2009, albeit at a much slower pace than in the preceding six months. The $477 billion decline in the total gross international claims of BIS reporting banks was considerably smaller than the $1.1 trillion and $1.9 trillion reductions registered in the prior two quarters but it was still the fourth largest in the last decade (Graph 1, left-hand panel). The shrinkage in international balance sheets was entirely driven by a contraction in interbank claims ($481 billion). By contrast, international claims on non-banks increased slightly (by $4 billion). Reporting banks' cross-border claims on emerging market borrowers also showed signs of stabilising. Conversely, their local positions in local currencies in many countries contracted modestly for the first time since the onset of the crisis.

Shrinkage in international balance sheets slows down

A large part (58%) of the overall contraction in international claims was due to a decrease in US dollar-denominated positions (Graph 1, centre panel). That said, the $278 billion decline in that segment of the market was significantly

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[1] Queries concerning the banking statistics should be addressed to Stefan Avdjiev, those concerning derivatives statistics to Jacob Gyntelberg and those concerning international debt securities to Christian Upper.

Changes in gross international claims[1]

In trillions of US dollars

By counterparty sector

By currency

By residency of counterparty

[1] BIS reporting banks' cross-border claims (including inter-office claims) in all currencies plus locally booked foreign currency claims on residents of BIS reporting countries.

Source: BIS locational banking statistics by residence.   Graph 1

smaller than those registered in the previous two quarters. US dollar claims on banks continued to shrink, falling $311 billion. In contrast, US dollar-denominated claims on non-banks increased slightly ($34 billion) after two consecutive quarterly declines. Meanwhile, total yen-denominated claims rose (by $92 billion) for the first time since the third quarter of 2008.

Claims on residents of the United States (down by $211 billion) and the United Kingdom ($195 billion lower) fell the most during the quarter (Graph 1, right-hand panel). Both these reductions were mostly driven by declines in claims on banks ($219 billion and $167 billion, respectively). In the meantime, claims on non-banks located in the United States increased modestly (by $8 billion) for the first time since the third quarter of 2008. Conversely, claims on non-banks in the United Kingdom declined (by $28 billion) for the fifth quarter in a row, albeit at a much slower pace than in the previous four quarters.

Non-US banks' US dollar books

The US dollar portfolios of many banks have changed significantly since the start of the crisis (ie since the third quarter of 2007). Graph 2 provides information on the composition of the consolidated US dollar positions of nine large banking systems. The sum of the positive (negative) stacked bars is the estimated total US dollar-denominated asset (liability) position for each banking system.[2] In turn, each of these is broken down into local positions (green bars) and cross-border positions (brown bars).[3] The difference between a banking

Claims on US and UK residents continue to shrink

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[2]   These estimates are constructed by combining information from the BIS consolidated banking statistics (immediate borrower basis) and the BIS locational banking statistics by nationality. See *BIS Working Papers* no 291 for details on the methods used.

[3]   Local positions are positions that are booked by a bank office in a given jurisdiction vis-à-vis residents of that jurisdiction, while cross-border positions are positions that are booked by a bank office in a given jurisdiction vis-à-vis residents of other jurisdictions. Note that while the

Reporting banks' US dollar foreign positions by counterparty location[1]

By banking system, in trillions of US dollars
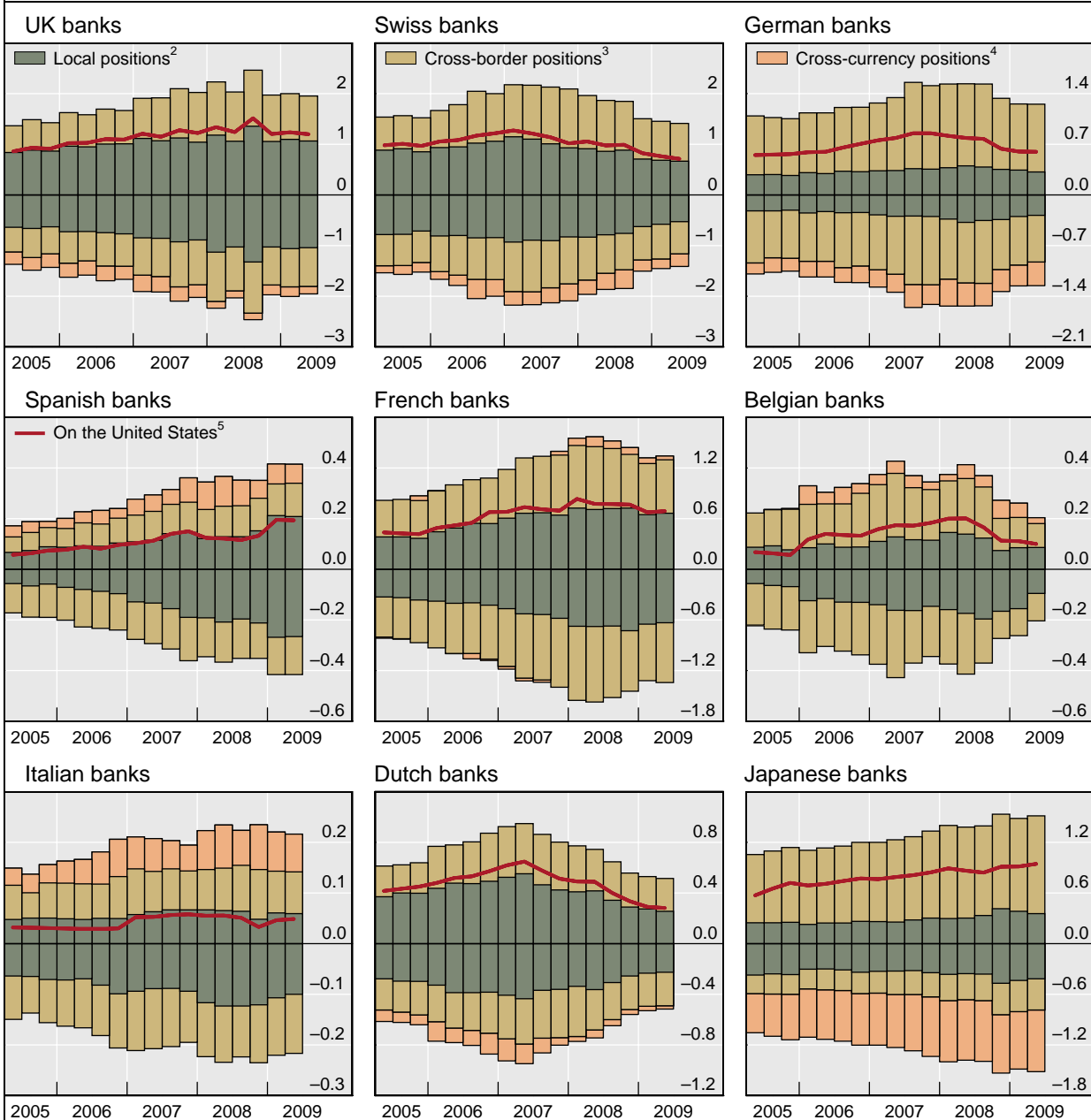
[1] Positive stacked bars denote assets; negative stacked bars denote liabilities. [2] Local positions are positions that are booked by a bank office in a given jurisdiction vis-à-vis residents of that jurisdiction. [3] Cross-border positions are positions that are booked by a bank office in a given jurisdiction vis-à-vis residents of other jurisdictions. [4] Cross-currency funding positions implied by the balance sheet identity. See *BIS Working Papers* no 291 for details on the estimating procedure. [5] Reporting banks' foreign claims on the United States (obtained from the BIS consolidated banking statistics, ultimate risk basis). It is implicitly assumed that these foreign claims, for which there is no currency breakdown, are US dollar-denominated.

Sources: BIS consolidated banking statistics (immediate borrower basis and ultimate risk basis); BIS locational banking statistics by nationality; BIS calculations. Graph 2

system's gross assets and gross liabilities in a given currency can be used as a proxy for its net FX swap positions in that currency (orange bars), under the

residence of the counterparties to banks' local positions is known by construction, there is no breakdown available for the residence of counterparties to banks' cross-border positions.

assumption that its open on-balance sheet currency positions are small.[4] Note that, while not an on-balance sheet position, the imputed net FX swap position can be thought of as a US dollar asset or liability, depending on whether the banking system has provided dollars to or borrowed dollars from the FX swap market.

Since the start of the crisis, European banking systems have registered the largest shrinkages in their US dollar books. In several cases (eg Dutch, German, Swiss and UK banks), these banking systems had net long US dollar positions before the crisis. In general, non-US banks' US dollar claims were primarily on residents of the United States (red lines in Graph 2), and these were typically skewed towards the US non-bank private sector.[5] Taken together, the claims of the above-mentioned banking systems on the US non-bank private sector have fallen by no less than $968 billion (or 15.2% of their total US dollar assets) since the start of the crisis, reflecting writedowns of assets, sales of securities and reduced lending. Meanwhile, their US dollar claims on non-US residents have dropped by only $241 billion (or 3.8% of their total US dollar assets). In contrast, the banking systems which had net short on-balance sheet US dollar positions before the start of the crisis (eg Belgian, Italian and Spanish banks) had, as a group, invested relatively small proportions of their US dollar portfolios in the US non-bank private sector.[6] Their total US dollar-denominated claims have held relatively stable during the crisis, and even expanded in the case of Spanish banks.

Graph 2 also highlights the different degrees to which various banking systems rely on cross-border claims and liabilities versus locally booked positions. For example, UK and Spanish banks book more than half of their US dollar-denominated claims locally. Conversely, German, Italian and Japanese banks book only about a quarter of their US dollar claims in host countries. Spanish and UK banks are also the ones that have the highest proportions of locally booked liabilities (64% and 53%, respectively), while German banks (23%) and Japanese banks (27%) rely on local liabilities the least.

Cross-border claims on emerging markets stabilise

After declining sharply in the previous two quarters, reporting banks' cross-border claims on emerging markets stabilised in the second quarter of 2009 (Graph 3). The modest overall increase in these claims ($5.3 billion) was the

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[4]   Note that a banking system which has a net long on-balance sheet US dollar position (ie its gross US dollar assets exceed its gross US dollar liabilities) would swap into US dollars and a banking system which has a net short on-balance sheet US dollar position (ie its gross US dollar liabilities exceed its gross US dollar assets) would swap out of US dollars.

[5]   Claims on the US non-bank private sector include corporate loans, loans to hedge funds in the United States and holdings of structured products issued by US non-bank financials. Japanese banks had invested a significant portion (29%, the highest of all reporting countries) of their US dollar portfolio in holdings of US government debt.

[6]   For the banking systems which had net short US dollar positions, the average proportion of US dollar assets that were invested in the US non-bank private sector was roughly a quarter. In contrast, this ratio averaged close to a half for the banking systems which had net long US dollar positions.

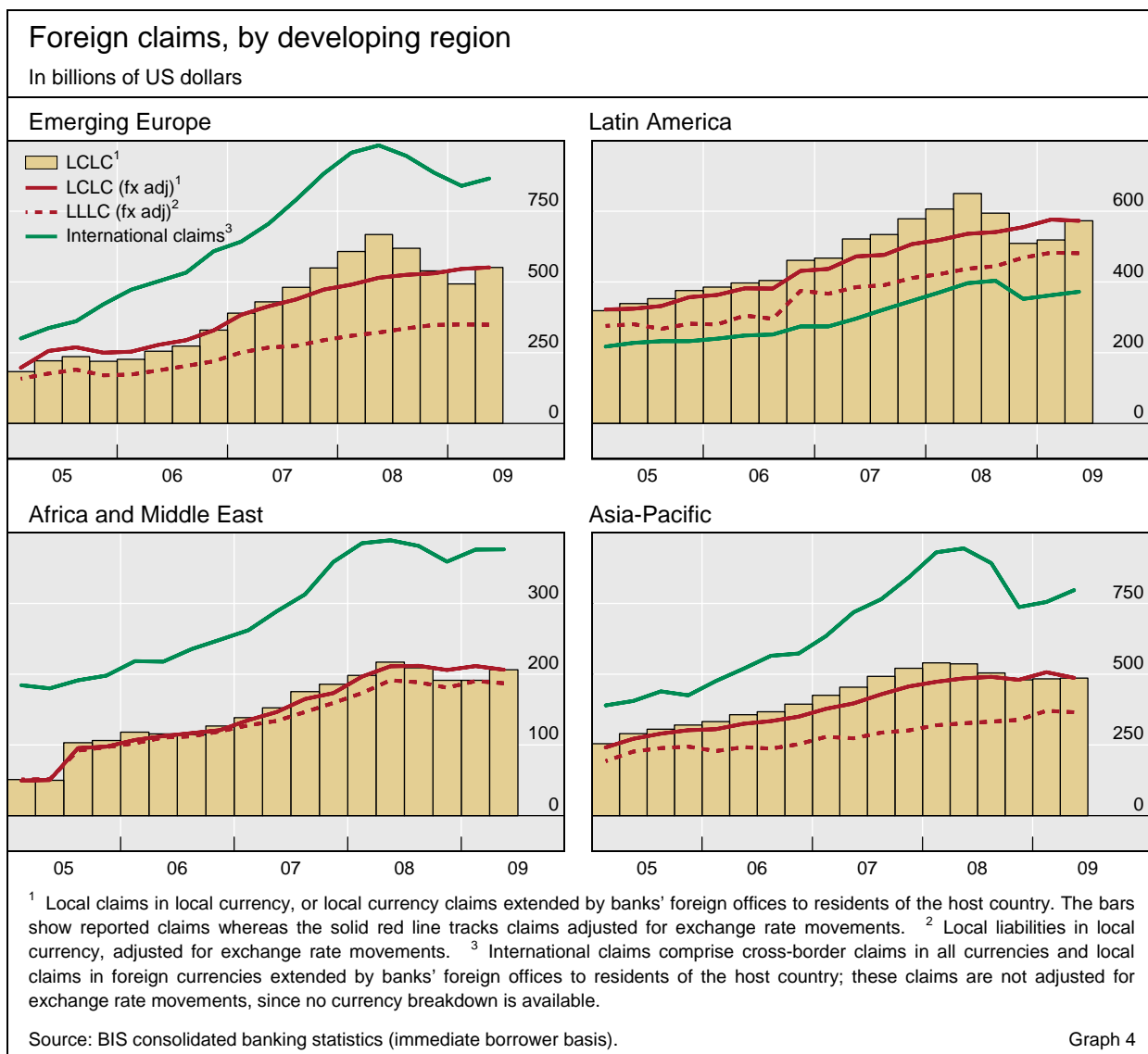## Changes in cross-border positions vis-à-vis emerging markets

In billions of US dollars

Emerging Europe

- Gross claims
- Gross liabilities
- Net claims[1]

Latin America

Africa and Middle East

Asia-Pacific

[1] Gross claims minus gross liabilities.

Source: BIS locational banking statistics by residence.

Graph 3
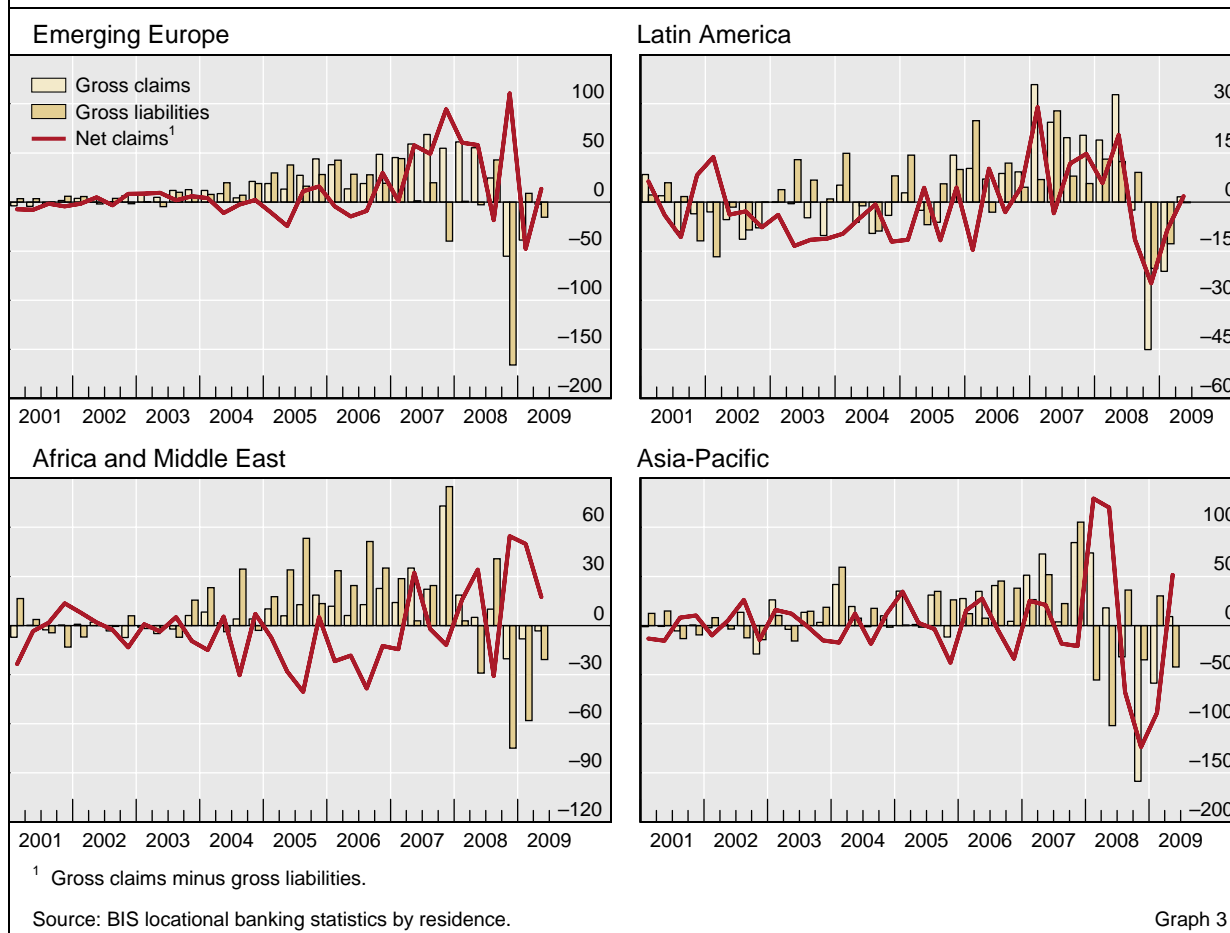
first overall increase since the third quarter of 2008. Claims on borrowers in Asia-Pacific and Latin America and the Caribbean expanded (by $9.2 billion and $1.6 billion, respectively). In contrast, those on emerging Europe and Africa and the Middle East contracted slightly (by $2.2 billion and $3.4 billion, respectively). Nevertheless, these declines were significantly smaller than in the previous two quarters.

At the level of individual economies, China ($49.2 billion), Hong Kong SAR ($46.8 billion) and Brazil ($15.3 billion) received the largest net inflows of cross-border funds. Whereas most of the net inflows to Brazil were due to an expansion in claims ($8.5 billion), those on China and Hong Kong SAR were almost entirely driven by declines in reporting banks' liabilities to residents of these economies (–$41.6 billion and –$49.3 billion, respectively). In the case of China, capital inflows to the country went hand in hand with a sharp expansion of domestic credit, as discussed in Box 1 on page 20.

Consistent with the locational statistics, the BIS consolidated banking statistics also point to a recovery in international lending to emerging markets (Graph 4). In the second quarter of 2009, consolidated international claims on emerging markets, which include cross-border positions and locally extended credit in foreign currencies, rose (by $77 billion, 3.3%) for the first time in four

Foreign claims, by developing region

In billions of US dollars

Emerging Europe

Legend:
- LCLC[1] (bars)
- LCLC (fx adj)[1] (solid red line)
- LLLC (fx adj)[2] (dashed red line)
- International claims[3] (green line)

Latin America

Africa and Middle East

Asia-Pacific

[1] Local claims in local currency, or local currency claims extended by banks' foreign offices to residents of the host country. The bars show reported claims whereas the solid red line tracks claims adjusted for exchange rate movements. [2] Local liabilities in local currency, adjusted for exchange rate movements. [3] International claims comprise cross-border claims in all currencies and local claims in foreign currencies extended by banks' foreign offices to residents of the host country; these claims are not adjusted for exchange rate movements, since no currency breakdown is available.

Source: BIS consolidated banking statistics (immediate borrower basis).   Graph 4

quarters.[7] Claims on all four emerging market regions expanded, with the largest increases being reported on residents of Asia-Pacific ($41 billion, 5.5%) and emerging Europe ($26 billion, 3.0%).[8]

At the same time, reporting banks' local positions in emerging markets decreased for the first time since the beginning of the crisis. Local claims in local currencies and local liabilities in local currencies, adjusted for exchange rate movements, declined by 0.1% and 0.6%, respectively. Banks' local-in-local

Local positions in emerging markets decline …

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[7] Unlike local claims in local currencies (for which the currency in each observation is known by definition), international claims cannot be adjusted for exchange rate fluctuations given that a currency breakdown is not available for them.

[8] While the bulk of the international claims on Asia-Pacific and Latin America and the Caribbean tend to be denominated in US dollars and, therefore, are not subject to large exchange rate adjustments, claims on emerging Europe are mostly euro-denominated, and are affected by exchange rate fluctuations. If it is assumed that all international claims on emerging Europe are denominated in euros, an FX adjustment would indicate that international claims on the region actually declined by 3.0%.

Foreign claims, by borrower country

In billions of US dollars

[1] Local claims in local currency, or local currency claims extended by banks' foreign offices to residents of the host country. The bars show reported claims whereas the solid red line tracks claims adjusted for exchange rate movements. [2] Local liabilities in local currency, adjusted for exchange rate movements. [3] International claims comprise cross-border claims in all currencies and local claims in foreign currencies extended by banks' foreign offices to residents of the host country; these claims are not adjusted for exchange rate movements, since no currency breakdown is available.

Source: BIS consolidated banking statistics (immediate borrower basis).   Graph 5

claims, which tend to be funded locally and are thus usually more stable than the other types of foreign claims, contracted in three out of the four emerging market regions (Asia-Pacific, Latin America and the Caribbean, Africa and the

Box 1: Analysing bank lending data in China

Eric Chan and Haibin Zhu

Credit growth has either slowed markedly or turned negative in most economies since the inception of the international crisis. A noticeable exception is China, where credit growth has accelerated remarkably since late 2008. Here we investigate the dynamics of Chinese banks' lending activity and its implications for the real economy.

Under the Chinese government's stimulus plan, credit expanded at an extraordinary rate in the first half of 2009. Chinese banks extended CNY 7.4 trillion worth of new loans, far more than the full-year total of CNY 4.2 trillion in 2008. The credit expansion contributed to the strong recovery of China's economy, but also raised concerns about excessively loose credit conditions. A significant portion of bank loans might have flowed into the equity and real estate markets, leading to asset price booms. In the first seven months of the year, the Shanghai Stock Exchange index rose by 87%, with the price/earnings ratio almost doubling from 15 to 29. Housing markets also regained momentum, registering increases in sales and investments as well as prices.

Against this backdrop, the Chinese government took prudential measures to curb lending to sectors with overcapacity as well as to improve the soundness of the banking system. The bank regulator issued a series of guidelines on lending practices to make sure that loans were not used for other purposes. Moreover, in order to strengthen the banking system's loss absorption capacity, the regulator also raised loan loss provisioning requirements for banks and tightened rules on the calculation of bank capital. In response, net lending eased notably in the third quarter, to CNY 1.3 trillion, and declined further in October to a year-low of CNY 253 billion.

The levelling-off of the lending expansion has so far had little adverse impact on the real economy. Indeed, GDP growth rose to 8.9% in the third quarter, and is expected to remain strong in the coming quarters. There are several possible reasons for this apparent disconnect.

First, the full impact of monetary stimulus on the real economy generally takes some time to be felt. In the case of China, strong economic growth in the third quarter may be the consequence of the rapid loan growth during the first half of the year.

Second, the slowdown in net bank lending since July may in part reflect seasonality in banks' lending practices. Loan growth in China is typically stronger in the first half of a year as banks tend to front-load their lending. We estimate that seasonal effects accounted for 14 percentage points of the 68% drop in monthly net lending from the first to the second half of the year. In fact, net lending between July and October was 28% higher compared with the same period one year ago.

Finally, and most importantly, the composition of credit has changed notably in recent months (Graph A). The drop in net bank lending was mainly driven by the sharp decline in the volume of discounted corporate bills and lower short-term lending. By contrast, the volume of medium- and long-term loans, which arguably provide more direct support for investment and real economic activity, continued to expand at a brisk pace.

Bank lending in China

Monthly changes in loans outstanding, in billions of renminbi

Source: People's Bank of China.   Graph A
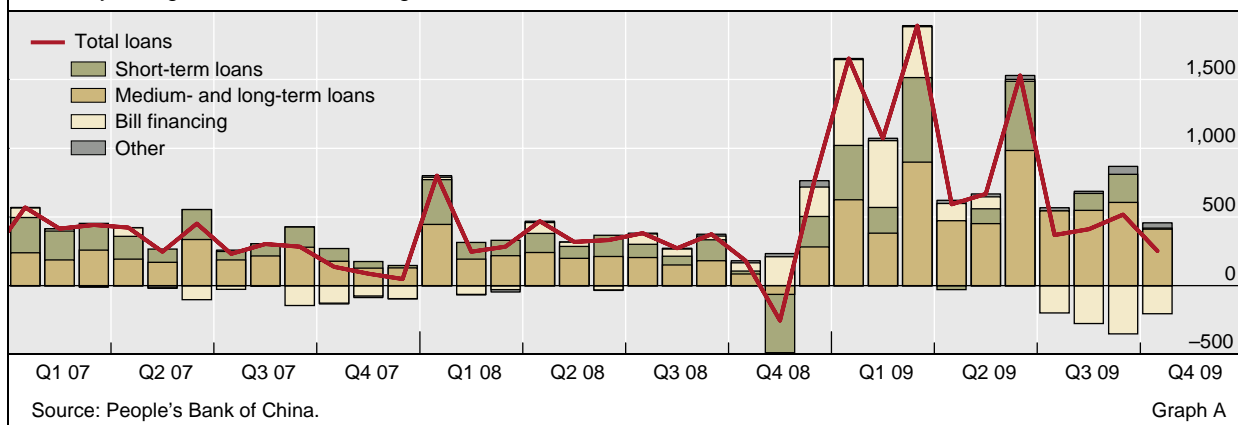
Bill financing totalled CNY 1.7 trillion in the first half of the year, the highest level on record. This probably reflected a strategy on the part of banks to increase total lending in response to the stimulus plan, while at the same time maintaining flexibility in their asset portfolios. Borrowers had traditionally used bills as a source of low-cost funding to meet their working capital needs. Arguably, a significant portion of those funds may have flowed into the asset markets. As from July, banks have started to reduce the supply of discounted bills, answering the regulator's call for more moderate credit growth. Meanwhile, the persistently strong issuance of medium- to long-term loans means that support for economic growth would be maintained. Given that outstanding bill financing amounted to CNY 2.6 billion at the end of October, there is still room for banks to adjust loan composition in the same direction.

While strong loan growth in China has fuelled the current economic recovery, it is not without risks. For one, the rapid credit growth in the first half of the year was unavoidably associated with an easing in credit standards, which could reduce the quality of banks' balance sheets in the future. In addition, the big increase in investment driven by credit expansion may imply additional demand for loans in the future, to complete the underlying projects. A tightening of monetary policy, therefore, may leave projects incomplete and lead to a build-up of bad loans in the banking sector. Together with the intensified pressure from the influx of international capital flows, Chinese policymakers may face significant constraints on their monetary and credit policy in the years ahead.

Middle East).[9] The only region in which they increased was emerging Europe (by 0.9%). In most countries, the shrinkage in local currency denominated claims was accompanied by a fall in real economic activity (eg in Chinese Taipei, Korea, Turkey, Argentina, Chile and Mexico). However, this was not the case everywhere. For example, local claims in local currencies on the residents of China, India and the Philippines all shrank, even though real output increased.

... especially vis-à-vis the Baltic states

A closer look at the Baltic countries reveals that BIS reporting banks' local claims in local currencies there contracted significantly during the second quarter of 2009 (Graph 5, top row). In Latvia, they decreased by 10.0% to $3.7 billion.[10] Most of the above reduction was recorded by Swedish banks, which, at the end of the quarter, accounted for approximately 88% of the outstanding local currency denominated claims of BIS reporting banks in the country. Local claims in local currencies also decreased in the other two Baltic states, Lithuania (–4.9%) and Estonia (–3.0%). Once again, the bulk of each of those declines was due to Swedish banks.

The picture in Latin America and the Caribbean (Graph 5, middle row) and Asia-Pacific (Graph 5, bottom row) was mixed. In Latin America, BIS reporting banks reduced their local claims in local currencies (adjusted for exchange rate fluctuations) on Peru (by 9.0%) and Argentina (by 4.3%) while simultaneously recording declines in their local liabilities in local currencies in these two countries (by 12.4% and 3.8%, respectively). In contrast, the local currency denominated claims of BIS reporting banks on Venezuela increased (by 4.3%)

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[9]   Matching the overall reduction in local claims, exchange rate adjusted local liabilities in local currencies recorded modest decreases in all four emerging market regions. Note that Austria, whose banks have a substantial presence in emerging Europe, does not report local liabilities in local currencies.

[10] In addition, residents of Latvia sharply decreased their local currency deposits in local offices of BIS reporting banks (by $1.0 billion, 23.4%). Reductions in local liabilities in local currencies were also reported in Lithuania (–2.3%) and Estonia (–1.2%).

for the fourth quarter in a row. In the Asia-Pacific region, local-in-local claims on Indonesia and Malaysia expanded by 7.6% and 1.3%, respectively. Meanwhile, in Chinese Taipei, they registered their fourth consecutive contraction (–8.5%).
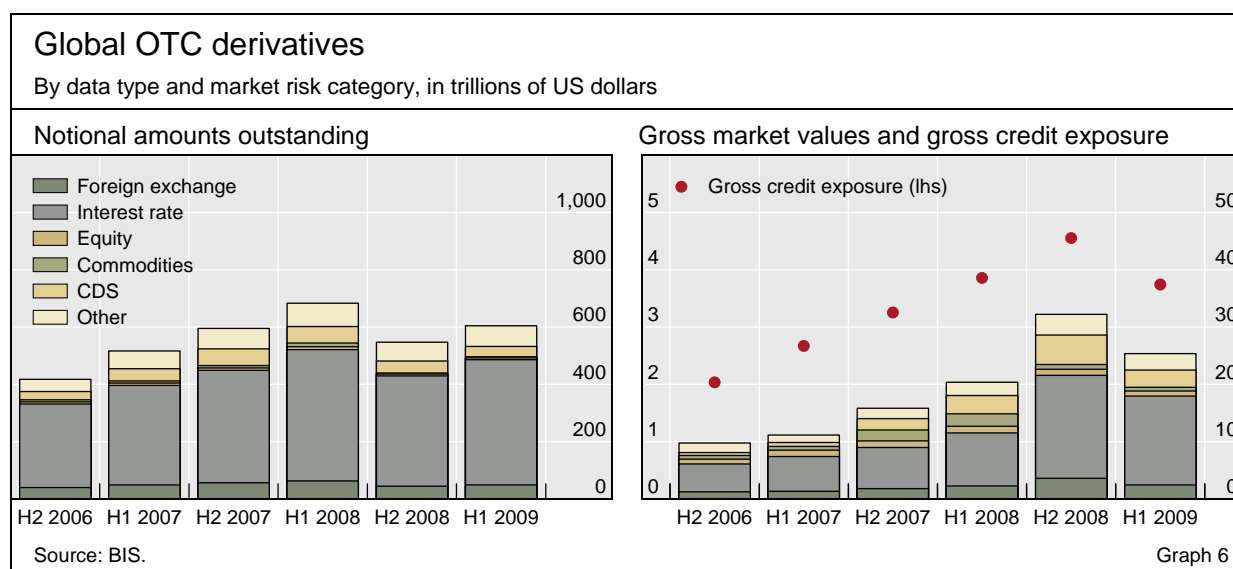
Derivatives markets

OTC derivatives

In the first half of 2009, notional amounts of all types of over-the-counter (OTC) contracts rebounded somewhat to stand at $605 trillion at the end of June, 10% higher than six months before (Graph 6, left-hand panel).[11] In contrast, gross credit exposures fell by 18% from an end-2008 peak to $3.7 trillion. Gross credit exposures take into account bilateral netting agreements but not collateral and provide a measure of counterparty exposures.[12] Gross market values also decreased, by 21% to $25 trillion (Graph 6, right-hand panel).[13]

Notional volumes rebound while market values decline

The increase in outstanding amounts was due in large part to interest rate derivatives, which at the end of June 2009 stood at $438 trillion, 13% above the end-2008 level (Graph 7, left-hand panel). Gross market values fell by 14% to $15 trillion, with interest rate swaps accounting for most of the decline. The increase in outstanding volumes was concentrated in the US dollar, sterling and euro (Graph 7, centre panel). The amounts of outstanding forward rate

Interest rate derivatives volumes increase …

Global OTC derivatives
By data type and market risk category, in trillions of US dollars

Notional amounts outstanding / Gross market values and gross credit exposure

Source: BIS.

Graph 6

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[11] Notional amounts outstanding at end-December 2008 were revised downwards by almost 8%. Gross market values were revised downwards by 5%. For details, see the BIS press release on *OTC derivatives market activity in the first half of 2009*, 12 November 2009.

[12] Gross credit exposure is the difference (taking into account legally enforceable bilateral netting agreements) between the gross value of contracts that have a positive market value and the gross value of contracts that have a negative market value. Credit default swap (CDS) contracts are excluded from this calculation for all countries except the United States.

[13] Gross market values measure the cost of replacing all outstanding contracts.

OTC interest rate derivatives

Notional amounts outstanding and gross market values, in trillions of US dollars

By instrument	By currency	By maturity

- Gross market values (lhs)
- Forwards
- Swaps
- Options

- Gross market values (lhs)
- Euro / Sterling
- Dollar / Yen
- Other

- One year or less
- Over 1 year and up to 5 years
- Over 5 years

Source: BIS.

Graph 7
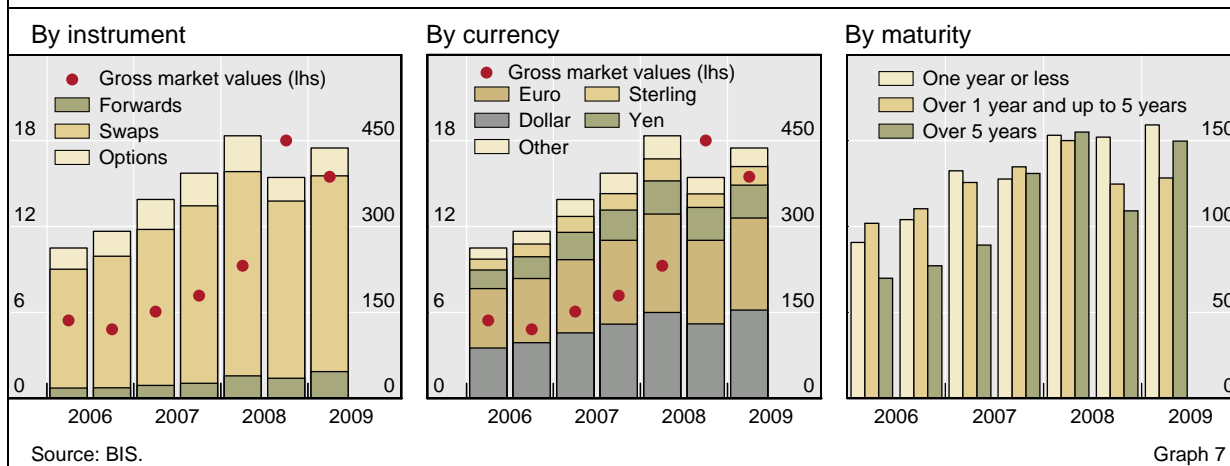
... driven by higher long-run swap volumes

CDS volumes continue to decline

agreements (FRAs) went up 34% to $47 trillion, while option volumes grew by 18% to $49 trillion. Consistent with increased hedging activity, the growth in outstanding volumes was concentrated in longer-dated swap and option contracts, with the latter increasing by over 70% (Graph 7, right-hand panel).

Continuing a trend which had begun in the first half of 2008, outstanding notional amounts of CDS contracts fell to $36 trillion at the end of June 2009 (Graph 8, left-hand panel). One factor was lower activity in the first half of the period, when credit markets were still strained (see Box 2). Activity did, however, increase subsequently. A second important driver was the expansion in the netting of offsetting positions by market participants, in particular the major dealers (Graph 8, centre and right-hand panels; see also Box 2). In contrast to the declining notional amounts between financial institutions, outstanding contracts between dealers and non-financial customers more than doubled.

Credit default swaps

In trillions of US dollars

By instrument	Notional amounts	Gross market value

- Gross market values (lhs)
- Single-name[1]
- Multi-name[1]

Reporting dealers / Other financial institutions / Non-financial customers

Reporting dealers / Other financial institutions / Non-financial customers

[1] Notional amounts outstanding (rhs).

Source: BIS.

Graph 8
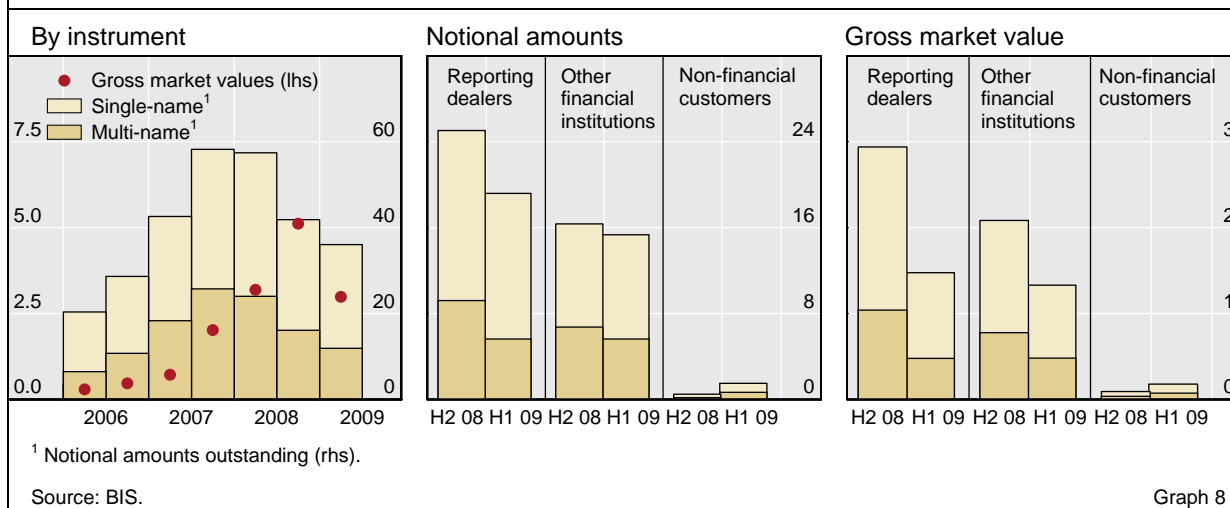
Box 2: The size of the global CDS market – BIS and DTCC data

Jacob Gyntelberg, Karsten von Kleist and Carlos Mallo

Recent developments in CDS markets have led to the availability of additional CDS data sources. In conjunction with the well known ISDA market survey and the BIS semiannual central bank survey on OTC derivatives markets, these new sources can be used to monitor global market trends more closely. One source that has attracted much attention is the Depository Trust & Clearing Corporation (DTCC) data on CDS. DTCC stores OTC credit derivatives data in a global repository called the Trade Information Warehouse (TIW). It then performs post-trade processing functions such as automated calculation, netting and central settlement of payment obligations, as well as settlement of credit events such as bankruptcies. Below we examine the DTCC data and briefly compare them with the data from the BIS semiannual central bank survey on outstanding CDS.

In early November 2008, DTCC started weekly publication of aggregated data as part of efforts to address market concerns about the lack of transparency in CDS markets. Initially, the data included outstanding gross and net notional values of CDS contracts for the top 1,000 underlying single-name reference entities as well as all CDS indices. Over time, more information has been published, but as yet no information is provided on market values or exposures. The DTCC data are based on CDS records registered in the warehouse, while the BIS data rely on dealers' reports to national central banks.

One indicator of the size of global CDS markets is the gross notional amounts outstanding, available in both the BIS and DTCC datasets. By counterparty, the BIS data distinguish between reporting dealers, other financial institutions and non-financial customers. By contrast, the DTCC data identify as counterparties only dealers and non-dealers (customers). To facilitate comparison, we combine the two non-reporting counterparty groups in the BIS survey in a single aggregate non-dealer category (Graph A, left-hand panel). In addition, for the DTCC data we include direct trades between non-dealers, which amount to only 0.1% of the total.

At first glance, the DTCC and BIS subsample data for the total gross amounts outstanding between dealers as of end-2008 match perfectly. This is, however, not the case for the mid-2009 data, where DTCC reports 12% higher volume of outstanding contracts than the BIS. The likely explanation for this difference is that DTCC covers more dealers.

The amounts outstanding of dealer/non-dealer contracts in the BIS survey are considerably larger than those reported by DTCC. The probable reason is that CDS providing protection on less standardised contracts such as collateralised debt obligations (CDOs) and asset-backed securities (ABS) are typically not confirmed electronically, so that CDS are less well covered by DTCC. In the future, CDOs and ABS might be included in the DTCC data.

Comparison of BIS and DTCC CDS data[1]

Outstanding notional amounts, in trillions of US dollars

By counterparty — Inter-dealer, With non-dealers[2]

By instrument — Multi-name[3], Single-name

BIS H2 08   DTCC H2 08   BIS H1 09   DTCC H1 09

BIS H2 08   DTCC H2 08   BIS H1 09   DTCC H1 09
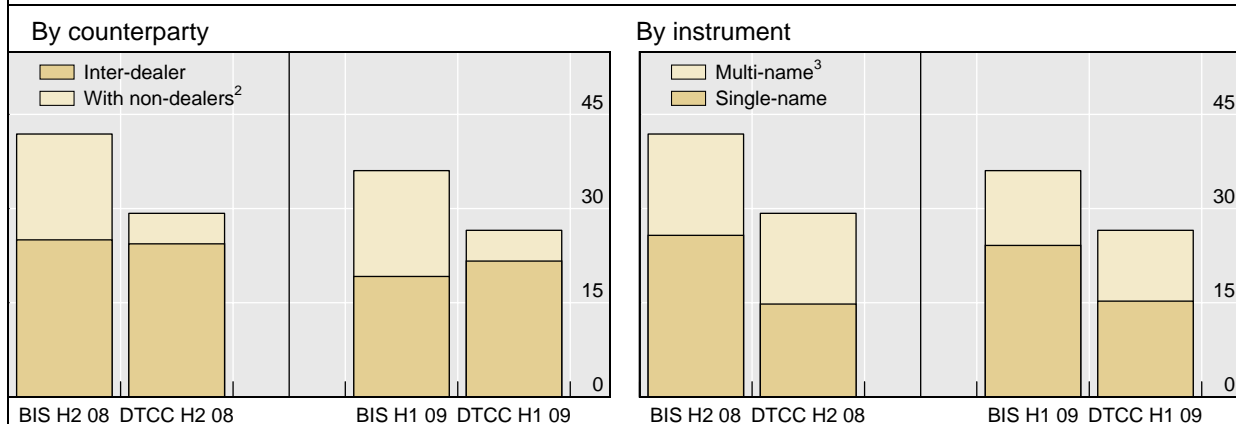
[1] The BIS sample includes banks whose head office is located in the G10 countries.   [2] The DTCC non-dealers category includes some inter-customer contracts.   [3] Multi-name contracts include credit default tranches.

Sources: DTCC; BIS.   Graph A

By instrument, the BIS-compiled data distinguish between single- and multi-name CDS contracts. The DTCC data, on the other hand, distinguish three categories of instrument: contracts on single names; contracts on credit default indices; and contracts on credit default tranches. Here we treat credit default indices and credit default tranches as multi-name contracts. For both periods, the BIS data report around 60% higher amounts outstanding in single-name instruments, while the amounts for multi-name instruments appear broadly comparable (Graph A, right-hand panel).

The combined pattern across counterparties and instrument types suggests that a main reason for the differences between the two datasets may be that outstanding single-name contracts used in the more customised transactions between dealers and non-dealers (including other financial institutions) are covered by the BIS but not yet by DTCC.

From the perspective of understanding developments in the CDS market, an important advantage of the DTCC data is that, while the BIS survey is semiannual, they are published weekly. This permits higher-frequency assessment of market size (Graph B, left-hand panel). DTCC also provides more information on the factors driving changes in the outstanding amounts. Increases due to relatively new trades and the inclusion of legacy transactions ("backloading") are identified separately, while reductions are broken down into those reflecting contracts that are fully or partially terminated because of netting and those reflecting contracts that mature or exit due to a credit event (Graph B, right-hand panel). The data for the first half of 2009 indicate that, on a monthly basis, new trades together with backloading added $3–7 trillion each month, while reductions were slightly larger, mainly owing to terminations of offsetting contracts.

The BIS and DTCC data combined with information provided by TriOptima and Markit, both of which offer multilateral termination services to OTC derivatives dealers, indicate that around 85% of all terminations take place in the more liquid CDS indices. All portfolio compression / tear-up activity occurs between dealers using these services. The DTCC data also suggest that there may be more tear-ups towards the end of each quarter, which may reflect the fact that CDS contract maturity dates are standardised on a quarterly cycle (20 March, 20 June, 20 September and 20 December) to match the International Monetary Market Cycle.

DTCC Trade Information Warehouse

Summary of transaction activity, in trillions of US dollars

Notional amounts outstanding

Increases and reductions

Increases: New trades[1]
Other[2]
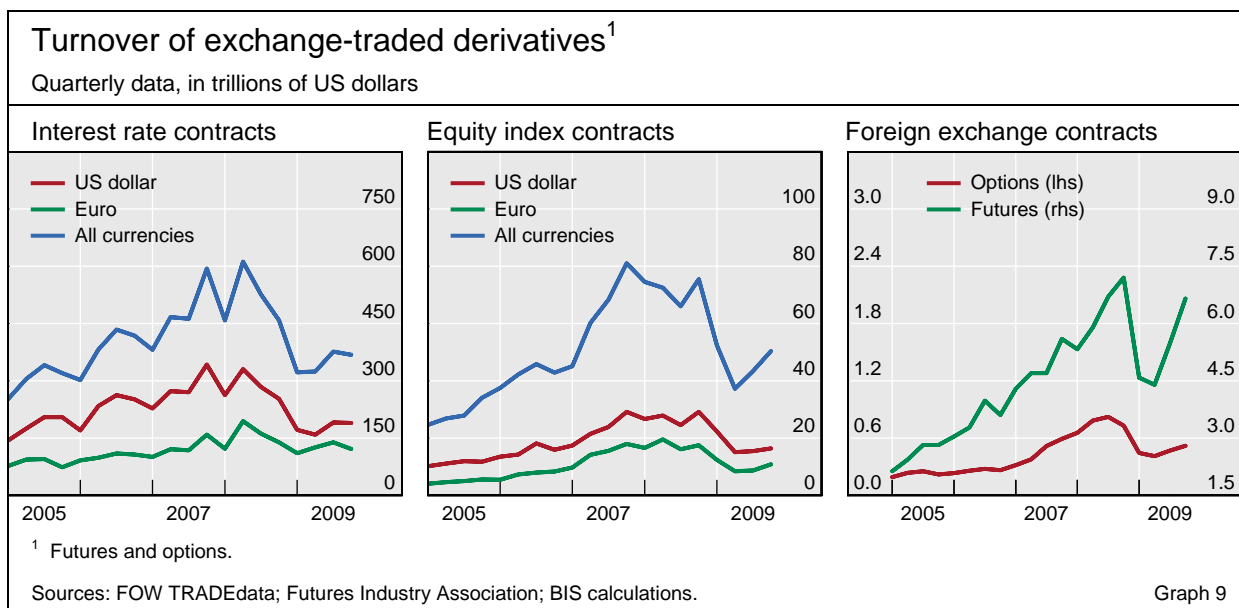Reductions: Terminations[3]
Other[4]
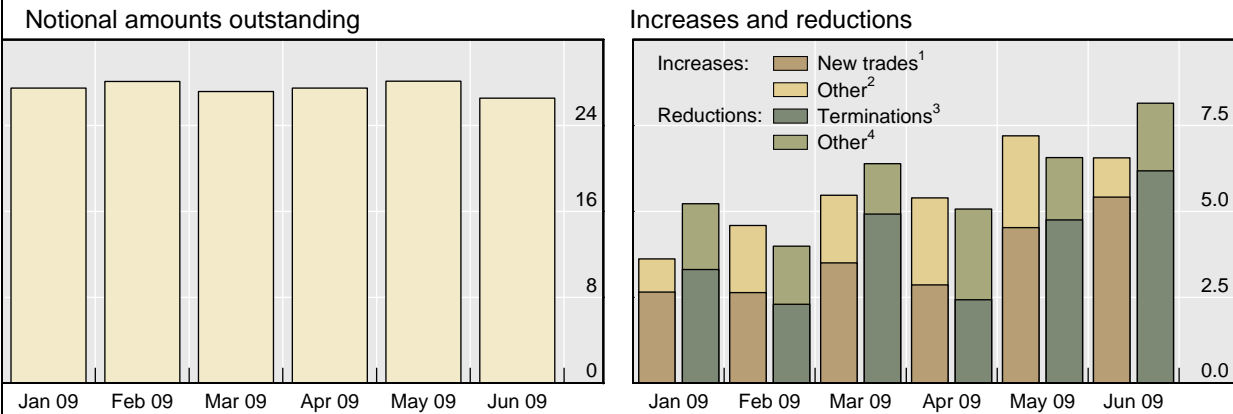
[1] Newly traded contracts. [2] Backloads, ie contracts previously executed and confirmed non-electronically. [3] Partial and full unwinding of contracts in the warehouse. [4] Matured contracts and contracts removed due to credit events.

Source: DTCC Deriv/SERV.   Graph B

Exchange-traded derivatives

In the third quarter of 2009 overall activity on the international derivatives exchanges stabilised, although trading volumes were still only around 60% of the high levels seen before the crisis. Total turnover based on notional amounts was unchanged from the previous quarter, at $425 trillion (Graph 9).

Turnover of exchange-traded derivatives[1]

Quarterly data, in trillions of US dollars

Interest rate contracts	Equity index contracts	Foreign exchange contracts

[1] Futures and options.

Sources: FOW TRADEdata; Futures Industry Association; BIS calculations.   Graph 9

Reflecting very low and stable policy rates in many of the largest economies, total activity in derivatives on interest rates declined slightly, to $368 trillion in the third quarter from $376 trillion in the second (Graph 9, left-hand panel). This decline was driven by a reduction in options turnover, with the decrease being more visible in the euro segment.

Against a backdrop of higher equity prices, turnover in equity index derivatives went up from $43 trillion to $50 trillion in the third quarter (Graph 9, centre panel). This increase was due to rising equity valuations, since turnover in terms of the number of contracts fell slightly, from 1.65 billion to 1.63 billion. The improvement reflected developments in the Korean and other Asian markets, where trading rose significantly, from $16.2 trillion to $19.3 trillion, in the third quarter.

Activity in foreign exchange derivatives also continued to grow in the third quarter (Graph 9, right-hand panel). This may in part reflect greater FX carry trade activity driven by interest differentials and higher investor confidence. Turnover climbed to $7.2 trillion from $5.9 trillion in the previous quarter. Activity rose in all the main currencies, with a smaller increase for the euro. Turnover also expanded significantly in the New Zealand dollar and the Australian dollar relative to the previous quarter.

Interest rate derivatives trading declines

Equity index turnover rises on the back of firmer Asian markets

Higher FX turnover suggests increased carry trade activity

The international debt securities market

Seasonal factors weighed on activity in the primary market for international debt securities in the third quarter of 2009, which includes the main holiday period in the northern hemisphere. Announced gross issuance declined by 16% quarter on quarter to $1,998 billion during the three months under review (Graph 10, left-hand panel). With roughly stable repayments, net issuance almost halved to $475 billion, the lowest level since the third quarter of 2008. Depending on the method used, seasonally adjusted issuance either remained stable at a high level or went up slightly. The strength of the underlying market

Seasonal drop in net issuance ...

International debt securities issuance

Net issuance, in billions of US dollars

International debt securities

- Announced issues
- Net issues

Emerging markets[1]

- Spreads (lhs)[2]
- Africa & Middle East (rhs)
- Asia-Pacific (rhs)
- Europe (rhs)
- Latin America (rhs)

Bonds and notes

- Equity-related
- Floating rate
- Straight fixed rate

[1] International debt securities issuance, by residency. [2] Quarterly JPMorgan EMBI Global Composite index, in basis points.

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; BIS.   Graph 10

is also confirmed by reports from commercial data providers of strong issuance in October.

... in developed economies

The decline in activity was mainly driven by lower net issuance by borrowers resident in developed economies (–45%), which account for the bulk of borrowing on the international debt securities market. The drop was evenly distributed across sectors.

Strong issuance by UK ...

One country that bucked the trend towards lower issuance was the United Kingdom. After relatively weak issuance in the first half of the year, UK residents tapped the international markets to raise $91 billion, 147% more than in the previous three months. Most of the issuance by UK residents was by financial institutions ($79 billion, after $18 billion in the second quarter). The share of bonds issued under a state guarantee fell from 27% in the second quarter to 8% in the third. Other developed economies with increased issuance were Ireland (up 75% to $41 billion) and Italy (up 98% to $36 billion).

... and emerging market borrowers

Residents in emerging market economies took advantage of the improved financing conditions and placed $34 billion of international debt securities (Graph 10, centre panel). This was 52% more than in the second quarter and well above the quarterly average for 2006 and early 2007, prior to the crisis. Issuance in Latin America and the Caribbean recovered from close to zero in the first half of the year to $13 billion between July and September. The rise in issuance was evenly spread across the region, with increases in all of the larger countries save Argentina. Economies in developing Asia and the Pacific raised $12 billion on the international market, 50% more than in the second quarter. Net issuance by residents in Africa and the Middle East remained virtually unchanged at $8 billion, $5 billion of which was accounted for by residents of the United Arab Emirates. Net issuance by borrowers in developing Europe fell to $2 billion (second quarter: $7 billion) amidst reports that issuers resident in some lower-rated countries had difficulties in placing their securities.

The sectoral composition of issuance varied considerably across these regions. Non-financial corporations dominated issuance in Latin America and

the Caribbean and in Africa and the Middle East, where they accounted for over 71% and 77%, respectively, of regional issuance. By contrast, financial institutions were the main borrowers in developing Asia (78% of net issuance in the region). Lastly, issuance in developing Europe was due entirely to governments ($4 billion), predominantly those of the larger and better-rated economies of the region. The financial and non-financial sectors recorded net redemptions of $2 billion and $1 billion, respectively.

Issuance of variable rate bonds became negative for the first time since 1991 (Graph 10, right-hand panel), as borrowers retired dollar-denominated floaters for $74 billion (net). This was only partly offset by a rise in issuance of sterling-denominated variable rate bonds ($33 billion, after $7 billion in the second quarter), resulting in total net redemptions of $7 billion.

Floaters become less attractive

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Macro stress tests and crises: what can we learn?[1]

Few, if any, of the macro stress tests undertaken before the current crisis uncovered significant vulnerabilities. This article examines the reasons for the poor performance by comparing the outcomes of simple stress tests with actual events for a large sample of historical banking crises. The results highlight that the structural assumptions underlying stress testing models do not match output growth around many crises. Furthermore, unless macro conditions are already weak prior to the eruption of the crisis, the vast majority of stress scenarios based on historical data are not severe enough. Last, stress testing models are not robust, as statistical relationships tend to break down during crises. These insights have important implications for the design and conduct of stress tests in the future.

JEL classification: E44, G01, G17.

The current crisis has underlined the importance of complementing the microprudential approach to regulation and supervision with a macroprudential perspective. One important issue is how to measure vulnerabilities and risks on a system-wide level.[2] Macro stress tests are seen as a promising tool. Central banks and the IMF had made extensive use of stress tests prior to the crisis, but generally without identifying significant vulnerabilities. For example, over a third of the countries considered in this article published macro stress testing results as part of an IMF Financial Sector Assessment Program in 2005, 2006 or the first half of 2007. The overwhelming majority concluded that their banking systems were robust even in the face of very severe adverse scenarios.[3] To be sure, not all of these countries subsequently experienced a full-blown banking crisis. But it is remarkable that not more warning flags were raised.

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[1] This article was written when Rodrigo Alfaro was a visiting research fellow at the BIS. The authors would like to thank Claudio Borio, Steve Cecchetti, Jean-Michel Mahler, Bob McCauley, Tariq Siddique, Kostas Tsatsaronis and Christian Upper for helpful comments, and Jakub Demski for excellent research assistance. The views expressed are the authors' own and not necessarily those of the BIS or the Central Bank of Chile.

[2] Borio and Drehmann (2009) provide a detailed discussion of how to operationalise frameworks for financial stability in the face of measurement challenges.

[3] In all the studies, the IMF was very careful to highlight potential shortcomings of the stress testing models used.

Why? Several reasons have been suggested: stress scenarios were not severe enough; important risks were missed; and feedback effects within the financial sector as well as between the real economy and the financial sector were ignored. No doubt, all these reasons are valid, and addressing them has sparked an ambitious research agenda that is likely to result in large and complex stress testing models.
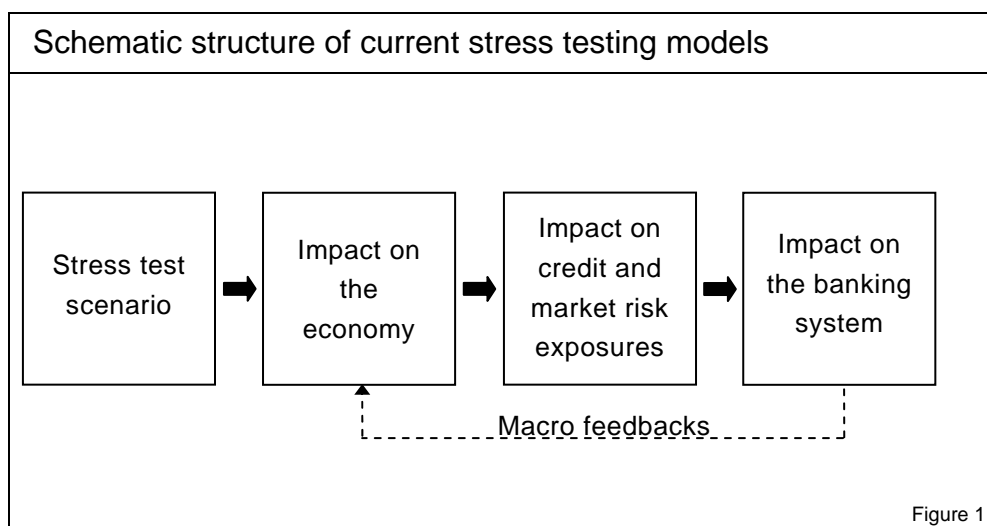
In this article, however, we take a step back and ask the why question slightly differently. In particular, we assess – within a very simple framework – three fundamental requirements that any stress test should fulfil to be informative: (i) it should use the correct model to capture the potential unfolding of crises in a realistic, yet stylised, fashion; (ii) scenarios should represent a severe event that ex ante is not beyond the realm of possibility; and (iii) models should be robust, particularly during the crisis periods they aim to simulate.

Disentangling fully which of these requirements, if any, may not have been met prior to crises is not feasible, even ex post. In particular, assessing whether the model used was correct in all respects is an impossibility. But, taking a bird's-eye view, we can provide some indications about the performance of stylised stress testing models around historical banking crises and analyse each of the key requirements in turn. We find that models may not be correct, insofar as the underlying structural assumptions do not match output growth around many crises. We also show that, unless macro conditions are already weak prior to the eruption of the crisis, the vast majority of stress scenarios based on historical data are not severe enough in comparison with actual events. Last, our results raise doubts about the robustness of the models, as many of our simple stress testing models break down during the ensuing crisis. This raises interesting and fundamental questions for future stress testing practices, which are discussed in the concluding section.

Can stress testing models simulate crises in a realistic fashion?

Macro stress testing models can differ significantly in terms of complexity and the risks considered (for an overview, see Drehmann (2009)). However, they all share a similar structure rooted in the quantitative risk management framework. This is the same structure that underpins banks' own risk management and stress testing models (Summer (2007)).

A standard macro stress testing model is built in a modular fashion (Figure 1). The stress simulation itself begins with a scenario. But at the heart of the model are a set of exposures that are captured by the analysis. These are often the credit risk exposures of a bank or a banking system in a specific country. More advanced macro stress tests also incorporate market risk or counterparty credit risk in the interbank market. A module then identifies a set of systematic risk factors and models their impact on the analysed exposures, for example with a market or credit risk model. The majority of macro stress tests assume that only domestic macroeconomic variables are systematic risk factors. Therefore, they use as another module some variant of a structural or reduced-form macroeconomic model to capture the impact of the stress

Schematic structure of current stress testing models

Stress test scenario → Impact on the economy → Impact on credit and market risk exposures → Impact on the banking system

Macro feedbacks

Figure 1

scenario on the economy. Given the state of macro modelling more generally, few stress testing models incorporate feedbacks from the financial sector to the real economy, and those that do tend to be very reduced-form.
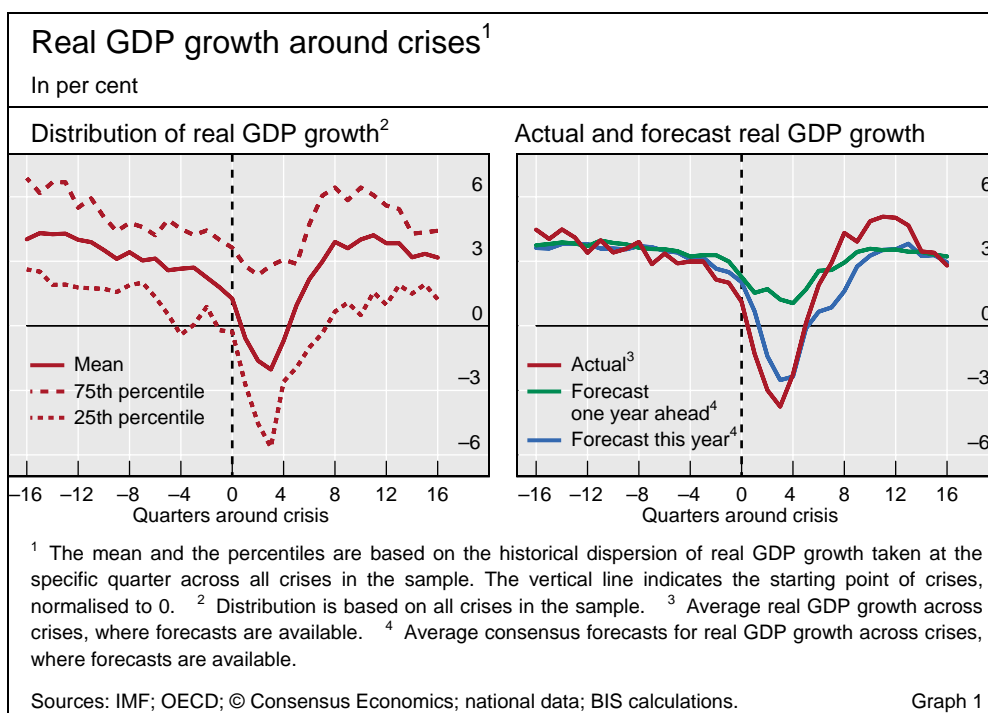
In short, current macro stress testing models assume that negative shocks to domestic macroeconomic factors drive stress events in the banking system. If this is a realistic description of how crises unfold, we should observe that domestic macroeconomic conditions weaken significantly ahead of banking crises. We assess whether this is true by looking at 43 banking crises in 30 countries, starting in 1974 and including the latest episodes.[4] And we assume that actual and expected real GDP growth are good summary indicators of broader macroeconomic conditions.

The average evolution of real GDP growth 16 quarters before and after the start of crises (denoted as 0 in the left-hand panel of Graph 1) suggests that the structural assumption may be justified. Average real GDP growth is above 4% four years prior to a crisis. It then starts to decline, with a marked drop one year ahead of the event. Once the crisis materialises, average GDP growth drops to −2% three quarters later. The recovery is V-shaped, and on average the economy returns to it pre-crisis growth path two years after the event. Average expected real GDP growth follows a similar pattern (Graph 1,

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[4] Historical banking crises are based on Laeven and Valencia (2008) and Reinhart and Rogoff (2008). From their large sample we exclude all crises where no quarterly GDP data are available at least 10 quarters prior to the crisis. In addition, we do not consider transition economies, given large apparent structural changes in those economies. To avoid overlaps in our analysis of pre- and post-crisis data, we also exclude the 1994 crisis in Brazil, which materialised less than four years after the previous episode. The following crises are included in the sample with the starting quarter in brackets: Argentina (Q4 1989, Q1 1995, Q4 2001), Australia (Q4 1989), Belgium (Q3 2008), Brazil (Q1 1990), Canada (Q4 1983), Denmark (Q4 1987), Finland (Q3 1991), France (Q1 1994, Q3 2008), Germany (Q3 2007), Iceland (Q4 1985, Q4 1993, Q3 2008), Indonesia (Q4 1997), Ireland (Q3 2008), Italy (Q3 1990), Japan (Q4 1997, Q3 2008), Korea (Q3 1997), Malaysia (Q3 1997), Mexico (Q4 1994), the Netherlands (Q3 2008), New Zealand (Q1 1987), Norway (Q4 1991), the Philippines (Q4 1983, Q3 1997), Singapore (Q4 1982), South Africa (Q4 1977), Spain (Q4 1977, Q4 1993, Q3 2008), Sweden (Q3 1991), Switzerland (Q4 2007), Thailand (Q3 1997), Turkey (Q4 2000), the United Kingdom (Q4 1974, Q4 1991, Q2 2007) and the United States (Q4 1988, Q3 2007).

Real GDP growth around crises[1]

In per cent

Distribution of real GDP growth[2]	Actual and forecast real GDP growth

Mean
75th percentile
25th percentile

Actual[3]
Forecast one year ahead[4]
Forecast this year[4]

Quarters around crisis

[1] The mean and the percentiles are based on the historical dispersion of real GDP growth taken at the specific quarter across all crises in the sample. The vertical line indicates the starting point of crises, normalised to 0.   [2] Distribution is based on all crises in the sample.   [3] Average real GDP growth across crises, where forecasts are available.   [4] Average consensus forecasts for real GDP growth across crises, where forecasts are available.

Sources: IMF; OECD; © Consensus Economics; national data; BIS calculations.   Graph 1

right-hand panel).[5] However, it appears that, on average prior to crises, consensus forecasts overestimate GDP growth. But once crises materialise, the average forecasts for the current year tend to underestimate the initial drop in output as well as the speed of the recovery. This aligns well with the current experience.

Two important caveats are worth highlighting. First, the timing of crises is not always unambiguous. We rely on Laeven and Valencia (2008) and Reinhart and Rogoff (2008), who define the beginning of crises by the emergence of large-scale policy assistance or the default of important players in the financial system. However, whether this method pinpoints the exact starting date is unclear. Boyd et al (2009), for example, show that stress often materialised beforehand. For example, Laeven and Valencia's (2008) approach dates the beginning of the current crises in Belgium, Iceland and Ireland after the bankruptcy of Lehman Brothers. An alternative starting date could be the first emergence of strains in global interbank markets in August 2007. If anything, such a dating would strengthen some of the messages in this paper.[6]

Second, looking at averages conceals the fact that domestic macroeconomic conditions remained rather robust around the beginning of a large fraction of banking crises. Some of the cross-crisis differences are apparent from the 25th and 75th percentiles of the distribution of real GDP growth (Graph 1, left-hand panel). The experience during the recent crisis is

… which conceals many exceptions

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[5] The sample of crises for which we observe consensus forecasts is smaller than our full sample. The consensus indicator is not as good a leading indicator as we would wish. The forecast for the current (next) year always refers to the current (next) calendar year independently of the quarter.

[6] For example, both the shape and the level of average GDP growth for the 2007 and 2008 crisis countries would have been almost identical in Graph 2 (left-hand panel).

even more illustrative. In the left-hand panel of Graph 2, we show the average across all crises as well as the average real GDP growth for the countries where the banking crises began in 2007 (2007 crises) and the countries which experienced systemic banking strains only after the collapse of Lehman Brothers (2008 crises). Up to one year ahead of the crisis, average real GDP growth for the latter group is broadly in line with the evolution of average real GDP growth for all crisis episodes.[7] Real GDP growth then drops significantly and falls deep into negative territory after the start of the crisis. Given limited data, we can obviously not show the recovery. The profile of average real GDP growth of the four 2007 crisis countries is significantly different. Until half a year after the crisis erupted, real GDP growth fluctuates around 2.5%. Only then does it begin to drop sharply, and it remains negative even two years after the event.

Overall, only just over one half of the crises in our sample were preceded by adverse macroeconomic conditions.[8] We define this broadly as a sharp drop in real GDP growth immediately prior to the crisis, or high macroeconomic volatility or low average growth in the previous three years.[9] For example, it seems that the structural assumptions about the pattern of GDP growth in stress testing models are justified for crises that are preceded by several years

Real GDP growth around crises for different subsamples[1]

In per cent

[1] The mean is based on the historical dispersion of real GDP growth taken at the specific quarter across all crises in the specified subsample. The vertical line indicates the starting point of crises, normalised to 0. [2] Average real GDP growth across all crises. [3] Average real GDP growth across crises which started in 2007 and 2008, respectively. [4] Average real GDP growth across crises, preceded by low (high) growth, defined as annual GDP growth being less than (more than) 2% on average in the three years prior to the crisis.

Sources: IMF; OECD; © Consensus Economics; national data.   Graph 2

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[7] This holds even if the average is calculated without the 2007 and 2008 crises.

[8] If crises were dated earlier, this share would be even lower.

[9] We always take a three-year horizon prior to the beginning of crises. Crises with high volatility are episodes where the standard deviation in output growth in this period is larger than the total average. A significant drop in GDP growth is defined as GDP growth dropping by more than 3 percentage points year on year. Low average growth is defined as average annual GDP growth in this period of less than 2%.

of low growth (Graph 2, right-hand panel). By contrast, for high-growth episodes, GDP growth is nearly 3% only two quarters prior to the beginning of the crisis.

Our finding that a large fraction of banking crises is not preceded by weak domestic macroeconomic conditions shows that current stress testing models are not able to replicate the dynamics of many past crises. This could be a result of stress tests considering the wrong risk factors and missing those which were the actual drivers of crises. For example, for many countries the current crisis was driven not by domestic exposures but by large shocks to foreign assets. Another explanation is that the underlying model structure is wrong and crises are not simply a result of large negative shocks to exogenous risk factors.

This dichotomy is already reflected in the literature on banking crises: one strand argues that banking crises are driven by shocks to fundamentals (eg Gorton (1988)). In other models, crises can emerge even when conditions are good. The classic panic-based bank run models (eg Diamond and Dybvig (1983)) are possibly the most obvious example. The same holds true for another intellectual tradition, which sees financial distress as the result of the build-up in risk-taking over time, owing to self-reinforcing feedback mechanisms within the financial system and between this and the real economy (Minsky (1982) and Kindleberger (1996)). In these models, the actual trigger for the crisis may be exceedingly small and unobservable (eg a change in mood). This contrasts strongly with current stress testing models, which require large shocks to generate a large impact. By construction, the endogenous build-up of vulnerabilities is also not possible with current stress testing models.

Different theoretical models have different implications for how stress testing models should be enhanced. We will discuss this below. For now, we remain within the assumed structure of stress testing models and assess whether it is possible to construct severe, yet plausible, scenarios.

Can we construct severe yet plausible scenarios?

Even though the preceding discussion showed that for a large fraction of crises the structural assumptions underlying stress testing models may not be met, output drops substantially in nearly all of our observed crises once stress emerges. A pragmatic approach to stress testing could use this as a starting point to construct scenarios, independently of whether falls in output truly reflect or cause crises.

The standard rule for scenario selection says that stress scenarios should be severe yet plausible (eg Quagliariello (2009)). But what does this mean in practice? Often scenario construction is guided by history in that either scenarios simply replicate historical stress events or shocks to risk factors are expressed in terms of high multiples of standard deviations of the historical distribution. For example, the shocks used for the UK IMF Financial Sector Assessment Program broadly corresponded to events three standard deviations away from the mean of a particular variable. The statistical

distributions, in turn, were based on the error variance of the Bank of England's macro model (Hoggarth and Whitley (2003)). It is also common practice to consider hypothetical scenarios designed to address current concerns without being constrained by the past. However, even then history provides a reference framework for judging the plausibility of the event: it is hard to argue that something is plausible if it is beyond the realm of anything that has been experienced.

We implement a historical approach to scenario selection in a highly stylised fashion to assess whether severe yet plausible scenarios can be constructed. We continue to consider real GDP growth as the main risk factor in our hypothetical stress testing models. And we assume that it depends only on its own past behaviour and random shocks.[10] To replicate the information available to policymakers before crises, we estimate a different model for each crisis in each country, using only data up to the crisis itself. For example, we observe two crises in the United States: the savings and loan crisis in the late 1980s and the current episode. Hence, one model is estimated with US data up to 1988, whilst the second model includes all information, including the past crisis, up to 2007.

As stress scenario, we use the worst negative forecast error of our crisis-specific models, regardless of whether this coincided with a banking crisis or not. We shock our models with these scenarios four quarters before the beginning of the crisis and compare the maximum drop in GDP growth during the stress test with the maximum drop during the actual episode.[11] This provides a rough benchmark to assess whether, based on information available before crises, a severe yet plausible scenario can be constructed. If so, we should find that the stress test we simulate is at least as severe as actual developments.

... may under-estimate vulnerabilities

We find strong evidence that a historical perspective does not always provide the right framework for scenario construction. In nearly 70% of all cases, the hypothetical stress scenarios fall short of the severity of actual events (Table 1). Interestingly, for none of the 11 countries that have experienced a banking crisis after 2007 do our stress tests anticipate the severe drop in GDP growth, even though several of these economies had previously experienced crises.

However, stress tests seem to be a useful tool to gauge the potential impact of further adverse shocks if macro conditions are already weak. In 64% of all low-growth episodes, stress scenarios are severe enough. This contrasts starkly with high-growth episodes, where in over 80% of all crises a stress test could not have generated the actual sharp decline in GDP growth.

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[10] Our stress testing models are simple autoregressive processes. Based on econometric selection criteria, we choose either an AR(1) or an AR(2) model as the best specification for each crisis. It is interesting to note that simple autoregressive models often outperform more complex ones in terms of forecast performance (eg Clements and Hendry (1998)).

[11] The maximum drop in GDP growth during the crises is calculated as the difference between GDP growth four quarters prior to the crises and the minimum GDP growth two years after the crises.

Comparison of the impact of stress tests with actual events[1]			
	Number of crises	Stress test less severe than actual events[2]	Stress test more severe than actual events[2]
All crises	43	67%	33%
Previous crises[3]	32	56%	44%
Current crises[3]	11	100%	0%
High growth[4]	29	83%	17%
Low growth[4]	14	36%	64%

[1] Comparison of the maximum drop in GDP growth during the stress test with the maximum drop during the actual episode. The stress scenario is the worst negative forecast error of our crisis-specific models.   [2] Percentage of crises in each category.   [3] Current crises are all crises which started in 2007 or 2008. Previous crises are those occurring before.   [4] Crises which were preceded by low (high) growth, defined as annual GDP growth of less than (more than) 2% on average in the three years prior to the crisis.

Sources: IMF; OECD; national data.   Table 1

Some of our results may be due to the inability of our simple model to capture macroeconomic feedbacks. Graphs 1 and 2 indicate that negative feedback spirals from the financial sector to the real economy seem to emerge during crises, as average real GDP growth drops sharply after crises began. On the other hand, we are also unable to capture the impact of policy actions implemented to contain the negative effects of banking crises. In both regards, our model is as limited as the vast majority of macro stress testing models currently in use.

It is also possible that our results are driven by the pre-crisis data sample, even though we use all the data that are readily available. We could take a longer-term perspective. For example, Haldane (2009) shows for the United Kingdom that the current crisis is not out of the ordinary in comparison with a historical perspective going back as far as 1693 for equity prices or 1857 for GDP growth. However, swings in output and the stock market index are very large if judged against the 10 years preceding current events.

The drawback of taking such a long-term perspective is that it ignores structural change. How could we assume that the economy has not evolved since the time when the United States was still a colony? Did the IT revolution not transform the interrelations within the banking system more recently? Clearly, the world is constantly changing. If models are not fully structural and parameters are not invariant to change, the estimated statistical relationships should be expected to change over time as well. From a stress testing perspective, it is especially important to ask whether such changes are likely to occur in an abrupt manner during crisis periods. If so, models will not be robust and the third requirement will be not fulfilled. We will explore this in the next section.

Are models robust during crises?

Model robustness is a crucial, but implicit assumption in any forecasting or simulation exercise. For stress testing models, it is generally assumed that the statistical relationships estimated prior to a crisis also describe the economy

adequately during a crisis. We use our simple model to test this implicit assumption for the crises in our sample.[12]

The results are discouraging: for 28 of our 43 crises (65%), the statistical relationships break down around the crisis date (Table 2). Models are particularly fragile after the beginning of the crisis.[13] And it seems that this is the case regardless of whether we look at high- and low-growth episodes or at current and previous crises. Even then, the current crisis stands out, as *all* our models experience a structural break after it started.

In principle, this result may be driven by the fact that we use the wrong model. But more realistic models are unlikely to fare better. We only look at a model with one variable. Cutting-edge stress testing models may have hundreds of equations, often estimated on an equation by equation basis. For the whole to be robust, we have to be confident that all equations are free of major structural breaks.

Both theory and the experience of past crises also make it very likely that reduced-form statistical models break down during crises. In most theoretical models, crises are associated with an abrupt change in the behaviour of economic agents. Independently of whether crises are assumed to be driven by fundamentals or not, these models imply that observables change suddenly and dramatically: depositors withdraw all their money, the interbank market freezes, banks ration credit, etc. And large public interventions are often the policy response prescribed by these models.

Structural breaks around crises						
	Overall	Before[1]	During[1]	After[1]	Only before[1]	Only after[1]
All crises	28	18%	75%	82%	0%	25%
Previous crises[2]	18	22%	83%	72%	0%	17%
Current crises[2]	10	10%	60%	100%	0%	40%
High growth[3]	20	20%	80%	90%	0%	20%
Low growth[3]	8	13%	63%	63%	0%	38%

[1] We estimate each model inserting dummies one year before and up to two years after crises started. We define a structural break if dummies in four consecutive quarters are jointly significant. (Only) Before / During / (Only) After indicates whether dummies are significant (only) before / during / (only) after the beginning of the crisis. Percentage of structural breaks in each category. [2] Current crises are all crises which started in 2007 or 2008. Previous crises are those occurring before. [3] Crises which were preceded by low (high) growth, defined as annual GDP growth of less than (more than) 2% on average in the three years prior to the crisis.

Sources: IMF; OECD; national data; BIS calculations.   Table 2

[12] Graphs 1 and 2 indicate that there is no permanent statistical break during crises as GDP growth recovers after several quarters. Therefore standard statistical break tests do not apply. Hence, we estimate each model using all available data including crisis periods and insert dummies one year before and up to two years after crises started. We define a structural break if dummies in four consecutive quarters are jointly significant (at the 10% level). This is a relatively strong test as it requires that the statistical relationships break down over a one-year horizon.

[13] Similar results have been found in the literature. Cecchetti et al (2009b) find that 50% of crises in their sample experience a structural break in the level or the trend in real GDP within one or two years of the beginning of the crisis.

Central bank balance sheets and spreads for the current crisis[1]

Three-month Libor minus OIS spreads[2]	Balance sheets of central banks[3]

[1] The vertical line indicates August 2007 as the starting point of the current crisis. [2] In basis points. [3] Index, 2007 average = 100.

Sources: Bloomberg; Datastream; BIS calculations.   Graph 3
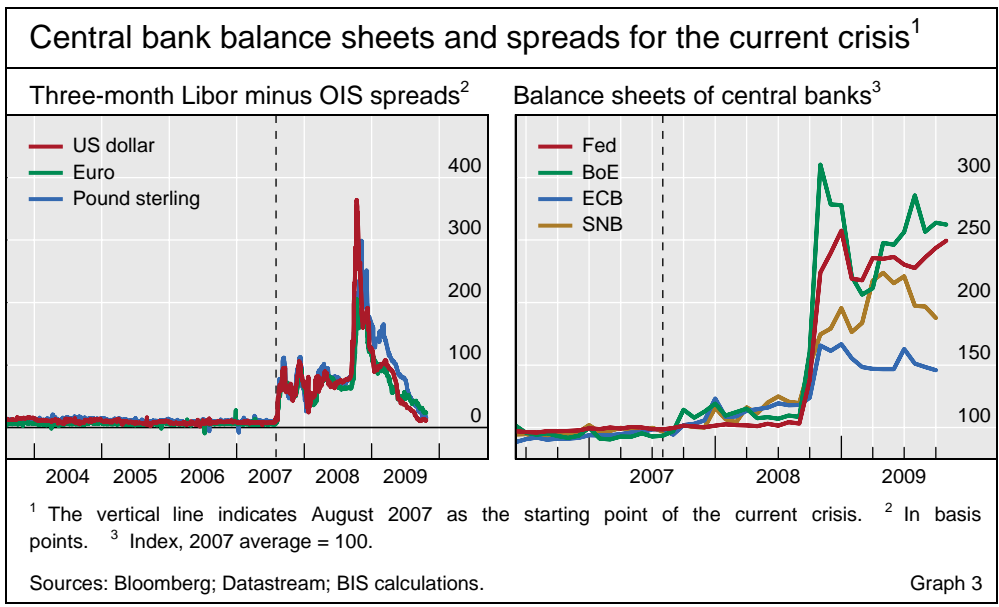
Looking at past crises, we also find that observables change drastically after a crisis, and often in ways which could not have been anticipated prior to the events. For example, before August 2007, the spread between interbank rates and overnight index swap rates had fluctuated between 10 and 15 basis points (Graph 3, left-hand panel). Ex post, it seems obvious that these spreads can widen dramatically. But ex ante, any hypothetical stress test that would have implied spreads climbing beyond 300 basis points would certainly not have passed the plausibility test. Policy also reacted in unforeseeable ways. Central banks around the globe undertook unprecedented policy operations. It would have been very hard to anticipate the degree of quantitative easing and, by implication, the ballooning of central banks' balance sheets (Graph 3, right-hand panel). Even more difficult would have been to foresee the effects of these policy interventions, as they are still not fully understood.

... in ways that are impossible to predict

Stress tests and crises – what do we learn?

For this article, we undertook stress tests prior to past crises and compared results with actual outcomes. In particular, we examined the performance of three fundamental requirements which should be fulfilled for stress tests to provide useful information. First, the correct model should be used. But it is questionable whether the current modelling framework aligns well with observables around historical banking crises. In nearly 50% of the analysed crises, the evolution of GDP growth does not seem to be in line with the structural assumptions of current stress testing models. Second, the stress scenario should be severe yet plausible. But unless macro conditions are already weak prior to the eruption of the crisis, we show that the vast majority of stress scenarios based on historical data are not severe enough in comparison with actual events. Last, models should be robust. Our results also question whether this can be generally assumed as 64% of our simple models break down during the following crisis.

Assumptions underlying stress testing models are often not met

What do these findings imply for macro stress testing? For stress tests to be useful, the underlying structure has to be improved to better capture crisis dynamics. An important avenue of future research is to incorporate more risk factors, such as international interlinkages or non-macro factors. But it is also crucial that future stress testing models should be able to replicate endogenous cycles, which are often the underlying driver of crises. This is a major challenge as macro models more generally are currently far from being able to do so (eg Cecchetti et al (2009a)).

But there is a fundamental problem. Like any other model, stress testing models can only capture reality in a stylised fashion.[14] Model builders therefore have to make choices concerning what is essential, what can be represented in a reduced-form fashion and what can be ignored.[15] This is not an easy task: as Caballero and Kurlat (2009) point out, ex post we may well be able to understand how models failed, but ex ante this is different. For the current crises, for example, we would have had to fully identify the dangers of structured investment vehicles and structured products. However, the prevailing view at the time was that these innovations were, on balance, highly beneficial, as they would shift risk to those better able and willing to bear it.

For the foreseeable future, the challenges in modelling crises appropriately seem enormous. And as we have argued, it is doubtful that the statistical models will be free of structural breaks once crises emerge. As a consequence, it is likely that stress tests will continue to underestimate the risks to the economy, as they did prior to the current crisis. There is, therefore, a real danger that stress testing results will continue to lull users into a false sense of security (Borio and Drehmann (2009)). We suggest three practical steps to reduce this risk.[16]

First, model outputs should not be taken at face value and all results should be interpreted with great caution. It is important that this is understood by all users of the output, be they policymakers, commercial banks or the media. One way to highlight this problem would be to publish stress testing results with confidence intervals, as is often done for macro forecasts.

Second, macro stress tests should not be seen as the final output but as the starting point for an effective discussion about potential financial stability threats. The modelling challenges imply that meaningful stress testing exercises will have to involve discussions and judgments. As Bunn et al (2005)

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[14] It is important to understand the ultimate objective of the model in order to make modelling choices (Drehmann (2008)). A model will never serve all objectives equally well, as model requirements can sometimes conflict. For example, the model with the highest forecast ability may not necessarily be the one which is most tractable and suited for story telling.

[15] The choices are often guided by history or banks' own risk management models and the risks these highlight. Relying on banks' own risk management models to identify risks raises an interesting conundrum. If banks' own stress testing models are useful, the results should feed into banks' capital and liquidity decisions (taken either voluntarily or through regulatory pressure) and thereby reduce the related risks.

[16] An important side benefit of stress testing is that repeated stress tests help to organise available data in a coherent and user-friendly fashion. The ready availability of this information can be highly valuable during crises or in addressing other policy questions.

have pointed out, one important value added of stress testing models is in providing a coherent framework within which to consider the implications of differing judgments, for example on how new financial products may change the dynamics of crises or how a vulnerability may crystallise in different ways. Taking account of judgments and a range of views across the organisation is also one of the key recommendations of the Basel Committee (BCBS (2009)) in its principles for sound stress testing practices.

Third, scenario design is critical. Regardless of how elaborate models or stress testing processes become, the outcome will always depend on judgments and the stress scenario. As we have shown in this article, a statistical approach to scenario selection will certainly fall short for many future crises. However, there is no easy answer to the question of how to do it best otherwise. An interesting starting point could be new products which grow rapidly, or business areas where banks make large profits. Historically, these areas could have identified some of the vulnerabilities in the run-up to crises. Scenario design will certainly require creative thinking and the courage to ask unusual questions because, as history has shown, once crises emerge we should expect the unexpected.

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Monetary policy and the risk-taking channel[1]

This paper investigates the link between low interest rates and bank risk-taking. Monetary policy may influence banks' perceptions of, and attitude towards, risk in at least two ways: (i) through a search for yield process, especially in the case of nominal return targets; and (ii) by means of the impact of interest rates on valuations, incomes and cash flows, which in turn can modify how banks measure risk. Using a comprehensive dataset of listed banks, this paper finds that low interest rates over an extended period cause an increase in banks' risk-taking.

JEL classification: E44, E55, G21.

Easy monetary conditions are a classic ingredient of financial crises: low interest rates may contribute to an excessive expansion of credit, and hence to boom-bust type business fluctuations. In addition, some recent papers find a significant link between low interest rates and banks' risk-taking, pointing to a different dimension of the monetary transmission mechanism, the so-called risk-taking channel (Borio and Zhu (2008), Adrian and Shin (2009)). This channel may operate in at least two ways. First, low returns on investments, such as government (risk-free) securities, may increase incentives for banks, asset managers and insurance companies to take on more risk for contractual or institutional reasons (for example, to meet a target nominal return). Second, low interest rates affect valuations, incomes and cash flows, which in turn can modify how banks measure risk.

This article analyses empirically the link between monetary policy and risk-taking by banks in the run-up to the crisis. Using a comprehensive database of listed banks from the European Union and United States developed by Altunbas et al (2009), it finds evidence that banks' risk of default implied by asset prices shot up by a larger amount in countries where interest rates had remained low for an extended period prior to the crisis. This result is consistent with the existence of a risk-taking channel and holds even if one

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allows for the influence of a wide range of macroeconomic and microeconomic factors.

The article is organised as follows. The first section discusses the functioning of the risk-taking channel from a theoretical point of view. The second section summarises the main stylised facts and previous empirical evidence. The third section presents new results, based on an econometric exercise conducted on a dataset of around 600 listed banks operating in Europe and the United States. The last section concludes.

Inside the risk-taking channel: theory

There are a number of ways in which low interest rates can influence risk-taking. The first is through the search for yield (Rajan (2005)). Low interest rates may increase incentives for asset managers to take on more risks for contractual, behavioural or institutional reasons. For example, in 2003–04 many investors shifted from low-risk government bonds into higher-yielding but riskier corporate and emerging market bonds. They were seeking to meet the nominal returns they had been able to achieve when interest rates were higher (BIS (2004)).

The risk-taking channel may operate through an increase in search for yield …

The inertia in nominal targets at a time of lower interest rates may reflect a number of factors. Some are psychological, such as money illusion: investors may ignore the fact that nominal interest rates may decline to compensate for lower inflation. Others may reflect institutional or regulatory constraints. For example, life insurance companies and pension funds typically manage their assets with reference to their liabilities. In some countries, liabilities are linked to a minimum guaranteed nominal rate of return or returns reflecting long-term actuarial assumptions rather than the current level of yields. Such minimum returns may be fixed by statute, as in Switzerland, or contractually, as in some cases in Japan and the United Kingdom in the recent past. In a period of declining interest rates, they may exceed the yields available on highly rated government bonds. The resulting gap can lead institutions to invest in higher-yielding, higher-risk instruments. More generally, financial institutions regularly enter into long-term contracts committing them to produce relatively high nominal rates of return. The same mechanism could be in place whenever private investors use short-term returns as a way of judging manager competence and withdraw funds after poor performance (Shleifer and Vishny (1997)).

… that reflects psychological, institutional or regulatory factors …

The second way low interest rates can make banks take on more risk is through their impact on valuations, incomes and cash flows.[2] A reduction in the policy rate boosts asset and collateral values, which in turn can modify bank estimates of probabilities of default, loss-given-default and volatilities. For example, low interest rates and increasing asset prices tend to reduce asset

… or through the ways banks measure risk

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[2] This is close in spirit to the familiar financial accelerator, in which increases in collateral values reduce borrowing constraints (Bernanke et al (1996)). Adrian and Shin (2009) claim that the risk-taking channel differs from and strengthens the financial accelerator because it focuses on amplification mechanisms due to financing frictions in the lending sector. See also Borio and Zhu (2008).

price volatility and thus risk perception: since a higher stock price increases the value of equity relative to corporate debt, a sharp increase in stock prices reduces corporate leverage and could thus decrease the risk of holding stocks.[3] This example can be applied to the widespread use of value-at-risk methodologies for economic and regulatory capital purposes (Danielsson et al (2004)). As volatility tends to decline in rising markets, it releases risk budgets of financial firms and encourages position-taking. A similar argument is provided in the model by Adrian and Shin (2009), who stress that changes in measured risk determine adjustments in bank balance sheets and leverage conditions, which, in turn, amplifies business cycle movements.[4]

Stylised facts and empirical evidence

In the aftermath of the bursting of the dotcom bubble, many central banks lowered interest rates to combat recession. With inflation remaining remarkably stable, central banks in a number of developed countries kept interest rates below previous historical norms for some time (Taylor (2009) and Graph 1). The implication of these strategies for risk-taking did not loom large in policy decisions. First, most central banks around the world had progressively shifted to tight inflation objectives. Second, financial innovation had, for the most part, been regarded as a factor that would strengthen the resilience of the financial system, by resulting in a more efficient allocation of risk.

One reason for not focusing on the effects that low interest rates could have on risk-taking was the absence of any solid empirical evidence. Only recently have a few studies specifically tried to test for the existence of the risk-taking channel. In the remaining part of this section we summarise these studies.
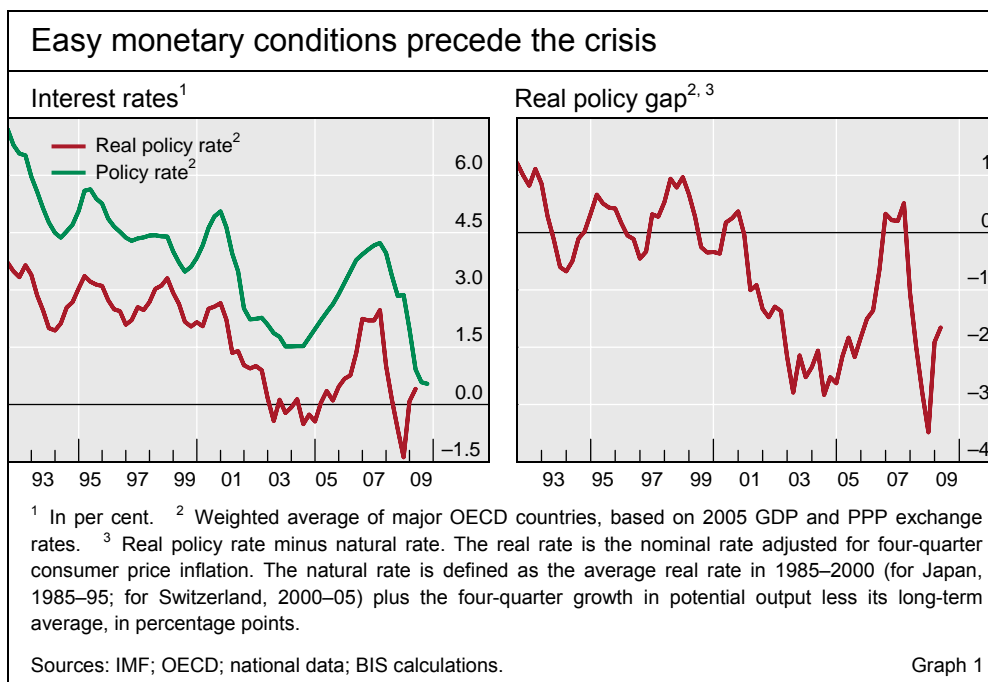
The paper by Jiménez et al (2009) uses micro data of the Spanish Credit Register over the period 1984–2006 to investigate whether the stance of monetary policy has an impact on the level of risk of individual bank loans.[5] They find that low interest rates affect the riskiness of the loan portfolio

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[3] For this reason, the link between asset prices and asset price volatility is sometimes described as the leverage effect. See eg Pagan and Schwert (1990) and the studies cited in Bollerslev et al (1992).

[4] Risk-taking may also be influenced by central banks' communication policies and the characteristics of policymakers' reaction functions. For example, a high degree of central bank predictability with regard to future policy decisions can reduce market uncertainty and thus lead banks to take on more risks. And agents' perception that a central bank will ease monetary policy in the event of bad economic outcomes can lower the probability of large downside risks, thereby producing an insurance effect. For this reason, Diamond and Rajan (2009) argue that in good times monetary policy should be kept tighter than strictly necessary based on current economic conditions, in order to diminish banks' incentive to take on liquidity risk.

[5] To solve the endogeneity problem (in principle, bank risk could influence monetary policy rather than vice versa), Jiménez et al (2009) use a German rate as a measure of the stance of monetary policy for Spain before 1999 and euro area rates afterwards. The authors explain this choice with the fact that "during the period analysed short-term interest rates in Spain were decided mostly in Frankfurt, not in Madrid". This is because, implicitly from mid-1988 and explicitly from mid-1989 when Spain joined the European Monetary System and its exchange

Easy monetary conditions precede the crisis

Interest rates[1]	Real policy gap[2, 3]

Interest rates[1]
- Real policy rate[2]
- Policy rate[2]

6.0
4.5
3.0
1.5
0.0
−1.5

Real policy gap[2, 3]

1
0
−1
−2
−3
−4

93 95 97 99 01 03 05 07 09

93 95 97 99 01 03 05 07 09

[1] In per cent. [2] Weighted average of major OECD countries, based on 2005 GDP and PPP exchange rates. [3] Real policy rate minus natural rate. The real rate is the nominal rate adjusted for four-quarter consumer price inflation. The natural rate is defined as the average real rate in 1985–2000 (for Japan, 1985–95; for Switzerland, 2000–05) plus the four-quarter growth in potential output less its long-term average, in percentage points.

Sources: IMF; OECD; national data; BIS calculations.   Graph 1

of Spanish banks in two conflicting ways. In the short term, low interest rates reduce the probability of default of *outstanding variable rate loans*, by reducing interest burdens of existing borrowers. In the medium term, however, due to the higher collateral values and the search for yield, banks tend to *grant more risky loans* and, in general, to soften their lending standards: they lend more to borrowers with bad credit histories and with more uncertain prospects. Overall, these results suggest that low interest rates reduce credit risk in banks' portfolios in the short term – since the volume of outstanding loans is larger than the volume of new loans – but raise it in the medium term.

Ioannidou et al (2009) take a different, complementary, perspective and analyse whether the risk-taking channel works not only on the quantity of new loans but also on their interest rates. The authors investigate the impact of changes in interest rates on loan pricing using Bolivian data over the period 1999–2003.[6] They find that, when interest rates are low, banks not only increase the number of new risky loans but also reduce the rates they charge risky borrowers relative to those they charge less risky ones. And interestingly, the reduction in the corresponding spread (and the extra risk) is higher for banks with lower capital ratios and more bad loans.

... and reduce the loan rates of risky borrowers relative to those charged to less risky ones

Altunbas et al (2009) take a more international perspective. They analyse the link between monetary policy and bank expected default frequencies (EDFs) using data for 600 European and US listed banks over the period 1999–2008.[7] From a macroeconomic point of view this analysis is relevant

The risk-taking channel is effective at the international level

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rate mechanism, the exchange rate target with the Deutsche mark was one of the main objectives of its monetary policy.

[6] They also use an exogenous measure of monetary policy, the US federal funds rate, because during the sample period the Bolivian peso was pegged to the US dollar and the banking sector was almost completely dollarised.

[7] The EDF is a forward-looking indicator of credit risk computed by Moody's KMV, which builds on Merton's model to price corporate bond debt.

because the dataset represents more than two thirds of the total lending provided by banks in the European Union and the United States. In order to examine whether policy rates were historically low prior to the crisis they compare them with two benchmarks: (1) interest rates implied by Taylor rules and (2) natural interest rates, calculated as a smooth trend of past interest rate levels. They find evidence of a link between low interest rates for protracted periods and increased risk-taking by banks over the last decade. This result holds when controlling for a wide set of factors: changes in business cycle expectations, differences in the intensity of bank supervision and changes in bank competition. The next section presents a simple model that builds on the analysis of Altunbas et al and tries to shed some light on the link between low interest rates and bank risk-taking with explicit reference to the crisis period.

Estimating the effects of low interest rates on bank risk-taking

Increase in bank risk materialises in a non-linear way…

The recent crisis has reminded us that risks can materialise in non-linear ways. The left-hand panel of Graph 2 shows the evolution of banks' EDFs over the last decade. Notice how the consequences of banks' risk-taking started to emerge suddenly in the third quarter of 2007, triggered by the subprime crisis, and became even more apparent after the Lehman Brothers bankruptcy in September 2008.

… in both interest rate spreads and bank lending supply …

This section tests empirically if low interest rates for an extended period prior to the crisis could have led banks to take on more risks. The right-hand panel of Graph 2 shows some preliminary descriptive evidence. In the United States, where the federal funds rate was below the benchmarks used by Altunbas et al (2009) for 17 consecutive quarters in 2002–06, the subsequent increase in banks' EDFs was greater than in EU countries, where the policy rate was below the benchmark for only 10 quarters on average. If the risk-taking channel is at work, in line with the findings by Ioannidou et al (2009), we should observe a progressive reduction of spreads and lending standards prior

Bank risk materialised suddenly after an extended period of low interest rates

[1] Over a one-year-ahead horizon; averages by country or group of countries. [2] Cross-sectional analysis for a sample of 588 listed banks. On the horizontal axis, interest rates have been considered low if below both the natural rate and the interest rate implied by a Taylor rule. For more details, see Altunbas et al (2009).

Sources: Altunbas et al (2009); Moody's KMV.   Graph 2

to the crisis. The left-hand panel of Graph 3 shows the difference between the interest rate paid on bonds by BBB- and AAA-rated firms, a proxy for the spread on risky relative to less risky borrowers. This spread narrowed significantly in both the euro area and the United States during the period of very low interest rates.
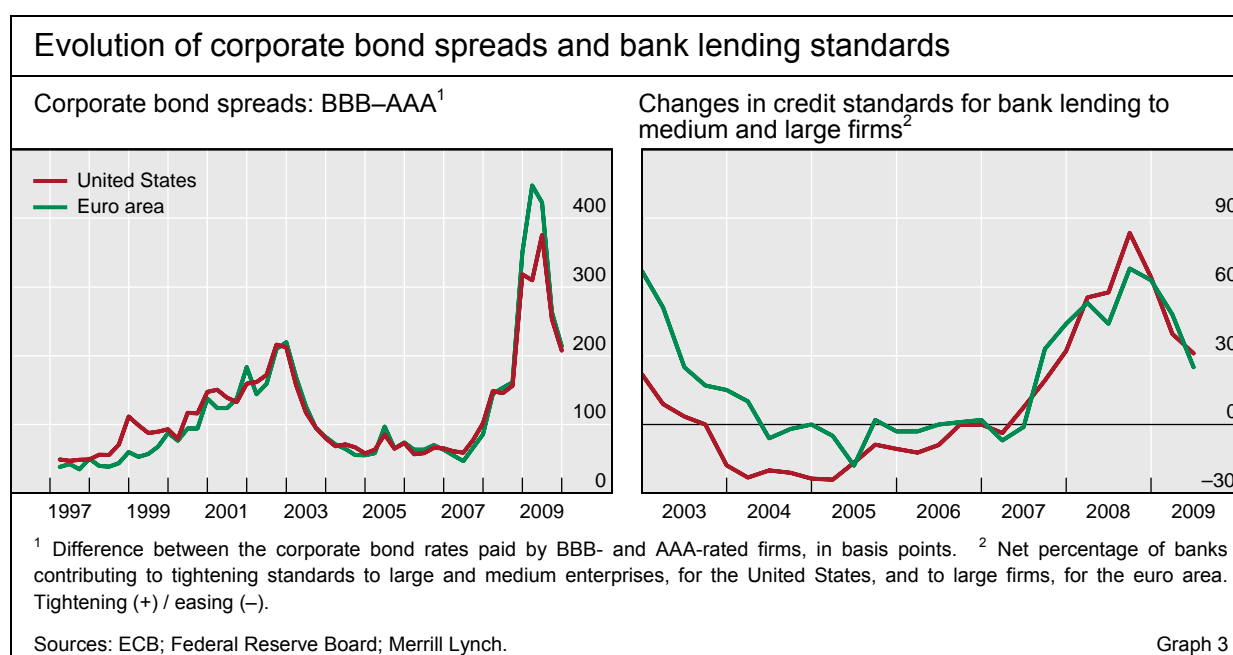
Bank lending surveys, in which bank loan officers are asked directly about their willingness to grant credit, provide further information on attitudes towards risk. The right-hand panel of Graph 3 reports the results from both the ECB Bank Lending Survey and the US Senior Loan Officer Opinion Survey on Bank Lending. This measure of credit conditions is the difference between the number of banks that reported a tightening in a given quarter and the number that reported an easing. We see that the crisis was preceded by a prolonged period of lending expansion. The subsequent manifestation of credit risk at the beginning of 2007 caused a significant drop in the quantity of lending (Chari et al (2008), Cohen-Cole et al (2008)).

Next, we turn to a more formal econometric analysis. The following identification strategy is used: since monetary policy conditions vary across countries, the hypothesis of the risk-taking channel would suggest that bank risk increases by more in countries where interest rates have been relatively low (below both the Taylor rule and the natural rate that reflects national economic conditions) for a greater number of consecutive quarters prior to the crisis. The use of microeconomic data allows us to rule out the possibility that the increase in banks' EDFs is simply caused by the realisation of a negative shock which affects all financial intermediaries in the same way, and to control for the impact on risk-taking of bank-specific characteristics.

… and more in countries where policy rates are low for an extended period of time

The econometric model (described in more detail in the box) relates the change in the EDF of a given bank during the crisis period (Q2 2007–Q4 2008) to average bank-specific characteristics and macroeconomic conditions of the country where the financial intermediary has its head office in the six years prior to the crisis (Q2 2001–Q2 2007).

The econometric analysis relates change in bank EDFs during the crisis to low interest rate periods

Evolution of corporate bond spreads and bank lending standards

Corporate bond spreads: BBB–AAA[1]

Changes in credit standards for bank lending to medium and large firms[2]

[1] Difference between the corporate bond rates paid by BBB- and AAA-rated firms, in basis points. [2] Net percentage of banks contributing to tightening standards to large and medium enterprises, for the United States, and to large firms, for the euro area. Tightening (+) / easing (–).

Sources: ECB; Federal Reserve Board; Merrill Lynch.

Graph 3

We relate changes in bank EDFs to country-specific macro variables because intermediation activity, which is the most important part of banks' business, is done mainly towards residents. Nevertheless, we are aware that a part of bank activities takes place on international markets and that national conditions could be less important for a number of big European banks located in small countries. However, if this were the case we should observe a less significant link between changes in individual bank risk and low interest rates in the country where the bank is headquartered. In other words, if a risk-taking channel is detected using our identification strategy, the strength of this channel would be expected to be even more significant when controlling for multinational activity.

The model is estimated using balance sheet data for some 600 listed banks operating in the European Union and the United States, enriched with individual proxies of bank risk. In the analysis we consider a number of bank-specific characteristics (size, liquidity, capitalisation, profitability, lending growth and degree of securitisation activity) and macroeconomic variables (change in nominal GDP, slope of the yield curve and real housing and stock market returns). We also include institutional characteristics, such as the intensity of regulation of bank activities.

Econometric results are consistent with the existence of a risk-taking channel …

Consistent with the risk-taking channel hypothesis, we see that when interest rates are low for an extended period banks' EDFs tend to increase. This is obviously not the conclusive test for the existence of a risk-taking channel, but, taken at face value, the estimation result suggests that if interest rates are maintained below the benchmark for 10 consecutive quarters, ceteris paribus, the probability of default of an average bank increases by 3.3%.[8]

… and confirm that developments in the housing market …

The empirical exercise points to a number of other interesting findings. First, developments in housing prices prior to the crisis appear to have contributed to bank risk-taking. An inflation-adjusted house price growth rate that is 1 percentage point above its long-run average for six consecutive years leading up to the crisis increases the probability of default of the average bank by 1.5%. This result is in line with the view that the housing market had a substantial role in the crisis and that banking distress was typically more severe in countries that experienced a more pronounced boom-bust cycle in house prices.

… together with excessive growth in bank lending, had a role in the crisis

Second, banks that experienced a higher growth rate of lending with respect to the industry average prior to the crisis proved to be riskier ex post. For example, lending of about 10% above average over the six years preceding the crisis caused an increase in bank probability of default by 3.9%.

Third, securitisation appears to play a secondary role in explaining the evolution of bank risk. Banks heavily involved in the securitisation market may

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[8]   The robustness of this result has been checked in several ways. First, we analysed different measures for bank risk (EDFs at different time horizons, credit default swaps, ratings), disentangled idiosyncratic and systematic risk components, and checked for the impact of business expectations. Second, the results were robust to different estimation methods (GMM, probit, logit). For a more complete list of robustness checks, see Altunbas et al (2009).

Does monetary policy affect bank risk-taking?

This box reports a simple econometric model that can shed light on which factors have influenced the evolution of bank risk in the current crisis. The model relates the change in the riskiness of a given bank i (proxied by its EDF) during the crisis period (Q2 2007–Q4 2008) to the macroeconomic conditions of the country where the financial intermediary is headquartered (k) and bank-specific characteristics over the six years prior to the crisis (Q2 2001–Q2 2007). The econometric model is given by the following equation:

$$\Delta EDF_{i,k} = \beta\, LOWINT_k + \chi\, \Delta GDPN_k + \delta\, SLOPE_k + +\vartheta ROA_{i,k} + \mu\Delta HP_k + \kappa\Delta SM_k + \alpha\, EDF_{i,k} +$$

$$+ \varpi\, SIZE_{i,k} + \tau\, LIQ_{i,k} + \xi\, CAP_{i,k} + +\phi EXLEND_{i,k} + \psi\, SEC_{i,k} + \lambda REG_k + \varepsilon_i$$

where the variables are described in Table A.

Regression results

Dependant variable: ΔEDF during the crisis period (Q2 2007–Q4 2008)	Variable definition	Coef	Std err	t	$P > t$
LOWINT	Number of consecutive quarters with interest rate below both the natural rate and the rate implied by a Taylor rule in the six years prior to the crisis	0.328**	0.129	2.54	0.011
ΔGDPN	Average growth of nominal GDP	−1.347**	0.672	−2.00	0.046
SLOPE	Average slope of the yield curve	−0.693	0.600	−1.15	0.249
ROA	Return on assets	−0.629	0.524	−1.20	0.231
ΔHP	Change in housing price index corrected for inflation (de-meaned)	1.543***	0.336	4.59	0.000
ΔSM	Change in stock market returns corrected for inflation (de-meaned)	0.259	0.396	0.65	0.513
EDF	Average level of bank EDF prior to the crisis	1.762**	0.685	2.57	0.010
SIZE	Log of total assets (USD millions)	0.185	0.136	1.36	0.176
LIQ	Liquidity to total assets ratio	−0.041**	0.017	−2.37	0.018
CAP	Capital to total assets ratio	−0.024	0.042	−0.56	0.576
EXLEND	Credit expansion relative to banking industry average	0.378***	0.097	3.88	0.000
SEC	Securitised lending over total assets	0.749	0.467	1.60	0.109
REG	Regulatory index: extent to which banks may engage in security, insurance and real estate activities	0.112	0.121	0.92	0.356
Constant		−5.867*	3.165	−1.85	0.064

All variables, except ΔEDF and LOWINT, are averages of quarterly data over the period Q2 2001–Q2 2007. Robust standard errors. *, ** and *** represent significance levels of 10%, 5% and 1%, respectively. Number of observations = 588; $F_{(13, 574)}$ = 5.38. Prob > F = 0.00; R-squared = 0.1363. Table A

As is common in cross-section analysis, the R-squared of the regression is not very high (14%). This reflects the fact that the model captures only some of the underlying long-term causes of the financial turmoil and does not use any information from the crisis period. This means that it neglects all those factors, such as negative changes in expectations, difficulties in financial markets, liquidity interventions and, most important, bank idiosyncratic shocks, that unfolded after the summer of 2007.

The results confirm the existence of a risk-taking channel: there is a positive and significant link between the number of consecutive quarters in which interest rates have been below the benchmark (LOWINT) and changes in the EDF of individual banks.

The empirical exercise also sheds light on other factors that may have influenced the evolution of risk. Better economic conditions (high $\Delta GDPN$) increase the number of projects becoming profitable in terms of expected net present value, thereby reducing the overall credit risk of the bank.

A steeper yield curve (*SLOPE*) increases bank profits (and decreases EDF) because of the typical maturity transformation function performed by banks (their assets have a longer maturity than liabilities). The effect is, however, not statistically significant even if we introduce the return on assets (*ROA*) directly.

The effects of improvements in borrowers' net worth and collateral are taken into account through the evolution of asset prices, where ΔHP and ΔSM are, respectively, the average quarterly changes in real housing and stock market returns over the five years prior to the crisis. The introduction of these variables accounts for the effects of the standard financial accelerator mechanism through which financing frictions on firms and households amplify or propagate exogenous disturbances (Bernanke and Gertler (1989)). With a given bank risk aversion (or tolerance), the coefficients of both variables should be negative: a boost in asset prices increases the value of collateral and reduces overall credit risk. By contrast, a positive coefficient should capture the fact that the market perception of risk could fall in good times and increase suddenly in bad ones (Borio et al (2001)). The results show that only the coefficient for housing prices has a statistically positive influence on bank risk. This result is in line with the view that the housing market had a major role in the crisis (Ellis (2008)).

The link between monetary policy and bank risk could also be influenced by balance sheet characteristics that summarise the ability and willingness of banks to supply additional loans or to tap funds on the market (Ehrmann et al (2003)). The specification also includes *SIZE*, the log of total assets; *LIQ*, securities and other liquid assets over total assets; and *CAP*, the capital-to-asset ratio. All other things being equal, liquid and well capitalised banks are less risky. However, only the effect of the liquidity ratio on bank risk appears to be particularly relevant, confirming the fact that the credit crisis has been characterised by a sudden shortage of liquidity.

Other variables affecting the increase in banks' EDFs during the crisis are excessive lending relative to the banking industry average (*EXLEND*) and the use of securitisation instruments (*SEC*) prior to the crisis, although the significance of the latter effect is statistically weak. The equation also includes an index developed in Barth et al (2004) that measures the extent to which banks are allowed to engage in securities, insurance and real estate activity (*REG*). In this case, too, the impact is positive but not statistically significant.

not have enough incentives to screen borrowers and monitor loans, which could result in underestimation of risk. Drucker and Puri (2007) argue that securitised loans tend to be less informationally sensitive than loans held by banks, ie banks sell loans such as mortgages for which screening and monitoring are comparatively less important. The econometric results show that banks that securitised a higher proportion of their assets before the crisis did become riskier during the crisis, but the effect is statistically weak.

Conclusions

The current credit crisis has drawn the attention of researchers and policymakers to the link between monetary policy and risk perceptions and attitudes (Borio and Zhu (2008), Adrian and Shin (2009)). Recent econometric studies have found a significant link between low interest rates and banks' risk-taking based on evidence from Spain and Bolivia (Jiménez et al (2009), Ioannidou et al (2009)). This special feature has confirmed these findings, drawing on a comprehensive database of listed banks operating in the European Union and the United States. Building on the econometric work by Altunbas et al (2009), the analysis finds evidence of a significant link between

an extended period of low interest rates prior to the crisis and banks' risk-taking.

The main implication of these findings is that monetary policy is not fully neutral from a financial stability perspective. This is of interest to both monetary and supervisory authorities. It is important that monetary authorities learn how to factor in the effect of their policies on risk-taking, and that prudential authorities be especially vigilant during periods of unusually low interest rates, particularly if they are accompanied by other signs of risk-taking, such as rapid credit and asset price increases.

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Government size and macroeconomic stability[1]

This article examines the potential role of government size in explaining differences in output volatility across OECD countries in the context of the latest recession. There is some evidence to suggest that government size as measured by the share of expenditure in GDP has a modest negative association with output volatility. Moreover, this link seems to have weakened further since the mid-1980s. Factors such as trade openness and exposure to terms-of-trade shocks as well as volatility of inflation appear important. Interestingly, the same set of factors seems to matter in explaining the severity of recession in OECD countries.

JEL classification: E6, E32, F41.

During the latest recession, output losses were large relative to those of past recessions and varied significantly across countries. Several factors were clearly at work, including the severity of the financial crisis and differences in exposure to external demand shocks. Even so, the decline in output appears to have been typically larger in countries where the size of the government was smaller. For instance, cumulative output losses between the third quarter of 2008 and the second quarter of 2009 were about 10% (not seasonally adjusted) in Hong Kong SAR, Mexico and Taiwan (China), which had a relatively smaller share of government expenditure in GDP (18–20%). By contrast, in Norway and France, where the share of government expenditure exceeded 40% and 50% of GDP, output fell by 2% and 1%, respectively. This has sparked a debate as to whether the size of the government has an influence on the depth of the recession.[2]

The link between government size and output volatility raises both conceptual and empirical issues. At the conceptual level, the stabilising role of fiscal policy could be traced to both automatic and discretionary effects. The former are linked to the share of the government sector in output. From this viewpoint, the larger the government size, the greater could be the automatic

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[2] For competing views, see eg Krugman (2009) and Reynolds (2009).

stabilising impact of fiscal policy. By contrast, provided it is conducted symmetrically during recessions and expansions, discretionary fiscal policy should neither be based on government size, nor should it affect the tax and expenditure shares in GDP across business cycles. Hence, an economy with a small government size should not have less capacity to dampen shocks. In addition, other polices – particularly monetary policy – can substitute for a countercyclical fiscal policy. And there may be situations where larger governments may contribute to increasing rather than reducing output volatility.

At the empirical level, the literature has generally found a negative relationship between government size and output volatility. Yet output volatility is affected by several factors, which may or may not be correlated with government size. Consequently, identifying an independent effect of government size on output volatility is not easy. And the impact found could vary depending on other variables in the model.

The purpose of this special feature is to examine the link between government size and output volatility in the light of the current recession. The focus is on 20 major OECD countries for which consistent time series are available since 1970. The article seeks to throw light on several issues. The first is whether government size is a major determinant of output volatility and, if so, how far. A second issue is whether there are other factors that are more important in determining output volatility than government size. A third issue is the extent to which government size may also matter for the severity of recessions as opposed to normal output volatility.

We find that although the share of government expenditure in GDP does in general stabilise the macroeconomy, the effect seems to have weakened since the mid-1980s. This is a period marked by a sharp reduction in output volatility across industrial economies (the Great Moderation) until the recent crisis and recession. Output volatility is significantly affected by the degree of exposure of economies to external shocks – particularly terms-of-trade changes – as well as the level and variability of inflation. Interestingly, the same set of factors seems to influence the severity of recessions. There is no clear evidence to suggest that government size has had a significant effect in terms of reducing the extent of output loss during major recessions.

The rest of this special feature is organised as follows. The first section provides a short theoretical review of why government size might matter. The second section presents some stylised facts regarding the relationship between output volatility and key fiscal variables. The third section provides a discussion of the empirical results. The fourth section concludes.

Why might government size matter?

There are two ways to measure the importance of the government in the economy: the GDP share of government expenditure and the average tax rate (or the GDP share of taxation). These two measures represent the most immediate counterpart to the variables appearing in most macroeconomic models. Distinguishing between the two is important because the channels through which they may affect output volatility are potentially different.

Measures of government size differ

Government expenditure has a potentially important role in stabilising aggregate demand and hence output for at least two reasons. First, a higher share of government expenditure may be associated with a larger provision of public goods and services as well as a larger fraction of workers employed in the public sector. To the extent that government expenditure is more stable than other components of aggregate demand, it should reduce the overall volatility of aggregate income and output (a composition effect). And to the extent that a larger fraction of workers are public employees, it should also reduce the volatility of aggregate personal disposable income and aggregate private consumption, all else equal (a job safety effect).

A second reason is that a higher share of government expenditure may also reflect the existence of a more generous social security system, which involves providing transfers to a larger number of citizens – eg unemployment benefits and state pensions. Similarly, a more comprehensive (and costly) system can also be associated with a larger role for automatic transfers to companies. Normally, automatic transfers to workers and companies are designed, alongside taxes, to reduce the volatility of their disposable income (automatic stabilisation). Stabilising disposable income matters for output volatility to the extent that households and firms respond more to current income than to the expectation of future income. This may happen, for example, if a significant fraction of households or firms are liquidity-constrained or likely to become so when income falls and therefore unable to smooth consumption or investment through borrowing.[3]

The tax share could also contribute to stabilising output volatility. Indeed, a higher tax share, other things equal, reduces the volatility of households' disposable income and firms' cash flows in the face of fluctuations in their gross incomes. Through this channel, it dampens the effect of shocks on output. This effect is larger, the more progressive the tax system, and the more sensitive private expenditure is to current cash flows.

The above arguments are intuitively appealing. Other, perhaps less intuitive arguments emphasise the role of supply side rather than demand side effects. These may strengthen, weaken or even reverse the previous theoretical negative link between government size and output volatility. Notably, higher taxes or government expenditure could alter the responsiveness of labour and investment decisions (besides the traditional negative impact on efficiency and potential output).[4] A controversial feature is the possible impact of progressive taxes on labour supply decisions. One mechanism, emphasised by the real business cycle literature, is that taxes reduce after-tax labour productivity and lead to an increase in the

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[3] Regardless of liquidity constraints, consumers and firms may also respond more to current income for other reasons, which include myopia, inconsistent preferences and limited rationality. For example, some consumers may not be able to estimate their future income due to lack of adequate information or cognitive ability, and hence could rely more heavily than other consumers on current and past income to do so.

[4] By raising distortions, a higher tax share could also reduce the impact of discretionary tax changes (see eg Caldara and Kamps (2008)).

responsiveness of labour supply and accordingly of output, other things equal.[5] However, according to Auerbach and Feenberg (2000) progressive taxation could have stabilising effects on output through the labour supply of similar magnitudes to those that work through aggregate demand.

Demand and supply side effects aside, there could be limits to the stabilising role of government size. An important factor that could partially or fully offset the stabilising properties of higher expenditure and taxes highlighted above is a high level of public debt (normally associated with large governments). If the public debt is sufficiently high, a recession could lead to the expectation of discretionary fiscal tightening or an unfavourable change in the rules governing long-term benefits and taxes (a change in built-in stabilisers). This could lead consumers and firms to further rein in expenditure when it is most needed. Moreover, unsustainable public debt levels may unsettle financial markets and raise long-term interest rates. Hence, large governments – to the extent that they are funded with high public debt – could be expected to increase rather than reduce output volatility.

A first glance at the data

A key stylised fact is that in the post-World War period, at least until the recent recession, output volatility had been declining in many countries. This phenomenon has often gone hand in hand with a significant increase in the size of the government and a growing participation in international trade and finance. In the case of the United States, for instance, De Long and Summers (1986) attribute the decline in the post-World War output volatility until the early 1980s to the introduction of a progressive tax system and countercyclical entitlements, such as unemployment insurance in the 1930s.[6]

What does recent evidence suggest about the link between government size and output volatility? Graph 1 looks at this relationship over time in each of the two major economic areas – the United States and Europe. The two variables are measured, respectively, by the standard deviation of GDP growth and the shares of taxes and expenditure in GDP. The graph does not suggest any consistent relationship between the size of the government and output volatility.
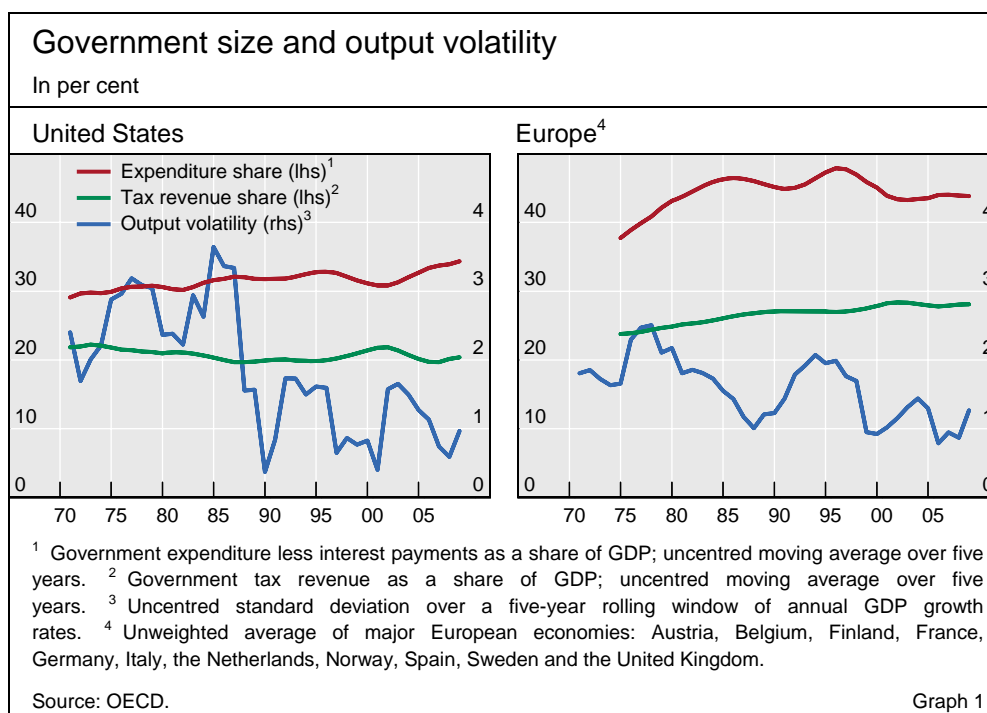
While US output volatility has declined the most since the mid-1980s – a period usually referred to as the Great Moderation – there has not been a concomitant rise in the share of government expenditure in GDP, at least until

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[5] See Galí (1994) for an explanation of the effects of the tax share and the government expenditure share on labour elasticity and the income multipliers in the context of an otherwise standard real business cycle model. More recently, Andres et al (2008) have shed further light on the theoretical link between government size and output volatility, emphasising the role of nominal rigidities and the role of consumers that respond to current income (as opposed to their income expectations). Another study stresses the role of real wage resistance by workers (Buti et al (2003)).

[6] Romer (1999) provides more direct evidence about the role of automatic stabilisers in reducing the fluctuations of US GDP. Her estimates suggest that in periods of extreme output volatility automatic stabilisers reduced the absolute value of the US growth rate by 1 to 2 percentage points, and in years of moderate output fluctuations by 0.5 percentage points.

Government size and output volatility

In per cent

United States

- Expenditure share (lhs)[1]
- Tax revenue share (lhs)[2]
- Output volatility (rhs)[3]

Europe[4]

[1] Government expenditure less interest payments as a share of GDP; uncentred moving average over five years. [2] Government tax revenue as a share of GDP; uncentred moving average over five years. [3] Uncentred standard deviation over a five-year rolling window of annual GDP growth rates. [4] Unweighted average of major European economies: Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden and the United Kingdom.

Source: OECD.   Graph 1

the early 2000s. Time series evidence reported by many studies seems to confirm the fact that automatic stabilisers tend to be rather weak, not least because state governments follow a balanced budget rule. For instance, Auerbach and Feenberg (2000) show that, despite significant changes to the US economy, the automatic stabilising role of the tax system remained weak, and may have become even weaker since the early 1980s.[7] This may also explain why the reliance on discretionary fiscal policy tends to be high in the United States.

… or in Europe

The reduction in output volatility in Europe has, in fact, been associated with a decline in the average share of government expenditure in GDP – particularly since the adoption of the Stability and Growth Pact in the second half of 1990s. But the share of taxes appears to have increased. Even so, the smoothing effects of automatic stabilisers differ across countries depending on the nature of shocks. For instance, estimates by the European Commission (2001) suggest that automatic stabilisers may smooth about 30% of GDP fluctuations in case of a consumption shock in Denmark and Sweden, which have a relatively high share of consumption taxes in GDP, compared with less than 20% in Germany, Spain and the United Kingdom. By contrast, the automatic smoothing effect of a private investment shock or an export shock is much smaller than that of a consumption shock.

Have economies with larger governments expanded their budget balance more during the recent financial crisis and recession? Graph 2 suggests that changes in cyclical budget deficits between 2007 and 2009 (projected) have indeed been positively correlated with government size across OECD countries
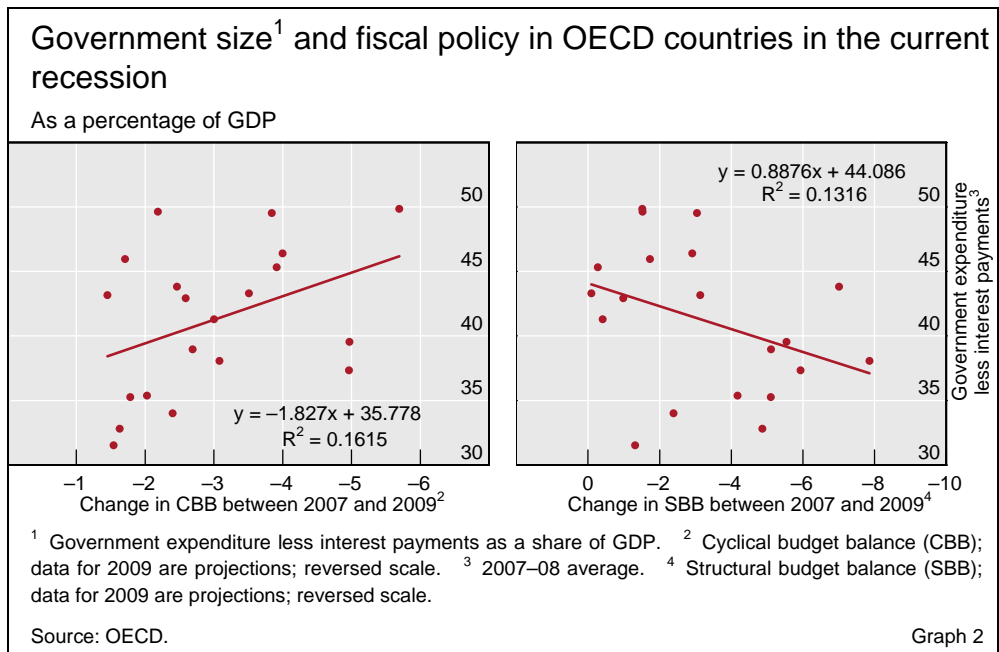
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[7] Their estimates suggest that automatic stabilisation of US aggregate demand is most significant through tax-induced consumption responses, which offset around 8% of the initial shock to US GDP. Cohen and Follette (2000) reach a similar conclusion for the United States.

(Graph 2, left-hand panel). At the same time, countries with smaller governments have sharply expanded their discretionary budget deficits in the current recession (Graph 2, right-hand panel). Hence, government size is unlikely to have constrained the ability of countries to implement a countercyclical fiscal policy.

Another way of looking at the same issue is to ask whether government size has had any impact on the severity of recessions. If government size indeed matters, recessions should have become less severe – in terms of both depth and duration – in countries with bigger governments. Measuring the severity of recession is, however, difficult without a universal definition for all countries, as business cycle dates are available only for the US economy.[8]

Table 1 presents evidence on the severity of recessions for major OECD countries based on a common definition of a recession as a peak in output followed by at least two consecutive quarters of decline. Similarly, a trough is reached if followed by at least two consecutive quarters of growth.[9] As a measure of the severity of recession, the third and fourth columns of Table 1 show the average peak-to-trough decline in output in all episodes of GDP contraction between 1960 and 1984 and those between the mid-1980s and the second quarter of 2009. The next two columns report the average number of quarters that elapsed between peaks and troughs over the two periods as a measure of the length of recession.

Government size[1] and fiscal policy in OECD countries in the current recession

As a percentage of GDP

Left panel: $y = -1.827x + 35.778$, $R^2 = 0.1615$; x-axis: Change in CBB between 2007 and 2009[2]

Right panel: $y = 0.8876x + 44.086$, $R^2 = 0.1316$; x-axis: Change in SBB between 2007 and 2009[4]; y-axis: Government expenditure less interest payments[3]

[1] Government expenditure less interest payments as a share of GDP. [2] Cyclical budget balance (CBB); data for 2009 are projections; reversed scale. [3] 2007–08 average. [4] Structural budget balance (SBB); data for 2009 are projections; reversed scale.

Source: OECD.   Graph 2

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[8] Going by the NBER recession dates, the average postwar US recessions up to the early 2000s lasted about 10 months compared with 18 months in the period 1919–45 and 22 months in the period 1854–1919. The current US recession has already lasted longer than any other postwar recession.

[9] Wherever the mechanical application of the criterion gives an ambiguous answer as to when the peaks and troughs occur (eg when the sign of the growth rate switches from positive to negative and then to positive again), we made a subjective decision. The number of times we needed to do this was, however, relatively small and should have only limited effects on the reported statistics.

	Government size		Severity of recession		Duration of recession	
Government size[1] and severity[2] and duration[3] of recession Period average	1960–84	1985–2009[4]	Q1 1960–Q4 1984	Q1 1985–Q2 2009[5]	Q1 1960–Q4 1984	Q1 1985–Q2 2009[5]
Sweden	45.2	55.9	–2.5	–4.2	2.0	4.0
Denmark	46.5	50.3	–3.3	–1.9	3.3	3.1
Austria	43.6	49.5	–1.1	–1.6	2.3	3.0
France	42.8	49.4	–1.4	–2.3	2.5	4.0
Norway	38.5	45.6	–0.0	–0.8	2.0	2.5
Germany	40.4	43.8	–1.9	–1.9	3.0	3.0
Italy	33.5	42.4	–2.1	–2.0	2.8	3.6
New Zealand		40.1	–5.4	–2.3	2.9	3.7
United Kingdom	41.6	40.0	–3.2	–4.0	4.0	5.0
Spain	27.2	38.4	–0.6	–3.5	2.3	5.0
Canada	32.8	37.6	–2.6	–3.3	4.0	3.5
Australia	26.0	33.2	–1.8	–1.7	3.2	5.0
Japan	24.2	32.9		–3.7		3.8
Switzerland		32.9	–4.2	–1.0	3.5	2.9
United States	29.6	32.8	–2.2	–2.6	2.8	3.5

[1] Government expenditure less interest payments as a percentage of GDP.   [2] Severity is defined as the period change in real GDP during the recession, in per cent; recession is defined as at least two quarters of consecutive decline in real GDP.   [3] Duration is defined as the number of quarters during the recession.   [4] Data for 2009 are projections.   [5] For the current recession, the trough is assumed to be the second quarter of 2009.

Sources: OECD; national data; BIS calculations.   Table 1

Output recessions have become deeper and longer

The table illustrates several interesting aspects of modern recessions. First, with a few exceptions, the average loss of output in a typical recession has increased in many OECD countries since the mid-1980s. This implies that the decline in overall output volatility does not appear to have reduced the depth of boom and bust economic cycles in OECD countries. However, this finding is dominated in several countries by the latest recession.[10] Second, recessions have also become considerably longer in the past quarter of a century, perhaps for similar reasons. Third, there does not seem to be an obvious relationship between government size and the severity of recessions. The average loss of output is smaller in some countries with larger governments (eg Denmark and Norway), but several countries with large governments have also suffered more severe recessions (eg Sweden).

Looking at the econometric evidence

As several variables in addition to government size are likely to influence output volatility or the severity of recessions, looking at simple correlations may be uninformative (and, at worst, misleading). Econometric studies therefore attempt to control for other influences on output volatility.

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[10]   Namely, in 10 out of 15 countries the average loss of output is lower as from the mid-1980s than in the previous period once the latest recession is excluded from the sample.

Econometric evidence has thus far provided support for the existence of a negative relationship between measures of government size and output volatility. Among the prominent studies, Galí (1994) is the first to document a negative link using cross-sectional data for 22 OECD countries over the period 1960–90. The main characteristic of Galí's study is that it assumes that the observed cross-country differences in expenditure and tax shares are mainly determined by differences in institutions, preferences and histories, which are taken to be mostly exogenous to output volatility. In addition, the study controls for the possibility that government size may be related to a more active use of discretionary fiscal policy. In this case, a negative relationship between output volatility and government size could simply reflect the more successful use of countercyclical policy rather than a larger government. Controlling for these various aspects of short-term policy variability (by including standard deviations of government size and their correlations with output), Galí (1994) finds support for the assumption that government size reduces output volatility.

A subsequent study by Fatás and Mihov (2001), which employs a set of 20 OECD countries over the period 1960–97, also finds a negative relationship, but using different econometric specifications than Galí (1994). In particular, Fatás and Mihov (2001) address a criticism that could be levelled against the earlier analysis of Galí (1994), namely the absence from the analysis of some potentially important control variables such as measures of trade openness and exposure to external risk. These variables have been found to be associated with higher output volatility as well as government size (Rodrik (1998)). Unlike Galí (1994), however, Fatás and Mihov (2001) do not consider measures of short-term policy or fiscal variability. Furthermore, the empirical relationship uncovered in their study is non-linear and implies that an increase in government size from, say, 10% to 20% has a larger impact on output volatility than an increase from 40% to 50%.[11]

In the remainder of this section, we revisit the empirical evidence regarding the stabilising impact of government size using the latest available data from OECD countries. Our main aim is to examine whether the significant relationship found in earlier studies still holds or, instead, has changed in more recent times. For this purpose, we carry out two types of empirical exercise. In the first exercise, we consider a number of panel regressions where we control for a number of factors that could be important determinants of both output volatility and government size. We employ a more recent dataset (1970–2008) than previous studies (which also partly covers the current recession).[12] We also exploit the time dimension of the data besides cross-country

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[11] Specifically, Fatás and Mihov (2001) regress measures of output volatility on the log of government expenditure (and tax share in GDP). The log transformation could be too extreme a way of capturing the non-linearity in the data. It is therefore possible that their study, while confirming a negative relationship, may give too much weight to relatively smaller-government countries at the expense of larger-government countries.

[12] Following changes in the statistical criteria with which OECD data are collected and compiled, the earlier date from which data are available on a consistent basis is 1970 and the number of countries is 20. This explains the difference between our study and the ones cited herein.

heterogeneity, which allows the inclusion of a greater number of observations and hence may lead to more precise estimates.

In the second exercise, we run a number of cross-sectional regressions of the average severity of recession (as measured by the peak-to-trough output loss) on the measures of government size and other control variables.[13] To the best of our knowledge, there is no study that focuses on the severity of recession specifically, even though policymakers and the public may be more interested in avoiding the consequences of recessions rather than avoiding the volatility of output outside recessionary episodes. To the extent that the former is the variable of interest, it is better to measure it directly rather than using measures of output volatility as proxies. Another related reason is that the severity of recession, unlike measures of output volatility, is not affected by measurement problems such as the choice of the detrending method.

Output volatility: panel data evidence

The regressions are estimated using two different measures of output volatility – namely, the standard deviation of: (i) the cyclical fluctuations of per capita GDP and (ii) the growth rates of per capita GDP.[14] Government size is represented, alternatively, by the GDP share of taxes (both direct and indirect) or the GDP share of government expenditure (excluding interest payments). All the regressors, including the control variables, are five-year centred moving averages of the respective variables.[15]

We rely on three sets of control variables. The first includes the standard deviation of the tax or government expenditure shares to control for short-term policy variability. The second captures the potential influence of other variables, such as measures of trade openness, external risks (eg terms of trade) and the share of the primary sector in total production. These variables are usually found to be positively associated with both output variability and government size. So omitting them is likely to lead to significant biases. The third set controls for other potential determinants of output volatility, which may or may not be correlated with government size. Including them in the regression provides a test of the relative importance of government size vis-à-vis other possibly more important determinants and may reduce potential biases. The variables are: the average public debt/GDP ratio; the average CPI and its standard deviation; and the private credit/GDP ratio. The level of public debt, which should be positively correlated with government size, could a priori increase output volatility. This possibility may arise, for example, if the government has to engage in procyclical fiscal policy (eg raise taxes or cut back spending) in order to stabilise the debt level when output growth slows or

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[13] For the definitions of recession in output and severity of recession, see Table 1.

[14] Unlike Galí (1994), who uses deviations from a linear trend, we estimate the cyclical component of per capita GDP using the band pass filter developed by Christiano and Fitzgerald (2003). For both measures of output volatility, we use five-year centred standard deviations.

[15] Because we are using overlapping observations, we estimate standard errors that are robust to arbitrary serial correlation.

interest rates rise. The level of private credit is meant to capture the financial development and sophistication of a country. On the one hand, to the extent that agents are able to smooth their consumption through credit markets, financial depth may reduce the need for automatic stabilisers and hence substitute for government size. On the other hand, a higher level of private indebtedness may also indicate that the economy is more vulnerable or prone to boom-bust cycles and therefore more volatile, all else equal. Under this interpretation, the need for automatic stabilisers remains. Finally, both the mean and the volatility of inflation are a crude way to capture the effectiveness of monetary policy. To the extent that monetary policy is more effective in stabilising output, there could be less need for the stabilising effects of a large government.

We report panel estimation results for the expenditure share in Table 2 (results for the tax share are available on request). Table 2 shows results for the full sample along with the results for two subsamples: 1970–84 and 1985–2008. These two subsamples correspond roughly to the pre- and post-Great Moderation period in the US context, as confirmed by Graph 1.

From Table 2 it is difficult to establish whether government size has a consistent relationship with output volatility. There is some evidence that the government expenditure share is negatively related to per capita output volatility for the entire sample period (1970–2008). This relationship appears to

The government expenditure share is found to be negatively associated with output volatility …

Panel regression – effects of government expenditure						
	Dependent variable: standard deviation of:					
	Cyclical component of per capita GDP (Christiano-Fitzgerald filter)			Growth rate of per capita GDP		
	1970–2008	1970–84	1985–2008	1970–08	1970–84	1985–2008
Average government expenditure share	−0.0146**	−0.0348**	−0.0033	−0.0113*	−0.0263	−0.0081
	(0.0064)	(0.0159)	(0.0062)	(0.0060)	(0.0170)	(0.0062)
Standard deviation of government share	0.1044***	0.2132***	0.0754	0.2639***	0.2024***	0.2977***
	(0.0301)	(0.0529)	(0.0474)	(0.0615)	(0.0701)	(0.0743)
Average degree of openness	0.4643***	0.1176	0.4958***	−0.0886	0.0897	−0.0443
	(0.1320)	(0.5145)	(0.1686)	(0.1136)	(0.5681)	(0.1290)
Average change in terms of trade	−0.0552*	−0.0305	−0.0441	−0.0592**	−0.0476	−0.0560**
	(0.0326)	(0.0397)	(0.0306)	(0.0260)	(0.0393)	(0.0241)
Average share of primary sector in GDP	−0.0242	−0.0385	−0.0059	0.0195	−0.0495	0.0692
	(0.0256)	(0.0474)	(0.0383)	(0.0291)	(0.0333)	(0.0438)
Average public debt/ GDP ratio	−0.0038*	−0.0012	−0.0039	0.0002	−0.0023	0.0014
	(0.0021)	(0.0043)	(0.0025)	(0.0014)	(0.0046)	(0.0017)
Average CPI inflation	0.0052	−0.0052	−0.0619*	0.0114	0.0083	0.0439*
	(0.0223)	(0.0448)	(0.0336)	(0.0187)	(0.0467)	(0.0260)
Standard deviation of CPI inflation	0.1833***	0.1376***	0.1325**	0.2214***	0.2129***	0.1010
	(0.0465)	(0.0396)	(0.0614)	(0.0533)	(0.0597)	(0.0847)
Average private credit/ GDP ratio	0.0044*	0.0014	0.0052*	0.0011	0.0020	0.0024
	(0.0024)	(0.0057)	(0.0027)	(0.0015)	(0.0051)	(0.0015)
R^2	0.23	0.32	0.18	0.39	0.34	0.30

All regressions include a constant term. White period robust standard errors are between brackets. *, ** and *** indicate that a coefficient is statistically significant at the 10%, 5% and 1% level, respectively. Number of cross sections: 20. Number of periods: 35. Total panel (unbalanced) observations: 538. Table 2

be robust to alternative measures of output volatility (eg growth rate of per capita GDP). Yet, splitting the sample between two different periods reveals that the stabilising effect is largely confined to 1970–84 and to the cyclical measure of output volatility. Since the mid-1980s, the impact has not been statistically significant. When it is significant, the coefficient indicates that a 10 percentage point increase in the government share is associated with a reduction in cyclical output volatility of about 15 basis points (or 11%) in the period 1970–2008 and of about 35 basis points (or 21%) in the subsample 1970–84; and with a reduction in the volatility of the growth rate per capita of output of about 11 basis points (or 7%) in the period 1970–2008.[16]

Some of the control variables turn out to have a statistically significant relationship with output volatility. In particular, the volatility of the expenditure share is statistically significant in all regressions with a positive coefficient, pointing to the possibility that discretionary fiscal policy on average increases output volatility (procyclical fiscal bias).[17] Average trade openness and the average change in terms of trade, as expected, increase output volatility, although they do not appear to be statistically significant in all periods. Inflation volatility is found to be statistically significant and positive in most regressions. This result is consistent with the evidence that monetary policy has become more effective (at least until the start of the current recession) in several countries, as highlighted by the recent literature on the Great Moderation of inflation (see eg Cecchetti et al (2005)). Finally, both the level of public debt and that of private credit are found to be marginally statistically significant in regressions of cyclical output volatility (but not in regressions of growth rate volatility). However, contrary to our prior, the coefficient on public debt is negative, suggesting a stabilising effect, although it is relatively small. The positive coefficient on the average private credit/GDP ratio is consistent with the hypothesis that economies with a more leveraged private sector are more vulnerable to shocks and hence more volatile, all else equal.

When the tax share is employed as a measure of government size, no consistent results are found across specifications and subsamples (the regressions' numbers are not reported but are available on request). We cannot rule out the hypothesis that the tax share has no empirical association with output volatility (regardless of how this is measured) during the period 1970–2008. In particular, the coefficient on the tax share is found to be negative and (weakly) statistically significant only during the subsample 1970–84 (when output volatility is measured by the standard deviation of the

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[16] These findings are in line with those of Viren (2005). Using a World Bank dataset that includes 208 countries, Viren (2005) finds that the relationship is either non-existent or weak.

[17] Adding the correlation of government share with output as a control variable has only a modest effect on the estimates and does not change the overall conclusions from the analysis. The only notable difference is a slightly smaller coefficient (in absolute value) on the average government share in the cyclical output equation in the period 1970–84 (ie –0.0282).

cyclical component of output). And its impact is actually perverse in the second subperiod, 1985–2008 (regardless of how output volatility is measured).[18]

Severity of recessions: cross-sectional evidence

We next test whether greater government size is empirically associated with smaller output losses from peak to trough during recessionary episodes. The findings of the corresponding cross-sectional regressions of recession severity on government expenditure shares, along with a number of control variables, are reported in Table 3 (the results for the tax share are available on request).

A number of findings are evident from these tables. First, government size does not appear to reduce the depth of recessions. The expenditure share is found to be negative across specifications but it is not statistically significant.[19] And there is no statistical evidence that the tax share is correlated with the depth of recession. Indeed, the standard errors on the tax share's coefficient are very large across all regressions.

No clear evidence that the severity of recessions is negatively related to government size …

Second, some of the control variables turn out to be significant across all specifications. Specifically, the degree of trade openness is positively associated with the severity of the recession – the more open the country, the greater the output loss it suffers, on average. In addition, a country that experiences a larger deterioration in its terms of trade tends to suffer a larger output loss. Finally, the volatility of the inflation rate is positively associated with output losses, pointing to a potential role for successful monetary policy.

… but strong link with trade openness, exposures to terms-of-trade shocks and inflation volatility

Cross-sectional regression, 1970–2009 (OLS)							
Severity	Government expenditure	Standard deviation of government expenditure	Trade openness	Change in terms of trade	Standard deviation of inflation	Private credit to GDP	R^2
(1)	−0.075 (0.063)		3.86 (1.367)**	−1.253 (0.546)**	0.552 (0.222)**		0.54
(2)	−0.063 (0.061)	−0.522 (0.340)	3.436 (1.339)**	−1.075 (0.535)*	0.752 (0.250)***		0.60
(3)	−0.078 (0.067)		3.84 (1.42)**	−1.251 (0.565)**	0.538 (0.255)*	−0.003 (0.0200)	0.54
(4)	−0.066 (0.065)	−0.522 (0.353)	3.417 (1.395)**	−1.073 (0.555)*	0.738 (0.279)**	−0.003 (0.019)	0.60

*, ** and *** denote significance at the 10%, 5% and 1% level, respectively. Standard errors are reported in brackets. GDP losses are averages of quarterly observations up to Q2 2009. Other variables are averages of annual observations up to 2008. Whenever a variable's observations are not available for the entire sample period, we take averages over a shorter period.

Source: Authors' calculations.   Table 3

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[18] A higher tax share may have contributed to increasing output volatility rather than reducing it. A possible interpretation is that the negative supply side effects of tax shares were perhaps more important than their stabilising effect on demand.

[19] Were the coefficients statistically significant, they would indicate that the magnitude of the empirical link is somewhat larger than found in the panel regressions of Table 2. Indeed, a 10 percentage point increase in the government expenditure share would be associated with a reduction of average output losses of 63–78 basis points (or about 20–25% of the cross-sectional average over the full sample).

Broadly speaking, these findings confirm those obtained in the panel regressions. The empirical association between government size and output volatility or the severity of recession appears absent or relatively small in magnitude.

Conclusion

This article has examined the potential role of government size in explaining cross-country differences in the observed output losses in the context of the latest recession. Although it might seem, from simple correlations, that government size may have played a role in mitigating the loss of output, the empirical analysis based on the historical record does not find evidence of a strong link with output volatility. The results for the period 1970–2008 indicate that a 10 percentage point increase in the GDP share of government expenditure is associated with a reduction in (average) output volatility of 7–11% depending on the measure of output volatility. Such a relationship is found to be stronger in the period 1970–84 and weaker and statistically insignificant after 1985. Furthermore, there is no clear evidence that the severity of recessions is negatively associated with government size, although further investigation to account for possible endogeneity and non-linearities could shed more light on the relationship.

Factors other than government size might have been more important. In controlling for the effects of several variables that could influence both government size and output volatility, we find that the role of external risks (eg the decrease of openness and terms-of-trade changes) and inflation volatility has been particularly important. A similar conclusion arises from the analysis of the average loss of output experienced during recessions. In the latest recession, such factors are also likely to have played a major role, consistently with the historical experience, given the large and sharp drop in international trade experienced worldwide. The strong coefficient on inflation volatility suggests that on average during the period, to the extent that monetary policy has succeeded in stabilising inflation, it has also played a key role in explaining differences in output volatility both between countries and over time.

The evidence of a weak link between government size and output volatility suggests at least two possibilities. The first is that the measures of government size that we used have become less and less valid as proxies for the stabilising properties of the government sector. For example, this could be the case if the composition of the public budget varies across countries and over time in a way that does not increase the size of the government but only its effectiveness in stabilising output. Governments may have become more aware that simply increasing the tax and expenditure shares has costs in terms of efficiency and potential output even when it achieves a given reduction in output volatility. Another possibility is that the improvement in the stabilising properties of monetary policy has to some extent reduced the need for larger government (at least until the start of the latest recession).

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Issues and developments in loan loss provisioning: the case of Asia[1]

In the aftermath of the Asian financial crisis of the late 1990s, many jurisdictions in Asia strengthened their approaches to loan loss provisioning, including the adoption of discretionary measures. This has contributed to stronger banking systems in the region.

JEL classification: G21, G28.

Loan loss provisions[2] have traditionally been backward-looking and highly procyclical. That is, they have tended to be low ahead of banking crises, and to rise sharply as losses mount. In response to the latest crisis, national and international authorities are considering measures to promote more forward-looking provisioning practices that would result in banks entering periods characterised by a deterioration in credit quality with higher levels of reserves. As loan losses materialise, the already higher level of reserves would reduce the downward pressure on bank earnings and capital that would otherwise occur.

Provisioning practices in Asia may provide useful lessons. Since the late 1990s, spurred by the severe losses of the Asian financial crisis, most jurisdictions in Asia have adopted more conservative loan loss provisioning standards. Some have implemented measures designed to secure larger provisions during times of economic and credit growth. As a result, loan loss reserves and provisioning expense levels were generally higher leading into the current financial crisis than they were before the Asian crisis. From a global perspective, they were also higher than those of many countries outside Asia that were significantly affected by the crisis.

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[2]   Technically speaking, loan loss provisions and reserves are two distinct concepts. The former reflects the flow of expenses, whereas the latter refers to a stock on the balance sheet. Often, however, these two concepts are lumped together under the broad heading of "loan loss provisioning".

This article is organised as follows. The first section provides a conceptual overview of loan loss provisioning and related issues. The second describes the regulatory approaches to provisioning in Asia. The third links these approaches to outcomes, reporting on observed provisioning levels in Asia over the past decade, in particular before and during the current crisis. The last section concludes.

Overview of loan loss provisioning

In making loans, banks face the risk that borrowers will default and the full amount of the loan will not be recovered. When a loan loss becomes likely, a bank will make a charge to the profit and loss statement ("provision") to create a loan loss reserve that is shown on the balance sheet. When the full amount of principal and interest on the loan becomes uncollectible, the loan balance is reduced through a charge to the loan loss reserve.

Credit risk assessment and supervisory requirements

Loan loss provisioning levels and the adequacy of the reserve are only as good as the methodology used to estimate losses in the loan portfolio. A loan grading scheme assigns each loan a grade that reflects its probability of default. Loans in one of the lower credit quality grades are often referred to as "non-performing loans" (NPLs), although the precise definition of what constitutes an NPL differs across countries and time.[3] An inadequate loan grading scheme undermines the provisioning process and leads to distortions in a bank's balance sheet and an overstatement of capital and capital ratios.

The importance of loan grading schemes

Loan loss reserves should reflect not only the probability of default, but also the amount the lender can recover in case of default. An important source of repayment in such an event is collateral. As the likelihood of default increases and the assigned loan grade worsens, the value of the collateral becomes more important. More specifically, it has a direct impact on the loss that a bank suffers in the event of default and the amount for which it must provision.

It is good practice to revalue collateral periodically, particularly when markets are volatile, the borrower's circumstances change or the terms of the loan are materially altered. The valuation should be performed by an independent expert and reviewed internally. Various approaches can be used to value collateral, and in the case of real estate the method will depend to some extent on the use and type of property (eg residential real estate is typically valued using a market comparable approach, whereas an income approach is frequently applied to commercial real estate). While the result is a current market value, an approach based upon estimated future income

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[3] For example, in some countries any loan that is delinquent more than 30 days would be considered an NPL while in other systems the designation may only apply to loans that are 90 days past due. In still other jurisdictions (eg Hong Kong SAR), the adoption of IAS 39 and its use of an "impairment" test has led to the NPL designation being abandoned.

streams will necessarily consider possible future changes in the business climate and the economy.

Since collateral can take many forms, the ease and accuracy with which it can be valued, and the legal ability to take possession and to liquidate it, vary. Thus, when considering collateral in the provisioning process, its value is discounted by some percentage to reflect these factors. In many emerging markets, where real estate is the predominant form of collateral, these aspects become even more important.

For each loan, after determining the probability of default and considering any collateral value, a bank makes an appropriate provision. In a number of jurisdictions, including many in Asia, supervisors prescribe the minimum level at which the reserve must be maintained based upon pre-defined supervisory credit risk grades that are assigned to loans and give an indication as to the probability of default. It should be recognised, however, that there is considerable variation in expected losses among loans of the same grade and it is possible that some loans may require a reserve below the supervisory minimum.

Accounting issues

Provisions should be forward-looking ...

From a risk management and supervisory point of view, provisions should be forward-looking, ie they should reflect losses that are expected during the remaining life of the loan. However, accounting standards require that financial statements present the position of a reporting entity as of the date of the financial statements and be based upon known events, rather than possible future events. More specifically, International Accounting Standard (IAS) 39 recognises loans as being impaired when there is objective evidence that, since the date that the loan was recorded as an asset in the bank's financial statements, one or more events have occurred that will have an impact on the estimated future cash flows of the loan.[4] The balance sheet amount of the loan should be reduced by the amount of impairment through the creation of a loan loss reserve on the balance sheet. Specific reserves are made for individually assessed loans that are found to be impaired, while a collective assessment reserve can be established for individually significant loans for which impairment is not identified, and those that, because of their small size, are impractical to individually assess.

... but IAS 39 is an "incurred loss model"

The fact that IAS 39 requires one or more loss events to have occurred before a reserve can be established has led to it being referred to as an "incurred loss model". This approach has been criticised for only permitting loan losses to be recognised fairly late in the credit cycle and for being, as a consequence, procyclical in nature.

In response to the global financial crisis, in April 2009 the Financial Stability Forum (now the Financial Stability Board (FSB)) recommended that accounting standard setters consider alternative models for loan losses that

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[4]   Since its issuance in 1998, IAS 39 has been amended several times and in 2010 will be replaced with a simpler standard that includes a changed methodology for identifying and measuring the amount of loan losses and the corresponding amount of reserves that should be established.

would permit their recognition earlier in the credit cycle, thereby reducing procyclicality in loan provisioning (FSF (2009)).[5]

Transparency and disclosures provide readers of financial statements with information about an entity's risk profile and risk management process. In the context of loan provisioning, disclosures push banks to adopt and implement policies that result in reserves being maintained at an adequate level and losses being recognised in a timely manner. As such, they are a critical part of the overall provisioning framework. The disclosure requirements for loan loss reserves and provisions are largely contained in International Financial Reporting Standard (IFRS) 7 (IASB (2009b)) and Pillar 3 of the Basel II capital framework.

Loan loss reserves and regulatory capital

Loan loss reserves and supervisory capital requirements based upon the level of risk in a bank's financial positions are directly linked. In particular, for regulatory capital, loan loss reserves are intended to cover losses that are expected to occur based upon historical experience adjusted for changes in the economic environment. Losses above this level are "unexpected" and are covered by capital.

Both the Basel I and Basel II capital regimes allow loan loss reserves to be included in regulatory capital, up to certain limits. To encourage more forward-looking provisioning methodologies (ie making provisions earlier in the credit cycle) and more robust levels of reserves than have traditionally been maintained, policymakers are re-evaluating these limits. Some would argue that these approaches, which to some extent rely on subjective inputs, may provide opportunities for banks to manage earnings and capital without proper regard to the underlying conditions. A balance must be struck.

Loan loss reserves and regulatory capital are linked

Loan loss provisioning regimes in Asia[6]

In the aftermath of the Asian financial crisis of the late 1990s, many Asian central banks and supervisory authorities tightened their prudential supervision to ensure that banks established reserves at a level commensurate with the level of risk in the loan portfolio in a timely manner (Table 1). Many of these moves involved convergence with internationally accepted norms: some regulatory authorities strengthened loan grading and provisioning schemes,

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[5]   Following the recommendation from the FSF, in June 2009 the International Accounting Standards Board (IASB) issued a Request for Information on an expected cash flow approach. Generally speaking, the expected cash flow approach requires that an entity continually re-estimate expected cash flows and does not use a trigger event as the basis for establishing a reserve. If higher levels of loan defaults are envisaged in the future, regardless of whether a trigger event has occurred, the relevant cash flows will be adjusted downwards and a reserve for the corresponding amount established.

[6]   Unless otherwise stated, information presented in this section has been obtained from supervisory rules and regulations published on the websites of supervisory authorities in the relevant jurisdiction.

Provisioning practices in selected jurisdictions									
	CN	HK	ID	IN	KR	MY	PH	SG	TH
Convergence with international standards									
General provisions[†]	✓	✓[1]	✓	✓[2]	✓	✓	✓	✓	✓
Adoption of IAS 39	✓[3]	✓[4]			✓[5]	✓[5]	✓[4]	✓[4]	✓[5]
Strengthening loan classifications			✓[6]	✓[6]					
National discretion									
Increase in specific provisions	✓[7]				✓				
Increase in general provisions	✓[7]			✓	✓				
Differences by industry sector				✓	✓				
"Expected loss" considerations	✓				✓[8]				
Issues of capital and incentives[††]									
Tax deductibility	✓[9]	✓[10]	na	✓[10]	✓[10]	✓[10]		✓[11]	✓[10]
Capital allocation	✓	✓[12]	na	✓[13]	✓[13]	na	✓[14]	✓[12]	✓[12]

CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; KR = Korea; MY = Malaysia; PH = the Philippines; SG = Singapore; TH = Thailand. ✓ = yes; blank space = no; na = not available.

Reflects available public information up to September 2009.

[1] The Hong Kong Monetary Authority established a Regulatory Reserve without a imposing a minimum level, but stated that banks are expected to maintain a regulatory reserve of between 0.5% and 1% of total loans. [2] In addition to general provisions, prudential norms require banks to create a "floating provision" which can only be used for predefined contingencies and under extraordinary circumstances as determined by the board; moreover, it may only be used for specific provisions and with prior approval from the Reserve Bank of India. [3] IAS 39 was implemented by all listed banks on 1 January 2007, and in 2009 for all other banks. [4] Effective since 2005. [5] Full implementation will occur in 2010, 2011 and 2013 for Malaysia, Korea and Thailand, respectively. [6] Reducing the number of days past due to assign an adverse supervisory loan grade (ie substandard or below). [7] Raising the NPL coverage ratio to a minimum of 150% by end-2009. [8] Based on forward-looking criteria which consider the borrower's business and operational environment, financial condition and future cash flow projection. [9] General provisions are tax deductible. [10] Specific provisions are tax deductible. [11] General provisions are tax deductible up to a maximum of 3% of qualifying loans and investments. [12] Aggregate of regulatory reserves and collective impairment allowance are allowed to be included in Tier 2 capital up to a maximum of 1.25% of risk-weighted assets. [13] General provisions may be included in Tier 2 capital up to a maximum of 1.25% of risk-weighted assets. [14] General provisions are allowed to be included in Tier 2 capital up to a maximum of 1% of risk-weighted assets. [†] Enhancements for prudential requirements for general provisions. [††] Information in this section is drawn from World Bank, *Bank loan classification and provisioning practices in selected developed and emerging countries (A survey of current practices in countries represented on the Basel Core Principal Liaison Group)*, June 2002; and J Barth, G Caprio and R Levine, *Bank regulation and supervision database*, World Bank, 2008.

Sources: National data.   Table 1

while others converged their accounting regimes with IFRS, including IAS 39, or announced plans to do so.

Authorities in the Asian region also adopted measures on a discretionary basis to encourage the build-up of loan loss reserves in good times. In some jurisdictions, they increased the level of reserves required in cyclical sectors; in others, they issued explicit instructions to take into account "expected loss" considerations.

At the same time, significant heterogeneity remains. Not all jurisdictions are converging with IAS 39. The treatment of collateral differs, as does the tax deductibility of provisions or the inclusion of reserves in capital. Even among those jurisdictions that have adopted IAS 39, most impose additional provisioning and reserve requirements. What follow are country-specific descriptions of the salient features of loan loss provisioning regimes in nine Asian jurisdictions.

China has raised reserve/NPL ratios

China. Banks in China have been required to set aside general reserves of at least 1% of loans outstanding since 2005. Effective 2002, as part of a

broader convergence with international practices, loan classification rules were revised such that specific reserves were mandated for the four lowest grades.[7] Prudential guidelines allow banks to establish specific reserves for loans graded either substandard or doubtful which are 20% greater or less than the prudential norm. Factors considered when determining the appropriate level of reserves include specific risk scenarios (which may vary by region or industry), probability of losses and historical experience. Further steps by the China Banking Regulatory Commission (CBRC) to ensure adequate reserve levels include statements encouraging banks to raise their ratios of total reserves to NPLs to 150% by the end of 2009. This recommendation is intended to provide sufficient coverage not only for currently identified problem loans but also for a potential increase in NPLs owing to the significant loan growth experiences in the first half of 2009.

Hong Kong SAR. Hong Kong implemented IAS 39 in 2005. As a result, loan provisions are made when objective evidence of impairment occurs. As an additional measure, to ensure that level of protection for expected credit losses does not decline, financial institutions are expected to maintain a "regulatory reserve" of approximately 0.5–1% of total loans to cover losses which may occur in the future. The regulatory reserve is an "earmarked" amount in retained earnings and is therefore distinct from loan loss reserves. The Hong Kong Monetary Authority expects that the regulatory reserve should approximate the difference between the sum of general and specific reserves that would have been established prior to the implementation of IAS 39, and the level of reserves required after its implementation.

<div style="float:right">Hong Kong institutes "regulatory reserves"</div>

India. Over the past decade, loan classification standards in India have become more conservative and have moved closer to international norms.[8] To this end, India has raised its benchmark general provision level for standard loans (from 0.25% to 0.40% in 2005), noting the need "to build up provisioning to cushion banks' balance sheets in the event of a downturn in the economy". Required reserve levels also consider collateral.

The Reserve Bank of India (RBI) applies a sector-specific approach to general provisions based on the riskiness of the sector and public policy objectives. For instance, required reserve levels for performing personal loans, residential housing loans above INR 20 million, and credit card, capital market-related and commercial real estate loans were increased from 0.40% to 1.0% in 2006. Again in 2007, the RBI raised general provisions for personal loans, capital market exposures and commercial real estate loans from 1% to 2%, and increased provisioning requirements for banks' exposure to systemically important non-deposit-taking non-banking finance companies from 0.4% to 2%. The RBI stated that higher requirements were a response to continued high credit growth and higher default rates. Conversely, provisioning requirements

<div style="float:right">India varies required general provisions by industry sector</div>

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[7]   The guidance on general reserves became effective 1 January 2002, with a final implementation date of 2005. The first introduction of a loan classification system in China dates back to 1998, with implementation required by 2002.

[8]   In 2004, the definition of an NPL was changed from 180 to 90 days past due.

for performing loans to the agricultural and SME sectors are exempted from the additional provisioning requirements enacted in 2005.

Indonesia. Bank Indonesia (BI) adopted a prudential loan classification scheme with five grades in December 1998, and later tightened the definition for each grade in 2005. BI permits provisions to be made net of collateral, with the appraised value of collateral reduced according to the age of the appraisal (ie older appraisals result in a greater discount to the appraised value of the collateral). General provisions of no less than 1% of loans are required, though the requirement can be waived if the loan is secured by high-quality collateral such as cash or gold.

<div style="float:left; width:20%;">Korea also varies requirements by sector</div>

Korea. Korea has tightened provisioning norms on numerous occasions over the past decade. The general reserve requirement for corporate loans was increased to 0.5%, 0.7% and 0.85% in 1999, 2005 and 2007, respectively. The minimum reserve levels for other categories of loans were also raised. Sectoral differences in provisioning requirements are also enforced, with higher provisioning requirements for residential housing and credit card loans relative to corporate loans in place since December 2006.[9] In addition to the sectoral differences, Korean prudential authorities explicitly incorporate "expected loss" considerations into their guidance on provisions: local banks, when assessing the loan classification, are required to apply "forward-looking criteria", including future cash flow projections, when determining an appropriate level of reserves. Korea plans to complete adoption of IAS 39 in 2011.

Malaysia. In the wake of the Asian crisis, the Central Bank of Malaysia increased its reserve requirements for various prudential loan grades. For example, until March 1998, no specific reserve level was required for loans graded substandard, while 50% and 100% were required for doubtful and loss loans, respectively. From March 1998, a 20% requirement for substandard loans (net of collateral)[10] was introduced[11] and general reserve levels were increased to 1.5% of total loans. Malaysia plans to implement IAS 39 by 2010.

Philippines. The Philippines adopted new accounting standards in 2005 in line with IFRS and the loan impairment criteria contained in IAS 39. For financial institutions, however, the Bangko Sentral ng Pilipinas (BSP) requires that reserve levels be maintained in accordance with IAS 39 or BSP guidelines, whichever results in a higher reserve. The BSP's requirements include a general provision for loans without heightened credit risk characteristics of 1% and 5% for those that were previously restructured. Specific reserves are determined based upon the particular loan grade assigned.

Singapore. As in Hong Kong and the Philippines, IAS 39 became effective in Singapore in 2005. Banks that are not yet compliant with IAS 39 must maintain a minimum specific reserve level based upon the supervisory loan

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[9] For example, general provisions of 0.85%, 1.0% and 1.5% are required for corporate, housing and credit card loans, respectively.

[10] Real estate is valued using a forced sales price for the property as it is currently being used.

[11] Though temporarily repealed as part of a stimulus package in September 1998, it was reinstated in March 1999.

grade. Though there is no specific guidance on general provisions, the Monetary Authority of Singapore (MAS) states that as a "transitional arrangement" the level should be maintained at not less than 1% of loans net of collateral values.[12] All minimum provision levels are net of collateral.[13]

Thailand. In 1998, Thailand significantly increased the minimum loan loss reserves required for the various supervisory loan grades, with the requirements applied net of collateral value. In 2006 and 2007, in order to mitigate the impact of a convergence with IAS 39, which is expected to take place over the next few years, the Bank of Thailand (BoT) further tightened provisioning standards for all loans graded substandard or below such that they are consistent with IAS 39. As a result, for these loans, a reserve equalling 100% of the difference between the balance sheet amount of the loan and the present value of expected cash flows from the debtor or the sale of collateral must be established. It is worth noting that the BoT has not yet fully applied IAS 39 to performing and so-called special mention loans, where provisions of 1% and 2% are required against loans net of collateral, respectively.[14] All banks are expected to be fully compliant with IAS 39 by 2013.

In summary, a number of measures taken by supervisors in Asia over the past 10 years have resulted in banks maintaining higher levels of loan loss reserves in relation to total loans during a period when many jurisdictions have been experiencing economic growth and declining levels of NPLs.

In three of the countries discussed above, authorities adopted measures on a discretionary basis to respond to increasing levels of risk (Table 1). Authorities in India and Korea, for example, increased their loan loss reserve requirements on several occasions in sectors experiencing rapid credit growth. China's recommendation that banks maintain a loan loss reserve to NPL ratio of 150% is another measure that has resulted in the establishment of reserves in advance of an identifiable deterioration in credit quality.

The process of convergence with international accounting standards has been managed so as to ensure increased provisioning standards ahead of the full implementation of IAS 39. But when the process has threatened to reduce loan loss reserve levels, a number of authorities have instituted additional provisioning requirements, maintained existing measures on a provisional basis (Philippines) or created a special regulatory reserve account (Hong Kong SAR).

Thailand has increased loan loss reserve requirements

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[12] According to MAS Notice 612, banks without a sufficiently robust loss estimation process or loan loss data of sufficient quality over a full credit cycle must comply with this provisioning rule for prudential purposes.

[13] MAS guidelines state that banks should apply, where appropriate, a haircut to the valuation of collateral or use the forced sale value to provide a more realistic estimate of the net realisable value of the collateral.

[14] BoT guidelines permit banks that are ready in terms of data and methodology to collectively assess performing and special mention loan portfolios and establish a reserve according to IAS 39.

Observed provisioning practices in Asia

This section examines the evolution of reserves and provisions[15] in Asia, starting with the aftermath of the Asian financial crisis of the late 1990s and concluding with the onset of sharp recessions in several Asian economies in late 2008. Did the shift towards more conservative provisioning regimes, documented above, result in a noticeable increase in reserve levels and annual provisions relative to total loans or total NPLs in the system? Did the adoption of discretionary measures by a subset of countries result in observable increases in reserves and provisions? What has been the relation of provisioning expenses to macro variables such as GDP and credit growth?

Yearly system-level data

To investigate these questions, we have collected yearly system-level data for each of the jurisdictions discussed above for the period 1998–2008. Our dataset includes total loans, non-performing loans, provision expenses, reserve levels, real GDP and loan growth. For China, the data are from 2003 and do not include provision expenses. For three of the economies – Hong Kong SAR, Korea and Thailand – we have data from 1995, several years prior to the start of the Asian financial crisis.

In Graph 1, we chart over the past 5–15 years the available data for the levels of provision expenses, as well as the stock of reserves and non-performing loans (all as a percentage of outstanding loans) for nine jurisdictions. In Graph 2, we present two macro variables (real GDP and loan growth) along with provisions and reserves, but this time as a percentage of NPLs.

Reserves have fallen much less than NPLs

For all of the economies in our sample, non-performing loans have fallen since the Asian financial crisis, while reserve levels (and provisions) have gone down at a much more subdued pace (Graph 1). In China, Hong Kong SAR, Korea, Malaysia and Singapore, the level of reserves went from being well below to being well above that of NPLs. Accordingly, the ratios of reserves to NPLs have increased over the decade for nearly all the economies in the sample (Graph 2), consistent with more conservative provisioning policies.[16]

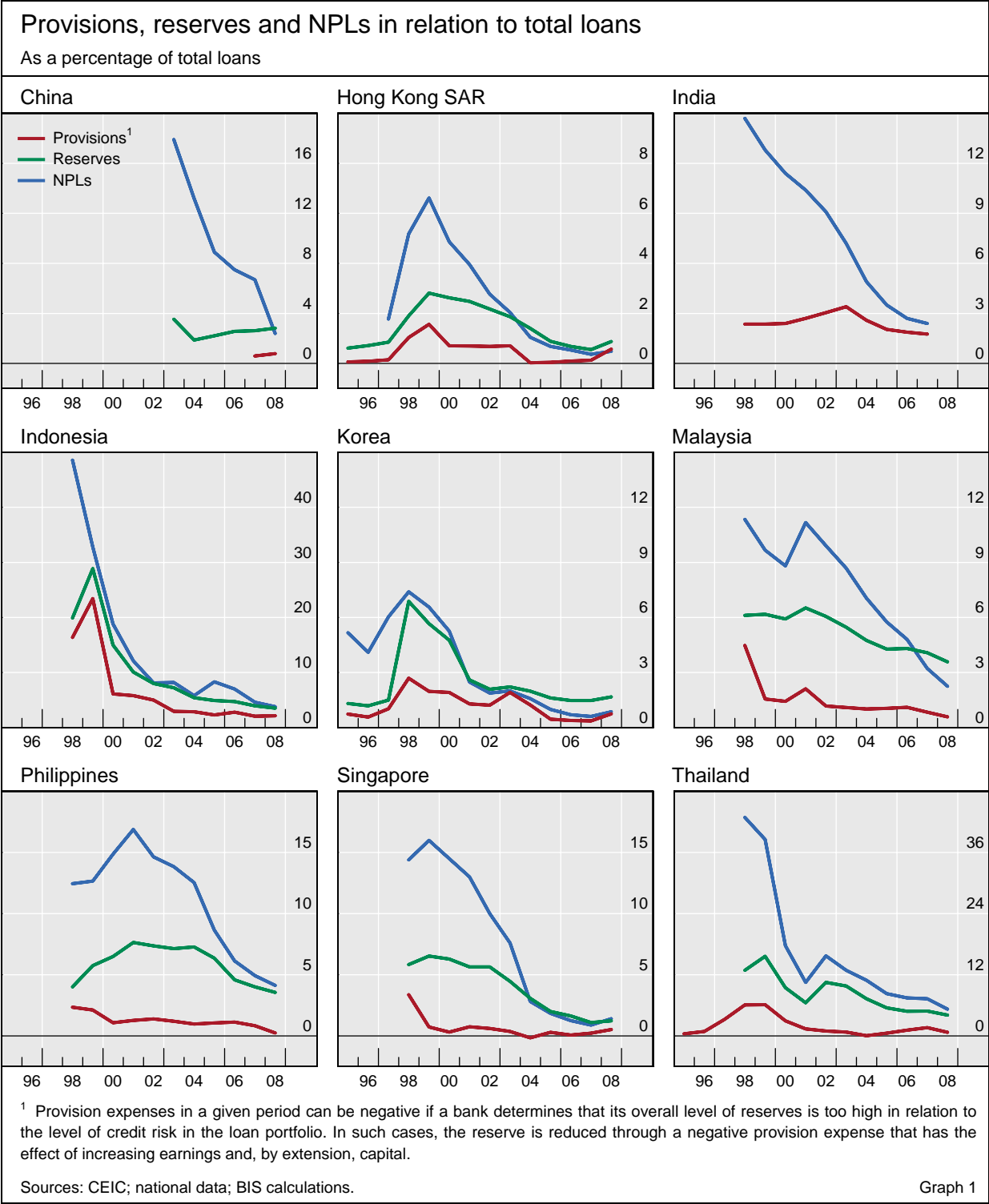Provisions and reserves greater than before the Asian financial crisis ...

In the jurisdictions for which data are available from the mid-1990s, it appears that the stock of reserves as well as the flow of annual provisioning expenses are greater now than they were before the crisis that started in 1997. In Korea, reserves represent a larger proportion of loans than before the Asian financial crisis, despite the fact that the ratio of NPLs to loans declined from around 5% in 1995 to less than 1% in 2008. In Thailand, provisioning as a

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[15] While reserves (as the stock variable) are the best measure of the degree of cumulated provisions against which losses can be charged, provisioning expenses (which are not affected by changes to reserves due to charge-offs) can be of independent value in assessing the impact of changes in a provisioning regime. In some cases, we have provisioning expenses data but do not have reserve data.

[16] While the definition of NPLs does differ somewhat from country to country, whenever the definition has changed for any country during the period, it has only become more conservative, to include more problem loans. Thus, the increasing trend in the ratio of reserves to NPLs would be amplified were we able to correct for such changes in definition. The steady increase in reserve to NPL ratios can also be interpreted as reserves being clearly insufficient in the aftermath of the Asian financial crisis of the late 1990s.

proportion of loans has been higher over the past few years than it was in 1995 (pre-crisis NPL and reserve data are not available in the Thai case). In Hong Kong SAR, reserve levels are similar to or greater than those before the crisis, and provisions as a fraction of loans averaged 0.31% between 2003 and 2008 (0.11% in 2006 and 2007 alone), compared to 0.07% in 1995 and 1996. This is despite the fact that the annual provisioning and stock of reserves for

Provisions, reserves and NPLs in relation to total loans

As a percentage of total loans

[1] Provision expenses in a given period can be negative if a bank determines that its overall level of reserves is too high in relation to the level of credit risk in the loan portfolio. In such cases, the reserve is reduced through a negative provision expense that has the effect of increasing earnings and, by extension, capital.

Sources: CEIC; national data; BIS calculations.   Graph 1

Provisions and reserves in relation to NPLs and macro variables

In per cent

China

- Provisions (rhs)[1]
- Reserves (rhs)[2]
- Real GDP growth (lhs)

Hong Kong SAR

- Loan growth (lhs)

India

Indonesia

Korea

Malaysia

Philippines

Singapore

Thailand
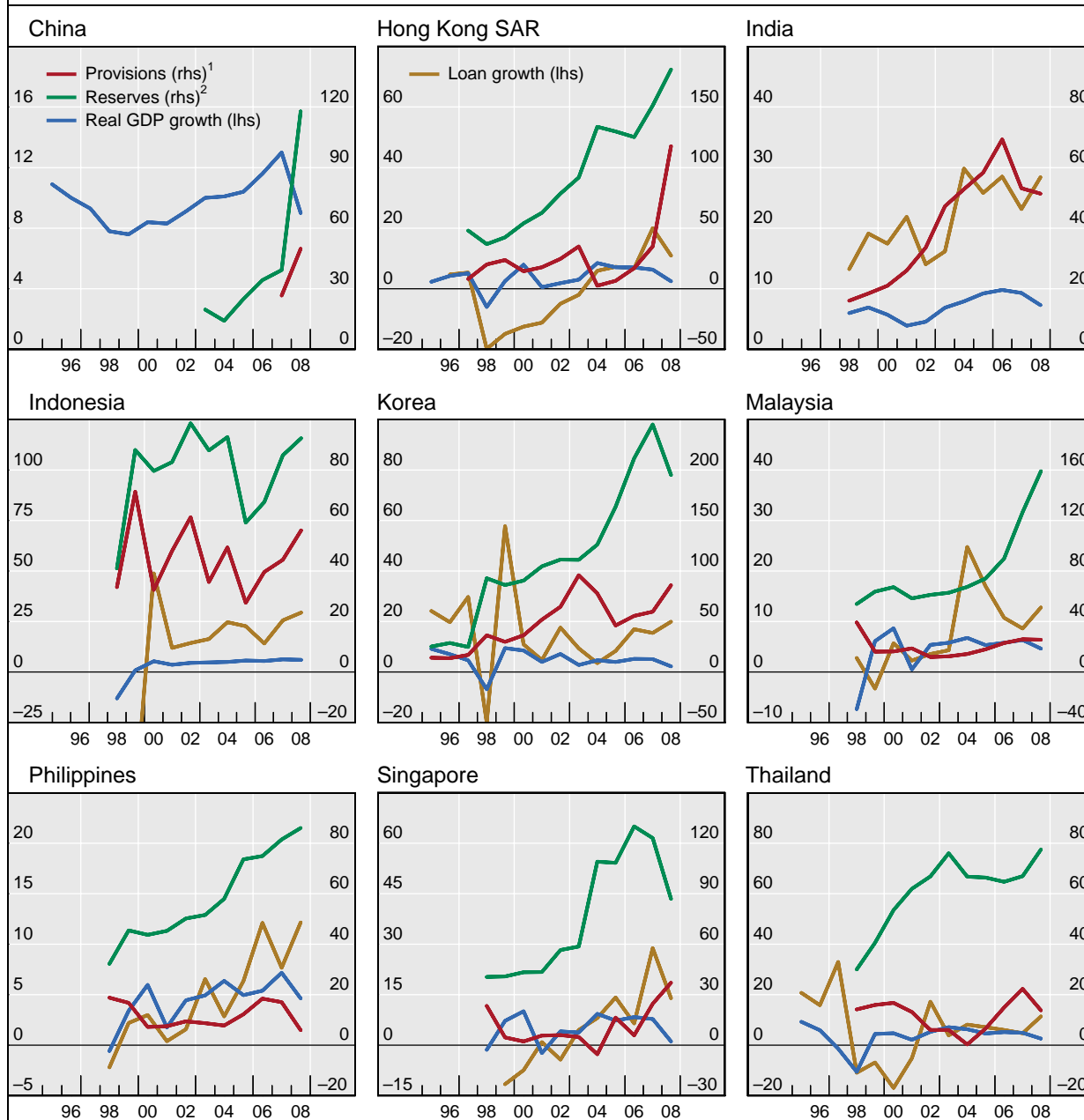
[1] Loan loss provisions as a share of NPLs. Regarding negative provision expenses, see Graph 1.   [2] Loan loss reserves as a share of NPLs.

Sources: CEIC; national data; BIS calculations.

Graph 2

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provisioning data do *not* include the additions to the regulatory reserves that started from 2005 as described in the second section.

… in part due to the discretionary tightening of standards

The discretionary tightening of standards identified above appears to have had a measurable effect in most cases. In Korea, where higher general as well as sectoral provisioning requirements came into effect from the mid-2000s, provisions stopped declining sharply as a share of total loans in 2005, and rose

Provisioning and financial system procyclicality

Research on loan loss provisioning used to focus narrowly from an accounting perspective on whether provisions were used by banks to smooth earnings (Greenawalt and Sinkey (1988)). More recently, work has focused on provisions' contribution to the procyclicality of financial systems by virtue of being lower when output and credit are expanding and higher in periods of contraction. In early work from this perspective, Borio et al (2001) document a strong negative correlation of bank provisions with the business cycle for 10 OECD countries. Subsequent empirical studies have used bank-level information to investigate the procyclicality of loan loss provisions in more detail (Cavallo and Majnoni (2002), Laeven and Majnoni (2003), Davis and Zhu (2005), Bikker and Metzemakers (2005), Bouvatier and Lepetit (2008)). Researchers use regression analysis to explain annual provisioning expenses, usually scaled by the total stock of loans or assets of the bank. Some of the explanatory variables used in these studies are discussed below.

GDP and *credit growth.* Provisioning expenses are found to vary negatively with the business cycle (real GDP growth) as well as credit growth. The latter result is consistent with provisions declining even as surges in new loans might indicate increased riskiness. Of the four studies that include both variables simultaneously, three find significantly negative coefficients on both; when only one or the other is included in other studies, it is invariably negative.

Earnings. If banks use provisions to smooth earnings, there should be a positive relationship between provisions and earnings. Evidence of the existence of earnings smoothing through provisions remains fairly strong, at least for industrialised countries. In a few papers, provisions are found to vary inversely with earnings when they are negative, which would contribute to procyclicality. Meanwhile, studies on emerging markets have not found evidence for earnings smoothing; in fact, earnings have been found to negatively affect provisioning in emerging Asia.

Capital ratio. Higher provisioning when capital is low is consistent with capital depletion being correlated with efforts to build up a greater reserve cushion. However, studies do not document a strong association with capital constraints and provisioning. In two of the four studies in which capital is included as an explanatory variable, there is no significant impact of capital on provisioning; in the other two studies the impact is of opposite signs.

Asset prices. Provisioning may be lower when asset prices are rising, if the latter are reflected in collateral valuations. (Changed expectations about future fundamentals are another channel.) Davis and Zhu (2005) find that provisions are lower when commercial property prices are rising. This suggests that provisioning may amplify credit cycles through the collateral channel.

The most ambitious study focusing on Asia is that of Craig et al (2006), who investigate the provisioning decisions of 300 Asian banks between 1996 and 2003. Their findings are consistent with the view that provisioning practices in Asia exacerbated financial system procyclicality more than in other regions. Higher real GDP, loan growth, asset prices and earnings led to lower provisions. To be sure, these results were probably driven by the collapse in many variables during the Asian financial crisis, when provisions needed to be increased.

Provisions in Asia (1998–2008)[1]

Variable	1998–2008	1998–2002	2003–08
GDP growth	−0.09*	−0.02	−0.11*
Loan growth	−0.05*	−0.04*	−0.01
Earnings	−0.96*	−2.95*	0.19
Capital	−0.39*	−0.10	0.05
Property prices		0.01	0.01
Observations	77	23	38
Adjusted R-squared	0.89	0.86	0.81

[1] The dependent variable is loan loss provisions to total loans. The results are based on panel regressions with country fixed effect panel annual data during 1998–2008 (and subperiods) of Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. GDP growth is real GDP in local currency. Loan growth refers to year-on-year changes in gross loans. Property prices are the annual change in real house prices. Earnings are profits before tax and provisions divided by total assets. Capital is total capital adequacy ratio. * shows significance of test statistic at 95% level.

Sources: Bloomberg; CEIC; national sources; BIS calculations. The authors thank the national authorities that contributed data to this study.

Table A

Table A shows a preliminary attempt to explore the degree to which provisioning has been countercyclical in eight Asian countries, using system-wide data only, over 1998–2008. Regressions using annual data incorporating fixed country effects are reported above. Like Craig et al, we find over the full period that GDP and credit growth, earnings and capital are related to provisioning in a way that may exacerbate financial system procyclicality. However, when estimated over the more recent period only (2003–08), while GDP growth is statistically significant, other variables lose their significance. This suggests that many of the earlier results may have been driven by the behaviour of the variables around the Asian financial crisis of the late 1990s, and may not represent current provisioning practice. However, the paucity of observations and the lack of a full cycle in either subperiod limits the strength of any inferences to be drawn from the comparison.

relative to NPLs, as did reserves (Graph 1). In China as well, reserves have risen as a proportion of loans even as NPLs have declined, with the most recent marked increase in reserve/NPL ratio converging towards CBRC guidelines (Graph 2).

At the same time, the process of convergence with international accounting standards identified in the Thai case also resulted in higher provisioning. The tighter standards implemented in 2006 and 2007 resulted in higher provisions relative to loans compared to previous years, despite declining NPLs.
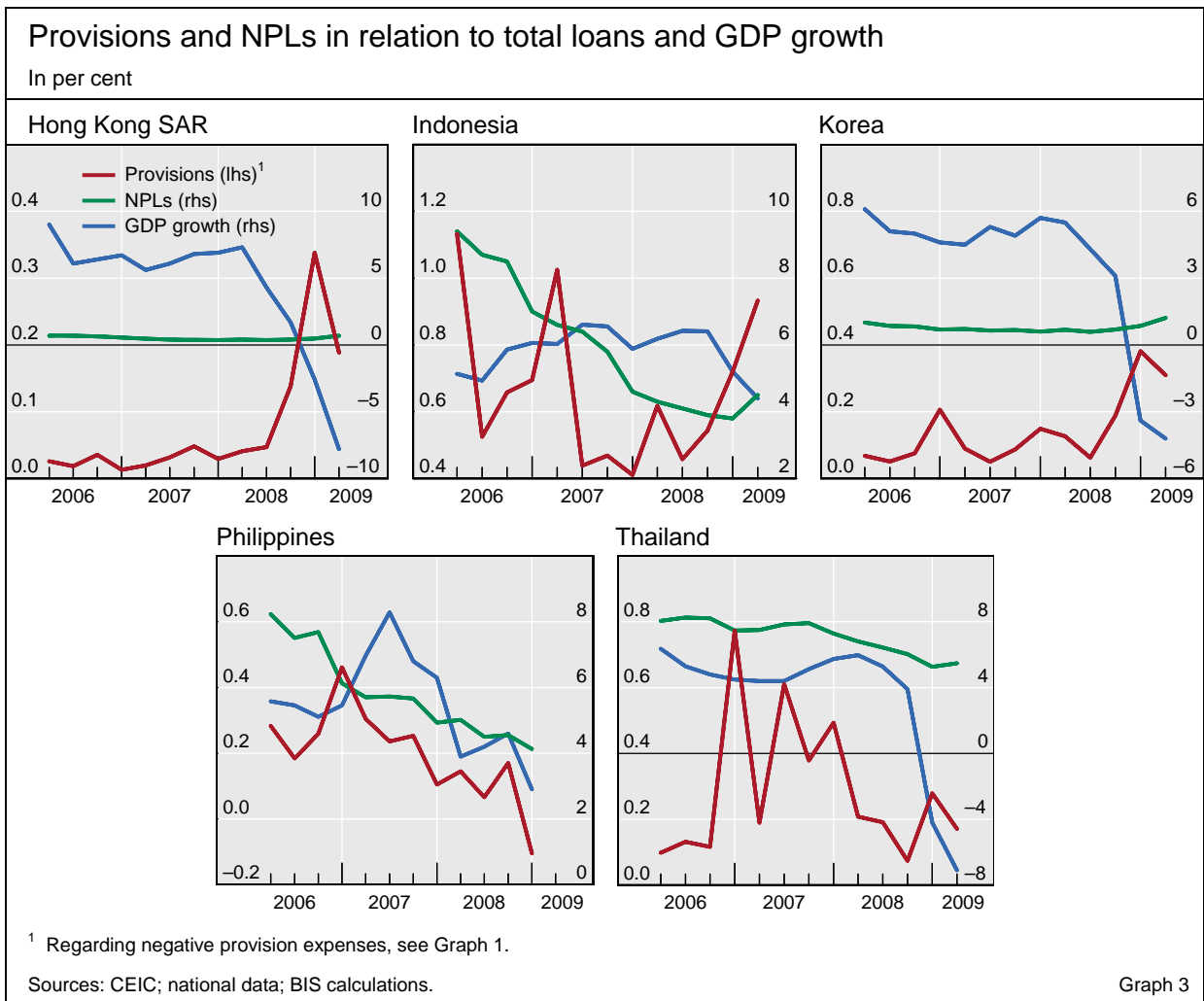
In India, the one other case where the authorities acted to increase provisioning in a discretionary fashion, the general improvement in credit quality was the more dominant factor in determining the overall level of provisioning. Despite the stricter requirements adopted by the authorities described above, the rate of provisions as a proportion of total loans has steadily declined since 2003 (Graph 1).[17]

Provisioning is still responsive to the business cycle

More recently, provisions have risen in some economies, reflecting a deterioration of economic conditions. Provisions have increased most sharply in those jurisdictions recording an increase in NPLs: Hong Kong SAR, Indonesia, Korea and Singapore (Graphs 1 and 3).[18] This probably reflects the fact that the decline in GDP growth (from peak to trough) has generally been the sharpest in those economies. In this sense, changes in provisioning regimes since the Asian financial crisis of the late 1990s have retained a degree of responsiveness to the business cycle. Indeed, in panel regressions, even when estimated over just the past six years (2003–08), GDP growth remains an important explanatory factor, though the relationship between provisioning and other factors that might amplify procyclicality, such as credit growth and earnings, appears to be less strong in the recent period than before (see box).

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[17] To be sure, this was during a period of extremely high loan growth (levels over 20% from 2005), so provisions have still grown in absolute terms, and relative to NPLs. The high growth of credit may also account for declining provisions as a percentage of loans, given that it takes time for loans to go sour (the "seasoning effect").

[18] The fact that increases in NPLs are observed only for these economies is not merely a case of the low frequency of the annual data: for the five economies for which quarterly data through the first quarter of 2009 are available (which do not include Singapore), an increase in the ratio of NPLs to total loans is only apparent in Hong Kong SAR and Korea (Graph 3).

Provisions and NPLs in relation to total loans and GDP growth

In per cent

Hong Kong SAR

Indonesia

Korea

- Provisions (lhs)[1]
- NPLs (rhs)
- GDP growth (rhs)

Philippines

Thailand

[1] Regarding negative provision expenses, see Graph 1.

Sources: CEIC; national data; BIS calculations.   Graph 3

Conclusion

In the wake of the Asian financial crisis, most jurisdictions in emerging Asia adopted stricter provisioning practices and began the process of converging with international accounting standards. While the incurred loss approach in those standards could have led to lower levels of provisioning and reserves for loan losses, a number of regimes overlay additional prudential provisioning requirements. A number of jurisdictions also adopted discretionary measures to increase provisioning in good times in response to rising levels of risk. As a result, levels of provisioning and reserves over the past few years generally appear to be higher, and banking systems more resilient, than before the Asian financial crisis a decade ago.

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Dollar appreciation in 2008: safe haven, carry trades, dollar shortage and overhedging[1]

This feature argues that a combination of factors caused the surprising US dollar appreciation in the second half of 2008. Both the global flight to safety into US Treasury bills and the reversal of carry trades amidst the crisis were sources of dollar strength. In addition, the surge in dollar funding costs in the interbank and FX swap markets provided price incentives for corporates to draw on non-dollar funding to pay down existing dollar debt. Finally, dollar asset writedowns left European banks and institutional investors outside the United States with overhedged dollar books. The squaring of their positions, which required dollar purchases, also boosted the currency.

JEL classification: F3, G2.

The US dollar's appreciation in late 2008, as sharp as any in the period since generalised floating began in 1973, surprised many observers. After all, the most frequent global macroeconomic stress scenario before the eruption of the current crisis highlighted the risk of a sharp depreciation of the currency. Some ascribe the dollar's rise to technical factors (Bénassy-Quéré et al (2009)).

This feature argues that a combination of factors contributed to this surprising development. We first discuss the concept of safe haven and suggest that the US dollar benefited from the global flight to safety into US Treasury bills in late 2008. Then we present evidence that the dollar profited from the reversal of carry trades – the currencies that fell the most during the rise of equity volatility to its all-time peak in October 2008 offered the highest yields in the preceding six months. We then explain how a dollar shortage developed in the international banking market (despite years of US current account deficits) and resulted in high dollar interest rates that supported the currency. Finally, we argue that dollar asset declines left European banks and institutional investors outside the United States overhedged and that their squaring of their positions may have also boosted the dollar. As European banks wrote down the value of holdings of dollar securities, they had to purchase dollars in the spot market to retire the corresponding hedges or

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liabilities. Similarly, European pension funds bought the dollar as they experienced losses on dollar securities hedged into the euro.

Safe haven

For some economists, the term "safe haven" indicates an asset with low risk and high liquidity, like the 10-year German government bund, which non-residents bought during the LTCM/Russian crisis (Upper (2000)). A complementary formulation is that a safe haven asset is what investors buy in uncertain times like the turn of the year 2000, as Kaul and Sapp (2006) assume the dollar was. Others have defined a safe haven as a hedge asset, one with a return unrelated (or negatively related) to that of the reference portfolio. A more restricted version is a rainy day asset, ie one that performs well when the reference portfolio suffers significant losses (Ranaldo and Söderlind (2007)).

Taking refuge in a safe haven needs to be distinguished from another reaction to uncertainty, which has been called homing (Aderhold et al (1988)). After the stock market crash of 1987, for instance, investors tended to sell foreign equities. Since major stock markets had all fallen by similar degrees, this was interpreted as a decrease in the weight on foreign equities. Thus, for a time the crash's trauma heightened investors' bias to their home market.

Net securities flows in the US balance of payments In billions of US dollars, annual rate	Pre-crisis	Phase 1	Phase 2	Phase 3
	2006– Q2 2007	Q3 2007– Q2 2008	Q3 2008– Q4 2008	Q1 2009– Q2 2009
Securities, total by private investors	368.8	–36.0	358.4	–244.6
Foreign purchases of US securities	765.0	189.9	60.0	12.7
Treasury	–19.7	73.2	323.1	62.0
Coupon securities	–22.9	–10.3	49.9	73.5
Bills	2.1	83.5	273.0	–11.6
Agencies	20.9	–107.4	–183.0	–98.8
Corporate bonds	572.8	82.5	–78.5	–34.3
Equities	191.0	141.6	–1.6	83.8
US purchases of foreign securities	–396.1	–225.9	298.4	–257.2
Bonds	–247.7	–113.3	200.7	–179.1
Equities	–148.5	–112.6	97.7	–78.1
Memo:				
Foreign official assets in United States	*494.7*	*614.3*	*199.1*	*391.8*
* Of which: Treasury bonds*	*194.2*	*172.1*	*103.9*	*275.9*
* Of which: Treasury bills*	*–27.2*	*66.4*	*486.9*	*207.7*
US official assets abroad	*5.0*	*–62.1*	*–1,048.7*	*875.9*

Source: Bureau of Economic Analysis.   Table 1

The recent financial crisis led to homing in global bond markets, but also to safe haven demand for US Treasury securities, especially bills (Table 1). With the intensification of the crisis after the Lehman Brothers bankruptcy, US investors sought to de-risk their portfolios by selling foreign bonds and stocks in the latter half of 2008. For their part, private foreign investors turned to selling US corporate bonds, including asset-backed securities, and accelerated their sale of agency mortgage-backed bonds and debentures.
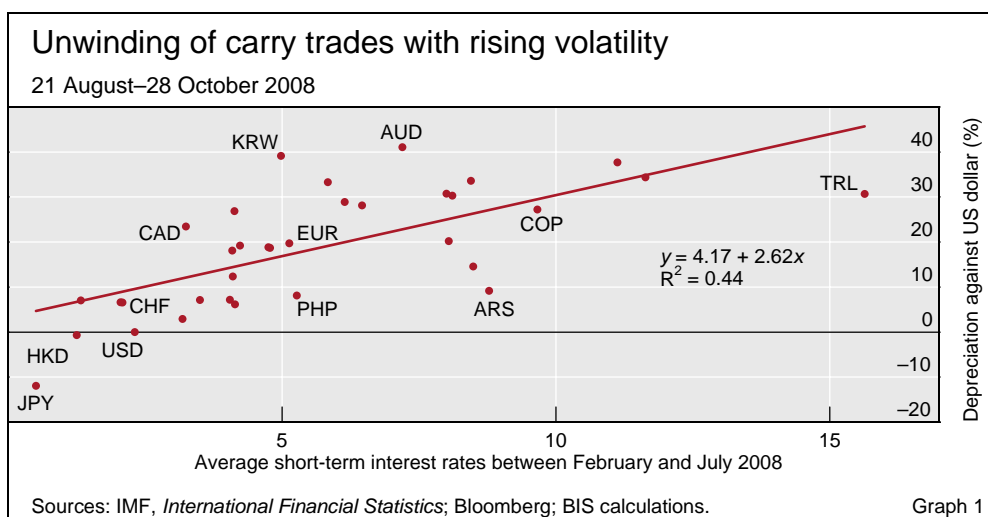
In contrast to this homing, however, was the flight to quality by private foreign investors into Treasury securities. On these rainy days, the safe haven of Treasuries gained in value as equities plunged and credit spreads widened to record levels. While government bonds performed well in France, Germany, Japan, the Netherlands, Switzerland and the United Kingdom, the attraction of Treasury bills kept global investors from staging a general retreat from US securities. To the extent that global investors sold other currencies against the dollar to take refuge in Treasuries, safe haven flows strengthened the dollar.

Unwinding of carry trades

A second source of pressure for dollar appreciation was the unwinding of carry trades. In a carry trade, an investor holds a high-yielding ("target") currency asset financed with a low-yielding ("funding") currency liability. A classic carry trade would be to buy an Australian dollar bond yielding 5% with Swiss francs borrowed at 1%. The profit from such trades over extended periods stands in stark contradiction to one of the major theorems of international finance: interest rate parity holds that what investors gain on an interest rate differential they lose over some horizon to currency depreciation. Strictly speaking, this definition of carry trade is used for leveraged investors, but it has also been loosely applied to unleveraged investors, such as the Japanese housewife ("Mrs Watanabe") investing in Australian dollars rather than in low-yielding yen.

A safe haven currency can serve as the funding currency in carry trades. For example, Jordan (2009) emphasises structural features of Switzerland to explain why the franc serves as a safe haven: the country's political, institutional, social and financial stability, low inflation, confidence in the central bank, comfortable official foreign reserves, high savings and net foreign asset position. For a funding currency in carry trades, however, such structural features matter less than low yields. Japan and Switzerland may have much in common, but it is primarily low yields that have recommended the yen and franc as funding currencies.

This distinction has a bearing on what one could have expected the effect of the sharp rise in market volatility in August 2008. The euro, the yen, and the dollar would all have been plausible candidates as safe haven currencies. However, previous episodes of extreme financial market volatility suggested that currencies would perform inversely to their prior yields, consistent with the unwinding of carry trades (Cairns et al (2007), Fender and Hördahl (2007), McCauley (2008)). When financial markets become very volatile, modest day-by-day yield differentials captured by carry trades pale in comparison to

Unwinding of carry trades with rising volatility

21 August–28 October 2008

Depreciation against US dollar (%)

KRW   AUD

CAD   EUR   COP

CHF   PHP   ARS

TRL

HKD   USD

JPY

$y = 4.17 + 2.62x$
$R^2 = 0.44$

40
30
20
10
0
−10
−20

5   10   15

Average short-term interest rates between February and July 2008

Sources: IMF, *International Financial Statistics*; Bloomberg; BIS calculations.   Graph 1

possible daily losses. It is understandable that investors would reduce such positions when the relationship of return to risk deteriorates. As a result, the target currencies that had offered the most lucrative yields would suffer the greatest depreciation, and the funding currencies would appreciate. The expectation based on the pattern of previous volatility spikes and on money market yields (in ascending order: yen, dollar, euro) was that the dollar would lose ground against the yen, but (unlike in previous episodes) gain ground against the euro. This proved to be the case. Declines in dollar interest rates by mid-2008 had already recommended the dollar to carry traders as a funding currency alongside the yen.

... make the dollar and yen funding currencies ...

When equity volatility (as measured by the VIX index) rose from a local trough of 19 on 22 August 2008 to a then all-time high of 80 on 27 October, the higher a currency's yield in the previous six months (February–July 2008), the greater its depreciation against the dollar was (Graph 1).[2] Target currencies, ranging from the Brazilian real and Turkish lira to the Australian dollar, were hard hit as investors sold them against the dollar or yen. Compared to the more moderate previous spikes in the VIX, the extent of currency depreciation associated with 1 percentage point increases in yields was larger (ie the least squares line was steeper). In particular, along the least squares line, a target currency yielding 1% more depreciated by 2.6% more: 2.6 years of yield advantage ("carry") was taken back in this brief tumult. This is stark evidence of the "fat tail" of negative returns in the distribution of carry trade returns (Gyntelberg and Remolona (2007)).

... which appreciate when markets become volatile

Dollar shortage
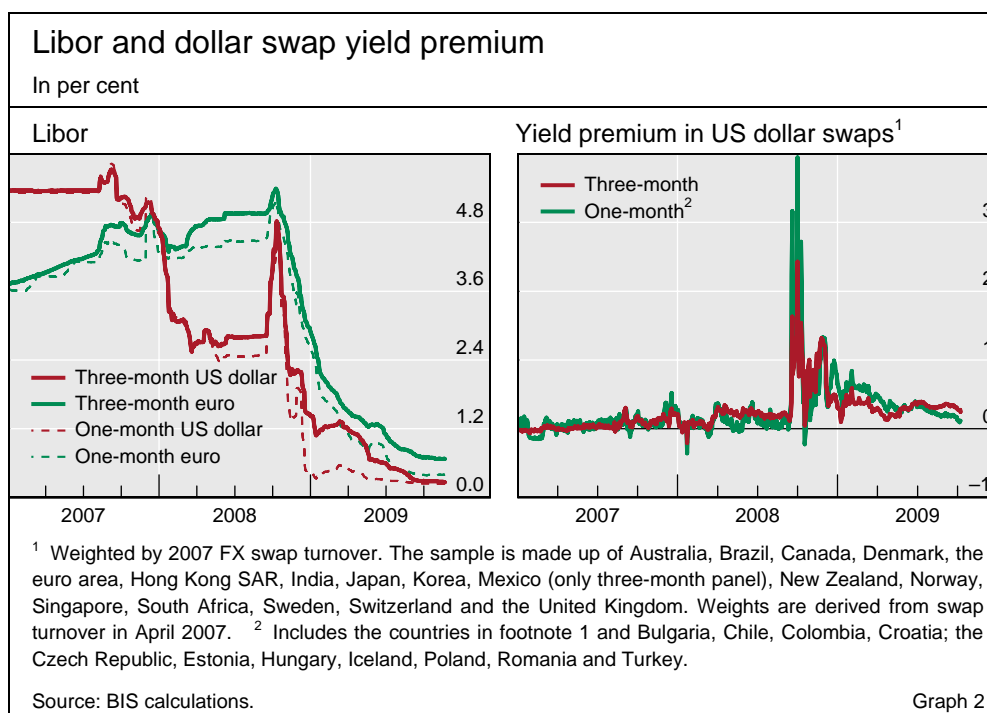
While the US dollar went into September 2008 with low money market yields, the subsequent scramble for the currency hiked dollar yields and rendered it operationally hard to borrow. Both price and quantity rationing provided a third source of support to the dollar's exchange rate.

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[2]   The observations would line up the same way if the euro or the yen were used as the numeraire.

Libor and dollar swap yield premium

In per cent

Libor

- Three-month US dollar
- Three-month euro
- One-month US dollar
- One-month euro

Yield premium in US dollar swaps[1]

- Three-month
- One-month[2]

[1] Weighted by 2007 FX swap turnover. The sample is made up of Australia, Brazil, Canada, Denmark, the euro area, Hong Kong SAR, India, Japan, Korea, Mexico (only three-month panel), New Zealand, Norway, Singapore, South Africa, Sweden, Switzerland and the United Kingdom. Weights are derived from swap turnover in April 2007.   [2] Includes the countries in footnote 1 and Bulgaria, Chile, Colombia, Croatia; the Czech Republic, Estonia, Hungary, Iceland, Poland, Romania and Turkey.

Source: BIS calculations.   Graph 2

Losses on banks' balance sheets ...

The dollar shortage – an acute difficulty for banks to raise dollars – reflected unbalanced growth in international banking. In expanding abroad in this decade, European banks accumulated dollar assets well beyond their dollar deposits, and funded the difference in the interbank and other wholesale markets. By contrast, US banks expanded their foreign claims modestly and ended up with comparatively little need for funding in European currencies.

The global financial crisis exposed the vulnerability of banks that relied on wholesale funding, especially in a currency other than their domestic currency. From August 2007, the prospect of having to fund off-balance sheet entities and the fear of the exposure of financial firms to impaired assets led interbank markets to dry up. After the bankruptcy of Lehman, a run on many US money market funds put at risk a trillion dollars of European banks' funding.

Much like Japanese banks 12 years ago, European banks that found it hard to raise funds in the interbank market relied more on secured funding markets, such as repos and foreign exchange swaps. As they swapped euros, pounds and Swiss francs for dollars, however, there was no matching new demand for European currencies by US banks. As a result of this demand-supply imbalance, and despite years of US current account deficits, the global banking system suffered from an acute US dollar shortage. The cost of dollar funding in the global foreign exchange swap market soared (Graph 2).

... push up borrowing costs for *all* dollar borrowers ...

This shortage, and high dollar yields in the market, contributed to a sharp appreciation of the currency in late 2008. Companies around the world that had been financing inventories or international trade in dollars found it hard to roll over maturing dollar debts and faced price incentives to draw on funding in other currencies to pay down such debts.[3] While there might have been an

... leading to repayment of dollar advances

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[3]   Banks in the United States report that dollar claims on non-banks outside the United States fell from $684 billion to $478 billion in the second half of 2008, according to TIC data.
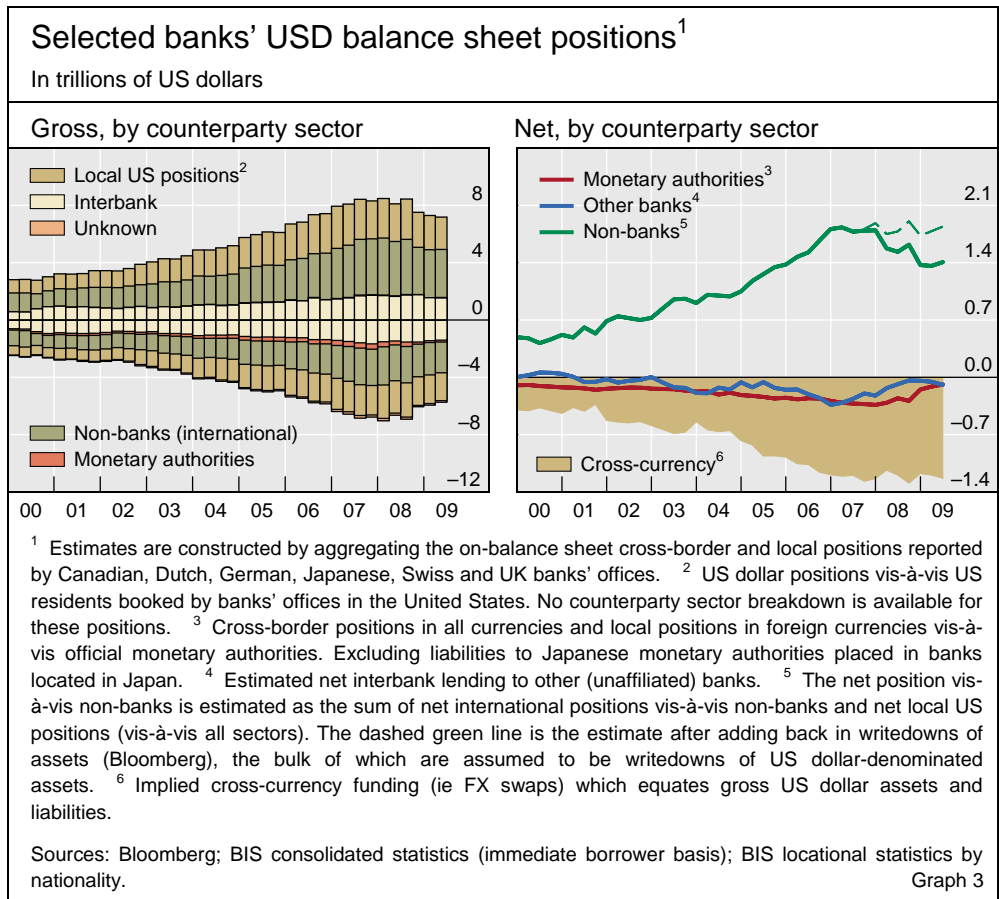
unusual degree of quantity rather than price rationing, one would expect dollar appreciation as these firms bought dollars in the spot market.

Overhedging: non-US banks

A fourth source of upward pressure on the US dollar arose as a result of the retirement of dollar debt in parallel with the recognition of losses on dollar securities by non-US banks. As noted, in the years to mid-2007, many banking systems invested heavily in US dollar assets (Graph 3, left-hand panel), funding these positions by borrowing dollars directly from a variety of counterparties, and via cross-currency financing using foreign exchange swaps (Graph 3, right-hand panel).[4]

As these non-US banks wrote down dollar assets, they had to square their books in a way that contributed to the upward pressure on the dollar. Writedowns for the banking systems in Graph 3 totalled an estimated $361 billion from the onset of the crisis to end-2008, and $434 billion by the

Selected banks' USD balance sheet positions[1]
In trillions of US dollars

Gross, by counterparty sector
- Local US positions[2]
- Interbank
- Unknown
- Non-banks (international)
- Monetary authorities

Net, by counterparty sector
- Monetary authorities[3]
- Other banks[4]
- Non-banks[5]
- Cross-currency[6]

[1] Estimates are constructed by aggregating the on-balance sheet cross-border and local positions reported by Canadian, Dutch, German, Japanese, Swiss and UK banks' offices.   [2] US dollar positions vis-à-vis US residents booked by banks' offices in the United States. No counterparty sector breakdown is available for these positions.   [3] Cross-border positions in all currencies and local positions in foreign currencies vis-à-vis official monetary authorities. Excluding liabilities to Japanese monetary authorities placed in banks located in Japan.   [4] Estimated net interbank lending to other (unaffiliated) banks.   [5] The net position vis-à-vis non-banks is estimated as the sum of net international positions vis-à-vis non-banks and net local US positions (vis-à-vis all sectors). The dashed green line is the estimate after adding back in writedowns of assets (Bloomberg), the bulk of which are assumed to be writedowns of US dollar-denominated assets.   [6] Implied cross-currency funding (ie FX swaps) which equates gross US dollar assets and liabilities.

Sources: Bloomberg; BIS consolidated statistics (immediate borrower basis); BIS locational statistics by nationality.   Graph 3

According to BIS data, banks outside the United States report that their dollar claims on non-banks outside the United States decreased by $115 billion in the same period.

[4] Graph 3 shows the aggregate US dollar balance sheet positions for those major banking systems which were long dollars prior to the crisis, ie whose on-balance sheet dollar assets exceeded their dollar liabilities, implying net dollar financing from the FX swap market. These estimates are constructed by splicing together information from the BIS consolidated banking statistics (immediate borrower basis) and the BIS locational banking statistics by nationality. See McGuire and von Peter (2009) for details.

end of Q2 2009 (right-hand panel, gap between solid and dashed green lines). These writedowns left banks that originally balanced their US dollar assets and liabilities with an excess of dollar liabilities over dollar assets – an "overhedged" dollar position. This imbalance could be redressed by not rolling over dollar debt and instead buying dollars outright in the spot market to repay debt. Such spot buying of dollars strengthened the dollar.

Overhedging: non-US institutional investors

A fifth source of upward pressure on the US dollar is a variation on the fourth, with the actors being "real money" institutional investors rather than leveraged banks. To limit the foreign exchange risk in holdings of US securities, long-term investors like pension funds in Europe and Australia sell dollars forward against domestic currencies. In Australia, about half of non-bank financial firm holdings of foreign securities are hedged back into domestic currency, evidently more so in the case of bonds than equities.[5] As the price of US equities and credit portfolios declined in the latter half of 2008, such hedges needed to be adjusted downwards, ie the portfolios became overhedged. Operationally, maturing forward sales of dollars that in more stable markets would be rolled forward (through foreign exchange swaps) were simply extinguished through spot purchases of dollars.

Of course, such dynamics would not put net upward pressure on the dollar if US portfolios of European and other non-US securities were of similar size and management. Such a notion of symmetry led some European institutional investors to approach their US counterparts, such as state employee and teachers' pension funds, about the possibility of swapping dollars and euros bilaterally, given the disruption in the markets. The Europeans learned that the European holdings of their US counterparts were smaller than their US holdings, and also typically not currency-hedged. Thus, it appears that dynamic currency hedging of European and Australian portfolios of US securities may exert an exchange rate effect because there is not symmetrical and offsetting hedging by large US portfolios. Thus, when US equity and risky bonds fell in value in the second half of 2008, pension funds outside the United States bought dollars, contributing to dollar strength.

Conclusion

The factors described above[6] played an unusual role in the second half of 2008. Under normal circumstances, expectations of monetary policy changes,

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[5]   The Australian Bureau of Statistics surveyed pension funds, mutual funds and other non-bank financial institutions in 2005 and found that about half of their foreign assets were hedged (Becker et al (2005)). Market data reported by Baker and Wong (2009) suggest that pension funds hedged almost all of their foreign bond portfolios back into Australian dollars, but hedged only a little under half of their foreign equity portfolios. Hedge ratios remain high (Australian Bureau of Statistics (2009)).

[6]   Ours is not an exhaustive list. See Jara et al (2009) for a description of foreign exchange option structures that led to dollar obligations by many emerging market companies, another case of overhedging.

the strength of investment demand, the stance of fiscal policy and long-run accumulation of international assets and liabilities figure more prominently in exchange rate developments.

Looking ahead, the factors reviewed in this special feature make for crosswinds for the dollar. Safe haven flows that favoured the dollar have been reversing (FOMC (2009)). Carry trades always defy measurement, but such positions, with the dollar as a funding currency, are thought to be increasing, putting upward pressure on higher-yielding currencies. In contrast, while the spread between Libor and expected overnight rates has normalised, the premium on dollars in swap markets is still providing some support to the dollar. Writedowns of dollar assets by non-US banks continue, albeit at a reduced pace, and are said to have some way to go (IMF (2009)). And, at writing, with asset prices rising, hedging of dollar holdings in the United States by European and Australian institutional investors weighs on the dollar.

It is worth noting that, at current US yields, carry trades *and* institutional investors' hedges respond similarly to big changes in asset prices and volatility. In particular, when equities fall, risk appetite shrinks and volatility is increasing, dollars are bought by *both* types of investors, as in late 2008; with "risk on", equity prices rising and declining volatility, dollars are sold by *both*, albeit perhaps at different frequencies.

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