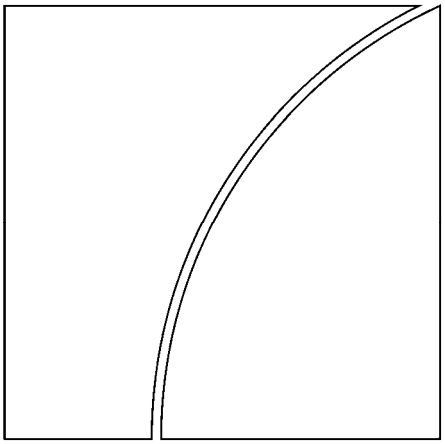
BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

September 2009



International banking and financial market developments

BIS Quarterly Review
Monetary and Economic Department

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Special features

Notations used in this Review

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

Differences in totals are due to rounding.

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Overview: cautious optimism on gradual recovery

Despite uncertainty about the pace of economic recovery, investors remained cautiously optimistic in the period between end-May and early September 2009. Positive macroeconomic news as well as strong earnings announcements gave market participants hope of a turnaround. Consequently, equity prices rose and credit spreads narrowed. Nevertheless, disappointing data releases at times led investors to doubt their regained optimism, resulting in bouts of volatility. Moreover, bond investors generally appeared somewhat less convinced about the pace of the recovery.

The financial sector continued to report surprisingly strong earnings for the second quarter. Although questions remain about the quality and sustainability of bank profits, the sector outperformed others in both credit and equity markets. Bank credit spreads rallied markedly, nearly reaching the levels prevailing before the Lehman failure, while financial sector equity prices surged by 15–20% in the period.

Generally, markets continued to show signs of normalising, as risk tolerance edged further upwards and risk premia receded. In interbank money markets, key spreads narrowed to levels not seen since the beginning of 2008, and in some cases even further. Improvements were also visible in credit markets, although important segments continued to rely on central bank support.

In this environment, government bond yields were volatile. This reflected the markets' evolving perceptions about both the economic outlook and the future path of monetary policy. Over time, bond investors seemed to increasingly take the view that the worst of the economic downturn was over, but that recovery was likely to be gradual and vulnerable to setbacks. This, in combination with low expected inflation, led them to scale back expectations that monetary polices would begin to normalise anytime soon.

Among emerging markets, the strong growth in some parts of Asia attracted attention. However, concerns over the extent of the credit expansion in China prompted expectations of imminent policy tightening and a reassessment of the country's growth prospects. The ensuing sharp correction in the Chinese equity markets in August exerted a drag on other stock exchanges in the region and at times even on major equity markets.

Bond market investors ponder pace of the recovery

Bond yields fail to rise …

The long-term government bond yields of advanced economies swung widely during the period, as investors reassessed the outlook for macroeconomic conditions as well as for monetary and fiscal policies. In the end, yield movements were mixed in major bond markets. Between end-May and 4 September 2009, the 10-year US bond yield was essentially unchanged, while corresponding euro area and Japanese sovereign yields fell by around 35 and 15 basis points, respectively (Graph 1, left-hand panel). Long-term real yields in the euro area declined in line with nominal yields over the period, while US 10-year real yields rose slightly (Graph 1, centre panel). Meanwhile, the rapid steepening of yield curves that had taken place in the first half of the year tapered off (Graph 1, right-hand panel).

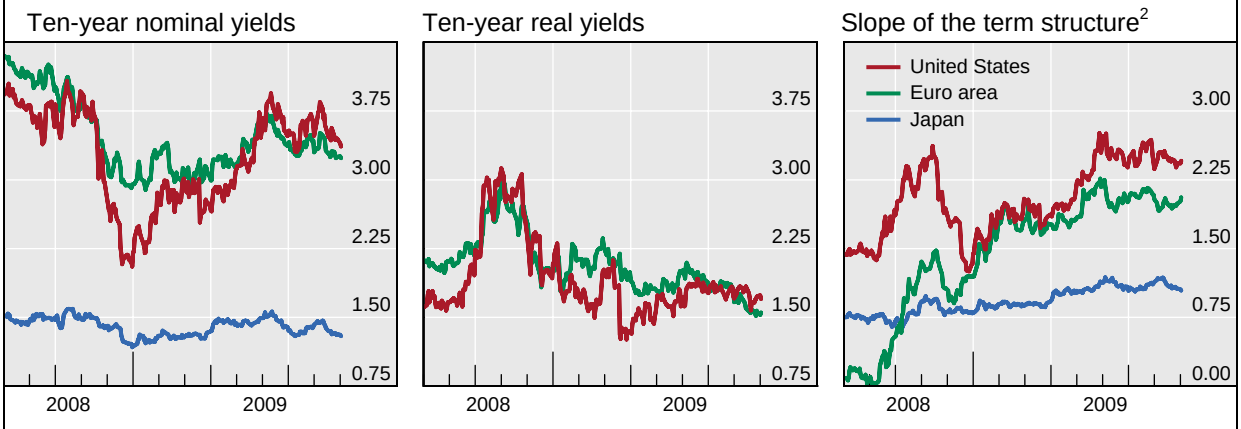
… despite some positive macro news …

Despite the absence of rising yields over the period, economic news generally pointed to recovery or at least to a pronounced slowdown of the rate of deterioration in economic conditions. A case in point was the 5 June US employment report, which showed that non-farm payrolls had fallen by 345,000 (later revised down to 303,000), not only significantly below the 520,000 expected drop but also a smaller decline than in any of the preceding seven months. Meanwhile, in the euro area the German and French economies grew unexpectedly in the second quarter, and the Japanese economy recorded its first quarter of positive growth since Q3 2008, although the rate of growth was lower than expected. In line with this, survey data indicated that expectations for 2010 GDP growth were gradually revised upwards in the United States and the euro area, while for Japan they levelled off (Graph 2, left-hand panel).

… as the recovery is seen to be taking some time

While bond yields tended to rise in response to news indicating economic recovery, from time to time they were pushed back down as disappointing data releases prompted investors both to doubt the strength of the economic recovery and to temporarily reduce their risk tolerance. This was evident on a number of occasions, including in the second half of June into early July and in the second half of August when weak economic data surprised markets (Graph 1, left-hand panel). For example, the US employment report released

Government bond yields[1]



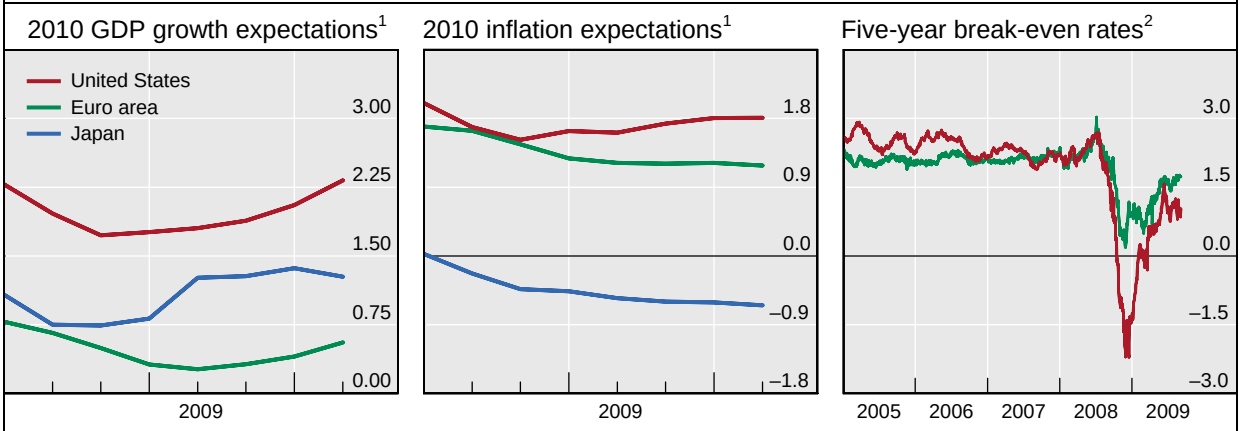
[1] In per cent. [2] Ten-year minus two-year nominal yields.

Sources: Bloomberg; BIS calculations.

Graph 1

Macroeconomic expectations and break-even inflation

In per cent



[1] Forecasts published by Consensus Economics; observations are positioned in the month in which the forecast was made. [2] Based on zero coupon real and nominal rates calculated using the Nelson-Siegel-Svensson method on nominal and index-linked government bond prices.

Sources: © Consensus Economics; BIS calculations. Graph 2

on 2 July showed that non-farm payroll employment had declined more than anticipated, and on 14 August there was news that US consumer confidence had retreated. Over time, bond investors seemed to take the view that while the worst of the economic downturn was over, the recovery process would be gradual and vulnerable to negative shocks.

Investors anticipate low levels of inflation …

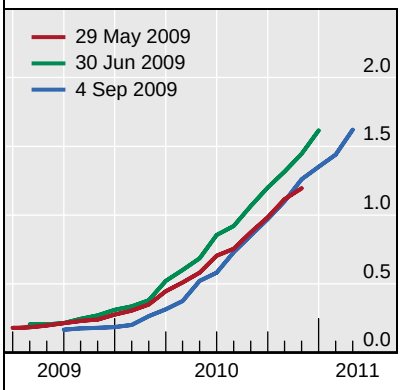
In this environment, survey and bond price data both indicated that near-term inflation expectations remained low in the United States and the euro area. For 2010, survey expectations pointed to inflation levels well below 2% for those two economies (Graph 2, centre panel), consistent with a view that the recovery might be protracted. Medium-term break-even inflation rates hovered at levels somewhat lower than the average in recent years (Graph 2, right-hand panel). With economic growth expected to pick up only gradually, and near-term inflation expectations stable and low, market participants continued to expect extraordinarily low monetary policy interest rates in coming months (Graph 3, left-hand and centre panels).

… and policy interest rates …

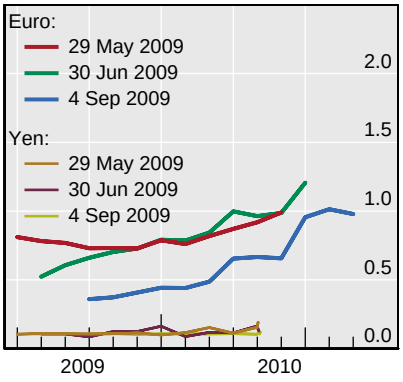
Amidst debate about the pace at which this monetary easing should be withdrawn, expectations of an early start to the normalisation process for policy rates were pushed back considerably. In the first few months of 2009, investors had begun to expect that policy rates would be lifted before the end of the year. For example, at the beginning of March 2009, the pricing of options on federal funds futures contracts indicated that the (risk neutral) probability that the Federal Reserve would raise its target above the 0 to 0.25% range by the end of this year exceeded 60%; that of a hike as early as September was around 50% (Graph 3, right-hand panel). The FOMC sought to temper these market expectations by announcing on 18 March 2009 that it expected "exceptionally low levels of the federal funds rate for an extended period". After that, option-implied probabilities of an early rate hike gradually dropped, with only a temporary reversal in early June following the much better than expected non-farm payrolls release mentioned above.

Monetary policy expectations

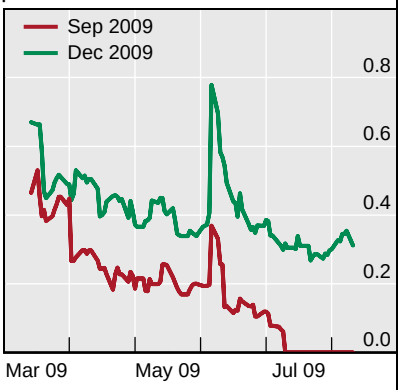
Federal funds futures



EONIA and JPY OIS forward rates[1]



Implied Federal Reserve rate hike probabilities[2]



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

Sources: Bloomberg; BIS calculations. Graph 3

… while some central banks prepare to end unconventional policies

Major central banks continued to implement unconventional policies, with the aim of further easing financial conditions in an environment of near zero policy rates. However, while some central banks expanded their unconventional measures, others sought to lay the groundwork for exiting (see box on page 6). In the first category, the Bank of England announced on 6 August that, in order to help steer the rate of inflation back up towards its 2% target, it was expanding the direct purchase of gilts and private sector assets by £50 billion to £175 billion. Meanwhile, citing its view that US economic activity was levelling out, on 12 August the Federal Reserve announced that it would stretch out its announced purchases of Treasury securities up to October before ending the programme.

Fiscal deficits remain on investors' minds …

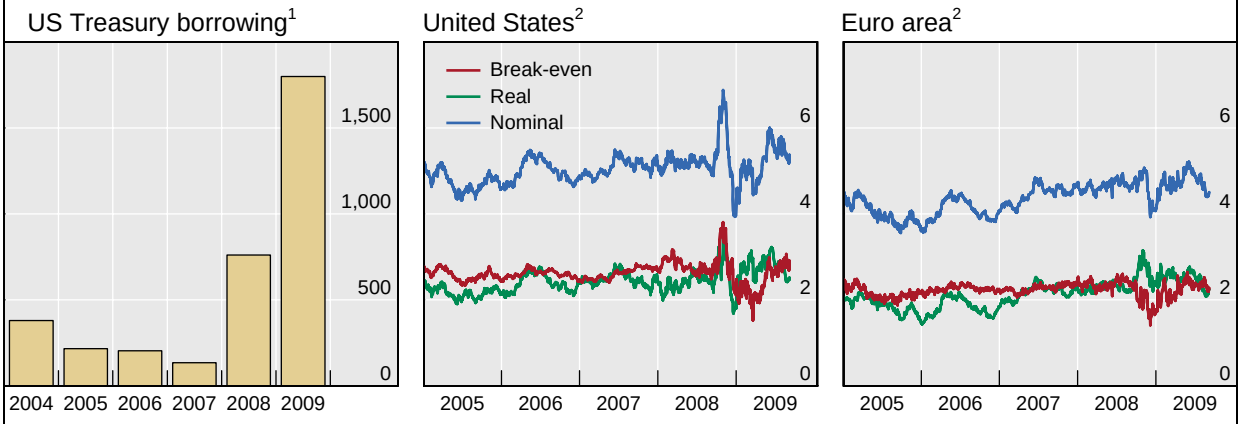
Bond investors continued to weigh the consequences of a growing supply of government debt. This was particularly evident in the case of the United States, where the government was expected to borrow a total of $1.8 trillion dollars, in net terms, in FY 2009 – a 137% increase from the already elevated level in FY 2008 (Graph 4, left-hand panel). Concerns that such a large amount of new government debt would be difficult for markets to absorb, in combination with worries about the sustainability of rapidly growing fiscal deficits, were seen as factors behind the rise in US long-term yields that took place in the first half of the year.

… but worries seem to have eased

However, more recently the upward pressure on yields resulting from such worries seems to have abated considerably, as indicated by a recent decline in five-year forward rates five years ahead. Fiscal sustainability concerns are likely to affect forward yields that span distant horizons, which are less influenced by near-term expectations about inflation, economic growth and monetary policy. In particular, rising concerns about the fiscal outlook could be expected to put upward pressure on *real* forward rates. Since end-May, however, both real and nominal five-year/five-year forward rates have dropped in the United States as well as in the euro area (Graph 4, centre and right-hand panels).

US government borrowing and implied five-year-ahead five-year forward rates

US Treasury borrowing[1] | United States[2] | Euro area[2]



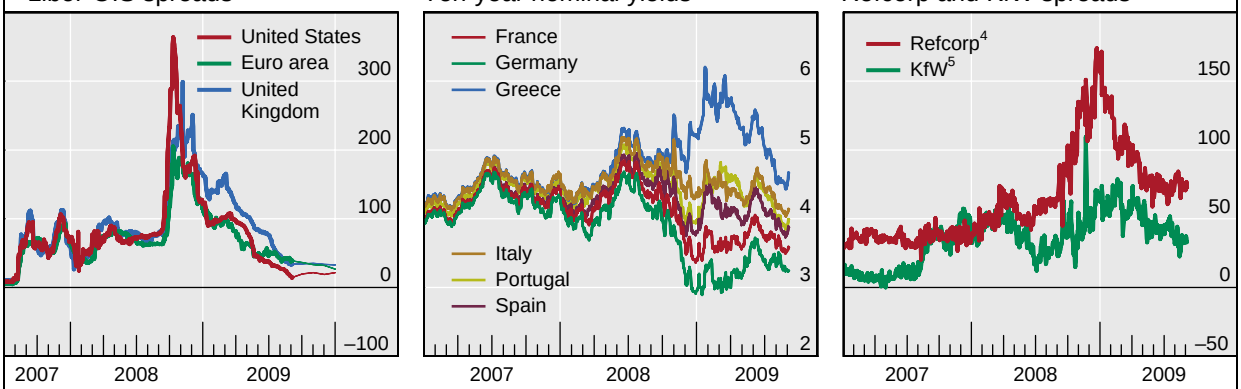
[1] Marketable borrowing in billions of US dollars. The years on the horizontal axis refer to fiscal years (October–September), and the value for 2009 includes a forecast for the fourth fiscal quarter by the US Treasury's Office of Debt Management. [2] Based on zero coupon real and nominal rates calculated using the Nelson-Siegel-Svensson method on nominal and index-linked government bond prices, in per cent.

Sources: Bloomberg; US Treasury's Office of Debt Management; BIS calculations. Graph 4

The possible inflationary repercussions of ongoing fiscal and monetary policies continued to be in focus throughout the period. Nonetheless, five-year forward break-even rates five years ahead were little changed over the period from end-May to 4 September (Graph 4, centre and right-hand panels). Long-term inflationary pressures therefore appear contained for now, despite surging fiscal deficits and record-low monetary policy rates. This may reflect the belief that the current high level of economic slack will persist for some time.

Yields and interest rate spreads

Libor-OIS spreads[1] | Ten-year nominal yields[2] | Refcorp and KfW spreads[3]



[1] Three-month Libor rates minus corresponding overnight index swap (OIS) rates (for the euro area, EONIA swap), in basis points. Thin lines show forward spreads, calculated as the difference between three-month forward rate agreement (FRA) rates and corresponding implied OIS rates, as at 4 September 2009. [2] Government bonds, in per cent. [3] Based on zero coupon rates, in basis points. [4] Ten-year zero coupon spread between yields on bonds issued by Refcorp (Resolution Funding Corporation, a US Treasury agency created in order to help resolve the savings and loan failures and whose debt is guaranteed by the US government) and US Treasury bonds. [5] Ten-year zero coupon spread between yields on bonds issued by KfW (a bank owned by the Federal Republic of Germany and the federal states and whose debt is guaranteed by the Federal Republic of Germany) and German government bonds.

Sources: Bloomberg; BIS calculations. Graph 5

Exiting from balance sheet policy of central banks

Robert N McCauley

With market conditions improving, discussion has turned to when, and how, central banks will tighten monetary policy and whether this will involve a disposal of the assets accumulated during the crisis to keep markets functioning and to affect asset prices ("balance sheet policy"). In principle, these decisions can be taken independently. As the BIS *79th Annual Report*, Chapter VI, points out, central banks can raise policy rates and reduce excess reserves without shrinking their balance sheets, provided they have an adequate set of tools at their disposal.

This box focuses on the factors conditioning the sequence of these two decisions. The two extreme cases are: working down the balance sheet and only then raising interest rates; and raising interest rates without shrinking the balance sheet. These cases can be represented as a move left then up, or a move straight up in the graph of balance sheet size (indexed to 100 at the highwater of balance sheet policy on the x-axis) and interest rate (starting at zero on the y-axis). It should be recognised that asset reductions carry different implications (and changes in composition of assets as well as their size can be important).

At one extreme, the Bank of Japan (BoJ) in 2006 shrank its balance sheet before it raised policy interest rates. Without the authority to pay interest on excess reserves, the BoJ stopped replacing maturing assets in the months after March 2006.[①] "Current accounts", or bank reserves, fell from ¥31 trillion at end-March 2006 to about ¥10 trillion by mid-June and total BoJ assets fell even more, from ¥145 trillion to ¥113 trillion on 20 June. This balance sheet reduction, along with the reopening of interbank credit lines and the introduction of trading in forward overnight interest rates, prepared market participants for the July rise in the short-term interest rate. Graph A shows a leftward move along the x-axis at zero interest rates, and then a return to positive interest rates. Running off assets in this manner depended on careful limits on long-term bond holdings,[②] and on the term of money operations. Interestingly, the BoJ continued, after this exit from excess reserves and return to positive interest rates, to buy bonds every month.

The BoJ's focus on its liabilities may limit the force of this precedent for how to exit from a low-interest high-asset situation. In the Japanese case, which assets were acquired to support central bank liabilities was portrayed as incidental and the choice of short-term assets permitted a rapid but passive run-down. The Bank of England and the Federal Reserve, purchasing bonds in order to lower long-term rates, and the Swiss National Bank, purchasing foreign exchange to hold down the Swiss franc, find themselves in different positions from the BoJ.

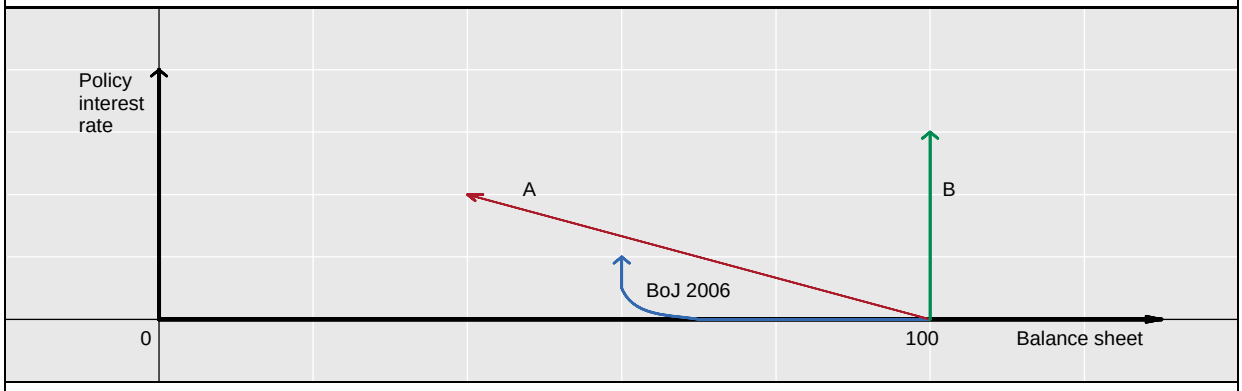
In these cases, various considerations will bear on the choice of exit path, including market functioning, prices and reaction, as well as the run-off of any short-term assets. Somewhat overlooked, different concepts of balance sheet policy – stock versus flow – may also condition the path chosen. On a stock view, monetary stimulus is seen as arising from the central bank's *holding* of assets like government or other bonds. On a flow view, monetary stimulus arises from the central bank's *purchase* of assets. From this perspective, stimulus ends when no more purchases are announced and asymmetry may be desired: maximum effect in buying and "neutrality" in selling.

This distinction could become important when the time comes to tighten policy. On the stock interpretation, to raise the short-term interest rate while never selling the bond holdings would be to tap the brake while the other foot remained firmly on the accelerator. On the flow interpretation, without a foot on the accelerator, one could consistently tap the brake. Thus, the stock concept would be consistent with a tightening path like vector A in the graph (or even a path like that of the BoJ), while the flow concept would permit a tightening path like vector B in the graph.

The Bank of England's policies have arguably been based on the stock view of balance sheet policy. In particular, its rationale for gilt purchases to reach an eighth of GDP included the quantity of broad money. The Bank of England has made clear that when the inflation target requires a withdrawal of monetary stimulus, it would have two tools: hikes in the policy rate and asset sales. Sales of Bank of England bills could absorb liquidity, "allowing us to stagger the sales of the gilts".[③] In response, market analysts are couching their forecasts of policy in terms of both rises in the short-term interest rate and gilt sales.

In contrast, statements from the Federal Reserve tend to view the monetary stimulus arising from its $1.75 trillion in bond purchases mainly in flow terms. Looking forward, the difficulty of calibrating the restraining effect of bond sales in view, inter alia, of financial firms' evolving balance

Stylised exits from balance sheet policies at low policy rates



Source: Author's calculation. Graph A

sheet constraints and risk appetite may argue against bond sales. That said, the Federal Reserve has signalled that it will not necessarily exit along a vertical vector like B. Able (like the Bank of England) to pay interest on excess reserves, the Federal Reserve *could* quit purchasing bonds and raise interest rates without shrinking its assets.[4] Or excess reserves *could* be absorbed without asset sales through short-term repo transactions against long-term securities or an extension of the Treasury's selling bills in excess of its borrowing requirements and depositing the proceeds with the Federal Reserve. Among the options listed, albeit mentioned last, were bond sales.

The Swiss National Bank has offered little guidance on its exit from its policy of purchases of foreign assets to resist currency appreciation. Conceptually, some recent studies of foreign exchange intervention focus on the effect on order flows, while the portfolio balance approach emphasises the relative size of stocks. Behaviourally, there are instances where central banks have reduced official foreign exchange reserve holdings after a series of purchases, but more cases like that of Japan since 2004, in which holdings remain at levels reached as a result of intervention. Recent experience in borrowing dollars from both the Federal Reserve and the market will factor in any reconsideration of the appropriate level of Swiss foreign exchange reserves.

In addition to the above factors, political economy considerations may also condition the exit path chosen. The Bank of England's asset purchases were capped ex ante by an exchange of letters with the UK Treasury, held in a special account and supported by a government indemnity against losses should interest rates rise. These arrangements allow the Bank of England to sell gilts without loss to its own limited equity so that these considerations might not be relevant. With less formal coordination of its asset purchases with the US Treasury, either as recipient of its profits or as debt manager, these considerations may be relevant for the Federal Reserve.

[1] Alternatively, the BoJ could have issued central bank bills to mop up liquidity, thus exchanging two types of liabilities while leaving assets unchanged. [2] Bank of Japan, Financial Markets Department, "Money market operations in fiscal 2006", *BoJ Reports and Research Papers*, July 2007; on bond purchases, "Government debt management at low interest rates", *Quarterly Review*, June 2009. [3] Deputy Governor Bean speech at Cutlers' Feast, Cutlers' Hall, Sheffield, 21 May 2009. On 21 July 2009, Bean was quoted as follows in the Nottingham *Evening Post*: "It is quite likely we will in the first instance raise bank rate. We can then start selling the assets we have bought at a rate which recognizes the market circumstances at the time." [4] "Monetary policy as the economy recovers", in Board of Governors of the Federal Reserve System, 2009, *Monetary Policy Report to the Congress* (Washington: Board of Governors, July), pp 34–7.

Conditions in money markets normalise further

Money markets continued to show signs of normalising, a process set in motion earlier in the year. In interbank money markets, spreads between three-month Libor rates and corresponding OIS rates fell to levels not seen since January 2008. In the case of US rates, the spread dropped to the lowest level since the outbreak of the financial crisis in mid-2007 (Graph 5, left-hand panel). Signs of receding liquidity premia and rebounding risk tolerance were also evident in bond markets. Yields on euro area government bonds continued to converge (Graph 5, centre panel). Moreover, spreads between yields on

government-guaranteed bonds and sovereign bonds narrowed further (Graph 5, right-hand panel).

Equity markets push higher despite bouts of volatility

Major equity markets rise to new highs for the year ...

Major equity markets continued to recover. While better than expected economic data and corporate earnings helped to lift benchmark indices to new highs for the year, trading conditions were at times volatile as market participants reassessed the pace of economic recovery and the prospects of earnings growth. Between end-May and 4 September 2009, the S&P 500 index rose by 11%, reaching its highest levels since early October 2008. The Dow Jones EURO STOXX index advanced by 12%, while the FTSE 100 rose by 10% during the same period. The Nikkei 225 index, which had tended to outperform other major indices until mid-August, failed to keep pace subsequently and ended the period up 7% (Graph 6, left-hand and centre panels).

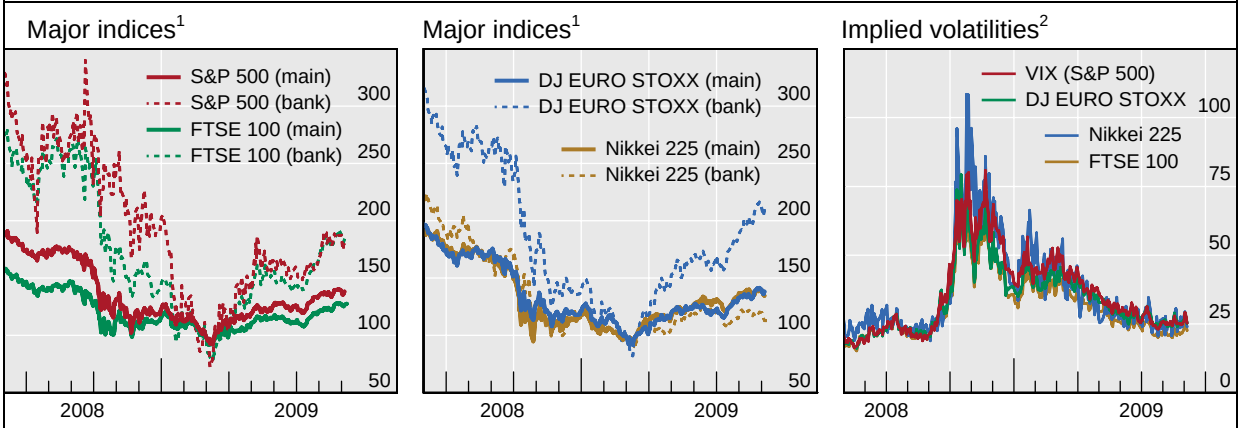
... but remain susceptible to doubts over economic recovery

Although gradual improvements in the global economic outlook set a positive tone for equities, market participants remained sensitive to any indications to the contrary. In June and early July, major equity markets saw outsized one-day declines on days with news or data releases that cast doubt on the prospects of a sustained recovery. By the second week of July, major equity indices had retreated to their lowest levels since late April. Investors' caution ceded to the flow of positive corporate earnings news between mid-July and early August, only to return in mid-August ahead of major central bank policy decisions. Moreover, major equity markets appeared to be more affected than usual by news on the Chinese economy (see emerging markets section below), further underscoring market participants' concern over the strength of economic recovery.

Financial sector shares rally on strong second quarter results

Periods of uncertainty notwithstanding, equity markets rallied between mid-July and early August on the back of mostly positive second quarter corporate earnings reports, which mirrored the ongoing upward revision of

Equity market prices and implied volatilities

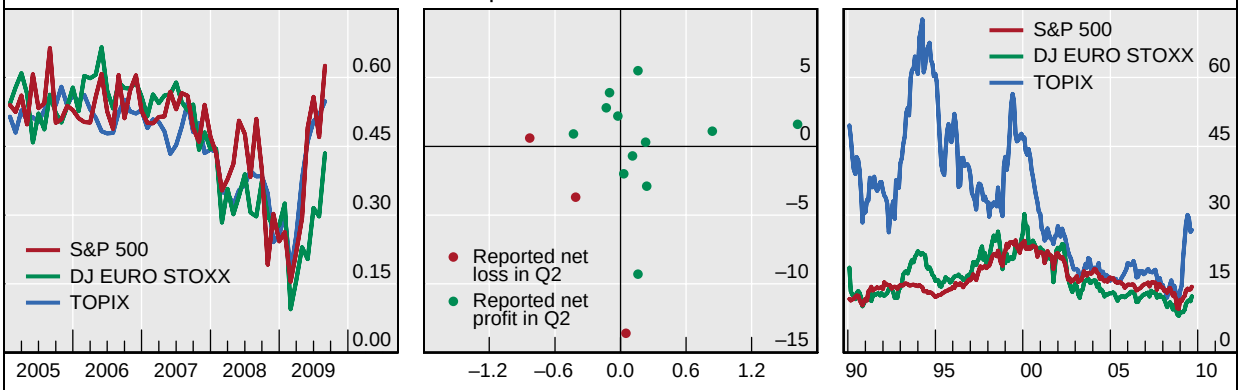


[1] In local currency; 1 March 2009 = 100. [2] Volatility implied by the price of at-the-money call option contracts on stock market indices, in per cent.

Sources: Bloomberg; BIS calculations. Graph 6

Earnings, equity prices and price/earnings ratios

Earnings revisions[1] | Banks' earnings surprises and stock price reactions[2] | Price/earnings ratios[3]



[1] 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. [2] X-axis = actual basic earnings per share minus consensus estimate prior to announcement (in US dollars); y-axis = change in bank's stock price on the day of announcement minus change in financial sector index (in percentage points). Sample covers 15 large banks that reported earnings between 14 July and 7 August 2009. [3] Based on consensus forecasts for one-year operating earnings.

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

earnings expectations (Graph 7, left-hand panel). Market participants welcomed, in particular, the fact that a number of major financial institutions were able to deliver a second consecutive quarter of strong earnings while some others, after having been in the red for several quarters, finally returned to profit. Against this backdrop, the S&P 500 financial sector sub-index rose by 16% between end-May and 4 September, recovering all losses since November 2008, though still some 30% down from its mid-2008 levels. Financial sector shares in the United Kingdom and on other European exchanges rallied by over 20% during the same period, while those in Japan advanced by a smaller degree. The financial sector, which had led the market down earlier this year, has continued to lead the market up since the turnaround in early March (Graph 6, left-hand and centre panels). This pattern stands in contrast to the one observed earlier this decade, when bank stocks traded as if bank earnings were relatively stable (see the special feature by King in this issue).

Signs of loan quality deterioration worry market participants …

However, instances of negative market reactions to positive headline results suggest that there were questions about the quality and sustainability of banks' profitability (Graph 7, centre panel). For example, despite a better than expected second quarter net income of €1.1 billion, Deutsche Bank's share price declined sharply (by 11%) on 28 July, underperforming that of other European banks, as the doubling of loan loss provisions over the preceding quarter to €1 billion caught market participants' attention. Likewise, despite reporting a rise in net income to $3.17 billion on 22 July, Wells Fargo also underperformed its peers, as investors took notice of the increase in problem loans and other non-performing assets. To be sure, a number of major financial institutions were still reporting losses (eg Morgan Stanley, Mizuho Financial Group, UBS, RBS), and their share prices tended to underperform on the day the results were announced.

Market participants interpreted headline results with caution for a number of reasons. First, banks' reported earnings in the past two quarters have been unusually influenced by a host of one-off or technical factors (eg gains or losses from asset sales, fair value changes resulting from fluctuations in the spreads on banks' own debt), which do not relate to underlying profitability. Second, the rebound in earnings of some banks has been driven by a surge in underwriting fees and trading revenue. Such a surge may prove transient, since the extraordinary environment that helped push up non-interest income in the first half of this year may not persist as market conditions normalise. Third, it is not always clear whether to interpret the rise in loan loss provisions as only a temporary drag on net income reflecting precaution, or as an indication of more loan losses to come.

… as do other caveats in the sources of bank profits

The overall improvements in equity market conditions, as reflected in the recovery of price/forward-earnings ratios from multi-decade lows (Graph 7, right-hand panel), helped financial institutions regain access to market funding and reduce the need for government assistance. In June, after demonstrating their ability to raise funds in the market unassisted, 10 large US financial firms were granted permission to repay a combined $68 billion of preferred shares issued to the government under the Capital Purchase Program. A number of these firms also subsequently redeemed the warrants attached to share purchase, thereby formally relieving themselves of the costs and non-price conditions of the programme. Similarly, non-US banks increasingly returned to the market, with some also seeking to reduce their dependence on government support.

Improved market conditions allow some banks to reduce reliance on government support

The continued recovery of major equity markets was accompanied by a general decline in volatility (Graph 6, right-hand panel). For example, the VIX, which had hovered around 32 in late May, eventually traded down towards 25 in August, the lowest levels since the eve of the Lehman bankruptcy in mid-September 2008.

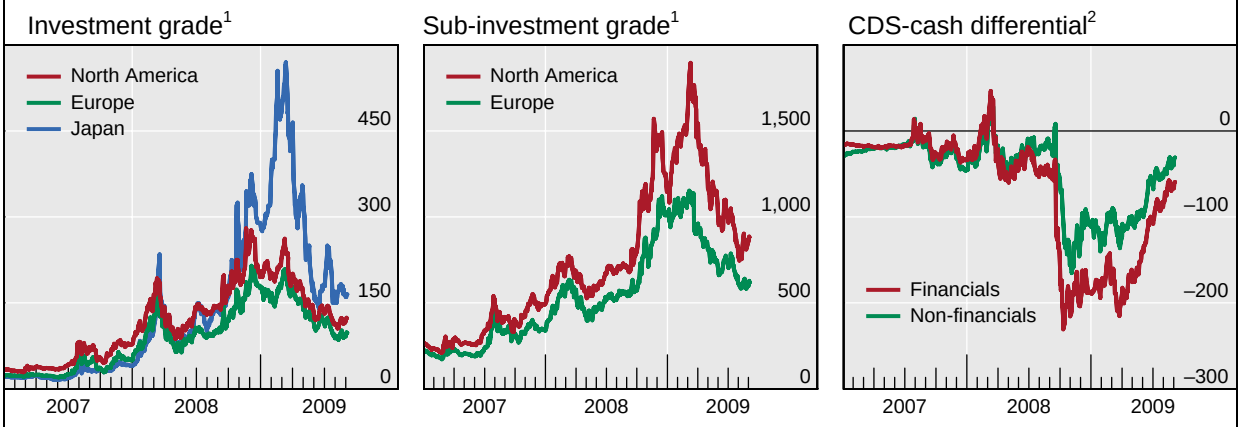
Credit markets continue to improve

Credit markets continued to improve over the last few months. Credit spreads tightened and corporate bond issuance remained high amid initial recovery signs and positive earnings news from a number of major financial institutions. Nevertheless, spreads were still elevated and important market segments, such as those for asset-backed securities (ABS) and commercial mortgage-backed securities (CMBS), remained subdued, prompting further policy actions to support these markets.

Further improvements in global credit markets

Improved market conditions were reflected in declining credit spreads, particularly for lower-rated borrowers. By early September, spreads on US and European investment grade debt had tightened by around 25 basis points from late May (Graph 8, left-hand panel). In Japan, spreads on investment grade bonds fluctuated widely over the period, reflecting mixed economic data. In contrast to the moderate declines in investment grade spreads, sub-investment grade spreads tightened substantially during the period. European and US sub-investment grade spreads narrowed by around 119 and 200 basis points,

Credit spread and CDS-cash basis indices



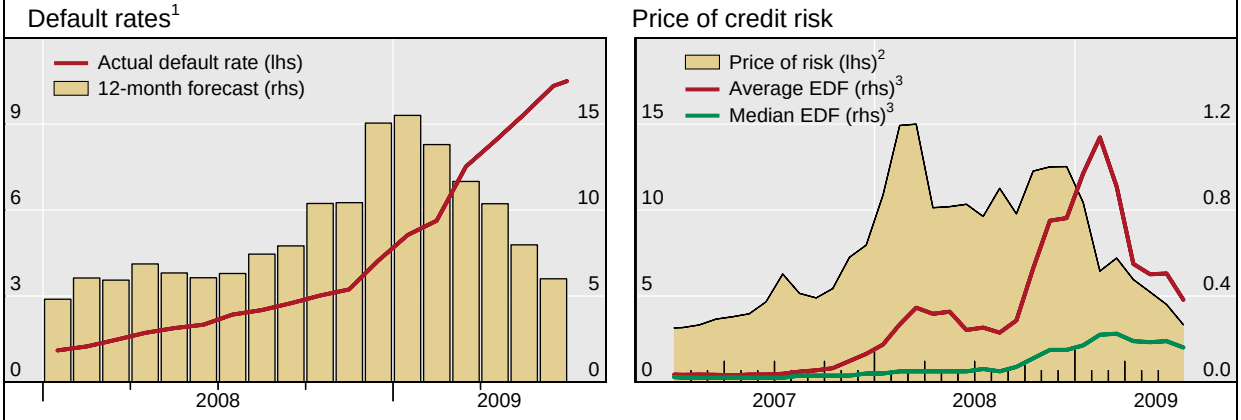
[1] Five-year on-the-run CDS mid-spread on index contracts of investment grade (CDX North America; iTraxx Europe; iTraxx Japan) and sub-investment grade (CDX High Yield; iTraxx Crossover) quality, in basis points. [2] CDS-cash measures, approximated by the difference between the iTraxx Europe (non-) financials five-year on-the-run CDS mid-spread and the iBoxx (non-) financials cash market spread.

Sources: Bloomberg; JPMorgan Chase; BIS calculations. Graph 8

respectively, reaching levels well below the highs recorded in March (Graph 8, centre panel). The gradual improvement in credit conditions was also reflected in the so-called CDS-cash basis, ie the difference between CDS premia and par asset swap spreads for the corresponding cash market bonds, which continued to tighten over the period, although it remained in negative territory (Graph 8, right-hand panel). This suggests that credit market dysfunctions are slowly disappearing, but are not yet gone.

Overall shrinking credit spreads also reflected improvements in the outlook for defaults (Graph 9, left-hand panel). Actual default rates continued to rise, but market forecasts of future default rates declined further, supported by early signs of economic recovery and positive earnings data. The growing

Default rates and price of credit risk



[1] Moody's global 12-month issuer-weighted speculative grade default rates for 2008–09; forecasts refer to the 12-month period starting at the reporting date. [2] Ratio of risk neutral to empirical probabilities of default, calculated using the methodology described in J Amato, "Risk aversion and risk premia in the CDS market", *BIS Quarterly Review*, December 2005, pp 55–68. Empirical probabilities are based on Moody's-KMV EDF data. Estimates of risk neutral probabilities are derived from US dollar CDS spreads (document clause MR) and estimates of the recovery rate. The reported ratio is the median in a large sample of investment grade entities. [3] In per cent.

Sources: JPMorgan Chase; Markit; BIS calculations. Graph 9

optimism was also reflected in the further recovery of indicators of risk tolerance. The price of credit risk, calculated as the ratio of credit spread-implied (risk neutral) to empirical default probabilities of investment grade issuers, declined over the third quarter (Graph 9, right-hand panel).

Financial sector spreads rally on earnings and early recovery signs

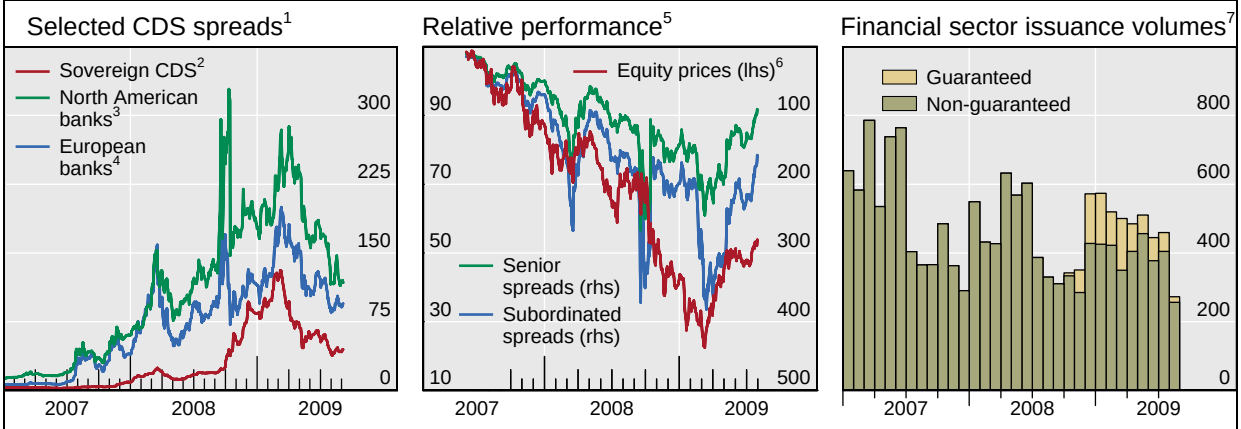
Financial sector credit spreads, particularly those on the subordinated debt of major banks, tightened substantially from mid-July (Graph 10, left-hand and centre panels). Nevertheless, the prospect of low economic growth and its negative impact on the sustainability of banks' profitability did lead to a widening of spreads for banks from June until mid-July (Graph 10, left-hand panel). The still less than robust financial health of banks was reflected in the continued tightening of lending standards. In addition, despite moderate financial sector bond issuance, banks continued to rely in part on government-guaranteed funding (Graph 10, right-hand panel).

Corporate bond issuance remains high

The ongoing improvement in credit market conditions was also reflected in the rate of global corporate bond issuance, which remained high throughout the period (Graph 11, left-hand panel). The high volumes of non-financial issuance in the major currencies coincided with banks' continued efforts to deleverage and improve their balance sheets.

The US mortgage and securitisation markets continued to benefit from government support (Graph 11, centre panel). Agency mortgage-backed spreads declined further over the period – a continuation of a downward trend which began last November following the Federal Reserve's announcement of plans to purchase agency securities. Increased refinancing by borrowers into lower rate agency loans resulted in a temporary rise of 30-year conventional mortgage rates at the end of June. These refinancing activities also led to an increase of $100 billion in the total volume of outstanding MBS from the first to the second quarter. Meanwhile, as a consequence, outstanding agency MBS volumes grew by over $200 billion over the second quarter of the year, while non-agency MBS volumes declined by more than $100 billion.

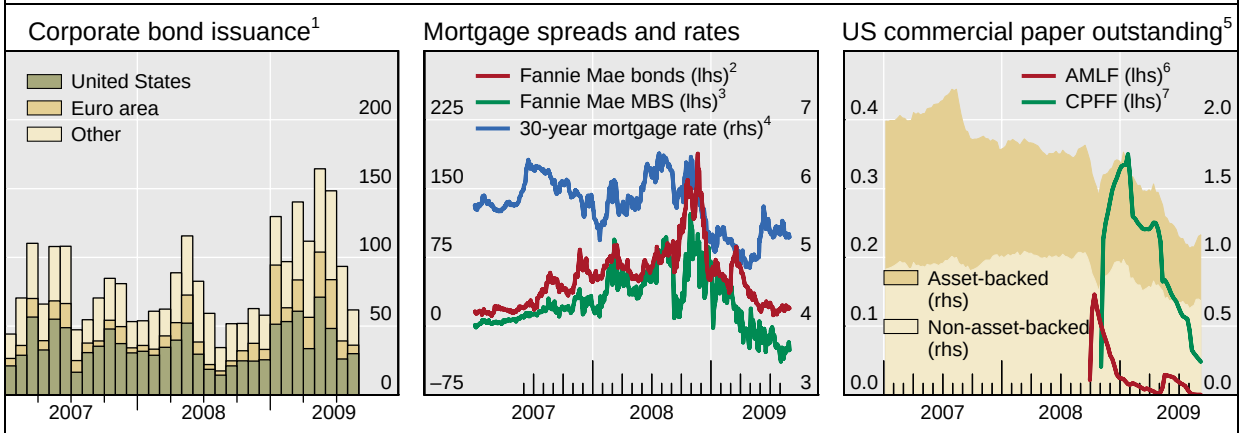
Financial sector indicators



[1] Equally weighted average senior CDS spreads, in basis points. [2] Five-year for France, Germany, Japan, the United Kingdom and the United States. [3] Eleven banks headquartered in North America. [4] Twelve banks headquartered in Europe. [5] Equity prices (in US dollars, equally weighted average) and spread data (equally weighted average, inverted scale, in basis points) are for the universal banks in the left-hand panel for which both subordinated and senior spreads are available. [6] 1 August 2007 = 100. [7] Syndicated international and domestic debt securities placed by financial issuers, in billions of US dollars.

Sources: Bloomberg; Datastream; Markit; BIS calculations. Graph 10

Global corporate bond issuance, US mortgage and commercial paper markets



[1] Syndicated international and domestic debt securities placed by non-financial private issuers, in billions of US dollars. [2] JPMorgan index; two-year on-the-run spread to Treasuries, in basis points. [3] JPMorgan index; option-adjusted spreads over Libor, in basis points. [4] Fixed rate conventional; national average, in per cent. [5] In trillions of US dollars. [6] Asset–backed Commercial Paper Money Market Mutual Fund Liquidity Facility. [7] Net portfolio holdings of Commercial Paper Funding Facility.

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

ABS and CMBS markets remain weak …

While policy actions helped US mortgage bond markets, other parts of US credit markets continued to reflect the weak financial situation. Markets for ABS backed by consumer and business loans and for CMBS were most clearly affected. In response, the Federal Reserve and the US Treasury in mid-August extended the Term Asset-Backed Securities Loan Facility (TALF) until 31 March 2010 for newly issued ABS and existing CMBS, while it was extended until 30 June 2010 for newly issued CMBS.

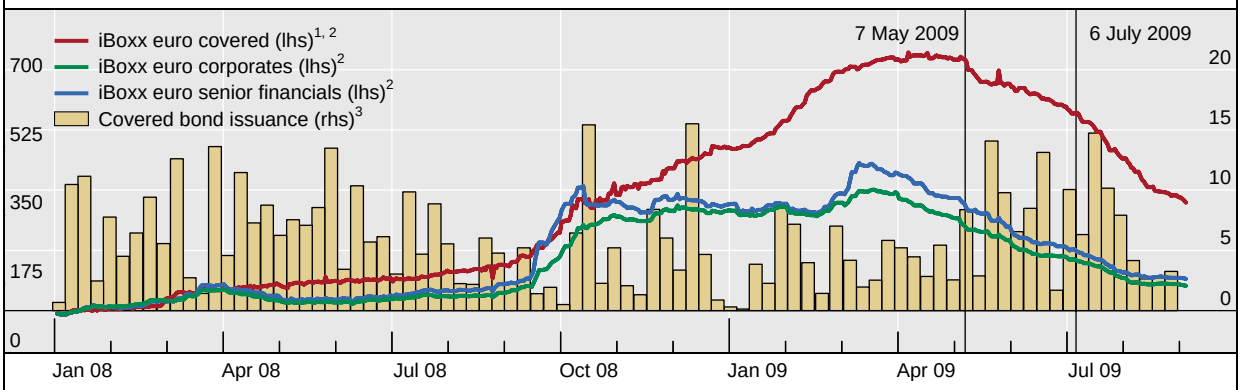
… while CP market shows early signs of recovery

Although weakness remained in the US commercial paper (CP) market, there were early signs of improvement. Up to mid-August, amounts outstanding fell to $1 trillion before they began to increase again, reaching $1.16 trillion by early September (Graph 11, right-hand panel). The lower rate of CP issuance, together with the high corporate bond issuance, point to a significant decline in short-term corporate funding. The recovery in the CP market was also reflected in the outstanding balances in the Federal Reserve's programmes targeting this market. The size of the Commercial Paper Funding Facility (CPFF) programme, which supports longer-maturity (90 days plus) CP, fell substantially from about $160 billion in late May to $48 billion by early September. The Asset-backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF) declined to just $79 million by early September, after having reached almost $29 billion in early May.

ECB support programme …

The euro area credit markets were affected by policies aimed at supporting mortgages and covered bonds. On 6 July, the ECB and the 16 national central banks of the euro area launched the Eurosystem covered bond purchase programme, which had been announced on 7 May. This programme provides for the purchase of covered bonds, with a targeted nominal amount of €60 billion. In the period from 6 July 2009 to early September 2009, covered bonds with a total nominal value of about €10 billion were purchased under the programme, corresponding to slightly less than 20% of total issuance over the same period.

Eurosystem covered bond purchase programme



[1] Covered bond spread between the yield of a covered bond and the rates quoted for euro interest rate swap contracts. [2] 2 January 2009 = 100; spread as index. [3] Syndicated debt securities placed in domestic and international markets; announced covered bond issuance by euro area residents, in billions of US dollars; weekly.

Sources: Bloomberg; Dealogic. Graph 12

... helps increase covered bond issuance

The programme influenced both credit spreads and issuance volumes in the European covered bond market. Since it was announced, covered bond spreads have narrowed significantly (Graph 12). The programme also appears to have helped revitalise the primary market for covered bonds. Primary market issuance, which had remained low since September 2008, increased visibly in May after the programme's announcement. In addition, borrowers have been able to issue at the lower end of the indicative spreads announced during the pre-marketing period, with many new bonds being oversubscribed. Since the launch of the programme, a number of covered bonds have been issued in the Spanish, French and German markets, as well as in Portugal, the Netherlands and Italy, where covered bond issuance has historically been limited. Furthermore, several bonds from institutions that have not previously issued covered bonds have been purchased under the programme.

Chinese equity correction reverberates in other markets

Revived risk tolerance continues to support emerging market assets

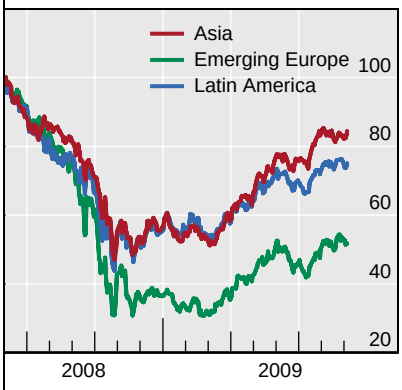
Investors' revived tolerance for risk continued to support emerging market assets. Between end-May and early September 2009, emerging market equities rose along with those in mature markets (Graph 13, left-hand panel). Sovereign and corporate credit spreads narrowed, albeit at a more gradual pace than before (Graph 13, centre panel). Improved market conditions encouraged a further pickup in both domestic and international issuance of debt securities by emerging market corporates (Graph 14, right-hand panel). Equity issuance, which had remained low up to March 2009, began to recover in the second quarter. Portfolio investment flows into emerging markets, which had resumed earlier this year, were sustained over the subsequent months. Emerging market currencies appreciated, though to different degrees, reflecting in part their attractiveness for investors in search of higher yields (Graph 14, centre panel).

Economic rebound in Asia attracts attention

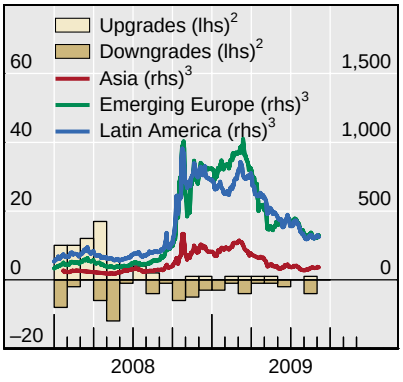
With market participants focusing on the pace and shape of global economic recovery, the strong rebound in activity in emerging Asia attracted

Emerging market indicators

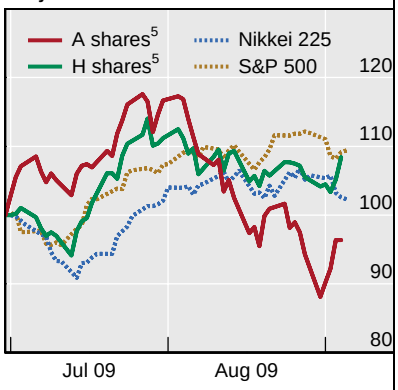
MSCI regional equity prices[1]



Rating actions and sovereign CDS spreads



Chinese equities and selected major indices[4]



[1] In local currency; 1 June 2008 = 100. [2] Monthly rating changes on long-term sovereign debt issued in foreign and local currency. [3] Weighted average of sovereign CDS spreads (in basis points), based on 2005 GDP and PPP exchange rates. Asia = China, Hong Kong SAR, Korea and Singapore; emerging Europe = the Czech Republic, Hungary, Poland, Russia and Ukraine; Latin America = Argentina, Brazil, Colombia, Mexico and Peru. [4] In local currency terms; end-June 2009 = 100. [5] Simple average of 10 largest Chinese companies by market capitalisation listed on both the Shanghai (A shares) and Hong Kong SAR (H shares) exchanges.

Sources: Bloomberg; Datastream; Markit; Standard & Poor's; BIS calculations. Graph 13

attention. In July, the release of preliminary second quarter GDP growth figures for Singapore (an annualised 20%, after several quarters of contraction) and Korea (an annualised 9.7%, the fastest quarterly growth in over five years) provided early hints that the region may be emerging from the downturn. Subsequent data releases from other Asian economies also suggest a revival of activity, attributable to the resumption of trade flows and the effect of fiscal stimulus measures. Expectations of the region's advance recovery added to the growing optimism that supported the demand for emerging market assets.

Market participants pin recovery hopes on Chinese policy stimulus …

China, in particular, became a focal point for market participants. Its ability to rekindle growth, which had been stalled by the slump in external demand around the turn of the year, was often ascribed to the early and forceful fiscal response of the Chinese authorities. However, since bank lending, especially that by the four large state-owned commercial banks, was instrumental in financing the stimulus, there was growing concern that the resulting rapid rise in bank credit (new lending in the first half of 2009 tripled year on year to over 7 trillion renminbi ($1 trillion)) would exacerbate the build-up of overcapacity in some sectors and fuel asset price inflation.

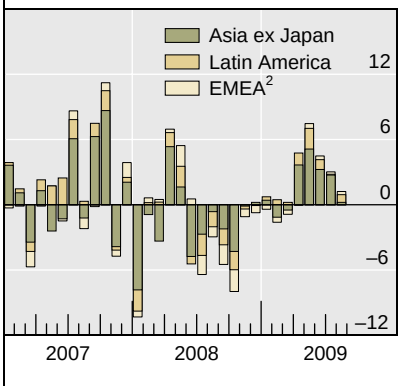
… but later worry about potential policy tightening

Hopes that robust Chinese growth would lead the global economy to recovery were eventually tempered by fears that the authorities might step in to prevent overexpansion. On 29 July, media reports suggesting an imminent tightening of bank lending drove the Chinese equity market down by more than 5% on the day. Moreover, given its perceived implications for global growth, this news reverberated in other major equity markets in Asia and beyond, temporarily stalling the rally that was under way (see equity markets section above). On 11 August, Chinese data showing less robust than expected industrial production and a sharp month-on-month decline in bank lending

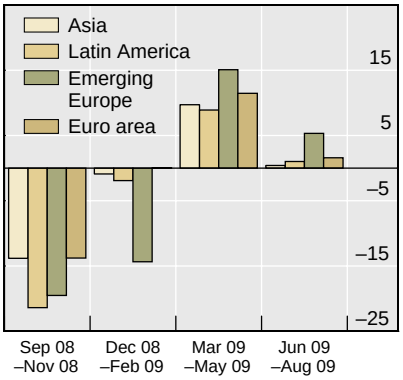
Chinese equity sell-off weighs on other exchanges …

Portfolio flows, currency returns and international debt issuance

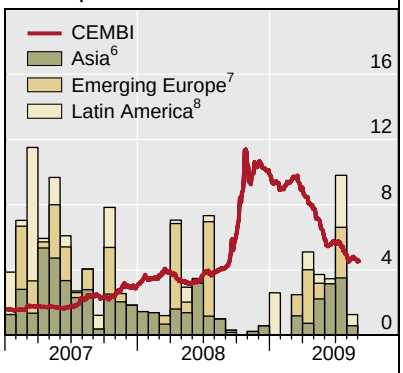
Flows to emerging market equity funds[1]



FX returns against US dollar[3]



Corporate debt issuance[4] and bond spreads[5]



[1] In billions of US dollars. [2] Europe, the Middle East and Africa. [3] Simple average of changes in the US dollar spot exchange rate, in per cent. Positive value indicates appreciation against the US dollar. Asia = China, India, Indonesia, Korea and Singapore; Latin America = Argentina, Brazil, Chile and Mexico; emerging Europe = the Czech Republic, Hungary, Poland, Russia and Turkey. [4] International syndicated debt securities (excluding preferred shares); announced issuance by non-financial corporates, in billions of US dollars. [5] In per cent. [6] China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines and Singapore. [7] The Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Russia and Turkey. [8] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela.

Sources: Bloomberg; Dealogic; EPFR Global; JPMorgan Chase; BIS calculations. Graph 14

provided another occasion for doubts about global growth and prompted further equity selling both at home and abroad.

… but only to a limited degree

That said, the influence of the Chinese equity market on other exchanges was limited. Although selected equity markets outside China did appear to exhibit sensitivity to movements of the Chinese market during this period, they were by no means as volatile. Even the shares of mainland Chinese companies that are traded in Hong Kong SAR (H shares) did not fall by as much as their A share equivalents traded in Shanghai (Graph 13, right-hand panel). The Chinese equity market continued to slide in the second half of August, even as other markets stabilised or recovered. By the end of the month, the Shanghai Stock Exchange Composite Index had declined by over 20% from its early August peak, erasing all its gains since early June.

The significant correction of Chinese equities in August weighed on Asia's overall equity market performance. The MSCI Emerging Markets Asia index was up by only 11% between end-May and 4 September, no longer outperforming the broader World index by as large a margin as in late July. Asian equity markets also ended the period underperforming their counterparts in emerging Europe (with the notable exception of the Russian market, which declined on net over the period) and some markets in Latin America. Data on investment fund flows indicate that while Latin America and emerging Europe equity funds continued to attract net inflows in August, net flows into Asian equity funds shrank to only a small fraction of their magnitudes in the preceding months (Graph 14, left-hand panel).

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Highlights of international banking and financial market activity[1]

The BIS, in cooperation with central banks and monetary authorities worldwide, compiles and disseminates several datasets on activity in international banking and financial markets. The latest available data on the international banking market refer to the *first* quarter of 2009. The discussion on international debt securities and exchange-traded derivatives draws on data for the *second* quarter of 2009.

The international banking market

As tensions in financial markets began to subside in the first quarter of 2009, the contraction of banks' international balance sheets slowed. Banks still registered an $812 billion fall in their *interbank* positions comparable to that experienced in the fourth quarter of 2008, reflecting protracted funding pressures. However, the decrease in international credit to *non-banks*, at $258 billion, was only one fourth that seen in the previous quarter (Graph 1). Banks also trimmed their international credit to emerging markets, but their local lending from offices in emerging market host countries remained stable.

Contraction in credit to non-banks slows

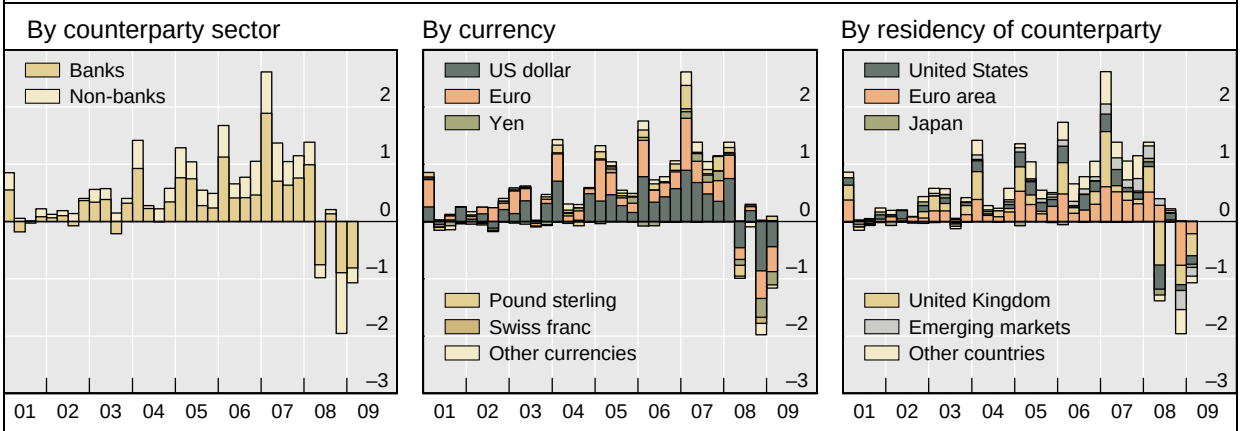
International bank credit to non-bank entities continued to decline in the first quarter of 2009. BIS reporting banks' international claims on these borrowers fell by $258 billion (to $12 trillion), much less than the $1 trillion decrease in the previous quarter (Graph 1). The drop occurred vis-à-vis non-bank residents of the United Kingdom (–$128 billion) and, to a lesser extent, Japan (–$40 billion) and emerging markets (–$29 billion).[2] By contrast, claims on non-bank entities in the United States changed little (Graph 2, left-hand panel).

[1] Queries concerning the banking statistics should be addressed to Patrick McGuire and Blaise Gadanecz, and queries concerning international debt securities and exchange-traded derivatives statistics to Naohiko Baba.

[2] Banks resident in the United Kingdom, Germany, Belgium, Hong Kong SAR, Ireland and Switzerland reported the largest declines in claims on non-banks.

Changes in gross international claims[1]

In trillions of US dollars



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

Source: BIS locational banking statistics by residence. Graph 1

Further writedowns and disposals of debt securities contributed to the reduction in claims on non-bank borrowers in the first quarter (Graph 2, centre panel).[3] Banks, particularly those in major euro area countries and Asian financial centres, reported reduced holdings of securities issued by residents of offshore centres (by $16 billion) and emerging markets (by $14 billion). Conversely, banks increased their debt securities claims on non-bank entities in the United States by $20 billion, in part the result of greater claims on the US public sector (see below).

Higher claims on the public sector

A closer look using the BIS consolidated banking statistics, which contain a finer sectoral breakdown, shows that banks trimmed their exposures to the non-bank *private* sector, whereas claims on the public sector actually grew (Graph 2, right-hand panel).[4] In particular, several banking systems registered lower consolidated claims on the US non-bank private sector. Euro area banks' claims dropped by $120 billion, or 8%, while Swiss banks' claims fell by $57 billion, or 13%. Intra-euro area claims on the non-bank private sector, as well as claims on the UK non-bank private sector, registered modest declines after taking currency effects into account.[5] At the same time, banks increased

[3] Overall, the BIS locational banking statistics actually show a modest increase in holdings of debt securities ($5 billion), following a large decrease in the fourth quarter of 2008 (–$202 billion). The increase in the first quarter seems to reflect larger holdings of US and euro area government securities, as evidenced by the BIS international consolidated banking statistics. According to loss data reported to Bloomberg by 85 large internationally active banks, writedowns and disposals amounted to $80 billion in the first quarter of 2009 and $218 billion in the fourth quarter of 2008.

[4] In the first quarter of 2009, investment banks were included for the first time in the population of reporting institutions in the US consolidated banking statistics. This creates a break in series of approximately $800 billion in US banks' total international claims ($1 trillion in their foreign claims, if local positions in local currencies are included). All quarter-on-quarter changes discussed in this section are corrected for this and other breaks.

[5] No currency breakdown is available in the BIS consolidated banking statistics. However, assuming that banks' foreign claims on the euro area non-bank private sector are denominated in euros, claims decreased by $62 billion (2%). A similar calculation for claims

their holdings of US Treasuries; their exposure to the US public sector rose by $116 billion or 16%, with the largest increase reported by Japanese, UK and euro area banks. Banks' claims on the euro area public sector also grew, by $32 billion (2%), once exchange rate movements are taken into account. In contrast, claims on the Japanese public sector declined by $39 billion (10%).[6]

Derivatives positions fall in value as market conditions stabilise

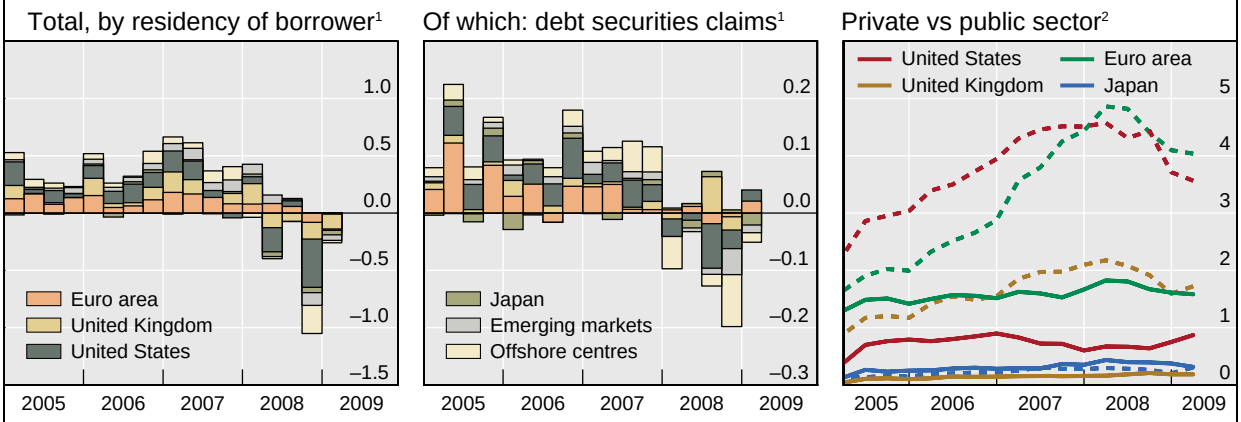
Banks also reported lower off-balance sheet positions, in part as a result of exchange rate movements. Reflecting a combination of cutbacks in new commitments and existing facilities not being rolled over, the value of undisbursed credit commitments, especially those granted by German, UK and Swiss banks, fell by $221 billion (5%) in the first quarter. Guarantees extended worldwide, including for trade credit, project loans and structured products, fell by $574 billion (9%). More than half of the decline was reported by US banks. Lastly, the value of derivatives contracts plunged by over $1 trillion (15%),[7] with UK banks responsible for half of this total.

Weak syndicated lending to non-banks in the second quarter

Data on syndicated loans suggest that lending to non-banks continued to be weak in the *second* quarter of 2009. Signings of international syndicated loan facilities granted to non-bank borrowers (in both advanced economies and emerging markets) in the first and second quarters of 2009 ($182 billion and $241 billion, respectively) were still only at approximately half their level of one year earlier. Average spreads over Libor on syndicated loan facilities continued to rise into the first quarter of 2009, but came down slightly in the second. In

Claims on the non-bank sector

In trillions of US dollars



[1] Quarter-on-quarter currency valuation adjusted changes. [2] BIS reporting banks' total consolidated claims on the public sector (solid lines) and the non-bank private sector (dashed lines). Stocks outstanding; not adjusted for movements in exchange rates.

Sources: BIS locational banking statistics; BIS consolidated banking statistics on an ultimate risk basis. Graph 2

on the UK non-bank private sector shows a $46 billion (3%) decline. The euro and sterling depreciated against the US dollar in the first quarter of 2009 by 4.6% and 2%, respectively.

[6] These calculations assume that claims on the euro area (Japanese) public sector are denominated in euros (yen).

[7] Banks' derivatives positions had risen during the crisis, particularly in the *fourth* quarter of 2008, reflecting the extent to which these positions moved "into the money" following central banks' coordinated interest rate cuts, as well as exchange rate movements and the general rise in volatility in all asset markets.

February and March, the ratio of the dollar volume of announced but not completed signings to total loan signings (for non-bank borrowers)[8] came down to levels closer to its historical trend, after spiking in November and then again in January.

Funding pressures persist

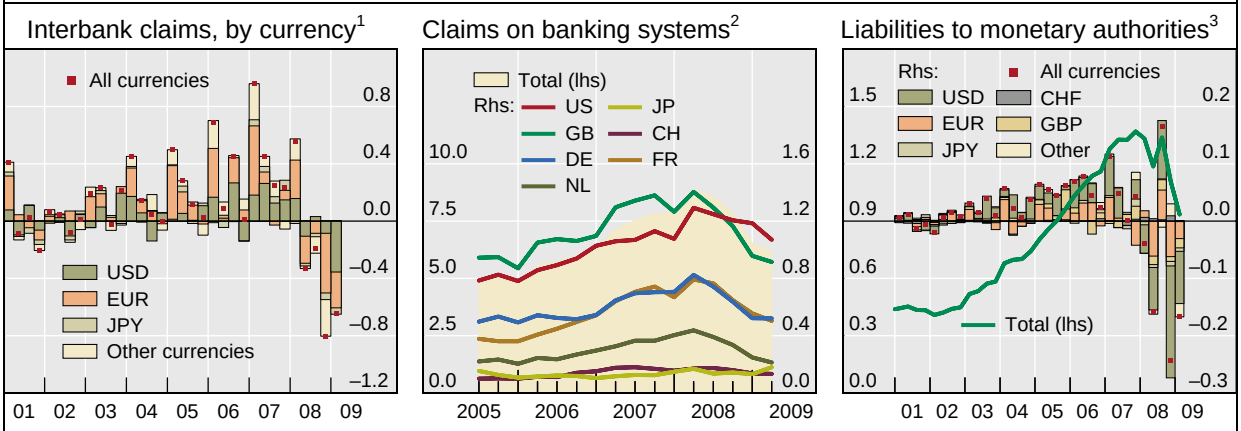
Interbank contraction continues

Throughout the crisis, but particularly after the Lehman failure, major central banks adopted unprecedented policy actions to supply banks with liquidity. Nevertheless, funding pressures remained evident in the first quarter, despite the reduction in Libor-OIS spreads and an easing of tensions in financial markets. Banks continued to trim their claims on other (unaffiliated) banks (Graph 3, left-hand and centre panels). The decline in these international positions, by a total of $646 billion, or 6%, occurred in both the euro and US dollar segments (it had affected mainly the euro segment in the fourth quarter of 2008). The contractions in interbank credit to euro area (–$348 billion), US (–$116 billion) and UK (–$67 billion) banks were the largest.

Contributing to banks' funding pressures, liabilities to central banks, which typically reflect deposits of foreign exchange reserves, continued to fall in the first quarter, albeit at a slower pace than in the previous one (Graph 3, right-hand panel). The $146 billion reduction (after adjusting for currency valuation effects) brought the outstanding stock of liabilities to monetary authorities to $932 billion, roughly two thirds of the peak level reached in the fourth quarter of 2007. The decline was registered by banks resident in the United Kingdom, the

Funding sources under pressure

In trillions of US dollars



[1] Exchange rate adjusted changes in international interbank credit to other (unaffiliated) banks. [2] Consolidated foreign claims (ultimate risk basis) of all reporting banks on banks headquartered in the country indicated in the legend; not adjusted for movements in exchange rates. [3] Exchange rate adjusted changes (stacked bars) in and stocks outstanding, expressed at constant Q1 2009 exchange rates (green line), of international liabilities to official monetary authorities.

Sources: BIS consolidated statistics (ultimate risk basis); BIS locational statistics by residence and nationality. Graph 3

[8] This ratio gauges the ease (or difficulty) with which lead arranger banks can place announced loan facilities on the market (syndicating them to second-tier banks and other participants). High values of the ratio signal a high syndication failure rate, suggesting insufficient market appetite to absorb the supply of new loans at the set of terms on offer.

United States and a number of other European countries, and mostly represented a withdrawal of US dollars.[9]

Banks' local lending in emerging markets holds up

Several banking systems continued to trim their exposures to emerging markets. While most registered reductions in the outstanding stock of international consolidated claims, their local positions in local currencies (corrected for currency valuation effects) remained relatively stable (Graph 4).[10]

Lower international claims on emerging markets, induced by valuation effects

Banks' consolidated international claims on emerging market borrowers fell by a combined $89 billion (4%) in the first quarter of 2009, although this was in part driven by the 4.6% depreciation of the euro against the US dollar.[11] Among those banking systems with the largest exposures to emerging markets, Austrian, German, Dutch, Swedish and UK banks reported the bulk of the decline (Graph 4, green lines). A large part of these banking systems' emerging market exposure is vis-à-vis counterparties in emerging Europe, where international claims dropped by $53 billion during the quarter. If one assumes that all international claims vis-à-vis these borrowers are denominated in euros, the adjusted decline is more modest, at $14 billion.

Looking only at international claims provides an incomplete picture of internationally active banks' total exposures to emerging markets. Indeed, most major banking systems' local claims in local currency are at least as large as their international claims (Graph 4). At one extreme are Spanish and UK banks. Spanish banks' local claims extended in local currencies to emerging market borrowers (mostly in Latin America) are three times the size of their international claims on the same borrowers, while those of UK banks are about 50% larger. At the other extreme are German and Swedish banks, whose international claims are about five times the size of their local claims in local currency.

Higher local positions in local currencies

As Graph 4 shows, after adjusting for currency effects and reporting breaks, local claims in local currencies on emerging market borrowers

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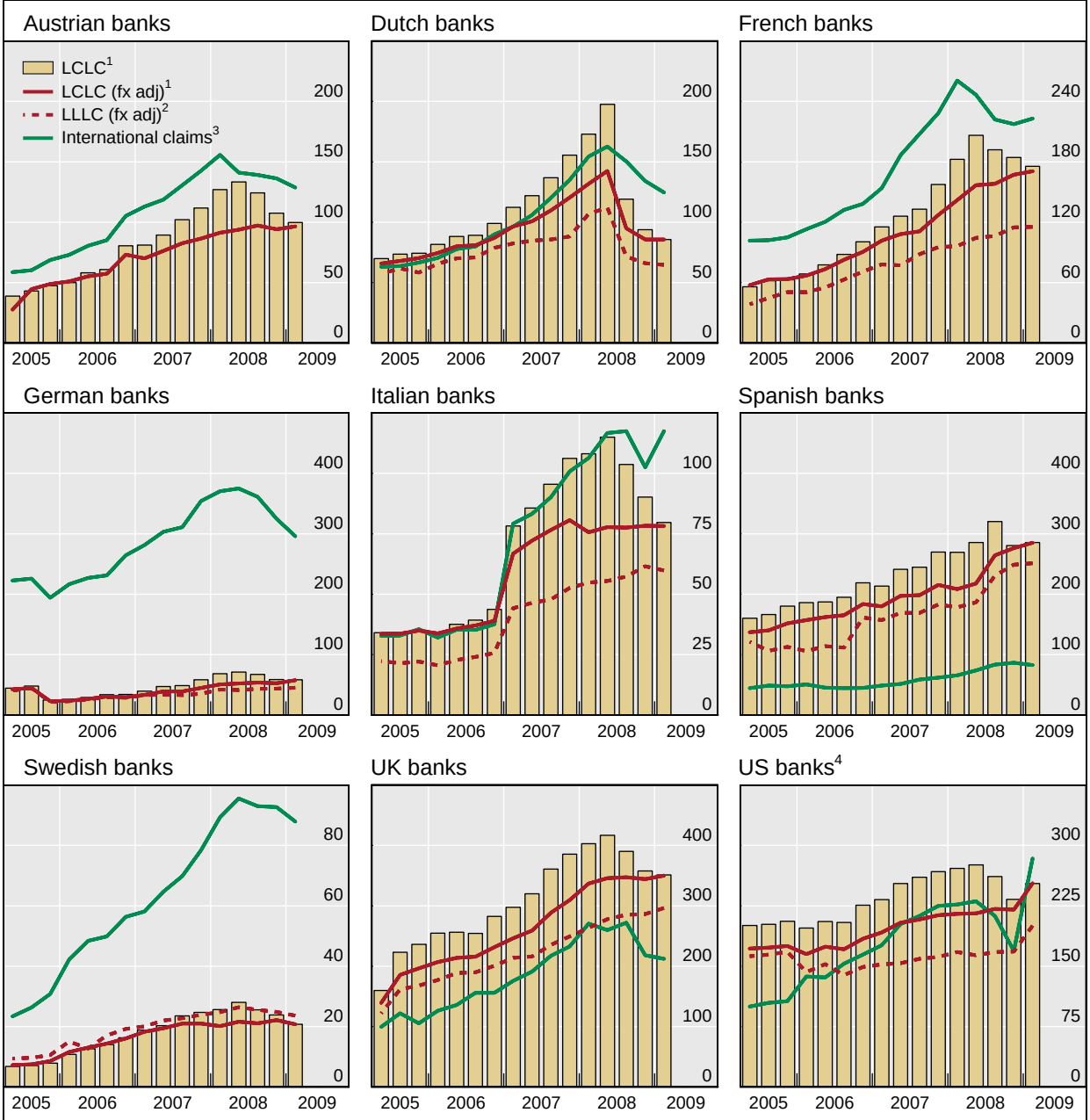
[9] It is impossible to identify in the BIS banking statistics which central banks accounted for these moves. However, data on the composition of foreign exchange reserves reported by 63 monetary authorities to the IMF indicate that monetary authorities in Japan, the euro area, Thailand and Ukraine reported decreases in placements of foreign exchange reserves in commercial banks. BIS reporting banks also registered large moves (vis-à-vis all sectors) in liabilities to residents of reserve-accumulating countries. Banks' international liabilities to all oil-exporting countries worldwide decreased by $73 billion, with US dollar positions down the most.

[10] The inclusion of US investment banks in the US reporting population (see footnote 4) accounts for the jump in US banks' local and international positions in the first quarter. Likewise, ABN AMRO sold some of its business units in the second half of 2008, which brought about a downward move in Dutch banks' positions during that period.

[11] The BIS locational banking statistics, which track reporting banks' exchange rate adjusted *cross-border* claims (including their inter-office positions), also show a decline. Overall, cross-border claims on emerging markets dropped by $134 billion in the first quarter of 2009, a large drop by historical standards but considerably less than the $282 billion reduction in the previous quarter. Claims on Asia-Pacific fell by $59 billion, while claims on borrowers in emerging Europe dropped by $41 billion.

Claims on emerging markets

By banking system, in billions of US dollars



[1] Local claims in local currency, or local currency claims extended by banks' foreign offices to residents of the host country. The bars show reported claims whereas the solid red line tracks claims expressed at constant Q1 2009 exchange rates. [2] Local liabilities in local currency, adjusted for exchange rate movements. [3] International claims comprise cross-border claims in all currencies and local claims in foreign currencies extended by banks' foreign offices to residents of the host country; these claims are not adjusted for exchange rate movements, since no currency breakdown is available. [4] See footnotes 4 and 10 in the main text.

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

increased by $50 billion. Reporting banks, in particular Belgian, UK, German and French banks, expanded their claims, in particular to borrowers in Korea, Mexico and emerging Europe. Austrian banks' local currency claims extended by their offices in emerging Europe stood at $99 billion, little changed from the previous quarter. By contrast, Swedish banks' local claims in local currencies on Baltic country borrowers declined by 9%, to $14 billion.

The international debt securities market

Higher issuance led by government support …

Continued government support led to an increase in net issuance of international debt securities in the second quarter of 2009. Against a backdrop of robust gross issuance together with significantly lower repayments, net issuance rose to $837 billion, up from $668 billion in the first quarter. The increase was mostly accounted for by bonds and notes issued by financial institutions, particularly in the euro area, as well as public sector borrowers. By contrast, possibly reflecting the shift to longer-term debt instruments, money market borrowing continued to stagnate with net repayments of $68 billion.

… dominated by bonds and notes in euros

Net issuance was dominated by bonds and notes denominated in euros, followed by those in dollars (Graph 5, left-hand panel). Net issuance in euros rose to $429 billion from $276 billion in the first quarter. By contrast, net sterling issuance decreased by almost half to $59 billion. Yen issuance contracted further, with net repayments of $12 billion. The Swiss franc segment saw a retreat from the record level in the previous quarter, but remained strong with net issuance of $9 billion.

The breakdown by nationality largely mirrors the pattern of the currency composition. In particular, French net issuance more than tripled to $131 billion in the second quarter. Conversely, net issuance by Swiss, UK and Japanese borrowers dropped. US net issuance also fell slightly, despite the increase in dollar-denominated issuance.

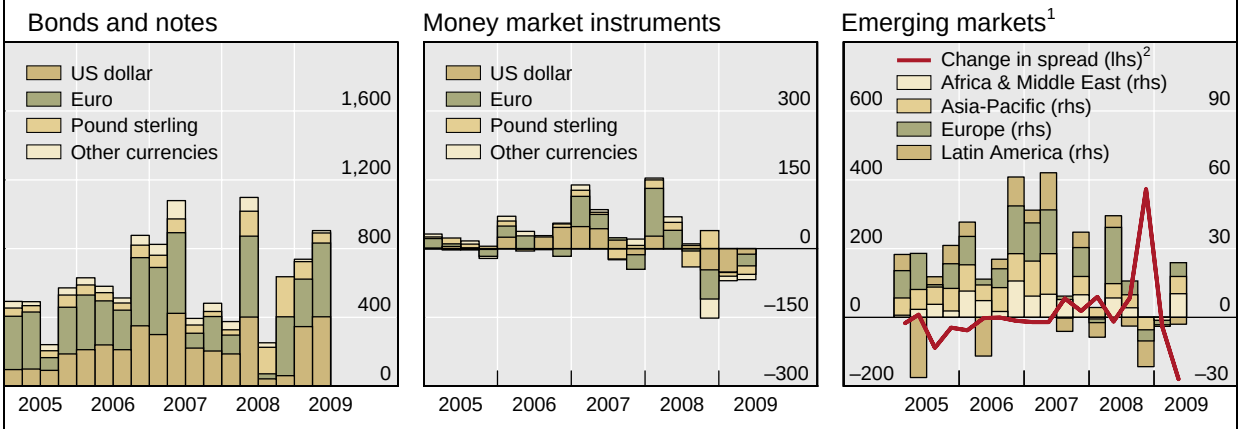
Strong issuance by financial institutions

Supported by government guarantee schemes, particularly in the euro area, financial institutions recorded the largest increase in net issuance of bonds and notes in the second quarter, from $427 billion to $544 billion. By credit quality class (for which only gross figures are available), gross issuance of investment grade bonds by financial institutions continued to be robust, while issuance of non-investment grade bonds remained weak.

Corporate borrowing fell slightly, from $181 billion to $172 billion. Borrowing by US corporations declined the most, from $121 billion to $81 billion. In contrast to the issuance by financial institutions, gross issuance

International debt securities issuance

Net issuance, in billions of US dollars



[1] Bond and note issuance, by nationality. [2] Quarterly change in spread of JPMorgan EMBI Global Composite index, in basis points.

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; BIS. Graph 5

of non-investment grade bonds by corporate borrowers picked up sharply in the second quarter.

Larger presence of public sector borrowers

Public sector borrowers continued to play a significant role in the international debt securities market in the second quarter. Their net issuance of bonds and notes rose to an all-time high of $348 billion. In particular, international organisations doubled net issuance of bonds and notes to $65 billion; the main issuers were the EIB and the IBRD. Governments increased net issuance from $98 billion to $124 billion. The most active government borrower in the second quarter was Greece, followed by Spain, the United Kingdom and France.[12] Borrowing by public financial institutions was also active at $139 billion, although it fell short of the record level in the previous quarter.

The shift from floating to straight fixed rate borrowing continued, as borrowers sought to lock in low interest rates. Also, equity-related bonds and notes recorded positive net issuance, which was last seen in the second quarter of 2008, against the background of the recovery in equity markets.

Strong recovery in emerging markets

In the emerging economies, net issuance of bonds and notes recovered strongly to $21 billion from net repayments of $4 billion in the previous quarter (Graph 5, right-hand panel). This coincided with a significant narrowing of emerging market bond spreads. The increase was most marked in Africa and the Middle East, followed by emerging Europe and Asia-Pacific. By contrast, Latin American borrowers continued to repay their debt. By nationality, the United Arab Emirates, Korea and Russia showed a particularly strong recovery.

Net repayments in the money market

Borrowing via international money market instruments continued to stagnate. Money market net borrowing was –$68 billion in the second quarter, compared to –$70 billion in the previous one (Graph 5, centre panel). The net repayments of money market debt possibly reflect the shift to issuance of longer-term bonds and notes, given the rollover risks highlighted during the recent financial turmoil. By currency, large decreases were recorded in the euro, sterling and Swiss franc segments, while the US dollar segment decreased net repayments substantially to $13 billion from $51 billion in the previous quarter.

Derivatives markets

Small rebound in derivatives activity

The second quarter of 2009 saw a small rebound in activity on the international derivatives exchanges, although trading volumes were still well below the pre-crisis level two years before. Total turnover based on notional amounts increased to $426 trillion from $366 trillion in the previous quarter, consistent with a return of risk appetite (Graph 6).

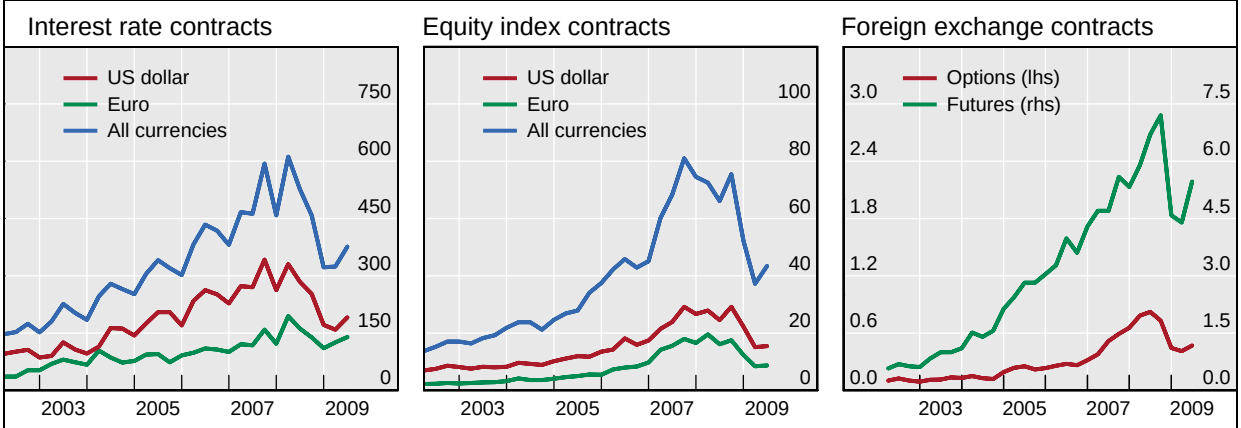
Robust activity in derivatives on US dollar short-term interest rates

The increase was mostly accounted for by derivatives on short-term interest rates. Turnover in this segment rose to $344 trillion in the second quarter, compared to $294 trillion in the previous one (Graph 6, left-hand panel). The increase was most marked in US dollar contracts, followed by euro,

[12] International bonds and notes only, comprising all foreign currency issues plus all domestic currency issues launched in the domestic market by non-residents.

Turnover of exchange-traded derivatives[1]

Quarterly data, in trillions of US dollars



[1] Futures and options.

Sources: FOW TRADEdata; Futures Industry Association; BIS calculations. Graph 6

sterling and yen contracts. In particular, turnover in futures on three-month eurodollar rates picked up sharply to $115 trillion from $96 trillion in the previous quarter, possibly due to stabilising money market conditions amid a gradual retreat of concerns over the financial system.

Turnover in equity index derivatives also increased in the second quarter, from $37 trillion to $43 trillion (Graph 6, centre panel). The increase was attributable in large part to the Korean market, where trading volumes rose significantly from $7.6 trillion to $12.0 trillion in the second quarter chiefly as a result of rising equity valuations. Global turnover measured in the number of contracts traded rose only by less than 100 billion.

Activity in foreign exchange derivatives began to recover as well (Graph 6, right-hand panel), with turnover increasing to $5.9 trillion from $4.8 trillion in the previous quarter. The gain in activity among the main currencies was particularly marked for contracts with one leg in sterling. A significant increase in notional amounts of futures contracts in such currency segments as the Australian and Canadian dollar, Swiss franc and New Zealand dollar possibly reflected renewed interest in FX carry trades as investors' confidence returned.

Trading in commodity futures and options increased slightly in the second quarter. Global turnover in commodity derivatives measured in numbers of contracts (notional amounts are not available) stood at 446 million, compared to 423 million in the previous quarter. Major contributors were contracts on agricultural products and non-precious metals, while trading in energy derivatives fell.

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The future of securitisation: how to align incentives?[1]

This article reviews the recent collapse of global securitisation markets and the loss of investor confidence in them. It then sets out measures that could be taken to revive and strengthen the securitisation process, including mechanisms based on retention requirements for originators. It ends with a number of simple implications for policymakers and market practitioners.

JEL classification: G100, G200.

Large losses in the value of mortgage-related products and an associated deterioration in investor appetite led to broad-based distress in securitisation markets from the summer of 2007. Problems started with subprime mortgage-related instruments, which experienced severe credit quality deterioration as a long period of appreciating house prices in the United States came to a halt. Losses were magnified by increasingly illiquid markets, and worsened further during the broad investor retreat from risk triggered by the Lehman Brothers bankruptcy and subsequent signs of global recession.[2]

As a result, spreads on securitised products soared (Graph 1, left-hand panel) and activity across most market segments came to a sudden stop. Issuance volumes, which had risen to a combined annual total for the United States and Europe of about $3.8 trillion over the 2005–07 period, collapsed to just over $2 trillion in 2008. Reflecting a generalised loss of investor confidence, most of this remaining issuance was in the US agency sector (ie securities underwritten by US government-sponsored mortgage financing enterprises) and in European securitisations used for refinancing activities with the ECB. The US subprime and Alt-A market, which had peaked at some $815 billion in 2006, vanished, as did markets for many other securitised instruments (Graph 1, right-hand panel).

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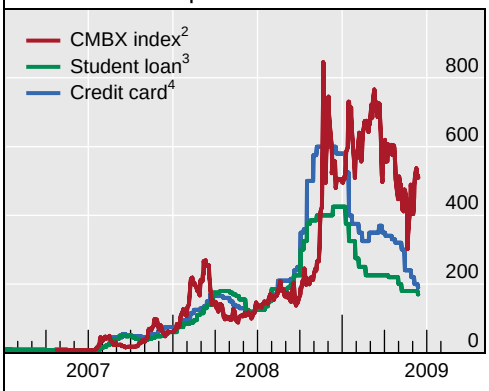
[1] The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS or the National Bank of Belgium. Any errors and omissions remain those of the authors, who thank Emir Emiray for assistance with the data and graphs.

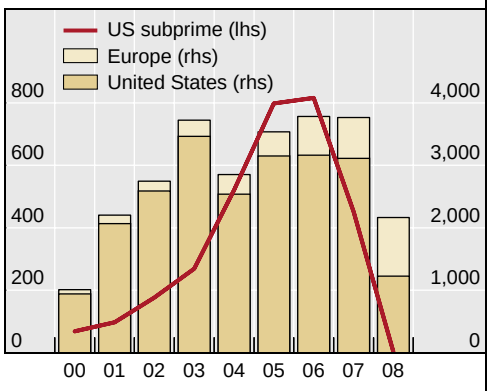
[2] See Chapter II of the BIS *79th Annual Report* (2009) for a five-stage description of the crisis.

Securitisation markets

AAA tranche spreads[1]



ABS issuance volume[5]



[1] In basis points. [2] Spreads on CDS index contracts referencing AAA-rated tranches of US commercial mortgage-backed securities (CMBX index, series 3). [3] Ten-year student loan ABS spreads to one-month Libor. [4] Ten-year floating credit card loan spreads to one-month Libor. [5] In billions of US dollars; includes agency and private label securitisations.

Sources: JPMorgan Chase; SIFMA; UBS; BIS calculations. Graph 1

Problems in the securitisation process were central to this collapse in activity. Securitisation involves the pooling of assets and the subsequent sale to investors of claims on the cash flows backed by these asset pools.[3] As such, securitisation tends to incorporate a rather long chain of participants and its functioning depends crucially on whether the relationships between these participants preserve discipline and maintain adequate information flows along that chain.

This article sets out measures that could be taken to revive and strengthen the securitisation process, thereby revitalising the flow of credit to sectors such as consumer and mortgage finance. Renewing securitisation has *conjunctural* as well as *structural* elements. Chief among the former is the large overhang of securitised products (ie the so-called legacy assets) sitting on bank balance sheets and the uncertainty regarding future asset performance, both of which are depressing valuations. In order to help markets recover, governments in a variety of countries have taken steps to remove this overhang – either in the form of "bad bank" and similar measures targeting bank balance sheets directly[4] or by reviving investor interest through the provision of government funding in the markets for particular securitisations. One example is the US Term Asset-Backed Securities Loan Facility (TALF), which provides loans on a collateralised, non-recourse basis to holders of certain types of newly issued asset-backed securities.

[3] In the remainder of this special feature, the term securitisation will be used both for "traditional" asset-backed securities (ABS) backed by large homogeneous asset pools, such as credit card and auto loans, and for collateralised debt obligations (CDOs) and related instruments, which are backed by smaller pools of more heterogeneous assets. In addition, it will be assumed that the liabilities backing these asset pools are tranched, forming a three-tiered capital structure of equity/first-loss, mezzanine and senior tranches.

[4] See Fender and Scheicher (2009) for a rationalisation of these measures based on evidence of sizeable illiquidity premia in prices for certain subprime mortgage securitisations.

Overall, these measures may be showing some signs of success. Spreads on securitised products have come down from their peaks (Graph 1, left-hand panel) and volumes have recovered somewhat, though unevenly across market segments. However, while providing temporary relief, these measures are unlikely to attract the stable base of dedicated longer-term investors needed for securitisation markets to recuperate in a sustained fashion. With large parts of the traditional investor community (such as structured investment vehicles (SIVs) and other conduits) having disappeared, more needs to be done.

Key to rebuilding investor confidence is addressing the structural weaknesses in securitisation that have been exposed by the crisis. These, and proposals to eliminate them, are reviewed below, focusing in particular on plans for originators and arrangers to retain some exposure to the securitisations they help to generate. The key finding is that the degree to which the originator's retained stake will be affected by a downturn will significantly influence the impact that the stake will have on incentives to adequately screen borrowers.

The remainder of this article is organised as follows. The next section briefly describes securitisation markets and how they work. This is followed by sections focusing on structural shortcomings revealed by the crisis and ways to address them. The last section concludes by identifying some implications for policymakers and market practitioners alike, including a set of simple "rules" for the design of tranche retention schemes.

Tackling the structural weaknesses in securitisation

Securitisation: a short review of the basics

(i) What is securitisation?

Key to securitisation …

The starting point for any discussion of structural weaknesses in securitisation markets is the securitisation process. In general, securitised instruments can be defined through three distinct characteristics: (1) *pooling of assets* (either cash-based or synthetically created); (2) *delinking* of the credit risk of the collateral asset pool from that of the originator, usually through the transfer of the underlying assets to a finite-lived, standalone special purpose vehicle (SPV); and (3) *tranching of liabilities* (ie issuance of claims with different levels of seniority) that are backed by the asset pool.[5]

… is the tranching process …

A key aspect of tranching is the ability to create one or more classes of securities accommodating different investor appetites. One way to achieve this is to generate some tranches whose rating is higher than the average rating of the underlying asset pool (other tranches, in turn, will carry lower ratings or remain unrated) or to generate rated securities from a pool of unrated assets. This is accomplished through the use of various forms of credit support to create securities with different levels of seniority. The main tool in this context is the priority ordering of tranches with regard to the allocation of losses

[5] See Fender and Mitchell (2005) for a broader discussion of these issues.

(ie subordination): the equity or "first-loss" tranche absorbs initial losses up to the level where it is depleted, followed by mezzanine tranches which take some additional losses, again followed by more senior tranches. As a result, the most senior claims are expected to be insulated – except in particularly adverse circumstances – from the default risk of the asset pool through the absorption of losses by subordinated claims.

… as a way to provide credit support for investors

Another type of credit support is provided through structural provisions based on triggers and threshold levels. One example is overcollateralisation tests, which, when triggered, divert cash flow to senior note holders, in an attempt to maintain stability of performance for these tranches over time. Another example is rules regarding the use of excess spread, which represents the difference between the income earned on the asset pool and contracted payments to the tranched liabilities. Excess spread tends to be accumulated for the benefit of all investors, but is released to equity holders once certain requirements are met.

In principle, these structural provisions can be used interchangeably with subordination. For example, a reduction in the credit support provided to senior tranches via subordination can be compensated through more stringent rules for releasing accumulated excess spread to equity tranche holders. A downside of these trade-offs is additional complexity and the associated analytical burden for investors: the evaluation of a securitised instrument (ie a tranche) cannot be confined to estimating the loss distribution of the asset pool alone. It is also necessary to model the distribution of cash flows from the asset pool to the tranches under different scenarios, based on an assessment of subordination and the deal's structural features (CGFS (2005)).

(ii) Market organisation and incentives

Securitisation involves …

One implication of the pooling and tranching that characterises securitisation markets is the need to involve a relatively large number of parties in the securitisation process (Graph 2 illustrates the range of participants for a generic transaction). Organising such a process in ways that maintain incentives (eg in terms of screening asset quality) and the flow of information along the chain of participants can be a challenge. For certain types of securitisations, this is now universally recognised to have gone wrong in the run-up to the current crisis.

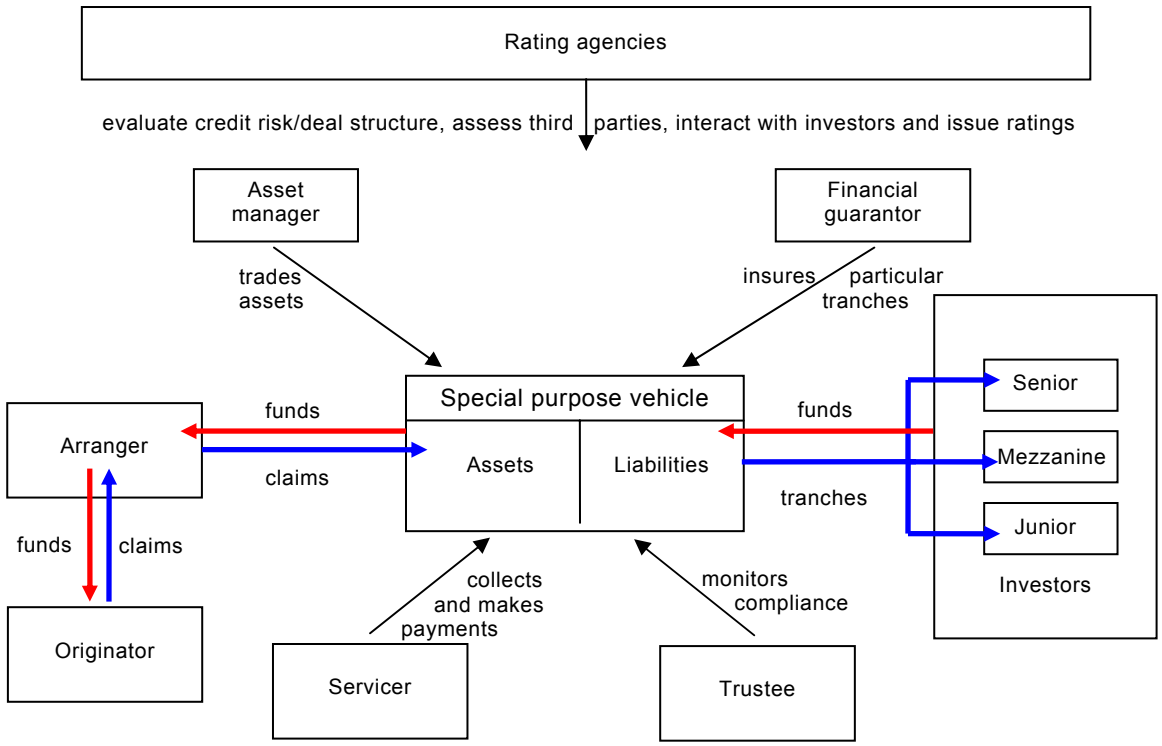
… originators …

The process starts with the originators, who extend loans or other forms of credit to ultimate borrowers. Those originators who, in the ordinary course of business, do not retain a portion of the loans that they have extended will have weakened screening incentives, something that may be exacerbated by business models emphasising volume over quality. Arrangers, in turn, source assets from originators (or may themselves originate these assets) for the purpose of securitisation, where funding is obtained through the tranches issued against the resulting asset pools. In principle, arrangers employ similar business models as originators and also tend to have compensation schemes that favour transaction volume. A key issue with respect to originators' and arrangers' incentives is whether loans are originated more or less exclusively

… arrangers …

Securitisation markets: key participants

Stylised overview of the "players" involved in securitisations and of their respective roles



Source: Adapted from Fender and Mitchell (2005). Graph 2

for the purpose of securitisation (ie whether the "originate-to-distribute" model applies) or whether only portions of portfolios are securitised and it is not known at the point of origination which loans will be securitised (ie "originate-and-distribute"). The former model appeared to be a distinguishing feature in US residential mortgage markets (Kiff and Mills (2007)), whereas banks in other countries often seem to securitise only relatively small parts of the loan and mortgage portfolios they originate.

… rating agencies …

Credit rating agencies have been another important part of the process, supplying investors with assessments of the credit risk (expressed as expected loss or probability of default) of securitised instruments. Because of the high proportion of their rating revenues derived from structured finance prior to the crisis, rating agencies may have been encouraged to rate highly complex products for which little or no historical performance data existed. For the same reason, the agencies may have failed to make their methodologies and related risks transparent enough (at least to investors), and to highlight the limits of ratings in measuring risks beyond expected loss (CGFS (2005, 2008)).

… and investors …

At the end of the securitisation chain, investors are usually expected to exert discipline on other parties involved in the production process through the price mechanism. However, the degree of discipline effected by investors critically depends on the availability and quality of information, and their ability to analyse securitised instruments using that information. As such, investor influence also tends to depend upon where in the capital structure they invest

(ie the degree of seniority of the tranche). Theory suggests[6] that more sophisticated investors (ie those more capable of analysing the risk of the underlying asset pool and of the tranched securities) would tend to buy the riskier and more information-sensitive tranches. By and large, these are the tranches at the lower end of the capital structure (ie equity and mezzanine), which will also pay the highest interest rates to compensate investors for their risks and the costs imposed by their due diligence efforts. Less sophisticated investors, in turn, would be expected to populate the more senior end of the securitisation market – and would receive lower interest rates in return.

… at different levels of seniority

Some market observers have argued that shifts in investor interest across tranches and instruments provided early signs of declining origination quality. One example is the disappearance of traditional mezzanine investors in the subprime market and the resulting placement of mezzanine tranches in complex instruments known as ABS CDOs (collateralised debt obligations backed by tranches of other asset-backed securities), which were themselves funded by a high proportion of AAA-rated tranches. There are also signs that, over time, arrangers found it increasingly difficult to place the most senior, AAA-rated tranches of mortgage-related securitisations at the prevailing spread levels. As a result, many of these tranches remained on banks' balance sheets or were financed through leveraged off-balance sheet entities (with implicit recourse via liquidity guarantees). This allowed banks to transform low AAA spreads into the relatively high equity returns required by investors.

(iii) Complexity, transparency and ratings

Given the market organisation reviewed above, the recent crisis brought to light at least three key structural weaknesses: too much complexity, insufficient transparency and an over-reliance on ratings. All of these tend to exacerbate existing incentive misalignments, while creating various information problems of their own.

Deal complexity …

Complexity. A key driver of complexity is the practice of tranching, which allows for the bulk of a given securitisation to be financed by AAA investors. The tranching of payoffs increases the layering between the performance of the underlying assets and the risk-reward profiles of the tranches held by final investors. As discussed above, links between tranche payoffs and the underlying asset pool performance are further complicated by existing trade-offs between the protection provided by subordination and other structural features. Additional complexities arise when a structure itself contains tranches of other securitisations (ie resecuritisations, including ABS CDOs). By implication, more complicated links between tranche payoffs and pool performance will also increase the difficulty for final investors to obtain a clear picture of the risk and return profile of their stakes. Overall, assessments of value and risk will tend to become increasingly dependent on models, which themselves are subject to uncertainty, as small changes in assumptions can lead to major differences in the risk assessments.

[6] See, for example, DeMarzo (2005). Related papers are reviewed in Mitchell (2005).

… transparency …

Transparency. Securitisation, while increasing the distance between borrowers and lenders, essentially assumes that incentives – for activities such as the proper screening of borrowers – are preserved along the securitisation chain. Historically, reputational considerations have been assumed to act as a control mechanism for the behaviour of originators, but the crisis has illustrated that this did not work sufficiently in the US mortgage context. This type of failure, in turn, puts a premium on the availability of information for proper deal analysis, particularly for those securitisation markets that have historically not provided such information.

… and undue reliance on ratings …

Ratings. One result of increasing complexity and limited transparency has been an over-reliance on ratings. A key issue in this context is that tranching causes ratings of structured securities to behave differently from traditional corporate bond ratings. Specifically, once downgrades of a tranched security occur, they will tend to be more persistent and severe than for corporate bonds. This results in a non-linear relationship between the credit quality of underlying assets and that of tranched products, which will tend to magnify changes in the valuation of securitisation tranches relative to those observed for the underlying asset pool. Investor reliance on ratings, unless supported by other measures of risk, can thus lead to mispriced and mismanaged risk exposures as well as unfavourable market dynamics if these exposures have to be unwound (Fender et al (2008)).

… have been exposed as weaknesses

It is now clear that many investors (including the arranging banks and their risk managers) were not fully aware of the fundamental differences in corporate bond and structured finance ratings, or of the nature of the risks they were taking on with structured products. That is, the disciplining function of investor scrutiny that would have been necessary to align incentives along the securitisation chain was not exercised. An important question is to what extent investors' lack of understanding was due to too little information being available or, rather, to their failure to demand and appropriately process the information that would have been necessary to conduct appropriate risk analysis. Much of the surprise in terms of the performance of securitised instruments occurred among investors in AAA securities, who were probably relying excessively on ratings. Interestingly, some of the most sophisticated institutions were found to be holding AAA-rated tranches and have taken the most severe valuation losses. This included tranches that these institutions themselves had originated, but which were considered "safe" or appropriately hedged (eg via "wraps" sold by specialised insurers).

Proposals for changes to the structure of securitisation markets

Measures to address these weaknesses include …

Several sets of measures have been proposed to address the structural weaknesses revealed by the crisis. The ideas underlying these measures are twofold: first, they should address the problems that have led or contributed to loose underwriting standards in securitisation, particularly in the residential mortgage market; second, they should rebuild confidence for those markets that have not seen a relaxation of credit standards but have nevertheless suffered from the broad investor retreat from securitisation. One of these proposals, required tranche retention, relates directly to the alignment of

incentives between originators and investors and is discussed in more detail in a separate section below. Additional measures relate to reduced complexity, increased transparency and improved ratings. As many of these have been discussed in more detail elsewhere,[7] the following discussion provides a brief summary.

(i) Reduced complexity

… simpler deal structures …

The dramatic losses suffered on exposures to ABS CDOs and other resecuritisations by even the most sophisticated financial institutions illustrate that the riskiness of complex products was vastly underestimated. Part of this problem has been fixed by the markets in that these structures have vanished, and more onerous bank capital requirements for resecuritisations are due to significantly change the economics of these instruments. At least in the near future, investors are likely to insist on simpler structures that are less vulnerable to model risk (ie risks arising from model selection and parameter choice) and easier to analyse.

In this context, simplicity could mean increased standardisation of structures, based on a smaller number of tranches and less reliance on structural features (other than subordination) for credit enhancement. There are early indications that such simpler deals are now starting to appear. Continuation of this development would aid analytical tractability and might thus help to bring investors back into the market. Eventually, additional standardisation would also be expected to support liquidity in secondary markets.

(ii) Increased transparency

… shorter securitisation chains …

Credit analysis of even "traditional" securitisations can be a demanding and information-intensive task. This puts a premium on the speed and quality of the information flow along the securitisation chain. Clearly, shorter chains would help, which argues against a revival of resecuritisations. In addition, better and more timely information, relating both to the riskiness of the underlying assets and to their performance over time, together with standardised reporting of this information, would assist investors in their due diligence efforts. This applies particularly for those market segments that have so far lagged behind in terms of information provision.

… and standardised disclosure of asset-level data

Examples of measures to improve the information flow along the securitisation chain include the American Securitization Forum (ASF) project RESTART. Scheduled to be implemented by end-2009, the proposal will introduce new procedures for disclosure and reporting by issuers and servicers for both new and outstanding securitisations. This includes a standardised disclosure package for use at the initiation of residential MBS, consisting of

[7] See, in particular, ASF et al (2008), CGFS (2008), ECB (2008), Franke and Krahnen (2008) and Issing Committee (2008). See Gorton (2009) for a more controversial approach aimed at supplying repo markets with a reliable source of collateral, based on regulating and supervising SPVs as banks and providing government guarantees for senior tranches of securitisations to facilitate their use as repo collateral.

pool- and loan-level information (such as loan-to-value ratios (LTVs), mortgage rates, location of property, maturity, monthly borrower incomes and payments on other debts). Similar data are to be provided as part of monthly reporting packages and made available to all investors, rating agencies and market participants. Similar proposals have been put forward in Europe, though with less detailed disclosure requirements. This contrasts with the traditional method of data provision, which tended to be pool-level and focused on a limited number of quality indicators. In principle, investors were able to alleviate these information problems if they chose to separately purchase loan-level data and related analytical tools from specialised vendors. However, in the past, data vendors themselves found it difficult to obtain detailed information for some markets and jurisdictions. In Europe, for example, concerns about the confidentiality of borrower data may have interfered with investor needs for more detailed information.[8]

(iii) Improved (use of) ratings

Mechanistic reliance on ratings needs to be reduced …

Over-reliance on ratings has been a key factor behind the crisis, which suggests a two-pronged approach to fixing related problems. First, to the extent that existing regulation encourages mechanistic use of ratings (ie in the form of regulatory ratings-based investment constraints or related privately imposed guidelines), authorities and trustees need to review these ratings-based rules and make any necessary adjustments.[9]

… and more information should be provided along with ratings

Second, better ratings might be required. Many observers have thus called for the rating agencies to improve their rating methodologies. Proposals have differed in depth and scope, and include: requirements to clearly distinguish structured product ratings from corporate debt ratings; provision of information on the sensitivity of structured product ratings to modelling assumptions; and specific demands for changes in rating methodologies, such as more conservative assumptions regarding key model parameters (eg asset-level probabilities of default, recovery rates or default correlations).

Each of the three major rating agencies has already introduced changes along these lines and taken steps to increase transparency in the rating process. A key point in this context is the one-dimensional (expected loss-based) nature of ratings, which implies that like-rated products can have very different risk properties. Multidimensional ratings or disclosures aimed at providing information on risks not covered by expected loss estimates can thus enhance the information content of ratings, while also encouraging more informed use by investors (CGFS (2008)).

In addition, the European Commission recently adopted legislation that will require registration of rating agencies by a competent member state authority and which gives authorities the power to supervise rating agencies, including

[8] The information gap between Europe and the United States may now be narrowing due to new information and monitoring requirements for securitisations contained in recently passed amendments to the Capital Requirements Directive (European Parliament (2009)).

[9] See Joint Forum (2009) for a survey of the uses of credit ratings for regulatory purposes.

the right to enforce "the use of methodologies that are rigorous, systematic, continuous, and can be validated based on historical experience".[10]

Aligning incentives in securitisation markets: tranche retention

Tranche retention requirements …

The measures discussed so far, while essential, are not likely to be sufficient to revive securitisation markets on a sustained basis. Although investors need to be able to adequately assess the risk of securitisations in order to exercise market discipline, measures aimed more directly at aligning the incentives of originators and arrangers are also desirable, for two reasons. First, it is unclear whether market discipline alone will be enough to align incentives in ways that would avoid an erosion of underwriting standards during a future upswing. Second, as a new investor base needs to be developed to replace, at least partially, the loss of leveraged demand in the market, a clearer commitment by originators and arrangers to underwriting quality may be needed to draw these new investors into the market. This also applies to segments of the securitisation market that have not suffered from quality erosion (ie those in which misaligned incentives may have played less of a role) but which have nevertheless been hit by concerns about securitisation more generally.

… have been proposed to align incentives

Along these lines, several recent proposals have focused on retention by the originator and/or arranger of some portion of the securitisation.[11] Such a requirement would guarantee that the originator or arranger has some "skin in the game", providing a direct incentive for prudent behaviour (eg to reliably originate loans based on agreed underwriting standards). The proposal most commonly advanced is to require retention of the equity/first-loss tranche. The idea underlying this requirement is that, by forcing the originator to bear the first losses on the underlying asset pool, the equity tranche will create "high-powered" incentives to exercise due diligence. At the same time, some recent proposals have specified that the originator should hold a share, or vertical "slice", of the portfolio, perhaps with the idea of balancing the originator's interests across all tranches with those of the different investor classes.[12]

It should be noted that the idea of tranche retention is not new. In fact, originators in many types of securitisations have traditionally held on to the equity tranche. Over time, however, investors appeared – rightly or wrongly – to become more comfortable with securitised products, leading to a relatively active market in equity tranches. In addition, use of credit derivatives made it possible to at least partially hedge existing equity tranche exposures. As a result, equity tranches, even when originally retained, were increasingly sold or

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[10] Similar requirements are also under consideration in other jurisdictions (European Commission (2008), US Treasury (2009)).

[11] See European Parliament (2009), US Treasury (2009) and IOSCO (2009).

[12] See European Parliament (2009). Investors in different tranches do have conflicting interests in certain dimensions. For example, equity tranche holders will favour assets with higher default correlations, which would tend to benefit them at the expense of investors in the more senior tranches. Such conflicts of interest, however, are likely to be of second-order importance relative to the determinants of overall asset pool quality.

hedged, weakening any incentives that might otherwise have been created for arrangers and originators. While this was known, it was also believed that reputation would play a role in aligning interests, as originators faced the business risk of having investors shy away from their loans if these were deemed to have been originated on the basis of weak underwriting standards.

But what should these requirements look like?

To the extent that a retention requirement is judged desirable, key policy questions are: how much should be retained, and what form should the retention take? Implicit in the latter question is a judgment on the degree of discretion originators should be given in choosing the form of retention, if a quantitative retention requirement exists. The answers to these questions will depend upon the impact of differing retention mechanisms on, among other things, the effort originators exert to screen borrowers or otherwise perform due diligence on the quality of the underlying assets in a securitisation.

Making tranche retention work: results from a simple model

It will be argued in this section that care must be taken in the design of any required retention scheme. The analysis for this purpose draws on results from recent research on the economics of tranche retention,[13] which shows that different retention mechanisms can have significantly differing impacts on the effort that an originator will exert to screen borrowers. In particular, while increasing effort relative to the case of non-retention, having the originator or arranger retain the equity tranche of a securitisation may lead to lower screening effort than other retention schemes.

Various retention mechanisms are possible …

Three types of retention mechanisms are considered: vertical slice, equity tranche and mezzanine tranche. As discussed in the accompanying box, the various retention mechanisms have different sensitivities to business cycle risk, which implies that the effectiveness of tranches in aligning incentives will be a function of tranche thickness and the economy's position in the cycle. Specifically, retaining the equity tranche yields lower screening effort than other retention schemes if the tranche is "thin" enough to be exhausted in a downturn and if that downturn is relatively likely (ie the equity tranche is likely to be "wiped out"). That is, the "loss cap" provided by the upper boundary of the equity tranche reduces screening incentives if the tranche becomes more likely to be exhausted.[14] Thus, a seeming paradox arises: the more likely screening is to be valuable (ie if a downturn is likely), the less desirable it may be to have the originator retain the equity tranche – or the thicker the equity tranche may have to be in order to generate adequate screening incentives. On the other hand, if the equity tranche is thick enough not to be exhausted in a downturn, this form of retention will dominate the others.

[13] See Fender and Mitchell (2009) for a more detailed analysis.

[14] Another way to think about this is in terms of loss timing. To the extent that assets in the collateral pool have very backloaded default profiles, thin equity tranches can capture sizeable returns before taking losses.

Incentives in securitisation – a simple model

The simple model described in this box focuses on an originating institution that extends loans, with the option to either carry them on balance sheet or pass them on to investors in the form of a securitisation.[1] The originator has an amount Z in funds and extends Z loans of value one each and with maturity of one period. Loans that default have zero recovery, and non-defaulting loans repay $R > 1$. The risk-free interest rate is assumed to be zero, and all decisions – by investors and the originator – are made under risk neutrality. Lending and financing relationships are one-off, with no reputation effects.

Borrowers and screening. There are two types of borrowers: bad (B) and good (G). Bad borrowers have projects with negative net present value; therefore, if the originator believes it is facing a type-B borrower, it will not extend a loan. However, type-B borrowers cannot be identified in the absence of screening. Costly screening effort exerted by the originator will influence the proportion of type-B borrowers in the loan pool: the higher the screening effort, the lower the proportion of B borrowers.

Systematic risk. The loan pool is assumed to be highly granular (ie Z is large), implying that idiosyncratic risk is diversified away. Default frequencies will be determined by the realisation of a systematic risk factor, which can take two possible values: low (L), corresponding to an unfavourable state of nature, or high (H), corresponding to a favourable state. Systematic risk affects borrowers' probabilities of default (PD) in the following way. If the low state is realised, all type-B borrowers default, but type-G borrowers default only with some probability $PD_G(L) < 1$; if the high state is realised, none of the type-G borrowers default, but type-B borrowers default with probability $PD_B(H) > 0$. The probability that the low state occurs is given by p_L and the probability of the high state is p_H.

Benefits of securitisation. Securitisation provides the originator with cash prior to loan maturity. The originator's profit then incorporates two potential sources of revenue: cash flows at maturity from loans (or portions of securitisations) retained on balance sheet, and cash received up front from investors when loans are securitised. The presence of market frictions implies that the cash generated through securitisation has value to the originator. In addition, securitisation often confers indirect benefits on originators through, for example, lowering of capital requirements (regulatory or economic) or remuneration schemes whose value depends on short-term profit. These direct and indirect monetary benefits of securitisation to the originator are captured by multiplying the cash received from securitisation by a parameter $\Omega > 1$.

Securitisation and expected profit. The originator is assumed first to choose whether to securitise the loan portfolio and what form of retention, if any, to use. The originator then chooses its screening effort, originates the loan portfolio and sells the securitised portion to investors. The effort is chosen to maximise expected profit, which has the following general form:

$$\Pi(e) = \Omega S + F(e) - c(e)Z - Z$$

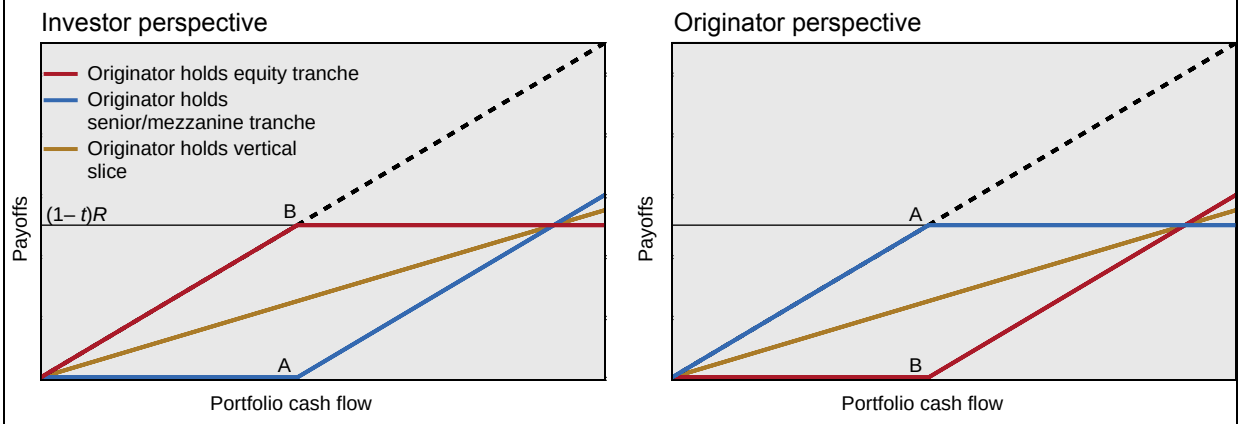
where e is the level of screening effort, S is the cash received from securitisation, $F(e)$ is the expected cash flow from loans (or part of a securitisation) retained on balance sheet, $c(e)$ is the (per loan) cost of screening effort, and Z is the size of the loan portfolio. Note that since screening effort is assumed to be unobservable, the amount of cash investors pay for a securitisation cannot be made contingent on a particular level of screening effort. Thus, once the form of securitisation has been chosen, the originator's choice of effort will be determined solely by the impact of effort on the cash flows $F(e)$ from the retained part of the securitisation, together with the cost of screening. (Investors, when deciding the price to pay for the securitisation, will nevertheless take into account the originator's optimal choice of effort, given the retention mechanism.)

Originator's payoffs with different retention mechanisms. The model is used to consider securitisation of the entire portfolio (where a proportional "slice" of the portfolio is retained by the originator) as well as tranched securitisations, which are assumed to consist of three tranches: equity/first-loss, mezzanine and senior. Retention by the originator of the equity tranche is then compared with retention of the mezzanine tranche and that of the proportional "slice". Key to understanding the differences in these tranches on the originator's choice of effort is the observation that the equity tranche payoff resembles that of a firm's equity investor: the cash flow to the equity tranche is a residual, paid only after the senior and mezzanine tranches have received

their promised payments. The payoff to the holder of mezzanine tranche, in turn, resembles that of (subordinated) debt: the tranche holder will receive a fixed payment unless the portfolio cash flow is too low to meet this payment, in which case the mezzanine tranche holder becomes the residual claimant (implying that the equity tranche is exhausted).[2]

Originator's effort choices with differing retention mechanisms. The logic of the argument is illustrated in Graph A below. The coloured lines depict the payment profiles across different retention schemes from both the investor's and the originator's perspective. Requiring the originator to retain the equity tranche (indicated by the red line in the right-hand panel) makes it the residual claimant with respect to the cash flows from the underlying portfolio. The investor (for simplicity, the graph assumes that there is only one combined mezzanine/senior tranche), then, holds a claim that has the familiar properties of standard debt (the red line in the left-hand panel). That is, the investor will receive the cash flows from the underlying pool of assets up to the point where he/she is being repaid (ie receives his/her share of the promised returns on the pool $(1–t)R$, where equity tranche width is assumed to be t% of the pool). Only from that point onwards will the originator begin to receive payouts. Mezzanine tranche retention works in a similar fashion (with the payoff profiles in the two panels reversed, as indicated by the blue lines), while a share in the overall pool generates a linear payoff profile for both the originator and investor (as suggested by the brown lines).

Retention mechanisms: payoff profiles



Source: Authors, based on Fender and Mitchell (2009). Graph A

In this simple setup, originator incentives for proper screening will depend on expected economic performance and the thickness of the retained tranche. This works as follows. If a downturn is likely (p_L is high) and the equity tranche is thin enough to be depleted if the downturn materialises, then cash flows generated by the asset pool are likely to imply tranche payouts to the left of points A and B in both panels of the graph. As a result, for the case of equity retention (red lines), the originator will expect zero payout. Knowing this prior to loan origination, when screening effort is chosen, reduces its incentives to exert effort. In contrast, both mezzanine tranche and vertical slice retention will tend to generate positive originator payouts for cash flow realisations to the left of points A and B (as indicated by positively sloped payoff profiles). Depending on parameter values, other retention schemes may thus dominate equity tranche retention. (The more standard case of equity tranche domination arises for the relatively high cash flow realisations to the right of A and B, ie situations where a downturn is relatively unlikely and/or the equity tranche is thick enough not to be exhausted in the downturn).

[1] See Fender and Mitchell (2009) for specification and analysis of the model. [2] While the model assumes that the equity tranche may be thin enough to be exhausted in the low state, it also assumes that income is always high enough in the high state for the equity tranche not to be exhausted. This assumption, which can be rationalised by rating agency requirements on subordination levels, excludes certain ranges of outcomes where the equity tranche holder may not receive a payout in either the low or the high state, but this is without loss of generality.

… but their effects depend on a variety of factors

These results suggest that imposing a particular form of retention scheme, while increasing effort relative to the case of non-retention, might generate unintended costs. Specifically, equity tranche (or any other form of) retention is not necessarily the most effective form of incentive alignment, implying that flexibility may be needed with regard to the position of any retained piece in the capital structure. At the same time, specifying the right retention amount will be difficult in that "optimal" amounts will differ across specific transactions and market segments. While this may not matter from an investor confidence perspective (where any amount of retention tends to help), broad minimum requirements (such as the 5% threshold currently contemplated in a number of jurisdictions) are likely to be either too high or too low. If quantitative retention requirements are too low, screening incentives would not be aligned as desired, while requirements that are too high could significantly raise the costs of securitisation in at least some market segments, potentially undermining the goal of market revival.

As a result, flexibility may be required …

Given these difficulties in choosing the size and position of any retention requirement, it may thus be desirable to keep such requirements flexible. One possibility might be to avoid fixing any retention amounts or their position in the capital structure, while mandating detailed disclosures of all relevant information regarding retention (at issuance and over time, including information on whether retained exposures have been hedged). If such information were supplied in a standardised and centralised fashion, in an easily accessible and understandable way, then all investors would be given the possibility to choose the form and volume of retention that they were comfortable with, at least in principle. Moreover, the provision of such information would permit both investors and authorities to track developments in the market, ie the importance of structures with and without retention and the size and position of any retentions. This information could be a valuable macroprudential surveillance tool and could also aid in the design of regulatory requirements (eg differentiated capital charges for securitisations with less retention) or any future supervisory measures aimed at securitisation markets.

… with mandated disclosures one possible solution

Disclosures like this could be achieved in various ways. One would be to incorporate such a requirement into the legal language for securitised instruments, ie by making them a mutually agreed covenant of the transaction between originators and investors. Another would be to use legislative means to require retention and related disclosures, eg via (banking) regulation, as recently agreed by the European Parliament. A third possibility would be for central banks to establish best practice principles via the eligibility requirements of their refinancing operations – an approach that could also be used to change current market standards with regard to deal complexity and availability of asset-level information. In all of these cases, third-party mechanisms will probably be necessary to verify any retentions and disclosures. Such services could be provided by either the supervisory authorities or, in the case of a covenant-based solution, specialised service providers.

Supporting measures

Supporting measures can include …

Retention and disclosure requirements alone may not be enough to guarantee that incentives are indeed aligned along the securitisation chain. As illustrated by the discussion in the box (ie the role played by the omega parameter), a host of factors can be expected to influence the economics of securitisation from an originator perspective. For example, accounting and regulatory features of securitisation, together with remuneration systems in financial institutions, have tended to generate "indirect benefits" to securitisation (going beyond those related to funding) relative to holding loans on balance sheet. These indirect benefits often represent "private" rather than "social" factors, and can encourage originators to favour mechanisms with low (or zero) amounts of retention in order to maximise the private benefits from securitisation.

… modified remuneration systems and accounting rules …

On this basis, current practices and the experience of the crisis may also offer support for initiatives to modify banks' remuneration systems and to adjust regulatory and accounting measures that make securitisation artificially more attractive than other sources of funding. This could include changes to accounting standards that would eliminate immediate recognition of gain on sale by originators at the inception of securitised instruments. Similarly, capital regulation might be adjusted to cover all originating institutions and to grant capital relief to originators only to the extent that true third-party risk transfer has taken place (reducing incentives to "sell" securitisations to vehicles such as SIVs with their implicit recourse to originators).[15]

… as well as capital regulation

Conclusion

The material reviewed in this special feature suggests that a sustained resurgence of issuance activity in securitisation markets will require active steps to address certain structural shortcomings revealed by the financial crisis. In particular, a revival calls for the entry of new investors into the market, which can happen only once confidence has been restored. As a result, action will need to be taken with respect to all market segments, including those that have not suffered from the same misaligned incentives as US subprime mortgage markets.

Many of the measures proposed for this purpose target investors, with the rationale of improving their ability to make informed decisions. Key among these proposals are initiatives aimed at reducing the complexity of securitised instruments, enhancing the availability and quality of information, and improving the reliability and use of ratings. Yet, by placing the burden of effective incentive alignment along the securitisation chain almost exclusively on investors, these measures alone may not be sufficient to fully rebuild confidence and revitalise the market. For such a revival to occur, more direct measures may be necessary. Along these lines, regulation requiring tranche retention by originators or arrangers is currently under consideration. However,

[15] See US Treasury (2009) and Goldman Sachs (2009).

in devising such schemes, care must be taken to appropriately account for trade-offs between market-based and regulatory approaches. In particular, while representing a valuable tool in principle, regulation that imposes a specific retention mechanism is unlikely to adequately align incentives for all transactions. Specifically, retaining equity tranches may not provide strong enough incentives for originators to screen borrowers if downturns are likely and if the retained tranche is thin enough to be exhausted in downturns (ie equity tranche retention is a more effective "fair weather device"). For example, even if originators had expected that housing prices would fall significantly, having them retain the equity tranche of subprime mortgages might not have had the intended effect, unless the equity tranche were very thick. As a result, rigid, "one size fits all" retention requirements that specify both which tranche to retain and how much retention to hold could end up being ineffective or raising costs in ways detrimental to the goal of a sustained market revival.

These observations suggest that forcing originators to disclose the size and nature of any retention may be an alternative to specifying retention amounts. To make such a mechanism work, and irrespective of any formal requirement to actually retain tranches, originators (or arrangers) could be required to disclose the details of any retained exposures, while being granted flexibility regarding tranche width and location in the capital structure. Ideally, such disclosures would then be mandated both at issuance and over the lifetime of any transaction, with a third-party mechanism to validate the information. This, then, would allow markets to flexibly determine the form and size of retention, though with the downside of leaving much of the burden of setting minimum retention amounts with investors.

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Central counterparties for over-the-counter derivatives[1]

Wider use of central counterparties (CCPs) for over-the-counter derivatives has the potential to improve market resilience by lowering counterparty risk and increasing transparency. However, CCPs alone are not sufficient to ensure the resilience and efficiency of derivatives markets.

JEL classification: G01, G15, G18.

Through its Financial Products Group, headquartered in London, American International Group (AIG) managed to sell enormous amounts of credit risk insurance without the financial resources necessary to cover potential payments. By end-June 2008, AIG had taken on $446 billion in notional credit risk exposure as a seller of credit risk protection via *credit default swaps (CDS)*.[2] A CDS contract is a credit derivative that, for a specified bond issuer, protects the buyer against a default or debt restructuring. AIG's unhedged sales of nearly half a trillion dollars of insurance represented a significant concentration of credit risk in a market participant that ultimately did not have the necessary loss absorption capacity. The widespread bond defaults during the recent crisis imposed substantial losses on AIG and other sellers of credit risk insurance. The losses made clear the risks to both individual institutions and the global financial system arising from the vast amount of CDS issuance – and showed that those risks were larger and more severe than anyone had realised. One result has been renewed calls from policymakers for a revision of regulatory frameworks and improvements in the organisation of derivatives markets to reduce the potential for such risks to build up.

Here we focus on an important emerging improvement in market organisation: the introduction of *central counterparties (CCPs)* for over-the-counter (OTC) derivatives, in particular for CDS. A CCP is an independent legal entity that interposes itself between the buyer and the seller of a

[1] The authors are grateful to Claudio Borio, Ingo Fender, Daniel Heller, Robert N McCauley, Frank Packer, Takeshi Shirakami, Philip Turner and Christian Upper 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.

[2] Italicised terms appear in the Glossary, p 57.

derivative security. When trading through a CCP, the single contract between two initial counterparties that is the hallmark of an OTC trade is still executed, but it is then replaced by two new contracts – between the CCP and each of the two contracting parties. At that point, the buyer and seller are no longer counterparties to each other – instead, each acquires the CCP as its counterparty. This structure has three clear benefits. First, it improves the management of counterparty risk. Second, it allows the CCP to perform *multilateral netting* of exposures as well as payments. Third, it increases transparency by making information on market activity and exposures – both prices and quantities – available to regulators and the public.[3]

We proceed by briefly documenting the dramatic growth in OTC derivatives markets in recent years and comparing different ways to organise derivatives markets. We move on to consider how a CCP addresses financial stability issues in OTC derivatives markets and report recent developments in the introduction of CCPs. We then discuss the structural and regulatory challenges related to the introduction of CCPs for trading CDS. The final section offers some concluding observations.

The growth of OTC derivatives markets

Derivatives volumes declined due to crisis ...

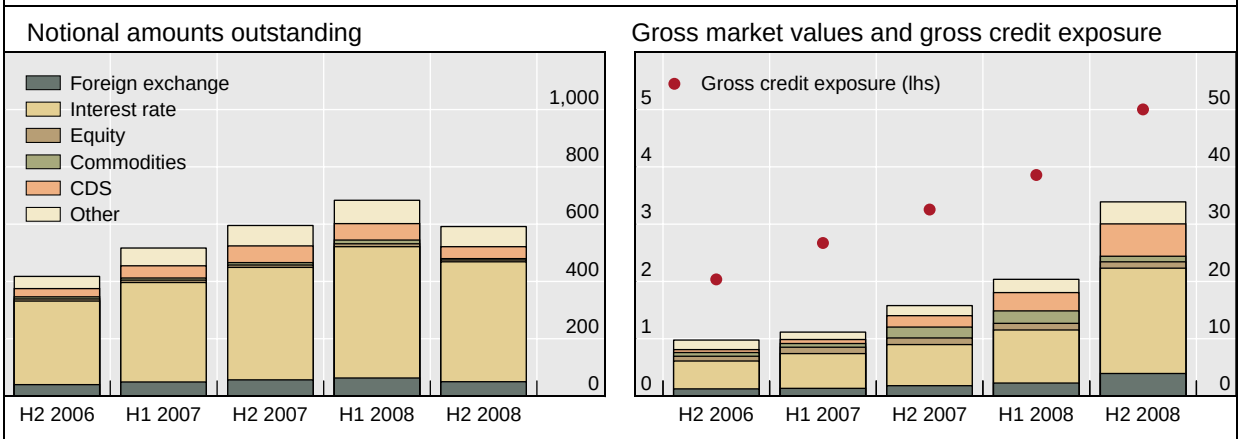
OTC derivatives markets grew continuously from their inception in the early 1980s through the first half of 2008, when their growth was halted and then reversed by the financial crisis. The first-ever decline of *notional amounts outstanding* came in the second half of 2008 (Graph 1, left-hand panel). Even so, by end-2008, outstanding amounts of all types of OTC derivatives contracts stood at $592 trillion, slightly below their level a year earlier.

... while exposures increased

Despite the drop in notional amounts outstanding, large movements in prices meant that the *gross market value* of contracts outstanding continued to

Global OTC derivatives

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



Source: BIS

Graph 1

[3] Some of these benefits may also be obtained through other mechanisms (see Ledrut and Upper (2007)).

rise dramatically, increasing by two thirds to almost $35 trillion at the end of December 2008 (Graph 1, right-hand panel). These higher market values were also reflected in higher *gross credit exposures*, which grew by almost 30% to $5.0 trillion. Anecdotal evidence suggests that as a consequence of the crisis, market-makers – the major dealers who facilitate trading in the OTC derivatives markets – have increased the fees they charge (by widening bid-ask spreads) and have also scaled back the level of their OTC derivatives positions. Furthermore, bank managers as well as regulators have pushed to increase capital allocated to counterparty and market-related risks, making derivatives trading more costly.

The organisation of derivatives markets

We can think of the organisation of derivatives markets as taking one of three forms (Table 1). The first, the bilateral OTC market, is a fully decentralised market in which participants trade – and clear their trades – directly with one another. The second is an OTC market with decentralised trading but with centralised clearing through a CCP. In the third type, an exchange-based market, both trading and clearing are centralised through an exchange that is typically linked to a CCP. As the last type of market organisation is well known, we focus on the first two.

Bilateral OTC market

Bilateral derivatives markets …

In a bilateral OTC market, participants trade directly with one another, either electronically or via telephone. The management of counterparty risk – the risk that the person or firm on the other side of the transaction will fail to live up to what is contractually agreed – has two components: collateral and *bilateral netting*.

… currently use over $4 trillion as collateral …

In the collateral component, the parties limit counterparty risk by requiring the daily posting of collateral reflecting the mark to market changes in the value of the contracts. Collateral agreements can be customised to reflect the contracting parties' assessment both of the riskiness of the position and of each other's credit quality. The posting of collateral implies that actual counterparty exposures are smaller than market values would suggest. Surveys conducted by the International Swaps and Derivatives Association (ISDA) indicate that roughly two thirds of OTC derivatives exposures are collateralised and that the estimated amount of collateral in use at the end of 2008 was approximately $4 trillion, of which almost 85% was cash (see ISDA (2009)).

… and have uncollateralised exposures of at least $1 trillion

The second component of managing counterparty risk, bilateral netting agreements, helps reduce collateral requirements. The ISDA margin survey cited above indicates that virtually all large banks rely on some form of bilateral netting agreement to control counterparty exposures. In many cases, bilateral netting agreements allow for netting across different contract types. BIS statistics on OTC derivatives suggest that the impact of bilateral netting is

Three forms of market organisation for derivatives, by market characteristic

Selected characteristic	Bilateral OTC	CCP	Exchange-based
Trading	Bilateral	Bilateral	Centralised
Clearing	Bilateral	Centralised	Centralised
Counterparty	Initial buyer or seller	CCP	CCP
Product features	All	Standardised and liquid	Standardised and liquid
Product examples	Foreign exchange swaps Interest rate swaps Credit default swaps	Plain vanilla interest rate swaps	Commodities Exchange rate futures Government bond futures
Participants	All	Typically larger dealers and higher-rated market participants	Typically larger dealers and higher-rated market participants
Market maker importance	Significant	Significant	Limited
Collateral practices	Bilateral posting of collateral	Margin requirements uniform for all	Margin requirements uniform for all
Margin movement	Decentralised and disputable	Centralised enforcement by CCP	Centralised enforcement by CCP
Risk buffers	Regulatory capital	Equity and margins	Equity and margins
Clearing and settlement	Bilateral	Centralised	Centralised
Netting	Some gross exposures netted bilaterally and some ad hoc multilateral netting	Exposures are netted multilaterally and position is against a CCP	Exposures are netted multilaterally and position is against a CCP
Regulation	Self-regulation and reliance on "market practices"	Self-regulation, reliance on "market practices" and public sector regulation of CCP	Self-regulation as well as public sector regulation of the exchanges and CCP
Transparency of exposures and activity	Limited or none	Detailed information available but not disseminated	Detailed information available but not disseminated
Transparency of prices	Pre-trade prices are non-binding quotes Actual transaction prices typically not published	Pre-trade prices are non-binding quotes No automatic publication of transaction prices	Pre-trade prices are binding quotes Actual transaction prices published

Table 1

substantial: at end-2008, the gross market value of all OTC derivatives was $33.9 trillion.[4]

However, after one accounts for bilateral netting agreements, the gross credit exposure came to $5 trillion at end-2008.[5] Combining this information with the estimated $4 trillion in collateral implies that uncollateralised OTC derivatives exposure at the end of 2008 came to about $1 trillion.

[4] Of that, $18.4 trillion came from interest rate derivatives and $5.6 trillion from CDS.

[5] Except in the case of the United States, the gross exposure excludes CDS contracts.

Derivatives contracts have gradually become standardised

Bilateral OTC markets have a number of advantages. First, they facilitate the creation of new financial instruments at a relatively modest operational cost. Second, bilateral OTC markets allow customers to tailor products to their individual needs. Nevertheless, in order to facilitate transactions, derivatives contracts have in many cases become more standardised. For example, over the years, *interest rate swaps* and foreign exchange derivatives have become highly standardised through voluntary industry initiatives. One can think of the variation in standardisation across various contracts as both intrinsic to the variation across the contracts themselves, reflecting how amenable they are to standardisation, and as a reflection of how "evolved" the contracts are.

OTC derivatives markets lack transparency

Their decentralised nature, combined with the heterogeneity of the instruments traded, naturally makes bilateral OTC markets less transparent than their centralised counterparts. Information on prices and quantities in bilateral OTC markets is much more difficult to come by. Also, in many bilateral OTC markets, market-makers play an important role as intermediaries, profiting from price discrimination among their customers – one possible explanation for the absence of voluntary post-trade price transparency. That said, many derivatives (including CDS) are increasingly traded on bilateral OTC markets featuring electronic platforms that provide efficient access to real-time pre-trade prices, at least for more liquid instruments.

Central counterparty

CCPs replace existing bilateral arrangements …

In an OTC market with a CCP, trading itself continues to take place on a bilateral basis. Once a trade agreement is reached, however, it is transferred, or "novated", to the CCP: the single contract between the two initial counterparties is replaced by two new contracts between the CCP and each of the two parties.

… and become the only counterparty to buyer and seller

This structure brings with it a number of benefits. First, as the counterparty for all trades, the CCP can net multilaterally, thereby facilitating the reduction of both counterparty and operational risks. Netting on a multilateral basis is done by summing each participant's bilateral net positions with those of the other participants to arrive at a multilateral net position. The resulting multilateral net position is the bilateral net position between each participant and the CCP. The available data indicate that multilateral netting of new CDS trades reduces gross notional exposures by approximately 90 percent. As more counterparties start using the CCPs, the benefits could be even larger.[6]

A second benefit from concentrating all outstanding derivatives positions of the participating buyers and sellers in a CCP is that it improves and simplifies the management of counterparty risk, as well as increasing the efficiency of collateral management. In addition, a CCP will also ensure

[6] In 2008, multilateral netting facilitated by third party operators such as TriOptima and CreditEx eliminated more than $30 trillion of CDS notional principal, or about three-fourths of total outstanding amounts at the end of the year. In the first half of 2009, TriOptima eliminated $9 trillion of CDS notional principal through this mechanism.

consistent *marking to market*, margining and exposure evaluation across its participants.

One crucial characteristic of a CCP is that it mutualises credit and market risk, spreading it among all of its participants. But the capacity of a CCP to absorb risk is determined by the equity capital injected by its members, who own it; the margin it collects; and the practice of marking positions to market. Existing derivatives CCPs generally collect an initial margin from its members to cover potential future exposure in the event that a clearing member defaults. This initial margin, which is a form of collateral, is typically delivered either in cash or in the form of securities that have high credit quality and can easily be sold. As a rule, the CCP will reject new trades from a member whose initial margin is no longer sufficient. In a manner similar to bilateral arrangements, CCPs control risk by marking positions to market and requiring that a variation margin be paid and received each day. In periods with high volatility, positions may be marked to market intraday to limit the size of uncollateralised exposures.

Financial stability and central counterparties

Derivatives markets have mostly worked well

Derivatives should serve to complete financial markets by improving the pricing of risk and helping market participants manage the risks they face. For a number of years this is exactly what the OTC markets for interest rate, exchange rate and commodities derivatives have done. And indeed, many of these markets continued to function well throughout the recent crisis. But the crisis brought to light several major systemic risks related to OTC derivatives markets.

Lack of transparency

Lack of transparency creates risks …

The lack of transparency with respect to exposures held by other market participants creates a variety of risks. One arises from the possibility that market participants and regulators will underestimate counterparty risk in a market dominated by a small number of large international banks and dealers. Before the crisis, market participants and regulators focused on net risk exposures of these firms, which were judged to be comparatively modest. In contrast, less attention was given to the large size of their gross exposures. But the crisis has cast doubt on the apparent safety of firms that have small net exposures associated with large gross positions. As major market-makers suffered severe credit losses, their access to funding declined much faster than nearly anyone expected. As a result, it became increasingly difficult for them to fund market-making activities in OTC derivatives markets – and when that happened, it was the gross exposures that mattered.

… by making large exposures more difficult to detect

A second risk arises from derivative contracts sold to unregulated counterparties. The use of derivatives by hedge funds and the like can create large, hidden exposures. For instance, the steep currency depreciations in Brazil, Korea and Mexico in the second half of 2008 brought to light unexpectedly large forex exposures of domestic corporations that arose from

OTC derivatives transactions.[7] In some cases, host country authorities lacked information about the extent of such local OTC derivatives exposures in which foreign financial institutions served as counterparties.

Finally, it is now clear that the lack of transparency significantly complicated private and public sector responses to the failures of several large financial institutions. As a consequence, policymakers have shown renewed interest in improving the transparency of derivatives markets. Previous efforts in that direction have included improvements in national data collection as well as international collaboration among central banks and the financial industry via the BIS. Under the auspices of the Committee on the Global Financial System (CGFS), the BIS publishes semiannual derivatives statistics as well as a triennial market survey. Moreover, information on outstanding trades in the CDS market are now stored in a centralised trade data warehouse (described below). Nevertheless, information is available only at relatively low frequencies and only for broad market categories. And there is still very little information on either exposure levels or the nature of counterparties.

Introducing CCPs would improve transparency by allowing for easy collection of high-frequency market-wide information on market activity, transaction prices and counterparty exposures for market participants who rely on them. The centralisation of information in a CCP makes it possible to provide market participants, policymakers and researchers with the information to better gauge developments in various markets on the position of individual market participants.

Better access to exposure information has important implications, particularly for the CDS market. For example, the information should help ensure that adequate collateral is posted by CDS protection sellers. By raising the cost of taking very large positions, the maintenance of adequate collateral helps lower concentration risk. Similarly, the stricter margining rules imposed by a CCP increases the cost of taking short positions. Short selling a company can hinder its ability to raise funds in capital markets and thus increase its risk of default. That is, the possibility exists that the buyer of CDS can make the payoff of the insurance more likely. If this is correct, interposing a CCP could help lower the risk of default created by uncovered CDS positions or short selling.[8]

Insufficient financial resources to cover potential losses

More financial resources to cover losses with a CCP

The limited capital available to cover losses from writing CDS has also become a major concern. Historically, protection sellers have been subject to much lower capital allocation requirements than have the writers of other types of insurance contracts. This concern is also addressed by a CCP. If the risk

[7] CGFS (2009).

[8] Also, and in contrast with buyers of many other insurance contracts, buyers of these contracts are not required to have any stake in the underlying asset. For example, most jurisdictions prohibit buying fire insurance on someone else's house or life insurance on another person's life. For CDS, there is no requirement that the buyer owns the bond or has any other stake in the company on which the insurance is written.

management of the CCP follows current recommendations and practices, it should result in a higher overall posting of financial resources relative to potential losses than with OTC markets. However, this, combined with the perceived high costs of operating CCPs, may in part explain the long-standing opposition among key market participants to the introduction of CCPs.

Increased procyclicality

Increased pro-cyclicality of markets ...

The increased use of CDS in recent years, combined with the rise in the volume of other types of derivatives, has arguably increased the procyclicality of the financial system. That is, greater notional quantities of derivatives outstanding could be a source of the reinforcing feedback between the real economy and the financial system. One reason is that in bilateral markets, OTC derivatives contracts normally require that, when downgraded, a protection seller must post more collateral. AIG is an important example. Asked to post significant amounts of additional collateral when it was downgraded from AAA, the largest insurance company in the world basically failed.

... less of a concern with a CCP

The tendency of derivatives markets to exacerbate the procyclicality of the financial system could be mitigated in a number of ways by the increased use of CCPs. First, by lowering counterparty risk concerns in periods of market stress, a CCP might help ensure that trading in CDS products continues in situations in which bilateral OTC markets might seize up. Second, more netting should result in less use of collateral, which would tend to reduce procyclicality. Third, a CCP may involve fewer downgrade-induced jumps in collateral, as it would require collateral to be posted by all counterparties, including those that are AAA-rated; this feature may in turn reduce pressure on markets for the securities used as collateral. Finally, a CCP has the potential to internalise market externalities by lowering margin requirements, as demonstrated during earlier equity market crises in, for example, Japan (Hardouvelis and Peristiani (1992), Borio (2004)). Nevertheless, because of their higher frequency in a CCP, centralised and uniform margin calls (compared with decentralised and less uniform collateral practices in bilateral OTC markets) could aggravate procyclicality.

Recent developments in the introduction of CCPs

Strong regulatory push for CCPs

In light of the weaknesses of bilateral OTC markets, there has been a strong push to introduce CCPs for CDS. For example, the Financial Stability Board (formerly the Financial Stability Forum) has urged market participants to create central counterparty clearing for OTC credit derivatives (FSF (2008)). Central counterparties for other derivatives, such as interest rate swaps, have been in place for a decade, and those for futures and options have, in some cases, been around for more than a century.

Interest rate swaps

CCPs for inter-dealer interest-rate swaps already exist

SwapClear, a UK-based CCP for interest rate swaps, was established in September 1999. Its purpose was to reduce counterparty and operational risk and to economise on the use of collateral for the major inter-dealer swap

traders.[9] SwapClear initially provided clearing for *plain vanilla* interest rate swaps of up to 10 years' maturity in US dollars, euros, Japanese yen and British pounds. Since then, the range of products, currencies and maturities cleared has been expanded to include 14 currencies and 22 indices. SwapClear estimates that they clear about 60 per cent of the global market for interbank OTC interest rate swaps. In May 2009, they announced plans to extend interest rate swap clearing beyond banks in the second half of 2009. Meanwhile, in 2008, two new CCPs for interest rate swaps were introduced in the United States.[10] At this writing, transaction volumes in these two American CCPs have remained low.

Credit default swaps

Over the past year, several measures have been introduced in CDS markets that should help facilitate the introduction of CCPs. First, industry on both sides of the Atlantic has moved toward standardising CDS contracts and trade practices. These initiatives have included introducing a small number of standardised fixed coupons as well as simplifying the set of conditions that trigger payments – so-called "default events." Also, following the March 2008 takeover of Bear Stearns, *close-out netting* was introduced to avoid the complications that arise when a protection seller fails. These rules allow similar contracts to be settled simultaneously rather than one at a time. Finally, in an effort to lower operational risks, work is proceeding to develop a new framework for resolving disputes about contract valuation and posting of collateral.

CCPs are being introduced in both the US and European CDS markets

The past year has also witnessed the introduction of several new CCPs for CDS, and more are likely to follow. In the United States, ICE Trust, owned by the Intercontinental Exchange (ICE), became operational in March 2009. So far ICE has focused on the most actively traded North American CDS index contracts. In the period since March up to mid-August, they cleared just over 21.000 contracts with a notional value of $1.8 trillion – still a relatively small fraction of the market.

In Europe, two CCPs – ICE Clear Europe, operated by ICE, and Eurex Credit Clear, operated by Eurex – began operation in the last week of July. And a third CCP, LCH.Clearnet, is expected to become operational by the end of this year. These CCPs for CDS focus on making it possible for market participants, in particular the larger dealers, to reduce counterparty exposures to the more actively traded single-name CDS contracts and to standardised CDS indices.

As for market transparency, an interesting new development has been the creation by Depository Trust & Clearing Corporation (DTCC) of a centralised trade-data repository or warehouse. The warehouse provides nearly complete

[9] SwapClear is part of LCH.Clearnet which is a recognised clearing house under UK law and is supervised by the Financial Services Authority.

[10] One of them, CME Cleared Swaps, is linked to the Chicago Mercantile Exchange, and the other, International Derivatives Clearing Group, is linked to Nasdaq.

Impact of multilateral netting on CDS volumes for selected reference entities			
	Gross notional[1]	Net notional[2]	Net over gross[3]
Financials			
Deutsche Bank	70.9	8.0	11
Morgan Stanley	85.2	6.5	8
Bank of America	121.4	6.0	5
Goldman Sachs	81.8	5.3	6
Corporates			
General Electric	81.5	10.9	13
Deutsche Telecom	63.0	3.9	6
Telefonica	51.8	3.8	7
France Telecom	63.3	3.6	6
Average, top 1,000 entities	14,621.5	1,401.7	10

For the week ending 6 March 2009.

[1] The sum of all contracts bought (or, equivalently, sold), in billions of US dollars. [2] The sum of net protection bought – or, equivalently, of net protection sold – in billions of US dollars. [3] In per cent.

Source: DTCC. Table 2

coverage of outstanding standardised single- and multi-name CDS contracts worldwide. Less standardised CDS contracts, including those that insure complex debt instruments such as CDOs and other credit derivatives, are not covered. The DTCC publishes weekly information on notional amounts outstanding, by counterparty type, on both a gross and net (after netting) basis for individual reference entities (Table 2).

Challenges related to the introduction of central counterparties

CCPs must be very robust …

Market participants and regulators face a number of challenges if the introduction of new CCPs for OTC derivatives is to be a success. As our previous discussion implies, a CCP concentrates counterparty and operational risks and the responsibilities for risk management. Therefore, it is critical that CCPs have both effective risk control and adequate financial resources. In addition to sufficient capital provided by the members, this means clearer and stricter rules on the posting of collateral to cover counterparty exposures than has been seen in bilateral OTC derivatives markets.

… which implies strong risk management standards

Because of the damage that would occur in the event of a disruption, central banks and securities regulators have taken a strong interest in defining best practices for CCP risk management. This can be seen, for example, in the detailed and comprehensive international standards for CCP risk management published jointly in 2004 by the Committee on Payment and Settlement Systems (CPSS) and the International Organization of Securities Commissions (IOSCO) (CPSS and the Technical Committee of IOSCO (2004)).[11] These standards were prepared for financial contracts, including derivatives traded on securities exchanges and in OTC markets. Nevertheless, applying them to

[11] The CPSS has also more recently considered the potential for expanding the use of CCPs to reduce counterparty risks (CPSS (2007)).

CCPs for CDS contracts will likely involve some interpretation. The introduction of CCPs for credit derivatives therefore raises the question of whether changes are necessary to the 2004 CPSS/IOSCO recommendations. For example, a clear procedure is needed for defining a default event, for valuation, and for margin. And, to avoid cross-border distortions, uniform application of standards is needed across all CCPs handling derivatives. Thus, in July 2009, the CPSS and IOSCO created a working group to review the application of the 2004 standards to clearing arrangements for OTC derivatives, with the aim of publishing their findings next year.[12] IOSCO has also focused on standardisation, increased transparency and minimising the risk of CCP failure in its recommendations for reform of CDS market infrastructure (IOSCO (2009)).

CCPs have generally worked well

It is worth emphasising that during the recent financial crisis, existing CCP arrangements have performed well. Good risk management and adequate capitalisation have ensured a well-functioning mutualisation of counterparty risk. Nevertheless, the crisis has exposed the need for international coordination of the oversight of systemically important CCPs by central banks and other relevant authorities. One important and as yet unresolved question is whether CCPs should have access to central bank credit facilities and, if so, when. Keeping a CCP liquid in the face of the failure of one or more participants requires that liquidity be available somewhere. Currently, however, access to central bank liquidity varies widely across jurisdictions.

Public support likely needed in crisis periods

The need to insure continued operation in the face of a systemic event, in which a number of participants collapse simultaneously, suggests that CCPs may require public sector support. The global nature of most derivatives markets, and the resulting need to coordinate liquidity (and possibly capital) support internationally, will pose a significant challenge. As is always the case, to minimise market-wide uncertainty during periods of stress, there may be a case for making the nature of any support clear ex ante; on the other hand, moral hazard risks argue for some degree of "constructive ambiguity" about the scale and terms of possible public sector assistance.

Moreover, the introduction of CCPs alone is not likely to be sufficient to ensure that OTC derivatives markets operate efficiently and remain resilient in the face of large shocks. It is important to complement the introduction of CCPs with improvements in trading and settlement infrastructure. This includes the greater use of automated trading, registration of all trades in central data depositories, and enhanced risk management and disclosure requirements for market participants themselves.

It is likely that more CCPs will be created. That development would have both advantages and disadvantages. For instance, having several CCPs could provide a level of redundancy in case of operational problems, and it could also

[12] The European System of Central Banks and the Committee of European Securities Regulators recently published recommendations for securities settlement systems and central counterparties in the European Union (ESCB and CESR (2009)). The recommendations for CCPs are consistent with the 2004 CPSS/IOSCO recommendations. However, they also consider a wide range of aspects relevant for the clearing of OTC derivatives in general and credit derivatives in particular, and they address the risks of clearing OTC derivatives.

help encourage technological competition and innovation. But these benefits could very well be outweighed by a variety of costs. First, with multiple CCPs, large market players would need to post equity capital and initial margin in each one. Second, the existence of multiple CCPs makes regulatory consistency important in order to prevent regulatory arbitrage. Third, with several CCPs, someone will have to go through the costly process of consolidating trading and position information. Finally, multilateral netting will be more difficult unless sufficient international coordination takes place across CCPs handling similar instruments. So while a single CCP would almost surely reduce systemic risk relative to a bilateral OTC system, multiple CCPs may not (Duffie and Zhu (2009)). This might make it less attractive for market participants to move their trades to CCPs.

Multiple CCPs increases need for international coordination

Concluding remarks

Experience during the recent crisis points to the need for fundamental improvements in the management of counterparty risk and transparency in OTC derivatives markets. The introduction of well-designed central counterparties (CCPs) can help achieve those gains in several ways. First, concentrating outstanding derivatives positions of participating buyers and sellers in a limited number of CCPs can reduce counterparty risk, making the entire financial system safer. Second, CCPs can help bring about significant gains in operational efficiency through the standardisation of risk management and more efficient management of collateral. Third, by facilitating data collection, CCPs can contribute significantly to improving market transparency. Fourth, assuming high-quality risk management, CCPs should increase the amount of collateral and capital available to absorb potential losses. And finally, the introduction of CCPs may help reduce the contribution of derivatives to the procyclicality of the financial system.

The introduction of CCPs alone, however, is not sufficient to ensure that OTC derivatives markets operate efficiently and remain resilient. It is important to complement the introduction of CCPs with improvements in trading and settlement infrastructure.

Finally, introducing CCPs for nonstandard, custom-made OTC derivatives may not be feasible or even desirable (Pirrong (2009)). OTC markets have been an engine of financial innovation and continue to offer cost-effective and well-tailored risk reduction products. Preserving the incentives to create new financial instruments is important – and here, OTC markets have clear advantages. As new contract types become more widely used, however, the overall benefits from using a central counterparty will likely outweigh the flexibility offered by the over-the-counter format.

Glossary

Bilateral netting: offsetting of positions between two counterparties.

Central counterparty (CCP): an entity that interposes itself between counterparties to contracts traded in one or more financial markets, becoming the buyer to every seller and seller to every buyer.

Close-out netting: an arrangement to settle all contracted – but not yet due – obligations to, and claims on, a counterparty through a single net payment, immediately upon the occurrence of one of the events of default as defined in the contract.

Counterparty credit risk: the risk that a counterparty will not settle an obligation in full value, either when due or at any time thereafter.

Credit default swap (CDS): a credit derivative contract covering the risk that a specified entity will default. Following a defined default event, the protection buyer receives a payment from the protection seller to compensate for credit losses. In return, the protection buyer pays a premium to the protection seller until maturity or a default event, whichever comes first. A CDS refers to either single entities ("single-name") or baskets of several entities ("multi-name").

Gross credit exposures: the gross value of contracts that have a positive market value after taking account of legally enforceable *bilateral netting* agreements.

Gross market value: the sum of the absolute values of all open contracts with either positive or negative replacement values at the prevailing market price. The term "gross" is used to indicate that contracts with positive and negative replacement values with the same counterparty are not netted.

Interest rate swap: an agreement between two parties in which one stream of future interest payments is exchanged for another based on a specified *notional amount*. Interest rate swaps often exchange a fixed payment for a floating interest payment (often linked to a Libor rate). This notional amount is used only for calculating the size of cash flows to be exchanged.

Marking to market: the revaluation of open positions at current market prices and the calculation of any gains or losses since the last valuation.

Multilateral netting: arithmetically performed by summing each participant's *bilateral net* positions with those of the other participants to arrive at a multilateral net position. Such netting is often conducted through a *CCP*. The multilateral net position represents the bilateral net position between each participant and the CCP.

Notional amount outstanding: the reference amount from which contractual payments are calculated. The sum of notional amounts outstanding is one measure of market size.

Plain vanilla transactions: generally, a type of derivatives transaction with simple, common terms that can be processed electronically. Transactions with unusual or less common features are often referred to as "exotic", "structured" or "bespoke".

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The cost of equity for global banks: a CAPM perspective from 1990 to 2009[1]

This article provides estimates of the inflation-adjusted cost of equity for banks in six countries over the period 1990–2009. This cost is estimated using the single-factor capital asset pricing model (CAPM), where expected stock returns are a function of risk-free rates and a bank-specific risk premium. Cost of equity estimates declined steadily across all countries from 1990 to 2005 but then rose from 2006 onwards. The fall in the cost of equity reflects (i) the decrease in risk-free rates over this period, and (ii) a decline in the sensitivity of bank stock returns to market risk (the CAPM beta) in all countries except Japan. The estimates show wide variation across banks, highlighting the difficulty of estimating expected returns using the CAPM.

JEL classification: G12, G21, G32.

One lesson drawn from the ongoing financial crisis is that banks should hold more common equity in their capital structure. Common equity is the first category of bank capital available to absorb losses; the greater this cushion, the more losses a bank can withstand while remaining financially viable. For this reason, common equity is also the most expensive form of bank capital, as investors expect to be rewarded for the greater risk they bear through some combination of dividends and capital appreciation.

If banks are expected to have more common equity in their capital structure, how much will this extra equity cost? Perceptions of banks' riskiness have clearly risen over the course of the crisis, as seen in falling stock prices and widening spreads on bank bonds and credit default swaps. Even so, the impact on banks' cost of equity is not immediately observable. Bank stocks have become more volatile and the risk premium for banks may have increased. However, this rise may have been offset by the sharp fall in risk-free rates and the support provided by governments and central banks. While it is too early to measure how these events might affect banks' cost of equity in the future, this paper traces changes in these inputs over 1990–2009.

[1] The views expressed in this article are those of the author and do not necessarily reflect those of the BIS. The author would like to thank Claudio Borio, Stephen Cecchetti, Jacob Gyntelberg, Robert McCauley and Christian Upper for very useful comments and discussions. Thomas Faeh provided excellent research assistance. All errors and omissions remain my own.

This feature provides estimates of the cost of equity for banks headquartered in six countries: Canada, France, Germany, Japan, the United Kingdom and the United States.[2] The 20-year period examined incorporates several business cycles globally, as well as a number of asset bubbles and other shocks to the financial system. Cost of equity estimates are generated using the capital asset pricing model (CAPM), which the Federal Reserve System has used as its sole methodology since October 2005 (Barnes and Lopez (2006)).[3] The study looks at a sample of 89 banks, and includes institutions that have merged or been acquired, gone bankrupt or been rescued, and those that have remained intact over this period.

The estimates of the cost of equity for banks declined steadily across all countries (except Japan) from 1990 to 2005 but then rose from 2006 onwards. There are clear cyclical patterns, with increases in all countries around 1994 and again in 1999–2000. Part of the overall decline is explained by the fall in risk-free rates over this period. The main contributor, however, is the fall in the banking sector risk premium, which represents more than two thirds of the level of the cost of equity estimates. This risk premium is the product of the CAPM beta and the historical equity market risk premium (which is treated as a constant). The decline is therefore due to the lower CAPM betas, reflecting the lower covariance of bank stock returns and market returns. Here again Japan is the exception, as the beta for banking stocks in that country has remained mostly unchanged over this period.

The article first reviews prior studies of banks' cost of equity and the methodologies employed. The second section outlines the CAPM, and the third presents the empirical results, with the details and data sources in a box. The fourth section looks at explanations for changes in the banking sector's cost of equity over time. The fifth section checks the sensitivity of the estimates to key assumptions, and the conclusion summarises the findings.

Prior studies of bank cost of equity

There are few studies of bank cost of equity

Even though banks must hold capital for regulatory purposes, only a few studies provide estimates of the cost of equity for financial institutions, particularly for banks outside the United States. Most corporate finance studies exclude banks, arguing that the role of leverage, taxes and other factors is different in this highly regulated sector.

One possible measure is the historical return on equity …

Zimmer and McCauley (1991) estimate the cost of equity for 34 international banks from six countries over the period 1984–90. They proxy the cost of equity using the bank-level return on equity (ROE). This measure takes the ratio of banks' reported earnings to market capitalisation, with earnings adjusted for inflation and accounting distortions. This ROE is then averaged over time and across banks from each country to arrive at the

[2] The cost of equity is one input into a firm's weighted average cost of capital, which reflects the costs and respective weights of debt, equity and preferred shares in a firm's capital structure.

[3] The cost of equity was also estimated using the multifactor Fama-French model (Fama and French (1996)). The results were similar and are available upon request.

Bank real cost of equity estimates across studies				
	Zimmer and McCauley (1991)	Maccario et al (2002)	This study	
Method	Real return on equity	Inverse of P/E ratio	CAPM	
	1984–90	1993–2001	1993–2001	2002–09
Canada	10.3	12.0	10.7	5.4
France	…	7.7	10.6	7.3
Germany	6.9	7.0	11.4	9.0
Japan	3.1	2.8	12.0	11.2
United Kingdom	9.8	8.9	9.5	6.6
United States	11.9	8.8	10.4	7.2

Sources: Maccario et al (2002); Zimmer and McCauley (1991); author's estimates. Table 1

country estimates. The authors recognise that although a backward-looking accounting measure may not be optimal for measuring the cost of equity, it has the advantage of being observable. Their results show that the ROE was highest for banks in the United States, Canada and the United Kingdom and significantly lower in Germany and Japan (Table 1).

… and another is based on a dividend discount model

Maccario et al (2002) measure the cost of equity for non-US banks using a dividend discount model (DDM) approach, adjusted for inflation.[4] They study banks in 12 countries over the 1993–2001 period and measure the cost of equity using the inverse of a bank's forward-looking price/earnings multiple (the earnings yield). To use the DDM in this manner, the authors assume that analyst forecasts are the best estimate of next year's earnings, earnings grow thereafter at the same rate as the economy, and a fixed ratio of earnings is paid out as dividends. A direct implication of this approach is that more profitable banks face a higher cost of equity. The authors conclude that banks located in Canada, Sweden and the Netherlands face the highest cost of equity, and German and Japanese banks the lowest (Table 1). While the use of earnings forecasts has its merits, accounting studies highlight the shortcomings of this approach as well as its sensitivity to the inputs (Easton (2009)). The DDM approach is therefore not used in this paper.

The Federal Reserve System uses cost of equity estimates to price its services …

Green et al (2003) and Barnes and Lopez (2006) describe the methods used by the Federal Reserve to estimate the cost of equity for US banks. Since the passage of the Monetary Control Act of 1980, the Federal Reserve Banks have been required to charge depository institutions for the Fed's payment services at prices that fully reflect the costs a private sector provider would incur. The Fed's methodology for imputing these costs is known as the Private Sector Adjustment Factor (PSAF). One input to this calculation is an estimate of the average bank's cost of equity, which until 2002 was based on the comparable accounting earnings method, where the cost of equity was set to

[4] A DDM views the price of a stock today as the discounted present value of future dividends payable to shareholders. By forecasting a bank's future earnings and dividends, an estimate of the cost of equity can be backed out from the current stock price.

equal the average ROE for a representative group of banks – similar in spirit to the measure used in Zimmer and McCauley (1991).

… and relies on the CAPM

Given concerns about these estimates, the PSAF cost of equity from 2002 to 2005 was the average of three estimates based on comparable accounting earnings, a dividend discount model and the CAPM (Green et al (2003)). The average estimate for US banks based on the CAPM by Green et al is 15%, much higher than the comparable estimates from either Zimmer and McCauley (1991) or Maccario et al (2002). In 2004 the Fed began an internal review of these methods, involving in-house research and consultations with academics and private sector consultants. As part of this review, Fed economists Barnes and Lopez (2006) tested whether the CAPM estimates were robust to changes in the size of the peer group, the introduction of additional factors and variations in the calculation method. They concluded that cost of equity estimates based on averaging CAPM estimates across a group of banks were reasonable for the purposes of the Federal Reserve System, which therefore adopted the method as the sole approach for estimating the bank cost of equity as of 2006. The CAPM approach is used in this study.

The capital asset pricing model

The cost of equity is the expected return on common stock …

The cost of equity is typically defined as the expected return that investors require to purchase common stock in a firm. It is therefore an important input for bank management when raising capital and making investment decisions and for investors when they value equity securities and construct their portfolios. The CAPM method remains the one most commonly used by practitioners and financial advisers to estimate a firm's cost of equity, as shown in surveys by Brunner et al (1998) and Graham and Harvey (2001).

… and compensates investors for risks …

According to the CAPM, the expected return demanded by investors should compensate them for the additional risk incurred from adding a given security to a diversified equity portfolio. The model implies that investors require a firm-specific premium for holding a company's stock, where this premium is related to how much the security changes the risk of the overall equity portfolio. The firm's cost of equity is then the sum of this firm-specific premium plus the return on a risk-free asset.

… based on the sensitivity of a stock to market movements

The firm-specific premium is the product of two components: the CAPM beta and the equity market risk premium. The former provides a measure of the sensitivity of a stock's returns to market risk. Specifically, it measures the covariance of bank stock returns and market returns, scaled by the variance of market returns. Details on the calculation of this beta are provided in the box. By definition the overall stock market has a beta of one; a stock with a beta below one is less variable than the market, while a stock with a beta above one is more variable. A higher covariance translates into more risk and requires a higher risk premium, while lower covariance requires a lower premium.

Investors expect to earn a premium for holding equity

The second part of the firm-specific premium is the equity market risk premium, which represents the incremental return that investors require from

Equity market risk premium, 1900–2001 Relative to long-term government bonds		
	Mean	Standard deviation
Canada	5.7	17.9
France	6.7	21.7
Germany[1]	9.6	28.5
Japan	10.0	33.2
United Kingdom	5.5	16.7
United States	6.7	20.0

[1] Excludes 1922–23.

Sources: Dimson et al (2002). Table 2

holding risky equities rather than risk-free securities.[5] The equity market risk premium is forward-looking, unobservable and probably time-varying. Given that the CAPM posits an equilibrium relationship, this risk premium is viewed as reverting to some mean value over the longer-term horizon that matters for companies and investors. The CAPM is therefore not appropriate for making short-term investment decisions or identifying market mispricing. Instead, the CAPM cost of equity is the discount rate that a firm should use when deciding to undertake capital investments over the life of a project. Similarly, an investor would use this estimate as the expected return when choosing between different asset classes on a buy and hold basis. Estimating the size of the equity market risk premium is controversial. Different authors have suggested that the correct premium for the US stock market is between 3 and 8% (Fama and French (2002)), with some researchers suggesting it is near zero. Resolving this debate lies beyond the scope of this article.

Historical returns provide a guide to the equity market risk premium

Given that the expected equity market return cannot be observed, the usual practice is to proxy the premium by looking at the historical returns on equities relative to risk-free rates. As they are the longest and most well researched measures for a wide selection of countries, this study uses the estimates of Dimson et al (2002) of the equity market risk premium for 16 countries over the 102-year period from 1900 to 2001 (Table 2).

Estimation and results

The cost of equity for each country's banking sector is the average across its banks

Estimates of the cost of equity for each country are calculated by taking the equal-weighted average of the individual estimates for its banks. Additional details are provided in the box. Working on the assumption that any cost of equity estimate will be imprecise, this study focuses on relative changes in country averages over time, and checks whether reasonable estimates can be obtained using a banking sector equity sub-index as a proxy for individual banks.

[5] DeLong and Magin (2009) survey the literature on the equity market risk premium.

Estimating the cost of equity

The CAPM is a general equilibrium theory that quantifies the trade-off between risk and expected return using a single risk factor, namely the return on the overall stock market (Campbell et al (1997)). An equity investor constructing a mean-variance efficient portfolio will seek to maximise returns for a given level of risk. Based on this theory, the nominal cost of equity (or expected return) for any stock is a linear combination of the nominal risk-free rate and a firm-specific risk premium:

$$E[R_i] = R_f + \beta_{im}(E[R_m] - R_f) \quad (1)$$

where $E[R_i]$ is the expected return on stock i, $E[R_m]$ is the expected return on the market portfolio, and R_f is the nominal yield on the risk-free asset. The difference between the expected market return and the nominal risk-free rate is the equity market risk premium, which is forward-looking and measures the average annual return that an investor may be expected to earn on their equity portfolio relative to a risk-free asset. While other market risk premia are time-varying, this expected return is the equilibrium return. β_{im} is known as the CAPM beta and measures the covariance of a stock's return with the market return, divided by the variance of the market return. The product of a firm's beta and the equity market risk premium is the firm-specific risk premium. Because an individual company's beta can change based on firm-specific factors, the firm-specific risk premium is time-varying.

The CAPM relationship is most commonly estimated using realised excess returns, measured as actual returns less the return on a risk-free asset. The assumption is that historical returns are a good proxy for expected returns, and monthly excess returns are approximately independently and identically distributed (IID) through time and jointly multivariate normal. Empirically, equation (1) is estimated using ordinary least squares for each stock, as follows:

$$R_{it} - R_{ft} = \alpha_i + \hat{\beta}_{im}(R_{mt} - R_{ft}) + \varepsilon_{it} \quad (2)$$

where i denotes the stock of a given firm and t denotes the time period. The CAPM beta (or market risk factor) is the slope coefficient in this regression. If markets are efficient, the intercept α_i should not be statistically different from zero and the residuals should be IID. Researchers have found that CAPM beta estimates for individual stocks are volatile and imprecise, and the residuals across firms may exhibit common sources of variation due to omitted variables (such as industry membership). The standard approach is to estimate betas and form portfolios that average across estimates; this study employs this type of approach. We form portfolios by country and measure the cost of equity as the average estimate across banks headquartered in a given country. Having calculated a bank's time-varying CAPM beta using equation (2), its cost of equity can be calculated using the equilibrium relationship in equation (1).

CAPM estimates are generated as follows. The first step is to calculate monthly returns on the equity index and individual stock using month-end values.[①] The monthly yield on a risk-free instrument is then subtracted to generate ex post excess returns. Next, monthly excess stock returns for each bank are regressed on the excess market returns for the national stock market index where a bank is headquartered. The study follows the standard approach of running rolling regressions using the past 60 months (five years) of observations, beginning in January 1985. This procedure produces the time-varying CAPM beta estimates from 1990 to 2009. Beta values in the 5% of the tails (both extremely low and high) are dropped to reduce the impact of outliers. The bank-specific equity premium is equal to the product of the CAPM beta and a country's historical equity market risk premium. The cost of equity is then the risk-free rate plus the bank-specific equity premium. The annual yield on a 10-year government bond is used as the risk-free rate, as this longer maturity approximates a shareholder's investment horizon. The inflation-adjusted cost of equity is then calculated by subtracting year-ahead inflation expectations from the nominal cost of equity estimates. Finally, the monthly estimates for the banks headquartered in a given country are averaged on an equally weighted basis to generate a monthly estimate of the cost of equity for each country's banking sector, as well as the standard deviation of this estimate.

Criticisms of the CAPM

Critics of the CAPM highlight a number of theoretical and empirical shortcomings of this model. Fama and French (2004) group these criticisms under two headings: the rational risk story and the behavioural story. Under the former, financial markets are efficient, investors are rational and forward-looking, and the expected return on an asset is a function of how its return covaries with the state of the economy. In this view, the main theoretical failure of the CAPM is the assumption that investors care only about the mean and variance of portfolio returns, and ignore other important dimensions of risk. The main empirical shortcoming is that a single market factor is not sufficient to explain the cross-section of realised returns, as seen in the large number of studies of CAPM anomalies. The solution is to use a more complicated asset pricing model along the lines proposed by the arbitrage pricing theory, where the risk factors reflect unidentified state variables that matter for consumption and investment choices.

The behavioural story views markets as irrational, with investor overreaction to good and bad times leading to swings in asset prices that cannot be justified by fundamentals. In this view, risk is not correctly priced due to cognitive biases of actors who overextrapolate past performance, leading to systematic and predictable mispricing of assets. These mispricings eventually unwind. Responding to this criticism, Stein (1996) argues that it does not matter whether expected return premia are rational or irrational since in either case they are part of the opportunity cost of equity.

Banks in sample by year

	United States	United Kingdom	France	Germany	Canada	Japan	Total
1990	28	11	4	6	6	9	64
1995	31	12	5	6	6	9	69
2000	33	17	8	6	6	10	80
2005	34	18	9	9	6	12	88
2009	34	18	9	9	6	13	89
All years	641	313	141	141	120	211	1567
% sample	41%	20%	9%	9%	8%	13%	100%

Table A

Data sources

The study is based on individual stock price data for 89 banks located in Canada, France, Germany, Japan, the United Kingdom and the United States. The sample banks are the largest publicly traded institutions, based on total assets, as reported in the annual survey of the top 1,000 banks by *The Banker* magazine. As many banks are included in each year as data are available. When two banks merge (eg JP Morgan and Chase Manhattan), only the surviving firm remains in the sample. Banks are included in the sample until their stock is no longer traded. As a result, the sample is unbalanced and changes over time as banks merge and are replaced by the surviving entity. Monthly data on the national stock market index for each country are taken from Datastream. The following indices are used: the S&P/TSX Composite (Canada), the CAC 40 (France), the DAX (Germany), the Nikkei (Japan), the FTSE 100 (United Kingdom) and the S&P 500 (United States). Results using MSCI indices for the European countries produce very similar estimates. Monthly data on government bonds are taken from the BIS Data Bank. Data on the historical equity market risk premia for each market are from Dimson et al (2002). Finally, monthly data on year-ahead expectations for inflation come from Consensus Forecasts.

[1] In the absence of data on the time series of dividends paid by banks to their common shareholders, this study uses monthly price returns, not total returns. This omission should not materially affect the results as banks in the countries studied pay dividends infrequently (quarterly, semiannually or annually) The covariance between bank returns and market returns is therefore not significantly affected. When dividends data are included for a subset of banks over the past five years, the results are very similar.

Bank-level estimates

Estimates vary significantly across countries …

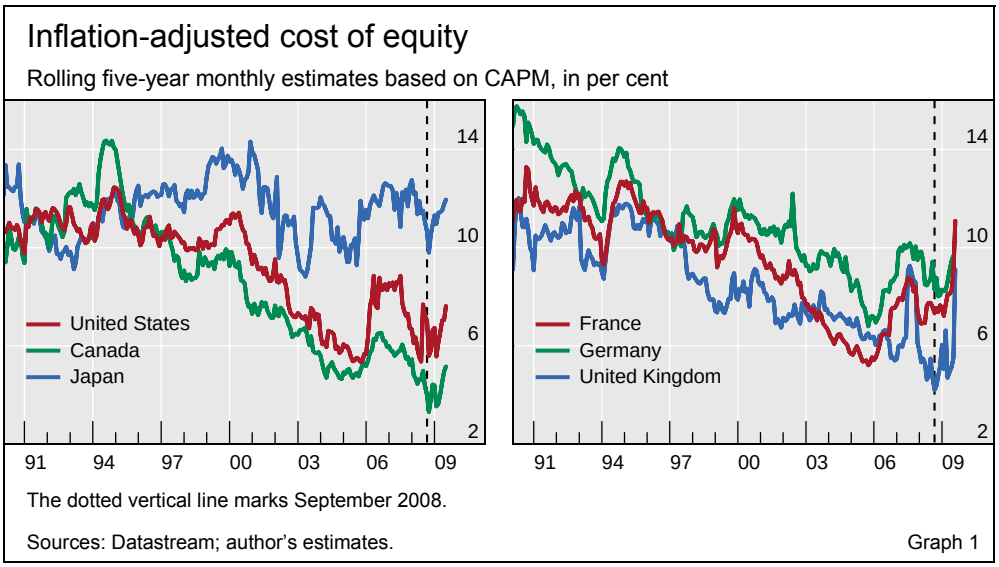
Graph 1 shows the monthly estimates of the cost of equity for banking sectors in the six countries from 1990 to mid-2009. Canadian and UK banks enjoyed the lowest average cost of equity over this period, followed by French and US banks. German and Japanese banks faced the highest costs, due to the high equity market risk premium in their countries. This relative ranking contrasts with the results based on earlier studies that estimate the cost of equity over different time periods and using different methods (Table 1). The studies' dissimilar results confirm that cost of equity estimates are sensitive to the methodology employed.

… with levels trending downwards over two decades …

The real cost of equity based on the CAPM has been trending downwards for most of the past two decades. The monthly cost of equity estimates reach a low in 1992 for Japanese banks, in 2005 for French, German and US banks, in 2008 for UK banks, and in 2009 for Canadian banks. The decreases in the cost of equity across countries are large and economically important, falling by more than 700 basis points over this period. The greatest decline occurred for Canadian banks, followed by German banks, which began the 1990s at the highest level of all six countries but then converged towards the levels seen in other European countries.

… punctuated by cyclical rises

While the trend is downward, there are clear cyclical patterns for each country, with upsurges in the banking sector cost of equity around 1994 and again in 1999–2000 for all countries. Banks in most countries also experienced increases in either 2006 or 2007, and again in 2009. While the rises in 2007 may be explained by the onset of the subprime turmoil in July of that year, those over 2006 were equally large: around 300 basis points for US banks relative to 2005, 150 basis points for Japanese banks, 115 basis points for Canadian banks and 40 basis points for French banks. The vertical line in Graph 1 marks September 2008, the month when Lehman Brothers declared bankruptcy, leading to a general loss of confidence in the financial sector. Cost of equity estimates rise following this event for all banking sectors, with the largest increases in the United Kingdom and France.



The dotted vertical line marks September 2008.

Sources: Datastream; author's estimates. Graph 1

Period averages reveal longer-term trends …

These trends are more apparent when examining country averages across three periods: 1990–2000, 2001–05 and 2006–June 2009 (Table 3). The table shows the average level of the cost of equity estimate and its standard deviation for each period. The next two columns break the cost of equity into two parts, the risk-free rate and the banking sector risk premium. The relative importance of these two components for the level of the cost of equity is shown in the next two columns, and the right-hand column shows the average CAPM beta for a country's banking sector. Here we discuss developments in the cost of equity, while movements in the components are examined in the next section.

The decade 1990–2000 saw an average cost of equity near or above 10% in all cases. The mean values of the cost of capital decline in each period for most countries, with the largest declines seen over 2001–05. By 2009, the average estimate for Canada had fallen to close to 5% and for the United Kingdom to 6%. Japan is the exception to this pattern: its banks have faced an estimated cost of equity above 11% since 1990.

… but conceal considerable variation across banks

The country averages conceal considerable variation across individual banks. Table 3 shows the standard deviation of the cost of equity estimates, based on the cross-section of the bank-level estimates for each country. For US banks during the 2006–09 period, for example, an estimate one standard deviation above the mean has a value of 10.3%, more than double a value one

Components of real cost of equity estimates

Country	Period	Cost of equity[1]		Of which:		As percentage of level:		CAPM beta
		Mean of estimates	Standard deviation	Real risk-free rate	Banking risk premium[2]	Real risk-free rate	Banking risk premium[2]	
Canada	1990–2000	10.7	0.8	5.0	5.7	46%	54%	1.0
	2001–05	6.1	1.2	2.8	3.3	47%	53%	0.6
	2006–09	5.2	0.8	2.0	3.3	37%	63%	0.6
France	1990–2000	11.1	1.4	4.7	6.4	43%	57%	1.0
	2001–05	7.3	2.5	2.7	4.6	37%	63%	0.7
	2006–09	7.6	3.2	2.4	5.2	31%	69%	0.8
Germany	1990–2000	12.2	2.7	4.1	8.1	33%	67%	0.9
	2001–05	9.5	3.6	2.8	6.8	29%	71%	0.7
	2006–09	9.0	4.2	2.1	7.0	23%	77%	0.7
Japan	1990–2000	11.8	3.3	2.6	9.2	22%	78%	0.9
	2001–05	11.1	3.6	1.6	9.5	14%	86%	1.0
	2006–09	11.6	4.6	1.2	10.5	10%	90%	1.1
United Kingdom	1990–2000	9.9	2.2	4.3	5.6	44%	56%	1.0
	2001–05	7.3	2.6	2.4	4.9	33%	67%	0.9
	2006–09	6.1	2.8	2.1	4.0	34%	66%	0.7
United States	1990–2000	10.7	2.2	3.4	7.3	32%	68%	1.1
	2001–05	7.4	2.7	2.2	5.2	29%	71%	0.8
	2006–09	7.5	2.8	2.0	5.5	26%	74%	0.8

[1] In per cent, based on simple average across sample banks for a given country. [2] The banking sector risk premium is the product of the CAPM beta and the equity market risk premium. Table 3

standard deviation below of 4.7%. Similar variation is seen for the other countries, with the highest dispersion for Japan. The standard deviation of the estimates has increased over time in five out of the six countries, highlighting the difficulty of measuring a bank's cost of equity using the CAPM method.

Sector-level estimates

Calculating bank-level estimates is data-intensive …

Collecting and calculating bank-level estimates of the cost of equity is data-intensive and time-consuming. Given the importance of these measures, it is useful to see whether reasonable estimates can be obtained using a banking sector equity sub-index as a proxy for individual banks. Banking sub-indices are available for the 20-year period for the United Kingdom and Germany, and from January 1988 for Canada, October 1988 for Japan, January 1995 for the United States and January 1999 for France. The monthly excess returns of these indices are regressed on the excess market returns from the national stock market index to generate the CAPM cost of equity estimates as before.

… but necessary as equity sub-indices are a poor proxy

The estimates based on banking sub-indices also trend downwards, and have an unconditional correlation with the bank-level estimates of 88%. Country estimates based on the banking sub-indices, however, are an average 122 basis points higher than those based on individual banks. The higher cost of equity based on the banking sub-index can be linked to the higher beta; the sensitivity of banking sub-index returns to market movements is higher than the sensitivity of individual bank returns. This higher beta is due to two differences between the banking sub-indices and the bank-level measures. First, the sub-indices are market capitalisation-weighted portfolios whereas the bank-level estimates are equal-weighted. Banks with a higher market capitalisation have a greater impact on the index returns. When a bank's stock price is rising (falling), its market capitalisation rises (falls) and its relative importance for the return on the sub-index increases (declines). The bank-level estimates, by contrast, are the simple average of the banks in the sample. Second, the banking sub-indices include only a subset of banks, namely those that are part of the market index. In some countries, the sample used in this paper is broader.

Overall the sub-index estimates are closest to the average bank-level estimates for the United States, but farthest away for the United Kingdom. The estimates diverge significantly during the recent crisis period, when the banking sub-index would suggest a much greater increase in the banking sector cost of equity. The cost of equity estimate based on the average of individual banks is preferable as it is more representative of the cost of equity for the average bank in a given country.

What explains changes in cost of equity estimates?

The CAPM cost of equity can be decomposed into two parts …

This section decomposes the cost of equity estimates for a given country's banking sector into two parts. The CAPM estimate is the sum of a current risk-free rate and a bank-specific risk premium. We look at the relative importance of these two components over time (Graph 2).

Components of the real cost of equity

… the contribution of risk-free rates …

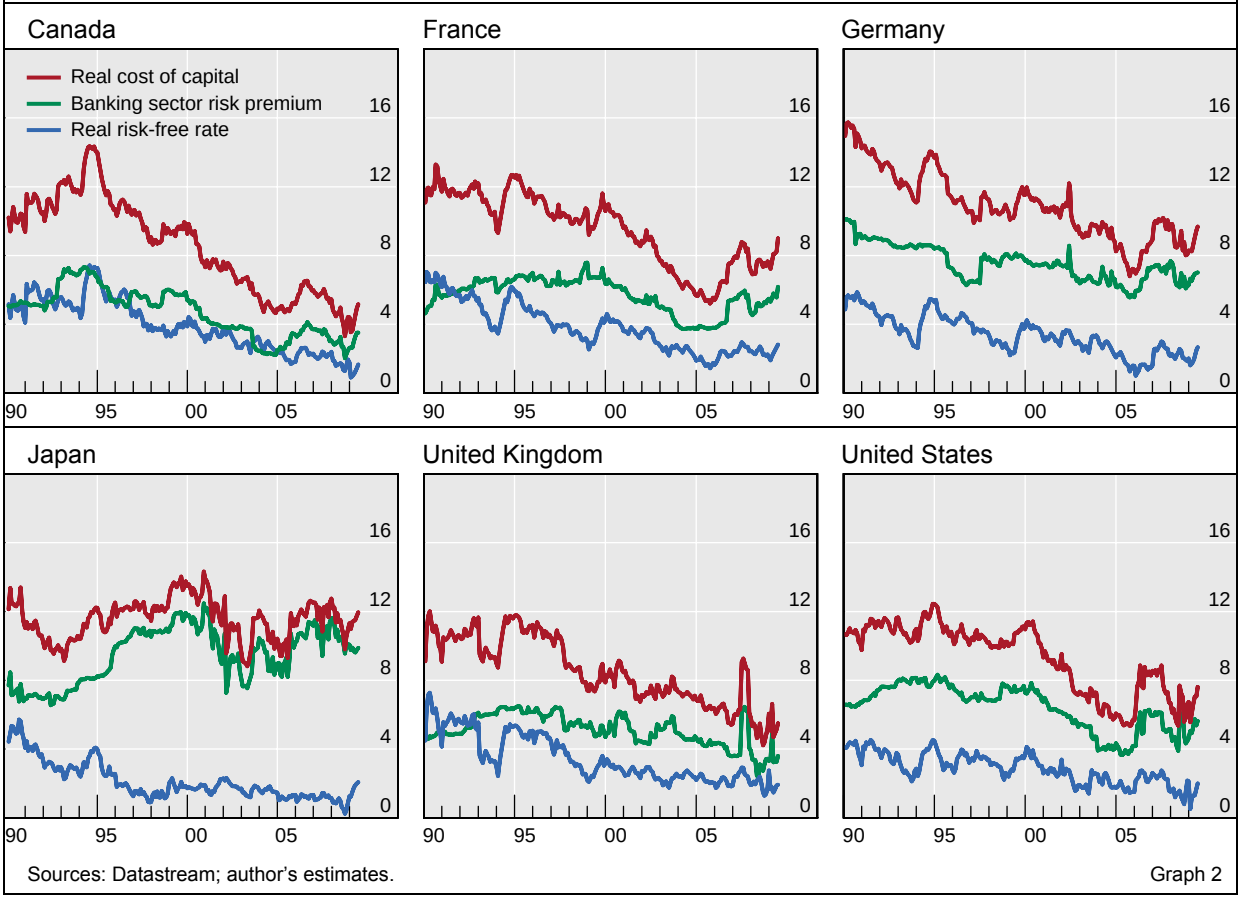
Under the CAPM, risk-free government bonds provide the benchmark return when evaluating an investment in equities. Given the greater risk associated with equities, an investor expects to earn a premium over the risk-free rate (Graph 2). On average, the risk-free rate represents one third of the level of the CAPM estimates over the 20-year period examined here. Yields on risk-free bonds adjusted for inflation have declined from 1990 to 2009, contributing to the decline in the cost of equity. These yields reached levels around 2% in most countries and close to 1% in Japan (Table 3). In Canada, inflation-adjusted 10-year Treasury yields have declined from an average of 5% in the 1990–2000 period to 2% in 2006–09. As a result, the contribution of the risk-free rate to the Canadian bank cost of equity has declined from 46% to 37%.

… and the banking sector risk premium …

In the CAPM, the banking sector risk premium is firm-specific and rises for stocks with greater sensitivity to market risk. While the level of this premium has been falling over time, its proportionate contribution to the cost of equity has been increasing (Table 3). In the period 2006–09, it represents two thirds of the estimate for banks in Canada, France and the United Kingdom, around three quarters for the United States and Germany, and 90% for Japan. Clearly, this risk premium is important for understanding changes in cost of equity estimates.

Components of cost of equity estimates by country

In per cent



Sources: Datastream; author's estimates.

Graph 2

The fall in the risk premium is due to the decline in the beta of bank stocks over time. A lower beta shows that the sensitivity of bank returns to market movements (both positive and negative) has diminished on average. Again this decline in bank betas is seen in all countries except Japan. In the United States, for example, the CAPM beta over 1990–2000 was 1.1, but it has since fallen to 0.8. Given that the equity market risk premium is treated as a constant, the lower beta leads directly to a decline in the banking sector risk premium in this estimation. For example, this lower beta explains a reduction of 200 basis points (ie (1.1 – 0.8) x 6.7%) in the cost of equity estimates for US banks.

… which has declined due to a fall in banking betas

Bank betas trend downwards for most countries over the 20-year period (Table 4). This decline has both a statistical explanation and an economic one. Statistically, betas decrease because either the covariance of bank returns with market returns declines (the numerator) or the variability of the market increases (the denominator). Both effects are present. The covariances increase on average over 2001–05 for all countries except Japan,[6] but the rise in variance of market returns is even greater, leading betas to fall. In Japan, the decline in covariance is less than that in market variance, so betas rise. Over the period 2006–09, covariances and variances are sharply lower in all countries, with changes of similar magnitude for both variables in five out of six countries, leaving betas relatively unchanged. The exception is the United Kingdom, where the drop in covariance is much larger, leading to a lower beta on average.

Bank betas decline in most countries

Economically, the declining covariance of bank stock returns with market returns reflects changing investor perceptions of bank profitability and riskiness. Over much of the recent period, bank earnings were high and stable, reflecting the growth in new sources of income. Banks steadily increased dividends, with global banks raising dividend payouts on average by a compound rate of 15% per annum over 2002–07. Higher earnings partly reflected an increase in risk that was not widely understood, with banks reportedly taking on more leverage (both on- and off-balance sheet) and funding mismatches. Investors do not appear to have priced this greater risk correctly until the financial crisis. As a result, stable and growing earnings with larger dividend payouts were associated with bank returns that were less volatile than the overall market prior to 2007.

Lower betas are due to a lower covariance of bank stock returns and market returns

The onset of the financial crisis coincided with a rise in bank betas (Table 4). Average bank betas increased over 2006 for most countries. The average US bank beta, for example, went up from 0.58 in 2005 to 0.84 in 2006, an increase of one third. European bank betas rose again over 2007, with the biggest increase for UK banks in the third quarter when Northern Rock received support from the Bank of England. After declining in the first quarter of 2008, US bank betas rose sharply through the third quarter of 2008 when Lehman Brothers went bankrupt. This movement of betas is consistent with investors viewing bank stocks as riskier as the crisis progressed, with the risk

Bank betas rise as the financial crisis unfolds

[6] Note that variances and covariances are estimated over the previous 60 months, which introduces some sluggishness into the beta estimates and consequently the cost of capital.

Bank betas by country[1]						
	Canada	France	Germany	Japan	United Kingdom	United States
1990	0.91	0.81	1.00	0.73	0.87	0.98
1995	1.04	1.01	0.83	0.87	1.14	1.19
2000	0.86	0.93	0.78	1.14	1.01	1.09
2005	0.52	0.57	0.61	0.93	0.79	0.58
2006	0.65	0.67	0.69	1.08	0.73	0.84
2007	0.61	0.83	0.76	1.09	0.87	0.83
Q1 2008	0.50	0.69	0.74	1.10	0.61	0.69
Q2 2008	0.54	0.77	0.65	1.06	0.49	0.70
Q3 2008	0.43	0.77	0.69	1.00	0.52	0.84
Q4 2008	0.43	0.80	0.65	1.01	0.61	0.67
Q1 2009	0.48	0.83	0.69	0.98	0.70	0.76
Q2 2009	0.60	0.86	0.73	0.98	0.61	0.83

[1] Averages across banks and periods for each country. Table 4

declining following government interventions to support systemically important banks in the fourth quarter of 2008. By the second quarter of 2009, bank betas were back to their 2007 levels for Canadian, French, German and US banks, but lower for Japanese and UK banks.

In summary, cross-country changes in the cost of equity estimates over time can be explained by variations in two factors: the decline in real risk-free yields and the decreasing sensitivity of bank stocks to market risk as measured by the CAPM beta. Lower betas are explained by a lower covariance of bank stock returns with market returns. Canada has particularly benefited over this 20-year period, with cost of equity estimates for its banks halving. In Japan, a decline in risk-free rates has been offset by a rise in the banking sector risk premium. This premium has increased due to the higher beta, which, when multiplied by the historical equity market risk premium for Japanese equities (10.0%), led to an increase in the risk premium for bank stocks.

Sensitivity of estimates to assumptions

The CAPM estimates are sensitive to the inputs

While the CAPM approach is motivated by theory, its implementation relies on a number of assumptions. This section considers the sensitivity of the estimates to changes in two assumptions – the equity market risk premium and the calculation of the beta.

The equity market risk premium may be time-varying, not constant

The CAPM estimates in this paper are based on a constant equity market risk premium for each country based on its long-term average (Table 2). As a direct result of this assumption, changes in the banking sector risk premium are only possible due to changes in the CAPM beta. How would allowing the equity market risk premium to vary across periods affect the estimates in this case?[7] Estimates are calculated assuming that the equity market risk premium

[7] Unfortunately there is no simple way to derive time-varying estimates of the expected equity market risk premium. As shown in Table 2, the historical proxies have high standard

in each country is 10% below its long-term mean over 2001–05, and 10% above its mean since 2006. Such a change affects the level but not the path of the estimates. It lowers the country estimates of the average cost of equity over 2001–05 by 32 to 94 basis points, with the biggest drop for Japan (where the equity market risk premium is highest). The cost of equity is 33 to 105 basis points higher than the estimates in Table 3 thereafter.

Beta estimates can be calculated in various ways

A second concern is the method used to estimate the CAPM beta, which relies on rolling regressions using the past five years of monthly observations. Overlapping windows imply that the beta changes slowly, with increases in the covariance of a bank's stock returns relative to the market only showing up over time. An alternative specification is to calculate betas for each year based on 12 months of returns. These estimates are noisier due to the reduced number of observations, but the periods no longer overlap and any changes in covariance will appear more quickly.[8] Overall this change results in no consistent pattern across countries. In the recent period (which includes the crisis), the cost of equity estimates are higher for France and Germany and lower for Japan. Counterintuitively, however, the estimates are lower for the United Kingdom and the United States as the measured betas are lower on average using this method.

Conclusion

This study provides estimates of the real cost of equity for banks headquartered in six countries over the period 1990–2009. The estimates are based on the single-factor CAPM model used by the Federal Reserve System. The real cost of equity decreased steadily across all countries except Japan from 1990 to 2005 but then rose from 2006 onwards. There are clear cyclical patterns for each country, with increases in the banking sector cost of equity around 1994 and again in 1999–2000. Part of the decline derives from the fall in real risk-free rates over the period examined. The main contributor, however, is the banking sector risk premium, which represents more than two thirds of the estimate. The sensitivity of banking stocks to market risk has diminished over time, as seen in the fall in CAPM beta estimates in all countries except Japan. This decline in bank betas is explained by the lower covariance of bank stock returns with market returns for much of this period. Since the onset of the crisis, bank betas have risen for most countries.

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deviations that are three times larger than the averages, suggesting periods with large positive and negative values. For more on this topic, see Fama and French (2002).

[8] The mean betas produced by this averaging method are statistically different from the rolling estimates at the 5% significance level for all countries except France.

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The systemic importance of financial institutions[1]

Prudential tools that target financial stability need to be calibrated at the level of the financial system but implemented at the level of each regulated institution. They require a methodology for the allocation of system-wide risk to the individual institution in line with its systemic importance. This article proposes a general and flexible allocation methodology and uses it to identify and quantify the drivers of systemic importance. It then illustrates how the methodology could be employed in practice, based on a sample of large internationally active institutions.

JEL Classification: C15, C71, G20, G28.

On 16 September 2008 the US authorities announced that they would take the unprecedented step of offering emergency financial support to AIG, a large insurance conglomerate. The decision was rooted in concerns about the repercussions of the failure of this institution on the economy at large, ie about its systemic importance.[2] Similar far-reaching and urgent decisions were taken by authorities in other jurisdictions. By contrast, in 1995, the Bank of England had allowed merchant bank Barings to fail because it considered this would have no material impact on other banks (which was subsequently confirmed).

More generally, the events of the past two years serve as a stark reminder that systemic financial disruptions can have large macroeconomic effects. As a result, the objective of strengthening the macroprudential orientation of financial stability frameworks has risen to the top of the international agenda.[3] The main distinction between the macro- and microprudential perspectives is that the former focuses on the financial system as a whole, whereas the latter focuses on individual institutions.[4]

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[2] The press release from the Federal Reserve explained: "The Board determined that, in current circumstances, the disorderly failure of AIG could add to already significant levels of financial market fragility and lead to substantially higher borrowing costs, reduced household wealth, and materially weaker economic performance."

[3] See G20 (2009) and de Larosiere (2009) for reports on this international consensus.

[4] See Crockett (2000), Knight (2006) and Borio (2009) for an elaboration of the macroprudential approach and progress in its implementation.

By necessity, however, the tools of financial sector supervision and key policy interventions are applied to individual institutions, even when decisions are motivated by systemic considerations. Thus, policymakers need analytical tools to help them assess the systemic importance of individual institutions. In times of crisis, these tools can help to gauge the likely impact of distress at a given financial firm on the stability of the overall financial system. In periods of calm, they can help to calibrate prudential instruments, such as capital requirements and insurance premiums, according to the relative contribution of different institutions to systemic risk.

This article presents a methodology that takes as inputs measures of system-wide risk and allocates them to individual institutions. The methodology is derived directly from a game-theoretic concept, the Shapley value, which describes a way of allocating the collective benefit created by a group to the individual contributors. The Shapley value approach satisfies a number of intuitive criteria and is quite general, being applicable to a wide spectrum of measures of system-wide risk.

The methodology makes it straightforward to quantify the impact of the various drivers of an institution's systemic importance. These include their riskiness on a standalone basis, their exposure to common risk factors and the degree of size concentration in the system. A key result is that the contribution of an institution to system-wide risk generally increases more than proportionately with its size.

We apply the methodology to real-world data on a sample of 20 large internationally active financial institutions. The results highlight the interaction among the various drivers of systemic importance. In our sample, none of them, taken in isolation, is a fully satisfactory proxy for systemic importance.

The article is organised in four sections. The first section describes the allocation procedure and its properties. The second section applies the procedure to a specific measure of systemic risk in hypothetical and highly stylised financial systems in order to analyse the impact of different drivers of systemic importance. The third section discusses how the methodology could be used in practice as a tool to mitigate systemic risk and applies it to real-world data. The last section concludes.

The allocation procedure: measuring systemic importance

A general methodology to attribute systemic risk ...

The problem of allocating system-wide risk to individual institutions is analogous to that of a risk controller in an investment firm seeking to attribute the use of the firm's risk capital to individual desk traders. The fact that the sum of the risks incurred by each desk in isolation does *not equal* the total risk for the firm complicates the controller's problem. Simple summation ignores that the interactions among individual positions could reduce or compound overall risk. They would reduce it when positions across desks partially cancel each other out; they would compound it when losses in one side of the business are incurred simultaneously with, or trigger, losses in another.

Game theorists have tackled similar problems in the context of cooperative games. These are general settings where a group of players

engage in a collective effort in order to generate a shared benefit[5] (called "value") for the group. The theoretical problem of allocating this value among individual players in a way that satisfies certain fundamental criteria is conceptually identical to that of risk attribution described above.

... draws on game theory ...

Lloyd Shapley proposed a methodology that distributes the overall value among players on the basis of their individual contributions (Shapley (1953)). The idea behind the allocation methodology is quite simple. Adding up what individual players can achieve by themselves (the equivalent of summing up the standalone risk of each trading desk in the investment firm) is unlikely to reflect their contributions to the productivity of others. Similarly, calculating the marginal contribution of a single player as the difference between what the entire group can achieve with and without the specific individual gives only a partial picture of the individual's contribution to the work of others. The reason is that this method also ignores the complexities of bilateral relationships. By contrast, the Shapley methodology accounts fully for the degree to which such relationships affect the overall outcome. It accomplishes this by ascribing to individual players the average marginal contribution each makes to each

Box 1: Shapley value allocation methodology: a specific example

This box illustrates the Shapley value allocation methodology by reference to a specific numerical example where three parties (A, B and C) can cooperate to generate a measurable outcome. If nobody participates nothing is produced, and each participant alone can produce 4 units. The output of each possible grouping of the three participants is detailed in the left-hand column of the table below.

Subgroup	Subgroup output	Marginal contribution of A	Marginal contribution of B	Marginal contribution of C
A	4	4	.	.
B	4	.	4	.
C	4	.	.	4
A, B	9	5	5	.
A, C	10	6	.	6
B, C	11	.	7	7
A, B, C	15	4	5	6
Shapley value	.	4.5	5	5.5

Table A

The marginal contribution of a player to a subgroup is calculated as the output of the subgroup minus the output of the same subgroup excluding the individual participant. For instance, the marginal contribution of A to the output of the overall group (A, B, C) is equal to the difference between 15, which is the overall group's output, and 11, which is the output of B and C together.

The Shapley value of each player is the average of its marginal contributions across all differently sized subgroups. For example, the value of B is equal to 5 (see bottom row). It is calculated as the average of 4, which is its individual output, 6, which is the mean contribution it makes to subgroups of size two, and 5, which is its marginal contribution to the overall group. The calculation can also be motivated as the expected marginal contribution of an individual participant in groups that are formed randomly by sequentially selecting players (see Mas-Colell et al (1995)).

[5] This is a very general concept that could be thought of as wealth, or collective output.

possible subgroup in which they participate (see Box 1 on the previous page for a detailed exposition of the methodology and a numerical example).

... and has many appealing features:

In addition to its simplicity, the Shapley value has a number of intuitively appealing features.[6] It ensures that the gains from cooperation between *any two* players are divided equally between them; in other words, it is "fair" in the sense that it does not lead to biased outcomes that favour or penalise particular players. It distributes *exactly* the total benefit to all players, without resulting in any surplus or deficit. It is symmetric, in the sense that two players with the same characteristics receive the same share of the overall value. And it assigns no payoff to a player who makes no contribution to any subgroup.

it measures individual contributions to risk;

An application of the Shapley value methodology to the measurement of institutions' systemic importance simply transposes the problem of distributing a collective value among individual players to that of attributing overall risk to individual institutions. It requires as an input a quantitative measure of risk for all groupings of institutions. These range from the largest group comprising all institutions to the smallest, which consist of single institutions. The methodology then attributes the overall (system-wide) risk to each institution on the basis of its average contribution to the risk of all the groups in which it participates. *The degree of systemic importance of institutions is therefore captured by the share of systemic risk that is attributed to each of them.* Institutions with higher systemic importance will have a higher Shapley value than others.

is general and flexible;

A major strength of the Shapley value methodology is its generality. It accommodates any systemic risk measure that treats the system as a portfolio of institutions and identifies risk with the uncertainty about the returns (losses) on this portfolio. In addition, existing allocation procedures are specific applications of the Shapley value methodology. This is the case, for instance, of the procedure recently proposed by Acharya and Richardson (2009) for the calibration of institution-specific premiums for insurance against systemic distress. Tarashev et al (2009) discuss these points at some length.

and is robust to uncertainty

Another strength of the Shapley value methodology is that it allows measures of systemic importance to account for model and parameter uncertainty. Such uncertainty may make it natural to measure systemic risk under alternative models and parameter estimates. This would lead to alternative measures of systemic importance for each institution. Being linear, the Shapley value implies that the weighted average of alternative measures (a linear combination) can be used as a single robust measure of systemic importance.

[6] For a fuller discussion of the technical properties of the Shapley value, see Mas-Colell et al (1995). Tarashev et al (2009) provide a more detailed description of how to implement a Shapley value decomposition in the context of the attribution of system-wide risk to individual institutions.

Drivers of systemic importance: stylised examples

Drivers of systemic risk

In this section we study three drivers of systemic risk and, hence, of the systemic importance of individual institutions. One is the riskiness of individual firms, as captured by their probabilities of default (PDs).[7] Another is the degree of size concentration, or "lumpiness", of the system, which increases as the number of institutions decreases or as their relative sizes become more disparate. The final driver is the institutions' exposure to common (or systematic) risk factors, which arises either because financial institutions are similar to each other (eg lend to the same sectors) or because they are interconnected. Importantly, while the probability of default (or insolvency) can be constructed on the basis of institution-specific characteristics alone, the other two drivers relate to characteristics of the system as a whole.

As a concrete measure of systemic risk, we use expected shortfall, which equals the expected (average) size of losses in a systemic event (see the appendix on page 86 for detail). In general, a systemic event is defined as one that generates losses deemed large enough to cause disruptions to the functioning of the system. In this article, a systemic event is defined as the occurrence of extreme aggregate losses that materialise with a given small probability, ie losses that exceed a certain threshold.[8]

The impact of the three drivers on systemic risk is quite intuitive. Keeping everything else constant, an increase in institutions' PDs leads to a higher level of systemic risk. Even if the PDs remain unchanged, greater lumpiness of the system reduces diversification benefits, raising the likelihood of extreme losses and, with it, expected shortfall. Similarly, greater exposure to common risk factors increases the likelihood of joint failures and hence also the likelihood of extreme losses in the system.

To explore the impact of the same three drivers on the systemic importance of individual institutions, we resort to numerical exercises. For these exercises, we allocate system-wide expected shortfall to individual institutions ("banks") on the basis of the Shapley value methodology. The results, based on highly stylised hypothetical systems, yield four key messages.

Systemic importance increases with ...

First, a rise in an institution's exposure to a common risk factor increases its systemic importance. This is illustrated in Table 1, which compares a number of banking systems, each comprising 20 banks. In every system there are two homogeneous groups, A and B, which differ only with respect to banks' exposures to the common factor. Keeping the strength of exposures to the common factor in group B constant but increasing it for group A (across columns to the right, in each panel) results in an increase in these banks' share in systemic risk. In the specific example of a strongly capitalised system, the

[7] Strictly speaking, an institution's standalone risk depends both on its PD and on its loss-given-default (LGD). This article abstracts from LGD by assuming that it is constant and equal for all financial institutions. Relaxing this assumption in order to account for certain empirical properties of LGD would not alter any of the qualitative conclusions derived below.

[8] A similar setting has been used in the context of financial stability by Kuritzkes et al (2005), who measure the expected loss to the deposit insurance fund using similar concepts.

Common exposures, systemic risk and systemic importance

	Strongly capitalised system (all PDs = 0.1%)					Weakly capitalised system (all PDs = 0.3%)				
	Exposure to the systematic risk factor (banks in group A)					Exposure to the systematic risk factor (banks in group A)				
	ρ = 0.30	ρ = 0.40	ρ = 0.50	ρ = 0.60	ρ = 0.70	ρ = 0.30	ρ = 0.40	ρ = 0.50	ρ = 0.60	ρ = 0.70
Group A (share)	44.0%	46.2%	50.0%	54.4%	60.4%	41.7%	45.4%	50.0%	56.2%	63.2%
Group B (share)	56.0%	53.8%	50.0%	45.6%	39.6%	58.3%	54.6%	50.0%	43.8%	36.8%
Total ES	4.0	4.4	5.0	5.8	6.8	6.6	7.2	8.2	9.8	11.5

Total expected shortfall (ES) equals the expected loss in the 0.2% right-hand tail of the distribution of portfolio losses; per unit of overall system size, in percentage points. The first two rows report the share of the two groups (each comprising 10 banks) in total ES. The exposure of each of the 10 banks in group A to the systematic risk factor is as given in the row headings. The exposure of each of the 10 banks in group B to the systematic risk factor corresponds to ρ = 0.50. See the technical appendix for a definition of ρ. The probaility of defaut (PD) of each bank is as specified in the panel heading. Loss-given-default is set to 55%. All banks are of equal size, each one accounting for 5% of the overall size of the system. Table 1

combined contribution of group A banks rises from 44% to roughly 60%. The result is similar for a weakly capitalised system.

... the strength of common risk factors ...

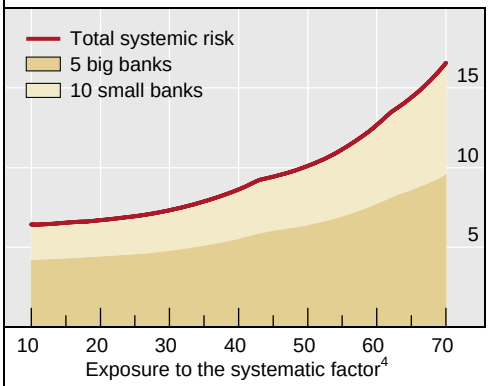
The reason for this result is that higher exposures to the common factor result in a higher probability of joint failures in the system. In turn, a higher probability of joint failures translates into higher average losses in the systemic event, which leads to a higher level of systemic risk, as measured by expected shortfall. Quite intuitively, the rise in the level of systemic risk is attributed mainly to the banks that contribute most to this rise, ie those that experience an increase in their exposure to the common factor (group A banks in Table 1).

... individual riskiness ...

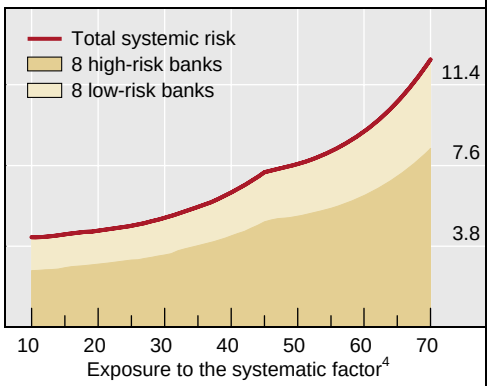
Second, the interaction between different drivers may reinforce their impact on systemic importance. A concrete example is provided by Graph 1 (left-hand panel) on the basis of a system in which banks differ only in terms of size. As the strength of exposures to the common factor increases uniformly across all banks in this system, the portion of the expected shortfall

Systemic risk: interaction of different drivers[1]

When banks differ in size[2]



When banks differ in PD[3]



[1] All numbers are in percentage points. Total systemic risk equals the expected loss in the 0.2% right-hand tail of the distribution of portfolio losses; per unit of overall system size. The contributions of the two groups of banks to the total are plotted as shaded areas. Each group accounts for half of the overall system size. Loss-given-default is assumed to be 55%. [2] Each bank's probability of default (PD) equals 0.3%. [3] The PD of a high-risk bank is 0.3% and that of a low-risk bank is 0.1%. [4] See the technical appendix for a definition. Graph 1

attributable to larger banks increases by a greater amount than that attributable to smaller banks. In other words, bank size reinforces the impact of common factor exposures on systemic importance. The right-hand panel of Graph 1 illustrates a similar point in the context of a system comprising banks that differ only with respect to their individual PDs. If all of these banks experience the same rise in their exposures to the common factor, the increase in the contributions to systemic risk is greater for riskier banks. Here, individual riskiness reinforces the impact of common factor exposures on systemic importance.

... and institutions' relative size

Third, changing the lumpiness of a system affects the systemic contributions of banks of different sizes differently. This is reported in Table 2, which considers hypothetical banking systems where all banks feature the same PDs and exposures to the common factor but differ in size. There are three big banks of equal size, together accounting for 40% of the overall system, and a group of small banks, making up the rest. As the number (but not the share) of small banks increases (across columns to the right, in each panel), diversification benefits reduce overall systemic risk.[9] This reduction is associated with a decline in the systemic importance of small banks and a rise in that of large banks (the first two rows in each panel). Moreover, the rise in big banks' systemic importance reflects not only a rise in the share but also in the amount of systemic risk that these banks account for. Considering the example of a strongly capitalised system (left-hand panel), a rise in the number of small banks from five to 25 results in a drop of systemic risk from 9.8 to 9.3 cents on the dollar. At the same time, the amount of this risk that big banks account for rises from 4.3 (or 42.8% of 9.8) to 6.3 (or 68.1% of 9.3) cents on the dollar.[10]

System lumpiness, systemic risk and systemic importance

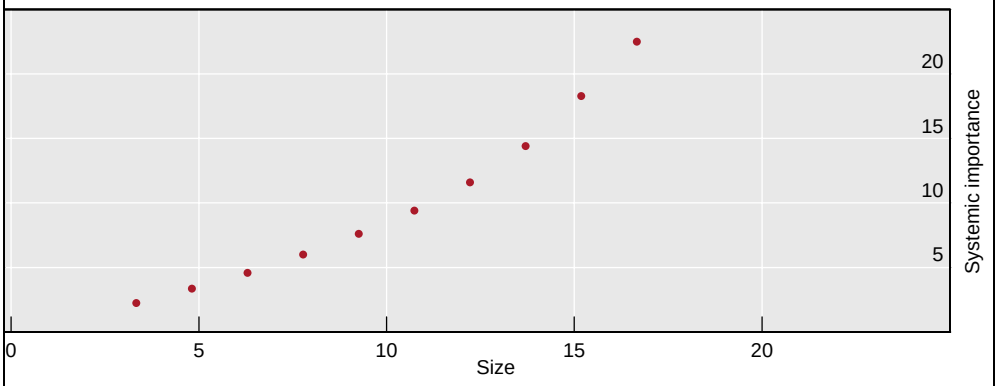
	Strongly capitalised system (all PDs = 0.1%)					Weakly capitalised system (all PDs = 0.3%)				
	Number of small banks					Number of small banks				
	n_s = 5	n_s = 10	n_s = 15	n_s = 20	n_s = 25	n_s = 5	n_s = 10	n_s = 15	n_s = 20	n_s = 25
Three big banks (share)	42.8%	56.8%	62.6%	66.0%	68.1%	41.6%	52.3%	56.5%	59.3%	60.7%
n_s small banks (share)	57.2%	43.2%	37.4%	34.0%	31.9%	58.4%	47.7%	43.5%	40.7%	39.3%
Total ES	9.8	9.4	9.3	9.25	9.23	16.7	15.0	14.7	14.4	14.3

Total expected shortfall (ES) equals the expected loss in the 0.2% right-hand tail of the distribution of portfolio losses; per unit of overall system size, in percentage points. The first two rows report the share of the two groups of banks in total ES. The group of big banks accounts for 40% of the overall size of the system and the group of small banks accounts for 60%. The probability of default (PD) of each bank is as specified in the panel heading. Loss-given-default is set to 55%. All banks are assumed to have the same sensitivity to common risk factors, implying a common asset return correlation of 42%. Table 2

[9] The decline in systemic risk is rather subdued because the assumed high exposure of banks to the common risk factor restricts the diversification benefits obtained from increasing their number. This general result is studied in detail in Tarashev (2009).

[10] The effect is even stronger in the case of a weakly capitalised system (right-hand panel).

Size and systemic importance[1]



[1] All numbers are in percentage points. The system comprises 10 institutions, each represented by a dot. Systemic importance is measured as the share of each institution in the expected shortfall of the system, defined as the expected loss in the 0.2% right-hand tail of the distribution of system-wide losses. Size is measured as a share in the aggregate size of all institutions in the system. Each bank's loss-given-default and probability of default equal 55% and 0.1% respectively. The loadings on the common factor (see the technical appendix) are constant across banks and equal 0.6. Graph 2

Finally, and quite generally, systemic importance increases more than proportionately with (relative) size. This relationship is a consequence of the fact that larger institutions play a disproportionate role in systemic events. The first column of Table 2, for example, relates to a system in which a big bank is roughly 10% larger than a small one but is assigned a 25% greater share in systemic risk.[11] This effect increases as banks' sizes become more disparate. For example, the fifth column of the table, which relates to a system where the sizes of big and small banks are roughly 5:1, reports that the respective shares in systemic risk are roughly 18:1.

Graph 2 presents further evidence of this non-linear relationship between size and systemic importance. It plots the contributions to system-wide risk of institutions that are all identical except for their size. In the particular example, the largest institution is about 5 times as large as the smallest one, but its relative systemic importance is nearly 10 times as high.

Implications for the calibration of prudential instruments

Even though the above examples have been cast in stylised settings, they illustrate robust results and point to concrete policy lessons. In particular, all else equal, they suggest that any "systemic capital charge" applied to individual institutions should increase more than proportionately with relative size. In other words, there is a clear rationale for having tighter prudential standards for larger institutions. In addition, the charge should increase with the degree to which an institution is exposed to sources of systematic risk. This means that higher capital charges would be applied to institutions that are more similar to the typical (or "average") institution: if they fail, they are more likely to fail in a systemic event.

The above examples also touch, albeit indirectly, on the notion of diversification from a systemic viewpoint. There is a potential trade-off between diversification in the portfolio of an *individual* institution and diversification *for*

[11] More precisely, the ratio of small and big bank sizes equals (0.4/3)/(0.6/5) = 1.11. The corresponding ratio of systemic importance measures is (42.8%/3)/(57.2%/5) = 1.25.

the system as a whole. This is because, by diversifying their own investment portfolios, institutions affect systemic risk in two ways. First, greater diversification of each portfolio is likely to reduce the riskiness of individual institutions. Second, it is also likely to result in more similar portfolios and, thus, in institutions being more exposed to common risk factors. The net outcome depends on how the first effect, which lowers systemic risk, compares to the second, which raises it.

Implementing the tool: beyond stylised examples

The previous analysis provides a structured framework for examining what factors are relevant in assessing the systemic importance of institutions. But what steps are needed to apply the Shapley value methodology in practice? What choices do policymakers have to make?

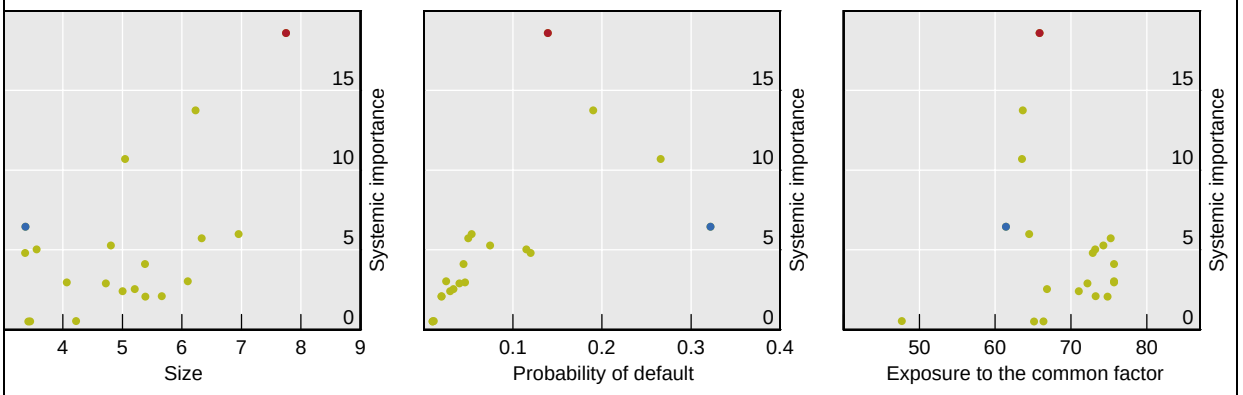
Operationalising the methodology

In making this general approach operational, a number of issues need to be addressed. Beyond choosing a specific measure of systemic risk, these include: the definition of the relevant "system"; the definition of the "size" of institutions; the choice of inputs; the uncertainty about the correct specification of the risk model and the true parameter values; and computational burden. Except for the last, all of these issues are related to the measure of systemic risk, rather than to the Shapley value methodology as such. Box 2 provides a discussion of the trade-offs and pitfalls involved and outlines the considerations that might guide policymakers' choices.

An application to real-world data ...

Once these choices are made, the application is straightforward. To illustrate how the methodology can be applied to real-world data, consider the following example. The chosen measure of system-wide risk is expected shortfall, as in the stylised examples of the previous section. We define the relevant "system" as comprising 20 large internationally active financial institutions and assume that a loss is incurred when one or more of them fail. We measure an institution's size as the book value of its liabilities, divided by

A system of large internationally active institutions[1]



[1] All numbers are in percentage points. Systemic importance is measured as the share of each institution in the expected shortfall of the system, which is defined as the expected loss in the 0.2% right-hand tail of the distribution of portfolio losses. The size of an institution equals the book value of its liabilities, expressed as a share in the sum of the liabilities of all institutions in the system. The probability of default is the one-year EDF provided by Moody's KMV for end-2007. Exposures to the common factor are derived on the basis of Moody's KMV GCorr estimates of institutions' asset-return correlations for end-2007.

Sources: Moody's KMV. Graph 3

Box 2: Applying the method in a policy context: choices and trade-offs

This box addresses the policy choices and practical issues that have to be confronted when implementing the methodology as an element in a macroprudential approach to regulation and supervision.

The definition of the appropriate "system", as a precondition for calibration, is not straightforward. This is less of an issue in current regulatory arrangements which focus on individual institutions but becomes critical when the prudential framework focuses on systemic risk. At least two aspects need to be addressed. The first relates to the institutional coverage of regulation – its so-called "perimeter". A systemic approach would need to take account of the risks generated by all financial institutions that are capable, on their own and as a group, of causing material system-wide damage. This is so regardless of their legal form. The second aspect relates to the geographical coverage of regulation. Should the approach be applied at a domestic level or at a more global level, say to internationally active institutions? And if the answer is to both, how would the adjustments be reconciled? Clearly, a large dose of pragmatism is necessary. And the precise answers will also depend on the extent of cooperation across regulatory jurisdictions.

The definition of the size of the institutions also merits attention, and partly overlaps with that of the system. One question is whether to include only domestic exposures or both domestic and international ones. Another question is whether the appropriate measure refers to the assets (presumably including off-balance sheet items) or to the liabilities (excluding equity) of the institutions. Total assets better reflect the potential overall losses incurred by all the claimants on the institution; liabilities are a better measure of the direct losses linked to its failure.

Having defined the system and the size of the institutions, the next practical question is how to estimate the additional parameters, notably the probabilities of default and the factor loadings on the systematic risk factors. The sources of information range from market inputs, at one end, to supervisory inputs, at the other. Combinations of the two are also possible.

Market inputs have a number of attractive features but also limitations. On the plus side: they summarise the considered opinion of market participants based on the information at their disposal; they should reflect market participants' views of all potential sources of risk, regardless of their origin (eg poor asset quality, bank runs, counterparty linkages); and they are easily available on a timely basis. On the minus side: they may not be available for all institutions (eg equity prices for savings banks); they require the use of "models" to either filter out extraneous information (eg risk premia, expectations of bailouts) or complete the information they contain (eg to derive probabilities of default from equity prices), giving rise to "model" uncertainty; and they may contain systematic biases: for example, it is well known that market prices tend to be especially buoyant as financial vulnerabilities build up during booms (Borio and Drehmann (2009)).

Supervisory estimates have their own strengths and weaknesses. On the plus side, they can be based on more granular and private information, to which market participants do not have access; on the minus side, they may simply not be available, or may be hard to construct for certain inputs. For example, supervisors have a long tradition in producing measures of the soundness of individual financial institutions, such as rating systems. However, they have as yet not developed tools to derive measures of exposures to systematic risk factors and correlations across institutions based on balance sheet data. The available techniques are in their early stages of development.

All this suggests that, in practice, it might be helpful to rely on a combination of sources and to minimise their individual limitations. For example, currently market prices appear to be especially suited for the estimation of exposures to common factors. And long-term averages of such prices would help to address the biases in the time dimension. This would be especially appropriate if the tool is used to calculate *relative* contributions of institutions to systemic risk and to avoid procyclicality (Borio (2009)).

These difficulties highlight the need to deal with the margin of error that will inevitably surround the estimates of systemic risk and hence, by implication, of institutions' contributions to it (Tarashev (2009)). Fortunately, as noted above, the linearity property of the allocation procedure makes it possible to address this issue in a formal, simple and transparent way. This property allows one to combine alternative estimates, weighting them by the degree of confidence that one attaches to them (Tarashev et al (2009)). In addition, it may be advisable for policymakers not to rely too heavily on the resulting point estimates. One possibility would be to allocate institutions into a few buckets, each of them comprising an interval of point estimates – akin to a rating system. This grouping has the added advantage of reducing the computational burden of assessing risk at the level of subgroups of institutions.

the sum of the liabilities of all institutions in the system. In addition, we measure an institution's standalone riskiness as the Moody's KMV estimate of its one-year probability of default and assume that loss-given-default is constant at 55%. We also impose a single-common-factor structure on the Moody's KMV estimate of the 20 institutions' asset-return correlations in order to derive the strength of exposures to systematic risk. Both sets of estimates are based on market prices of equity and relate to end-2007. Finally, we abstract (for simplicity) from model and estimation uncertainty. Given these assumptions, we then derive the expected shortfall of the system and each institution's contribution to it. The results are shown in Graph 3, which plots each institution's contribution to system-wide risk against three of its drivers, namely the institution's size, probability of default and exposure to the common factor.

... illustrates that there is no single proxy for systemic importance

The results indicate quite clearly that the interaction of the various factors plays a key role. None of them, in isolation, provides a fully satisfactory proxy for systemic importance. For example, the largest institution in the system illustrated in Graph 3 is also the one with the biggest contribution (red dot). However, owing to its comparatively high probability of default, the institution with the fourth largest contribution is also one of the smallest and the least exposed to the common risk factor (blue dot). This highlights an important strength of the Shapley value methodology, namely that it allows for a straightforward *quantification of the interactions* of the various drivers.

Conclusion

This paper has presented a very general methodology to quantify the contribution of individual institutions to systemic risk. For a given measure of systemic risk, this is equivalent to calculating their systemic importance. The methodology can be applied to a wide variety of measures of systemic risk, and is very intuitive and flexible. As shown elsewhere, it subsumes other much more restrictive procedures as special cases (Tarashev et al (2009)). The methodology is very helpful in structuring an analysis of the drivers of systemic importance and in quantifying their relative impact.

In practice, any measure of individual institutions' systemic importance will necessarily be based on a specific measure (or measures) of systemic risk. The construction of such measures faces a number of tough challenges. These largely reflect the need to define what the relevant system is and to estimate the appropriate parameters. In the specific setting used here, these parameters include the probability of default and loss-given-default of individual institutions, exposures to common risk factors and the size distribution of the system. We have discussed how some of these challenges can be met and illustrated this with a concrete but simplified example using real-world data. In future, tools such as this one will inevitably be part of the arsenal of weapons needed to implement a financial policy framework with a macroprudential orientation, as called for by the international policy community.

Technical appendix: expected shortfall

Expected shortfall, also known as expected tail loss, is the measure of systemic risk we use in all numerical examples. It is defined as the expectation of default-related losses in the system, conditional on a systemic event. This event occurs when system-wide losses equal or exceed some (in this article, the 98th) percentile of their probability distribution.

We specify this probability distribution as follows. System-wide losses equal $\sum_{i=1}^{N} s_i \cdot LGD_i \cdot I_i$, where s_i is the size of the liabilities of institution *i*, LGD_i (loss-given-default) is the share of s_i that is lost if that institution defaults, and I_i is an indicator variable that equals 1 if institution *i* defaults and 0 otherwise. Without loss of generality, the overall size of the system is set to unity, $\sum_{i=1}^{N} s_i = 1$, and, for simplicity, it is assumed that $LGD_i = 55\%$ for all institutions. Finally, in line with structural credit risk models, institution *i* is assumed to default when its assets V_i fall below a particular threshold. Specifically, this happens when $V_i = \rho_i \cdot M + \sqrt{1-\rho_i^2}\, Z_i < \Phi^{-1}(PD_i)$, where the value of assets is driven by one risk factor that is common to all institutions, M, and another risk factor that is specific to institution *i*, Z_i, and both factors are standard normal variables. In addition, PD_i denotes the unconditional probability of default of institution *i* and Φ^{-1} is the inverse of the standard normal CDF. Finally, the loadings on the common (or systematic) factor, $\rho_i \in [0,1]$ for $i \in \{1,\cdots,N\}$, determine the correlation of defaults within the system.

We quantify expected shortfall using Monte Carlo simulations that take as inputs the following parameters for each institution *i*: s_i, LGD_i, PD_i, ρ_i.

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