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**Financial Stability Review**

December 2005

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## The **Financial Stability Review** aims:

- to encourage informed debate on financial stability issues, domestically and internationally
- to survey potential risks to financial stability
- to analyse ways of promoting and maintaining a stable financial system

### Essential information

The *Financial Stability Review* is available as a complete document in pdf format, together with additional information about the *Review*, on the Bank of England's website: [www.bankofengland.co.uk](http://www.bankofengland.co.uk). The *Financial stability themes and issues* section is at: [www.bankofengland.co.uk/publications/fsr/2005/themesandissues0512.pdf](http://www.bankofengland.co.uk/publications/fsr/2005/themesandissues0512.pdf) and the *Financial stability conjuncture and outlook overview* is at: [www.bankofengland.co.uk/publications/fsr/2005/overview0512.pdf](http://www.bankofengland.co.uk/publications/fsr/2005/overview0512.pdf).

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# themes and issues

Since the June *Review*, the immediate circumstances for borrowers and lenders have suggested few reasons for a reassessment of credit and market risks. The UK financial system remains healthy. However, the persistence of the ‘search for yield’ across financial markets continues to fuel an increase in highly leveraged and potentially illiquid financial products. It has placed pressure on financial intermediaries to ease lending terms, challenged operational controls within the financial sector, and may have heightened the vulnerability of the UK financial system to adverse developments. The Bank of England’s regular assessment of the ‘Financial stability conjuncture and outlook’ considers these issues in detail.

In the light of current risks, major initiatives to support the resilience of the financial system are reviewed in the regular article ‘Strengthening financial infrastructure’. Several are designed to address problems affecting payment and settlement systems, which have the potential to generate systemic risk by spreading contagion among financial institutions and disrupting payment transactions. Key issues arising in this area are reviewed in the article by Stephen Millard and Victoria Saporta, ‘The future of payments’, which summarises a conference held at the Bank in May 2005. The conference focused on, among other things, the role of central banks in the operation and oversight of payment systems, and on the future development of payment systems and their implications for monetary and financial stability.

One issue discussed at the conference related to the implications of the ‘tiered’ structure of the large-value UK payment systems, in which a small number of ‘first-tier’ (or settlement) banks provide payment and settlement services to a much larger number of ‘second-tier’ (or customer) banks. The risks from tiering were highlighted by the International Monetary Fund in their 2003 Financial System Stability Assessment of the United Kingdom. Greater direct membership of the large-value payment systems would limit the risks from tiering by reducing payments-related credit exposures among the large banks. The recent decisions by Abbey and UBS to become direct members of CHAPS Sterling are therefore a welcome contribution to ensuring financial stability. Some of the implications of tiering are considered in the article by Sally Harrison, Ana Lasoasa and Merxe Tudela, ‘Tiering in UK payment systems: credit risk implications’. Using survey data collected by the Bank, the article quantifies the credit risk to settlement banks that arises from a tiered structure.

# themes and issues



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Tiering essentially involves a small number of financial institutions dominating a particular market. Another form of concentration risk may arise if key market participants take similar positions in a market. This is one of the issues considered by Paul Tucker in 'Where are the risks?', a speech he gave to the Euromoney Global Borrowers and Investors Forum in June 2005. He notes that the increased use of securitisation and credit derivatives has facilitated greater diversification of risk. But there may be occasions when a concentration of short positions in options contracts among dealers may cause normal dynamic hedging strategies to amplify asset price movements, with potentially destabilising effects on financial stability. As with tiering, this risk may only materialise in stressed conditions. It may also only arise where the underlying market is not particularly liquid. Tucker concludes, *inter alia*, that market participants — and the authorities — should always seek to identify major imbalances in option positions in markets where liquidity might come under pressure during stressed conditions.

This points more generally to the need for the authorities to analyse ways in which liquidity needs and processes could contribute to the risks of financial instability. The factors affecting liquidity in modern global markets are considered by Sir Andrew Large in a speech 'Financial stability: managing liquidity risk in a global system', given to the City of London Central Banking and Regulatory Conference on 28 November 2005. Just as increased concentration in the global financial system can lead to tiering in payment systems, and may also be a factor behind 'crowded trades' in financial markets, so it can create new demands on the liquidity of increasingly interconnected global firms in the event of market stress. Central banks and regulators therefore need to review the appropriateness of current liquidity standards and their consistency across jurisdictions. Sir Andrew also concludes that the private and public sectors should co-operate to develop mechanisms and best practice standards for addressing global liquidity risk.

Notwithstanding the growing participation of large and complex financial institutions in new risk transfer markets and the implications for these firms' liquidity requirements, the core business of most banks remains the provision of loans to companies and households, subject to meeting regulatory capital requirements. The factors impinging on the willingness of banks to supply loans are considered by Erlend Nier and Lea Zicchino in their article 'Bank weakness and bank loan supply'. They find that banks that are weakened by rising loan loss provisions appear consistently to reduce their credit supply; that this effect is stronger for banks with smaller initial capital buffers; and that the adverse effect of such smaller capital buffers on loan supply becomes stronger as economic growth falls. These procyclical effects are found to be pervasive across countries and to apply

regardless of whether or not countries have suffered banking crises, although they appear to be stronger in 'crisis' countries.



The procyclicality of bank loan supply may contribute to systemic risk if it exacerbates macroeconomic downturns, which tend to increase the risk of contagion across financial institutions and markets. Contagion may also lead to global financial instability if a problem in one country spreads to others. This possibility is examined in the article by Cristiana De Alessi Gracio, Glenn Hoggarth and Jing Yang, 'Capital flows to emerging markets: recent trends and potential financial stability implications'. The authors consider the extent to which the increased finance provided to emerging market economies (EMEs) in recent years originates from common creditors. They find that bond finance is quite diversified for most individual EMEs. But that may not preclude the propagation of contagion across EMEs through 'herding behaviour' by investors. The authors conclude, however, that most EMEs are less vulnerable to a precipitate withdrawal of international capital, and have in place a more flexible policy framework to deal with any such shock, than was the case in the 1990s. The likelihood of widespread contagion across EMEs affecting global financial stability is therefore judged to be somewhat lower than in the past.

The special articles in this edition draw attention to the dangers that could emerge if systemic risk were to materialise.

Maintaining financial stability is assisted by monitoring reliable forward-looking indicators. One possible measure, derived from the markets for standardised credit default swap (CDS) indices, is considered in the article by Tom Belsham, Nick Vause and Simon Wells, 'Credit correlation: interpretation and risks'. The spreads on different CDS index tranches reveal market perceptions of the degree to which defaults may occur together or in isolation ('default correlation') over the next five years. They may, therefore, provide information on the expected behaviour of factors likely to precipitate the widespread and interrelated failures commonly associated with the crystallisation of systemic risk. Great care is needed in interpreting developments in CDS index spreads and using them to draw conclusions about default correlation, given that these markets are not yet fully developed. But they do appear to have the potential to provide the authorities with a useful new market-based indicator of financial stability.





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# The financial stability conjuncture and outlook

## An overview of UK financial stability: threats and resilience

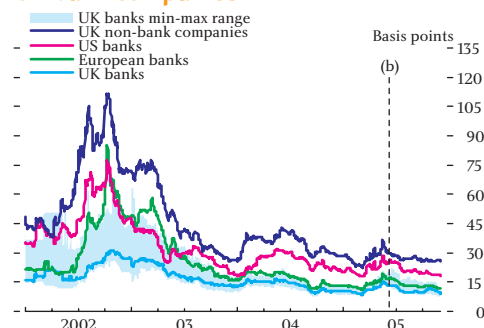
The UK financial system remains healthy. Near-term risks to stability from the domestic economic environment and from conditions in global financial markets seem limited. The major UK banks continue to be profitable, well capitalised, and capable of withstanding significant adverse shocks to their balance sheets. Consistent with this picture, the willingness to pay for protection against defaults by the major UK-owned banks has changed little since the June 2005 *Review* (Chart 1).

Nevertheless, in the longer term, some significant downside risks remain. Previous *Reviews* have noted the continuing accumulation of debt by many borrowers and the aggressive ‘search for yield’ across financial markets. That has fuelled a rapid increase in highly leveraged financial products — a trend which, if anything, has intensified since June. The relaxation of lending criteria in some markets and increased appetite for potentially illiquid instruments suggest that financial discipline may also have weakened somewhat. Previous experience suggests that such developments could herald future problems if assessments of risk were to change sharply.

### Search for yield and the dispersion of credit risk

The favourable near-term outlook for UK financial stability largely reflects a combination of financial innovation and ongoing macroeconomic stability in the United Kingdom and other major economies. Rapid financial innovation — particularly in derivative and securitisation markets — has facilitated risk diversification, allowing banks in particular to transfer some credit risks to a wide base of investors beyond the banking system. At the same time, low, stable inflation and less volatile economic growth have reduced uncertainty around future cash flows. Together, these forces have contributed to expectations of low asset price volatility (Chart 2) and a reduction in risk premia. It seems that this has, in turn, encouraged investors to seek out riskier assets. Market contacts indicate that a high tolerance for risk continues to be sustained across a range of financial markets, and in the credit markets in particular.

**Chart 1**  
Credit default swap premia for banks and non-bank companies<sup>(a)</sup>

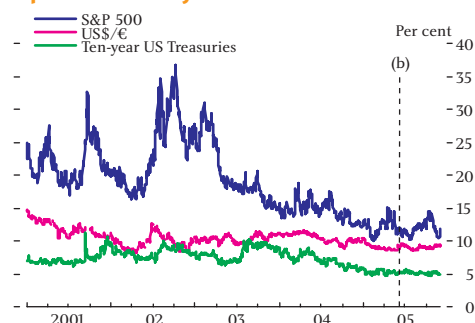


Sources: Bloomberg, JPMorgan Chase and Co, Markit, published accounts and Bank calculations.

(a) Data are available for 7 major UK banks, 36 other FTSE 100 companies, 20 continental European banks and 9 US banks, weighted by total assets.

(b) June 2005 *Review*.

**Chart 2**  
Implied volatility of financial markets<sup>(a)</sup>



Sources: Bloomberg, Chicago Mercantile Exchange, British Bankers Association and Bank calculations.

(a) Implied from three-month (or close to three-month) option prices.

(b) June 2005 *Review*.

Financial innovation and macroeconomic stability do not necessarily mean, however, that the financial system has become intrinsically less risky. Although banks have transferred some risks to other investors, they often retain residual exposures and have additional counterparty exposures. They could also retain indirect exposures if they are extending finance to purchasers of the transferred risk. Furthermore, banks might be holding risky assets in preparation for subsequent securitisation and could face significant losses if asset prices moved abruptly. Given strong competitive conditions and greater demand from end-investors for risky assets and bespoke financial products, financial intermediaries have sometimes taken on more exposures that may be difficult to hedge in wholesale markets.

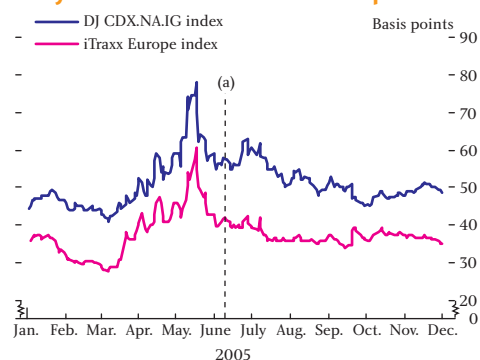
The use of dynamic hedging strategies across a wide range of financial markets to hedge risks has increased dependence on market liquidity. Any developments which precipitate a drying up of liquidity in some markets could amplify asset price movements and might generate losses for financial intermediaries. The recent deterioration in the perceived creditworthiness of General Motors, and the filing for protection from creditors by Delphi and Refco have had a short-lived impact on credit markets (Chart 3). While these episodes highlight the resilience of key markets, they also illustrate some of the channels by which contagion might spread across asset markets and disrupt financial intermediation following shocks.

The continued 'search for yield' could be leading some investors to underestimate risk, particularly if they focus on the absolute level of yields in an environment where (real and nominal) long-term interest rates are low (Chart 4). And some investors might harbour overly optimistic views about the capability of policymakers to offset shocks to the macroeconomy.

Consistent with the current pattern of global savings and investment, net corporate debt issuance, in recent years, has been scarce relative to net issues of low-risk government bonds. As a result, investors have sought to leverage existing assets in their quest to enhance potential returns. Financial intermediaries have responded by developing a range of structured credit products and by increasing the volume of leveraged loans (Chart 5). The strong competition for new business and mandates has seen growing pressure to ease lending terms, such as loan covenants, debt-income ratios, and maturities.

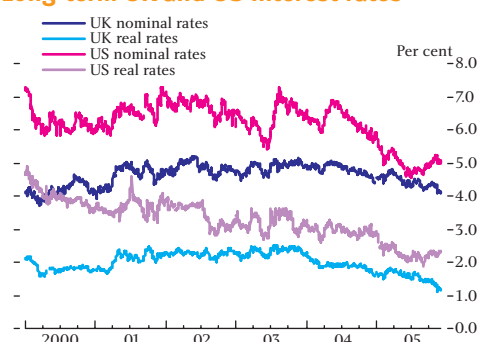
The major UK banks are significant participants in global markets. They have material counterparty exposures to large complex financial institutions (LCFIs) and other market participants. Taken as a whole, they are active in international markets for syndicated loans, leveraged-buyouts, and prime

**Chart 3**  
**Five-year on-the-run CDS index spreads**



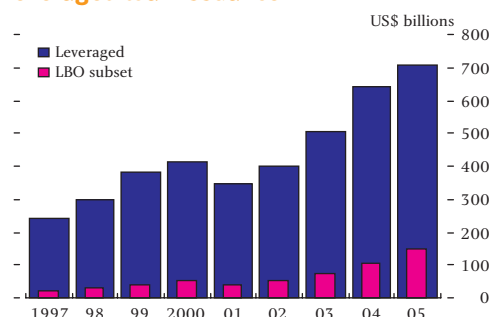
Source: JPMorgan Chase and Co.  
(a) June 2005 Review.

**Chart 4**  
**Long-term UK and US interest rates<sup>(a)</sup>**



Source: Bank of England.  
(a) All data are based on ten-year instantaneous forward rates, except US real interest rates which are based on eight and a half year instantaneous forward rates.

**Chart 5**  
**Leveraged loan issuance<sup>(a)</sup>**



Sources: Loan Pricing Corporation and Bank calculations.  
(a) Data for 2005 are annualised based on Q1-Q3.

brokerage. A generalised reassessment of risks — perhaps as a result of an unexpected credit event — might, therefore, have significant implications for their balance sheets. Some UK banks' assets have grown markedly in recent years, and the reliance of the banking sector on wholesale markets to fund balance sheet growth remains significant.

## The current conjuncture

The December 2005 *Review* highlights several areas where potential threats to UK financial stability remain.

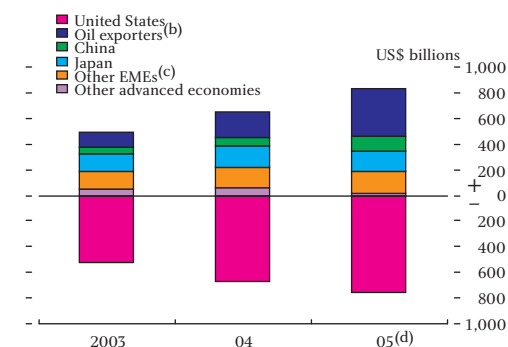
First, global imbalances have increased further (Chart 6). It is difficult to judge how long these imbalances will continue. To the extent that a correction requires the implementation of policies that foster real exchange rate depreciation and reduced domestic spending in deficit countries, and the opposite in surplus countries, it would take time to achieve. So some of the forces that have helped sustain low 'risk free' interest rates and the build-up of leverage could persist. But sudden shifts in international capital flows could disrupt a wide range of asset markets. The longer that these imbalances continue, the greater the potential for costly and disorderly adjustments in markets and so in the balance sheets of financial institutions — including those based in the United Kingdom.

Second, credit exposures to higher-risk firms in parts of the corporate sector, including commercial property, continue to build. As highlighted in recent *Reviews*, there has been substantial growth in banks' exposures to the commercial property sector in the United Kingdom (Chart 7) and internationally. The global mortgage-backed securities (CMBS) market has grown very rapidly, facilitating additional leverage of exposures. As with leveraged loans and with structured products engineered from instruments that are already leveraged, there are signs that the quality of the underlying asset pool may be deteriorating. So abrupt swings in financial market sentiment, or a marked deterioration in the economic climate, could create difficulties for firms and lenders, particularly as they increase their exposure to new and more illiquid financial products.

Third, vulnerabilities may arise if some firms in the financial sector pay inadequate attention to operational controls in the present environment. For example, the confirmation and assignment backlogs in structured credit markets raise the prospect of settlements problems that could complicate risk management should a major risk crystallise. As discussed in the article, 'Strengthening financial infrastructure', these backlogs reflect a collective action problem. In a competitive environment, the willingness of a firm to ensure that traders refrain from assigning positions to third parties without notification depends on the willingness of its peers to do

Chart 6

### Global current account balances<sup>(a)</sup>

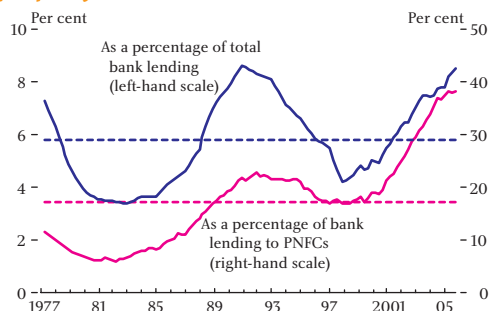


Source: IMF.

- (a) Global current account balances do not sum to zero due to errors and omissions.
- (b) The sum of the ten largest oil exporters in 2004 — Algeria, Iran, Kuwait, Mexico, Nigeria, Norway, Russia, Saudi Arabia, United Arab Emirates and Venezuela.
- (c) Other EMEs includes the newly industrialised Asian economies.
- (d) IMF forecast, September 2005.

Chart 7

### UK bank lending to the commercial property sector<sup>(a)(b)(c)</sup>



Source: Bank of England.

- (a) This includes companies involved in the development, buying, selling and renting of real estate.
- (b) Dashed lines represent averages from 1977 Q1.
- (c) Data are extrapolated from annual series between 1977 Q1 and 1997 Q3.

likewise. Encouragingly, industry participants have been collaborating with regulators to eliminate these backlogs.

In summary, the continued resilience of the UK financial system must be seen against a backdrop of longer-term global trends that have both buttressed financial stability and heightened the need for vigilance. The declining price of risk and the rapid growth of securitisation markets could indicate enhanced risk sharing. Shocks which may otherwise have disrupted financial intermediation might, therefore, have been more readily dispersed to those most capable and willing to absorb them. But such outcomes are by no means assured. Current conditions may have generated a degree of over-optimism about the underlying risk of some financial products. Moreover, this appears broadly based. Risk transfer markets have made the ultimate destination of these risks more opaque, have complicated contract enforcement problems, and increased leverage. While some market participants have provided liquidity in recent episodes of stress, their capacity to absorb the consequences of a generalised re-pricing of risk is uncertain. So although major UK banks remain in a strong financial position, the possibility that adverse developments could create significant balance sheet difficulties cannot be ruled out.

# 1 Credit risk

Overall, near-term risks to major UK banks from households, companies and foreign borrowers appear low. Consensus forecasts are for firm domestic and foreign economic growth. Write-off rates on banks' mortgage books are very low and losses on unsecured household lending are modest in relation to banks' profits. Finance to companies is readily available. Indeed, some banks have built up sizable exposures to the commercial property sector, and intense competition in the leveraged loan market has put pressure on terms and conditions to be eased. And imbalances in global saving-investment patterns have increased further, adding to the risks of a costly adjustment in the medium term.

The major UK banks play a central role in the allocation of savings in the economy. Credit risks on the balance sheets of these institutions are, therefore, pivotal to the stability of the financial system as a whole. Risks to credit exposures may crystallise as a result of shocks that originate internationally as well as domestically. So this chapter assesses the vulnerability of major UK banks' most significant worldwide exposures to corporate, household and sovereign borrowers, considers the financial pressures facing these borrowers, and identifies possible areas of stress.

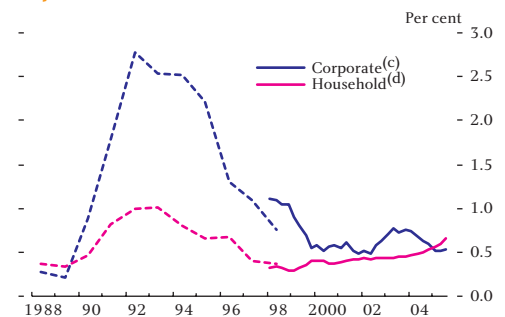
The level of write-offs on the major UK banks' credit exposures remains low.<sup>(1)</sup> This reflects continued macroeconomic stability, which has supported corporate profitability and household incomes. Although losses on the major UK-owned banks' unsecured household lending in the United Kingdom have continued to rise, increasing the aggregate household write-off rate (Chart 1.1), these losses remain low relative to banks' profits. And recent stress testing analysis suggests that even moderately large shocks would be likely to have only a limited impact on the profitability of the major UK banks.<sup>(2)</sup>

## 1.1 UK corporate credit risks

### Exposures

Lending to domestic firms is an important component of the major UK banks' balance sheets, accounting for about 10% of total assets. On a global basis, almost 30% of their 'large exposures' to non-financial companies are to UK-owned firms.

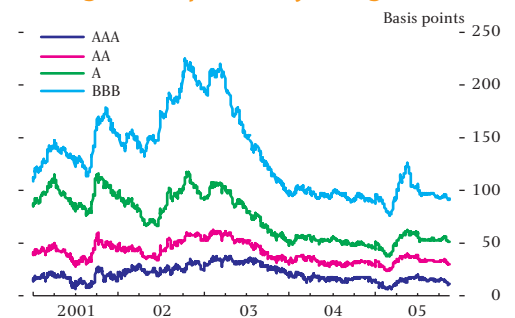
**Chart 1.1**  
Write-off rates on banks' lending to UK corporates and households<sup>(a)(b)</sup>



Sources: ONS and Bank of England.

- (a) Annual rates.
- (b) Solid line shows write-off rate for UK-owned banks, dotted line for all UK-resident banks (interpolated annual data for 1988–98).
- (c) Data are for private non-financial corporations.
- (d) Data are for individuals, unincorporated businesses excluded.

**Chart 1.2**  
Sterling credit spreads, by rating<sup>(a)</sup>



Source: Merrill Lynch Global Index System.

- (a) Asset swap spreads.

(1) Impairment charges in 2005 H1 were 27% of pre-tax profits, little changed on 2004 (26%). Impairment charges were previously called provisions under UK GAAP (see Box 4 in Chapter 3).

(2) Bunn, P, Cunningham, A and Drehmann, M (2005), 'Stress testing as a tool for assessing systemic risks', Bank of England *Financial Stability Review*, June. Also, Hoggarth, G, Sorensen, S and Zicchino, L (2005), 'Stress tests of UK banks using a VAR approach', *Bank of England Working Paper no. 282*.

Credit continues to be readily available to the corporate sector. Competition among banks for new corporate lending remains strong, while the cost of capital market finance is low (Chart 1.2). Non-price terms and conditions, such as covenants, have weakened (see Chapter 2). And some banks have increased their exposure to higher-risk firms since June, through the underwriting of debt issued by lower-rated borrowers, or by providing finance for leveraged buyouts (LBOs) (Chart 1.3).

Although the corporate sector has remained in financial surplus, bank borrowing has increased (although bond and equity issuance remains weak (Chart 1.4)). The annual growth rate of major UK banks' lending to domestic firms was 16% in October 2005, considerably stronger than the increase in household lending.

Some of the increase in borrowing has been used to fund mergers and acquisitions. Transactions by UK companies increased slightly in recent months, but activity remains below the average of the past 15 years. There has been a much larger increase in the acquisition of UK companies by foreign firms, including a number of recent bids for large companies.

The annual growth rate of the major UK-owned banks' lending to commercial property companies<sup>(1)</sup> remains particularly rapid, at around 18%. This sector has accounted for almost half of their net new lending to non-financial corporations so far in 2005 and now makes up over a third of its stock (Chart 1.5). Property also accounts for a significant proportion of banks' 'large' exposures.<sup>(2)</sup>

## Insolvencies and write-offs

Despite a slight increase in 2005, the UK company insolvency rate remains close to its lowest level for 25 years (Chart 1.6). The write-off rate on UK banks' corporate lending also remains low, with several institutions reducing their impairment charges in the past six months.

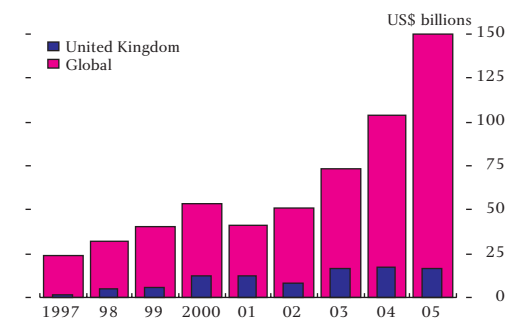
The low corporate write-off rate partly reflects favourable conditions in the United Kingdom — where economic activity has expanded for more than 50 consecutive quarters. And the low level of real long-term interest rates has reduced the burden of debt servicing. But the reduction in insolvencies since the early 1990s, and particularly over the past two years, has been greater than implied by models based upon the relationship with companies' debt, profitability, and the macroeconomic environment.<sup>(3)</sup>

(1) This includes companies involved in the development, buying, selling and renting of real estate.

(2) For regulatory purposes, 'large' exposures are defined as any exposures that exceed 10% of eligible capital (Tier 1 plus Tier 2 capital, less any regulatory deductions, eg related to insurance subsidiaries) at any point during the reporting period.

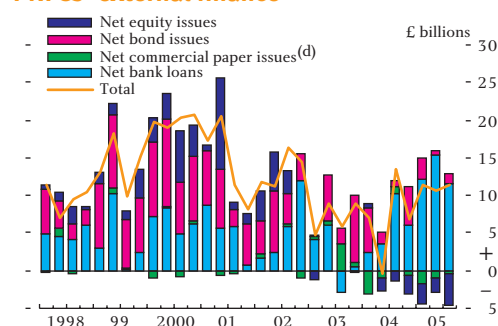
(3) Bunn, P and Redwood, V (2003), 'Company accounts based modelling of business failures and the implications for financial stability', *Bank of England Working Paper no. 210*.

**Chart 1.3**  
Loans issued to back LBOs<sup>(a)(b)</sup>



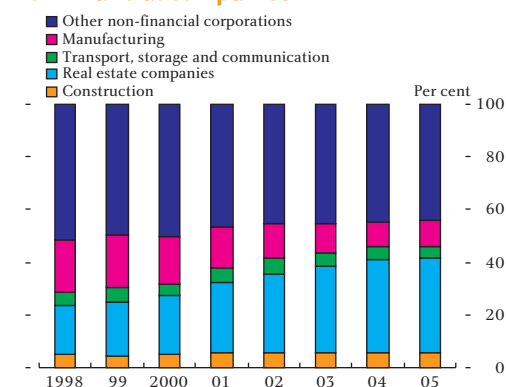
Sources: Loan Pricing Corporation and Bank calculations.  
(a) Includes senior and junior loan facilities.  
(b) Data for 2005 are annualised based on Q1–Q3.

**Chart 1.4**  
PNFCs' external finance<sup>(a)(b)(c)</sup>



Source: Bank of England.  
(a) The components do not sum to the total in each quarter because the total has been independently seasonally adjusted.  
(b) PNFC stands for private non-financial corporations.  
(c) Excluding securitisations and borrowing by PNFCs from non-resident monetary financial institutions.  
(d) No data available prior to January 2003 on issues of commercial paper denominated in foreign currency.

**Chart 1.5**  
Major UK banks' stock of lending to non-financial companies<sup>(a)</sup>



Source: Bank of England.  
(a) Data for 2005 are to end-September.



It is unclear if the easing in corporate lending conditions reflects a genuine reduction in long-term credit risk, an improvement in the management of that risk, or other factors. Institutions have improved their monitoring of loans, enabling them to take early steps to address any weaknesses. Financial innovation has allowed institutions to distribute and diversify risk (including the trading of distressed debt), lowering its cost. And heightened competition between financial institutions may have lowered margins.

But immediate conditions may also reflect unrealistic expectations about the ability of policymakers to control the short-run path of output in the face of economic shocks.<sup>(1)</sup> And, as discussed further in Chapter 2, the desire to increase returns could be leading some investors to underestimate default risk. Given the relative lack of new corporate bond issuance, investors may be taking advantage of the increased opportunities for leverage afforded by financial innovation and low interest rates. For the more leveraged institutions, an adverse shock could force the liquidation of long-term real assets, placing financial pressures on firms and, ultimately, on banks' balance sheets.

## Financial pressures on companies

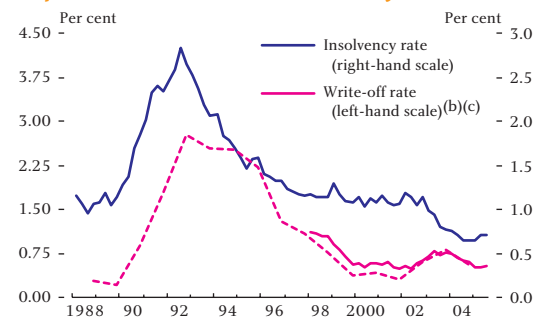
In addition to general economic factors, the main determinants of corporate failure are low firm-level profitability and high levels of debt relative to assets.<sup>(2)</sup>

### Profitability

The aggregate profitability of the UK corporate sector is robust and Consensus forecasts suggest that profit growth in 2005 and 2006 will be close to trend. Fortunes for oil companies have been buoyed by high oil prices. The service sector also continues to experience a high overall net rate of return on capital, although performance by the manufacturing sector is weaker (Chart 1.7). Company accounts data show that profit margins have increased throughout the profit distribution in 2004, and so far in 2005, although a significant fraction of firms continue to make losses (Chart 1.8).

Looking forward, total profit warnings in September reached their highest level since the 2001 slowdown. This partly reflects profit warnings from general retailers (associated with the weakness in consumer spending). The continued high oil price may also have contributed to the pressures facing some firms. But lower than expected profits need not necessarily imply deeper financial stress and subsequent corporate failure. Share prices for the FTSE All-Share index, and most sub-indices, have increased over both the past six months and since the beginning

**Chart 1.6**  
Corporate write-off and insolvency rates<sup>(a)</sup>



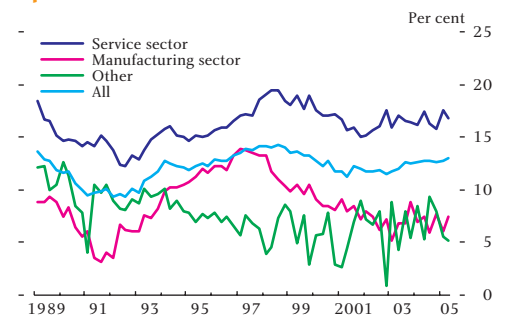
Sources: DTI and Bank of England.

(a) Annual rates.

(b) Solid line shows write-off rate for UK-owned banks, dotted line for all UK-resident banks (interpolated annual data).

(c) Data are for private non-financial corporations.

**Chart 1.7**  
Non-oil PNFCs' net rate of return on capital<sup>(a)(b)</sup>

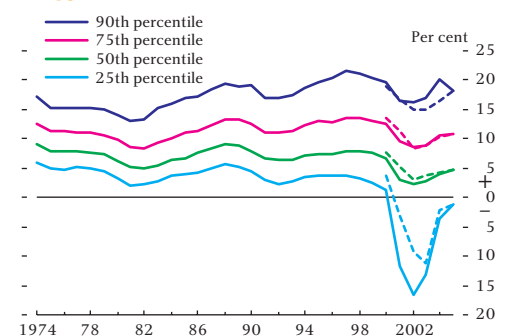


Sources: ONS and Bank of England.

(a) Net operating surplus/net capital employed.

(b) Other includes construction, energy supply, agriculture, mining and quarrying, but excludes oil companies.

**Chart 1.8**  
Distribution of profit margins of quoted PNFCs<sup>(a)(b)</sup>



Sources: Thomson Financial Datastream and Bank calculations.

(a) Earnings before interest and taxes divided by total sales.

(b) Dotted lines only include companies which have already reported in 2005.

(1) See, for example, the recent speech by the Governor to the CBI North East Annual Dinner, 11 October 2005. Available at [www.bankofengland.co.uk/publications/speeches/2005/speech256.pdf](http://www.bankofengland.co.uk/publications/speeches/2005/speech256.pdf).

(2) Bunn and Redwood (2003), *op cit*.

of the year (Chart 1.9). And a measure of the probability of corporate default in the next twelve months remains low (Chart 1.10).<sup>(1)</sup>

### Corporate debt

Robust profitability in the first half of 2005 helped firms remain in financial surplus. But although net liabilities fell, this was because the aggregate increase in firms' debt was more than offset by their accumulation of financial assets.

In general, firms are having little difficulty in servicing their debt: interest cover remains around the long-term average, while liquidity has increased further. But total debt relative to both capital stock and current earnings remains high (Chart 1.11), suggesting that the sector remains more vulnerable than normal to future adverse shocks. Pension deficits also continue to place financial pressures on some companies, with the increase in the value of assets over the past two years having been almost exactly offset by higher liabilities.<sup>(2)</sup>

### Commercial property

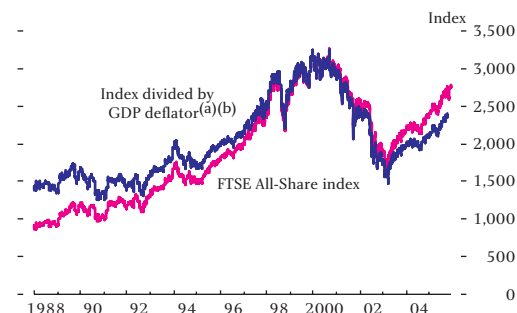
As discussed above, the commercial property sector has maintained its strong appetite for bank borrowing. With tenant defaults currently low, market conditions are being driven by the difference between property yields and the cost of debt finance. This is in contrast to the late 1980s, when investors in property were typically less highly leveraged and primarily seeking capital gains and rental growth.

In recent years, a significant proportion of commercial property lending has been used for the refinancing of loans secured on existing buildings, as new construction has been limited. But recent survey evidence<sup>(3)</sup> reveals that new development has increased by over 15% in the past six months, and that speculative development has risen by more than twice this.

Strong investor demand in the past few years has placed upward pressure on commercial property values (see Box 1). The increase appears to reflect an expectation that rental growth will pick up from its current levels. There remains a risk that these expectations will not be met, not least because the increase in supply could put downward pressure on future prices.

Losses on commercial property lending are currently low, with provisions in 2004 significantly less than 0.1% of outstanding lending. But the sector has proved to be highly cyclical in the past — the fraction of quoted property companies making a loss rose from zero to almost 30% between 1988 and 1992 — so

**Chart 1.9**  
**FTSE All-Share index**



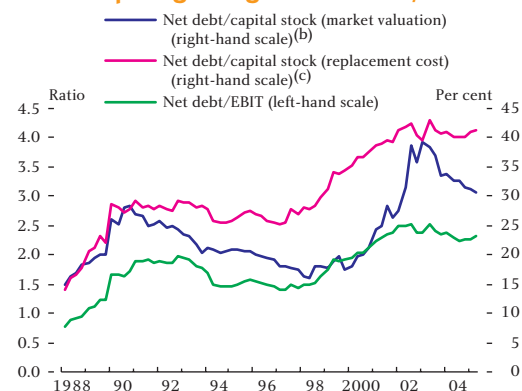
Sources: Bloomberg, ONS and Bank calculations.  
(a) Deflated series equal to the FTSE All-Share index at the beginning of 2000.  
(b) Last data point for FTSE All-Share index is 1 December 2005. But deflator and deflated series are only available to 30 September 2005.

**Chart 1.10**  
**One-year implied probability of default for UK-quoted companies<sup>(a)</sup>**



Sources: Thomson Financial Datastream and Bank calculations.  
(a) Excludes real estate companies.  
(b) Weighted by companies' liabilities.

**Chart 1.11**  
**PNFCs' capital gearing and net debt/EBIT<sup>(a)</sup>**



Sources: ONS and Bank calculations.  
(a) Earnings before interest and tax (EBIT) is defined as PNFCs' trading profits.  
(b) PNFCs' net debt divided by their market value.  
(c) PNFCs' net debt divided by the total value of capital at replacement cost.

(1) See Tudela, M and Young, G (2003), 'Predicting default among UK companies: a Merton model approach', Bank of England *Financial Stability Review*, June, pages 104–14.

(2) Latest data for October 2005. Source: Watson Wyatt, available at: [www.watsonwyatt.com/europe/services/retirement/deficit\\_index/index.asp](http://www.watsonwyatt.com/europe/services/retirement/deficit_index/index.asp)

(3) Source: Drivers Jonas' Crane Survey.

## Box 1: Commercial property prices

Commercial property prices have increased by over 10% in the past year (Chart A). What factors have underpinned this growth?

Asset pricing models can be used to assess the fair value of financial investments, and to analyse the determinants of price movements.<sup>(1)</sup> In these models, the fundamental price of an asset is given by the present value of expected cash flows returned to the asset holder. Most commonly, the dividend discount model (DDM) is used to measure equity prices, with the cash flows given by dividend payments.

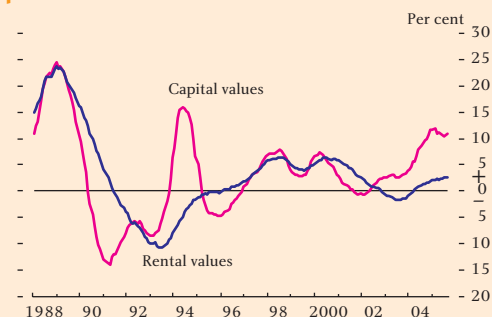
A similar approach<sup>(2)</sup> can be used to gain insight into commercial property values, by discounting future rental payments. Data on rental and capital values are available from the Investment Property Databank and expectations of rental growth from the Investment Property Forum. The risk-free interest rate used to discount future cash flows is taken to be the 10-year government bond yield. The risk premium is unobservable and is calculated as a residual.<sup>(3)</sup>

The level of the implied risk premium obtained by this method has fallen significantly since 2000 (Chart B). One possible explanation for this is that it has reflected the widespread ‘search for yield’, discussed in recent *Reviews*. But the spread between the yield on real estate and other corporate debt has narrowed significantly over this time, suggesting that property-specific factors, such as a reduction in expected future losses or a narrowing of margins, may also have been important.

The DDM model suggests that rental growth has made only a small contribution to property price growth in the past four years (Chart C). Instead, the main contribution over this time has been from the decline in the estimated risk premium. But over the past year and a half, the increases in future rental growth expectations, and the easing in the risk free rate, appear to have been the most important factors.

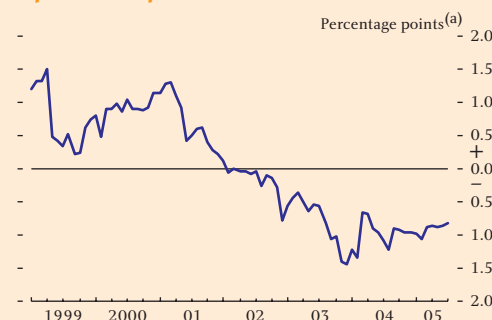
- (1) Cochrane, J (2001), *Asset Pricing*, Princeton University Press.
- (2) Using a model where cash flows are assumed to initially grow at a rate consistent with short-run expectations, before returning to a long-run average rate of growth via an intermediate transition period. See Panigirtzoglou, N and Scammell, R (2002), ‘Analysts’ earnings forecasts and equity valuations’, *Bank of England Quarterly Bulletin*, Spring, pages 59–66.
- (3) As such, the risk premium obtained here embeds measurement error and model misspecification. An absolute value cannot be calculated because indices, rather than values, are used for capital and rental values. For presentational convenience, the risk premium is centred on zero over the period 1998–2005.

**Chart A**  
Annual growth of commercial property prices and rental values<sup>(a)</sup>



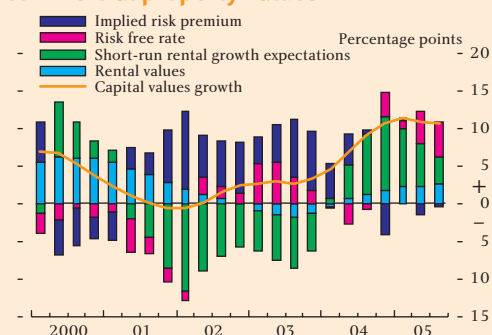
Source: Investment Property Databank.  
(a) Year-on-year growth.

**Chart B**  
Implied risk premium



Source: Investment Property Database, Investment Property Forum and Bank calculations.  
(a) Shows percentage points above or below the sample average.

**Chart C**  
Contributions to annual growth of commercial property values<sup>(a)</sup>



Source: Investment Property Database, Investment Property Forum and Bank calculations.  
(a) Positive contributions arise from a fall in the risk premium/risk free rate, or an increase in expected/actual rental growth.

current conditions may not be a reliable guide to medium-term prospects.

The favourable funding rates available in the capital markets have encouraged several banks to securitise part of their commercial property exposures. The UK commercial mortgage-backed security (CMBS) market has grown rapidly this year, with activity in the first half of 2005 greater than any previous annual total. Participants at the Bank's Property Forum suggest that competition among banks for lending that is subsequently securitised has been intense — and it is possible that the quality of the underlying assets has been reduced.<sup>(1)</sup> CMBS funding has the potential to promote stability in the market, by enabling a greater diversification of risks across the financial system. But banks holding first-loss positions are exposed if the quality of the asset pool deteriorates. And the demand from investors for CMBS tranches may be reduced if losses were to increase.

## 1.2 UK household credit risks

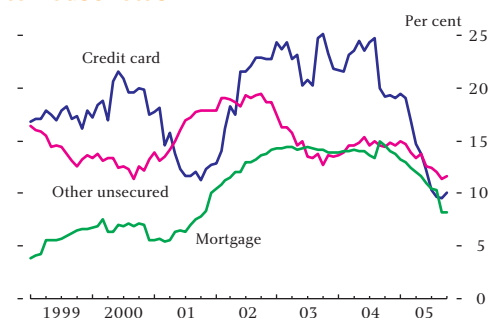
### Exposures

Lending to households accounts for the bulk of the major UK banks' domestic exposures. Around 85% of household lending is secured on property, while the remainder comprises lending via credit cards, overdrafts and personal loans. The annual growth of lending has slowed further since the June 2005 *Review*, particularly for credit cards (Chart 1.12).

As discussed in the November 2005 *Inflation Report* (page 7), the slowdown in lending to households may reflect a fall-off in the demand for credit. Lower unsecured lending growth could reflect slower consumer spending and growing pressure on some households' finances. And the easing in mortgage lending is consistent with the moderation in house price inflation over the past year and a half. But supply responses have also been important. While write-offs on mortgage lending remain exceptionally low, unsecured write-offs have increased by more than many banks had predicted, leading the major UK banks to raise credit card interest rates and tighten unsecured lending credit-scoring criteria. Banks have been differentiating risks — the tightening has been largely selective, focused on applications for borrowing from higher-risk individuals.

Accurate credit assessment requires good data on customer payment capacity. The major banks are increasingly sharing information on loan commitments, payments and arrears. Some banks also share current account data, although concerns about competition have meant that this has not been universal. And lenders have been using indebtedness indices provided by credit

**Chart 1.12**  
Annual growth of major UK banks' lending to households<sup>(a)</sup>



Source: Bank of England.

(a) Data are for individuals; unincorporated businesses excluded.

(1) The Forum is described in more detail in Box 6, page 72, of the November 1999 *Review*.

reference agencies to prevent people transferring delinquent debts as readily as in the past.

## Write-offs

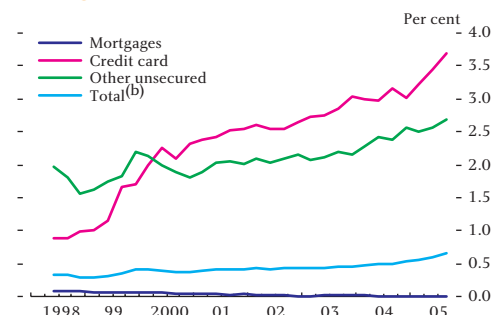
The risks from banks' secured lending continue to be very low (Chart 1.13). In the past year, write-offs on this lending by UK-owned banks were only £21 million, compared with banks' total profits from all activities of £17 billion. Mortgage arrears remain low.

In addition to easing the financial pressures on some mortgage holders,<sup>(1)</sup> the rise in house prices in recent years has increased the value of lenders' collateral, which would boost recovery rates in the event of an increase in default. For those major UK banks that disclose figures, the average loan-to-value (LTV) ratio on their stock of lending is around 45%. LTV ratios on new lending are considerably lower than during the early 1990s (Chart 1.14).

Write-offs on unsecured lending amounted to £3.6 billion in the year to September 2005, equivalent to about a fifth of banks' total net profits on all activities. The rate of loss continued to rise in the first half of 2005 (Chart 1.13), particularly for credit cards.<sup>(2)</sup> The current credit card write-off rate in the United Kingdom is about three quarters the level of that in the United States.

As noted in the November 2005 *Inflation Report* (page 7), although the number of households in financial difficulties has risen, with the number of debtors making petitions for bankruptcy increasing by more than a third over the past year, such households account for a small share of the total stock of outstanding debt. Moreover, over the past 15 years, the write-off rate on lending to households has fluctuated by less than that on lending to corporates. This greater stability reflects the preponderance of mortgage lending, where loss rates have been low. So, given the strong profitability of banks, financial pressures on households would have to increase substantially further before banks' household exposures posed a concern for financial stability.

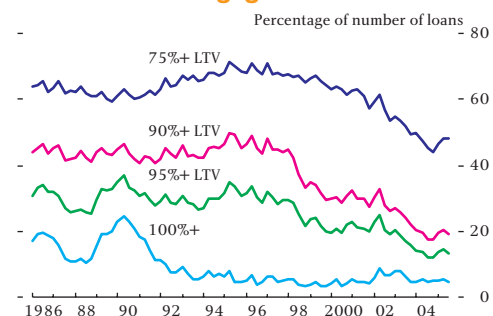
**Chart 1.13**  
UK-owned banks' annual write-off rates on lending to households<sup>(a)</sup>



Source: Bank of England.

(a) Data are for individuals; unincorporated businesses excluded.  
(b) 'Total' is the sum of mortgages, credit card and other unsecured.

**Chart 1.14**  
Incidence of higher loan-to-value ratios on new UK retail mortgages<sup>(a)(b)</sup>



Source: Council of Mortgage Lenders.

(a) By number of loans.  
(b) The questionnaire has recently been changed. Data pre-2002 include buy-to-let mortgages and are drawn from a 5% sample.

(1) The latest NMG survey found that 13% of mortgagors had remortgaged over the past year, and of these a quarter had used this as an opportunity to consolidate unsecured debts.

(2) Plastic card fraud amounted to around £500 million in the year to June 2005. Fraud has declined in recent months, reflecting the successful introduction of 'Chip and PIN' cards, although fraud relating to internet, telephone and mail order purchases has increased.

## 1.3 International credit risks

UK-owned banks' exposures to borrowers overseas accounted for around 45% of total assets at end-June 2005. The global macroeconomic outlook continues to be quite robust (Chart 1.15). Low interest rates in the major economies have supported economic activity, and have also been an important factor underlying the search for higher-yielding, but riskier, credit instruments and the build-up of leverage in international financial markets (see Chapter 2). Most recently, upward revisions to the expected path of policy rates have contributed to a slight rise in long-term rates. The ECB raised official interest rates by 25 basis points to 2.25% in December; market expectations are for official US interest rates to rise to around 4.5% by March 2006, having increased by 100 basis points since the June 2005 *Review*. These developments do not appear to have had a marked effect on assessments of credit risk.

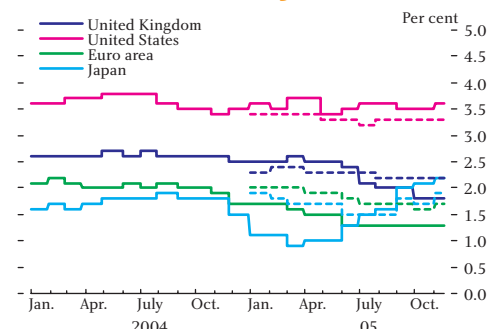
Global investment and savings patterns have played a central role in the long downward trend in 'risk-free' long-term interest rates. Investment rates have fallen in the euro area and East Asia (excluding China). And saving rates have increased in emerging market economies (EMEs), particularly in China, in contrast to the sharp decline in the United States. Rising oil prices have further reinforced this pattern (see Box 2), increasing saving in oil-producing countries and potentially detracting from investment in the (largely oil-importing) major industrial countries. In the first half of this year, the current account deficit in the United States increased to 6.4% of GDP, while the surplus in China widened significantly to 8.3% of GDP. And the combined current account surplus of the ten largest oil-exporting countries is now higher, in dollar terms, than that of the Asian economies as a whole (Chart 1.16).

When and how global imbalances will unwind remains very uncertain. It is likely to involve a combination of real exchange rate depreciation and a reduction in domestic spending in deficit countries and the opposite in surplus countries. The changes in policy required are likely to differ across countries and take time to implement. So low long-term yields could persist and continue to underpin the search for higher returns.

One factor contributing to the persistence of global imbalances has been the desire of surplus countries to limit the appreciation of their exchange rates. Foreign exchange reserves have been building up in a large number of EMEs (Chart 1.17), in some cases to levels well above those that would likely be required to withstand temporary balance of payments shocks.<sup>(1)</sup> The majority of these reserves have been invested in dollar-denominated securities, although there have been signs of

(1) For example, the ratio of reserves to short-term external debt in China and South Korea is now 6 and 2.8 respectively.

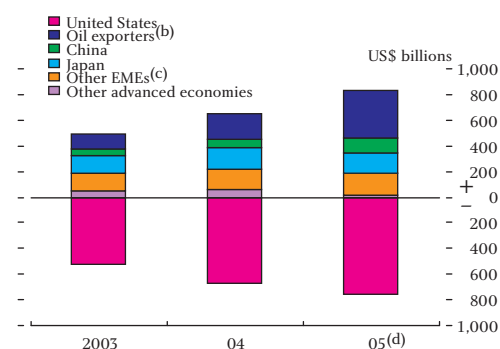
**Chart 1.15**  
Real GDP forecasts, 2005 to 2006<sup>(a)(b)(c)</sup>



Source: Consensus Economics Inc.

- (a) Solid lines show real GDP projections for 2005, broken lines show real GDP projections for 2006.  
 (b) Average percentage changes for the year shown relative to a year earlier.  
 (c) Horizontal axis refers to the month in which the survey of forecasts was taken.

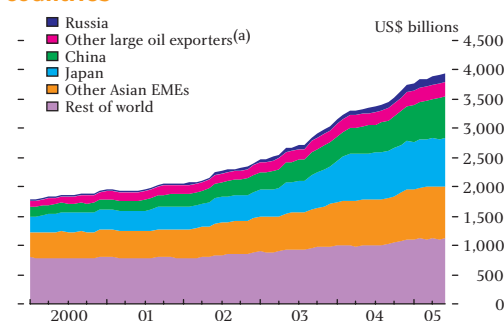
**Chart 1.16**  
Global current account balances<sup>(a)</sup>



Source: IMF.

- (a) Global current account balances do not sum to zero due to errors and omissions.  
 (b) The sum of the ten largest oil exporters in 2004 — Algeria, Iran, Kuwait, Mexico, Nigeria, Norway, Russia, Saudi Arabia, United Arab Emirates and Venezuela.  
 (c) Other EMEs includes the newly industrialised Asian economies.  
 (d) IMF forecast, September 2005.

**Chart 1.17**  
Foreign exchange reserves of selected countries



Sources: Bloomberg, IMF and Thomson Financial Datastream.

- (a) Algeria, Kuwait, Mexico, Nigeria, Norway, Saudi Arabia, United Arab Emirates and Venezuela. Data for Iran are unavailable.

## Box 2: The impact of higher oil prices on financial flows

Oil prices have risen by 80% since the start of 2004. During the previous episode of sharp and sustained rises in oil prices — the late 1970s — most of the windfall gain of oil exporters was saved rather than spent on imports. As Chart A shows, the current account balance of the seven largest oil exporters improved by 0.7% of world GDP between 1978 and 1980.<sup>(1)</sup> A large part of these surpluses were recycled through international banks to the EMEs at the time. This eased the short-term liquidity problems of these economies, but was a contributory factor to the Latin American debt crisis of the early 1980s.

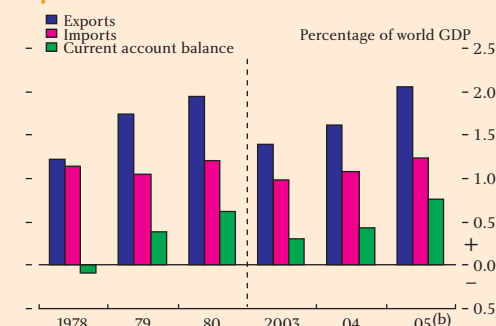
In the present environment, oil exporters have spent a larger proportion of the increase in export income.<sup>(2)</sup> The combined imports of the seven largest oil exporters have increased in line with their own nominal GDP since 2003 (25% a year). Consequently, their combined current account balance has increased by less, relative to both own and world GDP, than in the late 1970s (Charts A and B). This has limited the adverse impact of high oil prices on world activity and current account imbalances. The European Union has benefited most, in US dollar terms, from the increase in demand from oil exporters.

Nonetheless, unlike in the earlier period, oil exporters were already running large current account surpluses before the recent price hike. So, the combined current account surplus of the seven largest oil exporters is now higher than in 1980 relative to world GDP (Chart A), and expected to be broadly similar to that of Asian countries in 2005.<sup>(3)</sup>

Although data on the acquisition of foreign assets by oil-exporting countries are limited, and there are marked variations across countries, they show that more recently recycling has been through both deposits in international banks and the accumulation of foreign exchange reserves (Table 1). The BIS reports that the share of international banks' deposits from OPEC members denominated in US dollars has risen since the middle of last year.<sup>(4)</sup> There are no data on the currency composition of reserves, but data from the US Treasury show that oil exporters' net holdings of US Treasury securities grew by two thirds in 2004.<sup>(5)</sup> This accounted for 14% of total foreign purchases, but accumulation has eased significantly during the first nine months of this year.

**Chart A**

**Exports and imports of the seven largest oil exporters relative to world GDP<sup>(a)</sup>**



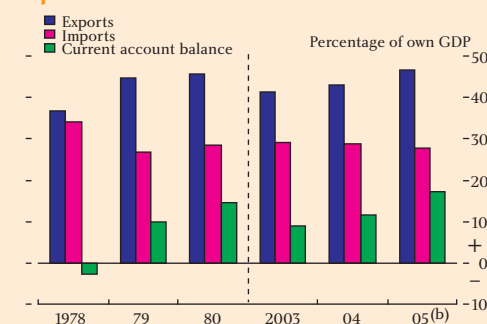
Source: IMF.

(a) Calculations aggregate the balance of payments components of the seven largest oil exporters for which data are available in each period. Errors and omissions in these current account data are large.

(b) IMF forecast, September 2005.

**Chart B**

**Exports and imports of the seven largest oil exporters relative to own GDP<sup>(a)</sup>**



Source: IMF.

(a) Calculations aggregate GDP and the balance of payments components of the seven largest oil exporters for which data are available in each period. Errors and omissions in these current account data are large.

(b) IMF forecast, September 2005.

**Table 1**

**Annual increase in selected balance of payments outflows of the seven largest oil exporters in the year to 2005 Q1<sup>(a)</sup>**

	Increase in oil export earnings <sup>(b)</sup>	Increase in imports	Increase in accumulation of net deposits at BIS-owned banks	Increase in accumulation of official FX reserves
US\$ billions				
Saudi Arabia	42.8	-5.6	-6.4	2.8
Russia	32.4	14.4	32.3	26.2
Norway	14.4	8.6	-18.9	-4.0
Iran	12.2	6.6	0.0	n.a.
Venezuela	11.6	7.1	6.9	-5.8
UAE	11.4	32.2	-4.9	-2.0
Nigeria	10.6	4.5	5.1	11.1
<b>Total</b>	<b>135.4</b>	<b>67.8</b>	<b>14.1</b>	<b>28.3</b>

Sources: Bank for International Settlements, British Petroleum, Energy Information Administration, IMF and Bank calculations.

(a) Data in the first two columns show the increase (in US\$ billions) in value in the twelve months to end-2005 Q1 over the previous twelve months. Data in the third and fourth columns show the difference between the increase in value in each of the two periods.

(b) This is based on the impact of the increase in the oil price assuming that oil export volumes are constant at 2004 levels.

(1) The largest seven oil exporters in 1978 for which data on current account balances are available are Saudi Arabia, Iran, Kuwait, Libya, Nigeria, Venezuela and Algeria.

(2) The seven largest oil exporters in 2003 are shown in Table 1.

(3) According to the latest IMF *World Economic Outlook*, September 2005.

(4) BIS *Quarterly Review*, December 2005.

(5) OPEC, Norway and Mexico are the oil exporters included in these data.

a gradual diversification in recent years.<sup>(1)</sup> Such policies could mean that the value of the dollar is higher and long-term US interest rates lower than they would otherwise have been.<sup>(2)</sup> So it remains the case that an abrupt shift in confidence of private sector investors, or in the reserve management policies of governments, could trigger a disorderly adjustment in asset prices. This, in turn, could result in a generalised repricing of risk in financial markets (see Chapter 2).

The rise in oil prices may also have a more direct bearing on UK-owned banks' international credit risk. However, the increase in prices has mainly reflected a rise in demand, especially from the United States and China, rather than a reduction in supply. So in contrast to previous rises in oil prices, the adverse impact on financial positions appears to have been limited so far to a few oil-intensive sectors, notably the automotive and airline industries, and some oil-importing EMEs.

But there is a possibility that the impact on borrowers' financial positions could become more broadly based. Spare capacity in the oil market is now at very low levels. The recent hurricanes highlight how oil prices remain sensitive to disruptions in supply. And the oil futures market now suggests that prices could remain above US\$ 50 per barrel for some time (Chart 1.18).<sup>(3)</sup>

## The United States

The United States accounts for 17% of the total assets of UK-owned banks. As discussed in the December 2004 *Review*, it is particularly important for Barclays, HSBC and the Royal Bank of Scotland.

## The private non-financial sector

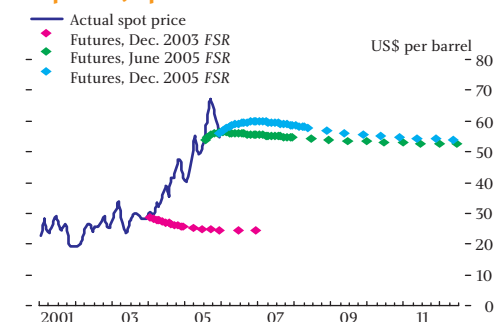
### The household sector

Credit risk from US mortgage lending appears low despite continued strong growth in mortgage debt, the shift towards adjustable-rate mortgages and the increase in short-term interest rates. The overwhelming majority of residential mortgages are well collateralised — official estimates suggest that, as of mid-2005, less than 5% of borrowers had loan to value ratios exceeding 90%.<sup>(4)</sup> The aggregate financial obligations ratio of homeowners has also changed little (Chart 1.19). This stability partly reflects the preponderance of long-term fixed-rate mortgages. A comprehensive study<sup>(5)</sup> indicates that only around 17% of residential mortgages outstanding at end-2004 were

- (1) The IMF estimates that EMEs as a whole held 60% of their foreign currency reserves in dollars at end-2004 — the share has fallen steadily from 70% at end-1998.
- (2) See, for example, Blanchard, O, Giavazzi, F and Sa, F (2005), 'The US current account and the dollar', *NBER Working Paper no. 11137*.
- (3) Note that the market for oil futures, like those for other commodities, is relatively illiquid at longer maturities — for example, less than 4% of trading volumes during November occurred at maturities over 18 months on the main international exchanges.
- (4) See remarks by Chairman Alan Greenspan to the American Bankers Association Annual Convention, 26 September 2005.
- (5) Pafenberg, F (2005), 'Single-family mortgages originated and outstanding: 1990–2004', Office of Federal Housing Enterprise Oversight, page 14.

Chart 1.18

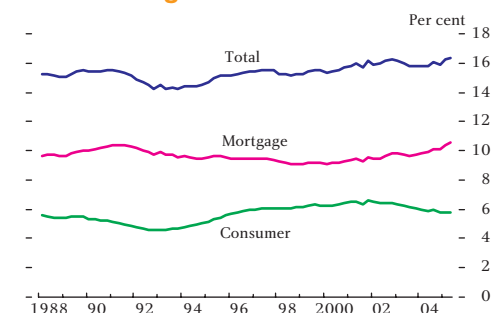
### Oil prices, spot and futures<sup>(a)</sup>



Sources: Brent futures on ICE Futures (formerly known as the International Petroleum Exchange) and Bloomberg.  
(a) Futures contract for Brent crude prices are quoted for the month of delivery. For longer maturities, contracts are not available for consecutive months (indicated by the dotted lines).

Chart 1.19

### Financial obligation ratios of homeowners<sup>(a)</sup>



Sources: Board of Governors of the Federal Reserve System and Thomson Financial Datastream.  
(a) Payments of interest and principal, plus other recurring obligations (such as rent, auto leases, homeowners' insurance and property taxes) as a proportion of personal disposable income.



adjustable-rate mortgages (ARMs) (Chart 1.20). Moreover, most ARMs are actually fixed for the first three to seven years, so borrowers are protected against rising interest rates in the near term. But it also means that many borrowers have yet to feel the full impact on debt service costs of the recent rise in US short-term interest rates.

One potential area of concern highlighted by US banking regulators is the increased use of ‘interest only’ (IO) ARMs and payment-option ARMs.<sup>(1)</sup> According to the Mortgage Bankers Association (MBA), IO ARMs accounted for 23% (by value) of mortgage originations in the first half of 2005, up from 17% in the second half of last year. These products can expose borrowers to sharp increases in mortgage payments even when market interest rates remain unchanged and, hence, significantly increase the risk of default.<sup>(2)</sup> If the rate of IO-ARM and option-ARM issuance seen in the first half of 2005 were to continue then it could increase the credit risk from US mortgage lending.

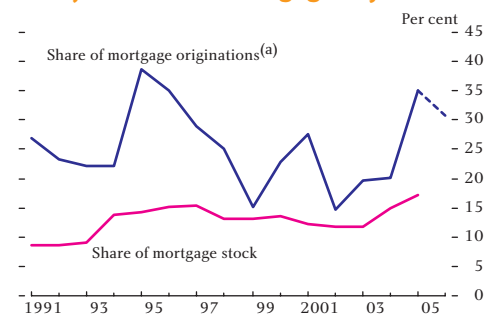
A number of banks, including HSBC, have announced that they expect to incur higher credit card charge-offs in the fourth quarter. The projected rise in charge-offs reflects the sharp increase in bankruptcy filings ahead of the change in US bankruptcy law that took effect on 17 October.

#### The non-financial corporate sector

Backward-looking measures of aggregate corporate credit quality suggest that credit risks facing UK-owned banks from the US corporate sector are modest. The proportion of commercial and industrial (C&I) loans that are non-current, and default rates on corporate bonds are all close to their mid-1990s’ lows (Chart 1.21). Aggregate measures of corporate income and capital gearing remain benign, and corporate liquidity is high.

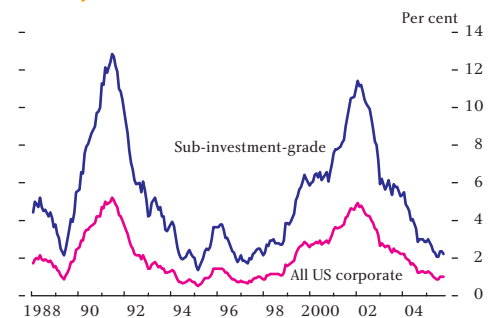
The notable exceptions to this generally positive picture are the auto and airline sectors. Delta and Northwest, two major airlines, and Delphi, the largest US auto-parts supplier, have filed for Chapter 11 protection since the June 2005 Review. The debt of General Motors and Ford, and their financing subsidiaries, has also been downgraded further and their credit default swap (CDS) premia have risen sharply. These are now close to or above their level during the height of the stress in credit markets during May (Chart 1.22). Although these events appear to have had a limited impact on perceptions of overall credit risk,

**Chart 1.20**  
**US adjustable-rate mortgages by value**



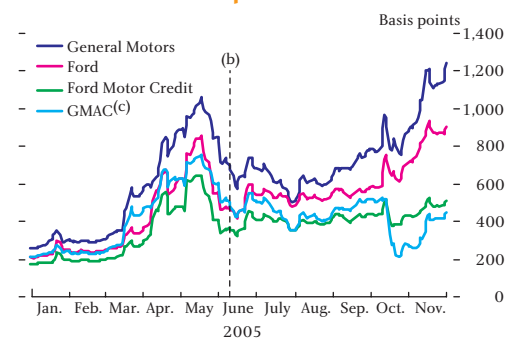
Sources: Federal Housing Finance Board, Office of Federal Housing Enterprise Oversight and Bank calculations.  
(a) Dotted line shows estimate for first ten months based upon Federal Housing Finance Board data.

**Chart 1.21**  
**US corporate default rates<sup>(a)</sup>**



Source: Moody's Investor Service.  
(a) Trailing twelve-month issuer default rates.

**Chart 1.22**  
**US auto sector CDS premia<sup>(a)</sup>**



Source: Markit.  
(a) Annual premia for credit protection on issuers using ISDA documentation, measured as mid-point between last bid and ask quotes of five-year senior debt CDS contracts.  
(b) June 2005 Review.  
(c) General Motors Acceptance Corporation.

(1) Payment-option ARMs give the borrower four payment options each month. The borrower can choose between a payment based on a 15 or 30-year repayment schedule, an interest-only schedule or a minimum payment tied to an initial low introductory rate. With IO ARMs, there is a fixed period, usually a few years, during which the borrower only makes interest payments, after which the borrower has to start making repayments of principal.

(2) See, for example, recent remarks by John Dugan, Comptroller of the Currency to the Office of the Comptroller of the Currency's (OCC) credit risk conference, 27 October 2005.

implications for UK financial institutions cannot be wholly disregarded. Delphi was heavily referenced in the CDO market, so its difficulties may have implications for market risk (see Chapter 2).

Lending to commercial real estate has continued to grow rapidly and now accounts for 14% of commercial banks' total assets — a higher share than immediately prior to the downturn in capital values in the early 1990s.<sup>(1)</sup> Delinquency and charge-offs rates are low, despite relatively high, though falling, vacancy rates. The strength of capital values and ready access to finance have contributed to the low delinquency and charge-off rates.

## Banking

The risks to UK financial institutions from the US banking sector remain low. US banks are well capitalised, with an aggregate Tier 1 capital ratio of 10%, and continue to be relatively profitable (Chart 1.23). However, there was a marked increase in loan-loss provisions at a few large US commercial banks in 2005 Q3. Although aggregate loan-loss reserves increased in 2005 Q3, they are very low relative to the size of loan books, so declining loan-loss provisions may not be a significant source of future profit growth. Net interest margins have changed little since 2005 Q1.

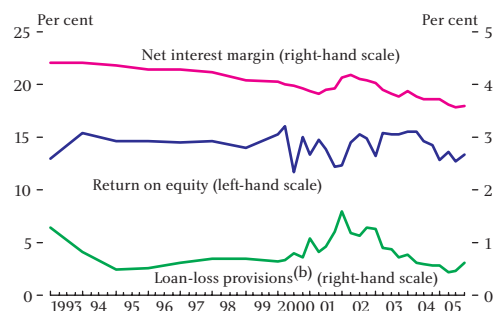
The OCC's 2005 credit underwriting survey reported a pronounced loosening of standards for commercial credit exposures, the first time since 1998. Bank examiners noted that the relaxation was most prevalent in syndicated lending and structured finance. And for the first time in the survey's eleven-year history, bank examiners identified a net easing of retail underwriting standards, particularly in residential mortgages and home equity loans.

## Europe

UK-owned banks' exposures to borrowers in the rest of Europe<sup>(2)</sup> accounted for 15% of assets at end-June 2005. The majority of UK-owned banks' claims are on banks, rather than the non-financial sectors. So major UK banks' exposures to household and corporate credit risk in Europe are more indirect than in the United States.

Euro-area banks' lending to households grew by 9% in the year to October. As in the United Kingdom and United States, household debt to income ratios have risen in a number of continental European countries in recent years (Chart 1.24). But household income gearing is moderate, and available data suggest that the share of non-performing loans is low. Growth in

**Chart 1.23**  
US commercial banks: profitability indicators<sup>(a)</sup>

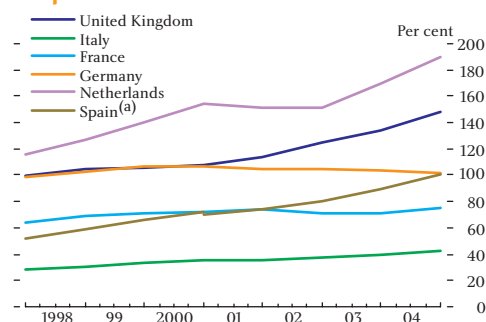


Source: Federal Deposit Insurance Corporation.

(a) Data points are annual from 1992 to 1999, and quarterly from 2000 Q1 onwards.

(b) Loan-loss provisions as a percentage of total loans.

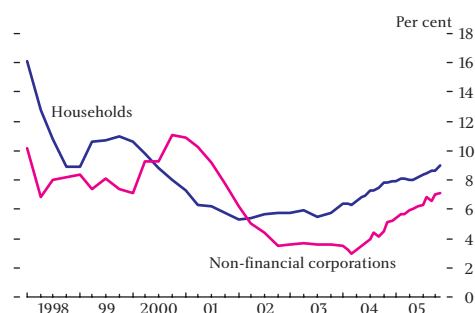
**Chart 1.24**  
European household debt to income ratios



Sources: Banca d'Italia, Banco de España, Banque de France, Deutsche Bundesbank, Eurostat, Netherlands Central Bureau of Statistics, ONS, Thomson Financial Datastream and Bank calculations.

(a) From 2000 onwards, series uses estimates of household income derived from Spanish national accounts data (base 2000).

**Chart 1.25**  
Household and corporate lending growth in the euro area<sup>(a)</sup>



Sources: European Central Bank and Thomson Financial Datastream.

(a) Data until end-2005 are quarterly. Data from 2004 onwards are monthly.

(1) The US banking regulators have announced that they intend to issue guidance on commercial real estate focusing on risk management of concentrated exposures.

(2) Defined as the euro area plus Denmark, Iceland, Liechtenstein, Norway, Sweden and Switzerland.

lending to companies has been weaker than to households in recent years (Chart 1.25), partly reflecting efforts by firms to restructure balance sheets. Corporate lending growth has, however, picked up over the past year, with lending to highly leveraged borrowers — associated with private equity activity — having risen rapidly. But corporate capital gearing has fallen back over the past two years, and income gearing remains moderate. Corporate profitability has also increased, despite high oil prices, and credit spreads remain low.

UK-owned banks' exposures to the European banking sector account for some 8% of UK-owned banks' assets; and a number of European banks have significant retail operations in the United Kingdom. The profitability of large European banks has remained robust overall (Chart 1.26), and solvency levels are comfortably above minimum regulatory standards.

As with some major UK banks, the growing exposure to highly geared corporate borrowers could heighten the vulnerability of some continental European banks to adverse economic and capital market shocks. And European banks' narrow interest margins indicate that profitability could be vulnerable to a sharp slowdown in household lending growth. But CDS premia have fallen since the June 2005 *Review*, and bank ratings upgrades have outnumbered downgrades, suggesting that the financial position of large European banks has generally improved over the past six months.

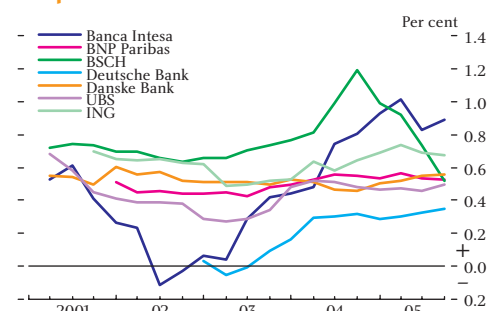
## Emerging market economies

Low global interest rates and strong world trade continue to support output growth in EMEs and to constrain their external borrowing costs. Notwithstanding persistently high oil prices, there have been several further sovereign credit rating upgrades over the past six months, including some for oil importers. And both the IMF and Consensus forecasts suggest that annual GDP growth in 2006 will remain robust, at 4% or over, in all the main regions (Chart 1.27).

The favourable external environment has allowed some of the large EMEs that had sovereign debt problems in the recent past, such as Brazil and Turkey, to stabilise or reduce further their outstanding government debts (relative to GDP). They have also improved balance sheet structures by lengthening debt maturities and/or issuing an increasing amount of local currency denominated debt. However, forthcoming political elections in a number of EMEs, particularly in Latin America, could make further near-term progress difficult.

Net capital flows to EMEs this year have been buoyant (Table 1.A), returning to pre-Asian crisis levels. And secondary market bond spreads continue to fall to new lows. But, as discussed in Chapter 2 and the article on pages 94–102, some of

**Chart 1.26**  
Return on assets for selected large European banks<sup>(a)(b)(c)</sup>



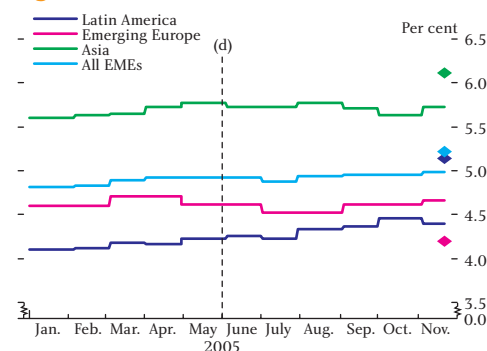
Sources: Banca Intesa, Bloomberg and Bank calculations.

(a) Four-quarter moving average.

(b) Rate of return on assets, defined as annualised net income divided by total assets.

(c) BNP Paribas reports assets on a half-yearly basis: assets are assumed to remain unchanged from previous half-yearly levels in the intervening quarters.

**Chart 1.27**  
Regional GDP forecasts, 2006<sup>(a)(b)(c)</sup>



Source: Consensus Economics Inc.

(a) An average of countries' monthly 2006 GDP forecasts. Bi-monthly forecasts in emerging Europe.

(b) Horizontal axis refers to the month in which the survey of forecasts was taken.

(c) Diamonds represent the IMF's current (September 2005) expected outturns for this year.

(d) June 2005 *Review*.

**Table 1.A**  
Net private sector financial flows to EMEs by region<sup>(a)</sup>

US\$ billions	2005	2004	2005e	2006f
<b>Latin America</b>				
Equity investment	24.8	36.4	39.8	37.8
Private creditors	1.9	-5.4	6.4	12.1
Banks	-15.2	-14.9	-4.8	5.4
Non-banks	15.1	9.5	11.2	8.6
<b>Asia</b>				
Equity investment	91.6	95.9	93.8	96.4
Private creditors	26.6	70.5	52.2	48.4
Banks	15.8	37.5	28.2	22.6
Non-banks	12.8	32.9	24.0	25.8
<b>Emerging Europe</b>				
Equity investment	8.1	28.1	41.7	41.4
Private creditors	57.0	80.9	89.8	69.4
Banks	27.3	37.9	39.2	31.1
Non-banks	29.7	43.0	50.6	38.3
<b>Total<sup>(b)</sup></b>				
Equity investment	128.9	167.5	191.3	184.4
Private creditors	84.8	149.8	153.9	133.3
Banks	25.4	61.1	63.5	57.8
Non-banks	59.4	88.7	90.4	75.5
<b>Total external financing</b>	213.7	317.4	345.2	317.8

Source: Institute of International Finance, 'Capital flows to emerging market economies', 24 September 2005.

(a) Equity investment equals the sum of direct and portfolio investment.

(b) Total also includes Africa and the Middle East.  
e = estimate. f = forecast.

the decline in spreads may reflect overly optimistic expectations about the creditworthiness of EMEs.

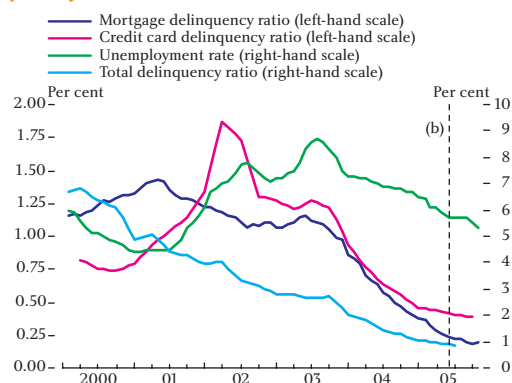
As discussed in previous *Reviews*, UK-owned banks have substantial claims on Hong Kong. Despite increases in interest rates, Hong Kong's annual output growth rose further in 2005 Q3. Export growth has been particularly strong, reflecting the expansion of exports to mainland China. Against this favourable backdrop, pre-tax profits of banks in Hong Kong grew by 8% in the first half of the year compared with the same period in 2004, and indicators of their domestic credit quality have continued to improve (Chart 1.28).

Given Hong Kong's increasing integration with the mainland, an indirect risk for UK banks stems from a sharp slowdown of growth in China due, for example, to a marked fall in investment growth<sup>(1)</sup> or financial dislocation resulting from difficulties in the banking sector.

According to official Chinese data, annual (output-based) GDP continued to grow at close to 10% in 2005 Q3 and there has been no slowdown this year in the pace of investment growth.<sup>(2)</sup> However, investment seems to have been increasingly met from domestic production rather than imports, suggesting that China's growth is having a less stimulatory impact on the Asian region than hitherto (Chart 1.29). More importantly, the sustainability of China's exceptionally high rate of investment is open to question — according to official data, the ratio of investment to GDP increased to 46% in the first nine months of this year.

The reform of China's state-owned banks continues apace and there have been a number of large foreign investments in recent months.<sup>(3)</sup> Although the non-performing loans ratio of the major banks<sup>(4)</sup> continued to fall this year, the strong cumulative increase in bank credit over the past three years poses a risk that a new set of NPLs could be realised in the future.

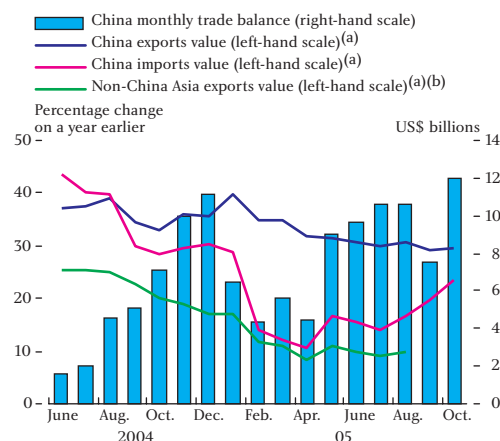
**Chart 1.28**  
Hong Kong: indicators of banks' credit quality<sup>(a)</sup>



Sources: Hong Kong Census and Statistics Department and Hong Kong Monetary Authority.

- (a) The delinquency ratio is loans more than three months in arrears as a proportion of total outstanding loans.  
(b) June 2005 *Review*.

**Chart 1.29**  
China's trade balance



Sources: Bloomberg, Customs General Administration of China and national sources.

- (a) Three-month moving average.  
(b) Combined exports of Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea and Taiwan.

(1) A marked decline of investment, unless offset by an increase in consumption, would also likely increase China's current account surplus and exacerbate current global imbalances.

(2) A GDP proxy constructed by UBS — a physical production index — suggests that China's output growth has increased, rather than remained flat, during this year.

(3) The IPO by China Construction Bank in October, at \$8 billion, is the largest undertaken globally since 2001.

(4) The four large state-owned banks plus the eleven major commercial banks.

## 2 Risks in the international financial system

The international financial system has remained stable. Large complex financial institutions (LCFIs) have posted strong profits and markets have been orderly. Despite the rise in government bond yields since the previous *Review*, the ‘search for yield’ persists. This is evident in, for example, persistently low credit spreads; the injection of risk into the corporate sector via leveraged buyouts; hedge fund and LCFI migration towards illiquid instruments; and continuing innovation in structured finance. Many such innovations support financial stability via better diversified portfolios, and the transfer of risk beyond the firms at the core of the payments system. But they may also create circumstances in which risk might flow back to the banking sector should adverse shocks crystallise.

### 2.1 International financial markets

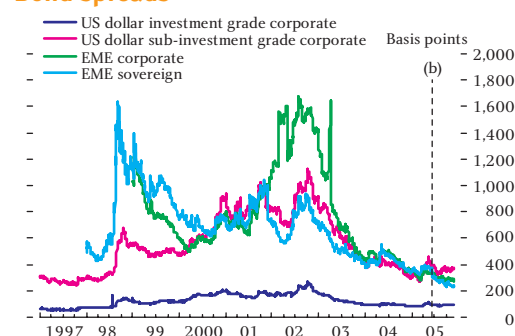
The June 2005 *Review* concluded that it was too soon to assess the wider significance of the episode of stress in credit markets — triggered initially by concerns about General Motors (GM) and Ford — in the spring and early summer. It now appears that the consequences were limited. The impact on core financial market intermediaries — banks and securities dealers — was modest. Although some hedge fund closures over the summer partly reflected credit market conditions, the risk of widespread investor redemptions — identified by some market commentators — did not materialise.

Since the June 2005 *Review*, a number of further developments have tested the resilience of credit markets. These have included continuing difficulties in the airline and auto sectors in the United States, with filings for Chapter 11 protection by Delta and Northwest airlines and by Delphi, an auto parts supplier. There were further ratings agency downgrades of GM. Refco, a large financial intermediary, went into administration.

None of these idiosyncratic events precipitated a generalised reassessment of risk. Nor have there been particularly marked signs of investors — including those with exposure to structured credit products — making significant portfolio adjustments. Having risen in the late spring and early summer, both investment and sub-investment grade corporate and EME sovereign credit spreads subsequently fell (Chart 2.1). EME local currency bond issuance remains strong (Chart 2.2), with many issues heavily oversubscribed. Measures of implied default correlation between corporate credits — derived from the prices of equity tranches of CDS indices — remain low.<sup>(1)</sup> Market contacts continue to draw attention to the increasingly buoyant conditions in parts of the syndicated loan markets in Europe and the United States. Actual volatility, and measures of

Chart 2.1

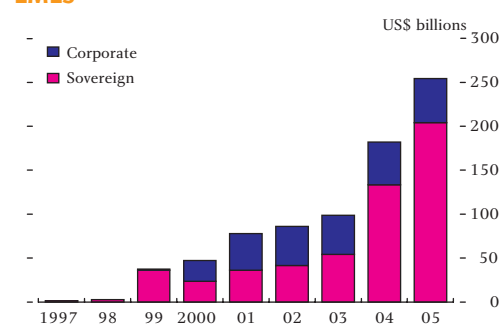
#### Bond spreads<sup>(a)</sup>



Sources: Merrill Lynch and JPMorgan Chase and Co.  
(a) Option adjusted spread over government bonds.  
(b) June 2005 *Review*.

Chart 2.2

#### Issuance of domestic currency bonds by EMEs<sup>(a)(b)</sup>



Sources: Dealogic and Bank calculations.  
(a) Data for 2005 are annualised based on 2005 Q1–Q3.  
(b) Issuance in domestic market only.

(1) See Belsham, T, Vause, N and Wells, S, ‘Credit correlation: interpretation and risks’, in this *Review*, pages 103–15.

forward-looking volatility implied from options prices, have remained relatively low in most markets for most of the period (Chart 2.3).

The June 2005 *Review* identified two broad sets of factors that might have contributed to a reduction in the price of risk. First, it may represent some combination of a perceived decline in uncertainty in the macroeconomic environment, and financial innovation that has brought about greater dispersion and diversification of risk. The limited consequences of recent idiosyncratic credit events provide some support for this view. Stronger corporate and financial sector balance sheets in industrial countries, and improved EME fundamentals may also have played a part. It is noteworthy that the price of risk has remained low even as the US Federal Open Market Committee (FOMC) has continued to raise official dollar interest rates; as expectations of policy tightening in many other industrial economies have increased; and as government bond yields have risen.

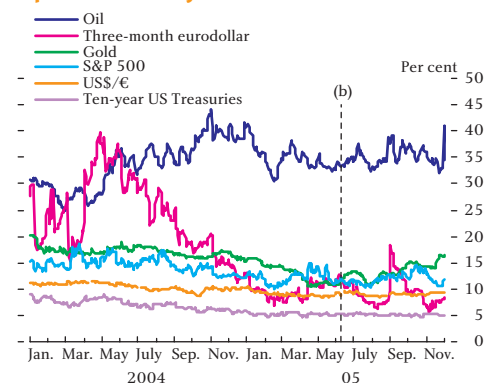
Second, other, less fundamental, factors may also have lowered the price of risk. Investors may not have adjusted fully their target nominal returns to a lower inflation environment. They may also hold overoptimistic expectations about the ability of policymakers to offset shocks to the economy; and underestimate the potential for new channels of contagion in the financial system if a crisis were ever to develop. This second set of factors raises the possibility that market participants may be mispricing risk. That is important in the context of the so-called ‘search for yield’ highlighted in previous *Reviews*.<sup>(1)</sup>

## Recent developments in the search for yield

In the past few years, many investors have been reassessing the expected returns on equities, and attempting to match more closely their liabilities and assets. In consequence, there have been moves to diversify portfolios into fixed income-like assets, and into ‘alternative investments’ of various kinds, many of which have been producing high *ex-post* risk-unadjusted returns. This has coincided with low policy interest rates in the major economies, contributing to lower government bond yields; and with a period in which corporate net debt issuance has been relatively modest. As a result, a higher proportion of net debt issuance has been lower risk and low-yielding government bonds. The duration of the stock of government and corporate debt fell in the United States, and in other major industrial countries it has risen only slightly, in recent years (Chart 2.4). At the same time many investors — including pension funds — have been seeking to increase the duration of their assets in line with that of their long-term liabilities.

(1) For a discussion of the manifestations and persistence of the search for yield, see pages 51–55 of the June 2005 *Review*.

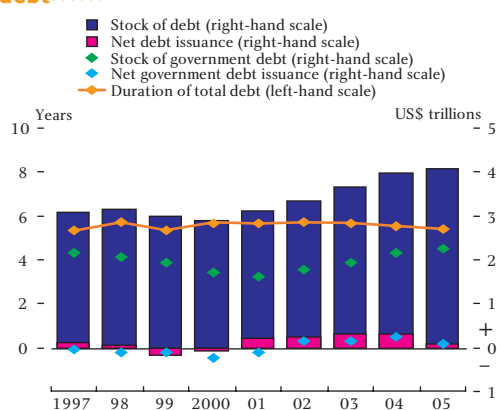
**Chart 2.3**  
Implied volatility of financial markets<sup>(a)</sup>



Sources: Bloomberg, New York Mercantile Exchange, Chicago Mercantile Exchange, British Bankers Association and Bank calculations.

- (a) Implied from three-month (or close to three-month) option prices.  
(b) June 2005 *Review*.

**Chart 2.4**  
Stocks, net issuance and duration of US debt<sup>(a)(b)(c)</sup>



Sources: Merrill Lynch and Bank calculations.

- (a) Based on indices comprised of bonds issued by the government and corporates of the United States.  
(b) Duration is calculated as the average of the duration of each bond index, weighted by the size of that index.  
(c) Data for 2005 are to November.

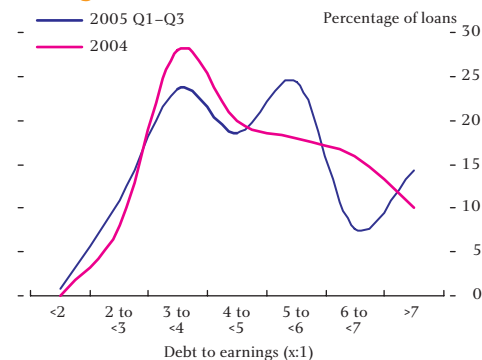
In this environment, there has been strong demand for higher-risk assets. Financial intermediaries have responded by developing a variety of ways to leverage — that is, inject risk into — existing assets. This can be seen in, for example, the wave of leveraged buyouts, the innovations and growth in structured finance; and a migration of hedge funds and investment banks towards less liquid forms of risk taking.

Leveraged loan market conditions in the United States and Europe are widely seen as remarkably buoyant. Measured as debt to earnings, the leverage in buyout deals has risen; and concerns continue to be expressed about dilution of loan covenants to the disadvantage of lenders. There has been an increase in the proportion of new loans issued to firms able to be levered more than seven times (Chart 2.5). Leveraged lending is on track for record volumes in 2005 (Chart 2.6). Recent estimates suggest that, in the first three quarters of 2005, nearly \$400 billion was raised by private equity funds globally, in part for leveraged buyouts (LBOs) (Chart 2.7). LBOs can be thought of as a means by which sponsors force an increase in leverage in target companies, in the context of low aggregate corporate sector leverage due to strong profitability and continued weak demand to borrow to invest.

Some market participants have suggested that the private equity business model has gradually changed from one of buying struggling companies with the aim of transforming their performance, to one of leveraging up essentially healthy companies, although the pattern is not uniform. This is in addition to the now established business of re-leveraging companies that have already undergone an LBO.<sup>(1)</sup> ‘Club deals’, by which a group of private equity funds act in concert to acquire the target company, can perhaps also be seen in this light; and mean that larger companies may be targets of LBO activity.

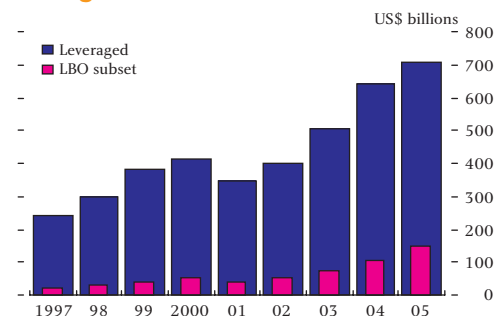
If LBOs leverage up companies, structured finance provides leverage for investors by the way in which underlying claims on companies or households are bundled up and distributed. Structured credit products such as collateralised debt obligations (CDO) and, increasingly, commercial mortgage-backed securities (CMBS) are ways of leveraging corporate credit exposure (Chart 2.8). Contacts refer to CMBS structures being more leveraged, on top of greater leverage — and, in some countries, perhaps stretched valuations — in the underlying commercial mortgages. In a broadly similar way, other asset-backed securities (ABS), such as those secured on cash flows from residential mortgages, home equity loans and credit card receivables, can be seen as a way of leveraging up portfolios of household credit, in an environment

**Chart 2.5**  
Leverage covenants on new loans<sup>(a)(b)</sup>



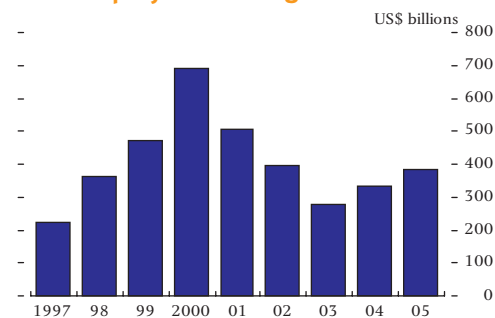
Source: Loan Pricing Corporation.  
 (a) Covenants on leveraged loans issued in the United States. Defined as those issued to non-investment grade or unrated borrowers and priced at greater than Libor +150 basis points.  
 (b) The covenant states the maximum level of debt allowed as a multiple of the company's earnings before interest, tax, depreciation and amortisation (EBITDA).

**Chart 2.6**  
Leveraged loan issuance<sup>(a)</sup>



Sources: Loan Pricing Corporation and Bank calculations.  
 (a) Data for 2005 are annualised based on Q1-Q3.

**Chart 2.7**  
Private equity fundraising<sup>(a)</sup>



Sources: Thomson SDC and Bank calculations.  
 (a) Data for 2005 are based on Q1-Q3.

(1) So-called ‘recaps’, if undertaken by the existing sponsor, or ‘secondary LBOs’, if undertaken by a new sponsor.

where the household sectors of many countries have themselves become more indebted in recent years. In this context, market participants have noted strong demand and narrowing spreads in, for example, the junior (ie riskier) tranches of US ABS of sub-prime and so called 'Alt A' residential mortgages.<sup>(1)</sup> The development of CDS on ABS is said to be in part a consequence of demand for junior ABS tranches running in excess of new issuance. The demand appears to be from CDO managers looking to include more leveraged ABS tranches in their (partly or wholly synthetic) portfolios.

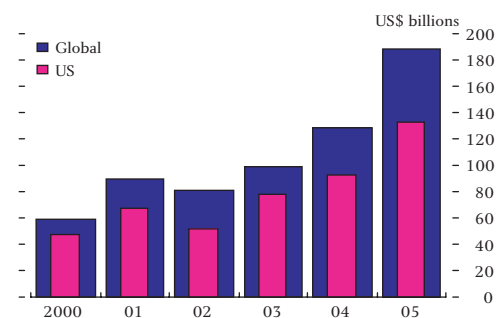
Continuing the pattern of recent years, these developments highlight the increasing interlinkages among different forms of leveraging. In some cases, it is also associated with a move towards investing in relatively illiquid asset classes. One example, combining both, is the demand from hedge funds and collateralised loan obligation (CLO) vehicles for leveraged loans. Hedge funds are involved in the LBO market as investors at all levels of the debt capital structure, including second-lien loans, payment-in-kind (PIK) notes, and in bridge loans (see Box 3 for analysis of the role of hedge funds in the leveraged loan market). Some hedge fund involvement in the loan markets may be financed by themselves creating, managing and retaining tranches — typically equity tranches — in their own CLOs.

In many respects, these innovations and developments in leveraged products are positive for financial stability. They are part of the process of the completion of missing financial markets. The unbundling and rebundling of risk into tranches with different risk/return characteristics, and risk transfer instruments more generally, enable risk to be tailored to the specific requirements of investors, given their differing appetites for risk and their ability to manage it. It also facilitates the distribution of credit and other risks more widely throughout the global financial system, including outside the banking system and so away from the core of the payments system. However, if investors are currently underpricing risk, or if they have underestimated the possibility of new channels of contagion arising from these innovations — as further leveraged products are engineered from instruments that are already leveraged — then it cannot be ruled out that they may become sources of vulnerability in the event of an abrupt repricing of risk.<sup>(2)</sup>

## Potential vulnerabilities

Previous *Reviews* have identified some potential triggers for such a re-pricing, which have centred on the possibility of higher global interest rates than financial markets may be anticipating; of abrupt changes in the current pattern of international capital

**Chart 2.8**  
**Issuance of CMBS<sup>(a)</sup>**



Source: JPMorgan Chase and Co.  
(a) Data for 2005 are to October.

(1) Alt A borrowers are those, often self-employed, people in the United States that cannot or will not provide standard documentary evidence of their earnings.

(2) See for example the speech by Paul Tucker in June 2005, 'Where are the risks' (reprinted in this *Review*, pages 73–77), and Rajan, R (2005), 'Has financial development made the world riskier?', *Federal Reserve Bank of Kansas City Symposium*, Jackson Hole, 27 August.



flows (see discussion in Chapter 1) and of a significant credit event or series of credit events. These potential triggers, which may not be independent of each other, remain relevant.

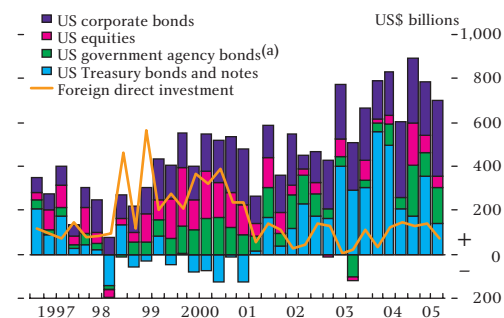
Although persistently high energy prices have largely reflected demand factors, the possibility of further price rises remains. There is a risk that these could represent a supply shock to the major economies that could conceivably dislodge inflation expectations. Market participants appear to view that risk as having receded recently as oil prices in particular have fallen back from the highs reached in the summer. More generally, the progressive flattening of yield curves — short rates rising relative to longer-term rates — has not triggered an abrupt adjustment in fixed-income markets. Views vary, however, on the possible impact if yield curves were to invert — that is, if short rates were to be higher than longer-term rates. Significant parts of the euro-denominated structured notes market seem, for example, to be predicated on a notion that inversion is extremely rare and therefore unlikely.<sup>(1)</sup>

As highlighted in Chapter 1, the continued willingness of foreigners to invest a large proportion of their savings in US assets, and so satisfy the external financing needs of the United States, remains a potential vulnerability. Much of the recent growth in inflows appears to represent discretionary portfolio allocations by private sector agents, rather than official sector investment into US dollar-denominated reserve assets as a consequence of the maintenance of more or less fixed exchange rates against the dollar (Chart 2.9). Market participants have suggested that private sector investors in US assets, perhaps especially in Asia, may be increasingly exposed to exchange rate risk. In particular, they are thought less likely to hedge against currency movements between the dollar and their domestic currencies, given the rise in US yields relative to those in their domestic economies, which has resulted in higher forward prices of these currencies against the dollar.

Despite the apparently smooth reaction to recent idiosyncratic credit events, the possibility remains that a major unanticipated default, or series of such defaults, could represent a trigger for a more general repricing of risk and even for contagion, including via innovative markets and products.

The consequences for structured credit markets and for the convertible bond market of the credit ratings downgrades of GM and Ford in the spring — which were widely anticipated — illustrate some possible mechanisms for contagion, even though spillovers proved limited in that case. The depth and reliability of many of the new markets in inter-linked and leveraged

**Chart 2.9**  
Foreign net purchases of long-term US securities



Sources: Board of Governors of the Federal Reserve System.  
(a) Includes bonds and MBS issued by government sponsored entities.

(1) Market participants note that a popular structure has been notes with coupons linked to the spread between two and ten-year euro swap rates. Coupons on the notes typically fall to zero if the yield curve is flat. But they do not go negative if the yield curve inverts, so that originators have, in effect, written investors an option on yield curve inversion.

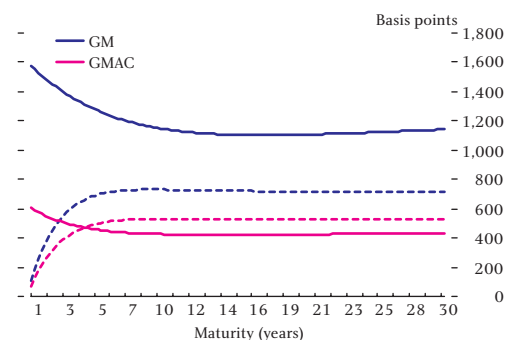
products under stressed conditions has, inevitably, not yet been fully tested. Moreover, risk transfer markets can make the ultimate destination of risks more opaque, which complicates assessments of the likely behaviour in stressed circumstances of the holders of these risks.<sup>(1)</sup>

One possible channel might be a sudden reduction, or reversal, in the strong demand seen in recent years for mezzanine tranche credit risk exposure from a large number of regional banks and long-term savings institutions — sometimes referred to as the ‘structured credit bid’.<sup>(2)</sup> Reflecting the filing for Chapter 11 protection by Delphi, Standard & Poor’s lowered the credit ratings on 127 CDOs — more than 5% of its total universe of publicly rated CDOs in Europe and North America — with exposure to the firm. A series of further large credit events could cause downgrades, and perhaps even losses, on mezzanine CDO tranches and so weaken the appetite of investors to continue to hold them. It is noteworthy that recent developments at GM, including further ratings agency downgrades, have resulted in the inversion of GM’s CDS term structure (Chart 2.10). This suggests that market participants have significantly increased the probability they attach to a near-term default by GM. GM, and its financing arm GMAC, are the most common names included in CDOs, and may appear in ‘CDO-squared’ structures multiple times.<sup>(3)</sup>

One possible mitigant, dampening any potential spillovers, is the increase in the amount of risk capital available to traders — at hedge funds, and the proprietary trading desks of LCFIs. That represents a potential source of liquidity provision in stressed conditions. Hedge funds have probably been a stabilising influence in more than one episode over the past few years: for example, in US interest rate markets when yields rose and swap spreads widened abruptly in July and August of 2003;<sup>(4)</sup> and, together with some active institutional investors, in the structured credit and convertible bond markets in the early summer of this year. In the context of possible credit events, it may therefore be significant that the amount of capital available to fund managers whose strategy is to acquire, and maximise returns from, distressed assets is reported to have increased markedly (see Box 3).

However, these potential liquidity providers are most likely to provide effective mitigation in the context of stresses that seem likely to them to prove limited or containable, and which stop short of a systemic shock resulting in a generalised reduction in risk appetite. The business model of distressed debt funds, for

**Chart 2.10**  
**GM and GMAC CDS term structure<sup>(a)</sup>**



Source: Markit.  
(a) Solid lines as at 1 Dec. 2005, dashed lines as at June 2005 Review.

(1) See speech by Sir Andrew Large in November, ‘Financial stability: managing liquidity risk in a global system’, (reprinted in this Review, pages 78–84).  
(2) For a discussion of the ‘structured credit bid’, see page 62 of the June 2005 Review.  
(3) ‘CDO-squared’ are CDOs of existing CDO tranches. Other things being equal, these structures might be expected to add leverage, although risk should in principle be reduced by diversification of portfolios.  
(4) See Kambhu, J (2004), ‘Trading risk and volatility in interest rate swap spreads’, *Federal Reserve Bank of New York Staff Report no. 178*. Available at [www.newyorkfed.org/research/staff\\_reports/sr178.pdf](http://www.newyorkfed.org/research/staff_reports/sr178.pdf).

## Box 3: Hedge funds and leveraged loans

A 'leveraged loan' is typically issued by a sub-investment grade borrower, often in the context of a leveraged buyout, and has traditionally offered a spread to Libor in excess of 150 basis points. The risk is divided into multiple tranches, for example senior secured debt (further divided into revolving credit and term loans), mezzanine debt and an equity tranche. More recently, it has become quite common to include a so-called 'second lien' tranche below the senior secured debt, which (in liquidation) has a second claim on the assets after first lien holders have been paid.<sup>(1)</sup> Typical financial leverage multiples (ie debt/EBITDA) have risen to around five times, from around four times in 2003–04.

Leveraged loans have produced high returns in recent years, benefiting from a supportive macroeconomic environment (with low default rates) and falling spreads as investors sought higher-yielding assets.

### Hedge fund involvement

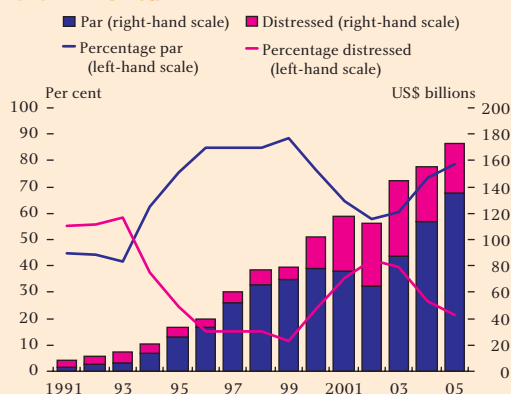
While retaining an interest in high-yield bonds and secondary loans, in recent years hedge funds have become active in the primary loan market, investing across the leveraged-loan capital structure and in bridge loans (interim finance provided until longer-term loan/bond funding can be secured). Their degree of participation tends to account for a greater proportion of tranches below the senior debt (especially second lien, but also mezzanine and PIK notes), where risks and potential rewards are higher.

Hedge fund exposure to leveraged loans can be achieved in several ways. Total return swaps (TRS) are the preferred instrument for many funds — the fund receives the economic return (net of any defaults) on a specified loan portfolio or index from a dealer, which holds the underlying loans and receives a floating rate, such as Libor +50 basis points, from the fund. TRS provide an efficient means to lever an investment (the initial cash outlay is limited to the margin posted with dealers); market participants suggest that leverage multiples of 2–4 times are currently the norm. Hedge funds can also gain loan market exposure via direct holdings (cash holdings, although margined, can be used as collateral to add

leverage), by sub-participation via banks, or via leveraged loan CDS (launched by some dealers in 2005). Another alternative is to issue a collateralised loan obligation (and retain the equity tranche for example), which provides longer-term funding.

Distressed debt funds tend to hold assets outright,<sup>(2)</sup> have a long-term focus, a lock-in period for their own investors, and are generally not leveraged. Along with some 'credit opportunity' funds, they look out for individual companies in difficulty. Their motivation may include: turning the company around by influencing the management strategy; or simply taking a more sanguine view of the company's longer-term prospects (or recovery prospects in bankruptcy) than other market participants. The existence and secondary market trading of 'distressed loans' may be related to the business cycle, as suggested by peaks in the early 1990s and 2001–03 (Chart A).

**Chart A**  
Secondary loan trading in  
North America<sup>(a)(b)</sup>



Source: Loan Pricing Corporation.

(a) Par is defined as loans trading at 90 or more cents in the dollar, and distressed at less than 90 cents.

(b) Data for 2005 are annualised, based on Q1–Q3.

### Potential risks

Hedge funds are attracted to the more risky tranches, where smaller funds — including those with possibly limited credit research functions — are said to be prevalent, notably in second lien. While most market participants seem comfortable with the risk-reward profile of second lien, some contacts indicate that it

(1) Over the past year, PIK notes have also sometimes been included (above the equity tranche), which pay interest in the form of more securities.

(2) As well as leveraged loans, exposure could be gained via debtor-in-possession financing bonds, CDS or equity.

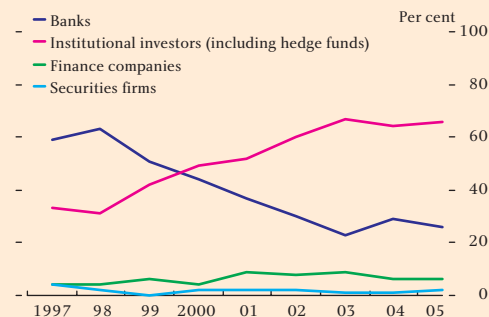
may be viewed by a number of issuers as an attractive alternative to higher-yielding mezzanine finance, suggesting that spreads of 4.5%–7.5% may be insufficient to compensate for the risks.

As with US MBS that embed a pre-payment option for holders of the mortgages on which these instruments are secured, second-lien tranches (and PIK notes) are negatively convex.<sup>(3)</sup> They embed a short call option that allows the issuer to buy the debt back just above par within 1–2 years if spreads fall, as well as the effective put option sold to the equity holders. For buyers of second lien, this represents a bet on low volatility which could result in marked-to-market losses if and when equity/bond price volatility increases.

From a financial system stability perspective, the dispersion of risks on leveraged loans beyond banks and securities firms represents a positive development (Chart B). However, a period of stress could nevertheless affect banks/dealers via secured financing of hedge fund portfolios in the prime brokerage businesses. To guard against this, banks typically require 10%–30% ‘haircuts’ on portfolios of first/second-lien loans, although they sometimes offer hedge funds a commitment not to increase margin requirements for a specified period. In markets, especially less liquid ones, where hedge funds are effectively the ‘marginal buyer’, and must mark their investments to market, a key risk is that there could be a disruptive ‘rush for the exits’ in the event of an abrupt re-pricing of credit risk, perhaps following a default.

Hedge funds are often more ‘fleet-of-foot’ than other investors. Some market participants are concerned that any credit downturn could be exacerbated by hedge fund sales, especially if funds are required, perhaps by the prospect of investor redemptions, to reduce leverage.

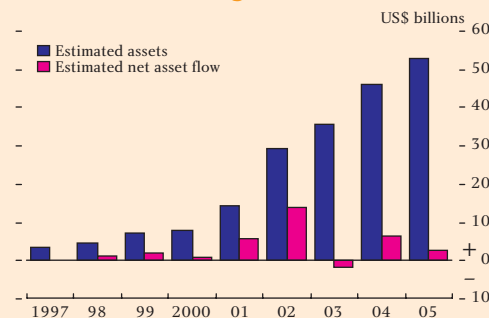
**Chart B**  
Primary market for highly leveraged US loans by broad investor type<sup>(a)</sup>



Source: Standard & Poor's Leveraged Commentary & Data (LCD).  
(a) Data for 2005 are for the year to 2005 Q3.

In a market downturn, the degree to which distressed debt funds provide liquidity will be important. Such funds have certainly seen strong asset growth in recent years (Chart C), and anecdote suggests they have a significant amount of cash holdings. Distressed debt fund would inevitably wait until they thought prices had reached their nadir, however, and are likely to provide only limited support in the event of a system-wide credit downturn.

**Chart C**  
Estimated assets of, and flows into, distressed debt hedge funds<sup>(a)</sup>



Source: Hedge Fund Research Inc.  
(a) Data for 2005 are annualised, based on 2005 Q1–Q3.

(3) For negatively convex bonds, the price rises more slowly as the yield falls (at least near the strike price of the embedded option(s)).

example, is on the whole for dealing with idiosyncratic risk; it seems unlikely that they would have the capacity or willingness to absorb the consequences of a widespread credit downturn. Moreover, a generalised reduction in risk appetite has the potential to limit the ability of funds and bank trading desks to perform a stabilising role.

## 2.2 Hedge funds

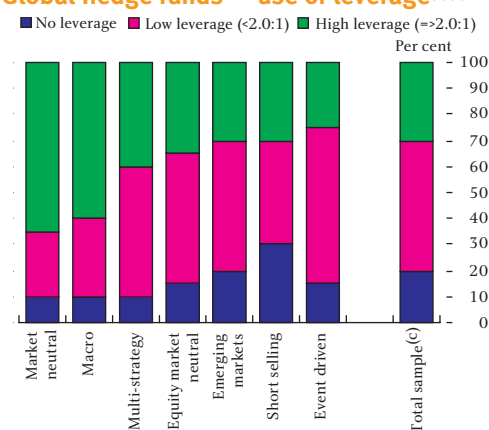
An impairment of hedge funds' ability to perform a stabilising role could be more likely if funds were themselves part of any such stress event. The consequences would partly depend on the extent of hedge fund leverage, and on whether their liability structures have adjusted to their holdings of (potentially) less liquid assets. It would also depend crucially on whether any problem were judged by prime brokers to be idiosyncratic and so containable. If not, pressure from prime brokers to reduce risk levels might oblige hedge funds to unwind positions across a range of markets. It cannot be ruled out, therefore, that circumstances could occur where hedge funds switched from being marginal liquidity suppliers in a wide range of markets, to being liquidity demanders. Much has been done in recent years by bank prime brokers and hedge funds themselves to enhance their risk management and so to mitigate these risks. The recent report of the industry Counterparty Risk Management Policy Group is an important part of that process.<sup>(1)</sup>

Given the relative paucity of data, it remains difficult to draw firm conclusions about the extent of hedge fund leverage and the management of their liability structures. There is, however, a widespread belief among market participants, including fund managers themselves, that leverage is not currently especially high — particularly in comparison with the late 1990s, although that is not obviously a prudent benchmark. An industry survey recently suggested that approximately 20% of hedge funds used no leverage at the end of 2004; and that a further 50% used leverage of less than one times their equity (Chart 2.11). The survey, however, does not further disaggregate leverage levels of those funds leveraged more than 2:1. Also, even if hedge fund financial leverage is relatively modest, they are increasingly active in markets in innovative financial instruments that themselves embed leverage, and which may prove illiquid in stressed conditions.<sup>(2)</sup>

The June 2005 *Review* described a number of the safeguards employed to manage redemption risk.<sup>(3)</sup> Market participants'

Chart 2.11

### Global hedge funds — use of leverage<sup>(a)(b)</sup>



Source: Greenwich-Van Advisors.

(a) As of Dec. 2004.

(b) Short positions are counted as leverage. Derivatives are not included.

(c) Total sample includes other strategies not included in the chart.

(1) See 'Toward greater financial stability: a private sector perspective', the *Report of the Counterparty Risk Management Policy Group II*, July 2005. Available at [www.crmpolicygroup.org](http://www.crmpolicygroup.org).

(2) For a discussion of the forms of leverage in the hedge fund industry, see Box 4 on page 53 of the June 2004 *Review*.

(3) For a discussion of hedge fund liability liquidity management, see pages 63 and 66 of the June 2005 *Review*.

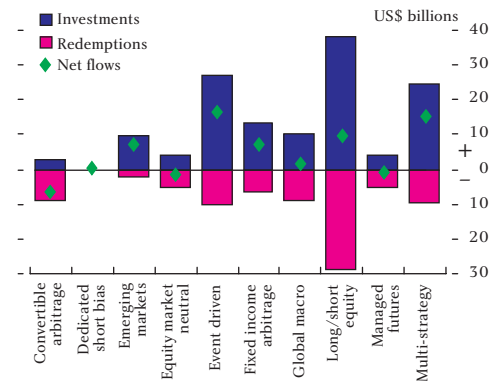
views are mixed on whether hedge funds' investor lock-ins have extended commensurate with their increasing holdings of less liquid assets. For the largest and most successful hedge funds, and for high-profile start ups, the sense is that lock-ins have been extended. Some funds also have dedicated longer-term financing for their least liquid investments (so-called 'side pockets'). Partly this reflects the negotiating position the most successful and popular fund managers enjoy in the face of strong desired investor inflows. According to some, longer lock-ins have also been given impetus by the US Securities and Exchange Commission's registration requirement on funds with a lock-in of less than two years.

Other market participants have noted, however, that lock-ins on capital do (eventually) expire, and that it is important to assess the maturity profile of investor capital as well as the headline lock-in length. It has also been suggested that long lock-ins may not universally be the norm; and that they can be difficult for more marginal players to negotiate, particularly if they are reliant for capital on funds of hedge funds, which are themselves aiming to minimise any mismatch between the maturity structure of their investments in hedge funds and that of their own liabilities.

Meanwhile, as a symptom of the broader search for yield, net investor inflows into hedge funds have remained relatively strong, while some way down from the 2004 H1 peak. For the first nine months of 2005 they are estimated to have been around \$49 billion, compared with around \$107 billion in the same period in 2004. Overall, redemptions have been modest, even in the wake of poor performance and concerns surrounding the much-publicised credit market events of the spring (Chart 2.12). The pattern of inflows has reflected recent returns, with strong inflows into, for example, emerging markets, multi-strategy and long/short equity (Chart 2.13 and 2.14). Consistent with a longer period of relatively weak performance and the more recent stress in the sector, funds classified as convertible bond arbitrage experienced net investor outflows for the fifth successive quarter in 2005 Q3.

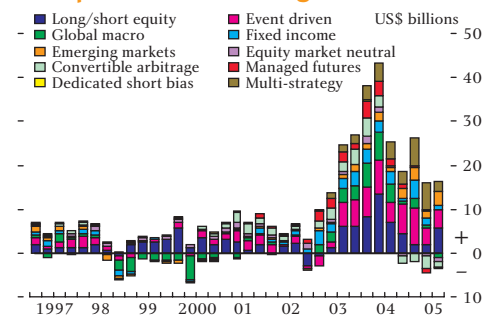
Looking ahead, an important question is whether investors will require the same levels of return performance they have enjoyed over the past decade or so. Greater efficiency of markets, fostered by the trading of the funds themselves, might make that a challenge, conceivably tempting some into greater risk taking. Arguably, broadly similar considerations might apply to investment bank returns.

**Chart 2.12**  
Flows of capital into hedge funds<sup>(a)</sup>



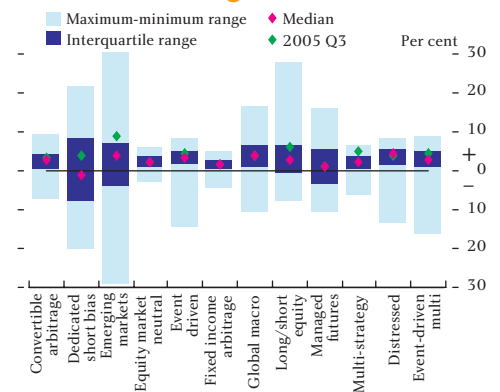
Sources: Tremont Capital Management, Inc. and Bank calculations.  
(a) Data for 2005 are based on Q1–Q3.

**Chart 2.13**  
Net capital flows into hedge funds



Source: Tremont Capital Management, Inc.

**Chart 2.14**  
Performance of hedge funds<sup>(a)</sup>



Sources: CSFB/Tremont and Bank calculations.  
(a) Distribution statistics calculated using data from 1994 Q1 to 2005 Q3.

## 2.3 Large complex financial institutions

From the perspective of the stability of the financial system as a whole, a key issue is whether and, to what extent, potential vulnerabilities materialise; and, if they do, the extent to which risks could flow back into, and strain, the banking system and core money markets. The robustness of large complex financial institutions (LCFIs) is therefore particularly important.<sup>(1)</sup> As a group they remain highly profitable, and have proved able to withstand recent idiosyncratic shocks (Chart 2.15). Proxied by CDS premia, the market's assessment of their credit risk has fallen and remains low (Chart 2.16).

Disclosures of Value-at-Risk (VaR, used as a proxy for trading book market risk) continue to suggest that LCFIs' trading risks are low, though the amount of risk has been rising (Chart 2.17). It is difficult to judge how good a proxy VaR is. First, as discussed above, the search for yield seems to be encouraging the origination and trading of inherently less liquid products, with LCFIs increasing private-equity style principal investment activities. To capture this development, VaR measures would need to be adjusted somehow for the additional liquidity risk.

Second, in providing tailored investment products and hedging to clients, investment banks assume risks that cannot always be laid off exactly in wholesale markets; for example, via writing exotic options on bespoke baskets of equities for structured note investors. Views vary on how well VaR models capture the resulting 'basis risks'. It is unclear to what extent the latter would offset each other or co-move in the event of large asset price changes and/or market illiquidity.

Third, investment banks provide principal protection to investors in notes linked to, for example, funds of hedge funds and, more recently, individual funds, hedging dynamically (constant proportion portfolio insurance).<sup>(2)</sup> This exposes the banks to the risk that they are unable to hedge quickly enough should the value of the underlying funds fall very sharply ('gap risk').

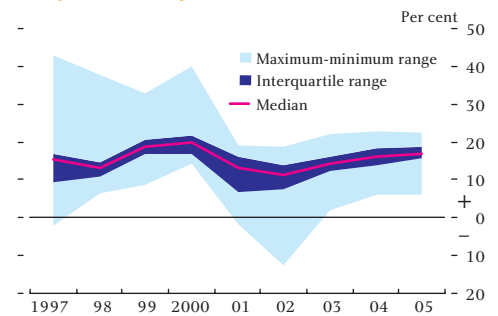
These examples underline the need to complement VaR-based analysis with stress tests, an issue well appreciated by market contacts and regulators.<sup>(3)</sup> It forms an essential element of their market risk management process, although designing effective stress tests is hard.

(1) Page 81 of the December 2001 *Review* describes the criteria used to determine an LCFI peer group. It comprises: ABN Amro, Bank of America, Barclays, BNP Paribas, Citigroup, Credit Suisse, Deutsche Bank, Goldman Sachs, HSBC, JPMorgan Chase and Co., Lehman Brothers, Merrill Lynch, Morgan Stanley, Société Générale and UBS.

(2) For a description of constant proportion portfolio insurance on funds of hedge funds, see Box 9 on pages 60–61 of the June 2005 *Review*.

(3) In May, the FSA released a discussion paper on Stress Testing (DP05/2), following consultation with market practitioners. Available at: [www.fsa.gov.uk/pubs/discussion/dp05\\_02.pdf](http://www.fsa.gov.uk/pubs/discussion/dp05_02.pdf).

Chart 2.15  
LCFI profitability<sup>(a)(b)</sup>

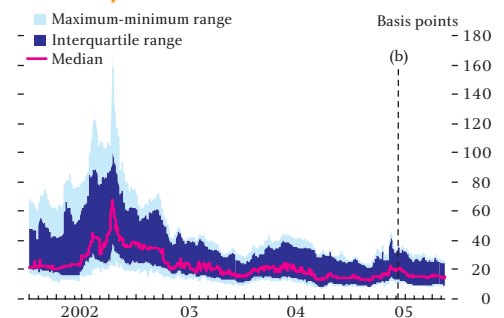


Sources: Bloomberg and Bank calculations.

(a) Return on equity. Calculated as net income divided by average shareholders' equity.

(b) Data for 2005 are annualised based on H1.

Chart 2.16  
LCFI CDS premia<sup>(a)</sup>

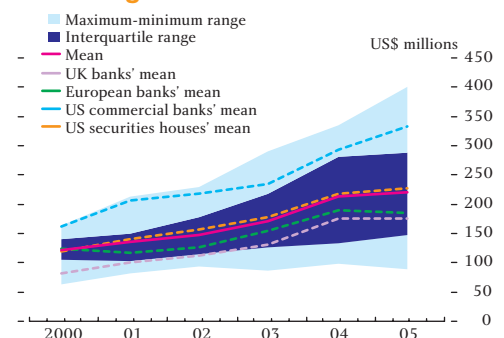


Sources: Markit and Bank calculations.

(a) Annual premia for credit protection on issuers using ISDA documentation, measured as mid-point between last bid and ask quotes of five-year senior debt CDS contracts.

(b) June 2005 *Review*.

Chart 2.17  
LCFI trading book VaR<sup>(a)(b)</sup>



Sources: Published accounts, regulatory filings and Bank calculations.

(a) Average daily VaR for LCFIs reporting annual and semi-annual data, adjusted to a ten-day holding period, 99% confidence interval and US\$, as necessary.

(b) Data for 2005 are based on H1.

More broadly, the current environment may pose some particular challenges for LCFIs and commercial banks more widely, including UK banks to a greater or lesser extent. Other things being equal, earnings may be impaired by flatter yield curves. If so, that may reduce the first buffer available to absorb losses from any unwinding of the wider search for yield.

Relatedly, firms appear to face a difficult trade-off between, on the one hand, financial risk from the possibility of risk being underpriced and, on the other hand, business risk from cutting back involvement only to find that any market correction does not occur for some time.

This dilemma may apply particularly to risk from primary issuance business. To some degree, investment banks are always exposed to so called 'pipeline risk' from their warehousing of risky assets in preparation for issuing, for example, ABS and CDOs. This risk may well have risen commensurate with the increasing size of individual deals and the uncertainty about the robustness of current asset valuations.

Broadly similar risks arise from the provision of liquidity lines protecting corporates from disruption to debt capital markets; for example, back-stop facilities underpinning commercial paper (CP) issuance programmes. Given the current scale of LBO activity, another important example is the provision of bridge loans to companies planning to issue high-yield bonds. LCFIs and other commercial banks also supply liquidity facilities to conduits of different sorts — asset-backed CP vehicles, CDOs and other innovative products that embed leverage. These lines can be drawn upon in the event that the vehicle cannot meet payment obligations.

Another way that risk could flow back to the banking sector is if firms have sold the expected loss (first-loss tranches) of the risk in credit portfolios, but have retained the residual exposure. They are then exposed to actual or mark-to-market losses proving to be greater than expected.

Risk of all kinds is transferred by LCFIs to hedge funds. Contingent risk is retained, however, if the funds' acquisition of the risk is financed — in cash or via a total return swap — by the LCFIs' prime brokerage operations, as the collateral held may prove inadequate in the event of large asset price movements. The development of risk management techniques has been a priority for prime brokers, and for hedge funds themselves, over the past few years. Nevertheless, it is possible that, in stressed circumstances, the adequacy of the margin requirements imposed by prime brokers on hedge funds' positions may be tested, particularly those on relatively new and less liquid instruments.



These are various ways in which risk could crystallise in, or flow back to, the banking sector. Banks, including UK banks, face the challenge of identifying and managing these potential risks. In that connection, a number of possible lessons emerged from the credit market events of May.

### **Trading book imbalances**

Many LCFIs had unbalanced CDO books in the spring, being long of mezzanine protection, but short equity and senior protection. They had sold some of this position to hedge funds and to other banks and dealer proprietary trading desks, but remained exposed and adjusted positions rapidly following the credit ratings downgrades of GM and Ford.<sup>(1)</sup> Since then, intermediaries have taken a number of steps to balance their correlation books better. These have included innovative ways of packaging and on-selling non-mezzanine tranches of senior CDO tranches, including via providing principal protection for equity tranches and leverage to increase the yield on super senior tranches.<sup>(2)</sup> This has allowed LCFIs to transfer some of these risks off their own books.

### **Model risk**

Valuation models for complex instruments may not always be able fully to keep pace with the rapid rate of innovation in financial markets. If models fail to predict with accuracy how the values of complex instruments change with movements in market variables, intended off-setting positions will prove imperfect hedges, potentially exposing LCFIs to unexpected losses. This 'model risk' is exacerbated by a paucity of historical data (needed to test models) and therefore of experience of the behaviour of these structures in a wide range of circumstances.

### **Operational risk in credit derivatives**

The June 2005 *Review* discussed the confirmation backlog and assignment issue in the credit derivatives market.<sup>(3)</sup> While the confirmation backlog was an operational challenge, the assignment issue (whereby counterparties may assign trades to third parties without providing notification) was a more serious concern for financial stability. This is because it created the possibility that core market participants might not be able to gauge the true extent of their counterparty exposures. Since then, progress has been made, spurred by official encouragement and private sector initiatives (see Box 1 on credit derivatives in the 'Strengthening financial infrastructure' article). Importantly, action is being taken not just by the key intermediaries, but by other active traders and end-users. Market practitioners are more optimistic about these issues; though the diversion of key operational staff to respond to credit events (such as the recent

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(1) See pages 59 and 62 of the June 2005 *Review*.

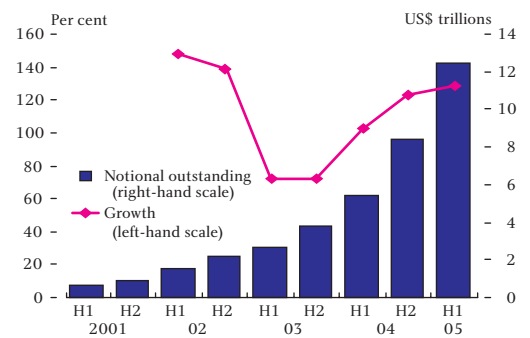
(2) Belsham, T, Vause N and Wells S *op cit* in this *Review*, pages 103–15.

(3) See pages 66–67 of the June 2005 *Review*.

Delphi default) is an obstacle to clearing backlogs in a market that is still growing extremely rapidly (Chart 2.18).

The episode has highlighted some more general lessons: a need for investment in middle and back-office processes and procedures to keep pace with front-office pressures (driven by fast-growing and highly profitable innovations); and for much better co-ordination within the industry when it is faced with a collective problem.

**Chart 2.18**  
**Growth in credit derivatives<sup>(a)</sup>**



Sources: ISDA Market Survey and Bank calculations.

(a) 'Growth' calculated as year-on-year change of notional amount of CDS outstanding.

## 3 UK financial sector resilience

Major UK banks appear well placed to absorb the credit and market risks discussed in the previous chapters of this *Review*. Published capital and liquidity ratios are well above regulatory minima. Reported profits remain high. Strong growth in corporate banking and capital markets income has offset more moderate growth in retail banking. Although large customer funding gaps — the difference between the stock of customer lending and deposits — remain a challenge, the major UK banks have continued their efforts to fill this gap from more diversified, longer-term, funding sources.

The robustness of the UK financial system depends not only on the nature of UK banks' exposures to the threats discussed in Chapters 1 and 2, but also on the extent to which they can absorb shocks. This chapter focuses on three key aspects of the resilience of UK financial institutions: profitability and capitalisation; funding and liquidity; and the links between financial intermediaries.

### 3.1 Profitability and capitalisation

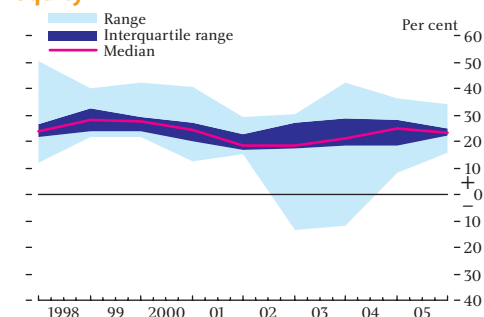
#### Profitability

The major UK banks<sup>(1)</sup> profitability remains strong, with the median pre-tax return on equity for the nine listed major UK banks stable at 23% (Chart 3.1). Overall, profitability in 2005 H1 was either above or near the upper end of Consensus forecasts for the majority of banks, and the median return on assets increased to around 0.9%. However, much of the increase reflected accounting changes following the introduction of International Financial Reporting Standards (IFRS) (see Box 4).

Consistent with this positive picture, market indicators suggest few concerns about the resilience of the major UK banks. Credit default swap (CDS) premia are below those of most other major US and European banks (Chart 3.2). Bank financial strength ratings for the UK banks are also high compared with other large internationally active banks (Table 3.A).

The strength of overall profitability, however, masks a continuing shift in the composition of income. As noted in previous *Reviews*, the declining contribution of net interest income was evident under UK accounting standards. The new accounting changes suggest that net interest income, at 43% of total income, no longer accounts for the majority of banks' income. For the five largest banks, reduced revenue growth from retail lending has been largely offset by revenues from corporate banking,

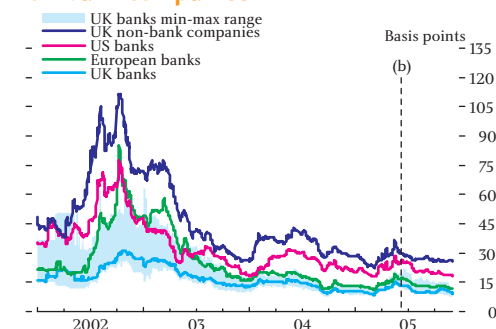
**Chart 3.1**  
Major UK banks' pre-tax return on equity<sup>(a)(b)(c)</sup>



Sources: Published accounts and Bank calculations.

- (a) Excludes Nationwide due to lack of data.
- (b) Pre-tax return on equity calculated as pre-tax profit as a proportion of shareholders' funds and minority interests.
- (c) Data for 2005 H1 results are annualised.

**Chart 3.2**  
Credit default swap premia for banks and non-bank companies<sup>(a)</sup>



Sources: Bloomberg, JPMorgan Chase and Co, Markit, published accounts and Bank calculations.

- (a) Data are available for 7 major UK banks, 36 other FTSE 100 companies, 20 continental European banks and 9 US banks, weighted by total assets.
- (b) June 2005 *Review*.

(1) This chapter focuses on the major UK banks, a group of selected large banks, building societies and 'other finance providers' as discussed in Box 1 on page 18 of the June 2005 *Review*. Due to changes introduced under International Financial Reporting Standards (IFRS), this chapter uses the most comparable data available for 2004.

## Box 4: International Financial Reporting Standards

As of 1 January 2005 the major UK banks have prepared their group financial statements in accordance with International Financial Reporting Standards (IFRS). The move is a step towards the harmonisation of accounting standards for all companies listed in the EU. It is designed to improve the direct comparability of published accounts across different markets and countries.

These accounting changes have implications for the measurement of UK banks' profitability and capitalisation and, therefore, affect assessments of the robustness and resilience of the UK financial system.<sup>(1)</sup> Key among these are:

- A substantial increase in the major UK banks' balance sheets, due primarily to tighter netting rules under IFRS. These changes are likely to cause some balance sheet volatility going forward. Financial instruments, including non-traded derivatives, are now generally shown gross and at fair value. This is a change to UK GAAP where such instruments were usually netted and measured at cost. Furthermore, repurchase agreements are grossed up and the majority of securitised loans have been brought on balance sheet.

- Changes in the valuation of bad debt provisions. UK GAAP was not prescriptive in how bad debt provisions should be calculated. IFRS calls such losses 'impairments' and introduces more stringent definitions of the circumstances in which such a loss can be recognised and how it is valued.
- Full disclosure of insurance income and expenses. In particular, the consolidation of insurance business, including life assurance, on a line-by-line basis has increased both operating income and expenses and has impacted cost-income ratios.

As highlighted in previous *Reviews*, consistent, economically meaningful information plays a key role in facilitating the decision making of financial market participants.<sup>(2)</sup> The major UK banks restated their 2004 full year financial results adopting IFRS standards alongside their 2005 interim results<sup>(3)</sup> and they suggest that the accounting changes are unlikely to have an impact on the assessment of the underlying economic risks underpinning their businesses. But rating agencies are likely to withhold judgement on the full impact of IFRS until full-year results are published in 2006.

(1) The following analysis offers only a summary review of how IFRS has affected the major UK banks' financial statements. A comprehensive discussion of the financial institution and instrument standards is beyond the scope of this box.

(2) See Michael, I (2004), 'Accounting and financial stability', Bank of England *Financial Stability Review*, June, pages 118–28, and Large, A (2004), 'Financial instrument accounting', Bank of England *Financial Stability Review*, December, pages 107–11 for discussions of the economic channels through which accounting affects financial stability.

(3) Not all banks restated their Profit and Loss accounts to accommodate IFRS 4, 32 and 39, although all banks did restate their balance sheets to incorporate these changes. However, there were some exemptions relating to hedge, non-traded derivatives and fair-value accounting.

international banking, and capital markets. Profit growth from these business areas also surpassed profit growth from retail lending (Chart 3.3), despite heavy recruitment, strong investment, and higher operating expenses. Within non-interest income, dealing profits increased markedly (Chart 3.4), reflecting continued expansion into wholesale markets by some banks.

Looking forward, the profitability of major UK banks could moderate. The interim result presentations of some banks point to the likelihood of slower income growth and the possibility of further credit quality deterioration, partly reflecting unsecured lending exposures. Commentators and market analysts have also questioned the sustainability of major UK banks' profit growth, given the slowdown in UK retail lending growth and intense competition. That may account for the relative

**Table 3.A**  
Moody's weighted-average bank financial strength index<sup>(a)</sup>

	Index
United Kingdom	91.1
Netherlands	90.3
France	90.0
United States	87.2
Canada	86.0
Spain	85.7
Germany	84.2
Australia	83.4
Ireland	83.1
Italy	79.4
Hong Kong	76.7
Japan	76.1

Sources: Moody's and Bank calculations.

(a) Constructed according to a numerical scale assigned by Moody's using November 2005 weighted-average bank ratings by country, with zero and a hundred indicating the lowest and highest average ratings respectively.

underperformance of banks' equity prices — since the June 2005 *Review*, the FTSE bank equity index has increased by 7%, compared with a 10% rise in the FTSE All-Share index. But there is little to suggest that banks' returns on equity could fall sharply from their current robust levels.

## Capitalisation

The major UK banks' published capital ratios were little changed over 2005 H1, and are well above regulatory minima. For example, 'prime Tier 1' capital — which excludes components of Tier 1 capital that carry debt servicing obligations — remains high at all the major UK banks (Chart 3.5).

Stress tests suggest that, over a plausible range of shocks, major UK banks retain sufficient profits and capital to meet outstanding assets and liabilities. Recent updates of the stress tests used in the 2002 IMF Financial Sector Assessment Programme (FSAP) indicate that even the 'worst case' scenario — combining the four scenarios used in the FSAP tests together — costs the banking sector just 0.35% of total assets.<sup>(1)</sup> Such losses would have to increase substantially before they posed concerns for financial stability.

## 3.2 Funding and liquidity

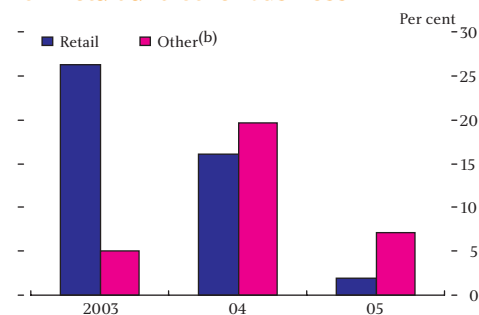
The role of banks and building societies as intermediaries — transforming deposits into illiquid loans — leaves them vulnerable to liquidity risk. Therefore, it is important to assess both market and funding liquidity to ensure that banks hold a sufficient stock of liquid assets to fulfil both expected and unexpected financial commitments as they arise.

## Funding

Previous *Reviews* have noted how, at an aggregate level, major UK banks have seen the annual growth rate in lending to non-bank 'customers' outpace the corresponding growth in deposits from this sector. This has created a 'customer funding gap': the stock of lending to customers exceeds the stock of customer deposits. Banks have differed historically in the extent of this divergence but, although there are still variations between the banks, all the major UK banks now have a customer funding gap. For most, this gap stood at over 10% of total assets at 2005 H1 (Chart 3.6). But the growth rates of customer lending and deposits have converged somewhat (Chart 3.7), reducing the rate at which the funding gap is increasing.

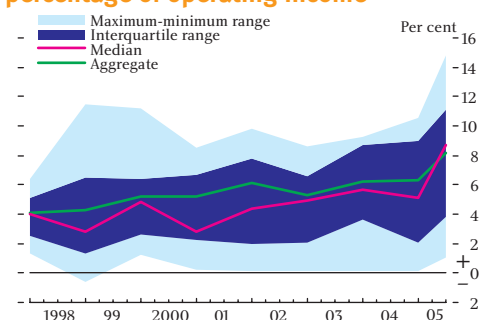
The major UK banks have filled the customer funding gap by issuing debt securities, such as certificates of deposits (CDs), and by borrowing in the interbank market (Chart 3.8). Wholesale

**Chart 3.3**  
Profit growth of the five largest UK banks from retail and other business<sup>(a)</sup>



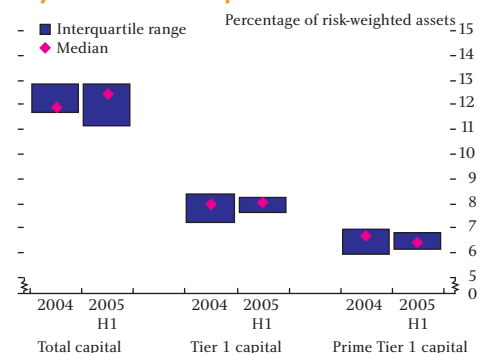
Sources: Published accounts and Bank calculations.  
(a) Data for 2005 H1 results are annualised.  
(b) Where disclosure allows, business banking profits included in 'other' category.

**Chart 3.4**  
Major UK banks' dealing profits as a percentage of operating income<sup>(a)(b)</sup>



Sources: Published accounts and Bank calculations.  
(a) Data for selected major UK banks, where data are available.  
(b) Due to changes introduced under International Financial Reporting Standards, figures for 2004 and 2005 use the most comparable data possible.

**Chart 3.5**  
Major UK banks' capital ratios<sup>(a)(b)</sup>



Sources: Published accounts, FSA regulatory returns and Bank calculations.  
(a) Prime Tier 1 comprises ordinary shares, associated reserves and retained earnings.  
(b) Data for selected major UK banks, where data are available.

(1) See Bunn, P, Cunningham, A and Drehmann, M (2005), 'Stress testing as a tool for assessing systemic risks', *Financial Stability Review*, June, pages 116–26.

funding is typically more expensive, lumpier, and more volatile than retail funding. It is also generally short term and needs to be refinanced regularly. In times of market-wide stress, these liabilities may therefore pose liquidity risks.

Banks continue to mitigate liquidity risk by diversifying their funding and issuing debt with lengthier maturities. They have issued both senior debt and covered bonds.<sup>(1)</sup> Since the June 2005 *Review*, major UK banks have issued a further £5 billion of covered bonds. Their attractiveness may be enhanced further following the FSA's review of the regulation of covered bond issuance.<sup>(2)</sup> Other methods of diversification include securitisations such as residential mortgage-backed securities (MBS). Although the retention of residual portions by issuing banks means that securitisation does not transfer all risk from banks, the scale of such holdings is relatively small compared with the balance sheets of the major UK banks.

### Liquidity

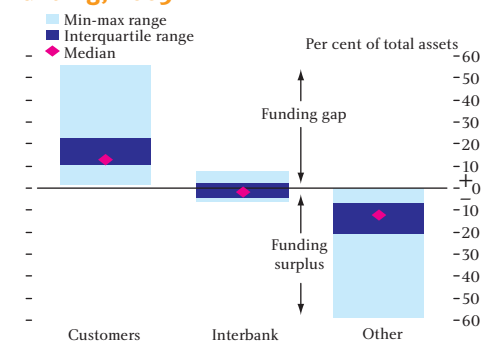
Financial institutions also hold high-quality liquid assets to mitigate the liquidity risk inherent in both their on and off balance sheet activities.<sup>(3)</sup> The regulatory minimum for major UK banks' holdings of liquid assets is determined by the sterling stock liquidity ratio (SSLR). Since the June 2005 *Review*, SSLRs have remained above the regulatory minimum of 100% for all the major UK banks (Chart 3.9).<sup>(4)</sup> The SSLR, however, is based on sterling outflows, while foreign currency liabilities represent about half of major UK banks' total funding. As such, its usefulness for gauging aggregate liquidity risk is limited.

## 3.3 Links between financial institutions

Aggregate measures of resilience are insufficient, by themselves, to provide a full assessment of the UK financial sector's ability to withstand adverse shocks. The major UK banks have both direct and indirect counterparty exposures to banks, building societies, other finance providers, and major global financial institutions such as LCFIs. These links between financial institutions create the potential for a shock that crystallises at one institution to be transmitted quickly throughout the financial sector as a whole.

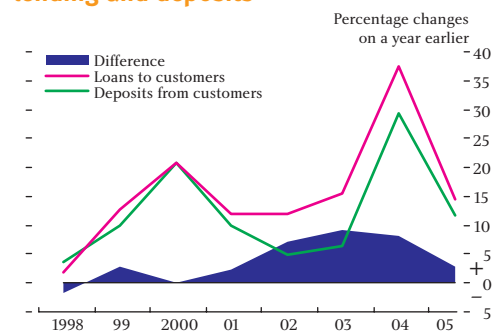
(1) UK covered bonds are long-term securities (typically with 5 to 15-year maturities) backed by pools of mortgages.  
 (2) In August 2005, the FSA gave further clarification over the regulatory treatment of covered bond issuance and suggested that any revision to a bank's Individual Capital Ratio (ICR) would be unlikely until issuance moved towards 20% of total assets. For FSA guidance, see [www.fsa.gov.uk/pubs/other/covered\\_bonds.pdf](http://www.fsa.gov.uk/pubs/other/covered_bonds.pdf).  
 (3) See Large, A (2005), 'Financial stability: managing liquidity risk in a global system', pages 78–84 in this issue of the *Review*.  
 (4) As noted in previous *Reviews*, the SSLR includes a proportion of banks' holdings of other banks' CDs as admissible assets, which may not protect the banking system as a whole in the case of a system-wide liquidity shock. But, even excluding holdings of CDs, the median stock liquidity ratio has remained above 100% since the June 2005 *Review*.

**Chart 3.6**  
Major UK banks' funding gaps, by type of funding, 2005 H1<sup>(a)(b)</sup>



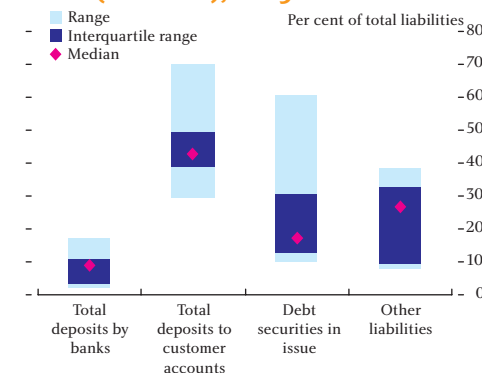
Sources: Published accounts and Bank calculations.  
 (a) Measured as assets less liabilities in the balance sheet categories shown, as a percentage of total assets.  
 (b) 'Customers' comprises all non-bank borrowers and depositors.

**Chart 3.7**  
Major UK banks' growth in customer lending and deposits<sup>(a)(b)</sup>



Sources: Published accounts and Bank calculations.  
 (a) 'Customers' comprises all non-bank borrowers and depositors.  
 (b) Data for 2005 H1 results are annualised.

**Chart 3.8**  
Constituents of major UK banks' balance sheets (liabilities), 2005 H1



Sources: Published accounts and Bank calculations.

## Funding and trading exposures

Interbank lending remains the largest single form of counterparty exposure between the major UK banks. Gross interbank loans and advances amounted to more than twice these institutions' Tier 1 capital (Chart 3.10).

Counterparty links are also formed through off balance sheet activities, such as over-the-counter (OTC) derivatives. These exposures are managed predominantly through netting and collateral arrangements. As Chart 3.10 shows, major UK banks' net exposures via OTC derivatives are small compared with direct lending between banks. So counterparty risks as a result of mark-to-market valuations are likely to be moderate.

## 'Large' exposures

Regulatory 'large' exposures data capture both on and off balance sheet exposures to major counterparties.<sup>(1)</sup> The data indicate that, as well as exposures to each other, the major UK banks have significant exposures to LCFIs and internationally active banks (Chart 3.11). In fact, exposures to non-UK LCFIs have increased by around 25% since the June 2005 Review, and are now significantly larger than exposures to other major UK banks.

A counterparty is more likely to be systemically important if a number of banks have significant exposures to it. At the end of September 2005, the major UK banks had 'large' exposures to over 50 different counterparties. There are now 20 institutions to which five or more of the major UK banks have 'large' exposures, up from 18 at end-2004. The institutions that appear most frequently in this data are the major UK banks themselves and non-UK LCFIs. These bilateral links suggest that there is an important direct channel through which risk can be transmitted between and among the two groups of institutions, as well as through capital market participation.

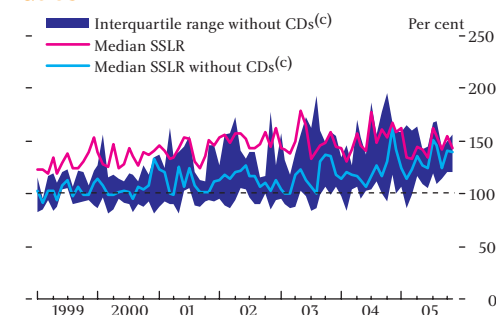
## Payment and settlement systems

Several major UK banks participate directly in payment and settlement systems — in the United Kingdom and overseas. The two largest payment systems by value in the United Kingdom — CHAPS Sterling and the embedded payment system supporting securities settlement in CREST — are real-time gross settlement systems and, in the case of CREST, securities settlement takes place on the basis of delivery versus payment. As such, their operation does not give rise to credit exposures between settlement banks. But the 'tiered' nature of these systems implies that the exposures of settlement banks to non-members still need to be managed.<sup>(2)</sup>

(1) For regulatory purposes, 'large' exposures are defined as any exposures that exceed 10% of eligible capital (Tier 1 plus Tier 2 capital, less any regulatory deductions eg related to insurance subsidiaries) at any point during the reporting period.

(2) See Harrison, S, Lasoas, A and Tudela, M (2005), 'Tiering in UK payment systems: credit risk implications', on pages 63–72 in this issue of the Review.

**Chart 3.9**  
Major UK banks' sterling stock liquidity ratios<sup>(a)(b)</sup>



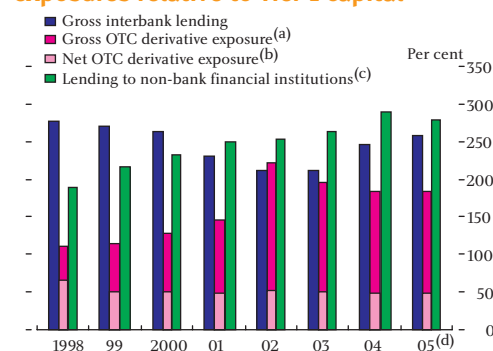
Source: FSA regulatory returns.

(a) Data for selected major UK banks, where data are available.

(b) The FSA regulatory minimum for the sterling stock liquidity ratio is 100.

(c) Certificates of deposit.

**Chart 3.10**  
Major UK banks' selected counterparty exposures relative to Tier 1 capital



Sources: Bank of England and published accounts.

(a) Gross OTC derivative exposure should be taken as a minimum only; where gross OTC derivative exposure is not disclosed, net exposure has been used.

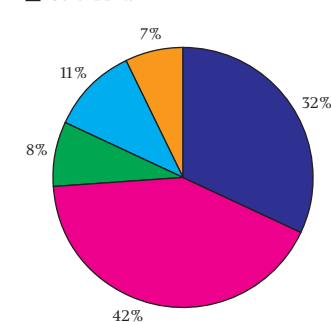
(b) Net OTC derivative exposures are trading positions net of margining and collateral held.

(c) Data includes intragroup lending, converse to the other featured series. Data for selected major UK banks, where data are available.

(d) Derivative exposures use end-2004 data.

**Chart 3.11**  
Major UK banks' 'large exposures' to banks and LCFIs by counterparty, end-Sep. 2005

Major UK banks (dark blue), Non-UK LCFIs (pink), Benelux banks (green), Other European banks (light blue), Other banks (orange)



Source: FSA regulatory returns.

The Continuous Linked Settlement (CLS) system is one aspect of the payment system architecture that helps reduce foreign exchange settlement risk. Although a significant proportion of foreign exchange transactions are still settled outside CLS, the values of foreign exchange transactions settled in CLS on a payment-versus-payment basis have continued to increase over the past few months.

As well as minimising settlement exposures between banks, well designed payment, clearing and settlement systems reduce the threat of system wide disruptions. But the importance of such systems also opens up the possibility that problems within the financial infrastructure could adversely affect financial intermediaries. Current initiatives to reduce risks within the UK financial system infrastructure, and the issues confronting policymakers in this area, are discussed in the next article.



# Strengthening financial infrastructure

The continued stability of the financial system relies on robust financial infrastructure. In particular, strong risk management within payment, clearing and settlement systems reduces both the likelihood and impact of episodes of financial instability. This article looks at two issues relevant to financial infrastructure. The first part describes recent developments, and future trends, in the value of payments flowing through the CHAPS Sterling payment system and their implications for financial stability. The second part describes an international initiative to reduce risks in clearing and settlement globally.

## Recent developments, and future trends, in CHAPS Sterling values

### Background

The CHAPS Sterling payment system plays a pivotal role in supporting the UK financial markets and the economy more generally. This can be illustrated by the fact that, on a typical day, it handles payments with an overall value of around £200 billion. CHAPS Sterling became a real-time gross settlement (RTGS) system in 1996, since when all payments between direct members of the system have settled individually and in real time. As a result of this, the credit risk that had previously arisen between banks in CHAPS Sterling when it was a deferred net settlement (DNS) system was eliminated, with positive implications for financial stability in the United Kingdom.

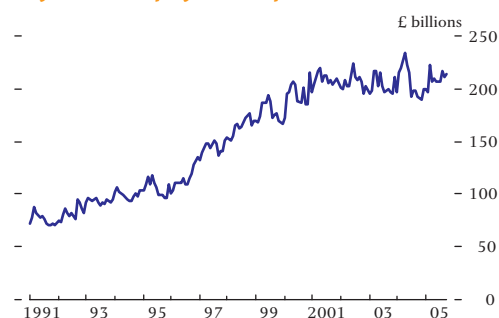
But, as can be seen from Chart 1, since the beginning of 2000 CHAPS Sterling values have flattened out. Does this mean that large-value payments are passing through other, possibly less safe, systems? Or are there other explanations for this trend? Below, we consider three possible explanations for the flattening in CHAPS Sterling values and examine the financial stability implications of each. We close with a discussion of future trends in CHAPS Sterling payments and their implications.

### The replacement of CHAPS payments with CREST payments

In October 2003 settlement of dematerialised versions of money market instruments (MMIs — certificates of deposit, commercial paper, Treasury

Chart 1

### Daily value of payments processed in CHAPS Sterling<sup>(a)</sup>



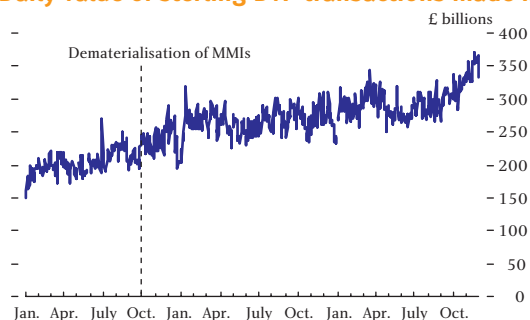
Sources: APACS and ONS.  
(a) Average over each month.

bills and bankers' acceptances) migrated to CREST on a delivery-versus-payment (DvP) basis. The payments associated with settlement of these instruments are now processed in the embedded payment system in CREST. Prior to that, some MMIs were settled against CHAPS Sterling payments. The daily turnover of MMIs in 2002 Q3 was estimated to be £10.6 billion, although the value of the corresponding CHAPS Sterling payments would have been lower (since much of this turnover was netted before being settled in CHAPS).<sup>(1)</sup> As can be seen in Chart 2, the value of sterling DvP transactions in CREST did not appear to rise immediately after the dematerialisation, but has since risen from £220 billion per day to around £340 billion per day.

In addition, the sterling repo markets have been growing over the past few years; the payments leg of

(1) *Bank of England Quarterly Bulletin*, Winter 2002, page 361, Table B.

**Chart 2**  
**Daily value of sterling DvP transactions made in CREST**



Source: Bank of England.

such transactions is made in the securities settlement system and not in the CHAPS Sterling payment system. The daily value of overnight interbank gilt repos (transacted in CREST) increased from around £4 billion at the start of 2000 to £17 billion at the start of 2005.<sup>(1)</sup> The daily value of equivalent unsecured loans (transacted in CHAPS) also increased, but by proportionately less. This suggests that there has been some substitution of secured for unsecured lending and that this has helped explain the flattening in CHAPS Sterling values (at least relative to CREST).

Both these developments are positive from a financial stability viewpoint. Before October 2003 paper MMIs were settled in the Central Moneymarkets Office (CMO). Since then, the newly issued securities have been settled in CREST on a DvP basis, where the seller delivers securities in exchange for a commitment by the buyer's settlement bank to make a simultaneous unconditional and irrevocable payment to the seller's settlement bank; payments between settlement banks are settled gross in real time in central bank money. This reduces settlement risk by eliminating the intraday exposures that were present between settlement banks in CMO. Using gilt repo as a substitute for unsecured interbank lending reduces credit risk in the system, because it involves a shift from unsecured to secured lending.

### Consolidation in the banking sector

Another factor that may explain part of the flattening in CHAPS Sterling values is the consolidation that has

taken place within the UK banking sector, in particular the RBS acquisition of NatWest Bank in March 2000. With fewer settlement members of CHAPS, more payments will be between customers of the same bank and be internalised within the settlement bank's system rather than processed through the CHAPS system. Furthermore, market intelligence suggests that correspondent banking activity has become more concentrated, increasing the proportion of payments that are internalised across the books of settlement banks.

The risk implications of this development are mixed. A payment between two indirect members of CHAPS settled across accounts at the same CHAPS settlement member would not enter the large-value payment system and so would not enjoy the additional protection against legal challenge to its finality that is granted in systems designated under the Settlement Finality Regulations. The concentration of payments through fewer settlement banks also increases the 'single point of failure' risk, although the internalised payments themselves are less subject to operational risk since they require only one system to be operational rather than three.

### The introduction of Continuous Linked Settlement (CLS)

A third explanation for part of the fall in CHAPS Sterling values is that CLS was introduced, in September 2002, to reduce foreign exchange settlement risk.<sup>(2)</sup> Because members transfer only their multilateral net currency balances to and from CLS, the size of the foreign-exchange-related sterling payments through CHAPS is reduced (compared with gross settlement).<sup>(3)</sup> Since the introduction of CLS, the average daily volume and value of sterling trades processed through CLS has increased to around 15,000 trades and £85 billion respectively. The sterling netting factor has risen to 40 compared with 4 at its outset.<sup>(4)</sup> This means that settling a given value of foreign exchange transactions can be achieved with CHAPS Sterling payments of only a tenth of the value previously required. Based on this calculation, if we assume that all the sterling sides now being settled in CLS were instead settled

(1) Source: Bank of England. These data do not include self-collateralising repos (SCRs). CREST deliveries-by-value (DBVs) used as collateral in stock loans are not included; those undertaken as a generalised-collateral repo are.

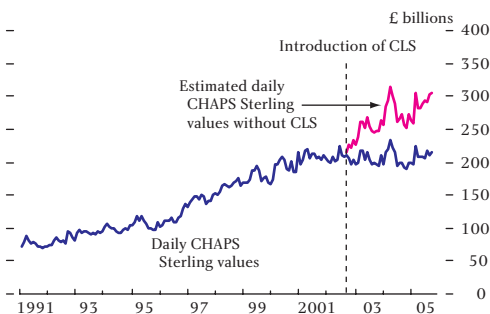
(2) For a full discussion of the development of CLS, and the reduction in foreign exchange settlement risk resulting from it, see Sawyer, D (2004), 'Continuous linked settlement (CLS) and foreign exchange settlement risk', *Financial Stability Review*, December, pages 86–92.

(3) Since 28 November, CLS Bank has been a settlement member of CHAPS Sterling, with sterling payments made to and from it directly over the CHAPS Sterling system. But this change will have had no effect on CHAPS Sterling values since, prior to then, sterling payments to and from CLS were made over the CHAPS Sterling system via the Bank of England, which acted as the settlement bank for CLS.

(4) The netting factor is defined as the total gross value of transactions settled divided by total pay-ins to CLS.

individually and gross in CHAPS Sterling, the aggregate value of payments flowing through CHAPS Sterling would be around £90 billion higher per day, as shown in Chart 3. However, this is likely to be an overestimate of the impact on CHAPS Sterling payments resulting from the introduction of CLS, because there already was a degree of bilateral netting of foreign exchange transactions between market participants before CLS was introduced. Nonetheless, it seems likely that CLS has had a significant effect on CHAPS Sterling values.

**Chart 3**  
The impact of CLS on daily CHAPS Sterling values<sup>(a)</sup>



Sources: APACS and ONS.  
(a) Average over each month.

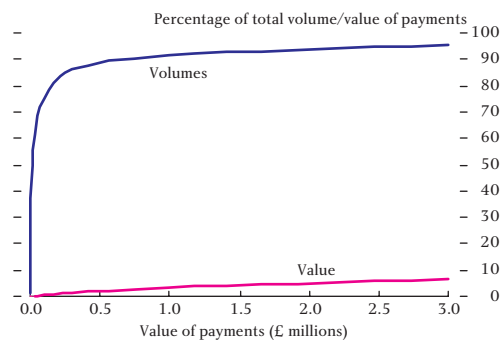
From a risk perspective, the introduction of CLS is positive given that it has removed settlement risk between its members. CLS currently has 57 settlement members and over 600 third-party users who settle their foreign exchange transactions in CLS through settlement members. While third-party users in CLS may incur 'settlement agent risk' on their settlement member, they would still be exposed to settlement agent risk through their correspondent banks if they settled outside CLS, and participation in CLS can significantly reduce the size and duration of their FX principal exposure.

### Future trends

In the future, it is likely that there will be a trend towards decreased CHAPS Sterling volumes, although the trend in values is less clear. Two reasons for this are the introduction of a new 'Faster Payments' service and the possible introduction of a new Land Registry system through which house purchase payments will be made.

The Faster Payments service represents the response of UK banks to the recommendation of the Payment Systems Task Force, led by the Office of Fair Trading (OFT), that such a service be introduced by end-2007. The service will operate on a 'near real-time' basis with multiple same-day settlement.<sup>(1)</sup> Currently, as can be seen from Chart 4, most CHAPS payments are relatively low value; in particular, half of all CHAPS payments are for values of less than £10,000 and only 14% are for values greater than £300,000. It seems reasonable to assume that a considerable proportion of the low-value payments are likely to migrate to the Faster Payments service, leading to a considerably lower volume of payments passing through CHAPS Sterling. The number of payments that will migrate will be determined in large part by the individual transaction value cap imposed on the Faster Payments service.

**Chart 4**  
Distribution of CHAPS Sterling payment values and volumes



Source: Bank of England.

House purchase payments may also start to migrate away from CHAPS Sterling to the proposed new Land Registry system. This is an electronic conveyancing system with a funds transfer system to link payments with changes in title. Early services for electronic conveyancing will be piloted in 2007, with electronic funds transfer to be introduced from 2008. The same agent bank will be used for all transactions in a housing chain, implying a fall in interbank CHAPS transfers. Payment amounts and timing may also be affected, as net amounts will be pre-funded the day before completion.

(1) In a 'near real-time' system, the account of a customer receiving a payment is credited as soon as the receiving customer's bank receives confirmation of the transaction from the paying customer's bank. In order to send confirmation to the receiving customer's bank, the paying customer's bank — following input of a transaction by the paying customer — must carry out a number of checks to authenticate the transaction and ensure that the paying customer has sufficient funds in their account. This confirmation process should take only a matter of seconds, hence the term 'near real-time'.

The effect of these developments on financial stability will depend on the size of the intraday exposures created by payments migrating to these new systems. Although both these developments are likely to result in the migration of payments away from CHAPS, these payments are likely to be low value; in turn, the size of intraday exposures within the new systems is likely to be small. Moreover, multiple settlement in a new Faster Payments service, along with legally robust netting, will reduce the amount of liquidity needed to make these payments.

But with fewer payments flowing through CHAPS Sterling, the cost per payment of running the system would rise in the absence of compensating changes. Such a rise in costs would need to be judged by banks against the increase in risk were they to migrate large-value payments away from CHAPS onto other systems and/or resort to other, potentially riskier, arrangements for making these payments. Such a migration would raise substantial issues from a financial stability point of view.

The Bank of England's money market reforms are also likely to reduce interbank money market transactions and therefore the value transmitted over CHAPS Sterling, perhaps considerably. Currently, settlement banks' excess reserves held with the Bank do not attract any interest, and an overdraft attracts a penal rate. Banks therefore need to square off their balances to zero on a daily basis, by means of unsecured lending and borrowing in the interbank market; the resulting payments are made through the CHAPS Sterling system. However, the Bank is moving to a system where it will offer banks a voluntary reserve account. Reserves held on this account will be remunerated, and balances can be used to fund CHAPS payments. But these accounts need only meet their target reserve requirement on average over the maintenance period (a month). This means that settlement banks can run above or below their target level of reserves to square off their overdrafts on their CHAPS account if necessary — obviating the need to go into the interbank market, particularly late in the day. As a result, interbank exposures will be lower and fewer payments will be made over CHAPS late in the day. Both are positive developments.

In addition, the Bank's money market reforms may encourage more banks to join CHAPS as direct members — particularly those banks which have significant sterling business.<sup>(1)</sup> To the extent that this happens, CHAPS volumes and values will increase, counteracting, to a degree, the effects noted in the previous paragraph. The more an indirect member bank's payments are internalised by its settlement bank at present, the greater the increase in CHAPS volumes and values will be if the indirect member becomes a direct member. In addition, the business profile of the bank may also affect the extra contribution to CHAPS volumes. For example, a bank with a sizable mortgage business may contribute less to CHAPS volumes in the future because of the introduction of e-conveyancing. But the net result of an increase in CHAPS membership is a reduction in credit risk and, as such, is positive for financial stability.

### Conclusions

The factors listed above go some way towards accounting for the stabilisation of the average daily value of CHAPS Sterling payments over the past four years. A rough calculation suggests that without these developments CHAPS Sterling values could have been up to £100 billion higher.

The introduction of CLS, the dematerialisation of MMIs and the increase in the use of gilt repos as a substitute for unsecured interbank lending all seem to be positive developments from a financial stability perspective — reducing credit and operational risk. The consolidation in the banking sector may reduce the liquidity requirements of making all payments through an RTGS system, but increases legal and concentration risk — especially in the case where customer banks only have a relationship with one settlement bank.

Looking forward, innovations in the low-value payments market and the Bank of England money market reforms are, on the whole, expected to dampen volumes and value although the implications for financial stability are positive.

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(1) Two examples of this are Abbey, which became a settlement member of CHAPS Sterling on 14 November, and UBS AG, which plans to become a direct member during 2007.

## Taking forward the G30 Plan of Action for Global Clearing and Settlement

### Background

The Group of Thirty (G30) Clearing and Settlement Monitoring Committee, chaired by Sir Andrew Crockett and with the Bank of England as an observer, published in April 2005 an interim report on progress to meet the recommendations set out in the Group's January 2003 Report *Global Clearing and Settlement: a Plan of Action*.<sup>(1)</sup> The Report set out 20 recommendations aimed at reducing risk, increasing efficiency and enhancing governance in global clearing and settlement. The recommendations were drawn up by a Steering Committee chaired by Sir Andrew Large,<sup>(2)</sup> Deputy Governor of the Bank of England, and including representatives of both the public and private sectors. The Bank has maintained an interest in progress to meet the recommendations given that they are designed to strengthen the clearing and settlement infrastructure further and promote financial stability.

The G30 was concerned that national clearing and settlement infrastructures, if developed across markets unevenly or with inconsistent business practices, could give rise to systemic risk and inefficiency. These concerns posed particular challenges in relation to cross-border clearing and settlement. The recommendations set out standards to target best practice in international markets. Both public and private sector organisations were charged with action to meet these standards.

The G30 noted that an important starting point was the joint work of the Committee on Payment and Settlement Systems (CPSS) of the G10 central banks and the International Organisation of Securities Commissions (IOSCO) in drawing up *Recommendations for Securities Settlement Systems* in November 2001. The G30 Report built on, and in some cases strengthened, these recommendations, and sought to make them operable in a global context. The Steering Committee also monitored the work of the Giovannini Group, which advises the European Commission on EU financial market issues and which had identified

15 barriers to efficient cross-border clearing and settlement in the EU.<sup>(3)</sup>

Since publication of the 2003 Report, work has been undertaken by the public and private sectors to meet the recommendations. A number of organisations, including the Association of Global Custodians, the International Securities Services Association and SWIFT, have agreed to take forward the work on specific recommendations. There are, however, a number of recommendations in which the public sector has a direct involvement or interest and which no single party is able to take forward on a global basis. The recommendations aimed at reducing risk are a case in point.

Work by central banks and securities regulators at both European and global levels has resulted in the development of relevant regulatory standards, including some that address the Report's recommendations aimed at reducing risk. For example, the G30 noted that the CPSS-IOSCO *Recommendations for Securities Settlement Systems* were aimed predominantly at securities settlement systems and less so at central counterparties. G10 central banks and securities regulators have since worked to fill this gap by publishing the CPSS-IOSCO *Recommendations for Central Counterparties* in November 2004.<sup>(4)</sup>

Specifically at the European level, a working group of the European System of Central Banks and the Committee of European Securities Regulators (ESCB-CESR) published draft *Standards for Securities Clearing and Settlement in the European Union* in September 2004. These were produced after studying the G30 Recommendations and include elements relating to standardisation, communication and messaging and business continuity.

### Progress with systemic risk reduction in the United Kingdom

The Bank of England is continuing to work on a range of issues identified by the G30. It hosted a seminar in May 2003 to assess how best to meet the G30 Recommendations.<sup>(5)</sup> It takes a particular interest in

(1) The Group of Thirty is a private sector group concerned with the working of the international financial system. Further details and summaries of the 2005 *Plan of Action and Interim Report* can be found on the G30 website [www.group30.org](http://www.group30.org).

(2) Sir Andrew became the chairman of the Steering Committee before joining the Bank of England and continued as chairman until publication.

(3) Further information on the Giovannini Group can be found on their website [http://europa.eu.int/comm/economy\\_finance/giovannini/clearing\\_settlement\\_en.htm](http://europa.eu.int/comm/economy_finance/giovannini/clearing_settlement_en.htm).

(4) Both sets of recommendations are available at [www.bis.org/](http://www.bis.org/) and [www.iosco.org](http://www.iosco.org).

(5) The purpose of this seminar was outlined in the *Financial Stability Review*, June 2003, Box 2, page 79.

the recommendations which relate to the reduction of systemic risk. This is not only in respect of UK domestic systems, but also in respect of those foreign securities settlement systems identified as important to UK markets.<sup>(1)</sup> As the G30 Report pointed out, the risk recommendations stand on their own merits and warrant concerted action. The implementation of these recommendations by the relevant UK entities is outlined below.

*Recommendation 9: Financial integrity of providers*

Central banks and securities regulators continue to be actively engaged in assessing infrastructures against relevant risk standards. In international regulatory debates, UK authorities have advocated the 'functional' approach to regulation, proposed by the G30, which applies recommendations to an entity's activities, and the associated risks, without regard to its legal or regulatory status. The Bank and Financial Services Authority (FSA) are jointly assessing the UK clearing and settlement organisations LCH.Clearnet Ltd and CRESTCo against the relevant CPSS/IOSCO Recommendations. These findings will address G30 Recommendation 9 ('ensure the financial integrity of providers of clearing and settlement services').

*Recommendation 10: Risk management of users*

In accordance with Recommendation 10 ('reinforce the risk management practices of users of clearing and settlement services providers'), LCH.Clearnet Ltd establishes minimum criteria for members' financial resources and creditworthiness, which vary depending on the markets to be cleared and the type of membership.

*Recommendation 11: Transfer of assets*

In the securities settlement arena, G30 Recommendation 11 ('ensure final, simultaneous transfer and availability of assets') is met for payments in sterling and euro through CREST. Arrangements for making US dollar settlement more compliant are being pursued. Since 2003 settlement through CREST has conveyed full legal title to money market instruments, as was already the case for UK gilts and equities, hence meeting this Recommendation.

*Recommendation 12: Business continuity and disaster recovery*

The Bank and the FSA are currently carrying out a formal benchmarking assessment of the current level of resilience of critical infrastructure against a range of scenarios, as called for in Recommendation 12 ('ensure effective business continuity and disaster recovery planning'). In May 2005 the European Central Bank announced a 'consultation on business continuity in payment systems' that adopts the language of the G30 on transparency.

*Recommendation 13: Failure of a systemically important institution*

Recommendation 13 'addresses the possibility of failure of a systemically important institution'. The Bank's role in financial crisis management in the United Kingdom is set out in the Memorandum of Understanding (MoU) between the Bank, HM Treasury and the FSA.<sup>(2)</sup> Separately, an agreed MoU, covering the EU banking supervisory authorities, central banks and finance ministries, came into effect on 1 July 2005.<sup>(3)</sup> Such co-ordination among authorities to manage a cross-border financial crisis is important, given the international nature of UK financial firms, and London's role as an international financial centre.

*Legal Recommendations (14, 15 and 16)*

General principles of English law already support Recommendation 14 ('strengthen assessment of the enforceability of contracts'). Furthermore, protection against the impact of insolvency law in the European Union is provided by the designation of payment systems (eg BACS, CHAPS Sterling and CHAPS Euro, CLS, CREST and LCH.Clearnet Ltd) under the UK Regulations implementing the EU Settlement Finality Directive.<sup>(4)</sup>

The signature and ratification of the Hague Securities Convention, concerning the identification of the relevant governing law for interests in securities held through financial intermediaries, is called for in Recommendation 15 ('advance legal certainty over rights to securities, cash or collateral'). The Financial Markets Law Committee also concluded that the Convention provides a workable solution to a significant issue of legal uncertainty in the

(1) Kerry, W (2004), 'Securities settlement systems: assessing their relative riskiness', *Financial Stability Review*, December, pages 93–98.

(2) A copy of this can be found at [www.bankofengland.co.uk/financialstability/mou.pdf](http://www.bankofengland.co.uk/financialstability/mou.pdf).

(3) For further information see the Press Release at [www.ecb.int/press/pr/date/2005/html/pr050518\\_1.en.html](http://www.ecb.int/press/pr/date/2005/html/pr050518_1.en.html).

(4) The Financial Markets and Insolvency (Settlement Finality) Regulations, 1999.

international financial markets, and that implementing it without delay would be of considerable benefit. The EU Legal Certainty Group is seeking to identify areas of legal uncertainty relating to the integration of EU securities clearing and settlement systems; one such area of interest is the harmonisation of substantive laws in relation to the holding and transfer of securities held through financial intermediaries. At a global level, UNIDROIT (the International Institute for the Unification of Private Law) is covering similar ground in its preliminary draft *Convention on Harmonised Substantive Rules regarding Intermediated Securities*.<sup>(1)</sup> The Bank is considering further work that could be undertaken in the legal area relating to this and other Recommendations.

As regards Recommendation 16 ('recognise and support improving valuation and closeout netting arrangements') the robustness of English law in the context of the default of a participant in a UK payment system, securities settlement system or central counterparty is further supported by the system's designation under the UK Regulations implementing the EU Settlement Finality Directive. In addition, the UK Regulations implementing the EU

Financial Collateral Directive have added express statutory provisions dealing with the legal enforceability and robustness of financial collateral arrangements that extend beyond the context of designated systems.

### Next steps

The Bank engages actively where issues raised by the G30 fall within its own areas of responsibility. Many of the Recommendations require action at an international level so, on these, the Bank looks forward to continued co-operation with all interested parties. The G30 Monitoring Committee is due to publish a final report in Spring 2006 that will indicate key areas where action is still necessary. It will be important for the public and private sectors to continue working together to address the key outstanding gaps and to monitor progress. Transparency will be crucial, so the Bank of England intends to provide further updates in future. We understand that other organisations, including the ECB, the IMF and the Hong Kong Monetary Authority, have indicated that they will consider producing similar updates and we hope that other countries will also be able to report on progress in relation to the risk recommendations.

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(1) A detailed description of the UNIDROIT project is set out in the Overview paper which, together with a preliminary draft of the Convention, released in June 2005, is available at [www.unidroit.org](http://www.unidroit.org).

## Box 1: Credit derivatives

The Bank has previously highlighted that growth of the credit derivatives market has not been matched by developments in back-office processing.<sup>(1)</sup> Firms that trade over-the-counter derivatives can become exposed to significant risks when business development runs ahead of infrastructure and documentation. Three issues in particular have attracted attention: confirmation backlogs, assignment backlogs and settlement problems.

### The problems

According to a survey by the International Swaps and Derivatives Association (ISDA), the average backlog of unconfirmed credit derivative transactions for major dealers was equivalent to 23.5 business days' worth of average trade volumes in 2004.<sup>(2)</sup> This confirmation backlog has been exacerbated by traders assigning their positions to a third party without obtaining consent from the original counterparty.<sup>(3)</sup> Since such assignments are not legally valid without consent of all three parties this creates legal risk; and by introducing uncertainty over counterparty exposures, it impairs credit risk management.

Settlement problems can arise when a credit default swap (CDS) or other structured credit product requires the protection buyer to deliver the underlying debt to the seller but the notional amount of outstanding CDSs is large relative to the total underlying amount of deliverable debt. When Delphi filed for bankruptcy on 8 October 2005, an estimated \$21 billion of protection had been written on Delphi bonds using single-name and index CDSs. This compares with \$2 billion of bonds outstanding.

### Regulatory actions

Problems with confirmation and assignment backlogs have been highlighted by regulators and industry groups: the UK FSA in February 2005 called for steps to tackle the level of outstanding confirmations in credit derivatives; and the Counterparty Risk Management Policy Group (a group of major market participants) in July 2005 also called for firms to address this backlog and to develop electronic trade

matching and confirmation generation systems. Progress was galvanised by a meeting arranged by the Federal Reserve Bank of New York (FRBNY) in September 2005 of 14 major firms and 14 financial services regulators, including the FSA. At this meeting, industry participants gave a commitment to targets and deadlines for reducing confirmation and assignment backlogs, and to make efforts to improve the settlement process.

### Market initiatives

A number of platforms now facilitate automated post-trade processing for credit derivatives.<sup>(4)</sup> However, there is still substantial room for improvement: according to the ISDA survey, automatic confirmations covered only 40% of credit derivative transactions in 2004.<sup>(5)</sup> ISDA launched, in late September, a Novation Protocol (agreed at the earlier FRBNY meeting) requiring either prior written consent of the remaining party, or an exchange of electronic communications, when a counterparty assigns its position to a third party. Over 2,000 firms, including all major dealers, hedge funds and investment managers, have now signed up to the protocol. Here regulatory pressure helped accelerate industry resolution of a collective action problem.

The settlement issue is being resolved through a combination of market innovations. First, companies such as TriOptima have offered a contract termination service that aggregates the multilateral exposures of participating customers and identifies offsetting positions that can be 'torn up'. Following Delphi's bankruptcy filing, TriOptima terminated early \$11.5 billion worth of single-name CDS protection, and index swaps with a Delphi component of approximately \$3.5 billion. Second, for index trades with Delphi as a reference name, a new ISDA protocol allowed parties to substitute cash settlement for physical settlement. The cash-settlement price was determined at an auction administered by Creditex and Markit in partnership with major credit derivative dealers. Ultimately such experiences may lead to a more widespread use of cash-settled CDS contracts.

(1) See the speech by Paul Tucker, 'Where are the risks?', in this Review. See also David Rule (2001), 'The credit derivatives market: its development and possible implications for financial stability', *Financial Stability Review*, June, pages 117–40.

(2) ISDA Operations Benchmarking Survey (2005).

(3) The Counterparty Risk Management Policy Group (July 2005) estimates that assignments account for 40% of total CDS trade volume.

(4) The Depository Trust and Clearing Corporation's Deriv/Serv confirmation service has recently been enhanced to allow automated processing of assignments.

(5) ISDA Operations Benchmarking Survey (2005).



## Box 2: Update on initiatives in the financial infrastructure

Issue	Significance	Progress
Bank of England provision of concentration bank services to LCH.Clearnet Ltd	<p>The payment arrangements through which LCH.Clearnet Ltd collects and disburses the margin funds its members must provide involve the concentration of funds on unsecured deposit. Transfer of the concentration bank role to the Bank of England removes any risk that the concentration bank might itself be unable to provide funds in a financial crisis.</p>	<p>Over the past two years, preparations have been made to transfer the role of concentration bank for sterling and euro payments to the Bank of England. This transfer took place on 29 September 2005. Following the completion of the concentration bank project, LCH.Clearnet Ltd has begun investigating ways of eliminating, or at least reducing, credit risk in the US dollar payment arrangements. For other currencies, the impact of potential disruption to concentration bank operations is not deemed sufficiently large for there to be a need to alter current arrangements.</p>
Foreign exchange settlement risk and CLS	<p>The CLS (Continuous Linked Settlement) system significantly reduces settlement risk in foreign exchange transactions.</p>	<p>CLS has been working with members to expand the scope of the risk-reduction and cost-saving benefits that it offers. In September 2005 it announced its intention to offer, subject to regulatory approval, services for the settlement of cash-flow positions for foreign exchange non-deliverable forwards and option premiums by 2007.</p>
Shorter clearing cycles	<p>The United Kingdom's three-day clearing cycle for the majority of both electronic and paper-based retail payments is longer than in most other G10 countries. In addition to benefits to bank customers, shorter clearing cycles would reduce the duration of exposures between settlement banks and so lower aggregate settlement risk.</p>	<p>An APACS-led Implementation Group has continued to work towards delivering a faster retail payment service, in response to recommendations made by the OFT-led Payment Systems Task Force in May.<sup>(1)</sup> The Implementation Group has agreed the new service will operate on a near real-time basis, with multiple same-day settlement. This in itself will significantly reduce settlement risk. Other risk-reducing functionality will also be included within the infrastructure for the new service.</p> <p>The Implementation Group will shortly report its progress to the Task Force. The new service is due to be operational from end-2007, at which time some payments from BACS and lower-value payments from CHAPS are expected to migrate to the new service. At this stage the scale of such migration remains unclear.</p>

(1) Available at: [www.ofg.gov.uk/Business/Payment+systems+task+force/default.htm](http://www.ofg.gov.uk/Business/Payment+systems+task+force/default.htm).

Issue	Significance	Progress
Capital requirements	<p>Bank capital requirements mitigate the moral hazard and externalities inherent in banking activities. It is hoped that one of the main benefits of the more risk-sensitive Basel II framework will be the strengthening of internationally active banks' risk management practices. Further, the new framework should reduce the distortions in banks' risk capital allocation induced by the Basel I framework.</p>	<p>On 30 September 2005 the US regulatory agencies announced a one-year delay in their Basel II domestic implementation plans. The earliest opportunity for US banks to operate under Basel II capital requirements will now be 1 January 2009 and the agencies will implement more conservative capital floors than those specified in the June 2004 Basel II text.</p> <p>In Europe, the Capital Requirements Directive (CRD), implementing Basel II, has been agreed by the Council of Ministers and the European Parliament and is expected to be formally adopted around April 2006. The simpler approaches will be available to EU banks from 1 January 2007 while the more sophisticated 'Advanced' approach will be available from 1 January 2008.</p> <p>The final Trading Book Review<sup>(2)</sup> text, covering the treatment of so-called 'double default' exposures and certain exposures arising from trading activities, was published by the Basel Committee on 18 July 2005, in collaboration with the International Organization of Securities Commissions.</p>
Crisis management preparation	<p>Preparations for dealing effectively with a financial crisis, in order to reduce the impact on the financial system and the wider economy, are of primary importance to the tripartite authorities in exercising their financial stability mandate.</p>	<p>The tripartite authorities have identified firm-specific information they would need to be able to respond to a financial crisis in a timely and effective manner. This information can be collectively thought of as a 'Factbook' on a firm. The authorities have access to much of this information already, but where there are gaps the authorities are asking the firms to provide a limited amount of additional information on a voluntary basis, both in advance of, and during, a crisis. On 17 October 2005 the FSA published proposals on 'Factbooks'<sup>(3)</sup> setting out the type of information that might be sought from firms.</p>

(2) Further details about the Trading Book Review can be found in the June 2005 *Review*, pages 80–81.

(3) Information needed on firms in a financial crisis, [www.fsa.gov.uk/pubs/other/factbooks.pdf](http://www.fsa.gov.uk/pubs/other/factbooks.pdf).

Issue	Significance	Progress
Preparations for major operational disruption	Financial sector preparations for dealing effectively with major operational disruption, caused for example by a terrorist attack or natural disaster, are vital in order to reduce the impact on the financial system and the wider economy.	Over 2005, the UK financial sector has been involved in the Resilience Benchmarking Project to measure their preparedness for a major operational disruption. A Discussion Paper highlighting the main results was published in December. In addition, on 28 November, the UK financial sector took part in a desk-based market-wide test of its preparedness to respond to a major crisis such as a terrorist attack. The exercise was organised by the tripartite authorities (Bank, HM Treasury and FSA) and involved the authorities themselves and some 80 organisations across the United Kingdom, including banks, insurers, payment and settlement systems and exchanges. The exercise was an opportunity to put into practice the crisis management arrangements put in place by the tripartite authorities, including the use of the <a href="http://fsc.gov.uk">fsc.gov.uk</a> website as a communications tool.
Supervision of multinational institutions	Ensuring effective and efficient arrangements for the supervision of cross-border institutions and infrastructure is central to managing potential risks as financial services markets become more integrated.	Within Europe, the CRD will set a statutory framework for a much-enhanced collaborative approach to the supervision of cross-border banking groups. To complement this, the Committee of European Banking Supervisors has proposed a practical model of co-operation between home and host supervisors, <sup>(4)</sup> which represents a proportionate and risk-based approach to supervisory co-operation. Within the framework set by the CRD, the extent of co-ordination, co-operation and information sharing will be influenced by the significance or systemic relevance of the entities, both within the group and in their local market(s). The emphasis on a risk-based approach is in line with the proposals set out in the tripartite paper on the EU financial services market, published in January 2005. <sup>(5)</sup>
Guarantee schemes	Guarantee scheme design is an important component of financial services policy: through their effect on consumer confidence, schemes can help to reduce the likelihood of crises. Guarantee scheme design can also affect market efficiency and competitiveness.	In October 2005 the tripartite authorities published a discussion paper <sup>(6)</sup> in response to the European Commission's consultation on the Deposit Guarantees Directive. The paper discusses the major policy challenges in Europe and proposes a framework for action comprised of: strengthening financial services supervision; designing appropriate guarantee schemes; and ensuring effective operation of guarantee schemes.

(4) Available at [www.c-ebis.org/Consultation\\_papers/CP09.htm](http://www.c-ebis.org/Consultation_papers/CP09.htm).

(5) Available at [www.bankofengland.co.uk/publications/other/europe/fsapjan05.pdf](http://www.bankofengland.co.uk/publications/other/europe/fsapjan05.pdf).

(6) Available at [www.hm-treasury.gov.uk/media/366/01/guarantee\\_schemes271005.pdf](http://www.hm-treasury.gov.uk/media/366/01/guarantee_schemes271005.pdf).



# The future of payments

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On 19–20 May 2005 the Bank hosted an international conference on ‘The future of payments’. The conference represented an opportunity for all professionals in the area — private sector participants, central bankers and academics — to identify the key issues for the future policy, research and operational agenda in the field. Papers presented at the conference demonstrated that the economics of payments lies at the intersection between mainstream monetary and banking theory and industrial organisation — and at the heart of central banking. This article reviews the key messages learned from the papers and discussions that took place during the conference.

**CENTRAL BANKS AROUND THE WORLD** generally share two core purposes: the preservation of monetary and financial stability.<sup>(1)</sup> To carry out these roles, central banks stand ready to supply the ultimate medium for settlement of payments — central bank money. In addition, many central banks, including the Bank of England, operate large-value payment systems, act as settlement agent for other payment systems and oversee the operations of private systems they view as systemically important. In other words, payment issues are at the core of central banking and have been since the inception of central banks. Understanding how payments will evolve is therefore crucial in identifying the key issues that will shape the future role of central banks in the payments arena.

To that end, on 19 and 20 May 2005 the Bank hosted an international conference on ‘The future of payments’. The conference was an opportunity for private sector participants, central bankers and academics to identify the key issues that will shape the future operational, policy and research agenda in the area of payments. It also sought to engage mainstream researchers in monetary economics, banking and finance and industrial organisation, in the area of payment economics.

A background paper by the Bank of England provided context for the conference.<sup>(2)</sup> This described the development of payment systems and central banking, arguing that, historically, they have been inextricably linked. It described current trends in the

environment within which payment systems operate and considered a selection of current public policy issues that follow from these trends. It concluded by offering some tentative ideas about the future direction of payment systems and of central bank involvement.

In the remainder of this article the key lessons learned from the conference are outlined. It discusses the core roles of a central bank in payment systems, explores current policy issues in payments, and takes a look at how payments may evolve in future.

## What is the role of a central bank in payment systems?

Ed Green (Pennsylvania State University) argued that a central bank’s role as monetary authority does not necessarily imply any role in payments.<sup>(3)</sup> But given that there is a role for some institution to stand at the apex of the banking system and to enact interbank settlement across its accounts, the central bank might well be best placed to take on this role. In performing this role, the central bank should stand ready to provide free credit in unlimited quantities for the purposes of making payments. But, Green argued, the central bank should not regulate payment arrangements, as it had a conflict of interest and would promote use of its own money over, for example, the liabilities of a private clearing house.

Against Green’s arguments for minimalist central bank involvement in payments systems, Morten Bech (Federal Reserve Bank of New York) argued that

(1) See the Bank’s 2005 *Annual Report* for a statement and a definition of the Bank’s twin core purposes — [www.bankofengland.co.uk/publications/annualreport/2005report.pdf](http://www.bankofengland.co.uk/publications/annualreport/2005report.pdf).

(2) A copy of this paper — and all the other papers discussed at the conference — can be found on the conference website: [www.bankofengland.co.uk/financialstability/futureofpayments/index.htm](http://www.bankofengland.co.uk/financialstability/futureofpayments/index.htm).

(3) Woodford (2003) argues that in theory a central bank can set interest rates without using its money as a settlement asset. See Woodford, M (2003), *Interest and prices: foundations of a theory of monetary policy*, Princeton University Press.

during periods of crisis — episodes of extreme financial instability — close involvement in payment systems would be useful to the central bank in discharging its role as a lender of last resort. In discussion, Charles Goodhart (formerly at the London School of Economics) argued that information on interbank settlement can assist the central bank in assessing risks to financial stability.

Jeffrey Lacker (Federal Reserve Bank of Richmond) agreed with Green's view that central banks should not own or operate payment systems. But he argued that the moral hazard implicit in the central bank's granting of credit for the purposes of making payments — particularly in a crisis — created the need for central banks to oversee payment systems, ie, assess risks in them and take steps to mitigate such risks. He also suggested that it was hard to see market failures that would justify public intervention in payment systems. On the other hand, Charles Freedman (Carleton University and former Deputy Governor of the Bank of Canada) argued that central bank intervention is justified by 'systemic risk' — the risk that the failure of a participant in the system could lead to multiple participant failures and/or the failure of the system itself — an externality and hence a market failure. This implied a need to oversee large-value payment systems, but not retail systems, where systemic risk is low. John Mohr (JPMorgan and former Chief Operating Officer of CHIPS) argued that the key role of central banks is to provide 'finality' in payments (a public good). Richard Pattinson (Barclays Bank) also argued that central banks needed to oversee payment systems, ie ensure good governance, continue efforts to reduce risk and generally lead the market towards the efficient outcome.

### Some current issues in payments policy

In supplying their money to the banking system, central banks typically make a distinction between lending overnight and intraday. They typically charge the policy rate for credit extended overnight, but charge little or nothing for credit extended within the day.<sup>(1)</sup> The historical reasons for this distinction lie in a policy choice to segment the implementation of monetary policy from lubrication of the payment system. This may ultimately stem from technological constraints on monitoring, and charging interest on,

intraday balance sheet positions. These constraints no longer bind. For example, current real-time gross settlement technology implies that there is nothing to prevent a central bank from charging interest within the day, if it so wished.

The paper by Matthew Willison, George Speight and Jing Yang (all Bank of England), co-authored with Morten Bech, explored the monetary and financial stability implications of a central bank increasing the frequency at which it imposes its policy rate, say, to twice per day. The paper argues that such a change would have no material impact on monetary policy implementation. The financial stability implications would not, however, be neutral. Assuming that banks passed on at least some of this charge to their customers, such customers would have an incentive to use intraday credit more efficiently, resulting in less credit risk within the system — a positive development from a financial stability perspective. However, the risk of payments not being made on time in the event of operational problems would increase as banks were more likely to delay payments if they were charged for borrowing. Which of these two effects dominated was an empirical question.

In applying prudential policies, regulatory authorities also typically make a distinction between intraday and overnight requirements. Capital requirements are applied on exposures measured at the end of the day. In addition, in the United Kingdom, UK-owned banks are required to hold a stock of liquid collateral for prudential reasons at the end of the day. During the day, these liquidity requirements do not bind, however, as long as the collateral is used to obtain liquidity from the Bank for payment purposes. Jean Charles Rochet (University of Toulouse) analysed the rationale for this distinction within a paper that explored the broader rationale and design of prudential liquidity policy. Rochet suggested that liquidity should be regulated for two reasons: micro-prudential externalities arising from information asymmetries between depositors and bank owners and macro-prudential externalities arising from common shocks hitting the system. In evaluating the costs and benefits of any prudential liquidity regime, the authorities needed to take into account the costs to the banking system of holding liquidity during normal times. Other things being

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(1) Most central banks charge a 0% rate for credit extended within the day. An exception is the Federal Reserve, which charges a small fee for overdrafts incurred within the day.

equal, these costs are larger when banks settle their large-value payments in a real-time gross settlement system (RTGS) than in a net settlement system. A sufficiently large increase in these costs may deter bank participation in such a system, thereby increasing systemic settlement risk.

The potential systemic risks arising from the small number of 'first-tier' banks participating in the UK large-value payment system were highlighted by the International Monetary Fund (IMF) in their 2003 Financial System Stability Assessment of the United Kingdom.<sup>(1)</sup> Will Roberds (Federal Reserve Bank of Atlanta) and Charles Kahn (University of Illinois) tackled the formal analytics of such tiered payment structures. Their key finding is that a tiered system can improve social welfare relative to a non-tiered system, by improving monitoring of potentially unreliable participants. This means that there could be a rationale for limiting access to both private and public payment systems. Settlement in central bank money within public payment systems can improve welfare under certain circumstances, however, especially in periods of crisis. Martin Andersson (Sveriges Riksbank) highlighted contagion risk arising from the intraday credit lines first-tier banks extend to second-tier banks as a further argument against a tiered payment structure.<sup>(2)</sup>

### The future of payments

Harry Leinonen (Bank of Finland) proposed extending the decentralised network concept of the internet to payments. In Leinonen's world, person-to-person payments would be made in real time with central bank money 24 hours a day, seven days a week — that is, settlement would be continuous and decentralised. But payment providers had little interest in changing current payment services and the provision of payment services is often restricted via regulation, Leinonen argued. To speed up change, Leinonen suggested that the regulatory authorities act as a catalyst.

John Mohr agreed with this vision, arguing that past developments in payments had resulted from the balance between competition and co-operation in the banking industry. This balance meant that the payments industry was always moving towards the

efficient outcome, if not necessarily at the right speed. Richard Pattinson thought we were already in a real-time payments world in which large-value payment systems were interconnected, with the Continuous Linked Settlement (CLS) system (which links the RTGS systems of all major currencies) at the centrepiece of this world. This interconnectedness had led to a large 'risk balloon' developing. While settlement risk had largely been eliminated, it had simply been translated into liquidity risk and operational risk elsewhere in the system.

George Selgin (University of Georgia) argued that central banks were at the top of the payments pyramid as a result of monopoly privileges granted by the government. These act as a barrier to entry for private money providers. Increased private sector innovation would lead to a diminished but continuing role for central banks. Charles Goodhart pointed out that one cannot really separate government from central banks. He agreed that the demand for central bank money will not fall to zero as, unlike private providers, the central bank does not maximise profits and (with government support) can survive even if seigniorage revenue falls.

Stefan Schmitz (University of Vienna) discussed central banks and electronic money. He argued that central banking will survive electronic money, since users and issuers of e-money face strong disincentives to switch from an established generally accepted medium of exchange and uniform unit of account — central bank money. Randy Wright (University of Pennsylvania) presented a model of paper money and e-money, focusing on the safety of the two types of media of exchange: paper money is not safe (as it can be stolen) while e-money was assumed to be safe.<sup>(3)</sup> The general discussion brought out the point that the definition of e-money matters: Schmitz was using e-money to mean instruments like 'stored-value cards' that are no safer than cash, whereas Wright's model was one of credit/debit cards.

Charles Freedman said that he did not think that e-money was likely to be a practical threat to central banks in the near future. Like all previous changes in payment systems, the advent of e-money will necessitate changes in monetary policy

(1) See also the 'Strengthening financial infrastructure' article of the December 2004 issue of the *Review*, and Chapter 4 of the Bank of England *Payment System Oversight Report 2004* at [www.bankofengland.co.uk/publications/psor/psor2004.pdf](http://www.bankofengland.co.uk/publications/psor/psor2004.pdf).

(2) The article by Sally Harrison, Ana Lasoosa and Merxe Tudela in this *Review* analyses this issue in detail.

(3) Wright employed a 'search-theoretic' approach to modelling payments. Alternative approaches were used in papers presented by Neil Wallace (Pennsylvania State University) and Jamie McAndrews (Federal Reserve Bank of New York).

implementation, but will not fundamentally affect the ability of the central bank to carry it out.

#### **Where next?**

The conference has helped inform the Bank's public policy and research agenda in the payments field. In

addition, the conference papers and discussions, which are posted on the conference website, may hopefully stimulate further work in the payments arena and promote greater interaction among academics, practitioners and public policymakers in the field.



# Tiering in UK payment systems: credit risk implications

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This article employs a credit risk framework, calibrated using survey data collected by the Bank of England, to analyse the potential credit risk to settlement banks arising from the tiered structure of the large-value payment systems in the United Kingdom. The results suggest that the direct credit exposures arising from this structure, although sizable in absolute terms, do not pose undue risk in normal circumstances. The model framework abstracts from the risks to second-tier banks that could arise from changes in the behaviour of first-tier banks in periods of stress. Anecdotal evidence suggests that these risks could be significant. Direct membership of the large-value payment system or contingency clearing arrangements between second-tier and first-tier banks can both go some way towards mitigating these risks.

## Introduction

**IN THEIR 2003 FINANCIAL SYSTEM STABILITY ASSESSMENT OF THE UNITED KINGDOM,**<sup>(1)</sup> the International Monetary Fund (IMF) highlighted the potential risks arising from the highly tiered structure of the UK large-value payment systems — CHAPS and the embedded payment system in CREST. In these systems, a few member banks ('first-tier' or 'settlement' banks) settle directly at the central bank and a larger number of customer banks ('second-tier' banks) process their payments through the direct members. The IMF drew attention to the exposures arising between the first-tier and second-tier institutions and the potential for contagion risk, that is, the risk that credit problems in a second-tier bank might spill over to first-tier banks. Their assessment was that the tiered structure of the UK payment system may result in significant intraday exposures between direct and indirect members of the payment system.

Since the IMF assessment was published, the Bank has analysed the risks arising from tiering in UK payment systems and reported on its findings in the 'Strengthening financial infrastructure' article of the December 2004 *Financial Stability Review*<sup>(2)</sup> and in the 2004 *Payment Systems Oversight Report*.<sup>(3)</sup>

The Bank's analysis suggests that tiering in payment systems introduces several types of potential risk compared with a structure in which all banks with significant sterling payments flows are settlement members. These include: a greater risk of operational incidents at a settlement bank leading to disruption of payments throughout the financial system; a larger risk of settlement banks running into liquidity problems arising from the need to make payments on behalf of their customer banks; potentially, a lesser degree of finality in payments since internalised payments<sup>(4)</sup> are not covered by the Settlement Finality Directive; and greater credit exposures between first and second-tier banks.

This article concentrates on credit risk. It proposes a framework to assess the credit risk exposures of first-tier banks arising from the overdraft facilities extended to their customer banks to facilitate settlement of transactions. The framework neither evaluates other risks resulting from a tiered structure, nor analyses the benefits that a tiered structure offers.

For example, one potential risk-related benefit from tiering is the increase in monitoring by first-tier banks of the financial position of second-tier banks. Kahn and Roberds (2005)<sup>(5)</sup> argue that tiering increases the

(1) Available at [www.imf.org/external/pubs/ft/scr/2003/cr0346.pdf](http://www.imf.org/external/pubs/ft/scr/2003/cr0346.pdf).

(2) Available at [www.bankofengland.co.uk/publications/fsr/2004/fsr17art4](http://www.bankofengland.co.uk/publications/fsr/2004/fsr17art4).

(3) Available at [www.bankofengland.co.uk/publications/psor/psor2004](http://www.bankofengland.co.uk/publications/psor/psor2004).

(4) Payments made between customer banks of the same settlement bank and settled internally across the settlement bank's books without being forwarded to the payment system.

(5) Kahn, C M and Roberds, W (2005), 'Payments settlement: tiering in private and public systems', April 2005, University of Illinois and Federal Reserve Bank of Atlanta, presented at the Bank of England conference on 'The Future of Payments', available at [www.bankofengland.co.uk/financialstability/futureofpayments/kahnroberdsBOE.pdf](http://www.bankofengland.co.uk/financialstability/futureofpayments/kahnroberdsBOE.pdf).

level of monitoring by first-tier banks and reduces the incentive to default by second-tier banks. If a second-tier bank proves itself to be unreliable (in the sense of not fulfilling its credit commitments), it will be required to collateralise fully its payment activity at an additional cost. If it is reliable, it only needs to be monitored. Hence, the first-tier bank has an incentive to monitor efficiently and the second-tier bank has an incentive to behave reliably.

However, in the United Kingdom market intelligence suggests that the majority of CHAPS and CREST first-tier banks do not monitor the usage of customer credit limits intraday as a matter of course, until the limits are hit. At the same time, given that capital and liquidity regulations do not apply intraday, regulators do not tend to monitor intraday exposures either. Banks do of course undertake regular credit analysis of counterparty banks when setting and reviewing credit limits. But given that this analysis is similar to that conducted for longer-term exposures to the same banks, it does not appear that tiering in itself has a significant positive effect on interbank monitoring.

In the next section, the tiered structure of the two main high-value payment systems in the United Kingdom — CHAPS Sterling (the United Kingdom's large-value interbank payment system) and the embedded payment arrangements supporting CREST (the settlement system for many UK-issued securities) is explained briefly. This is followed by a description of the theoretical framework used to compare credit risks arising from tiered and non-tiered structures and an explanation of how the model is calibrated to derive a measure of credit risk. The article goes on to examine how the balance of risks may change during times of financial stress. It concludes with an overall assessment of the risks stemming from the tiered structure of the main large-value payment systems in the United Kingdom.

### Tiering in UK large-value payment systems

#### CHAPS Sterling

As discussed in the December 2004 *Review*, CHAPS Sterling is highly tiered. There are 14 CHAPS Sterling

settlement members, including the Bank.<sup>(1)</sup> This is a small number relative to the number of UK-resident banks (around 340)<sup>(2)</sup> and also relative to the structure in other countries (Table A).<sup>(3)</sup> Survey evidence<sup>(4)</sup> indicates that more than half of the approximately £200 billion of average daily payments settled in CHAPS in 2003 were made on behalf of other customer banks. Another £60 billion of daily payments were made between customer banks of the same settlement bank and settled internally across the settlement bank's books without being sent to CHAPS.

**Table A**  
Settlement banks in large-value payment systems

Country	System name	Number of settlement banks <sup>(a)</sup>
United Kingdom	CHAPS Sterling	14
Belgium	ELLIPS	16
Canada	LVTS	14
France	TBF	156
	PNS	21
Germany	RTGS Plus	93
Japan	BOJ-NET	371
Netherlands	TOP	106
Sweden	E-RIX	13
	K-RIX	19
United States	Fedwire	7,736

Source: Committee on Payment and Settlement Systems (CPSS) Statistics on payment and settlement systems in selected countries (2005).

(a) Includes central banks. Data for 2003, except United Kingdom where data relate to 2005.

#### CREST Sterling

CREST acts as both a central securities depository and a securities settlement system. Transactions processed through CREST are on a 'delivery-versus-payment' basis — that is, securities and funds are transferred simultaneously. CREST Sterling settlement generates interbank transfers of around £300 billion each day, which is greater than the daily turnover in CHAPS Sterling. On the payments side of CREST, there is significant tiering between the 14 CREST settlement banks that have accounts at the Bank and the 2,300 corporate and financial institutions with cash memorandum accounts.<sup>(5)</sup> Transactions between CREST members who share the same settlement bank can be internalised by that settlement bank and if so will not result in any account transfers across the real-time gross settlement (RTGS) payment system. The value

(1) Counting National Westminster Bank and the Royal Bank of Scotland as two separate members.

(2) Although it is important to note that many of these have little or no sterling business, given London's role as an international financial centre.

(3) As noted in the December 2004 *Review*, in some countries banks with direct access to large-value payment systems use other settlement banks rather than their own central bank accounts to make payments, implying that the figures in the table understate the degree of tiering in those countries.

(4) Based on a survey of CHAPS Sterling and Euro settlement banks conducted by the Bank of England as part of a European System of Central Banks (ESCB) initiative. The sample period covered ten days in September 2003. Five settlement banks participated in the survey, accounting for about 70% of payments by value in CHAPS Sterling.

(5) There is potentially an additional layer of tiering between the banks settling in the embedded payment system and CHAPS member banks. This second layer, however, is unimportant in practice because only one bank is a CREST Sterling settlement bank and not a CHAPS Sterling settlement bank.

of these internalised transactions is estimated to be as high as £30–£40 billion per day.

A comparison with securities settlement systems in other G10 countries reveals that the number of settlement banks in CREST Sterling is among the lowest (Table B). On the face of it, this would suggest a significant degree of tiering by international standards. However, the number of settlement banks is not always an accurate indication of the degree of tiering. This is the case, for example, in the highly tiered market for settlement of government bonds in the United States. All the major participants in the US government securities markets depend critically on two commercial banks (the ‘clearing’ banks) to settle their trades and to facilitate financing of their positions. It is hard to draw definitive conclusions about the degree of tiering in the payment systems of other countries from the raw data.

**Table B**  
**Settlement banks in securities settlement systems**

Country	System name	Number of settlement banks <sup>(a)</sup>
United Kingdom	CREST Sterling	15
Belgium	NBB	109
	CIK	93
Canada	CDS	6
France	Euroclear France	330
Germany	Clearstream Germany	411
Japan	JASDEC	275
Netherlands	Euroclear Netherlands	80
Sweden	VPC	44
United States	DTC	436
	Fedwire Securities	9,100

Source: CPSS Statistics on payment and settlement systems in selected countries (2005).  
(a) Includes central banks. Data for 2003, except Fedwire Securities and CREST Sterling where data relate to 2005.

### A framework for understanding the credit risk effects of tiering in payment systems

To assess the effect on credit risk from tiering in UK payment systems, we use a model that compares the change in the distribution of credit losses incurred by a bank that moves from only processing payments on behalf of its own customers (‘no tiering’ scenario) to carrying out correspondent business on behalf of second-tier banks (‘tiering’ scenario). In the tiering scenario, consistent with our survey evidence, we assume that first-tier banks extend unsecured intraday credit to second-tier banks to facilitate correspondent business.

The model is based on the standard credit risk framework developed by Vasicek (1987)<sup>(1)</sup> and extended by Greenberg, O’Kane and Schlögl (2004).<sup>(2)</sup> It models the ‘core portfolio’ of a representative first-tier bank as a homogeneous portfolio consisting of many assets — all loans to customers, other than those that represent correspondent business with second-tier banks — and a ‘clearing portfolio’ that consists of a single asset that represents the unsecured intraday credit the settlement bank extends to its second-tier bank to facilitate settlement. All non-settlement-related exposures of first-tier banks to second-tier banks are assumed to be in the core portfolio. This enables us to concentrate on the marginal increase in a settlement bank’s expected losses resulting from it providing settlement services to a second-tier bank. Previous work at the Bank<sup>(3)</sup> examined interbank exposures more generally but, in that work, intraday exposures were not included. Our paper helps fill this gap. In the ‘no tiering’ scenario the entire portfolio consists of core exposures, but the size of the total portfolio is assumed to be the same in the ‘tiering’ and ‘no tiering’ scenarios.

In the ‘no tiering’ scenario the expected loss to the settlement bank is therefore given by the loss on the core portfolio only. This loss depends on: (i) the return on each asset within the core portfolio; (ii) the probability of default of each asset (each of the homogenous assets defaults if its return falls below a defined default threshold); and (iii) the loss given default (or recovery rate). The return on each asset in the core portfolio is assumed to be normally distributed with a systematic component that depends on the market return (and is determined by the correlation of the asset return with the market return)<sup>(4)</sup> and an asset-specific (idiosyncratic) component. The annex provides a technical description.

In the ‘tiering’ scenario, the expected loss to the settlement bank is the sum of the expected loss on the core portfolio and the expected loss on the clearing portfolio. The expected loss on the clearing portfolio is a function of: (i) the return on the clearing portfolio (where the single asset in the clearing portfolio comprises systematic and

(1) Vasicek, O (1987), ‘Probability of loss on loan portfolio’, *Working Paper*, KMV Corporation.

(2) Greenberg, A, O’Kane, D and Schlögl, L (2004), ‘LH<sup>+</sup>: A fast analytical model for CDO hedging and risk management’, *Fixed Income Quantitative Credit Research*, Lehman Brothers.

(3) Wells, S (2002), ‘UK interbank exposures: systemic risk implications’, *Financial Stability Review*, December, pages 175–82.

(4) Applying the law of large numbers, this correlation will be the same for all assets in the core portfolio.

idiosyncratic parts, similar to the return on the core portfolio assets); (ii) the probability of default of the clearing portfolio; and (iii) the loss given default of the clearing portfolio.<sup>(1)</sup>

Given these assumptions, we can calculate, for each scenario, the probability of the loss exceeding a given level. We take that threshold to be the Tier 1 capital ratio of the bank.<sup>(2)</sup> The market return is the systematic driver of default across the portfolio: high values of the market return factor translate into small losses on the core portfolio. Integrating over the market return, we are able to compute, for each scenario, the probability of the portfolio loss exceeding any threshold and hence generate the whole distribution of losses by the bank.

### Calibrating this risk framework to UK financial infrastructures

Survey evidence suggests that CHAPS settlement banks typically manage their unsecured intraday overdraft facilities to their customer banks using credit limits. Credit limits are a function of each customer bank's payments profile and credit rating. When the limit is reached, the settlement bank will not process any more payments until the overdraft is reduced or the settlement bank's risk department authorises an increase in credit limit. There are some exceptions where the settlement bank requires its correspondent customer bank to collateralise its overdraft entirely. For example, settlement banks do not usually extend unsecured overdraft facilities to smaller or less creditworthy customers.

We use data collected from a survey of CHAPS and CREST settlement banks to estimate an upper bound on the use of banks' credit limits. In particular, we have data on the maximum intraday credit extended to each of the three largest customer banks of each of the CHAPS Sterling settlement banks that responded to the survey. We also have data on the value of payments business with those same customer banks. Assuming that the maximum credit extended to all other correspondent clients as a percentage of their payments business is similar, we can obtain an upper bound for intraday exposures for each of the settlement banks. This assumption means that we are

probably overestimating the overdraft that settlement banks extend to their customer banks, in the sense that a settlement bank is likely to extend a larger overdraft per pound of payment business to a large customer than to smaller customer.

Expressing this exposure as a percentage of the total assets of each settlement bank, we estimate an upper bound for the proportion of the total portfolio of a representative settlement bank dedicated to the clearing portfolio (ie, the usage of the credit limits). Our estimates for this proportion range between 0.1% and 5.2% of the banks' assets, with a mean of 2.1%. The credit limits as a proportion of total assets are estimated to be between 0.1% and 10.4%, with a mean value of 5.9%.

As with CHAPS, CREST settlement banks provide intraday credit to their customer banks to facilitate settlement. But unlike CHAPS, typically part of that credit is collateralised. The exposures incurred by settlement banks are managed through separate (secured and unsecured) 'debit caps' or credit limits for each customer bank, with some of the less creditworthy customer banks only being granted secured credit. The centralised management of credit limits is another difference between CREST and CHAPS. Settlement banks inform CREST of their credit limits with each customer bank and CREST ensures that no transactions take place if this limit is breached. Additionally, eligible transactions in CREST automatically generate intraday liquidity through the self-collateralised repo mechanism (SCR).<sup>(3)</sup> Given that SCRs imply virtually no risk for settlement banks, they do not count towards debit caps.

Assuming that settlement banks require sufficient collateral and apply adequate margins to cover the secured part of their credit to customer banks for settlement business, we focus on the size of the unsecured part of that exposure. We have data on the relative size of the unsecured credit limits for eight of the 15 CREST settlement banks. These caps range from 1.6% to 6% of the banks' total assets, with an average of 4.1% — lower than the unsecured credit limits in CHAPS Sterling. We have very limited information on the utilisation rate of these credit

(1) In the limit of a large core portfolio, the model assumes that there is a proportion of the homogenous portfolio that always defaults. The default probability of the core portfolio is equal to this proportion.

(2) Tier 1 capital consists predominantly of shareholders' equity plus irredeemable and non-cumulative preference shares.

(3) The SCR mechanism generates back-to-back intraday repo transactions between CREST members and their settlement banks and then between settlement banks and the Bank.

limits, but we know that the secured line is normally used first and that it represents between 21% and 85% of total credit facilities, with an average of around 50%. With this information we are able to estimate that the unsecured overdrafts settlement banks extend to their customers range between 0.2% and 3.2% of the banks' total assets, with an average of 1.2% in normal circumstances.<sup>(1)</sup>

Some settlement banks allocate credit limits on a counterparty, rather than system, basis. That is, overdraft limits for CHAPS, CREST and any other business must not exceed an 'umbrella' limit for a particular counterparty. Within this total limit, there can be some flexibility in the sub-limits for CREST and CHAPS. Given this and the fact that there is a high degree of overlap between membership in CHAPS Sterling and CREST, we take the overdraft limits and their utilisation for CHAPS and CREST together and then express them as a percentage of the bank's total assets. The average figure calculated this way is 3.5%,<sup>(2)</sup> based on the assumption that the clearing portfolio includes settlement of payments and securities and that all other business is included in the core portfolio of a representative settlement bank. As noted above, this figure gives an upper bound estimate of the overdraft that settlement banks extend to second-tier banks to facilitate settlement of payments and securities for two reasons: (i) we assume that exposures to all second-tier banks are in line with those to the three largest customer banks; and (ii) all overdrafts are assumed to be drawn simultaneously by second-tier banks. Both assumptions would be unlikely to hold in most circumstances. In particular, it is unlikely that all customer banks of a settlement bank would be overdrawn at the same time, given the fact that one bank's outgoing payments are another bank's incoming payments.

Recovery rates depend on the type of credit (secured or unsecured), and on the amount of monitoring

carried out by settlement banks on their normal business (core portfolio) and second-tier customers (clearing portfolio). Davydenko and Franks (2005)<sup>(3)</sup> find that, for a sample of 1,405 UK defaulted businesses between 1996 and 2003, the average recovery rate was 74%.<sup>(4)</sup> We use this figure as the recovery rate on the core portfolio in our model, since it includes a mix of secured and unsecured exposures. The same study finds that the average recovery rate for unsecured loans was 58%, for UK business. We use this figure as the recovery rate on the clearing portfolio, since it consists of the unsecured credit lines that settlement banks extend to their customer banks to facilitate settlement.<sup>(5)</sup>

To estimate the probabilities of default of assets, we use default probabilities inferred from equity prices and credit ratings for a sample of settlement banks.<sup>(6)</sup> We estimate a probability of failure over a one-year horizon for the core and clearing portfolios of 0.2%. Note again that all diversification benefits are captured in the probability of default for the core portfolio; we are concerned with the marginal contribution to a settlement bank's expected losses of its clearing portfolio.

To estimate the correlation of the core portfolio return with the market return, and of the clearing portfolio with the market return, we use information on equity prices of settlement banks and second-tier banks and the FTSE All-Share index. We define returns as daily percentage changes of equity prices.<sup>(7)</sup> We then calculate the correlation of the returns for each individual bank with the market return. To estimate the correlation of the core portfolio with the market return we take a simple average of the correlation of the return of each settlement bank with that of the market. This gives an estimate of 0.71. For the correlation of the return of the single asset in the clearing portfolio with the market return, we use an average of the correlation of second-tier banks' returns with the market return,<sup>(8)</sup>

(1) Specifically, we assume that the utilisation rate of the credit limits for those banks for which we do not have any information is an average of the utilisation rates of the banks for which we have data. We apply this utilisation rate to the credit limits set by settlement banks and then assume, according to evidence, that secured lines are used first; only the excess over the secured credit limit is considered unsecured credit extended to second-tier banks to facilitate settlement. These estimates, as said in the text, range between 0.2% and 3.2% of the settlement bank's total assets.

(2) This figure does not lie between the 2.1% CHAPS figure and the 1.2% CREST figure because those banks that extend the biggest overdrafts for CHAPS-related business do not necessarily coincide with the ones that extend the biggest overdrafts for CREST-related business.

(3) Davydenko, S A and Franks, J R (2005), 'Do bankruptcy codes matter? A study of defaults in France, Germany, and the United Kingdom', *mimeo*, University of Toronto and London Business School (see [www.rotman.utoronto.ca/Davydenko/Bankruptcy.pdf](http://www.rotman.utoronto.ca/Davydenko/Bankruptcy.pdf)).

(4) The recovery rate is one minus the ratio of total write-offs for the firms expressed as a proportion of exposure at the point of default.

(5) Note that these recovery rates correspond to all UK businesses rather than merely to financial institutions.

(6) The probabilities were generated by a structural credit risk model specifically tailored to incorporate key features of a bank's balance sheet. We do not have equity-based default probabilities for all UK banks.

(7) Other frequencies, such as weekly, have also been used as robustness checks.

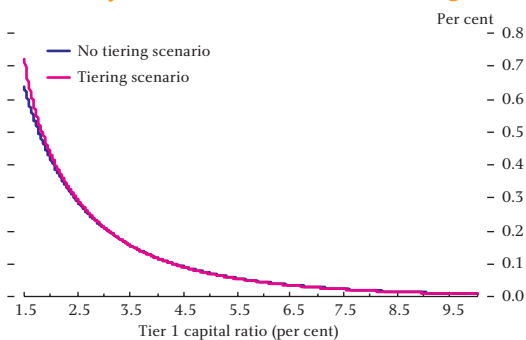
(8) Subject to data availability.

which is estimated to be 0.50. We use these estimates in calibrating our benchmark model.

### Results from the calibration

Chart 1 shows first-tier banks' portfolio loss distribution in the 'tiering' and 'no tiering' scenarios. Tiering does not have a significant effect on the default probability of first-tier banks. This is because the exposures from clearing on behalf of other banks represent only a small proportion of their total credit exposure. If a settlement bank has at least a Tier 1 capital ratio of 2.5%, the probability of its loss exceeding capital is the same regardless of whether this settlement bank has a tiering portfolio or not. The Basel II Capital Adequacy Framework requires that banks hold Tier 1 capital equivalent to at least 4% of their risk-weighted assets. In practice, all UK settlement banks have Tier 1 capital ratios of between 6% and 12%.<sup>(1)</sup>

**Chart 1**  
Probability of default of first-tier bank against capital<sup>(a)</sup>



Source: Bank calculations.  
(a) The parameters used to calibrate the model are those stated in the main text for the benchmark model. The 'no tiering' scenario attaches a zero weight to the clearing portfolio in the total portfolio.

Taking each system in isolation, the risks arising from the tiered structure of CHAPS Sterling are greater than those arising from the structure of the embedded payment arrangements in CREST Sterling. However, given the small size of unsecured exposures of first-tier banks to second-tier banks relative to Tier 1 capital, the risks from tiering are not severe enough in either system to increase substantially the likelihood of default of a first-tier bank in normal circumstances.

We conducted sensitivity tests on the benchmark model. The probabilities of default of first-tier banks were robust to changes in both the weight of the

clearing portfolio in the first-tier bank's total portfolio and the recovery rate on the clearing portfolio.

### Risks from a tiered payment system structure in stressed circumstances

This section examines how the risks to first-tier banks might change in stressed circumstances. We assume that a stressed situation involves an unexpected increase in the probability of default of the second-tier banks of a representative settlement bank, which would also have direct implications for the probability of default of the core portfolio.<sup>(2)</sup> As a consequence, this set of second-tier banks face larger outflows than normal from other banks and from non-bank depositors. This implies that second-tier banks are required to make larger outgoing payments via their settlement bank and may need to utilise all their credit limits.

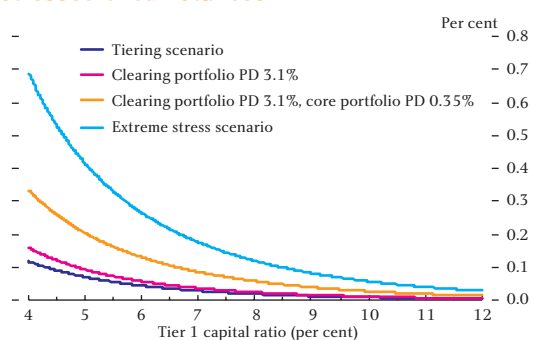
The first-tier bank could respond to the shock in two ways. First, it could extend additional credit to the second-tier bank in the belief that its difficulties are temporary. In that case, the extra credit might help keep the second-tier bank afloat and increase the likelihood of recovery of the whole of the loan. Second, the first-tier bank could immediately cut the intraday credit it extends to the second-tier bank in order to minimise its own losses. In our framework, the first option would mean increasing the portfolio weight of the first-tier bank's clearing portfolio. The second option would mean reducing that portfolio weight.

Chart 2 shows how the default probability of the first-tier bank changes with the probability of default of the clearing portfolio (associated with the probability of default of the second-tier banks), the probability of default of the core portfolio, the overdraft extended to second-tier banks and the loss on the clearing portfolio. Any increase in the probability of default of second-tier banks will also increase the probability of default of the core portfolio, due to other non-settlement-related interbank exposures with the same banks. Equally, a shock that simultaneously affects several second-tier banks is also likely to affect non-bank obligors in the core portfolio, also increasing the probability of default of the core portfolio.

(1) See Box 7, page 68, of the December 2004 *Financial Stability Review*.

(2) Since we examine the effects on a representative settlement bank and second-tier banks normally bank with one settlement bank, we only need to assess the impact of shocks to this settlement bank's customer banks, and not all second-tier banks.

**Chart 2**  
**Probability of default of first-tier bank given capital in stressed circumstances<sup>(a)</sup>**



Source: Bank calculations.

(a) PD is probability of default. The assumptions for the extreme stress scenario are: PDs of the clearing and core portfolio of 5% and 0.5% respectively, and the tiering portfolio represents 5% of settlement bank total assets.

For a 4% Tier 1 capital ratio (well below the observed Tier 1 capital ratios of between 6% and 12%) and for probabilities of default of the clearing portfolio ranging from 0.2% (benchmark model) to 3.1% (equivalent to a B rating according to Moody's), the probability of loss to first-tier bank exceeding capital varies from 0.12% to 0.16%. This probability increases to 0.33% if the probability of default of the core portfolio also rises, from 0.2% to 0.35% (equivalent to an A Moody's rating). If there is a further increase in the probabilities of default of the clearing portfolio to 5% (equivalent to a credit rating of C) and of the core portfolio to 0.5% (equivalent to a credit rating of between A and Baa), and customer banks reach their credit limits (equivalent to the clearing portfolio representing 5% of the total portfolio), the probability of default of the representative settlement bank would be of 0.69% (given a Tier 1 capital ratio of 4%).

Moody's Investors Service rates those companies with a probability of default of 0.36% or less as A to Aaa, of 0.36% to 0.75% as Baa, and of 0.75% to 2.23% as Ba. This implies that, in the extreme stress scenario described above, the credit rating of a first-tier bank could fall to the investment-grade boundary. But it needs to be emphasised that the stress scenario is based on a set of assumptions that have never been realised in practice.

The framework captures the direct credit risk to the first-tier bank, but the effect on the second-tier bank from a stressed situation is not considered. For example, survey evidence suggests that settlement banks may respond to information about a customer bank facing liquidity problems by temporarily cutting

credit lines. Such a response, although rational from an individual bank's perspective, could exacerbate any temporary liquidity problem faced by the customer bank and, under certain circumstances, turn a liquidity problem into a credit problem.

The decision of the first-tier bank is likely to depend on the amount of information it has about the second-tier bank's solvency, the amount of extra credit needed, and whether the second-tier bank has alternative access to intraday funding. To mitigate the risk of insufficient intraday credit, the second-tier bank could establish contingency arrangements enabling intraday credit to be extended by two or more settlement banks. This would also help reduce operational risk in the event of an operational disruption at the second-tier bank's settlement bank.

Access to intraday credit by a second-tier bank can, of course, be guaranteed by becoming a direct member of the payment system, albeit with the credit then needing to be fully collateralised. This may be particularly valuable to large complex financial institutions operating in sterling markets, in which liquidity pressures might arise quickly due to market movements, especially during financially stressed situations.

## Conclusion

In normal market conditions, the risks to first-tier banks from their credit exposures to second-tier banks appear to be low. The maximum exposures to second-tier banks are small relative to the capital of first-tier banks, and these limits cannot typically be breached or extended without prior authorisation. Under certain extreme assumptions, however, it can be shown that a substantial increase in the credit risk of second-tier banks, combined with an increase in the utilisation of intraday settlement credit limits and the probability of default of the core portfolio, can lead to a significant increase in the credit risk faced by the settlement bank.

The framework employed here focuses on the direct effects of tiering on the credit risk of first-tier banks; it does not capture possible second-round reactions. For example, the optimal reaction of a first-tier bank to a liquidity crisis might be to reduce credit lines to second-tier banks, thereby exacerbating the initial shock and potentially spilling over to the market as a whole.

Direct membership of the large-value payment system or contingency arrangements between second-tier banks and first-tier banks may go some way towards mitigating this risk. The Bank is currently supporting efforts on both these fronts.



## Annex 1: Using the LH<sup>+</sup> model for understanding the effects of tiering in payment systems

We use the LH<sup>+</sup> model of Greenberg, O’Kane and Schlögl (2004) to analyse the tiered structure of UK payment systems. We identify the homogenous portfolio in the LH<sup>+</sup> model as the normal business of a settlement (first-tier) bank, and the single asset as the intraday uncollateralised credit that first-tier banks extend to their customers (second-tier banks) for the provision of payments services. The focus is on the effect on the loss distribution of first-tier banks of extending that intraday credit to second-tier banks (not on the change in the loss distribution of second-tier banks or on the banking system as a whole). In explaining the model and our application to UK payment systems, we follow closely Greenberg, O’Kane and Schlögl (2004).

Consider a first-tier bank with a portfolio  $H$  consisting of a set of homogenous assets, with an average default probability  $p$  and recovery rate  $R$ . Each of these homogeneous assets defaults if its return falls below the default threshold  $C$  as given by  $C = \Phi^{-1}(p)$ , where  $\Phi$  denotes the standard normal distribution function. Let  $Z$  represent the market factor return and  $\beta$  the correlation of the portfolio of homogenous assets with the market return. In addition, consider a single asset with similarly defined characteristics  $R_0$ ,  $p_0$  and  $\beta_0$ , which defaults if its return falls below the implied threshold  $C_0 = \Phi^{-1}(p_0)$ . This asset represents the intraday credit that the first-tier bank extends to its second-tier banks to facilitate payments. We assume this is a proportion  $\alpha$  of the total settlement bank’s portfolio;  $(1-\alpha)$  is, therefore, the proportion of the homogenous part of the settlement bank’s portfolio. If the settlement bank chooses to grant credit to second-tier banks (tiering case),  $\alpha$  is greater than zero; otherwise,  $\alpha$  is zero and all is invested in the homogenous part (‘no tiering’ case).

In the limit, as the number of assets in the homogenous part of the portfolio becomes very large, the law of large numbers guarantees that we can approximate the expected loss on the homogenous part by the probability of default (conditional on the market return) multiplied by the loss on default  $(1-R)$ . Assuming the return distribution for each asset in portfolio  $H$  to be:

$$Z_i = \beta_i Z + \sqrt{1 - \beta_i^2} \varepsilon_i \quad (\text{A1})$$

where  $Z$  and all  $\varepsilon_i$  are independent standard normal random variables and all  $\beta_i = \beta$ , we can express the conditional default probability of asset  $i$  in the homogenous portfolio as:

$$p^H(Z) = \Phi\left(\frac{C - \beta Z}{\sqrt{1 - \beta^2}}\right) \quad (\text{A2})$$

The amount of loss given default is  $(1-R)(1-\alpha)$ . We can then write the expected loss on the homogenous part as  $L^{H,NT} = (1-R)P^H(Z)$  if there is ‘no tiering’, and as  $L^{H,T} = (1-R)(1-\alpha)P^H(Z)$  if there is ‘tiering’. In the tiering case, we still have to include the loss for the single asset. Assuming that the idiosyncratic part of the single asset return is  $\varepsilon_0$ , its returns distribution is given by:

$$Z_0 = \beta_0 Z + \sqrt{1 - \beta_0^2} \varepsilon_0 \quad (\text{A3})$$

where  $\varepsilon_i$  and  $\varepsilon_0$  are independent standard normal random variables and the default probability of the single asset conditional on  $Z$  is given by:

$$p^0(Z) = \Phi\left(\frac{C_0 - \beta_0 Z}{\sqrt{1 - \beta_0^2}}\right) \quad (\text{A4})$$

We can now write the total expected loss of the portfolio in the ‘tiering’ case as:

$$L^T = L^{H,T} + (1 - R_0)\alpha P^0(Z) \quad (\text{A5})$$

That is, the expected loss for a settlement bank that extends a proportion  $\alpha$  of its total portfolio to second-tier banks is given by the expected loss on the homogeneous part,  $L^H$ , and the expected loss on the credit extended to second-tier banks.

To derive the portfolio loss distribution for the ‘tiering’ and ‘no tiering’ scenarios, we need to compute the probability that the loss exceeds a given level  $K$  in each case. We can interpret  $K$  as the Tier 1 capital of the settlement bank. For the tiering case, we can find two values  $A(K)$  and  $B(K)$  defined as:

$$A = \frac{1}{\beta} \left[ C - \sqrt{1 - \beta^2 \Phi^{-1} \left( \frac{K}{(1-R)(1-\alpha)} \right)} \right], \quad (\text{A6})$$

$$B = \frac{1}{\beta} \left[ C - \sqrt{1 - \beta^2 \Phi^{-1} \left( \frac{K - (1-R_0)\alpha}{(1-R)(1-\alpha)} \right)} \right] \quad (\text{A7})$$

If  $Z \leq A$ , the loss on the homogenous part is sufficiently great to exceed  $K$  irrespective of whether the single asset defaults or not. If  $A < Z \leq B$ ,  $K$  is exceeded only if the single asset also defaults. If  $Z > B$ , the loss would never exceed  $K$ , because the loss on the homogenous part is so small that even if the single asset defaults we never reach  $K$ . Mathematically, we can write the conditional probability of the loss reaching  $K$  in the ‘tiering’ case as:

$$P(L^T \geq K | Z) = 1_{\{Z \leq A\}} + P^0(Z) 1_{\{A < Z \leq B\}} \quad (\text{A8})$$

where the first term captures the probability of the market return being less than  $A$  and the second term captures the joint probability of the single asset defaulting and the market return being between  $A$  and  $B$ . Integrating over the market factor, we can write the unconditional probability as:

$$P(L^T \geq K) = \Phi(A) + \Phi_{2,\beta_0}(C_0, B) - \Phi_{2,\beta_0}(C_0, A) \quad (\text{A9})$$

where  $\Phi_{2,\beta_0}(C_0, B)$  denotes the cumulative density function of the bivariate normal distribution with correlation coefficient  $\beta_0$  evaluated at  $C_0$  and  $B$ . The first part in expression (A9) denotes the probability of the market factor return being smaller than  $A$ ; the remainder of the expression denotes the joint probability of the single asset defaulting and the market return falling between  $A$  and  $B$ . Using (A9) we can compute the probability of the portfolio loss exceeding any threshold  $K$  and plot the whole loss distribution.

Similarly, we derive the loss distribution in the ‘no tiering’ case:

$$P(L^{NT} \geq K) = \Phi(A') \quad (\text{A10})$$

$$\text{where } A' = \frac{1}{\beta} \left[ C - \sqrt{1 - \beta^2 \Phi^{-1} \left( \frac{K}{(1-R)} \right)} \right]$$

We can use the model to derive the loss distribution for the ‘tiering’ case, using expression (A9), and for the ‘no tiering’ case, using expression (A10), for the different parameter values and compare under which conditions one exceeds the other.

# Where are the risks?<sup>(1)</sup>

Paul Tucker, Executive Director for Markets and a member of the Monetary Policy Committee, Bank of England.

In this speech, Paul Tucker,<sup>(2)</sup> Executive Director for Markets and a member of the Monetary Policy Committee, discusses whether today's capital markets are well placed to absorb adverse shocks. He characterises the growth of derivative and securitisation markets as having facilitated greater dispersion of risk around and beyond the banking system, enabling less risk to be concentrated at the core of the payments systems that underpin financial markets and the economy more generally. But he also cautions that when short positions in options contracts — or economic options embedded in other financial products or trading strategies — are concentrated amongst bank intermediaries and other leveraged short-term traders, dynamic hedging can occasionally amplify asset price adjustments with potentially destabilising spillovers. Noting previous episodes, most recently in the structured credit markets, he urges the major intermediaries — and the authorities — to try to identify structural imbalances in those option markets where liquidity might be strained in stressed conditions. This is a regular feature of the Bank's Market Intelligence work. On the rapid innovation in wholesale financial markets, Mr Tucker points to two challenges for market practitioners. First, the need to consider whether past returns can prudently be extrapolated into the future. And second, the vital importance of the major firms ensuring that their back and middle office capability, and the market infrastructure, keep pace when innovative complex products take off, as recently underlined by the large backlog of credit derivative confirmations and assignments.

**CENTRAL BANKERS ARE FOND** of discussing myriad uncertainties in the global macroeconomic and financial environment. Yet judging by the level of implied volatility, derived from option prices, on a wide range of asset classes, the market perceives uncertainty as fairly low. And, even after the recent adjustment, credit spreads across a wide range of instruments suggest that the premium charged for risk has fallen over recent years. This, all in an environment where long-maturity risk-free forward rates — real and nominal — are unusually low. It is hard to know quite what to make of this, but it forms an important backdrop to the few remarks I want to make today.

For this audience, I think the interesting question is not whether or not risk will crystallise, as in one form or another risks crystallise every day. Rather, the important question is whether, in the event of nasty shocks, our capital markets can absorb them or whether they have developed characteristics which may, as some suggest, leave them vulnerable. Or,

more constructively, what risk managers — and the authorities — might usefully monitor to help contain any such risks.

It is hardly a new question. But it is one that has gained colour from the debate about derivatives. An oddly polarised debate. Overstating it somewhat: in one corner, a group contending that derivatives bring tangible benefits to civilisation. In the other, a group arguing that they have within them the seeds of severe disorder.

Unsurprisingly, my take is that the truth lies somewhere in between. It is nicely illustrated by the quite extraordinary development of the credit derivatives market over the past five years or so.<sup>(3)</sup>

## Dispersion of risk and the price of risk

Credit derivatives plainly have been used as an effective risk management tool by a number of banks and others. Contrary to some suggestions, the acid test is not especially whether banks, individually or in

(1) Delivered at the Euromoney Global Borrowers and Investors Forum, The London Hilton on 23 June 2005. This speech can be found on the Bank's website at [www.bankofengland.co.uk/publications/speeches/2005/speech251.pdf](http://www.bankofengland.co.uk/publications/speeches/2005/speech251.pdf).

(2) My thanks to Mike Cross, Colin Miles and David Rule for long-running debates on the issues discussed here. For comments, to Peter Andrews, Andrew Bailey, Alex Bowen, Alastair Clark, Paul Fisher, Damien Lynch, Peter Westaway and Simon Wells. And to Sandra Bannister for secretarial support.

(3) For an early review, see Rule, D (2001), 'The credit derivatives market: its development and possible implications for financial stability', *Financial Stability Review*, Issue 10, June, pages 117–40 and Rule, D (2001), 'Risk transfer between banks, insurance companies and capital markets: an overview', *Financial Stability Review*, Issue 11, December, pages 137–59.

aggregate, have been net sellers of credit risk. Individual banks have been able to reduce concentrated loan exposures to single corporates, industries or countries. As the Telecom episode reminded everyone just a few years ago, that is really important, if elementary. Individual banks have also been able to increase their exposure to borrowers with which they do not have a lending relationship. (Indeed, some commentators suggest that it may sometimes be more effective for second-tier and smaller banks to take corporate credit exposure via the derivatives market than via participation in the lower tiers of loan syndicates.) If, overall, the result were a greater dispersion of risk around the banking system and fewer large exposures relative to capital, the system as a whole would probably be safer even if, net, no credit risk had left the banking industry in aggregate.

According to various surveys, some credit risk has been shed to non-banks, including insurance companies, pension funds and hedge funds. That too should, on balance, promote the resilience of the system, not least because non-banks are not part of the core payment systems that underpin our financial markets — provided, of course, that banks prudently manage their counterparty exposures to non-bank sellers of credit protection. As others have argued, this is a change of degree rather than kind: with the growth of corporate bond markets, and especially securitisation, non-banks have been running credit portfolios for years. By separating the provision of liquidity from exposure to credit risk, credit derivatives, and the related developments in structured finance, give non-banks new ways of accessing credit risk.

As well as more dispersed risk buttressing systemic stability, the innovation of credit derivatives has plausibly taken us a further step towards complete markets, in effect providing a richer market for credit insurance than previously existed. Investors and others may, therefore, be able to get a little closer to the portfolios they really want to hold, which would facilitate a better allocation of risk and so bring broader welfare benefits. This works in the direction of reducing the price of risk, which would reduce the risk premium used to discount uncertain future cash flows.

There are, therefore, tangible benefits from the new derivative markets for unbundling and transferring

credit risk. And the same can be argued for the earlier development of interest rate, foreign currency and equity derivatives.

So where is the catch?

### Short option positions and market dynamics

Everyone is familiar with the risk present in markets if 'everyone' tries to sell — or buy — at once. Various features of markets can create the conditions for, or reinforce, such herd like behaviour. Panic in the presence of excess leverage is the familiar culprit, and goes back to well before the invention of derivatives, as various authors have documented in the context of the Great Crash. Derivatives have not altered the firmament in some deep, unrecognisable way. But they have introduced some novel variations on old themes.

One of the most interesting can potentially arise when a particular market is characterised by traders who have structurally short option positions, have short holding periods, and are leveraged; and where the underlying markets are not highly liquid. That needs a bit of unpacking.

Options can, of course, be hedged with an offsetting position in a similar option: a so-called 'static hedge'. Where, for one reason or another, traders cannot do that, they can attempt to hedge by running a position in the underlying instrument, with the intent that gains or losses on the value of their option positions will be offset by losses or gains on the underlying asset position: a so-called 'dynamic' hedge. It is dynamic hedging that can be interesting.

The effects of dynamic hedging of long and short option positions can be quite different. Broadly, dynamically hedging a long option position entails selling the underlying asset as prices rise, and buying as prices fall. Conversely, those who have sold (or written) options need to buy to balance their hedge when the value of the underlying asset is rising, adding to the buying pressure. And, if the price of the underlying instrument is falling, they need to sell to balance their hedge, adding to the selling pressure.

This is, of course, going on every day in a wide variety of deep and liquid markets without anything particularly odd happening to market dynamics. Things are potentially more interesting when markets

are structurally imbalanced, with short-term traders, dynamically hedging, concentrated on one side. If short-term traders are structurally long, their dynamic hedging may have the effect of dampening market movements, producing zones of local stability. But where, as a group, they are structurally short, their dynamic hedging can sometimes amplify price movements, increasing volatility, if the market proves illiquid under stress.

While I have set this out in a rather general way, it is not fanciful. There are examples of it going back over nearly 20 years: some involving the explicit writing of options; some implicit writing of options; and some arising from trading strategies that mimic optionality.

For example, the 1987 equity market crash was exacerbated by the prevalence of portfolio insurance, a trading strategy akin to delta hedging an option: sell when prices are falling. A dynamic variant of a 'stop loss'.

Similar strategies are now a key feature of some principal protected hedge fund investments, via so-called constant proportion portfolio insurance. To preserve the nominal principal, the 'guarantor' will sell units in, say, a fund of funds as its value falls, and *vice versa*. I guess some assumptions are made about underlying liquidity, and that these are reflected in how such strategies are effected.

In 1994, and again in 2003, hedging the negative convexity of US mortgage-backed securities amplified the rise in dollar bond yields, with some violence.<sup>(1)</sup> The underlying factors here, of course, are that US mortgage borrowers have an option to prepay, so they are long options on mortgage interest rates. The financial sector has, correspondingly, a structurally short option position, which it can — and does — slice and dice in various ways in an attempt to distribute the option exposure to those who want it. But to a greater or lesser extent, a residue is left, some of it with institutions which *de facto* seem to have short holding periods. They dynamically hedge, either continuously or within thresholds.

A rather graphic — if, ultimately, not stability-threatening — example of what I am describing occurred a few weeks ago in the structured credit markets. I will spend a few moments on this as

the distribution of optionality was quite complex. For some while, a wide range of regional banks, insurers and pension funds in Europe and Asia have been selling protection on intermediate tranches of credit portfolios, say on losses between 3% and 7%. Although they are effectively short an option on portfolio credit risk, they are widely regarded as passive investors who do not dynamically hedge. Their counterparts, the dealers, are initially long an option on portfolio credit risk; as spreads generally widen, the value of the bought-protection position increases non-linearly. Over time it became popular among short-term leveraged traders to exploit the strong supply of intermediate (or mezzanine) protection by holding a bought-protection position on mezzanine tranches as a hedge against selling protection on equity tranches. This was a so-called long credit correlation position, as its value would tend to increase with rises in the implied correlation of default risk among the companies represented in the underlying portfolios. In effect, traders were betting that implied correlation, as modelled, would not fall. As well as being highly convex, the position's popularity no doubt owed something to a straightforward search for yield: the big positive carry from being long high-yielding equity tranches and short lower-yielding mezzanine. This type of position did, though, leave holders exposed to so called idiosyncratic risk; that is to say, a deterioration in the credit of a few constituents of the underlying portfolio. This was akin to a short option position, requiring dynamic hedgers to buy protection as spreads widened on troubled names. When GM and Ford spreads rose, these correlation positions unravelled as traders went into the market to cover themselves. In effect, the structured credit market was reminded that credit risk has a major idiosyncratic element; that even the most sophisticated statistical models can be found wanting when they are detached from fundamentals and/or based on short runs of data; that hedging can hurt when a trade is 'crowded'; and that, in such circumstances, volatility can suddenly spike and spreads move in unplanned-for ways.

There are still-more complex variants. In some instances, options are embedded into products where there is not a liquid market in options with quite the same characteristics or long expiry dates. Power-reserve dual currency bonds may be an

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(1) 'The dynamics of US dollar interest rate adjustment', *Financial Stability Review*, Issue 15, December 2003, page 22.

example,<sup>(1)</sup> although not one where excess volatility has yet crystallised.

While these and other examples suggest that, in certain conditions, volatility can be exacerbated by option driven or option like trading strategies, related developments in global capital markets can at times help to dampen volatility. Notably, with the growth of the hedge fund industry, there are more short-term traders willing to take risk — in effect providing liquidity — when they perceive a temporary anomaly, as perhaps happened in the US bond market during Summer 2003. That is somewhat less likely, though, when the prior trading strategies of funds themselves have become part of the underlying imbalance.

This points up a useful lesson. That the major intermediaries — and the authorities — would do well to try to identify where there might be big structural short, or imbalanced, option positions in a market whose liquidity might be strained in stressed conditions. Sometimes, as for example in the US mortgage market, this amounts to identifying a structurally long position and asking whether the counterpart short positions are well distributed and how managed. Sometimes, as perhaps in the structured credit market, it may amount to asking whether there is anything that could trigger an exit by apparently long-term and passive holders of short option positions. For the firms themselves, this kind of analysis may be something that could be fed into stress tests developed in recent years to examine the effects of the exit of a dealer or major fund. Central banks rely largely on market intelligence. At the Bank of England, one of the questions we now more or less routinely ask in our market intelligence work goes along the lines of ‘is the Street and/or is the fund community short volatility/gamma/vega in a big way in any particular market?’<sup>(2)</sup> Regulators can put any general information gleaned from market intelligence alongside their more granular sources on the positions of firms.

A risk properly understood is, I hope, a risk that can be managed effectively. And so my analysis of the impact of options hedging on market dynamics does not cancel out the benefits that derivatives can potentially bring. For the reasons described earlier, the plugging of ‘missing markets’ is something to welcome.

## Innovation, competition and risk management

That so many markets are no longer ‘missing’ owes something to innovation in the wholesale financial services industry. The underlying forces driving innovation seem to be powerful, and indeed perhaps self-feeding. They may also give rise to some risk management challenges.

One possible story — there are others — would go along the following lines.

Core wholesale markets have become more efficient. This has been driven by a whole host of things, including improved technology and deregulation reducing transaction costs; the unbundling of different types of risk associated with the development of derivatives; and the entry of relatively unconstrained traders, including hedge funds. One result is that in ‘vanilla’ markets it may have become more difficult for intermediaries to make positive risk adjusted returns that exceed their cost of capital. Anecdotally at least, they make a more attractive return on, among other things, exotic products and via transactions tailored to address the risk management challenges of particular clients or client types. As such, they have a powerful incentive to innovate.

Over time, many of the most successful innovations become mainstream, enhancing market efficiency, helping to optimise the distribution of risk, and reducing the initial supernormal returns to the innovators, who move on to the next thing; and so on. As put, that sounds like a benign story for society. And, by and large, I think it is. It does, though, have at least two corollaries.

First, investors — whether in funds or firms — should occasionally ask themselves whether they can safely extrapolate into the future the returns that they have earned in the past.

Second, investment bank innovators may from time to time face a challenge in keeping the industry’s controls up to speed with what, *ex post*, turn out to be their most successful innovations. Imagine that, at any particular time, a firm has a portfolio of many innovations. Some will succeed, some will not. *Ex ante*, they will not know for sure which is which.

(1) ‘Structured notes and the US dollar/yen exchange rate’, *Financial Stability Review*, Issue 14, June 2003, page 43.

(2) See, for example, ‘Market dynamics and options selling’, *Financial Stability Review*, Issue 18, June 2005, pages 60–61.

Plausibly, it might not be economical to put controls in place for every single innovation on an assumption of 'exponential growth'. So when exponential growth occurs, controls can sometimes be left behind.

Maybe something like that helps to explain the backlog in credit derivative confirmations, which the FSA cautioned banks about a few months ago. Growth in the market has been relentless. And to the concerns about confirmations have been added concerns, among practitioners, about unnotified assignments of credit derivative positions, related in part to the growth of hedge fund participation in the structured credit market. If something really bad were to happen, the system would, perhaps, be less robust than otherwise if dealers were not sure about who their counterparties were, etc.

This is the type of challenge where collaboration across the industry is needed; and where individual firms' incentives are stronger if they can each be confident that their peers are taking broadly the same actions. What I have in mind is the disincentive a firm faces in being tough with a hedge fund client if they doubt their peers will take the same line. Bodies such as the International Swaps and Derivatives Association have a role to play here, and I understand are doing so.

### Collective elements in atomistic markets

So, where are the risks? They are all around us all of the time, of course. Some will crystallise. But that

need not lead to disorder. Indeed, in most circumstances, global capital markets are deep and liquid enough — having a sufficiently wide range of participants able to trade with each other, and with different risk appetites and different actual risk exposures — to absorb shocks. But history suggests that strains can appear at times. And as the system develops, we need to be alive to whether cracks might show up in new places or old weaknesses manifest themselves in new ways.

The two challenges I have sketched out for today's markets — the incidence, now and then, of structural short option positions among short-term traders; and of controls occasionally lagging behind innovations — have a common feature. They both entail understanding markets as something more than the positions of atomistic agents. In the first case, market participants have an interest in factoring into their risk management an assessment of whether a market has structurally imbalanced option (or option like) positions. In the second case, market participants have an interest in working together to establish robust practices and infrastructure when a particular innovation takes off.

Many risk managers are, of course, well seized of this. Let us hope they are empowered too. As practitioners, you can, and should, play a part in buttressing the system — by continuing to innovate, and by factoring collective outcomes into your private calculus and risk management.

# Financial stability:

## managing liquidity risk in a global system<sup>(1)</sup>

Sir Andrew Large, Deputy Governor, Bank of England.

In this speech Sir Andrew Large,<sup>(2)</sup> the Bank of England's Deputy Governor for Financial Stability, puts the case for central banks and regulators in all jurisdictions to review the appropriateness of current liquidity standards. He argues that even in today's relatively benign environment banks are vulnerable, by their nature, to liquidity risk; certain features of modern risk transfer markets may create new vulnerabilities. Liquidity cushions remain the first line of defence in periods of stress, and the increasingly global nature of financial firms and their activities means that national financial stability depends on liquidity standards imposed in many jurisdictions. He does not call for full harmonisation of liquidity standards in the way that capital standards have been harmonised. But central banks and regulators need, at least, a common understanding of what they are individually seeking to achieve with liquidity regulation.

### Introduction

Much is written today about the search for yield. Much is said about the factors that underlie it: accommodative monetary policy; savings gluts; and financial engineering which multiplies the opportunities for increasing leverage. And much, too, is said about new instruments, such as those involving credit risk transfer, or new players, such as hedge funds, that trade them.

However, my main concern today is not with the search for yield as such, nor with market innovations or new players. Rather, it is with the financial vulnerabilities to which they could give rise, and what can be done to mitigate those vulnerabilities.

Because it seems to me that the search for yield also highlights some less benign aspects of today's financial system: the opacity of markets in some new instruments; the difficulty of knowing the real value of assets and contracts; reliance on models that have not been tested in the full range of economic conditions; the uncertainties over behaviour of new participants in the markets should events turn adverse; and the difficulty we have in judging just how deep markets will prove to be should a substantial number of investors decide simultaneously to try to realise their investments.

On a more practical level, there is no lack of evidence that things can and do go wrong. We have recently seen lack of operational discipline in some financial markets leading to documentation backlogs and to uncertainty over the enforceability of transfer of risks. We see more relaxed lending criteria in the LBO market, increased reliance on potentially illiquid instruments in trading strategies, and questionable quality of some IPOs. We have seen specific examples of significant downgrades or outright failures such as GM/Ford, AHBR and, more recently, Refco and Delphi.

One reaction to these episodes is that they show the market doing its work and are testimony to the effectiveness of market discipline. The fact that the financial system has coped with these problems may well also be testimony to the strengths of that system.

On the other hand, might not these episodes be a potential sign that all is not well? The question is: are vulnerabilities mounting, and will they one day crystallise when a bigger shock arrives that the market simply cannot absorb?

The fact is, we just don't know. And that is why we need to be particularly vigilant and to think through the implications.

(1) Delivered at the Fourteenth City of London Central Banking and Regulatory Conference at the National Liberal Club, London on 28 November 2005. This speech can be found on the Bank's website at [www.bankofengland.co.uk/publications/speeches/2005/speech261.pdf](http://www.bankofengland.co.uk/publications/speeches/2005/speech261.pdf).

(2) The author is grateful to his colleagues Alastair Clark and Alan Sheppard for their help in preparing this speech.



Such questions lead me to think about issues relating to liquidity. If a period of market stress materialises, triggered by a sharp snap back in prices, it is critical that the financial system should be able to meet a temporary increase in the demand for cash without precipitating, in the vernacular, a ‘market meltdown’. Liquidity is therefore the focus of my remarks today. By liquidity I mean two things. First, institutional liquidity: the continued ability of individual financial institutions to meet claims as they fall due. And second, market liquidity: the depth of markets for the sale or loan of assets or the hedging of the risks that underlie those assets.

To set the scene, it is perhaps worth reflecting on how liquidity needs and processes may amplify the risks of instability — that is, their ability, in stressed conditions, to disrupt the functioning of the financial system generally, and the banking and payment systems specifically.

The traditional route arises from the banking system’s role in maturity transformation between short-term deposits and long-term loans. Managing this mismatch whilst maintaining the confidence of depositors is the essence of the business of banking. However, the presence of this maturity mismatch means that individual banks are by their nature *fragile*. The *connections* between banks, and the potential for doubts about one bank to spread to others, mean that the failure of one bank to manage its mismatch can potentially put at risk the financial system more widely. Bagehot in 1873 summed up this link between maturity mismatch and systemic risk:

‘Of the many millions in Lombard Street, infinitely the greater proportion is held by bankers or others on short notice or on demand; that is to say, the owners could ask for it all any day they please: in a panic some of them do ask for some of it. If any large fraction of that money really was demanded, our banking system and our industrial system would be in great danger.’

In Bagehot’s time, the role of the Bank of England was to act as guardian of the reserve of bullion that underpinned the credibility of the whole banking system. The technology may have changed, but in essence the role of the Bank today is one that Bagehot would recognize. Central bank money is the

ultimate settlement asset. And banks still demonstrate their ability to meet depositors’ demands for repayment by holding a sufficient stock of high quality securities against which central banks — and in normal circumstances the markets — will lend. Confidence in the modern financial system is therefore underpinned by the preparedness of central banks to lend against such high quality security *without question*.

Central banks have, therefore, a keen interest in developments that affect the demand for and supply of liquidity. It is not surprising that they try to limit the likelihood of events that might lead to excessive increases in demand for liquidity or constraints on its supply, and also try to have in place the operational apparatus to respond to such developments, if felt necessary, at minimum cost.

The traditional sources of liquidity risk for banks are unusually heavy demands from depositors for repayment and from their customers to draw down pre-committed funding. Today’s environment encourages us also to recognise disruption to markets as a potential trigger for such extraordinary demand. If you think about the expansion of markets in which banks participate, both as principals and as intermediaries, and the fact that at times of stress investors would be likely to place a premium on ‘safe’ assets and ultimately on cash, then it soon gets you back to thinking about the robustness of arrangements that enable banks to satisfy unexpected spikes in cash demand, perhaps in unexpected locations. Markets rely on this in order for them to function with confidence.

### How has the world changed?

I said that Bagehot would recognise the modern role of central banks. However, the firms that comprise the financial system are much altered since his day. So I should like to make a few observations both about how this has affected firms’ own liquidity management, and crucially how the public authorities might react.

First, concentration in the global financial system has increased, with a relatively small number of global firms — banks and non-banks — representing a significant fraction of the system. These firms often employ centralised liquidity management. And they are increasingly strongly interconnected, within and across borders, and via new markets for risk transfer

as well as more traditional channels. Participation in risk transfer markets does more than just create new links between firms: it also creates a new potential demand on firms' liquidity in the form of margin calls. Moreover, this additional demand may be positively correlated with other liquidity risk that firms face in the event of market stress.

Second, there are certain features of the prevailing financial and economic environment that give us pause for thought. Market prices are at historically unusual levels: real and nominal returns on risk free assets are low and credit spreads are tight, both in traditional and structured products. It is of course hard to say definitively the extent to which today's markets are merely reflecting changed fundamentals. But it is quite possible that some investors have unwittingly taken on higher levels of risk in pursuit of what they would consider to be 'normal' levels of return. And it is certainly prudent to plan for the possibility of a sharp reversion of prices to historically more normal levels (or even beyond them, given the tendency of markets to overshoot). There could be a period of impaired market liquidity during any such correction. One could imagine a number of potential catalysts for such a correction, ranging from a geopolitical event to some form of major operational disruption.

The Bank concurs with the widely held view that the growth of markets in risk transfer should contribute to greater financial stability, by allowing a more efficient dispersion of risks. But the *depth* and *reliability* of the more recently developed markets in risk under stressed conditions has not yet been fully tested. Moreover, risk transfer markets can, and probably at present do make the ultimate destination of risks more opaque. This makes it more difficult for us to assess the overall stability of the financial system, and, potentially, to react effectively in a crisis.

### How have firms reacted to these changes?

The banking industry has, not surprisingly, responded to these changes by paying greater attention to liquidity risk management. And, as well as day-to-day management, banks have given more consideration to how they would cope with extreme or 'tail' events.

Banks have developed, or are at least in the process of developing, sophisticated scenario analyses, and are assessing the contingency arrangements that would

be required to respond to these scenarios. It is certainly encouraging to observe the determination with which many banks are addressing liquidity risk, and it is at the same time noteworthy how efficiency drivers have led many banking groups to take a more centralised approach to liquidity management.

But, despite the progress that banks are making in addressing liquidity risk, the framework that underpins their contingency plans makes a number of assumptions, particularly regarding access to funding markets. There seems, for example, to be a widespread view that, whatever has happened to a firm's access to wholesale unsecured funding, it will be able to borrow secured against good collateral. Lying behind this is probably an expectation that national authorities, and in particular central banks, will be ready to provide liquidity against good collateral in the event of the failure of one or more of the markets for secured borrowing.

Banks are also giving greater thought to both the sources of liquidity shocks and the impact of an extreme event on the value of collateral and the proportion of that value that can be borrowed, as well as the sale value of any assets that they might consider liquidating. The assumptions here might prove to be optimistic, particularly in circumstances such as those seen in 1998, when extreme events led to one-way markets and a vicious circle in which asset price falls did not lead to increased demand but rather to further increases in supply. It is for reasons such as these that the contingency planning that firms put in place needs to be sufficient.

### Policy responses

So what gaps does this leave, and what policy responses are therefore needed on top of firms' own actions? There is certainly scope for further work by the private sector on improving liquidity risk management. But there are also a number of issues for public authorities to address.

The preparations that firms make are influenced by regulation. When balancing the costs and benefits of measures to mitigate risk, banks naturally have regard to the interests of their own shareholders. But one of the roles of, and indeed justifications for, regulation is to ensure that firms also take sufficient account of the interests of others who would be adversely affected by their own failure: their own borrowers and depositors, for example, but also the customers of

other banks that would suffer losses if a particular bank were to get into difficulties. In other words, one purpose of regulation is to align *private* choices with *public* welfare maximisation.

Hitherto, public authorities have placed much emphasis on *capital* requirements as a way of achieving this reconciliation. Indeed, one reason for imposing capital requirements is to limit the risk of liquidity problems, by giving the market a level of assurance over the solvency of a firm. But this emphasis on capital has perhaps overshadowed the importance of direct liquidity requirements.

Analytically, liquidity is a more difficult area. But arguably the case for prudential liquidity requirements in some form is just as strong as for capital. Liquidity cushions are a first line of defence: in times of stress they can buy time, and where organisations *are* solvent they can help to prevent liquidity problems turning into solvency ones. I will return to this later.

But besides regulation, the public authorities — specifically central banks — have a crucial role as the ultimate providers of liquidity. They therefore need to ensure that they are properly equipped to carry out this function.

Avoiding or resolving liquidity problems is not just a matter of ensuring adequate aggregate liquidity; it also means ensuring that liquidity can be, and is, distributed effectively round the system. This was illustrated by the events of 9/11, when the US money market was temporarily unable to distribute liquidity to the banks that needed it. On that occasion, for example, the Federal Reserve injected considerable liquidity, more than \$100 billion, via a combination of daylight overdrafts, discount window lending, and general market support. 9/11 also highlighted the importance of central banks being able to lend directly to solvent institutions facing a liquidity crisis. Under stressed conditions, and with the associated uncertainties, attempts by a perfectly sound bank to borrow unusually large amounts from the market, even against good quality collateral, have the potential to raise, or exacerbate, doubts about that bank's solvency. But a solvent bank that is in need of liquidity can safely reveal its need to the central bank without precipitating a crisis in market confidence; uniquely, the latter is not at risk of experiencing a run, and so will not overreact in an effort to protect its own balance sheet.

In many countries 'automatic' direct liquidity provision against pre-defined acceptable collateral is hard wired into the operational framework for monetary policy implementation through so-called 'standing facilities'. In the United Kingdom we are broadening the range of firms to whom we can supply liquidity in this way. This implements Bagehot's prescription for mitigating systemic risk, that the central bank should as far as possible make clear in advance its preparedness to provide liquidity in stressed conditions. Referring to the central bank, he puts it thus:

'The holders of the cash reserve [the Central Bank] must be ready not only to keep it for their own liabilities, but to advance it most freely for the liabilities of others. They must lend to merchants, to minor bankers, to "this man and that man", whenever the security is good.'

The picture becomes more complex in the case of global firms that manage liquidity centrally. Such firms have liquidity needs in multiple currencies and locations. They may find it costly to hold enough liquid assets in every market in which they operate, and hence potentially face a mismatch between the location of their liquidity needs and that of their liquid assets.

In response to this several central banks, notably those in Switzerland, Sweden, the United Kingdom, and the United States, have taken steps to allow the cross-border use of collateral in some or all of their routine lending activities. Others have taken the alternative route of attempting to reduce collateral costs for banks, and hence relax potential constraints, by accepting a range of less liquid and non-marketable assets, while still controlling the credit quality of the assets involved. For example, the Eurosystem accepts a wide range of non-sovereign debt securities, including corporate bonds and asset-backed securities. The European Central Bank's proposed 'Single List' will also include certain bank loans; indeed these are already eligible in some member countries. Similarly, the Fed has broadened the range of collateral accepted at the Discount Window.

A working group commissioned in 2004 by the Basel-based CPSS (Committee on Payment and Settlement Systems) has examined whether existing arrangements would prove adequate in an emergency.

It would appear that some of the *infrastructure* required to facilitate more extensive cross-border use of collateral is already in place: links between securities settlement systems, for example. Nevertheless, central banks may need to put in place more co-operative and co-ordinated policies, such as the establishment of a framework for information sharing.

When risks do crystallise it is imperative that central banks, along with regulators and ministries of finance, are well prepared so that they are able to respond in an effective manner. The CPSS working group looked at preparations that are needed in order to be able to make effective use of existing infrastructure in a crisis. But it is equally important that central banks and regulators be in a position to make the decisions necessary for resolution of a crisis, both individually and, when needed, collectively.

This entails gathering data and intelligence on firms and markets, sharing it appropriately amongst all relevant public authorities, understanding the systemic conjuncture, and setting up national and international frameworks for co-ordination of decision making. I could give an entire speech about questions in these areas, and a number of current and potential initiatives to address them.<sup>(1)</sup> However, today I would like to return instead to the subject of liquidity regulation.

The potential willingness of the authorities to supply discretionary — as opposed to routine — liquidity in

a crisis is likely to give rise to moral hazard, because in the real world, faced with incomplete information, it is difficult or impossible to identify *ex ante* a ‘pure’ liquidity crisis. By, for example, relaxing normal criteria on collateral quality authorities may move from the injection of liquidity to what is effectively the provision of risk capital. Firms may then be inclined to tailor their risk-taking to their own assessment of the probability of intervention, while at the same time the incentive for firms to hold adequate buffers of liquid assets is likely to be reduced. The gap between the amount of liquidity that a firm will choose to hold, and the optimal public choice will then widen. It is not surprising, then, that in most jurisdictions firms’ liquidity management is subject to standards imposed by regulation.

Intervening in this way requires that the authorities be able to answer some difficult questions. There is the question of calibration: how much liquidity is ‘enough’ for any given firm? In other words, what is the optimal public choice of liquidity buffer? And for how long should a firm be expected to be able to survive without outside help? This is a much more difficult question for liquidity buffers than for capital, because in the case of liquidity it is not sufficient merely to analyse the structure of a firm’s assets and liabilities. The firm also has to take account of the possible ways in which its counterparties and creditors may behave in a crisis. Moreover, in a liquidity crisis, there is feedback from the actions that a firm takes to meet liquidity needs

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(1) One important pre-requisite is that the authorities have access to up-to-date and accurate information about financial firms, on which they can base shared assessments of the position of individual firms and the likelihood of a crisis affecting the financial system as a whole. The information needed includes, *inter alia*, a firm’s group structure, capital, liquidity, asset holdings, large exposures, and its involvement in markets and in payment, clearing and settlement systems. This information can be collectively thought of as a ‘Fact Book’ on a firm. In some countries much of this information is already available. The FSA recently published a paper outlining the information that the UK authorities collectively deem it necessary to have in a financial crisis, and asking for firms’ co-operation in making available a limited amount of additional information that is not already collected on a routine basis.

We also obtain a great deal of additional information in the course of our own market operations, through our involvement in payment systems and other infrastructure, through our counterparties and contacts, and in other ways. Intelligence of this sort allows us to understand the environment — the products, techniques, and markets — in which firms operate and how they and the markets in which they trade may behave in times of stress. It therefore supports analysis of how stress might spread and how the authorities can most effectively respond; and it helps to identify the appropriate channels for communicating this response. But analysis from intelligence can also provide early warning of symptoms of actual or incipient stress; for example, a high degree of leverage coupled with crowded trades in markets that can be illiquid.

The authorities then have time, where appropriate, to publicise any concerns so that firms can take action to prevent the risks from crystallising, and factor them into stress tests and scenario analysis. We provide such analysis regularly in our *Financial Stability Review*. And were a crisis to develop, an understanding of the ‘systemic conjuncture’ is also required to enable the authorities to assess on a continuing basis the likely systemic impact, and to choose an appropriate policy response.

As well as information exchange, strong co-ordination of decision making between central banks, regulators, and ministries of finance is likely to be essential for effective crisis management. This is true both at a domestic and an international level. A first step is for the relevant national authorities to have clear, well established, processes for decision making and for communicating externally, and to ensure that these processes are well understood by all parties. In the United Kingdom, HM Treasury (HMT), the Bank and the FSA have a published *Memorandum of Understanding (MoU)*, established in 1997, which sets out a high-level framework for co-operation in the field of financial stability.

Although there is no such agreement at an international level at an equivalent level of detail, a *Memorandum of Understanding on co-operation between banking regulators, central banks, and finance ministries of the European Union in Financial Crisis Situations* was signed earlier this year. It is fair to say, however, that this represents only a first step.

Finally, if the authorities decide to take measures to mitigate the systemic impact of a crisis — for example through emergency liquidity injection of one sort or another — it is vital that the central bank, supervisor and ministry of finance act, and are seen to act, in a decisive and joined up way. In the United Kingdom, the MoU provides for strategic management of a crisis at meetings of a ‘Standing Committee’, the members of which are senior representatives of HMT (who chair the meetings), the Bank, and the FSA.

— selling assets for example — to the market’s perception of its solvency and hence to the size of those very liquidity needs. Furthermore, it is arguable that buffers should vary to some extent with the level of risk that a firm brings to the financial system. Firms that, for example, are relatively large or opaque, or have more extensive connections to other parts of the financial system might be expected to meet higher standards under such a regime.

The impact of liquidity standards on a firm’s relationship with its central bank, both in normal times and in crisis, also has to be considered. In many countries, the United Kingdom included, firms need to obtain central bank money in order to make payments to other banks in the real-time gross settlement system and to settle delivery-versus-payment securities transactions. The ability to obtain central bank money — liquidity — depends at all times on having access to sufficient quantities of high quality collateral. And such collateral is of course amongst the best forms of insurance against liquidity problems. So the extent to which prudential liquidity standards *require* firms to hold collateral, and the precise way in such requirements are *calibrated*, have a direct impact on the economics of their participation in payment systems and in central bank operations to implement monetary policy.

The structural and conjunctural developments that I described earlier are most material to these questions. On calibration, for example, greater interlinkages between firms mean that the external costs of failure (the costs that are not borne by the firm itself and are therefore unlikely to be taken into account in its own planning) are greater. If markets on which firms now rely for some of their liquidity became fragile, then, all else being equal, firms would be more vulnerable to liquidity problems.

This argues for the authorities in all jurisdictions to review whether the liquidity standards that they currently impose are still appropriate, given the nature of firms and their activities. But globalisation also means that there is a case to look again at *consistency* of liquidity standards across jurisdictions. As central banks or regulators we are each seeking to achieve a high level of soundness in our respective financial systems. But the soundness of any of the global firms that are a major part of

those systems is a function of the standards imposed on the group and its major subsidiaries in many jurisdictions.

None of this necessarily argues for full harmonisation of liquidity standards in the way that capital standards have been harmonised. But each jurisdiction inevitably relies to a degree on liquidity standards imposed elsewhere to ensure the soundness of potentially systemically significant firms. Central banks and regulators need at least, therefore, to come to a common understanding of what they are individually seeking to achieve with liquidity regulation. Are we, for example, seeking with such regulation to limit the likelihood of crisis, or the impact of a crisis should one arise, or both? What sort of liquidity problems are envisaged in the regulation? Most importantly, we should seek a common understanding of that elusive dividing line between *ex-ante* insurance, and *ex-post* resolution.

## Conclusion

This is my last Financial Stability speech as Deputy Governor and I would like to leave you with several thoughts.

First, I can’t help feeling that it is at times such as this, when we have a relatively benign environment, that we should seek to address difficult and contentious issues of the kind I have been discussing. It is certainly true that the risk transfer markets and the financial system have coped, with remarkable success, and with few signs of instability, with the various events and shocks in recent years. But we need to be sure that we are not complacent in placing trust in the ability of the financial system to continue to absorb shocks smoothly.

Second, policymakers have sometimes found it hard to discuss lender of last resort issues because they can so quickly raise the spectre of moral hazard: by giving too many clues to their likely response to instability, policymakers fear undermining market discipline and so making crises more likely. Equally, public policymakers should recognise the distinction between clarity about processes — where transparency to my mind can only be positive for confidence — and transparency about how decisions might be reached in a particular case, where constructive ambiguity remains important as a mechanism to reinforce market discipline. On the other side of the fence, banks and financial

institutions have made impressive strides in coping with these realities, but may be reluctant to move explicitly to transparent best practice standards. Maybe this is for fear of giving up competitive advantage, or maybe it is a fear that regulators might seek to impose unwelcome prescription in how they manage liquidity risks.

Third, my message today is that both public and private sectors would be wise to overcome these inhibitions in the interest of developing mechanisms for providing liquidity in a manner that is fit for purpose in today's globalised world, and recognises the new environment and systemic conjuncture. In the case of private entities, they, to my mind, could show greater enthusiasm and leadership in coming up with sets of best practice standards, in the knowledge that failure in one institution could be severely damaging for others.

I say this in the knowledge that, in the case of the public authorities, debate on all these issues is rising rapidly up the agenda, not just in London where the FSA and ourselves have a shared responsibility, but in other major financial centres as well. Progress on understanding all of these difficult issues can be made through ongoing informal dialogue amongst these central banks and regulators that are most concerned with our largest financial institutions. I am encouraged that there are a number of informal groups who are undertaking work in this area. These feed into official groups such as the Financial Stability Forum where the vital connection between the public and private sector can be made.

These are certainly stimulating and fascinating issues. They are complex issues too. And I confidently expect them to occupy people's minds for many years to come.

# Bank weakness

## and bank loan supply

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A concern for policymakers is the possibility of an impairment of financial intermediation that arises when banks' balance sheets are weakened and banks are unwilling or unable to provide loans to companies and households. These loan supply effects have the potential to reduce aggregate investment and to amplify macroeconomic fluctuations. However, to date there is little systematic evidence on the strength of these effects. The research presented in this article brings comprehensive cross-country evidence to bear on this issue. Our results indicate that loan supply effects are pervasive and not confined to particular countries and particular times. They also suggest that bank capital requirements might play a role in increasing such effects, calling for careful study of regulatory design in this regard.

### Introduction

**Financial stability is undermined** when there is a disruption to the flow of funds from savers to investors. This flow of funds is often intermediated by banks. Therefore, a particular concern for policymakers is the prospect of an impairment to intermediation that may arise when banks are unwilling or unable to provide loans to companies and households.

When banks curtail their lending, companies that require credit to bridge funding gaps may be unable to obtain funds and may be forced to default on their obligations to corporate and bank creditors, resulting in costly early liquidation of long-term investments. Moreover, reductions in bank loan supply may result in companies having to pass up new valuable investment opportunities. In recent research, Dell'Ariccia, Detragiache and Rajan (2005) showed that large measured output costs associated with banking crises are rooted in a decline in investment that is precipitated by a reduction of bank loan supply. In particular, they show that during banking crises such output costs are larger in corporate sectors that are more dependent on bank finance.

However, it is possible that changes in loan supply might occur outside banking crises and might more generally add to the amplitude of macroeconomic fluctuations.<sup>(1)</sup> It is well known that

bank lending is procyclical in the sense that loan growth is stronger in periods of rapid economic growth and weaker in periods of slow economic growth. But clearly this might partly be due to investment demand, and thus loan demand, being weaker in periods of slow economic growth. A pertinent question is therefore whether loan *supply* is procyclical, in the sense that banks are unwilling or unable to provide loans in periods of slow economic growth, perhaps because the banks themselves might be weakened as a result of an increase in the default rate of companies or households.

These questions are relevant to the policy debate on the design of bank capital regulation. There has long been a concern that capital requirements imposed on banks might exacerbate the procyclicality of bank loan supply, see for example BCBS (1999). In economic downturns banks experience losses. An increased incidence of loan-loss provisions may eat into capital and result in bank capital requirements becoming binding in recessions. Moreover, in recessionary periods the cost of issuing new equity may be particularly high as a result of more pronounced uncertainty about the prospects of any particular banking firm and of the economy as a whole. As a result, when capital constraints become binding and banks are faced with the choice between issuing new capital and curtailing lending, banks may opt for the latter.

(1) This is suggested by a number of recent models of macro-systemic risk, as surveyed by Haldane *et al* (2004).

These arguments have caused some commentators to be concerned that the risk-based capital requirements mandated under Basel II, which are designed to overcome some of the shortcomings of the current capital regime,<sup>(1)</sup> may have the unintended consequence of further exacerbating the procyclicality of bank loan supply, eg Jackson (2002), Goodhart (2005). Under risk-based requirements, regulatory capital is likely to fall in expansionary periods and rise in recessions,<sup>(2)</sup> increasing the likelihood that requirements become binding in recessions. In response, a number of measures have been introduced in an effort to mitigate the cyclicity of the proposed new risk-sensitive framework.<sup>(3)</sup>

Despite these policy concerns, there is not as yet a comprehensive body of empirical evidence on the way a bank's financial position might affect its willingness or ability to lend. In particular, the available empirical evidence on changes in bank loan supply is largely confined to particular episodes and particular countries. Perhaps as a result, policymakers are divided as to how much they should be worried about such loan supply effects. Moreover, there is a question as to whether these effects might be stronger for particular countries and weaker for others, or whether they are relatively widespread.

The research presented in this article brings comprehensive cross-country evidence to bear on these issues. Using a sample of more than 600 listed banks from 31 different countries over the period 1993–2000, we study the following three questions: (i) Do banks that are weakened by loan losses reduce their supply of loans? (ii) Does the initial capital position of the bank affect the strength of this effect? (iii) Does thin capital lead to stronger reductions in loan supply when macroeconomic conditions are weak and banks find access to new capital expensive?

Importantly, we study these effects using a research design that effectively controls for differences across countries and across time. In a number of extensions to the main analysis, we then also address the question of whether these effects are stronger for particular countries and during particular episodes.

For example, we ask whether these effects might be stronger for countries that experienced a banking crisis during the sample period. We also investigate whether structural and institutional differences across countries might affect the strength of the effects.

### Prior evidence

The current evidence on these questions is largely confined to particular episodes and particular countries. For example, some economists have identified the introduction of capital adequacy regulation of banks as a possible explanation for the decline in bank lending in the United States during the 1990–91 recession. A study by Peek and Rosengren (1995) was one of the first attempts to assess the impact of binding capital regulation on bank loan supply. Evidence for a 'capital crunch' was found for New England banks during the 1990–91 recession — a period in which capital regulation was actively enforced. In particular, poorly capitalised banks reduced their lending more than their better-capitalised competitors.

Empirical studies of the impact of capital regulation on banks' lending behaviour outside the United States are rare and have generally followed the bank capital channel literature. This literature examines how capitalisation influences the response of banks' lending to unexpected macroeconomic shocks for particular countries, eg Kishan and Opiela (2000) for the United States. Gambacorta and Mistrulli (2004) also controlled for a 'regulatory' shock by explicitly modelling the effects of the introduction of capital requirements higher than 8% on lending volume by Italian banks. The authors found that it reduced lending by 20% after two years. Barajas, Chami and Cosimano (2005) find little evidence of a credit crunch induced by the adoption of the Basel Accord in Latin America, although they do find some evidence for greater sensitivity of banks' lending behaviour to certain risk factors.

### Empirical method and results

It is well known that bank lending decreases during periods of poor macroeconomic performance.

(1) See Jones (2000) for a discussion of regulatory arbitrage under Basel I and BCBS (2005) for an overview of the objectives of Basel II.

(2) The strength of these effects and the way this might depend on banks' ratings methods have been analysed in a number of recent contributions, eg Kashyap and Stein (2004).

(3) These include a flattening of the risk-weight functions, an emphasis on ratings to be through-the-cycle and on credit risk stress tests. See Jackson (2002) and ECB (2005) for further discussion.



However, the reduction in lending activity is in part the result of lower investment activity, and thus of a downward shift in the demand for loans during recessions. The pertinent question is therefore: is there a shift in bank loan supply as well?

If an observed reduction in lending during recessions is the result of a reduction in loan demand or of a reduction in loan supply solely due to a lower level of aggregate saving, all banks should react by reallocating their investment portfolios in the same way, independent of their specific characteristics. However, if different behaviour among banks with different characteristics is observed, this would be evidence of a 'supply-induced' restriction of credit<sup>(1)</sup> that could reflect imperfections in the market for bank funding<sup>(2)</sup> or alternatively differences across banks in their degree of risk aversion.<sup>(3)</sup>

We therefore test for the following three hypotheses:

(H1) Is the loan supply of banks with weaker balance sheets lower than that of stronger banks?

(H2) Is the effect of loan losses on bank loan supply stronger for poorly capitalised banks?

(H3) Is the effect of bank capital on lending stronger during periods of weak economic growth?

The sample used in this research contains data on more than 600 banks from 31 countries<sup>(4)</sup> from 1993 to 2000.<sup>(5)</sup> All regressions were performed using a feasible generalised least squares (FGLS) estimator.<sup>(6)(7)</sup>

To test our hypotheses, a bank's loan growth was regressed on measures of its financial strength — the bank's return on equity (RoE), its capital ratio ('Capital', defined as the ratio of capital to other liabilities) and its loan-loss provision ratio ('Provisions').<sup>(8)</sup> These regressions control for loan demand by including the nominal GDP growth ('GDP') of the country in which the bank is located.<sup>(9)</sup> Importantly, the analysis controls in addition for all conceivable differences across countries and through time that may affect a bank's loan growth, by use of country dummy variables and time-fixed effects.

The results in Table A document a positive and significant correlation between a bank's loan growth and nominal GDP growth, which proxies for domestic demand effects. This effect is also economically relevant: in specification (1), a 1 percentage point decrease in GDP growth causes a fall in loan growth of around 0.43 percentage points.

In addition, for any given level of economic growth, banks' balance sheet characteristics appear to influence their lending activity: more profitable banks and banks with lower loan-loss provisions tend to extend more credit than their weaker competitors.<sup>(10)</sup> An increase of 1 percentage point in a bank's RoE, and a decrease of 1 percentage point in a bank's loan-loss provision ratio, increases its loan growth by 0.25 percentage points and 1.84 percentage points, respectively. Finally, on balance, a bank's capital ratio appears to exercise a positive influence on its lending growth. However, this result is not statistically significant at

(1) In principle, a bank has two possibilities if it wants to reduce credit extension. It can change the terms and conditions for new credit, eg demand more collateral or charge a higher price, or it can refuse to grant credit at prevailing terms. Like most of the previous literature, we do not have access to data on terms and conditions and therefore do not attempt to distinguish between those two possibilities. Jimenez and Saurina (2005) use Spanish credit register data that contain such information. They show that banks lower collateral requirements in good times and increase them in bad times.

(2) These are likely to be rooted in asymmetric information between the bank and its investors, eg Myers and Majluf (1984), Kishan and Opiela (2000) and Eisfeldt (2004).

(3) This is emphasised by Gambacorta and Mistrulli (2004). However, these authors also point out that the theory is not clear cut. Under some models, a negative shock to capital is predicted to increase rather than decrease risk-taking, since lower capital increases the value of the deposit insurance guarantees.

(4) The countries in the data set are Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Finland, France, Germany, Greece, Hong Kong, Indonesia, Ireland, Israel, Italy, Japan, Korean Republic, Malaysia, the Netherlands, Norway, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, Thailand, Turkey, the United Kingdom, and the United States.

(5) Given that loan growth is the dependent variable, only seven years (between 1994 and 2000) are used in the regressions.

(6) The FGLS estimator allows for first-order autocorrelation within panels, for cross-sectional correlation and for heteroskedasticity across panels. However, we found first-order autocorrelation in the residuals to be small. This suggests that a static model is appropriate for our data.

(7) While the analysis routinely controls for country and time-fixed effects, an alternative procedure would have been to include bank-specific fixed effects. We found that the latter yielded results that were qualitatively and quantitatively similar to the ones we comment on in this article. The reason the chosen estimator is preferred is that some of the structural cross-country differences we analyse in this article, such as concentration and share of foreign banks, do not vary through time and thus are not estimable using a bank fixed effects estimator.

(8) The loan-loss provisions ratio will be a good measure of bank weakness if provisions are highly correlated with current expected losses. Under accounting standards in most countries, this is likely to be the case. See also Hoggarth and Pain (2002).

(9) GDP measures were obtained from the IMF's *International Financial Statistics*, while data sources for balance sheet variables were obtained from BankScope. See also the Annex for further detail on the regressions.

(10) This result is consistent with the results obtained by Peek and Rosengren (1995): the authors found a positive and significant impact of changes in capital (represented in our specification by banks' loan-loss provisions) on bank total liabilities.

conventional levels.<sup>(1)</sup> Overall, the evidence is consistent with hypothesis (H1): independently of macroeconomic conditions, healthier banks extend more credit than weaker ones.

**Table A**  
**Determinants of loan growth<sup>(a)</sup>**

Dependent variables	(1) Loan growth	(2) Loan growth	(3) Loan growth
RoE	0.25***	0.23***	0.42***
Capital	0.005	-0.09**	0.11***
Provisions	-1.84***	-2.85***	-1.53***
GDP	0.43***	0.43***	0.41***
Lagged Capital*Provisions		6.23***	
GDP*Capital			-0.51**
Year dummies	yes	yes	yes
Country dummies	yes	yes	no
Number of observations	3460	3453	3460
Goodness of fit <sup>(b)</sup>	0.25	0.25	0.18

(a) All variables are described in Table A-1 in the annex.

(b) The goodness of fit is calculated as the square of the correlation coefficient between the actual and the fitted value of the loan growth.

\*\*\* denotes statistical significance at the 1% level, \*\* at the 5% level and \* at the 10% level.

To test hypothesis (H2) an interaction term between a bank's loan-loss provision ratio and its (lagged) capital ratio is added to the specification in column (2). It is found that the adverse effect of a rise in loan-loss provisions on bank loan supply is stronger for those banks which are poorly capitalised to start with, consistent with the main finding in Peek and Rosengren (1995).

Finally, to investigate hypothesis (H3), an interaction term between GDP growth and each bank's capital ratio is added. As shown in column (3), the coefficient of the interaction term is statistically significant and negative: as GDP growth falls, the positive effect of capital on loan supply rises. In other words, capital 'matters' more in times of low economic growth.

In sum, we find evidence in favour of all three hypotheses. Banks weakened by loan losses appear to reduce their credit supply. This effect is stronger if banks start out with smaller capital buffers. And

banks' capital has a stronger effect on loan supply during periods of weak economic growth.

## Extensions

The main results were obtained when controlling for differences across countries — by use of country dummies — and across time — by use of time fixed effects — and were shown to hold on average across all countries and years in the sample. In this section, we extend the analysis and explore additional factors that may affect the lending behaviour of banks. This is intended to assess what might determine the extent of procyclicality of bank lending and its relationship with bank weakness, and how these effects might differ across time and countries.

### *Crisis and non-crisis countries*

First, there might be reason to believe that loan supply effects are stronger in periods of banking crises. Our sample comprises banks from a number of countries that experienced a banking crisis during the 1990s. It is therefore possible to assess whether credit supply effects might be stronger during such episodes. We split the data set into two subgroups according to whether banks are located in a country that experienced a banking crisis over the period covered by our sample, where this information is obtained from Caprio and Klingebiel (2003).<sup>(2)</sup> Table B, column (1) reports the results for the 'banking crisis' subsample and column (2) for the 'no banking crisis' subsample.<sup>(3)</sup>

The results of this specification confirm the evidence that a bank's loan growth depends positively on nominal GDP growth and that banks with higher return on equity and lower loan-loss provisions tend to extend more credit.

We next check whether coefficients are significantly different across the two subsamples, by interacting all coefficients with a dummy variable indicating whether or not the country underwent a crisis during the 1990s (results not shown). It turns out that, while the sensitivity of loan growth to loan-loss provisions does not vary significantly across the two subsamples, the impact of nominal GDP does. It appears that in countries that experienced a banking

(1) Again, this finding is consistent with Peek and Rosengren (1995), who found a positive but insignificant relationship between capital ratio and total liabilities. It is also plausible: note that 'Provisions' captures potentially unexpected changes to the bank's financial strength that the bank might wish to react to, whereas the capital ratio measures a level that might not, on average, call for a change in behaviour.

(2) According to Caprio and Klingebiel (2003) crisis countries in our sample are Argentina (1995), Brazil (1994–99), Indonesia (1994 and 1997–), Japan (1991–), Korea (1997–), Malaysia (1997–), Thailand (1997), Poland (1990s), Turkey (1994).

(3) Similar results were obtained when the analysis was refined to take account of the timing of the crises.

**Table B**  
**Determinants of loan growth: crisis versus non-crisis countries<sup>(a)</sup>**

	(1) 'banking crisis'	(2) 'no banking crisis'	(3) 'banking crisis'	(4) 'no banking crisis'
Dependent variables	Loan growth	Loan growth	Loan growth	Loan growth
RoE	0.21***	0.27***	0.18***	0.25***
Capital	-0.15	0.05	-0.44***	-0.06
Provisions	-1.69***	-2.44***	-3.33***	-3.98***
GDP	0.53***	0.76***	0.51***	0.8***
Lagged Capital*Provisions			15.33***	6.86***
Year dummies	yes	yes	yes	yes
Country dummies	yes	yes	yes	yes
Number of observations	1040	2420	1036	2417
Goodness of fit	0.41	0.15	0.42	0.15

(a) All variables are described in Table A-1 in the annex.  
 \*\*\* denotes statistical significance at the 1% level, \*\* at the 5% level and \* at the 10% level.

crisis, loan demand (which we proxy with nominal GDP growth) is less important in determining bank loan growth than it is in countries that did not experience a crisis. This finding is plausible and consistent with the idea that loan supply effects are stronger for crisis countries.

Finally, in specifications (3) and (4), we include the interaction between a bank's loan-loss provision ratio and its (lagged) capital ratio. The coefficient is significant in both subsamples, consistent with previous specifications, and turns out to be significantly larger for the 'banking crisis' sample. This means that the impact of loan-loss provisions on loan supply is not only stronger for poorly capitalised banks, but more so if these banks are located in countries that experienced a banking crisis, perhaps because it might be particularly costly to issue new equity capital during such episodes. Note that again, the analysis includes both time-fixed effects and country-fixed effects, controlling for unobserved heterogeneity in both these dimensions.

In sum, bank supply effects appear to operate both during and outside banking crises, but are stronger during crises.

#### *Financial development and structure*

The strength of loan supply effects might further differ across countries and might depend on a country's financial development and the structure of its banking system. We investigate these hypotheses

in Table C. In specifications (1) and (2) an explicit measure of the country's financial development is introduced, instead of the set of country dummy variables. Financial development is captured by the ratio of credit to GDP.<sup>(1)</sup> The results obtained are not qualitatively different from those in the baseline model. The added variable, 'Financial development', is found to reduce bank loan growth — ie banks in countries with low credit-GDP ratios extend more loans, *ceteris paribus*. This is consistent with a 'catch-up' theory of financial development. However, the coefficient of an interaction term between 'Financial development' and 'Provisions' is not significant. This suggests that bank weakness, as measured by loan-loss provisions, has a significant effect on banks' loan supply independent of the degree of development of the financial system of the countries in which banks operate.

In specifications (3)–(6) we include indicators of the market structure of countries' banking systems ('Bank concentration' and 'Foreign banks') that were obtained from a World Bank database (see Barth *et al* (2001)). 'Bank concentration' is defined as the fraction of deposits held by the five largest banks in a country, while 'Foreign banks' is the fraction of the banking system's assets that are 50% or more foreign-owned. The coefficient on 'Bank concentration' is negative and statistically significant — specification (3). This indicates that, everything else equal, higher concentration (and thus lower competition) has a negative impact on bank loan

(1) This indicator is contained in the World Bank's New Database on Financial Development and Structure (Beck *et al* (1999)).

**Table C**

**Determinants of loan growth: financial market development and structure<sup>(a)</sup>**

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: loan growth						
RoE	0.38***	0.39***	0.42***	0.42***	0.37***	0.38***
Capital	0.06*	0.05	0.05	0.05	0.09	0.09**
Provisions	-1.76***	-2.16***	-1.31***	-2.15***	-1.71***	-1.27***
GDP	0.2***	0.21***	0.36***	0.35***	0.28***	0.28***
Financial development	-0.09***	-0.1***				
Financial development*Provisions		0.77				
Bank concentration			-0.08***	-0.09***		
Bank concentration*Provisions				1.45		
Foreign banks					0.17***	0.18***
Foreign banks*Provisions						-1.67
Year dummies	yes	yes	yes	yes	yes	yes
Country dummies	no	no	no	no	no	no
Number of observations	3460	3460	3412	3412	3231	3231
Goodness of fit	0.19	0.19	0.19	0.19	0.19	0.19

(a) All variables are described in Table A-1 in the annex.  
 \*\*\* denotes statistical significance at the 1% level, \*\* at the 5% level and \* at the 10% level.

supply, as predicted by basic oligopoly theory. The sign of the coefficient on 'Foreign banks' is positive and significant — specification (5). Our interpretation is that the presence of foreign banks in a country fosters competition (eg between domestic and foreign banks) and that competition increases loan supply, again in line with basic theory and consistent with the result on concentration obtained in specification (3). In specifications (3) and (5), the basic results on bank weakness and bank loan supply are not qualitatively altered by the inclusion of these indicators of banking structure. Moreover, in specifications (4) and (6) we include the interaction of 'Bank concentration' with 'Provisions' and 'Foreign banks' with 'Provisions' respectively, and find that both coefficients are insignificant. In other words, bank weakness reduces loan supply *irrespective* of the structure of the banking industry.

In sum, we find that indicators of financial development and market structure do affect loan supply in plausible ways. However, they do not appear to affect the strength of the link between banks' financial position and bank loan supply.

**Conclusions**

Our findings are consistent with the hypothesis that procyclicality of bank lending is a widespread phenomenon and does not appear to be confined to the specific episodes that have been studied in the literature thus far, eg the US recession of the early 1990s. Using a large sample of banks from 31 different countries, the analysis shows that shocks to capital result in a reduction of bank loan supply more generally. While this effect is stronger in crisis times, it is present also for those countries that did not experience a banking crisis in the period under study. This suggests that bank loan supply effects are pervasive and that they can play a role in amplifying economic cycles more generally. Our results also suggest that loan losses result in a larger reduction of loan growth for banks with smaller capital buffers. This underlines the role that capital requirements might play in amplifying macroeconomic fluctuations and the importance of taking appropriate account of this in any proposals for the design and implementation of regulatory standards.

## Annex

Our basic specification can be represented as follows:

$$\Delta \log(\text{Loans})_{it} = \alpha W_{it} + \beta \text{GDP}G_{it} + \gamma Z_{it}, \quad (1)$$

where

$\Delta \log(\text{Loans})_{it}$  is the growth rate of total loans for bank  $i$  at time  $t$ ;

$W_{it} = [\text{RoE}_{it}, \text{Provisions}_{it}, \text{Capital}_{it}]$  represents bank-level measures of a bank  $i$ 's weakness;

$\text{GDP}G_{it}$  is the growth of GDP at time  $t$  of the country in which a bank  $i$  is located;

and  $Z_{it}$  represents a vector of control variables.

Table A-1 describes the variables included in the model in more detail.

**Table A-1**  
**Description of variables**

Variable	Data source	Description	Details
$\Delta \log(\text{Loans})$	<b>BankScope</b>	Growth rate of loans	
$W$		Provisions Capital RoE	Ratio of loan-loss provisions to total loans. Ratio of equity capital to debt and deposits. Net income divided by the book value of equity from the previous period.
$\text{GDP}$	<b>International Financial Statistics (IFS)</b>	GDP growth	Nominal GDP growth.
$Z$	<b>Beck, Demirgüç-Kunt and Levine (1999)</b>	Financial development	Ratio of private credit extended by deposit money banks and other financial institutions to GDP.
	<b>Barth, Caprio and Levine (2001)</b>	Bank concentration Foreign banks	Fraction of deposits held by the five largest banks. Fraction of the banking system's assets that are 50% or more foreign-owned.

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# Capital flows to emerging markets: recent trends and potential financial stability implications

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There has been a marked growth in capital flows to emerging market economies (EMEs) in recent years, intermediated increasingly through financial markets. This article describes the main patterns of these inflows and the potential implications for the way that adverse shocks in EMEs could be transmitted through, and to, the global financial system. Finally, it makes use of a relatively new data source to measure the extent of common creditor interlinkages between EMEs and assesses the current risk of market contagion.

## Introduction

**THERE HAS BEEN** a large inflow of capital into EMEs in recent years. This article discusses how this may have affected the potential channels of contagion across EME financial markets in response to a country-specific crisis. The first section describes the recent patterns of capital flows to EMEs. Section 2 discusses the potential channels of financial contagion across EMEs suggested in the academic literature. Section 3 assesses the empirical evidence on the current risk of contagion through EME financial markets.

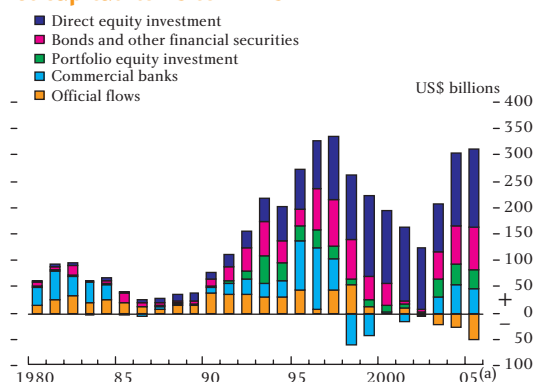
## Trends in market intermediation

Since the early 1990s, net private sector flows to EMEs, particularly market finance, have grown rapidly. These flows now dwarf those from foreign governments and multilateral institutions (Chart 1). Bond and equity finance has accounted for an increasingly large share of inflows, particularly since the Asian crisis. Over the past five years market-intermediated net inflows have been, on average, 3.5 times as large as bank finance.

The growth in non-resident ('external') bond finance of EMEs from the private sector has been concentrated mainly among EME sovereigns (Chart 2). The stock of long-term external market debt owed by EME governments was negligible throughout the 1970s and 1980s, but is now over three times as large as their bank borrowing from

abroad.<sup>(1)</sup> This represents a return to the pre-1930 period, when EME external debt was predominantly held in bonds rather than bank loans.

**Chart 1**  
**Net capital flows to EMEs**



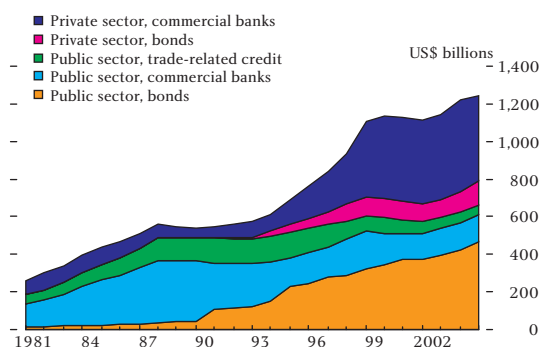
Source: Institute of International Finance (IIF).  
(a) IIF forecast.

EME (bank and non-bank) private sectors have also increased their borrowing rapidly from abroad since the early 1990s. Until the Asian crisis, this growth consisted mainly of bank loans. But more recently there has been a marked increase in EME private sector external bond issuance. The composition of external finance, however, has varied markedly across EMEs. On the whole, Latin American countries have a much larger share of outstanding external bond finance than emerging European countries and, in particular, emerging Asian ones, where almost two thirds of external debt still consists of bank loans.

(1) Long-term debt is defined as debt with more than one year original maturity. It is likely, however, that short-term debt consists mainly of bank loans.



**Chart 2**  
**EME long-term debt stocks held by non-resident creditors<sup>(a)(b)</sup>**



Source: World Bank.

- (a) Data exclude official creditor lending. Long-term debt is debt with an original maturity of more than one year.  
 (b) Data exclude newly industrialised economies (Hong Kong, Korea, Singapore and Taiwan).

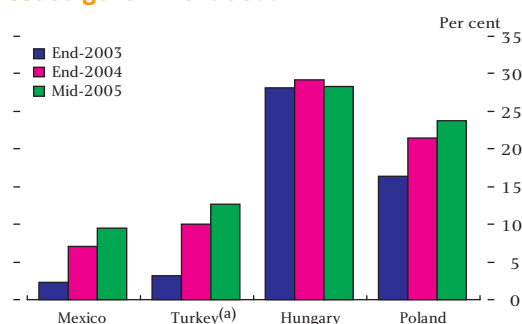
In total, net capital flows to EMEs are now almost back to levels witnessed before the Asian crisis and spreads on externally issued secondary market EME debt are at record lows. This renewed external demand for EME assets reflects a number of factors. There has been an improvement in EMEs' 'fundamentals'. Most EMEs have recorded strong output growth in recent years and many countries have been running continuous current account surpluses.<sup>(1)</sup> And despite the general shift to more flexible exchange rate regimes,<sup>(2)</sup> which should have reduced the need for reserves cover, most EMEs have built up their foreign currency reserves. Although government debt has remained high in many countries, debt structures have improved as active debt management has increased both the maturity of debt and the proportion that is denominated in local currency.<sup>(3)</sup>

The demand for EME assets has also been buoyed in recent years by low nominal interest rates in mature markets and an associated reduction in investor risk aversion. This has been accompanied by a broadening in the EME investor base, which could underpin financing in the future, even if cyclical factors, such as global yields, become less supportive. Following the marked decline of equity prices in developed countries during 2000–02, institutional investors have sought to diversify their portfolios,

including into EME assets. This has been accentuated by an increase in the number of EMEs rated as investment grade,<sup>(4)</sup> which has opened up the asset class to a broader range of investors. For example, according to JPMorgan's Investor Survey, non-speculative ('strategic') net investment by institutional investors in EME debt was US\$10 billion in the first ten months of this year — equivalent to 6% of total gross external debt issuance by EMEs during the period.

There has also been a marked increase in EME debt issued in domestic markets over the past three years, nearly all of which is denominated in local currency. There are no comparable EME-wide data on the proportion of local currency bonds held by foreigners, rather than domestic investors. But data on some of the most liquid domestic markets suggest that holdings of domestically issued government debt by foreign investors have increased markedly over the past two years (Chart 3).<sup>(5)</sup>

**Chart 3**  
**Non-resident share of outstanding domestically issued government debt**



Sources: Central banks and national treasuries.

- (a) Data for Turkey are calculated as a percentage of cash debt.

Foreign investors' demand for local currency bonds has been encouraged, in part, by an increase in risk tolerance. But it might also reflect a growing confidence in EME monetary policies.

Another recent (investor-driven) development in emerging markets has been the rapid growth in the OTC credit default swap (CDS) market. These derivatives are normally based on dollar and euro

(1) There are some notable exceptions. For example, according to the IMF (2005, September), Hungary and Turkey are expected to run current account deficits of more than 5% of GDP this year.  
 (2) The proportion of EMEs with fully floating exchange rates increased from under 20% in 1998 to 40% in 2004.  
 (3) For example, in Brazil the share of local currency bonds in the total public debt stock increased to around 77% at end-2004 from around 60% at end-2000.  
 (4) Almost half of the 32 EME sovereign bonds in the Emerging Market Bond Index Global (EMBIG) are now investment grade, compared with one quarter in 2002.  
 (5) There have also been some externally issued bonds, mainly by Latin American governments and corporates, denominated in local currency. In September 2005, the Brazilian government issued a local currency denominated bond in the global market worth almost US\$1.5 billion.

sovereign and corporate debt. Although there is no comprehensive data set on these instruments, the Emerging Markets Traders' Association (EMTA) reported that annual trading volumes in EME credit derivatives were almost \$200 billion in 2003 — roughly 5% of total trading in EME debt. The development of CDS indices based on sovereign and corporate debt contracts should facilitate further growth in EME usage of these instruments.<sup>(1)</sup>

### Propagation of EME shocks through the financial system

The increase in the amount and type of financial flows to EMEs outlined above has allowed borrowers to finance domestic expenditures at lower cost and lenders to diversify their portfolios. However, this closer integration of EMEs within the global financial system has also potentially increased the number and speed of channels through which shocks propagate across countries.

Financial crises in EMEs over the past 25 years have only materially affected financial stability in developed countries, including the United Kingdom, when they have occurred in close proximity to one another. For example, the marked rise in developed country bond spreads and the LTCM crisis during Autumn 1998 followed a wave of EME crises in the preceding 15 months. Therefore, this section assesses how the risk of spillovers from an individual EME crisis may have changed in light of the rapid growth in capital flows to EMEs in recent years and thus altered the likelihood of a more generalised financial stability disturbance from this source.<sup>(2)</sup>

Classens *et al* (2001) suggest that spillovers (contagion) from one EME to another can be characterised into two types: one relating to the borrowers' fundamentals and the other to the behaviour of creditors independent of the borrowers' financial strength. The likelihood of contagion through the latter channel is influenced by the nature of financial linkages.

For example, if a creditor experiences large losses on its loan book or the mark-to-market value of its assets in a crisis country, it may withdraw financing or sell

assets in other EMEs in the region or further afield.<sup>(3)</sup> For this indirect 'common creditor' propagation channel between EMEs to have a significant impact, it would probably have to affect the behaviour of the largest investors, which are usually domiciled in the major developed countries (see Kaminsky and Reinhart (2003) for evidence).

Selling assets over and above what would be expected based on the deterioration in the borrowers' fundamentals alone may be perfectly rational from the creditors' perspective. The relevant transmission mechanisms include:

#### Solvency/liquidity effects

Financial institutions subject to risk-based capital requirements may choose or be required by their regulator to restore capital ratios through selling assets, especially riskier ones. Japanese banks, which started with weak balance sheets, made large losses on lending to Thailand in 1997 and so withdrew credit lines from the region as a whole (Kaminsky and Reinhart (2000), Van Rijckeghem and Weder (2001) and Chui *et al* (2004)). But this channel of contagion may have diminished in relative importance with the increasing trend towards market-based finance.

A propagation channel that is potentially becoming relatively more important is the pressure, especially on non-bank intermediaries, of liquidity constraints. For example, in the face of losses in one EME, highly leveraged institutions, in particular, may face margin calls forcing them to sell marketable assets elsewhere (Valdes (1997), Calvo (1998)).

Even in the absence of margin calls, Schinasi and Smith (2000) suggest that highly leveraged investors would want to reduce risky asset positions, in general, following losses in one asset market. The largest, most liquid, markets might be expected to be affected most. This might partly explain the spillover from the crisis in Russia in 1998 to seemingly unrelated countries such as Brazil, Hong Kong and Mexico.<sup>(4)</sup> The downward spiral in asset prices might also cause losses for other financial firms holding similar assets and bring

(1) Currently, there are three broad emerging market CDS based indices: iTraxx Asia, CDX.EM and CDX.EM diversified.

(2) There is an important although separate question of whether the substitution of bond for bank finance is more or less likely to result in an individual EME crisis in the first place. See Tanaka (2005) for a recent discussion of the issues.

(3) Alternatively, creditors may regard EME borrowers as substitutes rather than as complements, especially if they have sufficient information separately to assess their financial strength. So in face of a country crisis, creditors may instead switch their portfolio between EMEs rather than withdraw funds generally from EMEs.

(4) See Kaminsky, Reinhart and Vegh (2003).

about funding problems if asset markets become illiquid.

The lack of comprehensive data on investors' market positions makes it difficult to judge with certainty whether this channel has indeed strengthened in recent years. Therefore, while reported profits of Large Complex Financial Institutions (LCFIs), in aggregate, are high, it is not possible to form a precise judgement on their exposures, or those of other investors,<sup>(1)</sup> to EMEs. An assessment is further complicated by the growing complexity of instruments, disguising the ultimate holder of risk. However, as described in Section 3, there are data that allow analysis at an aggregate country level.

### Investors' beliefs

In the face of a specific country shock, intermediaries might also re-evaluate the risks of other EMEs, even in the absence of a change in EMEs' fundamentals, or simply become more risk averse, thus causing a flight to quality and liquidity.

### Information asymmetries and herding

The impact on non-crisis countries would be accentuated if investors in financial markets follow the actions of others. When there are information asymmetries, investors may perceive that other investors that withdraw from an EME are privy to better information and thus follow suit (Banerjee (1992)). Using a mean-variance portfolio optimisation model, Calvo and Mendoza (2000) show that when the marginal costs of gathering and processing country specific information outweigh the benefits, it is rational for uninformed investors to follow the behaviour of perceived informed investors.

Given the incentives faced by individual fund managers, the recent diversification of institutional investors into EME assets could accentuate herding behaviour in EME financial markets in the face of an adverse shock. Scharfstein and Stein (1990), BIS (2003), and Rajan (2005) note, for example, that in practice fund managers' remuneration is based on their performance against other fund managers (usually proxied by the overall market

index). This makes it more likely that traditional (risk-averse) fund managers will follow the investment decisions of each other.<sup>(2)</sup>

However, the policy initiatives to improve the transparency of EMEs — and thus the availability of public information — in the wake of the Asian crisis should have reduced the risk of ill informed withdrawals from EMEs in the first place. Moreover, if institutional investors instead seek long-term EME investments to hedge against their long-term liabilities they may help to dampen market volatility.<sup>(3)</sup> And the increased activity in EMEs by hedge funds — whose managers are not remunerated by reference to the performance of other fund managers — may help to counteract the likelihood of herding if these investors take contrarian positions.

The size of these various propagation mechanisms and their impact depends, in part, on the ability of creditors and debtors to withstand adverse shocks. Even if a country has significant economic and/or financial links with a crisis country, the impact may be limited if it has built up a cushion of foreign reserves, or is prepared to adjust policy. And financial intermediaries are less likely to cut back lending or to sell financial assets the stronger are their balance sheets and those of their own creditors (depositors). Another factor which could reduce contagion is the extent to which crises are anticipated. These factors may help to explain why there was regional contagion following the Thai crisis but not after the more recent Argentine one (Hall and Taylor (2002) and Chui *et al* (2004)).

### Empirical evidence of the risks of contagion in EME financial markets

#### Recent crises

Given data limitations on bilateral capital flows, assessments of the extent of contagion across EME financial markets in past country-specific crises has relied mainly on analysis of financial prices. A number of studies show that co-movements in asset prices across EMEs have increased markedly in the aftermath of crisis (for example Calvo and Reinhart (1996) found an increase in (Brady) bond correlations

(1) There is evidence of an increase in hedge fund activity in EMEs. According to Tremont Capital Management, net asset flows into emerging market hedge funds were US\$7.5 billion in the first three quarters of 2005, compared with US\$6.6 billion in 2004 as a whole.

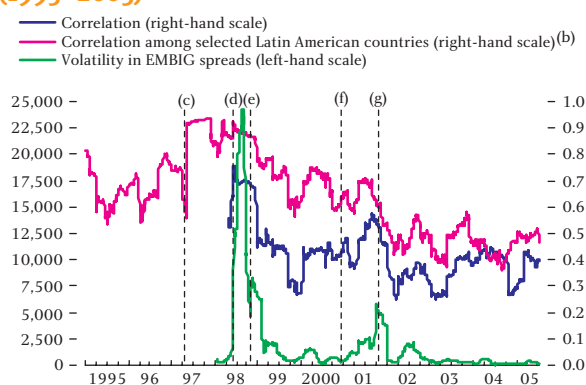
(2) The growing number of market entrants investing in EME assets may also have increased the likelihood of herding since these investors may find it less costly initially to follow the strategies of the market as a whole until they have established a reputation.

(3) See the *IMF Global Financial Stability Report*, September 2005, Chapter III, 'Aspects of Global Asset Allocation'.

in EMEs after the 1995 Mexican crisis and so did Baig and Goldfajn (1998) in the wake of the 1997 Asian crisis).

One measure of co-movements is the bilateral correlation of changes in asset prices. Chart 4 shows how the average cross-country correlation in emerging market sovereign bond spreads has evolved over the past ten years. This confirms that the largest jumps in correlations have been associated with some previous crises, particularly the Asian crisis in 1997 and the LTCM crisis in 1998. However, there was only a moderate reaction of spreads to the more recent Argentine crisis.

**Chart 4**  
**Average bilateral correlation in the EMBIG (1995–2005)<sup>(a)</sup>**



Sources: JPMorgan Chase and Co. and Bank calculations.  
(a) Average of the bilateral correlation of weekly changes in EMBIG spreads of the 20 countries included in the index: six-month moving window. Excluding Argentina makes little difference to the results.  
(b) Argentina, Brazil, Mexico and Venezuela.  
(c) Asian crisis – 27 October 1997.  
(d) Russia/LTCM crisis – 18 August 1998.  
(e) Brazil devaluation – 13 January 1999.  
(f) Turkey devaluation – 22 February 2001.  
(g) Argentina default – 23 December 2001.

## The current conjuncture

Given the rapid growth in market-intermediated flows and fall in bond spreads in recent years, an important question is how can data be used *ex ante* to assess the current risks of contagion between EME financial markets? As in the past, such contagion could have broader implications for global financial stability.

A survey recently introduced by the IMF — the *Co-ordinated Portfolio Investment Survey* (CPIS) — gives

an end-year snapshot of the outstanding amounts of long-term debt securities<sup>(1)</sup> (and equities) held, in aggregate, by investors resident in individual creditor countries in debtor countries.<sup>(2)</sup> The origin of investments is based on a residency basis (the ‘centre of economic interest’) rather than a company ownership one and so might not necessarily capture the location of the ultimate risk or investment decision. For example, investment made by a subsidiary of a US financial group located in London would be classified under the United Kingdom. There are also a number of gaps in the data, especially with respect to short-term debts (original maturity of one year or less), which are therefore excluded from the analysis reported below.<sup>(3)</sup> The data are also aggregated at the country level, so they do not show the market investment patterns of individual financial institutions. Nonetheless, they provide useful information in assessing the risk of contagion. In particular, unlike market prices, they can be used to assess the degree of dispersion of EME borrowing across creditor countries and the extent to which EMEs borrow from the same countries.

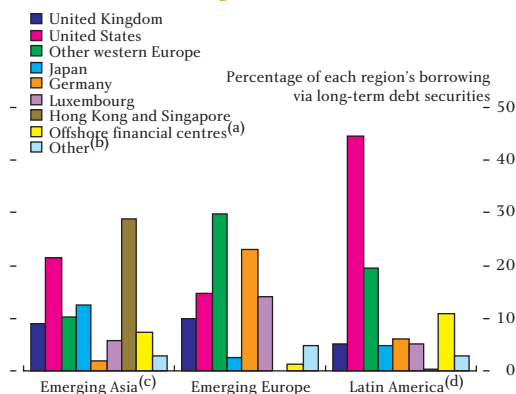
As discussed in the previous section, following a crisis in one EME, spillovers can occur indirectly in other EMEs through the actions of common creditors. Charts 5 and 6 show the concentration of borrowing via bonds, and for comparison from foreign (BIS) banks, by EME region at end-2003, according to the latest survey. Although there is a strong regional dimension to capital flows, in emerging Asia and Europe borrowing via long-term debt securities seems to be generally more diversified than borrowing from foreign banking systems.<sup>(4)</sup> This suggests that their access to finance is less reliant on the behaviour of individual creditor country investors for bond finance than for bank finance. Latin America appears to have the most concentrated borrowing via both bonds and banks (Table A).

A more precise measure of common creditors is the relative common creditor index proposed by Van Rijckeghem and Weder (2001) and Glick and

(1) Long-term debt securities cover bonds, debentures and notes with an original maturity over one year, but the data exclude financial derivatives.  
(2) The data are on a residency basis and include domestic private and public sector assets held by both foreign private and public sectors (excluding holdings of foreign exchange reserves).  
(3) The combined outstanding stock of long-term debt securities in the survey of the 23 EMEs (excluding the newly industrialised countries) in Chart 7 was US\$295 billion at end-2003 — about 60% of their combined total long-term bond debt reported in the World Bank Global Development Finance.  
(4) Similarly, from a creditor country perspective, including the United Kingdom, lending through long-term debt securities is generally well diversified across EME regions.

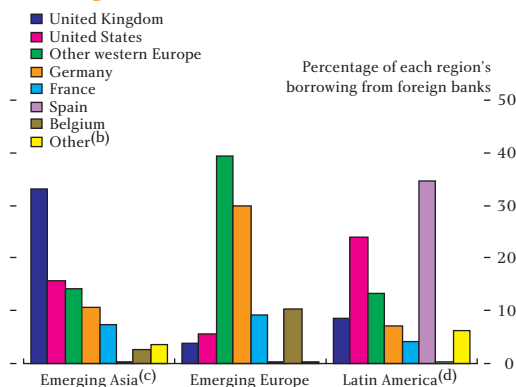
Rose (1999). The index captures the similarity of individual EMEs' borrowing (as a share of their total borrowing) from foreign creditors.<sup>(1)</sup>

**Chart 5**  
Dispersion of EMEs' borrowing in long-term debt securities, end-2003



Sources: Co-ordinated Portfolio Investment Survey, IMF and Bank calculations.  
 (a) Offshore financial centres consist of Aruba, Bahamas, Bahrain, Barbados, Bermuda, Cayman Islands, Guernsey, Isle of Man, Jersey, Lebanon, Macao, Mauritius, Netherlands Antilles, Panama and Vanuatu.  
 (b) 'Other' consists of Australia, Canada, Cyprus, Iceland, Malta, New Zealand and borrowing from other EMEs.  
 (c) Includes Hong Kong, the Pacific Islands and Singapore.  
 (d) Includes the Caribbean.

**Chart 6**  
Dispersion of EMEs' borrowing from foreign banks, end-2003<sup>(a)</sup>



Sources: Bank for International Settlements and Bank calculations.  
 (a) Foreign claims, immediate borrower basis.  
 (b) 'Other' consists of Australia, Brazil, Canada, Chile and Mexico.  
 (c) Includes Hong Kong, the Pacific Islands and Singapore.  
 (d) Includes the Caribbean.

**Table A**  
Herfindahl index: concentration of borrowing through long-term debt securities and foreign banks, end-2003

10,000/Herfindahl index <sup>(a)</sup>	Bank borrowing	Long-term debt securities
Emerging Asia <sup>(b)</sup>	6	8
Emerging Europe	7	8
Latin America <sup>(c)</sup>	5	4

Sources: Bank for International Settlements, Co-ordinated Portfolio Investment Survey, IMF and Bank calculations.  
 (a) A lower number represents more concentrated borrowing. The number can be interpreted as the number of equal-sized creditors that a country borrows from.  
 (b) Includes Hong Kong, the Pacific Islands and Singapore.  
 (c) Includes the Caribbean.

Chart 7 shows the bilateral matrix of relative common creditor indices between EMEs of borrowing via long-term debt securities at end-2003 (the last year of available data). Overall, the pattern of borrowing through bonds within EME regions is more similar than across regions (this is reflected by the darker colours in the 'heat' map in Chart 7). But, in general, EMEs' long-term debt borrowing patterns from foreign creditors are not very similar (reflected by the overall relatively light colouring in the 'heat' map).<sup>(2)</sup> This seems to suggest that the potential for contagion in EME bond markets, via the actions of common creditors — proxied by the residency of investors — is not high.

Even though the survey data suggest that EME borrowing from creditor countries through financial markets is quite dispersed, a shock to a particular EME could still lead to a generalised 'wake up' call to all EME investors. This would be accentuated if there is herding amongst investors. At first blush, as shown in Chart 4 above, the average bilateral correlations of changes in EME bond spreads in recent years has not been particularly high and less than before the Asian crisis — the last time there was a marked increase in EME asset prices and capital inflows (followed by a reversal). However, these averages mask a concentration of high bilateral correlations between some large EMEs, notably between Russia, Turkey and Brazil (all above 0.8).

(1) The index is calculated as:

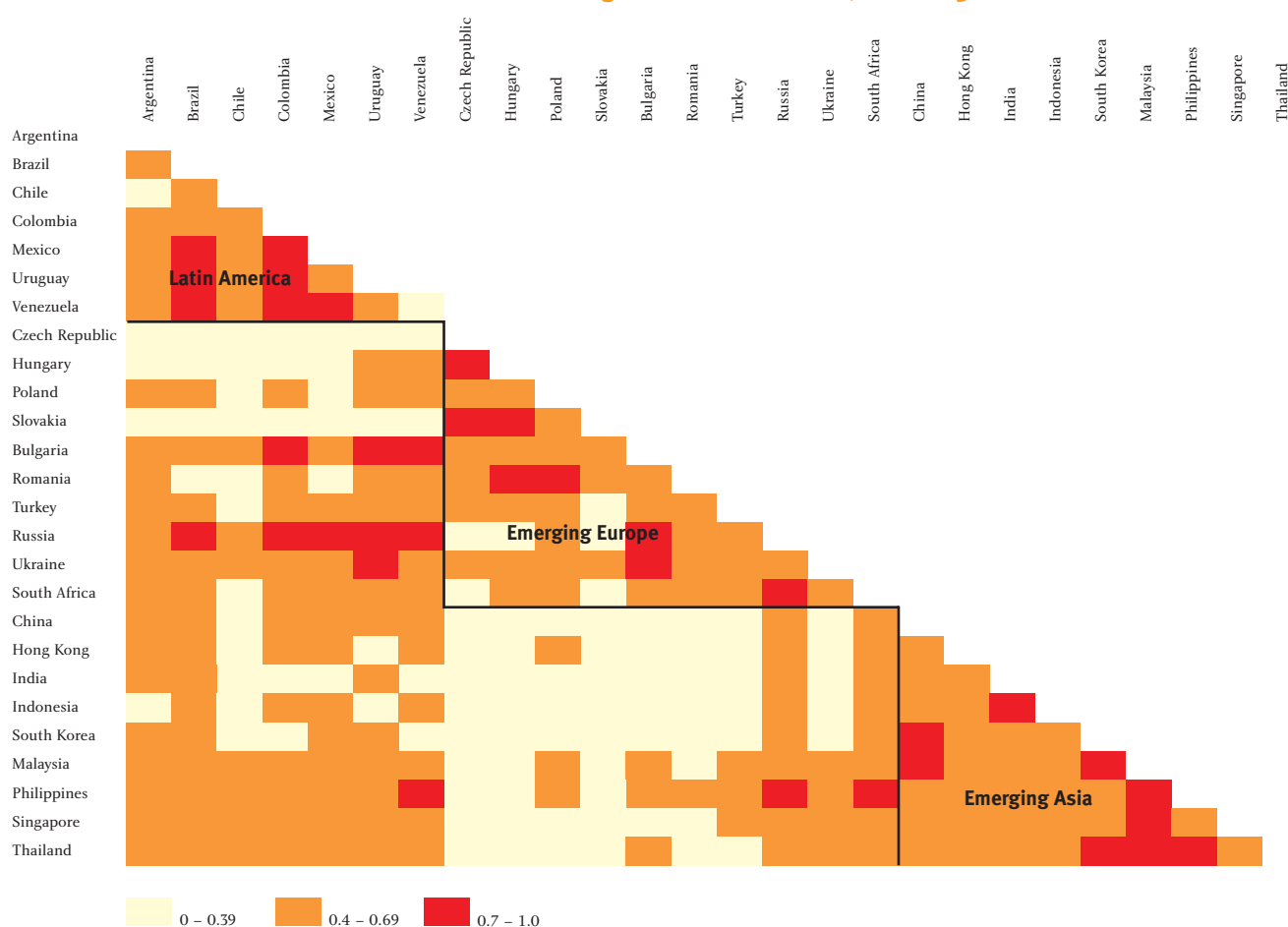
$$\text{Relative Common Creditor Index}_{(0,i)} = \sum_{\kappa=1}^{42} \left( \frac{B_{0\kappa} + B_{i\kappa}}{B_0 + B_i} \right) \left[ 1 - \left( \frac{\frac{B_{0\kappa} - B_{i\kappa}}{B_0 - B_i}}{\frac{B_{0\kappa} + B_{i\kappa}}{B_0 + B_i}} \right) \right]$$

where,  $B$  is the amount of external borrowing,  $0$  is the original crisis EME,  $i$  is another EME and  $\kappa$  are investors from the common creditor country. The index is a positive function of borrowing from common creditors (relative to the EMEs' total borrowing) and of the similarity of each EME's share of borrowing from foreign creditors. Therefore, as EMEs' overall borrowing patterns become more similar, the index approaches 1.

(2) They are also less similar than their borrowing from foreign (BIS) banks (see Chui *et al* (2004)).

Chart 7

Relative common creditor index for select EMEs of long-term debt securities, end-2003<sup>(a)</sup>



Sources: Co-ordinated Portfolio Investment Survey, IMF and Bank calculations.

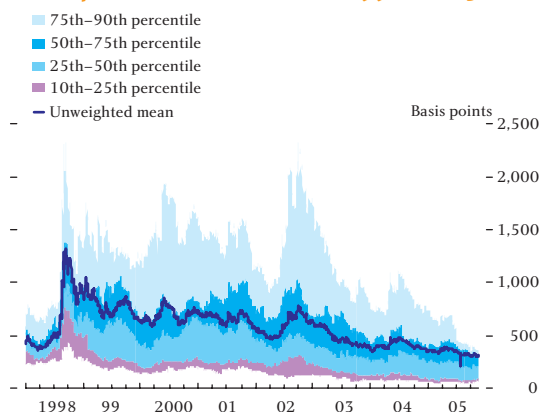
(a) Creditor countries consist of Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, the United States, Aruba, Bahamas, Bahrain, Barbados, Bermuda, Cayman Islands, Guernsey, Isle of Man, Jersey, Lebanon, Macao, Mauritius, Netherlands Antilles, Panama, Vanuatu, Hong Kong and Singapore.

A widespread reversal in capital flows would be more likely to the extent that inflows have been caused by factors other than sustainable improvements in EMEs' financial strength, such as an increase in investor risk tolerance or in global liquidity. Chart 8 shows the dispersion of bonds spreads within the EMBIG index (excluding default) since 1998.<sup>(1)</sup> The compression in country spreads is now as narrow as before the Russia crisis. More strikingly, the reduction in spreads has been concentrated among bonds with the initial highest yields, such as those issued by Brazil and Turkey. This decline in the level and dispersion of spreads has also been greater than changes in country credit ratings suggest is warranted. For example, whereas the EMBIG has fallen by nearly 600 basis points over the past three years, the average credit rating of EMEs in the EMBIG has increased by only two notches, while spreads on

bonds issued by countries with the lowest credit quality have fallen particularly more than suggested by changes in their credit ratings (Chart 9). This description is consistent with our in-house model, which suggests that less than 20% of the fall in EMBIG spreads since the peak of the US interest rate cycle in January 2001 can be attributed to an improvement in EME fundamentals (proxied by sovereign credit rating upgrades). The remainder reflects an increase in global liquidity and in risk tolerance. Spreads are also lower currently, by around 75 basis points, than suggested by this model and relative to their recent historical relationship with spreads on high yield US debt. This may indicate that investors are not paying sufficient attention to country differences and could make bond spreads sensitive to a decline in risk tolerance and deterioration in market liquidity conditions in the future.

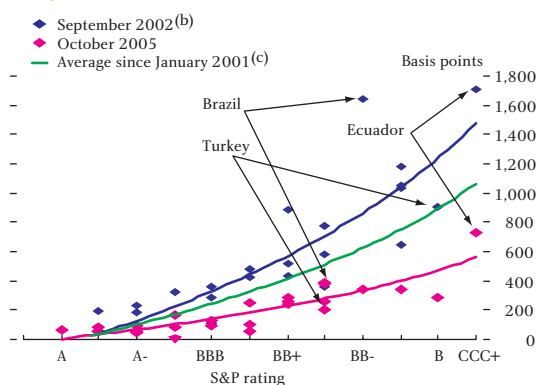
(1) The EMBIG index shown in the chart and discussed hereafter excludes defaulted bonds, primarily in Argentina.

**Chart 8**  
**The dispersion of the EMBIG<sup>(a)</sup> 1998–2005**



Sources: JPMorgan Chase and Co. and Bank calculations.  
 (a) Excluding default.

**Chart 9**  
**Sovereign credit rating and bond spreads for selected EMEs<sup>(a)</sup>**



Sources: JPMorgan Chase and Co. and Standard & Poor's.  
 (a) Lines represent the logarithmic best-fit. Ratings are plotted linearly.  
 (b) The peak of EMBIG spreads.  
 (c) Average of end-January observations for each year since 2001.

## Conclusion

There has been a marked increase in capital flows, especially intermediated through markets, to EMEs in recent years. This has also been associated with a broadening in the range of creditors, EME borrowers and types of instrument.

The last time that capital inflows to EMEs were as strong was before the Asian and subsequent Russia/LTCM crises, so the current conjuncture raises the question of how significant is the risk that capital

flows across EMEs could reverse, for example following an adverse shock to a specific country.

Any assessment is clouded by data limitations. Nonetheless, bond investments in EMEs at the aggregate country level seem quite well diversified from the perspective of debtor (and creditor) countries. Latin America appears to have the most concentrated foreign borrowing of bond (and bank) finance.

However, it is difficult to assess investors' liquidity risk. In particular, there are no comprehensive data on market exposures, including financial derivatives, by individual or type of financial institutions in EMEs. Also, data on the financial strength of institutions investing in EME debt is partial. Moreover, despite improvements in official data dissemination on EMEs' financial strength, there is still a risk of investors adopting herding behaviour in EME markets. Set against the background of continued strong world economic growth and low world interest rates, investors have collectively shifted funds into EMEs, including those with lower credit quality. Consequently, the level and dispersion of EME bond spreads have fallen close to record lows and by more than suggested by changes in their sovereign credit ratings. There has also been a high correlation recently of investment activity in a few large EME financial markets.

That said, recent episodes, such as the Argentine crisis, suggest that investors may be better able now to distinguish the credit quality of individual EMEs in times of stress. In addition, most EMEs appear to be less vulnerable to a withdrawal of international capital and to have in place a more flexible policy framework to deal with such a shock than was the case in the 1990s. Although necessarily tentative, the overall conclusion is that there is currently a risk of some reversal in investors' demand for EME assets but that the likelihood of widespread contagion affecting global financial stability is somewhat less than in the past.

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# Credit correlation: interpretation and risks

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Two of the most significant developments in global credit markets in recent years have been the rapid growth of the market for collateralised debt obligations (CDOs), which repackage the credit risk of bespoke asset portfolios into tranches and transfer it from dealers to investors; and the development of markets in tradable credit derivative indices and tranches of these indices. As well as the individual default risk associated with each asset in the underlying portfolios, investors and dealers in tranches are also exposed to correlation risk — uncertainty about the likelihood of defaults occurring in clusters. The existence of traded prices for index tranches makes it possible to infer market perceptions of correlation risk. This article uses a CDO valuation model to explore the usefulness of such information as a forward-looking indicator of risk to financial stability. The article also investigates the particular correlation risks taken by investors and dealers in CDOs, which may be relevant to global financial stability given the scale of risk transfer in recent years and the concentrated participation of large banks and dealers in these markets.

## Introduction

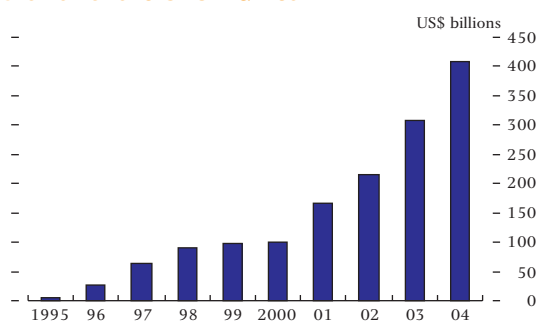
**COLLATERALISED DEBT OBLIGATIONS** (CDOs) repackage the credit risk on portfolios of debt-like assets<sup>(1)</sup> into multiple tranches of securities, which vary in seniority. If any of the assets in the portfolio default during the life of the CDO, the resulting losses accrue first to junior tranches and only to senior tranches if the losses reach a sufficient magnitude. The capital value of the most senior tranches is therefore only likely to be jeopardised by the possibility of widespread default.

The CDO market has grown rapidly since regular issuance began in the mid-1990s (Chart 1). Global issuance reached around US\$410 billion last year, which was equivalent to a little over 10% of the volume of US Treasury bills issued. And, according to a recent survey by the BIS, the notional principal outstanding of portfolio credit default swap (CDS) contracts on the books of dealers that report to the BIS was US\$1.2 trillion at end-June 2005.<sup>(2)</sup>

The growth of the bespoke CDO market in recent years has been supported by high demand for leveraged exposures to diversified credit portfolios from banks, asset managers and insurance companies,

especially in continental Europe and Asia (the so-called 'structured credit bid'). At the same time, a rapid pace of product innovation has enabled banks and dealers to structure bespoke CDOs to meet investors' needs more precisely.

**Chart 1**  
Growth of the CDO market<sup>(a)</sup>



Source: JPMorgan Chase and Co.

(a) Sum of issuance of funded CDOs, which are based on physical securities, and unfunded synthetic CDOs (see footnote 1 for definition).

Hedging of bespoke CDOs has been an important reason for the rapid growth in trading of standardised CDS indices and the tranches of these indices. Growth in trading of standardised tranches has been particularly marked since the merger, in mid-2004, of

(1) Portfolios may comprise bonds, loans, asset-backed securities such as mortgage-backed securities, or even other CDOs (generating a 'CDO-squared'). Synthetic securities that replicate the cash flows of other assets, such as credit default swaps, may also form portfolios (generating a synthetic CDO). For further detail see Rule (2001).

(2) See BIS (2005).

leading US and European CDS indices into single products — the CDX indices in the United States and the iTraxx indices in Europe.<sup>(1)</sup> One estimate of the total trading volume of CDS index tranches in 2005 Q2 was US\$140 billion.<sup>(2)</sup> Standardised index tranches have fixed ‘attachment points’ and ‘detachment points’ that determine how portfolio losses are allocated to each tranche.

A key feature of both bespoke CDO tranches and credit index tranches is that they provide exposure to the co-dependence between defaults in a portfolio — so-called ‘default correlation’.<sup>(3)</sup> Default correlation reflects the extent to which defaults are likely to occur in clusters when they materialise. For any portfolio of credits with a given expected default rate, higher levels of default correlation would imply that senior tranches were more likely to be exposed to losses over the life of the CDO transaction. The spreads at which CDO tranches are bought and sold consequently reflect not only the credit risk of each asset in the underlying portfolio, but also market perceptions of the level of default correlation between these assets.

This article uses a CDO valuation model (outlined in Box 1) to show how CDO tranches react to changes in market views about default correlation and how observed index tranche spreads can be used to make inferences about the level of perceived default correlation in portfolios. High levels of implied default correlation may be explained by an important determinant of default that is common across assets, or by strong interlinkages in the portfolio that could generate chains of default. Given that a cluster of corporate defaults may be more likely to threaten the banking sector, implied correlation may therefore be a valuable forward-looking indicator of financial stability.

The same valuation model is then used to investigate some of the correlation risks faced by CDO investors and dealers. While this topic has been discussed elsewhere (see, for example, Cousseran and Rahmouni (2005), ECB (2005) and Fender and Mitchell (2005)), this article attempts to quantify the risks. This is

particularly relevant to an assessment of the financial stability conjuncture given the scale of credit risk transfer in CDO tranches in recent years and the associated large ‘correlation books’ — collections of positions in bespoke CDO tranches and offsetting hedges in single-name CDS and CDS index tranches — of the major banks and dealers, even though these are designed (as far as possible) to be neutral to changes in the general level of credit spreads or implied correlation.

The next section explains how the value of CDO tranches depends on the level of default correlation, before a subsequent section inverts this logic to infer market perceptions of default correlation from tranche prices. A third section then considers some practical difficulties involved in making inferences about market perceptions of default correlations. The penultimate section uses the valuation model of Box 1 to quantify some of the correlation risks taken by investors and dealers. A final section concludes.

### Default correlation and CDO valuation

The valuation model outlined in Box 1 is similar to many textbook models for valuing credit portfolios. It uses data on the individual CDS that are included in the portfolio to estimate a loss distribution for each of the credits referenced by the CDS contracts. These loss distributions are then joined together (using a Gaussian copula function) to generate a joint loss distribution for the entire portfolio, which can be used to price individual tranches.

By calibrating the model to the 125 CDS contracts in the Dow Jones North American Investment Grade (CDX.NA.IG) index at the end of 2005 Q3, it is possible to simulate how default losses are distributed across tranches, and how this distribution varies with the assumed rate of default correlation.<sup>(4)</sup> Chart 2 shows the probability distribution of losses on the CDX.NA.IG index for two different assumptions about correlation — either that defaults are entirely independent or that there is a default correlation of 0.4. The dotted vertical lines in the chart mark attachment and detachment points of the three most junior standardised tranches, so it possible to see

(1) The main investment-grade indices are comprised of 125 CDS contracts that are judged to be the most liquid in their respective regions and sectors. Smaller sub-indices and high-yield indices are also widely traded.

(2) Source: Creditflux.

(3) Strictly, tranches provide exposure to the co-dependence of defaults, although market participants usually refer to them as providing exposure to ‘default correlation’. Co-dependence is a broader notion of association than correlation, although for random variables drawn from joint elliptical distributions (such as the Normal distribution) the two concepts are equivalent.

(4) To improve the accuracy of the model presented in Box 1, future cash flows are discounted to present values using the five-year US swap rate in this calibration exercise.

## Box 1: A simple CDO valuation model

This box outlines a CDO valuation model that uses Monte Carlo simulation to calculate fair CDO tranche spreads. The model has three stages. The first stage uncovers market perceptions of default probabilities for each of the underlying assets at various horizons and simulates a probability distribution of losses on each of these assets. The second stage combines these distributions for individual assets into a *joint* distribution of losses in the underlying portfolio, before aggregating over assets to deduce a probability distribution of total losses. In the final stage, total losses are allocated to tranches, along with associated probabilities, and fair tranche spreads are derived. These stages are described in more detail in a hypothetical example below.

Consider a CDO based on a portfolio with a face value of US\$1 billion, comprised of US\$10 million holdings in each of 100 assets. Three tranches of securities are issued against this portfolio: an equity tranche, a mezzanine tranche and a senior tranche. The face values of each are respectively US\$50 million, US\$100 million and US\$850 million. All the securities mature in one year's time.

The equity tranche bears the first of any losses on the underlying portfolio. So, if one of the assets in the portfolio were to default and only 40% of its face value were recovered, the resulting US\$6 million loss would fall on the equity tranche, reducing its value to US\$44 million. Any subsequent losses would continue to erode the capital of the equity tranche until total losses reached US\$50 million. This is the detachment point of the equity tranche. It is also the attachment point of the mezzanine tranche, so additional losses would fall on this tranche, until total losses reached the mezzanine detachment point of US\$150 million. If still further losses were incurred before the maturity of the CDO, these would fall on the senior tranche.

Each CDO tranche pays an income stream to investors, providing compensation for the possible capital losses that might be incurred. The income yields of tranches, which are reported as spreads over a risk-free rate of interest, therefore depend on the

probability distributions of these potential losses. These, in turn, depend on the joint probability distribution of losses in the underlying portfolio.

A first step towards estimating the joint probability distribution of losses is to estimate individual default probability functions for each of the portfolio assets. A default probability function,  $p_i(h)$ , measures the probability that asset  $i$  will default over any horizon,  $h$ , from the present to the maturity of the CDO,  $\tau$ . A crude way to estimate these functions is to infer market-implied probabilities of default at certain horizons from available yield spreads and to interpolate. For example, if the yield spread on asset  $i$ , which matures in one year, is  $s_i(1)$ , then one point in its default probability function is given by:

$$p_i(1) = \frac{s_i(1)}{1 - r_i + s_i(1)}, \quad (1)$$

where  $r_i$  is the fraction of face value that can be recovered in the event of default.

Equation (1) is derived by setting the expected income gain from investing in asset  $i$  (which is  $(1 - p_i(1))s_i(1)$ ) equal to the corresponding expected capital loss (which is  $(1 - r_i)p_i(1)$ ).<sup>(1)</sup> As this equation is based only on expected cash flows and does not take into account the distribution of upside and downside possibilities around these expectations, the market-implied probability of default,  $p_i(1)$ , that emerges is a 'risk-neutral' probability. Risk-neutral probabilities generally do not correspond to true market perceptions about the likelihood of default.<sup>(2)</sup> Nevertheless, they can still be used to value CDO tranches — and indeed simplify the process — as long as the computation of tranche spreads from probability distributions of tranche losses is conducted using the same risk-neutral basis.

Having estimated individual default probability functions, the next step is to simulate whether each asset in the portfolio defaults before the maturity of the CDO and, if so, to calculate a default time. This may be done by comparing each  $p_i(h)$  function with a random drawing from a uniform probability density

(1) To simplify this illustration of CDO valuation, the risk-free rate of interest has been set to zero, so there is no need to convert future gains and losses into present values by discounting.

(2) The only exception would be if market participants were actually neutral in their attitudes towards risk.

that is distributed between zero and one,  $u_i$ . If  $u_i = p_i(h)$  at a particular value of  $h < \tau$ , asset  $i$  is assumed to default at time  $h$  in the current simulation. Otherwise, it is assumed not to default over the life of the CDO. Crucially,  $u_i, \dots, u_{100}$  are not independent, but generated by a joint probability distribution that reflects whether or not assets are likely to default simultaneously.

A positive correlation between most  $u_i$  and  $u_j$ , for example, might be expected if common factors affect default prospects and/or there is the potential for spillovers between the financial strength of related companies. A popular way to introduce correlation between  $u_i$  and  $u_j$  is to set  $u_i = \Phi(v_i)$  and  $u_j = \Phi(v_j)$ , where  $v_i$  and  $v_j$  are drawn from a standard joint normal probability distribution with correlation parameter  $\rho$ , and  $\Phi$  represents the cumulative standard normal probability function. The joining function that generates  $v_i$  and  $v_j$  is known as a 'copula function'. In this example, we are using the 'Gaussian' or 'normal' copula. Chart A illustrates the determination of default times in one simulation.

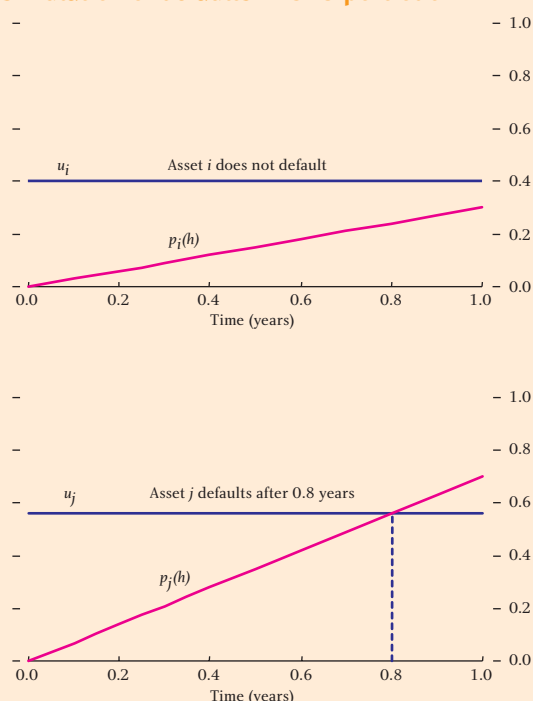
This simulation is repeated many times. On each occasion a new set of  $u_i, \dots, u_{100}$  determines which assets default and the timing of these defaults. Assuming a constant recovery rate across bonds of 40%, the number of defaults in each simulation can be translated into losses by multiplying by US\$6 million. These losses are subsequently allocated to tranches according to attachment and detachment points, as outlined above. The probability associated with each simulation is the reciprocal of the total number of simulations. Running a large number of simulations generates the required probability distribution of losses on each tranche.

The final step is to compute tranche spreads,  $s_t$ , from the probability distributions of tranche losses. The appropriate formula is:

$$s_t = \frac{E_m(L_{mt})}{E_m(C_{mt})}, \quad (2)$$

where  $L_{mt}$  denotes the capital loss on tranche  $t$  in simulation  $m$  and  $C_{mt}$  denotes the average remaining capital<sup>(3)</sup> of the tranche over the life of the CDO, again in simulation  $m$ . This formula is also derived by setting expected income gains,  $s_t E_m(C_{mt})$ , equal to expected capital losses,  $E_m(L_{mt})$ . Only the expectations of gains and losses are required, because the probability distributions of tranche losses have been derived on a risk-neutral basis.

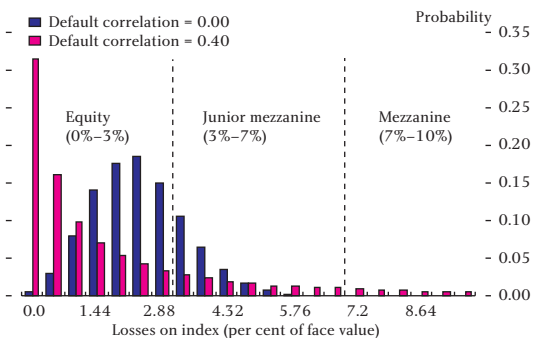
**Chart A**  
**Simulation of defaults in CDO portfolio**



(3) It is necessary to simulate the timing of defaults, and not simply the incidence of default, in order to compute  $C_{mt}$ .

how losses would fall on some of the tranches issued against this index. Box 1 explains how losses are distributed across tranches in more detail.

**Chart 2**  
**Probability distribution of losses on the Dow Jones CDX.NA.IG index<sup>(a)</sup>**



Sources: Bloomberg, Markit and Bank calculations.  
 (a) Attachment and detachment points are quoted as a percentage of the face value of the CDX.NA.IG index.

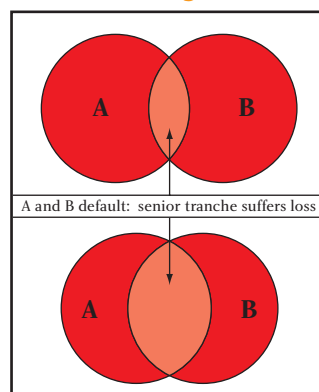
A higher rate of default correlation increases the likelihood of polar outcomes in which either the majority of underlying credits default or very few credits default over the life of the CDO. As a consequence, a high rate of default correlation also reduces the likelihood of intermediate outcomes in which a modest proportion of the underlying credits default. This benefits equity investors, because the transfer of probability mass from intermediate outcomes to outcomes with very few defaults increases the chance of equity capital being preserved over the life of the CDO. At the same time, investors in senior tranches become worse off because there is more chance of clustered defaults, which could erode some of their capital.

To understand more intuitively why the value of equity tranches rises with default correlation whereas the value of senior tranches falls, consider a two-tranche CDO that is backed by a portfolio of just two assets, A and B. Assuming a recovery rate of zero, if either A or B were to default, this would eradicate the capital of the first-loss or ‘equity’ tranche but would not affect the senior tranche. If A and B were to default, however, the capital of both the equity and senior tranches would be eradicated. These potential outcomes are illustrated in Chart 3.

The top panel depicts a low default correlation between A and B. In this panel, the likelihood of the senior tranche incurring a loss (indicated by the size of the light red area) is small relative to the likelihood

of the equity tranche incurring a loss (indicated by the size of both the light and dark red areas). In contrast, the lower panel depicts a high default correlation between A and B. Despite there being no change in the default probabilities of the individual assets, it is clear that the increase in default correlation has reduced the potential for equity tranche losses, while the potential for senior tranche losses has increased.

**Chart 3**  
**Illustration of high and low default correlation<sup>(a)</sup>**



(a) Each point in the rectangle represents a potential outcome for the portfolio. The dark red areas represent events where one of the underlying assets defaults. So the light red overlap between the circles shows events where both assets default and the white area indicates no defaults.

The effect of default correlation on intermediate tranches is more complicated. An increase in default correlation from a low level increases the risk of loss faced by an intermediate tranche, because the likelihood of defaults occurring on a scale sufficient to affect the capital of the tranche rises. But beyond a certain level, further increases in default correlation can reduce the potential losses to mezzanine tranches because the increased probability of very few defaults is of greater benefit than the accompanying increase in the probability of highly clustered defaults.

The spread earned on CDO tranches reflects the probability distribution of losses on each tranche. It follows that default correlation is an important determinant of tranche spreads through its effect on the probability distribution of losses on each tranche. Chart 4 illustrates the relationship between default correlation and tranche spreads.

**Standardised index tranches and implied default correlation**

The development of an actively traded market in standardised index tranches has made it possible to

infer market views about default correlation. More specifically, it is possible to invert CDO valuation models such as the one described in Box 1 to compute a measure of implied default correlation, given observed tranche prices. The process is analogous to inverting the Black-Scholes option pricing model to quote options prices in terms of implied volatility. Indeed, standardised tranches are often quoted as implied correlations rather than spreads. At present, the index tranche market is most liquid at the five-year maturity, which gives a view of anticipated default correlation over the next five years. But liquidity is increasing at the seven and ten-year maturities, which should make it possible to derive a correlation forward curve in due course.

portfolio, and other factors such as expected recovery rates and risk premia required for bearing default and recovery risk.

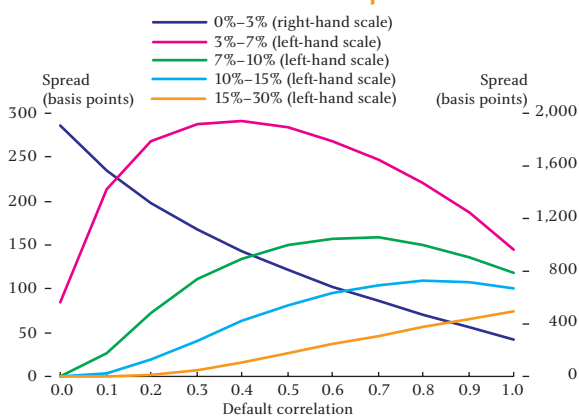
Tranche spreads reflect how the market expects total credit losses on the portfolio to be distributed across the different tranches. Moves in tranche spreads *not* accompanied by a change in the perceived riskiness of the index as a whole should, in principle, reflect only a change in the market view of default correlation. More specifically, a rise in the proportion of expected losses contained in the equity tranche should, other things equal, coincide with a reduction in the losses expected on senior tranches and a fall in implied correlation. Intuitively, moves in the relative riskiness of each tranche are like squeezing air in a balloon — squeezing risk out of one tranche necessarily forces it into the others. These relative shifts are reflected in changes in implied correlation.

In practice, however, changes in observed implied correlation rarely occur in isolation from changes in spreads on the overall index, given that both measures are continually evolving. A widening in index spreads accompanied by a fall in implied correlation might suggest that the increase in expected default is expected to fall mostly on the equity tranche, consistent with a rise in the likelihood of default by one or two companies referenced in the index, but no change in the perceived risk of the other constituents and no generalised rise in risk premia.

In contrast, a widening in spreads accompanied by a shift in risk into the more senior tranches would raise implied correlation. This might suggest an increased risk of a cluster of defaults, perhaps linked to a common shock affecting several sectors of the economy. Alternatively, it might reflect an increase in required risk premia by investors, perhaps associated with greater macroeconomic uncertainty or increased investor risk aversion.

To illustrate how spreads on different traded tranches (and the levels of default correlation they imply) can be used in conjunction with other credit indicators to make inferences about market perceptions of the likelihood of a ‘systemic’ event, Chart 5 shows the evolution of the spread on the main five-year Dow Jones CDX.NA.IG index. It shows that spreads on the index widened sharply in early May 2005,

**Chart 4**  
**Default correlation and tranche spreads<sup>(a)</sup>**



Sources: Bloomberg, Markit and Bank calculations.  
(a) Attachment and detachment points are quoted as a percentage of the face value of the CDX.NA.IG index.

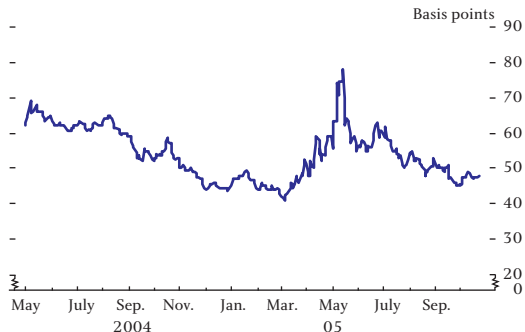
For market participants, the availability of a market-based measure of default correlation has facilitated the valuation of bespoke CDOs and, in turn, the marking-to-market of their positions that are sensitive to the rate of default correlation. For example, dealers are able to calibrate their models used to price bespoke CDO tranches to ensure that, as far as possible, the default correlation assumptions that they maintain to price more exotic products are consistent with those observed in standardised index markets.

### Implied correlation as an indicator of financial stability risk

A CDS index is effectively a diversified credit portfolio and so index spreads reflect market participants’ perceptions about expected losses on a diversified, liquid portfolio. More specifically, index spreads reflect the expected number of defaults in the

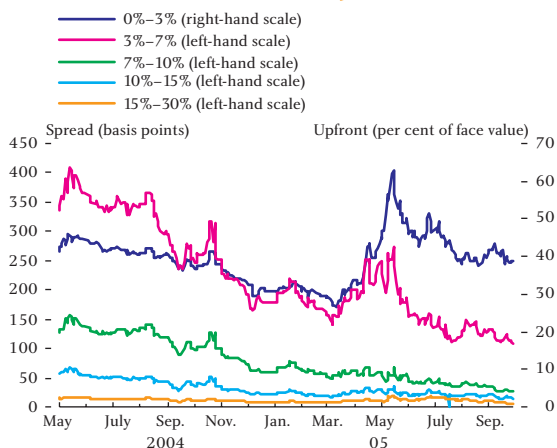
which could have been interpreted as a widespread deterioration in credit quality and/or increase in risk premia.

**Chart 5**  
Dow Jones CDX.NA.IG index spread<sup>(a)</sup>



Source: JPMorgan Chase and Co.  
(a) Five-year on-the-run CDX.NA.IG index.

**Chart 6**  
Dow Jones CDX.NA.IG tranche prices<sup>(a)(b)</sup>

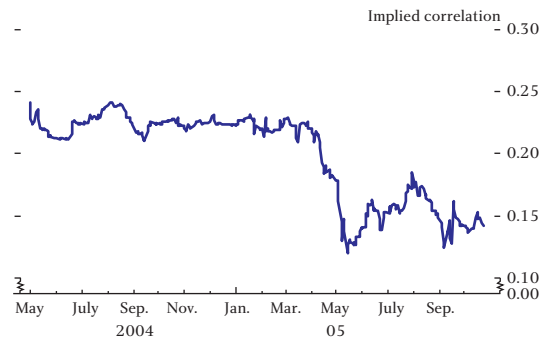


Source: JPMorgan Chase and Co.  
(a) Five-year on-the-run CDX.NA.IG tranche spreads.  
(b) The market convention is to pay a running spread of 500 basis points on equity tranches and to make an upfront payment that increases with possible losses, rather than to pay a much higher running spread.

But the spreads on different traded tranches of the CDX.NA.IG (Chart 6) reveal that the sharp widening in spreads only affected the more junior tranches. In part, this may have reflected the fact that the spread widening was triggered by developments in a single sector of the economy, namely the downgrade of Ford's and General Motors' debt to sub-investment grade.<sup>(1)</sup> As the spreads on the 7%–10% mezzanine tranche and more senior tranches did not rise significantly or even narrowed, it appears that investors did not interpret these ratings actions as a signal of increased default risk beyond the

automobile industry. The movement in tranche spreads was also inconsistent with a broad-based rise in risk premia. The apparent shift of risk into the equity tranche was reflected in a sharp fall in implied default correlation (Chart 7).

**Chart 7**  
Implied correlation of Dow Jones CDX.NA.IG equity tranche



Source: JPMorgan Chase and Co.

More generally, however, the narrowing in credit spreads on mezzanine and senior tranches since the middle of 2004 suggests a decline in market participants' perceived likelihood of a generalised downturn over the next five years and/or a fall in associated risk premia. Both would be consistent with the wider 'search for yield' in credit markets.<sup>(2)</sup>

### Practical considerations affecting implied correlations

There are some important caveats to interpreting moves in market-derived measures of implied correlation as indicators of changes in economic fundamentals. Some important technical considerations relating to the models used to derive measures of default correlation are described in Box 2. But there are also practical considerations to take into account. In particular, it appears that different types of investors are active in trading different CDO tranches and this may be influencing prices. Market contacts report that strong demand for mezzanine and senior tranches from continental European and Asian financial institutions may have compressed spreads relative to those of equity tranches to levels unrepresentative of the underlying risks. Indeed the sharp widening in equity tranche spreads during May 2005 may have been exacerbated by the unwinding of leveraged positions speculating against the perceived expensiveness of mezzanine

(1) For a more thorough account of these events and their impact on structured credit markets, see the Box entitled 'Credit correlation trading', Bank of England *Financial Stability Review* (2005), June, pages 56–57.  
(2) The wider search for yield is discussed in Chapter 2.

## Box 2: Base correlation

A well-known drawback to Gaussian copula models like the one outlined in Box 1 is that intermediate tranche spreads can be consistent with more than one value of implied correlation. Furthermore, values of implied correlation may not even exist at high levels of tranche spreads. Both these factors are apparent from Chart 4 in the main text. This contrasts with the estimation of volatility from option prices using the Black-Scholes formula, where the price of the option increases monotonically with implied volatility.

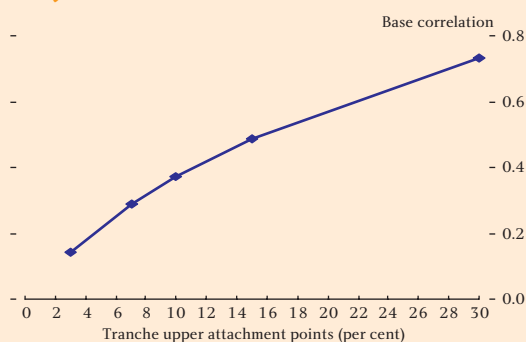
To overcome the problem of multiple solutions, market participants have generally adopted a quoting convention for CDO tranches known as 'base correlation'.<sup>(1)</sup> Base correlation exploits the fact that the expected loss and, hence, the spread on the equity tranche always falls as default correlation rises. It is defined as the value of implied correlation consistent with the price of a tranche that has a lower attachment point of zero. So, for the Dow Jones CDX.NA.IG index, base correlations would be quoted for 0%–3%, 0%–7%, 0%–10%, 0%–15% and 0%–30% tranches. From this list, the 0%–3% tranche is the only standard tranche, given that the others are not actually traded. Instead, the values of other tranches are calculated from observed tranche spreads using a bootstrapping procedure.

The bootstrapping procedure involves non-equity tranches being priced using a combination of base correlations. For example, rather than quote an implied correlation on a 7%–10% tranche, a dealer might quote base correlations on two hypothetical equity tranches — a 0%–7% tranche and a 0%–10% tranche. By calculating the expected loss associated with these base correlations, an investor can price a 7%–10% tranche by calculating its expected loss. This is done by subtracting the expected loss on the 0%–7% tranche from the expected loss on the 0%–10% tranche, providing a unique solution for reasonable input values.

Chart A shows an example set of base correlations, derived from the Dow Jones CDX.NA.IG index. It reveals a well-known phenomenon associated with implied correlation, which is that different tranches are consistent with different levels of implied correlation,

despite referencing the same underlying portfolio. This is known as the 'correlation skew'. Reasons for the shape of the skew are not altogether clear. It may reflect high demand for mezzanine tranches from some investors, for example, or the fact that market participants often use more complicated models than the Gaussian copula model when pricing tranches.

**Chart A**  
Dow Jones CDX.NA.IG base correlation skew



Source: JPMorgan Chase and Co.

Base correlations can be generated by many different models, and this potentially adds another complication when interpreting moves in implied correlations. In particular, the simplifying assumptions maintained by some models may mean that, while the implied correlations they suggest are useful communication tools for market participants, they may be less suited to making inferences about changes in economic fundamentals.

To illustrate this, suppose that the Gaussian copula model outlined in Box 1 adequately captures the true interdependence of defaults in a CDO, but that market participants use a less complex model when deriving and quoting base correlations. A suitable candidate for a less complex model is the so-called a Large Pool (LP) model. LP models are also Gaussian copula models, but for simplicity and tractability they assume that CDO portfolios consist of large numbers of assets that each have the same default probability and face value. Under these assumptions, it becomes relatively straightforward to compute a value of implied correlation using observed tranche spreads and their attachment points.<sup>(2)</sup>

(1) For more details on base correlation see McGinty *et al* (2004b).

(2) A more detailed description of a large-pool model is given in McGinty *et al* (2004a).

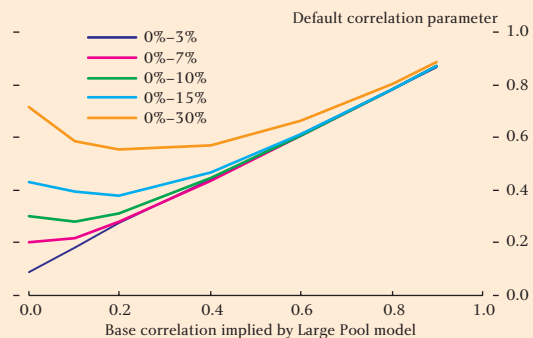


The model described in Box 1 can be simulated to generate fair tranche spreads given an assumed level for default correlation. These tranche spreads can then be used as inputs to the LP model in order to back out an estimate of implied correlation. Taking the outputs of one model (that is assumed to adequately capture the market dynamics) and using them as inputs to another model allows us to model crudely the relationship between the pre-determined underlying levels of default correlation and base correlations that might be quoted in the market.

The results of this highly stylised exercise, shown in Chart B, have clear implications for making inferences about changes in the underlying rate of default correlation from changes in base correlations derived from a simple LP model. First, note that for the 0%–3% base correlation, the relationship holds as one might expect, with higher fundamental default correlation translating into a higher base correlation. Furthermore, the relationship is almost linear. But this is not the case for some of the other base correlations, at least for low levels of default correlation. For example, at low levels of correlation,

the base correlation for the 0%–10%, 0%–15% and 0%–30% tranches actually falls as the pre-determined correlation parameter in the model rises. So while base correlation may be a useful quoting convention, this counter-intuitive result highlights a need for caution — at least for more senior tranches — when using them to make inferences about changes in fundamental levels of default correlation.

**Chart B**  
Base correlations implied by Large Pool model vs assumed level of default correlation<sup>(a)</sup>



Sources: JPMorgan Chase and Co. and Bank calculations.  
(a) Attachment and detachment points are quoted as a percentage of the face value of the underlying index.

relative to equity tranches, which had become a ‘crowded trade’.<sup>(1)</sup>

As the structured credit market develops and different types of investor enter the market, the imbalances in supply and demand that have been a feature of the market may reduce, implying that tranche spreads may better reflect perceived fundamentals. Indeed, market intelligence suggests that recent innovations have enabled dealers to allocate the entire capital structure of CDOs to investors more effectively. For example, some dealers have sought to make super-senior tranche exposure more attractive to a wider class of investor by offering products that provide leveraged exposure to super-senior risk (so-called ‘leveraged super-senior’ products). At the other end of the capital structure, dealers have been looking for ways to reduce the riskiness of junior mezzanine and equity tranches, for example by using constant proportion portfolio insurance (CPPI) structures.<sup>(2)</sup>

### Risks faced by investors and intermediaries

The valuation model outlined in Box 1 can also be used to quantify some of the risks faced by investors and dealers in CDOs. This may be relevant to financial stability given the scale of credit risk that has been transferred in recent years (Chart 1) and the concentration of dealers in this market. Fitch (2005) recently reported, for example, that the top 15 global banks held over three quarters of all protection against credit risk that had been bought and sold at the end of 2004.

### Risks to investors

First, as is apparent from Chart 2, CDOs are particularly risky for investors in junior tranches, because this is where the majority of the credit risk of the underlying portfolio is typically concentrated. But, as mentioned previously, all tranches are sensitive to correlation risk, given that the rate of default correlation determines the distribution of losses across tranches (Chart 2).

(1) For more details see the Box entitled ‘Credit correlation trading’, Bank of England *Financial Stability Review* (2005), June, pages 56–57.

(2) CPPI structures are a variant of portfolio insurance: funds are typically allocated between risk-free and risky assets (in this case, CDO tranches). When the risky assets are performing well, more funds are allocated to them. Conversely, when they are performing less well, more funds are held in risk-free assets with the aim of protecting overall returns.

Table A shows how three measures of risk vary across the available tranches of the Dow Jones CDX.NA.IG index. For purposes of comparison, the same risk measures are also reported for the whole of the index. The first column shows the proportion of capital that investors can expect to lose on average over the life of the CDO. As losses are uncertain, however, and could be higher, the second column reports the standard deviation of possible losses. The final column shows how the value of each tranche would be affected relative to the value of the index by a general decline in creditworthiness that increased the spread on each of the underlying assets by a single basis point. This is known as the 'delta' of the tranche.

**Table A**  
**Risk measures by tranche**

Tranche (per cent of index)	Expected loss (per cent of index)	Standard deviation of losses (per cent of index)	Delta
0%–3%	53.8	37.4	24.17
3%–7%	14.2	29.8	9.53
7%–10%	4.0	17.7	4.39
10%–15%	1.1	9.0	1.41
15%–30%	0.1	2.2	0.12
<i>Memo</i>			
0%–100%	2.4	2.7	1.00

Source: Bank of England calculations assuming default correlation of 0.2.

Table A illustrates the scale of risk borne by the equity tranche, which has an expected loss and delta of over 20 times that of the underlying index. Gibson (2004) obtains similar results, although based on a different modelling approach. In principle then, this scale of risk could be replicated with a 20-times leveraged investment in the index.

As well as bearing a disproportionate quantity of credit risk, junior CDO tranches are also relatively sensitive to the idiosyncratic risks affecting individual constituents of the index. Investors seeking a diversified credit portfolio that is not sensitive to changes in the default prospects of individual assets would therefore tend to hold relatively senior CDO tranches.

Table B reports the sensitivity of Dow Jones CDX.NA.IG tranche spreads to an idiosyncratic shock and a systemic shock that both have the same impact on the average spread of the index. The former is represented by a 375 basis point increase in the spread of one of the underlying CDS contracts. This

may be interpreted as a 'fallen angel' scenario, because the change in spread is consistent with a downgrade in credit quality from near the top of the ratings scale to near the bottom. The systemic shock, in contrast, is represented by a three basis points increase in the spread on each of the 125 underlying CDS contracts. This might occur, for example, as a result of a downgrade in the prospects for economic growth and, hence, corporate profits.

**Table B**  
**Sensitivity of tranche spreads to idiosyncratic and systemic risk**

Tranche (per cent of index)	Initial spread (basis points)	Scenario (change in spread, basis points)	
		Idiosyncratic shock	Systemic shock
0%–3%	1316.5	80.5	68.7
3%–7%	267.5	22.3	27.8
7%–10%	72.6	7.7	12.7
10%–15%	19.6	2.0	4.2
15%–30%	1.8	0.2	0.5

Source: Bank of England calculations assuming default correlation of 0.2.

Table B shows that only the equity tranche is more sensitive to the idiosyncratic shock than to the systemic shock and that the relative sensitivity of other tranches to the systemic shock increases with seniority.

The development of a liquid market in credit correlation products has given rise to 'correlation trading', whereby investors take views on the future direction of credit correlation. By exploiting the different amounts of leverage embodied in different tranches, market participants can structure trades that are, in principle at least, hedged against small moves in credit spreads but exposed to the level of default correlation.

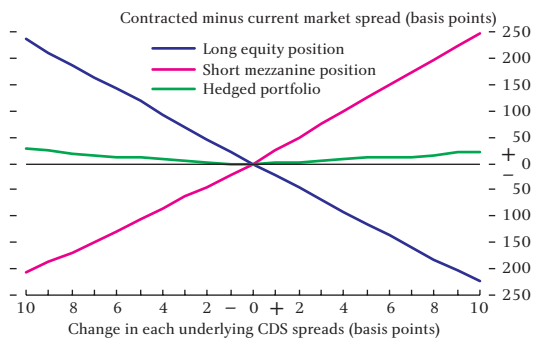
One such trade would be to hedge a unit exposure to the equity tranche of the Dow Jones CDX.NA.IG index by buying protection (shedding risk) on 5.5 units of the mezzanine tranche.<sup>(1)</sup> So if spreads on the underlying CDS contracts were all to increase by one basis point, the extra spread income that could then be earned on a new investment in the equity tranche would be balanced by the extra spread income that would have to be paid on a new short position of 5.5 units of the mezzanine tranche. The spread income on the hedged position, and its market value, would therefore be unchanged (Chart 8).<sup>(2)</sup> The market value of the trade would, however, be

(1) This is based on the relative deltas of the equity and mezzanine tranches reported in Table A, ie  $24.17 \div 4.39 = 5.5$ .

(2) As Chart 8 illustrates, however, the position is not perfectly hedged for larger changes in underlying spreads. If spreads moved significantly, investors would need to adjust the size of the mezzanine position in order to delta hedge the equity position going forward.

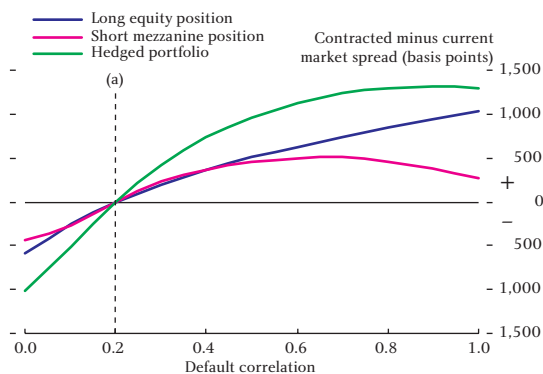
directly exposed to changes in implied correlation. Rising correlation would bring gains and falling correlation losses (Chart 9).

**Chart 8**  
Sensitivity of delta-hedged equity position to spreads on constituents of underlying index



Sources: Bloomberg, Markit and Bank calculations.

**Chart 9**  
Sensitivity of delta-hedged equity position to default correlation<sup>(a)</sup>



Sources: Bloomberg, Markit and Bank calculations.

(a) Initial default correlation.

### Risks to dealers

Dealers run large so-called ‘correlation books’ comprising positions in tranches of bespoke portfolios (on which they have typically shed credit risk to customers) and positions in single-name CDS, the credit indices and the tranches of these indices (on which they are typically net takers of credit risk). In managing the risk of these aggregate portfolios, dealers attempt to control their overall exposure to possible market movements, including generalised changes in credit spreads, shifts in implied correlation and idiosyncratic movements in the credit spreads of particular companies or groups of companies.

Dealers can construct reasonably good hedges for their exposure to changes in the overall level of credit

spreads: for example, by estimating the deltas of different tranches and taking offsetting positions in the standardised credit indices.

A more finely tuned approach to hedging is to take offsetting positions in single-name CDS on underlying components of particular indices or bespoke portfolios. Again, it is possible to calculate the appropriate deltas for each credit in the portfolio to hedge a position in a particular tranche. But holding a hedge position in every name can be expensive, so a common approach is to pick the names judged most appropriate to hedge the particular tranche. For example, in order to hedge credit protection purchased on an equity tranche, a dealer might sell protection on the companies in the portfolio that it judged most likely to default — typically those with the widest spreads and highest deltas. Alternatively, a hedge for a senior tranche might comprise positions in some of the names judged least likely to default.

Dealers adjust these positions continuously as spreads change in order to preserve the delta hedge. An important residual risk is a large and unexpected widening of the spread on a particular name (so-called ‘jump to default’). In such circumstances, dealers hedging purchased protection on equity tranches would need to sell protection on the name in order to add it to their delta hedge portfolio (perhaps partly offset by a reduction in any smaller delta hedge position held against more senior tranches).

In principle, the only perfect hedges for the correlation risk on a bespoke tranche are to take an exactly offsetting position in the same tranche or to eliminate the correlation risk entirely by transferring the risk on the other elements of the capital structure too. But such opportunities are not always available and, for the most part, dealers manage their correlation risk by taking offsetting positions in tranches of the standardised credit indices. To the extent that the names in the indices and those in bespoke tranches differ, dealers remain exposed to the possibility that default correlation changes differently in the two portfolios (see the section on ‘model risk’ below). For example, bespoke portfolios often include a mix of European and US companies whereas the iTraxx and CDX indices comprise, respectively, only European and North American companies. Across a large number of bespoke

tranches in a dealer's book, however, such differences may cancel out to some extent.

### Model risk

As with any investment, the price that an investor may be prepared to pay for a CDO tranche will depend on the potential cash flows that the investment may generate. Errors in modelling these cash flows could therefore result in investors bearing more risk (relative to expected income) than intended, or in dealers being imperfectly hedged against underlying risks. Model risk is amplified for complex financial instruments like CDOs because, as well as the potential for inaccurate modelling of the cash flows generated by individual assets, there is also potential to model relationships between these cash flows inaccurately.

One difficulty is that recovery rates, which are often assumed to be constant, may start to fall as the number of assets in default increases. In a macroeconomic downturn, for example, recovery rates may fall, because it could be more difficult for a liquidator to sell assets at good prices and to collect debts if creditors are themselves experiencing financial difficulties. Failure to take this into account could result in over-valuation of CDO tranches, notably the more senior tranches.

Other difficulties lie in modelling the relationship between defaults in CDO portfolios. Gaussian copula models, for example, often do not allocate sufficient probability to extreme movements in financial data. When applied to CDOs, they may therefore underestimate the likelihood of clustered defaults.<sup>(1)</sup> This could also potentially result in the over-valuation of CDO tranches.

Small errors in modelling the cash flows generated by a CDO portfolio can prove particularly costly for investors in certain tranches. If, for example, the distribution of potential portfolio losses were clustered around an expected loss that fell just below the attachment point of a particular tranche, even small modelling errors could increase the expected loss of this tranche from a low level to a much higher level.

Table C investigates the potential effects of another type of error in modelling the interdependence of defaults in CDOs. In particular, it shows how the

spreads on tranches of the Dow Jones CDX.NA.IG index computed by the valuation model vary between two different 'dependence structures' that govern the incidence of default in the underlying index. In the first case, the default correlation between all pairs of the underlying assets is 0.2. In the second case, the average default correlation between asset pairs is also 0.2, but some pairs have a correlation of unity and others have a correlation of zero.

**Table C**  
**Sensitivity of tranche spreads to the distribution of pair-wise default correlations**

Tranche (per cent of index)	Tranche spread (basis points)	
	Constant correlations	Mixed correlations
0%–3%	1316.5	1241.5
3%–7%	267.5	124.1
7%–10%	72.6	79.8
10%–15%	19.6	60.6
15%–30%	1.8	33.2

Source: Bank of England calculations.

The perfect default correlation for some assets in the mixed correlation case increases the probability of very large losses on the underlying portfolio. This raises the spread on senior tranches, because the probability that they may incur losses has increased, while the opposite applies to junior tranches. Although the two dependence structures investigated in the table are polar extremes, the magnitude of the results suggests that even an error that made a smaller difference could still have a noticeable effect on the fair values of CDO spreads. This could be particularly relevant for dealers hedging a bespoke CDO tranche with an index tranche, as the two underlying portfolios could have similar average rates of default correlation across asset pairs, but different dependence structures.

As modelling errors could generate greater losses than anticipated for CDO investors, tranche spreads may incorporate a premium for model risk. This would help to explain, for example, why CDO tranches often trade at higher spreads than corporate bonds with the same credit rating.

### Conclusion

Two of the most important developments in the international financial system in recent years have been the increasing amount of credit risk transferred through CDO tranches, and the development of traded markets in standardised credit indices.

(1) For more details on extreme events in the Gaussian copula framework, see Mashal *et al* (2003).

These developments may have led to more efficient allocation of credit risk and, in turn, a more robust financial system. But the leveraged nature of junior CDO tranches means some investors may be highly exposed to small changes in overall credit market conditions. In addition, CDO tranches are exposed to changes in default correlation, which, given the bespoke nature of many CDO transactions, may be particularly difficult to hedge.

This article has used a fairly standard CDO pricing model to explain some of the financial risks faced

by investors and dealers in CDO tranches. It has also shown how the development of a traded market in credit correlation may provide valuable information for policymakers as an indicator of market expectations of generalised credit problems and perhaps of investor risk appetite. But, particularly while these markets are developing, care is needed in interpreting implied correlations quoted in the market to ensure that correct inferences are drawn about fundamental rates of default correlation.

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