EUROPEAN CENTRAL BANK

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FINANCIAL STABILITY REVIEW

JUNE 2007

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PREFACE

Financial stability can be defined as a condition in which the financial system – comprising of financial intermediaries, markets and market infrastructures – is capable of withstanding shocks and the unravelling of financial imbalances, thereby mitigating the likelihood of disruptions in the financial intermediation process which are severe enough to significantly impair the allocation of savings to profitable investment opportunities. Understood this way, the safeguarding of financial stability requires identifying the main sources of risk and vulnerability such as inefficiencies in the allocation of financial resources from savers to investors and the mis-pricing or mismanagement of financial risks. This identification of risks and vulnerabilities is necessary because the monitoring of financial stability must be forward looking: inefficiencies in the allocation of capital or shortcomings in the pricing and management of risk can, if they lay the foundations for vulnerabilities, compromise future financial system stability and therefore economic stability. This Review assesses the stability of the euro area financial system both with regard to the role it plays in facilitating economic processes, and to its ability to prevent adverse shocks from having inordinately disruptive impacts.

The purpose of publishing this review is to promote awareness in the financial industry and among the public at large of issues that are relevant for safeguarding the stability of the euro area financial system. By providing an overview of sources of risk and vulnerability for financial stability, the review also seeks to play a role in preventing financial crises.

The analysis contained in this review was prepared with the close involvement of, and contribution by, the Banking Supervision Committee (BSC). The BSC is a forum for cooperation among the national central banks and supervisory authorities of the European Union (EU) and the European Central Bank (ECB).

I OVERVIEW

SOURCES OF RISK AND VULNERABILITY FOR FINANCIAL STABILITY

The strength and resilience of the euro area financial system has benefited from generally favourable economic and financial conditions in recent years. Profitability in both the banking and insurance sectors has been improving, and the amount of problem loans has remained relatively low. For the most part, financial markets have been characterised by unusually subdued volatility, while credit spreads have remained very low and many asset prices have reached historically high levels. In the six months after the finalisation of the December 2006 Financial Stability Review (FSR), the shock-absorbing capacity of the financial system was again tested by the third significant burst of market volatility in the past two years, which it comfortably weathered. In late February and early March 2007, against a background of rising delinquencies in the US sub-prime mortgage market and increasing uncertainty about the US macroeconomic outlook, equity prices fell, credit spreads widened and market volatility rose across a host of asset classes – including foreign exchange markets, where some carry trades were unwound. Improvements in the risk management practices of financial firms appear to have contributed to ensuring that higher financial market volatility did not prevent capital markets from facilitating the intermediation of capital.

The fact that the global and euro area financial systems have so far proven resilient to a series of adverse disturbances, while comforting, does not provide any ground for complacency. The disturbances endured by the financial system over the past couple of years have all been rather small in scale and although market volatility rose, it still remained well below longer-term historical averages. Moreover, these episodes occurred in an environment of fairly abundant market liquidity, strong macroeconomic fundamentals and where the balance sheets of financial firms were generally in good shape. The experience of these events, therefore, is unlikely to offer much guidance on how financial systems would perform if subjected to a larger disturbance at a less favourable stage of the credit cycle, especially if risk appetites were to diminish. However, these episodes have served to reaffirm concerns about pre-existing vulnerabilities, and the most recent one revealed direct exposures of some European institutions to the US sub-prime mortgage market. Concerns have also been raised about other potential vulnerabilities such as the possibility that the crisis in the US sub-prime mortgage market could deepen and spread to other markets, potentially affecting higher quality structured mortgage and corporate credit markets to which euro area financial institutions may have exposures.

With the euro area financial system in a generally healthy condition and the economic outlook remaining favourable, the most likely prospect is that financial system stability will be maintained in the period ahead. However, there are some vulnerabilities and associated risks which, if they were to materialise, could pose significant challenges and which financial firms should be seriously taking into account in their risk management arrangements. In particular, the vulnerability of the financial system to an abrupt and unexpected loss of market liquidity appears to be increasing. There are also concerns that greater and possibly excessive leverage in parts of the corporate sector is being facilitated by remarkable growth in the credit derivatives markets and by the growing presence of new players in these markets such as credit portfolio managers, hedge funds and private equity firms. In particular, there is some unease that the delegation of credit risk monitoring to rating agencies and credit portfolio managers could have led to some slippage in credit risk assessment standards and pricing.

The likelihood that the euro area financial system could be significantly challenged by adverse scenarios related to these vulnerabilities is not judged to be high at present. Nevertheless, these vulnerabilities warrant attention, as it is

important to consider how the system would cope with plausible adverse and potentially high-impact events, however unlikely these may appear at present.

The remainder of this section examines these sources of risk and vulnerability in more detail, and concludes with an overall assessment of the financial stability outlook.

SOURCES OF RISK IN GLOBAL CAPITAL MARKETS

Financial market liquidity is usually thought of as a measure of the ability of market participants to undertake securities transactions without triggering large changes in their prices. While it is challenging to precisely measure financial market liquidity, it is generally agreed that highly liquid markets are characterised by a myriad of buyers and sellers who are willing to trade. Moreover, prices in such markets ordinarily carry low liquidity risk premiums – that is the compensation demanded by investors (and bid into expected rates of return) for uncertainties associated with the ease with which transactions can be executed in the future. By these yardsticks, symptoms of abundant market liquidity have been plentiful across a host of global financial markets for some time. Since mid-2003 bid-ask spreads have fallen and transactions volumes have surged. For large global banks this has meant a swelling of trading revenues, fees and commissions. For financial markets, lower market liquidity risk premiums also appear to account, at least in part, for the near vanishing of term premiums on government bonds, credit spreads reaching near-record lows, and market volatility waning across virtually every asset class.

Another sign that markets have been teeming with liquidity is that reactions to events which, in the past, could have triggered broader and more disorderly asset price adjustments have been relatively calm. The effects of recent financial market shocks all proved remarkably contained, short-lived and self-correcting. These included the credit market turbulence of May 2005, large declines in mature equity markets in May and June 2006, the failure of Amaranth Advisers and a coup in Thailand in September 2006, plus the turmoil of late February and early March 2007.

While broad consensus exists among participants that financial markets have been exceptionally liquid in recent years and that this has fostered higher leverage and greater risk-taking, there is far less consensus on the precise source of this liquidity. From a financial stability viewpoint, an assessment of the durability of financial market liquidity requires a good understanding of its sources. An important factor in this regard is that financial markets have been undergoing remarkable structural changes in recent years which have probably significantly enhanced their liquidity.

Spurred by advances in risk-management techniques and a shift by large global banks towards the so-called originate and distribute business model – whereby banks extend loans but then distribute much of the underlying credit risk to end investors – financial innovation has led to dramatic growth in the market for credit risk transfer (CRT) instruments. This is the case whether gauged by transaction volumes or by the proliferation of products. Over the past four years, the global amount outstanding of credit default swaps has multiplied more than tenfold, and investors now have a much wider range of instruments at their disposal to price, repackage and disperse credit risk throughout the financial system. As investors can now hedge and unwind positions without having to transact in the underlying (or cash) markets, this has enhanced market liquidity. This has occurred, in part, because a greater variety of instruments and trading opportunities has attracted a broader and more heterogeneous pool of investors in terms of risk tolerance, investment horizon preferences as well as abilities to leverage and enter into short positions. Generally speaking, the greater the degree of heterogeneity of investors in a market, the higher the number of buyers and sellers willing to trade under different market conditions will be. In this vein, the growing

presence of hedge funds and private equity firms in financial markets may contribute to explaining why financial markets have been exhibiting greater shock absorption capacities than in the past. Hedge funds, for instance, have become important participants in the credit derivatives markets, and are also thought to account for sizeable shares of trading volumes across a host of other asset classes.

While better market liquidity can enhance the stability of financial systems by facilitating greater efficiency in the reallocation of financial resources between savers and investors through improved risk management capabilities and by raising asset prices, the flipside is that a loss of market liquidity after a period of continued abundance can reveal vulnerabilities that hitherto went undetected. In this vein, there are concerns that abundant market liquidity may have led to slippages in risk assessment standards, especially in the credit markets, and could have pushed some investors into taking on too much market risk. The upshot has been a "pricing for perfection" in some markets, above all in the credit markets, in the sense that valuations appear to be based on very favourable expectations regarding future economic outcomes, and low liquidity risk premiums. Apart from creating the potential for resource misallocation over the longer term by squeezing term premiums, abundant market liquidity has eaten into bank lending margins. It may also have left some asset markets vulnerable to unexpected changes in risk perceptions, while the business models of some financial institutions may have become overly reliant on market liquidity being sustained.

If history is any guide, liquidity can vanish abruptly from financial markets when investor uncertainty and risk aversion rise. In such circumstances, sharper asset price movements than those implied in options prices could materialise, implying significant and unexpected market portfolio losses for banks and non-bank financial firms. And primary issuers, especially corporations with ratings at the lower end of the credit quality spectrum, could struggle to find investors for their securities. Some banks would also face heightened counterparty risks if the institutions they have extended credit to are thrown into financial distress. At the same time, in the event of the collapse of a key hedge fund or of a cluster of smaller funds that were particularly active in the protection-selling side of the CRT market, credit protection may not be available when it is most needed. Given the reliance of private equity-sponsored leveraged buyout (LBO) deals on smoothly functioning CRT markets and on hedge funds to take the riskiest credit exposures, a loss of market liquidity could significantly impair this activity and, through the materialisation of underwriting risk, leave some banks holding unplanned credit risk exposures. Moreover, if market liquidity were impaired it could undermine the hedging of credit risk more generally and could even trigger a deterioration in the credit cycle itself by making banks more cautious about extending loans if they find they cannot lay off the credit risk or would have to pay significantly more to do so. Hence, risks for financial markets in the future would seem to depend on liquidity proving durable under stress; this also relies on the ability of the trading and settlement infrastructures supporting these markets to cope with unexpected jumps in volumes. This means that institutions should seek to ensure that their liquidity buffers remain adequate and that stress-testing frameworks pay sufficient attention to market liquidity risks.

SOURCES OF RISK FROM EXPOSURES TO EURO AREA NON-FINANCIAL SECTORS

Against a background of strong economic conditions, low financing costs and abundant market liquidity, the rate of borrowing by the euro area corporate sector began to quicken after mid-2005, and by the end of 2006 key indicators of the leverage of the sector had reached unprecedented heights. This development began to raise questions about the likelihood and possible consequences for the financial system of an adverse turn in the credit cycle. Although closely related to business cycles, credit cycles are also driven by the criteria applied by banks

and other investors when extending credit. Hence, apart from demand, the amount of credit in the economy depends on the financial and risk management constraints faced by banks and investors, as well as their tolerance for risk. By this yardstick, several quarters of inertia in bank lending standards and the persistent tightness of credit spreads do not suggest that euro area firms have been facing financing constraints. On the contrary, with greater emphasis being placed on the "originate and distribute" business model by banks, new opportunities have been opened up for pension funds, insurance companies, mutual funds and hedge funds to acquire exposures to credit. Not only has this catered for a greater diversity of credit risk appetites, but it has also raised the risk-bearing capacity of the financial system more generally and improved diversification.

It seems that the recent releveraging in the euro area corporate sector has not been broad-based, but rather has been centred among unlisted firms – including not only small and medium-sized enterprises but also firms which have been de-listed through private equity deals. In addition, there are some indications that greater amounts of credit are being extended for riskier business ventures than in the past: for instance, rising levels of leverage in private equity-sponsored LBO deals in the euro area have been a growing source of unease recently. To some extent, this has been made possible by financial innovations which have allowed credit exposures to be sliced and structured into tranches carrying varying degrees of risk. In addition, supply has met demand through greater appetites of some investors for exposures to the riskiest tranches and by growing direct hedge fund participation in such deals. While greater leverage in LBO deals could simply reflect greater risk appetite among new participants in the credit markets, there are concerns that slippages could be occurring in the quality of credit risk monitoring, e.g. because of delegation to others such as rating agencies, or to managers of structured credit vehicles such as collateralised debt obligations (CDOs).

Credit cycles often turn when lenders begin to doubt the capacity of borrowers to repay their debts. While there have been no indications of such qualms recently, there are some concerns that investors have been underestimating the longer-term risks of higher indebtedness in an environment where default rates, both realised and expected, have remained very low. The number of euro area firms being placed on review for a rating downgrade has increased vis-à-vis the number on review for a rating upgrade. However, to a large extent these actions seem to reflect credit risk reassessments based on idiosyncratic – so-called equity-friendly corporate finance decisions – such as LBOs, share buybacks, and mergers and acquisitions (M&As), all of which have raised leverage with the aim of increasing value for shareholders. Moreover, rising downgrades have not translated into significantly rising default rates. Although there has been a slight upturn in euro area speculative grade default rates recently, these have been much lower than expected by rating agencies for a considerable period of time. It has even been suggested that the existence of abundant market liquidity is one of the reasons why rating agencies have, since late 2004, consistently pushed their forecasts of rising global default rates further out into the future. In particular, with the emergence of new players in credit markets with greater risk tolerances, it seems that less than creditworthy firms may have found it easier to refinance and restructure their debts – including through weaker loan covenants – than in the past. If that is the case, then firms may only be deferring their financial difficulties, so that when the credit cycle finally turns, it could turn out to be more abrupt and severe than past experience might suggest.

Looking ahead, rapidly rising leverage and increasing recourse to short-term funding has left euro area firms' balance sheets more vulnerable to various adverse disturbances such as the possibility of slower than expected economic growth, unexpected increases in oil prices, or unanticipated increases in the cost of capital. In this vein, firms are already facing

higher debt-servicing costs, and the pace of profit growth is expected to slow somewhat. From a financial stability viewpoint, a significant and broad-based deterioration in corporate sector credit quality involving a higher frequency of unexpected defaults would not only imply greater loan losses for banks, but could also trigger an erosion of liquidity from credit derivatives markets. This would undermine hedging, and the adverse impact on the valuation of credit portfolios would be amplified for investors in credit products that carry embedded leverage.

Turning to the euro area household sector, there have been concerns for several years about the sustainability of unprecedented levels of mortgage-related leverage in some countries, especially if households were to be confronted with a more challenging macroeconomic environment. A further rise in the indebtedness of the sector after the finalisation of the December 2006 FSR has further fuelled these concerns. While rising short-term interest rates may have challenged the ability of some households to service their debts, there are however a number of mitigating factors which are likely to support household sector balance sheets going forward. In particular, the outlook for employment and household income has improved further in the past six months. At the same time, the pace of new borrowing by the household sector has slowed since spring 2006, albeit remaining at high levels. There have also been signs of moderation of house price inflation in a number of euro area housing markets, while the risks of potentially more disruptive reversals in the future appear limited. Although the risks posed by larger and more leveraged euro area household sector balance sheets than in the past are still judged to be rather low for the euro area as a whole, vulnerabilities may be growing for households in those parts of the area where, ceteris paribus, housing valuations appear stretched, where the debt build-up has been most pronounced, and where the majority of debt is financed at variable interest rates.

RESILIENCE OF THE EURO AREA BANKING SECTOR

The financial soundness of large and complex banking groups (LCBGs) in the euro area was strengthened further in the second half of 2006, consolidating on the steady and broad-based improvement from 2003 onwards. Profitability continued to rise, underpinned by strong macroeconomic conditions and, for the most part, very low levels of financial market volatility. While the interest income of most institutions either remained flat or increased only slightly, banks enjoyed further improvements in fee, commission and trading income. Loan impairment charges remained low, and cost-to-income ratios improved further. This, however, did not translate into an improvement of solvency ratios because there was also a rise in risk-weighted assets, indicating greater risk-taking. Nevertheless, solvency ratios remained very comfortable relative to regulatory requirements.

Looking forward, it seems likely that the maturity transformation activities of euro area LCBGs will continue to be challenged by the flatness of the euro area market yield curve. Moreover, recent signs of a slowdown in lending growth to euro area households could adversely affect interest income. Market analysts expect that LCBGs will overall remain highly profitable in the near-term, reflecting expectations of a pick-up in euro area growth and a continued favourable assessment of the creditworthiness of borrowers. However, profits are not expected to grow at the rates seen in the recent past and there are some risks to the outlook. Within the banking system itself, banks have faced challenges in recent years in increasing, or even maintaining, interest income, given margin erosion and intense competition in loan markets. Moreover, as low interest rates may have sustained tight credit spreads, medium-term vulnerabilities related to the pricing of credit risk could be building up, as banks' pricing of credit risk is market-sensitive. Although significant advances have been made by LCBGs in their credit risk management practices in view of the implementation of the new Basel II

framework and the greater emphasis placed on the "originate and distribute" business model, banks' credit risk exposures have risen relative to their buffers as a result of a combination of rapid lending growth to both households and firms, historically low loan impairment charges and some signs of weakened credit standards. Even if the exposures seem on average manageable given comfortable solvency ratios, pockets of vulnerability could be developing in some parts of the euro area household and corporate sectors, where credit losses could prove greater than expected in a more challenging environment. For instance, there are concerns that highly competitive pressures in markets such as lending for LBOs could have induced banks to take on excessive risk in the pursuit of market share. That said, it is difficult quantitatively to assess what the full impact on euro area LCBGs would be in the event of a general adverse turn in the credit cycle. This is because data are lacking on the extent of credit risk being transferred within and outside the banking system, making it impossible to assess the extent to which LCBGs are hedging against such a scenario. However, there are some indirect indications: just as the very low levels of loan impairment charges over recent years might, in part, be explained by increasing recourse of large banks to the CRT markets to shed and diversify their credit risks, the impact of an adverse turn of the credit cycle on banks could be more muted than in earlier downturns because of hedging.

Concerning market risks such as the possibility of an upturn in long-term interest rates and of credit risk premiums, the direct risks faced by LCBGs are likely to prove manageable. However, these institutions may still face risks to other market-related business activities from which banks have garnered significant income in recent years, as well as counterparty risks from non-bank financial firms, where risk management practices may be less advanced. While counterparty risk management practices in large banks are known to be improving, it is unclear whether the intensity of competition, for instance in the securitisation markets or in the provision of prime brokerage services to hedge funds, may have compromised standards at the margin, especially for medium-sized banks. It is therefore of paramount importance that LCBGs practise sound counterparty risk management in the period ahead in order to isolate and address potential problems before they occur. Banks providing prime brokerage services to highly leveraged institutions, in particular hedge funds, will constantly need to review the adequacy of assumptions underlying their credit limit, margining and collateral policies.

Forward-looking indicators based on asset prices continue to suggest that the outlook for euro area LCBGs remains bright. Their credit ratings alos remained high and stable, reflecting a view that euro area LCBGs have strong fundamentals and that they are favourably positioned to withstand a cyclical downturn. Nevertheless, some options-based market indicators do suggest that downside risks to banking sector profitability could outweigh upside risks in the period ahead, possibly reflecting the fact that vulnerabilities and financial imbalances have continued to grow over the past six months.

RESILIENCE OF THE EURO AREA INSURANCE SECTOR

There was broad-based strengthening of the profitability of large euro area insurers in 2006, with even the profitability of the weakest-performing firms in 2005 also improving. Underlying stronger profitability was a significant strengthening of investment income because of buoyant stock markets and higher interest rates, as well as cost control and lower insurance claims, so that firms' underwriting business was generally profitable. This – together with greater focus on risk management and risk-adjusted pricing – has continued to support a positive outlook for the euro area insurance sector as a whole. Further improvements in asset liability management, together with improved capital structures – resulting from increased use of securitisation

and the issuance of hybrid capital and subordinated debt – also support the generally positive outlook.

However, risks and challenges for the sector remain and have in some cases increased. In particular, life insurers could be challenged by vulnerabilities in the financial markets. Non-life insurers are still faced with strong competition and could be exposed, together with reinsurers, to a greater risk of natural disasters in 2007. Against this background, although the central scenario is bright, market indicators have been signalling greater uncertainty and a potential for deterioration in the financial condition of large euro area insurers. Although few defaults are expected in the period ahead, insurers' stock prices fell by more than the overall stock market during the February/March 2007 turmoil in financial markets, and other forward-looking indicators suggest that fragilities might be building up in the sector.

OVERALL ASSESSMENT

The strength of the euro area financial system has remained solid in the six months following the finalisation of the December 2006 FSR, and the system has comfortably absorbed a further bout of market volatility. However, several of the previously identified main potential sources of risk and vulnerability have remained and some have grown in the past six months. Against this background, low-probability but plausible and challenging risk scenarios for financial systems could be triggered by adverse disturbances which resulted in unexpected changes in global market liquidity conditions or by unanticipated credit events.

Within the financial system, as the likelihood is growing that the operating environment could become more challenging, there is greater concern that some asset price valuations could prove vulnerable to several potential adverse disturbances, especially if they were to materialise simultaneously. In this vein, a key area of concern is that financial market vulnerabilities – especially those in credit markets – could be quickly unearthed if financial market liquidity were to decline sharply and abruptly, possibly triggered by higher investor uncertainty and lower risk appetite. In such a scenario, banks could be faced with greater than normal market and counterparty risks. At the same time, there has been growing unease about rapid releveraging in some parts of the corporate sector – especially concerning LBOs – and, related to this, the extent of credit risk which has been shifted to other parts of the financial system. Greater emphasis on the "originate and distribute" business model by banks has been possible in a relatively benign credit market environment. However, there are uncertainties about how all of the counterparties in this process would be collectively affected if the CRT markets were to be subjected to severe stress, possibly triggered by an adverse turn in the credit cycle.

Looking further ahead, the possibility of an abrupt unwinding of global imbalances continues to pose a medium-term risk to global financial stability. While the likelihood of an abrupt adjustment still appears rather low, if such an event were to materialise, it would represent a significant challenge for the risk management systems and loss-absorption capacities of key financial institutions.

The potential triggers for adjustment of financial imbalances cannot be predicted with any degree of certainty, but financial institutions can mitigate potential problems before they occur through appropriate risk management including through stress-testing and vigilant monitoring of the financial soundness of their counterparties.

II THE MACRO-FINANCIAL ENVIRONMENT

1 THE EXTERNAL ENVIRONMENT

After the finalisation of the December 2006 Financial Stability Review (FSR), global financial markets underwent a bout of volatility through late February and early March, the precise trigger for which was difficult to pinpoint. This volatility was still lower than historical averages, but the episode served to remind market participants of the vulnerability of valuations in some asset markets to adverse disturbances. A global source of medium-term risk for the stability of the global financial system continues to be global financial imbalances, which remain large despite some rebalancing of global growth patterns and a decline in oil prices.

1.1 RISKS AND FINANCIAL IMBALANCES IN THE EXTERNAL ENVIRONMENT

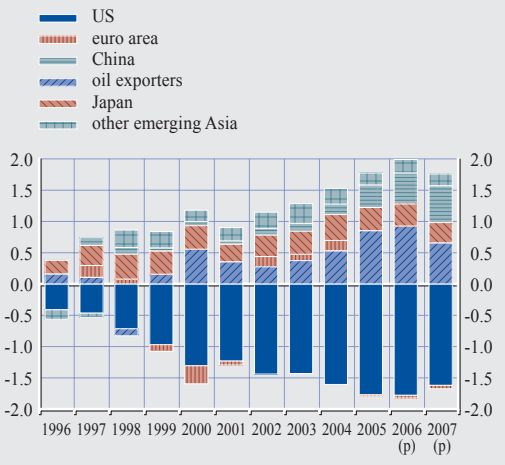
Risks from global imbalances have remained broadly unchanged since the publication of the December 2006 FSR. Some favourable developments have become more apparent, including the partial rebalancing of global demand patterns and indications that current account positions might be stabilising. US growth remained broadly stable in 2006 at 3.3%, while growth in the euro area accelerated to 2.7% (up from 1.4% in 2005). This was mirrored by growth in Japan, which rose from 1.9% to 2.2% over the same period. This could assuage concerns as to the likelihood of an abrupt and disorderly correction of global imbalances in the short term, even though this remains a significant vulnerability for the global financial system in the medium term.

GLOBAL FINANCIAL IMBALANCES

Since the December 2006 FSR, global financial imbalances – comprising persistently large current account deficits in some parts of the world, notably the US, and large surpluses in others, especially in Asia – continued to represent an important vulnerability for the global financial system. In particular, capital flows remained susceptible to the risk of abrupt reversals, which also created the possibility of large and unruly asset price adjustments. While recent patterns in these imbalances continued to lend some cautious support to a central scenario of a gradual adjustment in existing imbalances, the likelihood – albeit low – of a disorderly unwinding remained in an environment of large external imbalances. In particular, there are some indications that imbalances may be peaking: the US current account deficit reached 6.5% of GDP in 2006, close to its level in the previous year, and is expected, according to International Monetary Fund (IMF) projections, to decline to 6.1% of GDP in 2007 (see Chart 1.1). Within the group of economies in surplus, favourable developments included the relative stabilisation of Japan's current account position in 2006, as well as a slight decline in the surpluses of a few emerging Asian economies. Conversely, China's current account surplus continued to widen significantly, exceeding 9% of Chinese GDP in 2006 notwithstanding a moderate appreciation of the renminbi in real effective terms, and this surplus is projected to reach 10% of GDP in 2007. Oil exporters remained the largest economies in surplus in 2006, with high oil prices continuing to boost export revenues. However, these surpluses are expected to narrow in 2007, reflecting projected developments in oil prices and greater domestic absorption capacity.

Chart 1.1 The US current account deficit and its counterparts

(1996 - 2007, % world GDP)



Sources: IMF World Economic Outlook and ECB calculations.

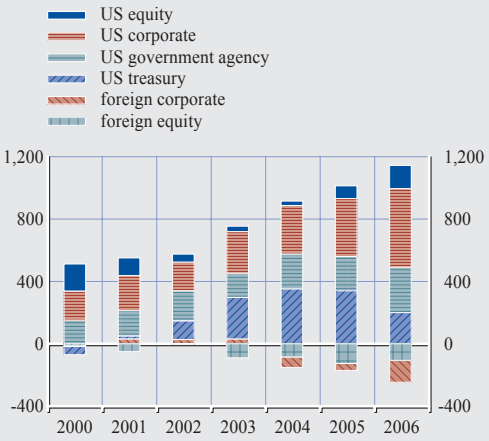
Chart 1.2 Main reserve holders among emerging economies

(2006)

Sources: IMF World Economic Outlook, Global Insight and ECB calculations.

Chart 1.3 Capital flows into US long-term securities, broken down by instrument

(2000 - 2006, USD billions)



Sources: US Treasury International Capital System and ECB calculations.

Benefiting from large surpluses, the emerging economies continued to accumulate sizeable amounts of reserve assets, and China became the world's largest reserve holder in absolute terms, ahead of Japan, with over USD 1 trillion by the end of 2006 (see Box 1).[1] When measured as a share of GDP, the relative magnitude of reserve holdings was nevertheless larger in some of the small open economies of emerging Asia (see Chart 1.2).

The financing of the US current account deficit continued to proceed smoothly in 2006 and the first months of 2007. A large share of purchases of US long-term securities originated in the UK and the Caribbean financial offshore centres, both of which are known conduits for the recycling of funds from oil-producing countries in the Middle East, and this continued to suggest that a substantial part of oil revenues continued to be invested in US assets. As pointed out in past editions of the FSR, while the recycling of oil revenues has helped finance the US current account deficit, it might also have left US financial markets more vulnerable to the risk of volatility in capital flows, especially with regard to geopolitical risk.

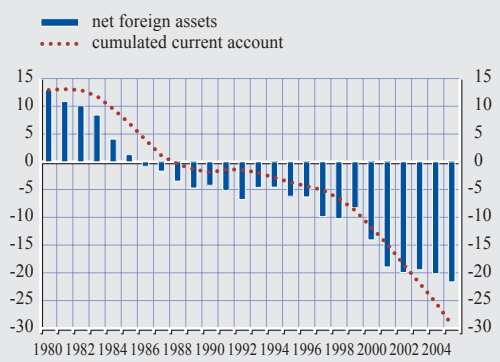
Concerning the flow of foreign capital into US securities markets during 2006, there was some shift towards riskier market segments. Investors increased the share of their investments in higher-yielding bonds issued by the corporate sector and US government agencies, while reducing the share of US Treasury debt (see Chart 1.3). This funding pattern might have left the financing of the US current account deficit more vulnerable to changes in market sentiment.

Despite persistently large current account deficits, the latest data available for 2005 indicate that the external indebtedness of the US had risen more moderately than accumulated current account balances (see Chart 1.4). This underscores the role that valuation gains stemming from exchange rate and asset price changes have played in containing external indebtedness. Nevertheless, valuation effects are volatile and run the risk of reversing. In this vein, the US balance of income turned negative

1 Early in 2007, the Chinese authorities also announced their intention to establish an investment agency responsible for the management of a share of China's reserves.

Chart 1.4 US net foreign assets and cumulated current account

(1980 - 2005, % of GDP)



Sources: US Bureau of Economic Affairs and ECB calculations.

in 2006 on account of less favourable return differentials than in previous years.

Overall, risks from global imbalances have remained broadly unchanged over the six months since the finalisation of the December 2006 FSR. Some favourable developments have become more apparent, including the partial rebalancing of global demand patterns and indications that current account positions might be stabilising. This could assuage concerns as to the likelihood of an abrupt and disorderly correction of global imbalances, at least in the short term. However, as noted in previous issues, the possibility of a disorderly adjustment remains a significant vulnerability for the global financial system in the medium term.

Box 1

SAVING BEHAVIOUR AND GLOBAL IMBALANCES: THE ROLE OF EMERGING ECONOMIES

Although global private savings have, at an aggregate level, represented a relatively stable share of world GDP at around 20% over the past quarter of a century or so, there has been considerable variation in savings patterns across countries and regions (see Chart B1.1). In particular, the private savings of developed economies, as a proportion of GDP, have trended slightly downwards from the early 1980s onwards. By contrast, private savings have risen more or less continuously in emerging Asia, with the exception of the years in the immediate aftermath of the financial crisis of 1997-98, while they have been relatively volatile in Latin America. Understanding the drivers of these regional divergences is important in order to ascertain whether the so-called global savings glut could possibly explain the significant widening of global current account imbalances over the past five years.[1] It is also relevant in terms of assessing the extent to which ample savings in emerging economies have possibly contributed to a significant lowering of global long-term real interest rates in recent years. In view of these considerations, this Box examines the empirical drivers of private savings within a large panel of emerging and developed economies over the past quarter of a century.

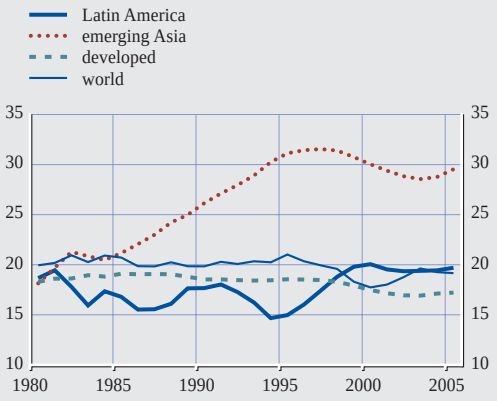
To evaluate the determinants of savings, a reduced-form model is used which relates private savings to a set of economic fundamentals identified in the literature, while controlling for structural factors and institutional differences among countries.[2] The analysis allows for a

1 See B. Bernanke (2005), "The Global Saving Glut and the US Current Account Deficit", remarks at the Homer Jones Lecture, April. Clearly, a full understanding of a country's current account position requires a joint analysis of developments in both domestic savings and investment. In particular, together with high savings, an "investment drought" is often mentioned to explain the high current account surpluses in emerging Asia. However, gross national savings (and within this, private savings) seem to have played a prominent role in explaining the widening external imbalances recently. In this regard, it has been argued that regional divergences in saving behaviours have closely matched the diverging patterns of current account balances globally. Across world regions, increases in saving rates have typically been associated with higher current account surpluses, and vice versa.

2 See G. Ferrucci and C. Miralles Cabrera (2007), "Saving Behaviour and Global Imbalances: The Role of Emerging Economies", mimeo.

Chart B1.1 Global private savings

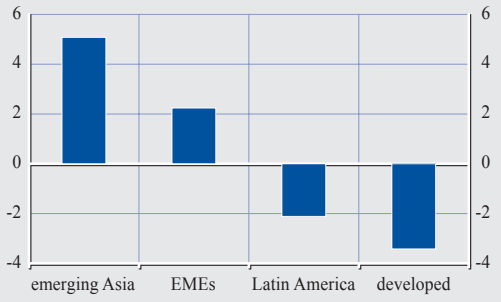
(% of GDP)



Source: ECB calculations.
Note: Private world savings are calculated as a weighted average of the private saving ratios in countries representing around 85% of global GDP.

Chart B1.2 Deviation from long-run equilibrium of global private savings

(% of GDP)



Source: ECB calculations.
Note: The bars represent the deviation (in percentage points of GDP) between the group's actual and predicted value of the saving rate. Both statistics are calculated as averages through 2000 to 2005.

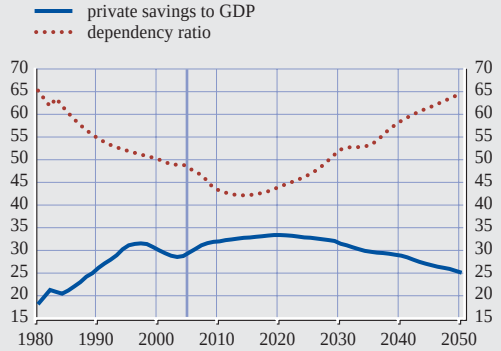
separation between short-run adjustment and the long-run equilibrium. The model includes explanatory factors grouped into the following categories: demographics; fiscal policy; the macro environment, and institutional factors. The age structure of the population may affect private savings through Modigliani's lifecycle hypothesis, which suggests that individuals save for retirement when they are of working age, and dis-save when they are old. Fiscal policy affects private savings in several ways: Ricardian equivalence suggests a trade-off between private and public saving; furthermore, under-provision of public services (e.g. pensions, education and healthcare) may also foster precautionary savings. The country's macro environment, as summarised by GDP growth, terms of trade shocks and inflation, is also likely to have an impact on private saving. Finally, the development of the financial system (private credit to GDP) also affects precautionary savings as it removes borrowing constraints.

The analysis suggests that, on average, aggregate saving rates across all emerging economies are higher than their estimated fundamental value, significantly so in emerging Asia, and slightly lower in Latin America and developed economies than the model predicts (see Chart B1.2). In addition, the model suggests that the abundance of savings in emerging Asia stems mainly from demographic changes and, to a lesser extent, from the small decline in fiscal spending over the sample period.[3] At the same

3 Favourable demographics, in particular the fall in the dependency ratio from 67% to 49% of the total workforce during the past 25 years, alone account for around 60% of the rise. Another 5% of the rise can be attributed to the reduction in government spending by 2 percentage points of GDP.

Chart B1.3 Projected savings and dependency ratios in emerging Asia

(%)



Source: ECB calculations.

time, the development of the financial system has contributed to putting significant downward pressure on savings in emerging Asia.

These findings have important implications for global financial stability. In particular, further financial sector reform and population ageing could lead to some decline in saving rates in emerging economies, contributing to a gradual unwinding of global imbalances in the long run. As a simple simulation exercise using the estimated model, projecting a 14 percentage point rise in the elderly dependency ratio in emerging Asia over the next half of a century (as suggested by United Nations' projections) produces a fall in the saving ratio of 5 percentage points of GDP (see Chart B1.3).[4] Governments can also play a role in lowering savings over the medium term, especially through structural reforms, which include increasing the depth of domestic financial markets through financial sector reform, and thus fostering a better intertemporal smoothing of consumption.

4 An important caveat is that this estimate only captures the first-round effects of an increase in the dependency ratio on savings, i.e. it fails to capture the second-round effects of ageing on potential growth, fiscal spending, etc.

US SECTOR BALANCES

Public sector

According to the Congressional Budget Office (CBO), the US federal budget deficit declined to 1.9% in the fiscal year ending on 30 September 2006, down from 2.6% in the previous year. Meanwhile, developments in fiscal year 2007 up to early May suggested that the fiscal situation continued to improve. This has been an important short-term factor in containing further expansion of the current account deficit.

Despite this short-term improvement, the medium-term US fiscal outlook has remained a source of concern given the absence of corrective measures designed to counter the prospect of increasing public retirement and healthcare system costs in the US.

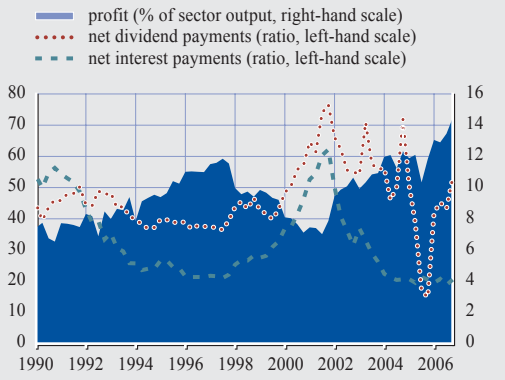
Corporate sector

Despite a moderation in the pace of US economic activity, the profitability of the non-financial corporate business sector reached new record heights in the third quarter of 2006, both in terms of levels and as a percentage of the output of the sector. This continued strength in corporate profitability can be attributed not only to steps taken by firms to enhance cost efficiency together with a decline in the share of operating income needed to make interest payments on debt (see Chart 1.5), but also to strong profit earnings abroad. Moderation in the pace of economic activity coupled with the possibility of a return of profit shares to historical averages would however imply that it is likely that corporate profit growth will be more subdued going forward.

Whereas in the course of 2005 the bulk of profits were retained by US non-financial corporations, resulting in declining dividend payout ratios, corporations have recently drawn

Chart 1.5 US corporate sector profits and shares of interest payments and net dividend payments in profits

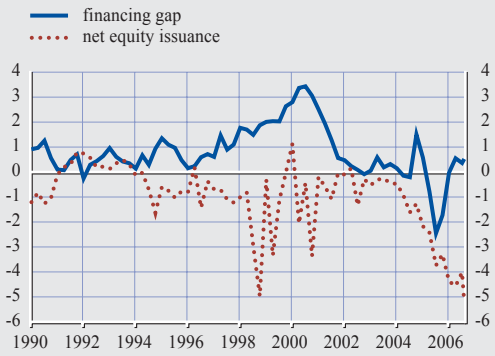
(Q1 1990 - Q4 2006)



Source: US Bureau of Economic Analysis.
Note: Profits are non-financial corporate pre-tax profits.

Chart 1.6 The US non-farm, non-financial corporate sector financing gap and net new equity issuance

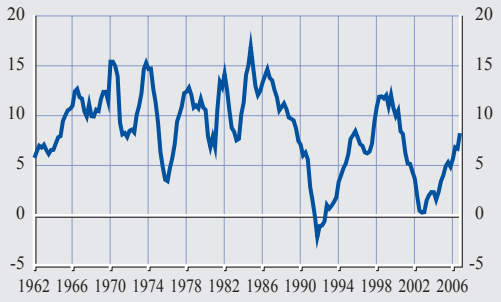
(Q1 1990 - Q4 2006, % of GDP)



Source: US Federal Reserve Board.
Note: The financing gap equals capital expenditures less internal funds and inventory valuation adjustments. A positive gap indicates a need for external financing.

Chart 1.7 US business credit growth

(Q1 1962 - Q4 2006, % per annum)



Source: US Federal Reserve Board.
Note: Growth in credit market borrowing.

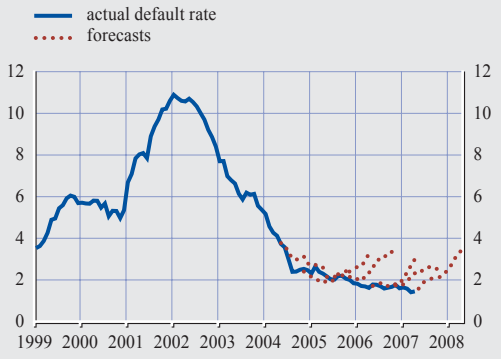
down their fairly elevated cash levels. Reflecting this, there was a pick-up in business spending, dividend payments as well as share repurchases by firms (see Chart 1.5). As the need for external debt financing thus increased, the financing gap moved back into positive territory after the second quarter of 2006, as the need for external debt financing increased (see Chart 1.6).

Apart from the aforementioned factors, low interest rates and solid growth prospects may have underpinned the pick-up in the growth of business credit (see Chart 1.7). Moreover, as noted in the January 2007 Federal Reserve *Senior Loan Officer Opinion Survey on Bank Lending Practices,* firms faced additional demands for funds stemming from growing activity in M&As and, related to this, a surge in LBO activity.

Despite the pick-up in business credit, the debt-to-net worth ratio of the US non-financial corporate sector continued to decline in 2006, standing close to 40% by the fourth quarter of the year, down from over 50% in 2001. The cash-to-debt ratio stood at 24% at the end of 2006 according to the flow-of-funds statistics, the highest quarterly value since 1969. These factors – coupled with the continued strength of profitability – suggest that the financial condition of US corporations has remained strong since the December 2006 FSR. This strength is also reflected in the very low default rates on corporate bonds (see Chart S3). However, some observers have suggested that low default rates and the consistent pushing of rating agencies' default rate forecasts out into the future is a symptom of abundant market liquidity (see Chart 1.8). In particular, there are reasons to believe that innovations in structured finance over recent years may have led to

Chart 1.8 Global speculative-grade default rates and forecasts

(Jan. 1999 - Apr. 2008, %, 12-month trailing sum)



Source: Moody's.

excessively loose credit standards (e.g. less onerous debt covenants than in the past), making it easier for firms with low credit quality to acquire funding or to roll over their debts, thereby potentially sowing the seeds of future vulnerabilities in the medium term.[2] In this respect, it is notable that persistently greater numbers of rating downgrades than rating upgrades have not so far translated into higher default rates (see Chart S4). If default rates have been held at artificially low levels, the next turn of the credit cycle, when it comes, could be more abrupt than expected. Nevertheless, over the six months since the finalisation of the December 2006 FSR, risks have remained broadly unchanged.

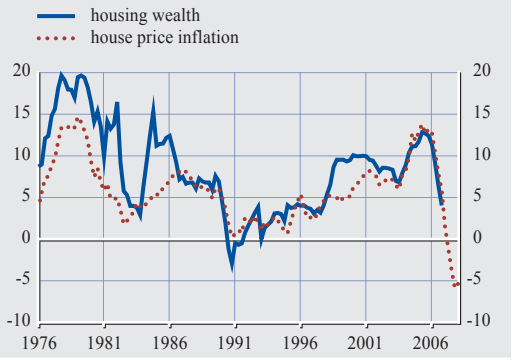
Household sector

After accelerating rapidly in recent years, the leverage of the US household sector rose further in 2006 (see Chart S5). However, while still remaining rather high, the ratio of financial obligations to personal disposable income levelled off in the course of the year, as did the debt servicing ratio (see Chart S6). This partly reflected moderation in the pace of mortgage refinancing and home equity extraction, against a background of higher short-term interest rates and declining house price inflation (see Chart 1.9). Looking ahead, the prices implied in futures contracts based on the S&P Case-Shiller Composite Home Price Index as traded on the Chicago Mercantile Exchange suggest that market participants expect further downward adjustment in the course of 2007.

More generally, the predominance of fixed-rate mortgage contracts locked in at low rates has insulated borrowers from increasing short-term interest rates during the latest phase of US monetary policy tightening.[3] Nevertheless, signs of financial strains have appeared more recently in the so-called variable-rate sub-prime segment of the borrowing population (i.e. borrowers with lower creditworthiness). While relatively small, this segment of the US mortgage market has grown significantly in recent years, and sub-prime borrowers are likely to be more vulnerable to income and interest rate shocks than higher-income households (see Box 2).

Chart 1.9 US housing wealth, house price inflation and expectaions

(Q1 1976 - Q1 2008, % change)



Sources: Federal Reserve Board of Governors, OFHEO and Bloomberg (Chicago Mercantile Exchange).
Note: Historical house price data is based on the OFHEO index while the house price inflation expectation is based on the Case-Shiller house price index. Originally conceived by Karl E. Case and Robert J. Shiller in the 1980s, the Case-Shiller Home Price Indexes (now known as the S&P/Case-Shiller Home Price Indexes) measure home prices based on recorded changes in home values and a repeat sales methodology.

In recent years these vulnerabilities had been exacerbated by loose financing conditions and relaxed lending standards, along with more aggressive lending practices by specialised lenders, and they were quickly exposed by both the rise in short-term interest rates and the deceleration of house price inflation. Looking ahead, the strains in the variable-rate sub-prime mortgage segment are expected to dent US housing sales and house prices for the next two years as foreclosed houses are added to the inventory of unsold homes. However, given the limited size of the market segment, the aggregate impact should remain relatively contained. At

2 In this context, see R. Altman (2006), "Are Historically Based Default and Recovery Models in the High-yield and Distressed Debt Markets Still Relevant in Today's Credit Environment?", mimeo, New York University.

3 However, in the past few years the share of adjustable-rate mortgages in new loan applications has increased significantly (rising from less than 20% in 2001 to a peak of almost 50% at the beginning of 2005), as borrowers took advantage of low short-term interest rates.

the same time, there is a risk that credit problems in the variable-rate sub-prime segment may disturb the flow of credit to other segments, including to sound borrowers, creating the potential for spillover effects in the broader economy. However, such spillover effects have not yet materialised.

Nevertheless, mirroring the deteriorating housing market outlook, respondents to the January 2007 Federal Reserve *Senior Loan Officer Opinion Survey on Bank Lending Practices* reported a tightening in credit standards for residential mortgage loans (the highest net percentage of US banks tightening mortgage credit standards since the early 1990s). At the same time, demand for such loans further weakened.

Overall, in the period since the finalisation of the December 2006 FSR, the risks that could potentially emanate from US households to financial stability have increased. Indeed, recent strains in the variable-rate sub-prime mortgage market segment have turned out to be more severe than anticipated at this point in the housing cycle. In addition, the weakness in the US housing market appears to be more severe and prolonged than earlier anticipated.

Box 2

US SUB-PRIME MORTGAGE SPILLOVER TO CREDIT RISK TRANSFER MARKETS

The share of adjustable rate mortgages (ARMs) in new mortgage credit extended in the US has risen significantly since 2002. Whereas at the end of 2002 the share of ARMs was about 20% in dollar volume terms and just over 10% by number of new mortgages granted, their respective shares peaked at around 50% and 35% in mid-2005, after which they declined somewhat (see Chart S7).[1] Of these mortgages, a substantial number were "sub-prime" – i.e. mortgages granted to individuals with poor credit histories.[2] This Box explains why delinquencies on these loans rose significantly after mid-2005, and shows how this ultimately led to spillovers into certain portions of the CRT markets in early 2007.

Delinquency rates on sub-prime mortgages increased markedly after mid-2005, especially on loans that were originated in 2005-2006, for four main reasons. First, sub-prime borrowers are typically not very creditworthy: they are often highly leveraged – usually with high debt-to-income ratios, while the mortgages extended to them typically have relatively large loan-to-value ratios – and frequently they have little in the way of assets to cover unexpected mortgage repayments. Second, sub-prime mortgages are short-reset loans, i.e. the interest rate initially charged to a sub-prime mortgage borrower is much lower than standard mortgage rates, but after a two to three year period, it is typically reset to a much higher rate. Because of this, although short-term market interest rates began to increase in the US from mid-2004 onwards, resets did not begin to translate into higher mortgage repayment burdens until sometime later. However, debt service burdens for loans eventually increased, and began resetting to higher rates from 2004 onwards. This led to financial distress for some of this group of borrowers.

Third, in states that had previously seen high rates of house price inflation since the early 1990s, and consequently where housing had become less affordable, sub-prime borrowers had

1 Source: US Mortgage Bankers Association.
2 Sub-prime borrowers have often either missed payments on a debt or been late with payments. Lenders charge a higher interest rate to compensate for potential losses from customers who may run into trouble or default. Various estimates put the stock outstanding of sub-prime mortgages loans at 12-15% of total household mortgage credit in the US.

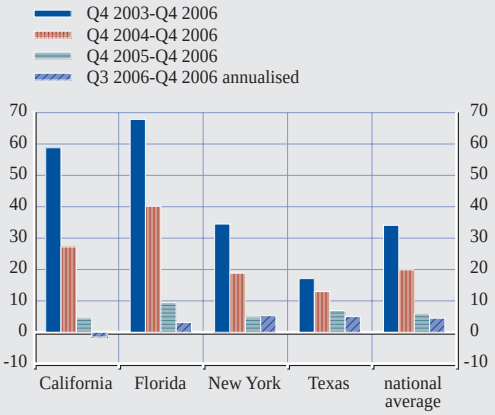
Chart B2.1 US house price inflation

(% per annum)

Sources: Office of Federal Housing Enterprise Oversight (OFHEO) and ECB calculations.

Chart B2.2 House price inflation in selected states in the US

(% change)



Sources: OFHEO and ECB calculations.

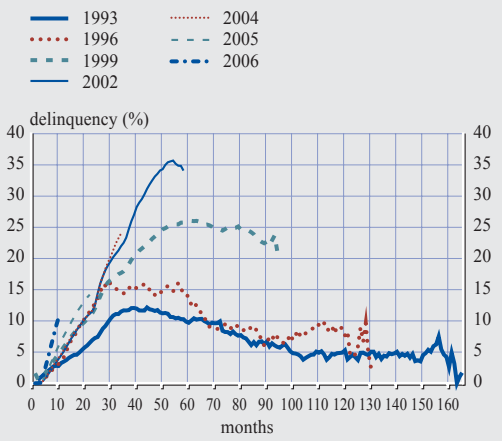
counted on being able to refinance or repay mortgages early through home sales. For instance, according to one estimate, just under 50% of the outstanding amount of securitised sub-prime mortgages in 2006 was accounted for by just four states.[3] As the rate of US house price inflation began to decline after April 2005 (see Chart B2.1), it slowed substantially in these states (see Chart B2.2). As a result, there was a decline in the probability of sub-prime mortgages being refinanced or of being paid off early through home sales before being reset at a higher mortgage interest rate. As this possibility was pushed further into the future, sub-prime borrowers ended up incurring higher mortgage costs than they might have expected to bear at the time of taking out their mortgage. Slower house price inflation also limited the opportunities of borrowers wishing to withdraw equity – i.e. to pay down debt – through selling. This further reduced the ability of already delinquent borrowers to carry out a cash-out refinancing to remedy the delinquent status of their loans.

Fourth, the availability of sub-prime mortgages was amplified by investor demand for higher yielding assets. This boosted demand for residential mortgage-backed securities (RMBS) and Collateralised Debt Obligations (CDOs) containing mortgage-backed securities (MBS), which offered higher returns compared to those available from corporate or sovereign credit. The supply of sub-prime assets responded, aided by the application of excessively loose credit standards by mortgage originators – including those originated by mortgage brokers, whose share in total originations in this market has increased dramatically in recent years. As most of these loans originated by brokers were subsequently securitised, it appears that the originating brokers now have less incentive to monitor borrowers' creditworthiness.[4] The combined result of financially stretched borrowers, higher interest rate resets, and reduced abilities to avoid resets or to carry out a cash-out refinancing for delinquent loans because of declining house price inflation, was increased delinquency rates on securitised sub-prime mortgage loans. The most recent vintages of sub-prime mortgages originated in 2005 and 2006 saw delinquency

3 Source: JP Morgan Chase & Co.
4 To some extent this should have been mitigated by brokers having to repurchase delinquent loans from the underlying asset pool. However, as some of the brokers were experiencing financial difficulties and even in some cases filed for bankruptcy, this did not occur, leading to even greater losses on the underlying asset pools.

Chart B2.3 Delinquency rates on securitised sub-prime adjustable rate mortgage loans by vintage year in the US

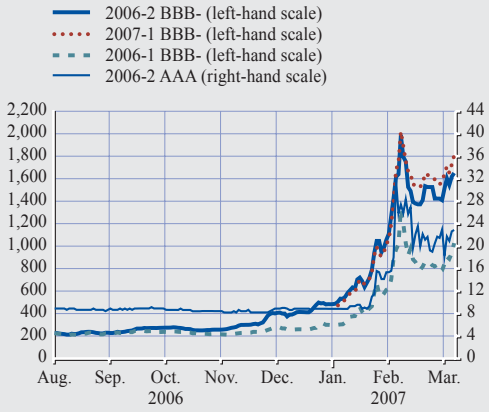
(basis points spread)



Source: Fitch Ratings.
Note: Includes RMBS transactions rated by Fitch Ratings.

Chart B2.4 ABX-HE-BBB- and AAA-rated spreads over the risk-free rate in the US

(basis points spread)



Source: JP Morgan Chase & Co.

rates on securitised mortgage pools climb much faster than on older vintages (see Chart B2.3).

As the frequency of sub-prime mortgage delinquencies rose, the impact on the lower quality end of the CRT market was substantial, and market participants' concerns over deteriorating sub-prime credit quality led to a significant increase in the cost of credit protection associated with sub-prime non-agency RMBS. For instance, the spreads on an index comprised of lower quality tranches of securities ultimately backed by sub-prime loans – originated during 2006 – rose from around 200 basis points in August 2006 to over 1,000 basis points by the end of March 2007 (see Chart B2.4).[5] This indicated that market participants had rapidly reappraised the risks associated with these securities and demanded much higher premiums for credit protection compared to either risk-free rates or to premiums paid on higher-rated (AAA) tranches for the same vintage. Moreover, the impact on spreads for different vintages varied among the lower-rated tranches, probably reflecting expectations that lower house price inflation in the second half of 2006 would affect the underlying assets, as the loans in the underlying RMBS pools of the later reference series (i.e. 2006-2 and 2007-1) have yet to reset, indicating more delinquencies are probable during the second half of 2007.

The extent to which this deteriorating performance of sub-prime RMBS could affect broader structured credit markets depends on the concentration of these assets as collateral for CDOs and how developments in the ratings of these sub-prime assets feed through to CDO tranche ratings. In 2006, according to Moodys, the average share of sub-prime assets in CDOs asset pools was about 45%; just over 22% of this was rated Baa or lower. Depending on the type of CDO there was a great deal of variability around this average figure, no sub-prime collateral

5 This ABX.HE index is the most relevant index covering US sub-prime non-agency RMBS. The index allows market participants to buy or sell credit protection on the index depending on the level of risk they wish to hedge or assume. The index is composed of series ranging from AAA-rated to BBB-. Each series is comprised of a basket of 20 CDS referencing sub-prime non-agency MBS. Every six months a new series is created referencing 20 new RMBS. The underlying mortgage assets in the RMBS were originated during the first and second halves of 2006, and the first half of 2007.

for 'high-grade' CDOs, i.e., containing only prime residential mortgage backed (RMBs), and as much as 88% of the pool for so-called 'mezzanine' CDOs.[6] A substantial amount of this sub-prime CDO collateral is currently poised for rating downgrade review and some of it had already downgraded between Q4 2006 and Q1 2007. It cannot be ruled out that further poor performance of collateral and subsequent downgrading could trigger downgrades of CDO's tranches themselves and lead to a reassessment of risk in structured credit markets.

6 See Moody's (2007), "The impact of sub-prime residential mortgage-backed securities on Moody's-rated structured finance CDOs: a preliminary review" Special Comment, March, and Moody's (2007), "US sub-prime mortgage market update: April 2007", Special Report, April.

REGION-SPECIFIC IMBALANCES

Non-euro area EU countries

The pace of macroeconomic activity in most non-euro area EU countries remained strong after the finalisation of the December 2006 FSR, with the economies of central and eastern Europe operating above their supply capacity. These very strong cyclical conditions suggest that the risk of overheating in several of the economies in this region persists, and some central banks accordingly increased their official interest rates, continuing the tightening cycle that started in 2006. Notwithstanding higher interest rates, preliminary information suggests that growth in domestic demand and house prices generally remained strong since mid-2006. At the same time, however, growing domestic and external imbalances (see Box 3 in the December 2006 FSR) may have heightened the risks associated with bank lending in the region.

In the UK, the largest economy in this group of countries, GDP growth in 2006 was strong, underpinned by private spending and investment, and is expected to be largely sustained in the near term. Lending growth since mid-2006 also remained strong, led by lending to households (mainly secured) and non-financial corporations. According to the April 2007 Bank of England Financial Stability Report, the UK financial system remains highly resilient, although its key vulnerabilities as a whole are considered to have edged up over the last nine months. Areas of concern include the interrelationship between low risk premiums and corporate debt vulnerabilities. Risks related to the household sector have also risen slightly given the sharp rise in personal insolvencies, although the prospect of problems arising from secured debt exposures remains low and unchanged.

Economic growth in Sweden and Denmark also remained strong despite some deceleration in the second half of 2006, supporting continued buoyant bank lending to households and companies.

In the central and eastern European EU Member States, GDP growth remained strong or accelerated further from already very high levels in the second half of 2006. Growth was driven primarily by domestic demand and fuelled by rapid credit expansion, which remained high in most countries, most notably in the Baltic countries (at or above 40% per annum in February 2007). This notwithstanding, bank lending growth broadly stabilised in most countries towards the end of 2006 and early 2007, possibly as a result of the recent interest rate hikes, or because of a reassessment of the risks.[4] The growth outlook in the central and eastern European EU Member States remains positive, although a gradual deceleration in the medium term is expected in the fastest growing countries, notably in Hungary as a result of ongoing fiscal stabilisation efforts.

4 The Bank of Latvia has increased interest rates twice since the finalisation of the December 2006 FSR, citing the high levels of inflation, growing external imbalances and rapidly growing external debt.

The high share of foreign currency lending in many of these countries and the resulting widening currency mismatches, particularly of households, remain an important concern from a financial stability perspective, as banks will bear the credit risk should the local currency in question suddenly depreciate vis-à-vis the currency in which the loans were extended.

Overall, whilst bank lending growth in most central and eastern European EU Member States broadly stabilised towards the end of 2006 and early 2007, risks to financial stability have increased since the December 2006 FSR in some countries which continue to experience strong growth in bank lending activity coupled with increasing domestic and external imbalances.

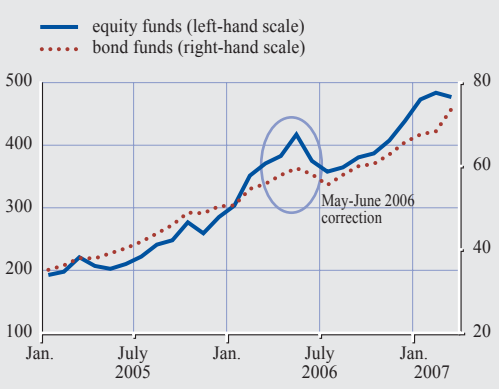
Emerging economies

Economic activity in emerging economies has remained dynamic since the finalisation of the December 2006 FSR. Strong domestic demand, generally sound policies, still benign global financial conditions as well as high commodity prices – some recent declines notwithstanding – have supported favourable growth prospects, and suggest that the macroeconomic risks originating from these economies – for instance through a downward correction in their contribution to global demand – remain contained.

Given generally favourable fundamentals, capital inflows into emerging economies remained buoyant. The Institute for International Finance, for instance, raised its estimates of net capital inflows to these economies for 2006 to about USD 500 billion, a level close to historical highs. For 2007 it projected a slight moderation to USD 470 billion.[5] This notwithstanding, emerging sovereign borrowers continued to buy back large amounts of external debt and to rely increasingly on domestic funding. In line with this, inflows into dedicated emerging equity funds grew by more than 30% in the second half of 2006 compared with mid-2006, and reached around USD 470 billion in March 2007. Similarly, inflows into bond funds have risen by more than 20% to stand close to USD 70 billion (see Chart 1.10). However, inflows into equity funds slowed somewhat in the wake of the late February and early March 2007 correction.

Chart 1.10 Net inflows into dedicated emerging market economy funds

(Jan. 2005 - Mar. 2007, USD billions)



Source: EmergingPortfolio.

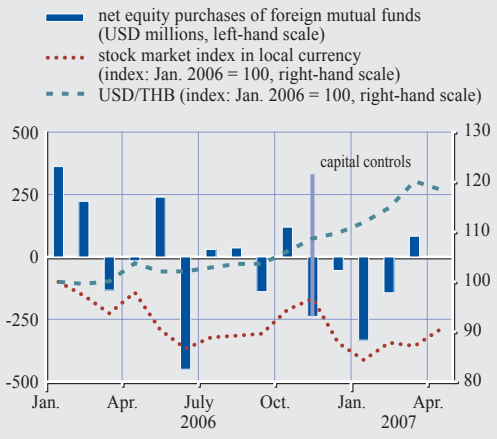
Factors supporting these strong inflows include investors' perception that the current cycle of monetary policy tightening in advanced economies may have matured, carry trade strategies and hedge funds' growing interest in emerging economies' domestic financial assets. The main positive structural factors include major improvements in emerging market fundamentals, strong returns on emerging financial assets in recent years, as well as growing demand from institutional investors.

A recent and growing concern is the increasing challenge that emerging economies face with regard to managing strong capital inflows, and some countries have already experienced difficulties in finding effective tools to dampen the macroeconomic and financial impact of these inflows. Whereas some economies allowed their exchange rates to appreciate in response to these strong inflows, others continued to accumulate sizeable amounts of reserve assets and intervened in the foreign

5 See Institute of International Finance (2007), "Capital Flows to Emerging Market Economies", January.

Chart 1.11 Selected financial indicators for Thailand

(Jan. 2006 - Apr. 2007)



Sources: EmergingPortfolio and Bloomberg.

exchange markets so as to minimise any potential losses in external competitiveness. When these interventions were not fully sterilised, they did support credit and monetary growth, thus in some cases complicating monetary management, stretching financial asset valuations and dragging on banking sector profitability.[6] Furthermore, some emerging Asian economies such as China and India increasingly resorted to reserve requirements to manage abundant liquidity, while others attempted to relax controls on resident outflows.[7] Such challenges were perceived to be particularly acute in Thailand, where – following a close to 13% gain of the Thai baht against the US dollar between January and November 2006 (see Chart 1.11) – the Thai authorities introduced reserve requirements on foreign capital inflows in December 2006 in order to preserve external competitiveness.[8] Even though some concerns remain about a possible reversal towards trade and capital controls, the regional and global implications arising from this event were limited, with authorities in other emerging Asian countries reaffirming their commitment to capital account liberalisation.

Overall, many of the risks facing emerging economies which have been highlighted in past editions of the FSR remained. In the near term, these risks include the vulnerability of these economies to abrupt shifts in global liquidity conditions as well as to shifts in investor sentiment, as illustrated by the impact of the financial market turbulence in late February and early March 2007 (see sub-section 1.2). Furthermore, as the decline in export growth in some emerging economies observed in late 2006 illustrates, downside adjustments to external demand remain a risk. Another risk which has become more prominent over the past six months was the increasing difficulty for some economies to find effective tools to cope with strong capital inflows. Further ahead, one of the main vulnerabilities for emerging economies remains the possibility of an abrupt correction of global current account imbalances.

1.2 KEY DEVELOPMENTS IN INTERNATIONAL FINANCIAL MARKETS

On 27 February 2007 the Chinese equity market fell by 9%. This was followed shortly thereafter by asset price adjustments across global financial markets. Equity markets and most emerging market assets declined, while G3 government bonds benefited from a "flight to quality". Equity and foreign exchange volatility increased, and the Japanese yen appreciated as a result of some carry trade unwinding.

6 Strong capital inflows into China have potentially weighed on bank profitability in recent years, with sterilisation bond yields falling below the yields paid by banks on deposits. See ECB (2007); "Putting China's economic expansion in perspective", *Monthly Bulletin*, January.

7 Recently India doubled the annual limit on individual outward remittances, Korea substantially increased limits on residents' investments in overseas financial assets and real estate, and the Philippines raised the limit on commercial banks' long foreign exchange positions and doubled the ceiling on outward foreign investment by resident firms.

8 Foreign short-term capital inflows were subject to a 30% reserve requirement, and early withdrawals before a minimum one-year holding period were taxed. The authorities initially proposed that the tax would include all inflows, but later reduced the scope of the measures significantly after an adverse market reaction, with the stock market declining sharply and foreign mutual funds selling Thai equities. The measures did not apparently manage to alter investors' views about the currency's strength as the Thai baht continued to appreciate against the US dollar over most of the period.

Several specific factors were mentioned as possible explanations for the magnitude of these changes in financial markets, such as fears of a possible bubble in the Chinese equity market (which had risen by 31% over the two months prior to the correction), and concerns over the possibility of a recession in the US or a negative downturn in the credit cycle. Market focus turned to the US sub-prime mortgage market, and the credit spreads of most US financial institutions widened amidst fears that the turmoil in this market segment could spread to the broader US mortgage market.

However, these specific risk factors appeared to be mere triggers of a correction which was expected and deemed inevitable by many market analysts. Indeed, equity markets had experienced a relentless eight-month rise, while credit spreads had reached a historical low ahead of the turbulence. Some emerging equity markets, particularly in China, had been booming in the months preceding the correction. Besides this, foreign exchange implied volatility had declined to unprecedented lows, creating a very favourable environment for carry trades.

In an environment of low volatility and high correlation across markets, this episode serves as a reminder of the need to monitor carefully the underlying risks across markets, and of the dangers of excessive market complacency.

US MONEY MARKET

Short-term interest rates in the US have remained broadly stable since the finalisation of the December 2006 FSR. Market participants priced in expectations of several official fed funds target rate cuts during 2007 well before the words "any additional firming" were eventually removed from the Federal Open Market Committee (FOMC) statement following its March meeting. However, uncertainties about whether the Fed might lower rates and when the change of direction might come caused expectations to fluctuate (see Chart 1.12).

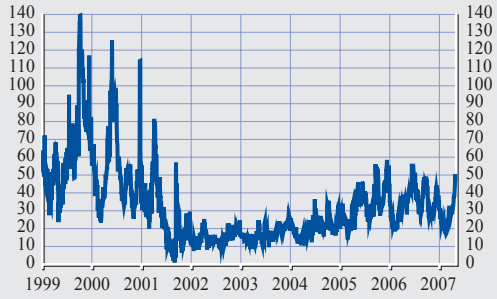
Chart 1.12 Rate implied by the Eurodollar three-month future maturing in December 2007

(Jan. 2006 - May 2007, %)

Source: Bloomberg.

Chart 1.13 US three-month TED spread

(Jan. 1999 - May 2007, basis points)



Source: Bloomberg.
Note: The TED spread is the difference between uncollateralised money market interest rates and risk-free Treasury bill rates of similar maturity.

A narrowing of the TED spread in the second half of 2006 indicated that concerns about money market counterparty credit risks had eased slightly (see Chart 1.13). The spread widened modestly again when markets underwent a bout of turbulence in February/March 2007, but this was quickly reversed. Notwithstanding such unease, issuance activity in commercial paper markets remained robust, suggesting that the money markets continued to intermediate funds smoothly.

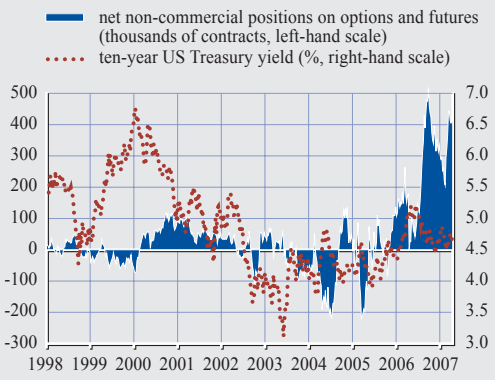
US FIXED INCOME MARKETS

Over the six months following the finalisation of the December 2006 FSR, US long-term bond yields have changed little (see Chart S24). Some downward pressure was exerted on yields as a result of safe-haven demand, and possibly also expectations of lower short-term interest rates as a result of falling and more volatile equity prices from late February onwards.

Even though longer-term US bond yields had increased significantly from the low-points of 2003, they still remained lower than expected, given expectations of nominal GDP growth over the same horizon (4.7% versus 5.1%). Moreover, the US yield curve remained inverted (see Chart S24) – traditionally but not necessarily suggesting that there is greater risk of a future US recession – despite the fact that the pace of US economic activity is only expected to slow down temporarily. Factors which may have held long-term bond yields down include reduced variability of inflation and output (and lowered risk premiums), greater market liquidity and demand for US securities from foreigners, as well as only modest business capital spending.

Chart 1.14 Net non-commercial positions on futures and options and the ten-year US Treasury yield

(Jan. 1998 - Apr. 2007)



Sources: Commodity Futures Trading Commission (CFTC) reports and Bloomberg.

Looking ahead, government bond yields would seem to be vulnerable to the risk of an abrupt unwinding of speculative long positions on bond futures and options (see Chart 1.14). Potential triggers for adjustment could include lower foreign demand for US government bonds, for instance in case of a sharp depreciation of the US dollar.

US CREDIT MARKETS

Persistently low US credit spreads continued to support buoyant market conditions for corporate bond issuance in the period after the finalisation of the December 2006 FSR, with large increases in net issuance of commercial paper and corporate bonds still registered in the last quarter of 2006. The broad strength of US non-financial corporate sector balance sheet positions as well as low default rates on corporate bonds (see Chart S3) contributed to maintaining narrow credit spreads.

Credit markets underwent a bout of turbulence through end-February and early March as global risk appetite receded. Corporate bond spreads at the lower end of the credit quality spectrum widened, albeit only slightly. Higher premiums for protection against credit risk were also seen in the main US CDS indices, the CDX, especially in the lower-grade segments (see Chart S36). Nevertheless, credit markets remained liquid across the rating spectrum. Notwithstanding this market turbulence, by early-May US corporate bond spreads were similar to those in early November 2006 (see Charts S34 and S35). Even though corporate balance sheet positions remained strong, some underpricing of credit risk cannot be excluded, especially in view of expectations that the pace of US economic activity will slow down over the coming 12 months, and that the relatively high share of profits in US national income raises questions about the future sustainability of high rates of corporate profitability. Furthermore, the surge in LBO and share buyback activity in 2006 and early 2007 is typically not beneficial for corporate bond investors.

Should a large credit event materialise, possibly related to concerns about excessive leverage in recent private equity deals, or if incidences of corporate sector defaults were to increase more generally and abruptly, the most likely result would be turbulence in the corporate credit markets. In this vein, there are some expectations that default rates will increase over the coming year (see Chart S3).

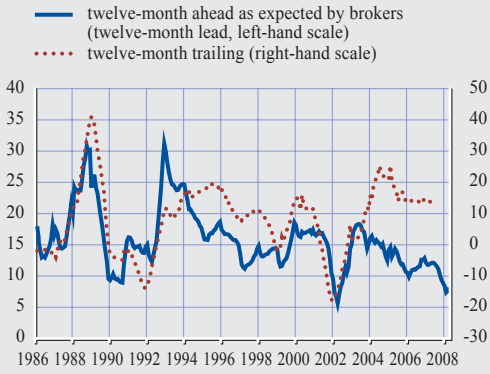
US EQUITY MARKETS

Although corporate earnings growth continued to exceed analyst expectations formed one year before (see Chart 1.15) and despite an upturn in inflows to equity mutual funds, US stock prices underwent a correction in late-February and early March 2007, erasing all of the stock price gains recorded after the December 2006 FSR was finalised. This took place amidst a global sell-off of shares which was spurred by concerns that stock prices may have climbed too high during a four-year rally (see Chart S26). Given indications of a significant build-up of leverage behind equity positions (see Chart S31), stock markets may have become increasingly susceptible to adverse disturbances. The turn in risk appetite among investors (see Charts S18 and S27) reflected concerns about downside risks for the US and for global economic growth, fears of a potential spreading of the crisis in the sub-prime mortgage market, and the reaction to the largest insider trading scandal in the US since the 1980s.[9] Although the abrupt decline in the S&P 500 was not considered a high probability scenario in late 2006, it still remained well within the boundaries of probability distributions implied in options prices, so it is unlikely to have challenged financial institutions risk-bearing capacities. At the same time, initial public offering (IPO) and secondary public offering (SPO) activity (see Chart S33) remained buoyant, despite the rise in stock market volatility.

Consistent with the retrenchment of risk appetite among investors that began in late February, the stock prices of firms in so-called defensive sectors outperformed the broader market. By contrast, financial sector stock prices, which are more sensitive to business cycle conditions, underperformed other sectors, which to some extent also reflected concerns about financial firms' exposures to the troubled sub-prime mortgage market.

Chart 1.15 S&P 500 earnings per share growth

(Jan.1986 - Apr. 2008, % per annum)



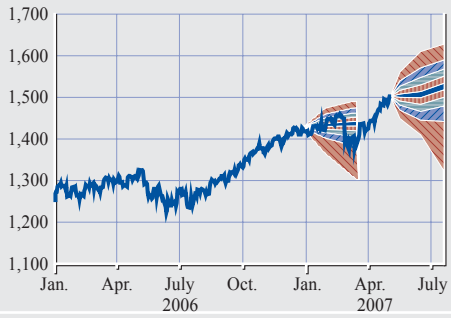
Source: Thomson Financial Datastream (I/B/E/S).

Looking ahead, there are a number of potential sources of risk for the US stock market. Regarding stock market valuation, there was little change in the price-earnings (P/E) ratio for the S&P 500 based on ten-year trailing earnings, which continued to remain high (see Chart S29), and well above longer-term historical averages of around 15. One of the reasons why valuations have changed little over recent years has been rises in stock prices, which closely matched corporate earnings growth. However, there have been some indications of a slowing down in the pace of profit growth, and a further slowdown is expected over the coming year. This could

9 Announced by the Securities and Exchange Commission on 1 March, see http://www.sec.gov/news/press/2007/2007-28.htm.

Chart 1.16 Options-implied fan chart for developments in the S&P 500 index

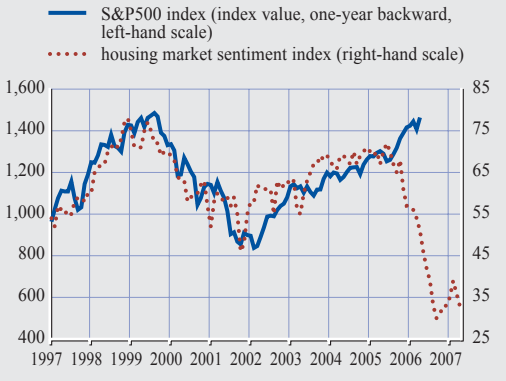
(Jan. 2006 - July 2007, fan charts for 28 Dec. 2006 and 7 May 2007, index value)



Sources: Bloomberg and ECB calculations.
Note: Every field shown in the fan charts represents 10 percent deciles where the S&P 500 is expected to be in the nearby future. The upper and lower limits represent the 90% probability bounds. The distributions are based on options expiring in 24, 52 and 80 days.

Chart 1.17 US equity and housing market sentiment

(Jan. 1997 - Apr. 2007)



Sources: National Association of Home Building (NAHB), Standard & Poor's.
Note: The NAHB-Wells Fargo Housing Market Index measures the strength of the single-family housing market each month through surveys of NAHB members.

make recent valuations more difficult to sustain in the period ahead. In this vein, the likelihood of large swings in US stock prices – as reflected in increased levels of implied stock market volatility and further downward skewing in the implied probability distribution – as priced by market participants increased significantly after the episode of turbulence in late February/early March (see Charts 1.16 and S26).

Another potential source of risk for the US equity market stems from the fragility of the US housing market. A strong interplay between the housing and equity markets has been evident over at least the last decade, with the housing index leading the S&P 500 by about a year (see Chart 1.17). The reasons for this seem to be that weak housing market conditions typically result in low consumer confidence and low home equity withdrawal, which in turn implies less investment in the equity market. Finally, the equity market also remains vulnerable to the possibility of a sudden rise in the long-term interest rate.

EMERGING FINANCIAL MARKETS

Segments in emerging financial markets remained vulnerable to potentially abrupt downward corrections after the finalisation of the December 2006 FSR, a risk that was also evident when the large emerging financial market correction of February 2007 contributed to a more widespread correction in global, including euro area, financial markets. This suggested that shocks to the global financial system might increasingly originate in emerging financial markets (see Box 3).

Emerging financial markets continued to rebound at the end of 2006 – following last year's May-June correction – and performance was robust in the first months of 2007. In the year to early May 2007, emerging equity market valuations – as tracked by the MSCI index – gained about 7% on average, EMBIG spreads on international bonds remained at historically low levels, at around 170 basis points, and yields on long-term domestic bonds – as tracked by the GBI-EM index – rose by around 10 basis points, to 6.1%. A number of

events – such as the introduction of capital controls in Thailand, the nationalisation plans unveiled in Venezuela and concerns about a debt default in Ecuador – were associated with large declines in equity or external debt prices in the countries concerned. These events tended not to have any significant spillovers into other emerging markets, suggesting that investors continued to discriminate across economies on the basis of fundamentals. However, the global correction of late February and early March affected a broad spectrum of emerging financial markets.

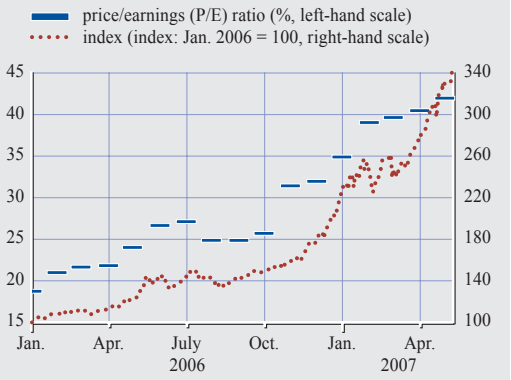
A large decline in Chinese equity prices on 27 February – when the Shanghai composite index lost close to 9%, the largest daily decline in a decade – was seen by some market participants as potentially triggering a more widespread correction. This had followed a substantial rally, whereby the index had risen 130% in 2006 and 13% in the year to the eve of the correction, when the market closed at an all-time high. As of early-May, price declines had reversed, although high P/E ratios suggested that valuations remained potentially stretched (see Chart 1.18).

The correction in the Chinese equity market reflected, at least in part, investor concerns about accelerating domestic inflationary pressures and about the possible introduction of measures to dampen equity prices. Although the underlying fundamentals remained strong, the episode served to illustrate how changes in investor sentiment can lead to sharp, abrupt changes in valuations.

Other emerging financial markets weakened in the wake of the correction in China, although significant price movements remained largely confined to equity markets. According to the MSCI index, emerging equity markets lost altogether about 5% between late February and mid-March – a loss somewhat smaller than that endured during the May-June 2006 correction. The magnitude of the correction across emerging markets was generally commensurate with the rise in share prices that took place in the preceding year. This suggests that market developments reflected, to a large extent, a

Chart 1.18 Shanghai composite equity market index and price-earnings ratio

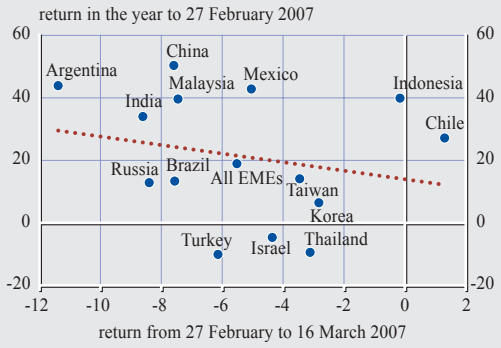
(Jan. 2006 - May 2007)



Source: Bloomberg.

Chart 1.19 Emerging market equity returns in the year to 27 February 2007 and in the period 27 February - 16 March 2007

(returns in %)



Sources: JP Morgan Chase & Co. and ECB calculations.
Note: Estimates based on the MSCI indices in local currency of the corresponding emerging economies.

period of "normalisation" and represented an opportunity for profit-taking (see Chart 1.19).[10] However, there were other factors at work, as countries with poorer fundamentals (Turkey) or where authorities were concerned about potential overvaluations or overheating (China and India) experienced some of the sharpest declines. Emerging equity markets remained volatile, however, most notably because of concerns about the risk that tensions in the US sub-prime mortgage market could spread, coupled with the implications for the US growth outlook and, therefore, emerging market exports.

Other emerging market asset classes remained largely unaffected by the volatility in equity markets, suggesting a high degree of investor discrimination was maintained. Price movements in local bond markets and foreign exchange markets were relatively limited. EMBIG spreads on international bonds widened modestly, by around 20 basis points. Many asset prices then recovered partially, indicating that – at least as of early May – the episode did not involve a substantial reassessment of fundamentals.

Overall, the emerging financial markets handled the shock relatively well, remaining liquid and well-functioning, while volumes rose to high levels in some countries. However, the episode served as a useful reminder that segments of the emerging financial markets that are characterised by stretched valuations and potential investor complacency remain a possible source of market risk for the euro area financial system, either through spillovers of valuation adjustments to euro area financial markets or via direct or indirect exposures of euro area financial institutions to these markets.

10 In Russia, observers seeking to explain the extent of the correction mentioned the large share of retail investors and day traders in the investor base, which is considered as being less prone to absorbing losses than institutional investors.

Box 3

THE IMPACT OF EMERGING MARKET SHOCKS ON GLOBAL EQUITY MARKETS

Recent events in emerging market economies (EMEs) – such as the introduction of capital controls in Thailand, the unveiling of nationalisation plans in Venezuela, the Russia/Belarus conflict over oil exports to western Europe, and concerns about the risk of a possible default in Ecuador – contributed to inducing substantial corrections in emerging equity markets. A relevant issue for global financial stability is to assess the extent to which such events or shocks – originating in EMEs – affect global equity markets more broadly, including those in the euro area. The debate on the relevance of EMEs for global financial markets has traditionally focused in particular on transmission and contagion during financial crises in EMEs.[1] Yet emerging market assets have become an increasingly important global asset class over the past decade, meaning that their potential to influence pricing in other markets – also during normal times

1 See e.g. K. J. Forbes and R. Rigobon (2002), "No Contagion, Only Interdependence: Measuring Stock Market Co-Movements", *Journal of Finance,* Vol. 57 (5), 2223-2261; and G. L. Kaminsky, and S. Schmukler (1999), "What Triggers Market Jitters? A Chronicle of the Asian Crisis", *Journal of International Money and Finance,* Vol. 18 (4), 537-560.

Table B3.1 Transmission of EME shocks – all shocks, by region

Event shock to:	All 14 EMEs		Latin America 4		Emerging Asia 6		Emerging Europe 4	
Market reaction of:	coef.	*std.err.*	coef.	*std.err.*	coef.	*std.err.*	coef.	*std.err.*
World	0.300 ***	0.04	0.362 ***	0.06	0.149 **	0.07	0.268 ***	0.07
Latin America	0.402 ***	0.06	0.592 ***	0.07	0.101	0.09	0.315 ***	0.10
Emerging Asia	0.302 ***	0.05	0.220 ***	0.07	0.407 ***	0.09	0.234 ***	0.08
Emerging Europe	0.635 ***	0.08	0.400 ***	0.10	0.329 ***	0.13	0.966 ***	0.16
Euro area	0.354 ***	0.06	0.307 ***	0.08	0.278 ***	0.11	0.373 ***	0.10
Japan	0.216 ***	0.07	0.238 ***	0.10	0.212 *	0.12	0.072	0.11
United Kingdom	0.318 ***	0.05	0.315 ***	0.07	0.234 ***	0.10	0.292 ***	0.10
United States	0.328 ***	0.06	0.457 ***	0.08	0.107	0.10	0.271 ***	0.10

Source: ECB calculations.
Note: The table shows the transmission coefficients for EME shocks. ***, ** and * indicate statistical significance at the 99%, 95% and 90% levels respectively.

– may be increasing. This makes it important to understand whether, and to what extent, EMEs have systemic importance for global financial markets, above and beyond their influence during crises episodes. This Box aims at shedding light on the transmission of EME equity market shocks to global equity returns as well as to 15 individual mature economies' markets.[2]

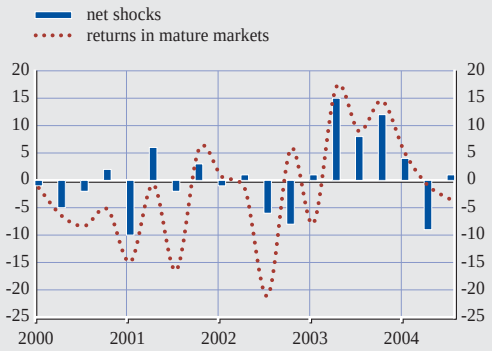
Using a novel database of economic and political events in 14 systemically relevant EMEs[3] over the period 2000-2004, the empirical analysis conducted yields a number of findings that are relevant from a financial stability viewpoint, of which three main ones can be highlighted. First, on a daily frequency, EME shocks have a significant and sizeable effect, inducing on average 0.3% change in global equity returns (see Table B3.1). The subsequent rows of Table B3.1 show the response of regional equity market return indices for Latin America, emerging Asia and emerging Europe, as well as the return indices of the large mature markets of the euro area, Japan, UK and the US. Global returns appear to be most sensitive to shocks emanating from Latin America, though they are also sensitive to shocks coming from emerging Asia and emerging Europe.

Second, the response of mature economy equity markets shows several disparities in terms of regional effects. In particular, US equity markets are significantly more affected by shocks from Latin America than from Asia or emerging Europe. By contrast, Japanese markets appear to respond most to Asian and Latin American shocks, and not at all to shocks emanating from emerging Europe. The euro area and the UK are again very different in that their reaction is very similar for shocks from all three EME regions. For instance, euro area and UK markets react more to shocks from emerging Europe than do the US and Japan. However, while these effects are significant in statistical terms, their economic importance for financial stability concerns from a euro area perspective should not be overstated.

2 For more details, see L. Cuadro Saez, M. Fratzscher and C. Thimann (2007), "The Transmission of Emerging Market Shocks to Global Equity Markets,", *ECB Working Paper*, No 724, February.
3 The database covers 14 EMEs, four in Latin America (Argentina, Brazil, Chile and Mexico), four in emerging Europe (the Czech Republic, Poland, Russia and Turkey) and six in Asia (India, Indonesia, Korea, Malaysia, Taiwan and Thailand). This list covers most of the systemically important EMEs, possibly with the exception of China. Hong Kong and Singapore are also not included, partly due to problems of data availability.

Chart B3.1 EME shocks and global equity returns

(three-month cumulative return and net shocks)



Source: ECB calculations.
Note: The chart shows the quarterly cumulated net EME shocks (cumulated difference between positive and negative shocks) and the stock market returns in mature economies. The correlation between net shocks and returns in developed markets is 0.70.

A third key result, which has been omitted here on grounds of brevity, is that global equity markets react almost as strongly to positive EME news as to negative news, with this result being robust across EMEs and over time. This underlines the importance of EMEs for global financial markets (and not only during crises or other less favourable episodes). Investors in mature economies also benefit from positive developments in EMEs. This may reflect factors such as the growing economic integration of EMEs in the world economy and their rising levels of trade and financial linkages with mature economies.

These empirical findings based on high-frequency data raise the question about the overall importance of EMEs as a driver of the global equity markets. This is difficult to answer as it is hard to quantify precisely the extent to which EME shocks affect the global equity markets. However, the high degree of persistence of the effects – which are still present in global equity markets after several weeks – stresses the economic relevance and systemic importance of EMEs.

Another way to gauge the overall relevance of EMEs is to compare the net shocks over a longer time period, i.e. the difference between positive and negative shocks in EMEs, and equity returns in mature economies (see Chart B3.1). There is a remarkably high degree of co-movement between the two series, in particular since the end of 2002. In fact, the correlation coefficient for the whole sample period is 0.70. It should be stressed that this relationship does not imply causality, but it underlines that developments in EMEs strongly co-move with those in global equity markets.

Overall, the analysis emphasizes the relevance of EMEs for global financial markets. EMEs appear to have gained in systemic importance for global financial markets, thereby exceeding their influence during relatively infrequent episodes of financial crises and market turbulence. Given the importance of and ongoing increase in cross-border financial investment as a transmission channel, coupled with the rapid growth of EMEs as an asset class, the results suggest that EMEs are likely to gain in importance in the determination of global asset prices in the future.

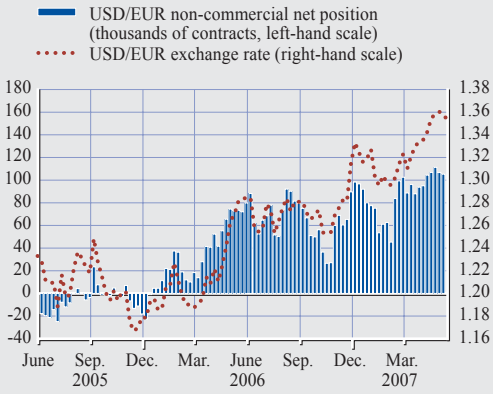
THE FOREIGN EXCHANGE MARKETS

The value of the euro vis-à-vis the US dollar changed little overall in the two month following the finalisation of the December 2006 FSR. At the same time, the euro continued to appreciate against the yen until end-February, when the value of the Japanese currency rose sharply in the midst of the period of financial turmoil. After the first days of March 2007, however, both the dollar and the yen weakened vis-à-vis the single currency, and in the first week of May the two currencies stood, respectively, 3.4% and 4.1% lower than the levels prevailing at the beginning of the year.

Overall, after the finalisation of the December 2006 FSR, movements in medium-term interest rate differentials, especially at the two-year horizon, moved significantly in favour of the euro. Net speculative positions also moved in accordance with a broad-based appreciation of the euro (see Chart 1.20), with the number of euro/dollar futures contracts reaching a historical peak towards the end of April 2007, after having fallen by nearly 50% in January. Short positions against the Japanese yen reached record values in the last quarter of 2006 and in January 2007, reportedly associated with sizeable carry trades in which the yen played the role of funding currency (see Box 4). Positions held against the Japanese yen started to accumulate again following the late February/early March correction.

Chart 1.20 Speculative positions on USD/EUR futures and the USD/EUR exchange rate

(June 2005 - May 2007)



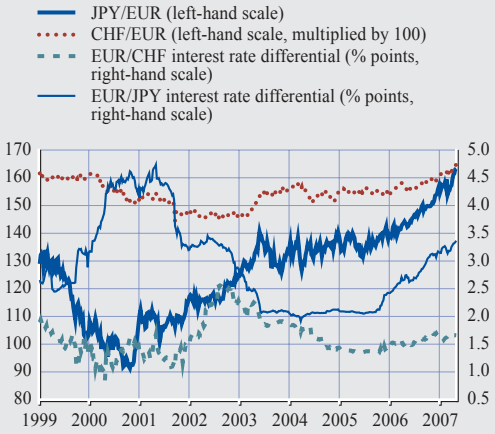
Source: Bloomberg.

Box 4

CARRY TRADES IN FOREIGN EXCHANGE MARKETS

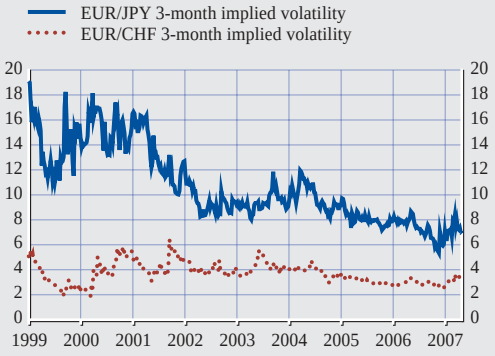
After nearly two years of broad stability, the Japanese yen began to depreciate vis-à-vis the euro in January 2005, and by May 2007 it had fallen in value by close to 15% compared with the end of 2004, and by around 45% compared with October 2000. By the same token, since around May 2006 the Swiss franc has depreciated almost continuously vis-à-vis the euro, reaching an all-time low in May 2007. Taking a long-term perspective and employing Consumer Price Index (CPI)-deflated bilateral exchange rates, both the Japanese yen and the Swiss franc are currently trading higher than their averages since 1992. In view of the prolonged phase of expansion experienced by the Japanese economy and the economic upswing recorded by Switzerland in 2006, the recent weakening of the two currencies is somewhat difficult to explain in terms of economic fundamentals. One factor often offered by market participants in explanation for the persistent weakening of the two currencies has been foreign exchange carry trades, driven by a significant widening of short-term interest rate differentials vis-a-vis the euro and especially the US dollar through 2005 and 2006 (see Chart B4.1 for developments vis-à-vis the euro). Carry trades are simple leveraged investment strategies consisting of borrowing in a low-yielding currency and investing in a higher-yielding one. The investment horizon for a carry trade is typically rather short in order to minimise the exposure to currency risk, thus requiring a systematic rollover to exploit gaps in interest rate differentials. From a finance theory perspective, the gains from carry trading are puzzling, as higher interest rate differentials should logically be offset by depreciation of the higher-yielding currency. However, in practice high-yielding currencies tend to appreciate on average, thereby increasing the returns and popularity of carry trades. When expected foreign exchange volatility is low – as was the case through 2005 and 2006 (see Chart B4.2) – further impetus can be given to investors to enter into carry trades since foreign exchange risk is perceived to be unable to affect the gains achieved from the interest rate side.

Chart B4.1 Differentials between euro, Swiss franc and Japanese yen three-month interest rates and JPY/EUR and CHF/EUR exchange rates



Source: Thomson Financial Datastream.

Chart B4.2 EUR/JPY and EUR/CHF implied volatility (three-month options)



Source: Bloomberg.

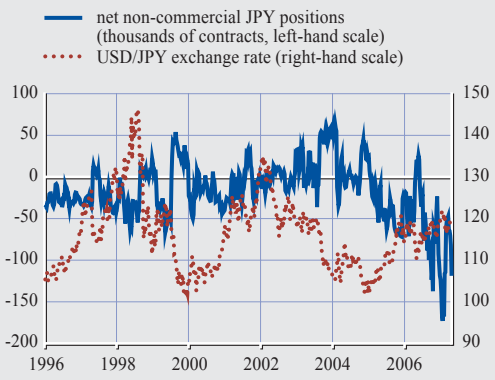
Despite the huge amount of attention recently paid to carry trades in research carried out by commercial banks and in the financial press, it is hard to provide evidence in favour of their existence or to estimate their size. As for the existence of such strategies, indirect evidence can be gathered, e.g. from the rise in realised correlation between the rates of change in the Swiss franc and in the Japanese yen vis-à-vis third currencies such as the US dollar (see Chart B4.3). Since the most noticeable feature shared by the Swiss and Japanese economies in the last couple of years seems to be the low level of their short-term interest rates compared to other industrial economies, there may be a direct link between such a feature and the prolonged phase of weakness affecting both. Another indicator commonly used to highlight speculative pressures on exchange rates is the net short non-commercial positions in currency futures, which is reported on a weekly basis by the CFTC. Such positions reached unprecedented levels in early 2007 both for the Japanese yen and the Swiss franc (see Chart B4.4), suggesting that carry

Chart B4.3 Correlation between weekly changes in the USD/JPY and USD/CHF exchange rates

(30-week correlation between weekly changes)

Source: Bloomberg.

Chart B4.4 Net non-commercial Japanese yen positions and the USD/JPY exchange rate



Sources: CFTC and Bloomberg.

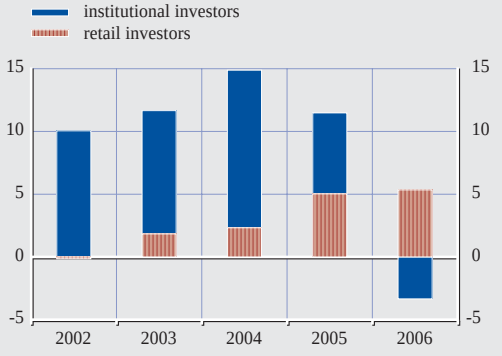
trading is indeed a strategy widely adopted by market participants, and has grown in size since the beginning of 2006.

Indicators of international capital flows also point to the possible existence of significant amounts of carry trading. Cross-border loans granted by Japanese banks to non-Japanese banks increased significantly throughout 2005, although the new flows of loans were scaled back in the course of 2006. Beyond the role of international investors in using the Japanese yen as a funding currency, Japanese retail investors also seem to have been particularly active in the purchase of overseas securities (see Chart B4.5). Between 2000 and 2006, overall purchases of foreign currency-denominated bonds (so-called Uridashi bonds as well as investment trusts) totalled about 30 trillion yen. Strong global growth and the fact that since 2005 investment trusts have become more accessible to households may have resulted in first signs of a "cultural shift" among Japanese households, typically characterised by a high level of home bias. Furthermore, the willingness of Japanese retail investors to take on more currency risk than before may also be highlighted by the development of foreign exchange margin trading, a type of investment strategy which enables investors to take positions in the foreign exchange market. In addition to purchases of foreign bonds, additional downward pressure on the yen may have derived from the behaviour of Japanese exporters: whereas Japanese companies appear to have become more willing to consider making overseas investments – as reflected in increased Japanese net foreign direct investment (FDI) – the hedging of their foreign currency-denominated revenues may have been constrained by the high cost required to set up these hedging strategies, as the high yield differential between most foreign currencies and the Japanese yen has made forward sales of foreign currencies extremely costly. On the other hand, hedging has become rather cheap for foreign exporters to Japan, thus potentially increasing the forward sales of Japanese yen.

From a financial stability viewpoint, large outstanding carry trade positions may be a concern if developments in financial markets lead to conditions that favour their unwinding and induce disorderly asset price movements, paralleling the episode in October 1998, when a sudden unwinding of carry trades was held responsible for a sharp and rapid appreciation of the Japanese yen. In March, such conditions seemed to have gained strength as financial markets displayed increasing concerns, as signalled by (i) a rise in implied volatility in yen bilateral

Chart B4.5 Japanese investors' net purchases of overseas bonds and stocks

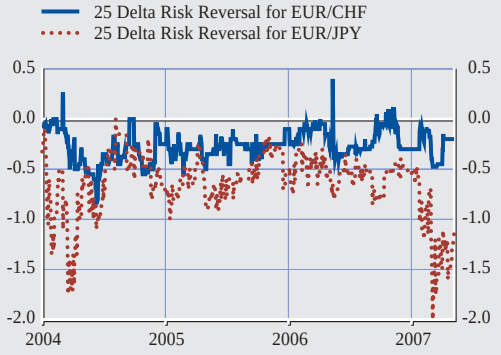
(JPY trillions)



Sources: Japanese Ministry of Finance and Bloomberg.

Chart B4.6 Risk reversals for EUR/JPY and EUR/CHF

(% points, refers to options with a delta equal to 25)



Source: Bloomberg.

exchange rates, (ii) stronger expectations of a yen – and to a lesser extent of a Swiss franc – appreciation, as signalled by risk reversals implied from currency options (see Chart B4.6), and (iii) increased overnight yen borrowing by foreign financial institutions on the Japanese call money market. This latter development may signal that foreign financial institutions perceive a significant risk of sudden movements in main yen bilateral exchange rates and therefore take on higher currency hedging activity than before. Since March such tensions have somewhat been easing, although the perceived riskiness in the yen foreign exchange market remains still higher than for other major currencies.

Implied volatility declined significantly across all currency pairs in the second half of 2006, with patterns diverging somewhat in the first four months of 2007. The falling trend in the implied volatility for the USD/EUR exchange rate was temporarily interrupted by the turbulences which surrounded the drop in the Chinese stock market, and a new local peak was reached around mid-March. After that, implied volatility on the USD/EUR rate continued to decline and in the first week of May it stood below its long-term average (see Charts 1.21 and S20). Similarly, the implied volatility on the EUR/JPY, already rising after mid-November, spiked up in the aftermath of the Chinese stock market drop, increasing by almost 60% by early April relative to the levels seen in November 2006.[11] By the first week of May it had reverted to levels prevailing at the end of 2006.

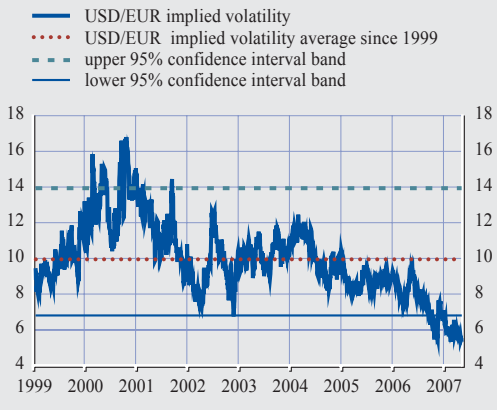
In the first two months of 2007 the USD/EUR implied volatility fell to a level significantly below that of historical (realised) volatility, returning in March to levels observed in the past. Realised volatility rose or remained stable for other major currency pairs during this period (see Chart 1.22). The large negative gap between implied and realised volatilities on the EUR/JPY since end-February suggests that markets exhibit significant uncertainty (see Box 5).

Market expectations about future exchange rate developments can also be gathered from risk

11 Investors may have been concerned about the risk of a sudden appreciation of the Japanese yen, as indeed occurred in 1998, when the yen gained almost 20% against the dollar in about two months.

Chart 1.21 One-month implied volatility on the USD/EUR exchange rate

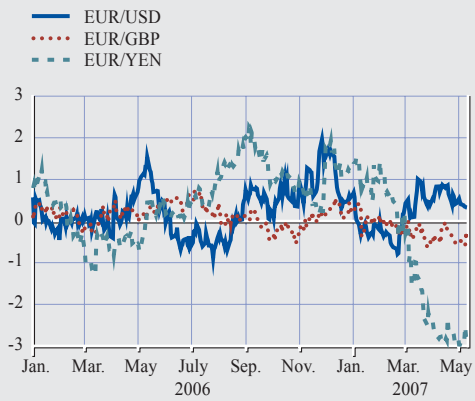
(Jan. 1999 - May 2007, %)



Source: Reuters.

Chart 1.22 Differential between implied three-month and realised volatility for main bilateral exchange rates

(Jan. 2006 - May 2007, %)



Source: Bloomberg.

reversals and butterfly spreads.[12] EUR/USD risk reversals gradually moved towards neutrality in January, and a greater likelihood of a significant appreciation than of a depreciation of the euro in March and April 2007. EUR/JPY risk reversals revealed increased market expectations of a yen appreciation vis-à-vis the euro between January and February 2007, and expectations of stability afterwards. Looking at the prices of butterfly spreads, the markets seem to have been concerned about the possibility of large movements in the EUR/JPY exchange rate after October 2006 while, by contrast, analogous concerns for the EUR/USD rate only started to emerge at the beginning of 2007.

Overall, market perceptions of risk vary across butterfly spreads, risk reversals and implied volatilities of major currency pairs. While low implied volatilities would suggest that exchange rate levels prevailing in early May were not expected to change significantly over the short term, the increased prices of butterfly options signals perceptions that sudden movements in nominal exchange rates gained in likelihood.

12 The first highlights the direction of the skew in the distribution of market participants' exchange rate expectations over a given time horizon, and the second the likelihood of large exchange rate movements.

Box 5

VOLATILITY AND RISK AVERSION IN MAJOR CURRENCY MARKETS

The volatility implied in options prices across both major asset classes and economic regions fell significantly after mid-2003, converging in major bond markets from values ranging between 10% and 6% annualised to around 4% in 2006, while falling in major equity markets from values ranging between 50% and 30% annualised in mid-2002 to about 10% by the end of 2006, despite a temporary rise between May and July that year. Implied volatility also fell in major foreign exchange markets after mid-2003, reaching historical lows in 2006. Several factors have been cited as being potential drivers of these patterns. First, as discussed in earlier editions of the FSR, very low risk-free interest rates and an abundance of liquidity in financial markets seemed to set in motion a search for higher yield. Second, the existence of ample market liquidity may have raised the risk appetite of investors, inducing them to take on greater risk. Furthermore, with greater market liquidity, financial transactions tend to have less of an impact on market prices, and some investors may have lowered their expectations of future volatility on account of this. The fall in implied volatility in recent years has often been seen as a manifestation of increasing risk appetite. Although the two quantities are intrinsically linked, financial theory does not however predict that movements in expected volatility, as gauged by implied volatility, are fundamentally proportional to changes in risk appetite or risk aversion. This is because implied volatility is composed of both a premium for volatility risk and expectations of future volatility. What is needed, therefore, to uncover the volatility risk premium – a yardstick of investor risk appetite – is a pure measure of expected volatility. This Box illustrates one way of doing this, and shows why movements in implied volatility should be interpreted with caution.

Volatility risk premiums are proportional to investors' risk appetite and can be inferred by comparing implied volatilities with expectations of future realised volatility. This identification is based on the fact that if investors do not demand compensation for volatility risk, then the

two measures will be, on average, the same. By contrast, if volatility risk is priced, then implied and expected realised volatilities will tend to diverge, and the amount by which they differ represents the compensation for volatility risk. This compensation, usually manifested in higher implied volatilities than expected realised volatility outturns, can be shown under certain assumptions to be inversely related to the coefficient of absolute risk aversion, i.e. the price of risk. Therefore, changes over time in the compensation for volatility risk, i.e. changes in the gap between implied and expected realised volatilities, can be directly interpreted as changes in investor risk aversion.[1] Estimates of the coefficient of risk aversion in foreign exchange markets could be produced by comparing expected future volatilities, based on an assumed empirical model, with implied volatilities. In this empirical illustration, implied volatilities for three major currencies, the US dollar, the euro and the pound sterling, were derived from the prices of interest rate swaptions, while expected volatilities were obtained from simulations of a conditional volatility model fitted to historical changes in swap rates offered on the three currencies.[2]

Chart B5.1 shows the time series of the implied volatility derived from the interest rate swaptions and those of the corresponding compensation for volatility risk for the two-year dollar, euro and pound swap rates. Both the implied volatilities and volatility risk premiums refer to expectations spanning six-month periods. Overall, this yardstick of risk aversion appears to co-move significantly across the main economic areas. Moreover, there is a significant positive relation between the volatility risk premium and implied volatility itself.

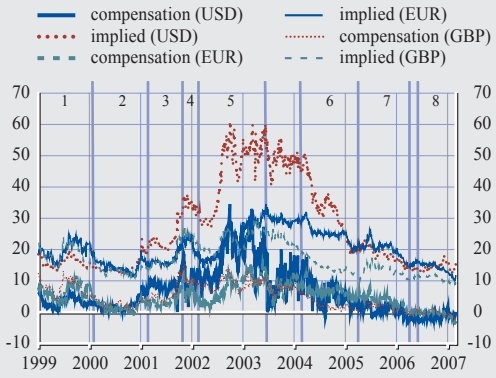
As the estimated time series of risk aversion are dependent on the model chosen to generate volatility forecasts, it is important to cross-check the behaviour of the volatility risk premium against events which are known to have induced distress in financial markets. This measure of risk aversion rose in the aftermath of the Russian debt crisis (August 1998), as well as in anticipation of the bursting of the technology bubble in global equity markets (which started around March 2000). It also increased sharply throughout the US recession (March to November 2001) and especially during the so-called deflation scare period (approximately from November 2002 to August 2003), when it peaked for the dollar. As for the last three events (the Madrid attacks in March 2004, the downgrading of Ford and General Motors' debt in May 2005 and the global stock market turbulence between May and July 2006), the indicator was relatively unperturbed and overall continued its descent from the peaks of June 2003. In this respect it is worth noting that implied volatilities also remained broadly stable around these three events, while the rise in risk aversion at around the time of the Madrid attacks may have been more related to uncertainty about the timing and magnitude of the first official rate increase by the Federal Reserve (which eventually occurred on 30 June 2004), which was a major source of concern for the financial markets at that time. Looking at the patterns of implied volatilities and the volatility risk premiums over the last couple of years shows that lower implied volatilities

1 See, for instance, T. Bollerslev, M. Gibson and H. Zhou (2004), "Dynamic Estimation of Volatility Risk Premia and Investor Risk Aversion from Option Implied and Realized Volatilities", *Board of Governors of the Federal Reserve System Finance and Economics Discussion Series*, 2004-56,. In this study, the coefficient of proportionality between compensation for volatility risk and risk aversion is estimated to equal one, so that minus the compensation for volatility risk can be directly seen as risk aversion. Their study refers to options on the Standard and Poor's 500 Index.

2 The expected realised volatilities of the swap rates to be compared to implied volatilities are calculated on a daily basis, from 15 October 1998 to 1 March 2007, by first estimating and then simulating an asymmetric GARCH (1,1) model on an expanding sample starting on 23 January 1997. The adoption of an expanding sample ensures that expected volatilities derived from the simulation reflect only the information that was available to economic agents when such expectations were formed. Considering a given day in the sample, conditional on the estimated parameters of the model, on the time series of the forecast errors that such a model produces and on the value of the volatility on that day, the model is simulated 5,000 times over a two-year horizon. Daily expected volatilities over a specific horizon are computed by averaging daily volatilities first across this horizon and then across the 5,000 simulations.

Chart B5.1 Implied volatility and estimated volatility risk premium on two-year rates

(six-month options)

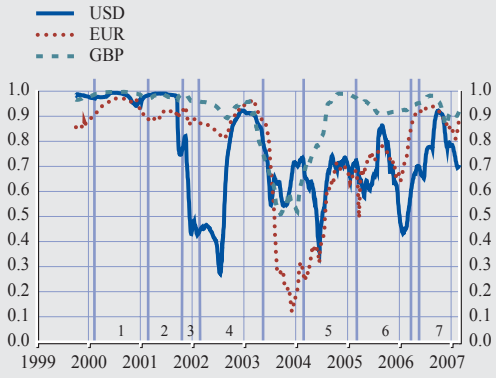


1 Russian debt crisis
2 Nasdaq starts to fall
3 US recession
4 9/11
5 stock markets weak at the beginning of recovery
6 Madrid train bombing
7 Ford and GM downgrades
8 global stock market drop

Sources: Bloomberg and ECB calculations.

Chart B5.2 Rolling correlation between implied volatility and volatility risk premiums on two-year swap rates

(rolling windows of 253 days; six-month options)



1 Nasdaq starts to fall
2 US recession
3 9/11
4 stock markets weak at the beginning of recovery
5 Madrid train bombing
6 Ford and GM downgrades
7 global stock market drop

Sources: Bloomberg and ECB calculations.

have been coupled with higher risk appetite for the major currencies, but also that movements in this measure of risk appetite have been far less pronounced. Notably, the volatility risk premium has recently reached very low levels, even becoming negative, suggesting that investors were prepared to accept almost no compensation for this type of risk.

Additional evidence on the relationship between implied volatility and risk aversion can be gathered from patterns in time-varying correlations between the two (see Chart B5.2). For all three of the currencies examined, the average correlation was high over the full sample, although there were also a number of large, albeit transitory, declines. In particular, for dollar rates the average correlation fell significantly in the aftermath of the events of 11 September 2001 and after the end of the 2001 recession (from about 1.0 to a low of 0.3), while for the other two currencies it declined only slightly over the same period (from about 1.0 to 0.9 for euro rates, and 0.8 for pound sterling rates). The decline in correlation was also sizeable and rather common across currencies around the end of the so-called deflation scare period, reaching zero for euro rates and about 0.5 for the dollar and the pound sterling. After this, correlations gradually recovered and by the end of February 2007 stood at about 0.7 for the dollar and 0.9 for the other two currencies.

The two main conclusions that emerge from the above are that the measure of risk aversion considered here – which is based on certain assumptions and is restricted to major currency markets – mostly moves significantly less than implied volatilities, and that while the correlation between the two variables is always positive, it can become almost negligible in periods characterised by the presence of sizeable uncertainty. Taken together, the two considerations are rather reassuring from a financial stability standpoint, as they imply that for a given range of changes in implied volatility, risk aversion tends to remain rather stable. Therefore the impact of higher uncertainty, as measured by implied volatility, on financial asset prices is not further amplified by large drops

in risk appetite, as changes in expected volatility lead to changes in risk aversion only to the extent that they exceed a given threshold. Accordingly, the rebound of implied volatilities seen in the first months of 2007 does not seem to have induced higher risk aversion.

COMMODITY MARKETS

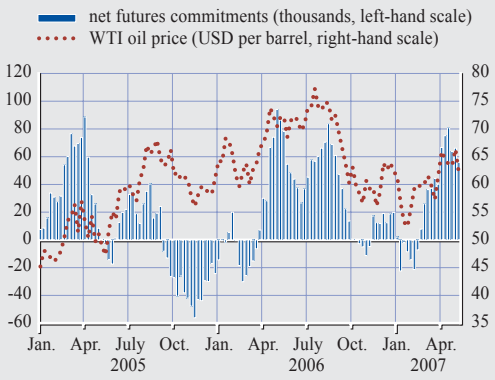
Following the sharp decline in September 2006, oil prices remained volatile in the remainder of 2006. Despite the support to prices of OPEC's announcement of two output cuts, a mild start to the winter in most parts of the northern hemisphere (with its dampening effect on the demand for heating oil) and initial scepticism about OPEC's ability to sustain the announced cuts had a countervailing influence and oil prices sharply declined in early 2007. Owing to colder weather conditions, lower OPEC supply and increased geopolitical concerns, however, a rebound took place amidst some fluctuation in speculative investor positioning in oil markets (see Chart 1.23).

Looking forward, risks to oil prices remain mainly on the upside. Robust demand, amidst persistently limited spare capacity, and unresolved geopolitical tensions might push prices higher in the near term. Implied distributions for future oil prices as extracted from options contracts indicate that the uncertainty surrounding near-term futures prices remains considerable, with very wide confidence intervals and the balance of risks tilted towards the upside (see Chart 1.24).

The prices of non-energy commodities continued to increase amidst some volatility after the finalisation of the December 2006 FSR, with the aggregate price index for non-energy commodities reaching a new peak at the beginning of May. Despite some short-lived declines at the end of 2006 and the beginning of this year, the prices of metals strengthened further, but were nevertheless expected by market participants to correct somewhat in the near-term.

Chart 1.23 Speculative positions on oil futures and oil prices

(Jan. 2005 - Apr. 2007)



Source: Bloomberg.
Note: Net commitment = number of long-short contracts, where each contract represents 1,000 barrels. "Non-commercials" denotes entities not engaged in crude oil production or refining.

Chart 1.24 Options-implied risk-neutral densities of oil prices

(Jan. 2004 - Dec. 2007, USD per barrel; 10%, 20%, 50%, 80% and 90% confidence intervals of estimations on 8 May 2007)

Sources: Bloomberg and ECB calculations.

Increased investor interest in the commodities markets could widen the investor base and broaden the range of commodity-related products available. Owing to their typical lack of correlation with other asset classes, commodities have become attractive for portfolio diversification. This partly explains the general rise in commodity prices over the past few years. The amount invested in gold exchange-traded funds (ETFs), for instance, has continued to grow in an environment of rising gold prices (see Chart 1.25).

At the same time, new structured products providing exposure to these markets have emerged that meet investor demand and allow complex strategies. These include collateralised commodity obligations (CCOs), which offer higher returns in exchange for higher risk on commodities. Such instruments may be interesting for fixed income investors as they generate a debt-style payoff, but require careful risk management.

Increasing investor interest in commodities may also be changing the traditional behaviour of commodity markets, for example by diminishing the role of gold as a "safe haven" for investors. During the episode of market turbulence at the end of February and beginning of March 2007, the price of gold declined, just as it did in May 2006, after having appreciated by more than 10% over the two months before the correction, which justified profit-taking for some investors. More generally, commodity markets may have increased their correlation with riskier assets, at least temporarily, and the increase in investment in commodities might create risks of higher price volatility and uncertain valuations, particularly in markets with limited liquidity and depth.

1.3 CONDITIONS OF GLOBAL FINANCIAL INSTITUTIONS

GLOBAL LARGE AND COMPLEX BANKING GROUPS

After the finalisation of the December 2006 FSR, full year 2006 financial results for global LCBGs became available, and these showed that profitability had slightly increased once more, consolidating the rise seen in the first half of the year. The simple average return on equity (ROE) was just over 21% for the full year of 2006, up from just under 19% for 2005

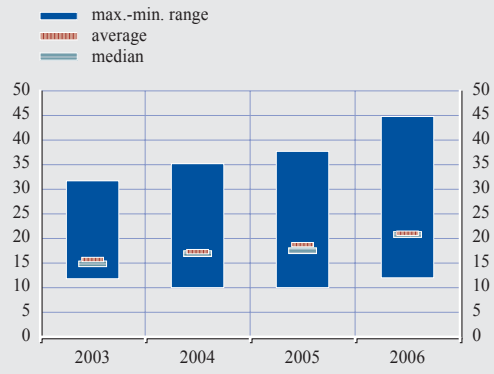
Chart 1.25 Gold prices and amounts invested in exchange-traded funds (ETFs)

(Mar. 2003 – May 2007)

Sources: Bloomberg and Exchange Traded Gold.

Chart 1.26 Return on equity for global large and complex banking groups

(2003 – 2006, %)



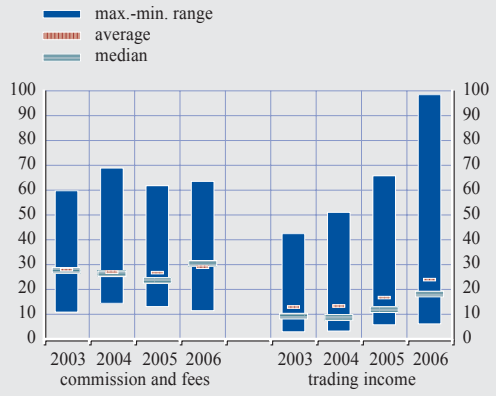
Sources: Annual reports, earnings releases and ECB calculations.
Note: The institutions included are Goldman Sachs, JP Morgan Chase & Co., Morgan Stanley, Merrill Lynch, Citigroup, Bank of New York, State Street, UBS, CSFB, Barclays, HBOS, RBS and HSBC.

as a whole, and around 5 percentage points higher than in 2003 (see Chart 1.26). The strengthening of profitability was also broad-based across institutions, with some earning substantial profits.

The sources of this further strengthening of profitability continued to be broad-based both in terms of geography and in terms of business lines. With regard to the former, LCBGs with retail banking subsidiaries benefited from growth in lending to both corporate and household sectors in North America, European retail markets, as well as emerging markets in Latin America and Asia. For LCBGs with substantial investment banking franchises, growth in profitability tended to be derived from fee income from debt underwriting owing to LBO activity, as well as equity underwriting. Net fee and commission income as a percentage of shareholder equity stood at just under 29% for the full year of 2006, increasing from 27% for 2005 (see Chart 1.27). Additional fee income was also generated from asset management, prime brokerage activity and other hedge fund-servicing activity.

Chart 1.27 Net fee and commission income and trading revenue for global large and complex banking groups

(2003 - 2006, % of shareholder equity)



Sources: Annual reports, earnings releases and ECB calculations.
Note: The institutions included are Goldman Sachs, JP Morgan Chase & Co., Morgan Stanley, Merrill Lynch, Citigroup, UBS, CSFB, Barclays, RBS and HSBC. Their inclusion is based on the availability of comparable data.

On the trading side, some LCBGs further developed significant structured credit product and commodities businesses in response to the compression of global corporate credit spreads after mid-2003 (see sub-section 1.2), low levels of financial market volatility across most asset classes and economic regions, and flat or inverted market yield curves in these regions during 2006. This added to trading income, combined with income from in-house hedge fund activity. As a proportion of shareholder funds, average trading revenues increased again for LCBGs from just over 17% in 2005 to about 24% in 2006 (see Chart 1.27, right-hand panel), indicating the growing importance of this source of income for LCBGs.

In 2006 some institutions faced rising loan impairment charges, with one large EU LCBG seeing a marked increase for 2006 as a whole. This was driven by a deterioration in the credit quality of sub-prime loans originated by its US subsidiary, where credit risk models had failed to predict the increased risk of credit losses.[13] This episode served to highlight the fact that the validity of the assumptions underlying the models used to price and manage the credit risk on these loans – such as those for prepayment rates and default probabilities of borrowers – are conditional on the operating environment.[14] In this respect, it should be recalled that this

13 On 7 February 2007, HSBC Holdings Plc, a large and complex banking group headquartered in the EU, issued a profit warning – the first ever since the firm first began trading in 1865. It announced that its loan impairment charges for 2006 Q4 would be materially higher – at USD 1.8 billion – than it had previously indicated in its December 2006 update. The additional charge was due to greater than expected losses on sub-prime mortgage loans originated by its US subsidiary HSBC Finance. This revision brought the total loan impairment charge for the firm for 2006 as a whole to just under USD 11 billion.

14 In a conference call on 8 February 2007, HSBC's CEO and CFO attributed the increase in impairment charges to a resetting of mortgages to higher interest rates as well as to the absence of appreciation in home equity – due to lower house price appreciation – which reduced the ability of borrowers to refinance. They also noted that the credit risk models used to manage the risks, in particular reset risk, associated with this product did not have a sufficiently long credit history to assess risks adequately. In particular, the loans were originated during a time of extraordinarily low interest rates, and the models failed to capture the credit risk associated with subsequent rate increases by the US Federal Reserve.

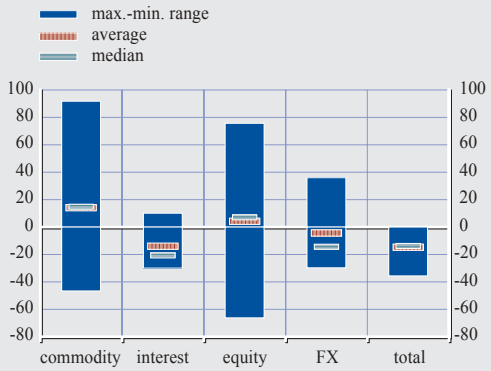
risk was relatively widely known and attention had been drawn to it some time before.[15]

Concerning the market risk-taking of LCBGs, two main patterns were apparent in the VaR numbers published by these institutions for 2006. The first was a slight aggregate reduction in the total VaR figures for those LCBGs that publish these numbers and for which meaningful comparisons can be made (see Chart 1.28). While a reduction in the overall (unweighted) average VaR of about 15% in terms of capital took place between 2005 and 2006, there was also considerable variation around this average figure, most likely due to wide differences in the scale of trading operations of individual institutions. The overall reduction in total VaR, however, concealed a second pattern of further increases in exposures by some LCBGs to commodities (and energy), as well as to equity markets. This reflects the capacity of these firms to readjust their risk-taking capacity dynamically to take advantage of market conditions such as increased volatility. Overall, however, interest rate and equity market risks remained the greatest source of market risk for these institutions (see Table S2).

One financial risk which is not captured adequately by VaR is that some of these institutions may have sizeable amounts of illiquid assets on their balance sheets as a result of increased activity in certain markets. These illiquid assets can include loans, illiquid bonds – including structured credit products, private equity exposures as well as retained interests in securitisations. While it is difficult to find comparable data for most of these institutions due to differences in the level of disclosure, it is likely that these exposures have grown hand in hand with their activities in these markets. While all of these LCBGs maintain pools of liquidity cover and have strong liquidity risk management capabilities, it cannot be ruled out that unexpected developments in the financial system could challenge these capabilities. A timely example of this was the revelation that some of these institutions had exposures to risks arising from an abrupt deterioration in credit quality in the US sub-prime mortgage market (see Box 2). Several global LCBGs are active in this market through the origination of loans by their own subsidiaries, the purchasing of loans from other originators, including mortgage brokers, and then the securitisation of the loans as non-agency RMBS. The institutions involved often retain the residual, or riskiest, exposures from these securitisations. However, it is extremely difficult to ascertain the actual magnitude of the residual exposures of these institutions to this segment of the US mortgage market based on publicly available information alone. However, thus far it appears that most of these institutions have not felt the impact of sub-prime mortgage market weakness spreading to other closely related areas of credit on their balance sheets such as prime MBS, prime mortgage loans, and consumer credit. Looking ahead, it is likely that lower securitisation volumes as well as possible credit losses due to loan impairments during 2007 may have a slightly adverse impact on earnings for at least

Chart 1.28 Change in Value at Risk levels as a share of Tier 1 capital for global large and complex banking groups

(2005 - 2006, % change)



Sources: SEC filings, earnings releases, annual reports and ECB calculations.
Note: The institutions included are JP Morgan Chase & Co., Bank of New York, Citigroup, UBS, CSFB and HSBC. Their inclusion is based on the availability of comparable data.

15 See, for instance, the ECB (2005), *Financial Stability Review*, December, which states that "because they are relatively new products, the pricing of the credit risk embedded within them is challenged by the lack of sufficient credit histories to conduct stress tests" (p. 22).

some of these institutions' mortgage origination platforms, as these are heavily based on US assets.

The impact of the sub-prime episode on market indicators was mixed. The CDS spreads of some of these LCBGs widened, reflecting investor concerns about exposures to this market (see Chart S13), while distance-to-default measures remained relatively benign. The effect on stock prices was differentiated across institutions: those with a greater direct exposure endured the largest declines as the market priced in lower earnings expectations (see Chart S12). Hence, it would appear that markets assessed the episode as being likely to have an adverse effect on the profitability of exposed institutions, albeit not significant enough to create any concerns about solvency.

Looking ahead, if problems in the sub-prime mortgage market deepen and spread into the higher-quality segments of the US mortgage market, this will likely weigh on the future earnings of some LCBGs. In addition, opportunities from underwriting may diminish if LBO activity is reduced – which could be triggered, for instance, by a deterioration of liquidity conditions in the global financial system, or in the event of an adverse turn in the credit cycle. In addition, if turbulent conditions in equity markets were to persist, this may lessen the rate of M&A deal completions and reduce the quantity of new IPOs globally. However, most LCBGs have indicated that they have strong pipelines of investment banking activity for the first half of 2007, pointing to a broadly positive assessment for the outlook for global banking groups. However, this has become more uncertain compared to the assessment made in the December 2006 FSR owing to uncertainties about the way in which stresses in US housing markets will play themselves out and how this will ultimately affect the balance sheet condition of the US household sector.

HEDGE FUNDS

Depending on the information source, estimates of the total capital under management of single-manager hedge funds globally by the end of 2006 ranged from almost USD 1.5 trillion[16] to more than USD 2 trillion.[17] In 2006 the European segment continued to grow faster than the overall sector, although Asian funds also grew rapidly. After the finalisation of the December 2006 FSR, significant investor inflows into hedge funds continued unabated, despite the short-lived episode of turbulence in global financial markets between late February and early March.

Based on the latest available comparable data, in 2005 the aggregate size of hedge fund net assets was close to half of the book value of the entire Organisation for Economic Co-operation and Development (OECD) banking sector's shareholder equity, even though it remained small relative to investors' capital entrusted to traditional funds or the value of traditional financial assets globally.[18] Nevertheless, the total leveraged (gross) assets of some hedge funds can sometimes be very large and comparable to those of large high-impact banks. Moreover, the growing influence of hedge funds on market activity and liquidity is far larger than their total capital under management or gross assets would suggest, since their active investment strategies tend to be associated with frequent and opportunistic trading.

So far, experience with the active participation of hedge funds in financial markets over the past decade has, on balance, been very positive, particularly for the development of financial

16 Lipper TASS, Hedge Fund Research and PerTrac Financial Solutions estimates were respectively USD 1.49 trillion, USD 1.44 trillion and over USD 1.41 trillion. See Lipper TASS (2007), "Lipper TASS Asset Flows Report: Hedge Funds, Fourth Quarter 2006", February; Hedge Fund Research (2007), "HFR Industry Report: Year End 2006", January; and PerTrac Financial Solutions (2007), "PerTrac 2006 Hedge Fund Database Study", February.

17 See Hedge Fund Intelligence (2007), "Global Hedge Fund Assets Surge Past USD 2 Trillion", 29 March, press release.

18 See L. D. Papademos (2007), "Monitoring Hedge Funds: A Financial Stability Perspective", *Banque de France Financial Stability Review*, No 10, April, 113-125.

markets in terms of product diversity and liquidity. Moreover, hedge funds, by taking more contrarian and in some cases even longer-term views than traditional asset managers, have sometimes provided a stabilising influence. At the same time, however, because of their growing importance and sometimes even dominance in some market segments, there are concerns that adverse events of sufficient gravity could lead to an unexpected suspension of hedge funds' presence or a simultaneous unwinding of similar investment positions, and that such a scenario could pose a serious threat to the orderly functioning of the financial markets in question.

Looking ahead, considerable structural changes have been taking place both within and outside the hedge fund industry in recent years, the implications of which for the longer-term outlook of the sector can sometimes be assessed and aggregated very differently. In terms of investor flows, hedge funds are increasingly seeing significant inflows from institutional investors – including pension funds and university endowments – rather than from wealthy individuals, who formerly had comprised their traditional investor base. At the same time, large hedge funds, which have been broadening their offerings by launching private equity and "long only" funds, have been growing faster than smaller players. In addition, banks are acquiring equity participations in hedge funds or otherwise expanding their hedge fund management businesses. A number of competing financial institutions have also been creating synthetic hedge fund replication products aimed at mimicking hedge fund-like returns, but more cheaply by investing in traditional liquid financial assets. Furthermore, traditional asset managers have been increasingly adopting hedge fund investment techniques, such as short-selling, for their mainstream products. A notable example is that some new launches of equity funds have been employing long-short strategies with various combinations of long and short exposures such as, for example, 130% of net assets long and 30% short.

Managed accounts

The focus on capital under management in hedge funds omits additional investors' money in private managed accounts that are run by hedge fund managers in parallel with their hedge fund structures. Moreover, the proprietary trading desks of large banks and some other investors also pursue strategies that are substantially very similar to those of hedge funds.

The main characteristics of private managed accounts that appeal to investors include the direct ownership of assets acquired by a hedge fund manager via a managed account, the nearly full transparency of portfolio composition and investment activity, and the possibility to withdraw money at short notice. However, the latter two features represent significant shortcomings from the hedge fund manager's point of view. As a result, it might be argued that managed accounts, despite their attractive features and transparency, could be subject to structural adverse selection problems, since only managers who perform less well or experience fund-raising difficulties are likely to give in to investor demands and offer a highly transparent managed account solution that would closely mirror the returns of the related hedge fund. For example, investable index platforms are normally based on the use of some form of managed accounts, and the returns of these indices tend to lag those of non-investable versions of the same indices, partly also due to the likely loss of an illiquidity premium associated with less flexible redemption terms that can allow making less liquid investments.[19]

Estimates of capital in private managed accounts run by hedge fund managers are difficult to come by, although their popularity might be growing owing to increasing demands for higher transparency from more risk-averse institutional investors. According to Tremont Capital Management, hedge fund managers

19 For more information on investable hedge fund indices, see also ECB (2006), *Financial Stability Review*, June.

operated about USD 325 billion in private managed accounts at the end of June 2005, or roughly one-third of the estimated total sector net assets in single-manager hedge funds at that time. Based on information available in the Lipper TASS database, a commercial hedge fund database, at the end of 2006 more than a quarter of reporting hedge funds by number and by capital under management indicated that they accept private managed accounts. Since the operating of managed accounts entails additional operational issues and customised service, the minimum sizes of managed accounts were multiples of minimum investment amounts, and often exceeded the net assets of a hedge fund by a large margin as at the end of 2006.

Performance

Judging from monthly hedge fund returns in February and March 2007, most hedge funds were not greatly affected by the turbulence in global financial markets between late February and early March. Only hedge funds pursuing managed futures strategies experienced negative returns, largely due to their exposures to currency carry trades and trend-following strategies.[20]

Taking a longer-term perspective, hedge fund returns in 2006 stood at around 13%, which was broadly in line with the median of historical returns, generated using all possible investment dates and varying holding periods of a theoretical investment into the broad non-investable hedge fund index (see Chart 1.29).

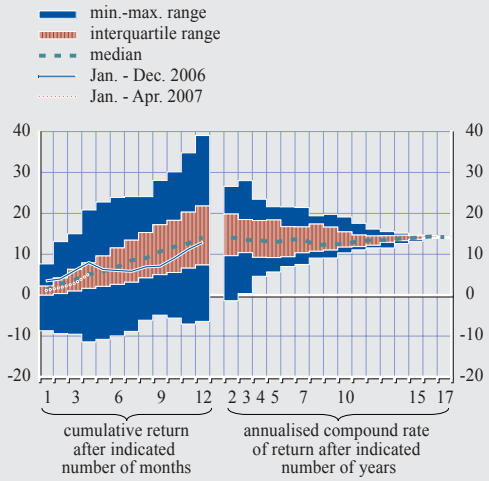
However, these patterns of historical returns conceal the fact that average hedge fund returns have been on a downward trend for a long time since the beginning of the last decade (see Chart 1.30). While this might be indicative of lower risk-taking – including lower leverage in investment strategies – the volatility of hedge fund returns only started to fall more recently.[21]

20 Monthly returns may conceal substantial intra-month fluctuations. For instance, higher frequency data, which are only available for some investable hedge fund indices, might reveal a less favourable picture. Moreover, in most cases it would generally facilitate a better assessment of hedge funds' risk profiles.

21 For a discussion on lower volatility of hedge fund returns see ECB (2006), *Financial Stability Review*, December.

Chart 1.29 Distribution of historical global hedge fund returns by investment holding period

(Jan. 1990 - Apr. 2007, %, monthly returns net of all fees in USD)



Sources: Hedge Fund Research and ECB calculations.
Note: HFRI Fund Weighted Composite Index. Distributions generated using all possible investment dates and varying investment holding periods until Apr. 2007.

Chart 1.30 Historical global hedge fund returns

(Jan. 1993 - Apr. 2007, %, rolling three-year annualised compound rate of return, net of all fees in USD)

Sources: Hedge Fund Research and ECB calculations.
Note: HFRI Fund Weighted Composite Index.

In addition to other possible reasons for declining returns, two interdependent plausible explanations are the significant growth of the hedge fund sector, possibly to the point of overcapacity, and a consequent lowering of the amount of profitable investment opportunities available.

Investor flows

In the second half of 2006, aggregate net inflows into the hedge fund sector remained strong, although of a lesser magnitude than those seen during the first half of the year (see Chart S15). Nevertheless, at the end of 2006 the annual rate of growth of global hedge fund capital under management was similar to the growth rate in mid-2006 of close to 30%, of which roughly 13% can be attributed to net flows, and 16% to returns (see Chart S16). Event-driven hedge funds were the chief net recipients of investors' money in the second part of the year (see Chart 1.31), and their share in global capital under management continued to rise (see Chart S17).

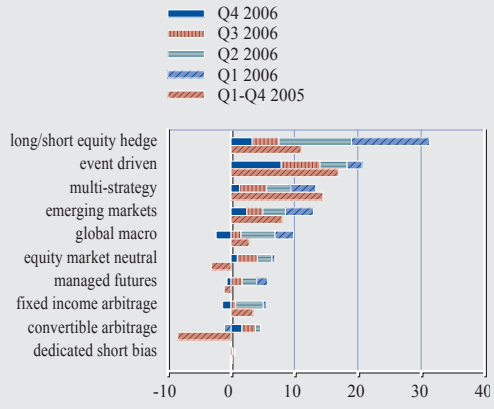
Notwithstanding positive overall inflows, several hedge fund strategies recorded net outflows in the fourth quarter, including hedge funds pursuing global macro, fixed income arbitrage and managed futures strategies. Even though net inflows into multi-strategy hedge funds were positive in the last quarter of 2006, they were weaker than in earlier quarters. This was attributed by some observers to concerns about the potential for large losses, based on losses experienced by Amaranth Advisors, a large multi-strategy hedge fund, in September 2006. It should be borne in mind, however, that aggregate net flows into hedge funds seem to exhibit seasonal patterns, with net flows during the third and fourth quarters of 2006 perfectly in line with longer-term seasonal patterns (see Chart 1.32).

Risks faced by hedge funds

In many ways hedge funds are not so different from other private pools of capital, and they face risks similar to those faced by other financial intermediaries. Nonetheless, their flexible investment mandates and a relative absence of regulatory constraints afford them the freedom of employing various sophisticated investment techniques, such as leveraging positions or short-selling, and allow them to invest in a wide range of non-trivial assets, including OTC derivatives. Concomitantly, this flexibility can make them more vulnerable to possible mismanagement of more complex and interacting internal risks.

Chart 1.31 Global hedge fund quarterly net flows by strategy in 2006

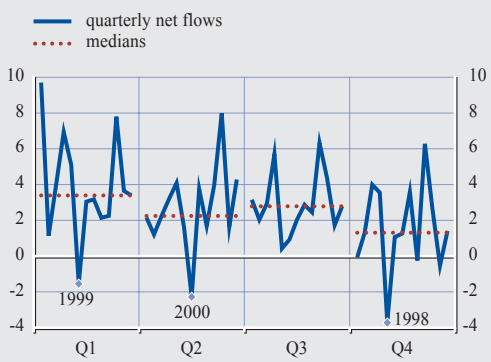
(Q1 2005 - Q4 2006, USD billions)



Source: Lipper TASS.

Chart 1.32 Seasonality of global hedge fund quarterly net flows

(Q1 1994 - Q4 2006, % of capital under management at the end of the previous quarter)



Sources: Lipper TASS and ECB calculations.

Endogenous vulnerabilities can build up within the hedge fund sector itself, and these include funding liquidity risk, excessive leverage and the nature and concentration of exposures to certain market risk factors. Potential operational risks along with inadequate risk management or external shocks beyond managers' control could lead to difficulties or an eventual failure of a large hedge fund or a cluster of smaller hedge funds with similar strategies, which could in turn have significant ramifications for exposed banks and affected financial markets (see also Box 6 on hedge fund liquidations).

Box 6

HEDGE FUND LIQUIDATIONS

Hedge funds are often considered to be a rather risky alternative investment, although the historical risk-adjusted performance of non-investable hedge fund indices of some investment strategies might suggest the opposite. Because the failure of a large hedge fund or a cluster of smaller hedge funds could cause financial instability by impairing banks' soundness and the smooth functioning of affected financial markets, this Box investigates hedge fund failures in greater detail.

Hedge fund failure has different implications for parties associated with a failed fund. For investors, credit and trading counterparties, a hedge fund failure constitutes a loss on their investments and credit exposures, whereas for the hedge fund manager, who has not committed own capital to the fund and does not manage other funds, it represents a failed asset management venture that culminates in the eventual liquidation of the fund.

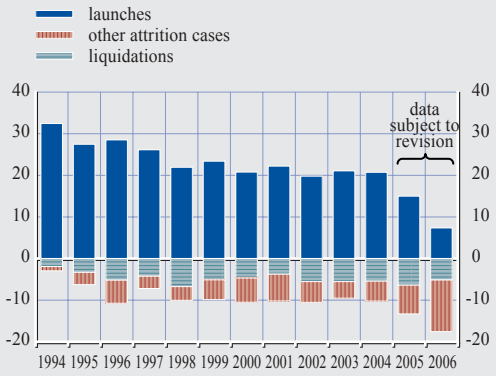
Liquidations can be either involuntary or voluntary at the initiative of the hedge fund manager. A forced closure would typically occur if investors demand the return of the remaining funds after investment losses that eroded a substantial part of their capital or because of any other reason that led to a loss of trust in the hedge fund manager. There is some evidence that in approximately half of cases scrutinised, hedge funds were forced to shut down owing to various operational risk factors, such as misrepresentation of investments, misappropriation of funds/general fraud, unauthorised trading and style breaches, or inadequate resources and infrastructure.[1] In the worst case, owing to fraudulent activity or investment losses, particularly on leveraged investment positions, all investor capital could be depleted and there would be nothing to return to investors.

If investors withdraw a substantial part of their money, the remaining capital under management may not be sufficiently large to make it economic for the manager to continue operating a fund. This is because without sufficient investor capital, the benefits of economies of scale cannot be reaped, and the flow of asset management and performance fee income may be inadequate for the manager. As a result, significant investor redemptions and unsuccessful fund-raising efforts are likely to be key reasons behind voluntary liquidations, although hedge funds can close for other reasons as well, such as the departure of key managers.

1 See S. Feffer and C. Kundro (2003), "Understanding and Mitigating Operational Risk in Hedge Fund Investments", *White Paper Series*, Capco Institute, March.

Chart B6.1 Launch, liquidation and attrition rates of single-manager hedge funds

(% of existing funds at the end of the previous year)



Sources: Lipper TASS database and ECB calculations.
Note: Only funds with last reported performance before December 2006 were used for the calculation of liquidations and other attrition cases.

It is important to emphasise that hedge fund liquidation and attrition rates are not the same thing, since the latter term is a broader concept that also encompasses liquidations and refers to all cases when hedge funds stop reporting to databases for whatever reason. Such reasons could, for example, include good performance that attracts investors and even leads to the closure of a fund to new investments, or poor performance after which the manager may prefer to stop reporting until the hedge fund has recovered from a temporary setback.

Since the beginning of 1994, the Lipper TASS database has tracked the reasons why hedge funds have left it, which allows liquidations to be separated from other attrition cases.[2] Based on information in the database, annual hedge fund liquidation and attrition rates fluctuated at around 5% and 10% respectively (see Chart B6.1).[3] These estimates are in line with evidence and anecdotal information on the probability of hedge fund liquidations from various market participants.[4]

Cumulative hedge fund liquidation and attrition rates are depicted in Chart B6.2. It shows that liquidated and all defunct single-manager hedge funds account for less than a quarter and almost half of all single-manager hedge funds in the database respectively. Moreover, the increase in cumulative liquidation and attrition rates slows down significantly after funds become more than ten years old. Cumulative hedge fund liquidation rates also vary by strategy. Managed futures and event-driven strategies appear to exhibit the highest and the lowest cumulative liquidation rates respectively after the tenth year since inception.

A more illustrative way to analyse the timing of hedge fund liquidations is to use hazard rate curves. The hazard rate is the conditional liquidation rate, or the fraction of funds that were liquidated during a particular time interval, given survival up to the beginning of the interval. Hedge fund hazard rates typically peak in the third year of a hedge fund's lifetime and can be very volatile, depending on the investment strategy (see Chart B6.3). As in the case of cumulative liquidation and attrition rates, the hazard rates of funds of hedge funds are lower than those of single-manager hedge funds.

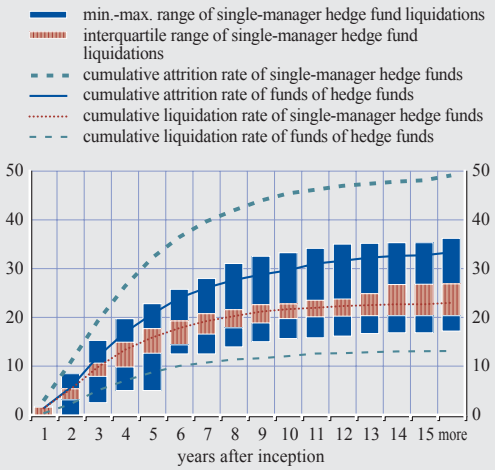
2 In the database, there are seven attrition cases: fund liquidated, fund no longer reporting, unable to contact the fund, fund closed to new investment, fund has merged into another entity, fund dormant, and unknown.

3 It should be noted that these estimates are not adjusted for the fact that some entries in the database may represent sub-fund structures (onshore and offshore versions or different classes of shares) rather than separate funds.
The estimated rates for 2005 and 2006 should be treated with caution, since hedge fund launch rates may increase, and liquidation and attrition rates may decline later as more funds join the database after successful incubation periods, backfill their historical track records and thereby augment the number of launched and existing funds. This also applies, albeit to a lesser extent, to earlier years as well, since hedge funds can add, delete and modify their historical and contemporaneous information in the database continuously. Moreover, the latest performance data are subject to incomplete reporting, and some funds which have not yet reported their late-2006 performance might choose to do so at a later date, and would then be removed from other attrition cases.

4 For example, Hennessee Group, an adviser to hedge fund investors, estimated that from 1999 to 2006 the average annual liquidation rate was 5.2%. See Hennessee Group (2007), "Hedge fund attrition rate at 5.1% for 2006", 31 January, press release.

Chart B6.2 Cumulative hedge fund attrition and liquidation rates and the dispersion of cumulative liquidation rates of single-manager hedge funds by strategy

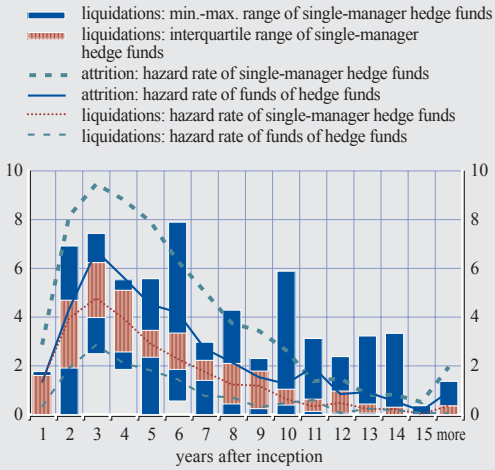
(up to Dec. 2006, % of funds)



Sources: Lipper TASS database and ECB calculations.
Note: Cumulative attrition rates comprise liquidations and other attrition cases where the last reported performance dates are before December 2006. The single-manager group includes ten strategies: multi-strategy, equity market neutral, convertible arbitrage, fixed income arbitrage, event driven, managed futures, emerging markets, global macro, dedicated short bias and long/short equity hedge.

Chart B6.3 Hedge fund hazard rates and the dispersion of hazard rates of single-manager hedge funds by strategy

(up to Dec. 2006, % of funds which reported up to the beginning of a particular year since inception)



Sources: Lipper TASS database and ECB calculations.
Note: The hazard rate measures the proportion of funds that stopped reporting during a particular year since their inception, given reporting up to the beginning of that year. Hazard rates for liquidations account only for liquidations, and every year the number of funds in the database was only decreased by the number of liquidated funds, thereby ignoring other attrition cases. Only funds with last reported performance before December 2006 were used to calculate liquidations and other attrition cases.

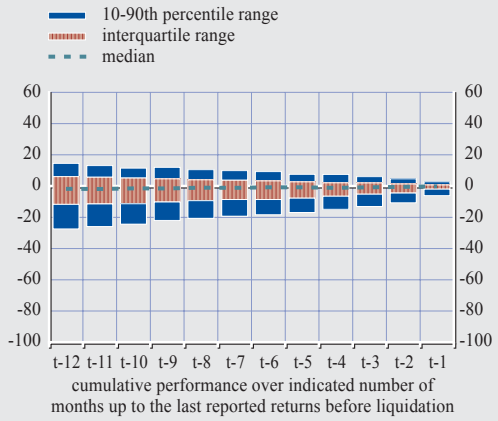
The rationale behind the highest hazard rates through the second to fourth years of operation is related to capital-gathering from investors. A new hedge fund first of all represents a start-up asset management venture that may succeed in the longer run only if it attracts and retains investors' money. During an incubation period that may last for one to two years, the hedge fund manager attempts to build up an attractive investment track record that would help woo investors. Of course, there are exceptions, since some managers succeed in securing large amounts of capital for quite long periods soon after or even during the launch phase, but such cases seem to be rare.

To investigate further the reasons for hedge fund liquidations, it is useful to examine the patterns of hedge fund performance and capital under management before liquidation. Such analysis is however hindered by so-called liquidation bias, which refers to the fact that hedge fund managers can stop reporting to a database before the final liquidation value of a fund. As a result, the time interval between the last reported returns and the actual liquidation may vary. However, according to researchers who have studied this bias the average loss to investors beyond information contained in databases may not necessarily be that large.[5] Nevertheless, even if hedge funds were to report all returns and capital under management up to the liquidation point, it would still remain unclear when the decision regarding the voluntary or forced

5 See C. Ackermann, R. McEnally and D. Ravenscraft (1999), "The Performance of Hedge Funds: Risk, Returns and Incentives", *Journal of Finance*, Vol. 54, No. 3, 833-874. Researchers used hedge fund information up to the end of 1995 and asked Hedge Fund Research, a database vendor, to determine the liquidation value of hedge funds. The average post-reporting loss was found to be only 0.7%.

Chart B6.4 Dispersion of single-manager hedge fund performance before liquidation

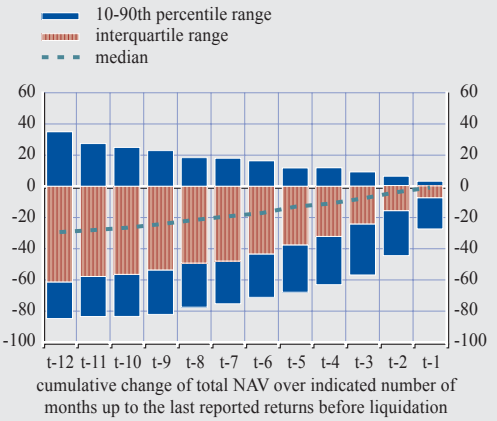
(cumulative % change of net-of-all-fees returns)



Sources: Lipper TASS database and ECB calculations.
Note: Only liquidated funds with last reported net-of-all-fees performance before December 2006 and capital under management data available at least on the date of last reported returns. Only observations with available matching cumulative change in total NAV included.

Chart B6.5 Dispersion of changes in single-manager hedge fund capital under management before liquidation

(cumulative % change of capital under management)



Sources: Lipper TASS database and ECB calculations.
Note: Only liquidated funds with last reported net-of-all-fees performance before December 2006 and capital under management data available at least on the date of last reported returns.

liquidation was taken and which part of time series reflects investment activity rather than managed liquidation of remaining investments in order to return proceeds to investors.

Charts B6.4 and B6.5 contain information on the dispersion of cumulative performance and change in capital under management during the last 12 months up to the last reported returns before fund liquidation. Both charts are based on the matched sample of liquidated single-manager hedge funds, which reported returns on a net-of-all-fees basis and for which capital under management data were available at least on the date of last reported returns before liquidation. The charts suggest that historically, hedge fund liquidations were generally not preceded by poor cumulative absolute returns very often, yet were associated with relatively large declines in capital under management stemming, therefore, predominantly from investor redemptions. However, the patterns of cumulative underperformance relative to respective strategy indices were much more negative than those of cumulative absolute returns. Chart B6.5 also indicates that there were funds which were liquidated after experiencing relatively strong growth of capital under management, but which, nonetheless, most likely were characterised by small total fund size or ceased operations for other reasons, such as, for example, the departure of key managers.

All in all, three main conclusions can be drawn from the information presented above. First, annual hedge fund liquidation rates appear to fluctuate around 5%, and are much lower than attrition rates from hedge fund databases. Second, the period after the incubation phase around the third year after inception appears to be critical for many hedge funds. Third, most hedge fund liquidations appear to be caused by business risk related to unsuccessful fund-raising and/or investor exodus, which, of course, largely depends on fund performance. Nevertheless, high-profile misfortunes, such as the ones experienced by Long-Term Capital Management in

September 1998 or Amaranth Advisors in September 2006, remain useful reminders of the potential risks to banks and financial markets posed by excessive risk-taking and deficient risk management within hedge funds.

Funding liquidity risk is associated with liquidity pressures arising either from asset/liability mismatches related to short-term financing provided by banks or from investor redemptions. The lack of liquid assets to meet liquidity obligations may force hedge funds, when they are under stress, to liquidate their positions in probably already frail markets. Inadequate liquidity buffers can also prevent hedge funds from putting their capital at risk in volatile market conditions, thereby leaving financial markets deprived of potential valuable stabilising intervention.

Of the two sources of funding liquidity risk, the one associated with banks' financing is more likely to prove perilous, particularly when coupled with high leverage levels. In times of stress, banks may react before investors and could change their stance dramatically; they can, for example, refuse to roll over financing, change haircuts, reduce the list of eligible collateral, raise margin levels, or become less patient and lenient with missed margin calls. This is why hedge funds tend to be very careful in negotiating agreements with banks, and some have even chosen to issue bonds in order to secure more permanent debt capital.

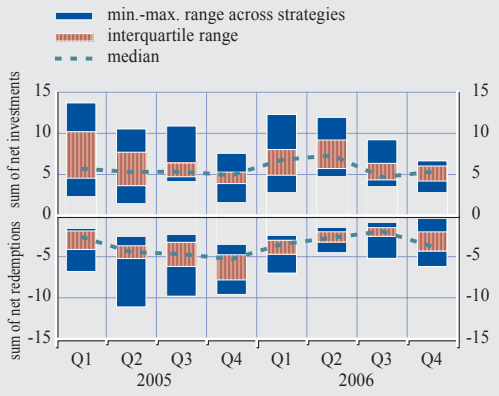
Hedge funds also face the risk of investor redemptions, which can also prove quite damaging and could ultimately determine the viability of a hedge fund if investor withdrawals are not compensated by new inflows. However, various redemption restrictions that properly reflect the liquidity of the underlying investment portfolio may provide some protection as well as the time needed to cope with unexpected investor withdrawals. Aggregation of those hedge funds that experienced net inflows or net outflows separately suggests that in the second half of 2006, investor redemption activity and associated funding liquidity risks were not very high across various hedge fund strategies (see Chart 1.33).

Information on hedge fund investor structures is not available, but by comparing minimum investment amounts of individual funds with their net assets, it is possible to obtain some indications as to the maximum number of investors that could have funds placed with an individual hedge fund. Based on the analysis shown in Chart 1.34, some smaller and medium-sized hedge funds had no more than 10-20 investors at the end of 2006, meaning that they could have been vulnerable to the withdrawal of funds by just a few investors.

All things being equal, higher leverage proportionally amplifies the impact of asset price changes and increases the vulnerability of investment positions to sharp unfavourable

Chart 1.33 Global hedge fund aggregate quarterly net redemptions and net investment across strategies

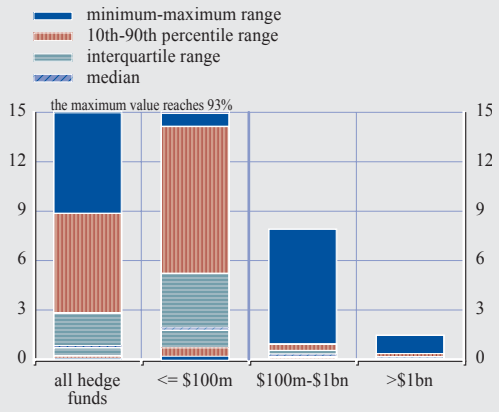
(Q1 2005 - Q4 2006, % of capital under management at the end of the previous quarter)



Sources: Tremont Capital Management, Lipper TASS and ECB calculations.
Notes: Excluding funds of hedge funds. For each of the ten strategies and for every quarter, net redemptions refer to the sum of outflows of managers suffering net outflows, while net investments refer to the sum of the inflows of managers receiving net inflows, both divided by the strategy's total capital under management at the end of previous quarter.

Chart 1.34 Ratio of minimum investment to capital under management by hedge fund size

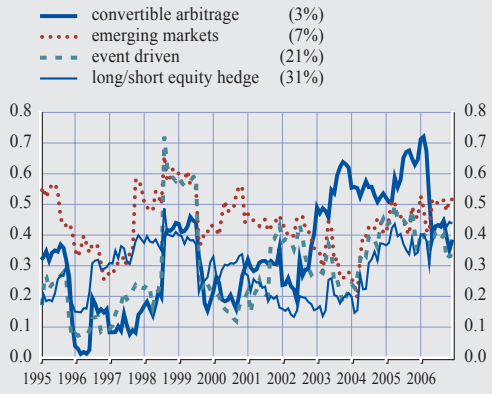
(Dec. 2006, %)



Sources: Lipper TASS database and ECB calculations.
Note: Excluding funds of hedge funds. Ratios above 100% have been excluded from the calculations.

Chart 1.35 Medians of pairwise correlation coefficients of monthly hedge fund returns within strategies

(Jan. 1995 - Dec. 2006, monthly returns in USD, net of all fees, moving 12-month window)



Sources: Lipper TASS database, Lipper TASS and ECB calculations.
Notes: The numbers in parentheses after strategy names indicate the share of total capital under management (excluding funds of hedge funds) at the end of December 2006, as reported by Lipper TASS. Medians are probably slightly biased, since the time series of hedge fund returns in the database were not adjusted for sub-fund structures, which represent onshore and offshore versions or different classes of shares with different fee structures, lock-up periods and other "technical" differences, and which basically correspond to the same pool of money managed in a highly correlated or nearly identical way.

price moves that could destroy a significant portion of investor capital, bring on margin calls and other funding liquidity pressures, and lead to further involuntary deleveraging with forced asset liquidations. There is a lack of reliable information in this regard, but there are some indications that hedge fund leverage started to rise recently[22] against a background of persistently low volatility across a multitude of financial markets and growing competition among hedge funds, as evidenced by declining average hedge fund returns.

Risks posed by hedge funds

There are two main channels through which hedge funds could affect financial stability. The first channel relates to banks' direct credit exposures to hedge fund clients arising from trading and financing activities (for more information, see sub-section 4.2). The second channel concerns the risks they can pose for the smooth functioning of financial markets, which could materialise in the event of a failure of a large and highly leveraged hedge fund, or if a collective unwinding of crowded trades by a cluster of smaller hedge funds were to take place. However, the risk of crowded trades is not confined to hedge funds, even though they have reportedly become dominant players in a wide range of markets.

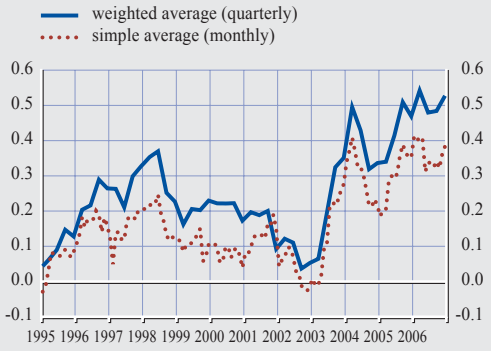
Both channels are closely linked with the endogenous vulnerabilities within hedge funds themselves. The confluence of internal vulnerabilities might prove particularly disruptive even for mature financial markets, if it were coupled with a sudden rise in risk aversion, lower market liquidity and if similar investment positions prevailed before an adverse disturbance across other hedge funds and major banks.

Individual hedge funds may be unaware as to whether rival hedge funds or major banks have entered into similar investment positions, although core dealers may have a somewhat

22 See IMF (2007), *Global Financial Stability Report*, April.

Chart 1.36 Correlations across hedge fund strategies

(Jan. 1995 - Dec. 2006, 12-month moving window, average pairwise correlation coefficients among ten CS/Tremont hedge fund indices)



Sources: Credit Suisse Tremont Index, Lipper TASS and ECB calculations.
Notes: The ten CS/Tremont indices comprise Multi-Strategy, Equity Market Neutral, Convertible Arbitrage, Fixed Income Arbitrage, Event Driven, Managed Futures, Emerging Markets, Global Macro, Dedicated Short Bias, and Long/Short Equity Hedge indices. The weighted average correlation is calculated according to the formula:

$$weighted\ \ average = \frac{\sum_{i<j} corr_{ij} \times (w_i + w_j)}{\sum_{i<j} (w_i + w_j)}, \text{where } corr_{ij}$$

is a pairwise correlation coefficient between 12 monthly returns of strategies i and j. Weights w_i and w_j refer to the shares of capital under management of strategies i and j at the end of the 12-month window.

better sense of where risks could be most concentrated. One way of gauging the risk of whether hedge fund positioning has become increasingly similar is to analyse the patterns of correlations across individual hedge fund returns within various hedge fund strategies. Within most strategies, median pairwise correlations remained broadly stable during the second half of 2006, although correlations within long/short equity hedge and emerging markets strategies have risen noticeably since the beginning of 2004 (see Chart 1.35). Nevertheless, the returns of convertible arbitrage hedge funds continued to diverge, and there was also some drop in the correlations among hedge funds in the rather diverse group of event-driven strategies.

By contrast, the degree of correlations of hedge fund returns across different strategies should also reflect the degree of correlations across the asset classes in which hedge funds invest. Average correlations across hedge fund strategies also remained at around the same levels as in mid-2006 (see Chart 1.36).

Overall, with the exception of possibly increasing leverage levels, all other backward-looking indicators suggest that the potential risks to financial stability posed by hedge funds have not changed since the finalisation of the December 2006 FSR. Nevertheless, some individual hedge funds and the whole sector have probably become as important as large banks for the smooth functioning of most financial markets.

2 THE EURO AREA ENVIRONMENT

After the finalisation of the December 2006 FSR, economic growth in the euro area remained dynamic with growth surprising on the upside. However, leverage in the corporate and household sectors continued to increase in 2006. While a continuation of strong economic growth should support fundamentals in both sectors as well as mitigate the risks to financial stability, it cannot be ruled out that the corporate credit cycle may turn in the period ahead due to growing leverage, increased short-term debt-servicing costs, and a deceleration in the rate of profit growth. Notwithstanding some recent moderation, valuations remain stretched in a number of euro area housing markets, and this remains a concern for the outlook for financial stability in the euro area.

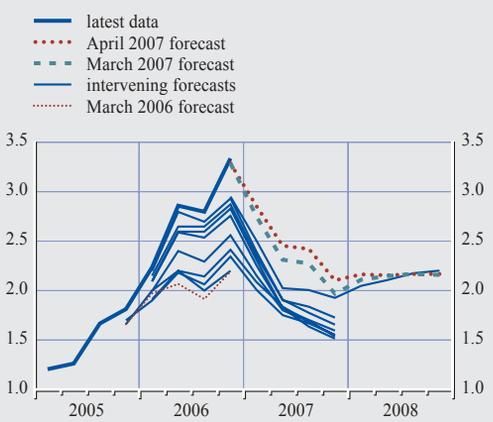
2.1 ECONOMIC OUTLOOK AND RISKS

After the finalisation of the December 2006 FSR, the euro area macroeconomic environment and outlook remained benign, thereby supporting a broadly favourable outlook for financial system stability. During the second half of 2006, the rapid pace of economic activity registered earlier in the year slightly moderated, but growth remained robust. Underpinned by strong domestic and overseas demand, the pace of GDP growth in 2006 was the strongest recorded since 2000 (see Chart S43), exceeding both ECB staff projections and private sector forecasts (see Chart 2.1).

Surveys of business and retail activity indicated that economic growth remained robust during the first quarter of 2007, and this supported the creditworthiness of both households and corporations. Consumer confidence reached the highest levels seen in over five years as households benefited from improved employment growth, together with a substantial decline in unemployment – which in March reached its lowest rate since the early 1980s (see Chart S45) – and, despite moderate wage growth, rising disposable income. Sentiment among firms also remained positive, buoyed by solid profitability and high demand.

Chart 2.1 Eurozone Barometer forecasts of euro area GDP growth

(Q1 2005 - Q4 2008, % per annum)



Source: Eurozone Barometer.

Looking ahead, the central short-term outlook remains positive. ECB staff macroeconomic projections published in March point to projected real GDP growth of between 2.1% and 2.9% in 2007, up from the range of 1.6-2.6% envisaged when the December 2006 FSR was finalised. For 2008, GDP growth is expected to fall within a range of 1.9% to 2.9%. Private sector forecasts of growth were also revised upwards.

For firms, robust world economic growth is projected to support exports outside the euro area; investment growth, already strong (see Chart S46), is expected to benefit from sustained external demand as well as continuing supportive financing conditions and further increases in profits. Regarding the household sector, strong employment growth is projected to underpin a pick-up in real disposable income growth, thereby supporting private consumption.

The risks surrounding the favourable outlook for economic growth are broadly balanced over the shorter term. At medium to longer horizons, the balance of risks remains on the downside,

owing mainly to external factors. These relate in particular to fears of a rise in protectionist pressures, the possibility of further increases in oil prices, concerns about possible disorderly developments owing to global imbalances and potential shifts in financial market sentiment. Many of these risks were also present six months ago and, as then, the probability of them materialising in a way that would significantly impair the economic outlook – in particular, the probability of a sharp slowdown in growth – still remains remote (see Chart S44). All in all, the most likely prospect is that the macroeconomic environment will continue to support stability in the euro area financial system.

2.2 BALANCE SHEET CONDITIONS OF NON-FINANCIAL CORPORATIONS

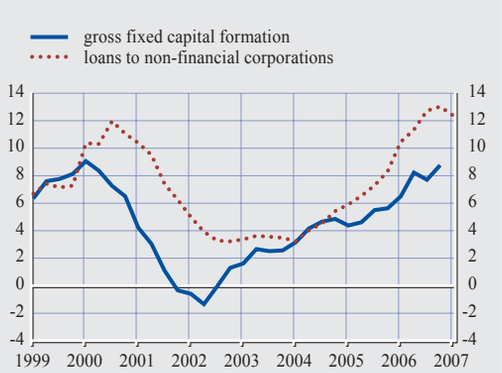
Although the condition of euro area firms' balance sheets has remained broadly favourable over the past six months, some degree of deterioration has taken place which could have adverse implications for the sector's creditworthiness in the period ahead. As already discussed in the December 2006 FSR, after several years of containment, indicators of financial leverage among euro area firms rose significantly from mid-2005 onwards. By the end of the first quarter of 2007, the aggregate debt-to-GDP ratio for the sector had reached 68%, up from 62% where it had remained for around four years (see Chart S51). Re-leveraging in the sector was fuelled in part by the strength of activity in the LBO segment of the euro area private equity market. Growing leverage can constitute a concern from a financial stability perspective if its financing is likely to prove unsustainable. In this respect, there are some concerns that LBO activity could have led to the creation of pockets of vulnerability among some firms with very high, or even excessive, leverage.

The significant increase in the rate of lending growth to the corporate sector after 2004 has translated into an increase in corporate sector leverage. The demand for external funding by firms was driven not only by a recovery in fixed capital spending (see Chart 2.2), but also by other factors such as more intense M&A activity.

In addition, part of the funds borrowed by non-financial corporations from banks in the euro area appears to have financed purchases of shares and equity in companies abroad and, to a somewhat lesser extent, the granting of inter-

Chart 2.2 Growth in gross fixed capital formation and MFI loans extended to non-financial corporations in the euro area

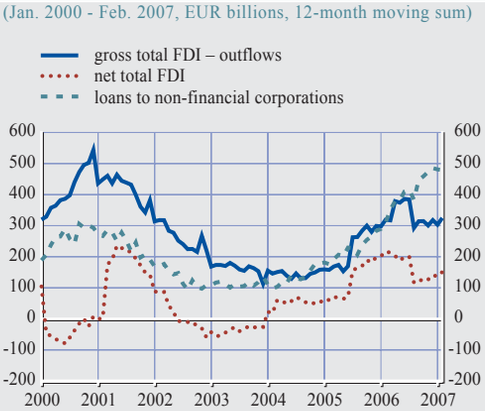
(Q1 1999 - Q1 2007, % per annum)



Sources: ECB and Eurostat.

Chart 2.3 Net and gross foreign direct investment (FDI) flows and MFI loans extended to non-financial corporations in the euro area

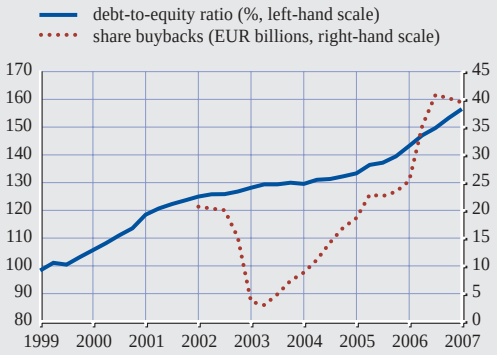
(Jan. 2000 - Feb. 2007, EUR billions, 12-month moving sum)



Source: ECB.
Note: Total FDI is the sum of direct investment in equity capital, reinvested earnings and cross-border inter-company loans.

Chart 2.4 Leverage and share buybacks in the euro area

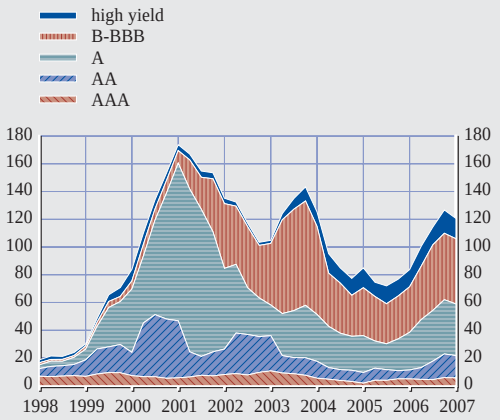
(Q1 1999 - Q1 2007)



Sources: Zephyr, ECB and ECB calculations.
Note: Leverage, measured by the debt-to-equity ratio, is calculated as a percentage of outstanding quoted shares issued by non-financial corporations, excluding the effect of valuation changes. Data for Q1 2007 are based partly on estimated data.

Chart 2.5 Gross bond issuance of euro area non-financial corporations by rating

(Q1 1998 - Q1 2007, EUR billions, four-quarter moving sum)



Source: Thomson One Banker Deals.

company loans to subsidiaries and affiliates abroad (see Chart 2.3).

Corporate leverage has also increased strongly when measured by the ratio of debt to equity, reflecting an upsurge in share buyback activities by euro area firms over recent years (see Chart 2.4), in part driven by the strength of firms' profitability.[1]

Driven by easier bank lending conditions, bank-based corporate borrowing may have substituted for market-based borrowing, which could be one of the reasons behind the relatively subdued growth in debt securities issued by non-financial corporations in recent years. This aggregate pattern conceals the fact that demand for higher yields by institutional investors has fuelled the supply of high-yielding but riskier corporate credit. The gross issuance of corporate bonds was particularly strong further down the credit quality spectrum, especially among issuers of BBB-rated bonds and high-yield bonds (see Chart 2.5).

As euro area corporate sector leverage reached unprecedented heights in recent quarters, it is difficult to assess whether or not it will prove sustainable over the medium term. This would seem to depend in part on whether corporations finance themselves with fixed or floating rate debt (see Box 8). Moreover, it should be recalled that during the last credit cycle downturn in 2002-2003, euro area firms were generally not as heavily indebted as they are now.

The use of aggregate data in the surveillance of risks building up within the non-financial corporate sector can have some shortcomings as it may conceal differences between specific groups of firms (see Box 7).

1 See ECB (2007); "Share buybacks in the euro area", *Monthly Bulletin*, May.

Box 7

COMPARING THE LEVERAGE OF LISTED AND UNLISTED CORPORATIONS

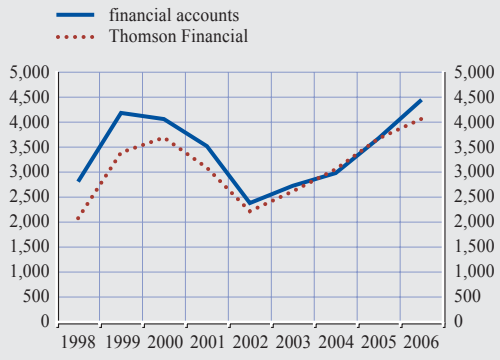
Aggregate financial accounts data show that after 2004, corporate sector leverage in the euro area, which was already high, began to rise again. Using aggregate data for the surveillance of vulnerabilities building up in the non-financial corporate sector may, however, conceal differences between specific groups of firms. For instance, there have been indications that private equity-sponsored LBO activity in the euro area has been significantly raising the leverage, perhaps excessively so, of the affected firms.[1] If that is the case, this would be seen in the leverage ratios of unlisted firms, as private equity deals either involve unlisted firms or consist of taking publicly listed firms private so that they no longer have a stock exchange listing. From a financial stability viewpoint, if leverage becomes excessive among private equity-backed firms, then the likelihood of a large default or of a cluster of smaller defaults becomes increasingly probable if the credit cycle were to deteriorate. As noted by the UK's Financial Services Authority, "this has negative implications for lenders (particularly before distribution), purchasers of the debt (particularly where these positions are concentrated or leveraged), orderly markets and conceivably, in extreme circumstances, financial stability".[2] Once firms are taken private, it becomes increasingly difficult to monitor the condition of their balance sheets. Nevertheless, this Box attempts to infer their condition by comparing leverage patterns for the non-financial corporate sector as a whole with leverage patterns of listed firms which do periodically issue financial statements.

The combined market capitalisation obtained from the published financial statements of around 2,000 non-financial corporations that were listed in 2005 shows levels and patterns broadly

1 See ECB (2007), "Large Banks and Private Equity-sponsored Buyouts in the EU", April.
2 See UK Financial Services Authority (2006), "Private Equity: A Discussion of Risk and Regulatory Engagement", Discussion Paper 06/06, November.

Chart B7.1 Market capitalisation of quoted shares issued by non-financial corporations in the euro area

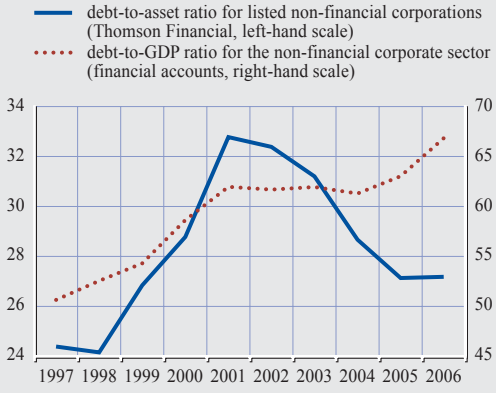
(EUR billions)



Sources: ECB and Thomson Financial Datastream.
Note: Figures for 2006 for listed non-financial corporations are based on a limited data set.

Chart B7.2 Debt ratios for the euro area non-financial corporate sector

(%)



Sources: ECB and Thomson Financial Datastream.
Note: The debt ratio derived from Thomson is calculated using total assets, owing to the varying sample size.
Note: Figures for 2006 for listed non-financial corporations are based on a limited data set.

similar to the total amount outstanding of quoted shares issued by non-financial corporations based on data drawn from national accounts. This suggests that the firm-level sample represents a high proportion of the quoted shares outstanding in the euro area as a whole (see Chart B7.1). In addition, the volume outstanding of quoted shares issued by non-financial corporations accounted for around 40% of the total equity of the sector (quoted and unquoted) in the euro area, on average for the period 1995-2004. This in turn implies that unlisted non-financial corporations account for 60% of the total equity of the sector, making it important to analyse developments in unlisted as well as listed non-financial corporates.

The debt ratios of the entire non-financial corporate sector and the debt ratios of listed non-financial corporations generally increased together in the period 1997-2002, but then appear to have decoupled somewhat (see Chart B7.2). The leverage of listed non-financial corporations decreased, whereas the leverage of the sector as a whole started to increase again. This could mean that leverage of unlisted firms started to rise recently.

All in all, these developments could imply that rising aggregate corporate sector leverage after 2004 conceals some differences in the leverage among listed and unlisted firms, although this tentative inference is surrounded by a high degree of uncertainty given the accounting differences in the two datasets.[3] While the surge in private equity deals may have had some influence, it is among the unlisted companies, often saddled with debt-to-earnings multiples of 8 to 9 times, where the ability to generate sufficient cash flows in the future to service debt and to provide internal funds for investment purposes can be questioned. Due to the lack of timely and public data, these firms represent a potential blind spot for financial stability analysis.

3 While the financial statements of firms can be used as a source for constructing national accounts data, there are important differences between financial statement accounting and the economic concepts used in a national accounts framework. For example, production costs in financial statement accounting are commonly recorded on a historical basis. By contrast, national accounts use the concept of opportunity cost, which is approximated by current market prices. Another difference is that financial statements are consolidated at the group level of the company, i.e. they net out intra-group transactions. This contrasts with the concept used in national accounting, which is compiled on the basis of unconsolidated data for individual corporate units. For more information, see for example United Nations (2000), "Links between Business Accounting and National Accounting", Handbook of National Accounting, Studies in Methods, Series F, No 76.

RISKS FACING THE CORPORATE SECTOR

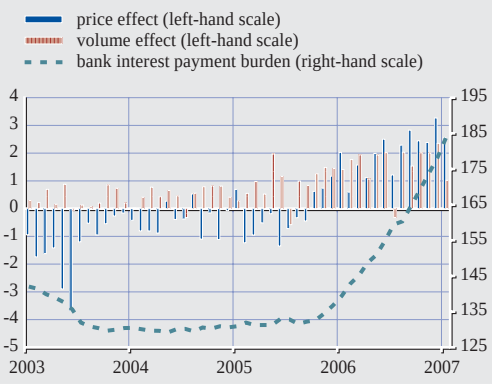
Triggers that could expose any vulnerabilities – such as excessive leverage – lurking in euro area corporate sector balance sheets include unexpected adverse disturbances affecting corporate profitability and/or interest rates. In particular, a significant deterioration in internally generated financial resources (profits) or financial commitments (repayment burdens) would imply a heightening of credit risks for banks with exposures to the corporate sector.

Regarding repayment burdens, the interest payments made by non-financial corporations to banks rose steadily after the end of 2005 (see Chart 2.6). This was driven by re-leveraging and higher short-term interest rates. Looking forward, the relative importance of floating rate funding in the total debt of firms has risen somewhat over recent years, and the recent upturn in debt-servicing costs would tend to suggest that while some large corporations may have hedged these risks through the swaps markets, hedging in the corporate sector as a whole is far from complete. At the same time, it should be mentioned that the increase in financial assets held by non-financial corporations has the effect of strengthening their repayment capacity.

The profitability of listed euro area non-financial corporations remained strong, but moderated somewhat in the second half of 2006 (see Chart 2.7). Looking ahead, it remains to be seen whether or not positive earnings expectations will be realised over the coming

Chart 2.6 Bank interest rate burden of non-financial corporations in the euro area

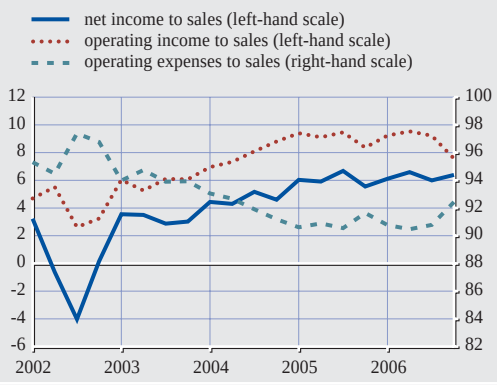
(Jan. 2003 - Feb. 2007, EUR billions)



Sources: ECB and ECB calculations.
Note: The bank interest rate burden is calculated as a multiple of the volume and bank interest rates on outstanding MFI loans to non-financial corporations. The "price effect" and "volume effect" reflect the monthly changes in the payment burden owing to changes in bank interest rates and loan volumes, respectively.

Chart 2.7 Profit ratios of listed euro area non-financial corporations

(Q1 2002 - Q4 2006, %)



Source: Thomson Financial (Worldscope).
Note: Calculations are based on an unbalanced sample of around 700 companies over time. Figures for Q4 2006 are based on a limited data set.

year. Three factors may possibly drag on earnings: second-round effects from a prolonged period of high oil prices; persistent upside risks to oil prices going forward in the course of 2007 arising from geopolitical tensions; and a generally appreciating euro.

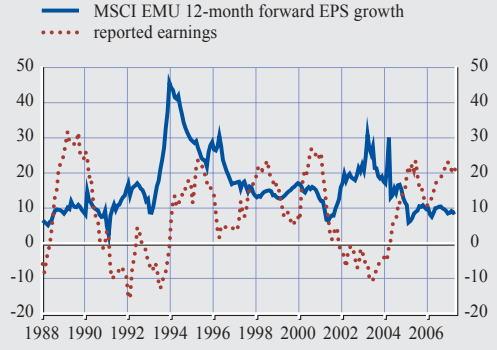
Concerning the profitability outlook in the short term, the current earnings cycle may have peaked with reported earnings growth slightly falling after the end of last year (see Chart 2.8). Moreover, the 12-month-ahead earnings growth forecasts for companies in the MSCI EMU (European Economic and Monetary Union) Index remained at comparatively low levels by early May 2007 implying a risk of deceleration.[2]

While corporate sector profitability remains strong at an aggregate level, there have been significant differences in profitability performances at the sectoral level. Earnings have been particularly strong in the oil/gas, basic materials, industrials and technology sectors, which profited from growth rates of 25% or more in the fourth quarter of 2006. By contrast, earnings in the consumer goods and utilities sectors have been much more moderate. As mentioned in the December 2006 FSR, part of these differences in profit performance may be related to the effect of oil prices, with energy-related sectors such as the oil/gas and basic materials sectors benefiting most when these prices are high. Moreover, diverging profitability in the euro area may reflect the fact that sectors reporting poor earnings (consumer goods and utilities) tend to be

2 See also Box 3 in ECB (2007), "Stock prices and earnings in the euro area", *Monthly Bulletin*, February.

Chart 2.8 Earnings cycle and short-term profitability outlook in the euro area

(Jan. 1988 - Apr. 2007, % per annum)



Source: Thomson Financial Datastream.

sheltered from international competition in the sense that profits are not adversely affected by euro appreciation. Earnings performance was comparatively stronger in more export-oriented sectors.

MARKET INDICATORS OF CORPORATE SECTOR CREDITWORTHINESS

Notwithstanding rising leverage and increasing debt repayment burdens, market indicators of prospects for corporate sector credit quality have been relatively unperturbed over the past six months. The spreads on corporate bonds have remained at very low levels, including the spreads for high-yield bonds (see Section 3). There was even a broad-based decline in expected default frequencies (EDFs) – a market-based indicator of expected rates of default over the coming year – including for riskier firms in the 75th and 90th percentiles (see Chart S55).

There are a number of possible explanations for these patterns in market indicators. Market participants may have assessed the likelihood of a crystallisation of the risks identified in this Section as being rather low, or they may have judged firms' balance sheets to be sufficiently robust to allow them to weather plausible sources of risk should they materialise. For example, Chart S52 suggests that the financial assets held by non-financial corporations have increased significantly, while total debt has risen noticeably at the same time (see Chart S51). This has a bearing on firms' repayment capacity, as they can therefore also sell their assets. However, it is also possible that these market indicators have been affected by the "pricing for perfection" phenomenon described in other parts of this and earlier editions of the FSR. Consistent with the latter interpretation, speculative-grade default rates began to rise in 2006 (see Chart S53), and non-financial corporations placed on review for a credit rating downgrade continued to outweigh upgrades (see Charts 2.9 and S54). While it cannot be ruled out that the majority of the credit rating downgrades may have been related to idiosyncratic credit reassessments of firms affected by LBOs, the upward movement of

Chart 2.9 Balance between euro area non-financial corporations placed on review for a credit rating upgrade/downgrade

(Jan. 2002 - Mar. 2007, number, 12-month moving average)

Source: Moody's.

EDF distributions between September 2006 and March 2007 (see Charts S56 to S58) suggests that this recent and slight deterioration in credit quality could be indicative of a general rather than firm-specific development.

OVERALL ASSESSMENT OF RISKS IN THE CORPORATE SECTOR

While the financial position of the euro area corporate sector has remained relatively sound at an aggregate level, there are some concerns that the likelihood of an adverse turn in the credit cycle could be growing. This is because the amount of debt being carried on firms' balance sheets has continued to grow, as has the cost of servicing short-maturity debt, while profit growth, although remaining high, has shown signs of slowing down. The slight rise in default rates by euro area speculative-grade firms through 2006 and early 2007, for the first time since 2003, may well be a harbinger of this, even if these default rates remain as yet very low. This raises questions about whether the historically low default rates seen after 2003 will be sustained in the period ahead.

Looking ahead, there are a number of potential factors which could reveal vulnerabilities in corporate sector balance sheets, three of which stand out. First, corporate profitability growth had moderated somewhat by early May 2007, despite remaining overall strong. Second, corporate credit quality may deteriorate further

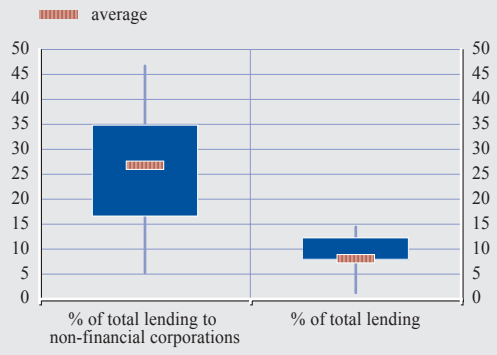
as past increases in interest rates translate into higher debt-servicing costs for firms which have increasingly contracted debt at floating rates. Third, abundant market liquidity could quickly give way to tighter conditions in the event of a large adverse credit event such as a large bankruptcy, fraud or a failed LBO, which would be sufficient to impair confidence and cause lending to be scaled back, especially to low-rated borrowers. In this vein, to the extent that easier credit conditions may have been a factor in keeping default rates low, a more general turn in the credit cycle – involving tighter lending standards and larger credit risk premiums – could produce an abrupt upturn in default rates. Moreover, the triggers for speculative-grade debt may not necessarily be the same as the triggers for debt higher up the credit quality ladder.

2.3 COMMERCIAL PROPERTY MARKETS

Commercial property market developments are important from a financial stability perspective for three main reasons. First, commercial property loans can be an important component of financial institutions' assets. Lending related to commercial property constituted about 8% of total bank lending in 2005 and around 27% of total lending to non-financial corporations in the euro area, although these shares differ widely across countries (see Chart 2.10). Second, commercial property lending has proven to be a volatile component in some bank loan portfolios, more so than residential property lending. This is because commercial property prices tend to be much more closely linked to business cycle conditions, and are more often bought as a speculative investment than residential property, which often serves as accommodation for its owners and has an intrinsic value. Finally, commercial property markets are also important from a financial stability perspective because euro area insurance companies and pension funds are large investors in real estate markets.[3]

Chart 2.10 Bank lending for commercial real estate purposes in the euro area

(2005, country distribution, maximum, minimum, inter-quartile distribution)



Sources: IMF and national central banks.
Note: Data for Belgium, the Netherlands and Luxembourg are not available.

Commercial property prices continued to rise significantly during 2006 in many euro area countries (see Chart S59), mainly as a result of the continued strength in commercial property transaction volumes. These were driven by comparatively low yields for other financial assets, which spurred demand for alternative investments, such as real estate, as part of a broadening of the hunt for higher-yielding assets.

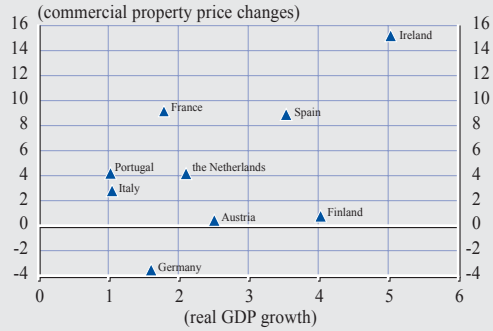
The considerable differences in commercial property price changes across euro area countries reported in the December 2006 FSR continued in 2006 (see Chart S59). These differences can to some extent be explained by country differences in business climate, as countries with high (low) GDP growth generally recorded the largest (lowest) price increases of commercial property from 2004 to 2006. There were, however, some exceptions where countries with comparatively weak GDP growth witnessed relatively high price increases for commercial property (see Chart 2.11).

Prices increased across all commercial property market segments during 2006, but the retail segment continued to enjoy larger increases than the office segment (see Chart S60).

3 Changes in commercial property prices may also directly affect banks' fixed assets and capitalisation if they own property, and can have indirect effects through their impact on the macroeconomic environment.

Chart 2.11 Commercial property price changes and real GDP growth for selected euro area countries

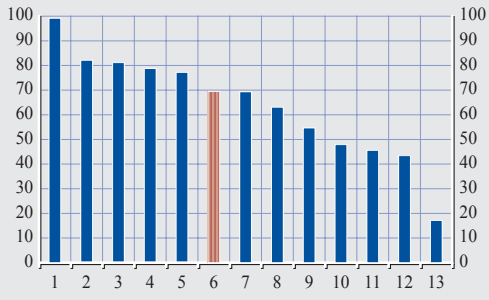
(average of 2004 - 2006, % per annum)



Sources: Investment Property Databank, Eurostat and ECB calculations.
Note: The coverage of the total property sector within countries ranges between around 20% and 80%.

Chart 2.12 Cross-border commercial property investments in the euro area

(2006, % of total value of investments in each country, flow data)



1 Luxembourg
2 Germany
3 Portugal
4 Spain
5 France
6 euro area
7 Greece
8 Belgium
9 Netherlands
10 Finland
11 Italy
12 Austria
13 Ireland

Source: Jones Lang LaSalle.

Commercial property price increases have been driven by a high level of investor demand for commercial property that has been witnessed in the euro area since around 2000. This picked up significantly in 2006, bringing euro area real estate investment volumes to new record levels. Total euro area transaction volumes stood at €120 billion at the end of 2006, almost double the level seen in 2005.

Cross-border activity, involving either non-domestic buyers or sellers of property, continued to account for the largest share of transactions, and accounted for almost 70% of total euro area investments in 2006.[4] However, large cross-country differences prevailed (see Chart 2.12). These differences can be attributed to differences in accessibility for foreign investors and varying profitability prospects of the investment opportunities as assessed by foreign investors.

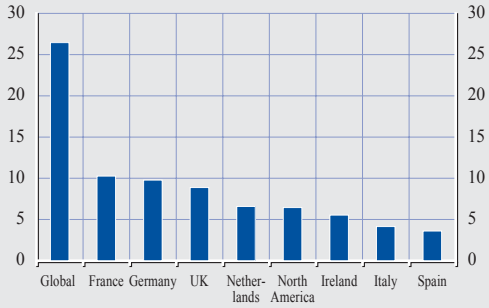
Global investors (i.e. investors with capital sources from several countries) accounted for more than 25% of euro area commercial property purchases in 2006 (see Chart 2.13). Investors located in the UK and North America were also large purchasers of euro area commercial property with shares of 9% and 6%, respectively.

A breakdown of the type of investors in the euro area commercial property markets shows that unlisted funds remained the largest investor type with around 40% of total acquisitions. With smaller sale volumes than purchases, the unlisted sector was a net investor

4 Data taken from Jones Lang LaSalle. For a description of the conditions in the European commercial real estate market, see Jones Lang LaSalle (2007), "European Capital Markets Bulletin 2006", February.

Chart 2.13 Investors in euro area commercial property markets

(2006, % of total value of investments in the euro area, flow data)



Source: Jones Lang LaSalle.
Note: Data include both domestic and cross-border investments for the euro area Member States. "Global" includes funds that raise significant capital from multiple regions, i.e. the source of capital is not identifiable as a single country or region.

in 2006. By contrast, the activities of listed property companies – real estate investment trusts (REITs) in particular – has been growing in several euro area countries.[5] This has been an important driver of the high investment volumes seen during the last couple of years. Private investors were the third largest investor group in commercial property in 2006. The bulk of private investment is still domestic.

COMMERCIAL PROPERTY MARKET OUTLOOK AND RISKS

The recent strength of demand for commercial property investments has shown little sign of abating. The generally positive outlook for economic activity in the euro area (see sub-section 2.1) should support demand for commercial property. However, commercial property markets in countries that have witnessed comparatively weak GDP growth together with high commercial property price rises during the last few years could prove vulnerable to a reduction in demand, potentially leading to price corrections.

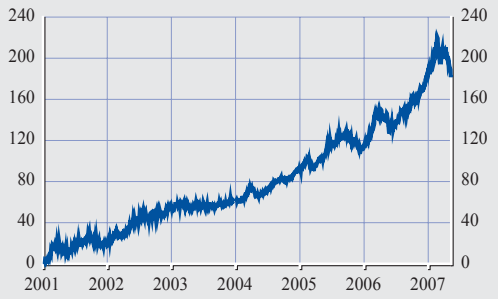
Real estate funds have continued to attract investors, new funds have started up, and private investors and property companies have remained active market participants. Growth in listed real estate vehicles and the introduction of REITs in Germany and Italy during 2007 could also support trading when companies restructure their portfolios to take advantage of more favourable tax conditions as well as to free up capital.

High prices and prospects of lower returns could lead investors to seek higher returns further up the risk curve through more development activity. Countries and cities outside the euro area with less developed property markets could also attract euro area investors searching for higher-yielding investments.

The high level of cross-border commercial property investment in the euro area witnessed during recent years, coupled with the growing presence of different types of investors, has been changing market dynamics and the ownership of euro area commercial property. Broader ownership could lead to more efficient price-setting behaviour in commercial real estate markets by providing a more diverse and stable market environment. However, some related risks cannot be excluded. For example, a greater cross-border dimension could increase the risk of contagion in terms of commercial property price corrections from one euro area Member State – or indeed from a non-euro area country – to another when investors have exposures to several markets at the same time.

Chart 2.14 Cumulative change in euro area commercial property stock markets relative to the Dow Jones EURO STOXX

(Jan. 2001 - May 2007, % points, base: Jan. 2001 = 0, euro area FTSE EPRA/NAREIT property index)



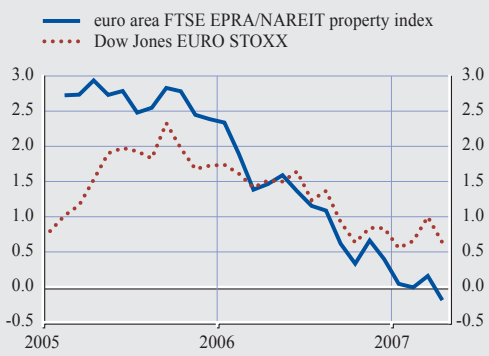
Sources: The European Public Real Estate Association (EPRA) and Bloomberg.
Note: The euro area FTSE EPRA/NAREIT property index includes traded real estate stocks of closed-end companies engaged in ownership, trading and development of income-producing real estate.

There have been large increases in the stock prices of companies engaged in ownership, trading and development of income-producing real estate since the end of the 1990s compared to the overall stock market thanks to the generally favourable developments in the euro area commercial property market. The pace of outperformance even accelerated after November 2006 (see Chart 2.14), before worsening temporarily as a result of the financial market turmoil in February/March 2007. Rather than reappraising the outlook for commercial property markets, these

5 REITs are publicly-traded real estate stock corporations which are exempted from both corporate income and trade income tax. They must derive at least 75% of their income from property investments, and pay at least 90% of their taxable income to shareholders.

Chart 2.15 Euro area commercial property and the overall stock market risk premium

(Feb. 2005 - Apr. 2007, % points)



Sources: EPRA and ECB calculations.
Note: The risk premium is the difference between the dividend yield and the real long-term government bond yield (CPI-adjusted).

developments could possibly be attributed to the status of commercial real estate as an alternative asset class which typically is more affected by changes in risk appetite among investors. Real estate companies' stock prices again fell during April and early May 2007. The decline was, however, not broad based across companies but mainly limited to companies exposed to real estate markets that have shown signs of moderation as of late.

Continued strength of demand for stocks of commercial property companies has led to a further reduction in the equity risk premium, as measured by the difference between the dividend ratio and the real long-term bond yield, for this asset class in the euro area since the publication of the December 2006 FSR. The commercial property equity risk premium has now fallen below the levels for the Dow Jones EURO STOXX (see Chart 2.15). This could indicate that asset prices are in this sector vulnerable to set-backs. The compression of this risk premium has been driven by both a reduction in dividend yields and higher real long-term government bond yields. The risk premium briefly turned negative in February 2007, due to the repricing of commercial property stock prices during this period of financial market turmoil, and again in April 2007, because of an increase in real long-term interest rates.

OVERALL ASSESSMENT OF RISKS IN COMMERCIAL PROPERTY MARKETS

With a favourable economic outlook, the overall outlook for the euro area commercial property markets also remains favourable but uncertain. Prices could prove vulnerable, at least in some countries where commercial property price increases have been larger than warranted by economic activity, especially if investor demand for this asset class is not sustained. A slowdown in investment activity could be triggered by higher than expected changes in interest rates, which would reduce the yield for commercial property investments further by increasing the cost of finance, and could see investor demand shifting to other asset classes. In turn, banks could suffer from a deterioration in the volume and quality of lending extended for commercial property investment.

2.4 BALANCE SHEET CONDITIONS OF THE HOUSEHOLD SECTOR

Although household sector indebtedness again reached new highs in the six months after the finalisation of the December 2006 FSR, thereby further fuelling existing concerns about sustainability, the overall assessment of household sector balance sheets as a potential source of risk from a financial stability perspective has not changed materially, with the central scenario remaining one of continued sustainability.

While rising short-term interest rates may have challenged the ability of some households to service their debts, there are a number of mitigating factors supporting household sector balance sheets. In particular, the outlook for employment and household income has improved further in the past six months. At the same time, the pace of new household sector borrowing has slowed since spring 2006, albeit remaining at strong levels. There have also been signs of moderation in a number of euro area housing markets, which points to a gradual softening while limiting the risks of a potentially

more disruptive reversal in the future. That said, vulnerabilities may be growing for households in those parts of the euro area where housing valuations appear stretched, where the debt build-up has been most pronounced, and where the majority of debt is financed at variable interest rates.

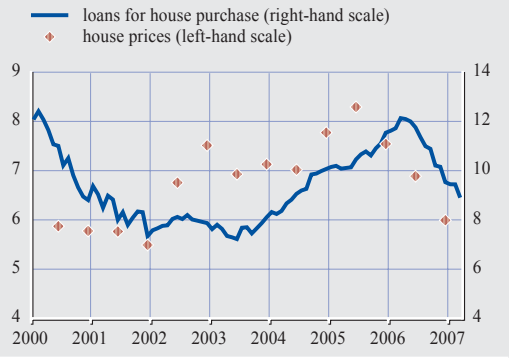
HOUSEHOLD SECTOR LEVERAGE

The annual rate of growth of bank lending to the household sector peaked at 9.7% in the second quarter of 2006, and decelerated moderately thereafter to 7.9% by the first quarter of this year (see Chart S61). Underlying this were slowdowns in both the annual rates of growth of loans for house purchase and of consumer credit. The slightly slower but still strong rate of household borrowing can be attributed to an environment of improving consumer confidence together with still favourable financing conditions – in terms of both lending rates and credit standards applied by banks – despite the increases in policy interest rates since December 2005. In particular, long-term interest rates have remained low throughout the period.

The moderate deceleration of mortgage lending in recent quarters paralleled a loss of momentum in the euro area housing market, with indications that the rate of house price inflation had peaked in the second half of 2005 (see Chart 2.16).

Chart 2.16 Loans for house purchase and house prices in the euro area

(Jan. 2000 - Mar. 2007, % per annum)



Source: ECB.

Higher house prices imply greater financing needs for households, and also raise their borrowing capacity as the collateral value of housing increases. On the other hand, easier access to credit and more favourable lending conditions can in turn fuel demand for housing and contribute to boom-bust cycles in housing markets, which might become a concern from a financial stability perspective.[6]

Forward-looking information suggests a further slowing of loan growth in conjunction with moderation in house price growth. According to the results of the April 2007 ECB Bank Lending Survey, housing market prospects were reported by banks to have exerted a significantly negative impact on households' demand for loans for house purchase in the first quarter of 2007.

Reflecting the persistent strength of household sector borrowing, the indebtedness of this sector in the euro area increased further reaching 58.5% of GDP in the fourth quarter of 2006 (see Chart S63). As mentioned in previous editions of the FSR, the household sector debt-to-GDP ratio remains relatively moderate compared with other industrialised countries.

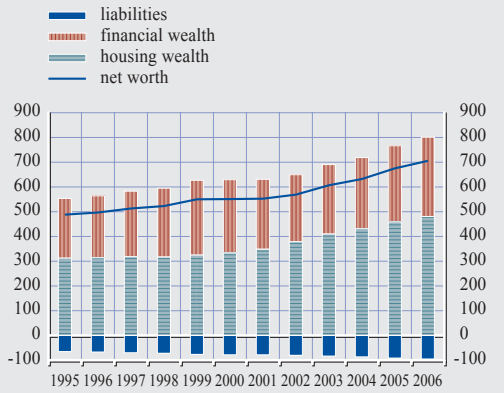
While measures of leverage compared to income can provide a rough indication of the ability to service debt, evaluating this ability compared to assets can provide an indication of the capacity to repay debt at an aggregate level. The value of household assets which are much larger than their debt has grown more than their liabilities, especially after 2002 as stock markets recovered the losses from the bursting of the high-tech bubble and as house prices rose. As a result, households have seen a notable rise in their net wealth over this period, driven by both the financial and, in particular, the housing wealth[7] component (see Chart 2.17).

6 For a discussion see ECB (2006), "Assessing house price developments in the euro area", *Monthly Bulletin*, February.

7 An estimate of housing wealth for households (based on limited country data covering around 80% of the euro area in terms of GDP) was published for the first time in Box 5 in ECB (2006), *Monthly Bulletin*, December.

Chart 2.17 Households' net worth in the euro area

(1995 - 2006, % of gross disposable income)



Sources: ECB and ECB calculations.
Note: Data on financial wealth and liabilities for 2005 and 2006 are based on estimates.

It is important to bear in mind that the volatility of household assets can be considerably higher than the volatility of outstanding liabilities, and that this can affect the ability to repay debt. The extent of this vulnerability depends on the structure and risk attributes of household assets. The share of housing wealth in total wealth was around 60% for the euro area in 2006.

The bulk of euro area households' financial wealth is held in relatively safe assets such as deposits and insurance products, whereas investment in directly held equity and mutual fund shares has remained subdued in recent years, with rises solely due to valuation effects (as highlighted in the December 2006 FSR). Overall, euro area households' exposure to financial market volatility seems well contained whereas, by contrast, their vulnerability to the possibility of corrections in house prices has increased substantially in recent years.

Considering the potential ability of households to repay debt if needed, the degree of household leverage, expressed as the ratio of total assets to liabilities, has overall changed little in recent years.

While aggregate data do not suggest that there are significant balance sheet vulnerabilities in the euro area household sector, it is important to bear in mind that assets and liabilities are distributed unequally across the population, and that the dispersion of indebtedness across households also varies across countries. Generally speaking, the degree of mortgage indebtedness depends on rates of home ownership, and tends to be more widespread among the higher deciles of the income distribution. In countries with high home ownership ratios and less developed rental markets the incidence of mortgage debt might, however, also be significant among the lower deciles of the income distribution.

The debt exposures of lower income and lower net worth individuals may have increased over recent years, partly as a result of mortgage market innovation, improved access to funding and a general lowering of credit standards in the face of strong competition among lenders. However, no timely euro area-wide micro-data currently exist to confirm this.

HOUSEHOLD SECTOR RISKS

Households are subject to two types of risks affecting their ability to service their debt: interest rate risk, which has recently increased overall; and income risk, which has been broadly declining. Households are most exposed to the risk of rising debt service burdens when loans are predominantly extended with variable rate contracts.

Interest rate risks of households

After the finalisation of the December 2006 FSR, the ECB increased key interest rates by 50 basis points, bringing the cumulative rise since December 2005 to 175 basis points. This has contributed to a moderate rise in households' overall debt-servicing burden (see Chart S65). Since 2005 interest payments have also been rising in addition to the trend increase in principal repayments associated with rising debt levels. This situation is different compared to earlier years, when interest rates had remained unchanged for an extended period. At the same

time, it should be borne in mind that for the household sector as a whole, the outstanding stock of interest-bearing assets exceeds that of liabilities, and increases in interest rates should therefore have a modest positive impact on their net interest receipts.

An additional factor to be taken into account when assessing developments in gross and net interest flows is that debt-servicing burdens are unevenly distributed among different household income categories, and that ownership of financial assets is highly concentrated. This again implies that the risks affecting the most financially vulnerable segments of the population cannot be properly addressed by looking at aggregate data. The impact of rising interest rates on household debt-servicing costs depends on the nature of mortgage contracts. Households with outstanding fixed rate mortgages will be shielded from interest rate risks for the duration of the fixation period. It has been estimated in the past that the share of outstanding mortgage debt subject to a variable rate or with an interest fixation of less than one year is relatively low in the euro area as a whole at around 25%.

During 2003 and 2004, fixed rate mortgages became less popular among borrowers in an environment of very low short-term interest rates. This has been partially reversed since the second half of 2005, as the spread between short-term and long-term interest rates on loans for house purchase diminished (see Box 8). The share of loans with a rate fixation period of more than ten years in all new housing loan business hovered at around 24% in the second half of 2006. This is the highest proportion recorded since this series became available.

Risks to household income

Looking at the debt-servicing burden in isolation may overstate the risks from increases in interest rates if other sources of risks to households are reduced. In particular, interest rates across the yield curve will generally tend to rise in an environment of stronger growth and income developments. The most challenging – albeit low probability – risk scenario for households could arise when adverse interest rate and income shocks coincide. This could take the form of a generalised rise in risk premiums, combined with a more severe correction in housing and other asset markets and a concomitant reversal in the growth outlook.

At the micro level, the holders of the bulk of euro area mortgage debt tend to belong to the highest income categories.[8] The key risk to households' ability to meet their debt-servicing obligations is linked to income volatility, largely in the context of unemployment, illness or divorce. The macroeconomic environment improved during the second half of 2006 and into 2007 in terms of growth and employment creation, and pointed to a reduction in income-related risks for households. In particular, the euro area unemployment rate has fallen significantly further since the December 2006 FSR, and in early 2007 – at 7.3% – was around a full percentage point below the rate recorded a year earlier. This trend is also reflected in survey evidence from the European Commission, which shows that euro area households have become less pessimistic (see Chart 2.18).

Reduced pessimism about employment prospects has not however translated into improved expectations about future financial conditions. This recent decoupling may reflect moderate developments in disposable income together with structural changes in labour markets, which has increased uncertainty in some parts of the labour market in recent years. In addition, households have benefited little from the most recent equity market boom. Households' increased awareness of risks related to changes in interest rates and housing markets may have contributed to the continued cautious assessment of financial prospects in recent quarters.

8 See ECB (2005), "Assessing the financial vulnerability of mortgage-indebted euro area households using micro-level data", *Financial Stability Review*, December.

Chart 2.18 Euro area households' financial situation and employment expectations

(Q1 1998 - Q1 2007, % balances, three-month moving averages)

Source: European Commission Consumer Survey.
Note: Expectations about employment prospects are obtained as the inverse of the balance of answers to the question "How do you expect the number of people unemployed in this country to change over the next 12 months?". An increase in this indicator corresponds to more optimistic expectations overall.

Risks to residential property prices

The financial position of households can be affected in various ways by developments in the residential property market. For example, if house prices drop below the residual value of outstanding mortgage loans, then households could suffer from negative equity. This may increase the probability of default on these mortgages if households experience reduced debt-servicing capacity at the same time (i.e. due to unemployment or other income shocks), and consequently have to sell their housing assets in order to service their debt.

In this respect, while housing markets remained dynamic in parts of the euro area during 2006, there was some moderation in euro area property price inflation (year on year) to 6.4% in 2006, down from 7.9% in 2005 (see Chart S67).[9] Although country developments remain diverse, signs of moderation were discernable in Belgium, Spain, France and Italy. In most other countries, growth rates have remained broadly stable (see Table S4).

In part, the decline in residential property price growth reflects a cooling of demand. The cost of mortgage debt rose and, as a consequence, the growth of mortgage lending slowed down during 2006. In addition, although housing supply usually adjusts more gradually than demand, available indicators suggest a response in some elements of housing supply. Construction output rose rapidly through 2006, and the ratio of residential investment to GDP remained high (see Chart S66). One leading indicator of increasing supply of newly constructed dwellings – the number of building permits granted – continued to grow although some signs of deceleration in the rate of growth were observed towards the second half of 2006.

Valuation measures based on house price-to-rent ratios indicate that residential property prices are overvalued at the euro area level and that the level of overvaluation seems to have increased compared with the last FSR (see Chart S68).[10] The euro area aggregate data mask cross-country differences, with some countries continuing to show persistent signs of overvaluation. It cannot be ruled out, however, that some of the rapid increases in residential property prices and a degree of the consequent overvaluations – in some countries – could be due to structural factors.

Some comfort may be taken from the moderate deceleration in prices observed over the past 18 months: so far, housing markets have avoided a swift correction that might have given rise to much greater financial stability risk. Although the vulnerabilities related to overvalued house prices have increased in importance over the past six months, the risk of a sharp downturn in housing activity in the near term seems reasonably small given the broadly positive outlook for the macro economy and euro area households.

9 See ECB (2007), "Developments in euro area residential property prices", May.
10 See also ECB (2006), "Assessing house price developments in the euro area", *Monthly Bulletin*, February.

OVERALL ASSESSMENT OF RISKS IN THE HOUSEHOLD SECTOR

Overall, compared with the December 2006 FSR, the risk assessment for households has not changed significantly. While household debt has continued to grow and the cost of servicing this debt has increased moderately, these factors are counterbalanced by brighter prospects for income and employment growth in the near term. This should support households' debt-servicing capacity even in the event of possible upward adjustments in interest rates across the yield curve. For the euro area as a whole, risks related to a more abrupt adjustment in house prices appear at the present juncture to be relatively remote, even though strong price developments and somewhat stretched valuations in some Member States remain a cause for concern.

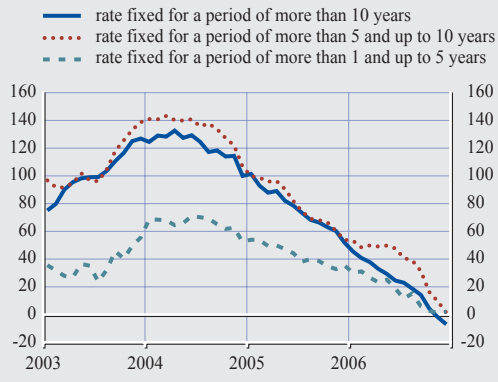
Box 8

TERM SPREADS AND FLOATING RATE LENDING TO HOUSEHOLDS AND NON-FINANCIAL CORPORATIONS IN THE EURO AREA

The degree of interest rate variability or the length of the initial period of interest rate fixation on bank loans determines whether the interest risks associated with them are predominantly borne by borrowers or by lenders. When loans are extended at variable interest rates, the bulk of the interest rate risk is carried by the borrowers. By contrast, when lending rates are fixed, borrowers are shielded from interest rate risk, yet banks can be left exposed to the risk of divergence between the cost of funding the loan and the interest earned on it, unless they hedge with appropriate market instruments. Hence, information on the distribution of new lending according to the degree of interest rate flexibility in the contracts can shed light on how interest rate risks are spread between borrowers and lenders. Moreover, the degree of interest rate risk borne by borrowers can have implications for banks' exposure to credit risk. When most loans are contracted at variable rates, the proportion of borrowers who could find themselves in difficulty when seeking to service their loans will tend to be larger in the event of an interest

Chart B8.1 Spreads between rates on new MFI loans for house purchase with a longer initial rate fixation period and floating rate loans in the euro area

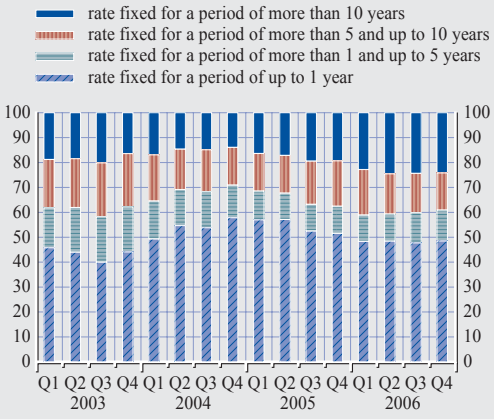
(basis points, interest rate difference vis-à-vis rates on loans with floating rates or rates fixed for a period of up to one year)



Source: ECB.

Chart B8.2 Breakdown of new MFI loans for house purchase by length of initial rate fixation period in the euro area

(%)



Source: ECB.

rate increase. Against this background, this Box assesses the extent to which changes in bank lending rates for loans with different periods of initial rate fixation affect the relative share of these loans in total new monetary financial institution (MFI) loans in the euro area.[1]

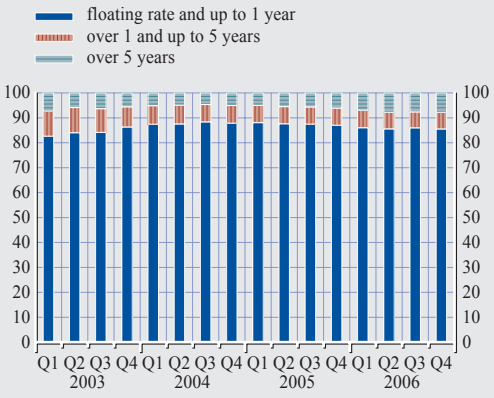
Reflecting increases in key ECB and market interest rates, nominal rates of interest on new loans to households for house purchase[2] began to rise in the euro area at the end of 2005. As the term structure of euro area market interest rates flattened during 2006, the increase in interest rates on floating rate loans (loans with a floating interest rate or a period of initial rate fixation of less than one year) was more pronounced than for loans with longer initial rate fixation periods. As a result, the spreads of interest rates paid on loans with longer periods of initial rate fixation over floating rates on new loans for house purchase, or term spreads, all practically disappeared, regardless of the length of the initial rate fixation period (see Chart B8.1).

Throughout the period for which data are available, loans for house purchase contracted at floating rates constituted the largest share of new business (in terms of gross flows) in the euro area, although this share did fluctuate widely between 40% and 60% (see Chart B8.2).[3] This variation seems to be partly explained by changes in term spreads on loans, with the relative demand for floating rate borrowing increasing when it becomes comparatively cheaper. For instance, the proportion of floating rate loans for house purchase rose between Q3 2003 and Q4 2004, coinciding with a general rise in term spreads. Similarly, the decline in the share of floating rate loans after Q1 2005 was coupled with a steady narrowing and eventual elimination of these spreads, although the fall in these spreads had started a couple of quarters earlier. This seems to suggest that when choosing between taking out a floating rate loan or one with a longer period of initial rate fixation, households may focus on the initial interest rate, not fully taking into account the possibility that the rate paid on floating rate loans could increase over the term of the loan.[4] However, expectations may well differ between households and the financial markets regarding future interest rate movements, with households potentially taking the view that floating rate mortgages are likely to prove cheaper than fixed rate ones with comparable longer-term maturities, not least because of term premiums in longer-term rates.[5] If that is the case, it could partly explain why the share of floating rate loans remained at around 50% despite the elimination of term spreads over most recent quarters. That said, other factors, possibly of a structural or supply-side nature, might also explain this. For instance, it might be indicative of supply-side constraints on banks in extending fixed rate mortgages – such as shortages of hedging instruments or of willing counterparties or even the absence of covered bond or MBS markets.[6] To the extent that this is the case, then the willingness of banks to extend fixed rate mortgages and bear the interest rate risk might be lower. Indeed, a look at the

1 The share of variable rate loans in total loans may overestimate the interest rate risk borne by borrowers, to the extent that the relevant loan contracts include interest rate caps. However, this information is not generally available.
2 Loans for house purchase account for approximately 70% of all MFI loans to households.
3 Information on the share of total outstanding loans for house purchase which will be subject to an interest rate change in the year ahead is not regularly available, although for 2004 this share has been estimated at approximately one-third (see Box 1 in ECB (2004), *Monthly Bulletin*, November). It should be noted, however, that given the large share of floating rate loans in new business since then, this share may have increased.
4 Indications of such myopic behaviour on the part of UK households are provided in D. Miles (2004), "The UK Mortgage Market: Taking a Longer-term View. Final Report and Recommendations", London: HM Treasury.
5 A perhaps more benign interpretation would perceive this behaviour as resulting from active risk management on the part of households that takes into consideration not only interest rate risk but also income risk. A stylised model where households engage in risk management of this kind is provided in J. Campbell and J. Cocco (2003), "Household Risk Management and Optimal Mortgage Choice", *Quarterly Journal of Economics*, 118, 1449-1494.
6 Although banks can hedge themselves relatively easily against interest rate risk using plain vanilla interest rate swaps, they can also be exposed to mortgage prepayment risk (to the extent that prepayment is possible), the hedging of which would require the use of more sophisticated instruments.

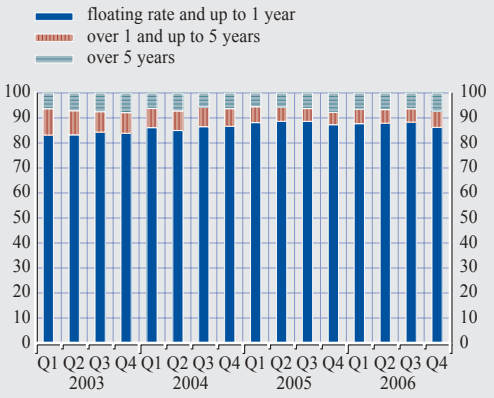
Chart B8.3 Breakdown of new MFI loans to non-financial corporations by length of initial rate fixation period in the euro area

(a) loans up to EUR 1 million, % points



Source: ECB.

(b) loans over EUR 1 million, % points



Source: ECB.

individual countries tends to provide some support for this view, as in some countries where such markets are well developed, a large share of loans for house purchase are contracted with long periods of rate fixation.[7]

With regard to non-financial corporations, sensitivity regarding the share of floating rate borrowing to bank term spreads can also be detected for loans of up to €1 million, but not for loans over €1 million.[8] The share of new loans up to €1 million with a floating rate or an initial rate fixation of up to one year in total new business has shown a positive correlation with term spreads (see Charts B8.3a and B8.4). The patterns of lending observed between firms and households are not immediately comparable because the purpose of lending differs. For example, housing is an asset with a long life which may be expected to be funded over the long term. By contrast, the data for total borrowing for non-financial corporations include borrowing for working capital. This will usually be funded in the short term, which explains why the share of floating rate borrowing is much higher in comparison to loans for house purchase. The volume of new business for loans to non-financial corporations at floating rate or up to one year initial rate fixation includes short-term debt that is rolled over more frequently than long-term debt.

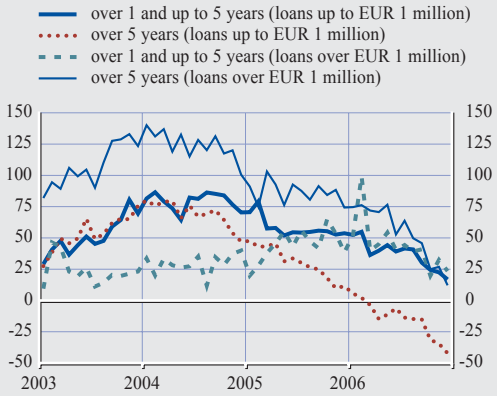
The share of floating rate loans over €1 million to non-financial corporations does not appear to be as sensitive to term spreads as is the case for smaller loans (see Charts B8.3b and B8.4). Large loans are typically associated with large enterprises, which presumably have better access to capital market borrowing. Over recent years, the share of debt securities issued by non-financial corporations at short-term interest rates – that is, short-term debt securities and long-term debt securities at floating rates – in total outstanding debt securities issued by the

7 Obviously, various other factors such as redemption fees for instance, might also affect the decisions of borrowers to undertake a fixed versus a floating interest rate loan. No data are available to allow the examination of their role explicitly. In any event, it is unlikely that such factors could have changed so dramatically during the period examined to the extent that they could explain the change in borrowers' behaviour.

8 The loan size is the available proxy for the firm size. In this respect, loans up to €1 million are typically associated with small and medium-sized enterprises (SMEs), while loans over €1 million are associated with large enterprises.

Chart B8.4 Spreads between rates on MFI loans to non-financial corporations with a longer initial rate fixation period and floating rate loans in the euro area

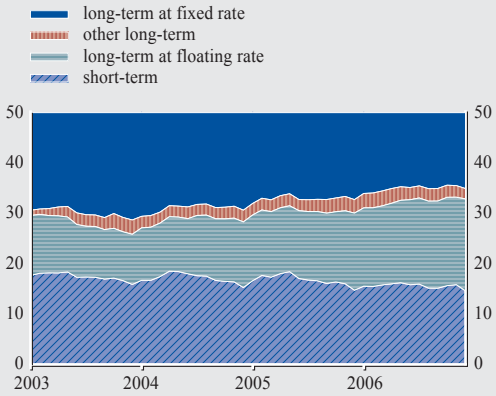
(basis points, interest rate difference vis-à-vis rates on loans with floating rates or rates fixed for a period of up to one year)



Source: ECB.

Chart B8.5 Debt securities issued by non-financial corporations in the euro area

(%)



Source: ECB.
Note: "Other long-term" comprises the residual difference between total long-term debt securities and fixed and variable rate long-term debt securities consisting of zero coupon bonds and revaluation effects.

sector increased from 30% in January 2003 to 33% in December 2006 (see Chart B8.5). A similar upward movement can be observed on the basis of the share of short-term debt securities and long-term debt securities at floating rate issued by non-financial corporations in total gross issues. Taken together, this suggests that large enterprises have increasingly borrowed at short-term rates – irrespective of whether the debt is intermediated or not. This may suggest that there is relatively strong investor demand for floating rate debt, particularly since the end of 2005, in an environment of generally rising interest rates.

All in all, there appears to be a relationship between term spreads on bank lending rates and the share of floating rate loans both for mortgage lending and for lending to small and medium-sized enterprises (SMEs). From a financial stability point of view, this may indicate that these borrowers bear the greater part of interest rate risk, but leave banks exposed to credit risk, especially in lending to SMEs. Moreover, the large share of debt that households and firms have contracted at variable rates may have left their balance sheets increasingly vulnerable to short-term interest rate changes. Greater opportunities for banks to shift these risks in financial markets to entities more willing to bear them – via derivatives or through the development of covered bond and MBS markets – could, in principle, mitigate some of these risks.

III THE EURO AREA FINANCIAL SYSTEM

3 EURO AREA FINANCIAL MARKETS

After the finalisation of the December 2006 FSR, there was a global sell-off amidst heightened market volatility which affected most asset classes between late February and early March 2007. This mainly reflected swings in risk appetite against a background of uncertainty about the global economic outlook. Nevertheless, by early May 2007 most financial asset prices had changed little compared with early November 2006. This means that the risk premiums embedded in the prices of financial assets, especially but not exclusively in the credit derivatives market, remain vulnerable to the possibility of risk reappraisal or of disappearing market liquidity. Moreover, the disappearing longer markets continue pricing for perfection – especially if they are too reliant on market liquidity being sustained – the more they will become vulnerable to the possibility of an abrupt correction.

3.1 KEY DEVELOPMENTS IN THE MONEY MARKET

After the finalisation of the December 2006 FSR there was a relatively smooth upward adjustment in market expectations of future short-term interest rates in the euro area, against a background of relatively positive economic data (see Chart 3.1). Volatility in the euro area money market remained low by historical standards (see Chart S71), despite increasing slightly after the market turbulence that began in late February 2007. At the same time, liquidity conditions in the interbank market – gauged by relatively narrow bid-ask spreads for EONIA swap rates – remained very favourable (see Chart S69).

A positive development in money markets from a financial stability viewpoint has been the increased use of secured money market instruments both in absolute and relative terms over recent years.[1] Together with certain areas of OTC derivatives, this was one of the few money market segments that recorded continuous growth after Q2 2001. By Q2 2006, the secured segment formed the largest part of the euro money market, accounting for more than 27% of overall turnover, compared with 18% for the unsecured segment.

Chart 3.1 Implied yield of the three-month EURIBOR futures contract maturing in June 2007

(Jan. 2006 - May 2007, %)

Source: Bloomberg.

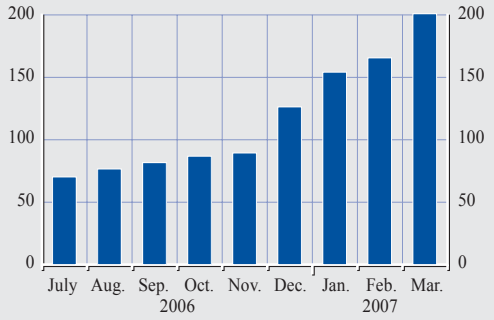
Another positive development in the money market has been the increasing use of new money market instruments which help investors hedge their exposures more accurately and allow them to express their views more precisely. These include instruments such as EONIA swaps, other interest rate swaps and forward rate agreements, the turnover of which rose by 52%, 34% and 34% respectively in 2006.

The pace of issuance of short-term securities by non-financial corporations accelerated in the second half of 2006 (see Chart S72), showing that issuing conditions for non-financial corporations in the money market remained favourable. Further evidence of these favourable market conditions was shown by significant growth in the amounts outstanding of short-term European paper (STEP) (see Chart 3.2). At the end of March, 80% of the STEP notes were denominated in euro. This corresponds to nearly

1 See ECB (2007), "Euro Money Market Study 2006", February. The study includes turnover data for the second quarters of each year, and the latest edition covers the period up to Q2 2006. See also ICMA (2007), "European Repo Market Survey December 2006", February.

Chart 3.2 Short-term European Paper (STEP) debt securities

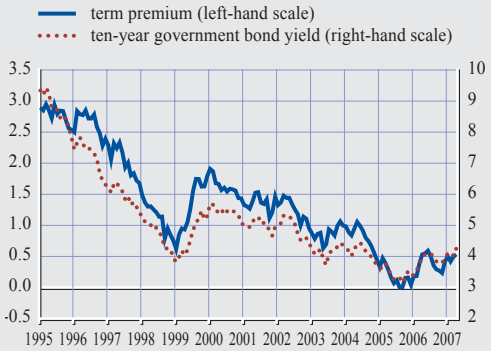
(July 2006 - Mar. 2007, EUR billions, amounts outstanding)



Source: ECB.

Chart 3.3 Euro area ten-year government bond yield and term premium

(Jan. 1995 - Apr. 2007, %)



Sources: Bloomberg and ECB calculations.
Note: The premium is calculated from a two-factor affine term structure model.

one quarter of the outstanding amount of euro-denominated non-government short-term debt securities. On 14 September 2006 the Governing Council of the ECB decided to accept the STEP market as an unregulated market for collateral purposes in Eurosystem credit operations.[2] The objective of the STEP initiative is to foster the integration and development of the European markets for short-term securities through convergence towards the best market standards.[3]

3.2 KEY DEVELOPMENTS IN CAPITAL MARKETS

GOVERNMENT BOND MARKETS

Against the background of a surge in global market volatility which lasted between late February and early March 2007, ten-year bond yields in the euro area declined as investors sought safe havens for their funds. However, by early May they stood at 4.3%, 45 basis points above their levels in early November 2006 (see Chart 3.3). The euro area market yield curve flattened slightly further (see Chart S73). Yields appeared to be fairly in line with the macroeconomic fundamentals: ten-year yields closely tracked Consensus Forecasts for average nominal GDP growth over the same horizon. Estimates of the term premium embedded in ten-year government bond yields suggest that an important factor in keeping long-term bond yields in the euro area rather low was a significant decline in the compensation that investors require for holding longer maturity bonds.[4] As explained in previous editions of the FSR, several demand-related factors appear to have kept the premiums embedded in long-term bond yields low, such as institutional and foreign investors' demand for euro-denominated bonds. Moreover, the very low levels of term premiums embedded in euro area government bond yields might perhaps also be a reflection of ample liquidity in financial markets, which appears to be leading investors to demand little compensation for the uncertainty that liquidity may not be available when they wish to unwind positions (see Box 9).

Looking forward, at the end of April 2007 the option-implied skewness coefficient for German ten-year bond yields no longer signalled a greater likelihood of a large future rise rather than of a major decline in long-term bond yields (see Chart S74). Pricing relative to the

2 Following the publication of yield statistics, the market was accepted from 2 April 2007.
3 These standards are described in Euribor ACI and Euribor – Fédération Bancaire Européenne (Euribor FBE) (2006), "Market Convention on Short-term European Paper (STEP)", June.
4 For more details, see Box 3 in ECB (2006), *Monthly Bulletin*, December, and Box 3 in ECB (2007), *Monthly Bulletin*, April.

macroeconomic fundamentals would tend to suggest that the risk of an independent unexpected and significant rise in euro area bond yields is lower in the euro area bond markets than in the US. Nevertheless, given the globalisation of the asset allocation process and high levels of correlation between bond markets, especially during episodes of stress, an abrupt rise in US long-term bond yields would most likely also affect euro area bond yields as well.

Box 9

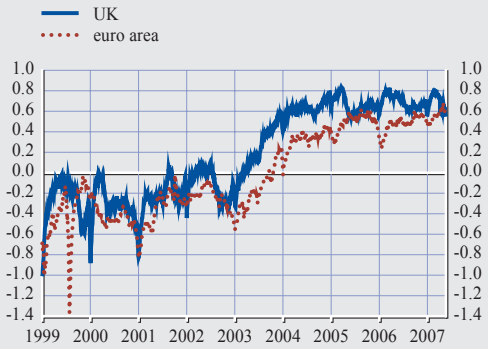
UNDERSTANDING FINANCIAL MARKET LIQUIDITY

Market intelligence indicates that financial market participants have rarely seen liquidity in global financial market as abundant as since 2003 and that an almost insatiable appetite has existed among investors for some time for privately issued assets, especially risky credit products. The term "liquidity" is, however, frequently used loosely and it is often difficult to disentangle precisely what concept is meant in this respect. It is useful to recall that economic theory offers at least two different concepts of liquidity.[1] One of them can be called monetary liquidity and it pertains to the quantity of liquid assets in the economy, which is in turn related to the level of interest rates. A second concept is market liquidity, which is generally seen as a measure of the ability of market participants to undertake securities transactions without triggering large changes in their prices. These two concepts are quite distinct from one another and although there can be relationships between them they are rather complex and by no means direct. From a financial stability perspective, it is important to identify the sources of financial market liquidity because if there are risks associated with the durability of the factors driving it, this could leave asset prices vulnerable to abrupt changes in market liquidity. Focusing on the second concept, this box introduces an indicator designed to gauge patterns in euro area market liquidity, it assesses some of the explanations commonly offered for perceptions of abundant market liquidity and it draws some financial stability conclusions.

Seen as a measure of the ability of market participants to undertake securities transactions without triggering large changes in their prices, symptoms of abundant market liquidity have been plentiful across a host of global financial markets for some time. Since mid-2003 bid-ask spreads have fallen and transactions volumes have surged. A composite metric designed to capture key elements of patterns in financial market liquidity can be constructed by combining such information across several markets – covering foreign exchange, equity, fixed income and credit – across three separate dimensions of market liquidity including tightness, depth and resiliency as well as estimates of liquidity premiums.[2] Tightness, that is the magnitude of risk premiums required by market-makers for holding inventories of securities, is usually gauged by the width of bid-ask spreads. Depth and resiliency, that is the degree to which trading impacts on asset prices, can be gauged using ratios of price movements to transactions in the relevant markets. Finally, liquidity risk premiums, that is the compensation required by investors for the risk that attempts to exit positions could be challenged by uncertain market conditions in the future, can be measured using various spreads between securities which are known to have varying degrees of liquidity. For euro area financial markets, a composite indicator constructed from several measures designed to capture these different aspects of

1 Several other concepts exist including, for instance, balance sheet liquidity – that is the amount of liquid assets on the balance sheets of non-financial institutions.
2 For further details on the construction of this indicator see Bank of England (2007), *Financial Stability Report,* April 2007.

Chart B9.1 Financial market liquidity indicator for the euro area and the UK



Sources: ECB, Bank of England, Bloomberg, JP Morgan Chase & Co., Moody's KMV and ECB calculations.
Note: The composite indicators are unweighted averages of individual liquidity measures, normalised on the period 1999-2004 (UK) and 1999-2006 (euro area). The data shown are exponentially smoothed.

market liquidity suggests that after mid-2003 there was a sharp and lasting rise in financial market liquidity (see Chart B9.1).[3] Notably, patterns in the composite indicator for the euro area have been very similar to the patterns seen in a similar indicator constructed for the UK financial markets especially from mid-2003 onwards. This would tend to suggest that reports of abundant market liquidity have been referring to a global rather than a local phenomenon.

As to the sources of greater financial market liquidity and risk-taking activity, several, not necessarily mutually exclusive hypotheses, have been put forward. Some of them have centred on monetary liquidity. In this vein, although there has been some moderation over the past few years in the rates of growth of measures of global monetary liquidity, it has been suggested that more rapid growth in monetary aggregates than nominal economic growth for some time may have bid asset prices upwards, a view supported by research undertaken at the ECB.[4] According to this viewpoint, monetary liquidity at the global level may be important,[5] as some of this excess monetary liquidity has also seeped across borders via carry trades, whereby money is borrowed in one (low interest rate) currency and invested in another. In addition, international capital flows have increased substantially on account of wide global financial imbalances. Excess savings relative to investment in some emerging market and oil-exporting economies has led to the accumulation of very large reserves of foreign currency-denominated assets. A large part of these reserves has been deployed to purchase substantial amounts of assets in mature economy financial markets.[6] While the relationship between monetary liquidity and financial market liquidity is complex and by no means direct, reserve accumulation by Asian central banks and oil producing countries has undoubtedly raised the number of, and the degree of diversity among, participants in mature economy financial markets.

Another view sees higher market liquidity as being closely linked with greater investor confidence and, as such, an appropriate response to lower macroeconomic volatility, with more stable GDP and low inflation reducing investor uncertainty, boosting confidence and

3 The financial market liquidity indicator combines eight individual liquidity measures. Three of them cover bid-ask spreads: (1) on the EUR/USD, EUR/JPY and EUR/GBP exchange rates; (2) on the 50 individual stocks which form the Dow Jones EURO STOXX 50 index and; (3) on EONIA one month and 3 month swap rates. Three others are return-to-turnover ratios calculated for: (4) the 50 individual stocks which make up the Dow Jones EURO STOXX 50 index; (5) euro bond markets and; (6) the equity options market. The last two components which measure the liquidity premium are gauged by: (7) spreads on euro area high-yield corporate bonds which are adjusted to take account of the credit risk implied in these spreads by expected default frequencies (EDFs) and; (8) euro area spreads between interbank deposit and repo interest rates. The composite indicator is a simple average of all the liquidity measures normalised on the period 1999-2006. Principal component analysis reveals that about half of the variance of these individual indicators can be accounted for by movements in the first principal component. In other words, there appears to be an important common factor, most likely the degree of financial market liquidity, driving movements in these series.

4 A structural interpretation of the association between asset prices and monetary aggregates is given in L. Christiano, C. Ilut, R. Motto and M. Rostagno (2007), "Monetary Policy and Stock Market Boom Bust Cycles", paper presented at the ECB Conference on "Money in the 21st Century", November 2006.

5 For a discussion of global liquidity, see R. Rüffer and L. Stracca (2006) "What is global liquidity and does it matter?", *ECB Working Paper,* No 696.

6 See B. S. Bernanke (2005), "The Global Saving Glut and the U.S. Current Account Deficit", Homer Jones Lecture, April.

attracting a greater number of buyers and sellers willing to trade in the markets. Consistent with this viewpoint, indicators of investors' risk preferences have pointed to much greater risk appetite in recent years.[7] This may reflect perceptions that greater macroeconomic stability will prove persistent which, if correct, should support higher asset valuations.

A key factor for financial market liquidity has been the remarkable structural changes which have been taking place in financial markets. These have included the liberalisation of international capital flows, the securitisation of loans and the development of new financial products (e.g. credit derivatives). At the same time, the emergence and growing presence of highly active participants, such as investment funds and hedge funds in particular, in financial markets has probably significantly enhanced market liquidity. This is because these developments have increased the number and diversity of market participants in financial markets and, generally speaking, the greater the degree of heterogeneity of investors in a market, the higher the number of buyers and sellers willing to trade under different market conditions will be. At the same time, there can be feedbacks as an increasing number of buyers and sellers who are willing to trade regardless of the direction of markets may explain why the number and frequency of financial market transactions has been increasing.

All in all, there are several indications that financial market liquidity has been abundant for some time. From a financial stability perspective, there have been positive dimensions to this: large global banks have seen a swelling of trading revenues, fees and commissions and new investment products, mostly credit derivatives, together with the entrance of new, less risk-averse, market players have significantly enhanced the possibilities for risk redistribution within the financial system. In financial markets, a larger number of highly active market participants seems to have had a stabilising influence on market dynamics as the probability of finding participants in such markets with opposing views is higher (i.e. there is a better distribution of opinions about market perspectives). In this vein, reactions to events which, in the past, could have triggered broader and more disorderly asset price adjustments have been relatively calm. The effects of several recent financial market shocks – including the credit market turbulence of May 2005, large declines in mature equity markets in May and June 2006, the failure of Amaranth Advisers and a coup in Thailand in September 2006, plus the turmoil of late February and early-March 2007 – all proved remarkably contained, short-lived and self-correcting. However, there are uncertainties and potential risks because the durability of financial market liquidity has not been tested by a large and unexpected disturbance at a less favourable stage of the credit cycle, especially in an environment of retrenching investor risk appetite. If history is any guide, when investor confidence is shaken, demand for the most liquid assets rises while attempts, often simultaneous, to adjust portfolio compositions results in the values of risky assets falling. This is mainly because investors begin to doubt that they will have the ability to execute transactions involving risky assets easily without suffering large losses. The probability of such a scenario materialising largely depends on financial market liquidity proving durable under different circumstances. In this vein, there are uncertainties about the extent to which the recent improvement in financial market liquidity will prove to be lasting. For instance, if buoyant market liquidity ultimately proves to be have been largely due to greater risk appetite, then it could suddenly and unexpectedly fade away if risk appetite was to diminish abruptly.

7 See the Special Feature in this issue of the Financial Stability Review entitled "Measuring investors' risk appetite".

CREDIT MARKETS

In the six months after the December 2006 FSR was finalised, the credit market environment remained relatively benign. Notwithstanding a temporary rise during the global sell-off of financial assets between late February and early March 2007, lower-rated corporate bond spreads in the euro area decreased further compared with early November 2006 (see Charts S81 and S82). Similar to other mature economy credit markets, the persistent tightness of corporate bond spreads in the euro area seems to reflect, in large part, the fact that investors require little compensation for liquidity risk.[5] Nevertheless, the fundamentals have also been supportive as corporations continued to generate strong cash flows in the first quarter of 2007 (see Chart 3.4). At the same time, low – albeit slightly rising – default rates on speculative-grade bonds and very low expected default frequencies have been a positive factor (see Charts S53 and S55). There are, however, some concerns that both low actual and expected default rates are a further reflection of the abundance of market liquidity, in that the emergence of new players in credit markets with greater risk tolerances may have created more receptive conditions for less creditworthy firms to refinance and restructure their debts.

In the European CDS market as well, premiums for protection against credit risk rose during the temporary global sell-off of risky assets between late February and early March 2007, but then fell back to lower levels than in early November 2006 (see Chart S83). CDS term spreads for the iTraxx Europe and HiVol indices only rose slightly compared with early November 2006 (see Chart 3.5). However, the range of variation across business sectors over the six months since the finalisation of the December 2006 has been relatively high (see Chart S85).

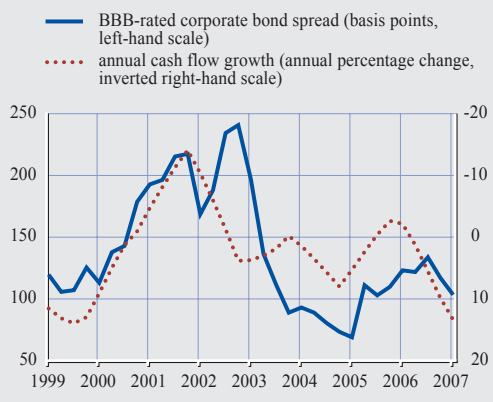
The euro-denominated credit derivatives market – including the structured products segment – continued to grow rapidly in 2006 (see Chart 3.6). Issuance of synthetic CDOs and cash CDOs rose by 63% and 371% respectively. The interest of investors in more complex credit products, such as constant proportion portfolio insurance[6] (CPPI) and constant proportion debt obligations (CPDOs, see Box 10), has also

5 See also Bank of England (2007), *Financial Stability Report*, April.

6 A CPPI is a security using a constant proportion rule to ensure the capital recovery at a specific maturity. The capital is allocated dynamically between a risky asset (CDS or CDO for a credit CPPI) and a risk-free asset. Leverage increases when the value of the risky asset rises, and decreases when the risky asset registers a mark-to-market loss.

Chart 3.4 BBB-rated corporate bond spreads and cash flow of listed euro area companies

(Q1 1999 - Q1 2007)



Sources: Bloomberg, Thomson Financial Datastream and ECB calculations.

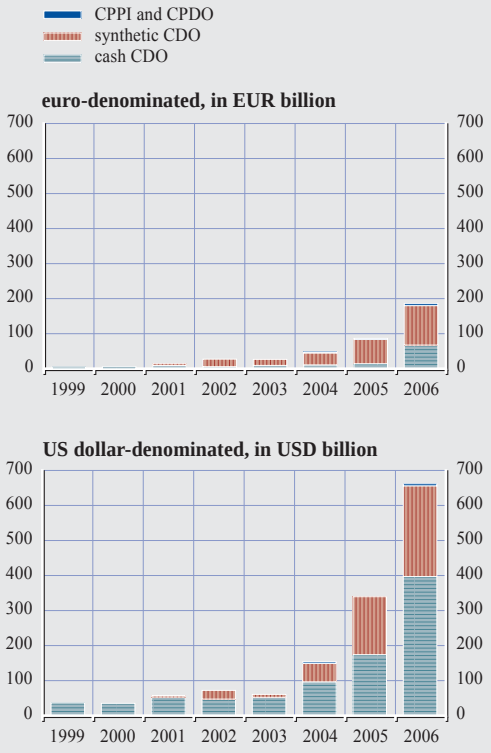
Chart 3.5 Term spreads for iTraxx Europe and HiVol

(Mar. 2006 - May 2007, basis points)

Sources: Bloomberg and ECB calculations.

Chart 3.6 Issuance of structured credit products

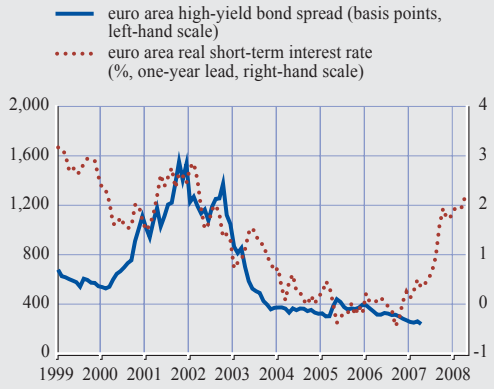
(1999 - 2006)



Source: Creditflux.

Chart 3.7 High-yield corporate bond spread and the real short-term interest rate

(Jan. 1999 - Apr. 2008)



Sources: Bloomberg, Merrill Lynch and ECB calculations.
Note: The high-yield spread is the spread between high-yield bond yields and the euro area AAA government bond yield. The real short-term interest is calculated as the three-month money market rate minus annual HICP inflation.

increased. Nevertheless, euro-denominated structured credit markets still remain significantly smaller than in the US.

Structured credit products cater for a wide diversity of credit risk appetites across different players in financial markets. For instance, banks typically buy the tranches with the best credit ratings, while hedge funds or "alternative asset" buyers often prefer the higher-yielding equity tranches. From a financial stability perspective, investors need to have a good understanding of the mechanics of these products in order to price them correctly and to assess the underlying risks more precisely.

Looking ahead, as rising short-term real interest rates are often followed by widening credit spreads (see Chart 3.7), the possibility of an abrupt adjustment in the credit markets cannot be excluded, especially if the credit cycle were to turn.

In this vein, partly because of increased focus via corporate governance on rising shareholder value – as suggested by high dividends, share buybacks,

Box 10

CONSTANT PROPORTION DEBT OBLIGATIONS

A feature of credit derivatives markets over recent years has been constant product innovation. Several recent products have evolved out of a risk management technique pioneered in the 1960s known as CPPI, a strategy designed to leverage investments while providing a measure of downside protection. CPDOs represent one of the most recent additions in this regard, and

were introduced for the first time in summer 2006. A CPDO is a fully funded credit structure that combines high leverage in the CDS market with a mechanism to place a part of an excess yield in a reserve in order to secure future payments and absorb losses. This Box describes the basics of the CPDO structure, as well as the possible impacts on credit markets and the risks associated with the structure.

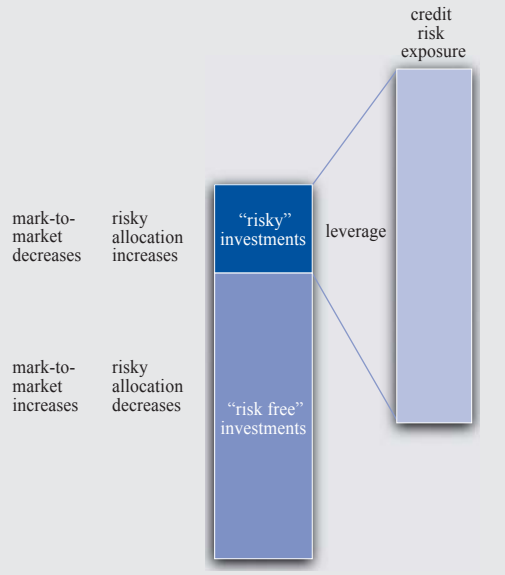
The credit exposures of the recently launched CPDOs have been achieved by selling protection on both the iTraxx and CDX main indices (usually 50% each). Because the main aim of a CPDO is to earn sufficient profit to meet the promised coupon and principal payments, the size of the portfolio is adjusted dynamically so that the CPDO only uses the leverage that it needs in order to make the scheduled principal and interest payments. Initial investments are made with high leverage in order to pay the coupon, but also to feed into a reserve towards future coupon payments and to absorb any losses resulting from a default in the indices. The degree of leverage changes depending on the market situation and the structure's performance:[1] when credit spreads widen and the CPDO records a decline in its value (mark-to-market loss) the leverage increases so that the structure can make up for the shortfall through its remaining life; in favourable market conditions when credit spreads tighten, the CPDO increases in value (mark-to-market gain) and, because the probability of paying the coupons increases, the leverage decreases to lower the exposure to risky assets (see Figure B10.1). One of the consequences of this strategy is that CPDOs buy credit protection cheap when spreads are low, and sell credit protection dear when spreads are high, thus adding to the profit potential of the structure. The fact that the CPDO rolls into the current index each time a new series is launched works in a similar way, because due to the roll-down effect the new series indices are usually priced higher than the older series. It also diminishes the default likelihood, as the new series contains only the most liquid names which, in case their credit quality deteriorates, would be dropped from the index at the next roll-over date. The recent CPDO rolls, however, do not offer the same advantageous pricing as previously, possibly reflecting the fact that other market participants took advantage of the known roll-over activity. If the CPDO market value reaches a level sufficient to cover the entire remaining coupon and principal payments before its maturity (usually ten years), a cash-in event is triggered. In such a case the structure unwinds all of its credit exposure and keeps its investments in low risk assets to protect the realised gains. The opposite scenario, a cash-out, is triggered when the market value falls below a certain threshold (usually 5-10% of the notional) and the CPDO has realistically no chance of recovering its losses before maturity. The credit exposure is also liquidated and the proceeds are invested in risk-free assets to preserve the remaining value. However, the investors are faced with a loss of principal as the CPDO would be unable to repay its face value in full at maturity.[2]

CPDOs offer investors a very attractive coupon rate (the first issues offered a coupon of LIBOR plus 200 basis points). At the same time, both its coupons and its principal are assigned a very high rating (usually AAA) by some rating agencies.[3] The unusually high coupon rate for such

1 The leverage is usually capped to limit the total amount of risk of the strategy. The cap can be either static (commonly around 15 times) or dynamic (linked to the CPDO market value and current index spread levels).
2 Losses exceeding the initial investment have to be made up for by the CPDO issuer, and therefore the purpose of the cash-out is to protect the issuer from such a risk (also called "gap risk").
3 The high credit quality view is not shared unanimously by credit rating agencies. Moreover, depending on the methodology used by rating agencies, the same product could be assigned considerably different ratings, which might create uncertainty for investors regarding the risk-return profile. See, for example, Fitch Ratings (2007): "First Generation CPDO: Case Study on Performance and Ratings", April. In this study, it is argued that the first generation CPDOs' sensitivity to even minor changes in the main parameters (e.g. spreads, number of defaults in reference entities, etc.) does not justify their high ratings; only the next generation products, some of which were issued back in April 2007, which allow for more active managing of the leverage (including a wider index universe, less strict index roll-over rules and individual name CDS), may deserve the highest credit marks.

highly rated instruments attracted considerable interest and, owing to their popularity among investors, similar structures were later offered with still high but significantly lower spreads of around 120 to 150 basis points over LIBOR. The narrowing of the coupon spreads on consequent transactions can be related both to the popularity of CPDOs, but also to the fact that the iTraxx and CDX index spreads narrowed significantly during the latter half of 2006, and were unable to offer such attractive conditions while at the same time seeking to maintain the high ratings. Market participants have stated that at least part of the reason for this tightening may have been expectations of further CPDO issuance. CPDOs gain exposure in the credit markets by selling protection on CDS indices. Due to their leverage (typically close to 15 times at inception), the amount of protection sold can be quite significant, and even though the main CDS indices are known to be rather liquid, selling protection for CPDOs as well as expectations of incoming CPDO supply should have left some impact on the market.

Figure B10.1 CPDO portfolio allocation

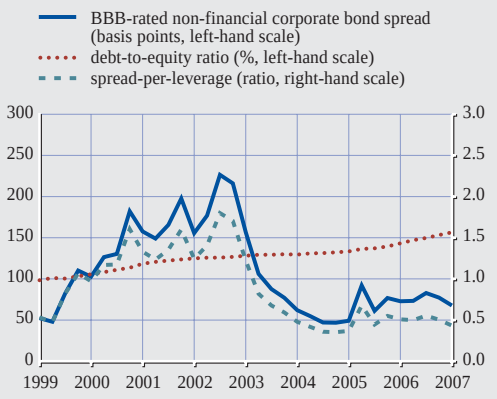


Concerning the risks associated with CPDOs, as with all credit products, there are two types of risk: the risk of default of one or more issuers forming the portfolio, and the risk of the product being marked-to-market, which is directly linked to the issuers' spreads. In the case of CPDOs, the risk of default is relatively low. On the other hand, there is a high risk of mark-to-market: the leverage on the indices is such that a significant upturn in spreads would lead to a substantial loss for the portfolio. In this vein, a key difference between a CPPI strategy and a CPDO is that the former reduces the leverage of the strategy when it is losing money, whereas CPDOs do the opposite by increasing leverage when it is losing. As long as spreads have mean-reverting properties, the CPDO strategy is clearly very appealing as it involves leveraging up when the market moves against the structure, and then waiting for spreads to revert to more normal levels. Moreover, CPDOs could even have a stabilising effect on credit spreads during normal times. However, there are concerns that a significant deterioration in the credit cycle could give rise to a significant and lasting widening of credit spreads so that investors would face substantial losses, given that the extent of leverage in the structures will be at its maximum at exactly the time when the market turns.

leveraged buyouts and acquisitions – corporate sector leverage in the euro area continues to be high and still rising (see Section 2). However, investors in corporate bonds do not appear to have been sufficiently compensated for the increasing risk (see Chart 3.8). In addition, debt has been increasingly denominated at floating rates, and profit growth is expected to lose momentum. All of this could impair the creditworthiness of corporations in the euro area in the future.

Chart 3.8 BBB-rated non-financial corporate bond spread, corporate leverage and spread-per-leverage

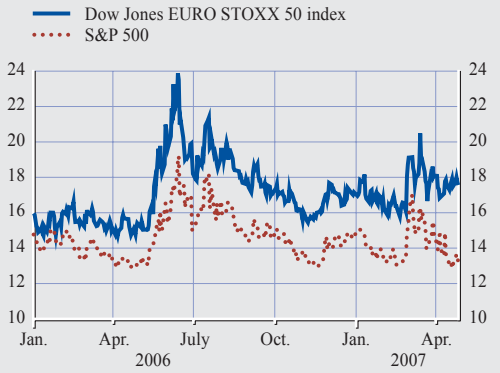
(Q1 1999 - Q1 2007)



Sources: ECB, Merrill Lynch and ECB calculations.
Note: Spread-per-leverage is the ratio between the BBB-rated non-financial corporate bond spread and the debt-to-equity ratio adjusted for equity valuation changes.

Chart 3.9 Six-month variance swap prices for euro area and US equity indices

(Jan. 2006 - Apr. 2007, %)



Source: JP Morgan Chase & Co.

For the credit derivatives markets there are not only concerns about the adequacy of pricing of risk, but also about the concentration of risk, the ways in which risk has been distributed among banks and non-banks, the adequacy of credit risk management systems, and the risk of settlement backlogs. It also remains to be seen how the credit derivatives markets will deal with market stress, such as a large credit event. Even with sound credit risk management, a sudden and sharp widening of credit spreads could result in unanticipated losses for investors in credit derivatives, especially in the more complicated credit products with embedded leverage. Those investors could include some leveraged hedge funds. In such a scenario, the suspension of market-making activities by several major derivatives dealers and hedge funds cannot be excluded, thereby posing additional risks of broad-based liquidity erosion across the market.

EQUITY MARKETS

Euro area stock prices increased further after the finalisation of the December 2006 FSR (see Chart S75). A short-lived global sell-off of risky assets between late February and early March 2007 resulted in a bout of stock market volatility during this period, as indicated for example by the prices of variance swaps in the major equity indices (see Chart 3.9). Unlike many other more conventional volatility indicators, variance swaps are actually traded and therefore clearly express the volatility views of investors (see Box 11).

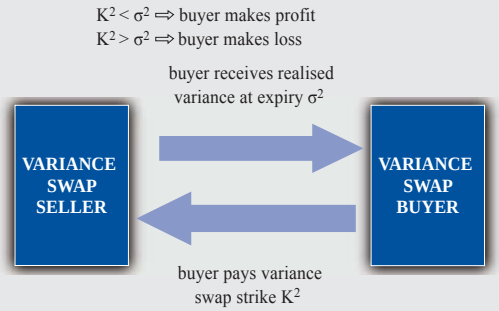
Box 11

VARIANCE SWAPS

In a financial market context, volatility is a measure of the extent of asset price fluctuations. It is a necessary input for various models used for pricing options and other financial instruments, and can be measured in many different ways. While so-called realised volatility measures the extent of past price variation, the volatility implied in options prices is used to gauge the market view of expected future price fluctuations. As the structures of financial instruments have

Figure B11.1 Variance swap cash flows

(variance swap strike = K^2; realised volatility = σ)



become increasingly complex, market participants need instruments which allow them to trade volatility in order to hedge structured transactions or to take purely directional views on volatility. While "plain vanilla" options contracts on underlying assets provide exposure to the volatility of the underlying asset, they are impure for hedging or taking positions on volatility because they simultaneously provide exposure to the direction of the underlying asset. Although hedging options according to the Black-Scholes prescription can remove the exposure to the underlying asset, so-called delta hedging is at best inaccurate because many of the Black-Scholes assumptions are violated in practice. For instance, volatility cannot be accurately estimated, financial assets cannot be traded continuously, transaction costs cannot be ignored, markets sometimes move discontinuously, and liquidity is often a problem.

One response to such needs and challenges is the variance swap.[1] This instrument has gained a (perhaps unwarranted) reputation of exposing its investors to large risks with the potential to cause sizeable losses and exacerbate sharp market moves. However, while such risks cannot be excluded or underestimated, the appropriate use of variance swaps, like many other financial derivatives, can be of great benefit to sophisticated investors and market-makers. This Box describes the basic features of this instrument and outlines its possible uses for different types of market participant.

A variance swap is a forward contract on the difference between the variance delivery price, fixed at the inception of the contract, and the realised variance over the period of the swap.[2] Its structure is very similar to other swap contracts, whereby the counterparties to the trade agree at the time of entering into the contract on the fixed variance level for the contract period (usually the prevailing market implied variance, so that the swap's market value at inception is zero). At maturity, the realised variance over the period is determined, and the difference, multiplied by the contract notional, is settled in cash. The variance swap buyer, holding a long position in variance (volatility), receives the payment from the variance swap seller (i.e. makes a profit) if the realised variance over the period is higher than the implied variance at the inception. If the realised variance over the period is lower than the implied variance at inception, the variance swap buyer must make the payment to the seller (who holds a short position in variance/volatility) and thus realises a loss.[3] The variance swap payout profile is asymmetrical, as the long position gains more when volatility is rising than it loses when volatility declines by the same amount. In other words, the variance swap is convex with respect to volatility. Because realised volatility cannot be less than zero, a long variance swap position has a known maximum loss.[4] The maximum loss on a short variance

1 See K. Demeterfi, E. Derman, M. Kamal and J. Zou (1999), "More Than You Ever Wanted to Know about Volatility Swaps (But Less Than Can Be Said)", Goldman Sachs, *Quantitative Research Strategies Notes,* March.
2 Variance is a square of volatility. While volatility swaps are also quoted and traded, it is less onerous to replicate and hedge variance in practice. This is why the market for variance swaps has developed to a greater extent than volatility swaps.
3 Realised volatility is systematically lower than implied volatility. This is due to the fact that implied volatility levels include a risk premium for tail events when there are unexpectedly large volatility spikes.
4 This turns out to be ½ times the strike price times the vega notional, where the vega is a coefficient measuring the sensitivity of an option value to a change in volatility.

swap is theoretically unlimited. However, because realised volatility can reach very high levels in case of market upheaval, potential losses are often limited by the inclusion of a cap on volatility.

Although variance swaps were first traded as early as the late 1990s, liquid markets for these instruments did not fully take off for some time because of a lack of a universally accepted pricing methodology. Only after robust pricing models had been introduced did the market develop properly.[5] Initially, variance swaps were offered on the most liquid equity indices, such as the S&P 500, the EURO STOXX 50, the DAX and the FTSE, and indices still remain the most common underlying assets in variance swaps. Variance swaps on individual stocks, especially the more liquid constituents of the popular equity indices, are also traded, and even though the market for equity indices as the underlying is the most advanced, there is no obstacle, at least in theory, to variance swaps being traded on other asset classes, including foreign exchange, commodities or interest rates.

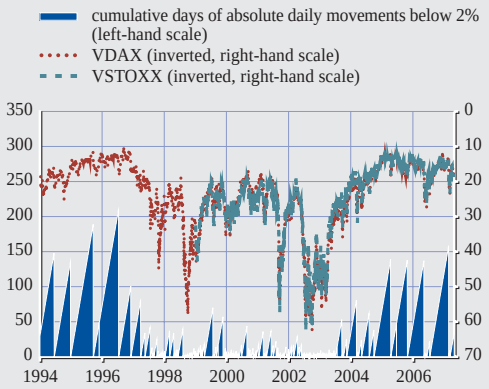
The variance swap market has grown steadily in recent years, with institutional investors increasingly using variance swaps for hedging purposes or for portfolio diversification. Numerous opportunities exist for variance swaps to be used in trading or hedging strategies, thus increasing the choices available to market participants to express their market views or to hedge their exposures. For example, life assurance companies now offer many products with guaranteed benefits (e.g. variable annuities, with-profit funds), and these expose them to short volatility positions that may be offset by using variance swaps. In addition, both outright directional volatility trades as well as spread trades exploiting relative value in volatilities across different assets or time periods are possible through the use of variance swaps. Because increases in volatility can persist for a period of time after a sharp (especially downward) movement in prices, equity investors can buy variance swaps to offset the risk of a fall in the value of their holdings if the market declines. Variance swaps can also be used for hedging purposes by market-makers wanting to dispose of their exposures from various client transactions.

Some concerns have been expressed about the potential that trading in variance swaps could amplify market volatility and perhaps even create adverse market dynamics. For instance, if a market-maker in the variance swaps market needs to hedge exposures arising from trading a variance swap with another market-maker or a client and therefore uses a large portfolio of options with dynamic delta hedging to replicate the variance swap's payout, this may result in different price dynamics compared to the "usual" delta hedging arising from a simple options trade. Because realised variance is determined on the basis of closing prices for each day of the contract period, variance swap market-makers who delta hedge their positions only need to hedge their exposure against the closing prices. If the underlying asset experiences a large daily move, this hedging action has the potential to amplify asset price changes still further, thus increasing volatility. On top of this, expectations of such hedging activities may prompt other market participants to take the same positions earlier during a trading session so that they too can benefit from price changes near the market close. This "feedback" effect has been frequently mentioned as one of the factors that amplified equity market volatility in May 2006.

5 These pricing models are based on the theory that a variance swap payout can be replicated using a large number of plain vanilla options at various strikes, complemented by dynamic delta hedging in the underlying asset. The number of options at each strike level is inversely correlated to the strike level, i.e. at low strike levels the portfolio holds a large number of options, and vice versa. In practice, only selected strike levels are used because of the low liquidity of deep out-of-the money options and high transaction costs.

Chart 3.10 Cumulative number of days with an absolute daily stock price movement below 2% and implied stock market volatility in the euro area

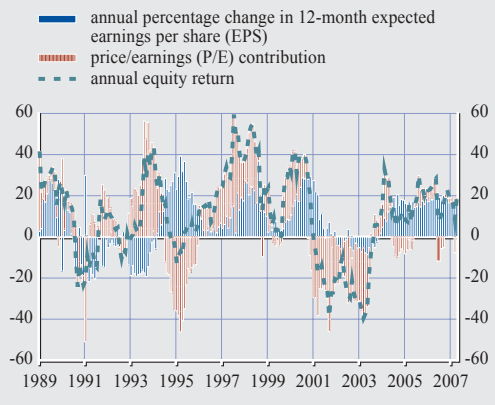
(Jan. 1994 - May 2007)



Sources: Thomson Financial Datastream and ECB calculations.
Note: The stock price index used is the Dow Jones EURO STOXX broad index.

Chart 3.11 Decomposition of annual stock market returns in the euro area

(Jan. 1989 - Mar. 2007, % change per annum)



Sources: Thomson Financial Datastream and ECB calculations.
Note: The stock price index used is the MSCI EMU.

The February-March 2007 period brought to an end a relatively long, but not unusual, period in which daily stock price movements remained below 2% (see Chart 3.10). Euro area equity investors became more risk averse as a result, and were prepared to pay more to protect themselves against sharp declines in stock prices (see Chart S77).

Notwithstanding the market turbulence in late February and early March, the continued strength of the euro area stock market after the finalisation of the December 2006 FSR can, to a large extent, be explained by relatively favourable profitability expectations (see Chart 3.11). Other factors that supported stock prices were the low levels of long-term interest rates and equity-friendly measures taken by firms, including share repurchases and M&As of listed companies. The surge in leverage buyout (LBO) activity might also have had a positive impact by creating expectations of further LBO deals.

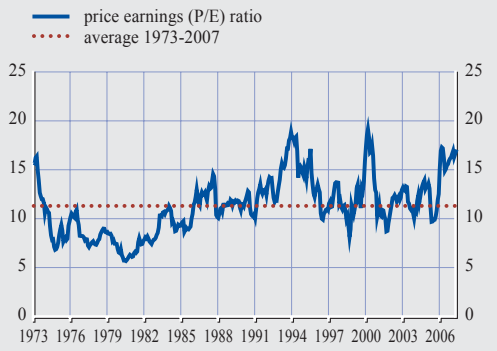
Taking a closer look at earnings, it is important to bear in mind that reported earnings may have been boosted in part by the adoption of new accounting standards in the euro area, the International Financial Reporting Standards (IFRS), through a shift in the focus from historical cost to fair-value accounting. In general, this shift is expected to make the profit figures disclosed by firms more volatile than in the past with higher reported earnings during economic "good times" and lower reported earnings in "bad times".

Looking at stock market valuation, some valuation metrics suggest that euro area stock prices have become expensive given the fundamentals if recently observed levels of corporate earnings are assessed as not being sustainable over the longer-term. The P/E ratio, based on ten-year trailing earnings, has remained historically rather high (see Chart S78). This ratio was also high for euro area non-financials in terms of 12-month trailing earnings, especially compared to its average level in the post-Bretton Woods era (see Chart 3.12). Nevertheless, the P/E ratios for other indices such as the Dow Jones EURO STOXX 50 do not show such explicit signs of overvaluation. In addition, the P/E ratio based on expected earnings rather than on reported earnings is somewhat closer to its historical mean.

Another indication of pricing vulnerability in the euro area equity market is that the P/E ratio

Chart 3.12 Price-earnings (P/E) ratio of non-financial corporations in the euro area

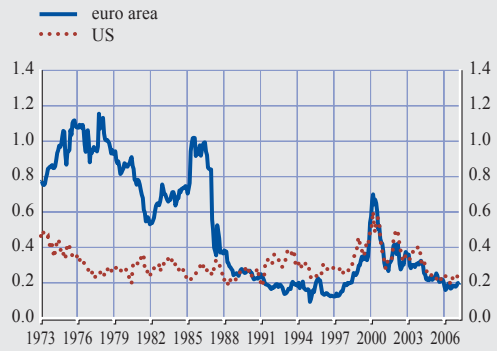
(Jan. 1973 - Apr. 2007)



Source: Thomson Financial Datastream.
Note: MSCI EMU P/E ratio based on reported earnings.

Chart 3.14 Dispersion of price-earnings (P/E) ratios across sectors in the euro area

(Jan. 1973 - Apr. 2007, standard deviation divided by the average)



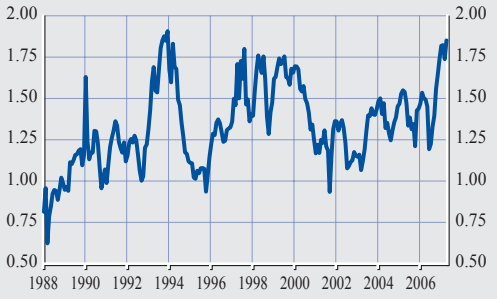
Sources: Thomson Financial Datastream and ECB calculations.
Note: P/E ratios are based on the reported earnings of ten economic sectors of the MSCI EMU index.

based on 12-month forward earnings relative to expected long-term (three to five-years ahead) earnings per share growth – also known as a P/E growth indicator – reached relatively high levels in early 2007, similar to those seen during the dot-com bubble around the turn of the century (see Chart 3.13).

Not only did valuations of euro area equities reach very high levels, but the degree of dispersion of valuations across sectors also became very narrow (see Chart 3.14). This pattern, which is also shared by US equity markets, has been seen by some observers as an indication of less discrimination among investors on the basis of fundamentals in an environment of increasing pressure on asset managers to generate yields in excess of those available from risk-free assets.

Chart 3.13 Price-earnings (P/E) growth ratio in the euro area

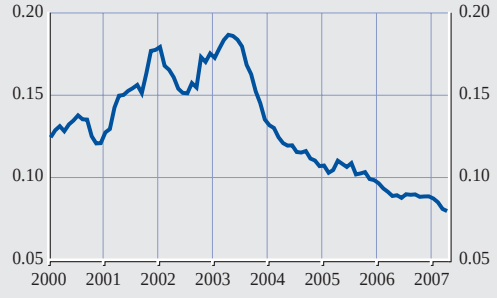
(Jan. 1988 - Apr. 2007)



Sources: Thomson Financial Datastream and ECB calculations.
Note: The price-earnings growth ratio is calculated as the ratio between the MSCI EMU price-earnings ratio based on expected 12-month ahead earnings and the expected long-term (three to five-year ahead) MSCI EMU earnings per share growth.

Chart 3.15 Dispersion of earnings per share (EPS) forecasts 12 months ahead in the euro area

(Jan. 2000 - Apr. 2007, standard deviation divided by average)



Source: Thomson Financial Datastream.
Note: The stock price index used is the Dow Jones EURO STOXX broad index.

While less investor discrimination on the basis of risk across different parts of the equity market might leave it comparatively sensitive to a sudden change in stock market sentiment, one possible explanation appears to be a pattern of convergence in expectations of future profit growth rates (see Chart 3.15).

High valuations in euro area stock markets may also partly explain the continued buoyancy of IPO and SPO activity in the euro area (see Chart S80). Nevertheless, equity issuance activity remained lower than in 2000 and early 2001.

Looking at the risks for equity markets, the perception of near-term risks, as reflected in implied stock market volatility, has increased somewhat over the past six months, but remains moderate, despite a short-lived but sharp rise between late February and early March 2007 (see Chart S76). Looking further ahead, the risk of a reappraisal of valuations in euro area equity markets appears to have slightly increased compared with the assessment presented in the December 2006 FSR. Several factors continued to point towards downside risks. Earnings growth in the euro area is expected to lose momentum, risk-free interest rates have risen. Moreover, in the first months of 2007, several stock market valuation indicators continued to suggest that the euro area stock market could be overvalued.

4 THE EURO AREA BANKING SECTOR

The financial conditions of euro area large and complex banking groups (LCBGs) continued developing favourably in the second half of 2006, with profitability underpinned by growth in several sources of income. Loan impairments remained at a low level, and cost-to-income ratios improved further. Although an increase in risk-weighted assets contributed to a slight decline in solvency ratios, the LCBGs' capital buffers remain comfortable relative to regulatory requirements. Looking forward, despite substantial improvements in risk management techniques – not least due to the ongoing implementation of the Basel II capital regime – intense competition in many lending markets could have contributed to some slippage in banks' credit standards. Against this background, some pockets of vulnerability may have developed in both household and corporate sector loan books. Regarding market risk, the persistently flat yield curve in the euro area continues to pose a challenge for generating interest income. As euro area LCBGs are becoming increasingly reliant on risk transfer techniques in many of their business lines, they need to place strong emphasis on sound counterparty risk management. All in all, although there are risks, forward-looking indicators derived from banks' securities prices suggest that the sector will continue to perform strongly for the foreseeable future.

4.1 FINANCIAL CONDITIONS OF LARGE AND COMPLEX BANKING GROUPS[1]

The full-year financial results of euro area large and complex banking groups (LCBGs) for 2006 published after the finalisation of the December 2006 FSR indicated that profitability remained high and that the financial condition of the euro area banking system is likely to remain solid in the period ahead. This strong performance in 2006 was underpinned by growth in several sources of income. Although the interest income of most institutions either remained flat or only slightly increased, this was compensated for by higher fees and commissions as well as trading and other income. Loan impairment charges increased slightly, although it is too early to tell whether this signals the beginning of a return to historically more normal levels. As growth in operating costs remained slower than growth in operating income this pushed down the cost-to-income ratios of these institutions further.

As noted in previous editions of the FSR, the continued strength of LCBG profitability also facilitated the internal generation of capital. For 2006 as a whole this was, nevertheless, outweighed by an increase in risk-weighted assets, which contributed to a slight decline in solvency ratios. This notwithstanding, capital buffers continue to provide a comfortable level of shock absorption capacity.

PROFITABILITY ROSE FURTHER

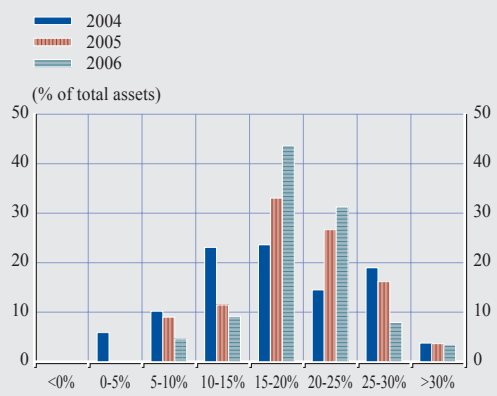
Building upon the strong financial performance recorded in 2005, most LCBGs continued to post growth in profitability for the full financial year of 2006 which was broad-based across institutions albeit slower than in previous years. The slower growth reflected the already high weighted average return on equity (ROE) which increased slightly from just below 19.2% in 2005 to about 19.6% in 2006 (see Chart 4.1 and Table S5). The median ROE increased from just under 18% in 2005 to just above 19% in 2006. Importantly, the frequency distribution across institutions became somewhat more compressed with institutions in the lower quartile of the distribution managing to increase their profitability slightly from 9.0% in 2005 to about 9.4% in 2006.

The weighted return on risk-weighted assets (RWAs), another measure of profitability which takes account of the risks borne by banks, increased to just over 1.5% for 2006, up

1 The group of LCBGs used in this analysis is selected according to a methodology which is described in ECB (2006), "Identifying large and complex banking groups for financial system stability assessment", *Financial Stability Review*, December. This group of financial institutions accounts for a significant portion of the domestic banking systems in the euro area and exemplify many of the patterns observed in the euro area banking system as a whole. However, as this group is a sample, it cannot be ruled out individual patterns in national banking systems of the euro area may sometimes diverge from those of LCBGs.

Chart 4.1 Frequency distribution of return on equity (ROE) for large and complex banking groups in the euro area

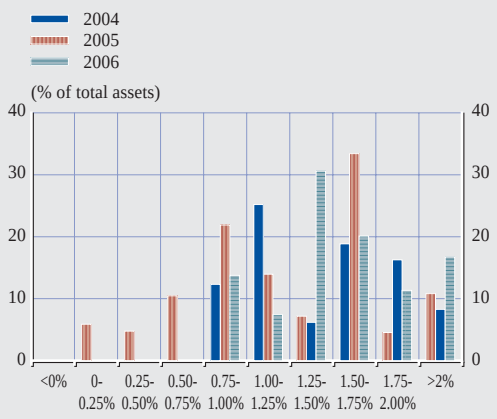
(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting LCBGs in the euro area.

Chart 4.2 Frequency distribution of return on risk-weighted assets for large and complex banking groups in the euro area

(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting LCBGs in the euro area.

from around 1.4% in 2005 (see Chart 4.2 and Table S5).[2] This was for the most part explained by a more rapid rise of full-year net income than of risk-weighted assets. RWAs expanded due to organic growth in loan books as well as in other exposures.

OPERATING INCOME CONTINUED TO GROW

Behind the strengthening of net operating income were two diverging developments regarding interest income. On one hand, there was continued volume growth in lending to the private sector in home markets (i.e., the banks' domestic market) to compensate for lower interest rate margins. Banks also continued to earn higher margins on lending in new markets in eastern Europe, Asia and Latin America.

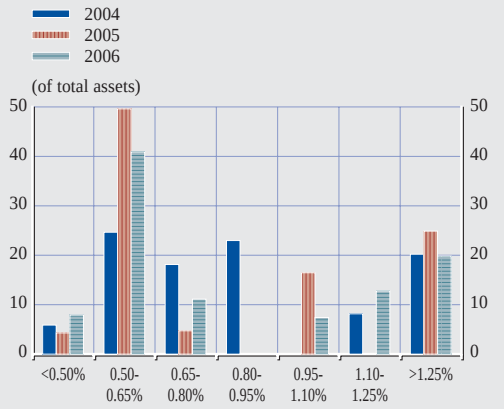
On the other hand, mainly in home markets, there was continued margin compression. This was partly driven by the flattening of the market yield curve as a result of rising short-term interest rates and relatively stable long-term interest rates. In addition, and as noted in previous editions of the FSR, the strength of loan demand observed in 2005 and 2006 had outpaced deposit inflows, forcing banks to resort to wholesale markets to fund some of their new lending. Because the loan-to-deposit ratio increased, this was a further factor explaining the compression of banks' margins. Increased competition in some retail and wholesale market segments also weighed on margins. As a result, net interest income as a percentage of total assets declined slightly from 0.89% in 2005 to 0.88% in 2006 (see Chart 4.3 and Table S5). This weighted average figure masks the fact that some banks managed to increase margins slightly in 2006 compared to 2005. The unweighted average of net interest income as a percentage of total assets increased slightly from 0.95% in 2005 to 0.96% in 2006 (see Chart 4.3 and Table S5).

Overall, net operating income continued to grow over the period as shown by increases in ROE and RORWA (see Table S5). In terms of the share of net operating income, net interest

2 RWAs are used to calculate regulatory (i.e. BIS-based) capital requirement ratios based upon on and off-balance sheet positions. They are computed by assigning each of the banks' assets and off-balance sheet items to several broad risk categories, each of which has different weights that increase with the level of risk, enabling the denominator for the capital requirement ratios to be calculated. The numerator is either the euro amount of Tier 1 capital or of total capital.

Chart 4.3 Frequency distribution of net interest income for large and complex banking groups in the euro area

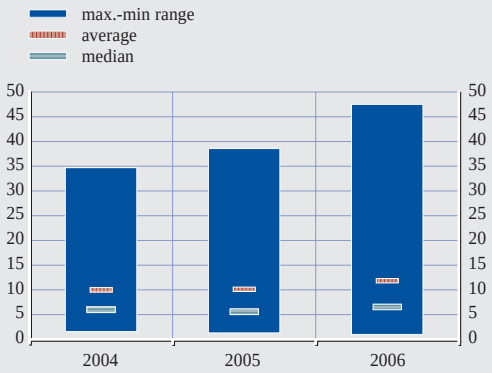
(2004 - 2006, % of total assets)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting LCBGs in the euro area.

Chart 4.4 Distribution of trading income as a percentage of Tier 1 capital for large and complex banking groups in the euro area

(2004 - 2006, % of Tier 1 capital)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting LCBGs in the euro area.

income, which declined by around 1% year-on-year on average, still remained the single-most important source of net operating income for euro area LCBGs in 2006, representing just under 45% of total operating income for the year (see Table S5).

The relatively slow pace of revenue growth from interest income was, for the most part, compensated for by growth in fee and commission income as a proportion of net operating income. Increasing by about 3% year-on-year in 2006 on average, it remained the most important source of non-interest income for LCBGs with a share in net operating income of almost 29% in 2006, up from just under 28% in 2005. There was variation among individual institutions in the composition of fee and commission income, but it generally comprised of retail banking fees for transactions as well as fees from banks' asset management and corporate finance activities.

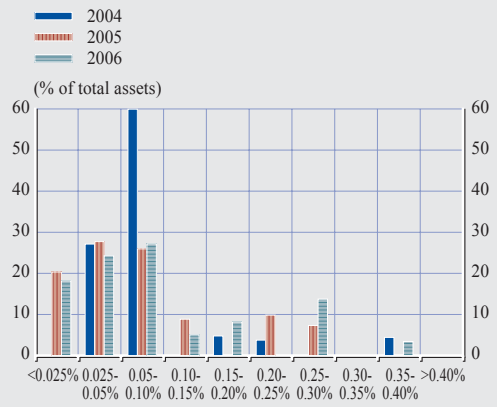
As a proportion of net operating income, banks' trading income increased its share significantly in 2006, by around 25% year-on-year on average, to reach just under 18% of total operating income for the full year of 2006, up from a share of about 14% in 2005 (see Table S5). However, this average figure disguises the fact that for some LCBGs with sizeable capital market operations, the maximum share of trading income accounted for nearly 50% of net operating income in 2006. Put differently, when expressed as a percentage of Tier 1 capital, average trading income increased from about 10% in 2004 and 2005 to over 12% in 2006. Most notably, some institutions increased their reliance on trading income so that at a maximum it amounted to over 45% of their Tier 1 capital in 2006 up from a maximum of over 35% in 2005 (see Chart 4.4).

CREDIT COSTS INCREASED BUT OPERATING COSTS REMAIN CONTAINED

As noted in the December 2006 FSR, for the first half of 2006 euro area LCBGs' net loan impairment charges remained extremely low by historical standards. However, the full-year results for 2006 showed a small upward movement in credit costs. On a full-year basis, the weighted average of loan impairment charges increased slightly from 0.08% of total assets in 2005 to almost 0.11% in 2006. After several years of decline, this was the first increase although it is too early to tell whether it represents a possible turning point for a return to historically more normal levels. The underlying reasons for the increase were slightly higher impairment charges on retail lending in

Chart 4.5 Frequency distribution of net loan impairment charges for large and complex banking groups in the euro area

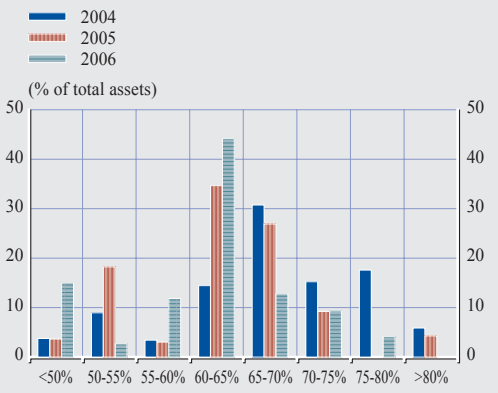
(2004 - 2006, % of total assets)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting LCBGs in the euro area.

Chart 4.6 Frequency distribution of cost-to-income ratios for large and complex banking groups in the euro area

(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting LCBGs in the euro area.

both home and overseas markets, such as eastern Europe, South America and Asia. For some institutions, a decline in the amounts of loan write-backs – that is previously impaired loans which have since recovered – contributed to an increase in the net figure, reflecting a lower degree of work-outs of loans that had been previously classified as impaired.[3]

Despite this slight increase in the weighted average of impairment charges, the levels reported by most institutions still remained low, as illustrated by a concentration towards the left-hand side of the frequency distribution of net loan impairment charges (see Chart 4.5). However, most euro area LCBGs are in a comfortable position to absorb this gradual increase, especially as the current level of impairments remained very low compared to historical averages.

Cost-to-income ratios remained in check for most euro area LCBGs, as the growth in operating income outpaced growth in operating costs. The weighted average cost-to-income ratio decreased from about 64% in 2005 to slightly over 61% for the full year of 2006. Institutions that in 2005 had recorded worse than average performance – such as those in the third quartile – continued to reduce their cost-to-income ratios from 67% to 66% over the same period.

Despite overall continued cost-containment, some LCBGs still had rather high cost-to-income ratios in 2006 (see Chart 4.6). This partially related to the structure of the business model pursued by these institutions which, for one or two of them, involves substantial investment banking activities that are associated with higher than average levels of expenditure on staff compensation and IT. While some progress has been made in restructuring and moving towards generating sustainable revenue, for the other institutions the 2006 figures showed that further improvement was needed.

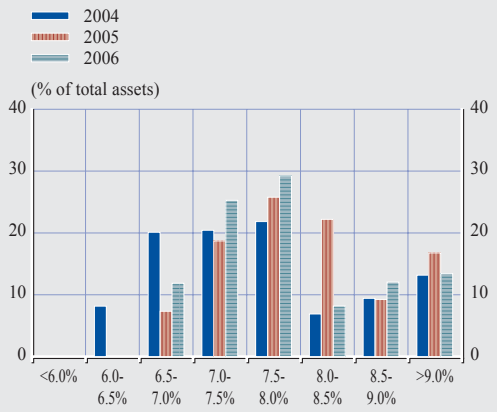
CAPITAL RATIOS DECREASED SLIGHTLY BUT REMAIN SOLID

The retention of slightly higher profits in 2006 contributed positively to euro area LCBGs' capital positions. However, the composition of

3 Gross impairment data only indicate the flow of new impairment charges whereas net impairments are the sum of new impairments minus reversals of previously impaired loans. A full set of these figures is not yet available for the entire sample of euro area LCBGs.

Chart 4.7 Frequency distribution of Tier 1 ratios for large and complex banking groups in the euro area

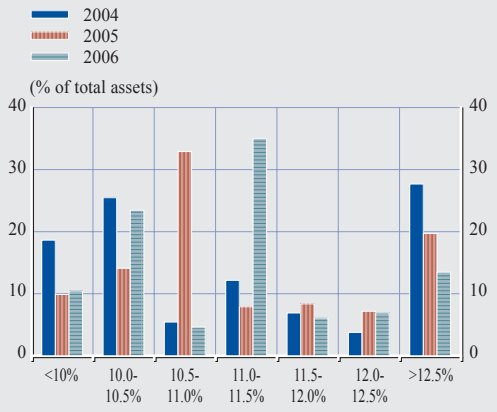
(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on 15 IFRS reporting LCBGs in the euro area.

Chart 4.8 Frequency distribution of overall solvency ratios for large and complex banking groups in the euro area

(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on 15 IFRS reporting LCBGs in the euro area.

further loan growth meant a more rapid increase in RWAs than capital. In addition, merger activity contributed to a slight decline in Tier 1 capital for a small number of institutions. Hence, there was a slight decrease in the weighted average Tier 1 ratio from 8.2% in 2005 to slightly above 8.0% for 2006 (see Chart 4.7 and Table S5).

Developments in overall solvency ratios mirrored the pattern for Tier 1 ratios. The overall solvency ratio declined slightly from 11.4% in 2005 as a whole to about 11.3% for the first six months of 2006 (see Chart 4.8 and Table S5). Encouragingly, the institutions which had the lowest capital ratios in 2005 improved their ratios over this period, although the number of banks in the lowest (i.e. 1st) quartile of the distribution increased slightly in the same period. While the weighted average readings of both the Tier 1 and the overall ratios declined, even the weakest institutions comfortably exceeded the regulatory minima, indicating that euro area LCBGs possess a comfortable shock absorption capacity.

Box 12

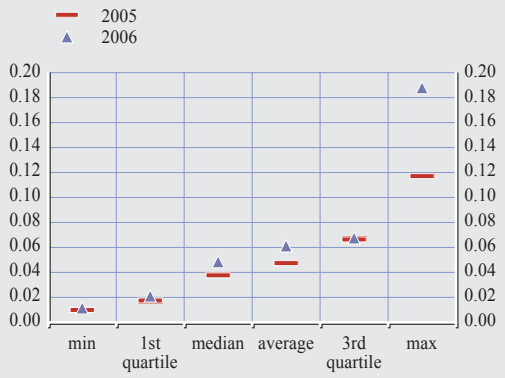
LOAN LOSS IMPAIRMENTS: WHAT IS BEHIND THE NUMBERS?

Credit risk is the most important risk that banks must face. This means that for assessing the effect of credit risk on banks profitability and solvency, adequate disclosures of potential and realised credit risk are important. Furthermore, information about how this risk is quantified and managed is important for effective market discipline.[1] One key piece of information that is needed for the assessment of credit risk is the loan loss impairment figures that are contained in banks' financial statements. Both 2005 and 2006 were transitional years in the euro area

1 See R. Gropp and A. Kadareja (2006), "Stale Information, Shocks and Volatility", *ECB Working Paper,* No 686. For a broader discussion of accounting standards from a financial stability perspective, see ECB/BSC (2006), "Assessment of Accounting Standards from a Financial Stability Perspective", and P. Amis and E. Rospars (2005), "Prudential Standards and the Evolution of Accounting Standards: The Stakes for Financial Stability", *Banque de France Financial Stability Review,* November. For a general discussion of IFRS and banks' asset quality, see Fitch Ratings (2005), "IFRS: The Impact on Asset Quality Assessment in the Banking Sector", Special Report, December.

Chart B12.1 Loan impairment charges for large and complex banking groups in the euro area

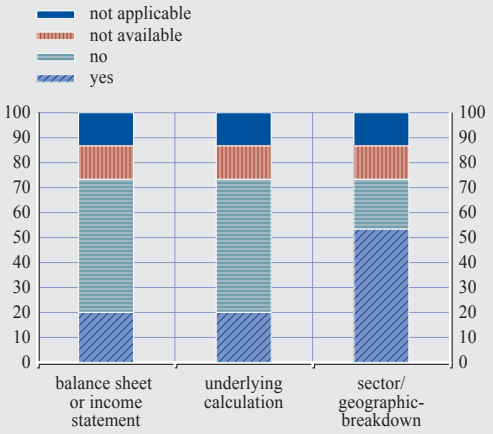
(% total assets)



Sources: Published annual reports, presentations of results and ECB calculations for 11 LCBGs.
Note: Impairments are new net impairment charges taken from the financial statements of LCBGs as a percentage of total assets.

Chart B12.2 Extent of information on the composition of loan impairment charges for large and complex banking groups in the euro area

(2005 - 2006)



Sources: Published annual reports, presentations of results and ECB calculations for 13 LCBGs.
Note: "Balance sheet or income statement" refers to whether or not the institution provides a detailed break down of net loan impairments in either of these financial statement; "Underlying calculation" refers to whether or not any quantitative or qualitative information is provided on how the impairment figures are calculated; "Sector/geographic" refers to whether or not the institution provides any information concerning the economic sector or geographical location of the impaired loans; "Not applicable" refers to two LCBGs that report a breakdown of impairment charges in both balance sheets and income statements because regulatory requirements in their home country requires them to do so.

banking sector since the full implementation of the new IFRS accounting standards by euro area LCBGs. This Box explains what loan impairments are; describes the figures that euro area LCBGs provided under IFRS in their 2006 results; as well as the information provided to interpret and compare these figures.[2]

The implementation of IFRS accounting standards has led to a change in the terminology and the way banks report actual or potential losses on loans. Following the implementation of IFRS, a loan is now regarded as impaired on the balance sheet date when there is objective evidence that a loss has occurred.[3] The implementation of IFRS has seen some banks report impairments both on individual loans and on portfolios of loans that are impaired but where the individual impairments have not yet been identified (this is known as "impaired but not reported", or IBNR), or alternatively, portfolio allowances.[4] As IBNR allowances are not explicitly described in IFRS, differing methodologies may have been applied to determine when loss events occur and when they are observed. The technical assumption that losses may have occurred in the portfolio but have not been recognised or observed by the bank leads to the IBNR or collective impairment allowance.

2 The comparability of 2004 local Generally Accepted Accounting Principles (GAAP) plus the 2004 data restated into IFRS with 2005 IFRS data is limited by the fact that most banks availed themselves of the transitional options for the restating of 2004 by not applying IFRS 4 ("Insurance activities"), and IAS 32/IAS 39 on financial instruments.
3 This evidence includes financial difficulty in the case of the borrower, breach of contract, and the probability that the borrower will enter into bankruptcy.
4 For a loan to be impaired, IFRS requires observable data on decreased estimated cash flows on the portfolio of assets.

The distribution of new impairment charges differs considerably across LCBGs that had reported IFRS results at end-2006 (see Chart B12.1). While this might reflect differences in the composition and quality of loan portfolios across these institutions, it is not possible to assess this with a high degree of confidence given wide variety in the amount and extent of the information provided by these institutions on their loan impairment charges (see Chart 12.2). Three main observations can be drawn from these disparities. First, the majority of LCBGs do not make a distinction in their loan impairment figures between specific and IBNR figures, either in their balance sheets (in terms of the stock of impaired loans) or in their profit and loss statements (in terms of new impairment charges). As such, it is difficult to determine what role – if any – is played by IBNR impairment charges in the overall figures.[5] Second, the majority of LCBGs do not disclose quantitative information on how they arrived at their impairment figures. Some LCBGs provide quantitative information – such as migrations on their internal rating scales – which determines whether impairment charges are made or not; most include somewhat vague qualitative descriptions in their financial statements, or provide additional information on the sources of credit risk in separate presentations. Third, several LCBGs provide a breakdown of their overall impairment figures by geographic region and/or business line, indicating where the sources of current credit losses originate.

Overall, only a few LCBGs currently break down their impairment figures into sub-categories, and provide relatively limited information to aid their interpretation, thus hindering comparability across institutions and countries. Notwithstanding the transition to IFRS, as well as Pillar 3 requirements from Basel II, additional quantitative and qualitative information could aid the interpretation of loan impairment charges and would prove more useful for assessing credit risk in euro area LCBGs. More encouragingly, this aspect of euro area LCBGs' financial disclosures may be improved by the implementation of IFRS 7 for 2007 financial results, as this requires particular disclosures concerning credit risk for loans and other financial instruments.[6]

5 For banks that make this distinction, IBNR impairments are typically much smaller than specific impairments.
6 IFRS 7 ("Financial instrument disclosures") contains various disclosure requirements for credit and other risks. Among the requirements for credit risk, banks should provide information about their maximum credit risk exposures on the balance sheet date, collateral and other credit enhancements, information on assets that are not past due or impaired, and various disclosures – such as vintage and how the assets were deemed to be past due and/or impaired. IFRS 7 has been mandatory since 1 January 2007.

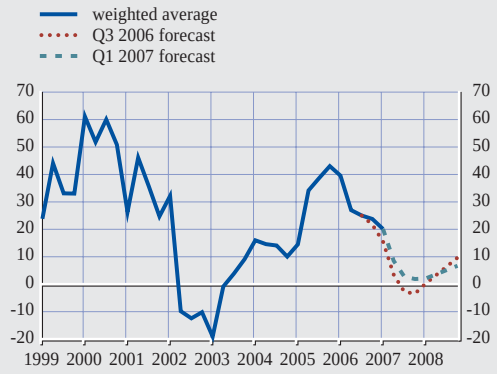
4.2 BANKING SECTOR OUTLOOK AND RISKS

Coming from a very high base in 2006, some slowdown in the pace of euro area LCBG profitability growth is expected by analysts in the short-term (see Chart 4.9). Nevertheless, with an improvement anticipated in the pace of economic activity, there was a slight upward revision to analysts' short-term forecasts for the earnings of these institutions after the finalisation of the December 2006 FSR.

After the finalisation of the December 2006 FSR, changes in the composition of balance sheets indicated that the exposures of LCBGs across various sources of risk changed little. Taking account of the likelihood of these risks materialising, the ranking of the various sources of risk facing LCBGs has likewise changed little. Nevertheless, it remains important to monitor and assess LCBGs' credit risk exposures to borrowers with relatively low creditworthiness in both the household and corporate sectors in their home markets (i.e. where the banks are headquartered). Credit risk exposures also arise from operations outside domestic lending markets. As noted in previous editions of the FSR, the operations of euro area LCBGs in central and eastern European markets as well as in emerging markets in Asia and Latin America

Chart 4.9 Earnings and earnings forecasts for large and complex banking groups in the euro area

(Q1 1999 - Q4 2008, % change per annum, weighted average)



Sources: Thomson Financial Datastream I/B/E/S and ECB calculations.

are important sources of income. Finally, if financial market conditions were to become more volatile, this would weigh upon non-interest income arising from activities including M&As, securitisation and credit risk transfer businesses.

HOUSEHOLD SECTOR CREDIT RISK

Although volume growth of lending by LCBGs to households remained robust, on average, through 2006, quarterly MFI data – which covers a much broader base of lending than that extended by LCBGs – indicates that lending growth, both for house purchase and for consumer credit, slowed down during the final part of the year and the first quarter of 2007 (see Chart S93). In historical terms, however, growth rates still remained vigorous, supported by the buoyant economic environment and interest rates that still remained relatively low. At the same time, banks increasingly eased their credit standards and, as reported in sub-section 4.1, their impairment charges have on average risen, albeit only marginally from previously very low levels. Overall, therefore, the indications are that euro area LCBGs' exposures to household sector credit risk most likely increased further after the finalisation of the December 2006 FSR, albeit possibly at a declining rate.

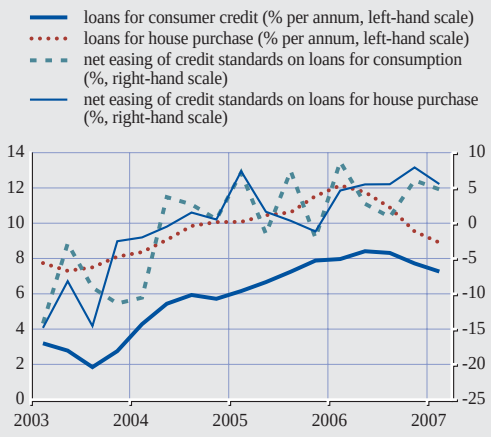
The development and active marketing of innovative new mortgage products by LCBGs – both in their home and foreign lending markets – has improved the access of borrowers to credit in many euro area countries and it has supported the continued and relatively rapid growth of LCBGs' mortgage portfolios. In addition, pursuit of lower risk-weighted assets – a goal that is rewarded by lower regulatory capital requirements in the new Basel II capital regime – may well have encouraged some banks to place greater emphasis on mortgage lending. At the same time, with short-term interest rates gradually increasing and conditions in some housing markets showing signs of cooling, euro area banks are facing the prospect of declining demand for mortgages, a market segment which has become the most important interest income source for many LCBGs over the past couple of years.

The results of the ECB Bank Lending Survey for April 2007 suggest that during the six-month period ending in March 2007, banks eased their credit standards applied to loans for house purchase (see Chart 4.10). According to the responding banks, a further easing of credit standards on mortgage lending can mainly be attributed to continuing competitive pressures from other banks (see Chart S104). By contrast, housing market prospects were seen by banks as a factor for tightening credit standards.

In a situation where banks' mortgage portfolios have been growing, the role of collateral is paramount for determining the prospects of loan recovery in the case of potential borrower defaults. Country-level information suggests that despite intensifying competitive pressures in the mortgage lending market, the average loan-to-value (LTV) ratios applied by euro area LCBGs on new mortgages have remained comfortable. Moreover, the continuing rise of house prices in most Member States, albeit at a decelerating rate, further improved the LTV ratios of the existing stock of LCBGs' loans extended for house purchase.

Chart 4.10 Changes in banks' credit standards applied to loans to households, and annual growth of MFI loans to households

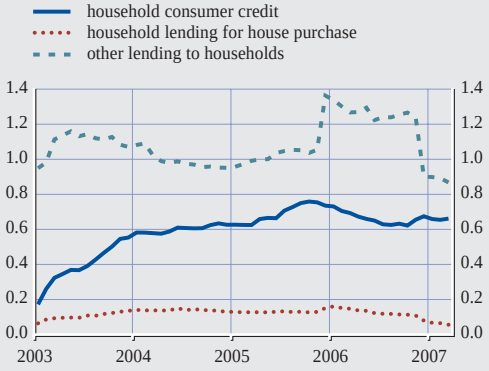
(Q1 2003 - Q1 2007)



Source: ECB.
Note: "Net easing" is defined as the difference between banks reporting that credit standards were eased compared to the previous quarter, and those banks reporting that credit standards were tightened (i.e. a positive figure indicates a "net easing")

Chart 4.11 Household sector lending write-off rates by purpose

(Jan. 2003 - Mar. 2007, 12-month moving sums, % of outstanding amount of loans)



Source: ECB.

Consumer credit, being unsecured, is inherently more risky than mortgage lending for banks, and a substantial rise in default rates in this segment sometimes heralds increases in problematic loans in other household lending categories as well. However, it represents a much smaller share of the total lending stock than mortgage lending. After the finalisation of the December 2006 FSR, unconsolidated MFI data show that the rate of growth of consumer credit also declined. In the latest ECB Bank Lending Survey, banks reported that demand for consumer credit continued improving during the six-month period ending in March 2007. Credit standards applied to consumer credit and other lending to households were continuously eased on a net basis, despite some concerns among banks about the creditworthiness of their borrowers, reflecting intense competition from other banks and non-banks for market share as well as the favourable economic outlook.

Banks' expected credit losses from their lending to households depend on the share of household loans that are expected to default over a given time horizon. In turn, the vulnerability of households to the risk of falling into loan payment arrears in the aftermath of a shock to income or interest rates is reflected in households' cash-flows vis-à-vis their loan interest rate burden. As long as the growth rate of the former exceeds the growth rate of the latter, vulnerabilities should remain contained. Backward-looking non-consolidated MFI figures indicate that loan write-offs from household lending decreased across all categories from the levels reported in the December 2006 FSR (see Chart 4.11). The slight reduction in write-offs in consumer credit came after a gradual increase throughout the latter part of 2006. These figures, which also partially explain the low levels of loan impairment charges among LCBGs, suggest that the impact of higher short-term interest rates has so far mostly been absorbed by borrowers, as there has not yet been any marked impact on the banks in terms of credit losses.

As discussed in more detail in sub-section 2.4 of this issue of the FSR, the euro area household sectors' debt-to-GDP ratio increased further after the finalisation of the December 2006 FSR and the overall debt-servicing burden of the sector is estimated to have grown further.

Higher debt service burdens have been mainly due to rising interest rates in an environment where the prevalence of loans issued on variable interest rate terms has been increasing. At the same time, house price increases have shown signs of slowing down in many countries. Against this background, banks' credit risks associated with lending to households are expected to increase gradually in the future.

As discussed in previous issues of the FSR, while the household sector credit risk outlook for euro area LCBGs still remains relatively benign, some vulnerabilities have most likely deepened. Several years of intense competition for market share appear to have encouraged many banks to extend credit on possibly excessively lenient terms to some borrowers or categories of borrowers. As a result, pockets of vulnerability may have developed among borrowers in the lowest-income and youngest-age categories, who typically combine mortgage debt and consumer credit, and who also tend to be the most vulnerable to income, unemployment and interest rate shocks.

The turbulence in the US sub-prime mortgage lending markets in the first quarter of 2007 (see Section 1 for more details) vividly illustrates how repayment arrears on loans that are seemingly concentrated among a limited group of borrowers can nevertheless have wider repercussions for financial institutions via effects on securitisation markets. Although it appears that lending to borrowers with little or no credit history by euro area banks has not been as pervasive as in the US, banks should still take a close look at their exposures to such products in the period ahead.

Looking forward, euro area LCBGs' seem to be in a rather good position to weather plausible adverse scenarios affecting their household sector credit exposures. This is confirmed by comfortable solvency ratios relative to regulatory requirements and several years of strong profitability, insofar as earnings have been retained to bolster capital buffers, as well as through credit risk mitigation activity. Nevertheless, the importance of household sector lending as a source of income to many LCBGs means that a sharp slowdown in this activity – although unlikely in the near term – would have a marked negative impact on banks' future interest income.

CORPORATE SECTOR CREDIT RISKS

The pace of lending growth to the corporate sector by euro area LCBGs remained strong over the past six months. Banks' lending decisions reflected not only the strength of corporate sector fundamentals – including high profitability and low default rates – but also the pursuit of market share and, for many LCBGs, the ability to securitise loans. Strong and increasingly broad-based economic activity in the euro area, coupled with favourable financing conditions, remained important demand-side factors for corporate sector lending, as firms sought external sources of funds for the financing of corporate investment and M&A activity. At the same time, banks' assessment of corporate credit conditions remained rather benign, as gauged from both the credit standards applied on loans and loan spreads. Although impairment charges increased slightly in financial year 2006 as a whole, it seems probable that euro area LCBGs' exposures to corporate sector credit risk increased over the past six months.

As discussed in sub-section 2.2 above, many firms in the euro area have after several years of containment found it optimal to gear up their capital structures. Euro area LCBGs have responded to growing demand for corporate loans, and this has improved their income diversification by increasing both interest and non-interest (fee) sources.

The outlook for the credit quality of euro area LCBGs' existing corporate loan portfolios has become somewhat mixed. While indicators of credit quality, such as corporate sector EDFs, provide a benign view, with default rates expected to remain contained in 2007 (see Chart S55), the balance of corporate sector rating upgrades to downgrades has become

increasingly negative, suggesting that the quality of LCBGs' existing corporate loan books could be gradually deteriorating (see sub-section 2.2 for more details). Although the cost of borrowing has become less sensitive to ratings downgrades, given the stage of the credit cycle, a maturing of the profit cycle could expose vulnerabilities among the lowest-rated companies and contribute to higher loan losses for banks in the future.

Regarding credit standards applied on new loans extended to enterprises, the ECB Bank Lending Survey for April 2007 revealed that on a net basis, banks slightly eased standards over the six-month period ending in March 2007 (see Chart 4.12). Competitive pressures from other banks and expectations regarding general economic activity supported an overall easing of credit standards (see Chart S102). Against this, the industry or firm-specific outlook was a factor for tightening standards but considerably less so than in the period up to the third quarter of 2006.

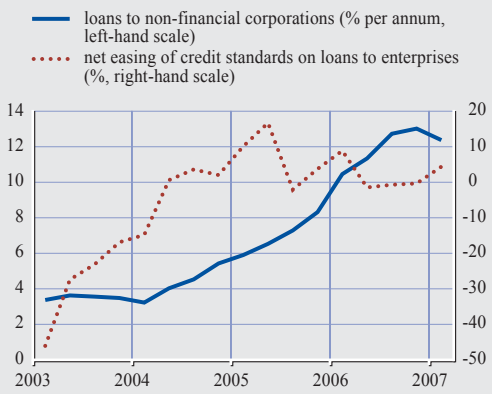
Taken together, this suggests that while banks see a risk of deteriorating creditworthiness among corporate sector borrowers, at least some of them have adopted lending policies which may have become excessively focused on retaining or growing market share. Partly mitigating such concerns, however, banks also reported that they had become more discriminating in their pricing of corporate credit risk. In particular, whereas margins on average loans to enterprises had narrowed, margins on riskier loans to enterprises had widened (see Chart S103).

The fact that variable rate loans have been gaining in popularity among corporate sector borrowers means that banks are less exposed to direct interest rate risks. However, they may have become more exposed to any deterioration in borrowers' credit quality as a result of rising interest burdens. Country-level information indicates that the level and quality of collateral that banks hold against their corporate loans is considered to be broadly adequate. An issue regarding banks' collateral policy that has emerged recently is an increasing tendency for banks to recycle collateral, i.e. to use collateral further in their own borrowing transactions (so-called re-hypothecation). Although such practices require the consent of the original collateral provider, banks and supervisors should be ensuring that collateral is always available should it be needed as security for the original loan transaction.

Ultimately, the risks euro area LCBGs face in their lending to the corporate sector depends on the loan repayment capacity of the firms which, in turn, is a function of indebtedness, the interest rate burden and current as well as expected profitability. Reflecting the benign credit environment, banks' loan losses in the recent past, measured by unconsolidated MFI data, illustrate that in the first quarter of 2007, corporate loan write-offs dropped to their lowest levels in four years. Although this is a purely backward-looking indicator, it could provide some justification for low levels of impairment charges and less stringent credit standards (see Chart 4.13).

Chart 4.12 Changes in banks' credit standards applied to loans and credit lines to enterprises, and annual growth of MFI loans to non-financial corporations

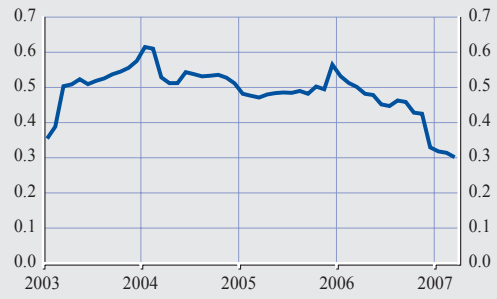
(Q1 2003 - Q1 2007)



Source: ECB.
Note: "Net easing" is defined as the difference between banks reporting that credit standards were eased compared to the previous quarter and those banks reporting that credit standards were tightened, i.e. a positive figure indicates a "net easing".

Chart 4.13 Non-financial corporate sector lending write-off rates

(Jan. 2003 - Mar. 2007, 12-month moving sums, % of outstanding amount of loans)



Source: ECB.

Chart 4.14 iTraxx Europe implied credit correlation

(Jan. 2005 - May 2007, iTraxx Europe main five-year maturity, 0-3% tranche correlation)

Sources: JP Morgan Chase & Co. and ECB calculations.

Looking ahead, as discussed in sub-section 2.2, while euro area corporate sector leverage has reached unprecedented levels in recent quarters, the sustainability of this development is somewhat difficult to assess from a medium-term perspective. However, as in the case of household sector exposures, conclusions based on aggregate figures can conceal concentrations of debt exposures and the interest rate burdens facing certain firms, especially those which have recently been taken private by LBOs or which have increased their gearing levels to protect themselves against such corporate actions. It cannot be excluded that new financial innovations in debt structures applied to LBOs – such as covenant-light loan contracts and back-ended amortisation schemes – could have insulated low-rated firms from short-term cyclical developments. However, should the macro-financial environment develop less favourably than currently forecast, hidden pockets of vulnerability may be revealed quickly bringing clusters of defaults and mounting credit losses for banks.

Finally, the CDS markets can provide a useful source of forward-looking information regarding euro area banks' credit risks. A steady rise in implied credit correlations among the 125 firms included in the iTraxx Europe CDS index after early 2006 suggests that investors had been attaching a greater likelihood to systemic rather than firm-specific credit risk, possibly illustrating an expectation of a gradual but more widespread deterioration in the corporate credit cycle (see Chart 4.14).[4]

All in all, against a background of greater leverage and higher interest rates, corporate sector financing costs in the euro area can be expected to rise in the period ahead, which means that euro area LCBGs will have to pay increasing attention to the management of corporate sector credit risks. In this context, the introduction of the new Basel II capital regime in the EU in 2007 will force banks to scrutinise all corporate loan exposures that are allocated to higher risk-weight asset categories than, for example, their household credit exposures.

CREDIT RISK MITIGATION ACTIVITY

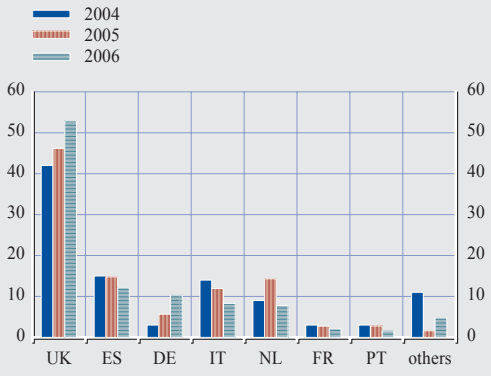
Over the past decade new techniques for credit risk mitigation have profoundly changed the way in which large banks manage their banking book risks.[5] Indeed, the number of instruments for securitising banks' credit exposures has

4 For details of this indicator, see ECB (2006) "The information content of CDS index tranches for financial stability analysis", *Financial Stability Review,* December. In interpreting the chart, the following caveats should be kept in mind. First, the chart refers to the most junior ("equity") tranche only and the other tranches ("mezzanine" and the more senior tranches) might behave differently. Second, the chart illustrates a risk-neutral measure that might incorporate a sizeable risk premium. Third, market participants often point out that technical factors in the market sometimes dominate fundamental determinants.

5 See Box 12 in ECB (2006) *Financial Stability Review,* December.

Chart 4.15 European loan securitisation issuance by country of collateral

(2004 - 2006, % of total)



Source: European Securitisation Forum.

Chart 4.16 Slope of the European investment-grade and high-volatility credit curves

(Oct. 2006 - May 2007, difference between ten and three-year premiums, basis points)

Sources: iTraxx and Bloomberg.

grown very rapidly, although the degree to which banks have adopted such tools still varies quite markedly across geographical locations and business models (see Chart 4.15).

There are at least three reasons for loan securitisation, either through true-sale securitisation (which involves the removal of loan exposures from banks' balance sheets) or through synthetic securitisation (which involves purchases of hedging instruments). First, it allows banks to reduce undesirable risk concentrations in their loan books and to diversify their credit risk exposures more effectively. Second, the proceeds from securitisation provide funds for further lending activity and in some cases may free up capital, although Basel II may have reduced incentives to use the latter. Third, loan exposure management by securitisation provides a better connection between the expected revenues (interest income) from a loan and the costs of hedging it, thus allowing banks to impose discipline in the loan origination process.

For banks, the cost of hedging credit risk exposures is subject to volatility. This can be seen from changes both in the parallel position of the credit curve and its slope (see Chart 4.16). The latter in particular provides a measure of the cost of insurance against credit defaults over different horizons. More recently, cost of hedging against credit risk particularly over longer horizons has been rising.

From a financial stability perspective, securitisation improves risk-sharing and, from this point of view, unambiguously enhances the resilience of the financial system. However, even in the case of true-sale securitisation, banks typically hold part of the credit risk on their balance sheet, which remains exposed to borrower defaults. The resilience of the securitisation market also relies on the end-holders of risk in the market having adequate risk management frameworks in place. Moreover, like all segments of the CRT market, securitisation markets have not yet been properly tested in less benign credit and market conditions. This implies that the pricing models applied in these markets have had to rely on strong assumptions regarding key parameters. For example, as the loan pools underlying asset-backed securities often include names whose default risks are positively correlated, if correlations move in unexpected ways under conditions of stress the holders of bank loan-backed securities – often other banks – may find they have taken on risks with insufficient compensation.

MARKET-RELATED RISKS

Interest rate risks

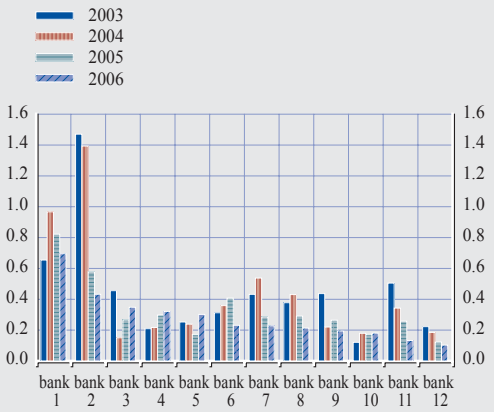
At an aggregate level, interest rate risks remain the most important source of market risk for LCBGs. The importance of interest rate risk for banks arises from the fact that changes in interest rates at different maturities have an impact on both the expected profitability of the banks' core lending business – the severity of which depends on the relative importance of loans with short versus long-term interest rate fixation – and on the various interest rate-sensitive asset holdings on banks' trading books.

As short-term interest rates in the euro area began to rise in late 2005, euro area LCBGs' were confronted with a gradual flattening of the market yield curve, as long-term interest rates rose more moderately than rates with shorter maturities. When market yield curves become flatter, banks typically find it more challenging to generate income from maturity transformation. During the past couple of years, however, the significant volume growth of new loans, which gradually became more broad-based across individual Member States, more than compensated banks for the reduced margins between deposit and lending rates. If long-term interest rates were to rise, it would therefore enhance banks' interest income derived from new lending business. However, if associated with greater funding costs for firms, it could lead to a deterioration of credit quality. Hence, this makes an assessment of the net effect on banks' loan books of a steepening of the yield curve complicated.

Information on banks' risks related to their trading book exposures is typically scarce and difficult to compare across individual banks. Information from selected banks' value at risk (VaR) metrics suggests that in 2006 many banks reduced their market interest rate exposures (see Chart 4.17). However, it is important to note that the macro-financial environment in 2006 was characterised by unusually subdued levels of volatility which, other things being equal, would translate into lower VaR figures. This means that some institutions might not be sufficiently prepared for an unexpected volatility spike. Moreover, VaR models can have some important drawbacks (see Box 13).

Chart 4.17 Interest rate Value at Risk (VaR) for large and complex banking groups in the euro area

(2003 - 2006, % of Tier 1 capital)



Source: Financial disclosures of euro area LCBGs which presented information on VaR measures.

Owing to the importance of interest rate risk both for their banking and trading books, euro area LCBGs manage interest rate risk in many different ways, primarily by using derivatives instruments. In addition, market risk stress-testing has become more widespread among LCBGs and typically involves scenarios for yield curve movements, including both parallel shifts and steepening curves. Banks also generally have substantially more experience and statistical skill in managing their market risk exposures as opposed to credit risk exposures.

The episodes of temporary increases in financial market volatility in May 2005, May-June 2006 and February-March 2007 demonstrate that euro area LCBGs have been able to weather shorter periods of interest rate volatility rather well. However, they could face challenges if there was a lasting rise in the volatility of long-term interest rates.

Box 13

MARKET RISK MEASUREMENT, BEYOND VALUE AT RISK

Financial risk management has evolved dramatically over the last few decades. One of the most widespread tools used by financial institutions to measure market risk is value at risk (VaR), which enables firms to obtain a firm-wide view of their overall risks and to allocate capital more efficiently across various business lines. This box places the VaR approach into a broader risk measurement context and compares the metric with alternatives.

VaR summarises in a single number the risk of loss of a portfolio over a defined time horizon and a given confidence level α so that the probability of exceeding this loss is equal to $p = 1 - \alpha$. If it is assumed, for example, that the VaR of a portfolio over a one-week period is equal to -1.5% of its value with a 95% confidence level (α), this implies that the investor could expect the portfolio to exceed this loss with a probability of 5% ($p = 1 - \alpha$). VaR depends on two arbitrarily chosen parameters: the confidence level α, which indicates the probability of an outcome of less than or equal to VaR; and the holding period or the period over which the portfolio's profit or loss is measured.

VaR owes its prominence as a risk measure in the financial markets to several positive characteristics of the metric. It enables risk managers to aggregate the risks of sub-positions into an overall and consistent measure of portfolio risk while simultaneously taking into account the various ways in which different risk factors correlate with each other. It is a holistic measure in that it takes into account all risk factors that affect the portfolio, and a probabilistic measure in that it provides information on the probabilities associated with specified loss amounts.

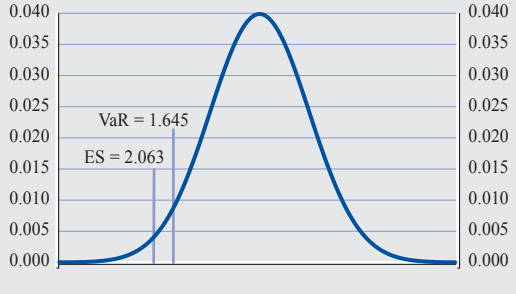
However, VaR has some drawbacks and limitations. One important limitation is that it cannot tell how much an investor can expect to lose should a tail event occur. Instead, it can only provide information on potential losses if the tail event does not occur. This could have undesirable consequences. Two positions may have the same VaR and therefore appear to have the same risk, but in reality they could have very different risk exposures, as one position could potentially lead to a very high loss in the tail.

Partially in response to criticisms of VaR, a newer risk measurement paradigm has emerged, following the theory of coherent risk measures as proposed by Artzner et al. (1999).[1] In contrast to VaR, this approach specifies the properties a risk measure should have in order to be a coherent measure. One important property is subadditivity. This property implies that when individual risks are added, there will be some diversification effects, i.e. the risk of the sum is always less than or equal to the sum of the risks. It turns out that VaR is not subadditive and therefore cannot be regarded as a proper risk measure. Other alternatives in the form of coherent risk measures need to be employed instead.

Expected shortfall (ES) is one such coherent alternative risk measure. It comprises the average of the worst 100(1- α)% of losses of a portfolio's profit and loss distribution. ES is a superior

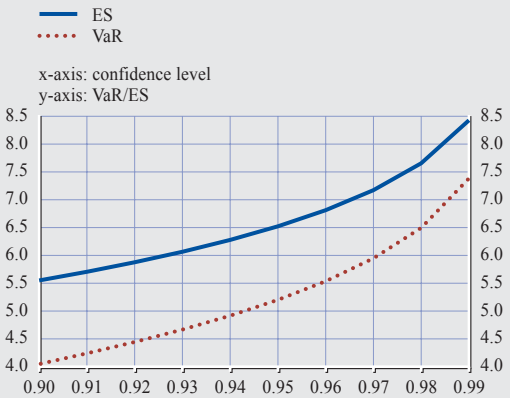
1 See P. Artzner, F. Delbaen, J.-M. Eber and D. Heath (1999), "Coherent Measures of Risk", *Mathematical Finance,* 9 November, 203-228.

Chart B13.1 Value at Risk (VaR) and expected shortfall (ES)



Source: ECB calculations.
Note: This assumes a 95% confidence level, a one-day holding period and that the daily profit and loss is distributed as standard normal (i.e. mean 0 and standard deviation 1).

Chart B13.2 Value at Risk (VaR), expected shortfall (ES) and the confidence level



Source: ECB calculations.
Note: This assumes a ten-day holding period, and that daily profit and loss is distributed as standard normal (i.e. mean 0 and standard deviation 1).

risk measure to VaR because, among other reasons, it produces a measure of what losses can be expected in a bad situation, whereas VaR only provides indicates that the loss will be higher than itself. The ES measure is coherent as it always satisfies subadditivity. Chart B13.1 shows the value of the ES measure and VaR for a return distribution based on a hypothetical stock whose price is normally distributed with mean 0 and standard deviation equal to 1. Chart B13.2 shows that the ES measure, like VaR, tends to rise with the confidence level.

However, the ES measure cannot be considered the "best" coherent risk measure even though its computational ease makes it widely used. In the normal world, investors are risk-averse so that risk aversion is an aspect that should be reflected in the risk measure. A more general coherent risk measure that is capable of capturing the risk aversion profile of investors is called the risk spectrum measure, which comprises the weighted average of the quantiles of the portfolio's loss distribution.

In this measure the investor needs to define the weighting function of the quantiles of the loss distribution, which weights losses according to their individual risk aversion characteristics. It turns out that the ES measure and VaR are special cases of this generic risk spectrum measure. For instance, the ES gives tail losses an equal weight of $1/(1-\alpha)$, and the other quantiles a weight of 0.

To produce a coherent risk spectrum measure, the loss-weighting function must meet a number of conditions. Crucially, the weighting function must give higher losses at least the same weight as lower losses, even though in normal circumstances, i.e. when there is risk aversion, higher losses are likely to be given greater weight. The weights attached to higher losses in spectral risk measures are thus a reflection of the user's risk aversion, or the rate at which the higher weights rise be related to the degree of risk aversion. To obtain a spectral risk measure, a particular form of the loss-weighting function must be specified. This makes this risk measure not as widespread in use as for example VaR, as each investor would need to use a distinct

weighting function. This drawback makes it impossible for example to use the measure for purposes of comparison across different investors.

The connection between the weighting function and risk aversion makes spectral risk measures a superior alternative to ES if the user is risk-averse, with a weighting function that gives higher losses a higher weight than the ES measure, which gives all losses in the tail region the same weight. However, if the user is risk-neutral, ES represents a superior measure.[2]

Within the coherent risk measure paradigm, scenario analyses represent another coherent risk measure, together with ES and spectral risk measures. The theory of coherent risk measures provides a solid justification for stress-testing. Indeed, the outcome of scenario analysis, i.e. loss estimates with a set of associated probabilities, can be regarded as tail-drawing from the relevant distribution function, and their average value is the ES measure associated with the distribution function. Since ES is a coherent risk measure, the outcomes of scenario analysis are also coherent risk measures. Scenario analysis and stress-testing are increasingly used to handle correlation and path-dependent effects in a portfolio context.

VaR remains the financial community's and banking supervisor's risk measure of choice with regard to market risk measurement. Although VaR is an effective risk measure with several positive characteristics, it has some important drawbacks. Conceptually superior alternatives exist such as ES, spectral risk measures and even scenario analysis. Financial institutions are increasingly incorporating these newer, more coherent risk measures into their risk control frameworks. In fact, it is not difficult to upgrade to an ES measure if a VaR calculation system is already in place. This process is welcome, and should contribute to a more robust and resilient financial system.

2 See for example H. Grootveld and W. Hallerbach (2004), "Upgrading Value at Risk from Diagnostic Metric to Decision Variable: A Wise Thing to Do?, in: *Risk Measures for the 21st century,* London: John Wiley and Sons.

Exchange rate and equity market risks

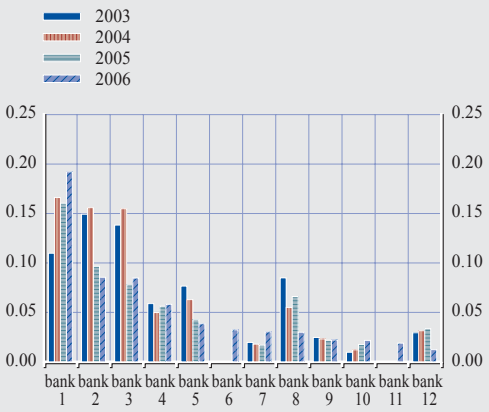
The net open foreign exchange rate positions of euro area LCBGs are very small in general, as banks regularly hedge their open positions which are subject to exchange rate risk. For this purpose, banks usually employ off-balance sheet derivatives instruments. However, the introduction of the new IFRS, which are also employed for supervisory purposes in several euro area countries, require such derivatives holdings to be reported on the balance sheet.

Focusing on on-balance sheet exposures to the US dollar, which is the major currency in which euro area banks hold foreign currency-denominated assets and liabilities, euro area LCBGs have narrowed the gap considerably between their issuance of US dollar-denominated loans, as a share of total foreign currency-denominated assets, and their holdings of US-denominated liabilities, as a share of total foreign currency-denominated liabilities (see Chart S99). This is expected to mitigate the direct impact of swings in the euro-US dollar exchange rate, should they materialise. Additional information on LCBGs' VaRs for foreign exchange risk indicates that this exposure remains small as a share of Tier 1 capital (see Chart 4.18).

Improved risk management by banks, also associated with ongoing implementation of Basel II across the EU, has prompted them to conduct regularly stress tests for exchange rate risk. Country-level information suggests that these stress tests point towards resilience with regard to foreign exchange risks.

Chart 4.18 Foreign exchange Value at Risk (VaR) for large and complex banking groups in the euro area

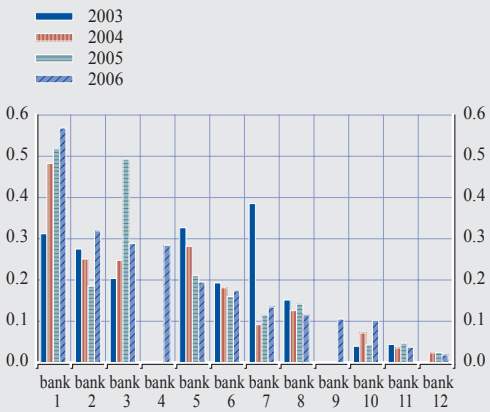
(2003 - 2006, % of Tier 1 capital)



Source: Financial disclosures of euro area LCBGs that presented information on VaR measures.

Chart 4.19 Equity market Value at Risk (VaR) for large and complex banking groups in the euro area

(2003 - 2006, % of Tier 1 capital)



Source: Financial disclosures of those euro area LCBGs that presented information on VaR measures.

On the other hand, some indirect risks could remain for banks if large swings in foreign exchange rates were to coincide with or result in a turn of the credit cycle. In this context, LCBGs that are active in foreign currency-denominated lending – an area that has grown very rapidly over the past couple of years in several non-euro area EU countries – could be vulnerable to credit risks arising from sudden and unexpected increases in borrowers' loan repayment burdens.

Euro area LCBGs' holdings of corporate equity instruments are generally limited and, since the positions are marked-to-market in banks' trading books, the exposures are frequently monitored. Information on selected banks' equity VaRs suggests that some had increased from the previous year, although still remaining at reasonable levels (see Chart 4.19). The episode of global financial market turbulence which took place in late February 2007 and carried into early March was particularly pronounced in the equity markets. Nevertheless, it appears that euro area LCBGs have not suffered material losses on their equity market holdings.

Credit derivatives market risks

Banks' exposures to credit derivatives markets provide a nexus between credit and market risks, as these instruments introduce elements of credit risk into their trading book holdings. Since credit derivatives are increasingly being used to gain exposures to loans that are originated by other banks, the possibility of unexpected losses emerging from such positions could have increased, as banks may not be fully aware of the credit quality of the underlying loan asset pools which are monitored by the originating banks.

The banking sector continues to be the largest holder of increasing amounts of CDSs and complex structured products, although the insurance sector and institutional investors also have important exposures. The fact that some LCBGs – in particular those with extensive investment banking activities – are more exposed to the credit derivatives markets than others is partially reflected by the rather wide dispersion of spreads on credit instruments issued by banks. In this regard, in the last quarter of 2006 the credit spreads of some global LCBGs, which all enjoy high credit ratings, widened beyond the average spread of generally much lower-rated investment-grade

corporate issuers. This "inconsistency" between credit ratings and credit spread developments could reflect heightened awareness of the risks that some global LCBGs are exposed to in the credit markets.[6]

Counterparty risks

By early May 2007, banks' exposures to hedge funds and private equity activity could be singled out as prominent sources of counterparty risk.

Banks' dealing agreements with hedge funds include, among other things, provisions for termination events, which allow banks to terminate transactions with particular hedge fund clients and seize the collateral held if the risk profile of a hedge fund worsens significantly. A set of total net asset value (NAV)[7] or NAV-per-share decline triggers, a NAV floor or some combination of these, are often used as NAV-based termination events. The share of single-manager hedge funds breaching total NAV decline triggers remained relatively stable in the second half of 2006 (see Chart 4.20). This owed both to strong hedge fund performance (see Chart 4.21) and unabated inflows into the sector.

Banks are only able to monitor their own dealings with a hedge fund client on an ongoing basis, and great emphasis is placed on adequate margins and collateral being posted to compensate for the lack of more frequent and detailed information on the hedge fund as a whole. At the same time, riskier exposures to hedge funds could be justified by higher potential revenues and adequate capital cushions – indeed, such an approach is in line with the notion of risk-based capital under the Basel II framework.

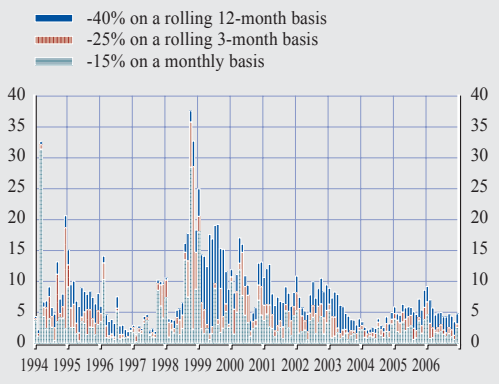
Nevertheless, competition among prime broker banks for the lucrative hedge fund servicing business remains intense, thereby undermining the effectiveness of counterparty discipline exercised by banks, and leaving them more vulnerable to adverse market shocks. The reduced downside protection is not confined to the less frequent use of initial margins at the

6 It may also reflect the fact that default probabilities extracted from CDS spreads are based on an assumption of risk-neutrality, which tends to contribute to a lower implied rating than rating agencies' assessments of default probabilities.

7 Net asset value is the total value of a fund's investments less liabilities. It is also referred to as capital under management.

Chart 4.20 Share of hedge funds breaching triggers of total NAV cumulative decline

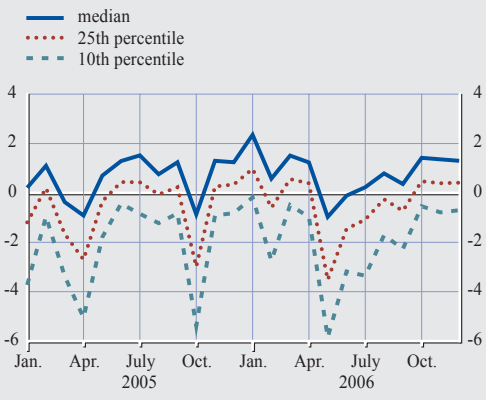
(Jan. 1994 - Dec. 2006, % of total NAV)



Sources: Lipper TASS database and ECB calculations.
Note: Excluding funds of hedge funds. NAV is the total value of a fund's investments less liabilities; it is also referred to as capital under management. If several assumed total NAV decline triggers were breached, then the fund in question was only included in one group with the shortest rolling period.

Chart 4.21 Distribution of global hedge fund returns

(Jan. 2005 - Dec. 2006, % monthly return, net of all fees)



Sources: Lipper TASS database and ECB calculations.
Note: Excluding funds of hedge funds.

inception of various OTC trades, but also refers to more aggressive VaR-based cross-product (portfolio) margining practices and looser collateral policies involving the wider use of lower-grade and potentially less liquid collateral. VaR measures may prove particularly inadequate should correlations between financial instruments increase, and if volatility rises from unusually subdued levels. New financial instruments with embedded leverage and difficult to value correlation-dependent, path-dependent and other complex structures may further blur the true risk profile and overall leverage employed by a hedge fund client.

Banks' exposures to private equity activity – and in particular the LBO segment – have been extensively surveyed in a recent Banking Supervision Committee (BSC) report.[8] Although euro area banks' direct credit, financing and income risk exposures to LBO funds were found to be relatively modest compared to their capital buffers, the rapid growth in activity suggests that some risks could be developing. In particular, the attractive fees and commissions available for banks have contributed to creating intense competition among lenders that could encourage them to compromise their credit standards. Moreover, before they distribute their credit exposures to the wider market, the banks underwriting the debt are frequently exposed to high credit risk concentrations at the early stages of an LBO.

Financial innovation has also introduced new debtor-friendly financing structures to the LBO market which could make the future credit risk exposures of the financing entities contingent on continuing benign market conditions.[9] Furthermore, should the environment in the LBO market deteriorate and default rates increase, the presence of new types of debt investors with potentially conflicting incentives could complicate debt workout processes possibly leading to unexpected legal and reputational risks for the banks involved. Finally, since the loans involved in LBO transactions are increasingly being included in the asset pools of synthetic structured credit vehicles, problems in the underlying loans could potentially spread rapidly via the securitisation markets, as has recently been demonstrated in the US sub-prime lending markets. For these reasons, LCBGs extensively involved in LBO lending and in loan securitisation markets need to monitor their credit and counterparty exposures carefully.

Emerging market exposures

The turbulence in the global financial markets in February-March 2007 led to cautiousness among international investors about their exposures to EMEs in general. While equity markets endured significant volatility, banks' lending exposures to individual countries are in general of a more long-term nature and several factors contributed to keeping foreign banks' exposure towards EMEs broadly stable: favourable macroeconomic performance of EMEs, the buoyancy of commodity prices, and relatively low global interest rates.

Concerning exposures to individual geographic areas, measured by the size of cross-border banking flows (loans and deposits) from euro area banks to selected EMEs (stocks at period-end), exposure to the main EMEs in Latin America continued to increase throughout 2006 (see Chart S100 for the major countries, and Table S6 for information on a larger set of countries). Euro area banks' exposures to Brazil and Mexico in particular continued growing steadily after 2004, and these two countries remain the largest recipients of euro area banking flows. Overall, euro area banks' exposures to EMEs in Latin America are likely to be beneficial due to the income diversification and relatively low risk-exposure they offer.

The level of exposure to Asian EMEs, measured by the size of cross-border banking flows, has

8 ECB (2007), "Large EU Banks and Private Equity Sponsored Leveraged Buy-outs in the EU", April.

9 In particular, the increasing tendency towards financing structures, where loan covenants are diluted or completely excluded, and where LBO sponsors may inject equity capital into the balance sheets of ailing companies, could allow firms with an excessive debt burden and/or deteriorating cash flows to remain in business longer than would otherwise be possible.

remained smaller than exposure to Latin America, but a sustained and faster pace of growth of exposures to Asian EMEs after end-2002 may indicate that eventually a rebalancing in the portfolio of euro area banks' exposures to different EME regions could take place (see Chart S101 for the major countries, and Table S6 for information on a larger set of countries).[10] In 2006 euro area banks' exposures grew across the region, especially towards the two largest countries, India and China. To the extent that the Asian economies continue to expand and macroeconomic conditions remain favourable, euro area banks' exposures are likely to prove beneficial to their overall profitability and resilience.

4.3 SHOCK-ABSORPTION CAPACITY OF THE BANKING SECTOR ON THE BASIS OF MARKET INDICATORS

MARKET INDICATORS BROADLY UNCHANGED

After the publication of the December 2006 FSR and notwithstanding the turbulence in financial markets of February-March 2007, market indicators continued to point towards a relatively positive outlook for the banking sector. The episode had a predominantly common effect across the banking system (see Box 14) and its main impact was concentrated on euro area banks' indicators of credit risk, such as CDS spreads, which widened albeit from very low levels (see Chart S108). The impact on banks' equity prices was less pronounced but there was a larger decline than of the general stock market index (see Chart S110). The implied volatility of bank stock prices rose but still remained low by historical standards and was not markedly different from the general rise of volatility (see Chart S111). Similarly, LCBGs' expected default frequencies remained low up to early May and on average were not affected by the recent market turbulence (see Chart S106). Distance-to-defaults (DDs) fell generally throughout the first quarter of 2007. However, DDs for the weakest LCBGs increased over the same period, although by not as much as in 2006.

Overall, these reactions of market indicators suggest that market participants viewed the temporary turbulence as mostly affecting banks through their exposure to credit. This was similar to the behaviour of credit risk indicators for global LCBGs although the reaction for euro area LCBGs was more muted. This might have reflected concerns about exposures of US banks to the sub-prime mortgage lending market. Moreover, considering the period extending up to early May, marked-indicators remained broadly unchanged overall after the finalisation of the December 2006 FSR.

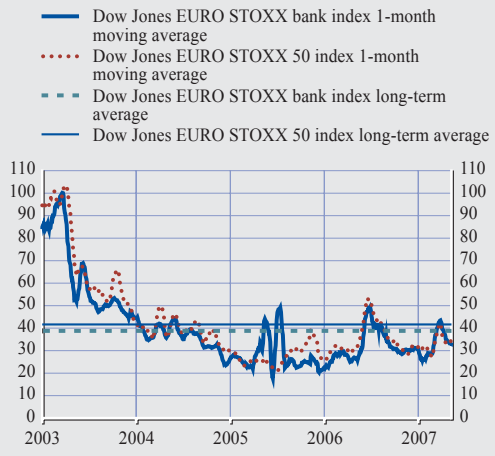
Some additional information on how the markets view the outlook for euro area banks can be gauged by indicators based on options prices, which provide a quantitative assessment of the costs that market participants are willing to incur to protect themselves against unfavourable events. Two examples of such indicators are risk reversals and strangles on the Dow Jones EURO STOXX Index. Both indicators moved markedly around the time of the recent market turbulence (see Chart S112). The risk reversal subsequently remained in negative territory, indicating a higher perceived probability of a large downward rather than of a large upward movement in banks' share prices.

Another indicator based on options prices which is useful for gauging market participants' views of the likelihood of extreme swings – i.e., skewness – in equity valuations is the so-called short butterfly (see Chart 4.22). When its current level is above its long-term average, as was the case after the start of the market correction at the end of February, it indicates that market participants expect the risk of extreme movements in stock prices to have increased. However, the level of this indicator subsequently fell below its long-term average,

10 Because of the lag in the BIS banking flows data, two major events concerning financial markets in emerging Asia cannot be traced: the rapid and abrupt fall and recovery of the Chinese stock market, and the experiment of introducing controls on capital flows in Thailand. These events and their impact on other EMEs and global financial markets, although not on euro area banking flows, are discussed in detail in Section 1.

Chart 4.22 Short butterfly of the Dow Jones EURO STOXX bank index and Dow Jones EURO STOXX 50 index

(Jan. 2003 - May 2007)



Source: Bloomberg.
Note: The short butterfly indicator is calculated as the difference between the sum of implied volatilities of an in-the-money (ITM) call with 75 delta and two ATM calls with 50 delta, and the implied volatility of an on-the-money (OTM) call with 25 delta.

Chart 4.23 Option-implied RND bands for the Dow Jones EURO STOXX bank index

(Jan. 2005 - July 2007, index value, 10%, 30%, 50%, 70% and 90% confidence intervals of estimation on 11 May 2007)

Sources: Bloomberg and ECB calculations.

pointing towards a return by market participants to a more positive view of LCBGs' conditions.

Looking at the implied probability distribution of the Dow Jones EURO STOXX index three months-ahead, based on the risk-neutral density function derived from options quotes in early May 2007, the central expectation was that the index would gradually recover beyond its end-December 2006 value but the confidence bands were wider on the downside suggesting some concerns that downside risks could outweigh upside risks in the period ahead (see Chart 4.23).

All in all, patterns in market indicators over the past six months have not indicated a decisive change in the overall positive assessment by market participants of the resilience of the euro area banking sector and the outlook that was pervasive until mid-February.

Box 14

DECOMPOSITION OF THE RISKS FACED BY THE BANKING AND THE INSURANCE SECTORS USING A FACTOR MODEL

From a financial stability perspective, it is useful to decompose the risks faced by the financial sector into systematic, sector-specific and idiosyncratic components. The aim of this Box is to apply a latent factor model framework to achieve such a decomposition for both the banking and insurance sectors.

Principal component analysis is a dimension reduction technique that makes it possible to approximate large multivariate datasets with a limited number of factors which account for the

largest share of the changes in the original data. The variance of the data can be explained by a model of unobserved factors that are common to all or most of the variables, and an idiosyncratic component which corresponds to variable-specific factors. In this way, each variable can be represented as a linear combination of common factors plus idiosyncratic ones.[1]

A factor model may be used to decompose the variance in equity price returns. The proportion of variance that can be explained by the common factor(s) may be associated with the systematic risk which is common to all equities, e.g. the risk of an unfavourable turn in the business cycle. Idiosyncratic variance is a measure of risks that are specific to individual companies.

Applying factor analysis to equity price returns lacks a strong theoretical background. This is particularly the case when it comes to choosing the number of factors and interpreting the risk premiums that are associated with each factor. For example, from the perspective of factor analysis, the popular capital asset pricing model (CAPM) suggests using just one common factor to represent the market risk premium. Both statistical tests and other more advanced theoretical models typically favour a framework of more than one factor, although in many empirical applications the optimal number of factors and their interpretation has not yet been determined.

An approach that is often adopted to analyse equity returns is to include one common factor and a few local market-specific factors associated with the geographical location of each company in the analysis.[2] However, since most large financial firms operate in a global marketplace, local conditions may not be as important as sector-specific factors.

The factor model can also be adapted to take into account sector-specific risks when equity returns of companies from different sectors are included in the dataset of observed variables.

Let r_{it} be the return of i-th equity, which may be represented in the factor model framework as:

$$r_{it} = \mu_i + \lambda_i C_t + \kappa_{ki} S_{kt} + \Phi_i f_{it}, \quad i = 1,..., n, \ k = 1,..., m,$$

where λ_i is a vector of loadings on the common factor C_t, κ_{ki} is a $n \times m$ matrix of vectors of loadings on the vector of m sectoral factors S_{kt}, each representing risks specific to k-th sector. Finally, Φ_i is a vector of loadings on the vector of n idiosyncratic factors.

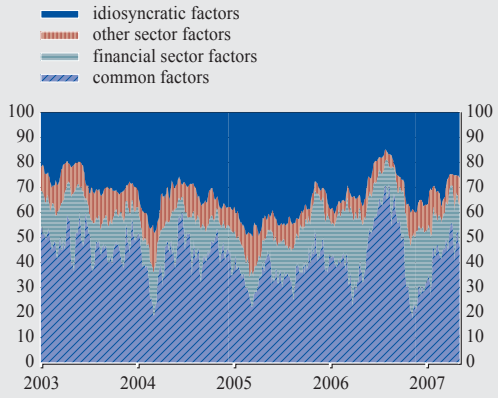
To observe changes in systematic, sector-specific and idiosyncratic risk over time, the framework described above was used to calculate loadings for different periods thus allowing changes in the share of variance to be decomposed into particular factors. The exercise was repeated 1,317 times in a moving window frame of 60 trading days from 14 December 2001 to 7 May 2007 for the factor models of equity returns of 50 companies included in the Dow Jones EURO STOXX 50 index. Taking into account the allocation of these companies to

1 Formally, in the factor model framework a vector of observed variables x_t is given by: $x_t = \mu + \Lambda c_t + f_t$, where μ is a constant vector of means, c_t is a vector of independent latent common factors and f_t is a vector of independent latent idiosyncratic factors. Λ is a matrix of coefficients of the k-th factor for the i-th variable. In the factor terminology, this is called the loading matrix.

2 See C. Hawkesby, I. W. Marsh and I. Stevens (2007), "Comovements in the Equity Prices of Large Complex Financial Institutions", *Journal of Financial Stability,* Vol. 2, No 4, 391-411.

Chart B14.1 Contributions of each of the factors to the variance of equity returns of the largest euro area banks

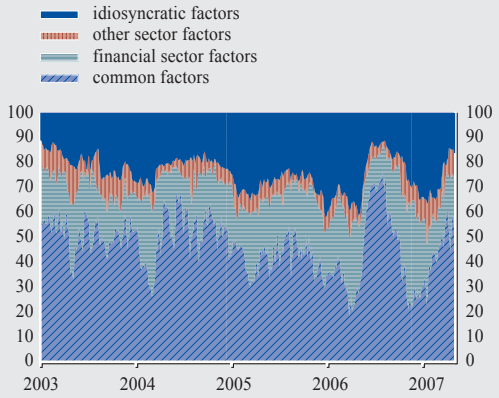
(% of equity variance weighted by the contribution of a company to the Dow Jones EURO STOXX 50 Index, five-day moving average)



Sources: Bloomberg and ECB calculations.

Chart B14.2 Contributions of each of the factors to the variance of equity returns of the largest euro area insurance companies

(% of equity variance weighted by the contribution of a company to the Dow Jones EURO STOXX 50 Index, five-day moving average)



Sources: Bloomberg and ECB calculations.

one of five sectors (banking, insurance, telecommunication, energy and retail), the restrictions on matrix κ were set as well.

The charts present the contribution of particular factors to the variance of equity returns of the 11 largest euro area banks and the seven largest euro area insurance companies. The sectoral factors were grouped into two sets: financial sector factors (the banking and insurance sectors) and other sectors (energy, telecommunication and retail).

The charts provide a picture of the relative importance of different risk factors for the largest euro area banks and insurance companies, as seen by market participants. Systematic risk represents a common factor that can be associated with general macroeconomic and market risk. The share of variance explained by financial sector factors in turn covers financial sector-specific risks, which could be thought of as systemic risk. For banks, this could be linked to risks arising from operations with other financial market participants, such as risks from interbank exposures or exposures to insurance companies, as well as contagion risk. For the insurance sector, financial sector factors cover the risks specific to this sector, e.g. the risk of catastrophic events. The fact that these kinds of risks are specific to insurance companies may explain why financial sector factors explain more of the variance of insurance company stock prices than is the case for banks. With regard to banks, the variance explained by "other sector" factors could be associated with credit risk arising from exposures to the corporate sector that are not covered by the common component (i.e. credit risk that does not result from the business cycle, but from sector-specific risks). The contribution to the variance from the "other sector" for the insurance sector is smaller on average and may be associated with the risk of unexpected claims from sectors where the insurance companies' clients operate. Finally, the residual variance that cannot be explained by common factors and sectoral factors represents idiosyncratic risk, i.e. the risk that is specific to the operations of each individual bank or insurance company.

The risk factor indicator suggests that the two recent episodes of financial market turbulence in May-June 2006 and February-March 2007 were predominantly driven by common factors, albeit less so in the most recent episode. At the same time, the variance explained by financial sector-specific factors increased beyond the long-term average levels prior to both of these episodes. The financial sector factor among banks was also relatively higher during the more recent market turbulence than during the one in May-June 2006, suggesting that investors' assessment of banking sector-specific risks increased in 2006 and remained above the long-term average in Q1 2007.

HIGH CREDIT RATINGS CONTINUED IN 2007

The ratings from the three major rating agencies for euro area LCBGs after the finalisation of the December 2006 FSR remained high. Both the average rating, at AA-, and the outlook, which is considered to be a medium-term indicator of credit quality (over one to two years) remained unchanged (see Table S7). Across the sample of LCBGs, the three major rating agencies assigned ten positive outlooks against no negative outlooks. Overall, the balance of positive to negative rating actions, which in addition to changes in rating outlooks includes changes in rating levels, remained high, notwithstanding a drop in late 2006 (see Chart S114). On an assets-under-management weighted basis, around 75% of the LCBGs' banking assets are controlled by banks that are rated AA- or higher. Although further positive rating actions cannot be ruled out, the high level of long-term ratings for LCBGs is increasingly limiting the scope for upgrades (see Chart S115).

This overall stable outlook and high rating level environment reflects the view of rating agencies that euro area banks continue to enjoy strong fundamentals. They are currently in a favourable position to withstand a cyclical downturn in the remainder of 2007 in the unlikely event that this could materialise (see Section 2.1). Despite this overall positive assessment, however, the rating agencies reported that rating pressures could still emerge if expectations regarding the resilience of earnings and the stability of risk profiles were not met. In particular, they viewed risks of an unexpectedly sharp deterioration in corporate or household sector credit quality or an increase in exposures to more volatile economies as possible triggers for downward rating revisions.

The rating agencies consider that the benign credit environment, together with improvements in risk management and greater focus on operational efficiency, has contributed to the strong performance of LCBGs over the past two years. However, they also reported that future threats to asset quality can be identified, especially in relation to sustained private equity activity and large debt-financed M&As. To the extent that the number of highly leveraged transactions continues to grow, defaults could increase. This could negatively impact euro area LCBGs, which reportedly keep a significantly higher proportion of leveraged finance risk than their US counterparts. However, leveraged finance losses are not considered likely to materialise before the second half of 2007 at the earliest.

With regard to household finance, at this stage rating agencies consider rising interest rates in the euro area more likely to produce a slowdown in mortgage credit expansion rather than a material rise in household bad debt charges.

Overall, rating agencies view the positive trends that have supported high rating levels and the recent positive rating actions, such as increased focus on cost efficiency, improved risk management, strong internal capital generation and growing diversity of revenue lines, as likely to provide euro area banks with sufficient buffers should a cyclical turn in the credit cycle materialise.

Box 15

BANK RATINGS AND SUPPORT ANALYSIS

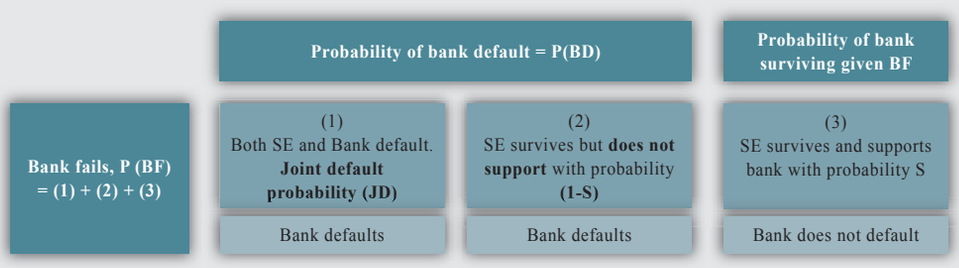
The banking system is a low-default sector in that banks default very infrequently, especially when compared with other corporate sectors. Different reasons could explain this low realised default rate. A significant one is that the banking sector is subject to supervision. Another reason, recently put forward by rating agencies, is the existence of external support which could prevent a bank in difficulties from entering into a state in which it could default. Support mechanisms can come in a variety of different forms. An important one is the potential support that a government could offer to a failed bank. Alternatively, external support could also come in the form of a parent or shareholder group injecting new funds into the troubled bank.

A debate has recently emerged between rating agencies and financial market participants on the usefulness and feasibility of explicitly accounting for such support mechanisms in bank ratings. From the investors' point of view, it can be argued that if bank ratings are meant to provide an assessment of default risk, the presence of support elements that mitigate this default risk should be taken into account. Rating agencies have been incorporating this information to varying degrees into bank ratings for a long time, but not always in a transparent or consistent way.

Explicitly accounting for support in bank ratings, while appealing, is a difficult undertaking that requires a model capable of linking the likelihood of a bank failing with the likelihood of support, S, from the supporting entity, SE (see Figure B15.1). In addition, a third element of complexity to the model is provided by the fact that the default risk of the supporting entity itself could be correlated to that of the bank, i.e. the probability that the supporting entity might jointly default with the bank with probability JD is different from zero, and JD could be so high as to make it impossible to provide support.

Once a bank has failed, three different situations can be identified that decide whether the bank will go into final default or not. First, if the supporting entity defaults, the bank would also default, as there is no longer a supporting mechanism to keep the bank afloat (State 1). Second, the supporting entity could survive but refuse to provide support, forcing the bank to default (State 2). Third, the supporting entity could survive and decide to support the failed bank, rescuing it and preventing it from defaulting (State 3). This allows the probability of default of a bank, P(BD), to be split into two additive components: first, the supporting entity defaults together with the failed bank (JD); and second, the supporting entity – while not defaulting – refuses to provide support, i.e. P(BD) = (1) + (2), as shown in Figure B15.1 below.

Figure B15.1 Bank default model with a supporting entity (SE)



To define the bank's probability of default more precisely, the probability of support (S), or no support (1-S) in States 2 and 3 also need to be defined. The probability of the supporting entity surviving and being unwilling or unable to provide support is equal to (1 - S) · (P(BF) - JD) (i.e. State 2), while the probability of the supporting entity surviving and being willing to provide support is equal to (S) · (P(BF) - JD) (i.e. State 3). This assumes that the probability of support S is linearly distributed between States 2 and 3. If P(BD) = (1) + (2), then the probability of default of a bank in the presence of support is equal to

$$P(BD) = JD + (1 - S) \cdot (P(BF) - JD). \quad (1)$$

If it is assumed, for example, that bank A has a probability of failing of 1% (P(BF)=1%), and a support entity, e.g. the government, is willing and able to support the bank with a probability S equal to 99% (1 - S = 1%), and that the joint default probability of the government and bank A is 0.05% (JD = 0.05%), then the probability of bank A defaulting with support would be equal to P(BD) = 0.05% + (1 - 99%) · (1% - 0.05%) = 0.059%.

It turns out that of the three parameters needed to calculate the probability of default from equation (1), one is relatively easy to estimate, i.e. the probability of a bank failing, whereas the other two, the JD and S, are much harder to estimate. The probability of a bank failing refers to the estimate or opinion of the rating agency of the relative stand-alone credit quality of a bank, i.e. without external support. Essentially, this opinion comes in the form of a rating which, for the purpose of the stylised model presented above, could be mapped into a probability of failure as estimated based on historical observations of bank failures. Such ratings of "stand-alone" bank credit risk are readily available – Moody's new bank rating JDA methodology terms this rating the Bank Financial Strength Rating (BFSR), while Fitch refers to it as the Individual Rating.

The probability of support is much harder to ascertain. From a statistical point of view, it is difficult to substantiate based on historical observations any support probability estimate owing to the lack of data. This estimation would require the collection and analysis of past instances in which banks have failed and defaulted (owing to a lack of support) or survived (thanks to support), as well as information on the supporting entities' own default or survival history. In practice, rating agencies would rely on a more subjective approach based on, for example, scorecards that focus on factors that could be used to forecast the preparedness for support (Moody's), the prior judgemental assessment of the ability and willingness to provide support (Fitch), or analysis of the propensity of the government to support a bank in difficulty, together with the assessment of how systemically important the bank actually is (Standard & Poor's).

Finally, the third parameter in equation (1), the joint probability of default of the bank and the supporting entity, is also difficult to estimate. Two elements are necessary for its computation: the probability of default of the supporting entity, and the default correlation between the two entities. Whereas an assessment of the default risk of the supporting entity could easily be obtained through existing ratings, for example, default correlation estimates are very difficult to compute. Owing to the lack of meaningful data from which to derive the default correlation, applications of a ratings framework for banks in the presence of support would require strong assumptions about the level of default correlation. These assumptions are however bound to be subjective, as there is no meaningful way to quantify default relationships.

The recent explicit incorporation of support analysis into final ratings for banks by one major rating agency (Moody's) has been widely cited as a way of overcoming perceived transparency and consistency problems in ratings. While any attempt to provide greater transparency and consistency to rating methodologies is welcome, it must also be recognised that incorporating support aspects into final bank ratings is bound to be challenging because, as the stylised model presented above shows, such a ratings framework would need to rely critically on estimates of the probability of support and the joint default of the bank and the supporting entity – estimates which are intrinsically very difficult to come by and, more importantly, to validate. In the absence of objective quantitative inputs for the support rating estimates, users of ratings and rating agencies' services are well advised to apply their own judgement when looking for the optimal balance between rating accuracy on the one hand and transparency and consistency on the other.[1]

1 See Moody's (2007), "Incorporation of Joint-default Analysis into Moody's Bank Rating Methodology", February; Fitch Ratings (2006), "The Role of Support and Joint Probability Analysis in Bank Ratings", May; and Standard and Poor's (2007), "External Support in Bank Ratings", March.

4.4 OVERALL ASSESSMENT

The financial soundness of large and complex banking groups (LCBGs) in the euro area was strengthened further in the second half of 2006, consolidating on the steady and broad-based improvement from 2003 onwards. Profitability continued to rise, underpinned by strong macroeconomic conditions and, for the most part, very low levels of financial market volatility. While the interest income of most institutions remained broadly stable, banks enjoyed further improvements in fee, commission and trading income. While welcome, the strength of growth in some of the more volatile components of non-interest income may prove difficult to sustain in the medium term, which suggests a potential risk of future income deterioration. Loan impairment charges increased slightly from a low base, and cost-to-income ratios improved further. This did not, however, translate into an improvement of solvency ratios because there was also a rise in risk-weighted assets, indicating greater risk-taking. Nevertheless, solvency ratios remained very comfortable.

Looking forward, it seems likely that the maturity transformation activities of euro area LCBGs will continue to be challenged by the flatness of the euro area market yield curve. Moreover, recent signs of a slowdown in lending growth to euro area households could adversely affect interest income. While market analysts expect that LCBGs will overall remain highly profitable, reflecting expectations of a pick-up in euro area growth and a continued favourable assessment of the creditworthiness of borrowers, there are however some risks. Within the banking system itself, banks have faced challenges in recent years in increasing, or even maintaining, interest income, given margin erosion and intense competition in loan markets. Moreover, as low interest rates may have sustained tight credit spreads, medium-term vulnerabilities related to the pricing of credit risk could be building up, as banks' pricing of credit risk becomes more market-based. Although significant advances have been made by LCBGs in their credit risk management practices in view of the implementation of the new Basel II framework and the greater emphasis placed on the "originate and distribute" business model, banks' credit risk exposures have risen relative to their buffers as a result of a combination of rapid lending growth to both households and firms, historically low loan impairment charges and some signs of weakened credit standards. Even if the exposures seem on average manageable given comfortable solvency ratios, pockets of vulnerability could be developing in some parts of the euro area

household and corporate sectors, where credit losses could prove greater than expected in a more challenging environment. For instance, there are concerns that highly competitive pressures in markets such as lending for LBOs could have induced banks to take on excessive risk in the pursuit of market share. That said, it is difficult quantitatively to assess what the full impact on euro area LCBGs would be in the event of a general adverse turn in the credit cycle. This is because data are lacking on the extent of credit risk being transferred within and outside the banking system, making it impossible to assess the extent to which LCBGs are hedging against such a scenario. However, there are some indirect indications, and just as the very low levels of loan impairment charges over recent years might, in part, be explained by increasing recourse of large banks to the CRT markets to shed and diversify their credit risks, the impact of an adverse turn of the credit cycle on banks could be more muted than in earlier downturns.

Concerning market risks such as the possibility of an upturn in long-term interest rates and of credit risk premiums, the direct risks faced by LCBGs are likely to prove manageable. However, these institutions may still face risks to other market-related business activities which have yielded significant income in recent years, as well as counterparty risks from non-bank financial firms, where risk management practices may be less advanced. While counterparty risk management practices in large banks are known to be improving, it is unclear whether the intensity of competition, for instance in the securitisation markets or in the provision of prime brokerage services to hedge funds, may have compromised standards at the margin, especially for medium-sized banks. It is therefore paramount that LCBGs practice sound counterparty risk management in the period ahead in order to isolate potential problems before they occur. Banks providing prime brokerage services to highly leveraged institutions, in particular hedge funds, will need to exercise vigilence in reviewing the adequacy of assumptions underlying their credit limit, margining and collateral policies.

Forward-looking indicators based on asset prices continue to suggest that the outlook for euro area LCBGs remains bright. The same is true of credit ratings, which have remained high and stable, reflecting a view that euro area LCBGs have strong fundamentals and that they are favourably positioned to withstand a cyclical downturn. Nevertheless, some options-based market indicators do indicate that downside risks to banking sector profitability could outweigh upside risks in the period ahead.

5 OTHER EURO AREA FINANCIAL INSTITUTIONS

5.1 THE EURO AREA INSURANCE SECTOR

Favourable developments in the financial conditions of primary insurers and reinsurers in 2006, together with greater focus on risk management and risk-adjusted pricing, continued to support a positive outlook for the euro area insurance sector as a whole. Further improvements in asset liability management, together with improved capital structures – resulting from increased use of securitisation and the issuance of hybrid capital and subordinated debt – also support a generally positive outlook. However, risks and challenges for the sector remain and have in some cases increased. In particular, greater financial market risks could pose a challenge to life insurers. Non-life insurers could be exposed, together with reinsurers, to a greater risk of natural disasters in 2007.

FINANCIAL CONDITIONS IN THE INSURANCE SECTOR[1]

Many large listed euro area insurers are composite firms, i.e. they are active in both the life and non-life insurance sectors (see Chart 5.1), and sometimes also in the reinsurance business. Given that complete separate accounts for life and non-life businesses throughout the euro area are not yet available for 2006, the separate analysis of these sub-sectors is generally only indicative.

Following a pattern observed in 2004 and 2005, the financial condition of large euro area insurers continued improving in 2006. Whereas life insurance premium growth remained stable, growth in non-life premiums showed an improvement in 2006 compared with previous years (see Chart 5.2).

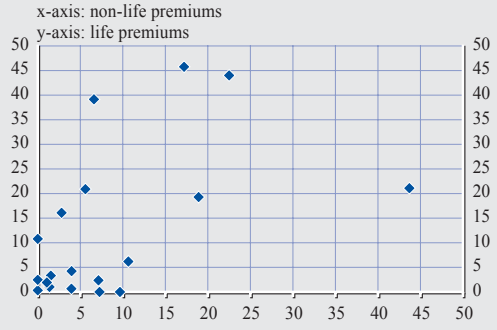
Against the backdrop of an expected increase in the share of retirees in the population, and pension reforms in several euro area countries designed to encourage people to shift from public to private life insurance schemes, life insurance business lines continued attracting demand from individuals seeking to invest in order to finance future pension payments. There are indications that favourable stock market conditions have continued to spur demand for unit-linked policies, which in turn has helped reduce insurers' investment risk.[2] Although

1 The analysis of the euro area insurance sector is based on the consolidated accounts of a sample of 20 listed insurers (composite, life, non-life and reinsurers) with total combined assets of about EUR 4.5 trillion. The sample represents about 60% of the gross premium written in the total euro area insurance sector. However, not all figures were available for all companies.

2 The return obtained by the policyholder of a unit-linked (or index-linked) life insurance product is typically linked to some financial index, such as an equity market index.

Chart 5.1 Gross premium written for a sample of large euro area insurers

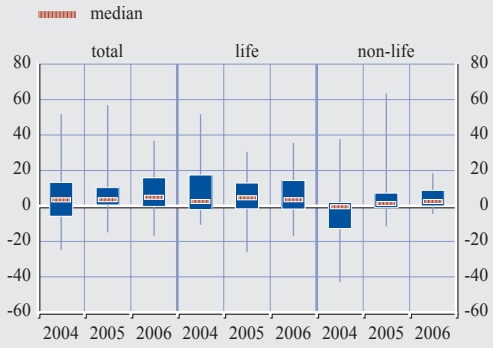
(2005, EUR billions)



Sources: Bloomberg and ECB calculations.

Chart 5.2 Distribution of gross premium written growth for a sample of large euro area insurers

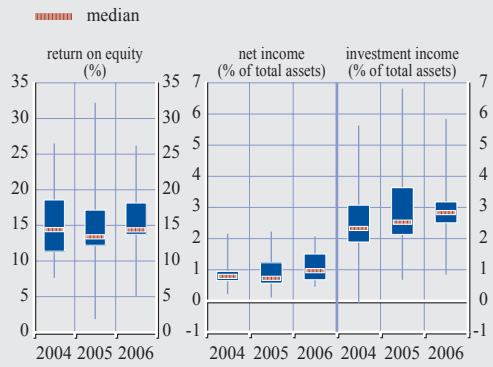
(2004 - 2006, % per annum, nominal values, maximum, minimum, inter-quartile distribution)



Sources: Bloomberg and ECB calculations.

Chart 5.3 Distribution of return on equity, net income and investment income for a sample of large euro area insurers

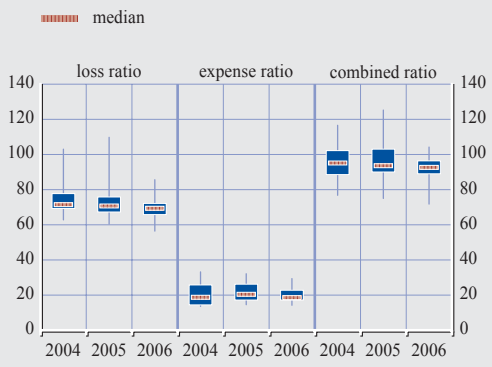
(2004 - 2006, maximum, minimum, inter-quartile distribution)



Sources: Bloomberg and ECB calculations.

Chart 5.4 Distribution of combined, loss and expense ratios for a sample of large euro area insurers

(2004 - 2006, % of premium earned, maximum, minimum, inter-quartile distribution)



Sources: Bloomberg and ECB calculations.

competition in the non-life insurance market remained strong, premium growth accelerated somewhat in 2006, partly owing to the lack of natural disasters throughout the year.

There was a broad-based improvement in profitability in 2006 among the insurers analysed. The average ROE stood at 14.4% in 2006, up from 13.4% in 2005 (see Chart 5.3). Further supporting the positive outlook, the profitability of the weaker performers in 2005 also improved in 2006, and the distribution of profit performance became more skewed towards higher values. Underlying this improvement was a strengthening of investment income, mainly owing to buoyant stock markets and higher interest rates.

Cost control and lower losses also underpinned the strengthening of profitability in 2006. In anticipation of the implementation of Solvency II, operational efficiency kept expenses stable and lower losses were recorded, resulting in a decline in combined ratios to below 100% for most insurers (see Chart 5.4).[3]

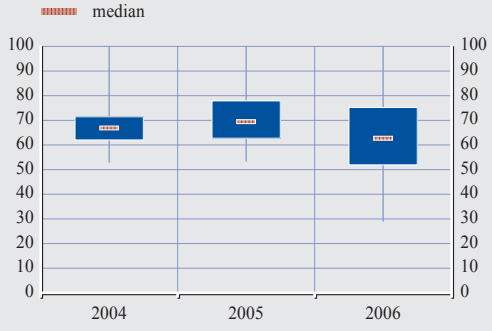
The large insured catastrophe-related losses endured in 2005 reduced the supply of reinsurance and increased reinsurance prices in some segments, which contributed to a shift in the distribution of retention ratios towards higher values in 2005. During 2006, however, retention ratios fell to levels of around 63% on average (see Chart 5.5).[4] In addition, insurers appear to have increased direct risk transfer via securitisation, using, for example, CDO structures, weather derivatives and catastrophe bonds.

3 The combined ratio is calculated as the sum of the loss ratio (net claims to premium earned) and the expense ratio (expenses to premium earned). Typically, a combined ratio of more than 100% indicates an underwriting loss for the insurer.

4 The retention ratio is calculated by dividing net premium written by gross premium written, and is a measure of how much of the risk is being carried by an insurer rather than being passed on to reinsurers.

Chart 5.5 Distribution of retention ratios for a sample of large euro area insurers

(2004 - 2006, %, maximum, minimum, inter-quartile distribution)



Sources: Bloomberg and ECB calculations.

In general, solvency positions seem to have remained adequate, partly due to favourable stock market developments and the increased use of securitisation and issuance of hybrid capital and subordinated debt.[5]

Financial conditions of major reinsurers[6]

The euro area reinsurance sector is particularly important for financial stability for three main reasons. First, reinsurers provide safety nets for primary insurers, and a reinsurer's financial difficulties can significantly affect the primary insurance sector. Second, because the business of reinsurers is to protect against extreme events, they are exposed more than primary insurers to rare and unexpected catastrophic events, such as natural disasters and terrorist attacks, the likelihood of which is difficult to quantify accurately. Third, like many primary insurers, reinsurers are also large institutional investors and have an important presence in financial markets.

Information which became available after the December 2006 FSR was finalised points towards improving financial conditions among large euro area reinsurers. Euro area reinsurers, which also tend to very active outside the euro area, proved to be resilient to the large insured catastrophe losses in 2005 (most notably hurricanes Katrina, Rita and Wilma in the Gulf of Mexico, totalling about USD 65 billion in insured losses, as well as the winter storm Erwin, and summer flooding in Europe). However, the severe catastrophic events of 2005 continued to affect the reinsurance sector in 2006 as premium rates increased significantly during the January and July renewal seasons. Reinsurance premiums for protection against potential losses, in particular in the US and Mexico, were repriced following greater risk awareness and the decision by some reinsurers to withdraw from some market segments or to reduce their exposures, which led to less competition in some market segments. As a result, global reinsurance prices increased by 32% in 2006, but there were wide differences among regions and countries.[7] As the overall demand for reinsurance increased, a broad-based increase in gross premium written in 2006 was evident (see Chart 5.6).

Increases in premium written, together with strong investment income and low catastrophe losses, led to a broad-based improvement in profitability in 2006 for euro area reinsurers

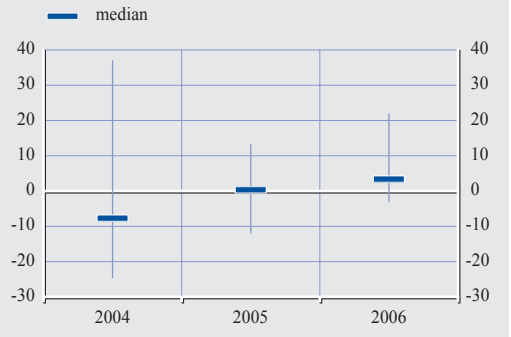
5 See CEIOPS (2007), "Interim Report on Financial Conditions and Financial Stability in the European Insurance and Occupational Pension Fund Sectors for the Period 2005-2006", forthcoming.

6 The analysis of the euro area reinsurance sector is based on consolidated accounts (including also primary insurance activity) for a sample of five large listed reinsurers with total combined assets of about EUR 310 billion, and representing about 10% of gross premium written in the total euro area insurance sector. However, not all figures were available for all companies.

7 See Guy Carpenter (2006), "The World Catastrophe Reinsurance Market: Steep Peaks Overshadow Plateaus", September.

Chart 5.6 Distribution of gross premium written growth for a sample of large euro area reinsurers

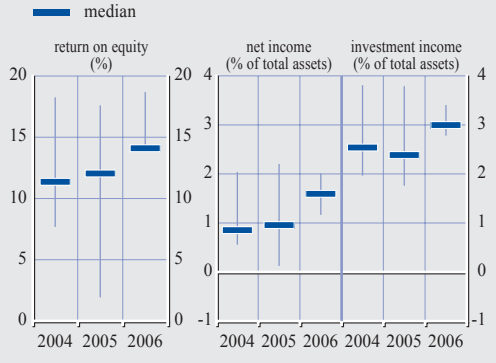
(2004 - 2006, % per annum, maximum-minimum distribution)



Sources: Bloomberg and ECB calculations.

Chart 5.7 Distribution of return on equity, net income and investment income for a sample of large euro area reinsurers

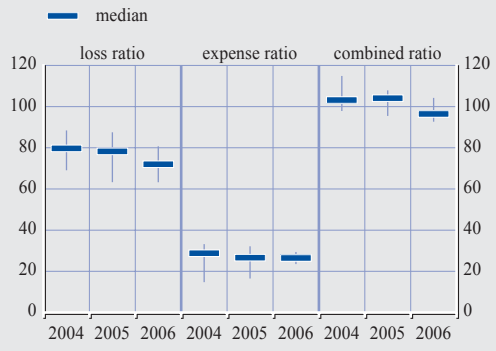
(2004 - 2006, % of total assets, maximum-minimum distribution)



Sources: Bloomberg and ECB calculations.

Chart 5.8 Distribution of combined, loss and expense ratios for a sample of large euro area insurers

(2004 - 2006, % of premium earned, maximum-minimum distribution)



Sources: Bloomberg and ECB calculations.

(see Chart 5.7). As was the case with primary insurers, reinsurers' investment income profited from increased interest rates and favourable stock market developments.

The catastrophic events in 2005 underpinned an increase in combined ratios, which passed the crucial 100% threshold that year for most reinsurers. In 2006, however, a significantly lower number of catastrophes resulted in declining loss ratios, and the average combined ratio fell below 100% (see Chart 5.8).

Despite the losses incurred by euro area reinsurers in 2005, their solvency positions proved to be sufficient. Their fairly strong performance in 2006, coupled with an increased use of securitisation as a means of risk transfer, indicates that solvency positions have remained adequate.

RISKS FACING THE INSURANCE SECTOR

The failure of several large, sometimes well established, insurers in recent years provides an insight into the potential sources and nature of episodes of stress, as well as to the important role played by the inversion of the insurers' production cycle[8] and the absence of a tough and sophisticated claimholder.[9] Independently from the insurer's business line, common elements of a stress episode are an initial unexpected shock to assets or liabilities, a resulting decrease in the company's net wealth known only to insiders, and a subsequent "gambling for resurrection" that will result in failure should an adverse outcome materialise. Owing to this development cycle of failures in the insurance sector, some balance sheet, operation and market-based indicators may paint an inaccurate picture of the risk of potential failure of an insurer in the medium term, which makes it absolutely essential to analyse carefully the detailed aspects of the operational environment of the sector – including the sources and nature of shocks – and its internal resilience.

External factors affecting insurance resilience

As already highlighted in the December 2006 FSR, periods of financial market turbulence – such as the most recent February 2007 episode – can have a disproportionate impact on large listed insurance companies. The reactions of stock prices can be amplified either by differing market exposures on the liabilities and the assets side, or by the general opacity of their balance sheet composition. In fact, one of the most prevalent risks facing insurers are financial market risks.[10]

A prominent risk for life insurers is the potential mismatch between income and cost flows. In this context, the recent gradual increase in short-term interest rates in the euro area has improved the margin between fixed income investment returns and the costs associated with guaranteed return contracts, thus alleviating the pressure to seek higher returns by taking on greater risk. At the same time, life insurers' liabilities have been reduced, as the net present value of the future stream of annuity payments has fallen.[11] The prospect in the short term of stable or rising interest rates should decrease the risks posed by abrupt interest rate

8 Unlike most goods and services, insurance services are only produced after – and sometimes significantly so – they are purchased by policyholders.

9 See G. Plantin and J. C. Rochet (2007), *When Insurers Go Bust: An Economic Analysis of the Role and Design of Prudential Regulation,* Princeton: Princeton University Press.

10 See CEIOPS (2007), ibid.

11 On the impact of low interest rates on insurers' balance sheets, see Box 17 in ECB (2005), *Financial Stability Review,* December.

movements, and should continue positively to supporting the financial condition of insurers.

Looking further ahead, the life insurance business continues to face the risk posed by increasing life expectancy. Longevity risk largely depends on the extent to which the reinsurance sector is able and willing to absorb it, and the demand for unit-linked products remains robust.[12] Whereas greater focus on risk management and risk-adjusted pricing has meant greater use by life insurers of unit-linked products, higher reinsurance costs appear to have encouraged some primary insurers to bear an increasing share of the risks.

Table 5.1 US Atlantic basin seasonal hurricane forecast for 2007 and historical average

(number of events)

Forecast parameter	as of 08/12/2006	as of 03/04/2007	1950-2000 Average
Named storms	14	17	9.6
Named storm days	70	85	49.1
Hurricanes	7	9	5.9
Hurricane days	35	40	24.5
Intense hurricanes	3	5	2.3
Intense hurricane days	8	11	5
Accumulated cyclone energy	130	170	96.2
Net tropical cyclone activity	140	185	100

Source: Colorado State University (http://typhoon.atmos.colostate.edu/Forecasts/).

For non-life insurers, the most important source of risk remains the potential for losses associated with catastrophic events, either from natural sources or from terrorism. Against the backdrop of a debate on the long-term impact of climate change on the insurance sector (see Box 16), the medium term remains fraught with risks, which is in distinct contrast to the very favourable environment that reigned in 2006. Largely due to a rapid dissipation of El Niño conditions early in the year, 2007 is expected to bring a renewed wave of hurricanes to the US Atlantic coast (see Table 5.1), with associated costs for the non-life insurance sector.

Hedge funds have reportedly significantly increased their exposure to insurance securities. Notwithstanding the increase in insurance capacity and greater efficiency in the sector that this has brought about, questions remain about the ability of reinsurers to cover the claims of a widespread catastrophic event in the event that the hedge fund sector could be unable to service the covered exposure. In addition to the possible mismatch between the short-term orientation of such investments and the longer-term nature of the reinsurance business, movements of capital triggered by hedge funds' strategic positioning and availability of equity capital may bring additional instability to the reinsurance sector.

A remaining risk for all lines of the insurance business – albeit one with an unknown or low probability of materialising – is the possibility of a pandemic event. No possible outbreaks have been reported since the December 2006 FSR was finalised, however, and there are no indications that the probability of such a risk materialising has changed.

12 See Box 14 in ECB (2006), *Financial Stability Review*, December, for a discussion on hedging longevity risk.

Box 16

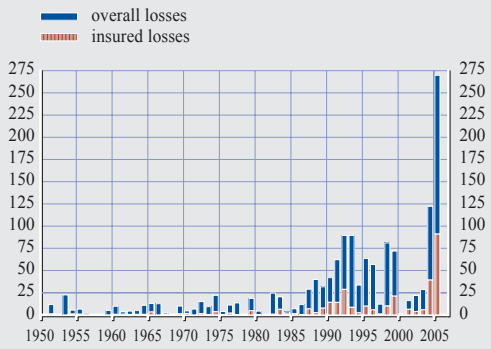
THE EFFECTS OF GLOBAL CLIMATE CHANGE ON THE EURO AREA INSURANCE SECTOR

Recent reports suggest that the earth's climate is becoming more volatile as a result of both human activity and natural variability. Indeed, the occurrence of extreme weather events such as drought or flooding has increased in recent years, as have heatwaves and windstorm activity.[1] As a result, financial losses and insured financial losses owing to global weather disasters have increased

1 See Intergovernmental Panel on Climate Change (2007), "Fourth Assessment Report – Climate Change 2007: The Physical Science Basis", and UK HM Treasury (2006), "Stern Review Report on the Economics of Climate Change", October.

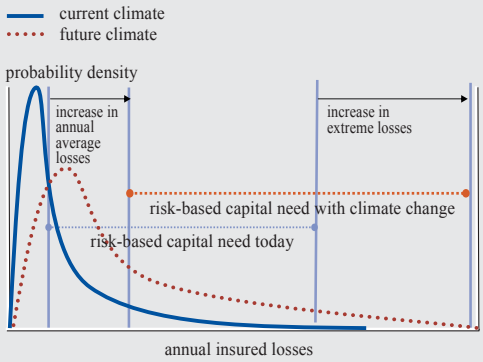
Chart B16.1 Overall and insured losses from global great weather disasters

(USD billions, 2006 values)



Source: Munich Reinsurance Company.
Note: "Great weather disasters" are defined by the UN and include events when interregional or international assistance is needed, thousands are killed, hundreds of thousands are made homeless, and substantial economic losses and considerable insured losses occur.

Chart B16.2 Climate change impact on the loss distribution for the insurance sector



Source: Association of British Insurers (2005), "Financial Risks of Climate Change", June.

significantly, especially over the past two decades (see Chart B16.1). Insurance underwriters and reinsurers offering protection for weather-related damage are increasingly faced with new challenges given the higher occurrence of extreme events. This Box reviews some of the potential risks and challenges that more volatile climate conditions pose for euro area insurers.

Weather-related losses have in the past caused insurers to go bankrupt, increased consumer prices for insurance, and led to withdrawal of insurance coverage.[2] Potentially greater uncertainty about the frequency, intensity and/or spatial distribution of weather-related losses will increase the vulnerability of insurers – in particular reinsurers, since severe and less frequent events are typically reinsured – and could complicate risk mitigation actions and increase the capital needed to cover extreme losses.

The insurance sector requires sufficient capital to bridge the gap between losses in an average year, which are all covered by premium income, and those in an "extreme" year, which are not. Climate change is expected to lead to a shift in the distribution of losses towards higher values, with a greater effect at the tail. Average annual losses (or expected losses) will increase by a smaller amount than the extreme losses, with the result that the amount of capital that insurers will be required to hold to deal with extremes will increase significantly (see Chart B16.2).

Non-life insurance, such as property and casualty insurance (which accounts for around 40% of total insurance premiums in the euro area) and in particular the related reinsurance segment, has been more vulnerable to weather-related events than the life insurance segment. In the longer term, it is however expected that climate change could also start to have an adverse effect on the life and health and asset management businesses because of the potential impact that climate change could have on, for example, mortality, the economy and financial asset prices. However, owing to structural changes in the industry, the distinction between different insurance sectors is becoming less clear as a result of consolidation and mergers. Greater

2 See Intergovernmental Panel on Climate Change (2001), "Third Assessment Report – Climate Change 2001: Impacts, Adaptation and Vulnerability".

diversification of insurers should prove beneficial when specific losses from one particular business line have to be absorbed.

A more volatile and changed climate has encouraged the creation of new insurance products such as financial protection for ski resorts against lack of snow, or for farmers against drought and flooding. While these insurance segments are exposing some insurers to more weather-related risks, they also provide new potential income sources and sometimes diversification possibilities as well.

Insurers typically reduce their financial vulnerability to extreme weather-related losses via risk transfer and risk reduction. Risk transfer usually takes place through reinsurance companies or directly through the capital markets. Insurers and in particular reinsurers can transfer part of the risk associated with natural disasters to the capital markets using instruments such as weather derivatives and catastrophe bonds.[3]

Exchange-traded weather derivatives are usually linked to widely followed measures such as temperature and rainfall, whereas bilateral deals traded over the counter are typically tailor-made for specific risks. Tradable indices are also starting to emerge. For example, UBS has recently launched a global warming index which is a tradable benchmark for global investments in the weather derivatives market.[4] Catastrophe bonds, by contrast, transfer a specified set of risks, such as natural disaster risks, from the insurer to the capital markets with a bond structure where the interest and/or the principal are forgone when a pre-defined catastrophic event occurs.[5] Whereas these insurance-linked securities have existed for a number of years, related CDO structures are relatively new. The use of risk transfer instruments by insurance companies increases the scope of risk spreading, but can also create new potential risks for financial stability. The sometimes complex structures of these instruments has underlined the need for sound risk management practices not only among institutional investors buying these instruments, but also among other investors, such as hedge funds, who have shown great interest in the extreme catastrophic risk market.

Whereas risk spreading is mainly an economic and distributional process, risk reduction focuses more on technology, environmental management, land-use planning, engineered disaster preparedness/recovery, and predictive modelling. Insurance companies' knowledge and rich historical data are useful for better understanding and identifying risks and for developing loss prevention in the form of, for example, land-use planning and fortifying property to withstand wind and floods. Insurance companies are also starting to include climate analysis in their loss models. For example, the reinsurer Swiss Re will incorporate results from a study which found a direct link between climate change and insurance losses in its proprietary windstorm rating tool.[6]

The euro area insurance sector, and in particular the reinsurance segment, is increasingly prepared to handle possible future high-impact, albeit low-probability, events, or several closely spaced events affecting parts of the sector and individual insurers. Trends toward diversifying business lines, together with improved tools to transfer and spread risk, should help maintain the robustness of the insurance sector.

3 See, for example, U. Hommel and M. Ritter, "New Approaches to Managing Catastrophic Insurance Risk", in M. Frenkel, U. Hommel and M. Rudolf (eds) (2005), *Risk Management – Challenge and Opportunity,* 2nd edition, Berlin: Springer Verlag.
4 See UBS (2007), "UBS Investment Bank Launches UBS Global Warming Index", press release, 24 April. UBS motivated the launch of this index by noting that global warming has created much more volatility in temperature and weather conditions, which has led to high growth and increased liquidity of weather derivatives.
5 For a more detailed description of catastrophe bonds, see Box 15 in ECB (2005), *Financial Stability Review,* June.
6 See Swiss Re (2006), "The Effects of Climate Change: Storm Damage in Europe on the Rise".

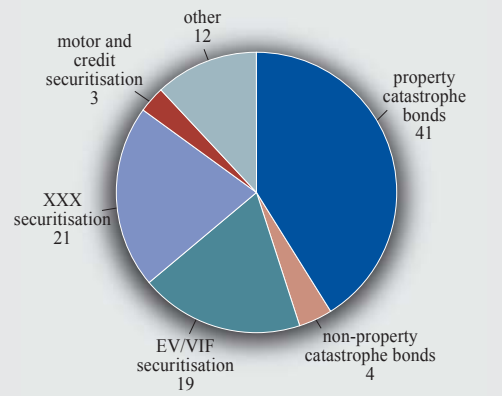
Internal factors affecting insurers' fragility

Greater focus on risk management, risk-adjusted pricing and core profitability continue to underpin a positive outlook for the insurance sector, especially for large firms where change is more evident. Improvements in asset liability management, together with more efficient capital structures – resulting from growing use of securitisation and issuance of hybrid capital and subordinated debt – have generally bolstered positive market valuation and risk indicators.

Use of improved risk management tools and catastrophe models became particularly evident among reinsurers after the 2005 catastrophes, both in terms of changes to the underlying assumptions of the models, and the level of reliance placed on their estimations. This reappraisal of risk has motivated a general increase in reinsurance premiums, which has resulted in some primary insurers keeping more of the insured risk. While in the long term more efficient risk pricing can only improve the way risks are spread within the insurance sector, some transition costs cannot be excluded, such as the failure of – primarily small – firms which lack the required experience. Furthermore, the reduction in reinsurance capacity and the ensuing price hike have increased the interest in insurance risk in the capital markets, possibly driven by the short-term potential for high returns. This has been observed in the greater willingness to (re)finance traditional insurance vehicles, and in the more direct forms of risk assumption, such as through "sidecars" and catastrophe bonds throughout 2006.[13]

Chart 5.9 Global insurance securitisation instruments

(2006, %)



Source: Fitch Ratings.
Note: Excludes sidecars and weather and property risk futures traded on exchanges. "XXX securitisation" is the securitisation of excess statutory reserves and is US-specific. EV denotes "embedded value", and VIF "value of in-force".

In both 2005 and 2006 the global insurance securitisation market grew well above trend, reaching around €22 billion by the end of 2006. Although still growing, the insurance securitisation market remains small compared to other securitisation markets and to European life reserves, with around €7 trillion and €1.5 trillion of global non-life premiums respectively. The growth of insurance securitisation has been hampered by various factors, such as difficulties in aligning the interest of investors and insurers, limited investor confidence owing to the limited size of the market, and the sometimes complex and non-standardised structures, which are expensive and time-consuming to structure or for investors to analyse.

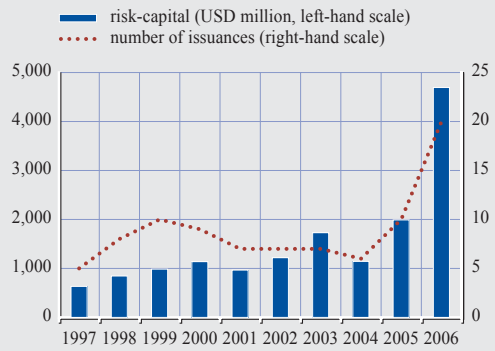
Securitisation has mainly taken the form of catastrophe bond issuance (see Chart 5.9), with global issuance in 2006 totalling USD 4.7 billion, more than twice as much as in 2005 (see Chart 5.10). Outstanding capital increased to USD 8.5 billion, compared with USD 4.9 billion in 2005.

While catastrophe bond issuance has become more standardised, sponsors have shown a growing inclination for innovation, including the introduction of hybrid triggers. These triggers, which generally rely on a combination of two or more existing trigger types, are intended to reduce sponsors' basis risk while, in most cases, also preserving a non-indemnity structure that is palatable to catastrophe bond investors.

13 See Guy Carpenter (2007), "The Catastrophe Bond Market at Year-end 2006 – Ripples into Waves", February.

Chart 5.10 Global catastrophe bond issuance

(1997 - 2006)



Source: Guy Carpenter.

Although the growing use of insurance securitisation and the potential for further growth should help insurers to transfer risks and therefore reduce potential vulnerabilities, some insurers are also large investors in the insurance securitisation market as part of their asset management, and could therefore face and magnify losses from insured events that are securitised.

In the aftermath of the turmoil in the US sub-prime mortgage sector (see sub-section 1.2), mono-line financial guarantors became the focus of attention owing to their prominent participation in the securitised business and in the transfer of credit risk from the banking sector. For the past decade, financial guarantors have maintained a large and increasing exposure to RMBS, including securitisations backed by non-prime/sub-prime mortgage assets. Financial guarantors appear relatively well positioned to withstand stresses placed on securitisations in the event of financial strains among the less stable RMBS originators and servicers. However, individual instances of problems, such as with a net interest margin (NIM) transaction or a mezzanine exposure, cannot be ruled out. Reassuringly, this sector remains relatively small in the euro area, and these exposures are likely to be isolated and small in relation to each financial guarantor's capital base and level of earnings.[14]

Greater focus on core profitability in the non-life sector has reportedly led to substantial premium competition, possibly embodying – if this has gone beyond the efficiency gains provided by better risk pricing – the risk of net wealth erosion and a resulting increase in the fragility of non-life insurers.

In relation to changes in the regulatory environment, as large firms in the sector continue to implement international accounting standards, any increase in volatility that may occur is likely to be outweighed by the benefits to market participants of greater transparency and a better management of risk in firms' balance sheets.

Looking further ahead, Solvency II should further strengthen risk management by recognising risk diversification and mitigation benefits, especially by enlarging the spectrum of eligible elements for regulatory capital (thereby optimising capital structures), and by an increased use of securitisation, subordinated debt and hybrid capital as funding sources. These positive implications notwithstanding, and as already mentioned in the December 2006 FSR, Solvency II may however lead to some stresses in the short term, as relatively small or inefficient insurance undertakings unable either to implement adequate risk management tools or to invest in financial and human resources could be forced to exit the market. Greater income volatility could also prevail in the medium term owing to more risk-responsive capital requirements. However, the overall drive for efficiency might lead to a higher concentration of risk in reinsurers' balance sheets and to a higher preponderance of rating triggers being included in reinsurance contracts, exposing reinsurers to significant liquidity risk on the liability side. This risk is likely to be ameliorated as securitisation transfers such risks to the capital markets.

14 Fitch Ratings (2007), "Subprime Worries? Financial Guarantors Exposure to Weaker RMBS Originator/Servicers", March.

The challenges for the financial sector as a whole posed by the continued creation of financial conglomerates as identified in the June 2006 FSR remain, as the potential pressure for consolidation stemming from regulatory developments is expected to continue in the short to medium term.

THE SHOCK-ABSORPTION CAPACITY OF THE INSURANCE SECTOR ON THE BASIS OF MARKET INDICATORS

Following a period of decline in November 2006, the euro area insurance stock price index rebounded in December 2006 and early 2007 amidst subdued implied volatility levels (see Chart 5.11). As a consequence of the market turbulence in late February/early March 2007 (see sub-section 1.2 and Section 3), however, stock prices declined sharply and implied volatility increased abruptly. Unlike the episode of turbulence in the financial markets in May/June 2006, its implied volatility had not returned to pre-incident levels, indicating that the uncertainty had not fully dissipated by early May 2007.

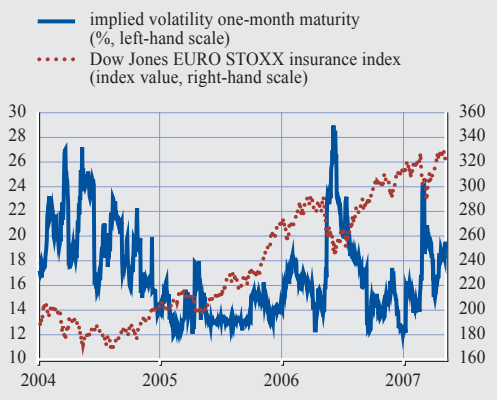
Relative to the market as a whole, the euro area insurance stock index fell further than the overall index, and its volatility rose well above that of the overall index (see Chart 5.12), thus repeating the pattern observed in early 2006, and highlighting the sensitivity of these measures.

Looking further ahead, the overall positive outlook for the euro area insurance sector a year ahead continued to be priced into median EDFs (see Chart S126). This outlook was also implied in asset swap spreads between senior and subordinated insurance debt, which have remained above the lows observed in early 2005 and 2006 (see Chart S127).

Risk reversal quotes and strangles of the Dow Jones EURO STOXX insurance stock index – which measures the market's assessment of large downward movements in insurers' stock prices and expected volatility in the volatility of stock prices – provide yet another angle with regard to the risk outlook. Risk reversals remained negative and thus continued to point in the direction of downward risks, especially in the aftermath of the market turbulence in late February/early March 2007 (see Chart S130), indicating that market participants regard the likelihood of a significant decline in insurance stock prices as outweighing the likelihood of a significant increase. This notwithstanding, a small increase in the value for strangles indicates that the probability assigned to

Chart 5.11 The Dow Jones EURO STOXX insurance index and its implied volatility

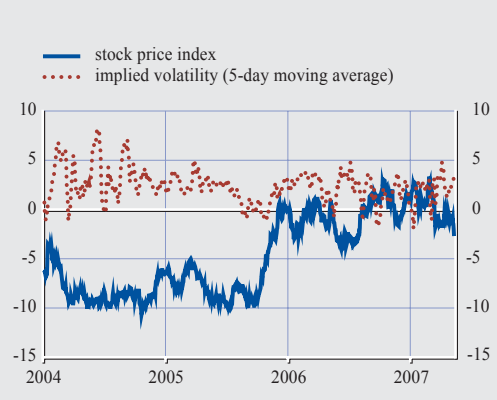
(Jan. 2004 - May 2007)



Source: Bloomberg.

Chart 5.12 The Dow Jones EURO STOXX insurance index and its implied volatility relative to the overall EURO STOXX index

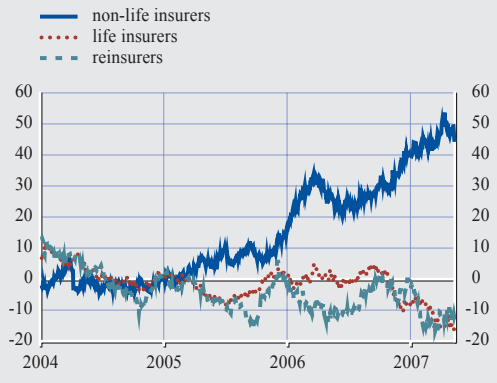
(Jan. 2004 - May 2007, %)



Source: Bloomberg.

Chart 5.13 Cumulative changes in the insurance stock indices relative to the Dow Jones EURO STOXX index

(Jan. 2004 - May 2007, % points, base: Jan. 2005 = 100)



Source: Thomson Financial Datastream.

extreme events, either positive or negative, is perceived as smaller. Such a decrease in uncertainty underlines the confidence in the sustainability of the performance of euro area insurers, despite the possibility of a further decline in equity prices.

The wide dispersion of equity-based performance across insurance business lines persisted after the publication of the December 2006 FSR (see Charts 5.13, S128 and S131). In contrast to the ongoing strong equity performance of insurers with primarily non-life business, reflecting the favourable conditions throughout 2006 and the ongoing progress in restructuring non-life business, the erosion observed in the life and reinsurance business lines may be related to market concerns about the challenges ahead for these sectors.

OVERALL ASSESSMENT

Generally favourable developments in the financial conditions of primary insurers and reinsurers in 2006, together with greater focus on risk management and risk-adjusted pricing, have continued to support a positive outlook for the euro area insurance sector as a whole.

Further improvements in asset liability management, together with improved capital structures owing to increased use of securitisation and issuance of hybrid capital and subordinated debt, have further strengthened the generally positive outlook for insurers. Looking at the regulatory environment further ahead, Solvency II should strengthen risk management practices by recognising risk diversification and mitigation benefits, and especially by enlarging the range of eligible elements for regulatory capital, thereby optimising capital structures, and by increasing the use of securitisation, subordinated debt and hybrid capital as funding sources. The preparations by insurers for the introduction of Solvency II may, however, lead to some stresses in the short term, as relatively small or inefficient insurers not capable of either implementing adequate risk management tools or of investing in financial and human resources could be forced to exit the market.

Relatively strong demand for life insurance is expected to be maintained as the share of retirees in the population increases and pension reforms aimed at shifting public old age provisions to private schemes continue to be introduced in several euro area countries. Tax and pension reforms, however, might shift the demand for life insurance products to pension funds, and life insurers are still faced with longevity risks. Life insurers might also be challenged if financial market risks and risks related to financial market volatility increase.

Despite the favourable developments in the non-life business, continued strong competition among non-life insurance businesses is likely to keep premium rates at bay and thus pose challenges for profitability. At the same time, tight competition among non-life insurers may increase their willingness to take on more risk and to transfer some of this risk to the reinsurance sector, which may in turn pass it on to the capital markets. With expectations of higher levels of insured losses from natural catastrophic events, non-life businesses could also face some challenges.

Euro area reinsurers successfully overcame the large insured catastrophe losses in 2005, and

their capital positions were strengthened during 2006 thanks to low insured losses and rising premium rates in many segments. As the sector continues to refine the financial instruments needed to manage risks more effectively, as well as to widen the investor base for diversifying those risks, the medium-term outlook of the sector should remain positive. However, the forecasted increase in 2007 of natural catastrophes such as hurricanes still poses risks to reinsurers.

Forward-looking market indicators signal some uncertainty and the potential for a worsening of conditions in the euro area insurance industry. Although few defaults are expected in the period ahead, insurers' overall stock prices fell by more than the overall stock market during the February 2007 turmoil in financial markets, and other forward-looking indicators suggest that fragilities in the sector have not fully dissipated.

6 STRENGTHENING FINANCIAL SYSTEM INFRASTRUCTURES

Ensuring the safety and efficiency of payment, clearing and settlement systems is primarily the responsibility of their operators. However, since safeguarding the safety and efficiency of such financial market infrastructures are also key public policy objectives, central banks have a distinct and important role to play as overseers. In this role, they set and enforce oversight standards and oversee compliance with them. In doing so, they contribute to the safety and efficiency of financial market infrastructures and infrastructure service providers. The reasons for entrusting central banks with this oversight function are straightforward: financial market infrastructures, together with the services they use, form the transmission channels for monetary policy and are the networks which allow market participants to settle their financial and business transactions. If market infrastructures and services were to face substantial risks and vulnerabilities, e.g. legal uncertainties or operational problems, and if such risks or vulnerabilities were to materialise, they could adversely affect the efficient flow of goods, services and financial assets in the economy. Indeed, malfunctioning market infrastructures and unreliable, insecure or inefficient provision of market infrastructure services would ultimately affect the stability of the financial system and lead to systemic risk.

As in previous editions of the FSR, the central banks as overseers continued to rate the financial market infrastructures as satisfactory overall. Since the December 2006 FSR, the stability of the financial system has been maintained by the key euro market infrastructures as well as the main infrastructure service providers. In particular, the Trans-European Automated Real-time Gross-settlement Express Transfer (TARGET) system and the Continuous Linked Settlement (CLS) system operated by CLS Bank International have continued to run smoothly and have maintained high levels of safety and efficiency in the period under review. None of the handful of incidents that have occurred since the December 2006 FSR have had any serious systemic implications or any adverse impact on the stability of the financial system.

Sub-section 6.1 discusses from an oversight perspective the developments in TARGET, CLS and S.W.I.F.T. (the Society for Worldwide Interbank Financial Telecommunication, henceforth simply SWIFT) since the December 2006 FSR. Furthermore, it examines the common methodology for the assessment of systemically and prominently important euro payment systems which the Eurosystem has developed to ensure that oversight standards are enforced in a consistent manner, hereby ensuring a level playing-field for all relevant stakeholders. Since the provision of payment and settlement services and the smooth functioning of market infrastructures and infrastructure service providers require a sound legal environment, this section also sheds some light on the latest developments regarding the envisaged new legal framework for payment services in the EU.

Sub-section 6.2 reports on the latest developments in the field of confirmation, matching, clearing and settlement arrangements for OTC derivatives, as recently published by the G-10 Committee on Payment and Settlement Systems (CPSS; see Box 17), and follows up on the June 2005 FSR, which reported on the substantial growth of the OTC derivatives markets in recent years, and the somewhat underdeveloped post-trading infrastructure for these markets, involving operational and risk issues such as backlogs of unconfirmed credit derivatives trades.

6.1 PAYMENT INFRASTRUCTURES AND INFRASTRUCTURE SERVICES

OVERSIGHT OF PAYMENT INFRASTRUCTURES

Payment oversight is a central bank task which is principally intended to promote the smooth functioning of payment systems and thus contribute to the stability of the financial system. The objectives of oversight are to protect the financial system from possible domino effects (systemic risk) which may occur when one or

more participants in the payment system introduce legal risks to the system and/or incur credit or liquidity problems, and to foster the efficiency and soundness of payment systems. Overseers carry out this task by using a variety of tools and methods to set and enforce oversight standards. The Eurosystem has been applying the "Core Principles for Systemically Important Payment Systems"[1] as its minimum oversight standard for payment infrastructures since January 2001. The constant monitoring of developments in payment infrastructures, in particular those that process and/or settle large volumes and values of cash flows, is a key element of effective oversight, and contributes to maintaining and promoting robust financial systems.

The following sub-sections provide an account of how the two key payment infrastructures that process and settle euro transactions (TARGET and CLS) have performed since the December 2006 FSR, and examine how they have contributed to financial system stability. In addition, this section explains how central banks have further enhanced the oversight framework of financial market infrastructures with the aim of supporting the operators in striving for high levels of safety and efficiency and ensuring the smooth operation of their systems and services.

DEVELOPMENTS IN KEY EURO PAYMENT INFRASTRUCTURES

TARGET

Owing to its criticality, the Eurosystem has a strong interest in the robust and resilient functioning of TARGET.[2] The structure and features of the existing TARGET system have remained unchanged in the reporting period; meanwhile, preparations are underway for the planned start of TARGET2 on 19 November 2007.

The average daily volume and value of transactions processed in TARGET continued to grow steadily between October 2006 and March 2007. In the reporting period, the average daily value settled in TARGET stood at €2.2 trillion, with an average daily volume of 348,000 transactions. With a share of around 90% in terms of value and 60% in terms of volume of total euro payments settled in systemically important euro payment systems located in the euro area, TARGET maintains its unambiguous leading position (see Chart S132). In comparison, EURO1,[3] the second largest euro payment system in the euro area in terms of value, processed a daily average of €207 billion in the same period.

No remarkable changes have taken place over the past six months in the concentration of TARGET turnover in the five largest national RTGS[4] systems (Germany, France, Spain, Italy and the UK), through which 83% of the value and 82% of the volume of all TARGET transactions were processed. The most important national TARGET component is the German RTGSplus system, with a 28% share of the total settlement value (see Chart S133).

One of the main features of TARGET – and of the forthcoming TARGET2 system – is that payments are settled with immediate finality in order to eliminate credit and systemic risk. The real-time processing capability of TARGET is characterised by the length of the average processing time. In the reporting period, 97.53% of all TARGET transactions were processed in less than 5 minutes (compared with 95.60% in

1 See CPSS (2001), "Core Principles for Systemically Important Payment Systems", BIS, January. The Core Principles are also part of the compendium of 12 standards that the BIS-located Financial Stability Forum considers essential for safeguarding financial stability. For a brief description of the Core Principles and their applicability in the euro area, see Box 16 in ECB (2005), *Financial Stability Review*, June.

2 With regard to Slovenia's entry into the euro area, Banka Slovenije (unlike Eesti Pank and Narodowy Bank Polski, whose euro RTGS systems are connected to TARGET via Banca d'Italia and its BIREL system) decided not to develop its own euro RTGS system, but rather to use the RTGS system of the Deutsche Bundesbank. As a result, an oversight review was not considered necessary as no new infrastructure was being introduced into TARGET.

3 The EURO1 system is the largest privately run payment system for euro credit transfers. It is operated by the CLEARING company of the Euro Banking Association (EBA CLEARING).

4 RTGS stands for real-time gross settlement system. This is a settlement system in which processing and settlement take place on an order-by-order basis (without netting) in real time (continuously).

2005), 2.07% were processed in 5 to 15 minutes (3.58% in 2005), and 0.24% in 15 to 30 minutes (0.40% in 2005). The frequency of TARGET transactions which took more than 30 minutes to process was just 0.17% of all cases. Moreover, TARGET maintained a very high level of operational availability; the overall availability ratio reached 99.84% in the reporting period (see Chart S134), which represents practically the highest figure since the system started operating in 1999.

As part of their regular TARGET oversight activities and in view of contributing to TARGET's continued compliance with CPSS Core Principle VII,[5] TARGET overseers also analyse information on the number, duration and types of TARGET incidents. Particular focus is placed on the analysis of significant incidents, i.e. those lasting more than two hours and/or resulting in a delayed closing of TARGET, and their possible impact on the security and operational reliability of the system. There were four such incidents in the reporting period, including one that delayed the closing of TARGET. The root cause of all of these major incidents was software failure. The oversight function concluded that these incidents were properly followed up by the TARGET operation function, and that there was no adverse impact on the TARGET system's observance of Core Principle VII in the reporting period.

Continuous Linked Settlement (CLS)

The CLS system was launched in September 2002 by CLS Bank International, New York. It is regarded as the industry's response to the central banks' policy objective and strategy for reducing systemic risk arising from settling foreign exchange (FX) trades.[6] From the outset, CLS was designed to serve a single purpose: the multi-currency settlement of FX trades in its books on a payment-versus-payment basis, thereby synchronising the two legs of an FX transaction and thus virtually eliminating FX settlement risk. The Federal Reserve is the primary supervisor of CLS Bank and is the lead overseer of CLS within a cooperative oversight arrangement comprising all central banks whose currencies are settled in CLS. The ECB is the overseer for the settlement of euro.

Today, CLS settles 15 of the world's most-traded currencies and is the largest payment infrastructure settling the euro outside the euro area. Since its inception the usage of CLS has steadily increased. Between 1 October 2006 and 31 March 2007 the volumes and values of FX trades settled in CLS grew further, thereby substantially reducing systemic risk and increasing the overall stability of the financial system. On 16 January 2007 CLS registered its highest volume to date (705,582 transactions[7] after a USD currency holiday and some volatility on the FX market after the Bank of England had raised its bank rate by 0.25 percentage point to 5.25% on 11 January 2007), while on 20 December 2006, a quarterly futures settlement day, it recorded a new highest value (of 6.62 trillion USD equivalent). Between October 2006 and March 2007 CLS settled on average 286,000 transactions per day with a daily average total value of 3.1 trillion USD equivalent, thus eliminating an equivalent USD 2.9 trillion of FX settlement risk (see Chart 134). The daily average euro values settled via CLS in this period amounted to

5 Core Principle VII reads as follows: "The system should ensure a high degree of security and operational reliability and should have contingency arrangements for timely completion of daily processing."

6 FX settlement risk is defined as the risk that one party to an FX transaction pays for the currency it sold, but does not receive the currency it bought. In the literature, this risk is often referred to as Herstatt risk, after the collapse of the German Bankhaus Herstatt in 1974 and its impact on US counterparties that, because of time zone differences in a correspondent banking environment, faced large FX settlement exposures to Bankhaus Herstatt and thus incurred substantial losses.

7 The volumes and values of settled FX transactions are twice the size of the volumes and values of FX trades because every trade involves two settlement legs, one in each currency. Thus, CLS settled an average of 143,000 trades a day with a total value of USD 1.5 trillion.

8 The reduction of FX settlement risk is smaller than the values actually settled in CLS because participants can trade down their positions in CLS via so-called inside/outside swaps ("I/O swaps"), whereby two participants conclude two opposite trades, one to be settled in CLS (the inside leg of the swap) and the other one (the outside leg of the swap) to be settled outside CLS, e.g. via traditional FX settlement methods such as correspondent banking. Because the outside leg of the swap reintroduces FX settlement risk, the value of the I/O swaps needs to be deducted from the values settled in CLS to obtain the real reduction of FX settlement risk achieved by CLS.

€442 billion, eliminating FX settlement risk of approximately €421 billion.[8]

In terms of operational reliability, CLS has remained robust and resilient since it started operating more than four years ago. A few issues, e.g. pay-in delays because of connectivity problems, slightly delayed the achievement of business deadlines, but these incidents had no serious systemic implications. Since the finalisation of the December 2006 FSR, the settlement completion rate for the FX trades to be settled and the payout rate of the funds in the currencies involved via the relevant RTGS systems, such as TARGET, were 100% each month.

CLS is preparing for the launch of its services for the settlement of non-deliverable forwards (NDFs) as first announced in 2005; settlement services for FX option premiums will probably be introduced in early 2008. Increasing the number of CLS-eligible currencies is also being discussed, for example to include the Mexican peso and the Israeli shekel in the medium term. The extension of eligible currencies would in principle have a positive impact on the reduction of FX settlement risk and might further increase the operational efficiency of CLS. However, the extension of CLS-eligible currencies still requires further analysis on the part of both CLS and the overseers.

ENHANCEMENTS TO THE EUROSYSTEM'S COMMON OVERSIGHT FRAMEWORK

Assessment methodology

In general terms, the Eurosystem's common oversight framework comprises two layers. First, there is the policy layer, which includes the Eurosystem's minimum oversight standards, as adopted by the Governing Council of the ECB. Second, there is the enforcement layer, which deals with the implementation of the oversight policy and the oversight activities as such. With respect to the second layer, the Eurosystem has inter alia developed oversight assessment methodologies which are designed to give guidance to overseers on the type and level of detail of information needed to ensure a sound and consistent basis for assessing the level of observance by the relevant infrastructures of the Eurosystem's oversight standards.

Until recently, the Eurosystem mainly used two sets of assessment methodologies (the so-called Terms of Reference) for assessing payment infrastructures: one for large-value payment systems (which the Eurosystem regards as being systemically important) and one for retail payment systems (which, depending on whether or not they fulfil certain criteria that are defined in the Eurosystem's "Oversight Standards for Euro Retail Payment Systems",[9] qualify as being systemically important, prominently important, or other systems). The adoption of the Eurosystem's "Business Continuity Oversight Expectations for Systemically Important Payment Systems (SIPS)" (hereafter: "BCOE for SIPS"), which were adopted by the ECB Governing Council in May 2006, led the Eurosystem to enhance further its common oversight implementation framework.[10]

The BCOE for SIPS specify the Eurosystem's interpretation of those aspects of Core Principle VII that deal with business continuity arrangements. They are applicable to any systemically important system irrespective of whether it is a large-value or a retail payment system. The integration of the BCOE for SIPS in the form of an implementation guide into the existing methodologies has resulted in the consolidation of the two assessment methodologies into a single methodology, the "Terms of reference for the oversight assessment of euro systemically and prominently important payment systems against the Core Principles".

So far, the Eurosystem has not disclosed its oversight assessment methodologies, primarily to avoid giving the impression that systems can observe the relevant oversight standards simply by ticking boxes. In the light of previous

9 See ECB (2003), "Oversight Standards for Euro Retail Payment Systems", June.

10 See ECB (2006), "Business Continuity Oversight Expectations for Systemically Important Payment Systems (SIPS)", June; and ECB (2006), *Financial Stability Review,* December.

assessment exercises, the Eurosystem has concluded that the infrastructure operators have fully internalised their responsibility of ensuring that their systems are sound and reliable and have taken into due account the contribution they make to the stability of the financial system. The Eurosystem strongly believes that making the single methodology publicly available will further promote payment infrastructure designers' and operators' understanding of overseers' safety and efficiency concerns, give additional incentives to operators to continue their efforts to mitigate or contain the various risks their systems may face, and ultimately help them to ensure that their systems function smoothly. In the spirit of the Eurosystem's policy of transparency, it is intended that the final version of the single methodology will be made available on the ECB's website following a public consultation between 14 May and 14 August 2007.

OVERSIGHT OF INFRASTRUCTURE SERVICE PROVIDERS

SWIFT

Although SWIFT is a messaging provider between financial institutions and infrastructures and not a payment infrastructure itself, it constitutes a key source of interdependence among the EU financial market infrastructures. The central banks' oversight focuses on technical security, operational reliability, resilience and good governance aspects to prevent SWIFT from posing a risk to the soundness of key market infrastructures and financial stability.

The organisation of the cooperative oversight performed by the central banks of the G-10 countries plus the ECB was described in the December 2005 FSR. The risk-based framework used for the oversight of SWIFT is based on a selection of best practices applicable to IT security and auditing, outsourcing and business continuity. The cooperative SWIFT overseers are in the process of defining a set of applicable oversight standards by taking SWIFT's specific structures and processes into consideration.

The dependence of the European market infrastructures on the messaging services provided by SWIFT underscores the need for the provider to implement and maintain effective and efficient resilience measures which could be activated in case of a major outage or severe disruption to its infrastructure. SWIFT has invested considerable resources in improving its resilience, taking into consideration the impact of extreme case scenarios on its availability.

The successful migration of its FIN messaging[11] service from X.25 to IP technology allowed SWIFT to initiate Phase 2 of this project. This phase deals with the establishment of a single security model, allowing its users to access all SWIFTNet services using public key infrastructure (PKI), which is a widely used industry security standard. Over the past two years SWIFT has completed all preparatory phases involving tests with interface vendors and pilot tests with a selected group of users. Since the beginning of 2007, SWIFT has been assisting its customers in upgrading their infrastructure (software and hardware), a necessary step for completing the migration. The SWIFT Oversight Group has closely monitored and examined both phases of the SWIFTNet migration, assessing all risks via extensive discussions with SWIFT.

DEVELOPMENTS IN THE LEGAL ENVIRONMENT FOR PAYMENT SYSTEMS

The EU Commission's proposal for a Directive on Payment Services was adopted by the European Parliament at its session of 24 April 2007. A general approach on the Directive was already reached at the March 2007 meeting of the EU Council of Ministers of Economic Affairs and Finance (ECOFIN), which means that the legislative process has been completed in its first reading in Parliament.

11 SWIFTNet FIN is SWIFT's core store-and-forward messaging service, enabling its customers to exchange financial data in a secure and resilient way. X.25 is a data communications interface specification adopted as a standard by the International Consultative Committee for Telegraphy and Telephony (CCITT).

According to the Directive, payment services can only be carried out by authorised payment service providers. These include existing credit institutions, electronic money institutions, post office giro institutions, and a new category of payment service providers which is introduced in the Directive, the so-called payment institutions. The Directive also sets out standardised rights and obligations for providers and users of payment services in the EU, and enhances consumer protection by making the payment service provider liable for incorrect execution, and by introducing a guarantee of full and timely payment.

The Directive is an important step towards realisation of the Single Euro Payments Area (SEPA). It will greatly facilitate the operational implementation of SEPA instruments by the banking industry, as well as their adoption by end-users, by harmonising the applicable legal framework. This will provide the foundations for a single "domestic" euro payments market. The Directive will also underpin consumer protection and enhance competition and innovation by establishing an appropriate prudential framework for new entrants to the retail payments market. This should encourage technological progress and the realisation of new product opportunities, such as e-invoicing, which can provide major benefits to the wider economy. The Directive should be transposed into Member States' national law by 1 November 2009 at the latest.

6.2 SECURITIES CLEARING AND SETTLEMENT INFRASTRUCTURES

DEVELOPMENTS IN THE POST-TRADING ENVIRONMENT OF OTC DERIVATIVES MARKETS

In 1998 the BIS published a report[12] summarising practices for the settlement of OTC derivatives, and since then this segment has grown considerably. This report focused on (i) risks from delays in documenting OTC trades, (ii) the use of collateral to mitigate counterparty credit risk, and (iii) the clearing of OTC trades via a central counterparty to mitigate credit risk. As a follow-up, the CPSS published a report entitled "New Developments in Clearing and Settlement Arrangements for OTC Derivatives"[13] in March 2007. This report records progress made regarding the three issues identified in 1998, and additionally investigates three new issues: (i) the risks associated with prime brokerage services for OTC derivatives, (ii) the risks from unauthorised transfers of trades to third parties (assignment or novation), and (iii) the potential for market disruption from the close-out of OTC trades following the default of a major participant or a few large participants, or during market stress (see Box 17).

The report also encourages market participants to automate their processes with a view to mitigating credit and operational risks in this rapidly growing market. A number of vendors are competing in offering automated services for the clearing and settlement of OTC derivatives. In parallel, in 2003 the Depository Trust and Clearing Corporation (DTCC) launched an automated matching and confirmation service for CDS, followed by a "trade information warehouse" in November 2006 to keep trade details of CDS. Moreover, since 1999 LCH.Clearnet has been the clearing house for 40% of all OTC interest rate swaps. At this stage, all these solutions are successfully coexisting, each model with its own advantages and disadvantages.[14]

Regulators will continue to monitor closely the above developments, as well as legal issues and back office robustness related to prime brokers.[15]

12 See BIS (1998), "OTC Derivatives: Settlement Procedures and Counterparty Credit Risk. Report by the CPSS and the Euro-currency Standing Committee of the Central Banks of the G10 Countries". According to BIS data, by end-June 2006, the notional amounts of OTC derivatives stood at USD 370 trillion, 24% higher than six months before, while gross market values, which measure the cost of replacing those contracts and are a better estimate of market risk, stood at USD 10 trillion, an increase of 3% compared with six months before.

13 See CPSS (2007), "New Developments in Clearing and Settlement Arrangements for OTC Derivatives", BIS, March.

14 In 1998 the report had contemplated the expansion of central counterparty clearing to OTC derivatives as a way of mitigating counterparty credit risk.

15 Prime brokers are regulated firms that grant credit and offer clearing and settlement services to clients, e.g. hedge funds.

Regarding the specific issue of backlogs in credit derivatives in particular, in September 2006 several regulators met in New York with market participants to review the progress that had been made by major dealers to strengthen the infrastructure for credit derivatives. According to data provided by the International Swaps and Derivatives Association (ISDA) in its 2006 Operations Benchmarking Survey,[16] the average number of business days elapsing between trading date and execution of the confirmation for credit derivatives has been reduced, dropping from 21.1 in 2003 to 12.9 in 2006. While the average time needed to confirm other plain vanilla products has remained almost unchanged over the same period of time, equity derivatives, which have experienced consistent volume growth, have shown persistent and noticeable backlogs in executing confirmations. The response of the regulators and the market was immediate. On 21 November 2006, 17 dealers committed themselves to promoting automation, streamlining documentation and reducing the average number of business days needed to execute confirmations in parallel with credit derivatives.

The ECB supports the strengthening of the trading and post-trading infrastructure for OTC derivatives and other financial instruments, in particular by means of:

- periodic portfolio reconciliation[17] by market participants to mitigate credit and operational risks;
- establishment of internal procedures and periodic testing of those procedures by market participants, including all relevant business units, to reveal swiftly their total exposure to all clients, particularly their largest; and
- continued efforts by the industry to reduce the documentation and confirmation backlogs in credit derivatives and, in parallel, the application of the same diligence to other products showing considerable growth, such as equity derivatives.

16 See ISDA (2006), "Operations Benchmarking Survey", Table 2.3, p. 8, available at www.isda.org.
17 This entails verifying the existence of all outstanding trades and comparing their principal economic terms.

Box 17

CPSS REPORT ON "NEW DEVELOPMENTS IN CLEARING AND SETTLEMENT ARRANGEMENTS FOR OTC DERIVATIVES"

This box refers to a CPSS report based on interviews with 35 major dealers worldwide. This report concludes inter alia that any post-trading infrastructure for OTC derivatives should ensure that other service providers, clearing houses, payment and settlement systems have open and fair access to its services and should aim to achieve interoperability with other types of infrastructure.[1]

The report addresses inter alia the following six topics:

1. Unsigned master agreements and outstanding confirmations

The report has established that the market has abandoned the practice of trading without written evidence because of the growth in this business. The number of unsigned masters has, as a result, been significantly reduced, as enforcing closeout netting and collateral is endangered when agreements are not in place. The market has also been working towards improving business practices and reducing the number of outstanding confirmations of credit derivative transactions.

1 Committee on Payment and Settlement Systems (CPSS) (2007), "New developments in clearing and settlement arrangements for OTC derivatives", March.

The same commitments used to reduce backlogs in confirming credit derivatives must be extended to other OTC products so that all OTC derivatives are confirmed promptly after the trade date.

2. Use of collateral

The use of collateral has considerably increased since 1998, with reportedly up to 60% of dealers' open positions with cash now the preferred type of collateral. The report warns against associated liquidity, custody, legal and operational risks, which need to be managed effectively for the benefits of collateral to be realised.

3. Central counterparties (CCPs)

The CCP section describes in detail the default procedures within LCH.Clearnet, the only CCP that clears OTC derivatives, accounting for 40% of the global OTC interest rate swaps. The advantage of CCPs are their operational efficiency and network externalities, as well as novation and the accompanying mitigation of credit risk.

4. The valuation of outstanding positions in the case of default

In 2005 the Counterparty Risk Management Policy Group II, a market group, raised concerns with respect to orderly closeout during market stress or for illiquid products in a report examining the private sector perspective with regard to financial stability.[2] Regardless of the valuation method specified, the non-defaulting party has a strong incentive to terminate and replace its contracts with an insolvent counterparty as soon as possible rather than delay until market quotations are feasible and thus expose itself to additional losses. The report recommends that a) counterparties should discuss ex ante and on a bilateral basis, as well as within their market associations, how they would implement the chosen closeout methodology they have agreed on, so that they can reach a common understanding of the implications of their choice; and b) market participants should work together to identify further steps that can be taken to mitigate the potential impact of the closeout of a major market participant. The report invites market participants to reflect ahead (e.g. to test their internal procedures) and to identify practices to use in times of stress.

5. Prime brokers

Hedge funds centralise their trades upon conclusion with a prime broker, and thus primarily gain operational efficiencies from portfolio margin and collateral set-off. Supervisors should monitor any legal issues with respect to brokerage agreements as well as the robustness of the back offices of regulated firms offering prime brokerage services.

6. Assignments (or novation)

The market has largely abandoned the practice of unilaterally transferring trades to other parties without the written consent of the remaining party in the trade which had an impact on credit and operational risks. In this regard, ISDA's "novation protocol" has provided the market with an efficient way of documenting assignments properly and on a timely basis.

2 Counterparty Risk Management Policy Group II (2005), "Towards Greater Financial Stability: A Private Sector Perspective", July.

IV SPECIAL FEATURES

A BANK INCOME DIVERSITY AND SYSTEMIC RISK

Since the enaction of the Second Banking Directive of 1989, European banks have been permitted to engage in any degree of functional diversification that they consider optimal in terms of risk and return. From a financial stability assessment perspective, it is useful to ask how functional diversification affects risk in the banking system. This Special Feature uses statistical techniques to generate a market-based risk measure, and examines how developments in banks' income components affect this risk measure during times of extreme equity market movements. The main findings are that size and trading income have a positive effect on the systemic risk measure used, while income from traditional intermediation activities is negatively related to the risk measure used.

INTRODUCTION

In Europe, banks' business activities span the areas of banking, securities and insurance. The main regulatory measure that governs these activities is the Second Banking Coordination Directive, which was enacted in 1989. The Directive was intended to create a level playing-field for banks in terms of competition by introducing a single banking license within the EU. This also laid the groundwork for the functional diversification of European banks. Since then, banks have been allowed to operate broad franchises, combining commercial banking, securities, insurance and other financial activities in one business entity.

As a result of these regulatory changes, European banks have been pursuing a variety of different business strategies since the early 1990s. Some have opted to remain active in traditional financial intermediation, focusing on branch-based lending and deposit-taking. By contrast, others have diversified into investment banking, a development comparable to that in the US, where some large banks have set up investment banking subsidiaries.[1]

Several European banks have pursued pan-European and global strategies in investment banking, in some cases expanding through acquisitions. The range of diversified financial groups in Europe extends well beyond investment banking, however. A number of banks have opted for the so-called bancassurance model, combining commercial banking and insurance activities, both underwriting and distribution. Moreover, a large number of banks are also active in brokerage activities, asset management, corporate finance and venture capital. All these non-traditional activities generate non-interest revenues in the form of fees, commission income or trading income.

The issue of how these different business models evolve is important to several stakeholders. A bank's management is concerned about how different revenue streams contribute to bank profitability, both in the short and long term. Shareholders are interested both in this and in a bank's risk profile to the extent that diversification could affect the return on their investment. Finally, public authorities responsible for promoting financial stability are interested in how these developments influence the stability of the financial system.

This Special Feature focuses on how income diversity is related to extreme movements in banks' equity returns as a proxy for financial system stability. It reviews the relevant literature on the impact of revenue diversity on bank risk, and then discusses the measurement of tail risk, how it evolves, and income diversity measures. Subsequently, it provides empirical results and some robustness checks, before ending with some concluding remarks.

1 Under US regulations, these are called Section 20 subsidiaries. These are regulated investment banking subsidiaries of a commercial bank that is eligible to conduct a range of investment banking activities in the US under specific powers granted by the Federal Reserve Board.

REVENUE DIVERSITY AND BANK RISK: A BRIEF REVIEW OF THE LITERATURE

The main idea behind revenue diversity is that a combination of banking, insurance and securities activities could lead to a more stable profit stream than a less diversified model. This is because the revenues from different business lines in a conglomerate are usually less than perfectly correlated. Earlier evidence for the US had already indicated that securities and insurance activities both have the potential to decrease earnings volatility, but that the effect largely depends on the type of diversifying activities that bank holding companies undertake.[2] Expanding banks' activities may reduce risk, with the main risk reduction gains arising from insurance rather than from securities activities.

However, more recent work has tended to find that the opposite is true.[3] For the US, studies using accounting data suggest that increased reliance on non-interest income raises the volatility of accounting profits without raising average profits significantly. There are only minor diversification benefits for bank holding companies, and these gains are offset by increased exposure to more volatile non-interest income activities for more diversified US banks.

Results based on US equity data arrive at a similar conclusion.[4] For a sample of US banks over the period 1997-2004, no significant link between non-interest income exposure and average returns across banks can be established. On the other hand, the volatility of market returns is significantly and positively affected by reliance on non-interest income.

Some evidence suggests that European banks with a greater share of non-interest income activities exhibit a higher level of risk than banks undertaking traditional intermediation activities. Risk is mainly positively correlated with the share of fee-based activities, but not with trading activities.[5] Studies on the effect of diversification on market-based measures of performance and riskiness (and the risk/return trade-off) have found that banks with a higher share of non-interest income in total income are perceived to perform better in the long run. Their franchise values, as measured by Tobin's Q ratio, are positively related to diversification.[6] More importantly, this diversification of revenue streams from different financial activities increases the systematic risk of banks, making the stock prices of diversified banks more sensitive to movements in a general stock market index than non-diversified ones.

To sum up, most of the available evidence identifies various relationships between functional diversification and bank risk in normal economic conditions. However, it is not yet clear how diversified financial institutions will behave in adverse economic situations, and what overall impact revenue diversification could have on banking sector stability in these circumstances. The remainder of this Special Feature therefore focuses exclusively on this aspect.

MEASURING BANKING SYSTEM RISK

The basic approach followed in this Special Feature consists in constructing a measure of

2 Notwithstanding the fact that regulatory impediments to functional diversification were removed earlier and more completely in Europe, most of the empirical evidence is based on US data. See S. H. Kwan and E. S. Laderman (1999), "On the Portfolio Effects of Financial Convergence: A Review of the Literature", *Federal Reserve Bank of San Francisco Economic Review*, 2, 18-31; and A. Saunders and I. Walter (1994), *Universal Banking in the United States*, Oxford: Oxford University Press.

3 See R. DeYoung and K. P. Roland (2001), "Product Mix and Earnings Volatility at Commercial Banks: Evidence from a Degree of Total Leverage Model", *Journal of Financial Intermediation*, 10, 54-84; K. J. Stiroh (2004), "Diversification in Banking: Is Non-interest Income the Answer?", *Journal of Money, Credit and Banking*, 36, 853-882; and K. J. Stiroh and A. Rumble (2006), "The Darkside of Diversification: The Case of US Financial Holding Companies", *Journal of Banking and Finance*, 30, 2131-2161.

4 See K. J. Stiroh (2006), "A Portfolio View of Banking with Interest and Non-interest Activities", *Journal of Money, Credit and Banking*, 38, 1351-1362.

5 See L. Lepetit, E. Nys, P. Rous and A. Tarazi (2006), "Product Diversification in the European Banking Industry: Risk and Loan Pricing Implications", mimeo.

6 See L. Baele, O. De Jonghe and R. Van der Vennet (2007), "Does the Stock Market Value Bank Diversification?", *Journal of Banking and Finance,* forthcoming.

extreme equity market movements and relating this measure to various income diversity measures. The methods draw on extreme systematic risk measures that have been discussed in previous issues of this Review.[7] Further detail is provided in Box A.1.

More specifically, tail betas are estimated for a large set of European banks. A tail beta is the estimated bivariate probability of a crash in a bank's stock return, and is conditional on a market-wide decline (details on how to estimate tail betas are provided in Box A.1). In one sense, it is the tail equivalent of the traditional systematic risk measures derived from asset pricing models.[8]

However, the tail beta measure differs in two main ways from the traditional market beta. First, the tail beta is in general not tied to a specific distribution. This contrasts with the traditional market beta, which has the disadvantage that it is a correlation-based measure based on the multivariate normal distribution. There is ample evidence to suggest that the marginal distributions of (bank) stock returns are not normally distributed, especially in the tail area (the area that represents large losses). As tail betas are based on statistical extreme value theory and are semi-parametric in nature, they do not depend on any distributional assumption. Second, since only the tail part is modelled, estimation only uses data from the tail area and hence is not biased towards the centre. The results are particularly useful for assessing the probability or magnitude of the most extreme negative outcomes.

7 See ECB (2006), "Assessing banking system risk with extreme value analysis", *Financial Stability Review*, June. A more technical account is provided by P. Hartmann, S. Straetmans and C. de Vries (2005), "Banking System Stability: A Cross-Atlantic Perspective", in M. Carey and R. Stulz (eds), *The Risk of Financial Institutions*, Cambridge: NBER.

8 For a more detailed exposition, see S. Straetmans, W. Verschoor and C. Wolff (2007), "Extreme US Stock Market Fluctuations in the Wake of 9/11", *Journal of Applied Econometrics*, forthcoming.

Box A.1

MEASURING BANKING SYSTEM STABILITY USING EXTREME VALUE ANALYSIS

In this Special Feature, extreme value analysis is used to measure banking system stability. The focus is exclusively on extreme downturns in banks' equity returns. The risk measure is a multivariate one, and estimates the probability of a decline or crash in a bank stock index, conditional on a sharp decline in the market portfolio index. The resulting co-crash probabilities provide an indication of systematic risk during crisis periods. They can be seen as a tail equivalent to betas obtained in classical asset pricing models. More specifically, the aim is to obtain estimates of the probability of a large negative return in a bank's equity returns, conditional on a decline in the market index. This can be expressed formally by the following expression: $P(X > x | Y > y) = \frac{P(X > x \cap Y > y)}{P(Y > y)}$,

where X is a bank's stock return (computed as the logarithmic first difference of a return index), Y is the return on the market index (the conditioning asset), and x and y are thresholds in the tail of the distributions. In common with the literature, the negative of the returns is used. The returns X and Y will have different marginal distributions. As a result, the threshold levels x and y will differ for the bank return index (X) and for the market return index (Y). The thresholds are defined such that unconditional events are equally unlikely to occur. This results in $P(X > x) = P(Y > y) = p$, where p denotes a very small probability. In this Special Feature, the quintiles are chosen so that the individual probability of a crash is 0.04%. This unconditional

probability serves as a benchmark to see whether both assets are dependent in the tails. Since the stock returns are observed at daily frequency, this corresponds to an event that happens on average once every decade (= the inverse of 250 times the crash probability of 0.04%).

As the risk measure is particularly interesting owing to its dependency structure, i.e. that X is conditional on Y, the impact of different marginal distributions has to be eliminated. To do this, the original returns series are transformed into series with a common marginal distribution. After this transformation, differences in joint tail probabilities across different banks can purely be attributed to differences in the tail dependency structure of the extremes. For reasons of comparability with the literature, the stock returns are transformed into unit Pareto marginals.[1] This transformation implicitly assumes that the threshold levels x and y are chosen so that the tail probabilities of the univariate events are all equal to p. This can, however, be generalised. The transformation of the return series affects the expression of the conditional probability as follows: $P\left(\tilde{X} > q \middle| \tilde{Y} > q\right) = \frac{P\left(\tilde{X} > q \cap \tilde{Y} > q\right)}{P\left(\tilde{Y} > q\right)} = \frac{P\left(\min(\tilde{X}, \tilde{Y}) > q\right)}{P\left(\tilde{Y} > q\right)}$.

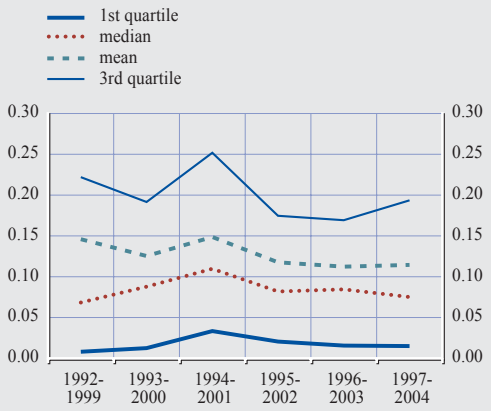
The thresholds for both assets are now normalised to q as a result of transforming the returns series to series with a common marginal distribution. Furthermore, the probability that both assets could exceed the threshold simultaneously can now be rewritten as a probability that the minimum (given that the negative of the returns are considered) of the two series will exceed the threshold. If the lowest value of the pair $(\tilde{X}, \tilde{Y})$ exceeds the threshold, the other will exceed it as well. This reduces the estimation of the multivariate probability to a univariate set-up. The tail behaviour of this univariate minimum series mimics the behaviour of the joint tail. The univariate exceedance probability of the newly created minimum series – $\min(\tilde{X}, \tilde{Y})$ – can now be obtained using univariate extreme value analysis. The crucial parameter will be the tail index of this minimum series, which determines the fatness of the joint tail. This tail index is estimated with a modification of the well-known Hill estimator, and captures the decay of the joint probability mass far from the centre of the distribution. The modified estimator extracts information from a range of conventional Hill estimates, which differ in the number of tail observations included. Weighted least squares is then used to fit a linear relation between the tail index and the number of observations used to estimate it. The intercept of this regression yields an unbiased estimate of the tail index (α). Note that, by using a large number of values of m, the number of observations that determine the tail region, this bias-corrected method is designed to reduce sensitivity to the single choice of m required by the Hill procedure. After estimating the optimal α, an automated grid search is performed to find a stable region in the Hill plot that is as close as possible to the optimal tail index; m is then taken as the midpoint from this region.

1 The empirical counterpart of transforming the stock returns to unit Pareto marginals is based on the following equation: $\tilde{X}_i = \frac{n+1}{n+1-R_{X_i}}$, where i = 1,...,n and R_{X_i} is the rank order statistic of return X_i.

EXTREME RISK MEASURES

This Special Feature uses data from listed banks that have their headquarters in one of the EU15 countries. Furthermore, a number of selection criteria are imposed: only those banks for which at least eight years of information is available from Thomson Financial Datastream are included, and at least eight years of daily stock market returns are needed to measure these extreme risk indicators.

Chart A.1 Co-crash probabilities (tail beta)



Source: ECB calculations.

Since the focus is on both cross-sectional dispersion of bank risk as well as the evolution of risk over time, the sample is rearranged in moving eight-year windows. Following the usual conventions, a liquidity criterion is imposed on the bank stock returns, as infrequently traded stocks may not absorb information accurately.[9] Chart A.1 provides an indication of the evolution of the time series as well as the cross-sectional dispersion in the estimated tail betas for a sample of EU15 banks.

The vertical axis of Chart A.1 shows the conditional probability that a bank will experience an extreme stock price decline given an equally unlikely large decline in the market index. The values are chosen so that the individual probability of a crash is 0.04%. Since the stock returns are observed at daily frequency, this corresponds to an event that happens on average once every ten years (i.e. the inverse of 250 times the crash probability of 0.04%).

The horizontal axis shows the eight-year moving time intervals. The co-crash probabilities are computed over an eight-year period.[10] Moreover, for the banks that are present in the sample for more than eight years, the tail beta is estimated for each eight-year period (which starts in a new calendar year) in the sample. Chart A.1 provides an indication of the time evolution of banks' tail betas, along with the mean, the median, and the 25th and the 75th percentiles of the estimated co-crash probabilities.

Three main observations can be made regarding the extreme risk measure. First, there is considerable cross-sectional heterogeneity over time, with the mean tail beta exceeding the median at each point in time. Although this gap has narrowed, it still remains substantial at around 5%. Second, at the beginning of the sample, the median tail beta increased from 7% to 10%, although in later periods, the mean and median levels declined and became rather stable towards the end of the sample. The median co-crash probability stabilised at 8%. Hence, when the return on the European market index declines, there is an 8% probability that a European bank will simultaneously experience an equally unlikely decline in its stock returns. Third, it seems that many banks have low co-crash probabilities and are thus only moderately vulnerable to market-wide shocks. Many banks have a tail beta (with respect to a broad European index) that is very close to zero. One explanation is that the least vulnerable banks are probably more exposed to local (country) shocks rather than regional

9 Stocks are only disregarded if they have more than 60% zero returns. Although bank stocks slightly below this figure are very illiquid, their non-zero returns could reflect micro-structure effects. Their inclusion does not affect the estimates of extreme risk.

10 The analysis is performed over the period 1992-2004. Only those banks for which at least eight years of information could be retrieved are included in the sample. Moreover, the 13-year sample period is split into moving sub-samples of eight years. For each sub-sample, one year of observations is removed from the sample and replaced by a more recent year for three reasons. First, looking at the same eight years for all banks facilitates comparison of the risk measures at a given point in time. Second, utilising this approach the number of observations for the second part of the analysis was increased. For interest, the results for various sub-periods are not changed substantially (see Table A.1, column (b)). Third, employing extreme value analysis requires a long time series to estimate the measures of tail risk. The choice of eight years is in line with the samples used in the literature.

(European-wide) shocks. This may be true in particular for the smaller banks.[11]

INCOME DIVERSIFICATION MEASURES

To construct the income diversity measures, balance sheet and income statement data on all banks with their headquarters in EU15 countries are needed. To this end, the stock market data were matched with the corresponding data from Bureau van Dijk's Bankscope to produce an unbalanced sample of 520 observations over the period 1992-2004. The independent variables are averages over an eight-year interval which is designed to match the time interval over which the dependent variable is estimated. Hence, the results should provide an indication of long-run relationships.

The main question posed in the introduction of this Special Feature was the extent to which different business activities affect banking system stability. Diversified banks provide a broad array of financial services, from granting loans, underwriting and distributing securities and insurance policies, managing mutual funds and so on. Unfortunately, detailed data on European banks' revenue structures are in general not available either from Bankscope or from published financial results.

Instead, a pragmatic definition of functional diversification was used which distinguishes between banks based on their observed revenue mix. Total operating income is divided into four revenue classes: net interest income, net commission and fee income, net trading income, and net other operating income. This will not bias the results, since these sources of non-interest income capture all income from non-traditional intermediation. This publicly available information forms the basis for analysts and investors to assess the long-term performance potential and risk profile of a bank.

The focus is on the differential impact that different revenue sources have on extreme bank risk. As the shares of net interest income, net commission and fee income, net trading income and net other operating income sum to one, the share of net interest income is left out of the regression equation. This implies that if the coefficients on the other shares are significant, they are likely to exhibit a different risk profile than interest-generating activities.

A number of other bank-specific characteristics were also controlled for. The net interest margin and the loans-to-asset ratio proxy respectively market power and specialisation in traditional banking markets. They are alternative indicators of a bank's dependence on and importance in traditional banking markets. If a bank has a higher interest margin, it may be able to create more rents, and could choose to protect these by engaging in less risky activities. The loans-to-asset ratio captures how specialised a bank is in terms of traditional intermediation activities. A cost efficiency variable was included as a control variable in an attempt to control for any possible relationships between risk and efficiency. A size variable was included to control for the possibility that larger banks may be more prone to market-wide events, and a capital buffer measure was included to control for the fact that better capitalised institutions may be less susceptible to market-wide events.

RESULTS

The results shown in Table A.1 reflect the relationships between various control variables and banks' tail beta measures.[12]

11 This has some support (for ordinary betas) in the empirical banking literature. See L. Baele, O. De Jonghe and R. Van der Vennet (2007), "Does the Stock Market Value Bank Diversification?", *Journal of Banking and Finance*, forthcoming; and O. Castren, T. Fitzpatrick and M. Sydow (2006), "What Drives EU Banks' Stock Returns? Bank-level Evidence Using the Dynamic Dividend-discount Model", *ECB Working Paper*, No. 677.

12 Size and ROE are orthagonalised with respect to all other variables. The regressions always include time and country dummies, and the standard errors are clustered at the country level. Furthermore, the pooling of cross-sectional and time series data of multiple observations on a given bank implies that the data may no longer be independently distributed. Therefore, robust estimation methods that control for groupwise heteroscedasticity were used. In addition, the methods used allow for first-order autocorrelation of the error term, in order to take into account the fact that the tail betas are estimated for overlapping rolling time windows.

Table A.1 Drivers of tail beta: full sample

	Full sample (a)	1997-2004 sub-sample (b)
Constant	0.1983	-0.1264
	[0.322]	[0.154]
Commission and fee income	1.2120 **)	1.3357 *)
	[1.998]	[1.825]
Trading income	3.6292 ***)	4.0100 **)
	[3.522]	[2.547]
Other operating income	1.9656 *)	3.7453 **)
	[1.717]	[2.352]
Net interest margin	-0.3969 ***)	-0.3224 ***)
	[5.255]	[2.998]
Loans to assets	-1.9233 ***)	-2.6089 ***)
	[3.074]	[3.306]
Size	0.6763 ***)	0.4881 ***)
	[15.407]	[8.450]
Equity to assets	-1.5953	-0.6873
	[1.200]	[0.672]
Cost to income	-1.2524 **)	-1.7315 **)
	[2.295]	[2.024]
Return on equity	1.8902 ***)	4.2259 **)
Time and country fixed effects included		
Observations	520	95
Number of banks	129	95
R-squared	0.85	0.77

Source: ECB calculations.
Note: Size and ROE are orthagonalised to all other variables.
z statistics in brackets
*) significant at 10%
**) significant at 5%
***) significant at 1%

Table A.2 Drivers of tail beta: euro area sample

Constant	-0.8928
	[1.157]
Commission and fee income	1.9833 ***)
	[2.680]
Trading income	3.8990 ***)
	[3.604]
Other operating income	1.4388
	[1.034]
Net interest margin	-0.3870 ***)
	[4.745]
Loans to assets	-1.9517 ***)
	[2.648]
Size	0.7601 ***)
	[14.531]
Equity to assets	-2.9610 **)
	[2.016]
Cost to income	-1.6531 ***)
	[2.771]
Return on equity	1.4313 **)
	[2.122]
Time and country fixed effects included	
Observations	403
Number of banks	102
R-squared	0.8641

Source: ECB calculations.
Note: Size and ROE are orthagonalised to all other variables.
z statistics in brackets
*) significant at 10%
**) significant at 5%
***) significant at 1%

The table shows that interest income is less risky than all other revenue streams. This can be inferred from the observation that the coefficients of all other revenue shares are positive. This means that the alternative revenue streams have a more positive impact on banks' extreme risk measures than traditional intermediation activities. The lowest of the coefficients is on the commission income share, although this is still significant at the 10% level. Larger coefficients are obtained for trading income and other operating income. Both are highly significant, and indicate that banks that are more involved in these kinds of activities have a higher tail beta. Trading revenue is the most significant contributor to having a higher tail beta.

The estimation results reveal that other indicators of bank specialisation in traditional intermediation corroborate the finding that traditional banking activities are less risky. Banks with a higher interest margin or a higher loans-to-asset ratio are perceived to be less affected by extreme market shocks, as higher values in these ratios significantly reduce banks' tail betas. Hence, banks that focus more on lending activities are less prone to systemic risk than diversified banks. However, as the balance sheet data do not include the type of lending undertaken by these banks, it is unclear whether certain types of lending reduce tail beta.

Size is by far the most significant driver of banks' tail betas. Larger banks are active in a

Table A.3 Implied changes in tail beta: full sample

	Percentage point change in tail beta
Commission and fee income	1.00
Trading income	1.22
Other operating income	0.95
Net interest margin	-2.91
Loans to assets	-1.77
Size	5.82
Equity to assets	-0.65
Cost to income	-0.95
Return on equity	0.77

Source: ECB calculations.
Note: The implied effects are reported as basis points.

variety of sectors in several countries and are more tied to European-wide shocks. Smaller banks are probably more tied to crashes in a local stock market index as they are predominantly active in their home country. Finally, the ratio of capital to assets exhibits the expected sign, but the coefficient is not significantly different from zero. This variable becomes significant for a smaller sample of euro area-only banks (see Table A.2).

The dependent variable is a probability bounded between zero and one. To recover the implied values of the dependent variable, the left-hand variable in the regression has to be transformed.[13] The effect of a change in one variable on the tail beta is shown in Table A.3. This shows the estimated impact on the tail betas if the value of any independent variable is increased by one standard deviation (and all other ratios are kept at their sample mean). The numbers shown are in basis points.

These implied changes indicate that bank size is by far the most important contributor to heterogeneity in tail risk. A bank that is one standard deviation larger than another bank will, all things being equal, have a 6% higher probability that a large drop in its equity return could occur if there is a large negative shock to the European market return index.

The implied effect of trading income is important in statistical and economic terms. A one standard deviation increase in bank income generated by trading activities increases the co-crash probability by a factor of 1.22. An identical increase in trading income has a larger effect than a parallel increase in commission income.

As expansion into non-traditional banking activities may be capital-intensive, this could be accompanied by a reduction in a bank's lending and consequently interest margins.

ROBUSTNESS CHECKS

The relationships between a bank's tail beta and averages of bank ratios (Tables A.1 and A.2) were estimated using multiple observations on the same banks over rolling eight-year time windows. One possible concern was the potential endogeneity of the relationship. The long-run relationship may have reflected the tradition that riskier banks engage in non-traditional banking activities, rather than the reverse. The equity-to-asset ratio and return on equity could also suffer from the same problem if banks' capital buffers are eroded by unexpected losses due to riskier income activity. Finally, given that the risk measure is based on stock market values, there could potentially be a spurious relationship between trading income and tail betas.

These possibilities were checked using the initial values of the ratio of each of these variables at the beginning of each eight-year period rather than the average values over the full period. For the other variables, the ratios remained eight-year averages. Trading income was still significant, which indicates that trading income causally affects bank risk. Second, return on equity had less of a significant impact. This indicates that part of the risk-return relationship can be attributed to the

13 The estimated regression takes the following form: $\ln\left(\frac{p}{1-p}\right) = X\beta$. The left-hand variable in the regression has been transformed using logistic transformation.

higher profits that risky activities generate. Banks that took on more risk (as measured over an eight-year period) saw higher average profits over that period. Nevertheless, the initial profitability level was still significantly and positively related to a bank's extreme risk exposure. Finally, a bank's initial capital ratio significantly reduces its exposure to extreme systematic risk. The tail betas of financially strong banks (at the beginning of the period) are less affected by a crash in the stock market return index. However, as noted earlier, the relationship is not statistically significant.

Large and complex banking groups (LCBGs) potentially differ substantially from the other banks in the sample.[14] They could exhibit differences in terms of asset liability structure as well as revenue composition. A difference in the means test between LCBGs and the remaining banks in the sample confirmed that both differ in respect of their asset composition and revenue structure. However, a separate regression showed that this variation does not affect the relationships between the revenue variables and the co-crash probabilities, having controlled for various effects including size and capitalisation. After controlling for numerous variables (see Table A.1), a similar change in the revenue structure of an LCBG and a non-LCBG will, all things being equal, lead to a similar changes in these banks' tail betas.[15]

CONCLUDING REMARKS

This Special Feature has investigated the relationship between individual banks' income diversity and extreme risk measures – tail betas – based on equity returns data for euro area and EU15 banks. The main findings are that there is a long-run positive relationship between size, trading income, and tail betas. Size – in terms of assets – and a higher proportion of trading income in total income contribute to a higher tail beta. By contrast, there is a negative relationship between the tail beta measure and interest income and other proxies of traditional intermediation activity, indicating that this tends to generate lower conditional probabilities.

While the present Special Feature has used conditional probabilities, further work could analyse the interaction between various income components; to understand what, if any, diversification effects exist; and whether this systematically affects accounting and stock returns measures. This would be especially useful given the dearth of work in this area for the euro area and the EU compared to that for the United States. Overall, these results confirm the necessity of analysing the underlying sources of profitability of large banking groups when assessing the stability of the euro area and EU financial system.

14 More information on how to obtain the set of LCBGs can be found in ECB (2006), "Identifying large and complex banking groups for financial system stability assessment", *Financial Stability Review*, December. Based on a multiple indicator approach, cluster analysis, it identifies 33 banking groups as LCBGs. 24 of these are located in the EU15, but not all of them are listed.

15 A dummy variable for LCBGs was used. The dummy variable was interacted with each income share. If the dummy was significant, this would have meant that this revenue type has a different impact on tail betas for LCBGs. However, none of the interacted variables were significant.

B GLOBAL MACRO-FINANCIAL DEVELOPMENTS AND EXPECTED CORPORATE SECTOR DEFAULT FREQUENCIES IN THE EURO AREA

Identifying the macro-financial factors that drive the default probability of banks' borrowers and thus the default risk in banks' loan books is important in order to obtain a better understanding of conjunctural sources of risk in the financial system. This Special Feature presents an original approach for modelling the links between a global macroeconomic model already used at the ECB for modelling international economic and financial linkages and corporate sector expected default frequencies (EDFs) in the euro area. The results show that euro area default probabilities are strongly affected by shocks to GDP, stock prices, exchange rates and oil prices. Furthermore, the model is capable of providing robust estimations under a wide range of shocks. It could thus be particularly useful for generating scenarios in order to stress test the resilience of individual banks along with the entire banking system.

INTRODUCTION

Modelling the link between global macro-financial factors and firms' default probabilities constitutes an elementary part of financial sector stress-testing frameworks. This is because default and credit risks show a cyclical pattern which can to a large extent be attributed to observable economic and financial variables. At the same time, with the financial system becoming increasingly globally integrated, the need to consider global rather than country-specific macro-financial factors has increased. Indeed, large banks, such as the euro area large and complex banking groups (LCBGs), are increasingly operating in the cross-border markets both in terms of their lending and their trading activities. This suggests that a global model is needed to analyse the impact of shocks on firm's default probabilities and banks' credit risk.

Nevertheless, previous studies in this field have often been restricted to a limited number of domestic variables. This Special Feature illustrates how to analyse the euro area corporate sector probability of default under a range of macroeconomic scenarios both at the domestic and global level. To this end, a Global Vector Autoregressive (GVAR) model is used, which takes into account a large set of international linkages across macroeconomic and financial variables. In addition, a "satellite" model is constructed to the GVAR, linking the EDFs of different euro area corporate sectors to a set of macroeconomic and financial variables. The results from the combined models (the Satellite GVAR model) show that, at the euro area aggregate level, the EDFs react most to shocks to GDP, equity prices, exchange rates and oil prices. In general, most sectoral EDFs react in a rather similar fashion, except for the EDF for the technology sector, which is relatively more sensitive in the sample period. Overall, the Satellite GVAR model appears to be a useful tool for analysing plausible macro-financial shock scenarios designed for stress-testing purposes.

Before presenting the model and the estimation results, this Special Feature first discusses some issues regarding the importance of the analysis of default rates from a financial stability perspective, together with a brief overview of previous work in this area.

THE IMPORTANCE OF MODELLING DEFAULT PROBABILITY FOR FINANCIAL STABILITY ANALYSIS

Financial institutions, especially banks, are at the heart of the financial system. Ensuring the financial soundness of banks is therefore paramount for safeguarding financial stability. Owing to the wide variety of their activities, banks are exposed to a number of risks. Among these, credit risk – the risk that a borrower may not pay a loan as called for in the original loan agreement, and could eventually default on the obligation – is the most important for banks as it is closely related to their lending activities. Looking at banks' credit risk exposures is therefore a natural starting point for a financial stability assessment, although a more complete

model should also incorporate elements of other parts of the financial system, including financial markets, other financial institutions and financial infrastructures.

For banks, an assessment of the probability that some of their borrowers may default over a given future time frame is an important input to the estimation of the expected losses and economic capital related to their loan portfolio. Expected and unexpected losses in turn determine the amount of funds for impairment charges and capital buffers that banks need to set aside as a cushion for shocks. At the systemic level, central banks and supervisors have a strong interest in the banks' shock absorption capacity, as liquidity and solvency problems in individual banks or groups of banks can easily spread on a wider basis to the system via interbank linkages or common lending exposures.

The default probability of firms and households, and hence the credit risk that the banks face, varies according to the economic cycle. At the same time, putting aside capital for unexpected losses is costly for banks, as these funds could be used to generate additional interest income. In recognition of these facts, the Basel II Capital Accord, which will be implemented in the euro area in 2007, allows banks to use internal models to estimate their risk-weighted assets and capital buffers. This opportunity has spurred great interest among large banks in particular regarding models that allow them to estimate the extent of cyclical variation in their credit risk exposures.

From a financial stability perspective, it is crucial that the models applied by banks to calculate capital reserves are adequate and provide them with reliable estimates regarding the expected credit quality of their loan books. For these reasons, central banks and regulators also have a natural interest in enhancing their understanding of the interlinkages between the macro-financial environment and borrowers' credit quality.

PREVIOUS WORK ON CONNECTING MACROECONOMETRIC MODELS AND FIRMS' DEFAULT PROBABILITIES

At the systemic level, the interaction between macroeconomic variables and firms' default frequencies can be modelled in different ways. For central banks, a natural choice for a macroeconomic tool where default analysis can be incorporated would be the structural models often designed as forecasting tools for monetary policy purposes. These models permit an internally consistent representation of the entire economy under various scenarios. However, since they are typically designed to project the most likely future macroeconomic outcomes and often incorporate explicit policy rules, structural models are not always suitable for financial stability purposes where the focus is, by definition, on low probability but high-impact events. Moreover, in an increasingly integrated global financial system, empirical modelling of the complete international macro-financial environment using structural models has become an increasingly complex task.

To this end, vector autoregressive (VAR) models provide an alternative multivariate approach which allows for interdependency between selected variables. VAR modelling is one of the principal tools that have been used for forecasting and policy analysis, such as assessing consistency with impulse response functions and judging the empirical adequacy of various theories.

Mainly due to the scarcity of non-confidential and sufficiently homogeneous data on household sector credit exposures, much of the work in this field has concentrated on the analysis of macro-financial shocks on corporate sector credit quality. Previous studies combining macroeconomic VAR models and variables measuring firms' default frequency have incorporated Moody's KMV expected default frequency data into a co-integrated VAR model to analyse the interaction between EDFs and

macroeconomic developments.[1] Other papers use realised default data to study the interactions between firms' balance sheets and the evolution of the macroeconomy.[2] These studies have found that the aggregate default frequency constitutes an important link between the financial and the real side of the economy, and that macroeconomic variables are relevant when it comes to explaining the time-varying default frequency.

As an extension to the traditional VAR analysis, global VAR (GVAR) models take into account a large number of linkages across macroeconomic and financial variables.[3] GVAR models consist of a set of individual VAR models for all countries included in the system. Each country is assigned its own set of "foreign" variables, depending on its own trade links. These country-specific foreign variables can be constructed using data on trade flows between the countries/regions. By providing a framework which is capable of accounting for both trade and financial transmission channels, the GVAR model is particularly suitable for analysing the transmission of real and financial shocks across countries and regions. Earlier financial stability applications of the GVAR models have used this modelling approach to generate conditional loss distributions of credit portfolios.[4]

METHODOLOGY AND DATA

To link the GVAR model with the financial sector, a framework is needed which quantifies the impact of domestic and global macroeconomic shocks on corporate sector probability of default. In what follows, an original framework is presented which links the EDFs of publicly listed companies in the euro area to a macro-econometric framework as modelled by the GVAR. The analysis considers the EDFs on both euro area aggregate and sectoral levels. The chosen approach provides new insights in three important respects. First, it quantifies the impact of domestic and global macroeconomic shocks on the EDFs for euro area firms. Second, by considering EDFs, a structural Merton-type model is combined with a macro-econometric model. Third, the analysis is restricted to consider purely the effect of economic and financial variables on the firms' default probability; it therefore explicitly ignores any feedback effects on the macroeconomy which are controversial to model and often challenging to interpret. For these purposes, a linking equation to the GVAR model is constructed which isolates the EDFs from the system. The GVAR model together with the linking equation to the EDFs is titled the "Satellite GVAR model".

In somewhat more technical terms, the Satellite GVAR model can take different representations. Corporate sector default rates vary over time and, in order to capture this dynamics, the multivariate distribution of risk factor changes is combined with the GVAR model. The model translates macroeconomic risk factor changes into default probabilities for different industry sectors, and allows for an analysis of macroeconomic stress-scenarios which are related to default probabilities. Intuitively, the EDFs can be interpreted as estimators that measure how closely a firm's assets are expected to approach its liabilities given the macroeconomic scenario. In other words, the

1 See I. Alves (2005), "Sectoral Fragility: Factors and Dynamics", *BIS Papers*, 22, who analyses corporate sector EDFs in a cointegrated macroeconomic model for the euro area; O. Aspachs, C. A. E. Goodhart, D. P. Tsomocos and L. Zicchino (2006), "Towards a Measure of Financial Fragility", *Oxford University Working Papers*, who consider the links between banks' equity prices and default probabilities and output in the UK; and H. Shahnazarian and P. Åsberg-Sommer (2007), "Macroeconomic Impact on Expected Default Frequency", Sveriges Riksbank (mimeo), who find evidence of a long-term relationship between EDFs and macroeconomic variables in Sweden.

2 See T. Jacobson, J. Lindé and K. Roszbach (2005), "Exploring Interactions between Real Activity and the Financial Stance", *Journal of Financial Stability*, 1, 308-341.

3 For a thorough discussion of GVAR and its properties, see S. Dees, F. Di Mauro, M. H. Pesaran and L. V. Smith (2007), "Exploring the International Linkages of the Euro Area: A Global VAR Analysis", *Journal of Applied Econometrics*, 22, 1-38.

4 See M. H. Pesaran, T. Schuermann and S. M. Weiner (2004), "Modeling Regional Interdependencies Using a Global Error-correcting Macroeconometric Model", *Journal of Business and Economic Statistics*, 22, 129-162, who use a portfolio consisting of 119 firms in 10 regions of the world. They use the GVAR as a linking model and assume that equity return of firms with debt outstanding is a function of the regional and global macroeconomic environment.

EDFs measure the conditional expectation of the default intensities in the different industry sectors. In the present model, the conditioning variables are the macroeconomic risk factor changes that describe a particular macro scenario generated by the GVAR model.

In the present study, a version of the GVAR model is applied which is calibrated for euro area data and frequently used at the ECB to analyse international macroeconomic and financial market developments.[5] The dataset for the GVAR model consists of 33 countries from different regions in the world. The data include eight of the eleven euro area countries that joined the single currency in 1999. These eight countries are grouped together in order to represent one region. Bilateral trade is a crucial factor for international business cycle movements.[6] The framework presented in this article uses fixed trade weights based on average trade flows over three years (1999-2001). The sample period for the variables included in the GVAR extends from 1979 to 2005 on a quarterly basis.

The EDFs for the euro area corporations are obtained from the Moody's KMV database, which combines a large database of historical firm-level accounting data with the volatility of the firms' stock prices. This Special Feature considers the median EDFs on both aggregate and sectoral levels on a quarterly basis for the period 1992-2005.[7] The median EDF at each point in time represents the median EDF among a panel of available corporations in the euro area or in a sector. The following sectors are analysed: aggregate (Aggr), basic and constructions (BaC), energy and utilities (EnU), capital goods (Cap), consumer cyclical (CCy), technology (TMT), consumer non-cyclical (CNC) and financial (Fin) sector.[8]

RESULTS FROM THE ESTIMATED SATELLITE GVAR MODEL

In the estimation, the GVAR framework is treated as an exogenous "state of the world" system within which the co-integration relationships are well established. The explanatory variables for the EDFs in the satellite model come from the GVAR model and are treated in first differences. In the satellite model, the left-hand side denotes the EDF, α and β denote the parameters, and GDP_t, CPI_t, EQ_t, EP_t and IR_t stand for euro area real GDP, consumer price inflation (CPI), equity prices, the real euro/US dollar exchange rate and short-term interest rate, respectively. All variables are extracted from the euro area model of the GVAR:[9]

$$EDF = \alpha + \beta_1 \Delta GDP_t + \beta_2 \Delta CPI_t + \beta_3 \Delta EQ_t + \beta_4 \Delta EP_t + \beta_5 \Delta IR_t$$

Table B.1 presents the estimated satellite model for sector-specific EDFs. The results show that most of the estimated parameters are significant, except for some for the sectoral EDF estimates.

5 For model presentation and full description of the data, see S. Dees, F. Di Mauro, M. H. Pesaran and L. V. Smith (2007), op. cit.

6 See M. Baxter and M. A. Kouparitsas (2004), "Determinants of Business Cycle Co-movement: A Robust Analysis", *NBER Working Paper*, No W10725; J. Imbs (2004), "Trade, Finance, Specialization and Synchronization", *Review of Economics and Statistics*, 86, 723-734; and K. J. Forbes and M. J. Chinn (2004), "A Decomposition of Global Linkages in Financial Markets over Time", *Review of Economics and Statistics*, 86, 705-722.

7 One of the advantages of the Satellite GVAR framework is that is allows the user to work on different sample periods for the GVAR and the satellite model.

8 See I. Alves (2005), op. cit., for a detailed discussion on the definitions of sectors used in this article. Recently, several authors have stressed the role of heterogeneity among firms which could be captured by using the information about the entire distribution of EDFs. See e.g. S. Hanson, M. H. Pesaran and T. Schuermann (2006), "Firm Heterogeneity and Credit Risk Diversification", Federal Reserve Bank of New York (mimeo).

9 While the euro area block of the GVAR model is represented by six macroeconomic and financial time series (together with oil prices as a common variable to all economies), it was found preferable to restrict the number of variables to five to avoid estimating too many parameters. It is important to note, however, that although a factor is excluded from the satellite model, the effect of that particular factor is still represented through the impulse responses. For example, the effect of an oil price shock is transmitted to interest rates, GDP and consumer prices even if the oil price series is not explicitly included in the satellite equation.

Table B.1 Estimated coefficients of the satellite model

(% change)

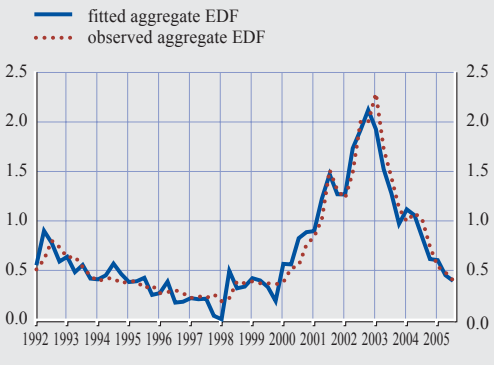
		Constant	GDP	CPI	Equity prices	USD/EUR exchange rate	Short-term interest rate
Aggr	beta	0.853	-0.350	-0.054	-0.018	-0.028	-0.010
	Pval	0.000	0.040	0.823	0.020	0.077	0.228
BaC	beta	0.663	-0.285	0.161	-0.014	-0.012	-0.007
	Pval	0.000	0.006	0.268	0.003	0.198	0.146
Cap	beta	1.167	-0.465	-0.097	-0.022	-0.034	-0.011
	Pval	0.000	0.030	0.749	0.025	0.089	0.268
CCy	beta	0.679	-0.266	0.018	-0.015	-0.017	-0.006
	Pval	0.000	0.022	0.915	0.005	0.120	0.270
CNC	beta	0.520	-0.117	-0.100	-0.010	-0.012	-0.003
	Pval	0.000	0.235	0.485	0.026	0.206	0.558
EnU	beta	0.160	-0.047	0.031	-0.005	-0.002	0.000
	Pval	0.000	0.080	0.421	0.000	0.332	0.737
Fin	beta	0.168	-0.030	0.081	-0.003	-0.002	-0.001
	Pval	0.000	0.118	0.005	0.001	0.196	0.404
TMT	beta	2.385	-1.179	-0.831	-0.062	-0.135	-0.038
	Pval	0.006	0.108	0.433	0.066	0.052	0.272

Source: ECB calculations.

The parameters can also be interpreted as elasticities. Most of the estimated signs are rather similar across the sectoral EDFs. Specifically, the estimation shows that a decrease in GDP causes an increase in euro area corporate sector default probabilities, which is an intuitive and well-established result in the literature. A decline in equity prices also contributes to an increase in euro area corporate default probabilities, as does an appreciation of the euro exchange rate. These latter results in particular reflect the importance for international financial developments and competitiveness for corporate default frequencies in the euro area. The impact of inflation is more mixed and varies across sectors, suggesting that the power of this variable in explaining developments in credit quality might be questionable in the present sample. The coefficients of short-term interest rates are mostly insignificant in the sample period.

Chart B.1 Goodness of fit of the Satellite GVAR model

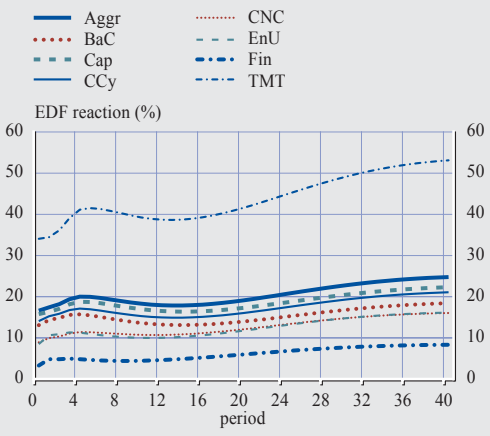
(% probability)



Source: ECB calculations.

Chart B.2 EDF reactions to a negative shock in euro area GDP

(% change)



Source: ECB calculations.

Once estimated, the satellite model is integrated into the GVAR model to form the Satellite GVAR model. Chart B.1 plots the fitted values of the Satellite GVAR model against the true aggregate euro area EDF time series. It is important to note that the present data set for euro area corporate EDFs is strongly dominated by the "new economy" cycle in the late 1990s and early 2000s. Nevertheless, the chart clearly shows that that the model fits rather well across the sample period.

REACTIONS OF EXPECTED DEFAULT RATES TO SHOCKS

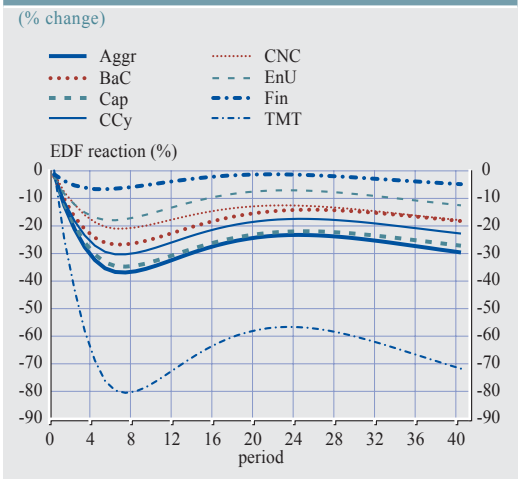
One of the benefits of the VAR approach is that it makes it easy to evaluate the impact of shocks to a variable on other variables, by picking up the dynamics of the model. This section illustrates the simulated reactions of sectoral euro area EDFs over a ten-year horizon, as a deviation from the baseline after a one-standard deviation shock to selected macroeconomic and financial variables. All reactions are plotted in Charts B.2-B.4. A general observation is that owing to the importance of the 1990s technology sector boom and bust episode in the sample period, the technology sector EDFs react particularly strongly to various shocks in the present model.

Chart B.2 illustrates that a negative shock on euro area GDP has a permanent positive impact on the EDFs of all sectors, with their intensity varying mostly between 10 and 20%.

As a reaction to a negative shock to euro area short-term interest rates, expected default decline (see Chart B.3). However, the size of this reaction varies quite substantially across sectors. Somewhat surprisingly, the financial sector seems to be less sensitive than most other sectors to variation in interest rates, whereas cyclical sectors react more strongly. This could be an indication that banks in the euro area manage these risks rather well through, for instance, hedging.

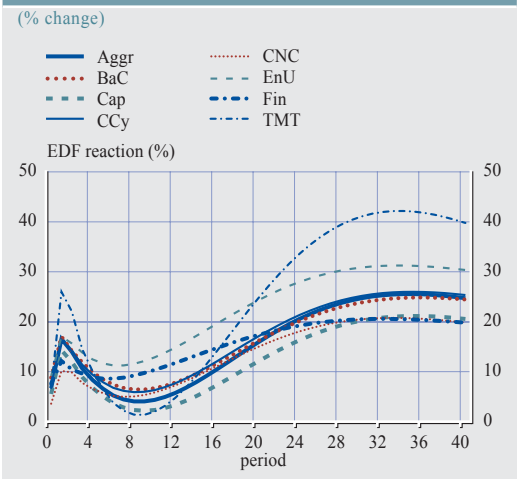
Finally, Chart B.4 shows that a positive oil price shock has a positive and permanent impact on euro area corporate sector EDFs which is quite uniform across all sectors, indicating that commodity price shocks could have a deteriorating impact on the credit quality of banks' loan books.

Chart B.3 EDF reactions to a negative shock in euro area short-term interest rates



Source: ECB calculations.

Chart B.4 EDF reactions to a positive shock in oil prices



Source: ECB calculations.

CONCLUDING REMARKS

This Special Feature has illustrated one possibility of creating a link between macroeconomic variables and firms' expected default probabilities. Previous literature on the relationships between the probability of default and economic activity has generally been restricted to a limited number of domestic variables. The framework presented here uses the GVAR model, which takes into account a wider perspective of interdependency between a large set of countries. In addition, a "satellite" equation to the GVAR model was constructed which provides a convenient way of linking a structural credit risk model for euro area corporate sector EDFs to a time series econometric model. For large euro area banks whose credit risk exposures are of an increasingly global nature, such an approach to modelling the cyclical variation in the default frequency of their borrowers would be particularly relevant.

The estimation results confirm that the Satellite GVAR model offers a promising framework for analysing the impact of a wide range of shocks to euro area corporate credit quality. Several extensions to this work are possible. For example, formulating a non-linear satellite model could capture some of the characteristics of financial crises where the impacts of shocks are typically amplified by financial accelerators. Exploiting the heterogeneity in the sectoral EDF distributions would also add important information about default risks in various sectors. Finally, the existing model could be conveniently linked to a credit portfolio model, such as the one presented in the next Special Feature in this Review ("Assessing portfolio credit risk in a sample of EU large and complex banking groups"). [10]

10 A credit portfolio model is also used by the Sveriges Riksbank to assess credit risks through the use of EDFs and their impact on economic capital. See Sveriges Riksbank (2006), "Using External Information to Measure Credit Risk", Financial Stability Report, 2006/1. In addition, the Bank of England and the IMF both use different variants of a framework which connects macroeconomic shocks, sectoral default rates and banks' portfolio losses and economic capital. See A. Haldane, S. Hall and S. Pezzini (2007), "A New Approach for Assessing Risks to Financial Stability", Bank of England Financial Stability Paper, No 2; and R. Avesani, L. Liu, A. Mirestean and J. Salvati (2006), "Review and Implementation of Credit Risk Models of the Financial Sector Assessment Program", IMF Working Paper, No 134.

C ASSESSING PORTFOLIO CREDIT RISK IN A SAMPLE OF EU LARGE AND COMPLEX BANKING GROUPS

In terms of economic capital, credit risk is the most significant risk faced by banks. This Special Feature implements a credit risk model – based on publicly available information – with the aim of developing a tool to monitor credit risk in a sample of large and complex banking groups (LCBGs) in the EU. The results indicate varying credit risk profiles across these LCBGs and over time. Notwithstanding some caveats, these results demonstrate the potential value of this approach for monitoring financial stability.

INTRODUCTION

The art of quantifying credit risk has advanced markedly since the late 1990s with the development and dissemination of models that permit the quantification of credit risk on a portfolio basis.[1] Broadly speaking, this can be attributed to advances in analytical methods of implementing these models; to the necessity of quantifying credit risk accurately in order to allocate capital efficiently within banks; and to regulatory developments such as the Basel II Capital Accord. As credit risk tends to be the largest source of risk for banks, any additional tool that could further aid the assessment of credit risk in EU LCBGs would be a useful addition to the financial stability monitoring tool kit.

This is particularly relevant for central banks that, like the ECB, lack supervisory responsibility and consequently access to supervisory data. The usefulness of these models as tools for financial sector assessment and financial stability work has been noted previously by the IMF, by the Bank of England and by Sveriges Riksbank. The latter in particular uses a framework of this kind to assess credit risk in the Swedish banking system.[2]

By way of background, this Special Feature first provides an overview of the main concepts used in credit risk modelling and the main types of models currently used by banks for assessing loan portfolio credit risk. It then describes the implementation of one of these models, Credit Suisse Financial Products' *CreditRisk+™*, using publicly available balance sheet information and data on implied probabilities of default to construct an indicator of credit risk among a sample of EU LCBGs.[3] It concludes by assessing the usefulness of this model as a monitoring tool, and identifies where additional work could be undertaken to improve it further.

ANALYTICAL CONCEPTS

Through their function of intermediating credit in the economy, banks may experience losses as a result of defaults. These losses can vary over time and in terms of their magnitude, depending on the number of such incidents and their severity. There are two useful ways of analysing the losses incurred by banks on their loan portfolios: firstly, by looking at the overall portfolio; and secondly, by examining the individual components of the portfolio.

1 Credit risk is the risk that a borrower may be unable to repay its debt. Typically, this risk can be calculated on the basis of the probability of default. This can either be based on the fact that a default has occurred (according to the bank's own procedures or national regulations), or a credit rating migration approach. In the former, the only risk that matters is the risk of default and not of a borrower approaching a default threshold. By contrast, the latter approach deals with all mark-to-market gains and losses owing to rating changes, i.e. the migration from one rating level to another. In this Special Feature, portfolio credit risk refers to the credit risk arising from loans and other credit exposures included in the loan items of banks' financial statements, instead of exposures from structured products or from other over-the-counter (OTC) derivatives exposures.

2 For a detailed overview of work that inspired the analysis presented in this Special Feature, see Sveriges Riksbank (2006), "Using External Information to Measure Credit Risk", *Financial Stability Report*, 2006/1; and R. Avesani, L. Liu, A. Mirestean and J. Salvati (2006), "Review and Implementation of Credit Risk Models of the Financial Sector Assessment Program", *IMF Working Paper,* No 134.

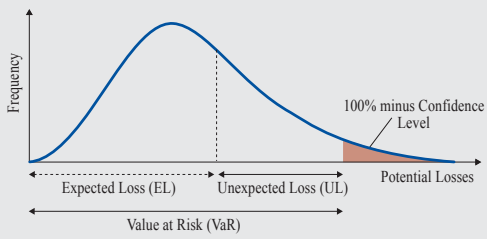
3 Similar kinds of models to the one described in this Special Feature have been implemented internally by LCBGs both in the EU and globally. One benefit of being able to measure credit risk more accurately is that it enables a better understanding of the impact of concentration and diversification on banks' overall credit portfolio risk, and consequently can indicate how economic capital requirements vary depending on how the portfolio changes. For a detailed explanation of the term "LCBG", see ECB (2006), "Identifying large and complex banking groups for financial system stability assessment", *Financial Stability Review*, December.

Looking at the overall portfolios, banks typically expect to lose a certain amount on average – this amount is called expected loss (EL). They cover EL by incorporating a risk premium into the interest rate charged to borrowers and by using loan impairment charges.[4] Losses that are in excess of expected losses are termed unexpected losses (UL); institutions are aware that such losses will occur, but are uncertain as to when these losses might take place, and as to their magnitude. Therefore, to cover UL, banks have to maintain adequate capital. The amount of capital held is a function of the bank's management and regulatory requirements, as well as requirements of external parties such as rating agencies, and the investors' view of the bank's risk-return profile. However, holding capital in excess of these requirements entails an opportunity cost, as this money could otherwise be used to finance additional lending. For this reason, it is important for banks as well as regulatory authorities to find the right balance regarding the optimal level of capital.

The concepts of EL and UL are utilised in the Basel II Capital Accord, which among other goals seeks to reduce the divergence between the amount of capital that regulators require and the level that banks want to hold. To quantify the ideal size of this capital buffer, a portfolio credit risk model can be used to approximate the level of losses that would be exceeded at a given probability.

Assuming the model adequately represents reality, the required capital value is set in such a way that it ensures that the probability of unexpected losses exceeding this value is extremely low. Typically, the shape of a stylised loss distribution of a risky credit portfolio is skewed and has a relatively fat right tail (see Chart C.1). This distribution indicates that losses less than or around the expected values are most frequent. However, the skew to the right means more extreme outcomes may also occur, and capital must be held to cover this possibility.

Chart C.1 Stylised loss distribution



Source: BIS.

The shaded area in Chart C.1 depicts the possibility that a bank will not be able to cover these losses with its capital and profits. The Value at Risk (VaR) at the borderline between the shaded and non-shaded area is the threshold value for which banks may incur a loss greater than that figure at a given confidence interval. Required capital can be set according to the difference between the EL and the VaR. Assuming that the EL is covered by adequate risk pricing/impairment charges, the likelihood of a bank's losses exceeding its capital (i.e. resulting in its insolvency) over a fixed time horizon is equal to the confidence interval.[5]

A second way of understanding losses on a loan portfolio is by looking at its individual components. For example, the expected loss of each loan exposure can be broken down into three components: the probability of default, the exposure at default, and the loss given default. The probability of not repaying the loan is called the probability of default (PD). It is important to note that the average PD of obligors may change over time – e.g. due to changes in the state of the economy or company-

4 "Loan impairment charges" is the term used in the International Reporting Standards (IFRS) for loan loss provisions. Under IFRS, banks incur charges for loans with objective evidence of impairment in their profit and loss account. In practice, banks also tend to set aside impairment charges for loans that are impaired but not recognised on the basis of past experience and internal credit portfolio models. See Box 12 in this Review for more information on loan impairments.

5 However, an important drawback of VaR in general is that it cannot explain how much will be lost if an unlikely event does occur. See Box 13 in this Review for a more in-depth discussion of alternative risk measures.

specific factors. PDs can be inferred from a credit rating, from a bank's internal database on past default history, from a structural model of default, or from a combination of all three.[6]

The exposure amount (E) is the amount outstanding in the event of the borrower's default. In that case, the loss given default (LGD), i.e. the actual loss faced by the bank, depends on how much of the original debt can be recovered through a bankruptcy proceeding and the amount of collateral if available.

BRIEF REVIEW OF THE MAIN CREDIT RISK MODELS

There are four main industry credit models that are widely implemented by banks,[7] which frequently use them to assess their own credit risk in addition to the Internal Ratings-based Approach (IRB) introduced by the Basel II Capital Accord (which builds on these industry models and sets the regulatory standard for credit risk assessment).[8] While the various approaches differ, the outputs of these models typically include a probability of default or a loss distribution for a given default horizon (e.g. one year). The first method is a *structural* model based on option pricing theory. This approach builds on the asset valuation model originally proposed by Merton[9], and is commercially distributed as Moody's KMV's *Credit Monitor*™. It is known as a *structural model of default* as it is based on modelling a firm's value and capital structure, and links default events to the firm's economic fundamentals (equity and assets). These default events are endogenous and usually occur when the firm's value reaches a certain lower threshold.

The next group of models are *reduced form* models, as these do not model firms' assets or capital structure, but instead specify that credit events occur owing to some exogenous statistical process. Reduced form models can be divided into models that construct credit events as migrations between rating classes (credit migration models) and those that specify the default time (intensity models). The credit migration approach has been developed by JP Morgan and is implemented as *CreditMetrics*™. This methodology is based on the probability of moving from one credit quality to another, including default, within a given time horizon. It is based on an ordered probit model, and uses Monte Carlo simulation to create a portfolio loss distribution on the horizon date.

Another way of quantifying credit risk is the *CreditPortfolioView*™ model developed by McKinsey, which uses a discrete time multi-period model in which default probabilities are conditional on the macro variables such as unemployment, the level of interest rates and economic growth – all of which, to a large extent, influence the credit cycle in the economy.

Finally, *CreditRisk+*™ by Credit Suisse Financial Products (CSFP) uses an actuarial approach, and purely focuses on default. In this model, default rates are not in absolute levels – such as 0.25% for a triple B-rated issuer – but are treated as continuous random variables. Given that most banks have large numbers of borrowers, some of these borrowers' default probabilities may be correlated. Moreover, since borrowers may be concentrated in certain economic sectors, it makes sense for a bank to take these factors into account when assessing the overall level of credit risk or potential losses in its loan portfolio.

In *CreditRisk+*™, default correlations are not modelled with indicators for regional economic strength or industry-specific weakness, but by

6 See the Vasicek-Kealhofer model described in P. J. Crosbie and J. R. Bohn (2002), "Modelling Default Risk", Moody's/KMV.

7 For a more comprehensive review of the industry models see M. B. Gordy (2000), "A Comparative Anatomy of Credit Risk Models", *Journal of Banking and Finance*, 24, 1, 119-149; and M. Crouhy, D. Galai and M. Robert (2000), "A Comparative Analysis of Current Credit Risk Models", *Journal of Banking and Finance*, 24, 1, 59-117.

8 See Basel Committee on Banking Supervision (2001), "The Internal Ratings-based Approach", BIS.

9 R. Merton (1974), "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates", *Journal of Finance*, 29, 2, 449-470.

estimates of the volatility of the default rate. These estimates are produced by measuring the standard deviation of the default rate, and are designed to depict the uncertainty that observed default rates for credit ratings vary over time. This feature allows a better capturing of the effect of default correlations, and produces a long tail in the portfolio loss distribution because default correlations induced by external factors are difficult to observe and are unstable over time.

The *CreditRisk*+™ model allows exposures to be allocated to industrial or geographical sectors as well over varying default horizons. As inputs, data similar to those required by Basel II are used, while the effects of concentration are incorporated as credit risk drivers. The main advantage of this model is that it requires a relatively limited amount of data – an important consideration when using publicly available information.

To sum up, each group of models has both advantages and disadvantages, and successful implementation depends on the specific purpose at hand. Given that the aim here is to generate a proxy of overall credit risk for a sample of EU LCBGs, structural models based on their public exposure data, such as Moody's KMV's default model, cannot readily be applied to some of the sectors (i.e. the household sector) in order to calculate default probabilities, as data on equity prices or asset volatilities are not available for this sector. This is a significant drawback, as the household sector is one of the main economic sectors in LCBGs' loan portfolios. Given that the ECB only has access to publicly available data from banks through their quarterly and annual reports, and no rating transition information on individual bank obligors within loan portfolios, the *CreditRisk*+™ model has an obvious appeal compared to some migration-based models.[10]

IMPLEMENTATION

The *CreditRisk*+™ model calculates the losses over a fixed horizon – one year in this case – for a given confidence interval. It does this by determining the frequency of defaults and the losses given these defaults. These two items are then used to calculate the distribution of default losses.[11] Since these rates can vary over time, this tends to make the distribution of defaults more skewed compared to time-invariant default rates.[12] Moreover, the default rate distribution affects the severity of losses because the amount lost in any default depends on the exposure to any given obligor. The number of defaults occurring in one period is independent of the defaults in other periods. Under these conditions, default for individual loans or bonds is assumed to follow an exogenous Poisson process.

Estimating portfolio credit risk models requires various inputs such as historical exposure data, default rates and their volatilities, and finally recovery rates. This sample consists of annual data for the period 2003-2005 for nine EU LCBGs including seven of the institutions analysed in Section 4 of this Review.[13] However, these data are generally not harmonised as each bank has its own definition of various types of lending, and so they were mapped to economic sectors to make the data comparable with the Moody's KMV data.

A second necessary input is expected default rates for the various economic sectors and their volatilities, as provided by Moody's KMV. Time series observations of default probabilities for households and the public sector were not available. In this case, default probabilities

10 However, it should be noted that for corporate sector exposures, an artificial credit rating migration matrix could be constructed using Moody's KMV EDF data, making the *CreditMetrics*™ model an alternative methodology to the one used in this Special Feature.

11 The version of *CreditRisk*+™ that is used in this Special Feature is implemented in Matlab and is based on a code originally written by Michael Gordy from the Federal Reserve Board.

12 Intuitively, this can be thought of as a change in the shape of the loss distribution, resulting in a fatter right tail that reflects a higher probability of more extreme losses. An assumption underlying the *CreditRisk*+ model is that the number of defaults occurring in one period is independent of the defaults in other periods.

13 Gathering data on the other EU LCBGs proved to be somewhat problematic as various institutions had changed their reporting breakdowns over the sample period.

were used based on previous work – including work by the Basel Committee and on individual banks' own estimates of probabilities of default for the household sector.

The portfolio was expanded in order to make it more granular by assuming 80% of the portfolio was of standard credit quality, with the remaining 20% of the portfolio split equally between higher and lower credit quality segments. The default probabilities of the lower and higher credit quality portions of the portfolio were also adjusted to reflect the differing credit qualities.[14]

The LGD values from LCBGs' annual reports were used when available. However, most institutions in the sample failed to publish suitable information. Therefore LGDs based on the Basel II Capital Accord were used, taking into account the experience of practitioners in commercial banks. In addition, information from other studies was used due to the unavailability of recovery rates for each exposure type.[15] As the majority of LGDs in this Special Feature can be classified as stressed or "economic downturn" LGDs according to the fifth Basel II Quantitative Impact Study, the loss distributions for each bank's portfolio may be more extreme – implying higher VaR estimates – than those obtained using through-the-cycle LGDs. However, publicly available data for LGDs on an industry- and country-specific level are still very limited, and financial institutions need to disclose further information.

Table C.1 Stylised credit portfolio example

Sector	Exposure (EUR millions)	LGD (%)	Loss value (EUR millions)	Probability of default (% probability)	Expected loss (EUR millions)
Corporate	1062	0.38	404	0.02	8.07
Corporate	4740	0.20	948	0.02	18.96
Corporate	1066	0.27	288	0.02	5.75
Bank	276	0.20	55	0.01	0.55
Household	10598	0.13	1378	0.01	13.77
Household	1776	0.47	835	0.04	33.38
Public	596	0.30	178	0.001	0.17

Source: ECB calculations.

Table C.1 shows a stylised version of the typical LGDs and default probabilities used in this Special Feature. It can be seen that the exposures and LGDs vary, as do the probabilities of default for the various economic sectors (for corporate and financial institutions). Owing to a lack of data on households, their default probabilities remain constant (0.01 for mortgage loans and 0.04 for the remaining). A further point to note is that the largest expected loss in this example – household consumer credit – comes from a relatively small exposure caused by a high LGD and a high default probability.

RESULTS

As mentioned earlier, in normal conditions banks expect on average to lose a certain amount (EL) given the composition of their portfolios. Chart C.2 shows how EL varies from one LCBG to the next in the sample. Over the sample period, they tend to decrease slightly owing to a decline in default probabilities, even though the size of their loan portfolios had expanded during the period 2003-2005.[16]

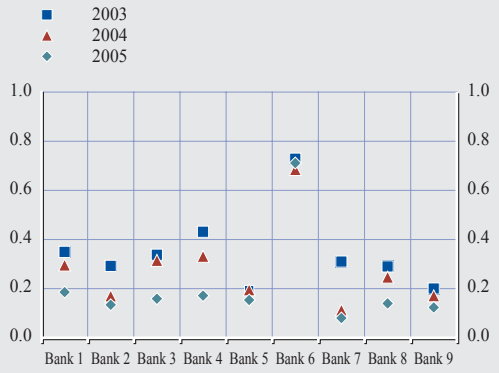
In the current implementation of the model, a single systematic risk factor is used. Chart C.3 shows the credit VaR for a sample of EU LCBGs as a percentage of their total loan portfolios, using a 99.9% confidence interval. This resulting VaR can be thought of as the capital in excess of expected loss that these LCBGs need to hold to cover unexpected losses from credit risk. This varies from bank to bank and from year to year.

Chart C.4 illustrates the credit VaR of each LCBG portfolio as a percentage of their total regulatory capital for the years 2003, 2004 and 2005. For some banks, a downward trend appears to be visible over time. This is not entirely surprising, as the default probabilities

14 This increase in granularity of the portfolio is based on best practice results (see also Sveriges Riksbank, op. cit.).
15 Ibid.
16 Default probabilities of corporates and financial institutions have declined by and large over the sample period. Default probabilities of households were kept constant due to the unavailability of data for the sector.

Chart C.2 Expected loss for a sample of large and complex banking groups in the EU

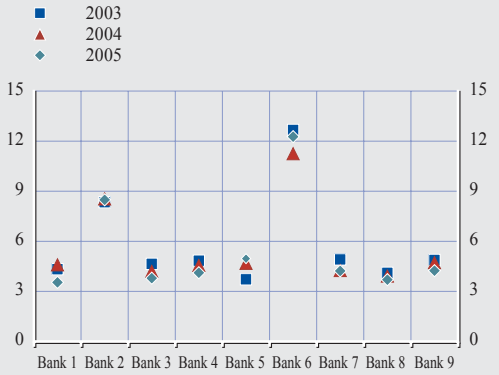
(% of total loan portfolio)



Source: ECB calculations.

Chart C.3 Credit VaR as a percentage of total loan portfolios for a sample of large and complex banking groups in the EU

(% of total loan portfolio)



Source: ECB calculations.

of corporate obligors in this sample tended to decline over time.

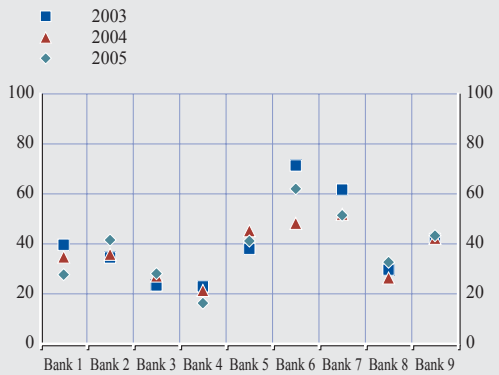
The credit risk profile of other LCBGs remained relatively constant as a percentage of regulatory capital. For one or two, some degree of change was apparent, as acquisitions increased the credit risk profile of the institutions. Overall, the results indicate that over the period 2003-2005, total regulatory capital was more than sufficient to cover credit risk in the sample LCBGs' loan portfolios.

A simple exercise was carried out to assess how credit VaR changed in response to a negative shock to real GDP. Changes to the implied default probabilities used in the credit risk model were estimated by applying a one standard deviation shock to real GDP in a Global Vector Auto Regression (GVAR) model.[17] These stressed default probabilities

17 See Special Feature B in this Review and S. Dées, F. di Mauro, M. H. Pesaran and L. V. Smith (2007), "Exploring the International Linkages of the euro area: A Global VAR Analysis", *Journal of Applied Econometrics*, 22, 1-38.

Chart C.4 Credit VaR as a percentage of total regulatory capital for a sample of large and complex banking groups in the EU

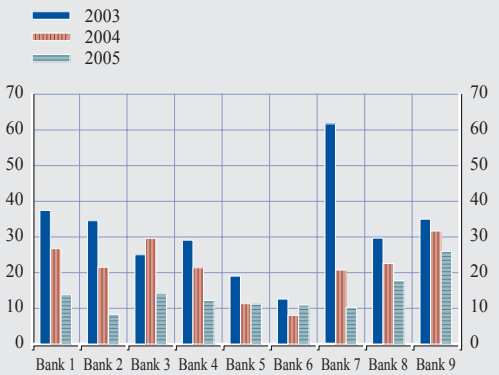
(% of total regulatory capital)



Source: ECB calculations.

Chart C.5 Effect of a five standard error negative shock to real GDP on credit VaR levels for a sample of large and complex banking groups in the EU

(change in VaR levels as a % of total regulatory capital)



Source: ECB calculations.
Note: Calculated as the difference between the stressed VaR level and the original VaR level as a % of total regulatory capital.

were then used as inputs to recalculate the credit VaR for each of the three years.

Chart C.5 shows the change in the level of credit VaR as a percentage of total regulatory capital for each LCBG when an extremely large negative global GDP shock occurs (i.e. not a country-specific shock). For some institutions the change was relatively limited, while for others more pronounced owing to the composition of their loan portfolios as well as the default probabilities of the obligors in their portfolios. For one LCBG, the negative shock caused its credit VaR to increase markedly in one year. The main reason for this was that its loan portfolio contained comparatively more exposures to corporate sub-sectors with a higher probability of default under a stress scenario.

Given that relatively conservative assumptions were used for LGDs as well as default probabilities, it is likely that the estimates presented in this Special Feature could overestimate credit risk in these LCBGs' portfolios. Various robustness checks were therefore carried out. To start with, the volatility of the default rates used was varied to ensure that the VaR numbers were not overly sensitive to the chosen volatility. No large change occurred in these values when they were altered. The LGD values were also changed to differing degrees. On average, the VaR values increased somewhat but remained in a similar range to what had been discussed earlier.[18] However, the variability in credit VaR seems to be mainly driven by differences in the distribution of loan exposures across the institutions covered in the current sample of LCBGs and their corresponding PDs.

Finally, an additional plausibility check was carried out by comparing the VaR estimates with the economic capital for credit risk held by those LCBGs that had published such figures. Encouragingly, the estimates using the current model tended to be in a similar range to the institutions' own economic capital figures. Three explanations can be advanced for differences in these estimates from those of the current model and the institution's estimates. First, better input data were available to the institutions themselves, including information on collateral for their exposures. Second, intra-group diversification effects were taken into account, making their figures lower compared to the estimates in this Special Feature. Third, some institutions supplied figures that included economic capital required for private equity exposures; these figures were not included in the current model.

CONCLUDING REMARKS

This Special Feature has described the analytical concepts underpinning credit risk modelling, and has implemented a credit risk model that seeks to gauge the credit risk profiles of a sample of EU LCBGs. To do so it uses publicly available exposure data from EU LCBGs' annual reports, together with several other inputs. While the sample is comparatively limited, the model nevertheless produces some relatively plausible estimates of the varying credit risk profiles of EU LCBGs, given the limited data inputs.

Two additional refinements would probably improve the results further. First, a more thorough disclosure of exposure information by LCBGs in their annual and quarterly reports would improve the main input and, consequently, the VaR estimates. Second, better information and analysis on LGD values, especially on how they interact with PDs in a downturn, could prove extremely useful in refining the outputs of these models. These improvements may further increase the usefulness of this tool for financial stability monitoring.

18 The effects of simultaneous increases in LGDs and PDs have not been explored extensively in the academic literature. For a recent contribution, see E. Altman (2006), "Default Recovery Rates and LGD in Credit Risk Modeling and Practice: An Updated Review of the Literature and Empirical Evidence", New York University, mimeo.

D MEASURING INVESTORS' RISK APPETITE

The willingness of investors to bear financial risk, commonly referred to as investors' risk appetite, has been a subject of growing interest among market participants and observers alike not least on account of the buoyancy of financial markets over the past three to four years. Many different indicators of risk appetite have been developed but patterns in them are not always the same even though they are supposed to capture the same phenomenon. This Special Feature aims at unearthing a common component between several commonly followed indicators and it develops a composite measure of risk appetite. The resulting composite measure appears to capture well several periods when markets underwent episodes of stress.

INTRODUCTION

Risk appetite is frequently cited in the media and elsewhere as a factor explaining asset price movements. The term risk appetite is generally understood to be the willingness of investors to bear financial risk with the expectation of generating a potential profit. Gauging the degree of risk appetite at any given point in time is highly relevant from a financial stability perspective because past episodes of sudden rises in risk premiums, declines in market liquidity and sharp asset price declines have often been associated with the loss of risk appetite on the part of investors. Recent studies and surveys have focused on several different measures of risk appetite. They are variously referred to as indexes of "risk aversion", "risk appetite", "investor confidence" and "investor sentiment". Although they have different titles, they are usually constructed with the objective of measuring the same phenomenon. However, the patterns in them are not always the same even during episodes of extreme investor pessimism. This Special Feature aims at clarifying concepts of risk appetite and it develops a summary indicator by extracting the common information provided by some of the measures commonly followed.

CLARIFYING RISK CONCEPTS AND TERMS

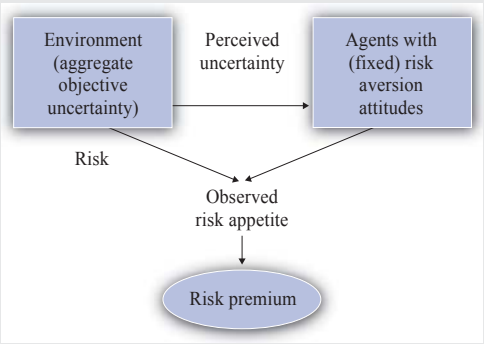
As discussed in Gai and Vause (2004), the terms "risk aversion", "risk appetite" and "risk premium" are often thought of as synonyms for one another.[1] Although there are links between them, each of these terms refers to a concept quite distinct from the other two. Fundamentally, investors prefer to avoid risk. In this vein, risk aversion measures the (subjective) attitude of investors towards uncertainty. As the degree of risk aversion of investors reflects deep-seated preferences, it is usually assumed to be constant in asset pricing models. Risk appetite encompasses the notion of risk aversion but it is a somewhat broader concept as it is also influenced by the amount of (objective) uncertainty which exists about asset price movements at any given point in time (see Figure D.1). In other words, risk appetite depends not only on the degree to which investors dislike uncertainty but also on the overall level of uncertainty about the fundamental factors which drive asset prices and by their perception thereof. Neither of these factors is directly observable from asset prices, only the combination of them. However, since the degree of risk aversion is usually thought to be fairly stable, risk appetite indices are usually considered to be tracking changes in investor uncertainty with risk appetite declining when uncertainty increases. The risk premiums embedded in asset prices are influenced by the degree of risk appetite as well as by the riskiness of the asset in question.

UNDERLYING RISK APPETITE INDICATORS

The pool of available indicators of risk appetite can be grouped on the basis of two fundamental approaches used for measurement and

1 See P. Gai and N. Vause (2004), "Risk Appetite: Concept and Measurement", *Bank of England Financial Stability Review*, December.

Figure D.1 Uncertainty and risk appetite



monitoring.[2] The first group of risk appetite indicators denoted here as market-based indicators are largely atheoretical measures which are constructed using simple statistical methods that aggregate information extracted from market prices. They are typically based on implied volatility and spreads of different asset classes, and are broken down by financial instrument (fixed income, equity, credit and commodities) and geographical location (emerging vs. developed markets) (see Table D.1). This group of indicators includes CBOE's Volatility Index (VIX), JP Morgan's Risk Tolerance indices – one global (JPM G-10 RTI) and one for the emerging markets (JPM EM RTI), UBS's FX Risk Index, Westpac's Risk Appetite Index (WP), Dresdner Kleinwort's Aggregate Risk Perception Index (ARPI), Merrill Lynch's Risk Aversion Indicator (ML RAI), Lehman Brothers' Market Risk Sentiment Index (MARS), and Bank of America's Risk Appetite Monitor (RAM).

The second group of indicators, referred to here as model-based measures, includes the Bank of England Index developed by Gai and Vause (FSI),[3] the State Street Investor Confidence Index (ICI), the Goldman Sachs Risk Aversion Index (GS), the Tarashev, Tsatsaronis and Karampatos Risk-Appetite Index (BIS),[4] and the Credit Suisse Global Risk Appetite Index (CS). These indices are typically based on a financial or economic model applied to a single financial market (see Table D.2). There are three main approaches: a more structured market-based method looking at the correlation between volatility and returns; a method based on the implied probability density function of prices, providing information on investors' expectations and their degree of uncertainty and permitting a separation between different individuals' attitude towards risk; and finally a pool of models which take a traditional structure, e.g. the capital asset pricing model (CAPM), and add a new element designed to capture the time-varying nature of investors' perceptions.[5]

METHODOLOGY

The indices described in the last section measure different facets of investors' risk appetite. However, being constructed using different approaches and focusing on different markets, they also have important idiosyncratic elements. One way of separating the idiosyncratic components of these indices from the unobservable component that is common to all of them, if it exists, is to analyse the data with principal components analysis (PCA).[6] PCA is a dimension reduction method which produces an orthogonal linear transformation of correlated variables, projecting a multidimensional space into a coordinate system with fewer dimensions. These coordinates, which are called components, are orthogonal to each other and retain the characteristics of the dataset that contribute

2 See M. Illing and M. Aaron (2005), "A Brief Survey of Risk-appetite Indexes", *Bank of Canada Financial Stability Review*, June. For data availability reasons, only some of the indicators currently available in the market are considered. Sources: Bloomberg, JP Morgan, UBS, Bank of America, Merrill Lynch, Dresdner Bank, Lehman Brothers, Goldman Sachs, Credit Suisse.

3 See P. Gai and N. Vause (2004), op. cit.

4 See N. Tarashev, K. Tsatsaronis and D. Karampatos (2003), "Investors' Attitude towards Risk: What Can We Learn from Options?", *BIS Quarterly Review*, June.

5 See W. F. Sharpe (1964), "Capital asset prices: A theory of market equilibrium under conditions of risk", *Journal of Finance*, Vol. 19 No. 3.

6 The PCA approach is supported by the arbitrage pricing theory advanced by S. Ross (1976) "The arbitrage theory of capital pricing", *Journal of Economic Theory*, December.

Table D.1 Market-based indicators

Index	Components	Method
VIX (+)[1]	• Implied volatility of S&P500 Index	Based on a weighted average of the implied volatility from eight calls and puts on the index.
JPM G-10 RTI (+)	• US swap spread (liquidity risk) • VIX (equity market risk) • EMBI+ (credit risk in emerging markets) • Trade-weighted Swiss franc (risk appetite in currency markets)	Constructed as an equally weighted average after having standardised the four components.
JPM EM RTI (+)	• VIX • EMBI+	A weighted average after standardising the two components (weights: 30% VIX, 70% EMBI+).
UBS FX Risk Index (+)	• US Treasury relative to the U.S. stocks • Three-month foreign exchange option implied volatility (USD/JPY and EUR/USD) • Gold in EUR and USD • VIX • EMBI+ • US Treasury spread • Differences in stock returns between the S&P financials and utilities • High-yield corporate spreads relative to the US Treasury	An arithmetic average of the normalised values of market variables.
WP (+)	• An average of the three-month implied volatility for six major currencies • VIX index • US ten-year bond-swap spread • JP Morgan emerging markets bond spread • US BB1 industrial bond spread	A 60-day z-score[2] of a base index calculated in three steps: the first step calculates the daily percentage change of each variable, then the figures obtained are averaged, and finally the index values are indexed to 100 on 1 January 1998.
RAM (-)	• EMBI spread • Carry AUD/JPY • Corporate bond spread BB • Carry EUR/CHF • Spread MSCI EM Lccy	The correlation (over a rolling six-week period) among a large sample of emerging economies for each of the three asset classes, multiplying them by a market direction measure (in order to distinguish between bullish or bearish periods). Finally, the correlation coefficients are aggregated with an equally weighted average.
ML RAI (+)	• US high-yield spreads (US higher yield spread over Treasuries, expressed as % yield) • VIX implied volatility • TED spreads (three-month euro-dollar deposits minus three-month T-bills) • US ten-year swap spreads, emerging market bond spreads (ML USD Emerging Markets Sovereign 'Plus' Index yield) • The trade-weighted Swiss franc, and emerging market equities (USD) • US small cap stock	For each item, this takes the standard deviations from 52-week moving averages. Then it sums the standard deviations of US high-yield spreads, VIX implied volatility, TED spreads, US ten-year swap spreads, emerging market bond spreads and the trade-weighted Swiss franc, while it subtracts those of EM equities and US small cap stock.
ARPI (+)	Based on high-frequency data (mainly spreads and implied volatilities) from five asset classes: • Fixed income basket (global and political risk) • Equity basket (equity investment risk) • Liquidity basket (liquidity risk) • Commodity basket (energy risk) • Credit basket (credit risk)	Based on a two-step principal component analysis (PCA), firstly within the baskets, and secondly between the principal components of these baskets.
MARS (-)	• Market volatility (one-year FX implied volatility and equity implied volatility), • EM event risk (EM CDS spreads and EM equities), • Market liquidity (G3 swap spread) • Risk appetite ratios (equity to bond returns, gold price to gold equity returns, and US equity P/E ratio).	Built on a four-step process: input transformation (a rank transformation of each risk input relative to its past 20 day values), data aggregation (a simple equally weighted average), transformation of the average rank into a score between 0 and 1, and finally a computation of the two-day moving average of the aggregate index.

1) "+/-" stands for the degree of correlation with investors' level of risk appetite.
2) The X-day z-score is defined as the value of a base index, net of its X-day mean, and divided by its X-day standard deviation.

Table D.2 Model-based indicators

Index	Components	Method
GS (+)[1]	• Real US per-capita consumption growth • The returns on real rate on three-month US Treasury bills • The returns on inflation-adjusted S&P 500 Index	This introduces a time-varying risk aversion coefficient within the CAPM. The discount factors are computed recursively with a fixed-range for the risk aversion coefficient. The obtained quadratic equation is used to obtain the risk aversion coefficient.
ICI (+)	The model is based on international holdings of sophisticated investors (large institutional investors), whose activities involve 22 million security transactions annually, across 45 countries.	The model calculates percentage changes in international holdings, given the country and the day, as the dollar flow for that day divided by the dollar holdings of the previous day. This measure is then expressed as a share of market capitalisation in each country over time using the MSCI measure of market capitalisation.
BIS (+)	The model is applied to the: • S&P 500 • DAX 30 • FTSE100	This indicator is obtained by comparing the statistical likelihood of future asset returns, which is estimated on the basis of historical patterns in spot prices, with an assessment of the same likelihood filtered through market participants' effective risk preferences, which are driven by options prices. The value of the index is the ratio of the left tails of the two distributions.
FSI (BoE) (-)	• S&P500 Index • Three-month options prices • US Treasury bills	Based on the CAPM, this model considers expected returns as a function of the probabilities of the state of the world assigned by investors. Different levels of risk aversion correspond to different probabilities. The difference between the mean risk-neutral probability density function and the mean of the investors' subjective probability density function captures investors' risk appetite. The approach is very similar to that of the BIS, but considers the ratio of the whole distribution rather than just the tails.
CS (+)	• A pool of safe assets (proxied by seven to ten-year government bonds) • A pool of risky assets (including equities and emerging market bonds)	This is based on the cross-sectional linear regression of excess returns and past risks (volatility). For each asset, the six-month excess return over cash and 12-month volatility are calculated; the slope of the regression line represents the risk appetite index.

1) "+/-" stands for the degree of correlation with investors' level of risk aversion.

most to its variance.[7] The principal components derived from PCA are natural summary measures capturing the co-movements of a variety of indicators. Put simply, principal components are linear combinations of the set of variables studied that show (decreasingly) the largest variance. Accordingly, the first principal component would capture the latent "commonality" of the underlying risk appetite indicators, explaining the largest share of their joint variation. Therefore, this component could be interpreted as a composite risk appetite measure.

The two criteria often used to decide upon the number of the components that have to be considered are known as the Kaiser and the Joliffe criteria.[8] The latter considers the last significant component with the explained cumulative variance reaching a certain threshold (for example 90%). By contrast, the Kaiser criterion considers all components whose eigenvalues are greater than 1. If the series taken into consideration follow a common pattern, the first principal component should be able to explain most of the variance, and

7 The first principal component is computed as a linear combination of the series in the group with weights given by the first eigenvector. The second principal component is the linear combination with weights given by the second eigenvector, and so on. These eigenvectors are the correlation coefficients between variable and components, namely the factor loadings.

8 See, for instance, G. H. Dunteman, (1989), *Principal Components Analysis, Series: Quantitative Applications in the Social Sciences,* Sage Publications, Inc., California.

consequently would be a satisfactory summary of all the series making it a useful measure of risk appetite.

RESULTS

Applying the PCA approach to all 14 risk appetite measures considered – market-based and model-based – over the period from February 1999 to July 2004,[9] it is found that the first principal component explains just 38% of the overall variance while the second explains 18%. The low proportion of the total variance explained by the first two components together may reflect the considerable variety of methodologies underlying the different indices. Both criteria for selecting statistically significant principal components produce a high number of them – five with the Kaiser criterion, and six with the Joliffe criterion. The factor loadings show that there is no systematic pattern in the way the original variables contribute to the various components. In other words, it is difficult to choose a criterion on the basis of which movements in a given component can be attributed to movements in a given subset of the original series.

It is of interest to consider whether the reason for the low degree of commonality between each of the indices is due to the method used to construct them, i.e. model or market-based. Regarding the five model-based indicators, application of the PCA technique over the sample from February 1999 to July 2004 finds that the number of relevant components is two with the Kaiser criterion and three with the Joliffe criterion. However, the first component explains 35% of the total variance while the second explains 30%. Again, this may reflect the variety of methodologies underlying the different model-based measures. The factor loading uncovers two main groups: the Goldman Sachs Index (GS) and the Credit Suisse Indicator (CS) show a high degree of correlation with the first component, while the BIS and the Bank of England indices have higher factor loadings related to the second component.[10] Overall, there does not appear to be a single model-based risk appetite measure.

Turning to the market-based indicators, the contribution of the first principal component rises to 47% of the overall explained variance, and the number of significant principal components decreases to two with the second explaining 26% of the variance. Hence, as with the model-based group, two distinct clusters stand out.

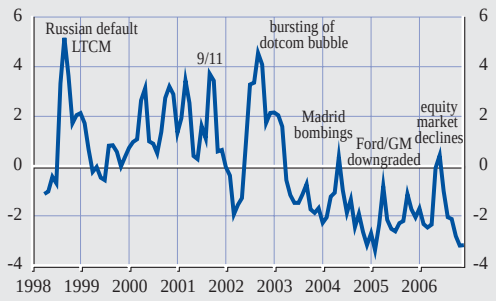
An examination of the standardisation process reveals that these indicators, even if they do use analogous variables, data frequencies and methods, differ in the assumed time they are expected to return to the series mean value once they have moved away from it. This affects data standardisation, as means and variances are across the different indicators are calculated based on periods of different length.

9 Due to data availability reasons of the model-based indicators, the sample has been restricted in the first two Principal Component Analysis estimations.

10 The last two measures are based on similar methodologies, which underlines the importance of the method used in the final outcome. The State Street indicator plays a stand-alone role as it is highly related to the third principal component, possibly because of the very specific methodology upon which it is based.

Chart D.1 Composite risk appetite indicator

(index value)



Sources: Bank of Canada, Merrill Lynch, UBS, JP Morgan, Lehman Brothers, Westpac, Dresdner Bank, Bank of America, Goldman Sachs, Credit Suisse, State Street Corporation and ECB calculations.
Note: The index is constructed as the first principal component of the market-based indicators. A rise in the index denotes a decline of risk appetite.

As it produces the greatest variance among possible composite measures, a deeper analysis of the first market-based component is warranted. To this end, the consistency of this composite risk appetite measure is mapped against some critical historical episodes. The highlighted peaks in Chart D.1 correspond to known episodes of market stress between April 1998 and December 2006 where investor pessimism was extreme and are closely matched by this summary measure. Moreover, the indicator has a desirable quality of smoothness.

CONCLUDING REMARKS

Central banks, investment banks and academics have developed measures of risk appetite in a variety of different ways. However, these measures are not always accordant with one another even during periods of extreme investor pessimism. Given differences in methodologies and underlying data, it is challenging to unearth a common component between several commonly followed indicators which explain large proportions of their variance. Nevertheless, an indicator can be derived from commonly followed market-based indicators and it appears to capture well several periods when markets underwent episodes of stress.

E ACCOUNTING FOR RISING LEVERAGED BUYOUT ACTIVITY

The value of global corporate leveraged buyout (LBO) transactions has expanded substantially over the past couple of years. Many of the deals have been characterised by high debt-to-equity ratios, which have reached levels comparable to those seen in the US LBO boom of the 1980s. Putting recent developments into historical perspective, this Special Feature recalls the implications of theories of optimal capital structure for recent developments and it explains how recent LBO activity has been facilitated by recently developed techniques for credit risk transfer. From a financial stability perspective, there are some concerns as it cannot be excluded that intense competition to win new deals in the pursuit of fee income, together with the strength of the bargaining power of private equity firms in negotiating terms for LBO transactions, may have led to an inadequate pricing of risks by investors in various forms of LBO debt. To mitigate these risks, banks will need to ensure the adequacy of stress-testing of their direct exposures and exercise vigilance in the monitoring of counterparty risks.

INTRODUCTION

In recent years, rapid growth in LBOs involving private equity sponsors has attracted considerable attention from market observers, central banks and prudential regulators alike. Private equity sponsors manage funds devoted to the acquisition of companies with the aim of improving their operational efficiency and financial structure. While originally the vast majority of target companies were not quoted in public equity markets, over the last couple of years, investments in listed companies, which are then taken private, have become increasingly common. In April 2007 the BSC, in cooperation with the ECB, published a report on large banks' exposures to LBO activity in the EU.[1] Based on a survey comprising more than 40 banks, the report found inter alia that debt exposures of banks to the EU LBO market are not large relative to their capital buffers. However, some vulnerabilities were found such as the fact that some banks might be materially exposed to underwriting risk in LBO deals.[2] In addition, some operational risks may arise from the fact that the functioning of the LBO market is rather dependent on recently developed techniques for credit risk transfer.

The purpose of this Special Feature is to highlight specific financial stability issues related to the debt financing of corporate takeovers, an area in which banks have been playing a particularly important role.

SEQUENCES IN LEVERAGED BUYOUT TRANSACTIONS

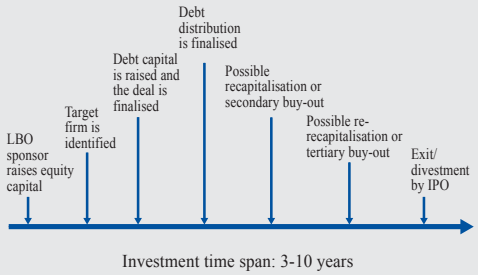
In broad terms, an LBO can be defined as an operation involving the acquisition, friendly or hostile, of a firm using a significant amount of borrowed funds (bonds or loans) to meet the cost of the takeover. LBO deals often involve private equity sponsors and where such a sponsor is involved, the assets of the acquired company, in addition to the assets of the acquiring private equity sponsor, are generally used as collateral for these loans. The debt usually appears on the acquired company's balance sheet and its free cash flow is used to repay the debt. Overall, LBOs allow private equity sponsors to make large acquisitions without having to commit a material amount of their own capital.

The financing of LBO projects tend to follow a particular model where equity and debt funding are raised sequentially (see Figure E.1). At the start, the general partners (GPs) – that is the managers of the LBO fund (or sponsor) – create

1 See ECB (2007), "Large Banks and Private Equity-Sponsored Leveraged Buyouts in the EU", April.

2 This risk arises from the large LBO debt concentrations which banks are exposed to from the day they agree to finance an LBO transaction until its completion, and throughout the debt distribution process by means of syndication or credit risk transfer (also called "warehousing" risk). This time frame, within which banks are vulnerable to changes in market sentiment and early defaults of acquired firms, has proven rather lengthy.

Figure E.1 Timeline of a leveraged buyout



Source: ECB.

a pool of capital by investing their own funds and raising equity capital from institutional investors (limited partners, LPs). The GPs may draw down these funds while companies targeted for acquisition are being searched for, but generally the funds need to be invested in target companies within a given time frame. Once target companies have been identified, debt financing is raised, typically from banks which subsequently distribute their credit exposures to the wider investor community.

During the corporate turnaround process, the LBO sponsors may either recapitalise the deal or sell the acquired company to another sponsor who will assume the remaining debt commitments. However, the most common exit by LBO investors – after the debt has been repaid – is by means of an initial public offering (IPO), where the acquired firm is floated on the stock market. After the exit, the proceeds of the operation are distributed among the general and the limited partners of the LBO fund.

Recent academic studies have suggested that the "sequenced" financing model used by LBO sponsors, which involves first general raising of equity capital followed by deal-specific debt financing, can be rationalised from the point of view of optimal contracting in the presence of informational asymmetries.[3] In particular, it can be argued that although the GPs are expected to dedicate their skills to gathering information about the quality of the potential LBO targets, it is optimal for the LPs (equity investors) to commit only a part of their funds and to induce the GPs into seeking additional deal-specific debt financing, as this increases the GPs' incentives to pick the most profitable projects. On the other hand, the research has also shown that the initial raising of equity funds deprives the debt providers (banks) of full decision rights on each individual LBO project, and increases the expected quality of the investments that are undertaken by the GPs.

DEBT VERSUS EQUITY AS A MEANS OF FINANCING CORPORATE TAKEOVERS

Although the sequenced LBO financing model can be justified from the point of view of informational asymmetries, it is not that clear why the share of debt in LBO transactions tends to be much higher than the share of equity. From the point of view of standard corporate finance theory, the well-known Modigliani and Miller (MM) theorem states that under certain conditions the value of the firm – measured as the sum of the values of all financial claims on the firm's future income – should be independent of whether the firms' financial structure is dominated by equity or debt.[4] Put another way, a decision by a firm to substitute debt for equity (e.g. to finance an LBO or to buy back its own stock) should not change the weighted average cost of capital that the firm has to pay to the investors who have claims on it. This is because a firm that increases its leverage by taking on more debt has to pay correspondingly higher returns to its equity holders, whose claims have become more risky because dividends are only distributed after interest is paid. Based on this argument, Modigliani and Miller conclude that decisions concerning a firm's financial structure can only affect the distribution of the total value of the firm (as measured by its future stream of cash flows or earnings) among its stakeholders,

3 See, for instance, U. Axelson, P. Stromberg and M. S. Weisbach (2007), "Why Are Buyouts Leveraged? The Financial Structure of Private Equity Funds", *NBER Working Paper*, No. 12826.

4 See F. Modigliani and M. Miller (1958), "The Cost of Capital, Corporation Finance and the Theory of Investment", *American Economic Review*, June.

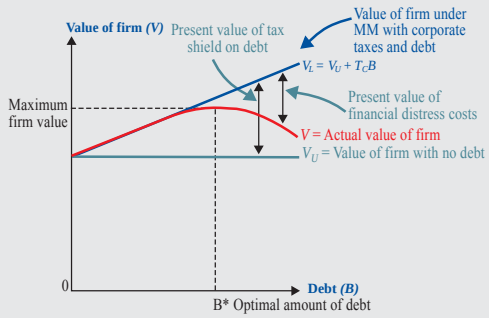
but not the magnitude of that value. Rather, the value of a firm should purely depend on "real" factors, such as cash flow and investment. All in all, given that the objective of an LBO sponsor is to maximise the resale value of the acquired companies, the MM theorem suggests that the nature of the claims (debt or equity) used to finance the acquisition should be irrelevant from the point of view of future value creation objectives.

In reality, however, institutional factors often play a role in determining the optimal financing structure of a corporate takeover. From this perspective, additional leverage may have both positive and negative impacts on the prospects of enhancing the expected future profits of the LBO acquired firm. On the positive side, the tax treatment of debt and equity typically differs, with a shift to debt financing often resulting in tax relief that positively affects the firm's future cash flows.[5] On the negative side, the existence of bankruptcy costs means that a higher debt burden, by increasing the firm's probability of default, will depress the expected value of the firm's expected future cash flows because of a higher cost of debt finance.

Figure E.2 illustrates the effect of taxes and financial distress costs on the expected value of a debt financed LBO project. The "tax shield" on debt arises from the fact that dividends are taxed while interest payments on debt are not. Therefore, the capitalised value of cash flowing to debt is greater than the same cash flows to equity. This preferential tax treatment increases the value of the firm for any additional level of debt. However, beyond an optimal level of debt such gains are partly offset by potential financial distress costs which rise with the leverage of the firm.[6]

More recently, researchers in corporate finance have pointed out that, apart from tax and bankruptcy considerations, the traditional MM framework also ignores the role of governance incentives, which is associated with the fact that the ownership of companies which have been acquired through LBOs tends to be rather

Figure E.2 The impact of debt financing on the value of a firm



Source: ECB.

concentrated, unlike publicly listed firms. Consequently, the LBO general partners, as representatives of the owners, may be in a better position to focus the attention of the acquired company's managers on maximising cash flow and profits. Governance structures can include contractual constraints and covenants that limit managers' actions, as well as managerial incentives such as salary structures that are connected to profits. The observation that increased leverage typically induces management to improve cost efficiency and generate additional cash flows to cover future debt repayments suggests that such governance incentives could provide a link, albeit not necessarily an unambiguous one, between debt financing and value creation.[7]

Finally, another factor important in determining the relative share of debt or equity financing in LBO deals appears to be the relative cost of debt versus equity financing which varies over the business cycle. Indeed, empirical observation of past episodes of intense LBO activity suggests

5 Indeed, the value of the company can be expressed as the value of a company financed by 100% equity plus the value of any future "tax shield" (i.e. the tax rate times the amount of debt) that can be created by adding debt to the capital structure.

6 Empirically, the tax advantage offered by debt financing is likely to be quite relevant. Indeed, some proposals by national policymakers to limit the activity of LBO sponsors have focused on the possibility of reducing the tax incentives for additional leverage.

7 See J. Tirole (2006), *The Theory of Corporate Finance*, Princeton: Princeton University Press.

that abundant liquidity and low interest rates have had a positive impact both on the share of debt in merger and acquisition (M&A) transactions and on the frequency of LBO deals.

CAPITAL STRUCTURE OF LBO TRANSACTIONS IN THE EU

The results of the BSC survey on private equity-sponsored LBOs in the EU provide a snapshot of the situation as of June 2006. Among other things, the results shed some light on the empirical distribution of debt versus equity in recent LBO deals in the EU. The survey results revealed that the equity component of the reported LBO transactions proved to be rather small. On average, equity represented slightly more than 20% of the capital structures of the five largest transactions to which each surveyed bank had committed capital in the year up to June 2006 (see Chart E.1).

In general terms, two factors seem to be important in explaining the low level of equity in recent LBO transactions. First, in a generally low interest rate environment and where market liquidity has been abundant the relative cost of debt capital has been significantly reduced. Second, in recent years equity appears to have been replaced in capital structures by subordinated debt, which has some equity-like characteristics but enjoys the tax advantages of debt financing.

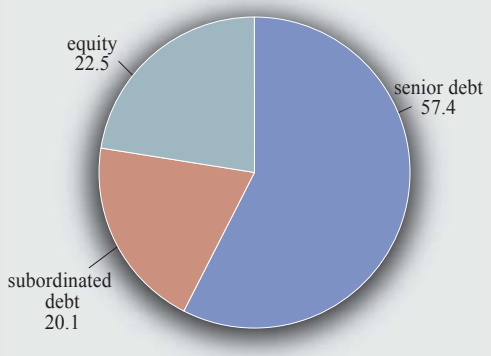
Testifying to a possible substitution effect between equity and subordinated debt, larger LBO transactions appeared to be associated with smaller shares of senior debt (or, conversely, larger proportions of subordinated debt, see Chart E.2). However, the low equity component per se seems to be a general phenomenon across recent deals, as no relationship between the equity share and the deal size, or indeed any other characteristic of the LBO transactions, could be found.

The breakdown of the debt component of the surveyed LBO transactions shows that in the EU, banks provide mostly senior debt to fund LBOs. For almost three-quarters of the banks surveyed, the safest type of senior debt – i.e. tranche A (secured) – constituted, on average, around 20% of LBO debt financing provided for their largest five transactions in the year up to June 2006 (see Chart E.3 for capital turnover banks). This is in contrast to the US market where, according to Standard & Poor's, senior tranche A debt accounted for a mere 0.8% of total bank debt to LBOs.[8]

8 See Standard & Poor's (2006), "European Leveraged Buyout Review", Q4.

Chart E.1 Capital structure of LBO transactions

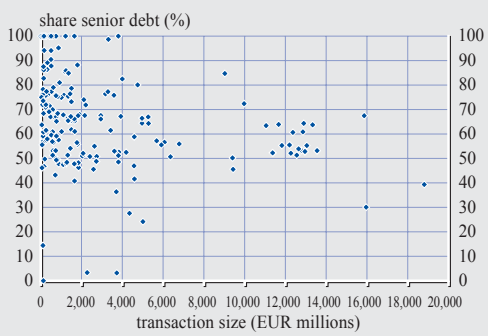
(percentages, June 2006)



Source: BSC.
Note: Based on the largest five LBO transactions of 41 large banks active in the EU leveraged buyout market.

Chart E.2 Size of LBO transactions and the relative share of senior debt in financing structures

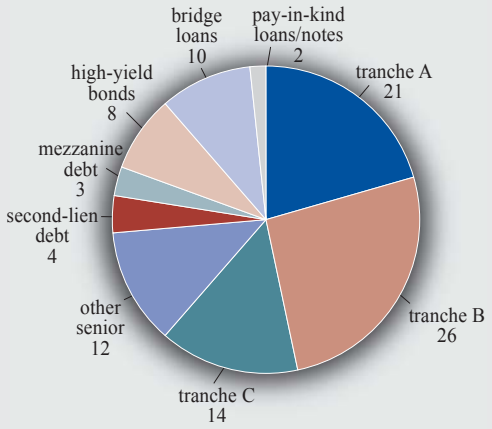
(June 2006)



Source: BSC.
Note: Based on the largest five LBO transactions of all banks.

Chart E.3 Debt composition of LBO transactions for capital turnover banks

(percentages, June 2006)



Source: ECB.
Note: Capital turnover banks are defined as banks whose participation in LBO transactions is mostly oriented towards fee income, thereby aiming at a rapid distribution of credit exposures. Breakdown based on the five largest LBO transactions of capital turnover banks.

A common feature in recent debt structures on both sides of the Atlantic seems to be that an increasing share of current LBO financing has been provided in the form of leveraged loans – generally comprising senior loan tranches B and C, usually with a non-amortising structure,[9] as well as second-lien and mezzanine debt. Leveraged loans, which are described in detail in the next section, are typically sold via syndication to other banks and institutional investors.

FINANCIAL INNOVATION IN THE DEBT MARKETS AND LBO ACTIVITY

This sub-section takes a closer look at the various parts of the LBO debt financing structures, and discusses the role of financial innovations which have facilitated LBO financing at different times.

JUNK BOND MARKETS AND THE US LBO BOOM OF THE 1980s

Some observers have compared the recent high level of LBO activity with the wave of hostile takeovers and LBOs in the US in the 1980s, when in some years acquisition volumes reached 10% of stock market capitalisation. The financing of the spate of corporate takeovers in the 1980s was to a great extent facilitated by the emergence and rapid growth of the high-yield, or junk, bond market. Typically entailing relatively high default risk, junk bonds are generally unsecured obligations, rated below investment-grade (i.e. lower than BBB- by Standard & Poor's, Baa2 by Moody's and BBB- by Fitch bond-rating services). Hence, investors also require higher yield to hold such instruments. Covenants on these bonds also tend to be looser than those on investment-grade bonds or bank loans, providing the issuer with more operating flexibility.[10]

Until the late 1970s new bonds publicly issued to large groups of investors were purely investment-grade. The junk bonds which were publicly traded at that time were generally securities which had originally been issued with an investment-grade rating but had subsequently been downgraded. The US corporate debt market changed when the first originator-issued junk bonds were launched in the 1980s, providing companies that had previously been excluded from the corporate bond market with access to the capital markets.[11] Investor appetite for low-rated debt derived from relatively high risk-adjusted returns: after deducting losses from the bonds that had defaulted, a diversified portfolio of junk bonds performed better than a portfolio of investment-grade bonds.

In the first half of the 1980s LBO companies which were financed by junk bond debt experienced improved operating profits and few defaults.[12] In the latter half of the 1980s,

9 A non-amortising (or bullet) loan is a loan that has a one-off payment of principal and interest at its termination.
10 Covenants are conditions imposed on the borrower in a loan agreement (e.g. obligations to make timely payments, or restrictions on actions such as selling or transferring assets).
11 The development of the junk bond market is often associated with Drexel Burnham Lambert, a US investment bank which dominated trading in the junk bond markets at the time.
12 See S. Kaplan and J. Stein (1993), "The evolution of buyout and financial structure in the 1980s", *Quarterly Journal of Economics*, No. 108.

however, roughly one-third of all LBO firms defaulted on their debt. Studies show that the reason for these defaults was not related to a drop in efficiency.[13] The profitability of the firms continued improving, but not sufficiently to pay off the enormous amount of debt that had been taken on during the takeover process. Moreover, towards the end of the decade, the search for LBO targets also extended to industries with less steady cash flows, which are inherently more risky candidates for LBO transactions. In addition, the success of many of the deals in the early 1980s attracted new market participants who understood the potential of the LBO market, and pushed up the purchase prices.[14]

Junk bond issuance in the US reached its peak in 1988 before there was an abrupt upturn in the number of defaults by junk bond issuers in 1989 and 1990. With the credit cycle turning, confidence of market participants in the junk bond market waned, which contributed to a drying up of liquidity in the market. The troubles in the junk bond market subsequently played a role in accelerating the LBO market bust as many underwriting banks were forced to buy back the bonds of insolvent and failing companies, thus depleting their capital and eventually bankrupting several institutions. A number of savings and loans (S&L) institutions, which had been major buyers of junk bonds, also went bankrupt. Although the roots of the S&L crisis went much deeper and cannot directly be attributed to the fall of the high-yield bond market, the difficulties experienced by S&L institutions added to the general negative sentiment at the time. For all of these reasons, the junk bond market is often mentioned as an important catalyst both for the boom and the bust of the US LBO market in the 1980s. Nevertheless, it subsequently recovered and has since proven to be a lasting financial innovation.

LEVERAGED LOAN MARKETS AS A MEANS OF CURRENT LBO DEBT FINANCING

The recent growth in LBO activity has coincided with an expansion of the market for leveraged loans (LLs). LLs are loans granted to sub-investment-grade borrowers who typically have very high debt-to-equity ratios on their balance sheets. These loans are secured instruments (unlike junk bonds), offering greater repayment flexibility and requiring less information disclosure than regular loans. A gradually increasing degree of standardisation in the LL market has also facilitated the development of hedging instruments such as loan credit default swaps (LCDSs), which improve the scope for risk management among investors. Against this background, over the past few years LLs have developed from an opaque, relationship-based business to a market that is both transparent and open to institutional investors, attracting very large inflows of investor capital both in the US and in the EU.[15]

In an important parallel to the junk bond boom of the 1980s, today's leveraged loans are increasingly originated by syndications of large LBO transactions. Indeed, according to Standard and Poor's data, the share of LBO syndications as a source of LLs doubled in 2005 and again in 2006 to total almost 50% of all leveraged loans. A key driver of supply has been LBO recapitalisations. Together with sales to other LBO funds (secondary buyouts), these have increased in popularity as an exit strategy for LBO sponsors at the cost of traditional IPOs. Such "recycled" LBO deals tend to be completed at steadily increasing enterprise value/EBITDA (Earnings Before Interest, Taxes, Amortisation and Depreciation) multiples: in 2006 these

13 See B. Holmström and S. Kaplan (2001), "Corporate governance and merger activity in the United States: making sense of the 1980s and 1990s", *Journal of Economic Perspectives*, No. 15.

14 Against this background, Holmström and Kaplan (2001) argue that seen ex post, much of the benefit of the improved discipline, incentives and corporate governance brought about by LBO transactions could have accrued to the selling shareholders rather than to the post-buyout LBO investors.

15 Standard and Poor's estimates that due to the surge of European LBO activity throughout the past couple of years, the European segment of the LL market is now almost comparable in size to the US market.

averaged 9.7 times EBITDA for recapitalisations compared with an average of 7.3 times EBITDA in public-to-private transactions. The average total leverage of LBO-syndicated LLs reached almost 6 times EBITDA in 2006.[16]

Senior secured LLs have developed into a stable asset class and, as they have attractive risk-return characteristics, demand for such loans has increased significantly. So-called institutional loans (loans which are positioned higher in the seniority structure) of issued leveraged loans are particularly appealing to managers of collateralised debt obligations (CLOs), who are attracted by the stable high yield to maturity guaranteed by the bullet-type amortisation structures. CLOs themselves are complex structured products that are designed to generate higher yields compared to equivalently rated debt instruments. The more subordinated LLs are typically purchased by dedicated credit hedge funds (see Chart E.4).

In 2006, 11% of new leveraged loans were rated in the sub-investment-grade BB category, and 87% in the lower single B category (see Chart E.5). Compared to the figures one year earlier, there was a deterioration in credit quality in the LL markets, as evidenced by the fact that within the single B category, 37% of all loans in 2006 were at the lower end (B-), compared with 33% in 2005. Also consistent with lower credit quality, market participants reported that borrowers had requested an increasing number of loan covenant waivers. Lenders and investors in LLs are often ready to accept such requests in order to secure a steady stream of excess yield or to ensure future deal origination fees.

All in all, innovations in the debt capital markets, themselves driven by strong demand by investors seeking high yield, could have been an important factor, although by no means the only one, in facilitating the activity in the LBO market both in the 1980s and at present.

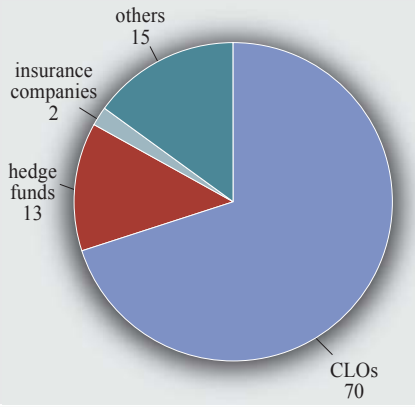
POSSIBLE FINANCIAL STABILITY ISSUES

Although the recent expansion of the global LBO market and the role that banks have been playing in this process have recently attracted considerable attention, it is important to recognise that banks have been actively involved in LBO transactions from the very outset of the market, and that although several

16 When assessing the credit quality of LBO sourced LLs, the total amount of debt, its maturity profile and the cost of debt servicing is typically assessed against its cash-flow generating ability to service the debt over time.

Chart E.4 Purchasers of European leveraged loans

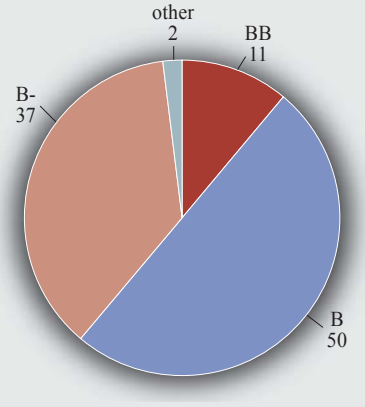
(percentages; 2006)



Source: Standard and Poor's.

Chart E.5 Credit quality of European leveraged loans

(percentages; 2006)



Source: Standard and Poor's.

lessons can be learned from earlier episodes, banks today are far better prepared to assess and manage risk than in the past.

In the current context, the negative impact of rising short-term interest rates on loan-servicing burdens could well have been partially offset by the buoyant economic environment, the strength of corporate profitability, low default rates, non-amortising debt structures and covenant waivers. At the same time, persistently low returns from long-term government bonds have been an important factor in driving investor demand for high-yielding securities such as leveraged loans. This combination has led to a situation where even poorly performing debtors continue to have access to new financing facilities, and where they can negotiate waivers and reset covenants. This may have held default rates at lower levels than might have otherwise been the case. These developments could raise some financial stability concerns, since an abrupt change in market confidence or in credit market liquidity conditions could result in an abrupt surge of default rates. Possible losses in the leveraged loan market could then contribute to a further withdrawal of funds, and hence accelerate the worsening of the credit cycle.

When contemplating the possible implications on financial stability of increasing activity in the leveraged loan markets, the following three aspects are worth mentioning. First, even though progress has been made, leveraged loans are still not a standard debt product, and hence fluctuations in the liquidity of the secondary market are more likely than in more mature markets. Second, and related to the first point, leveraged loans are more difficult to hedge. Third, recent developments in the LBO market – as highlighted in the BSC report – suggest that compressed margins on leveraged loans might not fully reflect the higher levels of risk embedded in "covenant-*lite*" or no-covenant debt structures and in non-amortising loan tranches.

In addition, some investment banks' active involvement in M&A and LBO transactions could have made their revenues excessively dependent on the fee income derived from these activities. According to Bloomberg data, in 2006 M&A fees collected by the largest 20 investment banks around the globe stood at around USD 35 billion, of which more than one-quarter was generated by LBO transactions. This figure far exceeds fee income from equity and bond underwriting, which were reported to account for just over USD 21 billion and USD 14 billion respectively. LBO transactions have also driven fees in bond markets and generated business for debt underwriters, as sales of junk bonds rose 50% in 2006 to reach just below USD 200 billion.

CONCLUDING REMARKS

While banks' LBO debt exposures appear to be contained, as indicated by the BSC survey results, it cannot be excluded that intense competition to win new deals in the pursuit of fee income, together with the strength of the bargaining power of private equity firms in negotiating terms for LBO transactions, may have led to an inadequate pricing of risks by investors in various forms of LBO debt. To mitigate these risks, banks will need to ensure the adequacy of stress-testing of their direct exposures and exercise vigilance in the monitoring of counterparty risks.

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6 EURO AREA FINANCIAL SYSTEM INFRASTRUCTURES

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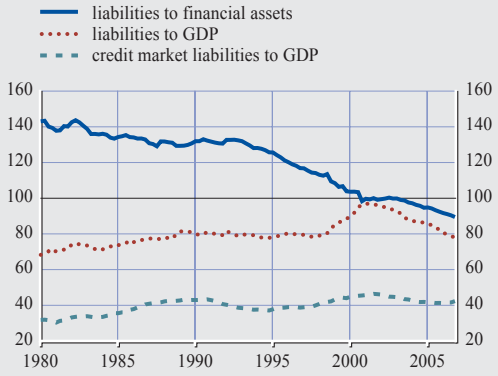
I EXTERNAL ENVIRONMENT

Chart S1 US non-farm, non-financial corporate sector business liabilities

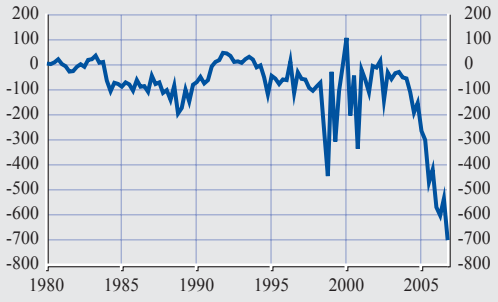
(Q1 1980 - Q4 2006, %)



Sources: US Federal Reserve Board and Bureau of Economic Analysis.

Chart S2 US non-farm, non-financial corporate sector business net equity issuance

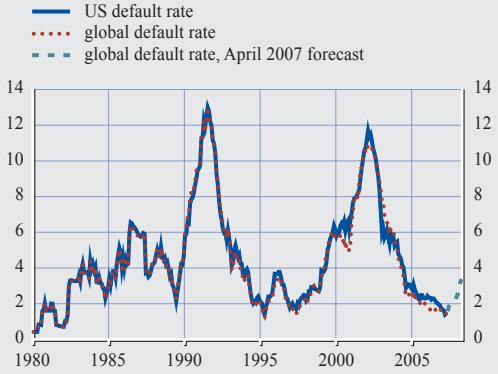
(Q1 1980 - Q4 2006, USD billions, seasonally adjusted quarterly annualised data)



Source: US Federal Reserve Board.

Chart S3 US and global speculative-grade default rates and global default rate forecast

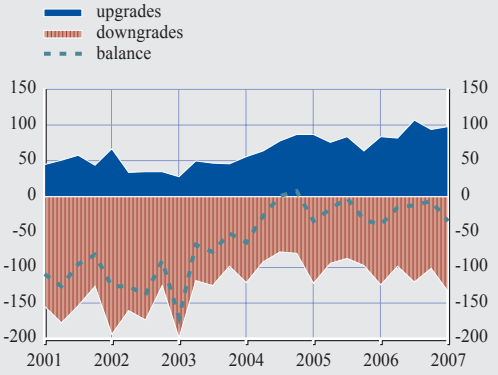
(Jan. 1980 - Apr. 2008, %, 12-month trailing sum)



Source: Moody's.

Chart S4 US corporate sector rating changes

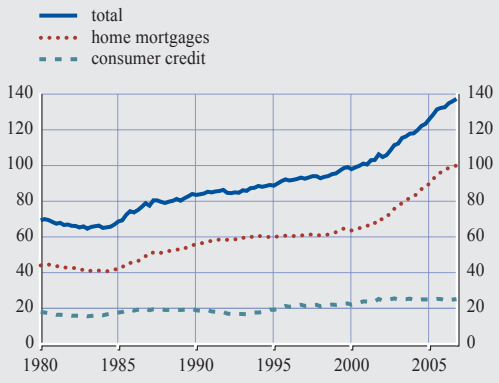
(Q1 2001 - Q1 2007, number)



Source: Moody's.

Chart S5 US household sector debt-to-disposable income ratio

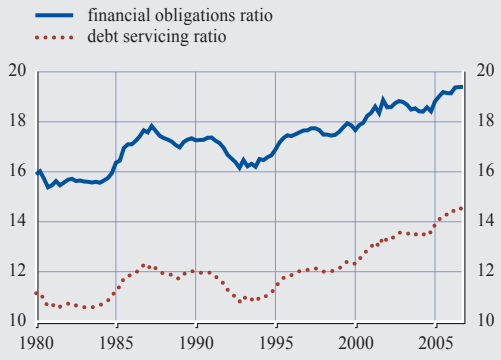
(Q1 1980 - Q4 2006, % of disposable income)



Source: US Federal Reserve Board.

Chart S6 US household sector debt burden

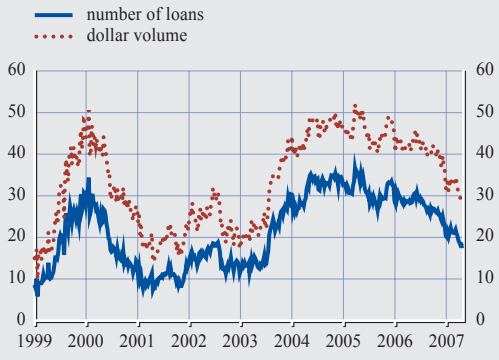
(Q1 1980 - Q4 2006, % of disposable income)



Source: US Federal Reserve Board.

Chart S7 Share of adjustable-rate mortgages in the US

(Jan. 1999 - May 2007, % of total new mortgages)



Source: Mortgage Bankers Association.

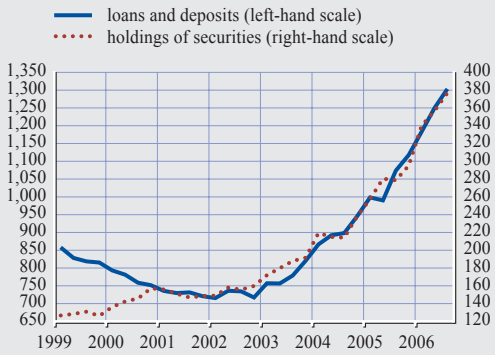
Chart S8 US general government and federal debt-to-GDP ratio

(Q1 1980 - Q4 2006, %)

Sources: US Federal Reserve Board and Bureau of Economic Analysis.
Note: General government gross debt comprises federal, state and local government gross debt.

Chart S9 International positions of all BIS reporting banks vis-à-vis emerging markets

(Q1 1999 - Q3 2006, USD billions)



Source: Bank for International Settlements (BIS).

Table S1 Financial vulnerability indicators for selected emerging market economies

	Current account balance (% of GDP)			External debt (% of GDP)			Short-term external debt (% of reserves)			Foreign reserves (in months of imports)		
	2005	2006	2007(f)	2005	2006	2007(f)	2005	2006	2007(f)	2005	2006	2007(f)
Latin America												
Argentina	3.1	2.9	2.5	73	59	50	52	46	39	7.5	7.7	8.4
Brazil	1.8	1.3	0.8	24	21	19	36	23	18	5.1	6.8	7.7
Chile	0.6	3.4	-0.1	39	33	35	41	59	60	4.0	3.1	3.2
Colombia	-1.6	-1.9	-1.6	31	31	32	17	17	17	5.7	5.8	5.8
Mexico	-0.7	-0.4	-1.2	23	20	19	46	45	44	3.4	3.1	3.0
Venezuela	17.8	15.5	7.7	32	24	18	41	32	43	8.2	8.5	5.7
Asia												
China	7.2	9.5	10.8	13	12	11	17	16	13	13.3	14.5	16.4
India	-1.1	-1.4	-1.3	18	19	19	12	11	11	8.6	8.4	7.9
Indonesia	0.1	2.3	1.1	46	36	33	66	62	55	3.7	4.1	4.4
Malaysia	12.2	8.5	6.5	39	33	31	12	10	11	6.0	6.0	6.0
South Korea	2.1	0.3	0.1	24	24	23	31	38	40	7.8	7.0	6.5
Thailand	-4.5	1.6	2.0	31	28	25	31	32	27	4.2	5.0	5.3
Emerging Europe												
Russia	10.7	9.6	4.5	31	29	30	34	25	23	10.9	13.5	13.6
Turkey	-6.3	-8.1	-7.2	49	57	56	117	114	120	4.6	4.8	4.6

Source: Institute of International Finance.
Note: Data for 2007 are forecasts.

Table S2 Value at risk (VaR) amounts by category of risk for global large and complex banking groups

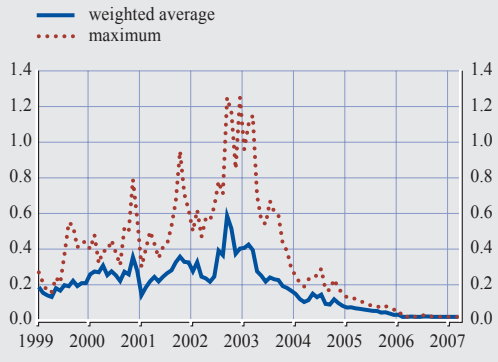
(USD millions, 99% confidence, ten-day holding period)

	Commodities	Equities	Interest rate	Foreign exchange
2005 average	37.8	91.1	191.4	39.4
2005 median	36.9	105.8	183.4	33.0
2006 average	56.5	111.6	184.4	47.6
2006 median	47.4	123.5	160.5	48.0

Sources: Securities and Exchange Commission (SEC) and institutions' quarterly reports.
Note: The institutions included are JP Morgan Chase & Co, Morgan Stanley, Citigroup, Bank of New York, UBS, CSFB and HSBC.

Chart S10 Expected default frequencies (EDFs) for global large and complex banking groups

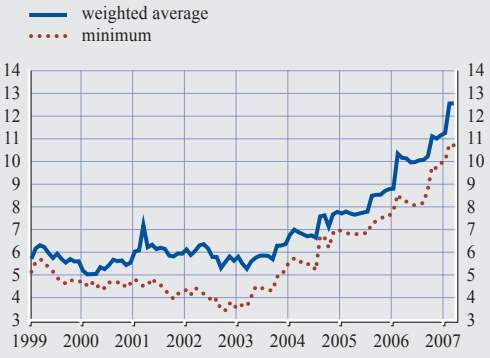
(Jan. 1999 - Mar. 2007, % probability)



Sources: Moody's KMV and ECB calculations.
Note: Due to measurement considerations, the EDF values are restricted by Moody's KMV to the interval between 0.02% and 20%. The sample includes Goldman Sachs, JP Morgan Chase & Co, Morgan Stanley, Merrill Lynch, Citigroup, Bank of New York, State Street, UBS, CSFB, Barclays, HBOS, RBS and HSBC.

Chart S11 Distance-to-default for global large and complex banking groups

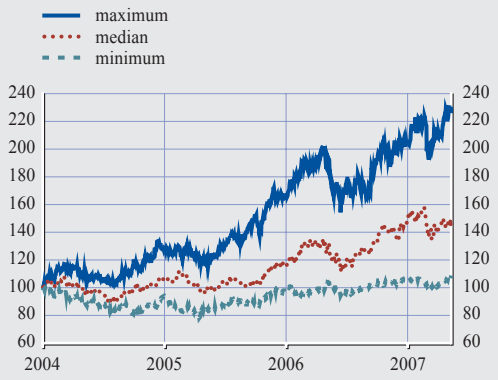
(Jan. 1999 - Mar. 2007)



Sources: Moody's KMV and ECB calculations.
Note: An increase in the distance-to-default reflects an improving assessment. The sample includes Goldman Sachs, JP Morgan Chase & Co, Morgan Stanley, Merrill Lynch, Citigroup, Bank of New York, State Street, UBS, CSFB, Barclays, HBOS, RBS and HSBC.

Chart S12 Equity prices for global large and complex banking groups

(Jan. 2004 - May 2007, index: Jan. 2004 = 100)



Sources: Bloomberg and ECB calculations.
Note: The sample includes Goldman Sachs, JP Morgan Chase & Co, Morgan Stanley, Merrill Lynch, Citigroup, Bank of New York, State Street, UBS, CSFB, Barclays, HBOS, RBS and HSBC.

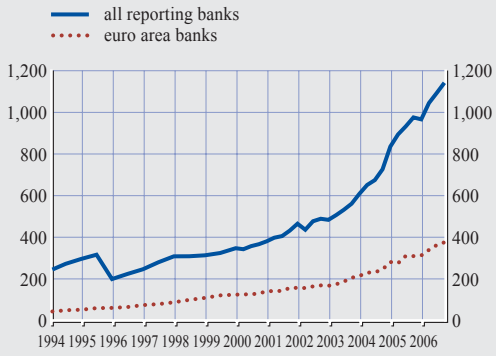
Chart S13 Subordinated credit default swap spreads for global large and complex banking groups

(Jan. 2004 - May 2007, basis points)

Sources: Bloomberg and ECB calculations.
Note: The sample includes Goldman Sachs, JP Morgan Chase & Co, Morgan Stanley, Merrill Lynch, Citigroup, Bank of New York, State Street, UBS, CSFB, Barclays, HBOS, RBS and HSBC.

Chart S14 Global consolidated claims on non-banks in offshore financial centres

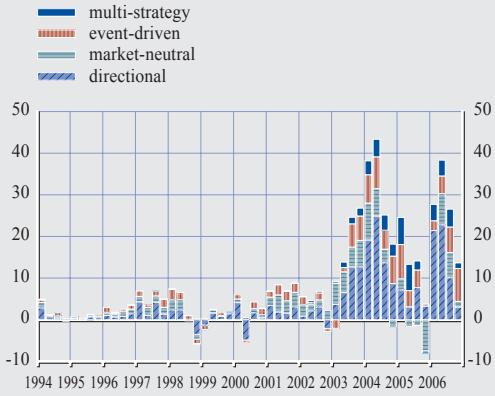
(Q1 1994 - Q3 2006, USD billions)



Source: BIS.

Chart S15 Global hedge fund net flows

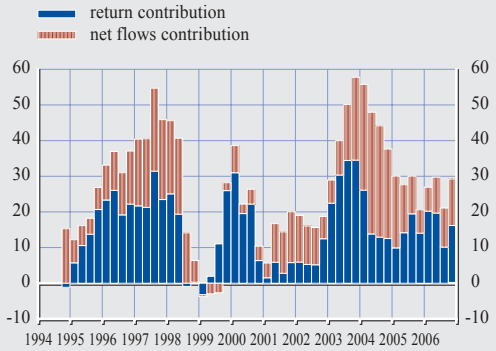
(Q1 1994 - Q4 2006, USD billions)



Source: Lipper TASS.
Note: Excluding funds of hedge funds.

Chart S16 Decomposition of the annual rate of growth of global hedge fund capital under management

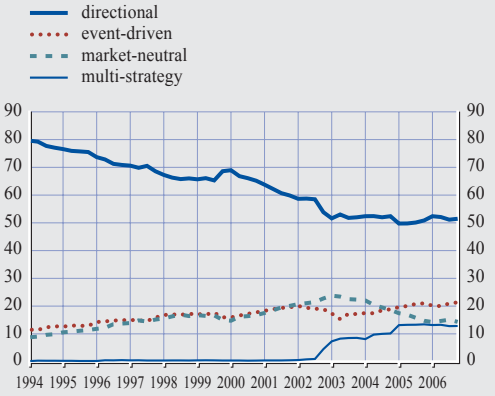
(Q4 1994 - Q4 2006, %, 12-month changes)



Sources: Lipper TASS and ECB calculations.
Note: Excluding funds of hedge funds. The estimated quarterly return to investors equals the difference between the change in capital under management and net flows. In this dataset, capital under management totalled USD 1.05 trillion at the end of December 2006.

Chart S17 Structure of global hedge fund capital under management

(Q1 1994 - Q4 2006, %)



Sources: Lipper TASS and ECB calculations.
Note: Excluding funds of hedge funds. The directional group includes long/short equity hedge, global macro, emerging markets, dedicated short bias and managed futures strategies. The market-neutral group consists of convertible arbitrage, fixed income arbitrage and equity market-neutral strategies.

2 INTERNATIONAL FINANCIAL MARKETS

Chart S18 Global risk aversion indicator

(Jan. 1999 - May 2007)

Source: Merrill Lynch.
Note: An increase in the risk aversion indicator reflects an increase in risk aversion. The indicator is based on eight indicators that have historically been sensitive to swings in risk appetite. Each component is expressed in terms of the number of standard deviations from its 52-week moving average, and the eight standard deviations are combined to generate a composite indicator.

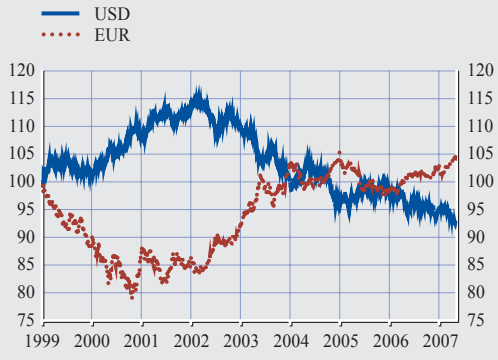
Chart S19 Real broad USD effective exchange rate index

(Jan. 1999 - Apr. 2007, index: Jan. 1999 = 100)

Source: US Federal Reserve Board.

Chart S20 Selected nominal effective exchange rate indices

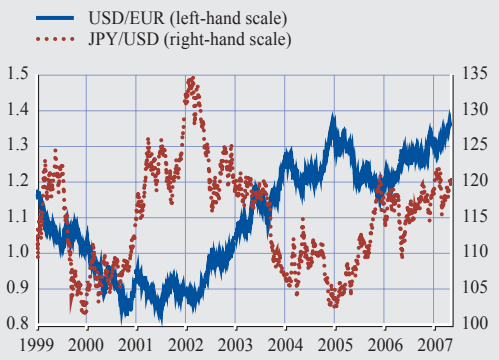
(Jan. 1999 - May 2007, index: Jan. 1999 = 100)



Sources: US Federal Reserve Board and ECB.

Chart S21 Selected bilateral exchange rates

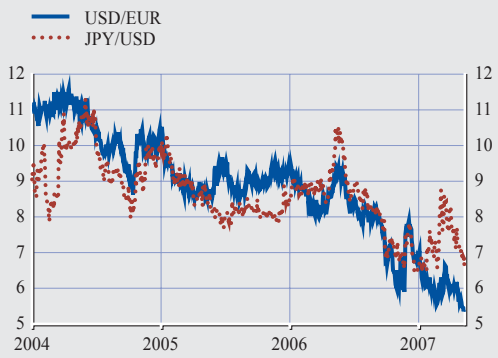
(Jan. 1999 - May 2007)



Source: ECB.

Chart S22 Selected three-month implied foreign exchange market volatilities

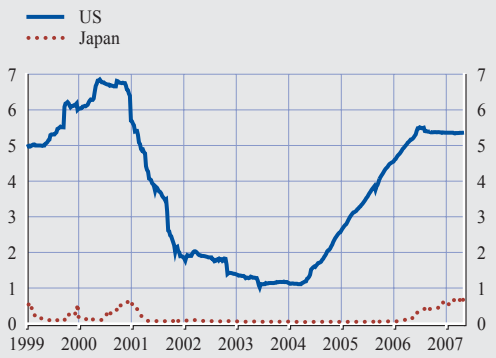
(Jan. 2004 - May 2007, %)



Source: Bloomberg.

Chart S23 Three-month money market rates in the US and Japan

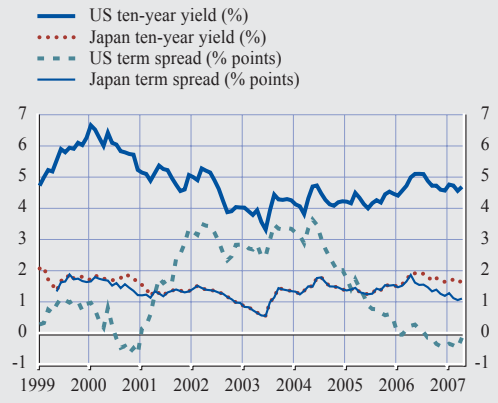
(Jan. 1999 - May 2007, LIBOR, %)



Source: Bloomberg.

Chart S24 Government bond yields and term spreads in the US and Japan

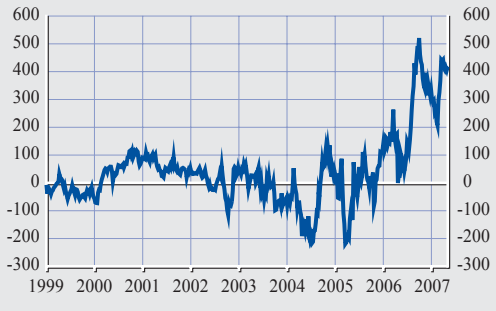
(Jan. 1999 - Apr. 2007)



Sources: ECB and Bloomberg.
Note: The term spread is the difference between the ten-year bond yield and the three-month T-bill yield.

Chart S25 Net non-commercial positions in ten-year US Treasury futures

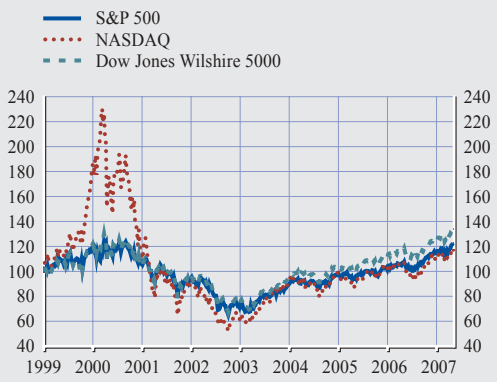
(Jan. 1999 - May 2007, thousands of contracts)



Source: Bloomberg.
Note: Futures traded on the Chicago Board of Trade. Non-commercial futures contracts are contracts bought for purposes other than hedging.

Chart S26 Stock prices in the US

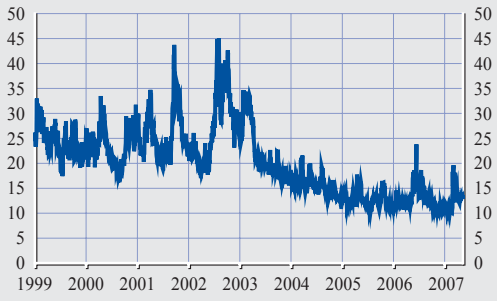
(Jan. 1999 - May 2007, index: Jan. 1999 = 100)



Source: Bloomberg.

Chart S27 Implied volatility for the S&P 500 index

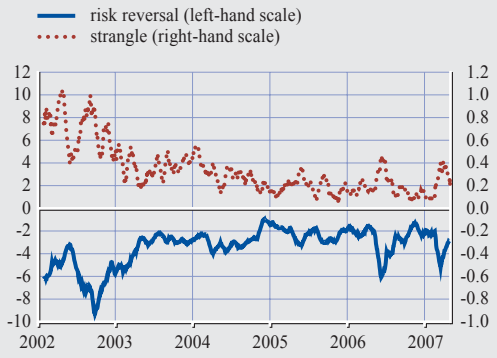
(Jan. 1999 - May 2007, %, CBOE Volatility Index (VIX))



Source: Thomson Financial Datastream.
Note: Data calculated by the Chicago Board Options Exchange (CBOE).

Chart S28 Risk reversal and strangle of the S&P 500 index

(Feb. 2002 - May 2007, %, implied volatility, 20-day moving average)



Sources: Bloomberg and ECB calculations.
Note: The risk-reversal indicator is calculated as the difference between the implied volatility of an out-of-the-money (OTM) call with 25 delta and the implied volatility of an OTM put with 25 delta. The strangle is calculated as the difference between the average implied volatility of OTM calls and puts, both with 25 delta, and the average at-the-money volatility of calls and puts with 50 delta.

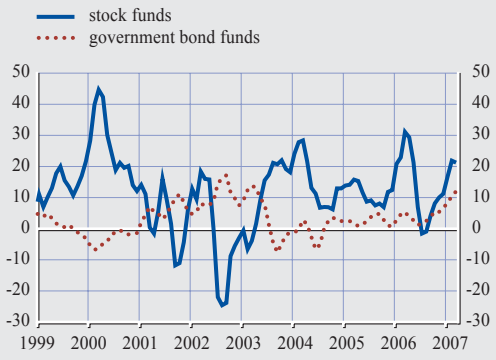
Chart S29 Price-earnings (P/E) ratio for the US stock market

(Jan. 1985 - Apr. 2007, %, ten-year trailing earnings)

Sources: Thomson Financial Datastream and ECB calculations.
Note: The P/E ratio is based on prevailing stock prices relative to an average of the previous ten years of earnings.

Chart S30 US mutual fund flows

(Jan. 1999 - Mar. 2007, USD billions, three-month moving average)



Source: Investment Company Institute.

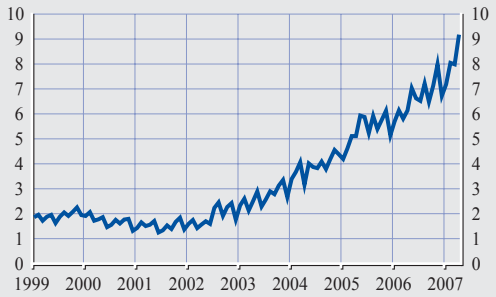
Chart S31 Debit balances in New York Stock Exchange margin accounts

(Jan. 1999 - Mar. 2007, USD billions)

Source: New York Stock Exchange (NYSE).
Note: Borrowing to buy stocks "on margin" allows investors to use loans to pay for up to 50% of a stock's price.

Chart S32 Open interest in options contracts on the S&P 500 index

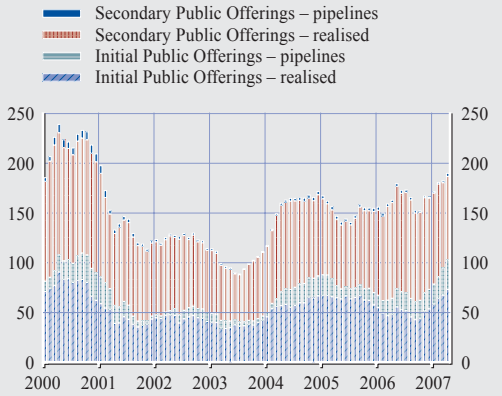
(Jan. 1999 - Apr. 2007, millions of contracts)



Source: Chicago Board Options Exchange (CBOE).

Chart S33 Gross equity issuance in the US

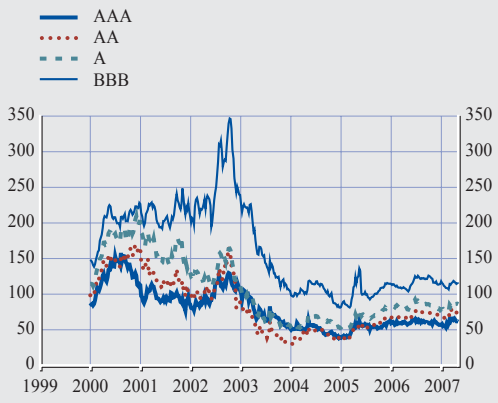
(Jan. 2000 - Apr. 2007, USD billions, 12-month moving sums)



Source: Thomson Financial Datastream.

Chart S34 US investment-grade corporate bond spreads

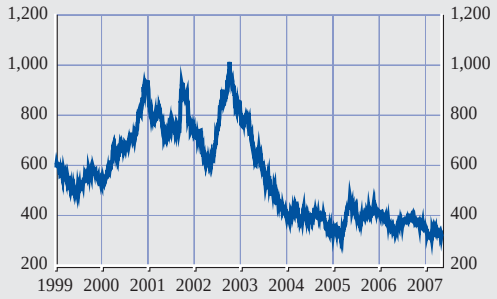
(Jan. 2000 – May 2007, basis points)



Source: JP Morgan Chase & Co.
Note: Spread between the seven to ten-year yield to maturity and the US seven to ten-year government bond yield.

Chart S35 US speculative-grade corporate bond spreads

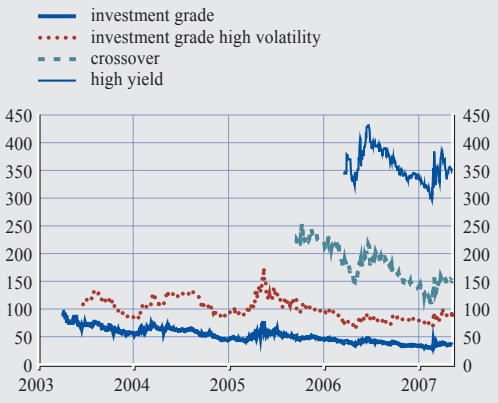
(Jan. 1999 - May 2007, basis points)



Source: JP Morgan Chase & Co.
Note: The spread is between the yield to maturity of the US domestic high-yield index (BB+ rating or below, average maturity of 7.7 years) and the US ten-year government bond yield.

Chart S36 US credit default swap (CDS) indices

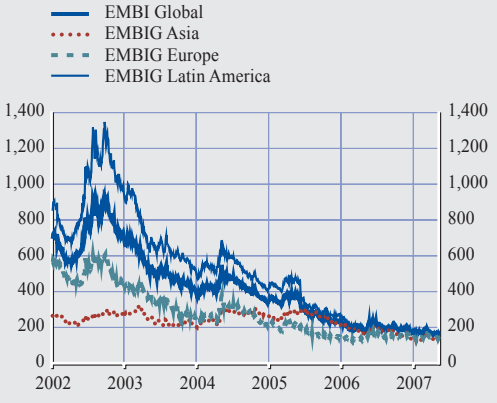
(Apr. 2003 - May 2007, basis points, five-year maturity)



Source: JP Morgan Chase & Co.

Chart S37 Emerging market sovereign bond spreads

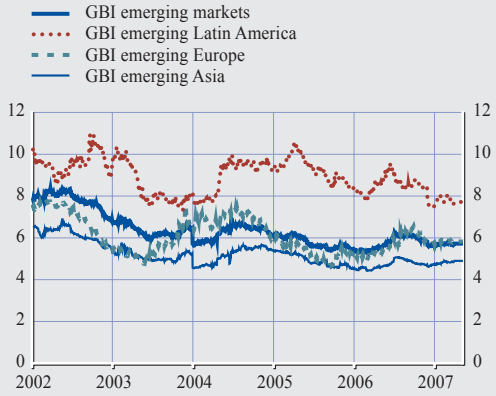
(Jan. 2002 - May 2007, basis points)



Source: JP Morgan Chase & Co.

Chart S38 Emerging market local currency sovereign bond yields

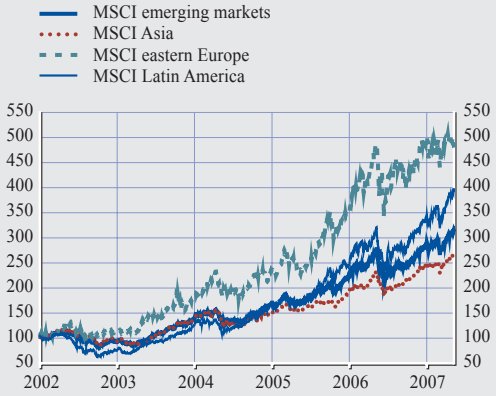
(Jan. 2002 - May 2007, % points)



Source: JP Morgan Chase & Co.
Note: GBI stands for Government Bond Index.

Chart S39 Emerging market stock price indices

(Jan. 2002 - May 2007, index: Jan. 2002 = 100)



Source: Bloomberg.

Table S3 Total international bond issuance (private and public) in selected emerging markets

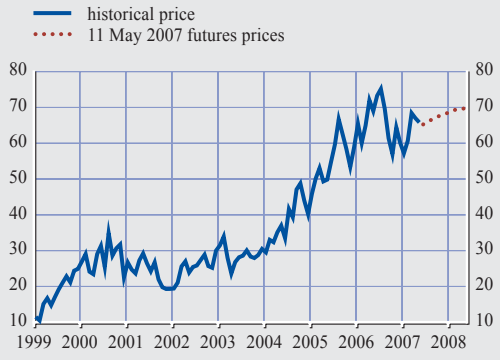
(USD millions)

	2001	2002	2003	2004	2005	2006	2006 Q1	2006 Q2	2006 Q3	2006 Q4	2007 Q1
Total Major EMEs	**66,664**	**64,983**	**99,448**	**114,727**	**162,758**	**135,957**	**31,540**	**22,824**	**28,188**	**53,405**	**44,607**
Latin America	**28,801**	**19,316**	**32,635**	**36,713**	**74,278**	**36,331**	**11,039**	**2,230**	**7,837**	**15,225**	**11,514**
of which:											
Argentina	3,328	-	-	915	36,179	1,463	100	250	76	1,037	300
Brazil	7,417	5,736	11,803	9,358	17,823	17,180	4,809	1,010	3,424	7,936	4,042
Chile	2,150	1,399	1,000	1,307	-	1,328	428	200	200	500	250
Colombia	4,004	1,000	1,265	1,544	2,097	3,177	238	170	2,300	468	554
Mexico	7,552	6,098	11,226	15,501	6,853	5,438	3,000	100	150	2,188	3,862
Venezuela	1,729	1,049	4,478	4,380	6,079	731	-	100	250	381	250
Non-Japan Asia	**32,466**	**35,032**	**50,108**	**58,117**	**58,766**	**61,334**	**14,389**	**13,556**	**13,611**	**19,778**	**17,853**
of which:											
China	2,552	860	2,979	6,188	3,766	3,468	291	682	592	1,902	1,340
Hong Kong	9,367	2,269	12,631	6,268	7,003	7,214	996	2,012	1,468	2,738	1,711
India	99	153	450	4,167	4,289	7,402	3,205	1,595	1,019	1,583	5,071
South Korea	6,385	11,843	11,028	16,018	16,759	17,114	2,517	3,981	5,301	5,314	4,022
Malaysia	2,516	5,215	1,364	3,440	3,248	4,253	1,450	-	1,022	1,781	565
Singapore	7,400	812	3,885	7,388	5,543	5,541	476	2,860	1,486	718	753
Thailand	- 48	300	1,400	1,800	1,549	270	320	124	835	-	
Emerging Europe	**5,397**	**10,635**	**16,706**	**19,896**	**29,715**	**38,292**	**6,111**	**7,038**	**6,740**	**18,402**	**15,240**
of which:											
Russia	1,503	3,713	8,585	10,490	17,324	25,611	3,271	5,345	3,598	13,396	9,937
Turkey	2,159	3,566	5,454	6,241	9,124	8,810	2,393	1,293	2,292	2,832	4,068
Ukraine	-	399	1,250	2,058	1,808	2,865	447	-	658	1,760	1,235
Bulgaria	223	1,248	62	10	260	622	-	401	-	221	-
Romania	794	1,062	814	-	1,199	-	-	-	-	-	-
Croatia	718	647	541	1,098	-	383	-	-	192	192	-

Source: Dealogic (Bondware).
Note: Regions are defined as follows. Latin America: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, Uruguay and Venezuela. Non-Japan Asia: Brunei, Burma, China, Special Administrative Region of Hong Kong, Indonesia, Laos, Macau, Malaysia, Nauru, North Korea, the Philippines, Samoa, Singapore, South Korea, Taiwan, Thailand and Vietnam. Emerging Europe: Bulgaria, Croatia, Romania, Russia, Turkey and Ukraine.

Chart S40 Oil price and oil futures prices

(Jan. 1999 - May 2008, USD per barrel)



Source: Bloomberg.

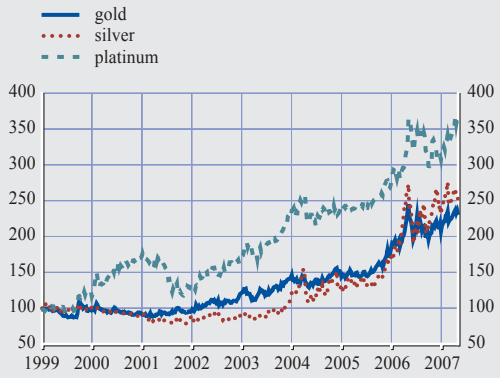
Chart S41 Crude oil futures contracts

(Jan. 1999 - May 2007, thousands of contracts)

Source: Bloomberg.
Note: Futures traded on the New York Mercantile Exchange. Non-commercial futures contracts are contracts bought for purposes other than hedging.

Chart S42 Precious metals prices

(Jan. 1999 - May 2007, index: Jan. 1999 = 100, prices in USD)



Source: Bloomberg.

3 EURO AREA ENVIRONMENT

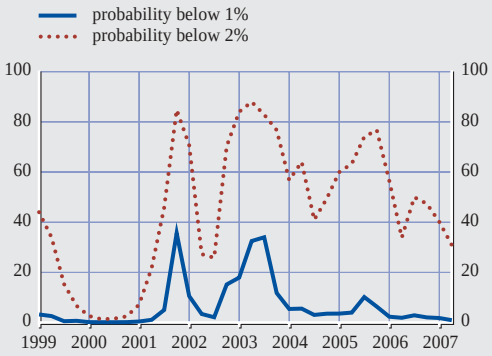
Chart S43 Real GDP growth in the euro area

(Q1 1999 - Q4 2006, % per annum)

Source: Eurostat.

Chart S44 Survey-based estimates of the four-quarter-ahead downside risk of weak real GDP growth in the euro area

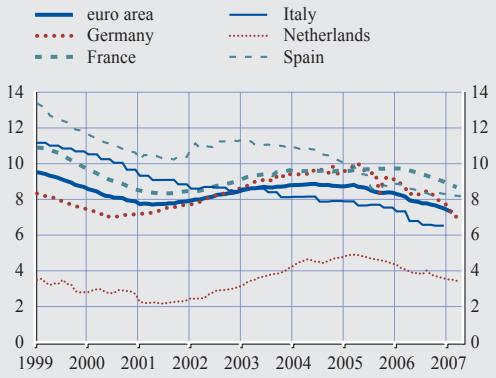
(Q1 1999 - Q1 2007, %)



Sources: ECB Survey of Professional Forecasters (SPF) and ECB calculations.
Note: The indicators measure the percentage of the probability distribution for real GDP growth expectations over the following year below the indicated threshold.

Chart S45 Unemployment rate in the euro area and selected euro area countries

(Jan. 1999 - Apr. 2007, %)



Source: Eurostat.

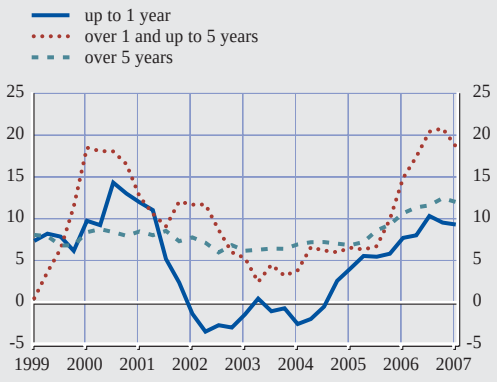
Chart S46 Gross fixed capital formation in the euro area

(Q1 1999 - Q4 2006, % of GDP)

Source: Eurostat.

Chart S47 Annual growth in MFI loans to non-financial corporations in the euro area for selected maturities

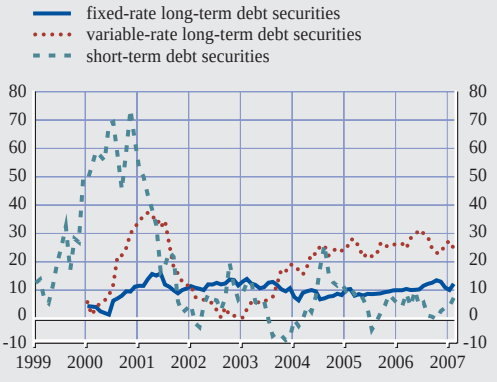
(Q1 1999 - Q1 2007, % per annum)



Source: ECB.
Note: Data are based on financial transactions of monetary financial institution (MFI) loans.

Chart S48 Annual growth in debt securities issued by non-financial corporations in the euro area

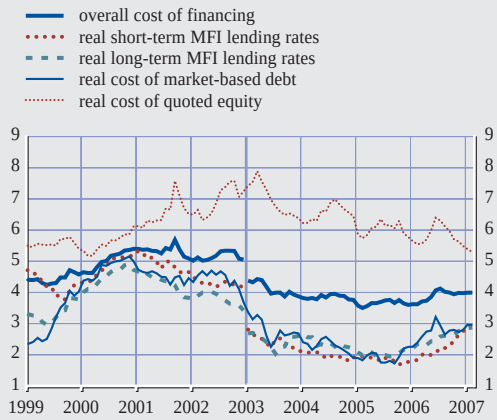
(Jan. 1999 - Feb. 2007, % per annum, outstanding amounts)



Source: ECB.

Chart S49 Real cost of external financing of euro area non-financial corporations

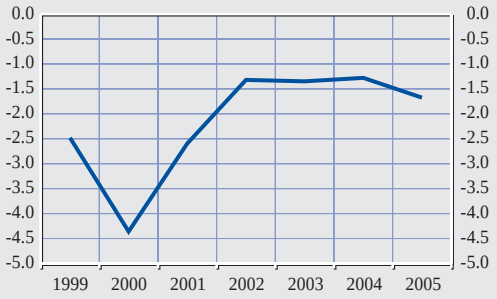
(Jan. 1999 - Feb. 2007, %)



Sources: ECB, Thomson Financial Datastream, Merrill Lynch, Consensus Economics Forecast and ECB calculations.
Note: The real cost of external financing is calculated as a weighted average of the cost of bank lending, the cost of debt securities and the cost of equity, based on their respective amounts outstanding and deflated by inflation expectations. The introduction of MFI interest rate statistics at the beginning of 2003 led to a statistical break in the series.

Chart S50 Net lending/borrowing of non-financial corporations in the euro area

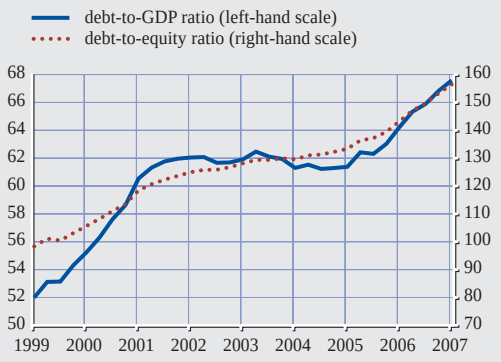
(1999 - 2005, % of GDP)



Sources: ECB and ECB estimates.
Note: Data for 2005 are estimates.

Chart S51 Total debt of non-financial corporations in the euro area

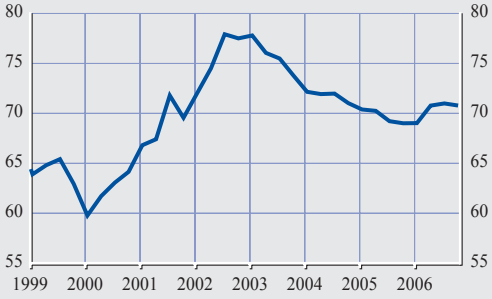
(Q1 1999 - Q1 2007, %)



Sources: ECB and ECB calculations.
Note: Data for the last quarter are partly based on estimates. The debt-to-equity ratio is calculated as a percentage of outstanding quoted shares issued by non-financial corporations excluding the effect of valuation changes.

Chart S52 Total debt-to-financial assets ratio of non-financial corporations in the euro area

(Q1 1999 - Q4 2006, %)



Source: ECB.

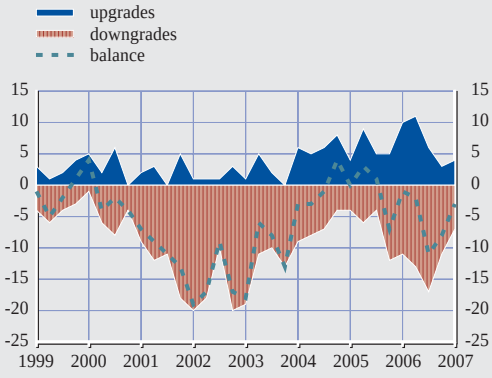
Chart S53 Euro area speculative-grade-rated non-financial corporations' default rates

(Jan. 1999 - Apr. 2007, %, 12-month trailing sum)

Source: Moody's.

Chart S54 Euro area non-financial corporations' rating changes

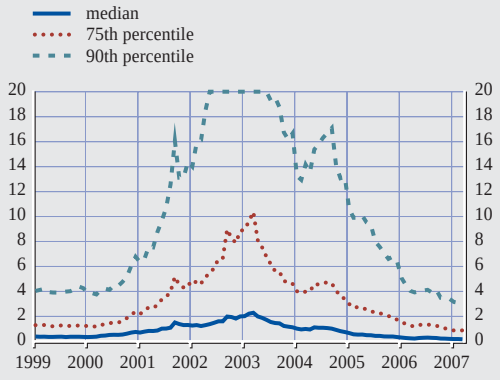
(Q1 1999 - Q1 2007, number)



Source: Moody's.

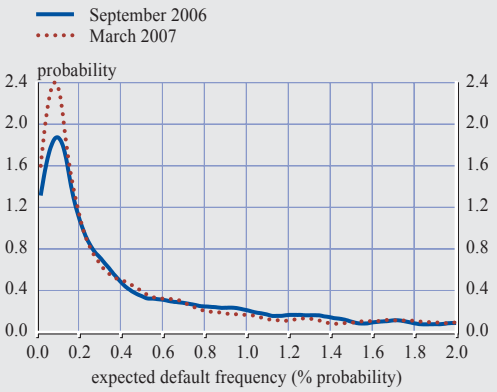
Chart S55 Expected default frequency (EDF) of euro area non-financial corporations

(Jan. 1999 - Mar. 2007, % probability)



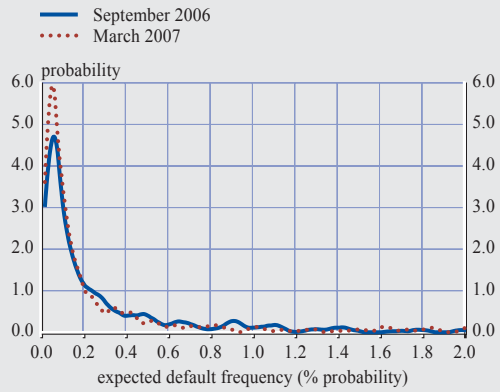
Source: Moody's KMV.
Note: The EDF provides an estimate of the probability of default over the following year. Due to measurement considerations, the EDF values are restricted by Moody's KMV to the interval between 0.02% and 20%.

Chart S56 Expected default frequency (EDF) distributions for euro area non-financial corporations



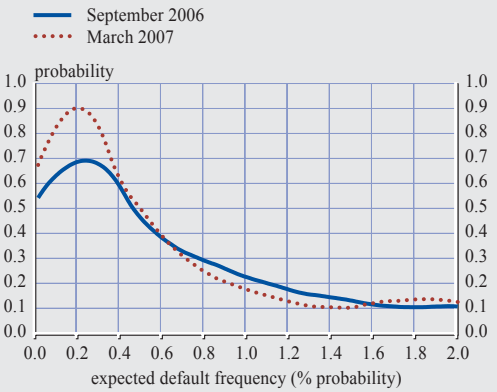
Sources: Moody's KMV and ECB calculations.
Note: The EDF provides an estimate of the probability of default over the following year.

Chart S57 Expected default frequency (EDF) distributions for large euro area non-financial corporations



Sources: Moody's KMV and ECB calculations.
Note: The EDF provides an estimate of the probability of default over the following year. The size is determined by the quartiles of the value of liabilities: it is large if in the upper quartile of the distribution.

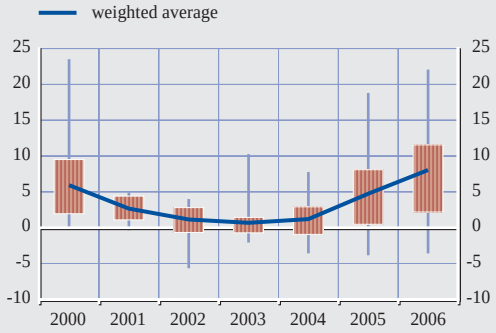
Chart S58 Expected default frequency (EDF) distributions for small euro area non-financial corporations



Sources: Moody's KMV and ECB calculations.
Note: The EDF provides an estimate of the probability of default over the following year. The size is determined by the quartiles of the value of liabilities: small if in the upper quartile of the distribution.

Chart S59 Euro area country distributions of commercial property price changes

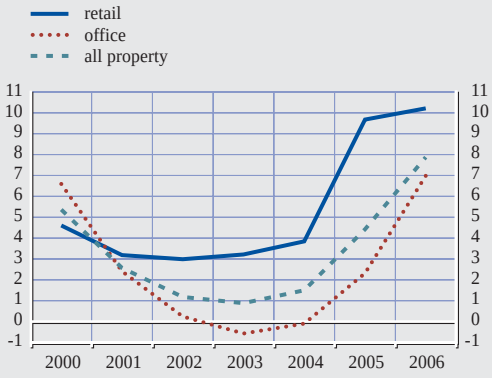
(2000 - 2006, capital values, minimum, maximum and inter-quartile distribution, % change per annum)



Sources: Investment Property Databank and ECB calculations.
Note: The data cover nine euro area countries. The coverage of the total property sector within countries ranges between around 20% and 80%.

Chart S60 Euro area commercial property price changes in different sectors

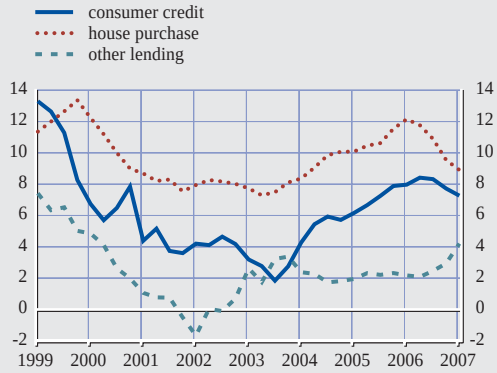
(2000 - 2006, capital values, % change per annum)



Sources: Investment Property Databank and ECB calculations.
Note: The data cover nine euro area countries. The coverage of the total property sector within countries ranges between around 20% and 80%.

Chart S61 Annual growth in MFI loans to households in the euro area

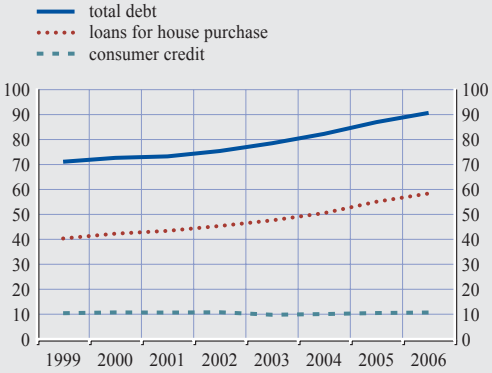
(Q1 1999 - Q1 2007, % per annum)



Source: ECB.
Note: Data are based on financial transactions of MFIs' loans.

Chart S62 Household debt-to-disposable income ratios in the euro area

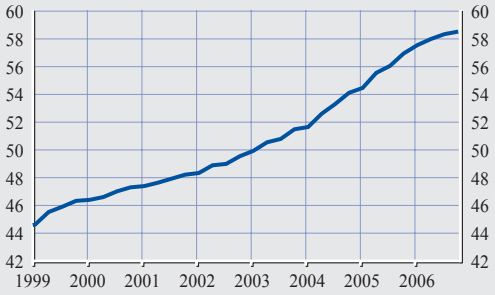
(1999 - 2006, % of disposable income)



Source: ECB.

Chart S63 Household debt-to-GDP ratio in the euro area

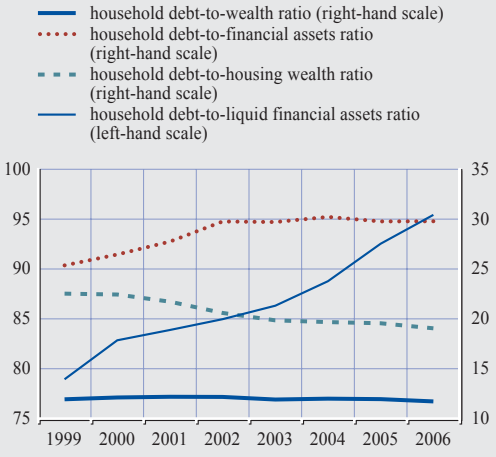
(Q1 1999 - Q4 2006, %)



Sources: ECB and Eurostat.

Chart S64 Household debt-to-assets ratios in the euro area

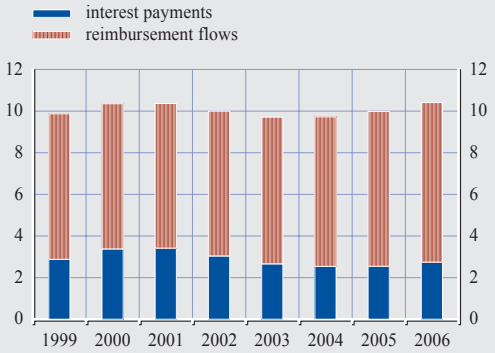
(1999 - 2006, %)



Source: ECB.
Note: Data for 2005 and 2006 are based on estimates.

Chart S65 Total debt-servicing burden of the euro area household sector

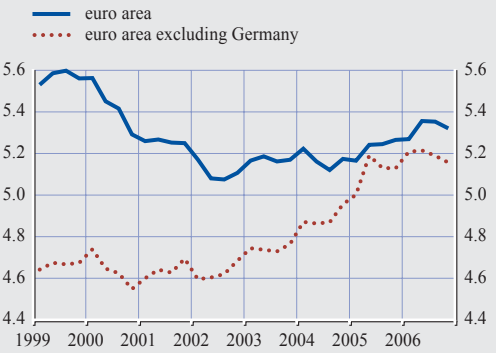
(1999 - 2006, % of disposable income)



Source: ECB calculations.
Note: Data for 2005 and 2006 are based on estimates.

Chart S66 Residential investment in the euro area

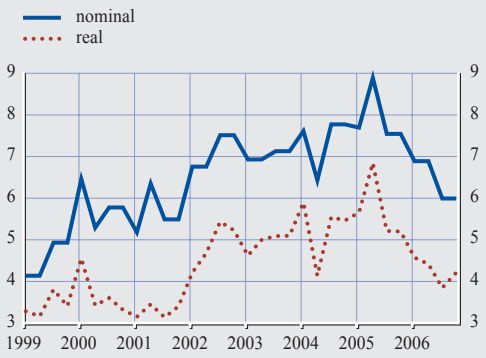
(Q1 1999 - Q4 2006, % of GDP)



Sources: ECB, Eurostat and ECB calculations.

Chart S67 Residential property price changes in the euro area

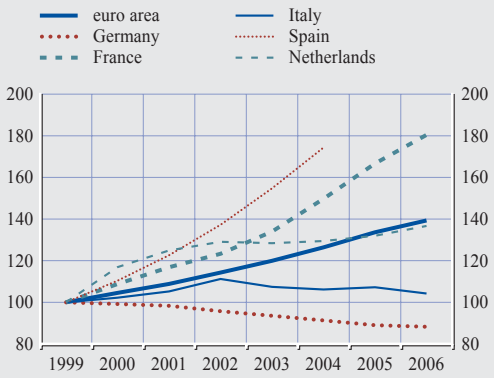
(Q1 1999 - Q4 2006, % per annum)



Sources: National sources and ECB calculations.
Note: The real price series has been deflated by the Harmonised Index of Consumer Prices (HICP).

Chart S68 House price-to-rent ratio for the euro area and selected euro area countries

(1999 - 2006, index: 1999 = 100)



Source: ECB.

Table S4 Residential property price changes in the euro area countries

(% per annum)

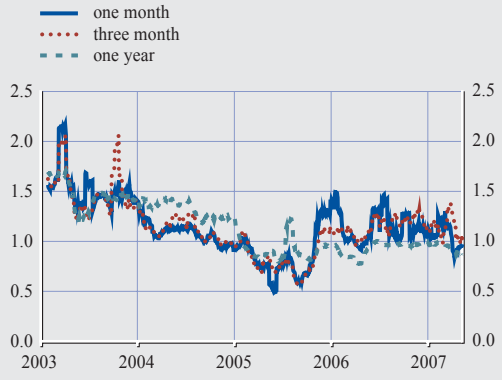
	2001	2002	2003	2004	2005	2005 H1	2005 H2	2006 H1	2006 H2	2006 Q1	2006 Q2	2006 Q3	2006 Q4
Belgium [1]	6.7	7.7	6.1	10.7	18.5	18.7	18.2	12.3	10.2	12.5	12.1	10.5	10.0
Germany [2]	0.2	-1.3	-1.3	-1.6	-1.6	-	-	-	-	-	-	-	-
Greece [2]	14.4	13.9	5.4	2.2	11.0	9.2	12.7	-	-	-	-	-	-
Spain [2]	9.9	15.7	17.6	17.4	13.9	14.8	13.1	11.4	9.5	12.0	10.8	9.8	9.1
France [3]	7.9	8.3	11.7	15.2	15.3	15.5	15.1	13.9	10.4	14.8	12.9	11.1	9.7
Ireland [2]	8.1	10.1	15.2	11.4	11.5	10.8	12.1	13.6	-	13.6	13.6	-	-
Italy [2]	7.4	13.7	10.6	9.2	9.6	11.6	7.8	6.4	7.0	-	-	-	-
Luxembourg [1]	13.8	11.7	12.9	10.0	-	-	-	-	-	-	-	-	-
Netherlands [3]	11.2	8.4	4.9	4.1	4.8	4.8	4.9	5.0	4.2	5.0	4.9	4.4	4.0
Austria [2]	2.2	0.2	0.3	-2.2	5.1	6.8	3.4	4.1	4.0	4.0	4.1	4.8	3.2
Portugal [2]	3.6	1.1	1.6	0.4	-	1.9	-	-	-	-	-	-	-
Finland [2]	0.7	6.1	6.3	7.3	6.1	4.6	7.6	8.3	-	8.8	7.8	6.9	-
euro area	5.6	7.1	7.0	7.4	7.9	8.3	7.5	6.9	6.0	6.9	6.9	6.0	6.0

Sources: National sources and ECB calculations.
1) New and existing houses, whole country.
2) All dwellings (new and existing houses and flats), whole country.
3) Existing dwellings (houses and flats), whole country.

4 EURO AREA FINANCIAL MARKETS

Chart S69 Bid-ask spreads for EONIA swap rates

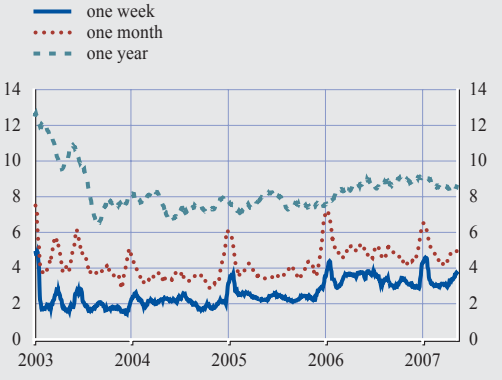
(Jan. 2003 - May 2007, basis points, 20-day moving average, transaction weighted)



Source: ECB.

Chart S70 Euro area spreads between interbank deposit and repo interest rates

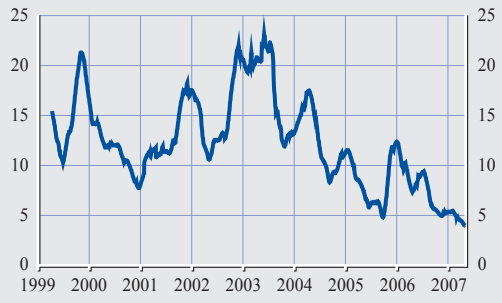
(Jan. 2003 - May 2007, basis points, 20-day moving average)



Source: ECB.

Chart S71 Implied volatility of three-month EURIBOR futures

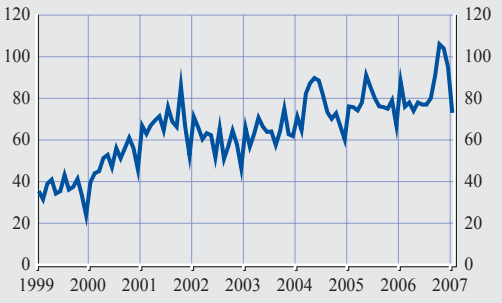
(Apr. 1999 - May 2007, %, 60-day moving average)



Source: Bloomberg.

Chart S72 Monthly gross issuance of short-term securities (other than shares) by euro area non-financial corporations

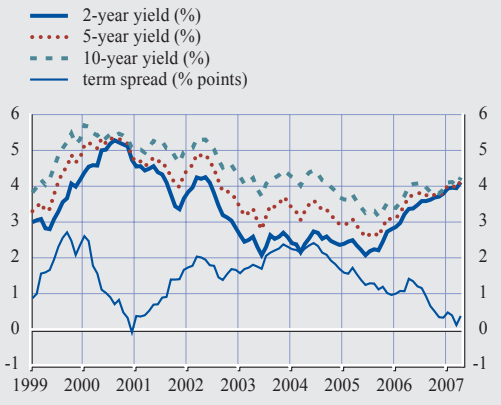
(Jan. 1999 - Jan. 2007, EUR billions, maturities up to one year)



Source: ECB.

Chart S73 Euro area government bond yields and term spread

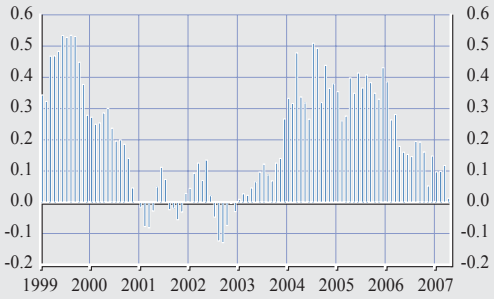
(Jan. 1999 - Apr. 2007)



Sources: ECB and Bloomberg.
Note: The term spread is the difference between the ten-year bond yield and the three-month T-bill yield.

Chart S74 Option-implied skewness coefficient for ten-year bond yields in Germany

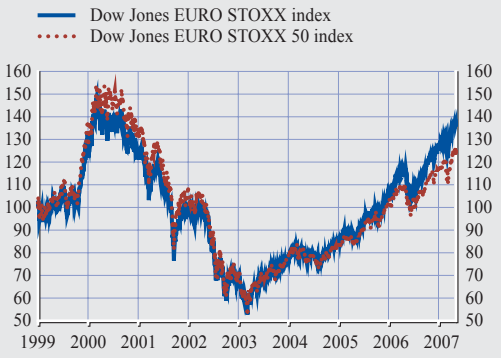
(Jan. 1999 - Apr. 2007, average monthly skewness)



Sources: Eurex and ECB calculations.

Chart S75 Stock prices in the euro area

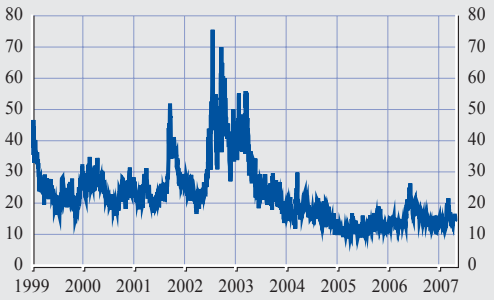
(Jan. 1999 - May 2007, index: Jan. 1999 = 100)



Source: Bloomberg.

Chart S76 Implied volatility for the Dow Jones EURO STOXX 50 index

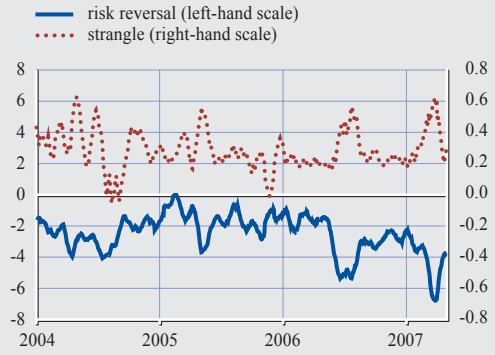
(Jan. 1999 - May 2007, %)



Source: Bloomberg.

Chart S77 Risk reversal and strangle of the Dow Jones EURO STOXX 50 index

(Jan. 2004 - May 2007, %, implied volatility, 20-day moving average)



Sources: Bloomberg and ECB calculations.
Note: The risk-reversal indicator is calculated as the difference between the implied volatility of an out-of-the-money (OTM) call with 25 delta and the implied volatility of an OTM put with 25 delta. The strangle is calculated as the difference between the average implied volatility of OTM calls and puts, both with 25 delta, and the average at-the-money volatility of calls and puts with 50 delta.

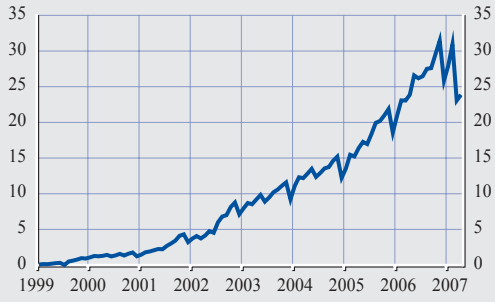
Chart S78 Price-earnings (P/E) ratio for the euro area stock market

(Jan. 1985 - Apr. 2007, %, ten-year trailing earnings)

Source: Thomson Financial Datastream.
Note: The P/E ratio is based on prevailing stock prices relative to an average of the previous ten years of earnings.

Chart S79 Open interest in options contracts on the Dow Jones EURO STOXX 50 index

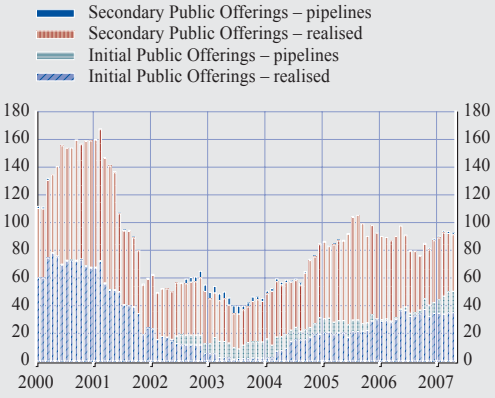
(Jan. 1999 - Apr. 2007, millions of contracts)



Source: Eurex.

Chart S80 Gross equity issuance and pipeline deals in the euro area

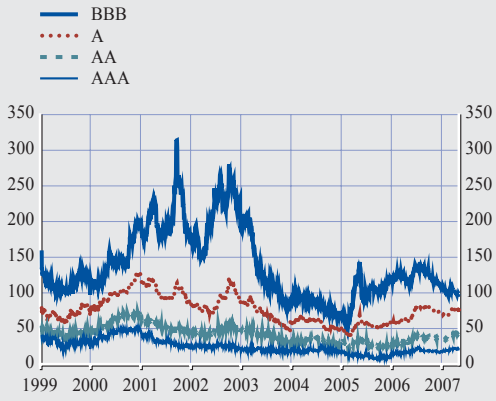
(Jan. 2000 - Apr. 2007, EUR billions, 12-month moving sums)



Source: Thomson Financial Datastream.

Chart S81 Investment-grade corporate bond spreads in the euro area

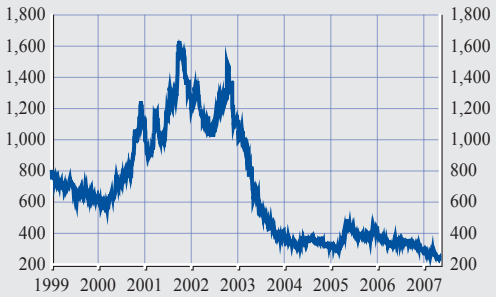
(Jan. 1999 - May 2007, basis points)



Source: Thomson Financial Datastream.
Note: Spread between the seven to ten-year yield to maturity and the euro area seven to ten-year government bond yield.

Chart S82 Speculative-grade corporate bond spreads in the euro area

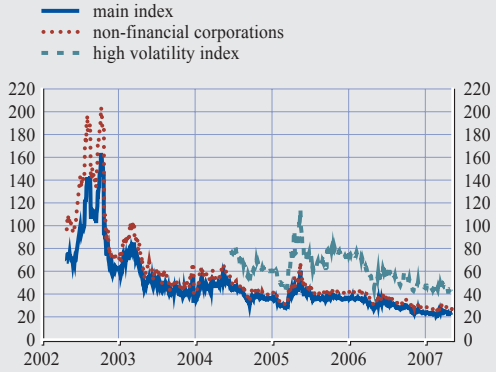
(Jan. 1999 - May 2007, basis points)



Source: JP Morgan Chase & Co.
Note: Spread between the yield to maturity of the euro area high-yield index (BB+ rating or below, average maturity of 5.5 years) and the euro area five-year government bond yield.

Chart S83 iTraxx Europe credit default swap indices

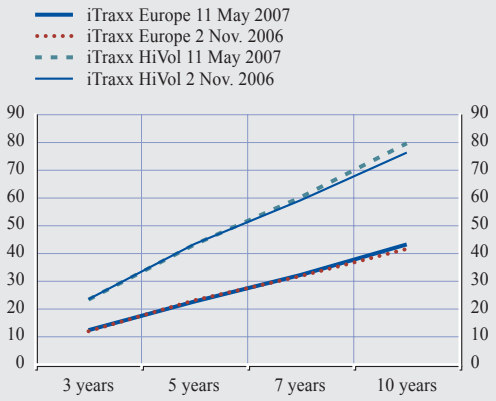
(May 2002 - May 2007, basis points, five-year maturity)



Source: JP Morgan Chase & Co.

Chart S84 Term structures of premiums for iTraxx Europe and HiVol

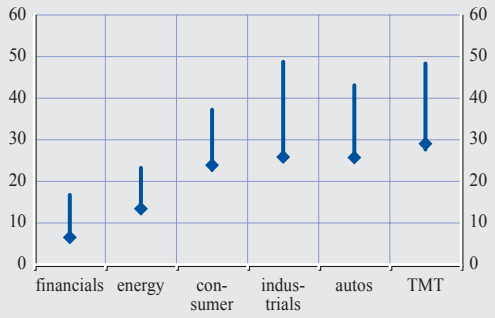
(basis points)



Sources: iTraxx and Bloomberg.

Chart S85 iTraxx sector indices

(Nov. 2006 - May 2007, basis points)



Sources: iTraxx and Bloomberg.
Note: The diamonds show the most recent observation and the bars show the range of variation over the six months to most recent observation.

5 EURO AREA FINANCIAL INSTITUTIONS

Table S5 Financial conditions of large and complex banking groups in the euro area

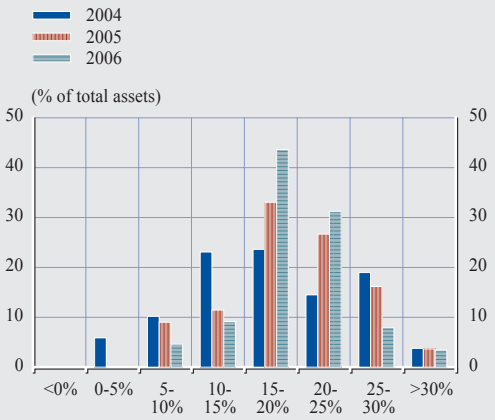
(2004 - 2006)

	min.	1st quartile	median	average	*weighted average*	3rd quartile	max.
Return on equity (%)							
2004	4.30	10.27	17.00	17.17	*17.32*	20.85	33.20
2005	9.00	13.95	17.60	18.93	*19.17*	23.25	37.00
2006	9.40	16.85	19.40	19.60	*19.59*	21.60	37.60
Return on risk-weighted assets (%)							
2004	0.20	1.11	1.14	1.14	*1.17*	1.50	2.26
2005	0.81	1.11	1.51	1.42	*1.43*	1.74	2.26
2006	0.77	1.20	1.43	1.54	*1.53*	1.85	2.66
Net interest income (% total assets)							
2004	0.43	0.68	0.90	1.04	*0.93*	1.31	1.87
2005	0.48	0.60	0.72	0.95	*0.89*	1.30	1.84
2006	0.33	0.62	0.69	0.96	*0.88*	1.22	2.03
Net interest income (% total income)							
2004	24.07	38.89	52.32	47.85	*47.85*	56.51	69.54
2005	23.53	35.22	50.36	48.12	*45.54*	59.88	68.70
2006	14.07	40.10	48.71	46.57	*44.21*	54.36	70.24
Trading income (% total income)							
2004	2.69	7.37	9.59	11.98	*12.98*	15.68	28.73
2005	2.58	6.86	9.66	12.73	*14.35*	15.35	37.14
2006	2.45	8.80	12.95	15.75	*17.81*	18.69	46.83
Fees and commissions (% total income)							
2004	15.90	20.67	29.34	29.27	*28.96*	36.84	44.15
2005	17.12	21.69	30.00	28.40	*28.19*	34.80	40.02
2006	18.20	23.11	27.61	28.66	*28.94*	31.08	43.03
Other income (% total income)							
2004	-3.07	2.51	4.25	5.81	*5.95*	6.88	26.70
2005	-0.76	2.74	4.71	5.75	*6.26*	2.74	16.73
2006	-0.15	2.03	5.26	5.89	*6.48*	10.62	16.73
Net loan impairment charges (% total assets)							
2004	0.03	0.06	0.07	0.11	*0.09*	0.09	0.40
2005	-0.02	0.02	0.05	0.08	*0.08*	0.11	0.29
2006	0.01	0.03	0.05	0.11	*0.10*	0.17	0.36
Cost-income ratio (%)							
2004	48.60	60.00	67.50	66.50	*68.48*	70.90	85.30
2005	43.20	57.40	63.40	63.16	*63.71*	67.00	89.40
2006	39.60	54.75	61.10	60.40	*61.51*	66.25	79.80
Tier 1 ratio (%)							
2004	6.32	7.04	7.70	8.03	*7.87*	8.45	10.90
2005	6.70	7.55	8.10	8.46	*8.25*	9.10	11.60
2006	6.70	7.41	7.80	8.20	*8.04*	8.82	10.40
Overall solvency ratios (%)							
2004	8.46	10.40	11.10	11.34	*11.02*	12.77	13.30
2005	8.50	10.74	11.30	11.70	*11.41*	12.48	16.30
2006	10.00	10.75	11.10	11.51	*11.34*	11.87	15.60

Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting large and complex banking groups in the euro area.

Chart S86 Frequency distribution of return on equity (ROE) for large and complex banking groups in the euro area

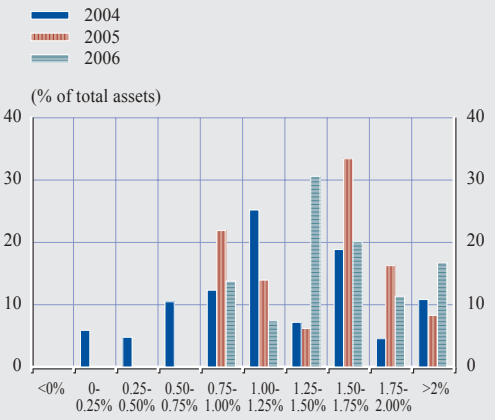
(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 International Financial Reporting Standards (IFRS) reporting large and complex banking groups in the euro area.

Chart S87 Frequency distribution of return on risk-weighted assets for large and complex banking groups in the euro area

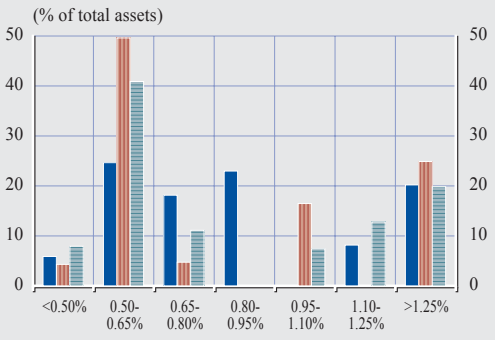
(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting large and complex banking groups in the euro area.

Chart S88 Frequency distribution of net interest income for large and complex banking groups in the euro area

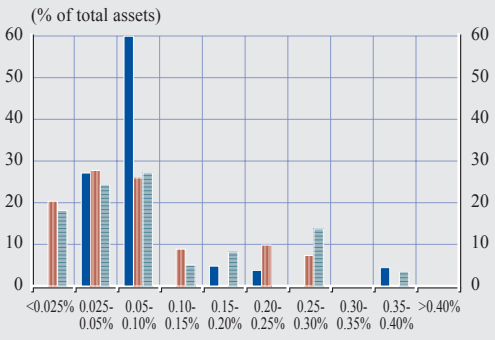
(2004 - 2006, % of total assets)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting large and complex banking groups in the euro area.

Chart S89 Frequency distribution of net loan impairment charges for large and complex banking groups in the euro area

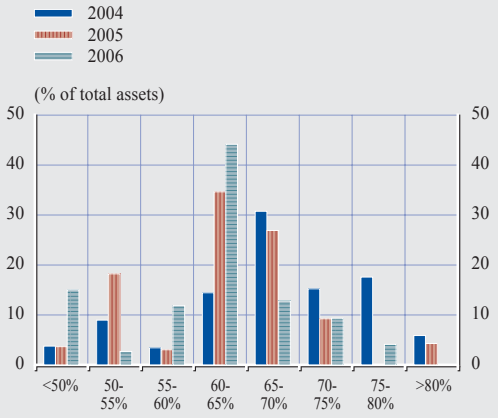
(2004 - 2006, % of total assets)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting large and complex banking groups in the euro area.

Chart S90 Frequency distribution of cost-to-income ratios for large and complex banking groups in the euro area

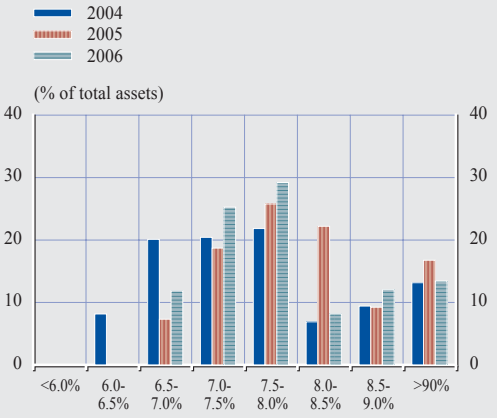
(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting large and complex banking groups in the euro area.

Chart S91 Frequency distribution of Tier 1 ratios for large and complex banking groups in the euro area

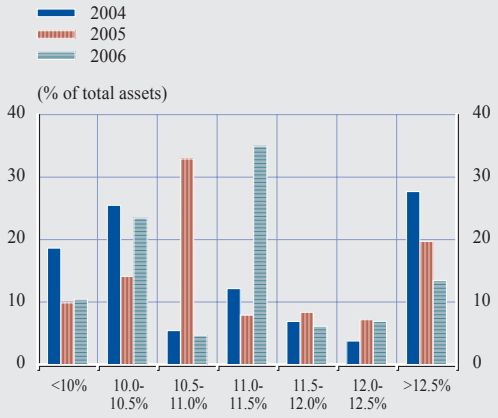
(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting large and complex banking groups in the euro area.

Chart S92 Frequency distribution of overall solvency ratios for large and complex banking groups in the euro area

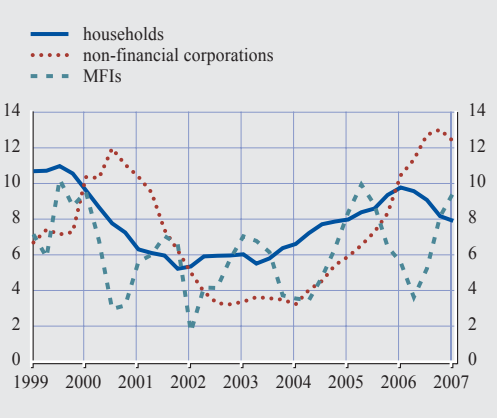
(2004 - 2006, %)



Sources: Individual institutions' financial reports and ECB calculations.
Note: Based on figures for 15 IFRS reporting large and complex banking groups in the euro area.

Chart S93 Annual growth in euro area MFI loans extended by sector

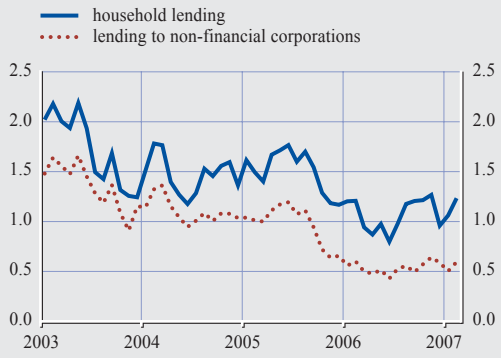
(Q1 1999 - Q1 2007, % per annum)



Source: ECB.
Note: Data are based on financial transactions of MFI loans.

Chart S94 Lending margins of euro area MFIs

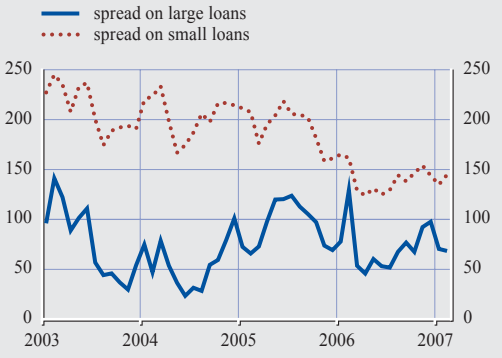
(Jan. 2003 - Feb. 2007, % points)



Source: ECB.
Note: The weighted lending margins are the difference between the interest rate on new lending and the interest rate swap rate, where both have corresponding initial rate fixations/ maturities.

Chart S95 Euro area MFIs' loan spreads

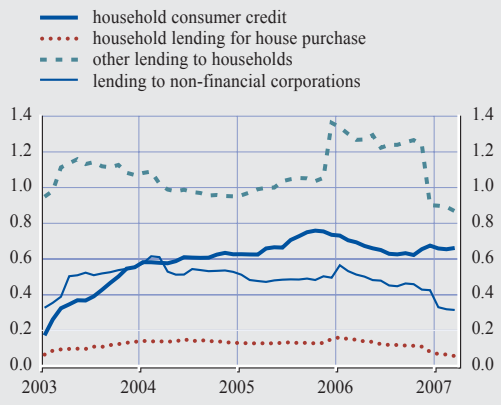
(Jan. 2003 - Feb. 2007, basis points)



Source: ECB.
Note: The spread is between the rate on loans to non-financial corporations with one up to five years of initial rate fixation below (small) and above (large) 1 EUR million, and the three-year government bond yield.

Chart S96 Write-off rates on euro area MFIs' loans

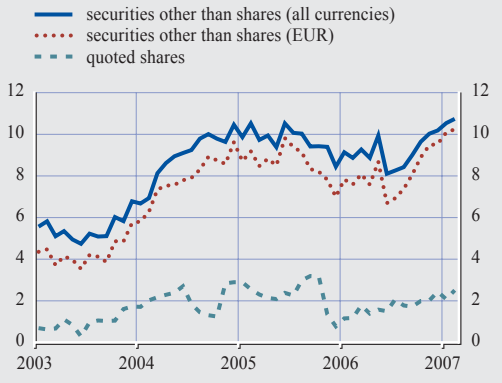
(Jan. 2003 - Mar. 2007, 12-month moving sums, % of the outstanding amount of loans)



Source: ECB.

Chart S97 Annual growth in euro area MFIs' securities and shares issuance

(Jan. 2003 - Feb. 2007, % per annum)



Source: ECB.

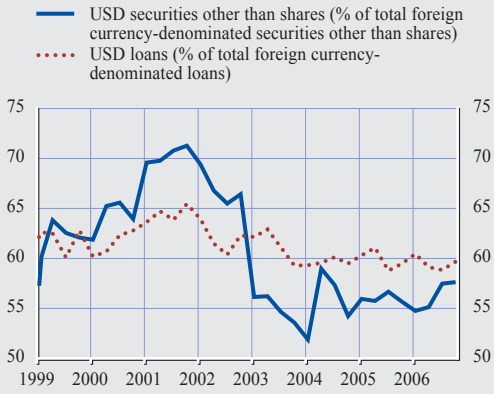
Chart S98 Deposit margins of euro area MFIs

(Jan. 2003 - Feb. 2007, % points)

Source: ECB.
Note: The weighted deposit margins are the difference between the interest rate swap rate and the deposit rate, where both have corresponding initial rate fixations/maturities.

Chart S99 Euro area MFIs' foreign currency-denominated assets, selected balance sheet items

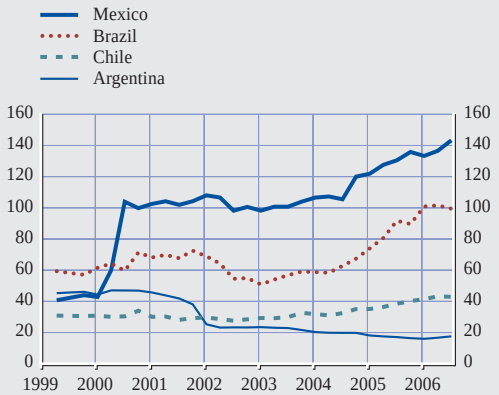
(Q1 1999 - Q4 2006)



Source: ECB.

Chart S100 International exposure of euro area banks to Latin American countries

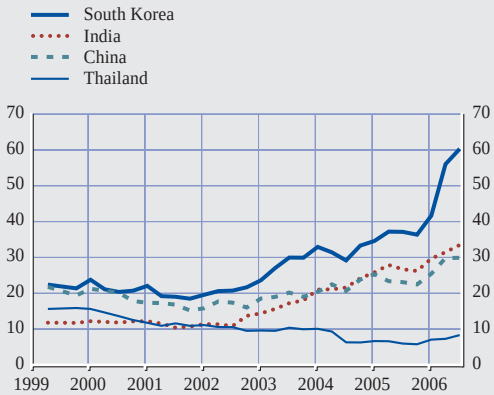
(Q2 1999 - Q3 2006, USD billions)



Source: BIS.

Chart S101 International exposure of euro area banks to Asian countries

(Q2 1999 - Q3 2006, USD billions)



Source: BIS.

Table S6 Euro area consolidated foreign claims of reporting banks on individual countries

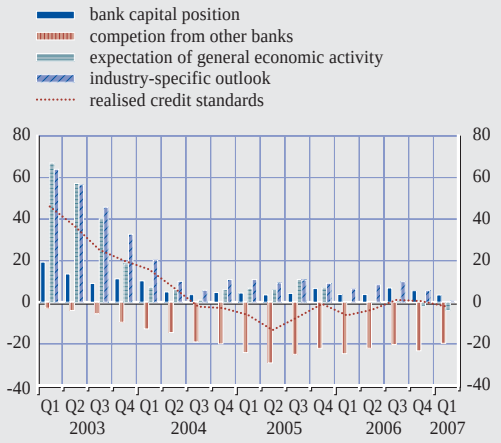
(USD billions)

	2004				2005				2006		
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Total all countries	**4,820.7**	**4,813.4**	**4,898.5**	**5,582.3**	**5,789.4**	**5,993.4**	**6,088.2**	**5,888.9**	**6,427.4**	**6,867.2**	**7,069.6**
Total non-developed countries (incl. offshore centres)	**1,183.5**	**1,208.7**	**1,238.5**	**1,408.5**	**1,435.5**	**1,551.8**	**1,600.0**	**1,574.6**	**1,688.2**	**1,804.2**	**1,870.5**
Hong Kong	35.3	36.3	36.7	41.1	35.9	48.1	54.2	46.9	44.9	56.1	54.8
Singapore	34.8	34.1	34.2	36.2	35.8	38.7	39.7	38.2	43.3	46.4	52.9
Total offshore centres	331.5	343.6	364.7	416.9	425.6	446.1	447.8	436.8	474.1	506.8	516.5
China	20.4	22.5	20.6	23.8	25.3	23.4	23.1	22.5	25.4	29.8	29.9
India	21.0	21.1	21.6	24.2	25.8	27.9	26.7	26.2	29.7	31.5	33.5
Indonesia	15.2	14.4	15.5	15.8	15.4	15.0	14.2	13.2	14.4	15.3	16.2
Malaysia	8.4	7.9	8.1	9.9	10.1	10.9	9.7	8.8	10.6	12.4	12.1
Philippines	8.8	8.7	9.0	8.4	9.2	8.6	8.7	8.7	9.2	8.6	7.9
South Korea	32.9	31.4	29.2	33.3	34.6	37.2	37.1	36.3	41.7	56.0	60.3
Taiwan China	22.1	23.7	20.5	23.6	20.9	18.7	17.1	17.5	18.7	18.7	18.0
Thailand	10.1	9.3	6.3	6.3	6.7	6.6	6.0	5.8	7.1	7.3	8.3
Total Asia and Pacific EMEs	**159.8**	**162.0**	**151.5**	**168.6**	**172.1**	**173.1**	**168.3**	**165.2**	**184.2**	**211.1**	**220.1**
Cyprus	30.4	33.7	33.7	37.8	37.4	40.1	41.6	42.1	44.7	50.1	53.2
Czech Republic	40.4	41.1	39.1	46.0	45.5	63.0	65.8	56.7	59.4	65.0	69.6
Hungary	37.2	39.5	41.4	49.8	50.4	61.9	63.0	58.0	60.1	63.0	66.2
Poland	62.9	65.2	69.4	87.2	88.5	93.6	97.7	83.1	88.0	92.9	96.2
Russia	37.1	34.2	34.2	40.7	40.0	49.2	53.4	57.6	62.2	63.0	63.6
Turkey	22.7	23.3	23.7	26.2	26.8	28.3	29.5	30.3	35.2	34.5	40.2
Total European EMEs and new EU Member States	**330.1**	**342.0**	**354.4**	**419.6**	**428.0**	**513.1**	**543.2**	**519.4**	**557.9**	**604.6**	**638.7**
Argentina	20.3	19.8	19.8	19.8	18.1	17.5	17.1	16.4	16.0	16.7	17.6
Brazil	58.8	58.4	62.7	67.4	73.9	80.7	91.7	89.6	100.9	101.6	99.5
Chile	31.9	31.0	32.5	35.0	35.1	36.4	38.5	40.2	41.5	43.2	42.9
Colombia	6.8	6.7	6.9	8.1	7.4	8.1	8.1	9.8	10.2	10.0	10.4
Ecuador	0.8	0.8	0.9	0.9	0.9	0.8	0.9	0.9	0.7	0.6	0.7
Mexico	106.6	107.2	105.5	120.0	121.9	127.6	130.5	135.8	133.3	136.6	143.3
Peru	9.3	9.5	9.6	10.0	9.9	10.3	10.4	11.1	7.0	6.9	6.6
Uruguay	1.9	2.0	2.0	2.0	2.3	2.1	2.2	2.4	2.5	2.5	2.6
Venezuela	12.1	12.5	12.8	14.7	14.3	15.6	16.6	18.7	18.6	19.3	19.2
Total Latin America	**257.5**	**256.5**	**261.3**	**288.2**	**294.4**	**309.4**	**326.4**	**335.8**	**341.2**	**350.1**	**354.8**
Iran	9.5	9.5	10.1	11.7	12.0	12.5	12.8	11.8	11.9	12.0	11.8
Morocco	10.5	11.0	11.4	12.6	12.6	11.0	12.7	12.5	13.1	13.7	13.8
South Africa	11.3	11.2	11.6	13.5	12.5	11.8	12.2	11.4	14.9	12.8	15.4
Total Middle East and Africa	**104.6**	**104.5**	**106.6**	**115.1**	**115.3**	**110.1**	**114.2**	**117.3**	**130.6**	**131.5**	**140.4**

Source: BIS.

Chart S102 Euro area banks' credit standards applied to loans and credit lines to enterprises and contributing factors

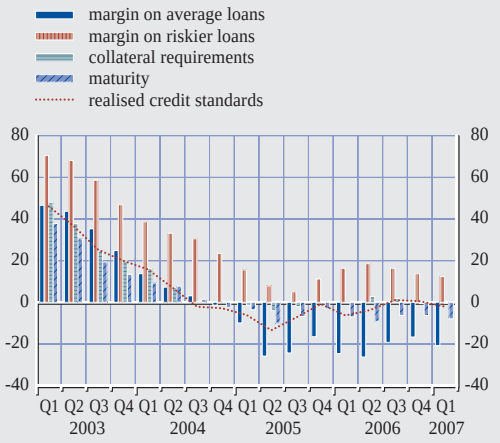
(Q1 2003 - Q1 2007, net %, two-quarter moving average)



Source: ECB.
Note: The net percentages refer to the difference between banks reporting that credit standards tightened and given factors contributed to a tightening of credit standards compared to the previous quarter and those banks reporting that they were eased.

Chart S103 Euro area banks' credit standards applied to loans and credit lines to enterprises and terms and conditions

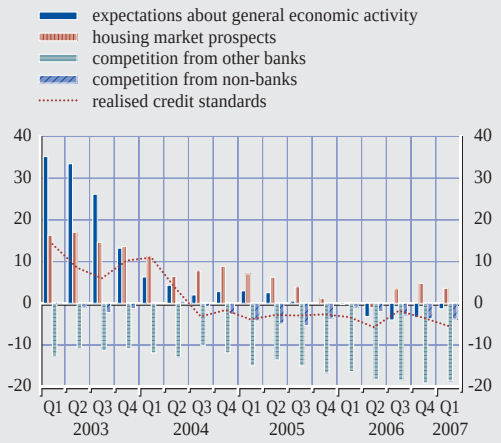
(Q1 2003 - Q1 2007, net %, two-quarter moving average)



Source: ECB.
Note: The net percentages refer to the difference between banks reporting that credit standards, terms and conditions tightened compared to the previous quarter and those banks reporting that they were eased.

Chart S104 Euro area banks' credit standards applied to loans to households for house purchase and contributing factors

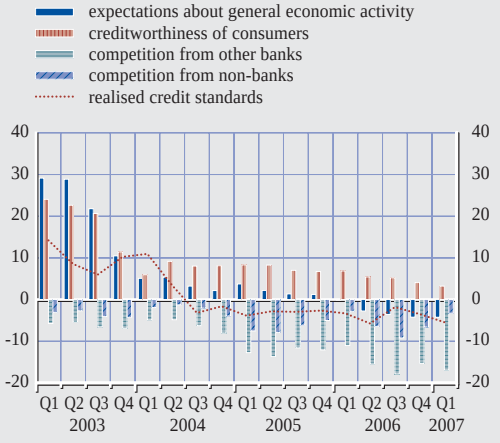
(Q1 2003 - Q1 2007, net %, two-quarter moving average)



Source: ECB.
Note: The net percentages refer to the difference between banks reporting that credit standards tightened and given factors contributed to a tightening of credit standards compared to the previous quarter and those banks reporting that they were eased.

Chart S105 Euro area banks' credit standards applied to consumer credit loans to households and contributing factors

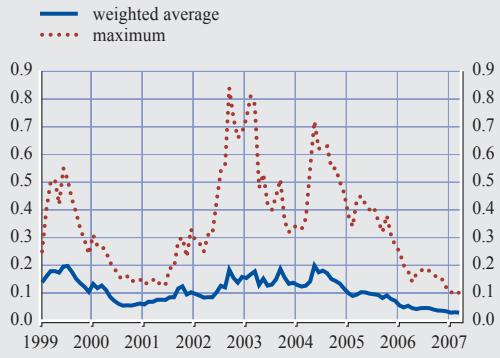
(Q1 2003 - Q1 2007, net %, two-quarter moving average)



Source: ECB.
Note: The net percentages refer to the difference between banks reporting that credit standards tightened and given factors contributed to a tightening of credit standards compared to the previous quarter and those banks reporting that they were eased.

Chart S106 Expected default frequencies (EDFs) for large and complex banking groups in the euro area

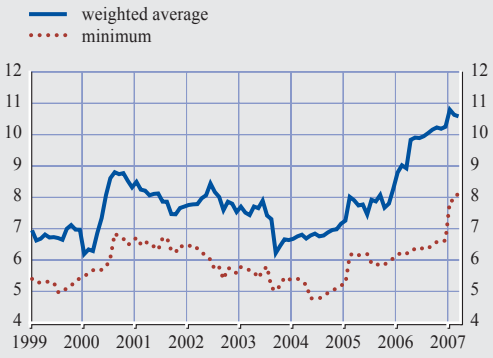
(Jan. 1999 - Mar. 2007, % probability)



Sources: Moody's KMV and ECB calculations.
Note: Due to measurement considerations, the EDF values are restricted by Moody's KMV to the interval between 0.02% and 20%.

Chart S107 Distance-to-default for large and complex banking groups in the euro area

(Jan. 1999 - Mar. 2007)



Sources: Moody's KMV and ECB calculations.
Note: An increase in the distance-to-default reflects an improving assessment.

Chart S108 European financial and non-financial institutions' credit default swaps

(May 2002 - May 2007, basis points, five-year maturity)

Source: JP Morgan Chase & Co.
Note: European financial institutions and non-financial institutions correspond to the definitions of JP Morgan Chase & Co.

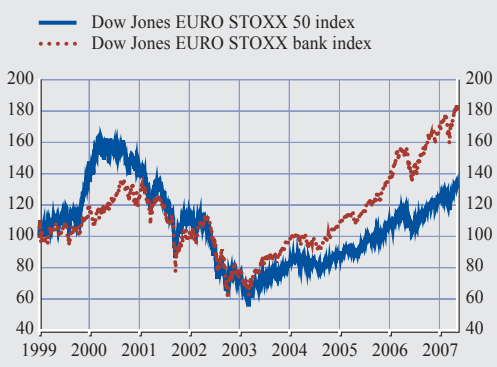
Chart S109 Earnings and earnings forecasts for large and complex banking groups in the euro area

(Q1 1999 - Q4 2008, % change per annum, weighted average)

Sources: Thomson Financial Datastream, I/B/E/S and ECB calculations.

Chart S110 Dow Jones EURO STOXX total market and bank indices

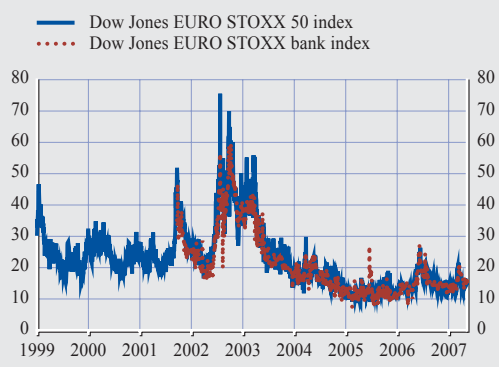
(Jan. 1999 - May 2007, index: Jan. 1999 = 100)



Source: Bloomberg.

Chart S111 Implied volatility for Dow Jones EURO STOXX total market and bank indices

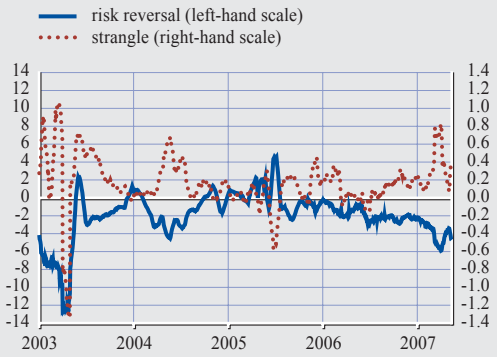
(Jan. 1999 - May 2007, %)



Source: Bloomberg.

Chart S112 Risk reversal and strangle of the Dow Jones EURO STOXX bank index

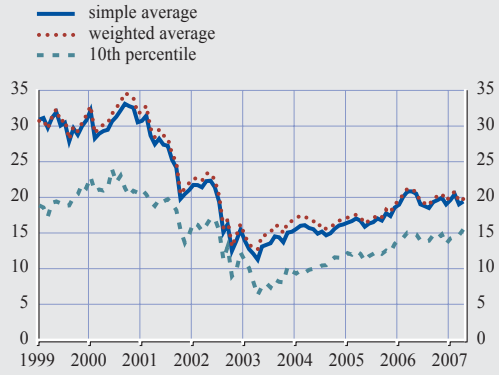
(Jan. 2003 - May 2007, implied volatility, %, 20-day moving average)



Sources: Bloomberg and ECB calculations.
Note: The risk-reversal indicator is calculated as the difference between the implied volatility of an out-of-the-money (OTM) call with 25 delta, and the implied volatility of an OTM put with 25 delta. The "strangle" is calculated as the difference between the average implied volatility of OTM calls and puts, both with 25 delta, and the average at-the-money volatility of calls and puts with 50 delta.

Chart S113 Price-earnings (P/E) ratios for large and complex banking groups in the euro area

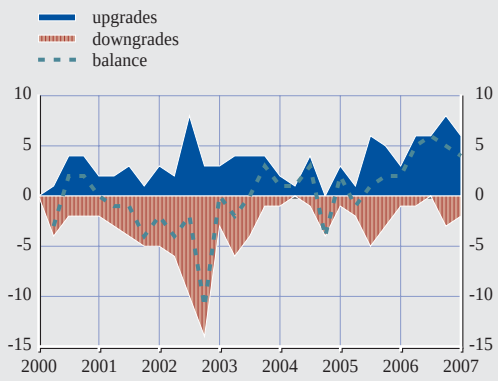
(Jan. 1999 - Apr. 2007, %, ten-year trailing earnings)



Sources: Thomson Financial Datastream and ECB calculations.
Note: The P/E ratio is based on prevailing stock prices relative to an average of the previous ten years of earnings.

Chart S114 Rating changes for large and complex banking groups in the euro area

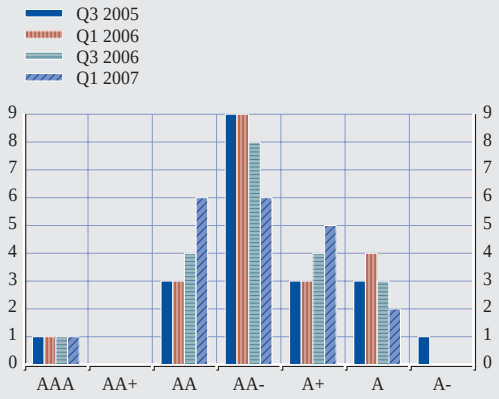
(Q1 2000 - Q1 2007, number)



Sources: Moody's, Fitch Ratings and Standard and Poor's.
Note: This includes both outlook and actual rating changes.

Chart S115 Distribution of ratings for large and complex banking groups in the euro area

(number of banks)



Sources: Moody's, Fitch Ratings and Standard and Poor's.

Table S7 Rating averages and outlooks for large and complex banking groups in the euro area

(Q1 2007)

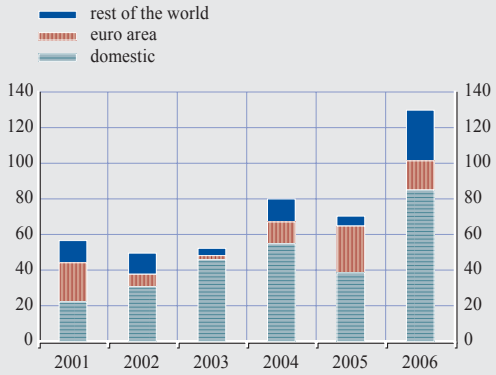
	Moody's	S&P	Fitch	Total
Ratings available out of sample	20	20	20	60
Outlook/watch available	20	20	20	60
Rating average	Aa2	AA-	AA-	3.85
Outlook/watch average	0.1	0.3	0.1	0.2
Number of negative outlooks	0	0	0	0
Number of positive outlooks	2	6	2	10

Rating codes	Moody's	S&P	Fitch	Numerical equivalent
	Aaa	AAA	AAA	1
	Aa1	AA+	AA+	2
	Aa2	AA	AA	3
	Aa3	AA-	AA-	4
	A1	A+	A+	5
	A2	A	A	6
	A3	A-	A-	7
	Baa1	BBB+	BBB+	8
	Baa2	BBB	BBB	9
	Baa3	BBB-	BBB-	10
	Ba1	BB+	BB+	11
	Ba2	BB	BB	12
	Ba3	BB-	BB-	13

Sources: Moody's, Fitch Ratings, Standard and Poor's and ECB calculations.

Chart S116 Value of mergers and acquisitions by euro area banks

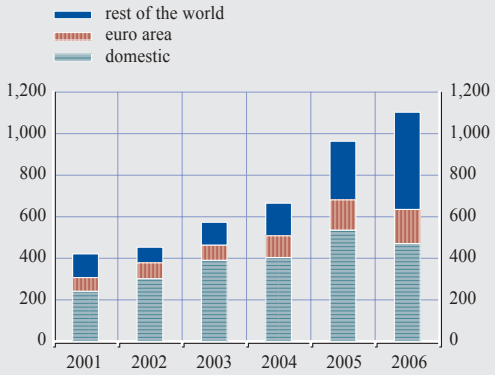
(2001 - 2006, EUR billions)



Sources: Bureau van Dijk and ECB calculations.
Note: All completed mergers and acquisitions (including also institutional buyouts, joint ventures, management buyouts/ins, demergers, minority stakes, and share buybacks) where a bank is the acquirer.

Chart S117 Number of mergers and acquisitions by euro area banks

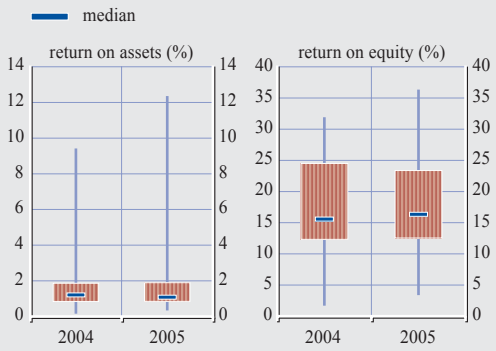
(2001 - 2006, total number of transactions)



Sources: Bureau van Dijk and ECB calculations.
Note: All completed mergers and acquisitions (including also institutional buyouts, joint ventures, management buyouts/ins, demergers, minority stakes and share buybacks) where a bank is the acquirer.

Chart S118 Distribution of profitability ratios of large euro area composite insurers

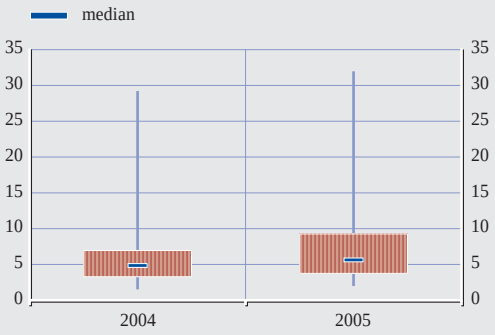
(2004 - 2005, %, maximum, minimum, inter-quartile distribution)



Sources: Bureau van Dijk and ECB calculations.

Chart S119 Distribution of solvency ratios of large euro area composite insurers

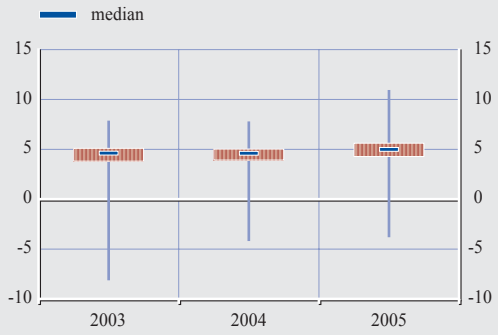
(2004 - 2005, %, maximum, minimum, inter-quartile distribution)



Sources: Bureau van Dijk and ECB calculations.

Chart S120 Distribution of investment yields of large euro area life insurers

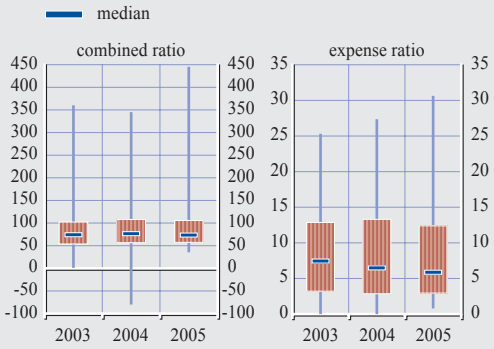
(2003 - 2005, %, maximum, minimum, inter-quartile distribution)



Sources: Bureau van Dijk and ECB calculations.

Chart S121 Distribution of combined and expense ratios of large euro area life insurers

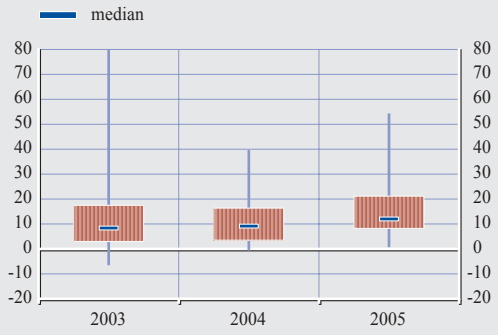
(2003 - 2005, %, maximum, minimum, inter-quartile distribution)



Sources: Bureau van Dijk and ECB calculations.

Chart S122 Distribution of ratios of non-life profit before taxes to surplus capital of large euro area non-life insurers

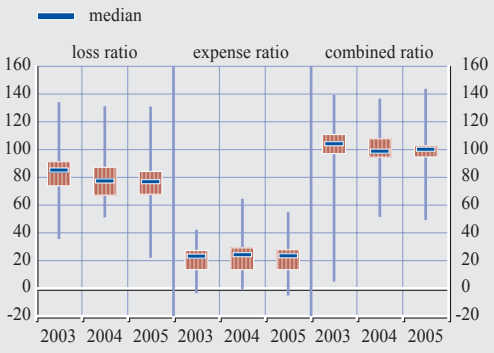
(2003 - 2005, %, maximum, minimum, inter-quartile distribution)



Sources: Bureau van Dijk and ECB calculations.

Chart S123 Distribution of combined, loss and expense ratios of large euro area non-life insurers

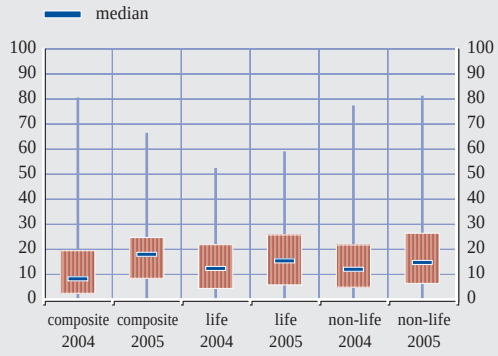
(2003 - 2005, %, maximum, minimum, inter-quartile distribution)



Sources: Bureau van Dijk and ECB calculations.

Chart S124 Distribution of equity asset shares of euro area insurers

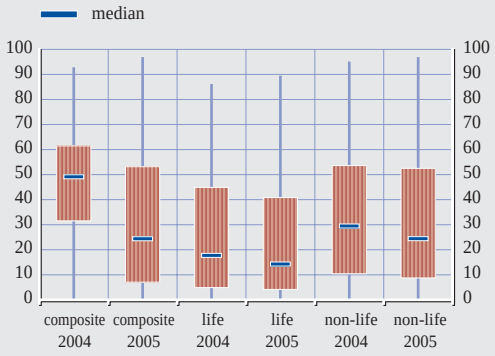
(2004 - 2005, % of total assets maximum, minimum, inter-quartile distribution)



Source: Standard and Poor's.

Chart S125 Distribution of bond asset shares of euro area insurers

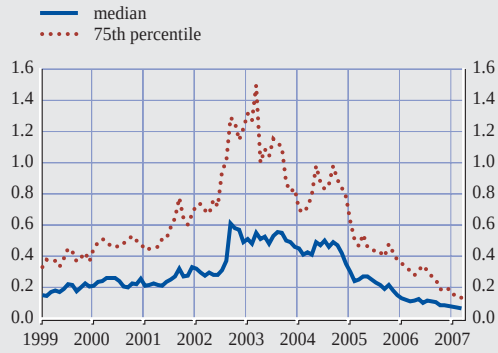
(2004 - 2005, % of total assets maximum, minimum, inter-quartile distribution)



Source: Standard and Poor's.

Chart S126 Expected default frequencies (EDFs) for the euro area insurance sector

(Jan. 1999 - Mar. 2007, % probability)



Source: Moody's KMV.
Note: Due to measurement considerations, the EDF values are restricted by Moody's KMV to the interval between 0.02% and 20%.

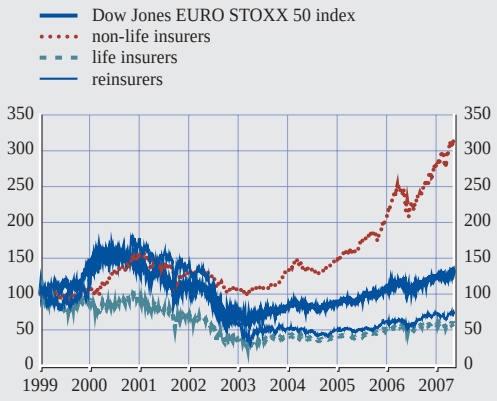
Chart S127 Subordinated bond asset swap spread for the euro area insurance sector

(Jan. 2001 - May 2007, basis points)

Source: JP Morgan Chase & Co.

Chart S128 Dow Jones EURO STOXX total market and insurance indices

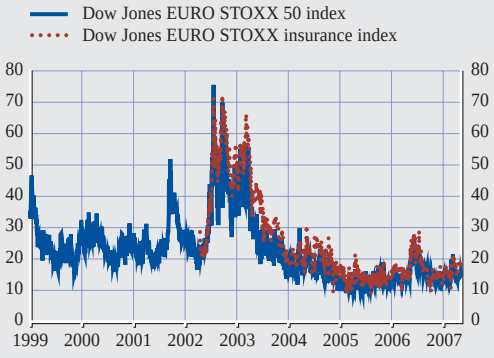
(Jan. 1999 - May 2007, index: Jan. 1999 = 100)



Source: Thomson Financial Datastream.

Chart S129 Implied volatility for Dow Jones EURO STOXX total market and insurance indices

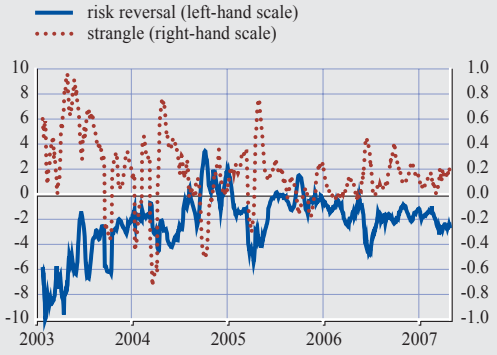
(Jan. 1999 - May 2007, %)



Source: Bloomberg.

Chart S130 Risk reversal and strangle of the Dow Jones EURO STOXX insurance index

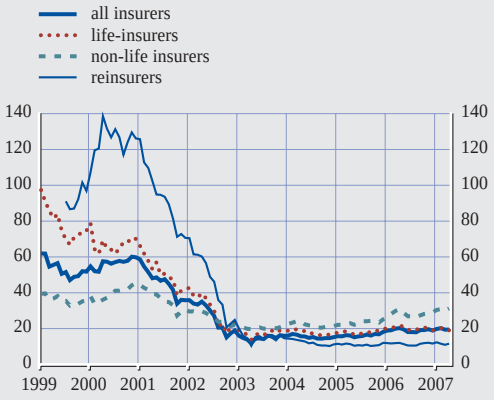
(Jan. 2003 - May 2007, implied volatility, %, 20-day moving average)



Sources: Bloomberg and ECB calculations.
Note: The risk-reversal indicator is calculated as the difference between the implied volatility of an out-of-the-money (OTM) call with 25 delta, and the implied volatility of an OTM put with 25 delta. The "strangle" is calculated as the difference between the average implied volatility of OTM calls and puts, both with 25 delta, and the average at-the-money volatility of calls and puts with 50 delta.

Chart S131 Price-earnings (P/E) ratios for euro area insurers

(Jan. 1999 - Apr. 2007, %, ten-year trailing earnings)



Sources: Thomson Financial Datastream and ECB calculations.
Note: The P/E ratio is based on prevailing stock prices relative to an average of the previous ten years of earnings.

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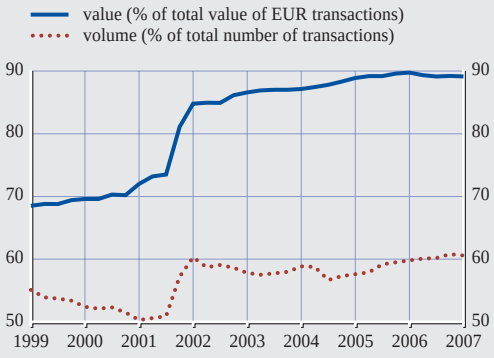
Chart S132 Large-value payments processed via TARGET

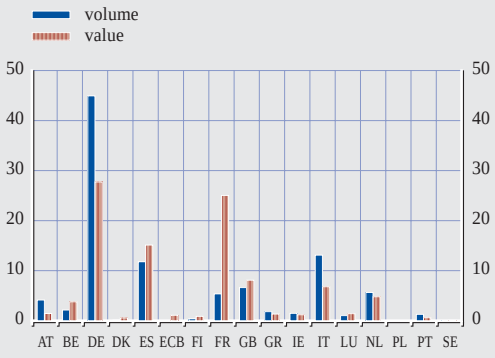
(Q1 1999 - Q1 2007)



Source: ECB.

Chart S133 Large-value payments processed via TARGET, by country

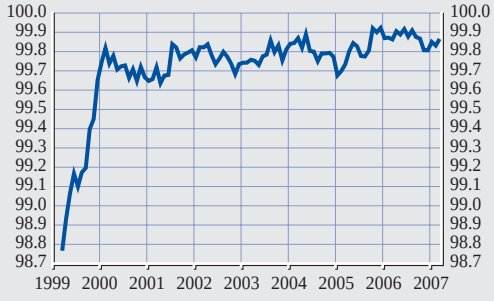
(Q4 2006 - Q1 2007, % of the NCB/ECB shares in terms of value and volume)



Source: ECB.

Chart S134 TARGET availability

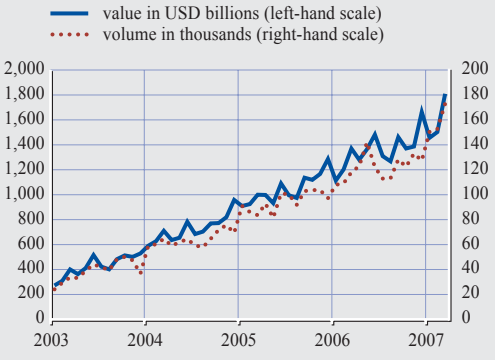
(Jan. 1999 - Mar. 2007, %, three-month moving average)



Source: ECB.

Chart S135 Volumes and values of foreign exchange trades settled via Continuous Linked System (CLS) in USD billion equivalent

(Jan. 2003 - Mar. 2006)



Source: ECB.

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