

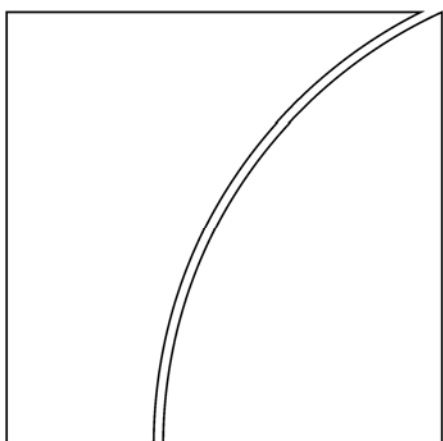


BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

September 2006

International banking
and financial market
developments



BIS Quarterly Review
Monetary and Economic Department

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Note from the Editorial Committee

The Editorial Committee is introducing a modified format for the September 2006 issue of the BIS Quarterly Review, with the aim of enhancing the publication's analysis of international banking and financial markets. In place of the previous three sections based on the BIS international banking, securities and derivatives statistics, we now provide a single highlights section covering in a more succinct fashion the latest quarterly movements in the statistics. To complement this change, we now expect to have one to two additional articles each quarter which use the BIS statistics in more depth to analyse topical issues. In this issue, the special features entitled "The changing composition of official reserves" and "Derivatives activity and monetary policy" rely heavily on the BIS statistics.

This reorganisation was based in part on the interests revealed by the 2004 survey of Quarterly readers as well as downloads of Quarterly material. We anticipate repeating the survey of Quarterly readers after gaining some experience with the new format. In the meantime, readers' views about this initiative would be welcome and can be sent to frank.packer@bis.org.

BIS Quarterly Review

September 2006

International banking and financial market developments

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Notations used in this Review

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

Differences in totals are due to rounding.

Overview: markets focus on monetary policy

The upward trend in government bond yields that had been evident in major bond markets for much of the year came to an end in June. This was largely due to investor perceptions of weakening economic growth, in particular in the United States, and to markets reassessing the likelihood of further rate hikes by the Federal Reserve. Given the view that the US economy might be at a crossroads with respect to near-term growth prospects and the direction of monetary policy, particular emphasis was placed on US data and signals from the Federal Reserve. These factors, along with monetary policy decisions by other major central banks and expectations about their future actions, largely shaped developments in global bond markets.

In world equity markets, prices gradually recovered after the broad sell-off in May and early June, but volatility remained higher than before the turbulence. Implied volatilities recovered only partially after the sell-off, suggesting somewhat heightened uncertainty among investors about the near-term direction of equity prices. This may partly have been fuelled by concerns about the economic slowdown in the United States, and by questions about the outlook for corporate profits amidst higher oil prices and geopolitical tensions. However, equity prices were supported by falling bond yields and a generally favourable outlook for growth in the euro area and Japan, as well as positive second quarter earnings announcements.

In credit markets, while euro area markets largely recovered, spreads on high-yield debt in the United States did not tighten much after the sell-off in May and June, being held up by higher energy prices related to rising geopolitical risks, as well as signs of increasing leverage. By contrast, on the back of a spate of sovereign rating upgrades, emerging markets regained much of the exuberance that had characterised the early part of the year, with sovereign spreads again approaching all-time lows for major indices. Credit markets in both developed and emerging market countries were supported by news seen as suggesting less tightening of monetary policy going forward.

Upward trend in yields reversed

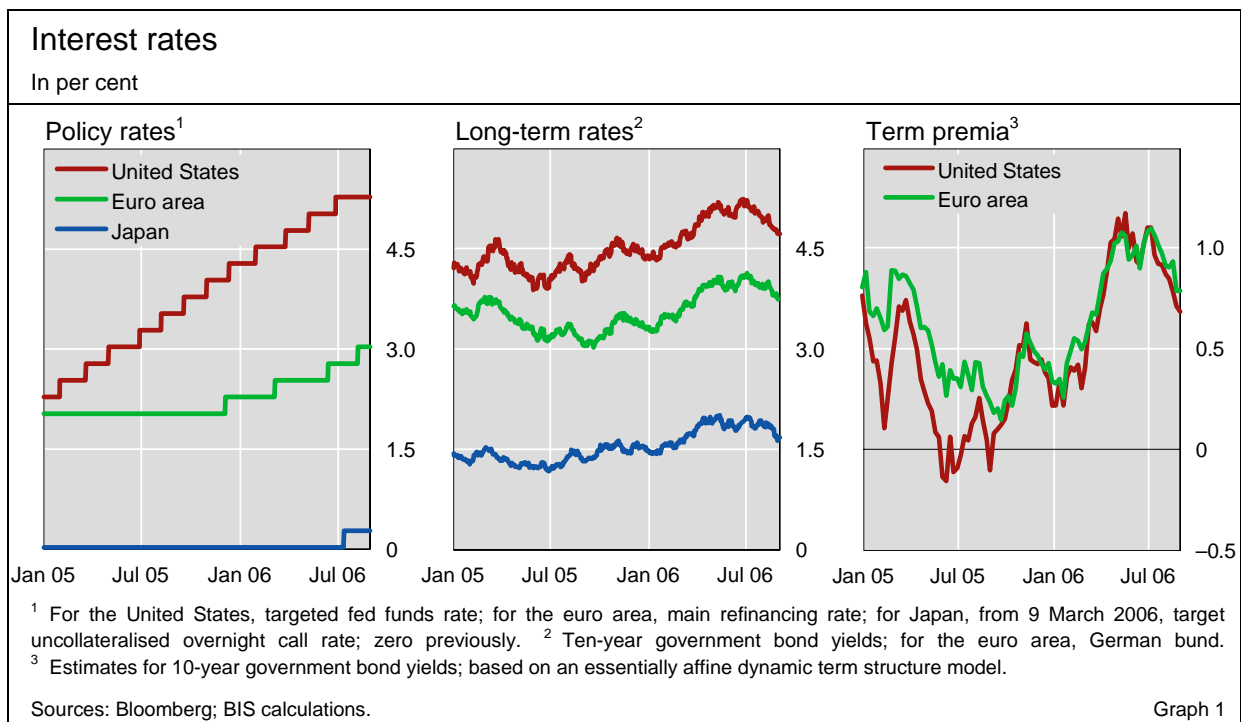
Towards the end of June, the general upward trend in bond yields that had been evident for much of the year came to an end. After increasing steadily throughout the first few months of 2006, bond yields in the major developed

economies retreated in May and early June when turbulence in international equity markets prompted investors to turn to the relative safety of fixed income government securities. As equity markets stabilised, yields briefly resumed their previous upward trajectories. However, by late June yields set out on a more enduring downward path. By 1 September 2006, 10-year government bond yields had fallen by more than 50 basis points in the United States and by almost 40 basis points in the euro area, compared to the peaks reached earlier in the summer (Graph 1, centre panel). In Japan, while yields on 10-year bonds initially displayed less of a decline than in the United States and the euro area, trading within a range just below the 2% level, towards the end of August they also started to fall.

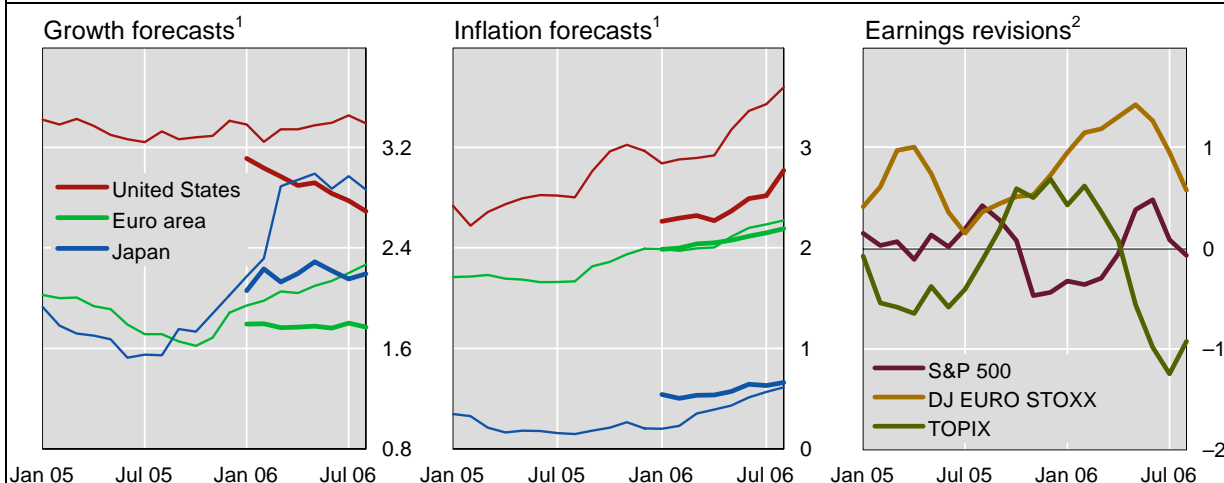
Bond yields end their upward trend and start falling ...

The bond market rally was partly the result of a shift in investors' perceptions about the strength of future economic activity, in particular in the United States. Consistent with this, signals from the Federal Reserve were interpreted by the market as indicating a lower likelihood of further interest rate hikes in the near future. These factors seem to have had a significant impact not only on US bond markets but also abroad, possibly due to the weight of the United States in the global economy. Moreover, contributing to the overall decline in yields was an apparent fall in term premia, in contrast to developments in the first half of the year when estimated premia had been rising (Graph 1, right-hand panel).

Market participants focused a great deal of attention on realised and expected actions of central banks during the past three months. All three major central banks raised their key interest rates in widely anticipated policy moves (Graph 1, left-hand panel). The Bank of Japan decided to bring the zero interest rate environment to an end by raising the short-term interest rate by 25 basis points on 14 July – its first rate hike in six years. The ECB raised interest rates by 25 basis points on 8 June and again on 3 August. The Federal



Macroeconomic outlook



¹ Forecasts as published monthly by Consensus Economics. Thin lines represent forecasts for 2006 while thick lines are forecasts for 2007; observations are positioned in the month in which the forecast was made. ² 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; to adjust for analysts' systematic overestimation of earnings, the mean of the diffusion index over the 2003–05 period (S&P 500 = 54.1; DJ EURO STOXX = 49.6; TOPIX = 53.2) was subtracted from each monthly observation; three-month moving average.

Sources: Bloomberg; © Consensus Economics; I/B/E/S; BIS calculations.

Graph 2

Reserve announced its 17th consecutive interest rate increase on 29 June, raising the federal funds rate by 25 basis points to 5.25%. The FOMC's accompanying statement, which was interpreted by investors as signalling an increased likelihood of a slowdown in the pace of interest rate increases, had a significant impact on bond markets in the United States as well as internationally.

... as the US growth outlook is revised downwards ...

New data releases contributed to reinforcing the perception among investors that growth in the US economy was gradually decelerating. For example, second quarter US GDP growth came in substantially below market expectations, and the unemployment rate rose more than anticipated in July. Both of these data releases resulted in sharply lower US long-term bond yields. In addition, activity in the US housing market showed clear signs of slowing rapidly. In view of the picture emerging from incoming data, US 2007 growth forecasts were continuously revised downwards during 2006 (Graph 2, left-hand panel).

... and Federal Reserve rate hike expectations decline

Signs of a cooling US economy, as well as statements by the Federal Reserve, prompted investors to conclude that the need for further near-term policy tightening had diminished. In line with these expectations, the FOMC kept interest rates on hold on 8 August, and indicated that it expected inflation pressures to abate as economic growth was moderating. Reflecting the market's reassessment of future US monetary policy, federal funds futures rates fell gradually in July and August. The pronounced downward shift across the entire fed funds futures curve that took place after June suggested that US policy rates were expected to remain steady or even start to decline next year (Graph 3, left-hand panel).

In contrast to the United States, perceptions about monetary policy moves in the euro area did not shift in the direction of a reduced pace of tightening, as

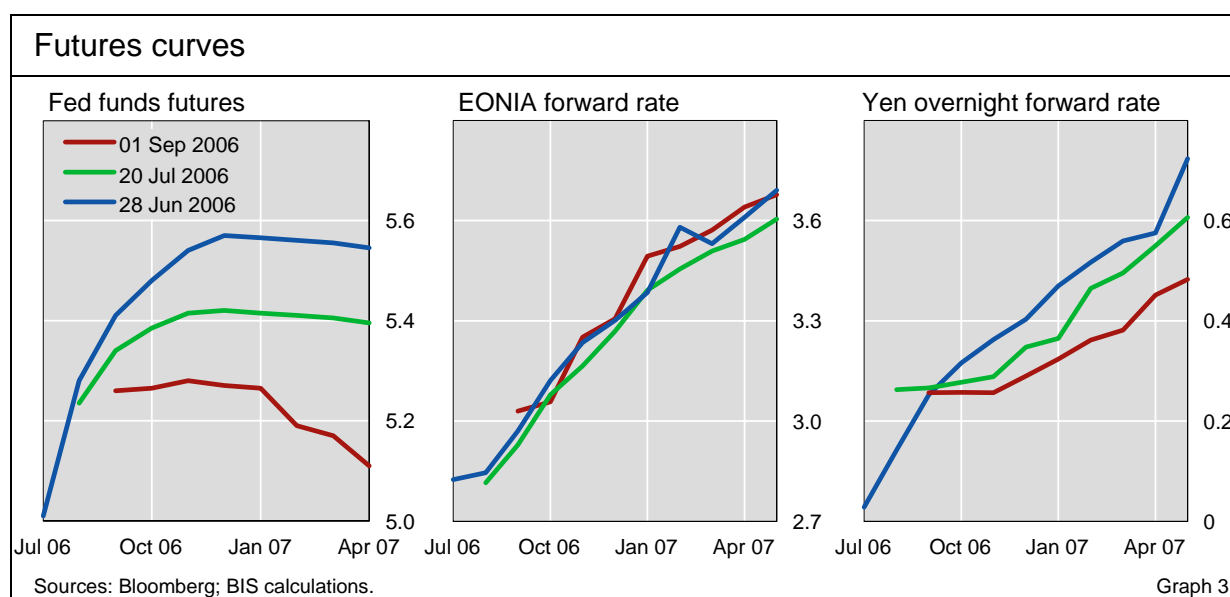
indicated by EONIA forward rates (Graph 3, centre panel). These expectations were in line with data releases indicating a continued pickup in euro area economic activity. For example, second quarter euro area GDP growth surprised on the upside, reaching its highest level in five years. Accordingly, survey forecasts for 2006 euro area growth were revised upwards (Graph 2, left-hand panel). The 25 basis point increase by the ECB on 3 August, two months after the previous rate hike, implied an acceleration in the pace at which the central bank was bringing rates back to a more neutral level, given that the previous two increases had come at three-month intervals. Statements by the President of the ECB in August reinforced investors' perceptions that policy rates in the euro area were likely to be raised again, and sooner rather than later.

Monetary policy expected to be tightened in the euro area ...

In Japan, economic news was also generally favourable during much of the past three months. The Bank of Japan's *Tankan* survey painted a brighter picture of the economy than the market had expected, and led to surging bond yields after its release in early July. Moreover, the Bank's July *Monthly Report of Recent Economic and Financial Developments* indicated that the output gap seemed to have entered positive territory, and that the economy was expected to continue to expand. However, not all news was upbeat with respect to growth prospects. Japanese bond yields declined on the day when data were released showing that second quarter GDP growth had been substantially below analysts' expectations. Yields fell further after it was announced that industrial production unexpectedly fell in July. Reflecting incoming data as well as signals from the Bank of Japan, the pricing of overnight index swaps suggested that policy rates were expected to rise only gradually following the July rate hike (Graph 3, right-hand panel).

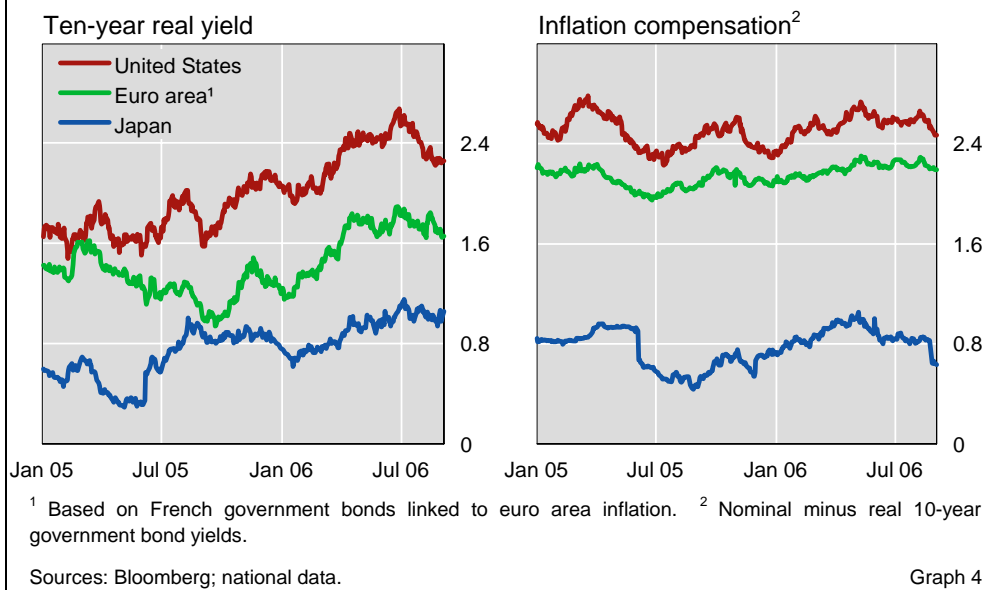
... and gradually in Japan

On the inflation front, much of the news during the past three months pointed to mounting price pressures in all three major economies, thereby resulting in upward revisions of survey inflation forecasts across the board (Graph 2, centre panel). However, data published in August suggested that these pressures might have started to ease in the United States and, to a



Real yields and inflation compensation

In per cent



Some signs of easing price pressures

lesser extent, in the euro area and Japan. Compared to a year earlier, core producer prices in the United States rose by 4.2% in July, which was lower than market expectations and also below the previous month's figure of almost 5%. Likewise, US CPI inflation for July was slightly below expectations at 4.1% year-on-year. Both of these releases led to sharp drops in US bond yields. In the euro area, figures for July HICP inflation showed that prices had increased by 2.4% compared to one year earlier, a pace somewhat below that of the previous month, and also lower than anticipated. Meanwhile, a data release showing Japanese consumer prices increasing substantially less than expected in July brought about a rally in Japanese bond markets in late August.

To a large extent, movements of nominal and real bond yields over the past couple of months reflected the aforementioned macroeconomic developments. In line with the outlook for slower growth in the United States, real bond yields fell in July and August, accounting for almost the entire decline in nominal yields over the same period (Graph 4). This left the inflation compensation demanded by investors for holding nominal bonds over the next 10 years little changed (see also the box on page 6). These developments contrasted with those during much of the first half of 2006, when not only higher real yields but also rising inflation compensation had contributed to the upward trend in nominal yields. In the euro area, real yields declined considerably less than in the United States, in line with the markets' perceptions of somewhat diverging expected growth trajectories in the two economies. The 10-year euro break-even inflation rate remained relatively steady, suggesting that long-horizon inflation expectations were stable. In Japan, both real yields and break-even inflation rates were little changed over the past three months. However, towards the end of August, the 10-year inflation compensation in Japan fell by almost 20 basis points, on the heels of lower than expected inflation data.

Forward break-even inflation rates and long-horizon inflation expectations

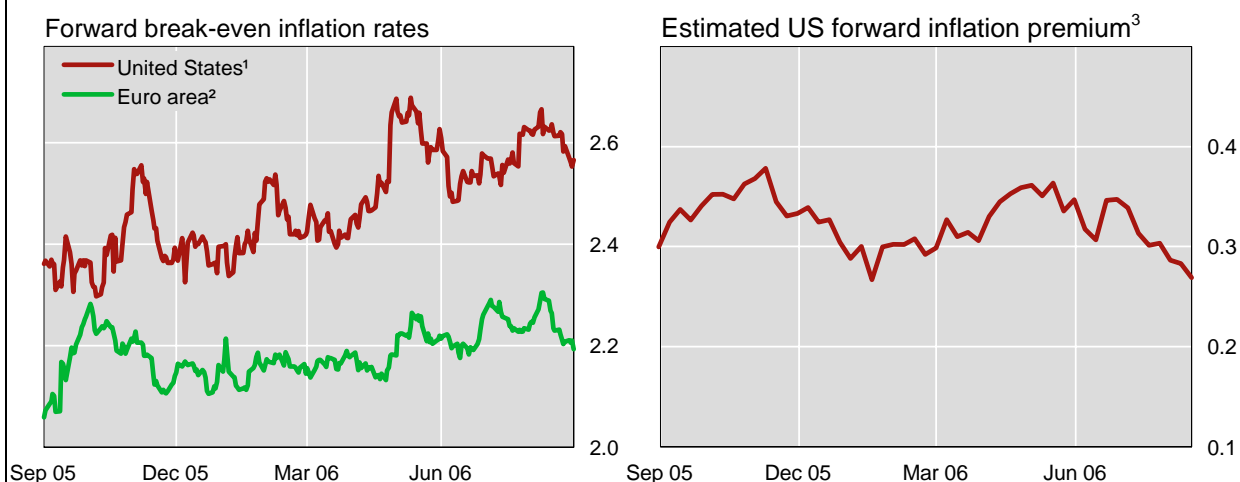
Break-even inflation rates, ie the difference between yields on nominal bonds and yields on real (index-linked) bonds of comparable maturity, have long been used as an indicator of the markets' inflation expectations over the horizon of the bonds, thereby complementing other measures such as survey forecasts. Another popular indicator in this regard is long-horizon forward break-even inflation rates, such as the five-year forward rate five years ahead. This type of measure is often seen as providing a cleaner indication of long-horizon inflation expectations because it should, in principle, not be affected by inflation movements expected over the near term, such as those caused by cyclical fluctuations.

In an environment where short-term inflationary pressures seem to have been rising for some time in both the United States and the euro area, forward break-even rates have been edging upwards, although more so in the United States than in the euro area. The left-hand panel of the graph below shows that over the past year US five-year forward break-even rates five years ahead have risen gradually by around 30 basis points, while corresponding euro area break-even rates displayed a more modest increase over the past couple of months after a period of relative stability.

In principle, however, an increase in the forward break-even rate can be attributed to expectations of higher inflation in the distant future or to a rising inflation risk premium, or a combination of both. The inflation risk premium, in this context, represents the additional return that investors require to invest in nominal bonds, which are exposed to risk stemming from fluctuations in inflation, as compared to the required return on real bonds. It is notoriously difficult to pin down the magnitude of risk premia, let alone to disentangle the inflation risk premium from its real counterpart, ie the required return associated with uncertainty in real interest rate fluctuations.

However, recent estimates using US data based on a dynamic term structure model might be able to provide some guidance in this regard. Kim and Wright (2005) use nominal US bond data in combination with inflation data to estimate the dynamics of the nominal term structure and to infer an implied real term structure, which in turn allows them to obtain estimates of real risk premia as well as inflation risk premia.^⑥ The technique also permits gauging the size of forward inflation risk premia, such as those that would influence the forward break-even rates shown below. Admittedly, this approach does not take into account information from index-linked bonds, and the results should therefore only be seen as indicative with respect to the break-even data displayed in the graph. In addition, other factors, such as liquidity considerations or institutional effects, may affect the level of break-even inflation rates. Even so, as long as these other factors are reasonably stable, recent changes in break-even rates should still be primarily due to changes in inflation expectations and/or changes in inflation risk premia.

Inflation compensation and term premia



¹ Five-year forward break-even inflation rates five years ahead; based on government bonds maturing in 2010, 2011, 2015 and 2016. Due to the limited number of available maturities for indexed-linked bonds, the forward break-even rates shown in the graph are approximations. ² Five-year forward break-even inflation rates five years ahead; based on French government sovereign bonds (OATs) maturing in 2012 and 2015; index-linked OATs are indexed to euro area inflation. ³ Five-year forward inflation risk premium five years ahead, in per cent; based on calculations by Kim and Wright (2005).

Sources: Federal Reserve Board; Bloomberg; BIS calculations.

Estimates using the aforementioned technique suggest that the five-year/five-year forward inflation risk premium in the United States has remained fairly steady during the past year. The inflation risk premium therefore seems to have been playing a limited role in explaining recent movements in the forward break-even rate. On this basis, the gradual increase in forward break-even inflation rates that has taken place in the United States over the past year is likely to be due largely to expectations of modestly higher inflation in the long run.

[©] See D Kim and J Wright, "An arbitrage-free three-factor term structure model and the recent behavior of long-term yields and distant-horizon forward rates," *International Finance Discussion Paper* 2005-33, Federal Reserve Board, August 2005. Other recent work in which inflation risk premia have been estimated includes: A Ang and G Bekaert, "The term structure of real rates and expected inflation," working paper, Columbia University, Graduate School of Business, 2005; A Buraschi and A Jiltsov, "Inflation risk premia and the expectations hypothesis", *Journal of Financial Economics*, 2005, vol 75, pp 429–90; and P Hördahl, O Tristani and D Vestin, "The term structure of inflation risk premia and macroeconomic dynamics," mimeo, ECB and BIS, 2006.

Equity markets recover but remain volatile

Stock prices
recover after sell-off

Equity prices in the major markets gradually recovered after the broad sell-off in May and early June, but volatility remained higher than before (Graph 5, left-hand panel). From the start of the sell-off on 10 May to the trough on 13 June, the S&P 500 Index had lost 7.7%, while the DJ EURO STOXX had fallen by 13.3% and the TOPIX by 16.5%. However, in subsequent weeks, these losses were largely recouped.

Despite the recovery, the brief sell-off of equities in May and June seemed to have left investors somewhat more nervous than earlier in the year, as indicated by higher equity price volatility. Implied volatilities, which had surged during the period of market turbulence, also recovered only partially after the sell-off, suggesting that investors remained somewhat more uncertain about the direction of equity prices in the near term (Graph 5, centre panel). In line with this, risk appetite among investors, which had taken a dive as global equities tumbled, seemed to remain somewhat subdued compared to levels seen in the recent past (Graph 5, right-hand panel).

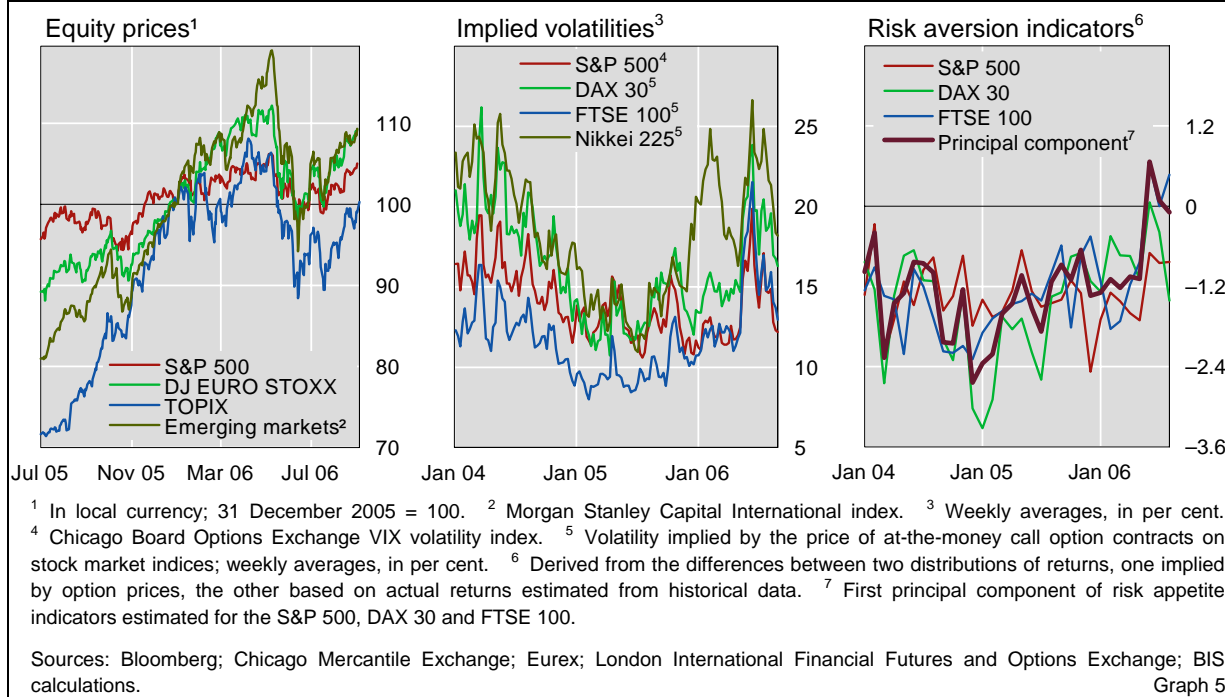
While uncertainties
remain ...

Contributing to the uncertainty among investors in the aftermath of the sell-off were questions about the degree and speed of the economic slowdown in the United States, and shifting perceptions of Federal Reserve monetary policy going forward. Geopolitical tensions, reflecting the outbreak of new hostilities in the Middle East, continued violence in Iraq, missile tests by North Korea and apprehension about Iran's nuclear plans, added to investors' uncertainty. On top of this, the ratio of positive to negative revisions of forecast earnings fell over the last quarter in the United States, Europe and Japan (Graph 2, right-hand panel).

... equities are
supported by
earnings and falling
bond yields

Nonetheless, equity prices received support from a number of factors. Actual earnings data remained upbeat: announcements for the second quarter indicated that aggregate S&P 500 earnings would grow at a double digit pace in year-on-year terms for the 17th consecutive quarter. News regarding growth prospects in the euro area and Japan was generally positive, and tended to balance the less favourable outlook emerging for the US economy. Moreover, falling bond yields and a growing perception among investors that the Federal Reserve had reached the end of its cycle of rate hikes lent further support to equities. In fact, data indicating weaker than expected US growth often resulted

Volatility and risk appetite in equity markets



in rising share prices, as markets revised downwards their expectations of the pace and intensity of future rate hikes, and hence the probability that tighter monetary policy would lead to sharply reduced growth. As data released in August pointed to somewhat diminished inflationary pressures in the United States, the market seemed increasingly to price in a scenario where the US economy would experience a “soft landing”, cooling just to the extent necessary to keep upward price pressures contained.

US equity markets price in a “soft landing”

In emerging markets, equities were hit particularly hard during the May–June sell-off, with the MSCI emerging markets equity index tumbling more than 20%. However, as was the case among the major markets, equities in emerging markets gradually recovered (Graph 5, left-hand panel). By 1 September, more than half of the losses incurred during the sell-off had been recouped. In general, during the past three months equity prices in emerging markets tended to mirror those in advanced economies, although they appeared more sensitive to specific geopolitical events. Local factors also contributed to sharp price movements in individual markets. The Turkish stock market tumbled in June as accelerating inflation and a rapidly falling lira prompted the central bank to raise interest rates sharply. The escalation of violence in the Middle East also weighed particularly heavily on Turkish equities. In Mexico, the Bolsa saw abrupt moves in July as investors reassessed the likelihood that either of the two main contestants would end up being declared the victor of the closely contested 2 July presidential election.

US corporate spreads range-bound at higher levels

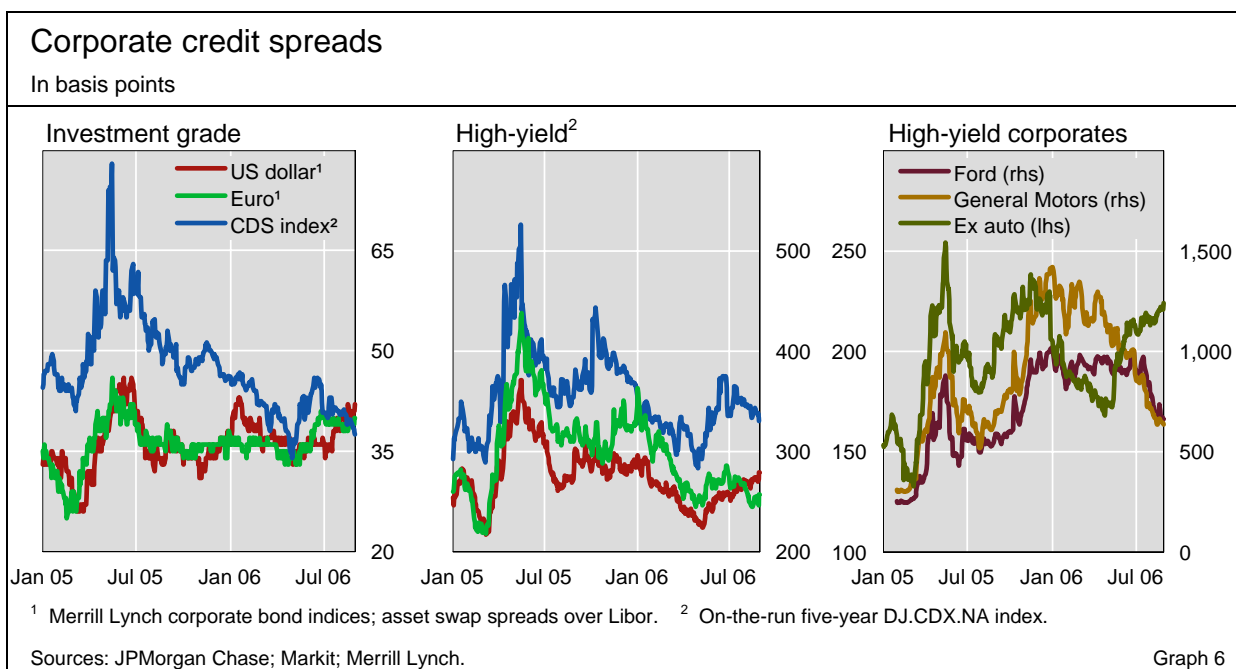
Developed country credit market performance was mixed following the May and early June sell-off (Graph 6). By 1 September, asset swap spreads over

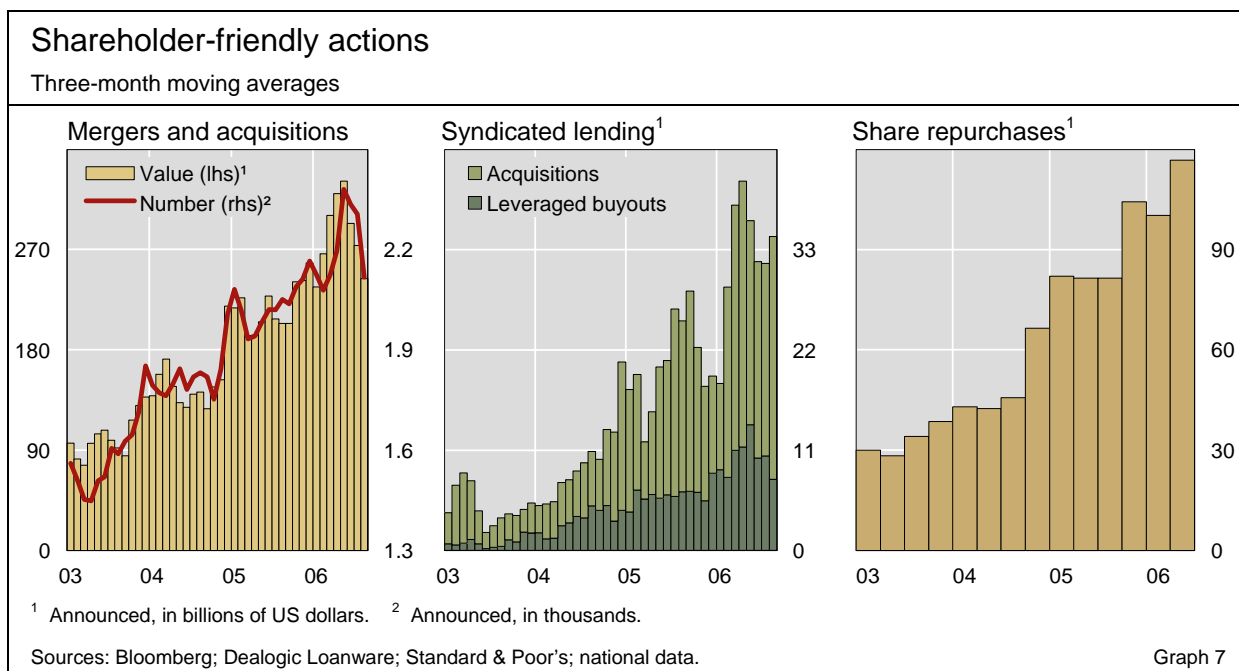
Libor on US dollar investment grade and high-yield corporate bonds were at 42 and 279 basis points respectively, both still well above the lowest levels of the year hit in May. North American credit default swap (CDS) spreads, which had moved up much more dramatically during the sell-off of the second quarter, retraced only a fraction of the earlier widening. Though also volatile, performance was somewhat better for euro area credits: high-yield spread indices in the euro area in late August returned to around the levels preceding the sell-off, perhaps due to the more positive signals on growth described above.

Middle East conflict contributes to rise in spreads

Similar to equity markets, spreads in corporate credit markets were driven in competing directions by higher energy prices related to rising geopolitical risks and changes in the near-term prospects of Federal Reserve action. The week of 10–14 July, in which oil prices rose sharply as conflict intensified in the Middle East, saw a 22 basis point rise in the North American high-yield CDS index (the investment grade index rose by 3 basis points). In contrast, both investment grade and high-yield CDS spreads fell sharply after the release of the FOMC statement on 29 June, and also in response to the Federal Reserve Chairman’s Congressional testimony of 19 July. Even a worse than expected GDP report in late July was taken as positive news for the high-yield sector, indicative of a market less worried about the deceleration in current growth than the possibility of the Federal Reserve raising rates too rapidly and thereby intensifying the slowdown.

Excluding the automobile sector, high-yield spreads would have moved up significantly more in June and July than they did (Graph 6, right-hand panel). Two of the largest issuers in the indices, the US automotive companies General Motors and Ford, saw their spreads compress during the period. Ford five-year CDS spreads fell to around 660 basis points by end-August, down more than 330 basis points from 28 June. GM five-year CDS spreads were around 640 basis points by end-August, declining by over 360 basis points over





the same period. Factors spurring the rally were probably idiosyncratic to the two issuers, including talk of a new GM restructuring plan, as well as an upside earnings surprise in July.

Rising concerns about LBO risk and increased leverage are likely to have weighed on corporate bonds, particularly in the United States. Indeed, an agreement for a \$33 billion leveraged buyout of the US hospital chain HCA was announced on 24 July, the largest such transaction ever. The announcement led not only to an immediate 150 basis point rise in spreads for HCA debt obligations, but also to a marked rise in spreads throughout the hospital operator sector. A boom in global mergers and acquisitions has been ongoing for some time, to a considerable extent financed by increased leverage (Graph 7). Meanwhile, leveraging of the corporate sector by share repurchase activity has also increased markedly. Announced share buybacks surged to around \$117 billion in the second quarter compared to \$100 billion announced in the first quarter and the quarterly average of \$87 billion in 2005.

LBO risk and increased leverage weigh on credit markets ...

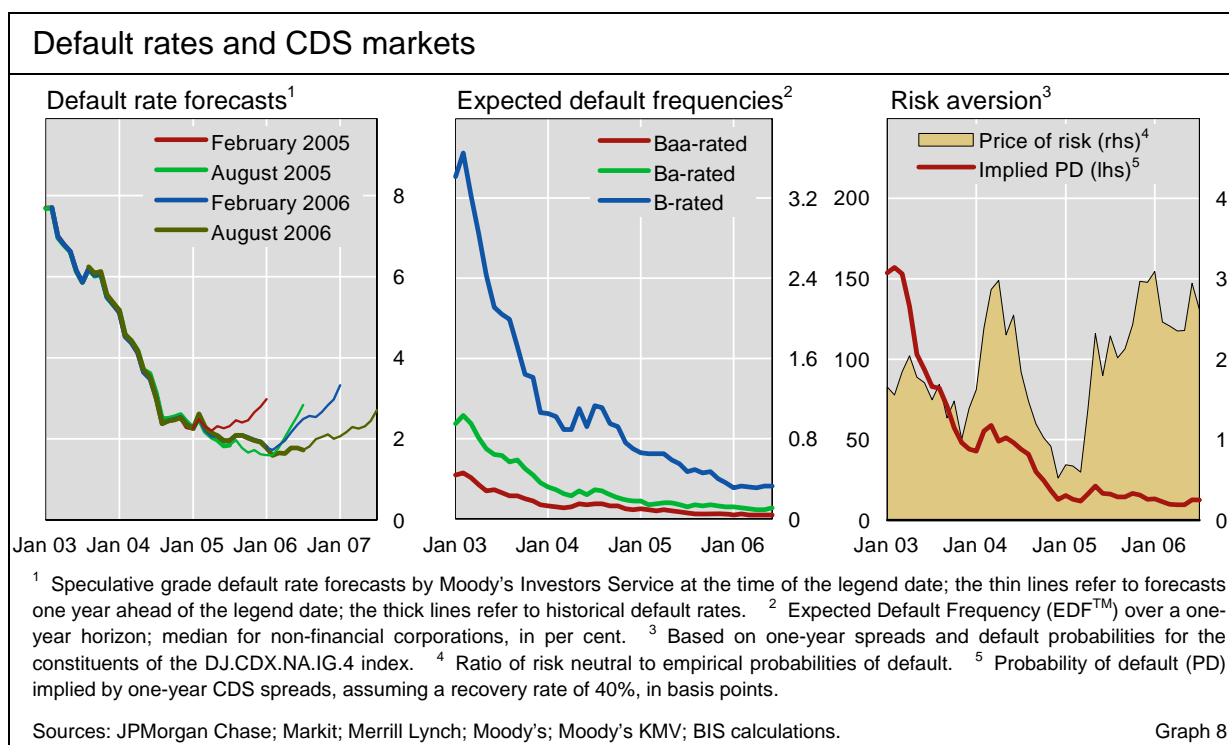
Major corporate spread indices stayed well above previous lows in the United States despite indicators of credit quality that showed few signs of deteriorating. Moody's forecast for the 12-month trailing speculative grade default rate for January 2007 was revised down by August 2006 to 2% from over 3% six months earlier, continuing a pattern of downward-revised forecasts over the past few years (Graph 8, left-hand panel). Expected default frequencies, as calculated by Moody's KMV based on balance sheet information and asset price volatility, were also stable at low levels for firms within rating categories (Graph 8, centre panel). The persistence of higher spreads in the face of a broadly unchanged outlook for credit quality is consistent with indicators showing that the appetite for credit risk never fully rebounded from the turmoil in corporate bond and CDS markets in the second quarter of 2005 (Graph 8, right-hand panel).

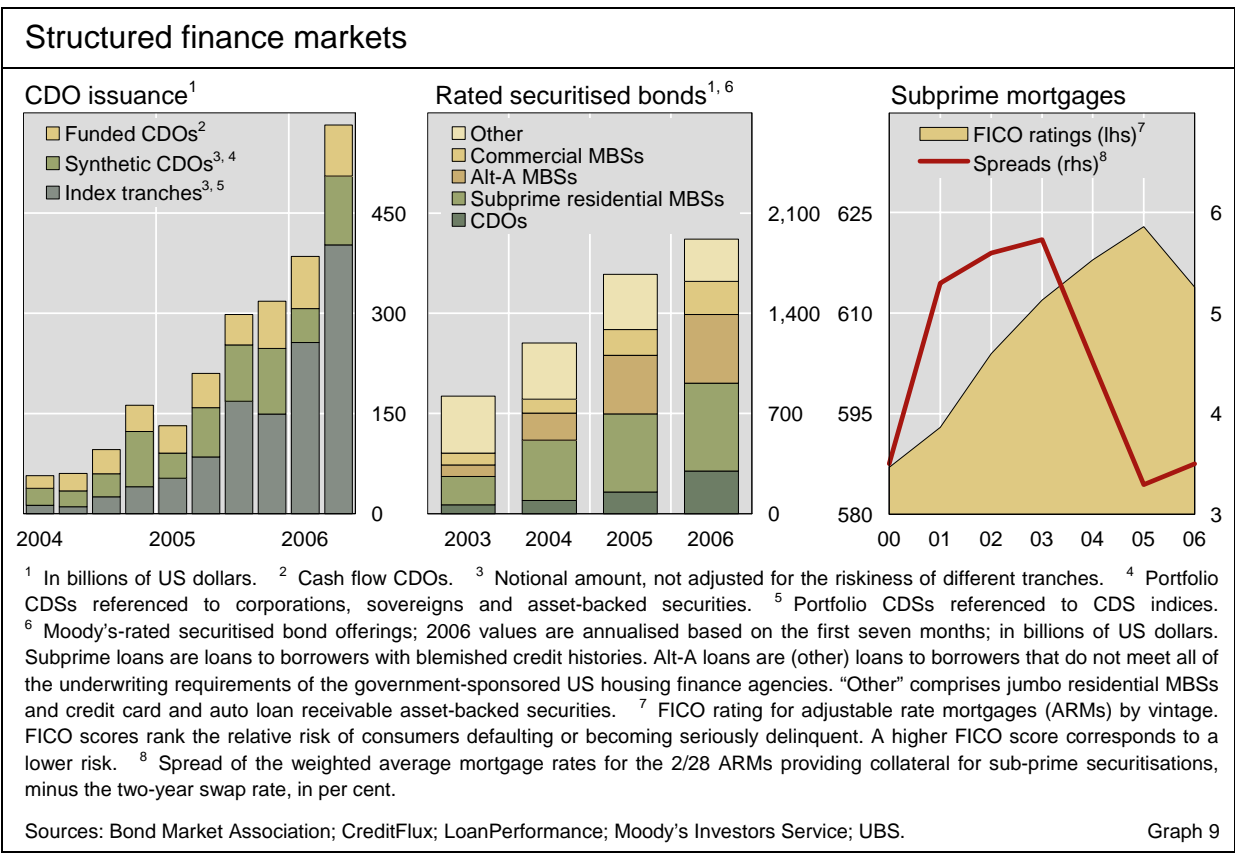
... though credit quality indicators show no signs of deterioration

Investor demand continues to be strong for structured financial products. Collateralised debt obligations (CDOs) – in which debt is structured and repackaged into higher-rated securities – are a particularly robust area of issuance (Graph 9, left-hand panel). Not only were cash-based CDOs, at \$76.2 billion in the second quarter, issued at more than double the pace of a year earlier, but the growth of issuance of so-called synthetic CDOs – backed by CDSs as well as CDS indices – also soared.

MBSs perform well despite cooling housing markets

Confidence in the functioning of the structured finance market may have been supported in part by the favourable performance of US mortgage-backed securities (MBSs) despite cooling housing markets. Signs of a weaker housing market did not lead to major changes in the pricing of mortgage-backed structured products, even for the securitisations of mortgage loans to subprime borrowers. Such loans, along with loans to Alt-A borrowers (who also do not merit prime borrower status), have constituted the underlying collateral for an increasingly significant portion of rated securitised bonds in recent years (Graph 9, centre panel). Despite declining FICO scores on subprime collateral (as well as increasing loan-to-value ratios), spreads on the mortgages underlying subprime-based securitisations rose only slightly (Graph 9, right-hand panel). Moreover, A and Baa-rated mortgage securitisations have in fact yielded higher excess returns over Treasuries in 2006 than more highly rated MBSs.





Emerging market spreads resume downward trend

Much more than other risk asset classes, emerging market credits regained in July and August much of the exuberance that had characterised the early part of the year. Not only did spreads on emerging market debt peak in late June at levels that remained quite low by historical standards, but they subsequently resumed their downward trend (Graph 10, left-hand panel). By mid-August, the EMBI Global spread index, calculated by JPMorgan Chase, had fallen to nearly 180 basis points. This was well below the 232 basis points of seven weeks earlier, and close to the all-time low of 174 in early May.

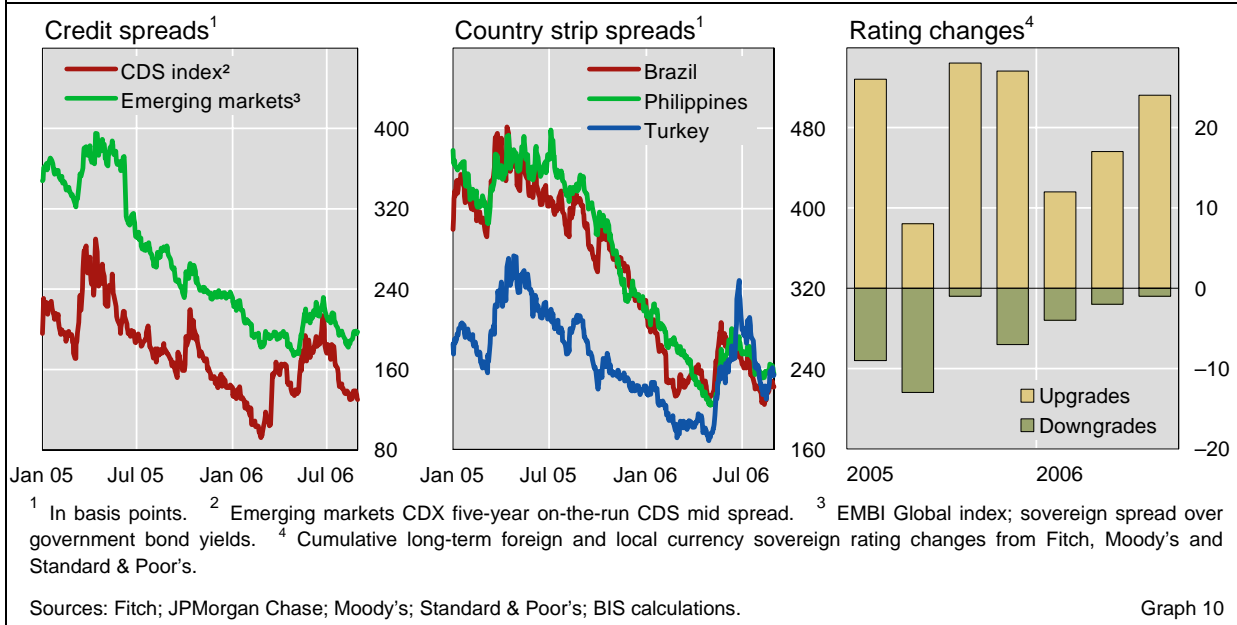
Renewed spread tightening ...

The improvement in spreads was evident across emerging markets. For instance, from 13 June to 1 September, the spread on Brazil's sovereign debt fell by nearly 51 basis points to 222 basis points, while that on the Philippines' sovereign debt fell by 45 basis points to 235 basis points. In CDS markets, typically more volatile and responsive to information flows than cash markets, spreads on Latin American credits such as Brazil and Mexico fell to levels below those prevailing when the retreat from risky assets had begun in May. Even the spreads on Turkish sovereign bonds, which had risen in an isolated move in late June on the back of fiscal concerns and a rating downgrade, fell from the peak of end-June by nearly 100 basis points.

... is widespread ...

The intensification of conflict in the Middle East did little to dent the downward trend in emerging market spreads. To be sure, when hostilities expanded into Lebanon in mid-July, and the price of oil rose to close to \$80 per barrel on concerns about potential supply disruptions, many emerging market bonds sold off. However, major indices recovered within days and

Sovereign spreads and rating changes



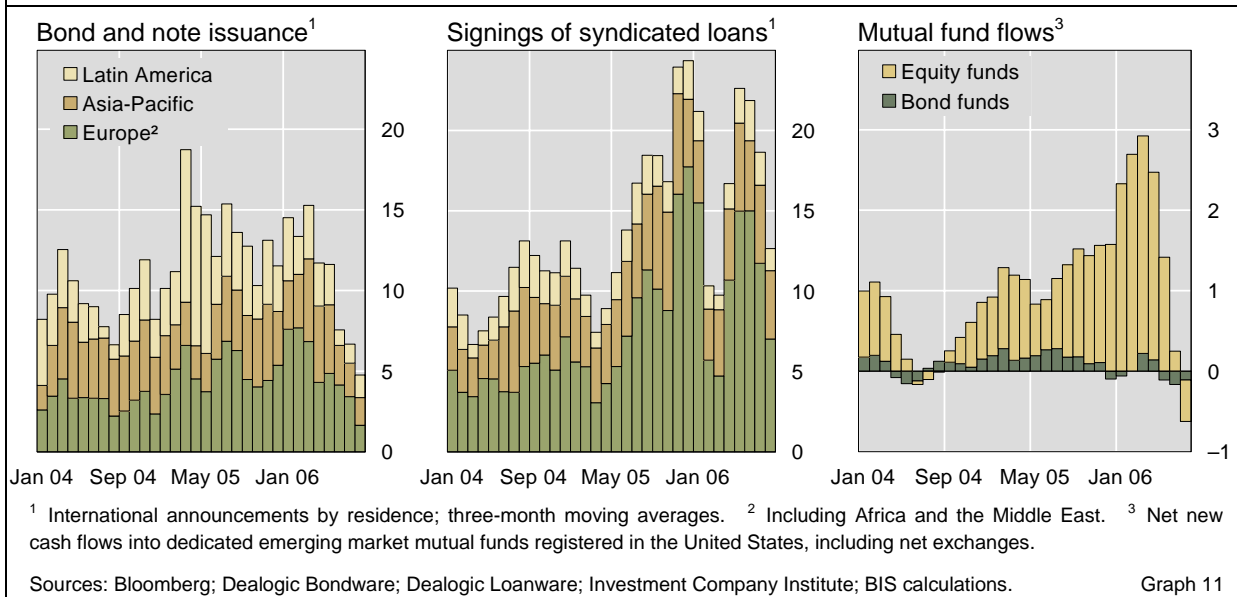
subsequently continued to narrow. Similarly, the market responded little to the London terror threat alert in mid-August.

... supported by rating upgrades ...

Improving country fundamentals provided support to the tightening of emerging market spreads. A large number of sovereign ratings were upgraded over the period; in July and August alone, there were 24 upgrades from one of the three major agencies on 12 different sovereigns – including China, India, Indonesia and Russia (Graph 10, right-hand panel). These upgrades were usually justified by improving external balances and/or better fiscal outlooks. In fact, there was only one downgrade action during July and August, for the country of Belize.

Private capital flows to emerging markets

In billions of US dollars



In addition, emerging market debt, even more than high-yield corporate debt, benefited significantly from an increased perception among market participants that the US Federal Reserve policy of steady rate hikes since mid-2004 was nearing its end. For instance, emerging market CDS index and North American high-yield CDS index spreads both narrowed by around 18 basis points on 29 June, the day of the release of the FOMC statement, and by 10 points the day of the Federal Reserve Chairman's Congressional testimony of 19 July. Both events had resulted in changed expectations about the course of US monetary policy. Lower than expected inflation numbers announced in mid-August also contributed to a significant decline in spreads.

... and perceptions of a peak in the US rate cycle

The improved financial position of many sovereigns contributed to a slowdown in international bond issuance (see Highlights on page 21). Many financial and non-financial corporations, however, continued to raise large amounts, especially in the loan markets (Graph 11). Demand appeared to remain robust. For instance, the \$750 million sovereign issue of the Republic of the Philippines in late July was 16 times oversubscribed. In addition, there were reports of net inflows picking up in early August as well as a large queue of emerging market issuers hoping to take advantage of favourable market conditions by issuing in September.

Highlights of international banking and financial market activity¹

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 following paragraphs draw on these data to highlight significant market developments. The latest available data on the international banking market refer to the first quarter of 2006. The discussion of the international debt securities market and exchange-traded derivatives markets draws on data for the second quarter of 2006.

The international banking market

Rapid expansion of international banking activity in the first quarter of 2006

Activity in the international banking market continued to expand at a rapid pace in the first quarter of 2006. Interbank and inter-office flows accounted for much of the increase in cross-border claims, although they seemed in turn to be driven by a pickup in corporate borrowing. Indeed, the rapid pace of cross-border activity coincided with strong growth in domestic lending to US and European firms, with capital spending and mergers and acquisitions helping to boost corporate demand for bank credit. Banks also reported a large increase in their cross-border claims on emerging markets, including substantial purchases of local currency debt securities. Emerging markets nevertheless experienced continued net outflows as a result of sizeable deposit placements with BIS reporting banks, most notably by Russian residents.

Locational banking statistics

The total cross-border claims of BIS reporting banks expanded by a record \$1.4 trillion in the first quarter of 2006. The 18% yearly increase pushed the total stock of cross-border claims to \$22.8 trillion. This surge mainly reflected an increase in new loans extended by banks located in the euro area and the United Kingdom. The growth of bank loans over the quarter interrupted the sustained decline of their share in total cross-border bank claims.² Since 1996,

¹ Queries concerning the locational banking statistics should be addressed to Goetz von Peter, those concerning the consolidated banking statistics and international debt securities statistics to Philip Wooldridge, and those regarding the derivatives statistics to Christian Upper.

² Cross-border claims comprise bank loans and holdings of debt and equity securities.

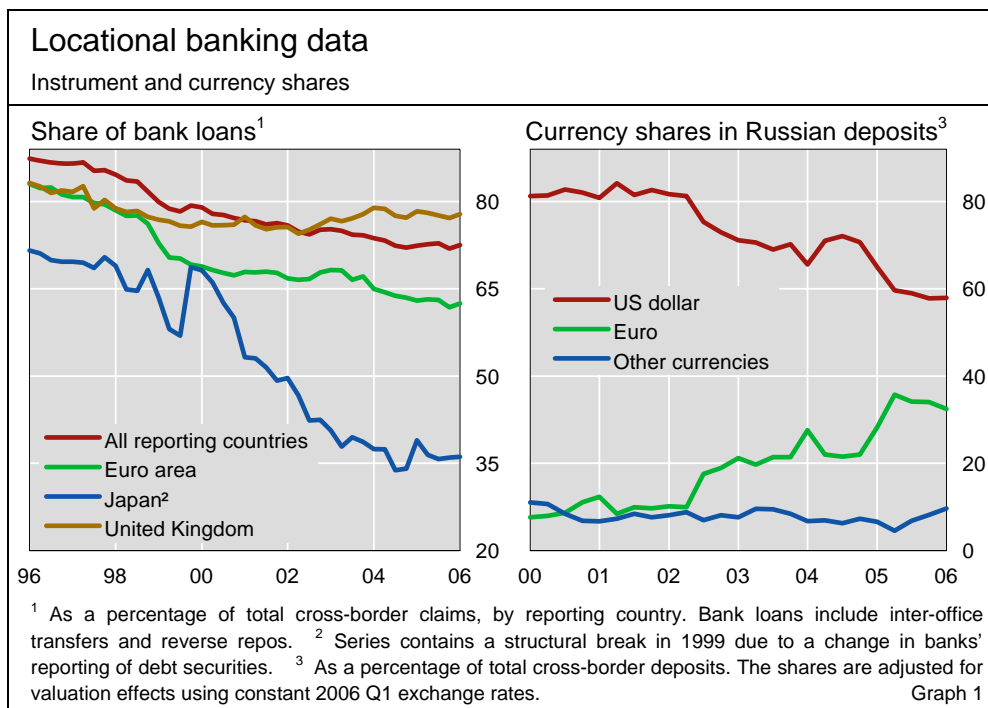
the loan share has declined by 15 percentage points in favour of securities holdings and currently stands at 72% (Graph 1, left-hand panel).

Interbank and inter-office activity explains a substantial part of the expansion in cross-border bank claims over the quarter, with much of the remainder accounted for by credit to corporates and other non-bank borrowers in the euro area and the United States. With the increase of \$896 billion in claims on banks, 37% of which were inter-office transfers, claims on banks currently stand at 64% of total cross-border claims. However, the overall expansion in interbank lending concealed a \$66 billion drop in claims on banks in Japan, which coincided with an \$81 billion drop in banks' overall yen-denominated claims. At the same time, cross-border credits to euro area non-banks swelled by \$137 billion, extended mostly by banks in the region; non-banks in the United States received \$119 billion, granted mostly by banks in the United Kingdom.

Large interbank and inter-office flows

Cross-border claims on emerging market economies grew by a record amount of \$99 billion in the first quarter of 2006. More than 60% of the increase reached non-banks, primarily in emerging Europe and Asia-Pacific.³ A comparison across regions reveals that the expansion of total credit from BIS reporting banks was largest in emerging Europe (\$46 billion), where it flowed mainly to Russia and Turkey, followed by Hungary, Poland and Cyprus. Notably, cross-border credit to Turkey increased by more than \$10 billion for a second consecutive quarter. Cross-border claims on Asia-Pacific residents rose by \$27 billion, mainly vis-à-vis non-bank borrowers in India and bank borrowers in China. The \$13.7 billion of new credit to Latin America was

Credit to emerging Europe and Asia-Pacific surges ...



³ More generally, emerging Europe and Asia-Pacific have been at the centre of the expansion of international credit to emerging markets since 2002; see "The international banking market", *BIS Quarterly Review*, June 2006.

extended almost entirely to borrowers in Brazil. Most of these flows originated in the United Kingdom and offshore centres, two major hubs in the international banking market.⁴

... and includes more local currency debt ...

Purchases of debt securities accounted for almost one third of the increase in cross-border claims on emerging markets. As much as 40% of these new purchases are estimated to be denominated in local currencies, twice the corresponding share for cross-border holdings of emerging market securities.⁵ This brought reporting banks' local currency bond holdings to \$46 billion, primarily bonds from emerging Europe (especially Poland, Hungary, Russia and Turkey) and from Asia-Pacific (especially India, Malaysia, Korea and China). These cross-border holdings of local currency bonds suggest that foreign investors are increasing their participation in local currency markets as these are being developed.

... yet emerging markets see continued net outflows

Cross-border deposits by oil-exporting countries and Latin American residents outweighed the strong growth of cross-border claims on emerging markets. As a result, these markets experienced, on aggregate, a fourth consecutive quarter of net outflows, which adds up to a year-on-year net outflow of \$113 billion. More than 40% of the \$110 billion in new deposits by emerging market economies flowed out of Russia, and were placed predominantly in the euro area and the United Kingdom.⁶ At the same time, the US dollar share in Russia's cross-border deposits continued to fall and now stands at 59%, down from 84% in mid-2001 (Graph 1, right-hand panel). Deposits by other oil-exporting countries, mainly Libya and Kuwait, as well as South Africa, drove a \$22 billion net outflow from the Africa-Middle East region. Funds flowed out of Latin America as well, by a net amount of \$12 billion, mainly as a result of new deposits by residents of Brazil. By contrast, large deposit withdrawals were made by residents of China, who withdrew \$15 billion primarily from banks in Hong Kong, the United States and Singapore.

Consolidated international banking statistics on an immediate borrower basis

Expansion driven by European banks

The consolidated banking statistics, which are based on the nationality of the reporting bank and net out inter-office positions, indicate that the expansion in international banking activity in the first quarter of 2006 was driven mainly by European banks. Admittedly, the role of European banks is inflated by the large amount of cross-border activity within the euro area. Yet even excluding euro area banks' international claims on euro area residents, European banks

⁴ Banks in the United Kingdom and offshore centres currently intermediate 47% of worldwide cross-border banking flows, transforming deposit placements into international loans and securities holdings.

⁵ These claims were reported in currencies other than the main international currencies, and exclude the domestic currency of reporting banks.

⁶ The deposit liabilities vis-à-vis Russia may, in part, be attributed to the placement of official reserves. IMF data indicate that Russia's official reserves placed with banks outside the country rose by \$12 billion during the first quarter of 2006. See "The international banking market", *BIS Quarterly Review*, September 2004, for a discussion of the long-term co-movement of Russian foreign exchange reserves and deposit liabilities of BIS reporting banks to Russia.

remained the most active creditors in the international banking market in the first quarter. UK and Swiss banks were largely responsible for the expansion of international claims on US residents, German banks for claims on UK residents, and UK banks for claims on emerging markets.⁷

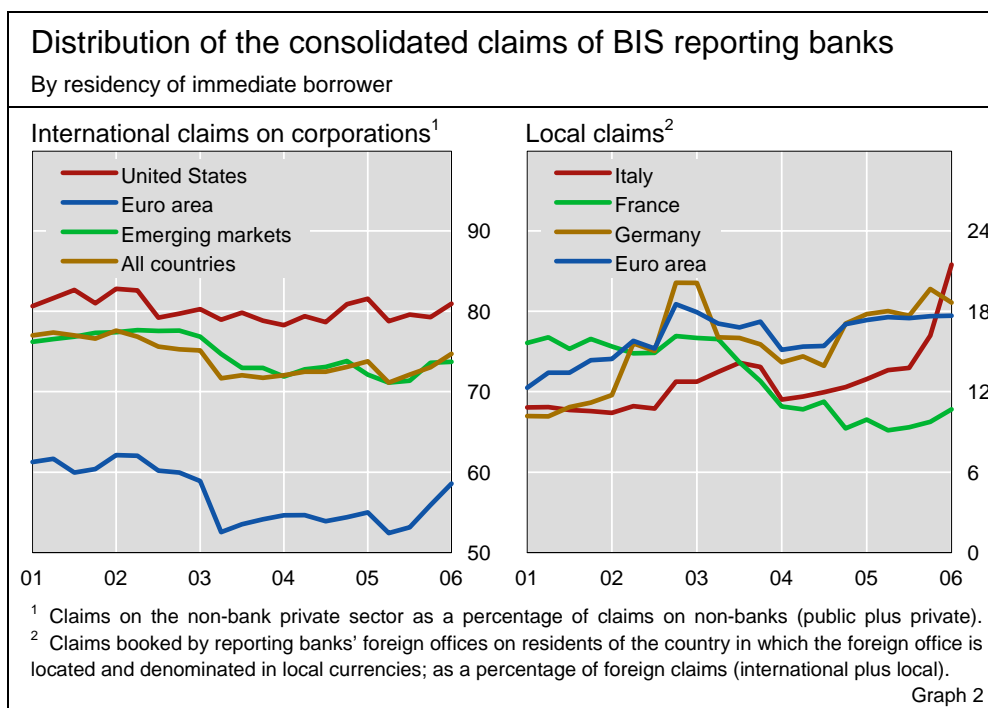
An acceleration in corporate borrowing appeared to lie behind the increase in international banking activity. For example, in the first quarter of 2006, syndicated lending for mergers and acquisitions and leveraged buyouts was well above 2005 levels. In the euro area, such lending contributed to a rise in claims on the non-bank private sector from 56% of international claims on all non-bank borrowers at end-December 2005 to 59% at end-March 2006 (Graph 2, left-hand panel). In the United States, the non-bank private sector's share rose from 79% to 81% over the same period. Corporate demand for credit in turn generated substantial interbank flows, as banks turned to the interbank market to meet part of their funding commitments.

Acceleration in corporate borrowing

In emerging markets, the rise in banks' claims in the first quarter was broadly distributed across sectors and maturities. Credit to the public sector kept pace with credit to the non-bank private sector, leaving the latter unchanged as a share of international claims on all non-bank borrowers (Graph 2, left-hand panel). The proportion of international claims on emerging markets maturing within one year was also unchanged at 48%.

Local claims in local currency kept pace with international claims, expanding by about 20% between end-March 2005 and end-March 2006 after adjusting for currency movements. In some countries, mergers contributed to the increase in local claims. Local claims had until recently accounted for an

Mergers boost local claims on Italy



⁷ International claims comprise cross-border claims in all currencies plus local claims in foreign currencies. Local claims refer to claims booked by reporting banks' foreign offices on residents of the country in which the foreign office is located.

unusually small proportion of foreign claims on Italy: 13% at end-March 2005 (Graph 2, right-hand panel). Among countries in the euro area, only in France was this proportion lower, at 10%. The takeover of two Italian banks by French and Dutch banks in late 2005 resulted in a sharp rise in foreign banks' local claims on Italian residents, and at end-March 2006 they accounted for 21% of foreign claims on Italy, slightly above the average for the euro area.

Consolidated international banking statistics on an ultimate risk basis

The consolidated banking statistics, when compiled on an ultimate risk basis, ie taking into account cross-border risk transfers, provide a comprehensive measure of banks' country risk exposures. They suggest that banks in the reporting area either maintained or increased their exposures to almost all countries in the first quarter of 2006, including a number of countries where financial markets were unusually volatile.

Market volatility has little impact on banks' exposures to Iceland ...

The turmoil in Icelandic financial markets in February and March 2006 did not appear to lead foreign banks to reassess their exposures to Iceland. In late February 2006, Fitch's announcement of a negative outlook on Iceland's sovereign rating had led some foreign investors to liquidate their króna investments, resulting in a sharp depreciation of the currency. Foreign banks, however, further increased their exposures to Iceland in early 2006. Foreign claims on the country, on an ultimate risk basis, totalled \$23 billion at end-March 2006, up from \$19 billion at end-December 2005 and \$12 billion a year earlier.⁸ Unused credit commitments were more or less unchanged in the first quarter of 2006 at \$3 billion, suggesting that the increase in claims was not driven by a drawdown of previously arranged lines of credit. Guarantees extended by reporting banks, including protection sold through credit derivatives, were also more or less unchanged at \$3 billion. Meanwhile, volatility in foreign exchange and asset markets contributed to a 50% increase in the market value of derivatives exposures, to \$1 billion. German banks were the single largest creditors, with foreign claims of \$8 billion at end-March 2006. However, exposures to Icelandic borrowers were a tiny fraction of BIS reporting banks' total foreign exposures, only 0.1% on average.

... and the Gulf region

In the Middle East, too, the precipitous decline in equity prices in March 2006 had no apparent consequences for banks' exposures to the region. This is consistent with the perception that the decline was unrelated to any change in fundamentals. Foreign claims on Saudi Arabia and other countries in the Gulf Cooperation Council (GCC) increased rapidly in late 2005 and early 2006, from \$67 billion at end-June 2005 to \$90 billion at end-March 2006.⁹ Guarantees and unused credit commitments boosted potential exposures by a further \$50 billion, and derivatives contracts added \$4 billion. Credit to borrowers in the United Arab Emirates (UAE) drove the increase and

⁸ According to the BIS locational statistics, about 70% of outstanding cross-border claims on Iceland were denominated in euros. Therefore, fluctuations in the euro/US dollar exchange rate will have a significant impact on consolidated claims reported in US dollars.

⁹ The GCC comprises Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

by end-March 2006 accounted for almost half of outstanding claims on the GCC countries. UK banks were the largest foreign bank creditors in the region, with foreign claims of \$36 billion at end-March 2006, including sizeable local operations in the UAE. Euro area banks, led by French and German banks, held claims totalling \$34 billion.

Banks' exposures to Lebanon, never large, had declined even before the breakout of hostilities in July 2006. Foreign claims totalled only \$4.3 billion at end-March 2006, down from about \$7 billion a year earlier. Credit commitments and guarantees added \$1.5 billion. Banks' small exposures to Lebanon, however, belie the country's role in the international banking market. The locational international banking statistics suggest that Lebanon provides a sizeable amount of funding to banks, with cross-border liabilities to Lebanese residents exceeding cross-border assets by \$23.6 billion at end-March 2006.

Large net liabilities to Lebanon

The international debt securities market

Investors' retreat from higher-risk assets in May 2006 seemed not to dampen issuance in the international debt securities market in the second quarter. Gross issuance of bonds and notes totalled \$1.1 trillion, close to the exceptionally strong pace recorded in the first quarter of 2006. Repayments rose slightly, and so net issuance of bonds and notes slowed to \$551 billion in the second quarter from \$630 billion in the first. Nevertheless, net issuance was still well above the previous year's pace.

Strong issuance in the international bond market in the second quarter of 2006 ...

Issuance in the international debt securities market in the second quarter was driven by non-bank financial institutions, including special purpose vehicles. They raised a record \$536 billion in bonds and notes, up from \$463 billion in the first quarter. Several of the largest transactions were securitisations. For example, the German government raised €7.5 billion through its second securitisation of pension contributions payable by the federal postal services' successor companies.

... driven by securitisation vehicles ...

Borrowing by non-financial corporations remained at the elevated levels seen in the first quarter. International bond and note issuance by euro area corporations was especially strong at \$45 billion, exceeding the previous peak of activity in early 2001. Mergers and acquisitions were partly responsible for the high volumes. For example, German chemical company Bayer placed three issues totalling \$3.7 billion to finance its planned takeover of German pharmaceutical company Schering. An unusually large proportion of corporate issuance was at floating rates: 19% in the second quarter of 2006, compared to 11% on average over the 2004–05 period.

... and non-financial corporations

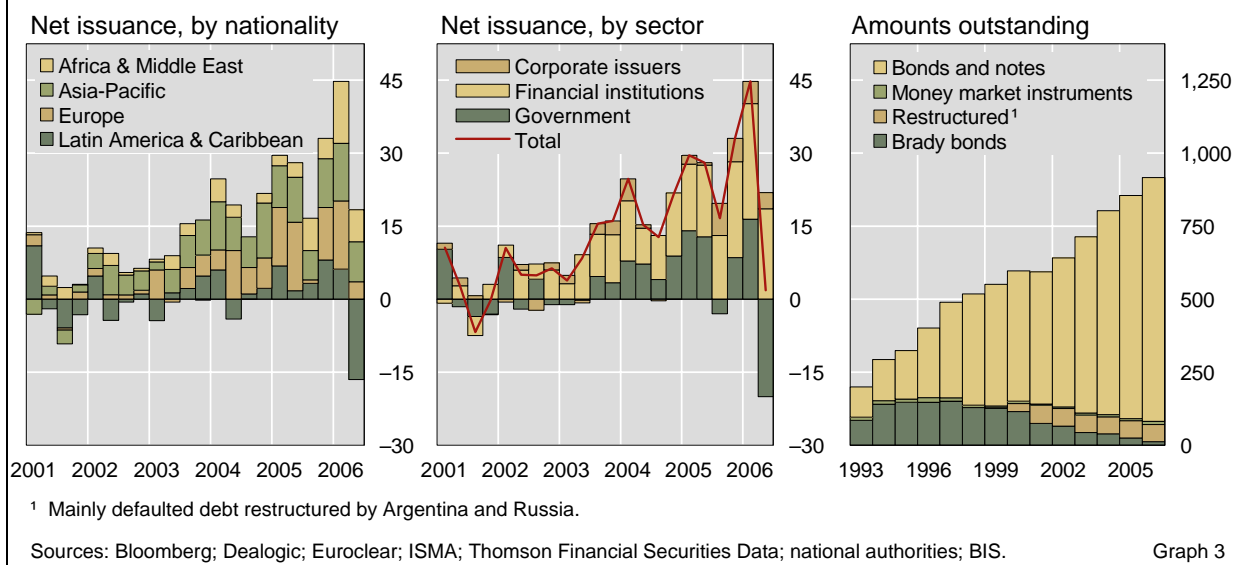
In contrast to issuance by industrial country borrowers, issuance by emerging market borrowers slowed sharply in the second quarter. In particular, sovereigns were virtually absent from the international debt securities market. Gross issuance of bonds and notes totalled \$31 billion, its lowest level in two years and about half the amount raised in the first quarter. Net issuance was close to zero (Graph 3).

Emerging market issuance slows sharply ...

The slowdown in emerging market issuance seemed unrelated to the deterioration in financing conditions in May 2006. In fact, issuance was

Emerging market bonds

In billions of US dollars



weakest in April, when spreads were near record lows, and strongest in May, when spreads widened. Furthermore, issuance by financial institutions and corporations remained robust throughout the quarter. Financial institutions from Kazakhstan were among the most active emerging market issuers, raising \$2.6 billion in the US dollar market. Concerns about possible currency mismatches on the banks' balance sheets led the Kazakh authorities, in mid-June 2006, to announce additional measures to slow the rapid increase in Kazakh banks' foreign currency borrowing.

... because
sovereigns are
already well funded

The slowdown in emerging market issuance appeared to reflect the favourable financial position of many emerging market sovereigns. By the first quarter of 2006, governments had already funded a large part of their external financing requirements for 2006. The current account surpluses posted by many emerging market countries also reduced the need for external financing, including in Latin America.

Indeed, Latin American governments, long the most active emerging market borrowers, made substantial early repayments in the second quarter. Brazil exercised a call option to retire almost all of its outstanding Brady bonds. Venezuela also retired the bulk of its outstanding Brady bonds. Debt exchanges and early repayments reduced total outstanding Brady debt to \$12 billion at end-June 2006, down from \$150 billion at its peak in 1997 (Graph 3).

Derivatives markets

Buoyant activity in
exchange-traded
derivatives in the
second quarter ...

Trading on the international derivatives exchanges was buoyant in the second quarter. Combined turnover measured in notional amounts of interest rate, equity index and currency contracts increased by 13% to \$484 trillion between

April and June 2006, following a 24% rise in the previous quarter.¹⁰ The high rate of growth in the first quarter had been caused by a surge in activity in US money market derivatives, which reverted to a more normal pace in the following three months.¹¹

Trading volumes rose in all risk categories. Activity in contracts on short-term interest rates increased by 15%, while trading in derivatives on stock price indices and on government bonds grew by a more moderate 6% and 5%, respectively. Turnover in futures and options on foreign exchange increased by 21%, outpacing activity in the other risk categories. However, with a turnover of merely \$4.2 trillion, or less than 1% of total volume traded on the international derivatives exchanges, the FX segment remains of limited importance as this type of risk tends to be traded over the counter.

... in all risk categories

Trading volumes in contracts on short-term yen interest rates soared ahead of the rate hike by the Bank of Japan in July, although they remain low both by historical standards and relative to activity in other currencies. Rates had remained at virtually zero for more than five years, which had contributed to a dearth of activity in derivatives on short-term Japanese interest rates (see the feature on the link between monetary policy and activity in money market derivatives on pp 65-76 of this issue). Futures turnover increased by 46% in the second quarter of 2006, while options volumes soared by 130%. However, at just below \$10 trillion between April and June, of which about \$1 trillion was in options, turnover in derivatives on short-term Japanese interest rates remained a fraction of the volumes recorded in other currencies. This contrasts with the mid-1990s, when contracts denominated in yen briefly accounted for over one fifth of worldwide turnover in exchange-traded money market derivatives (Graph 4).

Anticipation of BoJ rate hike lifts trading in yen contracts ...

Activity was also buoyant in some smaller currencies but more muted in the US dollar and the euro. Rapid increases in turnover during the quarter under review were also recorded in contracts on short-term Australian interest rates (44%), followed by derivatives on rates in the New Zealand dollar (28%), pound sterling (26%) and Canadian dollar (22%). Trading volumes in futures and options on short-term US dollar and euro interest rates grew by a more moderate 13% each.

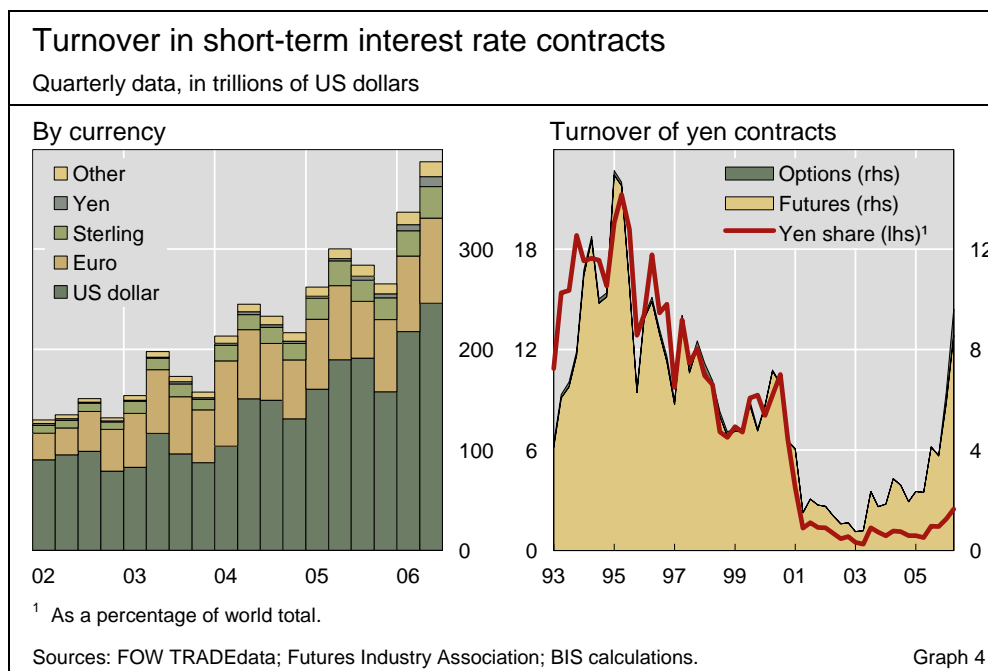
... but volumes remain low by international standards

Heavy trading during the sell-off in May and June lifted turnover in stock index contracts to a new high. Turnover measured by notional amounts reached \$46 trillion between April and June, 6% higher than in the first quarter of this year. In contrast to the preceding three months, the rise in activity was genuine and not merely the result of valuation effects. Turnover growth in stock index contracts was particularly strong in some English-speaking countries, above all Canada (47%), the United States, the United Kingdom and Australia (all 19%). Rapid growth was also recorded in contracts on Swedish equity indices (18%). Trading in euro-denominated contracts rose by almost one third

Turnover in equity index derivatives reaches new high

¹⁰ All growth rates refer to quarter-on-quarter changes, unless otherwise stated.

¹¹ Data on the volume of over-the-counter derivatives are published in the June and December issues of the *BIS Quarterly Review*.



in terms of the number of contracts traded, but increased by only 8% in terms of notional amounts. Weaker activity was recorded in Korea, where trading in stock index contracts declined by 11% in terms of both the number of contracts and notional amounts.

FX contracts surge on dollar volatility

Sharp movements in the US exchange rate led to a 23% rise in turnover in futures and options on foreign exchange in the second quarter. Trading volumes in euro FX contracts listed on the Chicago Mercantile Exchange reached \$750 billion in May alone. During the quarter as a whole, activity in this contract rose by almost one third, while turnover in yen derivatives was up 23%. Jointly, these two contracts account for more than one half of worldwide turnover in exchange-traded currency derivatives. Even more rapid growth was recorded in some emerging markets, for example in Russia (82%) and Korea (67%), even though the two currencies concerned did not experience any extraordinary volatility in the period under review. Turnover in Turkey increased by 172%, albeit from a low base. The Turkish lira was affected particularly strongly by the sell-off in May and June.

Strong trading in commodity contracts

The number of commodity contracts traded on the international derivatives exchanges (notional amounts are not available) grew by 10% in the second quarter. In the previous three months, activity had increased by 18%, mainly reflecting a 37% surge in activity in energy derivatives as oil prices had reached new highs. Trading in that product category continued to expand in the second quarter, in line with further price increases, but growth slowed to 8%. Turnover in contracts on agricultural commodities rose by 10% and that in derivatives on base metals by 7%.

Gold contracts peak during sell-off

Rapid growth (21%) was recorded in the precious metals segment of the commodity derivatives market. Turnover in futures and options on gold soared to over 6,000 contracts (measured in 100 ounce contract equivalents to account for a shift towards smaller-sized contracts) in May alone. This was more than one fifth above the previous monthly high in late 2005. In June,

turnover in gold contracts declined to 4,700. The monthly pattern of turnover in gold contracts contrasts with that of contracts on silver or non-precious metals, which peaked in April and subsequently declined. This is puzzling because price developments were largely similar.

The changing composition of official reserves¹

The way in which official reserves are managed is changing. Data compiled by the BIS on deposits placed by monetary authorities with commercial banks confirm that reserve managers approach diversification cautiously. Nevertheless, they have steadily shifted into higher-yielding, higher-risk instruments. The currency composition of reserve holdings is still highly concentrated in US dollars and euros, but the shares of some other currencies have changed significantly over time.

JEL classification: E58, F31, G15.

Reserves held by monetary authorities worldwide totalled \$4.9 trillion at end-March 2006, equivalent to 11% of world GDP.² This makes monetary authorities, as a group, important players in foreign financial markets. Indeed, changes in reserve management policies have become a subject of great interest to market participants for their possible impact on demand for certain assets and therefore prices.³ This special feature examines shifts in the composition of official reserves over the past two decades, exploiting in particular data compiled by the BIS on the deposits of monetary authorities with commercial banks.

Following the Mexican and Asian financial crises in the mid-1990s, a concerted effort was made to improve the coverage, frequency and timeliness of data on official reserves. Some countries now publish extensive details about their reserves, but many still do not. The BIS international banking statistics can help to fill some of the remaining gaps, in particular by providing additional evidence about the currency composition of reserves.

¹ Thanks are due to Claudio Borio, Robert McCauley, Frank Packer and Kostas Tsatsaronis for helpful comments and to Anna Cobau for excellent research assistance. The views expressed in this article are those of the author and do not necessarily reflect those of the BIS.

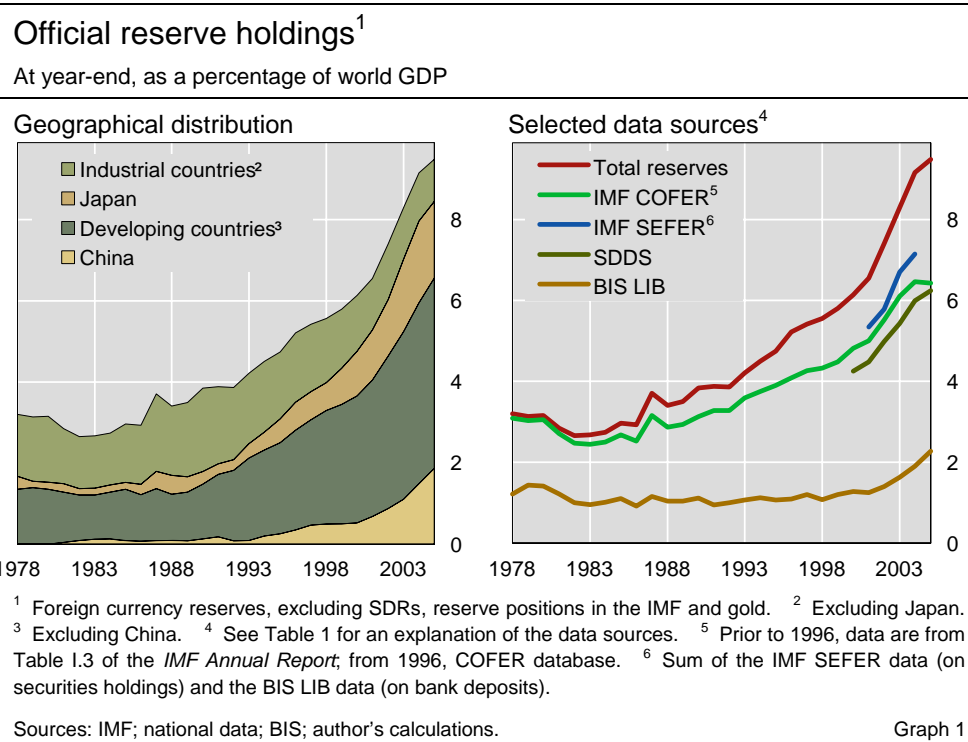
² IMF (1993, p 97) defines official reserves as “external assets that are readily available to and controlled by monetary authorities for direct financing of payments imbalances, for indirectly regulating the magnitudes of such imbalances through intervention in exchange markets to affect the currency exchange rate, and/or for other purposes”. Total reserves comprise gold, foreign currency assets, reserve positions in the IMF and Special Drawing Rights (SDRs).

³ In foreign exchange markets, reports of a reallocation of reserves away from US dollars have at times contributed to volatility while in bond markets purchases of US dollar securities by central banks were perceived by some to have contributed to the unusually low level of nominal dollar yields in 2004–05 (BIS (2005)).

Data sources

Almost all countries, save for Iran, Iraq and a few small states, regularly disseminate data on their total reserve holdings. However, details about the composition of reserves are not as readily available. There are three sources of detailed data – national sources, surveys and counterparty data – but all are incomplete. Differences between these sources are summarised in Table 1.

| Selected sources of data on the composition of foreign currency reserves | | | | | | |
|---|------------------------|----------------------------|------------------------|------------------------|---------------------|----------------------|
| | World total | National data | Survey data | | Counterparty data | |
| | IMF IFS ^{1,2} | SDDS template ² | IMF COFER ² | IMF SEFER ³ | US TIC ⁴ | BIS LIB ² |
| Identified holdings – in USD bn | 4,347 | 2,832 | 2,911 | 2,145 | 1,938 | 1,079 |
| – as % of total | 100.0 | 65.2 | 67.0 | 57.2 | 49.1 | 24.8 |
| Official institutions included | | | | | | |
| Monetary authorities | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Other national authorities ⁵ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| Government investment funds | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ |
| International organisations | ✗ | ✗ | ✗ | ✓ | BIS | BIS |
| Countries included | 184 | 65 | 114 | ? | 184 | 184 |
| Industrial countries | 24 | 24 | 24 | (23) ⁶ | 24 | 24 |
| Japan | ✓ | ✓ | ✓ | ✓ | ✓ | (✗) ⁷ |
| Developing countries | 160 | 41 | 90 | (45) ⁶ | 160+ ⁸ | 160+ ⁸ |
| China | ✓ | ✗ | ✗ | ✗ | ✓ | (✗) ⁷ |
| Taiwan, China | ✓ | ✗ | ✗ | ✗ | ✓ | ✓ |
| Instruments included | | | | | | |
| Cash in vault | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ |
| Deposits | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ |
| including reverse repos | ✗ | ✗ | ✗ | ✗ | ✗ | ✓ |
| Debt securities | ✓ | ✓ | ✓ | ✓ | ✓ | (✗) ⁹ |
| Equity securities | ✓ | ✓ | ✓ | ✓ | ✓ | (✗) ⁹ |
| Financial derivatives | ✓ | ✓ | ✓ | ✗ | ✗ | (✗) ⁹ |
| Other assets | ✓ ¹⁰ | ✓ ¹⁰ | ✓ ¹⁰ | ✗ | ✗ | ✗ |
| Disclosed breakdowns | | | | | | |
| By instrument | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ |
| By currency | ✗ | (✗) ¹¹ | ✓ | ✗ | (✓) ¹² | ✓ |
| Frequency | Monthly | Monthly | Quarterly | Annually | Annually | Quarterly |
| Disclosure lag | 1 week | 1 month | 3 months | 1 year | 1 year | 4 months |
| <p>¹ IMF's International Financial Statistics. ² At end-March 2006. ³ Combined with SSIO; at end-December 2004. ⁴ Annual survey of foreign portfolio holdings of US securities; at end-June 2005. ⁵ National authorities, other than the monetary authority, which hold foreign currency reserves, eg finance ministries and exchange stabilisation funds. ⁶ Countries that participated in the 2004 CPIS. ⁷ Coverage is incomplete for those countries where reserves are not held by the monetary authority. ⁸ Includes Iran, Iraq and other countries not included in the IMF's world total. ⁹ Deposits and loans accounted for 99% of reported liabilities to official monetary authorities; securities and financial derivatives accounted for the remainder. ¹⁰ Includes securities borrowed under reverse repos. ¹¹ Currencies in the SDR basket (grouped together) and all other currencies. ¹² Available only for total foreign portfolio holdings (private and official holdings combined).</p> | | | | | | |
| Sources: IMF; national data; BIS. | | | | | | Table 1 |



National data

SDDS data capture
65% of world
reserves

The most comprehensive source of information about reserves is the Data Template on International Reserves and Foreign Currency Liquidity, jointly developed in 1999 by the IMF and the Committee on the Global Financial System. The template is part of the IMF's Special Data Dissemination Standard (SDDS). Subscribing countries publish details about the liquidity of reserves and potential drains on them.

An important limitation of these data is that not all countries subscribe. The SDDS template is published by 65 countries, accounting for 65% of world reserves (Graph 1). All 24 industrial countries publish the template, but only 41 out of 160 developing countries do so.⁴ Among those missing are China, which alone holds 20% of world reserves, and Taiwan (China), which holds 6%. The number of countries which publish a detailed currency breakdown is even smaller, at around 20, accounting for 13% of world reserves (Truman and Wong (2006)).

Survey data

A second source of data is surveys. Countries which do not disseminate detailed data about their reserves are sometimes willing to participate in confidential surveys, in which only aggregate data are published and no

⁴ This article follows the classification of countries used in the IMF's International Financial Statistics, so as to facilitate comparisons. The main difference between the IMF's classification and that used in the Statistical Annex of the *BIS Quarterly Review* is that the latter excludes offshore financial centres from developing countries.

individual central banks are identified. The country coverage is often higher than for the SDDS, but it is still incomplete.

The IMF collects data on the Currency Composition of Official Foreign Exchange Reserves (COFER). Reserve managers report the market value of investments denominated in US dollars, euros, Japanese yen, pounds sterling, Swiss francs and all other currencies. COFER data capture less than 70% of total reserves because the holdings of some important developing countries are missing (Graph 1). Between 1995 and 2005, all industrial countries reported to COFER but only 80–90 developing countries did, accounting for between 51 and 66% of total developing countries' reserves. The IMF does not identify the contributing countries but, considering the size of the gap, China appears to be among those missing. Furthermore, changes in reporting practices make comparisons over time difficult.⁵

IMF COFER data capture 70% of world reserves ...

Some IMF members also participate in the survey of Securities Held as Foreign Exchange Reserves (SEFER). This survey provides details about the different types of securities held by reserve managers – equities, money market instruments and bonds – and about the residency of the issuer. SEFER data capture at most 75% of total securities held by monetary authorities. The IMF does not identify either the names or the number of contributing countries. Furthermore, the published data overestimate reserves held as securities because SEFER data are combined with data on international organisations' portfolio investments to ensure confidentiality.⁶

... and IMF SEFER data 75% of securities holdings

In addition to the IMF, investment banks and other market participants survey reserve managers on occasion. Their questionnaires are typically more qualitative in nature than IMF surveys and cover a broader range of topics. As such, they provide complementary information.

Counterparty data

The third and final source of data on the composition of reserves is counterparties. For every asset held as part of reserves there is a corresponding liability on the balance sheet of the issuer, and so counterparty data are a close proxy for reserve assets. They are, however, an imperfect proxy because the definition of liabilities to official institutions is often different from the conventional definition of reserves.

Counterparties' liabilities are a close proxy for reserve assets

A number of countries publish details about residents' liabilities to foreign official institutions. The most prominent source is the US Treasury International Capital (TIC) system. It distinguishes between cross-border holdings of US

⁵ Truman and Wong (2006) identify three breaks in series: first, in 1979 following the establishment of the European monetary system; second, in 1995 when the methodology underlying the compilation of COFER data was improved; and third, in 1999 when euro area countries excluded from official reserves any assets denominated in euros and euro legacy currencies. Also in 1999, countries outside the euro area began reporting their euro-denominated holdings and stopped reporting their holdings in Deutsche marks, French francs and Dutch guilders.

⁶ The IMF combines SEFER data with the Survey of Geographical Distribution of Securities Held by International Organisations (SSIO). The combined holdings are disseminated as part of the Coordinated Portfolio Investment Survey (CPIS).

securities by official institutions and those by private investors. Included with official institutions are many bodies which hold foreign currency assets not defined in IMF (1993) as reserves, such as the Kuwait Investment Authority, Norway's Government Pension Fund and other commodity funds. But excluded from the TIC data are US securities resold to monetary authorities through foreign brokers and held by foreign custodians. Also excluded are US dollar-denominated securities issued abroad, such as dollar bonds issued in London by foreign sovereigns. On balance, the TIC data appear to understate US dollar securities held as reserve assets (McCauley and Fung (2003)).

BIS LIB data
capture reserves
deposited with
banks ...

The locational international banking (LIB) statistics compiled by the BIS capture reserve assets placed with commercial banks in the form of deposits or repurchase agreements.⁷ Commercial banks in all important financial centres report their cross-border assets and liabilities, broken down by instrument, currency, sector and residency of the borrower or depositor. The reporting population has expanded over time, but the impact of changes in reporting practices is less important than for the IMF COFER data.⁸ Positions vis-à-vis so-called "official monetary authorities" are identified separately, albeit only in aggregate; no information about the nationality of the authority is provided.

Liabilities to official monetary authorities include some instruments not usually classified as reserves. In particular, the BIS LIB data include cross-border deposits denominated in domestic currencies. This concerns mainly euro-denominated repo transactions by Eurosystem central banks with banks outside the reporting country.

... but exclude
Japan and China

Nevertheless, because of differences in the institutions included, the BIS LIB statistics underestimate reserves placed in the form of deposits. Excluded from the definition of official monetary authorities are treasuries and government agencies, most notably the Japanese Ministry of Finance and the Chinese State Administration of Foreign Exchange (SAFE). This is significant because Japan and China are the largest holders of reserves and the Ministry of Finance and SAFE hold the bulk of their respective country's reserves. Therefore, even though banks report all cross-border and foreign currency positions, in practice the country coverage of the LIB data is incomplete. Also excluded from the LIB data are deposits placed by reserve managers with the BIS itself, or at least those deposits reinvested by the BIS in securities.⁹

⁷ A repurchase agreement, or repo, is essentially a collateralised loan: participants exchange securities for cash and agree to reverse the transaction at a prespecified date and price. In the BIS LIB statistics, reverse repos are reported together with bank deposits. By contrast, IMF (1993) recommends that monetary authorities classify reverse repos separately from bank deposits, as "other foreign currency assets".

⁸ The reporting population has expanded from 15 jurisdictions in 1977 to 39 in 2006. The largest expansion occurred in 1983, when offshore financial centres joined the reporting population. In 1999, the reporting of positions denominated in Deutsche marks, Dutch guilders, French francs, Italian lire and European Currency Units was discontinued and euro-denominated positions were reported instead.

⁹ The BIS accepts deposits from monetary authorities and then invests these funds in deposits, reverse repos and securities. The BIS is classified as an official monetary authority and so the LIB statistics indirectly capture the portion of funds deposited with the BIS and reinvested in bank deposits and reverse repos.

Compositional changes and reserve management

While the above-mentioned sources of data shed light on the composition of official reserves, care needs to be taken when using these data to make inferences about the management of reserves. Compositional changes are not necessarily synonymous with asset allocation decisions.

First, most of the available data, with the exception of the SDDS template, refer to gross reserves and do not take into account associated liabilities. Central banks have in recent years given greater consideration to the integrated management of their assets and liabilities (Cardon and Coche (2004)). This approach would tend to weaken the link between compositional changes in reserve assets and reserve management decisions.

Potentially weak link between changes in the composition of reserve assets ...

Second, risk exposures can be very different from the composition of assets. Portfolio managers sometimes use derivatives to manage different risks. Derivatives positions are typically recorded separately from the transaction to which they may be linked as hedges, and therefore balance sheet data can give an incomplete picture of managers' risk exposures. For example, central banks might use foreign exchange derivatives to increase their exposure to currencies other than the US dollar. If this were the case, data on the composition of assets might overstate central banks' exposure to the US dollar. While many central banks are not yet authorised to engage in such currency overlay strategies, a few are known to do so (Fels (2005)).

Finally, in aggregated data, such as the IMF COFER and BIS LIB data, compositional changes reflect both shifts in the allocation of assets (for a portfolio of a given size) and variations in the size of individual countries' reserves. For example, moves by some countries to diversify the allocation of their reserves could be masked by the growth of other countries' reserves.

... and reserve management decisions

Instrument composition

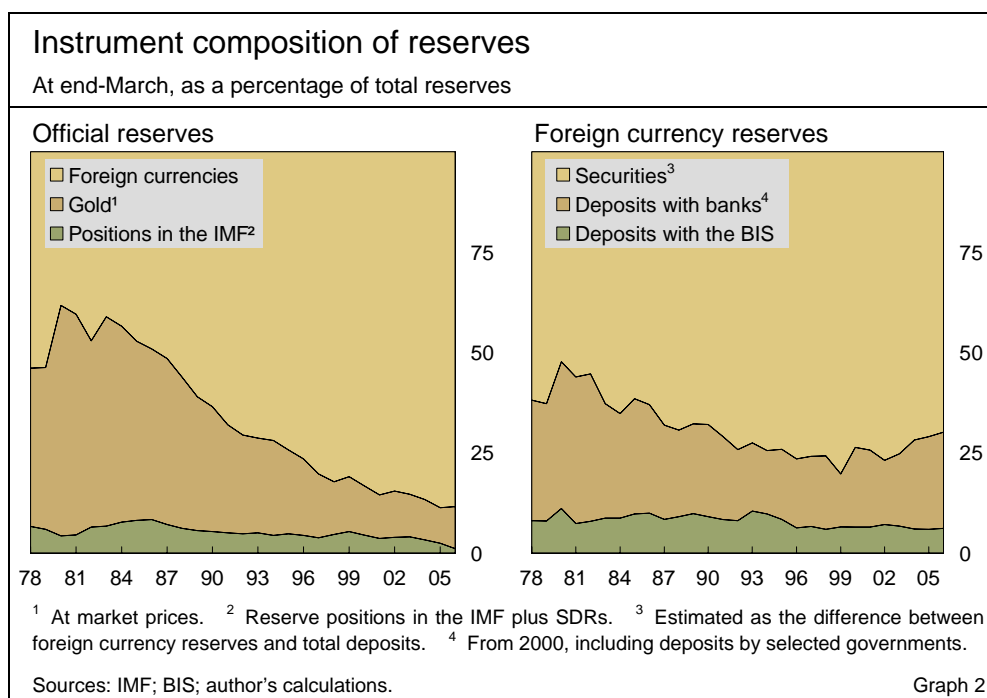
Monetary authorities have since the 1970s gradually diversified into higher-yielding, higher-risk instruments. Nevertheless, official reserves are still invested mostly in very liquid assets, with limited credit risk. After falling markedly, the proportion invested in bank deposits has increased slightly in recent years. This is mainly because of the rapid accumulation of reserves by developing countries, which tend to place a larger share of their reserves with banks than do industrial countries.

Gold holdings

Historically, the bulk of reserves were held in gold. That has changed radically over the past three decades. Gold holdings, valued at market prices, fell from about 60% of total reserves in 1980 to a low of 9% in 2005 (Graph 2). Today, the vast majority of reserves are invested in foreign currency assets, mainly deposits and securities. Whereas foreign currency assets totalled \$4.3 trillion at end-March 2006, gold holdings totalled only \$0.5 trillion (at market prices).¹⁰

Foreign currencies replace gold as the main reserve asset

¹⁰ Reserve positions in the IMF and SDRs added a further \$57 billion to total reserves.



The management of gold reserves has changed over time. Initially they were segregated from other reserve assets, and physical holdings of gold were left unchanged even as prices fluctuated and reserves accumulated. Then starting in the late 1980s, some central banks sold part or even all of their gold. The sharp rise in the price of gold in 2005–06 helped to boost gold's share of reserves above 10% in early 2006. Nevertheless, physical holdings of gold fell further, continuing to contract at a rate of about 2% per year.

Bank deposits

The shift from gold to foreign currency assets was part of a broader reallocation towards assets perceived to offer more attractive risk-adjusted returns. Starting in the mid-1970s, reserve managers began to diversify out of US Treasury bills and into bank deposits, at least in their US dollar portfolios (McCauley and Fung (2003)). During the 1980s and into the 1990s, they extended the maturity of their reserves significantly, investing in longer-dated securities and reducing their allocation to deposits.

The changing importance of deposits can be seen in the BIS LIB statistics. As discussed above, for a closer approximation of reserves held as deposits, deposits by selected governments and deposits placed by monetary authorities with the BIS should be added to the LIB statistics, and deposits placed by the BIS with commercial banks subtracted. At end-March 2006, these three adjustments boosted estimated deposits by over 20%, from \$1.1 trillion to \$1.3 trillion (Table 2).

Deposits are no longer as important as they once were, but they still account for a sizeable proportion of reserves. The share of foreign currency reserves (ie excluding gold and IMF positions) allocated to bank deposits peaked in 1980 at almost 50% and then gradually declined over the following two decades (Graph 2). Between 1996 and 2002, the proportion of reserves

Adjustments to BIS
LIB data boost
deposits by 20%

invested in deposits fluctuated around 23%, even as the absolute amount of reserves soared. The allocation to deposits then edged upwards to 30% at end-March 2006.

Developing countries allocate a much larger proportion of their reserves to deposits than industrial countries (Table 2). The SDDS and LIB data suggest that, in recent years, developing countries held about one third of their foreign currency reserves in deposits. Some developing countries placed the majority of their reserves with banks. For example, at end-March 2006, India had 76% of its \$145 billion of reserves invested in bank deposits and reverse repos, and Russia 69% of its \$198 billion. By contrast, industrial countries allocated only 21% of their reserves to deposits. Industrial countries' deposits were temporarily boosted by Japan's sharp accumulation of reserves in 2003–04, when the authorities were intervening actively in foreign exchange markets to slow the appreciation of the yen. Industrial countries' deposits subsequently declined, after Japan had shifted funds into securities (McCauley (2005)).

Deposits account for a large share of developing countries' reserves

Securities holdings

The bulk of global foreign currency reserves are invested in securities: about 70% at end-March 2006 (Graph 2). As reserve managers became more comfortable managing market risk, the allocation of their securities portfolios shifted towards longer-term instruments. Long-term debt securities accounted for 73% of total securities holdings at end-December 2004 according to SEFER data, and money market instruments only 25%. To be sure, a sizeable

Significant extension of maturities

| Reserves placed with banks | | |
|--|------------------------|------------------------|
| Outstanding bank deposits and reverse repos, at end-March 2006 | | |
| | Billions of US dollars | Percentage of reserves |
| All countries | 1,308.0 | 30.1 |
| BIS LIB statistics | 1,078.8 | 24.8 |
| + Deposits by governments ^{1, 2} | 116.0 | 2.7 |
| + Deposits with the BIS ³ | 268.0 | 6.2 |
| – Deposits by the BIS ⁴ | 154.8 | 3.6 |
| Industrial countries ¹ | 267.4 | 20.7 |
| Japan | 122.4 | 14.7 |
| Developing countries ⁵ | 1,033.7 | 33.8 |
| Identified deposits ¹ | 506.9 | 32.9 |
| India | 109.9 | 75.8 |
| Russia | 136.4 | 68.7 |
| Unidentified deposits ⁶ | 526.8 | 34.8 |

¹ Identified holdings of cash, deposits and other assets (mainly reverse repos), as reported by national authorities subscribing to the SDDS. ² Holdings reported by Japan and the UK government, excluding deposits placed with the BIS, the IMF and national central banks. ³ Deposits placed by central banks with the BIS, including funds invested in Medium-Term Instruments but excluding gold deposits. ⁴ Funds placed by the BIS with commercial banks, comprising time deposits, advances and securities purchased under resale agreements. ⁵ Calculated as total deposits of all countries less identified deposits of industrial countries. ⁶ Calculated as total deposits of developing countries less identified deposits of developing countries.

Sources: IMF; national data; BIS; author's calculations.

Table 2

| Foreign official institutions' holdings of US securities | | | | | | |
|--|---------------------------|----------|----------|-----------------------------------|----------|----------|
| | In billions of US dollars | | | As a percentage of total holdings | | |
| | Dec 1989 | Mar 2000 | Jun 2005 | Dec 1989 | Mar 2000 | Jun 2005 |
| Long-term debt securities ¹ | 197 | 565 | 1,439 | 100.0 | 100.0 | 100.0 |
| US Treasury debt | 188 | 465 | 1,054 | 95.4 | 82.3 | 73.2 |
| US agency debt ² | 7 | 88 | 324 | 3.6 | 15.6 | 22.5 |
| of which: ABSs ³ | ... | ... | 63 | ... | ... | 4.4 |
| Corporate and other debt | 2 | 12 | 61 | 1.0 | 2.1 | 4.2 |
| of which: ABSs ³ | ... | ... | 17 | ... | ... | 1.2 |
| <i>Memo: Bonds / all securities</i> ⁴ | ... | ... | ... | 59.5 | 62.4 | 74.3 |

¹ Market value of debt securities with an original maturity of greater than one year or an undefined maturity; based on benchmark surveys of foreign portfolio holdings of US securities. ² Debt securities issued by US housing agencies, mainly Fannie Mae and Freddie Mac. ³ Asset-backed securities; agency ABSs are backed mainly by home mortgages. ⁴ Long-term debt securities as a percentage of foreign official institutions' holdings of all US securities (short-term plus long-term, equity plus debt).
Sources: National data; McCauley and Fung (2003). Table 3

proportion of monetary authorities' bond holdings have a short remaining term to maturity, especially their US Treasury bond holdings. Still, reserve managers' willingness to take on market risk has certainly increased. The duration of their US agency and corporate bond holdings is significantly higher than that of their Treasury holdings, and the former account for a fast rising proportion of total holdings (Table 3).

Government bonds are the largest portfolio investment ...

Reserve managers continue to invest mainly in instruments with low credit and liquidity risk. Government securities are still the single largest portfolio investment. In 2005, Treasury securities accounted for 73% of official institutions' holdings of US bonds (Table 3). While this was down from 95% in 1989, agency securities – rated AAA and the most actively traded securities after Treasuries – made up most of the difference. Furthermore, reserve managers exhibited little appetite for equity risk: according to SEFER data, equities accounted for less than 2% of securities holdings at end-2004.

... but appetite for credit risk is slowly rising

Nevertheless, reserve managers' appetite for credit and liquidity risk has been increasing. About half of the 56 respondents to Central Banking Publications' 2006 survey of reserve managers reported an increase in the amount invested in non-traditional higher-risk assets (Carver (2006)). A sizeable minority of respondents held asset- and mortgage-backed securities and corporate bonds. The US TIC data confirm that in recent years official institutions have increased their exposure to mortgage- and asset-backed securities and corporate bonds. Together, they accounted for almost 9% of official institutions' holdings of US debt securities in 2005 (Table 3).

Currency composition

The massive accumulation of official reserves and gradual diversification into higher-risk securities have not been accompanied by a shift out of US dollars. The currency composition of reserve holdings is as concentrated today as it was in the 1980s, indeed more so if euro legacy currencies are not grouped

together. The most significant change, in recent years, has been the replacement of the yen by sterling as the third largest reserve currency.

The following discussion and accompanying Graphs 3 and 4 focus on the IMF COFER data and the BIS LIB data. Although the coverage of the latter is limited to deposits, they provide a cross-check to the COFER data, which, as previously mentioned, exclude some key developing countries and have important breaks in series. That being said, all of the available data de facto exclude China's reserves (see the box on page 37).

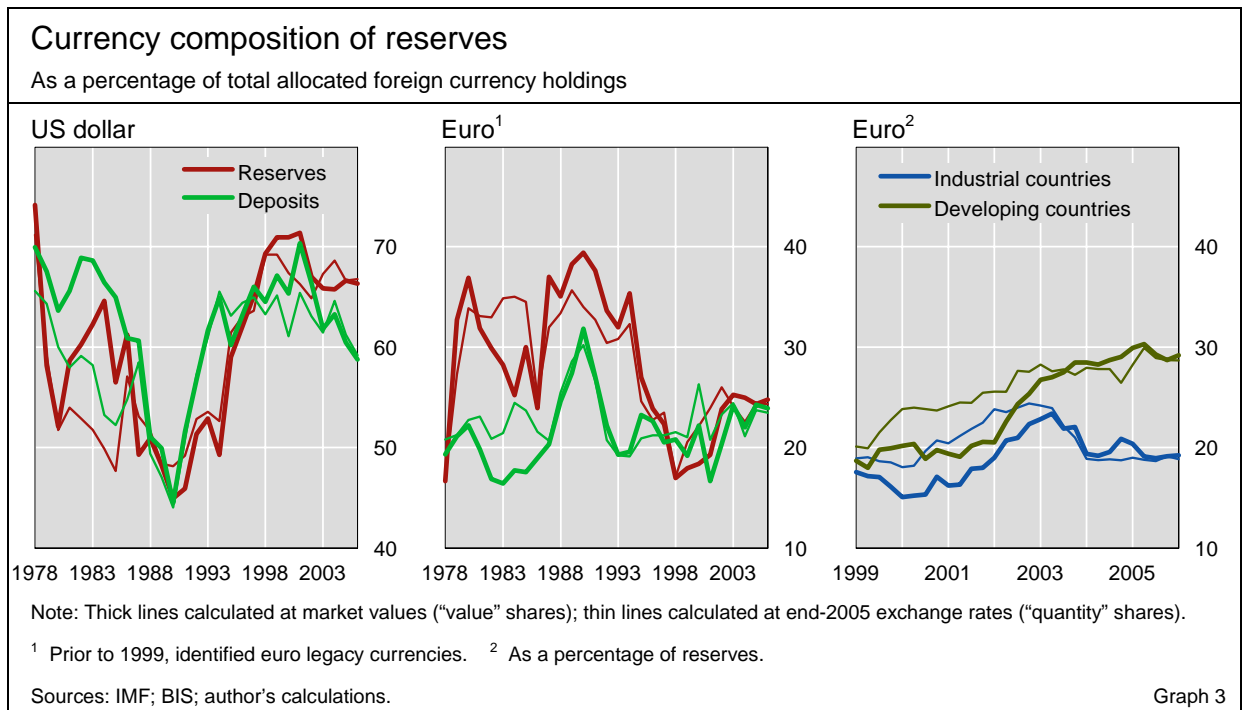
BIS LIB data as a cross-check to IMF COFER data

The currency composition of the COFER data loosely tracks that of the LIB data. Unexpected changes in reserves are likely to have a more immediate impact on deposits than on securities, and so the composition of deposits should in principle be more volatile than that of reserves. Yet the US dollar and euro shares of the LIB data are in fact less volatile than their shares of the COFER data. This may be because series breaks exaggerate the volatility of the latter dataset.

US dollar's value and quantity shares

The US dollar has, since the end of the Second World War, been the pre-eminent reserve currency, although its share of official reserves has been volatile. The thick lines in Graphs 3 and 4 plot currency shares at market values. In the 1970s, more than 70% of foreign currency reserves were invested in US dollar-denominated instruments (Graph 3, left-hand panel). During the 1980s, reserve managers diversified into Japanese yen and Deutsche marks, and the dollar's share declined to less than 50% by the end of the decade. The US dollar regained lost ground in the 1990s, peaking in 2001 at about 70% of holdings. Its share subsequently declined to 66% of reserves and 59% of deposits at end-March 2006.

US dollar's share is high but volatile



Currency shares are influenced by exchange rate movements ...

One factor contributing to fluctuations in the dollar's share of reserves and deposits is exchange rate movements. The thin lines in Graph 3 plot "quantity" shares, in which exchange rate movements are controlled for by redenominating all assets at constant (end-2005) exchange rates. During periods of pronounced dollar depreciation, such as 1985–87 and 2002–04, the US dollar's market value share declined even though its quantity share tended to rise. Similarly, during periods of pronounced dollar appreciation, such as 1981–84 and 1999–2001, the US dollar's value share rose even though its quantity share tended to fall. This suggests that, over these periods, reserve managers did not fully offset the impact of exchange rate movements. In other words, they did not continuously rebalance their portfolios to maintain a constant proportion in US dollars.

... changes in asset allocation ...

A second factor influencing fluctuations in the dollar's share is changes in reserve management. This includes adjustments to the strategic allocation of assets as well as decisions about deviations from the benchmark. In the 1980s, central banks participating in the European monetary system (EMS) switched to using Deutsche marks instead of US dollars to maintain parities within the EMS. This led to a large accumulation of Deutsche mark-denominated reserves by EMS members and a decline in the US dollar's share of global reserves and deposits (Deutsche Bundesbank (1997)). Following European monetary union on 1 January 1999, some developing countries reallocated their reserves towards euros. As a result, the proportion of developing countries' reserves denominated in euros rose from 20% in 1999 to almost 30% in 2006, after controlling for exchange rate movements (Graph 3, right-hand panel). The dollar's quantity share fell commensurately. This reallocation was most pronounced among countries with close trade or financial ties to the euro area, and less significant in Asia and the Americas (Lim (2006)).

... and the pace of reserve accumulation

Finally, differing paces of reserve accumulation across countries also contributed to fluctuations in the currency composition. The COFER data suggest that, during the 1990s, developing countries allocated a larger proportion of their official reserve holdings to US dollar instruments than did industrial countries. Therefore, the fast growth of developing countries' reserves, and consequent rise in their share of global reserves from 40% in 1990 to 60% 10 years later, helped to boost the US dollar's share of global reserves and deposits in the 1990s. Similarly, Japan appears to allocate a much larger proportion of its reserves to US dollar instruments than do other industrial countries. Thus Japan's rapid accumulation of reserves in 2003–04 helped to support the position of the US dollar in global reserve holdings.

Other currencies' shares

The euro share peaked in 1990 ...

For much of the past two decades, fluctuations in the dollar's share of reserves have been mirrored by fluctuations in the euro's share. The share of euro legacy currencies peaked in 1990 at 39% of reserves and 32% of deposits (Graph 3). Most of these funds were invested in Deutsche mark-denominated assets, with smaller amounts in French francs and European currency units. The share of euro legacy currencies then declined to around 20% on the eve of European monetary union.

Although the euro's share of reserves and deposits rebounded after monetary union, by early 2006 it was not much higher than it had been in the mid-1990s. COFER data suggest that the proportion of reserves allocated to euro-denominated instruments levelled off after 2003 at about 25%. While 25% is similar to the share of euro legacy currencies in the mid-1990s, this comparison is misleading because, prior to 1998, euro area countries' holdings of assets denominated in euro legacy currencies accounted for a substantial portion of total euro-denominated reserves. These assets were excluded from global reserves after monetary union. There is no break in the LIB data because banks continued to report their euro-denominated liabilities to euro area central banks even after 1998. These data confirm that the proportion of deposits denominated in euros was higher in 2005–06 than in 1994–96, but only slightly: 24%, compared to 22% for euro legacy currencies.

... and was only slightly higher after monetary union than in the mid-1990s

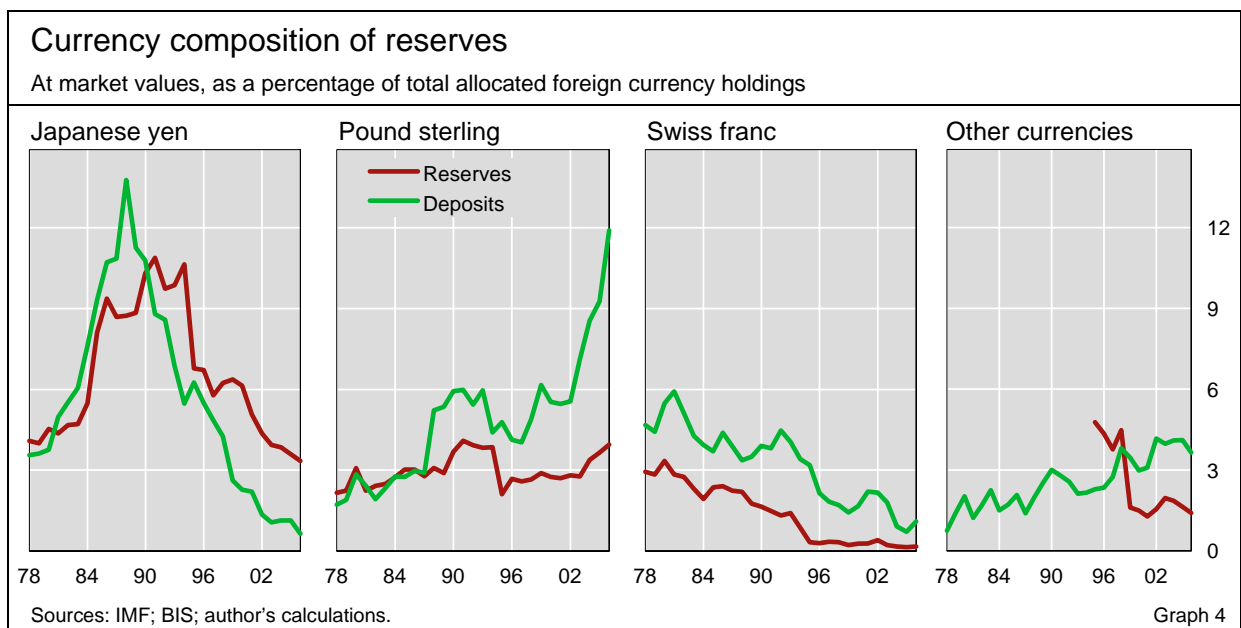
The Japanese yen's share of reserves has steadily declined since the early 1990s. In the 1980s the yen had begun to erode the US dollar's share, and at its peak the yen accounted for over 10% of reserves (Graph 4). By 2006, it accounted for less than 5%. The decline in Japanese asset prices and the subsequent long period of low relative returns on yen assets appear to have contributed to the shift out of yen reserves.

Sterling has replaced the yen as the third largest reserve currency

As a result of the decline in the yen's share, the pound sterling has replaced the yen as the third largest currency in reserve portfolios. According to the BIS LIB data, the share of sterling doubled between 1995 and 2006, from 5% of deposits to almost 12%. The IMF COFER data show a more modest increase, from 2% of reserves to 4%. The COFER data suggest that developing countries have diversified into sterling at a faster pace than industrial countries.

The Swiss franc, once a leading reserve currency exceeded in importance by only the US dollar and the Deutsche mark, has fallen out of favour since the 1970s. From a peak of 6% of deposits in 1981, the Swiss franc's share fell steadily to 1% in 2006. Movements in the Swiss franc/US dollar exchange rate

Swiss franc has fallen out of favour



Composition of China's reserves

An important caveat regarding the above discussion is that it does not take into account the composition of China's reserves. China's reserves are so large that small changes in their composition could have a significant impact on conclusions about trends in aggregate data. Only a small proportion of Chinese reserves appear to be deposited with banks in the BIS reporting area, and so the BIS LIB statistics do not provide much additional information. Deposits placed with banks abroad by Chinese residents totalled \$123 billion at end-March 2006. Of this amount, 72% was denominated in US dollars. However, interbank and inter-office positions accounted for the bulk of these liabilities. Placements by non-bank entities, including SAFE, equalled only \$26 billion. By comparison, China's foreign currency reserves totalled \$875 billion at end-March 2006. This suggests that China holds a much smaller proportion of its reserves in deposits than most other countries. The LIB data, though, exclude any reserves placed onshore with Chinese banks.

have for the past decade very closely tracked those of the euro/dollar (Galati and Wooldridge (2006)). This, coupled with a yield differential in favour of euro assets, may have reduced the attractiveness of the Swiss franc as a reserve currency.

The BIS LIB data suggest that, at the margin, reserve managers have increased their holdings of Australian and Hong Kong dollars, Danish kroner and other currencies in recent years. The share of currencies other than the major five rose to 4% of deposits in 2005–06. However, this increase is not confirmed by the IMF COFER data.

Conclusions

Reserve managers have so far approached diversification cautiously ...

The available data on the composition of official reserves indicate that reserve managers have approached diversification cautiously. The bulk of foreign currency reserves are still invested in bank deposits and government securities, and the US dollar has maintained its place as the dominant reserve currency. This is not too surprising. The primary reason to hold reserves is to be prepared for contingencies and, given the tendency for liquidity to concentrate, the range of investments available to satisfy this need is limited.

That being said, the management of reserves has been changing. Continuing a trend that began in the 1970s, when reserves were first reallocated from US Treasury bills to bank deposits, reserve managers have been gradually shifting into higher-yielding, higher-risk instruments. They seem most comfortable managing market risk but are beginning to take on more credit and liquidity risk too. The currency composition of their portfolios, while volatile, has not changed as much as the instrument composition. Nevertheless, there is some evidence that reserve managers have shifted into sterling-denominated assets over the past decade. Furthermore, aggregate data veil important shifts in individual countries and, by construction, give greater weight to the largest reserve holders rather than the most sophisticated. Therefore, they perhaps overstate the degree of inertia in reserve holdings. Likewise, moves by some countries, including Korea and Russia, to transfer part of their official reserves to government investment funds mask the extent to which foreign currency assets have been diversified.

Reserve diversification might possibly proceed more rapidly in the future. First, reserves are now commonly perceived to be greater than needed for intervention purposes. As a result, the focus of reserve management is likely to shift even further towards the maximisation of returns for a given level of risk and away from the preservation of liquidity and capital. Second, the liquidity and sophistication of euro financial markets are fast approaching those of US dollar markets (Galati and Wooldridge (2006)). This helps to strengthen the position of the euro as a possible alternative to the US dollar in official reserves.

... but might proceed more rapidly in the future

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Foreign exchange reserve accumulation in emerging markets: what are the domestic implications?¹

This paper discusses some of the domestic implications of the recent large-scale use of foreign exchange intervention by emerging market economies to resist currency appreciation. Over the past five years, many countries have adopted an accommodating monetary policy while intervening. Despite the prolonged period of low interest rates that resulted, various other forces have kept inflation under control and so eased one policy dilemma for central banks. Nevertheless, large and prolonged reserve accumulation can still create risks other than near-term inflation. These include: high intervention costs; monetary imbalances; overheated credit and asset markets; and very liquid and perhaps distorted banking systems.

JEL classification: E52, E58, F31, F41.

The accumulation of foreign exchange reserves by emerging market economies has continued on an unprecedented scale for several years. The latest working assumptions of the IMF are for further substantial accumulation both this year and next.² The general objective of this policy has been to resist or delay currency appreciation. How effective such a policy can be (and for how long) has been much debated. Contrary to the received wisdom for larger economies, whose financial markets are highly integrated with global capital markets, there is some evidence that sterilised intervention is more effective in influencing the exchange rate in emerging market economies.³ This issue is, however, not the main focus of this special feature. Rather, the question explored here is how prolonged reserve accumulation poses risks for the domestic economy that could eventually discourage further intervention.

¹ We are grateful to David Archer, Claudio Borio, Már Gudmundsson, Corrinne Ho, Robert McCauley, Ramón Moreno, Frank Packer, Srichander Ramaswamy, Sweta Saxena and William White for valuable suggestions; and to Stephan Arthur, Pablo García-Luna and Marjorie Santos for excellent statistical assistance. The views expressed are our own and do not necessarily reflect those of the BIS.

² According to the IMF *World Economic Outlook*, reserves of developing countries are projected to increase by a further \$584 billion in 2006 and \$562 billion in 2007 (IMF (2006)).

³ See Disyatat and Galati (2005) and Mihaljek (2005).

The financing of the prolonged and substantial accumulation of foreign exchange reserves has implications for the balance sheets of the central bank, the banking system and, indeed, the private sector. Major shifts in balance sheet variables can eventually have significant macroeconomic effects which depend both on how the associated risk exposures are managed and on how intervention is financed. One possibility is that balance sheet effects might reduce the effectiveness of sterilisation, with possible inflationary implications. Another set of potential problems includes the high costs of intervention, unsustainable increases in credit and asset prices, and an increasingly inefficient financial system.⁴ Overheating pressures and the high costs of intervention during the early 1990s, for instance, led many Latin American countries to abandon such intervention.⁵

It is important to note that the economic cycle has played an important role in allowing recent levels of intervention to be sustained. Many countries accumulating reserves over the past few years have faced conditions of substantial excess capacity and low inflation, which meant that policy rates could be eased in the face of upward pressure on the currency. In these circumstances, reserve accumulation did not create the dilemma policymakers faced in earlier high inflation episodes when they had to choose between their inflation objective and their exchange rate objective.

The first section of this special feature reviews the scale of reserve accumulation against some standard measures of the size of the economy and the financial system. The second section examines how far intervention has been sterilised. The final section considers whether some unwelcome side effects of even fully sterilised intervention could at some point force a reconsideration of the policy of heavy reserve accumulation.

An overview of recent reserve accumulation

Table 1 compares recent reserve accumulation across the major regions with two previous episodes in the early and mid-1990s. As the table shows, the scale of recent reserve accumulation has continued much longer than in the earlier episodes. Between 2000 and 2005, emerging market economies accumulated reserves at an annual rate of \$250 billion (or 3.5% of their annual combined GDP). This was almost five times higher than the level seen in the early 1990s. As a ratio to GDP, such accumulation has been particularly rapid in China, Korea, India, Malaysia, Russia and Taiwan (China). In Latin America and central Europe, reserve accumulation has been fairly modest, rising as a percentage of GDP only in Argentina, the Czech Republic, Mexico and Venezuela over the past five years. Many oil-exporting Middle East economies have also seen a large increase in their reserves.

Recent scale of
intervention
unprecedented

⁴ For an analysis of these issues, see Mohanty and Turner (2005) and International Relations Committee Task Force (2006).

⁵ See Reinhart and Reinhart (1999) and Griffith-Jones et al (2001).

| Balance of payments in emerging markets ¹ | | | | | | | | | | |
|--|-------------------------|---------|---------|----------------------------------|---------|---------|----------|---------|---------|------------------------|
| | Current account balance | | | Net capital inflows ² | | | Reserves | | | |
| | | | | | | | Change | | | Stock |
| | 1990–93 | 1995–96 | 2000–05 | 1990–93 | 1995–96 | 2000–05 | 1990–93 | 1995–96 | 2000–05 | July 2006 ⁷ |
| Asia | 6 | –64 | 899 | 160 | 230 | 211 | 119 | 110 | 1,178 | 2,025 |
| China | 20 | 9 | 347 | 35 | 79 | 291 | 4 | 53 | 664 | 941 |
| India | –17 | –12 | –5 | 20 | 16 | 95 | 7 | 0 | 99 | 156 |
| Korea | –14 | –32 | 82 | 20 | 41 | 51 | 5 | 8 | 136 | 225 |
| Taiwan, China | 39 | 16 | 117 | –29 | –21 | 30 | 10 | –4 | 147 | 260 |
| Other Asia ³ | –22 | –45 | 358 | 114 | 115 | –239 | 93 | 53 | 132 | 442 |
| Latin America ⁴ | –85 | –68 | –26 | 138 | 105 | 106 | 71 | 49 | 83 | 244 |
| Central Europe ⁵ | –2 | –11 | –102 | 6 | 34 | 134 | 16 | 21 | 39 | 99 |
| Russia | 1 | 18 | 290 | 9 | –26 | –31 | 10 | 7 | 167 | 243 |
| Middle East ⁶ | –90 | 6 | 383 | 111 | 9 | –302 | –3 | 8 | 50 | 89 |
| Total | –170 | –119 | 1,445 | 423 | 351 | 117 | 214 | 195 | 1,517 | 2,701 |

¹ Cumulative sum for the period, in billions of US dollars. Aggregates are the sum of the economies. ² Financial account, NIEs. ³ Hong Kong SAR, Indonesia, Malaysia, the Philippines, Singapore, Taiwan (China) and Thailand. ⁴ Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. ⁵ The Czech Republic, Hungary and Poland. ⁶ Kuwait, Libya, Oman, Qatar and Saudi Arabia. ⁷ Or latest available.

Sources: IMF, Balance of Payments Statistics; IMF, *World Economic Outlook*; Datastream. Table 1

The upward pressure on exchange rates, which intervention sought to counter, has generally reflected large current account surpluses. In the previous episodes, by contrast, it mainly reflected substantial net private capital inflows. There are, nevertheless, important exceptions. In China, Korea and Taiwan (China), the appreciation pressure has recently been driven as much by capital inflows as by current account surpluses. Net capital inflows have remained much larger than the current account deficit in India. This also remains true for most of Latin America and central and eastern Europe, with the notable exception of Russia, where current account surpluses have been boosted by increased oil prices.

While capital inflows – particularly portfolio inflows – have often been seen as temporary (perhaps justifying intervention), current account surpluses tend to endure and have persistent effects on the exchange rate. Moreover, there has been a tendency among investors and currency traders to identify persistent current account surpluses with an appreciation of the long-run equilibrium exchange rate. Resisting this may cause even larger capital inflows, potentially perpetuating a vicious circle of increased appreciation pressure and yet more intervention.

To what extent has intervention been sterilised?

Intervention has major impact on central bank balance sheets

Rapid reserve accumulation has significant implications for a central bank's balance sheet. Table 2 presents a stylised version of a monetary authority's balance sheet. Its assets consist of foreign currency and domestic assets; its liabilities comprise currency, bank reserves (taken together as monetary liabilities), its own securities, other liabilities (taken together as non-monetary liabilities) and equity capital. Of these, currency is largely determined by the

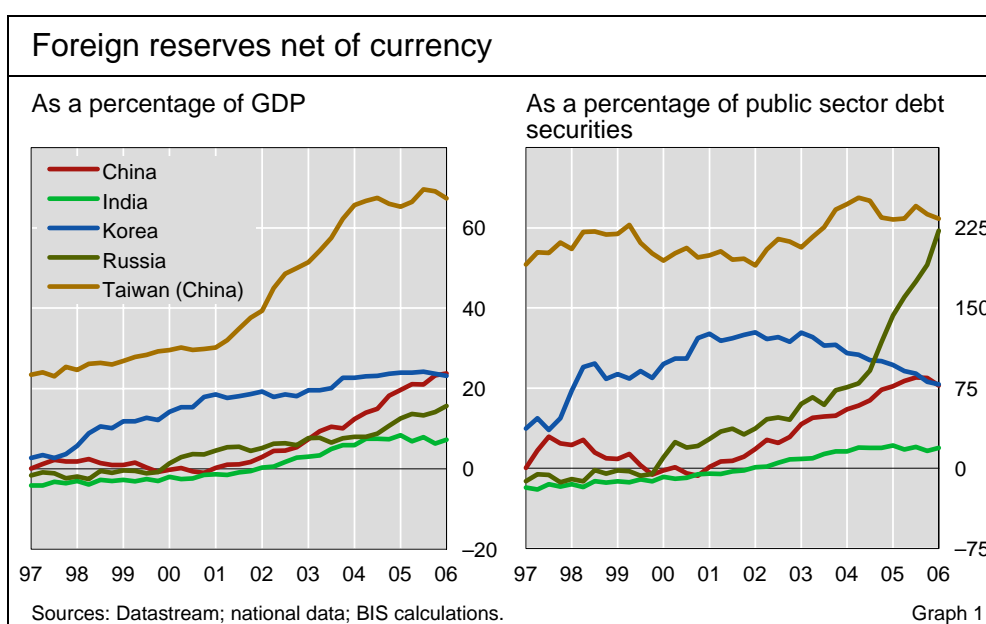
| A central bank's balance sheet | |
|---|--|
| Assets | Liabilities |
| Net foreign assets Net domestic assets | Monetary liabilities <ul style="list-style-type: none"> • Currency • Bank reserves Non-monetary liabilities <ul style="list-style-type: none"> • Central bank securities • Others Equity capital |
| Table 2 | |

public's demand for cash balances. Equity capital represents government transfers to the central bank (plus accumulated profits and losses). The remaining liabilities are within the control of the central bank.

An injection of equity capital in order to finance reserve accumulation would not result in monetary expansion, provided that the government did not finance this by drawing on deposits or using an overdraft facility at the central bank. Without increased equity capital, and assuming other things (ie the demand for cash) equal, the accumulation of reserves requires financing in some form. One simple measure of such a financing need is the excess of foreign currency reserves over currency in circulation. Up until the late 1990s, such a financing gap was either small or negative in many developing countries. In other words, forex reserve assets and currency in circulation were of a similar order of magnitude. However, the gap has widened appreciably over the past five years as a percentage of GDP in many emerging market economies, especially in Asia (Graph 1). In many countries, such a gap is also large in relation to the stock of public debt securities.

As intervention takes place, the central bank can finance this gap by issuing domestic monetary liabilities (typically commercial bank monetary reserves). Should these increased monetary reserves be allowed to put

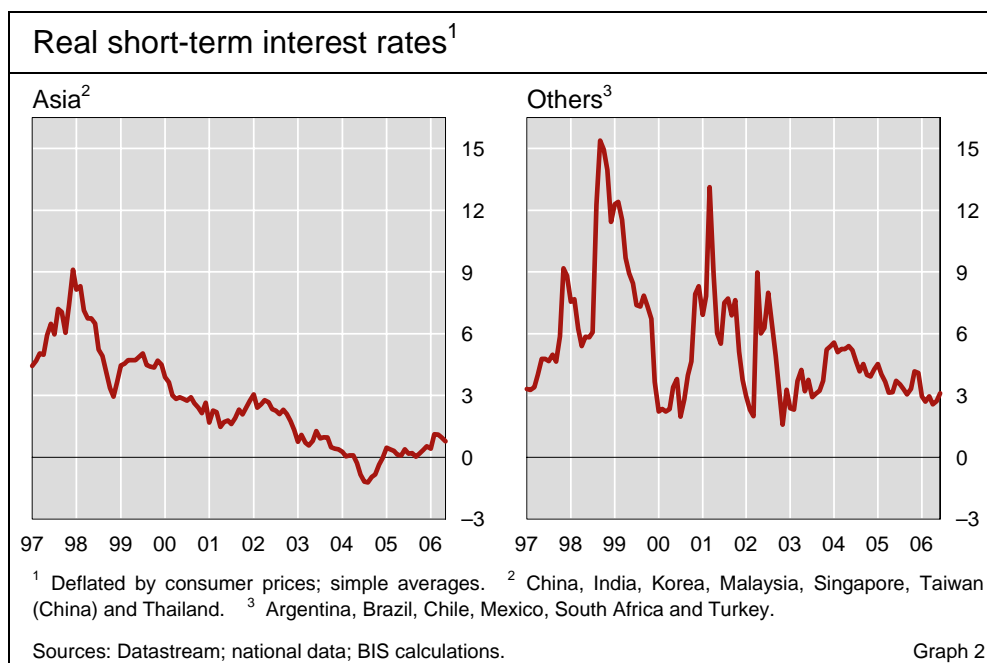
Impact on monetary policy



Monetary policy eased in a context of low inflation

downward pressure on the short-term interest rate (unsterilised intervention), bank credit would tend to expand and inflationary pressures would eventually mount. If central banks have a target for the short-term rate (usually the policy rate), they would attempt to offset increases in bank reserves through changes in other balance sheet items (usually selling domestic assets or issuing their own securities) over which they have control (sterilised intervention).

What have been the monetary implications of intervention? An analysis of changes in the balance sheet quantities in Table 2 suggests that, during the period from January 2000 to May 2006, changes in net domestic credit and non-monetary liabilities offset between 85 and 95% of changes in net foreign assets in India, Korea, Malaysia, Singapore and Taiwan (China), and over 70% and 60%, respectively, in the case of China and Russia.⁶ During much of the time central banks were building reserves, they also sought to deliberately ease monetary policy in an environment of low inflation and large excess capacity. As Graph 2 shows, real short-term interest rates have fallen more sharply over the past few years in Asia than elsewhere. This also remains the case in other countries accumulating large amounts of reserves (eg Russia). In other words, many central banks may have used reserve accumulation opportunistically to expand the monetary base to support their choice of a more accommodative policy stance.⁷ This low inflation context meant that



⁶ Estimated using the following equation: $\Delta DC_t = \alpha_0 + \alpha_1 \Delta NFA_t + \alpha_2 \Delta DC_{t-1} + \varepsilon_t$, where DC is net domestic credit in the central bank balance sheet adjusted for central bank securities and other non-monetary liabilities and NFA is net foreign assets. The model was estimated using seasonally adjusted data from January 2000 to May 2006.

⁷ For example, the People's Bank of China (PBC) has used flexible open market operations to sterilise its forex intervention to various degrees. For instance, during the first half of 2005, with inflation remaining low, the PBC injected base money of 1 trillion renminbi through foreign exchange purchases and withdrew 761 billion renminbi through open market operations, resulting in net base money expansion. However, it has intensified its sterilised

reconciling central banks' exchange rate and inflation objectives was easier than it would have been in other circumstances.

An important question therefore is whether inflation will remain low in emerging market economies. In China, inflation has been volatile but reached a peak of 5% in mid-2004, and subsequently receded. In India, the headline inflation rate has also fluctuated widely, between 8% in mid-2004 and 3% in mid-2005. Although inflation rates have risen in the past two years in Malaysia, Saudi Arabia, Taiwan (China) and Thailand, they are still within the limits of the central banks' inflation objectives. In contrast, reserve accumulation in Argentina, Russia and Venezuela has been associated with a relatively high rate of inflation (10–13% over the past two years).

While inflation has remained low ...

Low inflation to date might be partly structural, reflecting forces such as increased cross-border product and factor market integration as well as structural reforms strengthening competition in non-tradable products.⁸ The concern would be that these structural forces might recede or eventually be overwhelmed by the inflationary pressures arising from expansionary monetary conditions. Growth since 2002 has reduced excess capacity in the global economy, and commodity prices have risen strongly across the board. In such circumstances, central banks may have to raise interest rates and allow their currencies to appreciate at a faster rate than in the past.

... pressures seem to have been mounting

Challenges from sterilised intervention

Fully sterilising reserve accumulation can be challenging. Even when fully sterilised, intervention can have other unwelcome implications that can limit its usefulness as a policy instrument. This section discusses four possible and unwelcome implications.

(i) *The fiscal costs of intervention*

An earlier presumption was that intervention by central banks, in countries where local interest rates were well above international levels, entailed large carrying costs, and it was often these rising costs which led to policy reversals in the past. During the capital inflows episode of the early 1990s, the annual costs of intervention were estimated to have risen between 0.25 and 0.5% of GDP in several Latin American countries (Khan and Reinhart (1994)). By weakening fiscal positions, this also cast doubts on central banks' anti-inflation credibility (Calvo (1991)).⁹

operations since the second half of that year to tighten monetary conditions in the face of growing overheating pressures; see PBC (2005).

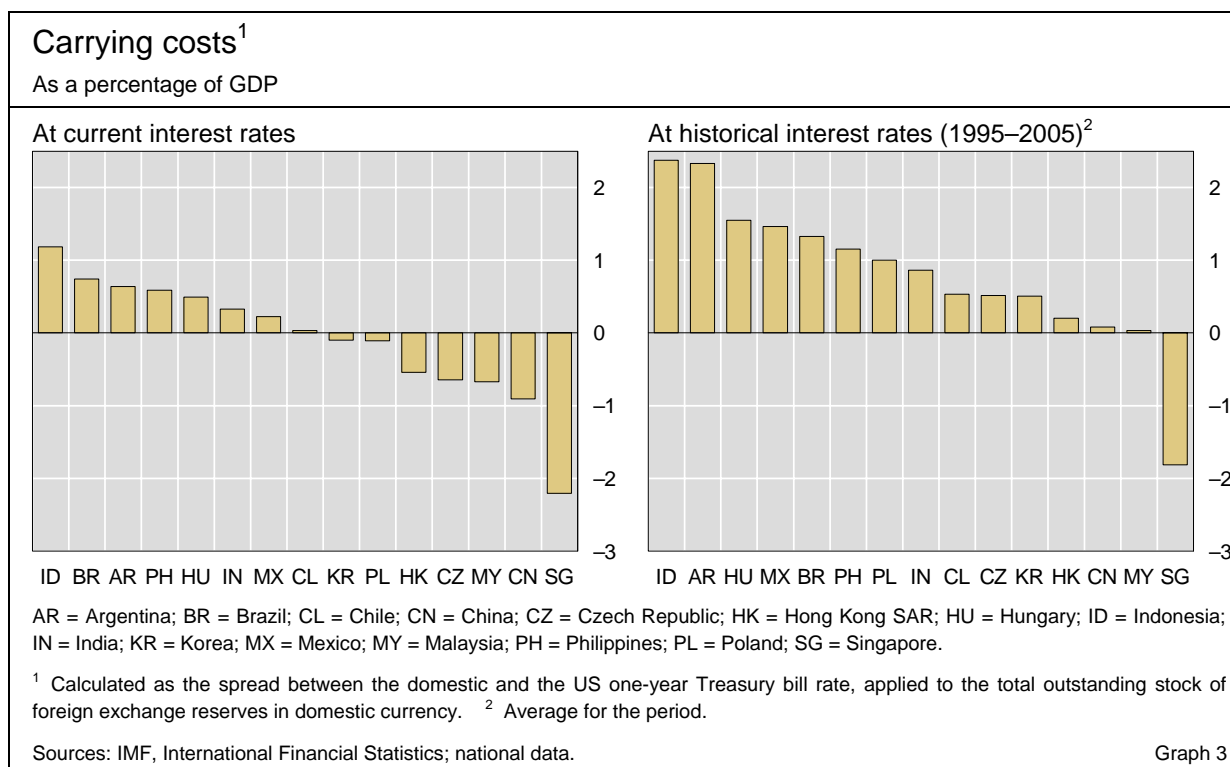
⁸ On this debate, see Borio and Filardo (2006), IMF (2006) and Yellen (2006).

⁹ In thin and imperfect financial markets, sterilised intervention often drives up interest rates on securities used for sterilised intervention; see Frankel (1993) and Turner (1991). In a recent speech, the Deputy Governor of the Reserve Bank of India said that large-scale sterilisation operations raise domestic interest rates, resulting in a "trap of even greater capital flows"; see Mohan (2006).

Carrying costs remain low but could rise ...

Graph 3 provides rough estimates of carrying costs as a percentage of GDP, based on one-year interest rate differentials between domestic currency bonds and US Treasury securities at the end of June 2006.¹⁰ As the left-hand panel of the graph shows, carrying costs are negative in a number of countries at current interest rates. In China, for instance, the one-year interest rate in June 2006 was less than half the comparable US Treasury bond rate. Hence the central bank is earning a positive carry.

Nevertheless, carrying costs are inherently cyclical, and interest rates are currently unusually low. One estimate of how sensitive carrying costs might be to a future rise in interest rates in countries accumulating reserves is shown in the right-hand panel of Graph 3, which indicates that costs would rise significantly should interest rates return to their average levels of the past 10 years. In this scenario, however, carrying costs would still remain low in some countries having large stocks of reserves – particularly China.¹¹ In addition, these hypothetical cost calculations do not capture capital gains or losses from changes in bond prices. The steady decline in long-term yields in international markets since 2001 has generated capital gains for central banks with long-term foreign currency assets but domestic short-term liabilities. Again, however, this seems more likely to reverse than to continue.



¹⁰ This is only an approximation. In practice, carrying costs depend on the difference between the average return on central bank liabilities and that earned by foreign currency assets.

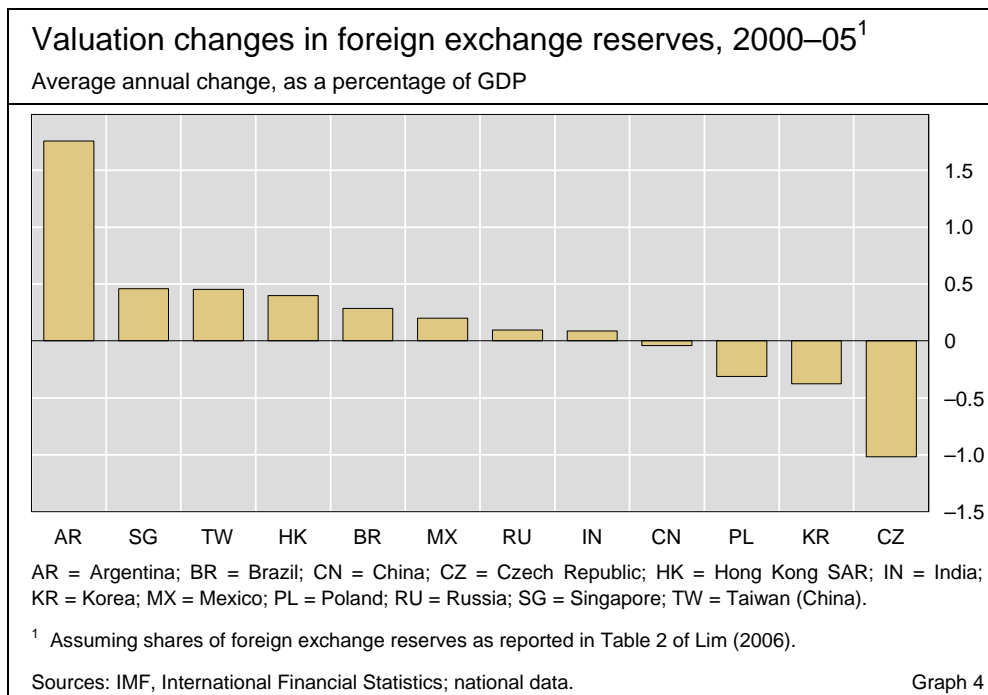
¹¹ Recently, several authors have reported higher intervention costs based on alternative estimates of the opportunity cost. For instance, Rodrik (2006) shows that there is a “social cost” to reserve accumulation to the extent that the private sector borrows at a higher rate than what the central bank earns on its foreign currency assets. Similarly, Summers (2006) suggests higher costs based on the forgone return on infrastructure projects.

Another concern associated with a large portfolio of foreign currency assets is that it exposes the central bank to potential valuation losses from currency appreciation. As a reference point, Graph 4 provides estimates of annual valuation changes as a percentage of GDP between 2000 and 2005. The estimates are obtained by applying actual exchange rate changes to an estimated currency composition of reserves. In the absence of individual country data on the currency composition of reserves, the share of each currency was estimated by applying regional averages published by the IMF since 2000 (Lim (2006)). According to this database, the dollar's share in total reserve holdings in the so-called dollar area countries (Asia and the western hemisphere) fell from 78% at the end of 2000 to 75% by the third quarter of 2005, and that of the euro increased from 14% to 18%. In non-dollar area countries (Europe), the dollar's share fell from 35% to 32% and the euro's share increased from 50% to 57%.¹²

... and there may be valuation losses

Graph 4 shows that countries that have had large currency appreciations against their major anchor currencies (from the viewpoint of their investment basket) have suffered significant valuation losses. In contrast, and despite their large reserves, such losses appear to have been moderate so far in Asia – but only because most Asian currencies have not appreciated significantly against the dollar.

It is debatable how far valuation losses might matter for the sustainability of intervention policy. The direct economic consequences might be limited. Valuation losses do not reduce the central bank's ability to intervene (ie to sell local currency to limit further appreciation), nor do they reduce the purchasing power of its foreign currency reserves in terms of foreign goods. To the extent



¹² See also Wooldridge (2006) in this issue.

that the private sector and the government are net borrowers in foreign currency, appreciation reduces their net debt burden. Valuation losses might matter, however, if they were to undermine a central bank's credibility or independence.

(ii) *Future monetary imbalances*

The long-term effectiveness of sterilised intervention in dealing with excess liquidity depends on the instruments used for sterilisation and which sector ends up holding such paper. Large-scale reserve accumulation typically raises the underlying liquidity position of the banking system. This can be partly neutralised by selling long-term government bonds to banks. If such bonds are then sold to non-banks, sterilisation can be thought to be reasonably complete: households or non-bank firms lower their holding of monetary assets and increase that of non-monetary assets such as government bonds.

Over the past five years, sterilised intervention has been associated with large issuance of central bank or government paper. In China, Korea and Taiwan (China), the stock of outstanding central bank securities rose rapidly to constitute 15%, 20% and 30% of GDP, respectively, at the end of June 2006. In most countries, sterilisation instruments have tended to be of short-term maturity. Most securities issued by the People's Bank of China and the Reserve Bank of India (largely government bonds under the monetary stabilisation scheme) have maturities of less than one year. In Korea, at the end of 2004, over 80% of outstanding monetary stabilisation bonds had a duration of three years or less. The maturity of other interest bearing instruments such as foreign exchange swaps and remunerated deposit facilities is generally much shorter, ranging from a few days to a few months.¹³

Banks, but not the non-bank private sector, have been the primary counterparty to the expansion of central bank and government securities. In China, for instance, over 80% of central bank securities were held by banks at the end of 2005. In India, banks held about 65% of domestic credit in government securities at the end of 2004. To the extent that banks with such liquid assets feel better placed to expand credit, the restraining influence of sterilised intervention on monetary growth could prove temporary.¹⁴ Another challenge is that a large stock of sterilisation securities and other forms of interest bearing non-monetary liabilities increases the interest payment liabilities of central banks, requiring further issuance of securities.¹⁵

Debt securities
often issued
short-term

... and held by
banks, with liquid
balance sheets

¹³ See Ho and McCauley (2006) for a discussion on various types of short-term money market instruments used by central banks in emerging markets for draining excess liquidity and their impact on monetary conditions.

¹⁴ See Kumhof (2004), who provides a formal model for examining the effectiveness of sterilisation using short-term bonds. He shows that increases in short-term bonds with monetary characteristics do lead to increased demand.

¹⁵ Another impact of large issuance of central bank securities is that it leads to market fragmentation in countries with similar government bonds, with adverse implications for liquidity and trading in domestic bond markets; see McCauley (2003).

A large stock of short-term liabilities could also expose central banks to future interest rate fluctuations similar to the government running a large debt rollover risk (for instance, risks of underfunding at the auction without lowering the price of securities substantially). One of the major factors that have helped the smooth absorption of sterilisation securities in recent years has been the strong demand for risk-free assets by banks. If this were to reverse, sustaining sterilised intervention through large-scale debt issuance could become more difficult and more costly. Last year, for example, the Bank of Korea (2005) expressed concerns about rising interest costs implied by the growing reliance on monetary stabilisation bonds.

Interest rate exposures

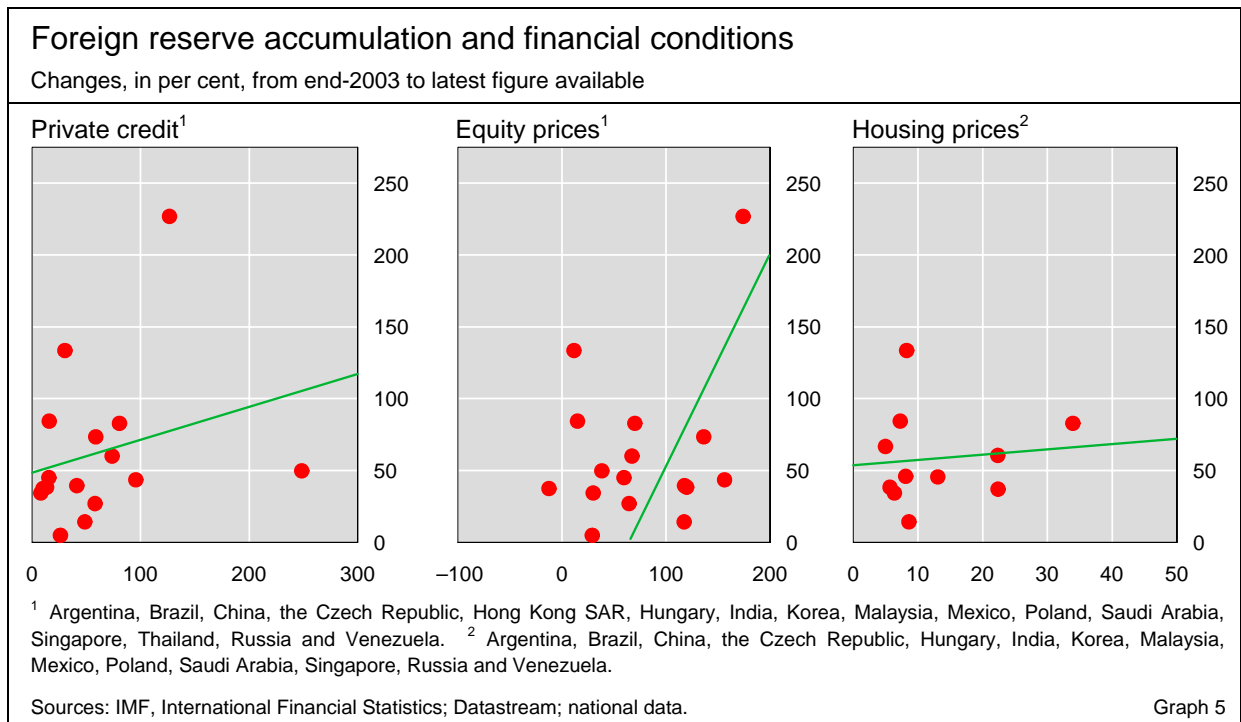
(iii) *Financial sector imbalances*

Intervention to prevent a rise in the exchange rate can accentuate macroeconomic and financial imbalances. There are several possible channels for this. As discussed above, increased bank lending resulting from partial or ineffective sterilisation could finance excessive investment in certain sectors such as property markets. Such effects could also be associated with a persistently low inflation and low interest rate environment (White (2006)). Another possible channel is that expectations of future currency appreciation could attract large short-term capital inflows, pushing up equity prices. Such an effect could be reinforced by perception of a one-way currency bet, leading to increased currency substitution and unhedged foreign currency borrowing.

Prolonged intervention may stimulate bank lending

The significance of each of these channels is difficult to determine as bank credit and capital inflows can be influenced by many factors. Nevertheless, reserve accumulation in a number of countries has been associated with easier financing conditions (Graph 5). Bank credit to the private sector has been rising strongly in several countries, which have been building up large reserve

... and ultimately lead to overheated credit and asset markets



holdings. Such expansion has been accompanied by particularly sharp increases in lending to the residential property sector. The exposure of the banking system to this sector (as a ratio of banks' total loans) rose rapidly in India from a very low level in 1999 to 10% by 2004. Corresponding increases were from 10% to 33% in Korea, and from 7% to 10% in Thailand. Another indicator of easier financing conditions has been the association of large-scale reserve accumulation with rapid growth in equity prices.

There are no simple indicators to show how far exchange rates might have become misaligned, or the extent to which investor expectations about future exchange rate movements might have been influenced, by continued sterilised intervention. Nevertheless, real exchange rates have not risen significantly in many countries with large and persistent current account surpluses. In some cases, real effective exchange rates are actually below what they were at the beginning of the decade, when current account surpluses were small. For instance, as of June 2006, the real effective exchange rates of China, Malaysia, Singapore and Taiwan (China) were 5–10% below the average base of 2000–02 and that of India remained broadly unchanged. In Saudi Arabia, the real exchange rate has depreciated by over 20%. In contrast, Korea and Russia have seen real appreciations of over 20% and 45%, respectively, during this period.

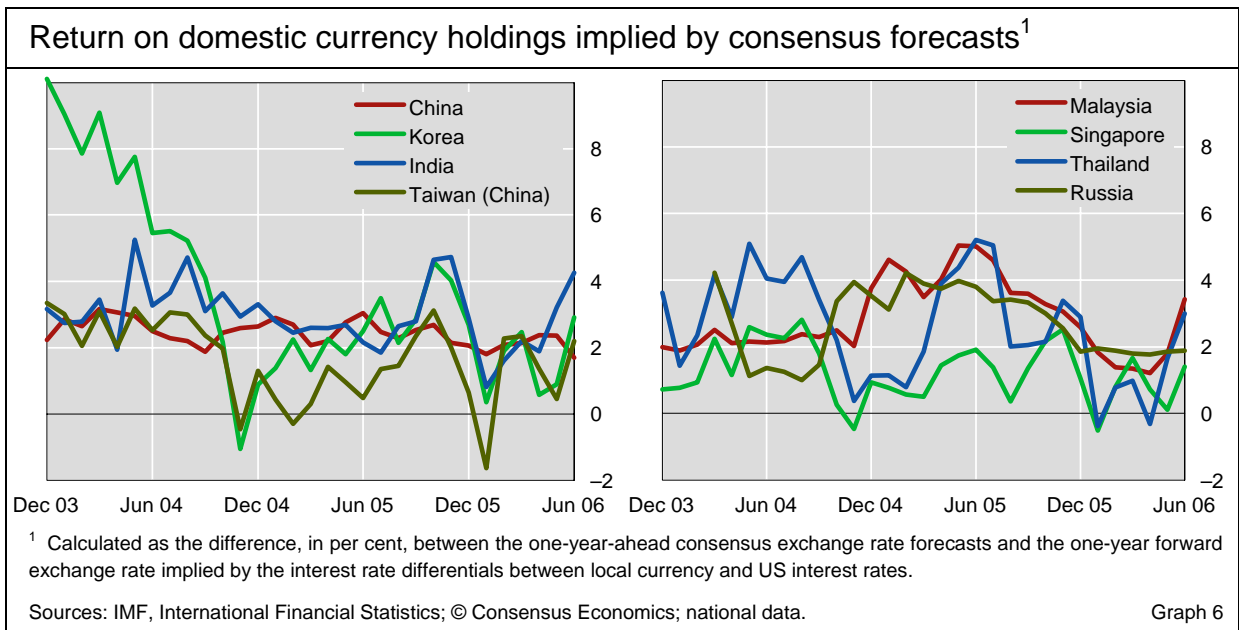
Graph 6 plots the difference, in per cent, between the one-year-ahead consensus exchange rate forecasts and the forward exchange rate implied by the interest rate differentials versus the US dollar for eight of the countries that have intervened heavily in recent years. Positive values indicate that consensus exchange rate forecasts predict excess returns on holdings in the domestic currency. With only a few exceptions, exchange rate forecasts have favoured unhedged long domestic currency exposures, consistent with the view that the currencies of countries engaged in sterilised intervention have been viewed as undervalued by many market participants.

(iv) Implications for financial intermediation

Intervention could
make financial
intermediation less
efficient ...

... through
increased use of
non-market
instruments ...

The difficulties experienced in sterilising large-scale intervention can lead to recourse to non-market instruments to drain excess liquidity, which may have adverse implications for the financial system. During the early 1990s, for example, in many East Asian economies large amounts of public financial institutions' deposits were transferred from the banking system to the central bank, often at below market interest rates. Malaysia sharply raised reserve requirements, while Indonesia imposed a 15% tax on interest payments by banks and introduced direct credit control measures. The drawbacks of such non-market instruments are well known. Reserve requirements effectively tax the banking system, and thus encourage financial disintermediation, while direct credit controls compromise the efficiency of resource allocation.



Use of non-market instruments has been limited so far in the current episode of reserve accumulation. China raised reserve requirements by 1.5 percentage points between September 2003 and April 2004, and another 1 percentage point in July 2006. These measures were supplemented by direct lending restrictions on banks in early 2004 and again in recent months to check rapid credit growth.¹⁶ India has also used reserve requirements selectively (in September and October 2004) to control monetary growth. One reason for reduced reliance on non-market instruments in many countries has been the recent development of a domestic bond market, which has made sterilisation easier.

There are several other channels through which reserve accumulation can affect the efficiency of financial intermediation, although it is difficult to be sure about their significance in the current episode. For instance, prolonged sterilised intervention could alter the behaviour of banks: easy profits from large holdings of treasury securities could weaken pressures on banks to become more efficient.¹⁷ Moreover, large-scale issuance of sterilisation-related debts might also hamper the development of a private bond market, as a large supply of risk-free government and central bank paper crowds out private sector issuance. In contrast, in countries where the stock of initial public debt securities is relatively low, the issuance of sterilisation-related debt could actually help develop a domestic bond market.

... and by altering banks' behaviour

¹⁶ Goldstein and Lardy (2006) argue that an undervalued exchange rate in China leads to frequent reliance by the central bank on quantitative credit control measures. This not only slows down the development of a credit culture but also reduces the profitability of the banking system.

¹⁷ In India, very large holding of government securities by banks presents a complicated challenge given that it exposes them to future interest rate risks; see Reddy (2005).

Conclusion

The scale and persistence of recent reserve accumulation are unprecedented. That such accumulation has continued for several years apparently without major adverse effects on inflation has come as a surprise. Should, however, inflation risks rise, the underlying policy dilemma posed by reserve accumulation might become more evident. Intervention over many years has had a major impact on balance sheets. Aggregate credit has already begun to expand rapidly in some countries, and financial sector imbalances are gradually building up. Continued intervention also creates risks for efficient financial intermediation.

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Forward currency markets in Asia: lessons from the Australian experience¹

Capital controls have resulted in the creation of numerous offshore non-deliverable forward (NDF) markets for Asian currencies. The Australian experience in the 1970s and early 1980s indicates that an NDF market may facilitate a smooth transition to a fully convertible currency.

JEL classification: F310, G150, G180, N250.

In recent years, non-deliverable forward (NDF) markets have become increasingly important for a number of currencies in the Asia-Pacific region. NDF contracts differ from ordinary forward currency contracts in that they are generally settled entirely in a foreign currency, that is, without the delivery of the local currency. These markets have evolved for currencies with foreign exchange convertibility restrictions, and trading has generally taken place in offshore financial centres. The availability of NDFs has allowed some hedging of exchange rate risks, even in the presence of currency restrictions.

Some Asian authorities are now contemplating the liberalisation of their currency markets. An important question they face is how to facilitate the transition from offshore NDF markets to regular onshore or deliverable forward markets.

Australia also had an NDF market that evolved in the early 1970s in the presence of currency restrictions. These restrictions were removed by the authorities around the time the Australian dollar was floated in 1983. In this paper, we draw lessons from the Australian transition from an NDF market to a deliverable market following the float of the Australian dollar, taking into account the current structures of Asian NDF markets.

In the next section, we provide an overview of the exchange controls in place in Australia in the 1970s and the development of the Australian NDF market, typically referred to as the “hedge” market. We next look at current Asian NDF markets, comparing these with the Australian NDF market. We then

¹ The authors are grateful to Mirza Baig, Claudio Borio, Michael Davies, Dan Fabbro, Robert McCauley, Frank Packer, Claudio Piron, Lee Chuan Teck and especially Eli Remolona and Mike Sinclair for useful discussions and comments. The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS or the Reserve Bank of Australia.

characterise the Australian transition from NDF to deliverable forward markets, from which we draw lessons for the Asian forward markets. The final section concludes.

The Australian experience

Prior to the floating of the Australian dollar in December 1983, exchange rate policy in Australia moved through a number of fixed or managed exchange rate regimes.² These arrangements were underpinned by a comprehensive system of exchange controls, with all foreign currency transactions requiring approval from the Reserve Bank of Australia (RBA). As a general rule, certain types of transactions were freely approved, such as those relating to trade and private capital inflows. However, to minimise the opportunity for speculation, restrictions were placed on the timing of such transactions in terms of leads and lags between accessing the funds and completing the transaction. For example, between 1972 and 1974, Australian residents were not granted approval for overseas borrowings (other than trade finance) that were repayable in less than two years. In addition, severe restrictions were placed on investment abroad by Australians and on borrowing in Australia by foreigners.

Australia had a fixed or managed exchange rate until 1983

During the 1950s and 1960s, there was little demand for hedging of exchange rate risk in Australia. Interest rate volatility was low and exchange rates were generally stable, with the Australian dollar pegged to the pound sterling. Forward markets were only available for trade-related transactions, with the additional requirement that the future payment have a maturity of six months at most. Forwards were not available for capital transactions, thereby exposing these transactions to movements in the exchange rate. Under these arrangements, which had been in place since 1939, the RBA provided cover to banks for the risks arising from their forward transactions with eligible customers, thereby transferring risk from private companies to the central bank. Commercial banks were required to buy from (sell to) the RBA each month the sterling equivalent of their excess foreign currency payments (receipts), at a cost defined as a fixed percentage of the notional forward amount.³ Banks were required to charge this cost to their customers and transfer it to the RBA as compensation for accepting the foreign exchange risk; thus, banks simply acted as agents for the central bank.⁴

Little demand for hedging prior to the 1970s

² See Debelle and Plumb (2006) for a more detailed discussion.

³ For the most part, the cost was the equivalent of 25 cents per £100, although it was reduced to 10 cents per £100 between November 1967 and September 1971.

⁴ From 1948, for contracts expressed in US and Canadian dollars, there was no charge. Banks dealt forward with customers in these currencies on their own account at rates based on the London foreign exchange market. Banks were required to cover forward risks (beyond a small limit) each day in these currencies with the central bank, between themselves or in overseas trading centres.

Evolution of the hedge market

Interest rate volatility and the floating of major currencies created demand for hedging

As interest rate volatility increased and a number of major currencies were floated in the early 1970s, managing exchange risk became increasingly important. With the deliverable market in Australia providing very limited forward exchange facilities, market participants developed a non-deliverable forward market as a means of providing exchange risk protection for transactions where hedging was not otherwise available. This became known as the foreign currency hedge market.

Hedge market was encouraged by changes in capital controls ...

Changes in foreign exchange market controls, particularly on forward transactions, in the first half of the 1970s facilitated the development of the hedge market. For example, in late 1971 banks were granted the authority to handle all foreign exchange transactions (both spot and forward) with customers as principals, rather than as agents of the RBA. Australian banks were able to trade between themselves and with offshore banks to cover their positions by the end of each day, although the RBA continued to provide facilities for banks to clear both spot and forward book positions. Also, restrictions were placed on the timing of eligible forward exchange transactions, such that those seeking cover for eligible transactions were required to enter into the forward agreement within seven days of assuming the exchange rate risk. This “seven day rule” was introduced in May 1974, following a number of costly episodes where importers bombarded the RBA with applications for forward cover just prior to a devaluation of the Australian dollar.

The mechanics of NDF markets are explained in Box 1. In the Australian case, contracts were based on settlement in Australian dollars, with no exchange of foreign currency, so hedging of exchange rate risk was achieved without violation of exchange controls.⁵ The first currency hedge contract in Australia was formalised in 1973, and with only minor modifications the structure of that contract was maintained throughout the life of the hedge market (Carew (1985, p 164)).

... developed onshore by the private sector and condoned by the authorities

The Australian hedge market was noteworthy in that it was developed onshore, whereas most NDF markets are developed offshore. It was developed within the private sector by local banks and non-bank institutions. The authorities were aware of its emergence and monitored its development, but chose to condone rather than discourage it. It was argued that transactions in the hedge market would not exert pressure on the spot exchange rate, because there was no direct connection between flows in the hedge and spot markets. Shifts in sentiment in one market, however, could affect trading in the other. For example, if NDF market participants anticipated a revaluation, thereby pushing the NDF exchange rate higher, it was likely that exporters and borrowers would hedge eligible payments in the spot market early, thereby placing upward pressure on the exchange rate.

⁵ Generally, contracts longer than 12 months were not readily available. Spreads between buy and sell quotes on short-term contracts were comparable with spreads quoted at the time on Reuters in European forward markets.

Box 1: How NDF contracts work

A forward foreign exchange contract is an obligation to trade one currency for another on a future date (settlement date) at an exchange rate that is set on the date of the contract (trade date). A typical foreign exchange NDF contract is similar to a regular forward foreign exchange contract, except that at maturity the NDF is settled in another currency, typically the US dollar, because the domestic currency is subject to capital controls, and is therefore “non-deliverable”. If, on the settlement date, the prevailing spot exchange rate has changed from the previously agreed forward exchange rate, the holder of the contract who has benefited from the exchange rate movement must compensate the other for the difference between the contracted forward price and the spot market rate. The contract is net-settled in US dollars based on the notional amount. The fixing rate is generally based on the prevailing rate in the domestic or onshore spot market for the non-deliverable currency.

Note that, in an *onshore* NDF market, circumventing exchange controls usually requires settling contracts in the local currency. That is, restrictions are imposed on the foreign exchange dealings of the local market participants, which can be avoided by dealing in the local currency. In contrast, in an *offshore* NDF market, restrictions on currency convertibility prevent settlement taking place in the local currency. Therefore settlement must take place in another currency, such as the US dollar.

Consider the following example for an offshore NDF market for the Australian dollar (A\$). Assume that Party A is due to pay A\$ 1,000 in one year. Concerned about appreciation of the Australian dollar before the payment, Party A enters into an NDF contract with Party B to purchase the contract equivalent of A\$ versus US\$. Assume that Party A buys the required A\$ 1,000 at a forward exchange rate of US\$ 0.7 per A\$, the equivalent of US\$ 700 at the forward rate. If at the time of settlement the spot rate is 0.6, ie the A\$ has depreciated relative to the forward rate, Party A pays an amount of US\$ 100 to Party B as compensation for the reduced US\$ cost of purchasing the required A\$ 1,000. Alternatively, if the settlement rate was 0.8, then Party A would receive US\$ 100 as compensation from Party B, because the value of the A\$ 1,000 Party B is selling has increased. The calculation is based on the following formula:

$$\text{US\$ settlement amount} = (\text{forward rate} - \text{settlement rate}) \times \text{A\$ notional amount}$$

Note that Party A still needs to purchase the required amount of A\$. This trade needs to be executed in the spot market and is separate from the NDF. Typically, Party A will carefully consider the timing and execution of the spot trade to ensure that the rate achieved is as close to the settlement rate of the NDF hedge as possible. The risk of having a difference between these two rates is referred to as basis risk.

There are several advantages of NDFs, due to the absence of any requirement to undertake cash transfers in the local market. First, an NDF enables participants with exposures not eligible for hedging under controlled capital regimes to hedge their price exposures. One aspect of this is that the structure can be designed to be undertaken between two offshore counterparties and can therefore be used to avoid currency controls or restrictions. Second, because an NDF, in contrast to a deliverable forward contract, settles only marginal amounts, counterparty risk is lower. Finally, it allows parties to avoid potentially high transaction costs of trading in local currencies.

There was significant development in the hedge market in the late 1970s and early 1980s. At the end of 1979, hedge contracts outstanding were estimated to be around A\$ 3 billion. This represented less than half of outstanding forward contracts of around A\$ 7 billion in the deliverable market at the time. However, the RBA estimated that, out of total forward and hedging business written, the contribution of the deliverable market fell over time, from 60% at December 1980 to around 20% by late 1983. Banks were heavily involved, with around 40% of their forward contracts written in hedge markets.

While the hedge market was primarily developed onshore, because regulations prevented non-residents from taking out cover in Australian hedge

Hedge market grew rapidly in the late 1970s ...

... and overseas interbank NDF markets were created ...

markets, interbank hedge markets in Australian dollars were established in overseas financial centres. However, Australian trading banks still played a prominent role. These offshore markets were smaller than onshore hedge markets, with estimated turnover in North American markets of around A\$2–3 billion each year. An important distinction between onshore and offshore Australian dollar hedge markets relates to the currency of settlement. In the onshore market, settlement of hedge contracts was in Australian dollars. This circumvented restrictions on foreign currency transactions (eg no forward cover for foreign capital transactions). In contrast, in offshore markets settlement could not take place in Australian dollars, due to the prevailing exchange controls (eg restrictions on foreigners borrowing Australian dollars). Therefore settlement in offshore markets was in US dollars.

... but markets were still not adequate

Despite the development of the onshore hedge market, it was argued that the forward markets during this time were still inadequate: capital investors did not have direct access to deliverable markets, and NDF markets lacked depth and range, at times showing poor ability to handle moderate- to large-sized transactions. Restrictions on non-resident participation in the NDF market and on banks' ability to hold balances abroad were two factors contributing to this.

Asian NDF markets

Asian NDF markets are similar to the Australian hedge market

Notwithstanding a gap of around 30 years, there are a number of similarities between the Asian NDF markets of today and the Australian hedge market of the 1970s and early 1980s. As in Australia, NDF markets in Asia have developed to provide an alternative hedging tool. In Asia, such hedging has been desired by foreign investors with local currency exposure and has arisen when convertibility of a currency is restricted or the domestic market in the currency is illiquid. NDF markets also allow investors to take investment positions in non-convertible currencies. The use of NDF markets by residents typically reflects the desire of resident exporting and importing companies to hedge their international trade-related currency exposures for those transactions subject to capital controls.

Similar capital controls

The foreign exchange restrictions and capital controls currently in place in selected Asian markets are very similar in nature to those formerly imposed in the Australian market.⁶ As was the case in Australia, the restrictions in today's Asian forward currency markets are designed to limit short-term capital flows not related to trade and direct investment and to discourage foreign market participants from holding short or long positions of a size that might exert pressure on the spot exchange rate. These restrictions take a number of forms. First, some Asian countries rely on formal approval processes or qualified investor schemes for foreign participants in onshore currency markets. Second, most countries only permit hedging for transactions relating to trade and

⁶ See Giacomelli et al (2006) and Citigroup (2006) for overviews of restrictions in Asian currency markets.

foreign direct investment, often referred to as real transactions.⁷ Third, non-residents are not allowed to borrow or fund themselves in the onshore market, except for clearly trade-related purposes. Finally, some countries, in contrast to Australia, also restrict the counterparties with which foreign market participants can interact in the onshore currency market.

Ma et al (2004) analyse prices in these markets to measure the impact of capital controls. Similar to the Australian hedge market in the early 1980s, Asian markets have well established trading and pricing practices and well organised market-making arrangements (Box 2). This is in part due to collaborative efforts by both market participants and policymakers in the country hosting these offshore markets.

Similar structure

Trading patterns in Asian NDF markets are comparable to those seen in the Australian hedge market, in that a large share of overall trading is between dealers. In both Asian NDF markets and the hedge market, the share of inter-dealer trading was more than three quarters of all trading.⁸

Although Asian NDF markets have matured in recent years, similar to the Australian hedge market, there is extensive use of third-party specialised voice brokers in these markets. In most NDF markets, the majority of, and in some cases virtually all of, the market-makers' non-client NDF trades are mediated by brokers rather than directly bank-to-bank. Although less efficient than electronic brokerage, voice brokers have probably helped the major NDF markets evolve to have sufficient depth and liquidity to enable market-makers to quickly offset their positions incurred through market-making activities.

Extensive use of brokers

There are, however, differences between the Asian NDF markets and the Australian hedge market. First, Asian NDF contracts are settled entirely in a foreign currency, specifically the US dollar, while the Australian hedge contracts were settled in the local currency, namely the Australian dollar. Second, the Asian NDF markets are located offshore, while the Australian market was an onshore market. Third, in contrast to the Australian case, where the hedge market was more influenced by local participants, global banks play a more important role in current Asian NDF markets.

Key differences between Asian and Australian NDF markets ...

The differences between today's Asian NDF markets and the Australian hedge market reflect a number of factors. Discussions with market-makers in Asia suggest that one important reason for the offshore location and the settlement in US dollars is that a lack of access to the domestic money markets limits market-makers' ability to hedge onshore, even when a local forward market exists. This was not the case in Australia, where the participants were local institutions which had access to the domestic money market. Second, market-makers have taken advantage of economies of scope by concentrating NDF trading in different currencies in a single location, predominantly Singapore.

... reflect a number of factors

⁷ Until it started deregulation in 1984, Japan had in place similar restrictions on capital flows. See Osugi (1990).

⁸ This is in contrast to the markets for major currencies. In 1995, nearly two thirds of all foreign exchange transactions were carried out directly between dealers. By 2004, only about every second trade took place in the interbank market. For a discussion of this, see Galati (2001) and BIS (2005).

Box 2: Size and structure of Asian NDF markets

Asian NDF contracts are traded over the counter (OTC) and offshore, with trading predominantly taking place in Singapore, followed by Hong Kong and, to a lesser extent, London and Tokyo. As NDF markets are OTC, it is difficult to gauge the volume of contracts traded and who trades. However, discussions with market participants suggest that liquidity has improved as turnover in Asian NDF markets has grown significantly in recent years (see Ma et al (2004) for data on size and liquidity in 2003/04). In addition, an NDF market for the Malaysian ringgit has developed in recent years.

Turnover and liquidity of Asian NDF markets

| | Contract tenures | Asian inter-dealer market daily trading volume, US\$ millions | Trade size, US\$ millions ¹ | Bid-ask spread, basis points |
|----------------|--|---|--|------------------------------|
| China | Liquid to 12 months, limited liquidity 3–5 years | 700 | 10 | 3–5 |
| India | Liquid to 12 months, limited liquidity up to 5 years | 500 | 5–10 | 3–5 |
| Indonesia | Moderate liquidity up to 12 months, illiquid beyond | 250 | 3–5 | 10–20 |
| Korea | Liquid to 2 years, limited liquidity to 5 years | 2,000 | 10 | 2 |
| Malaysia | Moderate liquidity up to 12 months, illiquid beyond | 450 | 5 | 10–12 |
| Philippines | Moderate liquidity to 12 months, limited liquidity 3–5 years | 250 | 3–5 | 7–9 |
| Taiwan (China) | Liquid to 12 months, limited liquidity up to 5 years | 1,000 | 5–10 | 2–4 |

¹ Trade size possible without moving prices on “normal” days.

Source: BIS estimates, 2006 Q2, based on discussions with Citigroup, Deutsche Bank and JPMorgan Chase.

In general, pricing is based on the interest rate parity formula, which determines equivalent returns over a set time period based on two currencies’ interest rates and the current spot exchange rate. When international investors have little access to a country’s onshore interest rate markets or deposits in the local currency, NDF prices are based primarily on the expected future level of the spot exchange rate.

Also, major financial institutions are involved in NDF markets through their market-making activities. Market-makers typically offset NDF positions incurred through market-making activities with other major banks through the inter-dealer market. These positions can be shifted between banks until a corporate customer is willing to take an opposing position. For NDF currencies where there are relatively well developed onshore currency, bond and interest rate markets, international banks are, to a limited extent, also used to offset risks onshore.

This dominance of a single location may also in part explain the more prominent role of global and large regional players in the Asian markets, as these are more capable of taking on a market-making role in a range of regional currencies. Finally, the concentration in a single offshore location also reflects the fact that the global financial system today is more integrated than it was in the 1970s and 1980s, as well as the significant advances in the use of IT in the financial industry.

Transition to a deliverable forward market in Australia

When restrictions on forward transactions in the deliverable market were removed in Australia in 1983, the hedge market faded out over several years and was replaced by the deliverable forward market which exists today. Several developments contributed to the emergence of this market. First, over time, the variation in forward margins became larger, reflecting larger variations in interest rates and speculation surrounding future exchange rate movements. For example, the announcement in February 1983 of Australian federal elections in early March saw heightened nervousness and volatility in financial markets. Substantial outflows of short-term capital and a significant premium on the US dollar (well in excess of interest differentials) were observed, reflecting expectations of an imminent and sizeable devaluation of the Australian dollar. This eventually occurred in the form of a 10% devaluation of the trade-weighted effective exchange rate shortly after the change of government at the elections.

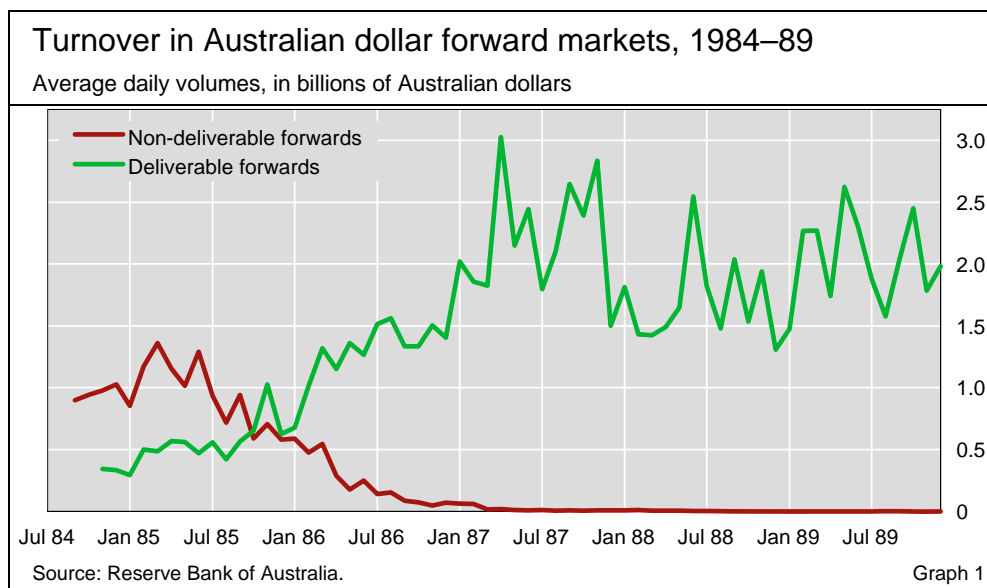
Australian hedge market was replaced by deliverable markets in the early 1980s

Second, in the early 1980s, alongside the increased integration with overseas financial markets, the growth of the currency hedge and futures markets themselves contributed to the erosion of the effectiveness of exchange controls.⁹ Eventually, in late October 1983, a significant change was made to forward foreign exchange arrangements, with the RBA withdrawing from day-to-day operations and removing outer limits on banks' dealings with customers. Forward rates were then allowed to respond directly to the forces of supply and demand, and banks could deal in forward exchange with customers at mutually agreed rates. Banks were no longer required to clear their net forward positions with the RBA, and could now offset forward positions, within limits, using spot positions. The "seven day rule" was also abolished, although non-trade-related transactions remained ineligible for forward cover until June 1984. Shortly after the float of the spot exchange rate in December 1983, the RBA also closed its net forward position. The forward rate had been floated in October, allowing banks to take spot against forward positions. By the time of the float of the spot exchange rate in December, the spot spread in the hedge market was equivalent to that in the deliverable market, as banks could arbitrage between markets.

Financial integration eroded capital controls

By mid-1987, turnover in the hedge market was negligible, while turnover in the deliverable forward market rose steadily in substitution (Graph 1). The increase in turnover in the deliverable forward market reflects in part an increase in the number of market participants. During 1984, foreign exchange dealing authority was given to 39 non-banks, a number of which were important participants in the hedge market. By the end of 1987, 59 non-banks were authorised foreign exchange dealers. Another reason for the increase in

⁹ Laker (1988).



turnover is that commercial banks, rather than policymakers, encouraged non-financial corporations to participate in the deliverable forward market.¹⁰

Hedge market improved trading skills

In terms of the broader development of the Australian financial system, the foreign currency hedge market, together with trading in third currencies (such as the US dollar against the Deutsche mark), yielded an important benefit, namely that the hedge market had enabled market participants to develop their trading skills. This facilitated the functioning of the foreign exchange market when the exchange rate was floated. The skills that had been developed by market players to participate in the hedge market were easily transferable to the deliverable forward market and the deregulated foreign exchange market more generally once the Australian dollar was floated and capital controls were removed in the first half of the 1980s. This undoubtedly eased the transition from the managed regime to the floating regime.

Lessons for the Asian markets

Australian experience holds lessons for Asia

There are three lessons that can be drawn from the Australian experience for today's Asian NDF markets. First, today's Asian NDF markets may facilitate a transition to fully convertible currencies by providing an interim hedging opportunity. Second, the market infrastructure developed for NDF markets can be adapted to the deliverable market. Finally, NDF markets allow for the development of trading experience and skills that are transferable to the deliverable forward market, provided that local market participants have access. The differences between the Australian hedge market and current Asian NDF markets do, however, add some nuance to these lessons.

Limited hedging possibilities in NDF markets

Despite the benefits of NDF markets for hedging purposes in Asia, particularly for currencies of countries attracting significant foreign investment,

¹⁰ Australian dollar futures continue to be traded on the Sydney Futures Exchange, although activity is smaller than in the deliverable forward market. The largest amount of activity in Australian dollar futures is on the Chicago Mercantile Exchange.

market participants cite a variety of limitations which are likely to be relevant in a period of transition. The first and most important limitation in Asia is that only global institutions and a restricted number of domestic institutions are able to use these instruments. Second, for most markets there is limited liquidity in contracts with a maturity over one year. Third, there is no guarantee that the holder of the contract will actually be able to trade foreign exchange at the fixing rate. An implication of this is that when a change in exchange rate regime is anticipated, there is a greater likelihood that the validity of the fixing rate as an indication of where a trade can be transacted is significantly diminished. Finally, the usefulness of NDF markets for hedging purposes in periods of market stress may be limited.¹¹

Asian NDF markets are located offshore, which might reduce their importance in a transition to a fully convertible currency. In particular, with NDF trading taking place offshore, local market participants may not have the same opportunities to develop their trading skills as they would have with an onshore market. However, there are reasons to believe that participants in Asian markets are already developing transferable trading skills. First, the significant presence of both global and regional players in Asian NDF markets suggests that some locally active market participants are already endowed with sophisticated trading skills. Second, in some Asian markets, onshore participants have at least limited access to offshore NDF markets. For example, Korean banks have had access to the Korean won NDF market since 1999, and daily transaction volumes are significant (Bank of Korea (2006)). Also, onshore banks can sometimes gain indirect access to NDF markets via offshore subsidiaries, such as a subsidiary of a Chinese bank located in Hong Kong trading in the renminbi NDF market. Third, in some countries (eg China) local market participants have greater access to deliverable forward markets than was the case in Australia prior to 1983.¹² In this respect, access to forward markets, either deliverable or non-deliverable, may be the key element in developing skills and experience, rather than the actual location of the market.

Asian NDF markets are offshore ...

... but local players do participate

Concluding thoughts

The Australian experience suggests that the transition to a deliverable forward market benefits from the fact that NDF market participants' skills and experience are transferable. Thus, in addition to providing a tool to manage exchange risk, the presence of an NDF market can facilitate a transition to a deregulated foreign exchange market. That is, NDF markets can be seen as an intermediate tool in the progress of market development from limited to fuller

NDF markets may facilitate transition to a deliverable forward market

¹¹ Following the end of the Argentine peso's peg against the US dollar in late 2001, Argentine authorities called an unscheduled market holiday for three weeks. This led to a disruption in determining the settlement rate of outstanding peso NDF contracts. As a result, even after foreign exchange trading resumed, the NDF market in pesos was stymied by continued uncertainty over fixing rates to be used for settlement. See Lipscomb (2005).

¹² In August 2005, new regulations enabled licensed banks operating in China to trade renminbi forwards and to enter into renminbi swaps. See People's Bank of China (2005).

currency convertibility. As illustrated by the Australian experience, once a currency becomes fully convertible, NDF markets tend to disappear.

While risks from
NDF markets
exist ...

There are, admittedly, risks to condoning NDF markets for countries seeking to keep short-term capital movements under control as financial markets develop. One risk is that pressures for appreciation or depreciation may flow from the NDF market to the spot market by making capital flows larger and more volatile. A second risk is that NDF markets may make it easier for sizeable speculative positions to build up. This may affect not just the currency in question, but also other “proxy” hedging currencies.

... policymakers
could consider
condoning NDF
markets

Nevertheless, for policymakers interested in facilitating a transition from a non-deliverable to a deliverable forward market, the comparison between the Australian hedge market and current Asian NDF markets suggests that policymakers do have a role to play. First, condoning rather than discouraging NDF markets may be desirable, because an NDF market may provide a “training ground” for both domestic and foreign market participants that allows them to improve both analytical and trading skills. Second, policymakers may consider the potential benefits of having large global players commit to taking an active role in organising markets, similar to the one they are given in some countries as primary dealers for government bonds. Finally, whether the market is onshore or offshore can influence the process of evolution, but at least as important is whether policymakers allow local institutions to participate in the NDF market, regardless of its location.

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Derivatives activity and monetary policy¹

Trading in futures and options on short-term interest rates has grown rapidly since the turn of the millennium. This feature provides some econometric evidence on the relationship between turnover in this market and changes in policy rates, both actual and expected. The volume of trading in exchange-traded money market derivatives appears to respond mainly to changes in expectations of future interest rates, which is in line with evidence suggesting that monetary policy has become more transparent and predictable relative to the 1980s and early 1990s. Increased uncertainty about future central bank actions is also associated with higher turnover.

JEL classification: E52, G12.

The outlook for monetary policy is an important driver of activity in the derivatives market. Although central banks typically control only a single, very specific short-term interest rate, their actions have an impact on the whole spectrum of yields and on other asset classes. This creates a natural demand for instruments that could be used to hedge against changes in policy rates or to take positions on policy shifts. Derivatives on short-term interest rates are attractive for both purposes, as trading in these instruments involves much smaller cash outlays for a given exposure to risk than borrowing and lending in the spot market. Moreover, they are also available to traders who, by virtue of their limited size or lower credit rating, cannot operate in the deep end of the spot market. Money market derivatives tend to be highly liquid, thus enabling traders to enter positions cheaply, quickly and with minimal impact on prices.

This feature explores the link between monetary policy and turnover in exchange-traded derivatives linked to the short-term interest rates of the G3 economies and provides some econometric evidence in this regard. It assesses the explanatory power for turnover and open interest of several variables measuring different aspects of market participants' perceptions of future central bank actions. Some of the variables, such as implied volatility, have been widely used in the literature; others, such as changes in expected rates or disagreement between economic forecasters, have rarely been considered in

¹ The author is grateful to Claudio Borio, Serge Jeanneau, Robert McCauley, Richhild Mössner, Frank Packer, William White and Philip Wooldridge for comments and suggestions, as well as to Anna Cobau and Carlos Mallo for their dedicated help with graphs and data. The views expressed in this article are those of the author and do not necessarily reflect those of the BIS.

this context. The aim of this exercise is twofold. More immediately, the results should facilitate interpretation of the data on activity in exchange-traded derivatives, regularly published by the BIS. In addition, understanding the determinants of trading may give us a better sense of how the market functions and, hopefully, also of how it relates to other parts of the financial system.

The results indicate that changes in expectations about future interest rates tend to have a sizeable impact on activity in most exchange-traded money market derivatives. By contrast, anticipated changes in spot rates do not appear to have any effect on turnover. Interest rate movements that had not been anticipated by the beginning of the month seem to depress activity in some contracts but not in others. Higher uncertainty about the future course of monetary policy is associated with higher turnover, while differences in opinion between traders reduce trading in some key contracts.

For the United States, there is some evidence of a “division of labour” between federal funds contracts, which are preferred when positions on central bank policy in the very short term are being taken, and derivatives on three-month eurodollar deposits, which tend to be used to trade interest rate risk more generally. EONIA futures do not play the same role in the euro area as federal funds futures in the United States, as very short-term interest rate risk tends to be traded over the counter using EONIA swaps.

Money market derivatives in the G3

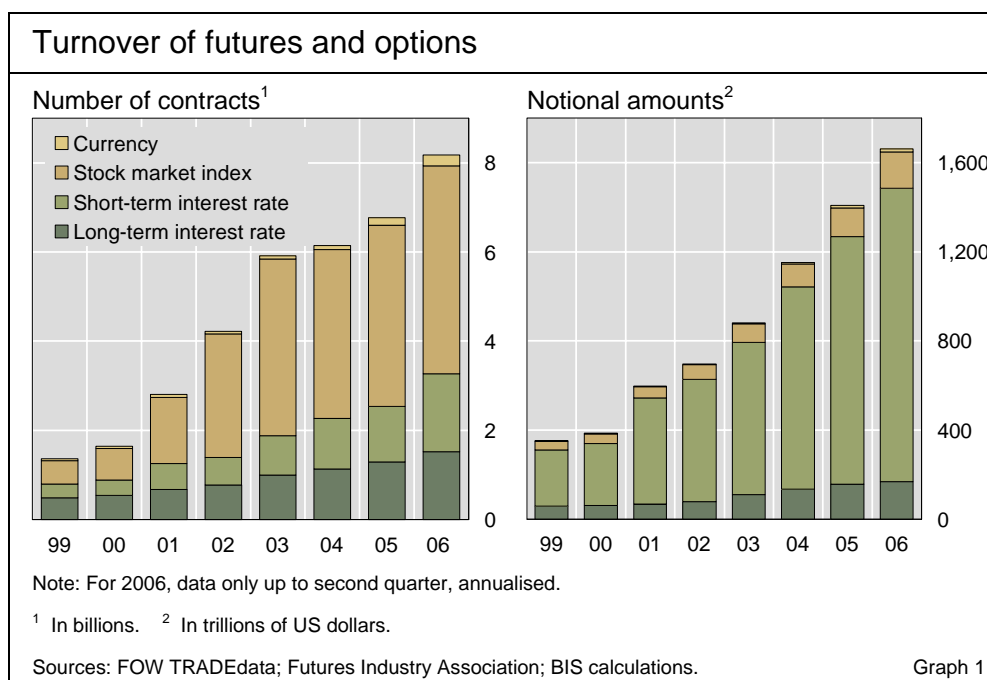
Futures and options on short-term interest rates are among the most actively traded financial contracts in the world. In the first half of 2006, one in every five financial derivatives traded on an organised exchange referred to a short-term interest rate (Graph 1).² Measures based on nominal amounts point to an even greater share of these instruments in total turnover, although issues arise concerning the measurement of the actual risks embodied in the contracts. Regardless of which measure is used, turnover in exchange-traded derivatives on short-term interest rates increased considerably in the early 2000s.

Short-term interest rate risk can also be traded over the counter (OTC) using a variety of instruments such as forward rate agreements, swaps, caps, floors and collars. Unfortunately, data on activity in OTC contracts are available only at relatively low frequencies and with a very coarse instrument breakdown.³ As a consequence, the analysis that follows is limited to exchange-traded futures and options, with only passing references to the OTC market.

Importance of derivatives on short-term interest rates

² I consider only futures and options on overnight and three-month interest rates, although traders reportedly also use contracts on two-year treasuries to take positions on central bank actions.

³ For example, the BIS semiannual survey on OTC derivatives activity breaks down interest rate derivatives into swaps, forward rate agreements and interest rate options. It does not differentiate between contracts on short-term interest rates and those on longer-term rates. Further information on this survey is available at <http://www.bis.org/press/p060519a.htm>.



Contracts on overnight rates permit clean positioning on central bank actions ...

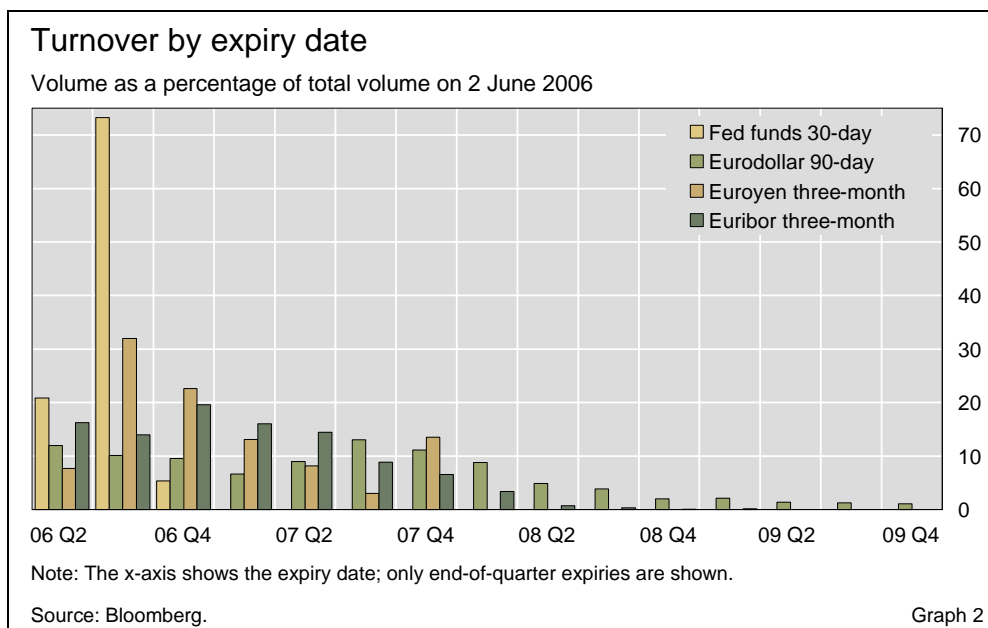
The derivatives most immediately related to central bank actions are contracts on overnight interest rates. Perhaps the best known of such contracts are federal funds futures and options, which are based on the average overnight rate in the month of expiry. Indexing to monthly averages rather than rates at a given point in time eliminates most of the impact on settlement prices of day-to-day fluctuations in overnight rates that are unrelated to monetary policy.

Futures on overnight interest rates have been much less successful outside the United States. Although two exchanges list futures contracts on EONIA, the benchmark overnight rate for the euro area, volumes are minimal. Instead, overnight interest rate risk is mainly traded over the counter using EONIA swaps, whose volumes have doubled since the turn of the millennium, with a sharp spike in the second half of 2003.⁴ Similar instruments are also traded in other currencies such as the Japanese yen.

... but are less liquid than derivatives on three-month rates ...

Although futures and options on overnight rates permit a cleaner positioning on central bank actions than derivatives on longer-term rates, their attractiveness for hedging purposes is limited by the fact that there are very few debt contracts based on such rates. Instead, interest payments on short-term and floating rate debt in the major currencies are often linked to three-month Libor. This may explain why turnover in derivatives on three-month rates, such as the eurodollar, Euribor or euroyen contracts, is much higher than that in any other money market derivative in the same currency. For example, approximately 120,000 federal funds futures and options with a notional amount of more than \$600 billion were traded on an average day in the first half of 2006, compared to 3 million (\$3 trillion) eurodollar derivatives.

⁴ In an EONIA swap, two parties exchange a payment linked to EONIA against a fixed amount set at the inception of the contract. A turnover index (albeit no notional amounts) for these products is published by the ECB in its annual Money Market Surveys (eg ECB (2006)).



Derivatives on three-month interest rates are also more liquid for longer expiries than contracts on overnight rates. For example, the breakdown of turnover by expiry date on a randomly chosen day in the spring of 2006 plotted in Graph 2 shows more or less active trading in all quarterly expiries up to December 2007 of eurodollar, Euribor and euroyen futures, but little in longer-dated contracts. By contrast, there was little trading in federal funds maturities other than June and September 2006.⁵ Similarly, almost half of the activity in the EONIA swap market is in contracts expiring in one month or less and very little trading is in expiries of more than one year.

... especially for longer maturities

Both the differences in contract design and the maturity breakdown suggest that derivatives on overnight rates are preferred for taking speculative positions on central bank actions, while contracts on three-month rates are used to trade interest rate risk more generally. Such a “division of labour” would be consistent with findings on the predictive quality of prices from these two instruments. For example, Gürkaynak et al (2002) show that, for short horizons of up to three months, federal funds futures dominate other contracts as predictors of future federal funds rates.

Hypothesis: “division of labour” between different contracts

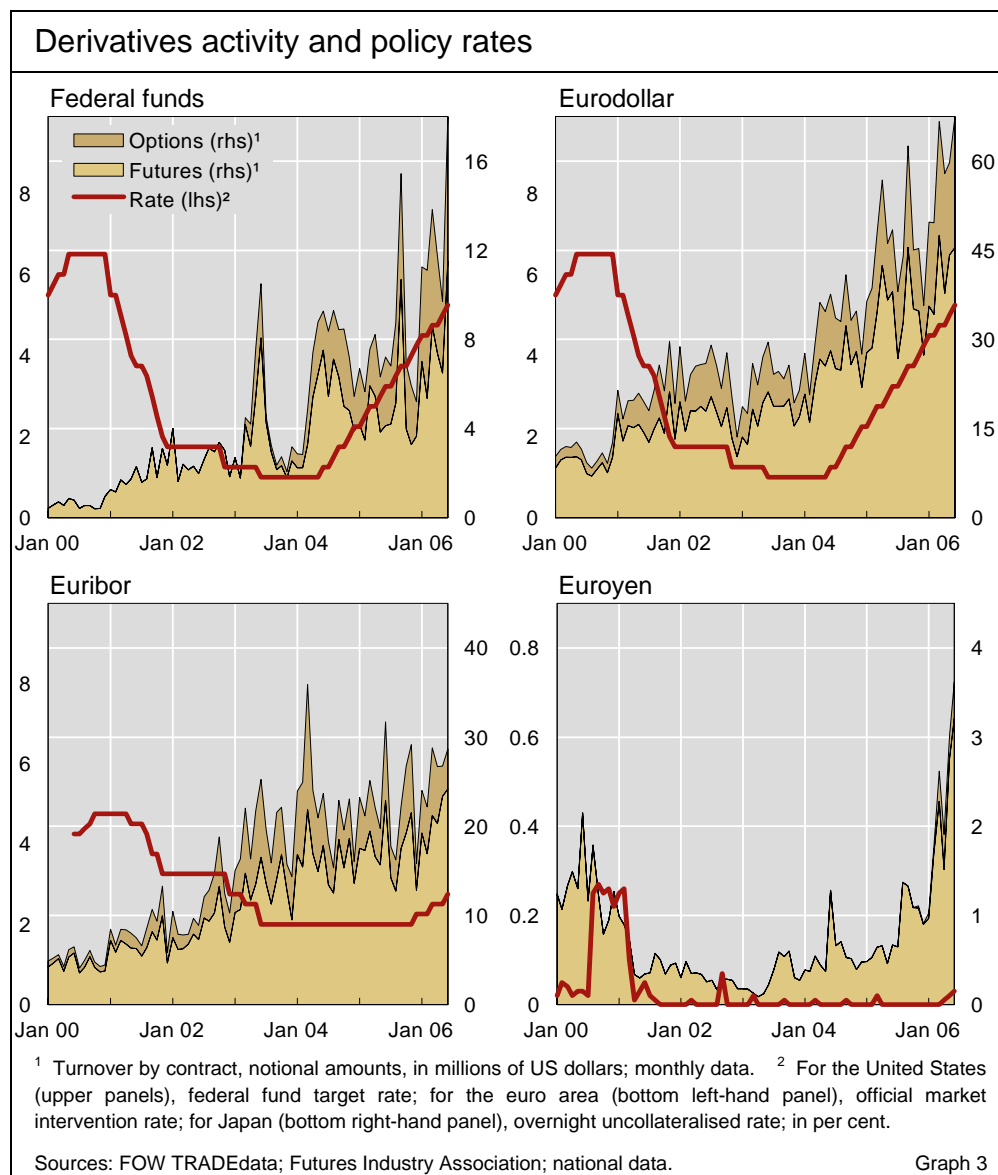
A visual examination of the relationship between turnover in different exchange-traded derivatives contracts on short-term interest rates and policy rates in the respective currency (Graph 3) broadly supports this hypothesis. Turnover in both federal funds derivatives (top left-hand panel) and eurodollar contracts (top right-hand panel) appears to be closely related to monetary policy. For example, turnover in both contracts increased sharply in late 2000 and early 2001, roughly coinciding with the time when the Federal Reserve began to cut interest rates. Likewise, activity in both contracts picked up

Turnover surges particularly during shifts in monetary policy

⁵ Futures on short-term interest rates are listed for much longer horizons than those shown in Graph 2. For example, eurodollar futures expiring any quarter during the coming 10 years are listed at any given point in time although there is extremely little trading in contracts maturing in more than a few years. Federal funds futures are listed for each of the coming 24 months, but there is very little trading in expiries other than the next two end-of-quarter months.

markedly during the deflation debate of 2003 and when the Fed began to tighten policy in the middle of 2004. However, while monetary policy appears to be the main driver of activity in federal funds futures and options (which began trading in March 2003), it seems to be only one of several determinants of trading in eurodollar derivatives. Turnover in these contracts is less volatile and surges in activity tend to be longer-lasting than could be explained by trading ahead of central bank policy shifts alone.

A positive relationship between derivatives activity and changes in interest rates is also visible in the euro area. Trading in contracts on three-month Euribor accelerated in early 2000 and 2003 prior to rate cuts by the ECB (bottom left-hand panel). By contrast, no clear relationship between rate changes and exchange-traded derivatives trading is apparent in Japan (bottom right-hand panel). This is not surprising given that short-term interest rates remained at virtually zero between April 2001 and July 2006 and there was hardly any short-term (nominal) interest rate risk during most of that period.

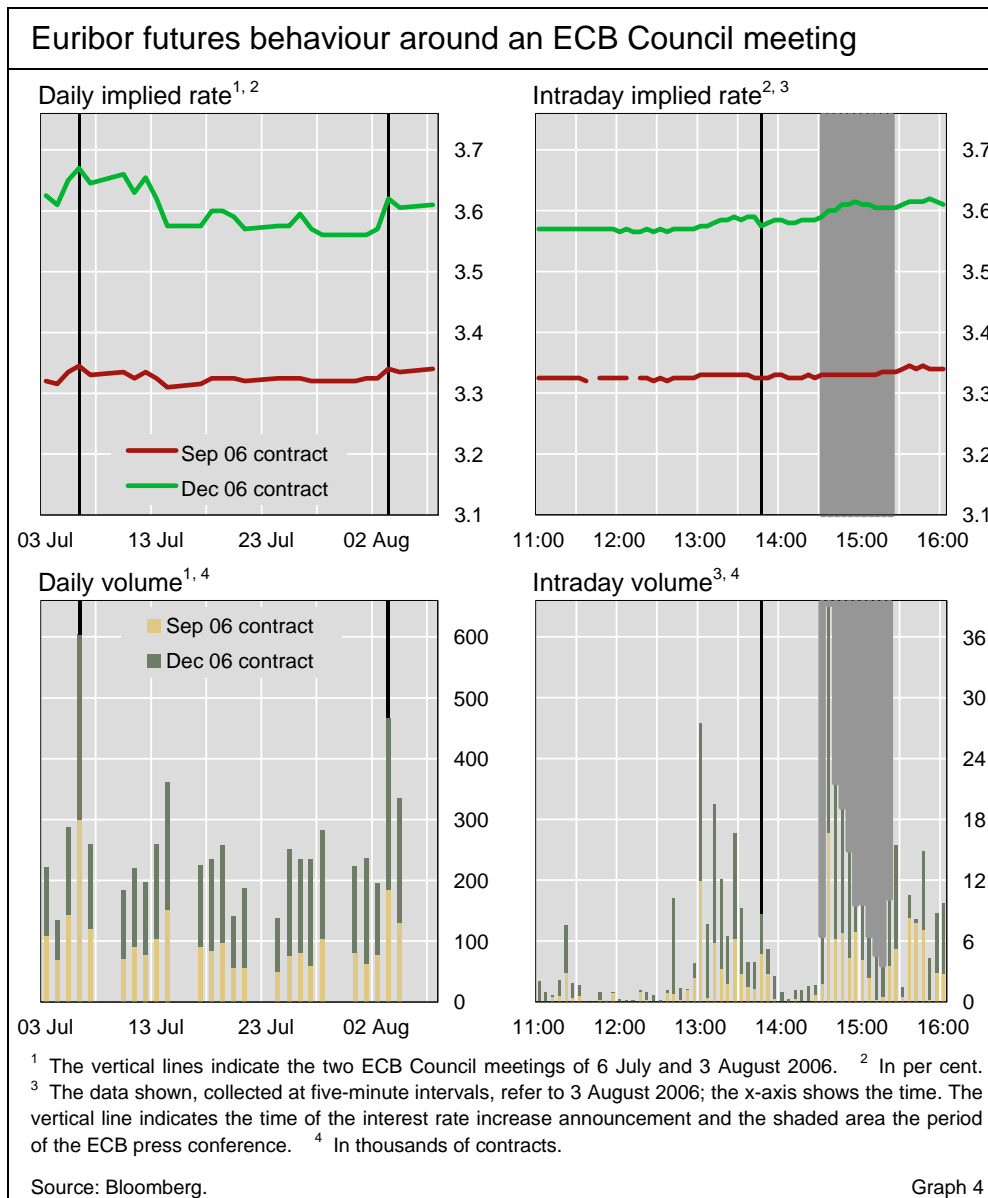


Disentangling the market's expectations of monetary policy

An examination of derivatives activity and interest rate changes at a monthly level provides a first impression of the influence of monetary policy on derivatives trading. One has to look at higher frequencies, however, to understand how traders' perceptions about monetary policy affect activity in derivatives on short-term interest rates.

High-frequency analysis ...

Graph 4 shows the evolution of prices and quantities of the September and December contracts on three-month Euribor around the ECB Governing Council meeting on 3 August 2006, when the ECB lifted the minimum bid rate for its main refinancing operations from 2.75% to 3%. The left-hand panels show daily data, while the right-hand panels plot intraday numbers around the time of the announcement (marked by a black vertical line) and the press conference (shaded area). At 13:00 Frankfurt time on that day, 45 minutes ahead of the ECB announcement, the Bank of England raised its base rate to 4.75%, a move that took most market participants by surprise. This hike was



... shows little effect of anticipated rate changes ...

... but strong response to news about future rate changes

Responses indicate high predictability of central bank actions

Ambiguous relationship between turnover and uncertainty

Differences in opinion may lead to speculative trading

followed by a slight increase in the rate implied by Euribor futures expiring in December and led to some repositioning in euro-denominated contracts too. The ECB's announcement at 13:45 was almost perfectly anticipated by market participants and therefore had little impact on futures prices. Turnover increased somewhat in the first five minutes after the release, but quickly fell afterwards. By contrast, statements by the ECB's President at the press conference one hour later were interpreted by many traders as indicating that interest rates might rise again and earlier than previously expected, which led to an increase in the rates implied by the prices of the December contract and a spike in activity. Overall, turnover on the day of the Council meeting was much higher than that on any day during the previous four weeks. While activity was strong in both the September and the December contracts, trading in the latter increased by a larger amount.

The trading pattern observed around the ECB Council meeting of 3 August is typical of those for other meetings, in the euro area as well as in other regions: trading appears to be triggered less by the actual policy move than by changes in expectations about future interest rates. Of course, this holds only if rate decisions are anticipated by the market, which is usually the case in most industrial countries today.⁶ Anticipation effects may take place well in advance of the actual rate change. In some cases, data releases or central bank communications affect forward rates many years into the future, although the breakdown by contract expiry shown in Graph 2 indicates that market participants do not use money market futures to take positions over such long horizons.

Revisions in the point estimates of future interest rates are unlikely to be the only drivers of derivatives activity: the uncertainty associated with these expectations is also likely to be important. However, the relationship between uncertainty and activity is by no means straightforward. Jeanneau and Micu (2003) argue that higher uncertainty increases hedging demand but has ambiguous effects on speculative activity. On the one hand, uncertainty creates trading opportunities, but, on the other, it also increases the risk associated with each transaction. In their empirical work, the authors document a statistically significant relationship between implied volatility as a proxy for uncertainty and activity in stock index contracts but not in futures and options on government bonds.

Another factor that could affect trading in derivatives on short-term interest rates is differences in opinion among traders, as opposed to a generalised increase in uncertainty.⁷ Although most information affecting interest rates, such as macroeconomic data releases or central bank announcements, is

⁶ A wide body of literature shows that monetary policy has become more transparent relative to the 1980s and early 1990s, and that this has increased the predictability of central bank actions. See BIS (2004, pp 73–80) for some evidence concerning predictability and an overview of the issues related to central bank transparency.

⁷ Differences in opinion and uncertainty are related, but distinct, concepts. For example, traders may differ in their (strongly held) views on a particular aspect of monetary policy even if there is little uncertainty otherwise. Theoretical models which analyse the relationship between differences in opinion and trading volume are Shalen (1993) and Harris and Raviv (1993).

public, traders could well differ in their assessment of this news. Indeed, one might argue that having a different perspective on the outlook for asset prices is a key reason for market participants to engage in speculative trading. In contrast to insider information, which tends to be incorporated into prices very quickly, differences in opinion may persist over prolonged periods of time and may therefore be associated with higher volumes even at lower frequencies (see also BIS (2005)).

Explaining activity with changing perceptions of monetary policy

This section offers a more systematic analysis of turnover based on regressions that incorporate the effect of traders' anticipation of interest rate moves, the uncertainty surrounding these expectations, and possible differences in opinion among market participants concerning future central bank actions. The analysis is done on a contract by contract level, as different contracts may serve different purposes. The estimation period ranges from February 1999 (March 2000 for Euribor contracts) to June 2006. Trading in federal funds options started only in March 2003, and trading in euroyen options and EONIA futures dried up during the sample period, so it was not possible to include these contracts in the analysis.⁸

The rate of growth of average daily turnover in each month is regressed on its own lagged values as well as a series of explanatory variables capturing different aspects of traders' perceptions of monetary policy. Changes in traders' expectations of future interest rates are measured by changes in implied three-month rates ($\Delta futrates$) two months ahead.⁹ In order to capture nearer-term developments in rates, the regressions also include contemporaneous changes in one-month interest rates, decomposed into anticipated ($\Delta antrates$) and unanticipated ($\Delta unantrates$) components. Since futures and options can easily be used to enter both long and short positions, the absolute change of interest rates is used instead of the signed change.

In line with common practice in the literature, the uncertainty surrounding future monetary policy is proxied by the volatility implied by the prices of at-the-money options ($\Delta impvol$). In principle, options on overnight rates, which are likely to be more closely related to central bank actions, would have been preferable, but such contracts were not traded for the entire sample period in any of the three major currencies. Implied volatility from eurodollar and Euribor options is used instead. For Japan, there is no uninterrupted series for implied

Regressions of turnover ...

... on changes in expected interest rates ...

... investor uncertainty ...

⁸ It is not clear whether turnover of money market derivatives has a unit root, as the corresponding tests give conflicting results. However, regressions in first differences of log turnover appear to be better specified than regressions in levels, which tend to have highly autocorrelated residuals. Nevertheless, the results concerning the relationship between expected rate changes and turnover also hold when the regressions are performed in levels and a linear trend is included to capture the structural growth of the market.

⁹ Implied forward rates need not coincide with expected rates due to the presence of term premia. However, differencing should eliminate most of the effect of term premia, which tend to vary over business cycle frequencies.

volatility as trading in euroyen options dried up during the middle years of the sample.¹⁰

... and dispersion of opinion indicator ...

Trader disagreement on the future course of monetary policy is proxied by the (cross-sectional) standard deviation of the individual forecasts for three-month interest rates compiled by Consensus Economics in any given month (*diffopinion*).¹¹ Although the economists included in the panel are not traders, most tend to be employed by firms with large trading operations. Nevertheless, it is possible that the data are distorted by strategic positioning which may affect the results of the estimations.¹² In addition, macroeconomic forecasts are usually made at frequencies lower than one month and are then updated using simple rules of thumb, which could introduce some inertia into the data.

... underline role of changes in expectations ...

The results from the estimations largely confirm the view that changes in expected interest rates rather than actual changes affect trading in derivatives on short-term interest rates, at least for some contracts (Table 1). The coefficient of $|\Delta futrates_i|$ is positive and statistically highly significant for

| Monetary policy and derivatives activity: estimation results | | | | | | |
|--|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------|
| | Eurodollar | | Federal funds | Euribor | | Euroyen |
| | Futures | Options | Futures | Futures | Options | Futures |
| $\Delta turnover_{t-1}$ | -0.33*** (-4.26) | -0.33*** (-3.63) | -0.36*** (-3.82) | -0.74*** (-8.94) | -0.46*** (-3.73) | -0.22** (-2.03) |
| $\Delta turnover_{t-12}$ | 0.37*** (5.07) | 0.33*** (3.75) | 0.22** (2.45) | 0.18** (2.23) | 0.15 (1.51) | 0.13 (1.17) |
| $ \Delta futrates_i $ | 0.55*** (4.86) | 0.57*** (3.81) | 0.42* (1.77) | 0.17 (1.44) | 1.02** (2.47) | 0.37 (0.51) |
| $ \Delta unanrates_i $ | -0.32** (-2.49) | -0.30* (-1.81) | -0.21 (-0.80) | -0.11 (-0.81) | -0.15 (-0.39) | -0.07 (-0.08) |
| $ \Delta anrates_i $ | 0.08 (1.23) | 0.07 (0.86) | -0.03 (-0.13) | 0.37 (1.44) | 0.32 (-0.45) | 0.18 (0.61) |
| $\Delta impvol_t$ | 0.010*** (3.17) | 0.008** (1.99) | 0.028*** (4.10) | 0.001 (0.21) | 0.022 (1.62) | . |
| $diffopinion_t$ | -0.43** (-2.26) | -0.44* (-1.75) | -0.08 (-0.21) | 0.25 (-0.70) | -0.37 (-0.49) | -0.11 (-0.08) |
| Adjusted R ² | 0.50 | 0.36 | 0.33 | 0.68 | 0.27 | 0.01 |
| Durbin-Watson | 2.06 | 2.08 | 1.97 | 1.99 | 2.21 | 2.02 |
| Sample period | 1999:2– 2006:6 | 1999:2– 2006:6 | 1999:2– 2006:6 | 2000:3– 2006:6 | 2000:3– 2006:6 | 1999:2– 2006:6 |
| No of observations | 89 | 89 | 89 | 76 | 76 | 89 |

Note: Dependent variable: $\Delta turnover$. t-values in brackets. *, ** and *** denote significance at the 10%, 5% and 1% confidence level, respectively.

Table 1

¹⁰ Implied volatility is another borderline case where unit root tests deliver ambiguous results. To avoid any spurious relationship stemming from non-stationarity, implied volatility enters the regressions as first differences.

¹¹ See BIS (2005) for a similar analysis for stock index derivatives.

eurodollar futures and options as well as for Euribor options. For eurodollar contracts, a 10 basis point change in implied forward rates raises turnover growth by approximately 5 percentage points. The impact on turnover in Euribor options is even larger. The estimation results for other contracts yield less clear results. The coefficient on $|\Delta futrates_i|$ is only weakly significant in the equation for federal funds futures and not significant at all in the case of Euribor and euroyen futures. In the latter case, this is probably related to the low level of and variation in Japanese interest rates, both actual and expected, over the period, which is also reflected in the very low explanatory power of the regression.

As expected, anticipated rate changes have no discernible impact on turnover in any contract. By contrast, unanticipated rate changes appear to reduce monthly turnover in eurodollar futures and options. At first glance, this may seem at odds with the earlier analysis based on high-frequency data. However, one should note that higher trading in the immediate aftermath of an interest rate surprise may be offset by lower volumes further down the road. A similar effect where a coefficient is positive at daily and negative at monthly frequencies has been documented by Jeanneau and Micu (2003) for the relationship between volatility and turnover.

... rather than actual moves

An increase in uncertainty over future central bank policy is associated with heavier trading in money market contracts for all three US contracts but does not appear to affect trading in futures and options on Euribor. Finally, the dispersion of interest rate forecasts is negative and statistically significant for both eurodollar contracts but not in the other regressions. Again, the sign is not in line with the priors suggested by the literature. It is possible that conflicting expectations dampen trading because they deter non-informed traders.

The regression results are broadly in line with the “division of labour” hypothesis that states that different contracts are used for different purposes. As mentioned above, the hypothesis states that traders use federal funds contracts for taking positions on relatively immediate changes in policy rates but use eurodollar contracts to trade interest rate risk more generally. This would imply that changes in expected rates several months ahead have a stronger effect on eurodollar than on federal funds trading, which is confirmed by the regressions. However, we would also expect changes in short-term interest rates that had not been anticipated at the beginning of the month but perhaps were anticipated immediately before the rate change to be associated with higher federal funds turnover. The lack of significance of the coefficient on $|\Delta unanrates_i|$ does not directly contradict this, but neither does it support it. Higher-frequency data may be necessary to settle this issue.

Weak support for “division of labour” hypothesis

¹² See Laster et al (1999) for a model and empirical evidence of strategic behaviour on the part of macroeconomic forecasters.

Conclusions

Results are in line with more transparent central banks ...

In a world with more transparent central banks and monetary policy that is increasingly predictable, actual rate changes should convey little new information to traders and have limited impact on turnover. Instead, market participants are more likely to adjust their positions in response to news about future interest rates. These predictions are largely borne out by the data, which show a statistically significant relationship between turnover and changes in expectations of future interest rates in several money market contracts. Anticipated rate changes, by contrast, do not seem to have any significant effect on turnover. A third result, namely that changes in interest rates that had not been anticipated by the beginning of the month appear to dampen turnover in some contracts but have no effect on turnover in others, does not contradict the notion that central banks have become more predictable. However, it would be interesting to see whether this result also holds at higher frequencies which permit a cleaner distinction between what has been anticipated and what not at the moment of the interest rate announcement.

... and different uses of various contracts

The econometric analysis is also broadly in line with a “division of labour” between different contracts, although the evidence in favour of this hypothesis is not very strong either. In part, this may be due to the use of monthly data. Moving to higher frequencies could give a better idea of the use of different contracts, although it would be hard to transfer the results of such an exercise back to the monthly level required when interpreting the regular BIS statistics on exchange-traded derivatives.

The low frequency and limited instrument breakdown of the available data on OTC derivatives stand in the way of an extension of the present analysis to that market segment. This is unfortunate, since futures and options traded on organised exchanges compete with relatively similar products that are traded over the counter. A much better understanding is required of why some products are traded OTC and others on exchanges, in particular in relatively standardised product categories.

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150 years of financial market volatility¹

This paper investigates the behaviour of the volatility of returns in bond and stock markets for a sample of eight countries using very long samples of data. Volatility has been high during episodes of economic and political turbulence, in particular during the interwar period. Moreover, volatility has generally been high since the early 1970s.

JEL classification: G1, G2.

Despite a rise in financial market volatility in the second quarter of 2006, volatility in most markets remains below where it was at the turn of the millennium.² Shifts in volatility affect investors' willingness to hold risky assets and their prices. The level of volatility in financial markets can also influence corporations' investment decisions and banks' willingness and ability to extend credit. Sharp changes in the level of financial market volatility can also be of concern to policymakers. For instance, a sudden increase in volatility might discourage major market participants from providing two-way price quotations, which in turn can reduce liquidity and trigger adverse price reactions, with potential consequences for the real economy.

The importance of financial volatility is demonstrated by the large literature it has given rise to. Since volatility – the second moment of the distribution of returns – is unobserved, much work has been devoted to measuring, modelling and understanding its evolution.³ For natural reasons, much of that literature is methodological and has focused on data for the recent past. To understand the importance of factors that may only gradually affect financial markets (such as changes in the probability distribution of macroeconomic outcomes, the effectiveness of risk management systems and

¹ The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. The authors are grateful to Katrin Assenmacher-Wesche, Claudio Borio, Petra Gerlach, Már Gudmundsson, Serge Jeanneau, Frank Packer and Christian Upper for helpful comments.

² See BIS (2006) for a discussion on the recent decline in financial market volatility.

³ Bollerslev et al (1992) and Poon and Granger (2003) survey the literature on modelling and forecasting volatility in financial markets. Ex ante measures of uncertainty derived from market prices on derivative instruments – ie “implied volatility” – are also frequently used in volatility analysis. However, such measures incorporate risk premia and, furthermore, data generally do not go back more than a few decades.

developments in market liquidity), it is of interest to investigate the behaviour of volatility over very long time spans and across a wide range of financial markets. While some such studies exist, these tend to focus on individual countries and markets or on specific episodes.⁴ To our knowledge, there is no cross-country study of the evolution of volatility for a range of financial markets and instruments over an extended period of time.

This article uses extremely long time series of monthly bond and stock returns to document the evolution of the volatility of returns in Australia, Canada, France, Germany, Italy, Japan, the United Kingdom and the United States. Depending on the country, the data start as early as 1850; all data end in 2005. We also discuss how the volatilities are linked to macroeconomic conditions. While it would have been interesting to also investigate the volatility of short-term interest rates and exchange rates, the data in many cases display little, if any, variation. Thus, short-term interest rates are typically closely tied to interest rates set by central banks, which in many historical episodes were fixed for long periods of time. Similarly, many bilateral exchange rates were fixed during extended time spans as a consequence of the operation of the gold standard or the Bretton Woods system. For this reason, we focus here on the volatility of stock and bond returns.

While the purpose of the study is merely to describe the evolution of volatility, several interesting conclusions are readily apparent. First, volatility varies considerably over time and is typically dominated, not unexpectedly, by occasional episodes of economic and political turbulence.⁵ Second, volatility has risen across the world since about 1970. Third, while the econometric analysis provides some evidence that weaker economic conditions or higher inflation are associated with higher volatility in financial markets, these correlations are unstable over time. Furthermore, there appears to be no robust relationship between macroeconomic volatility and volatility in financial markets. One possible explanation for these findings is that some relevant factors, for instance the occurrence of financial crises and episodes of political instability, have been omitted from the analysis.

Volatility varies over time ...

... but displays no robust link to macroeconomic conditions

Methodology and data

The volatilities of returns have been computed using exponentially weighted moving averages (EWMA) of squared returns, which follows closely the RiskMetrics methodology, as discussed in the box.

⁴ The Kearns and Pagan (1993) study on stock market volatility in Australia between 1857 and 1987 and the Mitchell et al (2002) study on the volatility of returns on consols in the United Kingdom in 1821–60 are examples of the first type of study. The studies by Choudhry (1997) on stock return volatility in 1926–44 and by Voth (2002) on stock market volatility during the Great Depression are examples of the second type.

⁵ Such episodes often involve financial crises, which Kearns and Pagan (1993) note play a major role in triggering financial volatility.

Estimating the volatility of returns

To compute the volatilities, let r_t^2 denote the squared returns in period t . The return volatilities are updated using the following recursive equation for the variance of returns:

$$\sigma_{t+1}^2 = \lambda \sigma_t^2 + (1-\lambda) r_t^2$$

where λ , the decay factor, is set at 0.95 for monthly data. This choice of λ ensures that, while computing volatilities, a less than 10% weighting is given to data older than 45 months. Further, the forecast errors (predicted variance minus the average squared monthly returns over the following three months) are lower on average for this choice of λ compared to others. The annualised volatility estimates using monthly returns (computed by multiplying monthly volatility by the square root of 12) are somewhat lower than those based on daily returns (computed by multiplying daily volatility by the square root of 256, which is the number of trading days in a year), perhaps because monthly returns have less measurement errors, but the choice of data frequency does not alter the inferences drawn on the changing pattern of volatility over time.

Stock returns are computed as the logarithm of the ratio of stock index levels:

$$r_t = \ln(P_t / P_{t-1})$$

where P_t is the stock index level at time t . Bond returns are computed using the following approximation (the available time series is bond yields):

$$r_t = -D_{t-1} \times (y_t - y_{t-1})$$

The return in time period t is thus approximated by duration, D , multiplied by the change in yield, y . The duration for the bond has been estimated on the basis of the underlying maturity of the bond yield time series. Specifically, let the yield data for different bonds correspond to a fixed maturity bond, say N years. Assuming that the bond is priced at par and is issued today, the duration of the bond can be determined using the following equation:

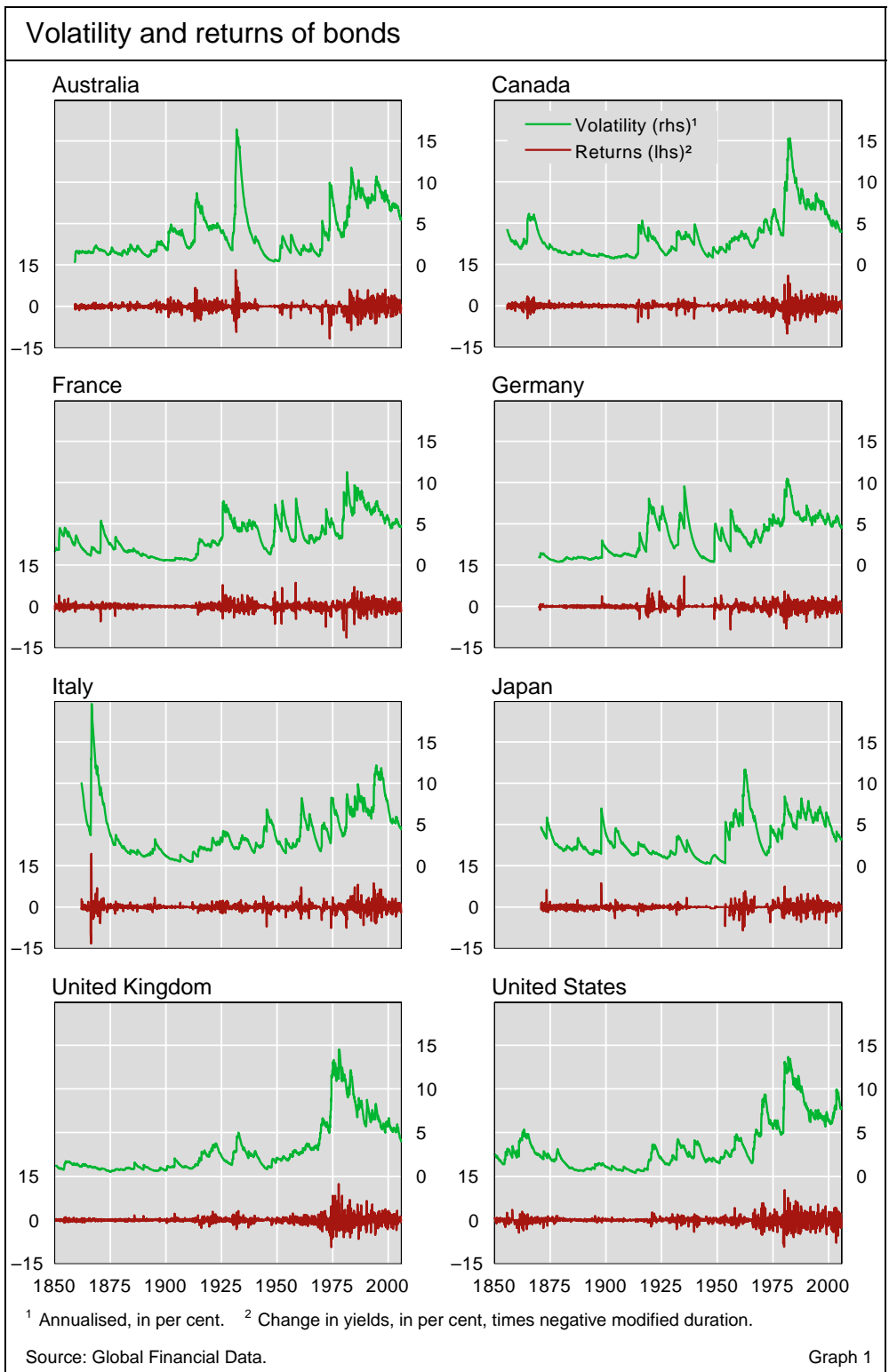
$$D = \frac{1}{(1+y)} \left[\sum_{i=1}^N \frac{i \times y}{(1+y)^i} + \frac{N}{(1+y)^N} \right]$$

We used a similar procedure to compare the volatility of GDP growth and inflation, but set the decay factor to 0.6 since that yielded a rate of decay similar to that of the monthly data when the latter were transformed into annual data.

While financial volatility is normally estimated using daily returns, we use monthly returns for data availability reasons. The volatilities of inflation and GDP have also been calculated using EWMA but applied to annual changes in the variables of interest.

The main source of data is the Global Financial Data database. The period under consideration covers the years between 1850 and 2005; depending on availability, the data start between January 1850 (French, German and US bond yields and US equity prices) and January 1919 (Canadian equity prices) and end in all cases in November 2005. A few data points were missing and had to be interpolated.

The data on long-term yields refer to government bonds with a maturity of 10 years for all countries except Japan, for which the maturity is seven years. Until the 1970s, the series is based on individual bonds. Stock price indices are constructed by taking the weighted average market capitalisation of each stock



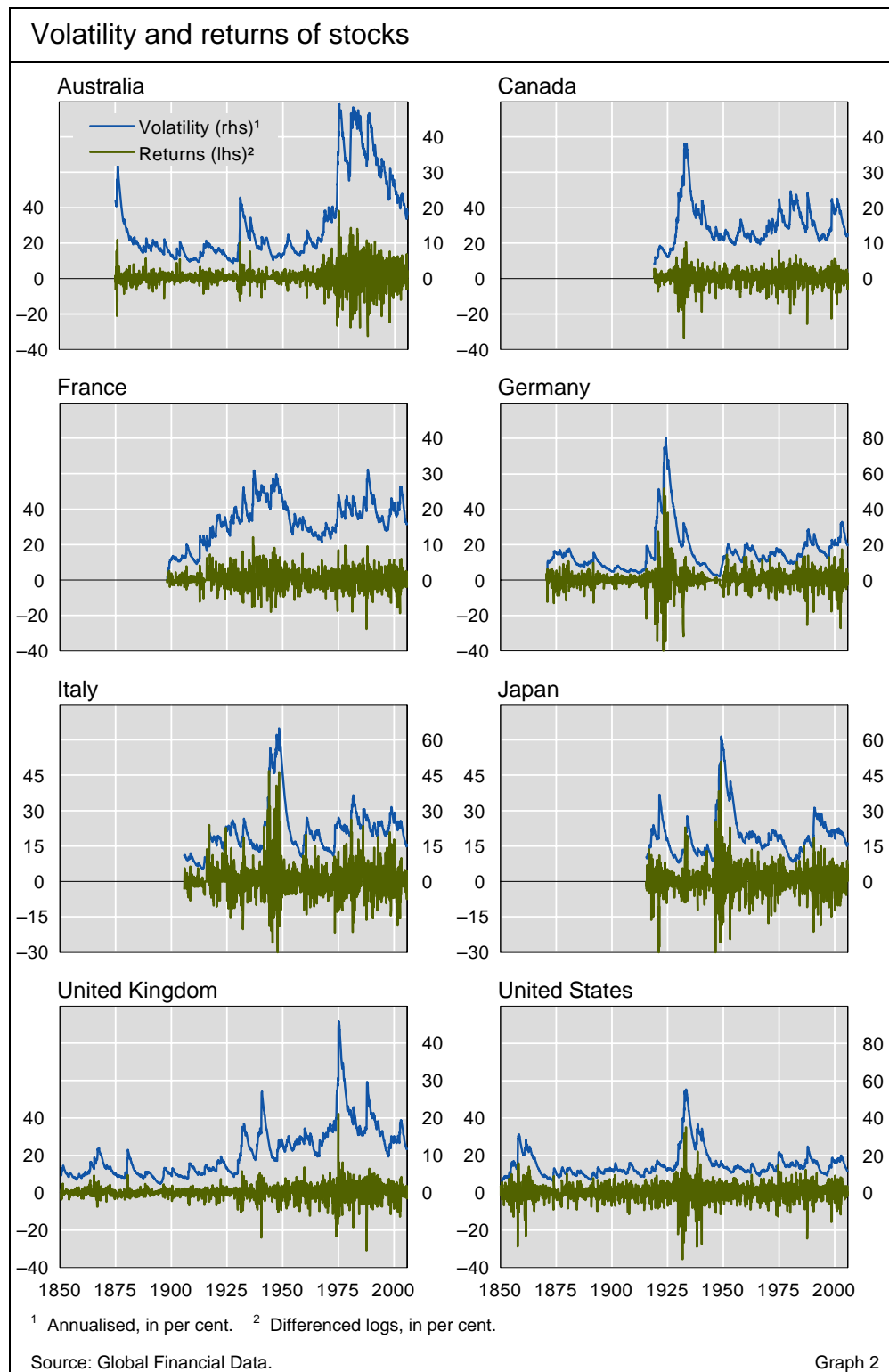
excluding dividends.⁶ Although the composition of the stock price indices has changed over time, it is unlikely that such changes would substantially alter the

⁶ The indices used are: S&P 500 for the United States, CDAX for Germany, SBF-250 for France, ASX-all ordinaries for Australia, TOPIX for Japan, FT-Actuaries all-shares for the United Kingdom, S&P/TSX 300 for Canada and Banca Commerciale Italiana index for Italy.

volatility of these indices, so that the conclusions of this study are likely to hold despite compositional changes in stock indices (Officer (1973)).

Equity and bond return volatilities

Graphs 1 and 2 show our estimates of volatility for bonds and stocks, respectively. Since these depend on the exact way in which we model volatility,



we also plot the bond returns and stock returns used to construct them. One empirical regularity is that the data are dominated by one or a few episodes of sharp increases in volatility. In most cases, these occur between the start of World War I (WWI) in 1914 and the end of World War II (WWII) in 1945. In Australia there is a spike at the beginning of the sample period and again during the 1930s, and in the United Kingdom a very sharp increase in 1975 and again in 1987. In the United States volatility rose to a high level in 1858 and remained high during the Civil War period in the 1860s, before peaking during the Great Depression in the 1930s.

Occasional episodes of high volatility

Several studies have investigated why volatility rose so dramatically in the interwar period. As is discussed below, volatility tends to rise in recessions. Given extremely weak economic conditions, and episodes of very high inflation in some countries, during much of the interwar period, it is not surprising that volatility rose sharply. However, as noted by Schwert (1989), the rise in volatility was so extreme that it seems likely that other factors played a role. Voth (2002) studied equity price volatility in 10 countries in 1919–39 and argued that political factors, in particular the fear of revolution, explain a substantial part of stock market volatility in this period. Bittlingmayer (1998) analyses the German experience in the interwar period and also concludes that political factors played a critical role in explaining both economic conditions and movements in stock price volatility. That political stability more generally reduces volatility in financial markets is emphasised by Brown et al (2006), who study the volatility of consol prices in the United Kingdom between 1729 and 1959. Jorion and Goetzmann (1999) identify wars and adverse political developments as the main factors causing major stock market declines, which tend to raise volatility sharply, in 39 countries between the 1920s and the 1990s.

Dramatic increase in interwar period

A further finding is that stock and bond return volatilities have been high since 1970 relative to their long-term averages.⁷ While the volatilities have

Volatility high since 1970

| Median level of volatility for stock returns | | | | | | | |
|--|-----------|-----------|---------|-----------|-----------|-----------|---------|
| Annualised, in per cent | | | | | | | |
| | 1850–2005 | 1850–1914 | 1914–45 | 1945–2005 | 1850–1969 | 1970–2005 | 2004–05 |
| Australia | 10.2 | 8.5 | 8.8 | 20.4 | 8.8 | 31.9 | 18.7 |
| Canada | 13.9 | ... | 15.3 | 13.6 | 12.2 | 15.6 | 12.8 |
| France | 17.0 | 6.1 | 17.7 | 18.1 | 15.5 | 18.9 | 17.7 |
| Germany | 13.4 | 8.6 | 19.2 | 15.3 | 11.5 | 16.4 | 23.2 |
| Italy | 20.4 | 8.7 | 18.0 | 22.5 | 17.6 | 23.3 | 16.9 |
| Japan | 18.3 | ... | 13.5 | 19.4 | 17.9 | 18.7 | 16.7 |
| United Kingdom | 9.1 | 5.1 | 8.8 | 15.1 | 6.6 | 17.2 | 13.2 |
| United States | 13.2 | 11.3 | 16.5 | 14.1 | 12.6 | 15.1 | 13.7 |

Sources: Global Financial Data; BIS calculations.

Table 1

⁷ An exception is stock market volatility in the United States. See Schwert (1989), Kearns and Pagan (1993) and Ineichen (2000) for a discussion of how volatility has risen. Campbell et al (2001) emphasise that while the volatility of US stock market averages has not increased over time, that of individual stock prices has. For a theoretical discussion of why volatility may vary over time, see Campbell and Cochrane (1999).

| Median level of volatility for bond returns | | | | | | | |
|---|-----------|-----------|---------|-----------|-----------|-----------|---------|
| Annualised, in per cent | | | | | | | |
| | 1850–2005 | 1850–1914 | 1914–45 | 1945–2005 | 1850–1969 | 1970–2005 | 2004–05 |
| Australia | 2.8 | 1.8 | 4.5 | 4.4 | 2.0 | 7.6 | 6.3 |
| Canada | 2.8 | 1.4 | 3.0 | 4.5 | 2.0 | 6.7 | 4.2 |
| France | 3.2 | 1.6 | 4.1 | 5.2 | 2.6 | 6.0 | 4.8 |
| Germany | 3.1 | 0.9 | 3.8 | 5.0 | 1.7 | 5.5 | 5.0 |
| Italy | 3.1 | 1.7 | 2.6 | 5.3 | 2.5 | 6.6 | 4.9 |
| Japan | 2.7 | 2.3 | 1.5 | 4.9 | 2.2 | 5.1 | 3.5 |
| United Kingdom | 1.9 | 1.0 | 2.5 | 5.5 | 1.3 | 6.9 | 4.9 |
| United States | 2.4 | 1.4 | 2.2 | 6.1 | 2.0 | 7.3 | 8.6 |

Sources: Global Financial Data; BIS calculations. Table 2

generally declined somewhat in recent years, they remain above their long-run averages. More importantly, they are below their peak levels, suggesting that sharp increases would not be unusual given their past behaviour.

Tables 1 and 2 show the median level of volatility for stock and bond returns, respectively, for the full sample and several subsamples. We first divide the sample into the period before the start of WWI in 1914, the period between 1914 and 1945, and the period from the end of WWII in 1945 onwards. The reason for choosing these subperiods is that volatility was very high in most countries during the tumultuous 1914–45 period, which involved two world wars, episodes of both rapid deflation and high inflation in the early 1920s and the Great Depression in the 1930s. It is therefore of interest to explore whether volatility differed before 1914 and after 1945. We also compute volatility for the period before and after 1970, since Graphs 1 and 2 suggest that it has risen in recent decades. For comparison purposes, we also tabulate results for the 2004–05 period.

The finding that volatility has been high since the 1970s is surprising, given that the increased completeness, integration and liquidity of financial markets should allow market participants to spread risks more effectively. One hypothesis is that the increased trading volume accompanying far-reaching deregulation and sharp reductions in transactions costs over the last 30 years has increased volatility. However, empirical evidence from stock markets suggests that although declines in transactions costs raise trading volumes, they reduce volatility.⁸ If so, this mechanism would not be operational.

Another possible explanation is that more rapid dissemination of news across the world could have increased the speed by which financial prices respond to economic and other events. However, the historical evidence suggests that capital markets have in this sense in fact been integrated for quite some time. For instance, Sylla et al (2004) compare the prices in New York and London on securities issued in the United States and argue that

⁸ See, for instance, Jones and Seguin (1997), who show that volatility on the NYSE fell after the reduction of fixed trading commissions in 1975, and the references cited therein. However, Summers and Summers (1989) hypothesise that declines in trading costs may raise the relative importance of “noise traders” in markets and thereby raise volatility.

Increased trading volume ...

... tends to reduce volatility

Faster dissemination of news ...

the speed and regularity of information flowing between the New York and London capital markets rose sharply already in the early 1800s as a result of innovation in the shipping industry. They conclude that the markets were well integrated even before the opening of the transatlantic cable in the 1860s. The hypothesis that increased information flow since the 1970s can explain the observed rise in volatility may therefore be implausible.

... not likely to explain increased volatility

It may also be that for some reason the shocks impacting on the global economy have been more severe since the 1970s. For example, the two oil shocks, perhaps coupled with poor monetary and fiscal policy responses that led to sharp increases in inflation, might have played a role. Another potential explanation for the rise in volatility is that leverage, which is positively correlated with stock market volatility, has risen. However, Campbell et al (2001) argue that this hypothesis is not supported by the US evidence since leverage declined during the 1990s when stock prices rose rapidly. They hypothesise instead that increased volatility at the firm level may be due to changes in corporate governance and to the growing role of institutional investors.

Overall, it remains important to conduct further research to understand better the sources of the observed increase in volatility in recent decades.

Volatility and the sign of returns

It is commonly observed that volatility tends to rise during periods of negative returns. For stocks, this could reflect the increase in (marked to market) debt/equity ratios when stocks decline, the so-called leverage effect proposed by Black (1976). For financial assets more generally, it could also reflect the limited tolerance for losses on the part of structurally long, leveraged investors, which was noted in government bond markets in the mid-1990s by Borio and McCauley (1996). But is the asymmetry of volatility movements in response to positive and negative returns a phenomenon that holds over the long time periods of our sample?

Does volatility respond asymmetrically?

Table 3 presents the results from regressions of bond market volatility on the lagged level of interest rates (since the level and volatility of interest rates are correlated), on the holding period return and on the absolute value of the holding period return. If volatility responds symmetrically to positive and negative returns, the parameter on returns should be insignificant and the parameter on absolute returns should be positive and significant. If volatility rises more in response to negative than to positive returns, we expect the parameter on returns to be negative and significant.

Since we are principally interested in exploring how bond return volatilities have changed over time (rather than how they differ between countries), we estimate panel regressions.⁹ Table 3 shows that the parameter on the lagged interest rate is always highly significant, as is the parameter on the absolute

⁹ These allow for fixed effects and incorporate seasonal dummies and 12 lags of the dependent variable to ensure that the errors are serially uncorrelated. The standard errors reported are robust to time-varying heteroscedasticity.

| Volatility and the sign of returns | | | | | |
|---|--------------------|--|--------------------|---------------------|--------------------|
| Dependent variables: bond and stock market volatility | | | | | |
| Sample | 1851:1– 2005:11 | 1851:2– 1914:6; 1945:9– 2005:11 | 1914:7– 1945:8 | 1851:2– 1914:6 | 1945:9– 2005:11 |
| <i>Bond market volatility</i> | | | | | |
| Long rate, lagged | 1.168 (10.282) | 1.246 (9.862) | 1.215 (2.431) | 2.598 (6.831) | 1.268 (7.663) |
| Return | –0.796 (–4.743) | –0.712 (–3.848) | –1.661 (–3.953) | –4.033 (–11.288) | –0.229 (–0.959) |
| Return | 3.455 (14.637) | 3.051 (11.615) | 5.511 (9.756) | 4.880 (10.587) | 2.584 (7.457) |
| R-squared | 0.991 | 0.992 | 0.985 | 0.988 | 0.987 |
| Durbin-Watson | 2.206 | 2.187 | 2.299 | 2.230 | 2.176 |
| <i>Stock market volatility</i> | | | | | |
| Return | –0.451 (–2.929) | –0.219 (–1.308) | –0.764 (–2.209) | –0.038 (–0.119) | –0.190 (–0.941) |
| Return | 3.010 (13.125) | 2.579 (10.087) | 3.620 (7.402) | 3.831 (8.308) | 2.306 (7.404) |
| R-squared | 0.991 | 0.992 | 0.990 | 0.989 | 0.990 |
| Durbin-Watson | 2.191 | 2.165 | 2.262 | 2.271 | 2.174 |

Note: t-statistics in parenthesis. Panel regression allowing for fixed effects, seasonal dummies and 12 lags of the dependent variable. White period standard errors. Table 3

value of bond returns. The parameter on returns is also typically significant and is always negative, consistent with volatility responding more to negative than to positive returns. Interestingly, the parameter on returns is much smaller and statistically insignificant in the 1945–2005 period, suggesting that the tendency for bond market volatility to be high in declining markets was not pronounced over the last 60 years, at least not at the monthly frequency.

Table 3 provides the analogue results for the volatility of stock returns (in which case, of course, we do not include the lagged level of the interest rate). While the parameter on returns is significant for the full sample, the subsample analysis indicates that it is only significant in the interwar period. Leverage thus appears to have played a role in raising volatility during the interwar period but not necessarily afterwards, as argued by Campbell et al (2001).

Macroeconomic conditions and volatility

In this section, we focus on the relationship between macroeconomic conditions and the volatility of bond and equity returns. Our main question concerns how output gaps and inflation impact on the volatility of asset returns. A number of papers have noted that volatility tends to be higher in recessions (see, for example, Officer (1973) or Schwert (1989)).

To address this question, we regress the level of volatility on its two lagged values, the current and lagged change in the output gap (which we

compute using the Hodrick-Prescott filter), the lagged level of the output gap, the current and lagged change in CPI inflation, and the lagged level of CPI inflation. The signs on the parameters on the lagged output gap and inflation indicate the impact of a permanent increase in these variables on volatility and are therefore of particular interest. Since the macroeconomic data are annual, we converted the monthly data on the financial volatilities into yearly averages. Panel regression results, which allow for fixed effects and time-varying heteroscedasticity, are shown in Table 3. Since the data in many cases are missing during WWI and WWII (and to allow for lags), we drop the observations for 1914–20 and 1940–47.

| Volatility and macroeconomic conditions | | | | | |
|---|-------------------------------------|------------------------|---------------------|---------------------|---------------------|
| Dependent variables: bond and stock market volatility | | | | | |
| Sample | 1853–1913 1921–1939 1948–2005 | 1853–1913 1948–2005 | 1921–1939 | 1853–1913 | 1948–2005 |
| <i>Bond market volatility</i> | | | | | |
| Δ GAP | –0.009 (–4.267) | 0.022 (13.123) | 0.043 (4.940) | 0.014 (7.207) | –0.115 (–15.050) |
| Δ GAP, lagged | 0.002 (0.692) | 0.036 (20.395) | –0.050 (–3.464) | 0.004 (1.071) | 0.185 (25.992) |
| GAP, lagged | –0.029 (–6.965) | 0.010 (4.237) | –0.021 (–1.153) | 0.002 (0.588) | –0.047 (–7.586) |
| Δ Inflation | –0.000 (–5.274) | 2.161 (2.793) | 0.000 (0.357) | 0.741 (1.084) | 1.722 (0.989) |
| Δ Inflation, lagged | –0.000 (–24.764) | 2.376 (6.470) | –0.000 (–12.662) | 1.249 (3.410) | 4.422 (6.630) |
| Inflation, lagged | 0.000 (10.480) | 3.687 (4.566) | 0.000 (9.090) | 0.740 (0.820) | 4.031 (3.351) |
| R-squared | 0.897 | 0.912 | 0.873 | 0.777 | 0.868 |
| Durbin-Watson | 1.839 | 2.067 | 1.951 | 1.766 | 1.985 |
| <i>Stock market volatility</i> | | | | | |
| Δ GAP | –0.124 (–5.224) | –0.032 (–2.612) | –0.089 (–2.416) | 0.019 (2.109) | 0.025 (1.168) |
| Δ GAP, lagged | –0.127 (–12.866) | –0.074 (–4.635) | –0.173 (–10.580) | –0.140 (–12.273) | –0.069 (–2.665) |
| GAP, lagged | –0.051 (–1.837) | 0.017 (1.133) | –0.021 (–0.392) | 0.216 (10.829) | –0.154 (–3.340) |
| Δ Inflation | 0.000 (40.285) | 4.396 (1.269) | 0.000 (41.636) | –0.298 (–0.150) | 2.757 (0.579) |
| Δ Inflation, lagged | 0.000 (7.978) | 1.592 (0.606) | 0.000 (2.328) | 3.150 (0.911) | 2.670 (0.735) |
| Inflation, lagged | 0.000 (14.575) | 14.141 (5.318) | 0.000 (10.834) | –0.470 (–0.342) | 13.792 (3.948) |
| R-squared | 0.911 | 0.914 | 0.926 | 0.858 | 0.894 |
| Durbin-Watson | 2.012 | 1.981 | 1.826 | 2.162 | 1.946 |

Note: t-statistics in parenthesis. Panel regression allowing for fixed effects. White period standard errors.

Table 4

We consider first the results for bond volatility in Table 4. For the full sample, we find that an increase in the output gap (a rise in real GDP relative to trend) is typically negatively correlated with bond market volatility. Moreover, a higher lagged level of the output gap is correlated with lower current volatility. Looking at the subsamples, however, we see that the parameters on the change in the output gap frequently change signs and are significantly different from unity. Given the observed time variation of the parameters, we focus on the results for the three subperiods identified above.

The results show that the contemporaneous change in the output gap is negatively correlated with the volatility of bond returns in the interwar period and the post-WWII period, but not in the pre-WWI period. The parameter for the lagged change in the output gap is insignificant before WWI, significantly negative in the interwar period and significantly positive in the post-WWII period. The lagged level of the output gap parameter is negative and significant only in the last subsample. Moreover, the parameters on the current and lagged change in inflation are generally positive, as is the parameter on the lagged level of inflation.

Next, we consider the results for stock return volatility. In this case, too, a strong time variation of the parameters is readily apparent, but there is some evidence that changes in the output gap have reduced volatility and that higher inflation tends to raise stock return volatility.

Overall, these results are compatible with the view that weaker business conditions and higher inflation have tended to raise volatility in financial markets but that this relationship is unstable over time. One potential reason for the lack of robustness is that some relevant factors, in particular financial crises and episodes of political instability, are not incorporated in the econometric analysis.¹⁰

Volatility, output gaps and inflation

Macroeconomic and financial market volatility

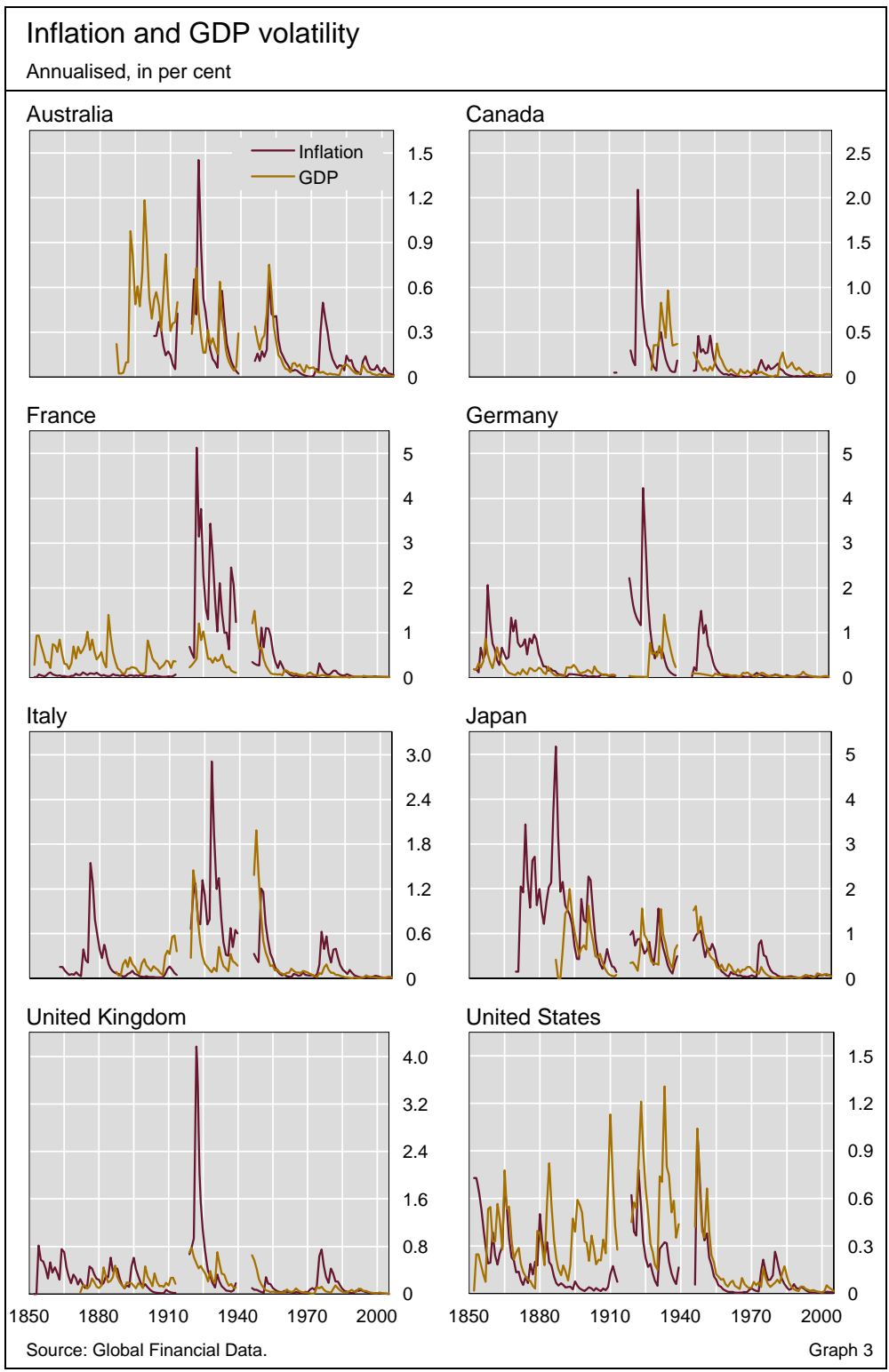
An alternative hypothesis for why financial volatility evolves over time is that the macroeconomy itself is subject to time-varying volatility. Several studies have shown that a number of economic aggregates have become more stable in the G7 countries since the 1980s.¹¹ If so, one would expect estimates of the volatility of output growth and inflation to be positively correlated with the volatility of bond and stock returns. From a longer-term perspective, however, the time series of financial market volatility are dominated by the *increase* in volatility from the 1970s onwards. For there to be a positive relationship between the two sets of variables in the full sample, macroeconomic volatility must also have increased in the last decades of the 20th century.

Macroeconomic volatility has declined ...

... but financial market volatility has risen

¹⁰ Using the dummy variables for banking and currency crises provided by Bordo et al (2001), we find that bond return volatility is correlated with the currency crisis dummy. Unfortunately, these dummy variables are available only for the 1883–1998 period and for a subset of countries.

¹¹ See, for instance, Sheffrin (1988), Romer (1999) or McConnell and Perez-Quiros (2000).



Graph 3 shows the long-run behaviour of the volatility of GDP growth and inflation.¹² Both time series are subject to sharp spikes, and these are larger and more frequent in the interwar period. However, the volatilities of inflation

¹² Since estimates of macroeconomic volatility are completely dominated by occasional spikes in inflation (such as the German hyperinflation) and growth, we assume that the rate of change of prices is at most $\pm 20\%$, and that the rate of change of GDP is at most $\pm 15\%$, in computing volatility.

and, in particular, output growth are generally low in the post-WWII period. Since bond and equity return volatilities have been high in recent decades while estimates of macroeconomic volatility have been subdued, there appears to be an *inverse* relationship between the two sets of variables.¹³ This suggests that there is no simple relationship between financial and macroeconomic volatility.

Estimating panel regressions analogue to those discussed above, but using the volatility of output growth and inflation as regressions, we find little evidence of a tight and stable relationship between macroeconomic and financial market volatility and we therefore do not report the results.¹⁴ Again, the omission of relevant factors in the regression analysis may play a role.

Conclusions

This article has used very long time series of data for eight countries to investigate the evolution of the volatility of stock and bond returns, the extent to which volatility responds asymmetrically to returns, and the relationship between broad macroeconomic conditions and financial market volatility.

The three main conclusions we draw are readily apparent. First, volatility is dominated by large, temporary increases that appear correlated with episodes of economic weakness, political instability and financial turmoil. Second, volatility has been much higher from the 1970s onwards than it was previously. This finding appears surprisingly robust across countries and financial instruments. Seeking to explain it would be an important topic for future research. Third, the movements in volatility that have been observed in recent years are small from a historical perspective. These findings suggest that financial institutions and policymakers alike would be well advised to note that a sharp increase in volatility from the level observed in the last few years would not be unprecedented.

¹³ However, in a series of articles, Christina Romer has demonstrated that data on real economic activity in the United States were more volatile before than after WWII, but that the decline is spurious and due to changes in the way the data were constructed (for a summary, see Romer (1999)). This suggests that great care should be taken in interpreting the long-run behaviour of macroeconomic volatility. Sheffrin (1988) studies the behaviour of real economic activity in six European countries and argues that in five of these the volatility has not changed over time.

¹⁴ We also included the volatility variables in the panel regressions with the output gap and inflation. This did not change the results very much, and in the interest of brevity we do not tabulate them.

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Recent initiatives by Basel-based committees¹

The Basel Committee on Banking Supervision (BCBS) and the Joint Forum announced a number of initiatives during the second quarter of 2006. The BCBS released three guidance papers as well as the results of the fifth Quantitative Impact Study (QIS 5). The Joint Forum published two issues papers.

Basel Committee on Banking Supervision

In June 2006, the Basel Committee on Banking Supervision published three guidance papers as well as the results of the fifth Quantitative Impact Study (QIS 5). The guidance papers, based on consultative documents that had been previously released for public comments, relate to home-host information sharing for effective Basel II implementation, sound credit risk assessment and valuation for loans, and the use of the fair value option.

The first guidance paper, on *home-host information sharing for effective Basel II implementation*, highlights the need for home and host supervisors of internationally active banking organisations to develop and enhance pragmatic communication and cooperation with regard to banks' Basel II implementation plans. It was developed jointly with the Core Principles Liaison Group, which includes banking supervisors from 16 non-Committee member countries, the IMF and the World Bank, and draws on a consultative document published in November 2005.² The paper aims to make the implementation of Basel II more effective and efficient, so as to conserve scarce supervisory resources and to reduce the burden on the banking industry. In addition to general principles of information sharing in the context of Basel II, the paper also sets out practical examples of information that could be provided by banks, home supervisors and host supervisors.

The paper stresses that, while communication between home and host supervisors is important, banks have a primary role to play in implementing

BCBS releases
guidance on home-
host information
sharing for effective
Basel II
implementation ...

¹ Donald L Kohn, Vice Chairman of the Board of Governors of the Federal Reserve System, was appointed Chairman of the Committee on the Global Financial System, effective 1 July 2006, succeeding Roger W Ferguson Jr in this capacity.

² See "Recent initiatives by Basel-based committees and the Financial Stability Forum", *BIS Quarterly Review*, March 2006.

| Main initiatives by Basel-based committees and other bodies | | | |
|--|--|--|--------------|
| Press releases and publications over the period under review | | | |
| Body | Initiative | Thematic focus | Release date |
| BCBS | <i>Home-host information sharing for effective Basel II implementation</i> | <ul style="list-style-type: none"> Revised version of consultative document published in November 2005; general principles for information sharing between home and host country supervisors in implementing Basel II. | June 2006 |
| | <i>Sound credit risk assessment and valuation for loans</i> | <ul style="list-style-type: none"> Revised version of consultative document published in November 2005. Provides supervisory expectations for banks and banking supervisors regarding sound credit risk assessment and valuation for loans. | |
| | <i>Supervisory guidance on the use of the fair value option for financial instruments by banks</i> | <ul style="list-style-type: none"> Revised version of the consultative document published in July 2005. Describes supervisory expectations related to using a fair value option for accounting measurements and conducting supervisory evaluations of risk management, controls and capital adequacy for organisations using a fair value option. | |
| | <i>Results of the fifth Quantitative Impact Study</i> | <ul style="list-style-type: none"> Evaluates the potential changes in minimum required capital levels under Basel II as the industry progresses toward implementation. Reflects all recent changes to the Basel II framework. | |
| Joint Forum | <i>The management of liquidity risk in financial groups</i> | <ul style="list-style-type: none"> Comprehensive study of liquidity risk management practices among 40 of the largest firms in the financial services industry. | May 2006 |
| | <i>Regulatory and market differences: issues and observations</i> | <ul style="list-style-type: none"> Cross-sectoral and cross-country comparison of market practices and regulatory approaches to various financial risks. | |
| Source: Relevant bodies' websites (www.bis.org). | | | Table 1 |

Basel II and in providing relevant information to home and host supervisors to allow them to meet their responsibilities. In particular, the local managers of foreign branches and subsidiaries need to be kept informed of the steps that are being taken at group level to manage group capital and of the decision to adopt one option or another under Basel II. In this regard, Basel II does not diminish the legal or governance responsibilities of subsidiary bank management within the group structure.

The paper on *sound credit risk assessment and valuation for loans* addresses how common data and processes related to loans might be used for assessing credit risk, accounting for loan impairment and determining regulatory capital requirements. The guidance draws on a consultative document released in November 2005³ and supersedes *Sound practices for loan accounting and disclosure*, published by the Committee in July 1999. The

... and on sound credit risk assessment and valuation for loans

³ See footnote 2.

paper discusses necessary processes for banks in sound credit risk assessment, valuation and control and the responsibilities of boards of directors and senior management to maintain appropriate provisions for loan losses. The paper also provides guidelines for how supervisors should evaluate the effectiveness of a bank's credit risk policies and practices when gauging the appropriateness of its credit risk assessment process, loan loss provisions and regulatory capital. It highlights provisioning concepts that are consistent with prudential and accounting frameworks. As noted in the paper, this supervisory guidance is not intended to set forth additional accounting requirements beyond those established by robust accounting standards.

Particular focus on responsibilities within banks ...

The guidance states that banks' boards of directors and senior management are responsible for ensuring that appropriate credit risk assessment processes and effective internal controls are in place that are commensurate with the size, nature and complexity of the banks' lending operations. These processes and controls allow provisions for loan losses to be determined in accordance with the banks' stated policies and procedures, the applicable accounting framework and supervisory guidance. The paper also stresses the need for banks to have a system in place to reliably classify loans on the basis of credit risk, and policies that appropriately address validation of any internal credit risk assessment models. It recommends that banks adopt and document a sound loan loss methodology which addresses credit risk assessment policies, procedures and controls for assessing credit risk, identifying problem loans and determining loan loss provisions in a timely manner; such individual and collectively assessed loan loss provisions should be adequate to absorb estimated credit losses in the loan portfolio. The importance of experienced credit judgment and reasonable estimates is highlighted, together with that of the necessary tools, procedures and observable data to use for assessing credit risk, accounting for impairment of loans and for determining regulatory capital requirements. Banking supervisors should periodically evaluate the effectiveness of a bank's credit risk policies and practices for assessing loan quality and should be satisfied that the methods employed by a bank to calculate loan loss provisions produce a reasonable and prudent measurement of estimated credit losses in the loan portfolio that are recognised in a timely manner. Banking supervisors should consider credit risk assessment and valuation policies and practices when assessing a bank's capital adequacy.

... policies and procedures ...

... and the role of supervisors

Fair value option: seven principles structured around two broad categories

The *guidance on the use of the fair value option for financial instruments by banks* results from a consultative document published in July 2005.⁴ The guidance is structured around seven principles that fall into two broad categories:

- (a) supervisory expectations for banks relevant to the use of the fair value option (regarding compliance with the criteria of IAS 39, the existence of appropriate risk management systems, the exclusion

⁴ See "Recent initiatives by Basel-based committees and the Financial Stability Forum", *BIS Quarterly Review*, September 2005.

- of instruments for which fair values cannot be reliably estimated and the provision of supplemental information by banks);
- (b) supervisory evaluation of risk management, controls and capital adequacy.

While this supervisory guidance refers specifically to the fair value option in IAS 39, the principles that it sets forth should be generally applicable to similar fair value option approaches that exist or are being considered in other accounting regimes. National supervisors will need to make this determination based on the criteria and requirements of the fair value option in their jurisdiction.

The guidance is not intended to set forth additional accounting requirements beyond those established by the IASB. Instead, it addresses such matters as bank risk management and capital assessment issues, and thus should not be in conflict with the IASB's accounting and disclosure guidance on the fair value option.

On 24 May 2006, the Basel Committee reviewed the calibration of the Basel II framework based on the results of the *fifth Quantitative Impact Study* (QIS 5) and decided to maintain the current calibration. The Committee's Working Group on Overall Capital and Quantitative Impact Study prepared a detailed *report* on the QIS 5 results. The primary objective of the study, which was undertaken in 31 countries, was to allow the Committee to evaluate the potential changes in minimum required capital levels under the Basel II framework as the industry progresses towards implementation. In contrast to previous exercises, the QIS 5 workbooks reflected all recent changes to the Basel II framework, in particular the move to an unexpected loss-only framework for computing risk-weighted assets under the internal ratings-based (IRB) approach, the change in the treatment of reserves, the 1.06 scaling factor applied to credit risk-weighted assets, the recognition of double default and the revised trading book rules.

BCBS publishes QIS 5 results and decides to maintain current calibration

The QIS results for G10 countries show that minimum required capital under Basel II (including the 1.06 scaling factor to credit risk-weighted assets) would generally decrease relative to the current Accord. For Group 1 banks (ie internationally active banks with Tier 1 capital in excess of €3 billion), minimum required capital under the most likely approaches to credit and operational risk would on average decrease by 6.8%. Group 2 banks show a larger reduction in minimum required capital under the IRB approaches due to the higher proportion of retail exposures for those banks.

QIS 5 shows decrease in capital required under Basel II relative to the current Accord for most countries

The retail mortgage portfolio contributes the most to the reduction in minimum required capital under the standardised and IRB approaches. Since there was no explicit capital charge for operational risk under Basel I, the highest increase was due to the new capital requirements for operational risk.

In order to analyse the incentives for banks to move to the more advanced approaches, the capital requirements for banks providing data on at least two different approaches were compared. This analysis showed that, on average, capital requirements provide an incentive for banks to move to the more advanced approaches.

Joint Forum

In May 2006, the Joint Forum published two issues papers, the first one on funding liquidity risk management and the second one on regulatory and market differences.

The management of liquidity risk in financial groups is the result of a comprehensive study of liquidity risk management practices among 40 of the largest firms in the financial services industry (banks, securities and insurance firms) spanning national borders, financial sectors and currencies.

The review addresses five key questions: (i) how large, complex banking, securities and insurance groups manage liquidity risks across jurisdictions, sectors and subsidiary units, particularly in times of stress; (ii) the impact of regulatory and supervisory approaches on liquidity risk management practices and structures; (iii) the nature of the products and activities that give rise to significant demands for liquidity; (iv) assumptions that firms make regarding available sources of liquidity; and (v) the scale of liquidity shocks that firms are prepared to address.

The paper entitled *Regulatory and market differences: issues and observations* presents the findings of a review that was prompted by discussions at an industry roundtable in 2003 on differences in the regulatory approaches to risk across the banking, securities and insurance sectors. The Joint Forum determined that cross-sectoral convergence in both market practice and regulatory approaches is occurring naturally and can be expected to continue as a result of a number of trends and developments highlighted in the paper. At the same time, however, the Joint Forum recognised that cross-sectoral convergence in regulatory approaches is not desirable in every instance. There may be good reasons for sectoral differences in regulatory approaches to the same risk. The paper draws conclusions from cross-country and cross-sector comparisons in the following areas: the purpose of capital, the alignment of regulatory capital requirements with measures of risk that are calibrated using economic capital models, the acceptance of internal models for regulatory purposes, valuation approaches, the treatment of interest rate risk and operational risk, metrics dealing with risk concentrations, the regulatory approach to risk mitigation, the use of external ratings and differences in regulatory reporting requirements.

Joint Forum addresses five issues in paper on the management of liquidity in financial groups ...

... and releases paper on cross-sectoral convergence in financial industry regulation and market practice

