

FSR

FINANCIAL STABILITY REVIEW

DECEMBER 2006

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A number of developments have marked financial markets since the last issue of the Financial Stability Review in spring 2006¹:

- **following a brief surge, long-term interest rates have returned to historically low levels.** The long-term interest rate conundrum therefore remains unresolved, with an inverted yield curve in the United States and a spread between 10-year and 2-year yields of close to zero in the euro area. This configuration is unprecedented;
- **stock prices stabilised and then rebounded after** the corrections observed in May and June. All in all, equity markets performed well in 2006: the MSCI Emerging Market index rose by 14% over the first 11 months of the year, while the EuroStoxx 50 and the SP500 put on 11.4% and 10.4% respectively;
- **on all financial markets, volatility (both historical and implied) remained low** despite losses incurred by several hedge funds (such as Amaranth). Markets remained impervious to geopolitical tensions in Asia (military coup in Thailand and nuclear testing in North Korea) and the Middle East (war in Lebanon). Tensions on commodities markets have gradually subsided after a period of sharp rises;
- **credit growth remains strong**, especially in corporate finance, where significant M&A and leveraged buyout activity is underpinning a strong appetite for debt.

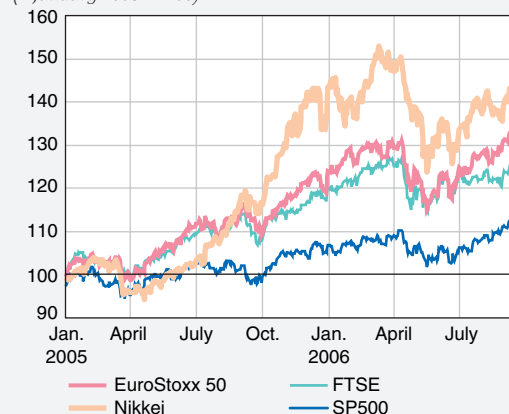
What are the prospects for financial stability in the coming months? The answer may depend on two developments: whether risks are properly priced on financial markets, given the current economic uncertainties and, against this backdrop, whether credit risk transfer mechanisms will prove sufficiently robust if and when shocks occur.

2 and 10-year government bond yields France

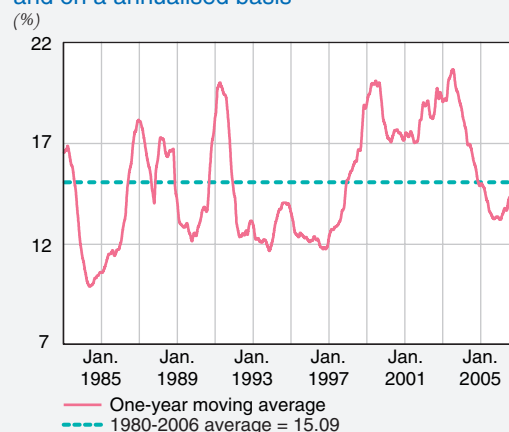


Stock market indices

(1 January 2005 = 100)



Average historical volatility on main markets Over a 20-day moving period and on an annualised basis



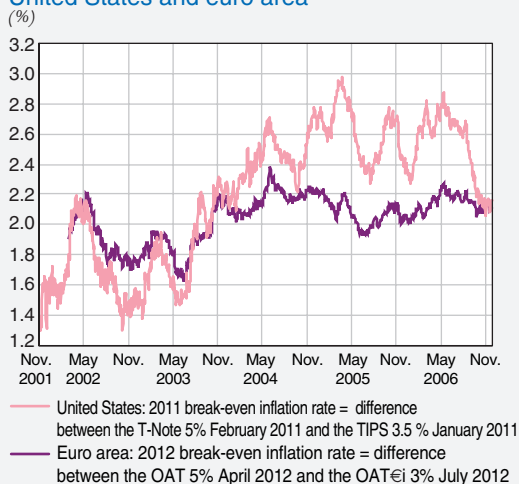
¹ Based on available data as of 1 December 2006. Developments relating to foreign exchange markets are not considered.

OVERVIEW

Are risks properly priced by financial markets ?

10-year break-even inflation rates

United States and euro area



Source: Bloomberg.

Inflation expectations derived from inflation swaps*

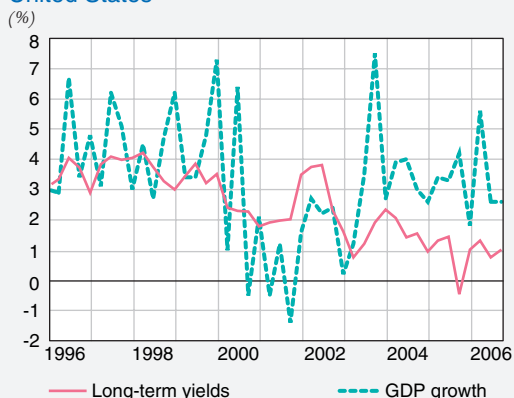
Euro area



* Harmonised index of consumer prices excluding tobacco.
Source: Bloomberg.

10-year yields deflated by inflation and annualised GDP growth

United States



Source: Bloomberg; Banque de France calculations.

ARE RISKS PROPERLY PRICED BY FINANCIAL MARKETS?

Financial asset prices are determined by their expected return, adjusted for a premium. High prices can therefore be attributed either to high expected earnings –underpinned by a favourable economic outlook– or to low risk premia. Both of these factors have played a role in the increase in financial asset prices over the past few years. However, in the recent period, the very low level of risk premia on all market segments has been the predominant factor. But is the level of risk premia ascribable to the economic environment, or does it reflect an inadequate assessment of the risks currently taken by investors?

Low risk premia

BOND MARKETS

Three factors may account for the very low level of long-term yields.

- **Stable inflation expectations.** These can be measured by either the yield spread between inflation-linked bonds and nominal bonds (break-even point) or, more directly, by the inflation-linked swap rate. Both measures show a decline in long-term expected inflation rates since last spring. This drop has been more pronounced in the United States than in the euro area.

- **Global excess savings.** Real long-term rates reflect the balance between savings and investment. Low real rates could therefore result from large (*ex ante*) surplus savings relative to global investment. The very high savings rates in several major emerging Asian countries seem to lend support to this analysis. This also explains why the US current account deficit has been easily financed in recent years, without a rise in long-term interest rates or significant dollar-depreciation. This analysis, however, leaves some fundamental questions unanswered. By definition, the real interest rate equals the marginal product of capital. It remains to be explained why the latter should be so low, given that several million new workers enter the global labour market each year, triggering strong growth in the demand for capital.

Other explanations cannot therefore be ruled out. It is possible that low interest rates chiefly reflect an optimistic assessment of long-term risk by bondholders.

• **Indeed, the term premia embedded** in long-term rates have declined in recent months. For investors, these premia compensate the uncertainty about returns and the lower liquidity of long-term bonds. According to US Federal Reserve estimates,² they have dropped significantly since 2004-2005, reflecting a lower perception of risk by investors.

CREDIT MARKETS AND EMERGING COUNTRIES

The most obvious and visible sign of the low level of risk premia is the level of credit spreads on corporate and emerging bond markets. These spreads represent the return on risk. We thus observe that:

- on the whole, sovereign credit spreads on emerging markets have remained stable, at close to historical lows;
- corporate credit spreads have also remained at very low levels, despite an upturn in private bond issuance (12% year-on-year at end-June 2006).

EQUITY MARKETS

In the case of equity markets, the impact of risk premia appears to be less clear and decisive.

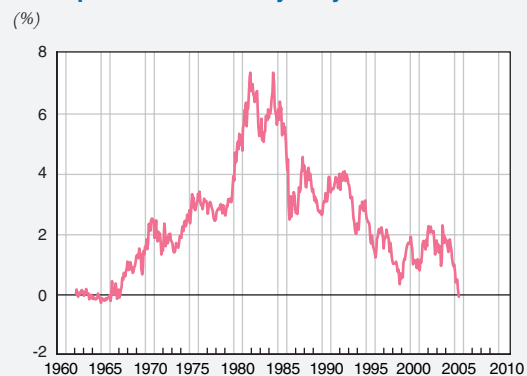
Equity valuation is based on interest rates, earnings expectations and risk premia. The low level of interest rates contributes to boosting prices, as do high profit expectations, especially since profit growth has been systematically underestimated in recent years (see Chart below). After taking account of these two factors, equity premia do not appear to be unusually low.

Is the economic environment favourable?

The lower perception of risk is ascribable, from the market perspective, to the favourable world economic outlook. Stable inflation, lower macroeconomic volatility and companies' financial soundness directly contribute to lowering risk premia. However, there remains a degree of uncertainty: the current asset price configuration seems to depend on whether the "ideal" scenario of strong growth and contained inflation prevails.

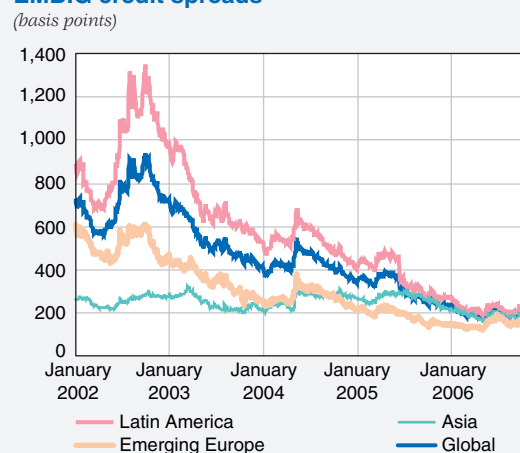
² See Don H. Kim and Jonathan H. Wright (2005) : "An arbitrage-free three-factor term structure model and the recent behaviour of long-term yields and distant-horizon forward rates", FEDS Working Paper 2005-33, Board of Governors of the Federal Reserve System.

Term premia for US 10-year yields



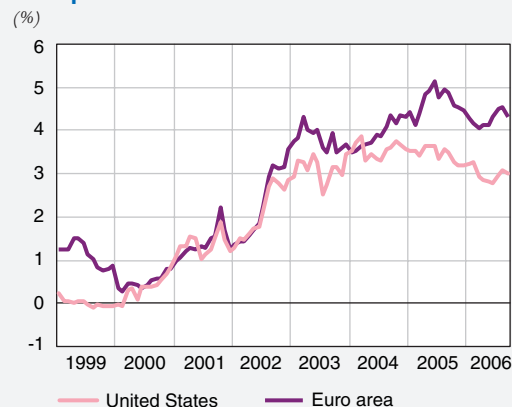
Source: Federal Reserve System.

EMBIG credit spreads



Sources: Bloomberg, JP Morgan.

Risk premia on stocks



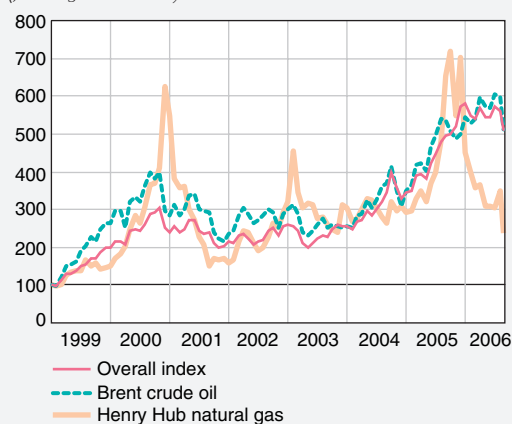
Sources: Bloomberg, IBES, Ecowin, Livingston, Banque de France.

OVERVIEW

Are risks properly priced by financial markets ?

Euro-denominated commodity prices

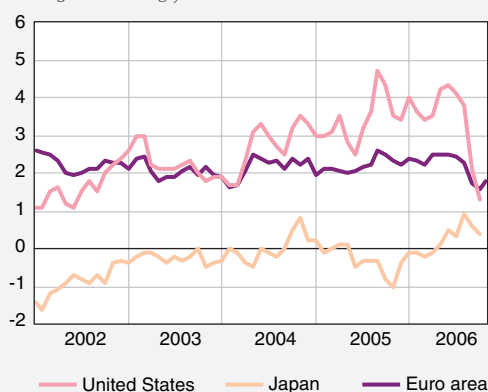
(January 1999 = 100)



Sources: Datastream, Banque de France.

Consumer prices

(year-on-year % change)

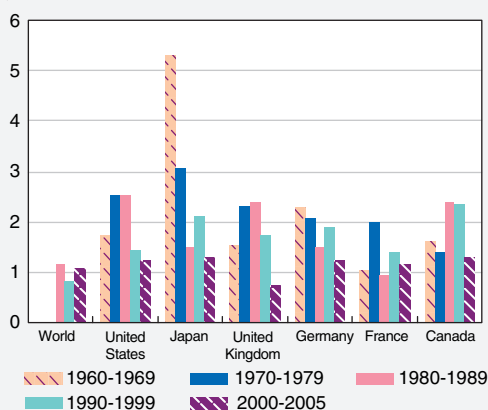


Sources: Bureau of Labor Statistics, Ministry of Public Management, Eurostat.

Volatility of GDP

Standard-deviation of yearly changes

(%)



Source: IMF; Banque de France calculations.

STABILITY OF INFLATION AND INFLATIONARY EXPECTATIONS

Inflation slowed from 4.3% in June to 1.3% in October in the United States and from 2.5% in June to 1.8% in November in the euro area.³ This slowdown is all the more striking since energy and commodity prices have risen sharply since 2005.

This situation contributes to anchoring inflation expectations at a low level (see above).

Low inflation is also less volatile, which creates a less risky economic environment. This in turn contributes to improving companies' financing conditions and to facilitating investors' economic calculations, which helps contain risk premia.

LESS PRONOUNCED VOLATILITY OF THE REAL ECONOMY

The fall in risk premia also reflects the decline in macroeconomic volatility, which is illustrated by the moderation of the fluctuations in GDP. This phenomenon is described by some observers as the Great Moderation.

In the case of emerging economies, this development was accompanied by a significant improvement in their macroeconomic situation and a modernisation of financial structures. They achieved this through substantial efforts to consolidate their public debt and widen their array of domestic investors.⁴

CORPORATE FINANCIAL POSITIONS

The low level of credit spreads is linked to corporate default rates, which have reached historical lows in both the United States and the euro area (less than 2% and 1% respectively for speculative grade companies). But will this situation prevail if the economic cycle turns around and the economic environment deteriorates? Some observers believe so, for the following reasons:

- Corporate profits are growing at a fast pace. Like in 2005, profit growth should be vibrant in 2006, at between 10% and 15%, and still relatively robust in 2007, at between 5% and 10%.

³ Taking into account a base effect to reflect the rise in energy prices in 2005 resulting from the natural disasters of the summer.

⁴ See the article "Do emerging market economies still constitute a homogenous asset class?" in this issue of the FSR.

• Companies are highly liquid. It is estimated that approximately 9% of their balance sheet is held in the form of liquid or quasi-liquid assets. This situation, which is also unprecedented, calls for an examination of corporate investment behaviour.⁵ In all events, these abundant cash reserves would enable companies to easily deal with shocks and considerably reduce default risk.

THE IDEAL SCENARIO OF STRONG GROWTH AND CONTAINED INFLATION

As we have already mentioned, financial markets are expecting a “best-case” scenario of a soft landing for the US and world economy:

- stable and contained inflation;
- slower albeit sustained growth, close to its potential;
- a stabilisation of short-term interest rates, followed by a fall (in the United States);
- steady growth in profits.

This scenario may pan out, but we cannot rule out divergences:

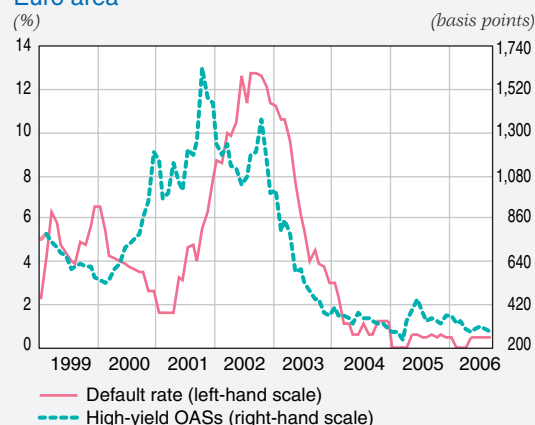
- inflation may accelerate, which would lead to a rise in interest rates. A number of statements by central bank officials appear to indicate that markets have not fully factored in this possibility;⁶
- growth could slow down more sharply than expected, in particular in the United States, should there be a real-estate shock. In this case, profits would be lower than expected and stocks would appear overpriced.

Do risk premia correctly reflect these risks? Patterns of wages and their share in value added deserve particular attention. Only unusually strong wage moderation at this stage of the cycle would justify the level of stock prices and long-term yields (see Box 1).

⁵ See the Focus entitled “Is corporate investment behaviour normal? ”, published in the August 2006 issue of the Banque de France Digest.

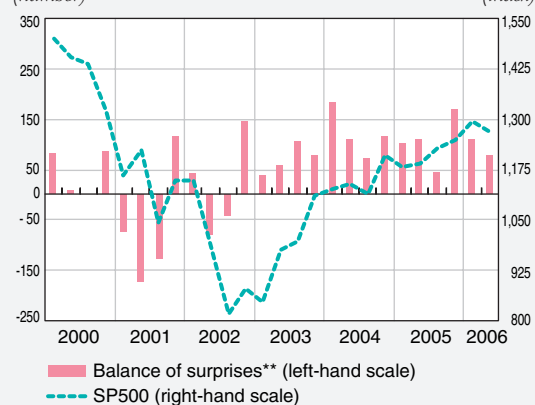
⁶ See remarks on the economic outlook made by Donald L Kohn, Vice Chairman of the Board of Governors of the US Federal Reserve System, at New York University on 4 October 2006.

Corporate credit spreads and default rates of speculative grade companies Euro area



Sources: Standard & Poor's, Merrill Lynch; Banque de France calculations.

Quarterly earnings surprises* of SP500 companies

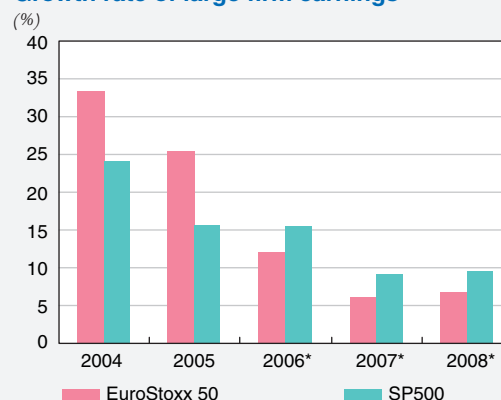


* A surprise is the differential between the earnings consensus after the release of results and expected earnings before their release.

** Difference between the number of positive and negative surprises.

Source: Jacques Chahine Finance (JCF); Banque de France calculations.

Growth rate of large firm earnings



* Forecasts at 23 november 2006.

Sources: Bloomberg, JCF.

Box 1

Are equity and bond market valuations inconsistent?

On bond markets, yield spreads are flattening again (in Europe), or even inverting (in the United States). In the past, such movements may have signalled a forthcoming recession. Yet, equity markets continue to predict significantly higher earnings in 2007 (around +10% for SP500 and EuroStoxx 50 companies), and therefore sustained growth of domestic economies. This raises the question as to whether equity and bond market valuations are consistent. The answer is yes if the ideal scenario of non-inflationary growth actually pans out, which would require a delicate balance in the wage-profit share over the coming period.

- Stock price developments appear consistent with those of their theoretical determinants: rising expected earnings, declining long-term yields, and stable equity risk premia.

- The positive correlation between equity and bond prices over the past six months is not completely new; this situation prevailed for a long period between 1990 and 1998, when interest rates were a key factor in asset pricing.

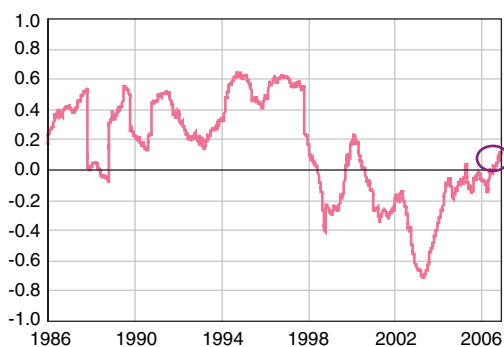
- However, the stability of the current configuration appears to be closely contingent on whether profits can continue to increase at a sustained pace after several years of strong growth. Yet, corporate profit margins are currently at historical highs in the United States, and also remain at high levels in Europe.

- While, in the medium term, profit growth is determined by the potential growth rate of the economy, in the short term, the share of wages in value added is the main factor. To date, wage demands have been contained, which results in wage moderation (in real terms) in most countries, and in particular in the euro area. As the economic cycle progresses, and based on past behaviour, we nevertheless expect an increase in the share of wages in value added, reflecting a catch up with productivity growth. This would result in:

- either a squeeze on margins at constant prices, which would be unfavourable for equity markets,
- or a rise in prices at constant margin, which would be unfavourable for bond markets.

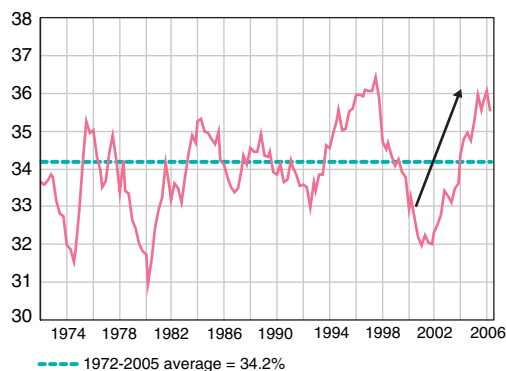
The probabilities attached to these two scenarios depend on companies' price-setting behaviour and wage dynamics. If the latter weakened structurally (due to a fairly high unemployment rate or the effects of globalisation), the ideal scenario, which currently appears to be driving financial markets, would prevail. However, if this were not the case, corrections may be seen, either on equity markets (if margins decline) or on bond markets (if inflation is higher than expected).

Correlation between the SP500 and US ten-year yields



Source: Bloomberg; Banque de France calculations.

Profit margins of US non-financial corporations (%)



Sources: BEA, BLS; Banque de France calculations.

An excessive appetite for risk?

At present, investors have a strong appetite for risk, underpinned by abundant liquidity. This fuels the search for yield (low risk aversion), which contributes to reducing risk premia.

A STRONG APPETITE FOR RISK

Risk appetite indicators can be constructed by observing markets. Several current techniques are described in an article in this issue of the FSR.⁷ These indicators show strong fluctuations in risk appetite over time.

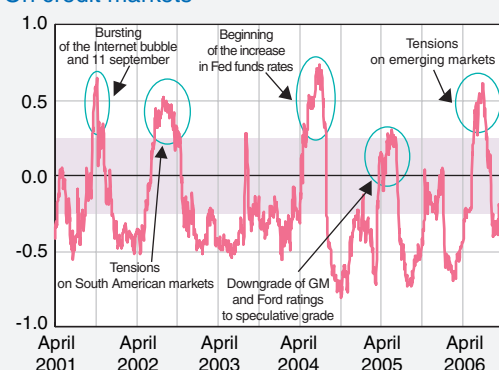
ABUNDANT LIQUIDITY

These ample liquidity conditions stem from ongoing accommodating monetary policy stances. However, interest rates have been raised in the United States, to a lesser extent in Europe and very marginally in Japan, but this has far from curbed the increase in liquidity seen since 2002 (see Box 2 for the different definitions and measures of liquidity).

Currency carry trades contribute to spreading, at the global level, the liquidity created in low interest rate countries. These transactions are particularly attractive when exchange rate volatility is low, which explains the current popularity of the yen carry trade (see Box 3).

Global risk aversion index

On credit markets



Note: The higher the index, the greater the risk aversion; the results are not significant within the central band.

Sources: JP Morgan, Morgan Stanley

Global liquidity indicator



Note: Constructed using the monetary bases and nominal GDPs of the major developed countries (United States, Japan, euro area, United Kingdom).

Source: Bloomberg; Banque de France calculations.

⁷ See the article "Can risk aversion indicators anticipate financial crises?"

Box 2

Liquidity

The concept of liquidity is complex: it has several, often interlinked, dimensions. From a central banking point of view, there are four: the liquidity of the economy, the liquidity of financial markets, bank liquidity and central bank liquidity. We first define each notion and provide a measure of it. We then establish possible links with the other notions, while stressing the significance for central banking

Liquidity of the economy

It is defined as the ratio of money to nominal GDP. The numerator is a narrow or broad monetary aggregate, such as M1 and M3 for the euro area.

It should be noted that the money-holding sector is made up of residents that are not monetary financial institutions.

The concept of liquidity is closely tied in with monetary policy through the quantity theory of money and the role of the interest rate as the opportunity cost of holding money.

Liquidity of financial markets

It is defined as the market's ability to trade a given volume of assets without significantly affecting prices. On financial markets, it is usually measured as the bid-ask spread.

Asset market liquidity is linked to monetary policy through the transmission mechanism, which is based notably on the spill-over of key rate changes to longer-term maturities and exchange rates and on wealth effects. We may, however, assume that, in liquid markets, this transmission occurs more rapidly and with greater intensity and that non-financial agents are better able to shift their portfolio allocation towards liquid assets.

Market liquidity is also closely linked to financial stability as market prices could post strong variations in the event that liquidity should dry up. This could occur following a sharp increase in the demand for liquidity (i.e. a strong demand or supply of assets) or a sudden drop in the supply of liquidity (market makers wish to maintain their own liquidity).

Bank liquidity¹

It is defined as a bank's ability to meet its immediate commitments. The narrow measure is the sum of central bank money and assets easily exchangeable for central bank money. The broad measure also takes into account the assets held by banks that may be liquidated but are not necessarily held for this purpose.

Bank liquidity is also linked to the monetary policy transmission mechanism, but in this case via bank balance sheets. It is also linked to financial stability given the possibility of bank runs and the role played by market makers in ensuring market liquidity. These two aspects may give rise to a systemic risk, which may in turn trigger the intervention of the lender of last resort.

Central bank liquidity

Central bank liquidity is measured as the sum of credit institutions' holdings on current accounts with the central bank (reserve requirements and excess reserves). It is a narrow measure of bank liquidity.

It is closely linked to monetary policy as the latter is implemented via the creation or destruction of reserves. As regards its link to financial stability, the tasks of a lender of last resort are implemented via the creation of reserves, either through market lending or lending to individual institutions.

¹ See the article "Bank liquidity and financial stability" in this issue of the FSR

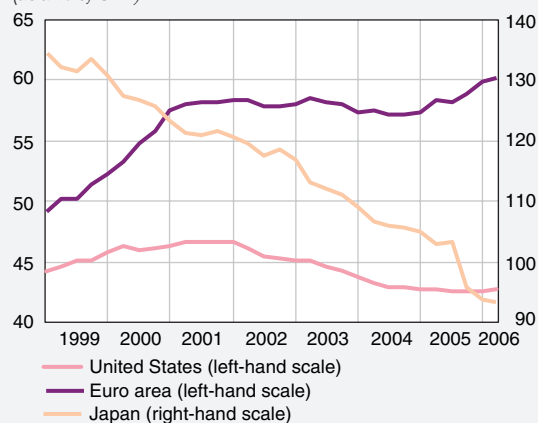
THE SEARCH FOR YIELD

In a low interest rate environment, it is harder to obtain high yields, which results in even greater risk-taking. If liquidity is abundant, it is easy to increase risk exposure, through strategies directly or indirectly based on leverage. In the current environment, there is therefore a two-fold incentive to take risks. This is reflected by the increase in complex financial transactions (venture capital, credit derivatives, commodities options, hedge funds, etc.) and the growth of leveraged financing.

This search for yield has contributed to reducing risk premia to a level that could result in an overly optimistic assessment of the soundness of financial systems.

Debt of non-financial corporations

(as a % of GDP)



Sources: United States' Federal Reserve System, ECB, Bank of Japan.

Box 3**Carry trades and their implications for financial stability: a market view**

This analysis has been enhanced by interviews conducted between July and September 2006 with a number of market participants.

A very broad notion

Carry trades consist in taking advantage of the yield spread between different asset classes by funding the purchase of higher yielding assets through borrowing in lower yielding assets, i.e. the spread between borrowing and investing. This notion may therefore cover a very wide range of transactions. Some see it as the linchpin of all financial activities: banks' maturity transformation of deposits into loans, investing in long-term securities through the sale of lower-yielding short-term securities, or shorting instruments with a high credit rating (for example a mezzanine debt tranche) to capture the risk premium offered by instruments with a lower credit rating (equity tranche). However, the yield spread is central to all of these transactions. Therefore, using this notion for instruments other than interest-rate products (e.g. equities) may seem abusive. In reality, it is mostly frequently applied to foreign exchange markets.

Currency carry trades

On foreign exchange markets, a carry trade involves taking a long position in higher interest rate currency (investment currency) and funding this position by borrowing in a lower interest rate currency (funding currency). For example, for a number of years, the yen, the Swiss franc and the Swedish krona have been funding currencies, while the New Zealand dollar, the Australian dollar and the pound sterling have been used as investment currencies. Bank deposits are the traditional instrument used for carry trades, but a number of commentators indicate that bonds are increasingly being used, including longer-dated instruments.

Gains or losses on these positions do not depend only on the yield spread, but also on changes in exchange rates.¹ Thus, for a carry trade to be profitable, the price of the asset held (the long currency position) must not fall to such an extent over the investment horizon that it offsets the profit on the spread. Currency carry trades are therefore deliberate exchange rate exposure strategies, banking on the fact that the investment currency will not depreciate significantly against the funding currency, or even that it will appreciate. In this respect, some market participants mention that carry trades are used less frequently in proprietary trading than in customer trading (mainly large companies). The bank's proprietary trading operations are more sophisticated than simple carry trades and/or have a shorter horizon, which generally means that, for many investors, a longer exposure is required to generate profits by merely capturing the yield spread.

Carry trades contribute to an increase in global liquidity by transferring the additional liquidity created in weak-currency countries to other countries.

Implications for financial stability

Carry trades are particularly attractive when exchange rate volatility is low. They may also be profitable when volatility is high, but only if the spread is very wide, which also implies higher risk exposure for investors.

A number of participants indicated that they were also vigilant about monetary policy developments, and more generally about the evolution of liquidity conditions. In this respect, monetary tightening and the resulting increase in carrying costs appear to have brought fundamental analysis back to the fore. They have also resulted in growing caution with regard to countries whose external accounts could have a negative impact on the exchange rate. While corrections have been limited to date, a number of emerging countries, which offer high interest rates attracting volatile capital flows and which show signs of external vulnerability, could suffer from the increased nervousness of investors playing the yield spread.

¹ In the case of bond investments, changes in their market price must also be taken into account.

Moreover, the very nature of carry traders contributes to the weakness, in certain periods, of carry trade strategies. Indeed, international investors (investment funds, hedge funds, etc.), which are among the main players in the carry trade, readily unwind their positions if they judge developments to be unfavourable. Many of these players use similar models to determine their trading strategies. Such herd behaviour may generate situations where a great number of investors have identical highly speculative positions (crowded trades), with carry trades being based purely on the belief that a basket of currencies will continue to offer a higher yield, without analysing the economic fundamentals. This speculative logic suggests that there may be a risk of a sudden, massive liquidation of positions affecting high yield currencies, if traders believe that a depreciation is imminent, which may furthermore be precipitated by their action.

Nevertheless, the market professionals interviewed do not believe, at present, that there is a very serious risk of this nature. They also point out that, over the recent period, players engaging in carry trades have been showing greater discrimination, but no lasting decrease in volumes has been seen for the most attractive currency pairs. These transactions therefore do not seem to be fundamentally called into question, especially those funded in yen: this type of carry trade remains very easy to fund, especially since Japanese banks, which have cleaned up their balance sheets, are seeking to expand their lending activity; we also observe that there has not been a decline in yen-denominated debt on international markets. Moreover, in relative terms, the yen appears, along with the Swiss franc, to be one of the last cheap funding currencies available. Furthermore, yen short positions reached historical levels in October.

However, some market participants consider that the role of carry trades in the yen's appreciation may have been overstated. In addition, over the past few months, Japanese institutional investors have started to diversify their portfolios, shifting out of yen-denominated assets.

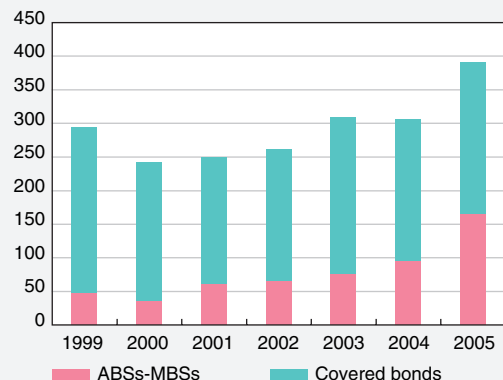
Overall, the unwinding of carry trades is a potential source of instability on international markets, but market sentiment is fairly reassuring. It should nevertheless be borne in mind that the diversity of transactions covered by this notion and the lack of knowledge of the volumes involved call for a degree of caution. Furthermore, particularly with regard to yen carry trades, does a yield spread of 5% with the United States and 3% with the euro area constitute an adequate risk/reward ratio? As historical experience shows, between August 1998 and January 1999, the yen appreciated by 35% against the dollar.

OVERVIEW

Are risk transfer mechanisms sufficiently robust?

Issuance of securitisation products

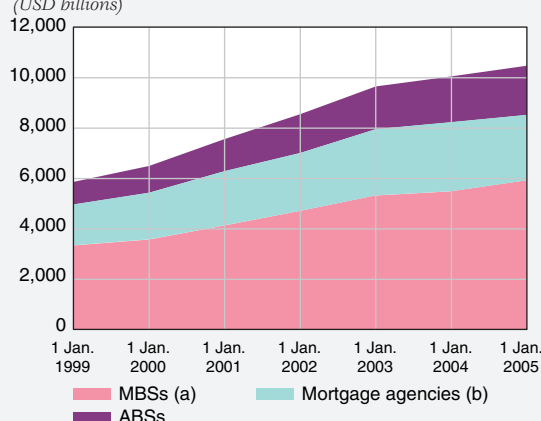
Euro area
(EUR billions)



Source: European Commission.

Securitisation products outstanding amounts

United States
(USD billions)



(a) Including MBSs guaranteed by GSEs and MBSs issued by private issuers.
(b) Uncovered bonds issued by mortgage agencies.

Source: The Bond Market Association.

Credit risk transfer instruments

Exposures

(USD billions)

Products	2003	2004	2005	H1 2006
Corporate banking				
US loan trading	144.6	155.0	176.34	55.7 ^{c)}
Global CDSs	3 779.4	8 422.3	17 096.1	26 000
Global CDOs ^{a)}	249.3	314.9	926.4	
Retail banking				
US private MBSs ^{b)}	1 816.1	1 926.3	2 226.5	2 279.8
US ABSs	1 693.7	1 827.8	1 955.2	1 985.8
European MBSs-ABSs	217.2	241.2	319.6	238.4
World total	7 683	12 646	22 381	30 266

^{a)} Issues.

^{b)} Excl. MBSs securitised and guaranteed by the US GSEs (Fannie Mae, Freddie Mac, FHLMC).

^{c)} First quarter 2006.

Sources: LPC, ISDA, Creditflux, TBMA, European Securitisation Forum.

ARE RISK TRANSFER MECHANISMS SUFFICIENTLY ROBUST?

One of the functions of financial markets is to transfer and reallocate risk among investors and financial institutions. Two techniques that serve this purpose have developed rapidly in recent years:

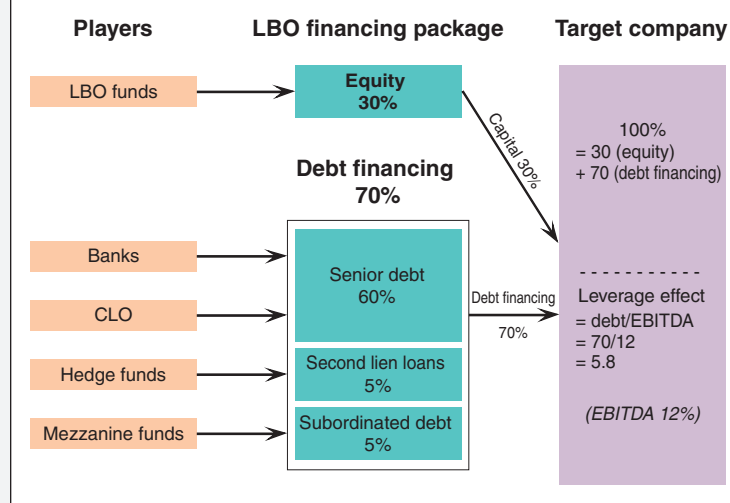
- **securitisation.** Claims are pooled and sold to a special purpose vehicle, which then issues securities that are subscribed by investors. The original holder of the claims therefore not only offloads the risk but also secures the refinancing of the original claims. Applied for the first time in the 1970s to US mortgage-backed securities (MBS), this technique has since been used with other types of claims: consumer loans and other household credit (asset-backed securities –ABS) or loans to enterprises (collateralised debt obligations –CDO). Highly developed in the United States, with outstanding amounts equivalent to those of government securities, negotiable debt has grown less quickly in Europe due to persisting legal obstacles (e.g. mandatory notification to the borrower, which interferes with the business relationship);

- **credit derivatives** allow default risk to be transferred without modifying the legal ownership of the underlying assets and without having to refinance the loan. As a result, they have developed rapidly in Europe. Individual credit default swaps (CDS) protect the buyer from the default of a company or sovereign borrower in return for a periodic fee similar to an insurance premium. Synthetic CDOs are complex securities that reference a portfolio of CDS split up into tranches (senior, mezzanine and equity) with different risk/return profiles. Standardised indices that benchmark the entire market were created for the credit derivatives market in 2004 in order to increase liquidity. This market is booming and notional amounts outstanding rose from less than USD 1,000 billion in 2001 to USD 26,000 billion at the end of June 2006, i.e. outstandings doubled yearly.

Risk transfer mechanisms are increasingly used in structuring leveraged buyout transactions (LBOs), conducted by private equity firms in particular. LBOs are structured as follows. The financing package of an LBO comprises a share of equity raised by LBO funds, which typically comes to some 30% of the acquisition amount, and a substantial share of debt, roughly 70%, provided by banks and, increasingly, by non-bank institutions such as hedge funds, securitisation vehicles and funds specialising in mezzanine financing.

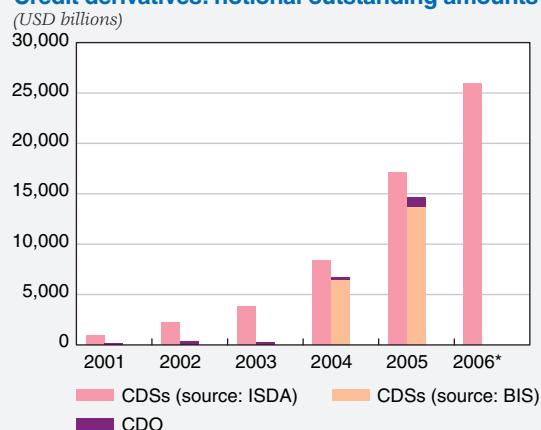
Box 4

Structure of an LBO transaction



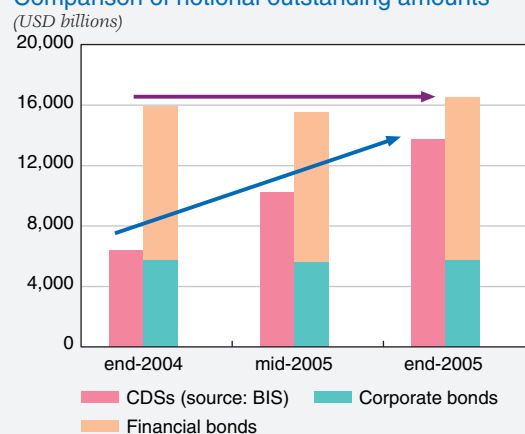
Buoyed by an economic and financial environment that remains very favourable, the resilience of these transfer mechanisms has not yet been fully tested for a severe shock scenario such as a marked slowdown in growth followed by a surge in default rates. The question of how sound they would be in such circumstances must therefore be addressed. While these mechanisms contribute to the efficiency and resilience of the financial system, they may also generate risks to financial stability that are poorly understood and controlled.

Credit derivatives: notional outstanding amounts



* 1st semester.

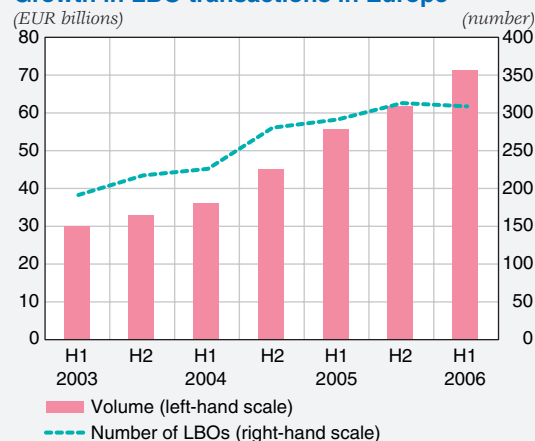
Sources: BIS, ISDA, Creditflux, The Bond Market Association; Banque de France calculations.

Credit derivatives and corporate bonds
Comparison of notional outstanding amounts

Note: Financial bonds do not include ABSs, MBSs or the securities issued by the US GSEs.

Sources: BIS, The Bond Market Association; Banque de France calculations.

Growth in LBO transactions in Europe



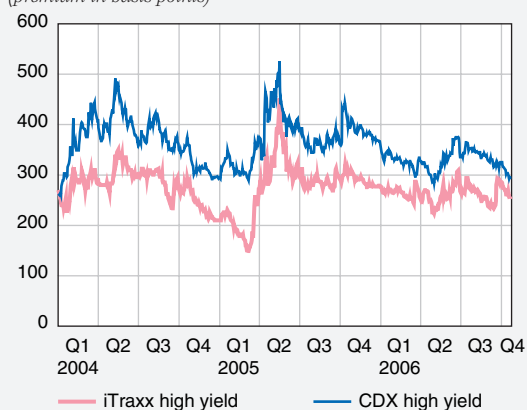
Source: Candover – Initiative Europe Barometer.

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Are risk transfer mechanisms sufficiently robust?

CDS indices

(premium in basis points)



Source: JP Morgan; Banque de France calculations.

Benefits and advantages of risk transfer mechanisms

The possibility of transferring risks has encouraged banks, in particular the largest ones, to change their behaviour substantially. Banks have moved from a static configuration in which they kept credit risk on their balance sheets for several years, to a dynamic configuration in which they can pass on the risk by transferring it to the market. This allows them to shift to activities that generate fees and commissions (consultancy, intermediation and structured finance activities), which are considered less risky and more stable. This shift could improve risk allocation at the level of the financial system as a whole.

GREATER DISPERSION AND IMPROVED DISTRIBUTION OF RISK

- **The arrival of new non-bank players has resulted in greater risk dispersion and increased market efficiency.**

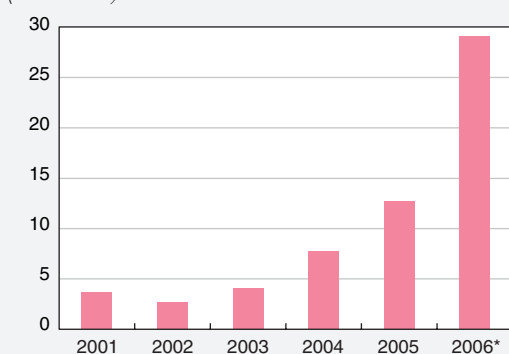
The major institutional investors (mutual funds and pension funds, insurance companies, etc.) have increased their exposure to risk transfer instruments, even though their investment policies remain fairly conservative. They therefore appear more attracted to traditional securitisation products and CDOs, especially the most highly-rated senior tranches. In Europe, these investors account for 46% of exposure to the ABS⁸ segment.

- **Hedge funds are increasingly becoming risk-buyers on the credit markets.**

Fitch Ratings estimates their share of derivatives trading at 25%. This figure is corroborated by major market players. Hedge funds trade mainly on the riskiest segments and often buy equity tranches of CDOs, which were previously the preserve of banks (Box 5 explains the additional yield offered by this type of instrument over standard bonds). These funds are particularly active in structuring LBO transactions. Dresdner Kleinwort estimates that hedge fund activity on the European leveraged loans market doubled in 2006. Hedge funds also participate in LBO transactions, either as investors in private equity funds, or as direct creditors through the purchase of other high-yield securities such as junk bonds (hedge funds account for 30% of the market), mezzanine or second lien⁹ loans and payment-in-kind (PIK).¹⁰

Issuance of collateralised loan obligations (CLOs) in Europe

(USD billions)



* First nine months.

Note: Only includes solely cash-flow (i.e. non-synthetic) CDOs.

Sources: JP Morgan, IFR, MCM, S&P, Moody's, Fitch, Bloomberg.

8 According to a recent survey on the European primary bond market by the Bond Market Association, the association that represents the major fixed income markets.

9 Second lien loan: a hybrid loan with a variable rate and security interests that are subordinate to senior debt but have priority over mezzanine debt.

10 Payment-in-kind: bond with capitalisation of interest whose coupons are paid not in cash but in the form of additional principal. This feature enables firms to increase their leverage without immediately incurring financial costs.

Box 5

Why do CDOs offer higher yields than similarly-rated bonds?

In the current low interest-rate environment, CDOs are in high demand from investors because they pay higher yields than similarly-rated traditional securities. The spread results from the specific additional risks that investors must take into account when investing in CDO tranches.

Ratings are a measure of average default probability; they do not reflect the dispersion of potential losses around this average. However, the risk of extreme losses in the event of default is greater for CDO mezzanine tranches than for corporate bonds due to tranching, which concentrates default risk on subordinated (junior/equity and mezzanine) debt. With corporate bonds, investors' loss in the event of the issuer's default is capped because investors always receive a certain recovery rate, which, while varying depending on the issuer, hovers at a historical average of 40%. By contrast, with CDOs, investors may lose their entire outlay in a subordinated tranche if the loss percentage on the reference portfolio exceeds a specific threshold. A "3%-7%" subordinated tranche therefore starts to record losses as soon as the loss percentage exceeds 3% (the "attachment point"), and investors lose their entire outlay as soon as the loss percentage on the portfolio surpasses 7%¹ (the "detachment point").

Ratings measure only credit risk; they do not take market, liquidity or other more specific risks such as model or operational risks into consideration.

The return on liquidity risk accounts for a share of CDOs' enhanced returns when compared to bonds. This is especially true for bespoke CDOs, which are acquired by a single investor that generally holds them to maturity. Similarly, even though standardised tranches of CDOs based on the iTraxx or CDX indices enjoy a high degree of liquidity in tranquil periods, this liquidity may evaporate rapidly in times of stress, as observed in May 2005 following the downgrading of General Motors.

CDO ratings are less reliable over time as downgrades are considerably more frequent for this instrument than for corporate bonds, and conversely, upgrades are less frequent (see comparative table).

Lastly, as CDOs are based on portfolios of single-name credits, they are exposed to the risk that the default of a single underlying name, or obligor, may be accompanied by the default of other obligors within the reference portfolio, namely correlation risk. If the correlation is low, the referenced credits may evolve independently of one another. However, if it is very high, two extreme scenarios may be considered: in the first, no obligor defaults and in the second, all obligors default simultaneously. While correlation is a crucial parameter for pricing CDOs, the uncertainty surrounding its assessment and possible impact in the event of crisis is high.

Comparing CDO returns and risks to those of similarly-rated corporate bonds

	A-rated corporate bond (1)	A-rated mezzanine synthetic CDO tranche (2)	Comparison (2) / (1)
Average returns at end-October 2006	Libor + 30 bp ^{a)}	Libor + 110 bp	Spread + 80 bp
Probability of default	0.61% ^{b)}	0.61% ^{b)}	
Maximum loss (in the event of default)	60% ^{c)}	100%	Ratio 1.6
Liquidity risk	Average	High	
Average annual frequency of rating downgrades ^{d)}	8.9%	10.9%	Ratio 1.2
Average annual frequency of rating upgrades ^{d)}	3.9%	0.6%	Ratio 6.8
Correlation risk	Inexistent	Very high	

^{a)} The Merrill Lynch index of A-rated US corporate bonds is used as a reference.

^{b)} Probability of default within 5 years of 0.61% for an A rating (Standard & Poor's data from transition matrices).

^{c)} Moody's long term historical average for US speculative grade corporate bonds.

^{d)} Moody's calculations for the 1991-2002 period.

Sources: Merrill Lynch, JP Morgan, Moody's, Standard and Poor's; Banque de France calculations.

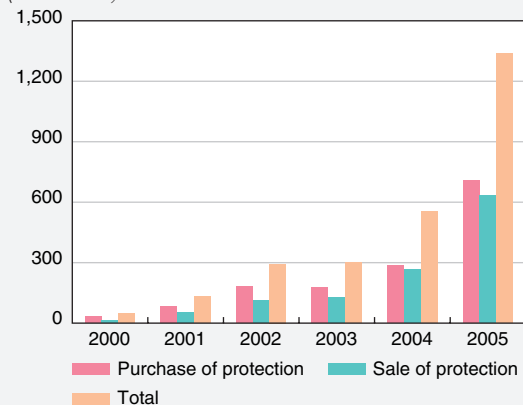
¹ The speculative grade default rate has exceeded 7% four times in the last twenty years (in 1990, 1991, 2001 and 2002).

OVERVIEW

Are risk transfer mechanisms sufficiently robust?

French banks: notional amount of credit derivatives traded

(EUR billions)



Source: Commission bancaire (Financial Agents Database BAFT).

- **Banks themselves may buy risk** and thus diversify their risk profiles by gaining exposure, *via* derivatives, to companies, sectors or geographical areas in which they do not have customer relationships. The foremost credit institutions currently consider credit derivatives to be essential portfolio management tools, especially *vis-à-vis* their major corporate customers. The amount of protection bought by major French banks rose from EUR 34 billion in June 2005 to EUR 123 billion in June 2006, for a total notional amount of outstanding credit derivatives of roughly EUR 1,500 billion.

- **Banks' behaviour therefore varies widely.** Some banks are seeking to hedge against a possible turnaround in the credit cycle by taking advantage of the current narrow spreads. Others have indicated that they securitise a significant share of their claims on large companies (20% to 30% of outstanding amounts) and ultimately retain the bulk of risk in the form of first-loss tranches.

According to Standard & Poor's, European banks currently sell roughly 50% of loans that they grant in LBO deals to non-bank institutions. Market participants confirm this figure for France.

RESILIENCE OF THE SYSTEM TO SHOCKS

Greater risk dispersion among financial institutions reduces the vulnerability of the financial system. This was corroborated by the fact that no systemic impact was observed on credit markets in the wake of the difficulties experienced in 2005 by large corporate issuers such as General Motors and Ford, whose ratings were downgraded and Delphi, which went bankrupt. These shocks were limited, admittedly, but no spill-over was observed, volatility remained in check and market liquidity satisfactory.¹¹ The soundness of financial institutions was not jeopardised.

More recently, the significant losses sustained by the hedge funds Amaranth and Vega did not generate market turbulence or disruptions (see Box 6 on the demise of Amaranth).

¹¹ With the exception of the liquidity disruptions on the tranches of CDS indices caused by the downgrades of GM and Ford in May 2005, an episode often described as a "correlation crisis".

Box 6**The demise of Amaranth Advisors**

In September 2006, the hedge fund Amaranth Advisors suffered, over the space of a few days, very heavy losses related to unhedged positions in the natural gas futures market: USD 6.4 billion, or almost 70% of its assets over the month. It was the greatest hedge fund industry debacle since the failure of LTCM in 1998, when losses totalled USD 5.75 billion.

Created in 2000, Amaranth billed itself as a multi-strategy diversified hedge fund. In reality, its positions in the energy sector represented around half of its assets and generated around 75% of its gains before the crisis. Like many hedge funds, its strategy was based on exploiting statistical regularities relating to market prices, which although likely to reoccur, may not necessarily do so. By betting on seasonal variations in natural gas futures prices, Amaranth could have made massive profits in 2005, compounded by the effects of hurricane Katrina. That year, however, the strategy did not pay off. The magnitude of the losses sustained by Amaranth can be explained not only by price movements, but above all by the relative size of its positions on the natural gas futures market¹.

Why did the financial system weather the Amaranth storm?

Despite its spectacular nature, the demise of Amaranth did not cause major or lasting upheavals on the markets. There are a number of reasons that account for this. First, there was no large-scale withdrawal of investors thanks to clauses preventing them from doing so, which limited Amaranth's liquidity needs. Furthermore, the fund was able to meet its margin calls as it could easily sell its leveraged loans (loans to speculative grade companies or firms undergoing leveraged buy-outs) and its convertible bonds, given the high demand in the current circumstances. The fund's difficulties did not excessively affect its bank creditors or result in a rise in counterparty risk. It also appears that other market participants had been aware of the fund's growing exposure to the natural gas futures market for a long time, which enabled them to take steps sufficiently early to avoid becoming enmeshed if Amaranth chose to suddenly close out its positions. Lastly, the way in which the fund resolved the crisis no doubt prevented it from spreading. In mid-September, the management of Amaranth decided to bring together a number of investment banks to organise the sale of its energy portfolio in an orderly manner. It was sold to JP Morgan Chase and the hedge fund Citadel on 20 September at a significant discount to market value, with no major impact on the natural gas market as a whole. Indeed, after falling between end-August and early October, the price of the third generic contract on the NYMEX now seems to have stabilised.

How to prevent such shocks from reoccurring?

The Amaranth case illustrates first and foremost the seriousness of the risks related to over-concentration on markets as narrow as that of natural gas futures contracts (in particular for the longest maturities). A simple examination of the notional value of Amaranth positions relative to its prevailing open positions in the futures market should have sent alarm bells ringing about the soundness of the strategy². Furthermore, it seems likely that a significant amount of the transactions were conducted on OTC markets via brokers and on electronic trading platforms such as Clearport and ICE (Intercontinental Exchange), which are not all regulated. The Amaranth affair therefore provides arguments to support projects by the US Senate calling for the same transparency requirements as those incumbent on NYMEX participants to be imposed on electronic trading platforms, in order to facilitate the management of counterparty risk. Lastly, the failure of Amaranth's risk management system is a reminder that value-at-risk (VaR) indicators are insufficient for assessing market liquidity risk³ and that it is dangerous to mechanically use tools that give a false sense of security.

Aside from the usefulness of the lessons learnt from the Amaranth debacle, this episode has highlighted the importance of good co-ordination between market participants, without intervention by the public authorities, to avoid potential negative externalities and the systemic implications associated with the liquidation of Amaranth's assets. It is uncertain, however, that such mechanisms would have worked if a number of hedge funds had experienced difficulties at the same time.

¹ As an indication of this, the USD 6.4 billion in losses represent over 300,000 times the spread between March and April futures contracts for 2007 on natural gas.

² See Till (H.) (2006): "Edhec comments on the Amaranth case: early lessons from the debacle", EDHEC Risk and Asset Management Research, October.

³ See Bervas (A.) (2006): "Market liquidity and its incorporation into risk management", Banque de France, Financial Stability Review No.8, May.

Outstanding questions

RISK TRANSFER MECHANISMS CONTRIBUTE TO A CERTAIN OPACITY IN THE DISTRIBUTION OF RISKS

- First, because most transactions are conducted on OTC markets and are not recorded in a centralised manner.¹² Despite the recent availability of statistics, which are nonetheless partial and often inconsistent,¹³ monitoring risk transfers remains a difficult exercise for central banks and bank supervisors.
- Second, and more fundamentally, because risks are usually transferred by banks, which are regulated and transparent, to entities that are barely regulated or not regulated at all and are not required to disclose their positions. It is therefore impossible for regulators and market participants to ascertain the identity or situation of the ultimate risk holders.
- It is therefore very difficult to determine banks' actual level of exposure. Firstly, they transfer some or all of their risk to the market. Secondly, they incur counterparty risk, either as prime brokers,¹⁴ or in other ways, *vis-à-vis* the ultimate holders, and in particular hedge funds. Basically, banks replace credit risk by a more uncertain counterparty risk, and their actual exposure is not necessarily known, in particular when a hedge fund does business with several prime brokers (nine in the case of Amaranth).

MARKET LIQUIDITY AND ASSET VALUATION

In a market where trading activities are prevalent,¹⁵ the liquidity of instruments, *i.e.* the ability to carry out transactions at market prices, without any notable delays or transaction costs, is crucial. Indeed, the liquidity of the simplest credit derivatives (CDSs) is tending to increase, in particular due to the creation of standardised indices.¹⁶ Nevertheless, the liquidity and valuation of complex instruments remain a potential source of fragility for the market.

¹² A recent project proposes the automated confirmation and recording of trades in the DTCC post-trade processing system. However, it is only expected to apply to new trades.

¹³ For single name credit default swaps (CDS), the main sources are the BIS half-yearly credit derivatives survey, the ISDA half-yearly credit derivatives survey and the annual Fitch Global Credit Derivative Survey. For portfolio derivatives (CDOs, tranches of CDS indices, etc.), the main source is Creditflux, a private data provider to which the main intermediaries report their transactions.

¹⁴ Banks provide a number of services to hedge funds: financing, settlement, custody, etc.

¹⁵ Since 2003, the amount of credit derivatives held with trading intent (trading book) is increasing very rapidly. For example, for French banks, it stood at EUR 1,831 billion in June 2006, compared with EUR 784 billion in June 2005.

¹⁶ iTraxx indices in Europe and CDX indices in the United States, based on a basket of CDSs made up of roughly 100 equally-weighted single-name CDSs, deemed sufficiently liquid and representative of the sector.

- Complex structured products (CDOs and alike) are fairly illiquid and cannot be valued at market prices, which often do not exist or are not very reliable. Firstly, these instruments are often held to maturity. And secondly, their complexity and lack of standardisation are not an incentive for market makers to invest in human and material resources in order to quote a price if trading volumes are too thin.

- Models must therefore be used to value such products. However, in view of their complexity, current models are not sufficiently robust (model risk), as they have not been tested over a sufficiently long period. For instance, the disruptions stemming from the ratings downgrades of General Motors and Ford in May 2005 highlighted the danger of using models that are unable to reproduce the price dynamics generated by the behaviour of market participants, in particular the simultaneous unwinding of similar positions in narrow and fairly illiquid markets.

- During periods of market stress, liquidity risk and model risk may arise at the same time. The liquidity of these instruments can dry up rapidly. Therefore, market prices may not behave in the way models predict, generating unexpected losses.¹⁷ Rather, the existence of liquidity and model risk should encourage market participants to be cautious in their valuation of the most complex products. Yet, the spreads at issuance of these products have been declining for the past two years, mirroring the fall in credit risk premia on other segments. In some cases, market prices probably do not fully reflect all the risks incurred.

THE TRANSFORMATION OF BANK-BORROWER RELATIONSHIPS

In a traditional customer relationship, banks provide both loans and services to borrowers. They may choose to maintain commercial relations with borrowers that they consider risky, if the latter provide other sources of income in the form of commission for example. The possibility of transferring this risk breaks this relationship, with two major consequences:

- The ultimate risk is no longer held by banks. To date, the new non-bank holders of risk have not been exposed to major or widespread defaults, thanks to the extremely benign default environment. However, their behaviour in these circumstances, which may be very different to banks' practices with their customers, is questionable. In particular, the most yield-sensitive investors (hedge funds) could behave more aggressively, favouring a rapid bankruptcy rather than attempting to restructure the debt,

¹⁷ In May 2005, it emerged that many hedge funds had taken similar positions on relatively illiquid products (long position on CDO equity tranches, "hedged" by a short position on mezzanine tranches), whose simultaneous liquidation resulted in major losses on both legs of the transaction, even though, according to the models, one of the legs should have offset the losses on the other.

OVERVIEW

Are risk transfer mechanisms sufficiently robust?

which involves a longer-term commitment with no guaranteed outcome. This could result in an amplification of credit cycles, with an increase in failures at the bottom of the cycle.

- If it became impossible to transfer risk, for example following a shock that significantly affected the functioning of the derivatives or securitisation markets, banks could cut back or interrupt their lending activity, or apply prohibitive margins. A credit crunch would have a significant and lasting macroeconomic impact, as historical precedents have shown, with a decrease in corporate investment, a rise in failure rates and an economic crisis exacerbated by possible cumulative effects. The resulting lack of financing raises the risk of failure and hence pushes up provisioning for non-performing loans, which dissuades, in equal measure, banks from lending.

THE SPECIFIC CASE OF LBOs

The fact that it is considerably less costly to raise debt capital than to issue shares has led to rapid growth in LBO activity. This development has a number of consequences.

- **The conversion of listed companies into unlisted companies.**

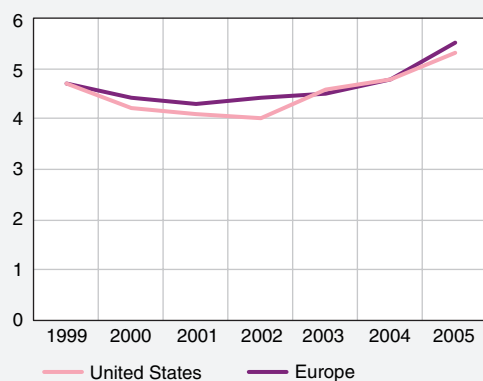
Consequently, stock market liquidity decreases and the size of the market could even shrink if delistings associated with LBOs exceed initial public offerings. Furthermore, this results in a decline in transparency as, once delisted, companies are no longer subject to transparency and disclosure requirements *vis-à-vis* the market authorities and the public.

- **A rise in the level of debt and leverage of non-financial corporations.** In order to finance increasingly expensive acquisitions,¹⁸ the average debt/EBITDA ratio of firms undergoing LBOs stood at 5.9 in the first half of 2006 compared with 5.2 in 2005 according to Standard & Poor's. Furthermore, other riskier forms of debt are gaining popularity (tranches of senior debt payable at maturity, second liens and payment-in-kind (PIK), see above). Overall, loan outstandings associated with LBOs are growing rapidly, but their credit quality is deteriorating.¹⁹

- **A deterioration of corporate balance sheets** could lead, in certain cases, to a real "loss of substance". After an LBO:

- the proportion of equity in the balance sheet declines while that of debt rises;

Leverage in LBO transactions



Source: Standard & Poor's LCD.

¹⁸ For example, Pages Jaunes, a former subsidiary of France Télécom was acquired by Kohlberg Kravis Roberts (KKR) for EUR 6.1 billion, or 11.8 times EBITDA (Earnings Before Interest Tax Depreciation and Amortisation). In 2005, the EBITDA multiple averaged 8.1 times for European LBOs.

¹⁹ According to Standard & Poor's, the share of lowest rated debt (B) increased from 17% in 2003 to 77% in 2005.

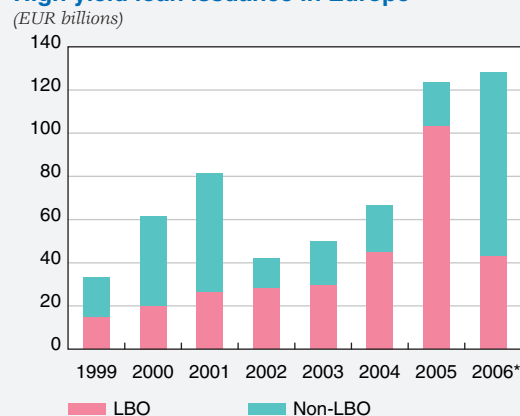
- the equity growth rate, all other things being equal, slows. In most cases, new shareholders pursue a very dynamic dividend policy, with, at times, payments of exceptional dividends to either themselves or existing shareholders;
- lastly, in some cases, the absolute value of equity declines. The practice of recapitalisation is developing whereby several months after the initial transaction, LBO funds refinance the initial loans and take out new loans in order to extend the maturity of the debt and pay exceptional dividends. This practice is becoming increasingly widespread. In relation to the original financing structure, leverage further increases *via* lower interest rates and longer maturities, and, if dividends are paid, equity decreases. This refinancing enables them to very rapidly generate and distribute high returns on investment, around 20 months after the acquisition, while the standard length of an LBO is four to eight years. Banks are particularly keen to grant such refinancing loans as they can securitise the risk and transfer it to the market, generating sizeable commissions. The end (non-bank) purchasers of the risk appear to focus on generating high yields.

LBOs can increase efficiency if the new shareholders, more than the existing ones, bring expertise, greater synergies and a new strategy to the firm. This is their true purpose. They may also result, if the distributed profits are reinvested, in an improved allocation of capital in the economy. However, this benefit must be set against the risks stemming from a deterioration in the balance sheets of the companies concerned, and a decline in their ability to absorb shocks.

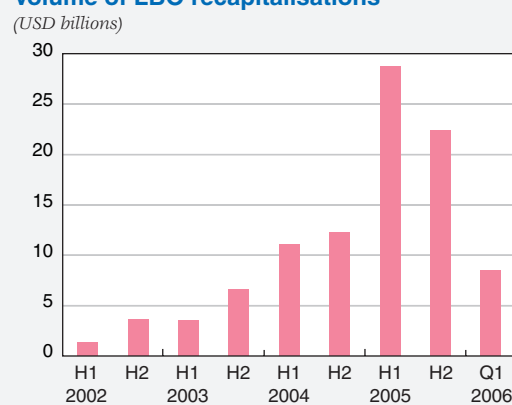
According to a recent study by Moody's, companies acquired by a private equity fund may, in certain circumstances,²⁰ have a significantly greater probability of defaulting in the following years. The number of defaults observed last September in Europe (five companies from various sectors: sea transport, aeronautics, telecommunications and automobile) had not been as high for a year, which may be an early indicator of more serious difficulties for credit markets going forward. The credit rating of one of these companies, owned by a private equity firm, was downgraded by Standard & Poor's. This confirms that if credit ratings agencies consider that a company's debt burden is too high or its cash flow is insufficient, they will not hesitate to downgrade its rating, which could result in an unexpected falls in stock prices.

²⁰ For instance, an issuer rated (BB) before the LBO could see its default risk double compared with companies of the same rating that are not undergoing LBOs. See Moody's Special Comment (2006) : "Default and migration rates for private equity-sponsored issuers", November

High yield loan issuance in Europe



Volume of LBO recapitalisations



Commodities: an asset class in their own right?

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The ideas and conclusions developed in the articles do not necessarily reflect the views of the Banque de France, despite the fact that most of the authors work in the Banque de France departments that deal with issues of financial stability.

Commodities: an asset class in their own right?

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Market Making and Monitoring Division

Investor interest in commodities has risen in recent years in line with the spectacular surge in most commodity prices. Some institutional investors, for instance Dutch¹ or Californian² pension funds, have confirmed that they have gained or intend to gain moderate exposure (less than 5% of their assets) to commodities. In parallel, the development of new investment vehicles has enabled individual investors also to gain commodity exposure.

Expectations of continued strong economic growth in Asia, which should result in Asian countries' sustained demand for commodities, may be the driver of the increased appetite for these assets. Interest also seems to be spurred by studies by academics and market analysts that highlight commodities as an effective way of diversifying portfolio risk.

This assessment and interpretation suggest that investors are slowly but sustainably including commodities in their portfolios. Can we however assert that commodities constitute an asset class in their own right? This study suggests they do, given that over the long term, returns on commodity-related investments appear to outperform risk-free returns, seem to have a low or negative correlation with other asset classes and can apparently not be replicated with a simple linear combination of assets.

¹ See *Global Investor Magazine* (2006).

² See *Business Week* (2006).

The sharp rise in commodity –especially oil– prices since 2001 has led many investors to place a growing share of their assets in commodities. Several articles³ have underlined the diversification benefits derived from including this new asset class in institutional investors' portfolios.

This study is divided into two parts:

- it first presents the main investment vehicles used to obtain exposure to commodities;
- it then defines the criteria that a vehicle must fulfil in order to constitute an asset class in its own right and attempts to ascertain whether commodities fulfil these criteria.

1 | COMMODITY INVESTMENT VEHICLES

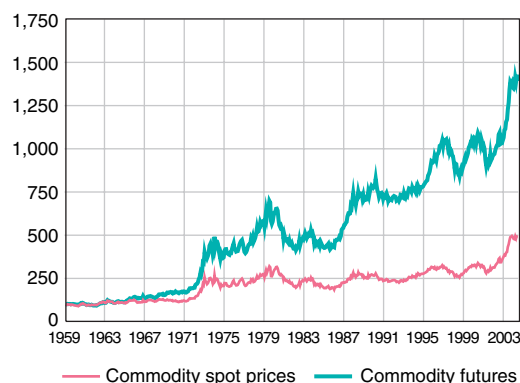
The vehicles used by investors to gain exposure to commodities are commodity futures contracts and funds benchmarked to commodity indices⁴ based on various underlying commodity futures.

Beyond the storage difficulties they entail, the purchase and holding of physical commodities do not yield attractive returns: historically, since the late 1950s, real returns on a basket of physical commodities have been much lower than those on a portfolio of commodity futures.

To buy commodity futures, investors have to post collateral to protect the seller against the risk of investor default should futures prices evolve unfavourably. The collateral is often made up of US Treasury bills.

Investing in commodity futures means rolling positions forward as futures contracts come up to expiry so as to avoid delivery of the underlying

Chart 1
Real performance of spot prices compared with indices of commodity futures
(July 1957 = 100)



Source: Gorton et Rouwenhorst (2005).

commodity. Depending on whether the forward price curve is in contango (futures prices are higher than spot prices) or conversely, in backwardation (the usual slope of the oil curve), the roll yield –i.e. the return from rolling the futures positions forward– is either positive or negative.

Overall, the spread between returns on futures contracts and returns on spot transactions, which is largely to the advantage of futures, corresponds to the sum of the roll yield and the collateral yield as shown by the following equation:

$$\text{Total return on a futures investment} = \text{yield on the underlying asset} + \text{roll yield} + \text{collateral yield}$$

In practice, roll yields have tended to be the largest contributor to the spread: between 1989 and 2004, the rate of return on a crude oil futures contract stood at an average of 20.1% per year, broken down into 6.0% for the appreciation of the underlying assets, 9.1% for the roll yield⁵ and 4.9% for the collateral yield. For gold however, the contango of the futures curve explains why the roll yield stood at a negative 5.7% per year on average between 1989 and 2004.

³ Several studies, including those by Gorton and Rouwenhorst (2005) and JP Morgan (2006), suggest that using commodities to create diversified portfolios improves the portfolio's risk/return ratio. Ibbotson Associates (2006) in fact place the optimal share of commodities in a diversified portfolio within a range of 22% to 29%.

⁴ The major commodity indices are the Dow Jones-AIG composite index, the Goldman Sachs commodity index (GSCI), the Deutsche Bank liquid commodity index (DBCI) and the RJ/CRB index. The main differences between these indices lie in the different means of weighting certain types of commodities, especially energy.

⁵ These results were obtained under the assumption that the collateral backing futures contracts consists of US Treasury bills with an annualised yield of 4.8% over the period considered.

Commodity market participants also invest in exchange traded funds (ETFs), which are instruments traded on an organised market where, *via* the purchase of ETF shares, participants may invest in commodities in the same way as in stocks. Many observers consider that investor interest in commodities –particularly from individual investors– has been boosted by the introduction of gold and silver ETFs.

While the main ETFs track gold prices, others are linked to oil prices and to composite indices of commodity prices. Gold ETFs are quoted on US, European, South African and Australian stock exchanges. An ETF share generally represents 1/10 of an ounce of gold. This recent product –the first contract was launched in November 2004– gathers individual investors' appetite for commodity-related investments. The gold held by individual ETF investors amounted to 548 tonnes in September 2006, which, according to the World Gold Council, places this investor category just behind the tenth largest institutional holder of gold.

2| COMMODITIES AS A SEPARATE ASSET CLASS

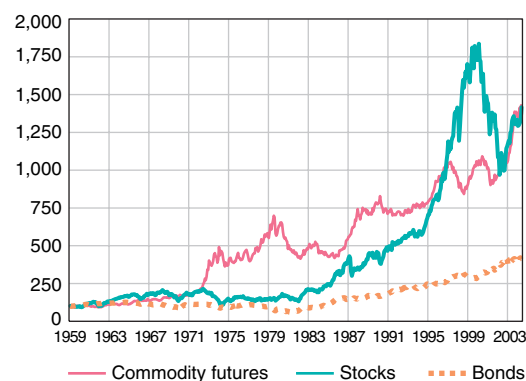
2|1 Definition of an asset class

A commonly used approach is to consider as an asset class any instrument:

- that generates returns that are higher than risk-free returns,
- whose returns demonstrate little or no correlation with other asset classes,
- whose returns may not be replicated with a simple linear combination of other assets.

Chart 2
Real returns on stocks, US bonds
and commodity futures

(July 1957 = 100)



Source: Gorton et Rouwenhorst (2005).

2|2 Fulfilling the criteria

OVER THE LONG TERM, RETURNS ON COMMODITY-RELATED INVESTMENTS OUTPERFORM RETURNS ON RISK-FREE INVESTMENTS

Over the long term, returns on commodity futures are close to stock returns and largely exceed bond returns.

The high annualised return on commodity indices over the long run is largely a result of the contribution made by the energy sector, as shown by the table below.

Total annualised return (underlying + roll yield + collateral yield) 1989-2004 (in annualised terms)

(%)

Crude oil	20.1
Heating oil	13.9
Aluminium	-1
Gold	1
Flour	1.2
Corn	-3.7

Source: Deutsche Bank (2005).

Annualised returns on different asset classes in business cycles between 1959 and 2004

(%)

	Stocks	Bonds	Commodity futures
Expansion	13.3	6.7	11.8
Early	16.3	10.0	6.7
Late	10.4	3.6	16.7
Recession	0.5	12.6	1.1
Early	-18.6	-3.9	3.7
Late	19.7	29.1	-1.6

Source: Gorton et Rouwenhorst (2005).

In addition, unlike stock and bond returns, commodity returns tend to increase in periods of inflation. Moreover, commodities provide diversification benefits, especially in times of financial market volatility: between 1959 and December 2004, annualised commodity futures returns rose by 1% for the quintile corresponding to the months in which stocks posted the sharpest falls. Commodity futures therefore appear to provide an effective hedge against stock market declines.

Lastly, commodity futures and funds tracking composite commodity indices enable diversification depending on the phase of the business cycle: their returns tend to be historically higher in late expansion phases, and then remain positive in early recession or economic slowdown phases; conversely, stock returns tend to be strongly negative in early recession phases.

LOW OR NEGATIVE CORRELATION

OF COMMODITY RETURNS WITH OTHER ASSET CLASSES

The following table shows a slightly negative correlation between commodity futures returns and stock and bond returns. Conversely, commodity futures returns are positively correlated with inflation.

Coefficients of correlation of annualised commodity returns with those of other asset classes between 1970 and 2004

US Treasury Bills	-0.1
US Treasury bonds	-0.32
US TIPS	0.41
International bonds	0.15
American stocks	-0.24
International stocks	-0.07

Source: Ibbotson Associates (2006).

Correlation between commodity futures, stocks and bonds from July 1959 to December 2004

Correlation coefficients	Stocks	Bonds	Inflation
One month	0.05	-0.14	0.01
One quarter	-0.06	-0.27	0.14
One year	-0.10	-0.30	0.29
Five years	-0.42	-0.25	0.45

Source: Gorton et Rouwenhorst (2005).

These results appear to be valid irrespective of the time frame considered, with the exception of the one-month correlation between commodity futures returns and stock returns, which is positive.

IT APPEARS DIFFICULT TO REPLICATE THE RETURNS GENERATED BY COMMODITY-RELATED INVESTMENTS WITH A SIMPLE LINEAR COMBINATION OF OTHER ASSETS

We examine in further detail below whether it is possible to replicate the returns on the major commodity indices with a linear combination of other types of assets.

The prices of four asset categories are considered:

- commodities, based on the Goldman Sachs commodity index (GSCI),
- stocks, based on the S&P500,
- bonds, based on the price of a 10-year US Treasury bond,
- US house prices, as reflected by the House price index produced by the Office of federal housing enterprise oversight (OFHEO) since 1975.

Weekly returns

Excluding US house prices, which are only available on a quarterly basis, we carry out a multiple linear regression of weekly changes in commodity prices on changes in the S&P500 and 10-year US bonds, using the ordinary least squares method for the March 1975-September 2006 period. We then examine the determination coefficient R^2 resulting from the linear regression, which is between 0% and 100% and reflects the quality of the adjustment:

the closer R^2 is to 100%, the larger the share of changes in commodity prices resulting from those of prices in other asset categories.

The linear regression results in a determination coefficient of almost zero (0.02%). It determines the coefficients a and b , which minimise the sum of the squared differences between the weekly returns observed for the GSCI and the estimated returns in the following equation.

$$\text{GSCI returns} = a * \text{S\&P500 returns} + b * \text{returns on 10-year US T-bonds} + c \text{ (constant)}$$

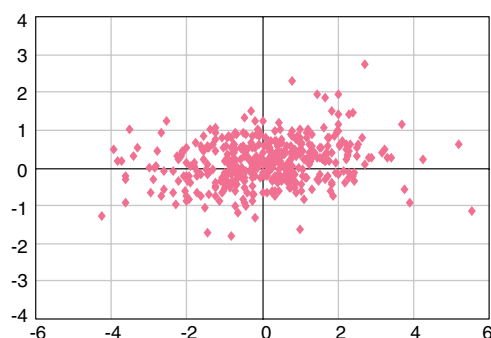
However, the coefficients a and b obtained do not necessarily fulfil the constraint $a + b = 1$, which reflects the fact that an investor could replicate GSCI returns with a combination of stocks and bonds making up a total investment amount equal to that which it would have invested in the GSCI. In order to take this additional constraint into account, we calculate weekly returns on ten composite portfolios made up of an increasing share of stocks (in this case the S&P500), from 0% to 100%, in increments of 10%, with the rest of the portfolio being invested in US Treasury bonds.

We then regress weekly GSCI returns on those of each of the ten portfolios. The results obtained once again indicate a very low correlation between GSCI returns and those of the ten portfolios, with

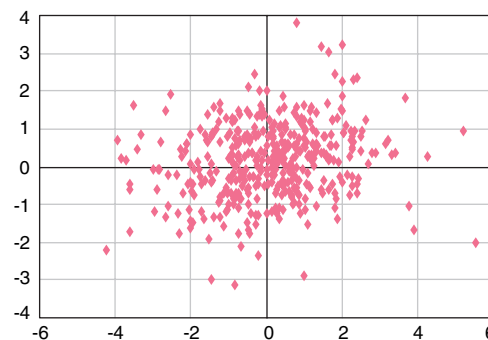
Chart 3
Weekly returns on the GSCI (X-axis)
and on a portfolio (Y-axis)
consisting of:

(%)

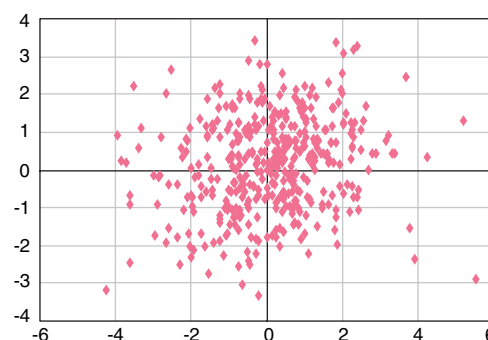
30% of S&P500 and 70% of 10-year T-bonds



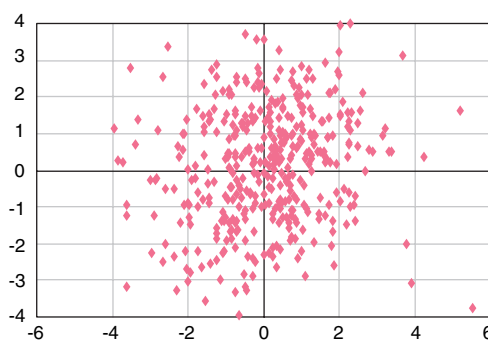
50% of S&P500 and 50% of 10-year T-bonds



70% of S&P500 and 30% of 10-year T-bonds



90% of S&P500 and 10% of 10-year T-bonds



Source: Bloomberg.

coefficients of determination R^2 still below 1%. These results are illustrated in the charts above.

For the different combinations of stocks and bonds used, the charts do not clearly indicate the existence of a linear relationship between weekly returns on the GSCI and on the various mixed portfolios.

Quarterly returns

Using quarterly returns in our econometric calculations allows us to take house prices into account. We thus carry out a linear regression of quarterly changes in commodity prices; this time on changes in the prices of the other three asset categories (stocks, bonds and housing) and also for the March 1975 to September 2006 period.

The coefficient of determination comes to 8.7%. This value, which is again very low, suggests that a linear combination of returns on the S&P500, 10-year US T-bonds and the OFHEO index would not make it possible to properly replicate returns on the GSCI composite index either.

Robustness of the results

Replacing the GSCI with other composite commodity indices does not modify the conclusion. In particular, the calculations carried out with the GSCI total return⁶ index result in a determination coefficient of 5.9% when quarterly returns are used.

If the CRB index is used over a period spanning from March 1975 to September 2006, the coefficient R^2 obtained is still much lower than 1% for weekly returns and stands at just 3.8% for quarterly returns.

⁶ Returns on the GSCI total return index comprise the yield on the underlying assets, the roll yield, the collateral yield (3-month T-Bills) and presuppose in addition that the interest on collateral is reinvested in futures and that gains/losses on futures are invested/disinvested in T-Bills posted as collateral.

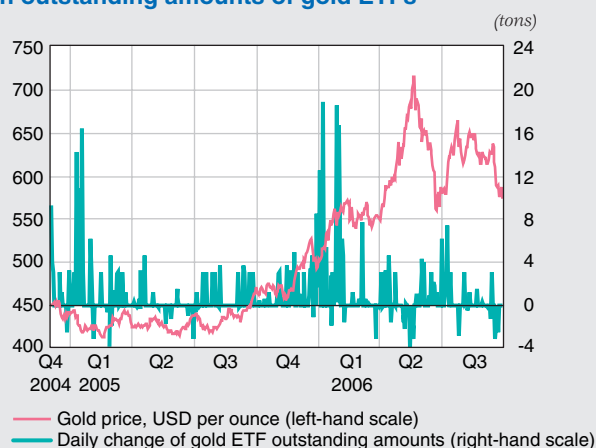
Commodity returns can apparently not be replicated simply with a linear combination of stocks, bonds and house price indices. Commodities therefore appear to adequately fulfil the three criteria set out above, which make it possible to define an asset class: returns that outperform risk-free rates, have no significant correlation with other asset classes and cannot be replicated with a combination of other asset classes.

We may therefore assume that returns on commodity-related investments are also subject to the same excesses as those on other asset classes and that it is possible to have price changes that are unrelated to economic fundamentals. Investor reaction to these undue changes will depend, of course, on their investment horizons as well as the level of diversification of their portfolios.

It is worth noting that ETF investors (who are mainly individual investors) continued to acquire ETFs during the sharp drop in gold prices in May 2006, whereas, conversely, they had tended rather to reduce their exposure during the boom in April. This suggests that their investments are not purely speculative.

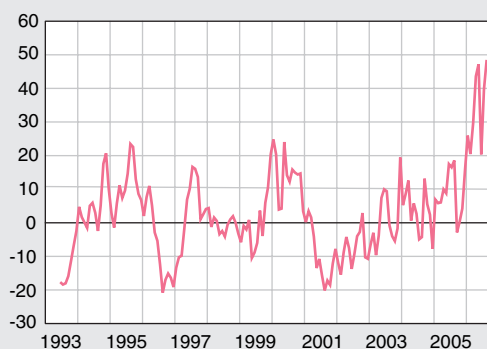
Commodities are nonetheless subject to speculative movements, even though it is difficult to evaluate the degree of speculation. Some observers believe it may be assessed by comparing changes in the spot prices of the underlying commodities on which futures contracts are based to changes in the spot prices of physical commodities. For example, Merrill Lynch estimates that speculators are more likely to trade on futures markets than on physical spot markets. Consequently, the difference between the price of a basket of commodities underlying futures contracts and that of a basket of physical commodities⁷ allows to calculate the speculation premium. At the end of August 2006, the speculation premium derived from this calculation amounted to 50%, the highest level recorded since Merrill Lynch began these calculations.

Chart 4
Gold prices in US dollars and changes in outstanding amounts of gold ETFs



Sources: www.exchangetradedgold.com, Bloomberg.

Chart 5
Difference between the annualised returns on a basket of commodities underlying futures contracts and those on a basket of physical commodities (%)



Source: Merrill Lynch.

⁷ The return calculated for each basket is an arithmetic mean of the annualised returns on all the commodities. The first basket (commodities underlying futures contracts) is made up of cotton, copper, aluminium, zinc, lead, crude oil, nickel and tin. The second basket consists of burlap, polyester, steel, plywood, rubber, tallow, benzene, red oak flooring, ethylene and hides.

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Do emerging market economies still constitute a homogenous asset class?

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The fundamentals of emerging market economies (EMEs) have improved significantly over the past few years and their integration into the global economy and international financial markets has strengthened. In 2005, net inflows of foreign private capital to EMEs reached a record level of USD 400 billion. Outstandings of government securities issued by EMEs on international markets increased six-fold between 1994 and 2005, rising from less than USD 50 billion to over USD 300 billion. Over the same period, their bank loan outstandings were more than halved, falling from USD 250 billion to USD 100 billion.

This considerable surge in market financing has been underpinned by substantial efforts to modernise the financial sector, which has enabled EMEs to offer investors an increasingly wide and sophisticated range of financial instruments and thus to attract new types of investors. Overall, EMEs are tending to put in place financial structures similar to those in advanced countries (1).

At the same time, several recent indices suggest that investors no longer necessarily regard emerging assets as a homogenous bloc in their portfolio choices. Their wariness vis-à-vis these markets and their attendant risks appears to be shifting towards greater discrimination between EMEs on the basis of their specific characteristics, or the type of financial instrument offered (2).

Nevertheless, these trends do not prevent emerging markets from being subject to occasional disruptions, especially if the economic and financial environment were to become less favourable. The narrowness of these markets, the dependence on the decisions of non-resident investors, and the low level of risk premia maintain uncertainty as to their reaction in the event of large-scale unforeseen shocks (3).

Against this backdrop, market participants are justified in basing their investment and financing decisions on a range of criteria assessed over the whole economic cycle.

1 | AT COUNTRY LEVEL

CONVERGENCE AND FINANCIAL MARKET DEVELOPMENT

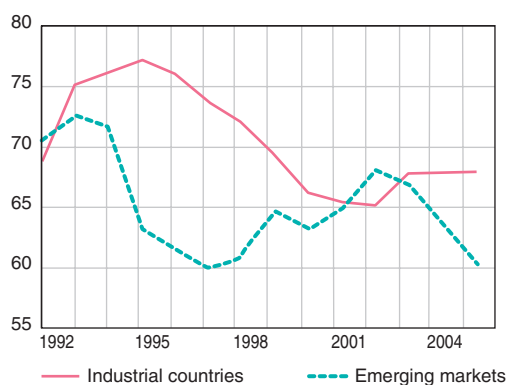
Over the past few years, the macroeconomic performance of most EMEs has improved significantly. The room for manoeuvre thus created has been used to undertake major efforts to modernise the financial sector, which have tended to bring the financial structures of EMEs more in line with those of advanced countries in various respects: composition of public debt; range of financial markets; types of investors.

1|1 Improvement in the structure of public debt

Public debt-to-GDP ratios have tended to fall over the past 15 years, notably as a result of more restrictive fiscal policies, at least during a number of years, under pressure from the International Monetary Fund (IMF) or other multilateral institutions. In some cases, revenues from privatisations or exports of commodities have been used to repay public debt.

Chart 1
Public debt

(simple average of a representative sample of countries, as a % of GDP)



Source: IMF (Global Financial Stability Review).

At the same time, since the mid-1990s, the financing of emerging sovereigns has increasingly taken the form of securities issuance and less and less that of syndicated loans extended by banks.

In the long run, the aim of these countries would be to comply with OECD best practices, which recommend financing in the form of fixed rate, long-term local currency denominated debt underpinned by a broad base of domestic investors. Accordingly, the share of long-term issues has increased, the government securities market now comprises a wider range of maturities, and the average maturity of debt may be lengthened still further.

Over the recent period, a trend towards the issuance of inflation-indexed bonds has been observed, which often allows countries that have experienced episodes of high inflation to issue longer-term debt. In addition, this debt is increasingly fixed rate, even if variable rate public debt remains predominant in some cases.

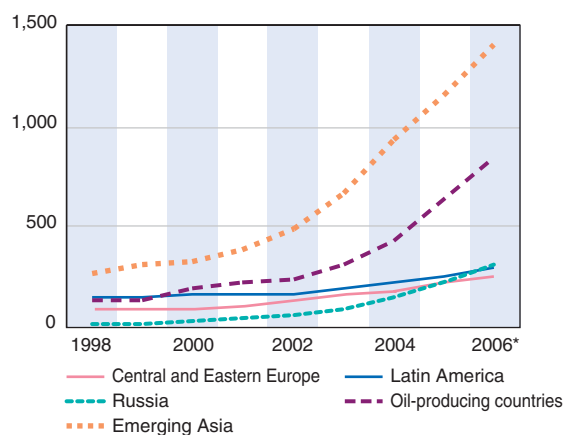
Lastly, public debt is more often issued in domestic currency, which reduces currency mismatches and makes sovereign solvency less dependent on exchange rate fluctuations.

Overall, according to an IMF estimate at the end of 2004,¹ foreign currency denominated debt now only accounts for an average 16% of EMEs' negotiable public debt (compared with 6% in OECD countries) and short-term debt for 11% (compared with 16% in the OECD).

A number of countries are particularly illustrative with respect to these developments. In Mexico, since the crisis in 1994, the share of long-term public debt has grown (from 62% of total public debt in 1996 to 77% in 2005) as has that of fixed rate public debt (from 5% in 2000 to 40% in 2005). In addition, the share of foreign currency denominated debt has fallen significantly (from 73% in 1996 to 32% in 2005), thanks to the use of innovative asset and liability management techniques such as the warrants issued in November 2005, which enabled dollar-denominated debt to be converted into pesos.

¹ On a sample of 18 EMEs representing 90% of the capitalisation of the EMBIG bond index.

Chart 2
Foreign currency reserves
(USD billions)



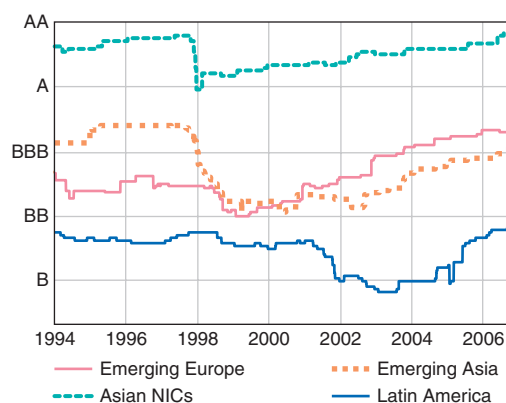
* Forecasts.

Source: IMF (World Economic Outlook).

Other countries such as Brazil, Colombia, Venezuela, Turkey and Panama have decided to repay all or part of their external foreign currency denominated debt in the form of Brady bonds or more generally debts to the Paris Club, thereby reducing their debt-servicing by a corresponding amount.

Combined with the often very large-scale accumulation of foreign currency reserves, efforts to consolidate public finances have resulted in an improvement in the ratings of sovereign bonds, enabling a return to levels seen before the Asian crisis in 1997. This trend has continued more recently. It undoubtedly reflects an improvement in the quality of EME public debt.

Chart 3
Rating of foreign currency denominated sovereign debt



Source: Simple average of S&P and Moody's ratings.

The risk premia on emerging bonds thus fell up to early 2006 to reach historical lows.

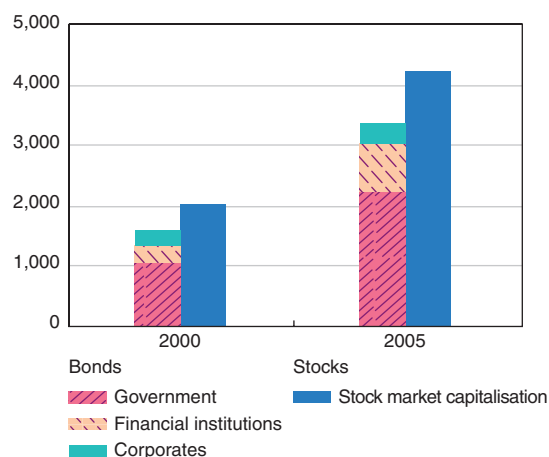
1|2 Broadening of the range of financial markets

The types of public and private financing in EMEs have also increased, with a broadening of the range of financial markets, alongside growth in financing raised on markets, notably in local currency.

In response to the banking crises during the 1997-2001 period, the structural reforms implemented have allowed banking sectors to be restructured and consolidated, financial systems to be opened up to foreign investors and supervision to be reinforced.

In parallel, the share of market finance has increased *via* the emergence of new financial instruments. Not only has there been growth in local currency denominated sovereign bond issuance (see above), but also, to a lesser extent, in private sector bond issuance, notably by financial institutions. Moreover, domestic stock exchanges have played an increasingly important role in the financing of resident companies.

Chart 4
Local currency denominated bond and stock market capitalisation of the major EMEs
(sum of a sample of 12 emerging market countries from Asia, Latin America and Central and Eastern Europe, USD billions)



Sources: BIS and World Federation of Stock Exchanges.

1|3 Diversification of investors

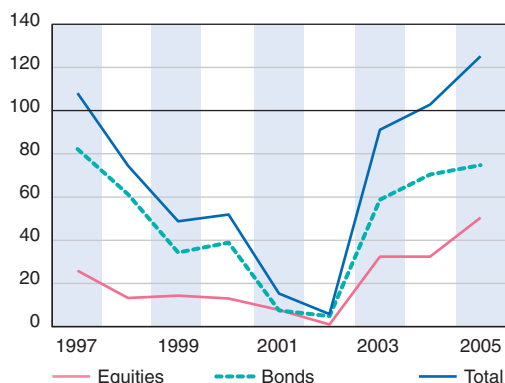
In this favourable climate, since 2002, international investors have turned back to emerging assets, having tended to shun them after the financial crises of the 1990s. Portfolio investment flows by non-residents into EMEs now exceed the amounts reached before the Asian financial crisis in 1997. The globalisation of financial markets and investment strategies together with the concern to diversify portfolios have also contributed to this trend.

The low level of interest rates over the past four years has also encouraged institutional investors in developed economies (insurance companies, pension funds, mutual funds, etc.) to position themselves on emerging markets with a view to garnering additional yield enabling them to meet their commitments.

While it is not possible to measure their precise impact,² all of these factors have probably encouraged the arrival on financial markets of players whose behaviour is more stable and who are likely to hold securities for longer periods. For example, the largest US public pension fund, Calpers, has increased its share of emerging assets in the funds under its management from 0.6% to 2.3% between 2002 and end-2005. The proportion of EME equities in the portfolio of the Swedish public pension fund AP2 rose from 3% to 5% in early 2006.

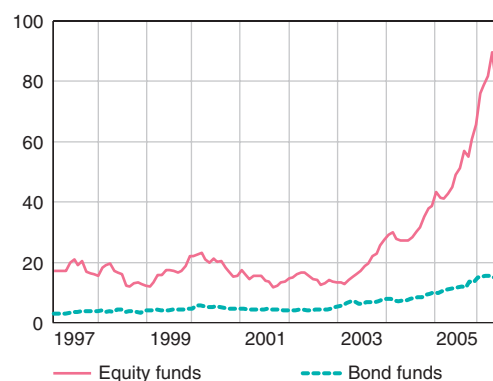
Chart 5
Portfolio investment flows to EMEs

(constant USD billions, 1997 = 100)



Source: Institute for International Finance (IIF); Banque de France calculations.

Chart 6
Net assets of US mutual funds specialising in EMEs
(USD billions)



Note: Developments incorporate a price effect linked to the strong rise in emerging stock markets between 2003 and 2006.

Source: Investment Company Institute.

Regarded as more volatile, the investment flows of mutual funds specialising in EMEs also recorded very strong growth between 2002 and 2006, even if they only account for 1.5% of funds under management in the United States.

Lastly, the participation of hedge funds specialising in emerging markets has increased both in terms of their number and the amounts invested. According to The Barclays Group, quoted by IXIS (2006), outstandings managed by hedge funds specialising in emerging markets have grown twice as fast as total hedge fund outstandings, rising from 6% of the total in 2002 to over 12% in the first quarter of 2006.

The geographical origin of investors participating in EMEs has also diversified. According to the IMF (2006), investors from Asia and the Middle East have begun to allocate part of their portfolios to assets from other EMEs, which appears to be a new phenomenon. In particular, central banks are, in a limited manner, taking part in this movement, thus seeking to diversify their reserves and to increase their returns. Regional initiatives, such as the Asian Bond Fund, are likely to contribute to this. Financed by the foreign currency reserves of the Asia-Pacific central banks, the Asian Bond Funds 1 and 2 (ABF1 and ABF2) were set up in 2003 and 2004. These funds are designed to invest in sovereign and quasi-sovereign bonds issued by eight members of the Executives' Meeting of East Asia Pacific Central

² In the absence of comprehensive detailed data on holdings of EME bonds.

Banks (EMEAP) denominated in US dollars in the case of the ABF1 and in local currencies for the ABF2.³

This development was made possible by the partial lifting of barriers to investment by non-residents, in particular fiscal ones, an easing of regulations and the beginnings of an improvement in transparency, which in some countries (such as Brazil) appears to have triggered a virtuous spiral between increasing investment from non-residents and the acceleration of domestic reforms.⁴

However, in order to meet their financing requirements, EMEs still need to develop a base of domestic institutional investors, such as mutual funds, insurance companies and pension funds that is sufficiently broad to significantly and durably reduce their external vulnerability. In some countries, this development is already under way, in part due to the introduction of pension systems based on capitalisation, such as in Chile, where pension fund assets represent 56% of GDP, or Mexico, where private pension funds, which were introduced in 1997, hold USD 50 billion worth of peso-denominated government bonds.

2| AT INVESTOR LEVEL: GREATER DISCRIMINATION BETWEEN COUNTRIES

The overall improvement in the fundamentals of EMEs masks a great dispersion regarding most of the benchmark indicators (notably GDP growth, inflation, balance of payments, foreign currency reserves and public finances). Thus, assessing emerging risk entails taking account of the specific situation in each emerging region, or even each country.

2|1 A diversity of situations...

The trend towards the consolidation of public finances and the improvement of the macroeconomic environment in EMEs should not lead to a hasty

assessment of the resilience of their financial systems. In reality, financial stability should be gauged against a set of variables that require constant monitoring on the part of the competent authorities and that vary depending on the country or geographical region in question. A non-exhaustive list of these would be:

- non-performing loans;
- GDP growth;
- the current account balance;
- the level of foreign currency reserves.

Qualitative aspects should not be overlooked either, notably the quality of governance and banking supervision and the effectiveness of risk assessment systems put in place by financial institutions.

This multicriteria approach is all the more necessary given that EMEs exhibit very diverse characteristics to investors, whether in terms of country size, the size of bond markets, energy dependence, the level of foreign currency reserves, sovereign debt ratings or, more generally, macroeconomic performances. Thus, not all EMEs display the same degree of exposure to hazards likely to affect the development of the global economy. For example, further interest rate rises could bring about a widening of emerging spreads along with a decline in foreign private capital inflows and would particularly affect the most-indebted countries. If energy prices continue to rise, this would have a greater impact on the domestic demand of economies that have an energy deficit. A slowdown in the US economy would particularly undermine those EMEs whose growth is strongly dependent on exports to the United States while their domestic demand is weak. The persistence of large fiscal imbalances in some EMEs is also a specific source of vulnerability for those countries.

2|2 ...increasingly reflected in valuations

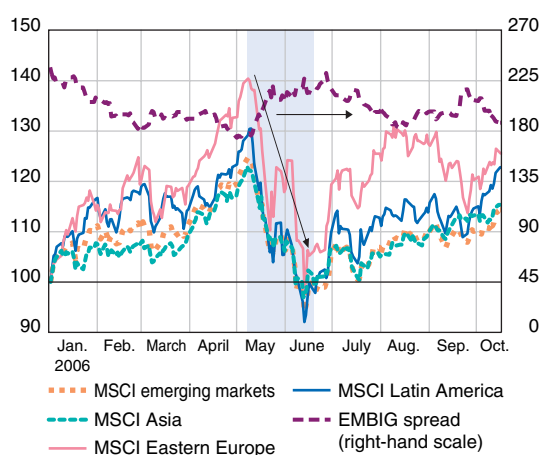
As the share of EME assets in their portfolios increases, investors are encouraged to develop and refine their analysis of idiosyncratic valuation factors specific to each market and country. In this respect, the correction that occurred on financial markets

³ See Guérin and Sa (2006).

⁴ See Banque de France (2006), "Proactive debt management in emerging countries: the case of Brazil", Financial Stability Review, No. 8, May, Box 3, p. 25.

Chart 7
Change in EMBIG sovereign spreads
and MSCI emerging stock market indices

(USD equivalent; 1st January 2006 = 100 for stock market indices; basis points for EMBIG spreads)



Sources: JP Morgan, Morgan Stanley, Bloomberg.

in May 2006, including on emerging markets, might be a sign that investors have stopped assessing emerging risk in a uniform fashion irrespective of the region concerned, unlike the trend witnessed in the 1990s.

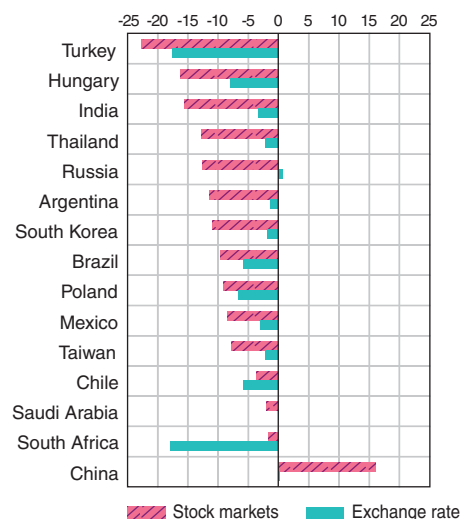
First, the relative stability displayed by EME credit risk premia while stock prices were falling sharply and their volatility was increasing showed bond markets' autonomy *vis-à-vis* stock markets.

Second, the correction affected most EME stock markets negatively, but to varying degrees depending on their fundamentals. Indeed, the correction affected countries that are most fragile in macroeconomic terms more markedly, which seems to confirm the start of a more refined and discriminating analysis of markets by investors. In the European zone, the impact was felt above all on the Turkish and Hungarian markets and there was no regional contagion, for example to other emerging European countries.

Lastly, investors appear to have taken particular account of the determinants that specifically underlie the valuation of local equity markets. Thus, the emerging stock markets that had risen most during the previous year but where valuations appeared the most uncertain recorded the largest falls

Chart 8
Variation in EME stock markets and exchange rates
between 1 May and 30 June 2006

(as a %)



Source: Bloomberg.

(e.g. the Middle East). Meanwhile, other stock markets such as China's continued to grow.

All in all, by enabling investors to better manage their risks, enhanced market transparency probably fostered this differentiated reaction.

3| FACTORS OF VULNERABILITY IN THE EVENT OF SHOCKS

3|1 Narrow financial markets

In spite of the progress made over the past few years, financial markets in EMEs still display some shortcomings linked to different kinds of factors: lack of domestic institutional investors; difficulty in channelling household savings in economies where the banking sector is often very underdeveloped; regulatory constraints; continuing limited transparency; governance mechanisms that provide little protection.

In particular, corporate bond markets in these countries remain small as a percentage of national income, but also in comparison to stock markets.

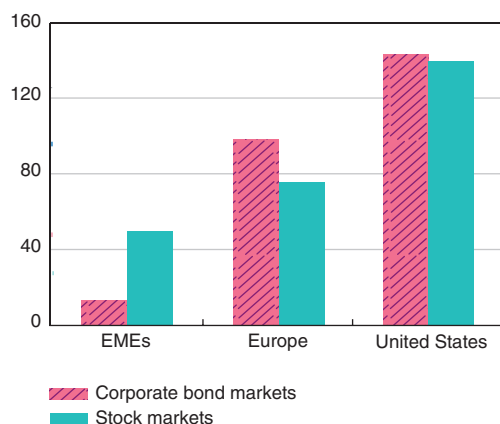
They are based on young structures, which do not yet satisfy all of the requirements already in place in advanced economies, in particular:

- the creation of a benchmark liquid bond yield curve, notably by establishing the role of market maker;
- smoothly functioning market infrastructures;
- the presence of a sufficiently broad base of domestic institutional investors;
- genuine opening up to non-resident investors.

This explains the low liquidity of many emerging markets (measured by the relation between transaction flows and outstandings held), which can lead to sharp fluctuations in the volatility of EME asset prices in the event of even slight portfolio reallocations by international investors.

Moreover, access to local currency denominated assets exposes foreign institutional investors not only to interest rate and credit risk, but also exchange rate risk. Their losses could therefore multiply when episodes of tension lead them to simultaneously revise their positions on all asset classes in one country or region, as was the case on Turkish markets in May 2006.

Chart 9
Size of financial markets
(as a % of GDP)



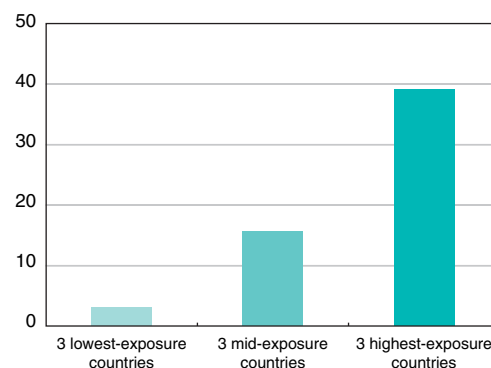
Source: IMF (Global Financial Stability Review).

3|2 Growth in foreign currency denominated private debt

Emerging sovereigns' currency mismatches have tended to diminish (see 1|1 above). However, those pertaining to the private sector (companies, households) have grown in some countries, reflecting the financial deepening of the economy. This may raise questions about the effects of the "euroisation" of household credit in new European Union Member States. In Poland, for example, the share of loans denominated in foreign currencies (euro, Swiss franc) in total housing loans stood at 75% in March 2006, of which a large proportion were variable rate loans.

The borrowing households in question may consider that, in the future they will have natural protection from exchange rate risk given that they are borrowing at a much longer time horizon than the date by which they expect their country to join the euro area. However, pending this hypothetical entry into the euro area, they remain highly exposed to exchange rate risk, with their foreign currency denominated assets (net of their liabilities) having been strongly negative since end-2004. This development could lead to financial difficulties given that it is likely to increase borrowers' probability of default.

Chart 10
Foreign currency denominated household credit in emerging Europe in 2005
(as a % of total household credit)



National sources.

A detailed analysis covering several Central and Eastern European countries would probably be necessary to assess the overall magnitude of the risks linked to foreign currency denominated household debt.

3|3 More complex distribution of risk

The development of credit risk transfer mechanisms facilitates the holding of EME assets. However, these mechanisms increase uncertainty regarding the actual risk holders and developments on emerging markets during periods of stress. They might also complicate further processes for restructuring sovereign debt.⁵ Thus, if certain emerging sovereigns defaulted in the current environment, their creditors would not necessarily bear the credit risk on account of the use of derivatives and might therefore have less incentive to reach an agreement rapidly.

Moreover, while the growing participation of hedge funds on emerging markets appears to have increased their liquidity, it could also complicate the assessment of risk. Indeed, these funds, some of which employ leverage (between 20% and 50% of hedge funds specialising in emerging markets, according to Tremont Capital Management), may be obliged to rapidly unwind their positions in the event of difficulty in satisfying margin calls or other financial obligations.⁶ Certain factors may also lead them to underestimate market risk: insufficient country diversification, misjudgement as to their ability to unwind their positions at reasonable prices, especially since several hedge funds may have the same positions (crowded trades).

3|4 A potential upside pressure on risk premia

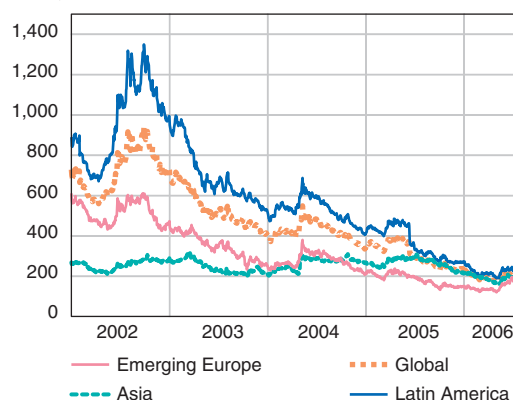
Risk premia on emerging bond markets have fallen significantly over the past three years, with

JP Morgan's benchmark EMBIG index dropping from over 1200 basis points in November 2001 to around 200 basis points in autumn 2006. How should this narrowing of risk premia be interpreted?⁷ Is it linked to the improvement in the economic fundamentals ("pull factors") or to external factors such as the abundance of liquidity at a global level and a decline in international investors' risk aversion⁸ ("push factors")? If the fall in risk premia were not caused by sound fundamentals but rather were explained by exogenous factors linked to international financial conditions, the future of cheap capital flows would not be guaranteed. In this regard, recent empirical studies carried out by the Bank of England (2005) and Goldman Sachs (2005) encourage caution as they show that "push" factors appear to have played a significant role in the narrowing of risk premia. The Bank of England indicates that economic fundamentals explain less than 20% of the fall between January 2001 and end-2005 while Goldman Sachs attributes 45% of the narrowing of spreads to risk aversion.

As a result, we may assume that a tightening of monetary policies would probably be accompanied by greater investor risk aversion and contribute to increasing risk premia.

Chart 11
EMBI* sovereign credit spreads

(basis points)



* EMBI: emerging market bond index.

Source: JP Morgan.

⁵ Bearing in mind that these have already had to take account of the increasing disintermediation of financing, with, notably, the introduction of collective action clauses (CAC), see Weber (2005).

⁶ See ECB (2006).

⁷ We may also question the relevance of conventional measures of these premia, such as yield spreads between issuers, given that benchmark issuers (United States, Germany) have appeared less than virtuous over the past few years. Other indicators such as swap spreads or CDS premia are already used by market participants.

⁸ See Coudert and Gex (2006).

In EMEs, the 1990s were characterised by the proliferation of crises of investor confidence, their rapid spread between economic sectors and countries and, as a consequence, erratic capital movements and exchange rate fluctuations.

By contrast, over the more recent period, the spillover of economic and financial shocks has been limited, as in the case of Argentina's default in 2001, even though the trade and financial integration of EMEs into the global economy has increased significantly.

Indeed, EMEs have undertaken substantial efforts to consolidate and modernise their financial sectors, which in part explains their strong economic growth and the fall in their financing costs. Their financial systems have also moved more in line with those in advanced economies. In addition, market participants appear to be seeking to better discriminate between EMEs on the basis on their specific situations. Lastly, it is possible that these countries have improved their capacity to prevent crises. Nonetheless, it is probable that this nascent immunity to shocks has been fostered by an extremely favourable economic and financial environment.

The recent nature of these developments should therefore caution us against concluding that contagion mechanisms have disappeared and encourage us to remain prudent in the presence of several factors of vulnerability: insufficient size and liquidity of markets, a still narrow domestic investor base, strong dependence on decisions of international investors, and a large exposure to exchange rate and credit risk. Thus, periods of sudden fluctuations in the price volatility of EME assets cannot be excluded, particularly in the event of an unforeseen large-scale shock. The current low level of risk premia reduces the protection afforded to investors, whereas the presence of global operators that are creditors vis-à-vis several EMEs simultaneously may constitute an additional factor in the propagation of shocks.

Against this backdrop, it is legitimate that investors and creditors pay greater attention over the medium term not only to the fundamental macroeconomic variables but also to the quality of financial structures, in order to base their investment and financing decisions on a multicriteria approach (supervision, regulation, transparency and infrastructure).

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Capital flows and credit booms in emerging market economies

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Private capital began flowing back to emerging market economies (EMEs) in 2002 and continued to mid-2006. In parallel, most of these countries also witnessed rapid growth in bank credit to the private sector (BCPS).

This paper seeks to determine whether this strong credit expansion reflects financial deepening or excess liquidity. In the first case, this phenomenon forms part of an economic catch-up process. In the second, the main emphasis is on the potential weakness of domestic banking systems and increased macroeconomic vulnerabilities of the concerned countries.

Capital inflows tend to exacerbate these risks, such that they often coincide with credit booms. Depending on the observation period and the sample of emerging countries, between 40% and 60% of credit booms took place at a time when capital inflows were high. However, the linkage between credit booms and banking and financial crises is weaker, insofar as only 6%-20% of credit booms lead to a crisis.

To explore the role of capital inflows in the observed credit expansion in EMEs, this article presents an econometric analysis of a 27-country sample over the last four years. A two-stage approach is taken: first, countries that have experienced excessive growth in bank credit to the private sector are identified; second, the causality relationship between capital inflows and bank credit in these countries is examined.

The main findings suggest that of the 27 EMEs, which on the whole recorded strong capital inflows over the last four years, just nine experienced a credit boom. Moreover, there does not appear to be a clear-cut causality relationship between capital inflows and BCPS. It is therefore difficult to draw general conclusions as regards financial stability. In some countries, a combination of substantial capital inflows and credit booms may generate risks of instability if the external financing causes profound macroeconomic and financial imbalances. In other countries, massive capital inflows and rapid credit growth may be linked to a healthier process of financial deepening.

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In 2005, net private capital flows to EMEs reached their highest level since the Asian crisis of 1997-1998. At the same time, a number of countries recorded sharp growth in bank credit to the private sector (BCPS).

This paper studies the relationship between capital flows and rapid credit growth in EMEs since 2002. It seeks to discern whether the recent strong credit expansion is keeping step with economic growth, or, conversely, whether it is being fuelled by private capital inflows, at the risk of creating speculative bubbles and/or disrupting the internal and external balances.

After reviewing the literature on credit booms, the paper presents stylised facts concerning the resumption of capital flows to EMEs and the rapid credit growth in these countries in the last four years. This is followed by an empirical analysis that seeks to identify countries that experienced excessive credit growth over the period and to determine whether capital inflows played a part in the rapid credit expansion.

1| REVIEW OF THE LITERATURE ON CREDIT BOOMS

Sharp growth in BCPS often reflects an improvement in economic conditions as part of a financial deepening process. However, it has also heralded banking and financial crises in a number of EMEs in the last decade. In the first case, credit growth corresponds to a deepening of the economy's financial system – a process that is likely to spur economic growth. In the second, it may reflect a credit bubble that could cause a sharp downturn in economic activity when it bursts. After reviewing the methods used to identify excessive expansions (*i.e.* credit booms or bubbles) during phases of marked credit growth (1|1), we examine the potential micro- and macroeconomic implications of credit bubbles (1|2).

1|1 Rapid credit growth : a sign of financial deepening or of a financial bubble?

THE FINANCIAL DEEPENING PROCESS

Traditionally, rapid credit growth is linked to an expansion and increased sophistication in the services that financial institutions offer to support economic activity. Financial intermediaries play a key role in different stages of economic development by mobilizing national savings; by improving the allocation of capital by gathering information and identifying the most profitable investment projects; by managing means of payment and by providing liquidity to facilitate the exchange of goods and services; and by making it easier to diversify risk. By reducing the financial constraints on economic agents, *i.e.* firms and households, they promote increased investment and consumption, and, ultimately, a higher economic growth rate.

The theoretical (Fischer, 1930; Gerschenkron, 1962) and empirical literature on developing countries emphasises the linkage between financial liberalisation and economic growth. The financial development model proposed by Shaw (1973) and Mc Kinnon (1973) shows that the development of the financial system makes it possible to optimise the portfolios of agents with surplus financial resources (households) and deficit financial funds (firms). This enables the economy to get away from self-financing prompted by the build-up of savings by agents with surplus financial resources. Resources can thus be used more efficiently, triggering a virtuous circle known as financial deepening, *i.e.* the strengthening of the underdeveloped and fragmented financial system.

Econometric research (King and Levine, 1993; Beck, Levine and Loayza, 2000; Benhabib and Spiegel, 2000; Demirgüç-Kunt and Levine, 2001) has largely validated the robustness of the relationship between financial development and economic growth. The level of monetisation, measured by the

broad money (M2)/GDP ratio, and the level of bank intermediation, captured by the BCPS/GDP ratio, are generally used as indicators of the financial deepening.

THE FINANCIAL ACCELERATOR MECHANISM

The financial accelerator models were notably developed by Bernanke and Gertler (1989, 1995). Empirically validated by Bernanke, Gertler, and Gilchrist (1996), these models indicate that conditions on the credit market tend to propagate and amplify the initial effects of monetary or real shocks through the economy. The underlying assumption of these models is that the external financing premium (the difference between the cost of external financing through the issuance of securities and the cost of self-financing) declines with the net wealth of the borrower, the value of its equity capital, and the price of assets used as collateral (Clerc, 2001).

When the economic picture is bright, an overly optimistic view on future earnings pushes up asset valuations, *i.e.* stock and real estate prices, increasing the net worth of the firms that hold these assets, reducing the external financing premium and so enhancing firms' ability to borrow and spend. However, this process is not sustainable forever. When it becomes clear that performance will fall short of expectations, earning forecasts are revised downwards, pulling down asset prices and putting the financial accelerator into reverse. Borrowers then have to contend with a decline in their net wealth and an increase in the external financing premium, even as their ability to service debt and access new loans is restricted. Firms will therefore tend to curb capital spending and trim output, amplifying the initial shock. Thus, the financial accelerator mechanism plays a key role in the severity and duration of economic recessions.

The financial accelerator mechanism provides two main channels through which credit cycles affect the business cycle: balance sheet and bank credit. Through the balance sheet channel, higher financial asset prices and improved corporate earnings during periods of economic expansion increase firms' ability to borrow. Banks, meanwhile, become more likely to grant loans to enable firms to grow their business. The bank credit channel assumes that there is no perfect substitute for bank loans,

such that only a sharp increase in bank credit to firms and households will enable them to finance their investment and consumption spending and so contribute to economic growth. In emerging and developing countries, financial accelerator effects tend to be amplified by the shallowness or even the non-existence of financial markets.

CREDIT BOOMS

Much empirical research on credit booms has sought to establish quantitative techniques to distinguish credit booms from episodes of rapid credit growth. A credit boom is defined as an exceptionally sharp increase in credit that collapses because it becomes unsustainable in the short and medium term. Rapid credit growth is linked to financial deepening in developing and emerging countries and may therefore stimulate economic growth in the long-run (IMF, 2004).

Deviation from a long-term value

Gourinchas, Valdés and Landerretche (2001) base their approach on deviations in the level of the BCPS/GDP ratio from a long-term trend determined using a Hodrick-Prescott filter. They identify credit booms when the BCPS/GDP ratio is "sufficiently above" trend (*i.e.* it exceeds a critical value). The authors consider absolute and relative deviations. The absolute deviation is defined as the difference between the actual BCPS/GDP ratio and the level predicted by the long-term trend (4.8% of GDP). The relative deviation, which is expressed as a percentage, is obtained from the absolute deviation divided by the actual BCPS/GDP ratio (threshold of 24.9%). The more that the absolute and relative deviations exceed the threshold values, the more the affected countries are likely to be experiencing a credit boom. The method identified credit booms in 91 countries (including 19 in Latin America) over the 1960-1996 period. These credit booms displayed the following characteristics: they were often accompanied by strong growth in investment and, to a lesser extent, in consumption; a slowdown in potential output; a surge in domestic real interest rates; a significant deterioration in the current account financed by large capital inflows; real exchange rate appreciation; a deterioration in the fiscal position; a decline in foreign reserves and a reduction in the maturity of external debt.

Many empirical papers have since used this methodology. Tornell and Westermann (2002), for example, show that rapid growth in real domestic credit is positively correlated with real exchange rate appreciation, a rise in the ratio of output of non-tradable goods to output of tradable goods, and an increase in investment. More recently, Cottarelli, Dell'Ariccia, and Vladkova-Hollar (2005) attempted to identify credit booms in Central and Eastern Europe and in the Balkans in 2002 based on absolute and relative deviations in the bank credit to households/GDP ratio. They found that Hungary experienced a credit boom in 2002.

Taking inspiration from Gourinchas, Valdés and Landerretche (2001), the IMF (2004) proposes identifying credit booms as deviations from the growth rate of bank credit, rather than from the BCPS/GDP ratio. The IMF paper therefore concentrates more on the growth, rather than on the level, of credit. A credit expansion in a given country is identified as a boom if it exceeds the standard deviation of that country's credit fluctuations around its long-term trend by a factor of 1.75. Episodes of rapid credit growth, meanwhile, are defined as periods where average real credit growth over three consecutive years exceeds 17%. The paper asserts that credit booms in emerging countries display the following four key characteristics: they are far less common than episodes of rapid credit growth; they are often associated with banking crises; they coincide equally frequently with either a consumption or an investment boom, and less often with an output boom; they are synchronised, to the extent that they occur simultaneously in several countries.

Deviation from an equilibrium value

Boissay, Calvo-Gonzalez and Koźluk (forthcoming) model BCPS growth as a function of its main macroeconomic fundamentals, namely GDP growth and the interest rate, plus the gap between the actual BCPS/GDP ratio and its equilibrium level, and a dummy variable. A credit boom occurs when bank credit in the country in question grows over the observation period at a higher rate than that defined by its three determinants (GDP growth, interest rate and the gap between the observed BCPS/GDP ratio and its equilibrium level). The equilibrium BCPS/GDP ratio is itself defined as a function of real GDP, the real interest rate and a trend. The study looks at eight Central and Eastern European

countries over the 1996-2004 period. The findings show that Bulgaria and Latvia have experienced excessive credit growth since 2001, as have Lithuania, Estonia, Hungary and Croatia though to a lesser extent. Conversely, rapid credit growth in Slovenia and Romania looks more sustainable because it is mainly attributable to financial deepening in these economies.

1|2 Implications of credit booms

CREDIT BOOMS AND CAPITAL FLOWS

Capital inflows and financial liberalisation play a major role in credit booms. Kaminsky and Reinhart (1997) find that domestic and external financial liberalisation policies stimulate foreign capital inflows. This results in excess liquidity, potentially leading to an increase in bank credit and in the money supply. When these massive capital inflows to the economy are intermediated by an under-capitalised and under-regulated banking system, they cause an increase in consumption, and hence in imports, while investment remains weak. The economy then becomes more exposed to exogenous shocks. The crises that swept Asia in the 1990s and Latin America in the 1970s and 1980s demonstrated that what mattered was not so much the size of the loans but the quality of the investment projects financed by these external funds (Hernandez and Landerretche, 2002).

Goldfajn and Valdés (1997) show that banks, in their capacity as financial intermediaries, amplify the effects of capital inflows in host economies. Hernandez and Landerretche (2002) analyse credit booms and capital flows for a sample of 60 countries (including 35 emerging and developing countries) over the 1970-1995 period. They conclude that the probability that a surge in capital inflows will lead to a credit boom is greater in developing countries (40%) than in industrialised countries (10%). They also observe that, in developing countries, the probability that capital inflows will lead to a credit boom is always higher than the probability that capital inflows will not lead to a credit boom. More recently, an IMF study (2004) of 28 emerging countries over the 1970-2002 period found that two-thirds of credit booms took place during a surge in capital inflows. However, only one-third of the episodes of rapid and

sustainable credit growth coincided with large-scale capital inflows.

RISKS ASSOCIATED WITH CREDIT BOOMS

Property and equity bubbles

Credit booms are sometimes associated with a rapid run-up in asset prices, particularly on real estate and stockmarkets. This may lead to the formation of speculative bubbles that could cause activity to collapse when they burst. The experience of Asian countries in the 1990s is a good illustration of the implications of high investment levels and soaring property prices. Thailand and Malaysia appeared to experience the largest swings in property prices, while South Korea was less affected. Collyns and Senhadji (2002) emphasise the crucial role that strong banking regulation plays in reducing the risks of bubbles and in limiting the destabilising effects produced when bubbles burst.

Current account deterioration

The external imbalances caused by credit booms are related to a deterioration in the current account resulting from an increase in imports of goods and services, where a consumption boom rather than an investment boom is being financed. Few concerns are raised if the expansion of bank credit finances capital goods imports that are then used to boost productivity and so improve the country's export capacity. Conversely, if the expansion mainly finances imports of consumer goods or capital goods for the non-tradable sector, it may fuel inflation and threaten the sustainability of the current account. The deterioration in the external accounts will cause an increase in external debt and/or a decline in international reserves, making the economy more vulnerable to exogenous shocks.

Vulnerability of banking systems

The strong credit expansion that accompanies economic growth creates more risk-taking opportunities for banks. Inadequate diversification of these risks may lead to bank failures. If strong credit growth leads to a deterioration in the quality of bank assets and a capital deficiency, it may compromise bank solvency. A bank may also be encouraged to engage in excessive risk-taking if the government is one of its shareholders, with the associated

implicit or explicit guarantees creating moral hazard (Hilbers *et al.*, 2005).

The vulnerability of banking systems is sometimes compounded by weak banking supervision and underdeveloped financial markets. Hernandez and Landerretche (2002) demonstrate, however, that the rapid credit expansion in Chile and Colombia in the 1990s did not lead to greater macro-financial vulnerability because both countries had strong financial systems. The authors found that in a 60-country sample, the economies with the shallowest financial markets were most likely to experience a credit boom.

Banking and financial crises

When the abovementioned circumstances materialise, they reinforce one other, unleashing far-reaching banking and financial crises. Demirgüç-Kunt and Detragiache (1997) say a banking crisis occurs when one of the following conditions holds: the ratio of non-performing loans to total assets exceeds 10%; the cost of rescuing the banking system is greater than at least 2% of GDP; banking system problems lead to large-scale nationalisation of banks; bank runs take place and the authorities enact emergency measures, such as introducing deposit guarantees, to cope with the crisis. Many empirical studies have highlighted the role of phases of credit expansion in banking and financial crises. This research emphasises the relevance of the BCPS/GDP ratio and the (lagged) growth rate of real BCPS as indicators of banking crisis (Sachs, Tornell and Velasco, 1996; Kaminsky and Reinhart, 1996; Kaminsky, Lizondo and Reinhart, 1997; Demirgüç-Kunt and Detragiache, 1997; Ottens, Lambregts and Poelhekke, 2005).

Recently, Cottarelli, Dell'Ariccia, and Vladkova-Hollar (2005) showed that, for a sample comprising Chile, Mexico, Finland, Sweden, South Korea, Thailand and Indonesia, the BCPS/GDP ratio rose by between 5 and 10 percentage points of GDP annually in the years leading up to banking crises. In their study of financial and banking crises in the last decade, which included Finland and Sweden (early 1990s), Mexico (1994), and Indonesia, Malaysia, Thailand, the Philippines and South Korea (1997), Duenwald, Gueorguiev and Schaechter (2005) found that the BCPS/GDP ratio increased on an annual average by 5 percentage points of GDP in the five years leading up to the crisis.

However, empirical research stresses that credit booms and banking and financial crises are not unequivocally linked. Based on the sample and methodology used, empirical work has shown that the likelihood of a banking crisis occurring after a rapid credit expansion varies between 6% (Tornell and Westermann, 2002) and 20% (Gourinchas, Valdés and Landerretche, 2001). These papers emphasise that while most banking crises are preceded by a credit boom, not all episodes of rapid credit growth will necessarily translate into a banking crisis. More recently, Hilbers *et al.* (2005) looked at the 1990-2004 period, separating credit booms that did not lead to a banking and financial crisis (those in industrialised countries like Australia, Iceland, New Zealand and in emerging countries like Egypt, Lebanon and Indonesia) from ones that did (Latin American countries and Turkey in the 1990s, and the Philippines).

2| STYLISTED FACTS: STRONG CREDIT GROWTH AND CAPITAL FLOWS TO EMERGING MARKET ECONOMIES

The review of the above-mentioned literature showed that strong credit growth may be attributable to an economic catch-up process. It

also indicated that private capital inflows tend to exacerbate the risks of credit booms. Since 2002, the rapid credit expansion in EMEs (2|1) appears to have coincided with a resumption of capital flows to those countries (2|2).

2|1 Rapid credit growth in emerging countries

BCPS has expanded sharply in a number of EMEs since 2000, reflecting both the rehabilitation of bank balance sheets after the financial crises of the previous decade as well as part of the financial deepening process. An analysis of the speed (measured by the growth rate) and level (measured by the ratio to GDP) of bank credit reveals several broad regional trends (see Chart 1).

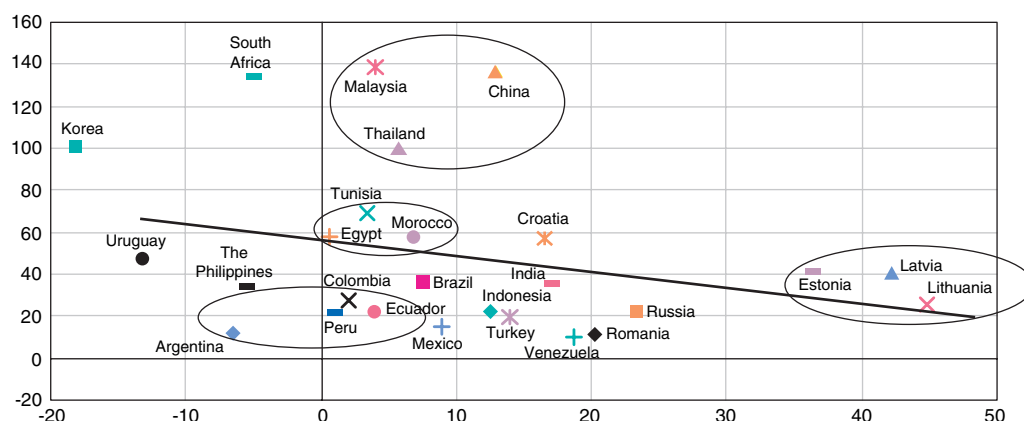
STRONG CREDIT EXPANSION

On average, emerging Europe has experienced rapid growth in BCPS over the last four years. Growth rates in 2005 exceeded 50% in Latvia, Lithuania and Estonia.

In Latin America, BCPS grew especially rapidly in Venezuela (around 50% in 2005 and 60% in 2004) and Ecuador. It expanded at a slightly cooler pace in Argentina and Uruguay owing to the 2001-2002 crises.

Chart 1
Growth rate of real bank credit to the private sector and the BCPS/GDP ratio
2002-2005 average

(as a %, X-axis: growth rate of real bank credit to the private sector; Y-axis: BCPS/GDP)



Source: IMF; calculations: Banque de France.

In Asia, China and India recorded the highest average growth rates over the period under review. However, while China posted the region's fastest BCPS growth between 2002 and 2003 with rates of close to 20%, it was overtaken by India and Indonesia in 2004 and 2005.

The rapid expansion in BCPS in EMEs can be traced back to local-currency loans granted by the local subsidiaries of foreign banks. While the increase in local-currency loans by these bank subsidiaries reduces the currency mismatches on corporate balance sheets, it exposes local banking systems to the risk of a sudden withdrawal of such funding, insofar as the credit expansion is financed by short-term bank borrowing from abroad (IMF, 2005).

Moreover, in emerging Europe, foreign currency lending is also driving the growth in BCPS, accounting for over 50% of loans granted to the private sector in Lithuania, Latvia, Estonia, Croatia and Romania (Hilbers *et al.*, 2005).

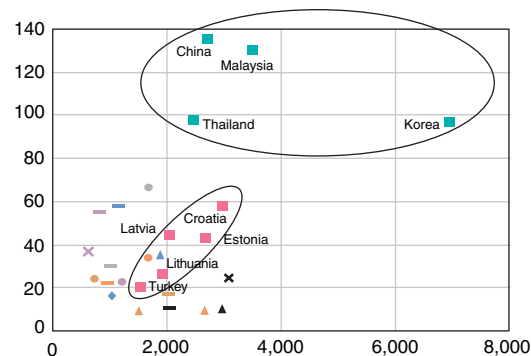
HETEROGENEOUS CREDIT LEVELS

In some countries, BCPS has grown at a sustained and rapid pace against a backdrop of shallow domestic financial markets. In emerging Europe, notably in Latvia, Lithuania, Estonia and Russia, BCPS/GDP ratios have doubled in the last five years, rising on average from 10%-20% of GDP in 2000 to 20-40% in 2005. These levels, though, are well below those seen in Asia, where bank loans have traditionally been the main source of financing for the economy (around 140% of GDP in China and Malaysia, and around 100% in Thailand and South Korea). At the other end of the spectrum come the Latin American countries, whose economies exhibit low BCPS/GDP ratios (10%-20%).

Interestingly, in emerging Europe, credit growth took off from low levels, *i.e.* BCPS/GDP ratios of around 10% to 40%. Conversely, in Asian countries where credit growth rates expanded less swiftly, BCPS/GDP ratios were already high, at around 100%-140%. North Africa and Latin America fit in somewhere between these two extremes. There, thus, seems to be a decreasing relationship between the growth and level of BCPS (see Chart 1).

Chart 2
BCPS/GDP ratio and level of economic development
2004, 27 EMEs

(X-axis: gross per capita saving –PPP, current USD; Y-axis: BCPS/GDP, as a %)



Sources : IMF, World Bank ; calculations: Banque de France.

In terms of purchasing power parity (PPP) in constant dollars, *per capita* income levels are higher in emerging Europe than in Asia (except South Korea). However, BCPS/GDP ratios are lower in emerging Europe, suggesting that the recent credit expansion in that region reflects an economic catch-up process. However, compared with some Asian economies, central and eastern European countries exhibit lower *per capita* saving levels expressed in terms of PPP in current dollars, which makes these economies more vulnerable (see Chart 2).

2/2 Resumption of capital flows to emerging market economies

Rapid credit growth in EMEs since the early part of the decade has been accompanied by a surge in private capital inflows *via* an increase in bank loans, although flows of foreign direct investment (FDI) continue to predominate. Low interest rates in mature markets have driven the capital inflows, as have improved macroeconomic fundamentals in emerging economies, as well as financial innovation and liberalisation on international capital markets, which have promoted increased mobility of capital flows. Despite these huge capital inflows, EMEs remain net exporters of capital, owing to their large current account surpluses and massive accumulation of international reserves.

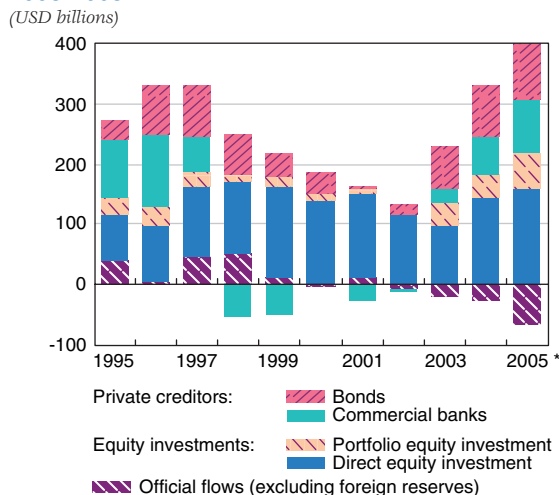
PREDOMINANCE OF FDI

In 2002, net private capital inflows to EMEs reached their lowest point since the 1997-1998 Asian crisis. In 2005, they hit a post-crisis high of USD 400 billion, which actually exceeded pre-crisis levels. However, the structure of these capital flows has changed. In 1996, debt flows (commercial banks and bond issuance) accounted for 60% of the total. By 2005, equity securities (FDI and portfolio investments) made up 55% of net flows (see Chart 3). Bond and equity finance has risen strongly, moving ahead of bank loans since the Asian crisis. However, the composition of external financing varies from region to region. While Latin America is the main issuer of international bonds, Asia and, to a lesser extent Europe, still relies essentially on FDI and bank loans.

FDI remains the main source of external financing for EMEs, accounting on average for 40% of total net private capital flows. In level terms, Asia is still the leading host region (with a marked preference for China) ahead of Latin America and emerging Europe (see Chart 4).

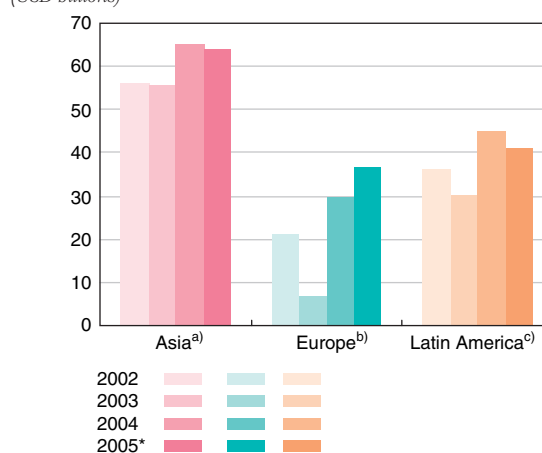
In Asia, local authorities notably used this external financing to recapitalise banks that were struggling in the wake of the Asian crisis. FDI in the banking sector has also increased sharply in emerging Europe since 2003 as a result of privatisation programmes.

Chart 3
Net private capital flows to EMEs
1995-2005
(USD billions)



Source: Institute of International Finance (IIF).

Chart 4
Net direct investment to EMEs
By region, 2002-2005
(USD billions)



* Estimate.

a) China, India, Indonesia, Malaysia, the Philippines, South Korea, Thailand.

b) Bulgaria, Czech Republic, Hungary, Poland, Romania, Russian Federation, Slovakia, Turkey.

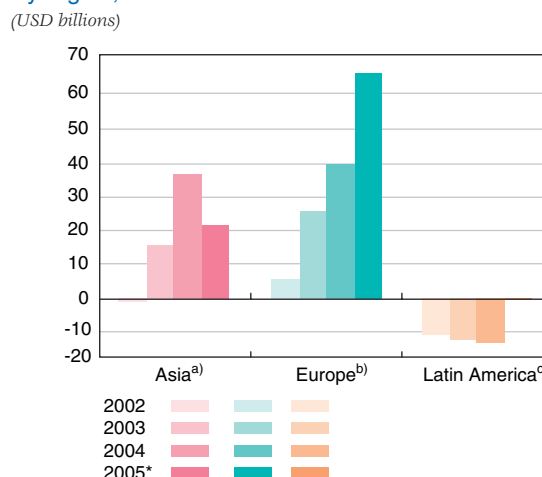
c) Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, Venezuela.

Source: Institute of International Finance (IIF).

REGIONAL GROWTH IN COMMERCIAL BANK LENDING

Flows of international bank lending to emerging European countries have been rising sharply since 2002 (see Chart 5). The amount of these loans increased more than tenfold between 2002 and 2005, and they accounted on average for more than half of the region's total external financing in 2005. In some countries, like Hungary, these foreign currency loans from international banks were used to finance local credits.

Chart 5
Net commercial bank loans to EMEs
By region, 2002-2005
(USD billions)



* Estimate.

a) b) c) See Chart 4.

Source: Institute of International Finance (IIF).

In Asia, China remains one of the main beneficiaries of international bank loans. However, the Chinese authorities have introduced administrative measures to impose quotas on loans from foreign banks, thereby limiting inward flows of this type of external financing. Latin America is the only region where countries, notably Argentina, Brazil and Mexico, have repaid commercial banks loans since 2002.

This snapshot seems to indicate that countries that recorded the highest growth rates of capital inflows were also the ones that posted the highest credit growth rates, namely in Asia and emerging Europe. In the next section, we look at the direction of causality between these two phenomena.

3 | CAPITAL FLOWS AND CREDIT BOOMS: AN ANALYSIS OF CAUSALITY

First, we detect the presence of credit booms in EMEs since 2002 (3|1). Second, we conduct analyses to determine whether the booms were caused by recent private capital inflows (3|2).

3|1 Identification of credit booms

METHODOLOGY

The sample is made up of 27 EMEs.¹ The BCPS series were constructed using the IMF's International financial statistics (IFS). They correspond to the sum of claims on the private sector by deposit money banks (line 22d) and by other banking institutions (line 42d). The series for real credit were computed by deflating the nominal credit series by the consumer price index –also available in the IFS. For most of the countries in the sample, real credit series compiled in this way are available from 1961.

We follow the IMF's methodology (2004) in defining credit booms as periods where the expansion in real credit to the private sector exceeds the standard deviation of credit fluctuations around

its long-term trend by a factor of 1.75. Assuming that the real BCPS growth rate series is normally distributed, the likelihood of it exceeding its standard deviation by a factor of 1.75 is 5%. The long-term trend is defined by applying a Hodrick-Prescott filter to the real credit growth rate series over the 1961-2005 period, with a smoothing coefficient of 100 (Appendix 1).

Of the abovementioned methodologies for detecting credit booms, the IMF's approach (2004) was preferred over that of Gourinchas, Valdés and Landerretche (2001) for three main reasons. First, the IMF's method makes it possible to dissociate changes in real credit and real GDP, thus taking account of financial deepening process in certain countries. Second, the IMF's method captures country-specific changes in BCPS instead of applying uniform ceilings (*i.e.* the relative and absolute deviation values defined by Gourinchas, Valdés and Landerretche, 2001) to all countries regardless of their level of economic development. Third, the fact that GDP series were not available for all countries in the sample in 2005 would have reduced the number of observations in the context of an analysis of BCPS/GDP ratios.

COUNTRY SELECTION

The results obtained by applying the above methodology to the 2002-2005 period show that nine of the 27 countries in the sample appeared to experience a credit boom, namely China, Estonia, India, Tunisia, Lithuania, Morocco, Argentina, Colombia and Venezuela (Appendix 1).

These countries may be sorted into three categories. Group 1 includes countries that appeared to experience a credit boom four years in a row (China, Estonia, India and Tunisia). Group 2 comprises countries that appeared to experience a credit boom three years in a row (Lithuania and Morocco). And Group 3 is made up of countries that appeared to experience a credit boom two years in a row (Argentina, Colombia and Venezuela).

China and India (for Asia) and Estonia and Lithuania (for emerging Europe) have experienced excessive credit growth since 2002-2003. In Latin America, credit has expanded briskly in Argentina, Colombia and Venezuela since 2004. Over the period as a

¹ Algeria, Argentina, Brazil, China, Colombia, Croatia, Ecuador, Egypt, Estonia, India, Indonesia, Latvia, Lithuania, Malaysia, Mexico, Morocco, Peru, the Philippines, Romania, Russia, South Africa, South Korea, Thailand, Tunisia, Turkey, Uruguay and Venezuela.

whole, credit growth rates were generally lower in North Africa (Tunisia and Morocco especially) than in other regions.

Interestingly, Levine (2002) classifies India (for Asia), Argentina and Colombia (for Latin America) and Tunisia (for North Africa) as bank-based economies where bank credit is the main source of financing. Classifying these countries as experiencing sharp credit growth seems therefore to be a relevant categorisation that is unbiased by the existence of a market-based financial system.

An empirical study of these nine economies was carried out in an effort to analyse the extent of the relationship between private capital inflows and strong BCPS growth.

3|2 Credit booms and capital flows: what is the causal link?

METHODOLOGY

Granger causality tests are used to determine whether credit booms in these countries were fuelled by capital inflows or whether, conversely, they triggered capital inflows. In the first case, credit growth may be viewed as risky, because it could generate financial and banking crises if accompanied by macro-financial imbalances and banking system weakness. In the second case, credit growth may be seen as healthy because it potentially reflects a catch-up process in the countries in question. Here, a favourable outlook for economic activity attracts foreign capital to finance large-scale financing needs.

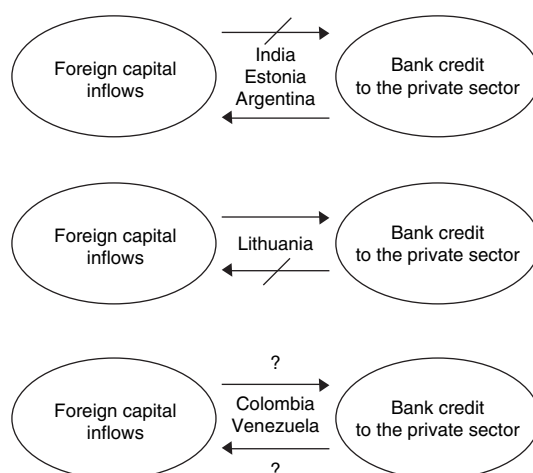
Granger causality tests are conducted on real BCPS and on international bank loans (for Estonia and Lithuania) or on FDI (for India and Argentina).² The causality approach makes it possible to determine whether capital inflows cause BCPS or *vice versa*, and not merely whether the two phenomena develop simultaneously. If causality is established, BCPS can, for example, be more effectively forecasted by using lagged capital inflows series rather than lagged BCPS series (Appendix 2).

HEALTHY OR RISKY CREDIT GROWTH

Stationarity and cointegration tests are conducted (Appendix 2). In the case of Estonia, Lithuania, Argentina and India, there is a long-term (or equilibrium) relationship between capital inflows to these countries and bank credit to the private sector. Conversely, in Colombia and Venezuela, there does not appear to be a stable long-term relationship between these two phenomena. Latin American countries were in a somewhat particular situation during the period under review. First, these economies (notably Colombia in 1999 and Argentina in 2001-2002) underwent a series of crises over the period under review. These crises caused external financing (bank loans) to halt abruptly and in some cases resulted in capital flight (portfolio investments). Moreover, the analysis conducted to identify credit booms reveals that these countries did not experience excessive credit growth until 2004 and 2005, after credit growth rates collapsed in 2002 and 2003. The rapid credit expansion seems therefore to form part of a wider process of post-crisis economic catch-up.

The results obtained from Granger causality tests show that there is no clear-cut relationship between capital inflows and bank credit to the private sector (see Chart 6).

Chart 6
Causality between BCPS and capital inflows



² Quarterly balance of payments series are not available for China, Morocco and Tunisia on a quarterly basis.

Box

Estonia and Lithuania: Macro-financial imbalances and banking system vulnerability

By comparing a few –though far from all– banking system indicators and macroeconomic variables, we can strengthen the case for distinguishing between risky credit expansion caused by capital inflows (Lithuania) and healthy credit growth resulting from financial deepening (Estonia).

In emerging Europe, Lithuania and Estonia (along with Latvia) recorded the highest rates of BCPS growth over the 2002-2005 period. In these two economies, the rapid expansion of BCPS (average annual growth of 37% in Lithuania over those four years, compared with 30% in Estonia) caused the BCPS/GDP ratio to rise from 14% in 2002 to 36% in 2005 in Lithuania and from 27% to 61% in Estonia over the same period. Most of the growth in BCPS can be attributed to credit to households. However, while the average annual growth rate in bank credit to households stood at around 40% in Estonia over 2002-2005, in Lithuania, average annual growth rates were around 80%. Bank credit to non-financial institutions grew at a cooler pace, with average annual increases of around 30% between 2002 and 2005 in Lithuania and 25% in Estonia. Furthermore, given the heavy presence of foreign banks in domestic banking activity (98% of total bank assets in Estonia and 91% in Lithuania in 2004), the recent credit growth can be largely traced back to these foreign banks, which also extend loans in foreign currencies, reflecting confidence in the credibility of the currency board principle and in the prospects for euro adoption by both countries.

In Lithuania, the rapid credit expansion took place against a backdrop of poorer-quality bank balance sheets. The non-performing loan ratio is higher and the capital ratio is lower there than in Estonia, suggesting that excessive BCPS growth could cause the banking sector's position to deteriorate further in the absence of a prudent framework of banking supervision and regulation.

The risks linked to macro-financial stability are more nuanced. In Lithuania, inflation has been contained and the real exchange rate has showed no signs of appreciating since 2002. Nevertheless, some vulnerabilities persist. The expansion in BCPS has been accompanied by a run-up in equity and property prices. Although the current account deficit is smaller than Estonia's, some 45% of it is financed by FDI, compared with 80% in Estonia. If FDI inflows were to slacken, the deterioration in the external account could result in an increase in external debt and/or a decline in international reserves, even though the latter do not totally cover short-term external debt. The current account deficit reflects an imbalance between national saving and domestic investment. Lithuania's saving rate is among the lowest of all emerging countries (17% of GDP compared with 20% in Estonia and 50% in China on average over the 2002-2005 period). Meanwhile, Estonia boasts one of the highest investment ratios, at 31% of GDP, compared with 23% in Lithuania and 40% in China over the same period. In addition to its current account deficit, Lithuania also has a twin budget deficit, unlike Estonia.

Vulnerability indicators

Average 2002-2005	Lithuania	Estonia
Real bank credit to the private sector (growth rate)	37.0	30.0
Vulnerability of the banking system		
Non-performing loan ratio	3.6	0.4
Risk-adjusted capital ratio	12.7	13.8
Financial and external vulnerability		
Inflation (HCPI, as a %)	0.8	3.0
Broad money, M2 (growth rate)	21.2	19.9
Stock exchange index (growth rate)	60.0	46.0
Current account (% of GDP)	-6.8	-11.4
Financial and capital account (% of GDP)	6.2	12.1
Budget balance (% of GDP)	-1.2	1.6
Real effective exchange rate (2002 = 100)	100.1	102.3
Short term external debt/Reserves	99.7	80.2

Sources: IMF, ECB, European Commission.

NB : This box has benefited from comments by P. Diev (Macroeconomic Analysis and Forecasting Directorate).

In Argentina, Estonia and India, capital inflows cannot explain rapid credit growth. In India, these flows have notably translated into an increase in international reserves and financing of the budget deficit. An analysis of the three countries reveals that BCPS growth, though excessive, reflects financial deepening and forms part of an economic catch-up process. Accordingly, the credit expansion looks healthy insofar as it is keeping step with economic activity. The results also suggest that the favourable economic outlook in these countries has tended to attract foreign capital inflows.

In Argentina, the financial deepening process, which was interrupted by the 2001-2002 crisis, appears to be at work once more. Alongside loans, deposits are also climbing swiftly, with the growth rate rising from 11 % in 2002 to 20 % in 2004-2005. Post-crisis restructuring measures to rebuild bank capitalisation and reforms relating to banking regulations and prudential supervision led to sustainable credit growth, which may have contributed to the resumption of foreign capital inflows.

Estonia's strong credit growth reflects a financial deepening process in the sense that it has been accompanied by a rapid expansion in bank deposits (the annual growth rate for all deposits rose from 13% in 2002 to 46% in 2005). This has taken place amid macroeconomic consolidation and falling real interest rates, which have also attracted foreign capital inflows.

In India, BCPS has expanded rapidly against the backdrop of shallow financial markets. The financial deepening process still underway in this economy therefore appears to be one reason for the strength of bank credit (IMF, 2006). BCPS has risen rapidly from low levels. Indian banks have long preferred to invest the lion's share of their deposits in public securities, rather than in loans to households and firms. Credit to the private sector, measured as a percentage of GDP, is lower than in most of the other countries in the region, at 7.2% in 2004, compared with more than 50% in Malaysia and Singapore.

Credit growth in India is clearly part of a financial deepening process, with supply-side reforms by the Reserve Bank of India to enhance transparency and competition on the credit market (creation of a credit register, disclosure of information on bank lending rates), and on the demand side, increased borrowing from households as part of robust growth in consumption and disposable income. At the same time, India's strong economic performance has attracted massive capital inflows, particularly in the shape of FDI.

In Lithuania, by contrast, capital inflows brought about rapid credit growth. The causality test tends to validate the intuition that credit growth may have been driven by international bank loans. The growth rate for bank loans has exceeded the growth rate for bank deposits since 2003. In this context, credit has been fuelled by international loans that expose the Lithuanian economy to several risks. First and foremost, the bulk of the credit growth has been in the household sector, where the growth rate averaged 73% between 2002 and 2004. These loans chiefly go towards financing consumer spending, creating the risk of a deterioration in the external accounts. The same sector also took out loans in foreign currencies (mainly euros), with growth rates of between 100% and 170% in 2003 and 2004 respectively. Secondly, the privatisation programme completed in 2002 also sharply increased competition in the banking sector. This made it easier to access consumer loans, posing a potential threat to the soundness of the domestic banking system.

The empirical results thus indicate that capital inflows to two economies in the same region may have fuelled a credit boom in one case (Lithuania) while having no effect on the credit expansion in the other (Estonia). The analysis of the potential risks of a credit boom fuelled by large capital inflows can be rounded out with an examination of macro-financial imbalances, *e.g.* inflation, real exchange rate and debt, and banking system vulnerabilities, such as non-performing loans and capital ratios (see Box).

The above analysis has significant limitations insofar as it is based on a small sample of emerging market economies and covers a short period. Accordingly, we should be careful in interpreting the results, particularly since the Granger method is sensitive to the length of the lag used.

Still, the study suggests that in some countries, the rapid credit growth in recent years is simply part of an ongoing financial deepening process. The potential for economic growth increases the attractiveness of these economies as a destination for foreign investment. In this scenario, the risks to financial stability remain limited. If, however, international bank loans contracted by local banks fuel bank credit to households, financing increased consumption and causing a deterioration in the external accounts, the situation becomes more uncertain from a financial stability perspective.

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APPENDIX 1

Identification of credit booms

Hodrick-Prescott filter methodology

The Hodrick-Prescott filter (HP filter) is a method widely used in macroeconomics to obtain a smooth estimate of the long-term component of a series. The method was first developed by Hodrick and Prescott (1997) to analyse US business cycles during the post-war period.

The HP filter breaks a series down into two components: a trend (x_t) and a stationary component ($y_t - x_t$), where y_t denotes the growth rate of real bank credit to the private sector (BCPS). It computes the smoothed series (x_t) from the actual series (y_t) by minimising the variance of y_t around x_t , so that:

$$\text{Min} \sum_{t=1}^T (y_t - x_t)^2 + \lambda \sum_{t=2}^{T-1} [(x_{t+1} - x_t) - (x_t - x_{t-1})]^2$$

λ is a smoothing parameter. If $\lambda = 0$, x_t will be minimised when $y_t = x_t$; if $\lambda = \infty$, x_t tends to a linear trend.

Results of the Hodrick-Prescott filter on BCPS (2002-2005)

	China	Estonia	India	Tunisia	Lithuania	Morocco	Argentina	Colombia	Venezuela
Growth rate of real BCPS									
2002	16.68	14.53	15.20	2.17	26.25	0.52	-38.54	0.35	-20.94
2003	17.73	26.92	5.50	2.03	47.48	6.54	-29.55	-4.13	-18.09
2004	6.73	33.30	22.98	2.83	32.30	5.29	10.61	5.63	48.81
2005	6.98	46.07	18.74	5.38	41.10	11.46	18.66	9.63	38.82
Ceiling estimated by the HP filter									
1961-2005	3.61	8.30	5.09	0.62	29.75	1.50	8.47	5.50	19.68

Notes: the estimation period may be shorter depending on the country.

Shaded areas correspond to the years for which a credit boom, i.e. a growth rate of actual BCPS that is higher than the ceiling estimated by the HP filter, has been identified.

Source: IMF; calculations: Banque de France.

APPENDIX 2

Private capital inflows and credit booms

Stationarity and co-integration tests

The empirical study covers the 2001-2005 period. BCPS data are available on a monthly basis from the IMF's International Financial Statistics (IFS). The series for liabilities in other investments (mainly made up of international bank loans) for Estonia and Lithuania and FDI inflows for Argentina, Colombia and Venezuela are available on a quarterly basis from the IMF Balance of Payments Statistics (but not for China, Morocco or Tunisia). The series for FDI inflows are published by the Reserve Bank of India (RBI) also on a quarterly basis. The quarterly data are computed on a monthly basis using quadratic interpolation.

The stationarity of series was tested using the augmented Dickey-Fuller unit root test. The results obtained show that the series considered are non-stationary but integrated of order 1 or 2 (See Table).

As the series considered were individually I(1) or I(2), their co-integration was tested for each country using Johansen tests and was validated in Estonia, Lithuania, Argentina and India. By contrast, the series for Colombia and Venezuela did not pass the co-integration test.

Results of unit tests

In absolute terms

Country	Value of <i>t</i>	
	Bank credit to the private sector	International bank loans/FDI
In first difference		
Estonia	3.808781** (1)	4.420323* (1)
Argentina	8.263239* (1)	4.673652* (1)
Colombia	9.381297* (1)	3.785854** (1)
Venezuela	4.656467* (1)	4.366944* (1)
In second difference		
India	9.918191* (1)	9.228770* (1)
Lithuania	13.27117* (1)	4.831370* (1)

Notes: (*) significant at 1%, (**) significant at 5%.

(1) Includes a constant and a trend.

Johansen co-integration test results

Country	Trace statistique N=0	Trace statistique N=1	Number of lags in the vector auto regression (1)
Estonia	25.75671*	12.12587*	3
Lithuania	30.90592*	7.751343*	11
Argentina	34.17357*	5.557412*	12
Colombia	21.26435*	0.870496	2
Venezuela	18.78164*	0.000517	8
India	25.10905*	9.427696*	2

Notes: (*) significant at 5%.

(1) Use of Akaike and Schwartz information criteria to determine the number of lagged observations.

Granger Causality Test

The Granger test (1969) assumes that the information required for forecasting the pattern of the respective variables, capital inflows (CF) and the growth rate of real bank credit to the private sector (BCPS) is contained solely in the time series of the two given variables.

The test involves estimating the following two regression functions.

$$\begin{cases} CF_t = \alpha_0 + \alpha_1 CF_{t-1} + \dots + \alpha_T CF_{t-T} + \beta_1 BCPS_{t-1} + \beta_T BCPS_{t-T} + u_{1t} \\ BCPS_t = \delta_0 + \delta_1 BCPS_{t-1} + \dots + \delta_T BCPS_{t-T} + \beta_1 CF_{t-1} + \beta_T CF_{t-T} + u_{2t} \end{cases}$$

Hypothesis H_0 of non-causality of CF to BCPS corresponding to a series of non-statistically different-from-zero coefficients β is tested: $H_0 : \beta_1 = \beta_2 = \dots = \beta_T = 0$

If H_0 is accepted then :

$$\begin{cases} CF_t = \alpha_0 + \alpha_1 CF_{t-1} + \dots + \alpha_T CF_{t-T} + u_{1t} \\ BCPS_t = \alpha_0 + \alpha_1 BCPS_{t-1} + \dots + \alpha_T BCPS_{t-T} + u_{2t} \end{cases}$$

There is no unidirectional causality from CF to BCPS.

Granger causality test results (2001-2005)

(likelihood in %)

Country	Null hypothesis	Value of F	Likelihood	Number of lags	Decision
Argentina	BCPS does not Granger cause CF	1.93056	0.09	12	Rejection of H_0
	CF does not Granger cause BCPS	1.29775	29.29	12	Acceptance of H_0
Estonia	BCPS does not Granger cause CF	1.97172	0.8	12	Rejection of H_0
	CF does not Granger cause BCPS	0.88853	57.0	12	Acceptance of H_0
India	BCPS does not Granger cause CF	1.81623	10.57	12	Rejection of H_0
	CF does not Granger cause BCPS	0.80633	64.16	12	Acceptance of H_0
Lithuania	BCPS does not Granger cause CF	1.21539	33.05	12	Acceptance of H_0
	CF does not Granger cause BCPS	3.06725	1.0	12	Rejection of H_0

Can risk aversion indicators anticipate financial crises?

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Fluctuations in investor risk aversion are often cited as a factor explaining crises on financial markets. The alternation between periods of bullishness prompting investors to make risky investments, and periods of bearishness, when they retreat to the safest forms of investments, could be at the root of sharp fluctuations in asset prices. One problem in the assessment of these different periods is clearly distinguishing the risk perceived by agents from risk aversion itself.

There are several types of risk aversion indicators used by financial institutions (the VIX, the LCVI, the GRAI, etc.). These indices, which are estimated in diverse ways, often show differing developments, although it is not possible to directly assess which is the most accurate. An interesting method in this respect is to link the indicators to financial crises. In principle, financial crises should coincide with periods in which risk aversion increases. Here we estimate probabilities of financial crises –currency and stock market crises– using the different risk aversion indicators as explanatory variables. This allows us to assess their respective predictive powers. The tests carried out show that risk aversion does tend to increase before crises, at least when it is measured by the most relevant indices. This variable is a good leading indicator of stock market crises, but is less so for currency crises.

Fluctuations in investor risk aversion are often cited as a factor to explain crises on financial markets. The alternation between periods of optimism prompting investors to make risky investments, and periods of pessimism, when they retreat to the safest forms of investments, could be at the root of sharp fluctuations in asset prices. One problem in the assessment of these different periods is clearly distinguishing the risk perceived by agents from risk aversion itself.

The concept of risk aversion has the advantage of being intuitive, given that it can easily be interpreted as a feeling of wariness on the part of investors regarding risky investments. It can also be defined more precisely within the framework of asset pricing models. In this context, we can decompose risk premia on different assets into a “price of risk”, which is common to all assets, and a “quantity of risk”, which is specific to each asset. Risk aversion is often considered to correspond to the “price of risk” obtained in this way. This is the definition we use here.

In the consumption capital asset pricing model (CCAPM), the price of risk depends on the variance of consumption. It may therefore vary empirically if this variance is estimated over different periods. In the specific case of the capital asset pricing model (CAPM), the price of risk varies with the variance of returns on a representative market portfolio (see Appendix 1).

There seems to be a paradox in regarding risk aversion as being variable over time when it is defined as a structural factor representing agents’ preferences. In fact, this paradox stems from the dual use of the term “risk aversion”.

- In its narrow sense, the term refers to the risk aversion coefficient present in the consumer’s utility function. This parameter is part of the intrinsic profile of economic agents and may therefore be assumed to be unchanged over time.
- In its broad sense –which is the one used here– risk aversion is defined as the “price of risk”. It is a decisive factor in the formation of asset prices, and makes it possible to reflect investor sentiment with regard

to risk in an ever-changing environment. Another advantage of this definition is that it constitutes the opposite of the concept of “risk appetite” frequently mentioned by market operators.¹

There are several types of risk aversion indicators in the economic literature. These indicators, which are estimated in diverse ways, often show differing developments, although it is not possible to directly assess which is the most accurate. An interesting method in this respect is to link the indicators to financial crises since, in principle, financial crises should be preceded by periods in which risk aversion increases. However, it is also possible for some financial crises to be preceded by periods of strong “risk appetite” during which investors are excessively optimistic, which creates a “speculative bubble” on the prices of risky assets.

The first part of this article describes the indicators most commonly used by financial institutions and compares their values over the period July 1995 to September 2005. The second part estimates probabilities of financial crises –currency and stock market crises– using these different indicators. The simulations carried out on the sample allow us to assess their respective predictive powers.

1| THE MAIN RISK AVERSION INDICATORS

1|1 Simple and aggregate indicators

SIMPLE INDICATORS, THE VIX

Some analyses use raw series to estimate changes in investors’ perception of risk. For instance, the price of gold may be used if we assume that, during periods of uncertainty, investors will reallocate their wealth to assets traditionally perceived as safe, such as gold. The same would be true of the Swiss franc exchange rate.

The implied volatility of options is also used. For example, the volatility index (VIX) created

¹ See Kumar and Persaud (2001), Gai and Vause (2004).

by the Chicago Board Options Exchange (CBOE) in 1993 equals the implied volatility on the S&P 500 (Chart 1). It is regarded by many market analysts as a direct gauge of fear.

However, the explanatory power of these indicators is limited. Indeed, proxies like the price of gold may be influenced by factors that have nothing to do with risk aversion. Similarly, a variation in implied volatility on a market may stem from a change in the quantity of risk on this market and not necessarily from a change in investor risk aversion.

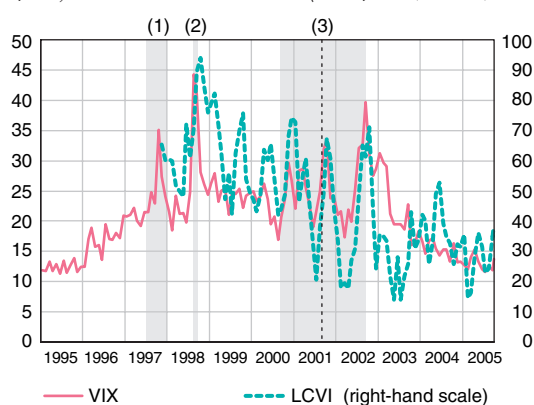
AGGREGATE INDICATORS, THE LCVI

Several indicators have been created by aggregating elementary series. These measures are relatively simple to put in place and can be easily interpreted. In most cases, they are weighted averages of a number of variables. The best-known indicators of this type are JP Morgan's liquidity, credit and volatility index (LCVI), the UBS (Union des Banques Suisses) risk index, Merrill Lynch's financial stress index and the risk perception indicator of the Caisse des Dépôts et Consignations.²

We have used the LCVI in our comparison (see Chart 1). This is often regarded as being a satisfactory measure

Chart 1
VIX and LCVI

(level of VIX) (level of LCVI; min = 0, max = 100)



(1) Asian crisis.
(2) Russian crisis and failure of LTCM.
(3) Downtrend on the main stock markets.
Dotted line: terrorist attacks of 11 September 2001.
Sources: CBOE, JP Morgan.

of risk aversion.³ The LCVI aggregates three types of information: first, two series capturing liquidity developments (yield spreads between a benchmark and little-traded US Treasury bills and spreads on US swaps); second, two risk premia indicators (yield spreads on speculative grade corporate bonds and the EMBI); and third, three measures regarded in this approach as representative of market volatility (the VIX, volatility on foreign exchange markets and the global risk aversion index –GRAI).

However, these aggregate indicators are limited in their power to explain risk perception. The underlying elementary variables are influenced by many factors other than investors' propensity to take risks. This is not offset by aggregating them, which consists, more or less, in calculating an arithmetical average. Moreover, the weighting of the different measures used is arbitrary. All in all, this approach appears based on intuition and lacks a real theoretical basis.

1|2 A common factor driving risk premia

Principal component analysis (PCA) may be applied to risk premia in order to identify a common factor in their variations (see Box 1). The assumption underlying this approach is that the yields on different securities are correlated as they depend on one or more common factors that are not directly observable.

The first common factor can generally be interpreted as the price of risk, if certain conditions are met, notably that it increases with each risk premium. In fact, this indicator is constructed exactly like a weighted average of risk premia, the weighting being given by the PCA.

Here, we construct an indicator of this type, referred to hereafter as PCA, using the first component of a PCA on several risk premia (see Box 1). The risk premia have been chosen so as to be representative of the changes observed across the fixed income market as a whole. These are, on the one hand, option adjusted spreads (OAS) on corporate bonds

² For more details on these indicators see Prat-Gay and McCormick (1999), Kantor and Caglayan (2002), Germanier (2003), Rosenberg (2003), and Tampereau and Teiletche (2001).

³ Dungey et al. (2003), for example, use it to study changes in risk aversion during the financial crises in emerging markets.

Box 1

Principles of principal component analysis

This approach is justified by Ross's arbitrage pricing theory (APT, 1976). According to this theory, the common variation in returns can be expressed as a linear function of a set of factors. However, APT specifies neither their number nor their nature. This leads to the use of statistical methods, such as principal component analysis (PCA), to identify them.

PCA allows us to extract from a set of p quantitative variables correlated among one another a list of k new variables called "factors" f_1, \dots, f_k ($k \leq p$) that are uncorrelated among one another. The common factors are constructed as linear combinations of variables. In order to condense the information, only the k first factors are considered, as they explain, by construction, the bulk of total variance. The proportion of total variance accounted for by these k first factors constitutes an overall measure of the quality of the PCA. Choosing how many factors to use is difficult. Two criteria are often used to make this choice: the Joliffe criterion –which consists in cutting off once the percentage of explained variance reaches a certain threshold (for example 80%)– and the Kaiser criterion, which only keeps eigenvalues greater than one if the correlation matrix is worked on.

Examples of use

Sløk and Kennedy (2004) use PCA to identify a common trend in risk premia on stock and bond markets in developed and emerging market countries since the beginning of 1998. According to them, the variance-explained weighted average of the first two common factors is strongly correlated with the OECD's leading indicator of industrial production and a measure of global liquidity. In this case, therefore, PCA captures the impact of the risk of the overall macroeconomic environment and liquidity risk on changes in risk premia. McGuire and Schrijvers (2003) studied –also using PCA– common developments in risk premia in 15 emerging market countries in the period 1997 to 2003. The first factor, which explains the bulk of the common variation, is interpreted as representing the investor risk aversion. The Deutsche Bundesbank (2004) calculates a risk aversion indicator by means of PCA using risk premia on investment and speculative grade corporate bonds in developed countries and sovereign risk premia for some Asian and Latin American countries.

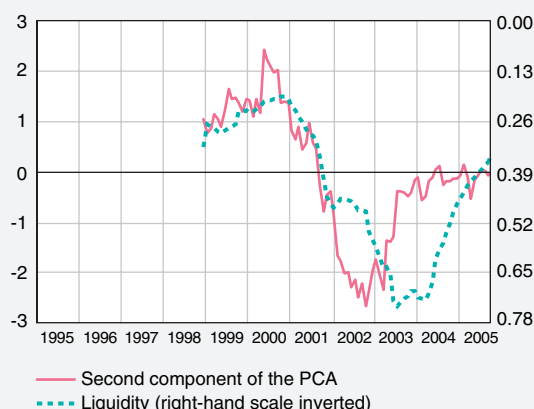
Calculation of a PCA indicator on risk premia

The method used here is PCA carried out using a set of standardised risk premia (see Appendix 3). The results show that the first factor explains 68% of the common variation of risk premia. The correlation of each of the risk premia with this first factor is positive. In addition, all of the original risk premia are well represented in this first factor, the weightings being of comparable order of magnitude; there is therefore no problem of over- or under-representation of certain series. For these reasons, we can consider that this first common factor gives a good representation of risk aversion.

The second factor explains 19% of the common variation of risk premia. We analyse it since it satisfies the Joliffe criterion, at the 80% threshold, and the Kaiser criterion. This second factor is negatively correlated with a measure of global liquidity.

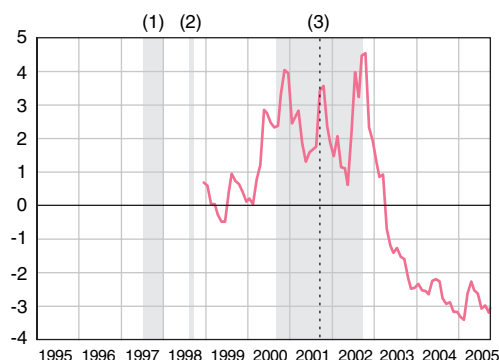
This is proxied here by the inverse of average short-term rates of the four largest economies (United States, euro area, United Kingdom and Japan), weighted by GDP (the correlation coefficient is equal to -0.69). We also note a high positive correlation between the second factor and swap spreads, which are often regarded as being strongly influenced by global liquidity developments.

Second component of the PCA compared with a measure of global liquidity



Sources: Bloomberg, JP Morgan, Merrill Lynch, OECD.

Chart 2
Risk aversion indicator
measured by the first component of the PCA



(1) Asian crisis.

(2) Russian crisis and failure of LTCM.

(3) Downtrend on the main stock markets.

Dotted line: terrorist attacks of 11 September 2001.

Sources: Bloomberg, JP Morgan, Merrill Lynch.

and swap spreads for the major developed markets; on the other, the EMBI Global sovereign spread and a corporate spread for emerging market economies.⁴ Details of these series are given in Appendix 3. The estimation period is from December 1998, when the indices used for emerging market countries were introduced, to December 2005 (Chart 2).

1|3 Indicators of the GRAI type

PRINCIPLES OF CALCULATION

Theoretically, an increase in risk aversion should lead to an increase in risk premia across all markets, but the increase should be greater on the riskiest markets. This is the idea on which the global risk aversion index (GRAI) is based, devised by Persaud (1996). Changes in risk aversion are represented by the correlation between price variations of different securities and their volatility: if the correlation is positive, risk aversion has decreased; if the correlation is negative, it has increased (for a more detailed presentation, see Appendix 2).

In practice, if we wish the GRAI to increase with risk aversion, the correlation must be given a negative sign.⁵ Instead of a correlation, a regression coefficient between price variations and volatilities may also be used (which is also given a negative sign). The indicator is then called the risk aversion index (RAI).⁶

In order to be entirely rigorous, confidence intervals need to be constructed around the estimated values. When this is done, GRAI indicators are often found to be in a non-significant area.⁷ However, it must be admitted that these confidence intervals are not calculated for other risk aversion indicators.

Kumar and Persaud (2001) applied this approach to *ex post* excess returns on foreign exchange markets. Several financial institutions and private banks, such as the IMF and JP Morgan, subsequently constructed their own GRAI. Others like Credit Suisse First Boston⁸ and the Deutsche Bundesbank have constructed RAIs.

LIMITATIONS OF ITS USE

From a theoretical standpoint, the construction is based on simplifying assumptions that are probably not borne out in reality, notably, the independence of excess returns and the independence between expected future prices and variations in risk aversion. Another limitation of this indicator is that it does not measure levels of risk aversion but rather changes in it. The correlation coefficient only makes it possible to distinguish periods in which risk aversion has increased from those in which it has fallen.

From an empirical point of view, the GRAI and RAI also display some limitations. Firstly, the measurements show that these indicators are extremely volatile. This seems counter-intuitive, as a good indicator should be stable during quiet periods. Secondly, changes in the indicator over time differ quite markedly depending on the period chosen for the calculations of volatility of returns as well as on the market concerned.

⁴ Risk premia on stock markets are not used on account of the great disparity in results obtained using the principal methods, which are mainly based on the Gordon-Shapiro model but with different underlying assumptions.

⁵ Spearman's correlation is often used, which is a correlation between ranks of variables.

⁶ See Wilmot, Mielczarski and Sweeney (2004).

⁷ More than half of the values in Kumar and Persaud's study (2001).

⁸ See Wilmot, Mielczarski and Sweeney (2004).

CALCULATION OF A CURRENCY AND STOCK MARKET GRAI

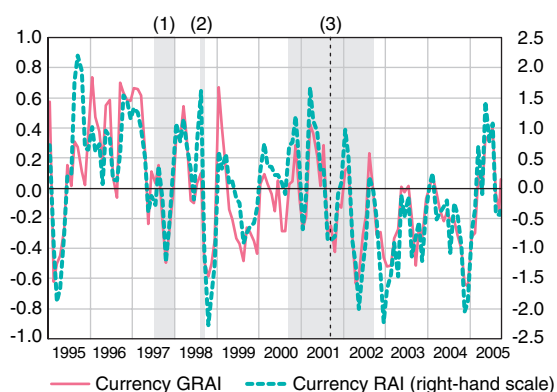
We calculate the GRAI and RAI for the foreign exchange and stock markets using monthly data. The currency GRAI is equal to the correlation (which is given a negative sign) between excess returns and volatility (see Chart 3). The sample comprises 12 to 15 currencies quoted against the US dollar depending on the periods for which data are available (Appendix 3). Excess returns are equal to the spread between the 3-month forward rate and the actual spot rate three months later. Volatility is calculated over the two previous years.

The stock market GRAI is equal to the correlation (given a negative sign) between price changes over three months and their volatilities, calculated over the two previous years (Chart 4). The sample is made up of the main stock market indices of 27 developed and emerging economies. The currency and stock market RAIs are calculated in the same way as the GRAIs, by replacing the rank correlation by the regression slope.

STATE STREET INDEX

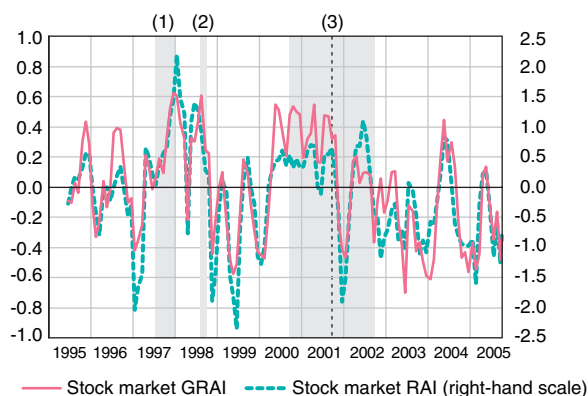
The State Street index (SST) is based on a measure in volume terms rather than prices.⁹ This index, which was created in 1998, can be regarded as a

Chart 3
GRAI and RAI calculated on the foreign exchange market



(1) Asian crisis.
(2) Russian crisis and failure of LTCM.
(3) Downtrend on the main stock markets.
Dotted line: terrorist attacks of 11 September 2001.
Source: Bloomberg.

Chart 4
GRAI and RAI calculated on the stock market

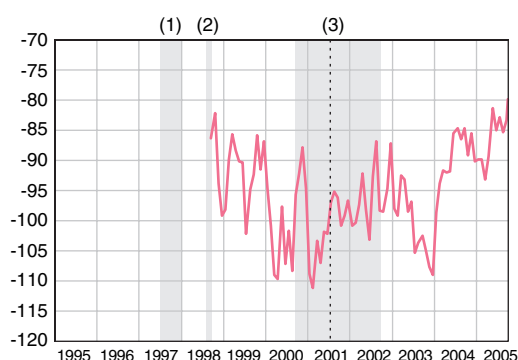


(1) Asian crisis.
(2) Russian crisis and failure of LTCM.
(3) Downtrend on the main stock markets.
Dotted line: terrorist attacks of 11 September 2001.
Source: Bloomberg.

GRAI calculated in terms of quantity. A rise in it corresponds to an increase in risky assets in the portfolio of a range of investors. It thus points to a trend of growing risk appetite, and a fall signals the reverse. In order to compare it directly with other risk aversion indicators, we give it a negative sign.

The index is calculated every month using State Street's proprietary database on the portfolios of institutional investors (see Chart 5). Like the other indicators in this category, this tool has the

Chart 5
State Street index (given a negative sign)



(1) Asian crisis.
(2) Russian crisis and failure of LTCM.
(3) Downtrend on the main stock markets.
Dotted line: terrorist attacks of 11 September 2001.
Source: State Street.

⁹ See Froot and O'Connell (2003).

advantage of being simple and can provide useful indices; however, it shows up trends that are not solely a reflection of risk aversion.

1|4 Other measures

Another category of indicators is obtained by comparing risk-neutral probabilities, calculated on options prices, with investors' subjective probabilities. We have not used this type of indicator here as it is tricky to estimate empirically subjective probabilities using historical data.¹⁰ We have not used either in our comparison indicators based on the optimisation under constraint of a consumption model, of which the Goldman Sachs indicator is an example.¹¹ Indeed, many studies have shown that consumption models underperform models that use market data such as the CAPM.

1|5 Comparison of the indicators

The different indicators react more or less to periods of crisis, identified in Charts 1 to 5 by vertical columns. Prior to the Asian crisis in 1997 and the Russian crisis in the summer of 1998, the VIX and LCVI show a rise in risk aversion.¹² However, the

GRAI and RAI do not display any very clear trend. During the stock market crisis in the early 2000s, several indicators signal an increase in risk aversion: the PCA, the GRAI and the RAI (which are positive as they point to a rise in risk aversion). The VIX, LCVI and SST do not show any very clear trend. The terrorist attacks of 11 September 2001 coincide with a peak of risk aversion in the VIX, the LCVI and the PCA. The other indicators do not record any particular change at this time.

One reassuring point to be underlined, however, is that these indicators are positively correlated between one another, even if the variations in them differ. The cross-correlations of these indicators show that 21 out of 28 of these correlations are positive (Table 1). Of the seven remaining, only three are significantly different from zero.

2| PREDICTIVE POWER OF THE INDICATORS

We attempt here to determine whether the risk aversion indicators described above can serve as leading indicators of crises, and whether they can help to improve forecasts using existing models. We carry out two estimates: on the foreign exchange market and on the stock market. Theoretically, investor risk aversion is the same on all markets, as a rational investor maximises his expected gains by making investment choices across all types of assets. We will therefore use the same risk aversion indicators, except for the GRAI where we have two distinct indicators.

Much work has been done to attempt to construct "leading indicators" of crises, notably after the Mexican crisis in 1995.¹³ The idea underlying this research has been to identify economic variables that behave in a particular way prior to periods of crisis. Their aim is to assess probabilities of crisis at a specific horizon (generally one or two years), taking account of the information available on the economic variables. Most of them use logit models that link a qualitative endogenous variable

Table 1
Cross-correlations of risk aversion indicators

	Stock market GRAI	Currency RAI	Stock market RAI	PCA	VIX	LCVI	SST
Currency GRAI	0.08	0.85 ***	0.07	0.00	-0.19 **	0.08	0.03
Stock market GRAI		0.18 *	0.85 ***	0.59 ***	0.31 ***	0.36 ***	-0.25
Currency RAI			0.15	0.11	-0.13	0.13	-0.07
Stock market RAI				0.45 ***	0.20 *	0.26 **	-0.27
PCA					0.84 ***	0.50 ***	-0.48 ***
VIX						0.55 ***	-0.32 *
LCVI							0.00

Significantly different from zero at the * 90%, ** 95%, or *** 99% confidence levels.

¹⁰ See Tarashev et al. (2003), Scheicher (2003), Bliss and Panigirtzoglou (2004); for a survey, see Gai and Vause (2004).

¹¹ See Ades and Fuentes (2003).

¹² In the case of the LCVI, only the Russian crisis is concerned, as the series is only available from the end of 1997.

¹³ See for example Kaminsky, Lizondo and Reinhart (1997), Berg and Patillo (1999), or Bussière and Fratzscher (2002).

(crisis or quiet period) to a set of quantitative exogenous variables.¹⁴ These models are estimated for a large number of countries and periods. We use the same method here.

2|1 The method used

In order to construct leading indicators of crises, an essential first step is to identify the crisis periods that occurred in the sample under review (Box 2). Crisis periods are identified by so-called “simultaneous” indicators, which will be used to construct the model’s dependent variable. Next, in order to assess the power of different risk aversion indicators to predict crises, they need to be compared with the indicators generally used.

EXPLANATORY VARIABLES

For currency crises, most studies use the same explanatory variables in their model.¹⁵ Here we tried out a number of variables and used those that are significant for our sample. These are the real exchange rate (against the dollar for Asian and Latin American countries and against the euro for European countries, quoted indirectly, with an increase corresponding to a depreciation of the emerging economy’s currency); official international reserves as a ratio of broad money, in year-on-year terms; and the interest rate on the money market taken in real terms. For the stock market, the explanatory variables used are the following:¹⁶ the price earning ratio (PER) in level terms, the year-on-year change in stock prices, and real interest rates.¹⁷

The explanatory variables are then introduced into the model in several stages to see whether the risk aversion indicators improve forecasts (see Box 3). Three models are tested in turn. Model (1) is referred to as the “base” and includes the usual explanatory variables without the risk aversion indicators. Model (2) adds the different indicators in turn. Model (3) only includes a risk aversion indicator as explanatory variable.

SAMPLE USED

The sample of panel data includes monthly data for the period from July 1995 to September 2005 for 20 emerging countries for currency crises and 27 countries for stock market crises. The countries and exact sources of the series are given in Appendix 3.

The aim is to compare the results obtained with these three types of model. To do this, the estimation sample must be identical. However, as some of our indicators (LCVI, PCA and SST) start later –in December 1998– we estimate models (2) and (3), which use these variables over this truncated period. In order to be able to compare them with the base models, we re-estimate this model over the same period.

2|2 Currency crises

The explanatory variables of currency crises have the expected signs (see Table 2). Appreciation of the real exchange rate is supposed to increase the risk of crisis, which corresponds to the negative sign found. A fall in international reserves relative to broad money also increases the probability of a crisis, hence the negative sign. The sign is positive on the real interest rate, an increase in which may signal a central bank’s difficulty in maintaining the currency’s parity. These three variables are significantly different from zero at the 99% level over the two estimation periods. The estimates are markedly more fragile for the shorter period as the number of crises is smaller, falling from 18 to 7.

The risk aversion variables all have the positive sign expected, with a rise in them contributing to increasing the probability of a crisis, except for the SST index. They appear very significant in regressions over the longer period. This is the case for the VIX, the GRAI and the RAI. In the estimates for the shorter period, only the PCA is significant at 99%.

¹⁴ See Frankel and Rose (1996), Sachs, Tornell and Velasco (1996), or Radelet and Sachs (1998).

¹⁵ For an exhaustive list, see Berg and Patillo (1999).

¹⁶ Among those proposed by Boucher (2004).

¹⁷ All of these explanatory variables have been standardised for each country in order to obtain homogenous data for all countries.

Box 2

Definition of crises

Currency crises

There is abundant literature on currency crises, which makes it possible to construct simultaneous crisis indicators. Most of them are obtained by statistical analysis of exchange rate and official international reserves series. The usual method consists in first of all constructing “pressure on the foreign exchange market” indicators, which correspond to a weighted average of the currency’s depreciation and relative losses in international reserves (see, for example, Sachs, Tornell and Velasco, 1996, Kaminsky, Lizondo and Reinhart, 1997, Corsetti, Pesenti and Roubini, 1998, Bussière and Fratzscher, 2002). The weighting used between the two series is generally inversely proportional to their conditional variance. When the pressure indicator goes above a certain threshold, it is deemed that there is a currency crisis. The threshold used is generally two or three standard deviations above the mean. The greater the number of standard deviations, the smaller the number of identified crises. Here we calibrate the number of standard deviations, so that all of the crises detected coincide with known crises on the markets and vice versa.

The sample used is described in Appendix 3. The reference currency to measure depreciation is the dollar for all the currencies of Latin America and Asia, regarded as being more or less part of a “dollar area”. In the case of European currencies, we have used the euro (and the Deutsche mark before 1999) except when the currency was pegged to another currency. When currencies were pegged to a basket, it is the change relative to this basket that is considered (for example, Hungary and Poland from July 1995 to December 1999). Countries that have had periods of hyperinflation (inflation higher than 150% in the six preceding months) are given particular treatment; this is the case for Bulgaria and Romania in our sample. In this case, we divide the sample in two: a sub-period of normal inflation and another of hyperinflation, as the measurement of averages and standard deviations is different for these two types of period.¹

With a threshold set at three standard deviations above average, the indicator thus constructed allows us to identify only known currency crises –such as those in the Asian countries in the second half of 1997 or in Brazil in January 1999 and Argentina in January 2002. In total, 18 crises are detected, that is, an average 0.9 crisis per country.

Stock market crises

There are fewer studies that address stock market crises. Nonetheless, it seems reasonable to define a stock market crisis as a sharp and rapid drop in share prices or in an index.² Two methods are used. Mishkin and White (2002) identify crises as falls in the price of a security or an index below a certain threshold (set arbitrarily at 20%) over a chosen time period (which may be a week, a month, a year, etc.)

Patel and Sarkar’s approach (1998) consists in calculating an indicator, the CMAX, which detects extreme price levels over a given period (24 months, for example). This involves dividing the current price by the maximum price over the period: $CMAX_t = P_t / \max [P_{t-24}, \dots, P_t]$ where P_t is the stock price at time t . This indicator equals 1 if prices rise over the period considered. The more prices fall, the closer it gets to 0. The threshold used is generally equal to the mean less two or three standard deviations. Given the indicator’s construction, the fall in share prices is already well under way when it signals a crisis. It is not, therefore, the turning point that is identified, but rather the point at which there has already been an abnormal drop in prices. On the other hand, the advantage of this indicator is that it only identifies confirmed crises that wipe out a substantial share of the gains made over the two previous years.

Over our sample (see Appendix 3), by using a threshold of two standard deviations below the mean, we identify crises that correspond to recognised events over the period.³ There are 30 crises in the sample, i.e. an average of 1.1 crises per country. They all occur during the stock market fall in the early 2000s.

1 The average and standard deviation are calculated by dividing the sample for hyperinflation countries. At the start of the period, they are calculated on data from August 1993 to December 1997, then conditionally, by gradually adding a month to the sample. We add an extra criterion to avoid counting the same crisis several times: if a crisis is detected within a 12-month period following another crisis, it is automatically cancelled out.

2 An alternative approach consists in seeking to detect the bursting of speculative bubbles, defined as the emergence of a substantial and lasting deviation of a share price or index from its fundamental price, followed by an adjustment period then a return to the fundamental equilibrium. The difficulty in applying this method lies in the practical determination of the fundamental value as well as the econometric identification of these bubbles (Boucher, 2004).

3 In order to have a sufficiently large sample, the mean and standard deviation are first calculated over ten years from March 1995 to March 2005, and then conditionally by gradually adding a month at a time to the sample. As with currency crises, if a crisis is detected within a 12-month period following another crisis, it is automatically cancelled out.

Box 3

Models used to predict crises

The dependent variable: creation of pre- and post-crisis windows

Using the crises defined above, we construct an indicator denoted $I_{i,t}$ composed solely of 0 and 1. It equals 1 for the 12 months preceding crises and the crisis itself; 0 in quiet periods. The 11 months following the crisis are excluded from the sample as the post-crisis period is irrelevant for the estimates and may even distort estimates if it is aggregated with quiet periods. This is the indicator used as a dependent variable in the regressions that follow. In seeking to estimate the probability that the variable $I_{i,t}$ is equal to 1, we estimate the probability of a crisis within a one-year horizon. Using a misnomer, we refer to this indicator $I_{i,t}$ as a “crisis indicator”.

Logit estimates

We carry out three types of estimate in turn. First, we estimate the base model, using the explanatory variables generally used to predict crises. This model is as follows:

$$\Pr(I_{i,t} = 1) = f\left(\alpha_0 + \sum_{k=1}^n \alpha_k X_{i,t}^k\right) \quad (1)$$

where $I_{i,t}$ is the crisis indicator variable described above $X_{i,t}^k$ the explanatory variables, f a logistical function of the type: $f(z) = \frac{e^z}{1+e^z}$.

Given the construction of our indicator $I_{i,t}$, this model directly estimates the probability of a crisis at a one-year horizon. Secondly, we estimate the same equation by adding a risk aversion indicator λ_t among the explanatory variables:

$$\Pr(I_{i,t} = 1) = f\left(\alpha_0 + \sum_{k=1}^n \alpha_k X_{i,t}^k + \alpha_{n+1} \lambda_t\right) \quad (2)$$

We try out, in turn, the VIX, the LCVI, PCA, the GRAI, the RAI and the SST as the risk aversion indicator λ_t .

Thirdly, we estimate the same model with the risk aversion indicator as the only explanatory variable:

$$\Pr(I_{i,t} = 1) = f(\alpha_0 + \alpha_{n+1} \lambda_t) \quad (3)$$

In order to be entirely rigorous, to obtain genuine crisis “predictions”, we would have to estimate the models over given period, then simulate them “out-of-sample”, that is, over a period subsequent to the estimates. Here we have estimated and simulated the probability of crises over the same period. The availability of our data is too limited to be able to shorten the estimation period. In addition, it would have been difficult to use this as a basis to assess the model's power to predict crises, as the sample includes very few crises at the end of the period. In this text, however, using a misnomer, we speak of the model's «predictive power» to refer to the adequacy of the values estimated by the model for the occurrence of crises within the sample.

The different models are then simulated over the sample period. The results give the estimated probabilities of a crisis. In order to obtain crisis predictions, a probability threshold needs to be set, above which it is decided that a crisis is predicted by the model. Here we have used 20%.¹⁸

The first estimate for the period July 1995 to September 2005 gives much better results as far as the quality of forecasting is concerned. Sixty-one percent of crises are correctly predicted by the base model. In the second estimate, which starts in December 1998, the number of crisis periods

18 This level is comparable to those chosen in similar studies (see, for example, Berg and Patillo, who review existing models in order to compare them and set thresholds at 25% and 50%). This threshold is not an intrinsic feature of the model; it merely serves to present the results. By setting it at a low level, as we do here, the probability estimated by the model has more chance of exceeding this threshold and therefore the number of crises predicted is greater. However, the number of “false alarms”, i.e. the number of wrongly predicted crises also increases.

Table 2
Logit estimates, currency crises

(estimation period: 07/1995 – 09/2005, number of observations = 2,186)

	Base model (1)	Model (2) VIX	Model (2) RAI	Model (2) GRAI
Constant	1.50 ***	1.17 ***	1.43 ***	0.29 ***
Real exchange rate	-4.47 ***	-5.21 ***	-4.42 ***	-4.26 ***
Reserves/M2	-0.96 ***	-0.97 ***	-0.92 ***	-0.92 ***
Real interest rate	1.19 ***	1.12 ***	1.21 ***	1.21 ***
Risk aversion indicator		0.05 ***	0.26 ***	0.86 ***
Log likelihood	-508.2	-502.9	-504.0	-501.4
Pseudo R ²	0.16	0.17	0.17	0.17
Crises predicted correctly ^{a)}	61.2%	62.9%	62.5%	63.4%
False alarms ^{b)}	59.1%	57.8%	58.8%	57.6%

(estimation period: 12/1998 – 09/2005, number of observations = 1,521)

	Base model (1)	Model (2) LCVI	Model (2) PCA	Model (2) SST
Constant	-0.20	-0.07	2.03 **	-2.83 *
Real exchange rate	-2.93 ***	-2.86 ***	-5.43 ***	-3.35 ***
Reserves/M2	-0.89 ***	-0.91 ***	-0.93 ***	-0.93 ***
Real interest rate	1.76 ***	0.78 ***	0.60 ***	0.72 ***
Risk aversion indicator		0.00	0.34 ***	-0.03 *
Log likelihood	-289.6	-289.6	-249.1	-256.0
Pseudo R ²	0.04	0.04	0.06	0.05
Crises predicted correctly ^{a)}	24.1%	24.1%	26.6%	26.6%
False alarms ^{b)}	65.5%	66.1%	61.1%	65.0%

Significantly different from zero at the * 90%, ** 95%, *** and 99% confidence levels (Student's t).

a) Number of crises predicted correctly as a % of total number of crises.

b) Number of crises wrongly predicted as a % of the number of crises predicted.

in the sample is considerably lower, with the Asian crises in 1997 notably disappearing from the sample. This leads to difficulty in estimating these crisis periods correctly. The ratio of correctly predicted crises then falls to 24%. The ratio of false alarms (number of false alarms relative to the total number of crises) for the two estimation periods is 59% and 66% respectively (see Table 2).

Introducing a risk aversion indicator makes it possible to improve the model's forecasts. This improvement is marginal when the model is estimated on the first period: the three indicators increase the ratio of correctly predicted crises by only 1%-2.5%, and reduce by only 1% the ratio of false alarms. By contrast, over the reduced period, given that the base model yields poor results, the improvement provided by the indicators is substantial, except in the case of the SST.

Table 3
Logit estimates, model (3), currency crises

(estimation period: 07/1995 – 09/2005, number of observations = 2,255)

	VIX	GRAI	RAI
Constant	-2.80 ***	-2.20 ***	-2.20 ***
Risk aversion indicator	0.03 ***	1.11 ***	0.35 ***
Log likelihood	-647.2	-732.0	-736.9
Pseudo R ²	0.00	0.01	0.01
Crises predicted correctly ^{a)}	0.0%	0.9%	0.0%
False alarms ^{b)}	na	88.9%	na

(estimation period: 12/1998 – 09/2005, number of observations = 1,543)

	LCVI	ACP	SST
Constant	-3.24 ***	-3.00 ***	-4.54 ***
Risk aversion indicator	0.00	0.15 ***	-0.02
Log likelihood	-311.1	-307.3	-311.1
Pseudo R ²	0.00	0.01	0.00
Crises predicted correctly ^{a)}	0.0%	0.0%	0.0%
False alarms ^{b)}	na	na	na

Significantly different from zero at the * 90%, ** 95%, *** and 99% confidence levels (Student's t).

a) Number of crises predicted correctly as a % of total number of crises.

b) Number of crises wrongly predicted as a % of the number of crises predicted.
na: No crisis predicted by the model.

When they are introduced into the regressions, the risk aversion indicators are significant, except for the LCVI and the SST (see Table 3). However, their power to predict currency crises is nil.

2/3 Stock market crises

All of the explanatory variables introduced into the base model of stock market crises are significant (see Table 4).¹⁹ The sign is positive for the PER, an increase in which may indicate an overvaluation of stock prices. It is negative for returns, which already tend to decline at the onset of the crisis, as well as for real interest rates.

When they are introduced into the regressions on stock market crises, the risk aversion indicators are significant and positive, both with the other explanatory variables (Table 4) or when taken alone (Table 5). Here again, the SST is the only exception.

19 Unlike in the previous case, shortening the estimation period does not reduce the quality of the estimates or forecasts. Indeed, the number of crises in the sample is not affected if we start our estimates in December 1998, given that all of the stock market crises took place in the early 2000s. As a result, here we only present the results for the shorter period, which makes it possible to compare the accuracy of the different indicators directly.

Table 4
Logit estimates, stock market crises

(estimation period 12/1998 – 09/2005, number of observations = 1,950)

	Base model (1)	Model (2) VIX	Model (2) GRAI	Model (2) RAI
Constant	-2.97 ***	-3.79 ***	-2.96 ***	-2.84 ***
PER	0.43 ***	0.42 ***	0.46 ***	0.44 ***
Returns	-2.33 ***	-2.18 ***	-2.22 ***	-2.22 **
Real interest rate	-0.20 **	-0.23 ***	-0.25 ***	-0.25 ***
Risk aversion indicator		0.04 ***	1.27 ***	0.60 ***
Log likelihood	-555.5	-552.1	-540.6	-538.8
Pseudo R ²	0.33	0.34	0.35	0.35
Crises predicted correctly ^{a)}	84.4%	84.4%	86.0%	84.1%
False alarms ^{b)}	49.9%	48.8%	48.3%	48.1%

(estimation period 12/1998 – 09/2005, number of observations = 1,950)

	Modèle de base (1)	Modèle (2) LCVI	Modèle (2) ACP	Modèle (2) SST
Constant	-2.97 ***	-2.51 ***	-3.37 ***	-5.74 ***
PER	0.43 ***	0.41 ***	0.43 ***	0.42 ***
Returns	-2.33 ***	-2.36 ***	-1.80 ***	-2.28 ***
Real interest rate	-0.20 **	-0.16 *	-0.33 ***	-0.21 **
Risk aversion indicator		-0.01 **	0.53 ***	-0.03 ***
Log likelihood	-555.5	552.5	-497.0	-552.2
Pseudo R ²	0.33	0.34	0.40	0.34
Crises predicted correctly ^{a)}	84.4%	84.8%	86.6%	84.4%
False alarms ^{b)}	49.9%	50.0%	48.5%	48.9%

Significantly different from zero at the * 90%, ** 95%, *** and 99% confidence levels (Student's t).

a) Number of crises predicted correctly as a % of total number of crises.

b) Number of crises wrongly predicted as a % of the number of crises predicted.

Table 5
Logit estimates, Model (3), stock market crises

(estimation period: 12/1998 – 09/2005, number of observations = 1,950)

	VIX	GRAI	RAI
Constant	-4.86 ***	-1.66 ***	-1.54 ***
Risk aversion indicator	0.14 ***	1.78 ***	0.97 ***
Log likelihood	-784.4	-822.9	-816.0
Pseudo R ²	0.09	0.05	0.06
Crises predicted correctly ^{a)}	43.3%	56.7%	66.4%
False alarms ^{b)}	77.5%	73.2%	70.6%

(estimation period: 12/1998 – 09/2005, number of observations = 1,950)

	LCVI	ACP	SST
Constant	-1.44 ***	-2.40 ***	-6.94 ***
Risk aversion indicator	-0.00	0.68 ***	-0.06 ***
Log likelihood	-871.4	-669.1	-848.2
Pseudo R ²	0.01	0.21	0.02
Crises predicted correctly ^{a)}	0.0%	74.5%	26.5%
False alarms ^{b)}	na	61.9%	84.1%

Significantly different from zero at the * 90%, ** 95%, *** and 99% confidence levels (Student's t).

a) Number of crises predicted correctly as a % of total number of crises.

b) Number of crises wrongly predicted as a % of the number of crises predicted.

na: No crisis predicted by the model.

The base model predicts 84.4% of stock market crises, with a false alarm ratio of 49.9%. Added into a regression with the other explanatory variables, the risk aversion indicators lightly increase these good results in terms of prediction (Table 4). When they are taken alone, all the risk aversion indicators also obtain good results, with the exception of the LCVI (see Table 5). The GRAI and RAI have fairly similar predictive powers, with 56% to 67% of crises correctly predicted and around 70% of false alarms. The VIX and SST yield much less good results.

The interpretation of these good results should, however, be put in perspective, recalling that it is not the turning point that is predicted by the model, but a point when the drop in stock prices is already such that the situation is “abnormal”. Consequently, it is not surprising that risk aversion has already started to increase before the crisis thus defined breaks out. Predicting turning points would be quite a different exercise.

On this basis, the PCA performs best, it being the only one to correctly predict 74.5% of the crises in the sample, with a false alarm ratio of 61.9%. How can the PCA's good performance, which is repeated when it is introduced alone in the regression (Table 5) or added to the other explanatory variables (Table 4), be explained? As the PCA is a linear combination of the eight spreads on which it is calculated, we may wonder whether the estimates would be further improved by replacing this variable in regressions (2) and (3) by the spreads themselves. The results (not detailed here due to lack of space) show that the eight spreads give estimates that are more or less equivalent to those obtained with the PCA. For Model (2), they succeed in predicting 88.2% of crises (compared to 86.6% for the PCA), with 44.7% false alarms (compared to 48.5% for the PCA). In Model (3), the eight spreads allow us to obtain a result of 76.3% of crises predicted correctly (compared to 74.5% for the PCA), with 50.6% false alarms (compared to 61.9% for the PCA). Overall, the predictions obtained with the PCA or the eight spreads together are more or less equivalent. Using a synthetic indicator such as the PCA is therefore preferable.

It appears then that risk aversion plays a part in stock market crises and that it is indeed captured by certain indicators. Their contribution is, however, small compared with the other explanatory factors.

Empirical risk aversion indicators are supposed to provide a synthetic indication of market sentiment with regard to risk. The tests conducted in this article show that risk aversion does indeed tend to increase before crises, at least when measured by the most relevant indicators. In other words, these indicators are significant in the regressions explaining the periods preceding financial crises. A rise in them also contributes to increasing the probability of a crisis. The fact that risk aversion is particularly high just before crises is consistent with the intuitive definition of this concept.

The predictive power of these indicators for currency crises is small. By contrast, in the case of stock market crises, most of the risk aversion indicators tested allow satisfactory results to be obtained. The best results regarding the prediction of stock market crises are obtained using principal component analysis on risk premia.

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APPENDIX 1

Theoretical framework

Review of a base model for asset prices: the CCAPM

We consider an investor who freely buys or sells an asset. To keep it simple, we assume that there is a single risky asset, two periods, constant consumer prices and a utility function that is separable over time. The investor must therefore maximise his utility by choosing an optimal quantity of asset to buy in the first period. The optimisation programme to be solved is as follows:

$$\begin{cases} \max_{\xi} u(c_t) + E_t[\delta u(c_{t+1})] \\ C_t = y_t - p_t \xi \\ C_{t+1} = y_{t+1} + x_{t+1} \xi \end{cases} \quad (1)$$

We denote consumption as c_t in t , non-financial revenue as y_t , the price of the asset as p_t , gross income from the asset x_{t+1} and the quantity of asset bought in t as ξ . δ is the intertemporal discount factor, which captures the consumer's preference for present.

The price of the asset p_t is deduced from the first order condition:

$$p_t = E_t \left[\delta \frac{u'(c_{t+1})}{u'(c_t)} x_{t+1} \right] \quad (2)$$

The asset price expressed in equation (2) can be interpreted as the expected income x_{t+1} , discounted by a discount factor, denoted m_{t+1} and referred to as the "stochastic discount factor":

$$p_t = E_t(m_{t+1} x_{t+1}) \quad (3)$$

with

$$m_{t+1} = \delta [u'(c_{t+1})/u'(c_t)] \quad (4)$$

Using the stochastic discount factor involves weighting income on the asset differently depending on the relative marginal utility of consumption over the two periods. If consumption in $t + 1$ is high compared to that in t , given that marginal utility diminishes, the discount factor is small. This means that the income arising from the asset in this case is weighted less. Conversely, if consumption is low, income from the asset is high for the consumer, who gives it greater weighting.

To express the risk premia, it is necessary to derive the gross return on the asset. To do so, we divide income x_{t+1} by the price p_t (i.e. $R_{t+1} = x_{t+1}/p_t$). We obtain:

$$1 = E(m_{t+1} R_{t+1}) \quad (5)$$

Risk-free asset

By definition, the income from a risk-free asset does not vary with states of the world, which amounts to saying that the risk-free rate in $t + 1$, denoted R_{t+1}^f , is known in advance:

$$\begin{aligned} 1 &= E(m_{t+1} R_{t+1}^f) = E(m_{t+1}) R_{t+1}^f \\ R_{t+1}^f &= \frac{1}{E(m_{t+1})} \end{aligned} \quad (6)$$

Risk premium

By definition, the risk premium equals the difference $E(R_{t+1}) - R_{t+1}^f$, i.e. the expected excess return on the risky asset compared to that on the risk-free asset.

Considering equations (5)²⁰ and (6), we have:

$$E(R_{t+1}) - R_{t+1}^f = -\text{cov}[m_{t+1}, R_{t+1}] R_{t+1}^f \quad (7)$$

The risk premium therefore equals minus the covariance of the return on the risky asset with the stochastic discount factor multiplied by the risk-free rate.

Price and quantity of risk

The risk premium can be decomposed as follows:

$$E(R_{t+1}) - R_{t+1}^f = \left(-\frac{\text{cov}(R_{t+1}, m_{t+1})}{\text{var}(m_{t+1})} \right) \left(\frac{\text{var}(m_{t+1})}{E(m_{t+1})} \right) \quad (8)$$

Generally speaking, assuming there are several assets subscripted from $i = 1$ to n , we can write:

$$E(R_{t+1}^i) - R_{t+1}^f = \left(-\frac{\text{cov}(R_{t+1}^i, m_{t+1})}{\text{var}(m_{t+1})} \right) \left(\frac{\text{var}(m_{t+1})}{E(m_{t+1})} \right) \quad (9)$$

which can be written in the form:

$$E(R_{t+1}^i) = R_{t+1}^f + \beta_{i,m} \lambda_m \quad (10)$$

with :

$$\beta_{i,m} = \left(-\frac{\text{cov}(R_{t+1}^i, m_{t+1})}{\text{var}(m_{t+1})} \right) \quad (11)$$

$$\lambda_m = \left(\frac{\text{var}(m_{t+1})}{E(m_{t+1})} \right) \quad (12)$$

We can consider that λ_m is the price of risk, which is common to all assets, and that $\beta_{i,m}$ is the specific quantity of risk associated with each asset.

Often, the price of risk λ_m is regarded as corresponding to risk aversion. We do the same in this article. However, to avoid any confusion, it needs to be distinguished from the parameter of risk aversion in the consumer's utility function.

Distinction between the risk aversion parameter in the utility function and the price of risk

We use the conventional power utility function $u(c_t) = \frac{1}{1-\gamma} c_t^{1-\gamma}$, where γ is the coefficient of relative risk aversion. The stochastic discount factor is then written:

$$m_{t+1} = \delta (c_{t+1}/c_t)^{-\gamma} \quad (13)$$

²⁰ Which can be developed using the definition of covariance, $\text{cov}(m_{t+1}, R_{t+1}) = E(m_{t+1}, R_{t+1}) - E(m_{t+1}) E(R_{t+1})$.

The expected return and price of risk depend on the rate of growth in consumption, denoted Δc :

$$\begin{aligned} E(R_{t+1}^i) &= R_{t+1}^f + \beta_{i,\Delta c} \lambda_{\Delta c} \\ \lambda_{\Delta c} &= \gamma \text{var}(\Delta c) \end{aligned} \quad (14)$$

The price of risk $\lambda_{\Delta c}$ is determined by the risk aversion parameter γ and by the volatility of consumption. Expected returns increase linearly with their betas and the volatility of consumption.

Consistency with the CAPM

The CCAPM model may be regarded as being a general representation from which the other models currently used to determine asset prices can be deduced. The CAPM of Sharpe (1964) and Lintner (1965) may be considered a particular case of the CCAPM. We therefore express the stochastic discount factor depending on the return, denoted R_{t+1}^w , on the “wealth portfolio” held by the consumer. This return R^w thus serves to approximate the marginal utility of consumption:

$$m_{t+1} = a - bR_{t+1}^w \quad (15)$$

a and b are parameters > 0

It is then possible to approximate R^w by the return on a broad portfolio of stocks regarded as the market portfolio. This can be a large stock index such as the EuroStoxx 50 or the S&P 500. This assumes that the consumer's wealth is invested across the whole of the market. If the return on the market portfolio is denoted R^m the stochastic discount factor will then be:

$$m_{t+1} = a - bR_{t+1}^m \quad (16)$$

This formulation is consistent with the previous model of consumption in which the market return plays a similar role to that of changes in consumption in the previous model.

Link with a factor model

The stochastic discount rate is expressed as a function of a number of factors f , which may be different from consumption or market returns.

$$m_{t+1} = f_{t+1}' b \quad (17)$$

If we consider that factors f are not directly observable, a factor analysis method is needed to estimate them (see Cochrane, 2001, p.175).

APPENDIX 2

The GRAI: risk aversion represented by the correlation between volatility and price changes

The framework is given by a CAPM model of the type:

$$E(R_{t+1}^i) - R_{t+1}^f = \rho \text{cov}(R_{t+1}^i, R_{t+1}^m) \quad (1)$$

with ρ representing risk aversion and R^m being the return on the market portfolio, equal to the return on all of the assets in this portfolio weighted according to their importance in the portfolio index α_i , so that:

$$R_{t+1}^m = \sum_i \alpha_i R_{t+1}^i \quad (2)$$

If we add an assumption of independent returns on different markets, the risk premia on each security no longer depend on the covariance with other premia, but only on the security's variance (denoted σ_i^2).

$$E(R_{t+1}^i) - R_{t+1}^f = \rho \text{cov}(R_{t+1}^i, \alpha_i R_{t+1}^i) = \rho \alpha_i \sigma_i^2 \quad (3)$$

By deriving formula [3] in relation to ρ , we obtain the change in the expected risk premium when risk aversion increases:

$$\frac{\partial [E(R_{t+1}^i) - R_{t+1}^f]}{\partial \rho} = \alpha_i \sigma_i^2 \quad (4)$$

Thus, an increase in risk aversion results in an increase in the expected risk premium that is proportional to the volatility of the asset's return, according to equation (4).

By deriving formula (3) in relation to σ_i^2 , we obtain the change in the risk premium when the asset's volatility, i.e. the risk associated with it, increases:

$$\frac{\partial [E(R_{t+1}^i) - R_{t+1}^f]}{\partial \sigma_i^2} = \rho \alpha_i \quad (5)$$

Equation (5) shows that an increase in an asset's volatility brings about an increase in the risk premium on this asset that is proportional to the risk aversion, but does not depend on the initial volatility.

To calculate GRAI indicators, variations in prices rather than expected excess returns are used, which explains the change in sign in the correlation.

The expected return equals the anticipated change in price:

$$E(R_{t+1}^i) = E(P_{t+1}^i) - P_t \quad (6)$$

By assuming that $E(P_{t+1}^i)$ is constant and using (6) and (3), we obtain:

$$\frac{\partial [P_t]}{\partial \rho} = -\alpha_i \sigma_i^2 \quad (7)$$

The GRAI indicator is therefore a correlation with a negative sign between price changes of the different assets and their volatility.

APPENDIX 3

The database

The GRAI

The currency GRAI comprises 12 to 15 currencies quoted against the dollar according to the periods for which the data are available: the Norwegian krone, the Czech koruna, the Swedish krona, the Deutsche mark then the euro from 1999, the Australian dollar, the Canadian dollar, the Hong Kong dollar, the Singapore dollar, the New Zealand dollar, the Swiss franc, pound sterling, the Mexican peso, the South African rand, the yen and the Polish zloty.

The currency RAI is made up of 12 currencies over the whole period as a different number of series over time would produce abrupt changes in the regression coefficient, which would distort the calculation.

The stock market GRAI and RAI include the major stock market indices of 27 developed and emerging economies: Argentina, Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Indonesia, Ireland, Italy, Japan, Malaysia, Netherlands, Norway, New Zealand, Portugal, South Africa, Spain, Sweden, Turkey, the United Kingdom and the United States.

Components of the PCA

Eight risk premia are used in the PCA. The data are taken from Bloomberg.

- Four OAS corporate bond spreads for the euro area and the United States:²¹ for each area, one spread for investment grade and another for speculative grade. These spreads are calculated by Merrill Lynch.
- Two spreads for emerging markets: first, the EMBI Global,²² representing the risk premium on their dollar-denominated external sovereign debt, calculated since mid-1998 by JP Morgan on a large panel of emerging market countries; and second, an index of corporate debt, denominated in dollars or euro and issued abroad, of a large number of emerging market countries. This index is calculated by the bank Merrill Lynch and satisfies certain liquidity conditions.
- Two swap spreads, one for the euro area and one for the United States.

Crisis indicators

Currency crises

The countries selected are the following: Argentina, Brazil, Bulgaria, Chile, Colombia, Czech Republic, Estonia, Hungary, Indonesia, Latvia, Lithuania, Mexico, Philippines, Poland, Romania, Singapore, South Korea, Thailand, Uruguay and Venezuela.

The sample period is from March 1995 to September 2005.

²¹ For this, we use bonds that have an optional component –the option adjusted duration– to calculate the credit spread between two bonds with the same maturity (Lubochinsky, 2002).

²² The Emerging markets bond index Global (EMBI Global) is an index that represents the average price of bonds in emerging market countries.

The data were taken from the IMF's International Financial Statistics (IFS) database for the 1995-2005 period as monthly data (quarterly data were made monthly by means of linear interpolation): total reserves minus gold, line 11.d; money, line 34, quasi-money, line 35, to obtain the reserves/M2 ratio; real exchange rate, line ae, consumer prices, line 64, to calculate the real exchange rate; and money market rate, lines 60, 60b or 60a (depending on the availability of data and in this order of preference), to calculate the real interest rate (with the aid of consumer prices).

Stock market crises

The countries selected are the following: Argentina, Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Indonesia, Ireland, Italy, Japan, Malaysia, Netherlands, Norway, New Zealand, Portugal, South Africa, Spain, Sweden, Turkey, the United Kingdom and the United States.

The estimation period is from December 1995 to September 2005.

The indices, taken from Bloomberg, are the following: DAX (Germany), S&P/TSX Composite (Canada), DJIA (United States), CAC 40 (France), OMX Stockholm 30 (Sweden), AEX (Pays-Bas), BEL20 (Belgium), MIB30 (Italy), Nikkei (Japan), FTSE 100 (United Kingdom), IBEX 35 (Spain), PSI General (Portugal), OMX Copenhagen 20 (Denmark), OMX Helsinki (Finland), ATX (Austria), Irish overall (Ireland), OBX (Norway), ASE General (Greece), ISE National 100 (Turkey), Johannesburg Stock Exchange (South Africa), S&P/ASX 200 (Australia), NZX Top 10 (New Zealand), Hang Seng (Hong Kong), Kuala Lumpur Composite (Malaysia), Jakarta Composite (Indonesia), MERVAL (Argentina), BOVESPA Stock (Brazil). The returns have been calculated using these indices. The PER on these indices have also been obtained from Bloomberg. Interest rates have been taken from the IMF's IFS database and calculated in the same way as for currency crises.

Bank liquidity and financial stability

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This article presents new asset-based measures of bank liquidity that capture and quantify the dynamics of liquidity flows within the French banking system between 1993 and 2005. We consider net changes in the “stock” of liquidity in banks’ balance sheets as the result of two simultaneous “flows”: the purchases and sales of liquid assets. Our “flow approach” allows us to assess the intertemporal dimension of liquidity fluctuations within the banking system (expansions, contractions and overall reallocation) on the basis of individual bank data. In turn, these fluctuations lend themselves to an insightful cyclical analysis.

Our main results can be summarised as follows. First, we find substantial evidence of simultaneous liquidity expansion and contraction, as well as extensive balance sheet liquidity reshuffling, in a context where bank liquidity is expanding overall. Second, positive and negative flows procyclically lead the cycle by approximately two quarters. Third, positive output shocks are likely to have a positive and persistent effect on liquidity flows. The liquidity responses to asset price and monetary policy impulses seem in line with the idea that liquidity flows are driven by “funding” versus “profit” motives in the presence of a trade-off between expected returns and interest-rate risk. On the one hand, liquidity is held to ensure the smooth financing of banking activities. On the other hand, banks may hold liquidity so as to maximise expected returns. Liquidity holdings therefore decline when alternative investment opportunities become more attractive.

From a policy perspective, the results suggest that under normal circumstances, the cross-checking of liquidity ratios and liquidity flows could prove useful to design a robust prudential approach to liquidity. Under extreme circumstances, the traditional concept of “bank liquidity” could be complemented by considerations on the liquidity of monetary and other financial markets when emergency liquidity provision is envisaged.

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Over the past decades, the rapid expansion of the financial system has given rise to increasingly diversified and complex financial activities and instruments. It has been argued that, in the process, financial sector developments have played an increasing role in shaping and sometimes amplifying macroeconomic fluctuations.

Concerns about the “excessive” procyclicality of the financial system have in turn prompted calls for policy actions in the fields of prudential regulation, accounting, risk measurement or monetary policy as a whole, in order to enhance financial system and macroeconomic stability.

With this in mind, this article focuses on one specific intersection of macroeconomic and financial stability, namely bank liquidity. We develop a flow approach to analyse the macroeconomic and cyclical properties of the French banking system’s liquidity, and to draw conclusions with regard to bank liquidity supervision and lender of last resort interventions.

The article is structured as follows. Section 1 presents the concepts of bank and market liquidity and puts them in the perspective of the last resort provision of liquidity to financial institutions. Data and stylised facts are described in Section 2, while our concepts and measurement methods are proposed in Section 3. Section 4 articulates our analysis and results.

1| BANK LIQUIDITY, MARKET LIQUIDITY AND THE LENDER OF LAST RESORT

An appropriate analysis of bank liquidity for macroeconomic and financial stability purposes could start with a holistic approach that takes into account the interdependencies between market liquidity and bank liquidity (1|1). The link between

liquidity management at the bank level and market practices indeed becomes particularly crucial in crisis situations where vanishing liquidity often causes market distress, contagion and systemic effects (1|2). It is certainly because the primary responsibility for preventing any sources of such instability lies with the liquidity and risk management function of the banks themselves that occurrences of lender of last resort interventions are often viewed as second-best and debated on those grounds (1|3).

1|1 Bank liquidity and market liquidity

Bank liquidity is commonly understood to be “the ability to meet cash obligations when due” and defined in two ways.¹ The banking literature originally focused on a narrow definition of liquidity, also labelled “funding liquidity”. Funding liquidity encompasses the liquidity (*i.e.* cash or assets readily transformable into cash and held for that purpose) needed either to accommodate counterparties’ withdrawal of short-term funding, or to support the bank’s operations. This dimension of liquidity is presumably predominant in the context of maturity transformation, as traditionally effected by banks.

The second –broader– definition of bank liquidity considers that banks are also involved, potentially heavily, in asset trading. This second dimension, which is closer to (and sometimes also labelled) “market liquidity”, relates to the ability of banks to literally *liquidate* a non-cash asset –*e.g.* an investment security originally bought to be held to maturity– in a last resort context so as to raise central bank money.²

Analogies between market and bank liquidity are underlined by Borio (2004), who states that “the genesis of market distress resembles quite closely that of banking distress”. Understanding the collective behaviour of market participants and the interdependencies between individual financial institutions and market dynamics therefore seems meaningful for monetary and financial stability purposes (Davis, 1994).³

¹ This twofold definition was adopted by the Joint Forum in 2004.

² For example, holding a liquid instrument may be of little value in an emergency situation if suddenly, no trading partner willing to buy the supposedly liquid asset at a reasonable price can be found on the market. In that sense, bank liquidity and market illiquidity may well coexist. Also, as noted by Brunnermeier and Pedersen (2005), funding liquidity to dealers, investment banks, etc. enhances trading and market liquidity. Reciprocally, market liquidity, by improving the collateral value of assets (margins are typically lower in a liquid market), eases funding constraints.

³ One should also keep in mind that some banks are large players on (in particular money) markets and contribute to a large part of market turnover (Hartmann and Valla, 2006), thereby also reinforcing the interaction between market and bank liquidity.

1|2 Illiquidity risk, contagion and systemic effects

The first symptoms of a liquidity crisis in the banking system generally take the form of a liquidity deficit in the balance sheet of a bank. Much has been written on the mechanism of “bank runs” since the seminal contribution of Diamond and Dybvig (1983). Liquidity risk, if materialised in the case of a so-called “systemic” institution, may entail contagion and jeopardise macroeconomic and financial stability. Contagion has been described in the context of peer monitoring on the money market (Rochet and Tirole, 1996), liquidation of interbank deposits in response to unexpected deposit withdrawals (Allen and Gale, 2000) or expected scarce reserves (Freixas, Parigi and Rochet, 2000) or adverse selection in interbank lending when the solvency statute of interbank borrowers is unknown (Flannery, 1996).

Recent literature on liquidity and banking crises has identified a number of central factors driving contagious failures of financial institutions. These factors include:

- the limited capacity of financial markets to absorb asset sales (Allen and Gale, 2002, 2004, 2005; Gorton and Huang, 2002; Schnabel and Shin, 2002),
- the inefficiency of the mechanisms at work when assets need to be liquidated (Diamond and Rajan, 2000),
- the strength of direct balance sheet interlinkages (Cifuentes, 2002; Eichberger and Summer, 2005)⁴,
- and phenomena related to changes in asset prices.⁵ For example, marking to market the asset book can generate endogenous asset sales and lead to contagious failures. In this context, liquidity requirements can –unlike capital requirements– can be effective in forestalling contagious failures (Cifuentes, Ferrucci and Shin, 2005).

Overall, the literature and practical experience suggest that bank and market instability are rare but potentially damaging events. While regulation and supervision have the task of ensuring that liquidity and risk management functions of banks remain at all times supportive of financial stability, it may not be possible to eliminate all risks of instability *ex ante*. In such cases, central banks are in a unique position to provide liquidity when warranted it is required.

1|3 Bank liquidity and the lender of last resort (LLR)

The provision of emergency liquidity assistance in crisis circumstances is often referred to as last resort lending (LLR).⁶ The LLR issue arises in the first place from the potential externality a failing bank may have on both the financial sector and the real economy, in a context where this externality cannot be easily eliminated due to asymmetric information.

LLR interventions consist in the exceptional provision, under specific stress conditions, of short-term loans to commercial banks facing acute liquidity problems. Bank liquidity therefore lies at the heart of LLR policy issues. Views on the “classic” approach to LLR interventions, rooted in the works of Thornton (1802) and Bagehot (1873), have given rise to distinct “streams of thought”. Their coexistence suggests that no consensus has been reached on the modalities of optimal and efficient interventions.⁷

The classic “Thornton-Bagehot” principle relies on a failure in the interbank market due to asymmetric information on banks’ solvency. Under asymmetric information, the willingness to pay a high interest rate following an adverse liquidity shock may in fact be interpreted as a signal of increased riskiness. If so, markets fail to insure against liquidity shocks and the central banks

⁴ See Cifuentes et al. (2005) for references to specific country studies in Switzerland, Germany, the United States, the United Kingdom and Austria. Models using actual cross-exposures in real banking systems are typically calibrated to simulate the effects of an individual failure on the system as a whole.

⁵ The liquidity-based approach to understanding financial crises via asset price fluctuations has been developed at length by F. Allen and D. Gale. With incomplete markets, financial institutions may be forced to sell assets to obtain liquidity. Because the supply of and demand for liquidity are likely to be inelastic in the short-run, even a little aggregate uncertainty may cause large fluctuations in asset prices (among others, Allen and Gale (2005) and references therein).

⁶ In this article, LLR refers to such interventions as conducted by central banks.

⁷ See Bordo (1990) for a comprehensive review, on which this paragraph is based.

should step in.^{8 9} However, the mere existence of market failures has been questioned by the “free banking” approach, which contends that markets themselves are capable of protecting the banking system from panics (Selgin, 1988 and 1989). A third view claims that central bank operations targeted at specific ailing institutions are simply unnecessary. Open market operations aimed at rebalancing liquidity conditions for the market as a whole would suffice to ensure the stability of the financial system (Goodfriend and King, 1988). A fourth view asserts that the clear-cut distinction between illiquidity and insolvency is a myth, at least *ex ante*. As a result, emergency lending facilities should be extended when needed, even though they do create moral hazard problems whereby banks may be tempted to adopt a more risky behaviour (Goodhart, 1987 and 1995). The possibility of contagion adds a compelling financial stability argument to systematic interventions for systemic institutions (Solow, 1982). Although actual LLR interventions are exceptional, anecdotal evidence suggests that this inherent difficulty (grey area between illiquidity and insolvency, moral hazard) has not been removed as yet.

In fine, the decision to supply emergency liquidity assistance for financial stability purposes hinges on the appreciation of the social cost associated with individual bank failures, bank panics or contagion effects. Available evidence suggests that LLR mechanisms have helped (Miron, 1986; Bordo, 1990; Eichengreen and Portes, 1986) or could have helped (Friedman and Schwartz, 1963) avoid costly bank panics. Contagion effects have been shown to be potentially costly (Aharony and Swary, 1983; Herring and Vankudre, 1987 ; Saunders, 1987), lending support overall to the usefulness of rescuing ailing institutions.¹⁰

Recent contributions have investigated the conditions under which LLR interventions may actually fail to ensure macroeconomic and financial stability (Antinolfi, Huybens and Keister, 2001). However, this literature concentrates on emerging

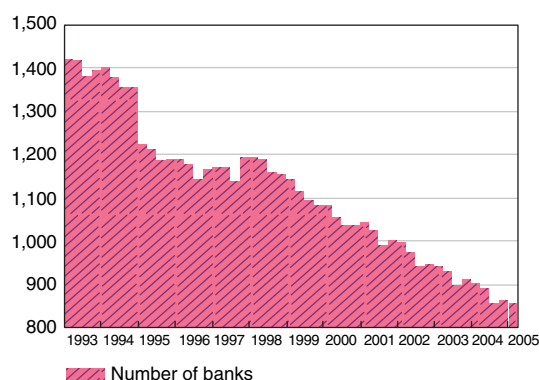
economies and is confined to the international dimension of the lender of last resort (Chang and Velasco, 2000).

2 | DATA AND STYLED FACTS ON THE FRENCH BANKING INDUSTRY

The French supervisory authority, the Commission bancaire, collects quarterly balance sheet data on an individual and consolidated basis for all banks falling under its regulation. Complete balance sheets are available from 1993-Q1 to 2005-Q1.¹¹

This period was one of marked consolidation in the French banking industry, as evidenced by the dramatic fall in the number of banks (from 1,400 to 850 in our panel) over the decade (Chart 1). In parallel, a number of regulatory changes took place during this period (they will be discussed below). Finally, the launch of Stage III of EMU in January 1999 spurred the development and integration of euro money markets and created a new environment for banks' liquidity management in Europe (see Bernhardsen and Ejerskov, 2005, or Hartmann and Valla, 2006).

Chart 1
Consolidation in the French banking system



Source: Commission bancaire.

⁸ It interest rate increases could also lead to price disruptions that may “crowd out” market participants, leading to market closure.

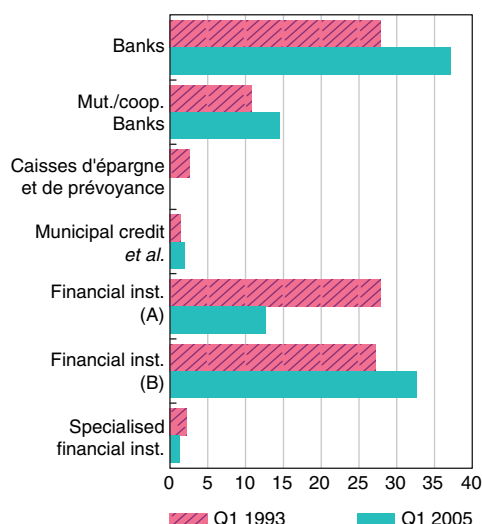
⁹ Bagehot principles read as follows: the LLR should lend to:

- illiquid but solvent financial institutions;
- at a penalty rate so as to avoid financial institutions using the funds to finance lending operations;
- and against good collateral;
- this LLR policy must be publicly announced *ex-ante* in a credible way.

¹⁰ Further references to financial stability and LLR policy, with some links to the euro area, may be found in Hartmann and Valla (2006).

¹¹ In selecting our panel, we tried to keep the most representative picture of the banking system over the sample period by removing banks subject to very specific regimes (categories 0, 8 and 9 in the Commission bancaire's nomenclature, corresponding respectively to public entities such as the Treasury or the Banque de France, specific securities financial corporations, and “miscellaneous” bodies).

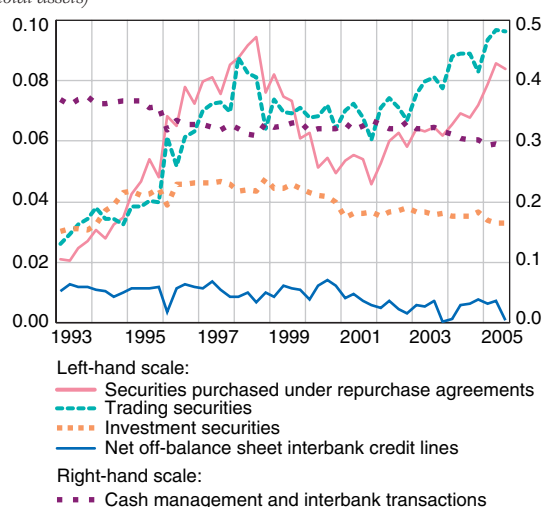
Chart 2
Evolution of the French banking system
 Distribution across bank categories in 1993 and 2005
 (%)



Source: Commission bancaire.

Alongside this consolidation process, the structure of the French banking industry evolved towards an increase in the share of banks and mutualist or co-operative institutions (their joint share rose from roughly less than 40% to more than 50%), while the share of financial institutions declined by the same proportion (from 58% to 47% approximately, see Chart 2).

Chart 3
Evolution of liquidity categories as a share of total bank assets
 (% total assets)



Source: Commission bancaire; authors' calculations.

¹² Our measure of bank liquidity is described in Box 1.

¹³ Key references in this area include Davis and Haltiwanger (1992). More recently, estimates of gross credit flows have been conducted in an analogous way, see Craig and Haubrich (2000) and Dell'Ariccia and Garibaldi (2005).

The liquidity structure of French banks as a share of their total assets can be seen in Chart 3.¹² While remaining the main component of our liquidity measure, short-term and interbank lending declined somewhat over the period (from 35% to 30%). By contrast, the share of securities bought under repurchase agreements and trading securities rose steadily, from 2% to 8% respectively. The share of investment securities (4%) and net off-balance-sheet financing commitments (1%) remained stable over the period under review.

3| MEASURING BANK LIQUIDITY

Our analysis of bank liquidity at the aggregate level is presented in this section. After a discussion of the concept and measurement of “gross liquidity flows” (3|1), methodological considerations associated with this concept are underlined (3|2). Aggregate liquidity measures are then presented (3|3).

3|1 Gross liquidity flows: concepts and measurement

The concept of “gross flows” originates from labour market turnover studies.¹³ Our efforts to measure and quantify liquidity dynamics in the banking sector build on this literature. This approach allows us to describe gross quantities of liquidity that flow in and out of the French banking system's balance sheet, as well as the rate at which liquidity is overall reallocated across banks. In turn, these fluctuations lend themselves to an insightful cyclical analysis.

An individual bank expands (contracts) liquidity in a given quarter if its liquidity growth is positive (negative). For example, a bank holding 100,000 worth of liquid assets in 1993-Q1 and 110,000 (respectively 90,000) in 1993-Q2 would have expanded (respectively contracted) liquidity in this quarter at a rate of 10%. At the aggregate level, gross liquidity expansion (contraction) is proxied by the sum of the absolute values of all liquidity changes across banks with positive (negative) liquidity growth. Gross rates of expansion and contraction are then computed. For example, if the banking system is composed of two banks of similar size

Box 1

Measuring bank liquidity

Liquidity management within a financial institution is governed by two main criteria. First, the institution should be sure that appropriate, low-cost funding is available at short notice. This might involve holding a portfolio of assets that can easily be sold, holding significant volumes of stable liabilities, or maintaining credit lines with other financial institutions. Second, liquidity management also needs to comply with profitability requirements. Financial stability issues lie exactly at this liquidity/profitability nexus: conditions should be ensured for banks to manage liquidity stocks and flows in the most profitable manner that at the same time does not jeopardise financial stability.

In France, bank liquidity is monitored on the basis of a liquidity ratio. The Commission bancaire's liquidity requirement consists in a monthly report on banks' global liquid assets and liabilities, which includes cash positions, claims including repo-related claims with at most one month remaining maturity, negotiable securities, as well as off-balance-sheet commitments and available liquidity lines. Using this information, the Commission bancaire establishes the ratio of liquid assets to liquid liabilities using a weighting scheme to reflect the likelihood of items being rolled over or being available in the event of a liquidity squeeze. The weighting scheme thereby recognises that assets that are liquid may be realized only with some delay and at some risk. This ratio has to be maintained above 100% at all times. The liquidity coefficient used by the Commission bancaire belongs to the family of "Asset-Liability" liquidity coefficients, based on measures of both liquid assets and liquid liabilities. Those coefficients are traditionally preferred for supervisory purposes on the grounds that banks' liquidity management relates not only to the liquidity of their assets but also to the nature, structure and transformation of their liabilities.

The measure presented in this article departs from the current prudential approach along two main lines. First, it is exclusively asset-based. Second, it is to some extent "agnostic", in that it does not rely on a normative weighting scheme across asset categories, and no threshold value is proposed to assess whether a bank has "too little" liquidity. We chose to concentrate exclusively on assets in order to decouple the monitored indicator from fluctuations induced by changes in the liability side of banks' balance sheet. No information stemming from the current prudential ratio is used in this process. The value-added of our indicator lies in its dynamic (flow) and panel-based dimensions. Our liquidity measure is based on the following asset categories: cash management and interbank transactions, securities bought under repurchase agreements, trading securities, investment securities, to which we add net off-balance-sheet financing commitments (i.e. financing commitments received minus financing commitments given to credit institutions). This measure belongs to the group of "Asset-based" liquidity indicators and is independent from the liability structure of banks' balance sheet.

In that respect, it should be kept in mind that our aim is to propose a methodology and assess its performance on a broad-based liquidity measure. Alternative indicators that could be ranked according to their degree of liquidity could be in turn generated. For example, one may ask whether investment securities are "liquid enough" to qualify for the construction of a liquidity measure, as those assets are meant to be purchased with the aim of being durably kept in the books. Since investment securities are fixed-income instruments that may be sold promptly in case of emergency, we decided to keep them in our measure. Another suggestion could be to concentrate only on specific sub-items of the chosen liquidity categories (in particular in the cash management and interbank transactions category, which is rather broad). Although a first check of alternative measures seems to produce outcomes coherent with the results presented in this article, refined applications of this approach would certainly generate fruitful and potentially new insights regarding bank liquidity. In fine, the cross checking of such measures with liquidity ratios (like the coefficient currently monitored by the Commission bancaire) may prove informative and robust for prudential purposes.

which expand and contract liquidity at the same rate, then we consider that liquidity stagnates at the aggregate level. A formal definition of those concepts is presented in Box 2.

At the bank level, liquidity contraction (represented by a negative value of the grow rate of expansion) can stem from either the active reduction in liquid portfolios, or from the fact that a temporary operation (e.g. a repo) is not rolled over at maturity and does

not correspond to an increase in other liquid items. Both events lead to a reduction in liquidity.

The interpretation of the aggregate series thereby obtained depends on how one measures growth at the bank level. In this article, we distinguish between gross *nominal* and gross *idiosyncratic* liquidity flows. First, nominal flows measure growth in absolute terms, as illustrated above. They reflect nominal liquidity expansion or contraction within the

Box 2**Bank liquidity flows**

Using the individual bank balance sheet data described in Section 2, we define l_{it} as the value of liquid assets of bank i at quarter t . The change in total liquidity is then given by $\Delta l_{it} = l_{it} - l_{it-1}$. The bias introduced by bank mergers (see Section 3/2) is corrected as follows. Consider that bank i absorbs bank j between t and $t-1$. In the absence of any other change in the structure of balance sheets, the liquidity registered for bank j at time t will be zero, while that registered by bank i will be equal to the sum of its own liquidity plus that of the absorbed bank j . Taking into account the changes in liquidity that occurred between $t-1$ and t , the liquidity of bank i at t will be equal to its own liquidity at $t-1$, plus the changes in its own liquidity, plus the liquidity of bank j at $t-1$, plus the changes in bank j 's liquidity between $t-1$ and t . In parallel, the liquidity of bank j at t will be zero. Without further corrections, the liquidity of j at $t-1$ would be counted twice, leading to an overestimation of both positive and negative liquidity flows. We therefore need to subtract the $t-1$ liquidity of bank j from the t liquidity of bank i , and add it to the liquidity of bank j at t . Formally, our corrected measure $\Delta l'_{it}$ reads:

$$\Delta l'_{it} = \Delta l_{it} - \sum_{k=1}^N A_{ikt} \Delta l_{k,t-1} - B_{it} \Delta l_{it}$$

where A_{ikt} and B_{it} are indicator variables and N the total number of banks at time t . A_{ikt} takes the value 1 when bank i absorbs bank j at t , 0 otherwise. B_{it} takes the value 1 when i is absorbed at t , 0 otherwise. Note that this approach allows for simultaneous mergers where one bank absorbs more than one institution.

The adjusted growth rate of liquidity is therefore given by:

$$g_{it} = \frac{\Delta l'_{it}}{(l_{i,t-1} + l_{i,t}) / 2}$$

for each bank i . At the bank level, all liquidity contractions (respectively expansions) give rise to a negative (respectively positive) value of g_{it} . The cross section of g_{it} s obtained for each quarter is then aggregated using two simple positive/negative partition rules.

Partition rule 1: nominal gross liquidity flows

Nominal gross flows are defined according to a partition rule around zero. The aggregate liquidity expansion rate between $t-1$ and t , POS^{nom}_t is defined as:

$$POS^{nom}_t = \sum_{i|g_{it} \geq 0} g_{it} \left(\frac{(l_{i,t-1} + l_{i,t}) / 2}{\sum_{i=1}^N l_{i,t-1}} \right)$$

The term in parenthesis weights individual growth rates by the bank's average share of the total liquidity. Likewise, the aggregate liquidity contraction rate NEG^{nom}_t is defined over the absolute value of aggregated weighted growth rates:

$$NEG^{nom}_t = \sum_{i|g_{it} \leq 0} |g_{it}| \left(\frac{(l_{i,t-1} + l_{i,t}) / 2}{\sum_{i=1}^N l_{i,t-1}} \right)$$

Nominal measures are principally useful to analyse cyclical properties of liquidity flows.

Partition rule 2: idiosyncratic gross liquidity flows

Idiosyncratic gross flows are defined according to a partition rule around the trend followed by the banking industry as a whole. This relative measure reflects the extent to which each bank distinguishes itself from the industry trend. This latter is proxied using the Hodrick-Prescott filter of aggregate liquidity growth (noted g_t^{tr}) with a standard quarterly smoothing parameter. For each bank i , we obtain an idiosyncratic growth rate g_{it}^{id} equal to:

$$g_{it}^{id} = g_{it} - g_t^{tr}$$

The idiosyncratic positive and negative liquidity flows rates are defined as:

$$POS^{id}_t = \sum_{i|g_{it}^{id} \geq 0} g_{it}^{id} \left(\frac{(l_{i,t-1} + l_{i,t}) / 2}{\sum_{i=1}^N l_{i,t-1}} \right)$$

$$\text{NEG}_{t}^{\text{id}} = \sum_{i|g_{it}^{\text{id}} \leq 0}^N |g_{it}^{\text{id}}| \left(\frac{(l_{i,t-1} + l_{i,t}) / 2}{\sum_{i=1}^N l_{i,t-1}} \right)$$

Idiosyncratic measures are relevant for the analysis of average liquidity flows.

Overall, one should keep in mind that at the aggregate level, negative flows do not necessarily reflect a generalised reduction in liquidity buffers. Likewise, positive flows do not imply an expansion of liquidity buffers. Positive and negative flows may coexist, but only the net measure of liquidity flows can indicate whether the liquidity of the banking system's balance sheet has expanded or contracted as a whole. Net liquidity flows are simply defined as:

$$\text{NET}_{t}^{\text{nom}} = \text{POS}_{t}^{\text{nom}} - \text{NEG}_{t}^{\text{nom}}$$

and

$$\text{NET}_{t}^{\text{id}} = \text{POS}_{t}^{\text{id}} - \text{NEG}_{t}^{\text{id}}$$

$\text{NET}_{t}^{\text{nom}}$ depicts the net growth rate of gross liquidity, while $\text{NET}_{t}^{\text{id}}$ reflects the cyclical component of net liquidity growth.

Finally, one may wish to get a sense of the overall reallocation of liquidity that occurs between banks. In the nominal case, the total, or “excess”, liquidity reallocation needs to be corrected for net liquidity changes, i.e:

$$\text{TOT}_{t}^{\text{nom}} = \text{POS}_{t}^{\text{nom}} + \text{NEG}_{t}^{\text{nom}} - |\text{NET}_{t}^{\text{nom}}|$$

In the idiosyncratic case where the trend component has already been adjusted, the overall reallocation growth $\text{TOT}_{t}^{\text{id}}$ is simply the sum of the positive and negative flow measures, i.e:

$$\text{TOT}_{t}^{\text{id}} = \text{POS}_{t}^{\text{id}} - \text{NEG}_{t}^{\text{id}}$$

banking system on aggregate. Second, idiosyncratic flows measure liquidity growth relative to aggregate trend growth. They are qualified as “idiosyncratic” in that they reflect purely bank-specific factors (specific trading strategies, isolated liquidity shocks, changes in corporate governance or internal structures, etc.). For example, a bank may increase its liquidity holdings by 10% in a given quarter when the banking industry increases its liquidity holdings by a 6% trend. The idiosyncratic component of that bank's liquidity inflow is equal to 4%. Idiosyncratic flows reflect the degree of heterogeneity of banks when expanding or contracting liquidity.

3|2 Methodological issues

Before describing the proposed liquidity measures in more detail, it should be noted that they are subject to two main methodological problems. Firstly, they ignore liquidity expansions and contractions that may simultaneously occur within each reporting entity, i.e. within each bank. This biases our estimates downwards, since liquidity

reallocation is likely to occur across different desks (for example between the repo desk and the treasury desk) of a bank. However, our data does account for liquidity flows across entities of the same banking group, as we use the BAFI 4000 Reporting Files that are collected institution-by-institution in a non-consolidated way.¹⁴

Secondly, flow measures may overestimate gross flows by recording unwarranted liquidity reallocations due to mergers and acquisitions. This bias is potentially problematic. We therefore chose to clean the data on the basis of merger files provided by the Banque de France division –DECEI/CECEI– that registers bank creations, closures and mergers (see Box 2 for details).

3|3 Aggregate liquidity measures

Gross liquidity flows are constructed as a cross-sectional aggregation of positive and negative changes in stocks as measured in quarterly balance sheet statements. The positive/negative partition of

¹⁴ Liquidity flows occurring between banks of the same group can not be isolated from those effected across different groups. As a result, negative and positive flows coexisting across banks that belong to the same group may reflect the intra-group reallocation of liquidity. Intra-group liquidity management has gained importance in France –in particular for mutualist banks– as the consolidation process has made headway.

the cross-sectional distribution is done in two ways, nominal and idiosyncratic. Nominal aggregates are the sums of the individual banks' liquidity growth rates relative to zero, weighted by market share. Idiosyncratic aggregates are the weighted sums of the individual banks' liquidity growth rates relative to the industry trend. The construction of liquidity measures is presented in Box 2.

The two aggregation strategies shed light on different dimensions of liquidity dynamics. Nominal growth rates show the macroeconomic evolution of liquid balance sheet items. This evolution may be substantial in a context where, for exogenous reasons, aggregate liquidity grows strongly. An example would be the steep growth in bank liquidity witnessed since the start of Stage III of EMU, also reflected in the strong dynamics of nominal monetary aggregates in the euro area. Nominal measures are therefore suitable for studying the cyclical properties of bank liquidity. In a banking system that grows along a trend, idiosyncratic flows reflect individual differences in bank liquidity management. These flows are the macroeconomic symptom of heterogeneous bank behaviour at the microlevel.

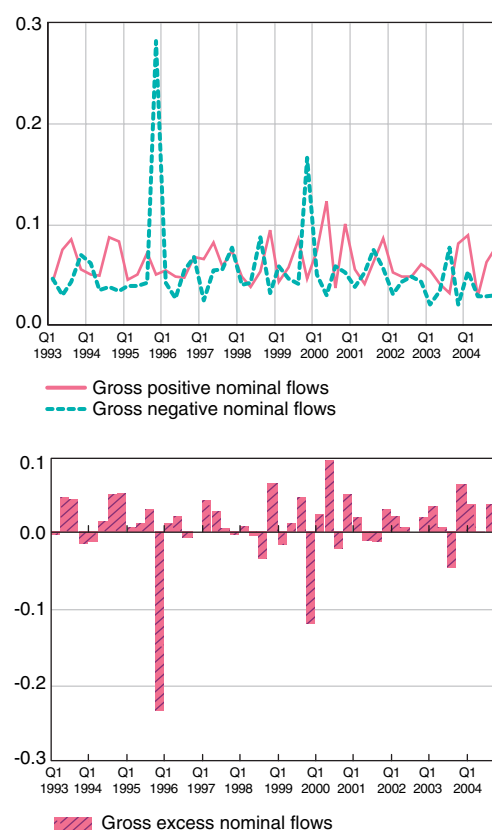
We can also derive net growth rates of liquidity together with "shadow" measures of liquidity reallocation. Net flows simply indicate whether banks lost or gained liquidity over a quarter. "Shadow", or excess, flows, picture the extent to which overall liquidity reallocation actually occurs across banks. For example, a bank whose liquidity grew in net terms by 1% over a given quarter may in fact have actively engaged in liquidity trading to a much wider extent than what the net variation alone would suggest. These effects can be accounted for by looking at nominal reallocation, *i.e.* aggregate expansion and contraction in excess of the net liquidity change, and idiosyncratic reallocation.

4| RESULTS

4|1 Gross nominal liquidity fluctuations

Estimates of gross nominal liquidity flows are reproduced in Chart 4. Their examination reveals that on average, positive flows have been larger than negative flows, resulting in net nominal liquidity flows growing by some 1% per quarter. This is

Chart 4
Gross nominal liquidity flows
(%)



Source: Authors' calculations.

not surprising in a context where bank liquidity is expanding overall. More interestingly, substantial liquidity expansion and contraction take place simultaneously along the sample, at a rate of 6% and 5% per quarter (Table 1), implying active market trading the beyond an already substantial growth in aggregate bank liquidity. A check of the behaviour of each liquidity subcomponent reveals that this trading intensity has occurred in all market segments involved in liquidity trading (money markets as well as capital markets for liquid instruments).

Negative and net nominal flows reveal that aggregate behaviour may have been atypical on two occasions, in early 1996 and early 2000. Both in 1996 and 2000, liquidity outflows markedly –but temporarily– increased, translating into large negative net liquidity adjustments.

Although causality can not be assessed, it is very likely that developments in 2000-Q1 depict a correction of liquidity loadings in anticipation of « Y2K » (year 2000).

The 1996-Q1 episode is less straightforward to explain. A closer look at regulatory events around that time reveals that this quarter coincides with the implementation of a number of European Council Directives geared towards the harmonisation of banking activities. In particular, the Directive authorising the inclusion of legally binding netting agreements for prudential purposes was approved

and implemented at that time.¹⁵ However, nothing guarantees that solvency regulation is the crucial point. After all, measures of own funds are usually determined on the basis of liabilities positions with at best an ambiguous effect on the sign of liquidity flows. In this light, it is more likely that the prudential acknowledgement of netting agreements simply led to a reduction of liquidity risk exposure for commercial banks, allowing them to hold less liquid assets.

Turning to deviations of flows from the industry trend, the idiosyncratic building-up of liquidity is substantial (idiosyncratic and nominal positive flows have comparable orders of magnitude), suggesting that a large number of banks expand in excess of trend growth. We visually checked whether idiosyncratic positive flows could result from aggregation issues or aggregate structural changes (that could be due to factors affecting the banking sector as a whole) and found that only a small part of aggregate heterogeneity seems to be accounted for by composition effects across liquidity lines or by differences across banks of different sizes. This conjecture could be investigated more formally.

Finally, total, or “shadow”, liquidity reallocation, the expansion and contraction in excess of net changes, amounts to about 8% per quarter. In other words, some 8% of the aggregate liquidity in the banking system’s balance sheet is reshuffled among individual banks each quarter.

Table 1
Nominal and idiosyncratic liquidity flows –Descriptive Statistics

Flows	Obs.	Average	Std. Error	Min	Max
Nominal					
Positive	49	0.059	0.021	0.000	0.122
Negative	48	0.052	0.041	0.020	0.281
Net	48	0.009	0.049	–0.232	0.093
Idiosyncratic					
Total reallocation	48	0.081	0.022	0.039	0.134
Positive	49	0.041	0.031	0.000	0.175
Negative	48	3.58e-8	3.22e-8	1.02e-8	2.25e-7

¹⁵ Preparatory work authorising the inclusion of legally binding netting agreements for prudential purposes led to a common proposal adopted by the European Council on 5 September 1995. The European Directive was finally approved early 1995. In parallel, the post-BCCI European Directive ensuring that the structures of a group to which a credit institution belongs do not pose a threat to its supervision, was adopted by the European Parliament and the European Council on 29 June 1996 and implemented in the first quarter of 1996. At the same time, the Basel Committee on banking supervision finalised its framework on the prudential treatment of market risk (extension of own fund covering to market risk and acknowledgement of internal credit risk models. See Commission bancaire (1996). The inclusion of netting agreements in prudential ratios de facto reduced own fund requirements underlying solvency ratios, as off-balance-sheet interest rate and foreign exchange instruments would, as from then, be taken into account in net and not gross terms, i.e. after all contracts termed with a given counterpart had been compensated. Such an adjustment would show up only once in liquidity growth rates, as it does in Chart 4.

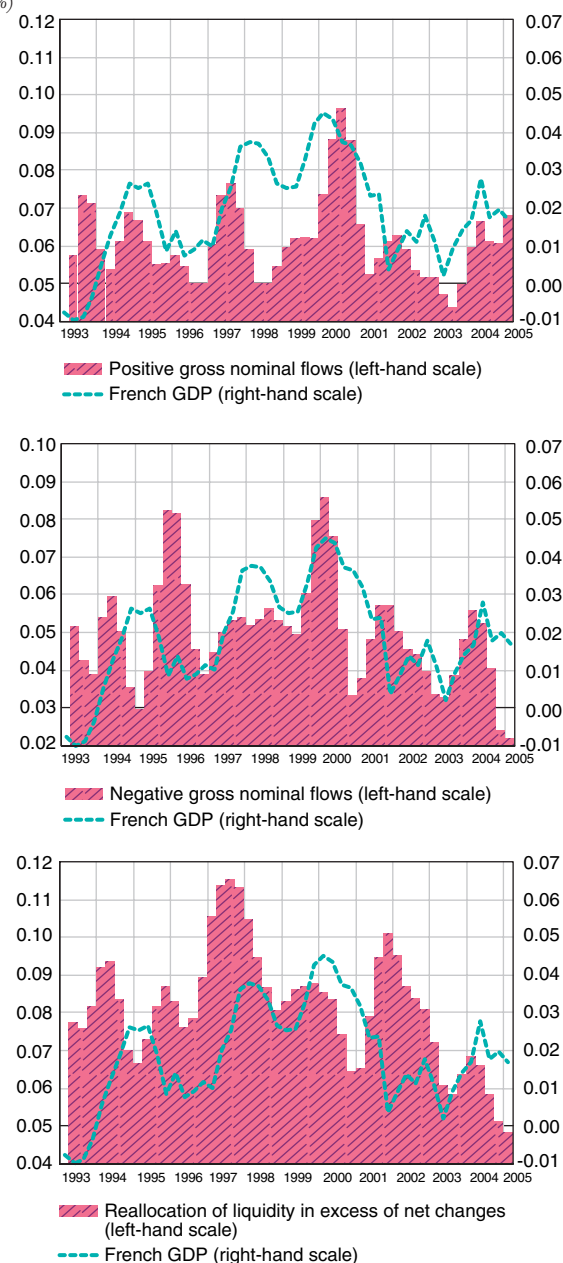
4|2 Bank liquidity and the macroeconomic cycle

The article now turns to the macroeconomic regularities that characterise bank liquidity flows. The French business cycle and our measures of bank liquidity are depicted in Chart 5. In this section, measures of liquidity flows have been seasonally adjusted using the X12 procedure.

As a useful starting point, we focus on the dynamic correlations between bank liquidity and French real GDP growth in France (Table 2). First, it turns out that liquidity expansions are strongly correlated with GDP growth. Positive flows lead the cycle by one to two quarters in a procyclical way. Second, liquidity outflows are also positively correlated with the cycle (although more mildly), which they lead by two to three quarters. This suggests a rather procyclical character of banks' liquidity management. However, excess balance-sheet reallocation is slightly countercyclical and lags the cycle by one to two quarters. These observations are discussed in turn.

One possible explanation for similar timing patterns of positive and negative liquidity flows relative to the cycle lies in the dual function (and distinct valuation) of liquidity within a bank. On the one hand, liquidity is held pure for "funding" purposes.¹⁶ Appetite for liquidity therefore increases when the level of economic activity picks up, as refinancing needs associated *inter alia* with a more sustained loan supply, also increase during expansions. Furthermore, it may be worth "frontloading" the acquisition of liquidity in the early phases of an economic upturn in anticipation of a pick-up in lending activity, hence the anticipation of positive flows ahead of the cycle. On the other hand, banks may hold liquidity for "trading" purposes. Such holdings are driven by expected returns and will be adjusted downwards during economic expansions, as more profitable investment opportunities

Chart 5
Aggregate bank liquidity flows and the French business cycle (%)



Source: OECD; authors' calculations.

Table 2
Dynamic cross-correlations of French GDP with gross nominal flows

	x(-4)	x(-3)	x(-2)	x(-1)	x	x(+1)	x(+2)	x(+3)	x(+4)
Positive	0.35	0.55	0.64	0.60	0.47	0.32	0.15	0.00	-0.12
Negative	0.15	0.17	0.16	0.13	0.12	0.06	0.00	-0.06	-0.10
Excess	-0.05	-0.03	-0.07	-0.15	-0.21	-0.25	-0.24	-0.24	-0.23

¹⁶ The term "funding" refers to "bank funding". One could also have in mind the liquidity commitments taken up by banks, which can be mobilised in case of stress (margin calls, rating changes, etc).

become available in other capital market segments. Conversely, downturns are accompanied by “flights to quality” whereby liquidity outflows decelerate. These cyclical downward adjustments are mirrored in the observed properties of negative nominal flows.¹⁷

Which of these effects dominates at the bank level ultimately depends on various bank –or sector–specific factors. Liquidity managers may wish to “prefer liquidity over profits”, in which case the first effect would dominate. It may also be that the liquid share of assets quantified in a bank’s balance sheet is spread across segmented in-house entities or desks whose portfolio decisions need not be motivated by the same objectives. At the aggregate level, the marked positive idiosyncratic measures (Table 1) may suggest that the French banking system tends to be “macroeconomically cautious” when managing its liquidity. This preference is consistent with regulatory constraints on banks’ liquidity management, suggesting that the current framework is conducive to stability-oriented bank behaviour.

Finally, “excess” balance-sheet reallocation is slightly countercyclical and lags the cycle by one to two quarters. This timing pattern may partly relate to the endogenous nature of liquidity trading to both banking sector behaviour and market activity. Recall that “excess” liquidity reallocation reflects the extent of liquidity reshuffling that effectively takes place on top of the visible netting of in-and outflows. Its moderate countercyclicality means that banks engage in liquidity trading more intensively (and with some lag) during downturns than during phases of economic expansion. Given the link between market and bank funding liquidity discussed in Section 1|1, ensuring the smooth and liquid functioning of markets at times when banks intensify their (liquid) asset trading activity could become a financial stability objective. In particular, the occurrences of liquidity dry-ups may generate vulnerability at a time when banks tend

to intensify their trading. Our measure suggests this happens following economic downturns, with a one-to-three quarter lag.¹⁸

A further operational implication of macroeconomic liquidity flows stems from the possible mismatched timing of changes in demand and supply of aggregate liquidity. The stronger comovement of positive liquidity flows (which in theory imply an acceleration of growth in the demand for liquidity) with GDP ahead of turning points may suggest that risks of excess demand (respectively supply) in the markets for liquid assets may be more acute ahead of economic upturns (respectively downturns).¹⁹ Institutions that would be subject to unforeseen adverse liquidity shocks may therefore have to face relatively stringent market conditions (likely, in turn, to worsen their vulnerability) ahead of upturns. The likelihood of LLR interventions would also be more acute. A closer monitoring of vulnerable institutions may therefore be warranted during the two quarters preceding economic upturns.

4|3 Responses of liquidity flows to macroeconomic shocks

We are now interested in the relationship between fundamental disturbances to key macroeconomic variables and bank liquidity. Since plots and correlations are suggestive but not conclusive, this investigation is done within a structural VAR model defined on output, stock prices, positive and negative nominal flows, and the short-run nominal interest rate taken to be the monetary policy instrument. All variables are specified in quarterly growth rates except the interest rate, taken in (quarterly) levels.²⁰

The approach consists of a two-stage procedure. In the estimation stage, an unrestricted VAR model is estimated. In the identification stage, restrictions are imposed to derive a structural form from which impulse

17 An alternative explanation based on the precautionary versus speculative motive would be that banks tend to increase their demand for liquidity in order to protect themselves from capital losses due to anticipated interest rate increases. In this case, it would be interesting to check the dynamic correlations between liquidity flows and the monetary policy interest rate.

18 Information about overall interbank liquidity trading volumes are contained in our measure of “excess” liquidity. Table 2 suggests that the growth of overall liquidity exchange intensifies during economic downturns with a one quarter lag.

19 The lagged countercyclicality of excess liquidity, together with the milder procyclicality of negative liquidity flows confirms this assessment.

20 French output and stock prices are defined as the log-differenced quarterly French GDP and the CAC40 index. The short-term interest rate is the 3-month money market interest rate measured on a quarterly basis. Seasonally adjusted positive and negative liquidity flows, measured in growth rates, have been constructed according to the methodology described above. Finally, 1996-Q1 and 2000-Q1 have been dummied out. Seasonal adjustment has been implemented using the X-12 procedure. VAR estimations and IRF computations have been conducted in E-views 5.

response functions of bank liquidity to fundamental macroeconomic shocks can be calculated.²¹

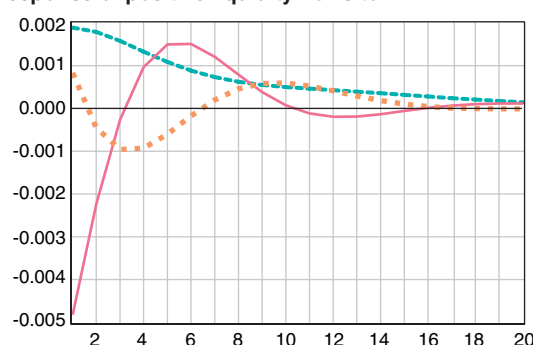
The choice of which restrictions to impose is the subject of the structural VAR literature, see for example Sims (1980), Blanchard and Quah (1989) or King *et al.* (1991). To derive the impulse response functions, we are free to impose a variety of identification schemes. In this example, we chose to impose long-run restrictions *à la* Blanchard and Quah (1989), implying *inter alia* that monetary policy shocks have no long run effect on output. Note however that the paucity of data due to the limited size of the sample entails significance issues in most cases. The responses of positive and negative nominal liquidity flows are shown in Chart 6. To test the robustness of our structural approach, we compared impulse responses under four alternative identification procedures: two Cholesky decompositions with different orderings (keeping output first in both cases), one generalised impulse decomposition as described by Pesaran and Shin (1998), and one structural representation with long-run restrictions (the one reported in this paper). The shape and intensity of the response to output shocks is the most robust across all specifications.

Given the standard deviations of output, asset prices and the interest rate, impulse responses can be interpreted as follows. A one standard deviation (respectively 1%) positive shock to output would have an impact of around 0.2% (respectively 0.25%) and 0.28% (0.36%) on positive and negative liquidity flows. The impulse is rather persistent and halves only after a year (two quarters for outflows). The pattern of responses to asset price and interest rate shocks is in line with the idea that liquidity flows are driven by “funding” versus “profit” motives. A one standard deviation shock to asset prices slows down liquidity inflows by half a percentage point while it stimulates liquidity outflows by around 0.17%. This is the “portfolio management” effect. Finally, interest rate changes have a limited short run impact on liquidity flows. A 25-basis-point interest rate rise leads to an immediate increase of balance-sheet liquidity inflows by 0.06% and decline of liquidity outflows by 0.2%. While this latter impact is counter-intuitive from a macroeconomic

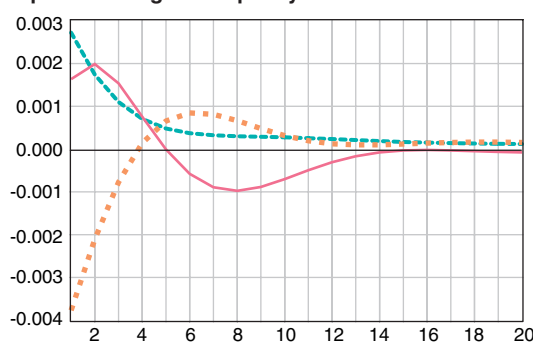
perspective, the dynamic reaction of liquidity flows remains in line with standard theory according to which liquidity reacts negatively to interest rate increases. The counterintuitive impact of interest rate shocks may be related to the trade-off between expected returns and interest-rate risk. Since banks’ liabilities typically tend to rotate or be repriced faster than their assets, interest expenditures typically change more than interest income in the short run. An interest rate rise would therefore potentially squeeze profits. Alternatively, positive interest rate shocks mechanically induce a decline in the market value of interest-bearing instruments. This decline may be larger for assets than for liabilities, leading to a decline in net value. Both events increase the need for liquidity.

Chart 6
Responses to one standard deviation structural shocks
(Standard deviation units)

Response of positive liquidity flows to:



Response of negative liquidity flows to:



— Asset prices (CAC40) - - - French GDP . . . Interest rate

Note: Standard deviations are 0.0077 for French GDP, 0.052 for asset prices and 0.39 for the interest rate.

Source: Authors' calculations.

21 An obvious alternative route would consist in fully analysing the trending properties of the variables and their seasonal fluctuations within a cointegrated VAR framework. This is however beyond the scope of this article and left for alternative research. To ensure the statistical validity of our approach, we engage in a number of model checks that can be summarised as follows. 1. Stationarity: unit root tests on the inverse roots of the characteristic AR polynomial (Phillips-Perron and ADF) reveal that all roots have modulus less than one and lie inside the unit circle. Stationarity is accepted for all variables at the 5% significance level (10% level for the interest rate, which is not surprising). 2. Lag-length: except from the AIC –well known to overestimate the lag-length– FPE, HQIC and SIC criteria indicate an appropriate lag-length of one. 3. Residual tests: standard tests on residual autocorrelation, heteroscedasticity and normality reveal that the model is subject to a limited degree of statistical weakness. However, a closer look at the multivariate normality of the residuals reveal that deviations from normality mostly come from kurtosis rather than skewness.

Bank gross liquidity flows realised within the French banking system between 1993 and 2005 reveal that in a context where bank liquidity is expanding overall, substantial liquidity expansions and contractions simultaneously coexist both at the bank level and on aggregate, suggesting intense and active market trading beyond the substantial growth in aggregate bank liquidity. In addition, excess liquidity reallocation, the “shadow” liquidity expansion and contraction within banks’ balance sheets on top of net flows, indicates extensive liquidity reshuffling.

Bank liquidity exhibits interesting cyclical properties. Positive and negative flows procyclically lead the cycle by around two quarters, while excess balance-sheet reallocation countercyclically lags the cycle. These timing patterns may reflect the multiple functions of liquidity within a bank – pure “funding” purposes and “trading” purposes. Furthermore, non-negligible positive idiosyncratic flows may reflect some “macroeconomic caution” probably guided by regulatory constraints on banks liquidity management. Finally, impulse response analysis suggests that positive output shocks have a positive and persistent effect on liquidity flows. The pattern of responses to asset price and interest rate shocks is in line with the idea that liquidity flows are driven by “funding” versus “profit” motives in the presence of a trade-off between expected returns and interest-rate risk.

Our findings may have some relevance to liquidity regulation and lender of last resort policies. As for the domestic regulatory authorities, the clear emergence of macroeconomic patterns in bank liquidity suggests that current macroprudential approaches could be reinforced so as to meaningfully complement the individual monitoring of financial institutions. The significant scale of bank liquidity flows and their cyclical properties also appear to press the case for placing emphasis on the health of the financial system as a whole when designing lender of last resort interventions. In particular, vigilance is warranted at times when liquidity flows tend to intensify, for example ahead of cyclical turnarounds. Overall, valuable information could be made available through the joint monitoring of market liquidity and bank liquidity risks when the prevention of individual liquidity failures is at stake.

All in all, further investigation is warranted on the mechanisms that can jointly elicit individual bank failure and financial market runs. In particular, the macroeconomic determinants of bank liquidity as well as the interconnection between liquidity and market runs are promising areas for further research, with possible implications for emergency lending operations.

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Microstructure of financial and money markets: lessons learned from the conference held in Paris on 6 and 7 June 2006

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The characteristics of trade and the efficiency and stability of markets depend on how such markets are organised. Market microstructure, which analyses this linkage, is an area of research that has grown extremely rapidly over the past years. However, progress has essentially been made with regard to financial markets. The few articles devoted to the money market are either descriptive (and most often applied to the case of the United States), or based on data whose frequency is insufficient to capture certain stylised facts.

For central banks, it is essential to have a good understanding of the practices and the organisation of financial and money markets, in particular the way in which they respond to monetary policy impulses. From a financial stability perspective, an in-depth understanding of market practices makes it possible to identify new categories of risk, such as short-term risk. In June 2006, the Banque de France organised in partnership with the Center for Research in Economics and Statistics (CREST) and the Europlace Institute of Finance (EIF), a conference on the microstructure of markets, and notably that of money markets.

This conference brought together researchers from central banks, French and foreign universities and renowned research centres. Robert Engle (New York University, Nobel prize 2003) and S. “Vish” Viswanathan (Duke University) presented two invited conferences, and Thierry Foucault (HEC Paris), Joël Hasbrouck (New York University) and Suresh Sundaresan (Columbia University and Federal Reserve Bank of New York) participated in the closing roundtable. The discussions spanned a wide variety of topics that have attracted much attention over recent years: risk measures, the quality of financial markets, the structure of financial and money markets, etc.

This summary first discusses the two invited conferences and the closing roundtable co-organised by the Banque de France. It then highlights a number of issues relevant to central banks, but does not give an exhaustive review of the different topics covered over the two-day conference in view of their variety and their often high level of analytical content. These issues fall into three main areas:

- realised volatility;
- microstructure of the money market;
- comovement, risk and financial stability.

1| INVITED CONFERENCES AND THE ROUNDTABLE

1|1 Invited conferences

In the opening lecture, Professor Engle proposed a measure of transaction costs taking account of the timing and speed of order execution. This measure makes it possible to assess the impact of the different order execution strategies (immediate execution or staggered orders) on the cost and the risk related, *inter alia*, to price changes. It differs from the traditional indicators that do not take into account the cost of a possible change in prices over the order execution time. Analysing orders can therefore be equated with a cost/risk trade-off problem comparable to a mean/variance type study.¹ This study is original from four points of view: it breaks down the transaction cost and its assessment obtained using extremely fine data; it uses an econometric model that explains this cost (mean and variance equations); it proposes a single analysis framework of the behaviour of the trader based on a cost/risk trade-off; lastly, it results in the calculation of a liquidation cost indicator comparable to the value-at-risk (VaR).

The preliminary results are based on US data, and more specifically on orders collected by Morgan Stanley.² They show that:

- the immediate execution of orders generates higher costs than those associated with gradual trading; however, in the case of the latter the risks are higher;
- the cost/risk trade-off depends on the state of the market and the characteristics of the order;
- in order to assess liquidation risk it is necessary to estimate the transaction cost equation.

This exercise appears difficult to reproduce for European markets given the lack of availability of relevant data series. Furthermore, the functional form used for the transaction cost assumes that the cost is always positive. This point is questionable given that the transaction cost is defined as a price spread.

In his lecture, Professor “Vish” Viswanathan presented the empirical tests of the theoretical models generally discussed in the literature. More specifically, his lecture focused on the following topics:

- the influence of market returns on liquidity;
- the impact of large variations in market returns on liquidity comovements;³
- contagion during periods of declining liquidity. The main liquidity indicator used by Professor “Vish” Viswanathan is the bid-ask spread. A number of tests were carried out with other measures of liquidity (proportional effective spread, etc.) that corroborate, in general, the results obtained with the bid-ask spread.

The most salient results of the study are:

- lagged market returns have a significantly negative impact on liquidity;

¹ This talk is based on two papers that are currently being completed. Robert Engle and his co-authors did not wish to distribute them but they should be accessible on their website after publication of this article.

² As the speaker does not wish to make his empirical results public for the moment, only a qualitative description of the main conclusions is given here.

³ Fluctuations in the levels of market liquidity are interrelated.

- the impact of past negative market returns on liquidity is more pronounced than that of positive returns, the response therefore appears to be asymmetric;

- stock liquidity is more sensitive to changes in market returns for small capitalisation stocks; past returns have a more marked impact on the liquidity of higher volatility stocks;

- negative market returns with a high absolute value reduce the liquidity of all stocks and increase liquidity comovement;

- the comovement in liquidity is due to the changes that affect both liquidity supply and demand; empirical studies often focus on the demand effect, but this does not explain the asymmetric responses mentioned above.

Some results are questionable such as the low significance of some coefficients, the *ad hoc* nature of some relationships, the low explanatory power of some models, etc. However, the empirical findings are in line with the expected theoretical results. Furthermore, this exercise could be reproduced for the case of European markets for example.

1|2 Roundtable

Professor Foucault's lecture centred on the competition for order flow and best execution. He focused on two issues:

- what is the effect of increased market fragmentation on market liquidity?

- Do investors get the best possible execution for their orders in multi-market environments? These questions are of interest to, among others, bodies charged with regulating or supervising markets. After highlighting a number of facts (the close relationship between intermarket competition and best execution; the controversy over the qualities of certain order execution procedures, *e.g.* a centralised limit order book; the inefficiency of some procedures leading to trade-throughs), the author discussed

a European experiment: LSE *versus* Euronext. He then put forward a model estimated using European data in order to respond to the two issues raised. In conclusion, he noted that:

- competition between pure limit order books results in a more liquid environment than centralisation;

- best execution rules affect the intensity of intermarket competition; the existence of trade-throughs may reflect a co-ordination problem in adopting new technology and/or agency problems.

Professor Sundaresan focused his lecture on the microstructure of US money markets. Particular attention was given to the role of the Federal Reserve and the US Treasury. The Federal Reserve has almost certainly contributed to the decline in the volatility of short-term money market rates, in particular of the Fed funds rate, by intervening more frequently on the money market through tenders and by offering standing facilities. The corresponding interest rate is a cap on daily repo rates.

In August 2005, the US Treasury announced that it was exploring the concept of a securities lender of last resort facility, making available a supply of securities in the event of markets coming under pressure. This announcement came in the wake of failures to deliver US Treasuries, in particular following the terrorist attacks of 11 September 2001 and in the second half of 2003; between August and mid-November 2003, negative rates were recorded on a number of government securities repurchase agreements. Indeed, too many failures of this type could eventually cause investors to turn to other securities, with detrimental effects for the liquidity of the Treasuries market.

Lastly, Professor Hasbrouck analysed transparency through the role of dealers and the interaction of the primary and secondary markets. He also made a brief comparison of the US and European regulatory frameworks (MiFID⁴ and Reg NMS⁵). He postulated that banks generally operate as dealers in opaque markets but regulatory forces favour transparency. This increased transparency should reduce the market power of banks as dealers and raise trading volumes and net profits.

⁴ Market in financial instruments directive.

⁵ Regulation national market system.

Furthermore, the results of theoretical models used to study transparency may lead to recommendations that are contingent on the market situation: in centralised floor markets, trade reporting rules were adopted before external regulation; however, when the market is more physically dispersed, it is more difficult or even more inefficient to enforce trade reporting at a predetermined frequency. After discussing the similarities and differences between the two regulatory frameworks, Professor Hasbrouck finished his lecture with two open questions:

- does Reg NMS indicate the direction of future European regulation?
- Will MiFID transparency enhance European equity markets so clearly that the Commission can extend them to bonds and other securities?

2 | REALISED VOLATILITY

In finance and financial econometrics, it is essential to analyse changes and volatility in asset prices. Volatility plays a key role in valuing derivatives, allocating assets and managing risk. More specifically, in order to describe the efficient price process on an asset market, it is necessary to take into account “local” volatility that measures the risk associated with instantaneous variance of the asset price. The problem is that volatility is a continuous, random and unobservable variable.

2|1 Summary of the articles

Following Merton (1980), given the random nature of volatility, researchers no longer focused directly on instantaneous volatility but on integrated variance or quadratic variation which represents the sum (the integral using a continuous-time model) of the squared instantaneous volatility. Integrated variance thus corresponds to the variance of a price over one day, obtained using intraday data (*i.e.* high frequency, 5, 10 or 30 minutes for example). Several approaches have been developed to determine a reliable and robust estimator of integrated variance.

Parametric approaches are based on the use of models that describe the dynamic pattern of the variance of returns. The autoregressive conditional heteroscedasticity (ARCH) model introduced by Engle in 1982, which consists in jointly estimating the return and conditional volatility equations of an asset and, in particular, one of its generalisations (the exponential ARCH model of Nelson, 1992) are serious contenders for measuring integrated variance. Nelson’s model has the huge advantage of making it possible to move relatively easily from continuous time to discrete time; consequently, it can be integrated in the analytical framework of continuous-time models in finance. Over the past few years the use of these models has increased significantly, especially in academic circles. The papers presented at the conference are based on this approach.

Conversely, realised variance (or again notional variance) is derived from a nonparametric approach. The realised variance of the price of an asset at date t (one day for example) is the sum of the observed squared returns at a given time step. It is a usual estimator of integrated variance, introduced by Merton in 1980 and discussed further in a number of recent studies (Andersen, Bollerslev, Diebold and Labys, 2001 and 2003; Bandorff-Nielsen and Shephard, 2001, 2002a, 2002b, 2005; as well as Comte and Renault, 2001). In theory, the smaller the time step, the more the realised variance should be a reliable indicator or converge to the integrated variance. Unfortunately, financial asset prices, more particularly at high frequencies, are subject to a very wide variety of frictions that we can interpret as imperfections of the trading process or microstructure effects such as differences in trade sizes or informational content of price changes, the strategic component of the order flow, inventory control effects, discreteness of data, etc. Owing to the existence of microstructure effects the efficient price is not observed. In fact, the observed price is the sum of the unobserved efficient price and a random variable that represents the microstructure effects. Therefore, the usual realised variance estimator is biased and inconsistent. Consequently, a consistent integrated volatility estimator must be determined using noisy data.

Box

Realised volatility

Specific techniques are required to model volatility. The approach put forward in this box is based on an estimate of realised volatility obtained from high-frequency data samples.

A number of recent studies, Andersen, Bollerslev, Diebold and Labys (2001 and 2003) and Zhou (1996) and Corsi et al. (2001) among others, have stressed the importance of using the information contained in high-frequency data to calculate volatility. This basically consists in estimating the daily volatility of an asset (integrated volatility) using intraday observations. The integrated volatility, estimated by the sum of intraday squared returns, is also referred to as realised volatility. More precisely, let p_t be the price of an asset described by a continuous-time process and characterised by the equation:

$$d\log(p_t) = m_t dt + \sigma_t dW_t$$

where $d\log(p_t)$ is the first order difference of the price, dW_t a standard Brownian motion, m_t the drift and σ_t the instantaneous volatility.

If t represents a day and h , a time step (a real such as $1/h$ is an integer, 5 seconds for example), the realised volatility, $RV_t(h)$ is defined by:

$$RV_t(h) = \sum_{i=1}^{1/h} r_{t-1+ih}^{(h)2}$$

where $r_{t-1+ih}^{(h)}$ is the return on the asset over a period corresponding to one time step $([t-1+(i-1)h; t-1+ih])$, thus:

$$r_{t-1+ih}^{(h)} = \log \left(\frac{P_{t-1+ih}}{P_{t-1+(i-1)h}} \right)$$

When h tends towards 0, $RV_t(h)$ converges under certain conditions towards the integrated volatility IV_t defined by:

$$IV_t = \int_{t-1}^t \sigma_u^2 du$$

It may be tempting to choose the smallest possible time step h in order to move closer to situation of convergence towards integrated volatility. However, the estimator obtained would be highly contaminated by microstructure effects.

This implies that there is a trade-off in the choice of h : a too large a time step may result in a move away from convergence conditions, while a too small a time step may lead to samples highly contaminated by microstructure noise.

Studies about the impact of microstructure effects on realised volatility were almost all published in the 2000s, notably Bandi and Russell (2003), Aït-Sahalia, Mykland and Zhang (2005), and Hansen and Lunde (2006). The most accomplished study was that of Aït-Sahalia, Mykland and Zhang which assumes that volatility is a random, non-constant variable. The estimator proposed by these authors, two scales realised volatility (TSRV), is based on an estimate of the integrated variance at two different time scales:

- the initial sample is partitioned into K non-overlapping subgrids and an integrated variance estimator is

calculated for each partition; the average of the estimated integrated variances is then calculated;

- lastly the TSRV⁶ is estimated.

Aït-Sahalia, Mykland and Zhang proposed the optimal number of subgrids to be used and showed that their estimator had most of the traditional proprieties of a good estimator (asymptotic convergence, etc.). For simplicity, we can say that TSRV dominates the variance or realised volatility that is biased, as we have already mentioned. Note that in both cases (TSRV or realised volatility), it is possible to isolate the biases from the discreteness and those introduced

6 More specifically, the final estimator is a combination of the realised volatility calculated during the first stage and that obtained from all the observations of the sample.

by pure microstructure effects. Furthermore, in a paper yet to be published, Zhang proposed a generalisation of TSRV, the realised volatility at a number of scales (multi-time scale realised volatility, MTSRV) that combines the realised volatilities at more than two frequencies.

Even though recent studies have made real advances in this field, a number of grey areas remain: the estimation methods used continue to pose a problem because the properties of the estimators are not entirely satisfactory; the same is true of the predictive powers of the different approaches put forward. This explains the ongoing interest in this area of research.

2|2 Contribution of the conference

Realised volatility estimators are used as a backdrop for a number of papers presented at the conference. They are considered from different perspectives in the various papers: as indicators in some, while in others their predictive performance is studied and in yet others their different estimation approaches are compared. In view of the bias or reliability problems of some estimators, we shall only present the papers belonging to the two latter categories.

The article by Aït-Sahalia and Mancini studies the predictive performance, in-sample and out-of-sample, of two integrated variance estimators, realised volatility and TSRV. To do this, the authors used as references the known theoretical models (the Heston model, a jump-diffusion model, a HAR-RV model, the Ornstein-Uhlenbeck model, etc.) and then compared these references to the volatilities associated with the two estimators in their study. In all cases, the TSRV very largely dominates the realised variance estimator. In practical terms, the variance or realised volatility, which is very frequently used, skews the perception of volatility, and could affect portfolio allocation behaviour. Consequently, it could have a detrimental impact on risk management.

Curci and Corsi propose a new measure of integrated variance based on MTSRV and a specific prefiltering of the original variables. This prefiltering process is supposed to better correct for microstructure effects. The authors show, *inter alia*, that the generalisation

of TSRV proposed by Zhang may be obtained in a relatively simple manner in the framework of their model. The approach advanced by Curci and Corsi therefore appears to be the most complete available today. Furthermore, these two authors highlight the robustness of their method, in particular that of the filtering process that appears to resist the different forms of dependence in the microstructure noise process. They conclude their study with theoretical simulations and estimates based on data from observations of certain financial asset prices (SP500, government bonds, etc.).

This article, which is highly original in that it opens up promising new avenues of research, was very well received and appraised. It was lauded because it extends the work of Aït-Sahalia, Mykland and Zhang who revolutionised the treatment of integrated variance. The referee's main criticism centred on the consistency of the estimator proposed by Curci and Corsi. Indeed, using a simple model, the referee showed that the integrated variance obtained from their model did not really correspond to that expected. This does not entirely call into question the paper, which marks an important step towards the correction of microstructure effects. However, the properties of the estimator will have to be examined in detail.

3| MICROSTRUCTURE AND THE MONEY MARKET

Many articles have covered the empirical aspects of the microstructure of money markets, and more specifically the modelling of their volatility. In his seminal article of 1996, Hamilton shows that the level and the volatility of the Federal funds rate exhibit empirical regularities that may be associated with the operational monetary policy framework: volatility increases significantly over the last days of the reserve maintenance period. Similar results are found for the euro area. Gaspar, Pérez-Quirós and Sicilia (2001) and Bartolini, Bertola and Prati (2003), among others, confirm the existence of seasonal movements in the level and volatility of the interbank rate linked to the Eurosystem's institutional monetary policy framework. The questions currently raised by literature on this topic are slightly different (Pérez-Quirós *et al.*, 2006)

as some papers presented at the conference show. They fall under the three following categories.

3|1 Are the different segments of the money market integrated?

In their article, Bartolini, Hilton and Prati attempt to determine whether the markets for Federal funds and Eurodollars, the two core components of the dollar money market, are integrated. The Federal funds rate is the rate that US banks charge each other for overnight loans of reserve balances. The Eurodollar rate is the interest rate on dollar-denominated deposits held by banks outside the United States. These two markets are the two main sources of funding for US banks, aside from funds obtained from the Federal Reserve.

There are at least two reasons to consider the degree of integration of these markets:

- first, to corroborate or invalidate the findings of previous studies showing that these markets are segmented. This is surprising given that both these markets have been subject to the same regulatory treatment since 1990. Why then might the behaviour of financial institutions result in unexploited arbitrage opportunities between these two markets?
- Second, this question is key for monetary policy implementation and impulses. The US Federal Reserve mainly targets the Federal funds rate. This choice stems from the idea that this market anchors the whole term structure of US interest rates. However, the Eurodollar market appears to be playing an increasing role as a source of bank funding. Funds obtained through borrowing from foreign banks stood at half those obtained from borrowings from US banks at the start of the 1980s. Today, the former amount to almost twice the latter. Recent trends in these markets raise the following question regarding monetary policy transmission: if these two markets are not sufficiently integrated, should the Fed not redefine its target more broadly to encompass trades executed in both markets?

Bartolini, Hilton and Prati consider their degree of integration of these two markets by analysing

the predictive power of the interest rate spread between them. Indeed, if the markets are integrated, the spread between the two rates should be unpredictable based on current information. An Exponential-GARCH process was used to model the interest rate spread. They show that the spread between these two rates is generally small and unpredictable. This result tends to indicate that these two markets are integrated.

3|2 Volatility transmission from overnight rates

The volatility of the very short-term euro area interbank market interest rate (EONIA) is sensitive to the operational framework of the Eurosystem. Notably, volatility increases at the end of the reserve maintenance period. This dependence associated with the institutional framework may be problematic if it is transmitted to longer-term interest rates. Indeed, long-term rates affect investment and consumption decisions and therefore have an impact on aggregate demand. Consequently, it is important to determine whether very short-term volatility is transmitted to the rest of the yield curve.

Two papers presented in this session try to answer this question. They are based on different approaches to modelling volatility:

- Durré and Nardelli construct daily volatility series using a sample of intraday observations. Volatility transmission is studied using a vector autoregression across the different maturities;
- Blanco and Alonso base their rationale on a conditional volatility model. The conditional volatility of the overnight rate is first estimated, and then used as an explanatory variable in the representations of the conditional volatility of longer-term interest rates.

The findings of these two articles suggest that volatility is not transmitted from very short-term to long-term interest rates. More specifically, the volatility of the overnight rate does not appear to influence that of interest rates beyond three months.

3|3 The impact of changes to the Eurosystem's operational framework

Prior to the changes to the operational framework in March 2003, problems of overbidding and underbidding in the ECB's main refinancing operations (MRO) could occur. This was mainly due to the fact that reserve maintenance period, which started on the 24th calendar day of one month and ended on the 23rd calendar day of the subsequent month, was independent of the dates of the Governing Council meetings in which ECB interest rate decisions were taken. Furthermore, in view of the maturity of the main weekly refinancing operations, the last MRO settled in one reserve maintenance period extended into the subsequent reserve maintenance period. Consequently, the bid behaviour adopted at the end of one reserve maintenance period could be affected by expectations of changes in the key ECB interest rates during the subsequent reserve maintenance period. In order to resolve this problem, the Governing Council adopted in March 2003 two measures that came into force in March 2004:

- the timing of the reserve maintenance period was changed to start on the settlement day of the MRO following the Governing Council meeting at which the monthly assessment of the monetary policy stance is pre-scheduled and end on the day prior to the settlement of the MRO of the following month;
- the maturity of the MROs was shortened from two weeks to one week.

These combined measures aimed to contribute towards stabilising the conditions in which credit institutions bid in the Eurosystem's MROs (ECB, 2004). They were expected to result in a decline in average interbank market volatility. However, under the new operational framework, the time frame between the last day of the reserve maintenance period and the settlement of the last MRO is equal to eight days, *i.e.* longer than the average time frame under the previous operational framework. This might therefore result in

higher volatility at the end of the reserve maintenance period.

The impact of changes to the operational framework on the volatility of the interbank rate is studied in two papers presented at the conference:

- Durré and Nardelli propose a linear model whose endogenous variable is a realised volatility series, previously calculated using intraday observations. This model includes, among other things, as an explanatory variable, a dummy variable taking the value of one for the last days of the reserve maintenance period. It is estimated before and after 2004. The authors show that the average volatility level is significantly lower under the new operational framework⁷; however, volatility observed at the end of the reserve maintenance period is higher after 2004, corroborating the concerns mentioned above;
- Cassola and Morana show a break in the level of the volatility of the interbank rate in 2004, but it is only significant on the very short end of the yield curve (one to two weeks).

4| COMOVEMENT, RISK AND FINANCIAL STABILITY

In this last part of this summary, we assess the more empirical contributions relating to European markets. To do this, we examine two papers presented at the conference.

4|1 Volatility and financial stability

This first paper is the study mentioned above by Cassola and Morana, which focuses on analysing volatility in the euro area money market. The authors set out to identify the factors behind the volatility in overnight interest rates in the euro area and to study the transmission

⁷ See also the July 2006 issue of the ECB's Monthly Bulletin.

of volatility shocks along the term structure. Their approach is interesting in that it combines the analysis of a real phenomenon with the use of several types of relevant and sophisticated tools:

- Cassola and Morana introduce a factor model and a simultaneous analysis of the short-run and long-run dynamics;
- they then supplement their analysis of volatility, and in particular its persistence, by estimating a realised volatility series, on the basis of high-frequency data (5 minutes), and a long memory process;
- they propose a decomposition approach that takes account of the properties of the series (permanent, persistent, non-persistent decomposition, etc.), making it possible to better understand the characteristics of the volatility.

Cassola and Morana find a number of interesting results:

- volatility persistence can be explained by two common factors, *i.e.* the way in which persistent volatility shocks are transmitted along the term structure, and excess persistent volatility at the longer end of the yield curve relative to the shortest end;
- there appears to be a forward propagation of persistent volatility shocks. But no evidence was found for a forward transmission of liquidity shocks.

However, as the referee stressed, some points should be clarified: for example, how should we interpret the forward propagation of volatility shocks? The authors do not specify what they mean by the “shorter” or “longer” end of the curve. Their results would have been easier to interpret had they given more detail on this point.

4|2 Volatility regimes and the provision of liquidity

The article by Beltran, Durré and Giot sets out to study the relationship between the level of liquidity⁸ and the low and high volatility regimes observed in the Belgian order book markets. A number of

empirical studies (Biais *et al.*, 1995, for example) have been conducted on this type of market but few of them examine the impact of volatility or rather the impact of the different volatility regimes on liquidity dynamics.

In order to determine the different volatility regimes, Beltran, Durré and Giot propose using either the traditional estimator of integrated volatility (here realised volatility), or traditional multi-regime models that, assuming that there are two regimes, can identify them exogenously. The authors also apply vector autoregression (VAR) models to liquidity in order to study the joint dynamics of a number of variables of interest (liquidity, volatility, etc.).

The main results are:

- the contemporaneous relationship between liquidity and volatility does not appear to be linked to the predominant volatility regime. However, they find that it is more costly to trade when volatility is high;
- the VAR analysis shows that liquidity dynamics are not dependent on volatility regimes. Therefore, liquidity dynamics are fairly similar in low and high volatility regimes. However, a drop in liquidity subsequent to volatility shocks is larger in the high volatility regime;
- the market studied is more resilient to liquidity or volatility shocks during periods of turmoil.

As we saw in Part 1, it is not necessarily wise to identify volatility regimes using realised volatility as the latter may be a biased estimator of integrated variance. We can also question the robustness of identifying regimes using statistical models. The convergence of the results obtained in the two different approaches could be interpreted as gauge of robustness. Further tests could be carried out to confirm the previous interpretation. As the referee stressed the empirical results are interesting but they are not easy to justify: how come liquidity is insensitive to volatility regimes while it is more costly to trade when volatility is high? Furthermore, it is difficult to ascertain whether the results obtained are specific to the Belgian market. It would therefore be interesting to extend the scope of the study.

⁸ Ex-post liquidity measures may be obtained from realised bid-ask spreads, trading volumes, the number of orders, and the average volume per trade.

The articles discussed in this summary do not cover all the topics dealt with at the conference. Nevertheless, they give an insight into the main conclusions that can be drawn:

- from a methodological point of view, the discussions provided an opportunity to consider recent advances in volatility and risk modelling. Progress has been made since the seminal work of Merton but there are still a number of grey areas. Going forward, an improvement in the integrated variance estimators should make it possible to better identify risks and, perhaps, better control them;*
- as regards the use of the microstructure approach in the analysis of the money market, the almost complete absence of academic research, at least with regard to the European market, is regrettable. It leads to a lack of innovation in the analysis of these markets;*
- lastly, aside from research on the money market for which monetary policy implications are generally clear, it will be necessary in future to more often consider the economic policy implications in research on market microstructures, in particular with a view to preserving financial stability. The analysis of comovements or transmission of volatility shocks along the yield curve is an excellent example of this.*

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The Basel II framework: the role and implementation of Pillar 2

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Discussions on the reform of the “Basel I” capital ratio, or “Cooke” ratio, which dates from 1988, were initiated in the late 1990s under the aegis of the Basel Committee. They culminated in June 2004 with the publication of a new Accord on international convergence of capital measurement and capital standards, commonly referred to as “Basel II”. The new Accord was updated in November 2005 to incorporate several technical additions.

The Basel II framework is designed to permit a more risk-sensitive and more comprehensive coverage of banking risks. It consists of three complementary and mutually reinforcing “pillars”. Pillar 1 consists of the basic minimum capital requirements. Pillar 2 introduces the principle of a structured dialogue between banking institutions and supervisors. Pillar 3 is focused on transparency and market discipline.

Each of these three pillars represents a major innovation, marking the transition from a prudential framework based on simple quantitative rules to a more complete set of standards which, in addition to using a more risk-sensitive quantitative approach, incorporates qualitative principles that institutions are expected to comply with. However, Pillar 2 has a unique characteristic that distinguishes it from the other two Pillars. It reaffirms and provides a rationale for the existing practice of many supervisors: conducting a quantitative and qualitative review of all risks using their own tools but also the processes for risk monitoring developed by banks themselves. These reviews may lead to various supervisory measures, including the imposition of additional capital requirements under Pillar 2.

The extensive consultations conducted in the past few years between supervisors and the banking industry have gradually led to the implications of Basel II being taken on board by all of the parties concerned. First of all, institutions focused on adapting their information systems to the requirements laid down in Pillar 1. For a long time, Pillar 2 was the least commented on part of the Basel reform. However, the entry into force of the new ratio will take place from the beginning of 2007 –in France as in the other countries of the European Economic Area– since the transposition of the Accord into Community law has taken the form of a new Capital requirements directive (CRD). In the run-up to this deadline, Pillar 2 has become a major topic of discussion between banks and their supervisors, and it therefore seems opportune to further clarify how the Commission bancaire will implement Pillar 2.

In particular, the cross-border implementation of the new framework raises many questions, to which European supervisors have responded by developing rules that are as harmonised as possible.

Beyond these considerations, thought needs to be given to the fundamental purpose of Pillar 2 and to its practical implementation. The increased risk-sensitivity of capital requirements under Pillar 1 undeniably represents a major advance, but it results in increased correlation of capital requirements with the business cycle, the degree of which will be specific to each institution. From the perspective of micro and macro-prudential stability, the fluctuations in the regulatory ratio that might result from this correlation must be understood and, if possible, kept in check. This article seeks to show how this objective could be achieved through a possible approach to Pillar 2 involving the putting in place of a capital cushion in addition to the regulatory minimum.

Conceived as a framework that goes beyond simple minimum capital requirements, the Basel II reform consists of three complementary and mutually reinforcing elements.

- Pillar 1 sets minimum requirements for capital. Its aim is to ensure that banking institutions hold sufficient capital to provide a minimum level of coverage for their credit risk, market risk, and operational risk. The innovation of Basel II, compared with the capital ratio of Basel I, is not only that it covers a broader range of risks (for example, the “Cooke” ratio does not implicitly capture operational risk), but also that it allows banks to choose between different levels of sophistication in the calculation of capital requirements. Thus they will be able, for credit risk and operational risk, to use either a set of standard risk weights that are a function of the quality of the counterparty,¹ or (risk weights based on) internal ratings.²

- Pillar 2 establishes a process of prudential supervision that complements and strengthens Pillar 1. It consists of the analysis by the bank of all of its risks, including those already covered by Pillar 1; the calculation by the bank of the amount of economic capital it needs to cover those risks; and the comparison by the banking supervisor of its own analysis of the bank’s risk profile with the analysis conducted by the bank, to inform its choice of prudential measures, which may take the form of capital requirements greater than the minimum requirements or any other appropriate technique.

- Pillar 3 is concerned with market discipline. Its aim is to improve the financial transparency of banks by requiring them to disclose the information needed by outside parties to form an accurate and complete view of their capital adequacy. It is hoped that this will improve market discipline.

These three elements form an indivisible whole. However, the implementation of Pillars 1 and 3 depends primarily on the actions of the institutions – while recognising that supervisors should also

be transparent in this regard, as is illustrated by the requirement that has been imposed on them to publish, by the end of 2006 at the latest, the national legislation transposing the European capital adequacy directive. By contrast, Pillar 2 can be understood only in the context of a structured and documented dialogue between banks and supervisors.

Pillar 2 has another particularity: banking supervisors have long “practised” it without knowing it. The innovation of Basel II is simply to systematise and thereby make more uniform and consistent approaches that until now have generally been implemented in isolation.

The remainder of this study provides greater detail on the definition and methods of application of Pillar 2 (1). We endeavour to show how Pillar 2 can be used to limit the volatility of the capital ratio resulting from the greater risk-sensitivity of the Basel II framework (2).

1 | UNDERLYING PRINCIPLES OF PILLAR 2 AND THE IMPORTANCE OF HARMONISED IMPLEMENTATION AT THE INTERNATIONAL LEVEL

1|1 Three major components

A reading of the Basel and European texts makes it possible to group the major features and objectives of Pillar 2 around the following key principles:

- Banks should set in place systems for assessing the adequacy of their economic capital in relation to their risk profile, and should maintain an appropriate level of capital at all times. This is the internal capital adequacy assessment process (ICAAP).

¹ For credit risk, this is the “standardised approach”, which consists in applying a risk weight to exposures that is a function of the intrinsic quality of the counterparty, based on the rating assigned by an external credit assessment institution, which may be a rating agency or another organisation. For operational risk, two approaches are based on this logic. In one, the “basic indicator approach”, a single risk weight is applied to an indicator of income which is close in conceptual terms to net banking income. The other, the “standardised approach”, is more elaborate: the various business lines of the institution allow a more detailed breakdown of the income indicator, and thus the risk-weight scale is broader and more representative of the level of risk.

² In the internal ratings based approach (IRB approach) to credit risk, institutions will be able to calculate all of the parameters used in the calculation of capital requirements. The institution itself calculates the probability of default, the loss given default, and the credit conversion factors (the “advanced” IRB approach), or only some of them (the “foundation” IRB approach, in which the institution itself determines the probability of default, the other parameters being set by the regulations).

The analysis should incorporate all risks, including those not covered by Pillar 1. These encompass not only risks that are quantifiable (interest rate risk in the non-trading book, concentration risk, transformation risk, and the residual risk that remains when collateral is lower than expected), but also risks that require a more qualitative approach (such as reputational and strategic risk).

- The banking supervisor compares its own analysis of the bank's risk profile with that conducted by the institution, and, based on its conclusions, may take prudential measures, which may involve setting capital requirements above minimum requirements or any other appropriate technique. This is the supervisory review and evaluation process, or SREP.
- It is important for supervisors to practise preventive supervision: they should intervene at a sufficiently early stage to prevent institutions' capital from falling below minimum requirements.

The application of these principles should be proportionate to the magnitude of the risks incurred; each risk should be considered not only in isolation but also in terms of its relative magnitude in comparison with other risks.

1|2 Close links with current practices and some aspects of current regulations

Pillar 1 of the Basel II framework means that supervisors attach greater importance to data produced by the institutions themselves, particularly data used in the internal approaches to calculating capital requirements for credit risk, market risk, and operational risk.

Similarly, Pillar 2 assigns an important role to processes developed internally by banks for monitoring and controlling all their risks, and to processes developed by the supervisors themselves. Nevertheless, this freedom is limited by the regulatory texts and by more detailed supervision of institutions, made possible by tools that are themselves more precise.

Banking supervisors did not wait for Basel II to take a close interest in this process. In France, regulation

CRBF 97-02, which has been amended several times since it was issued, specifies the rules that institutions must comply with in the area of internal control. In addition to regulatory provisions such as those introduced by regulation 97-02, supervisors have a long-standing practice of complementing their review of regulatory ratios with qualitative analyses of banks' internal management, particularly in the area of the monitoring of risks and transactions.

Nevertheless, Pillar 2 does much more than synthesise or provide a legal basis for supervisory practices already in place. It not only introduces a detailed methodology for analysing risks and the internal processes used by institutions to monitor them, it also introduces the principle of a structured dialogue between institutions and supervisors, who have their own tools. This is one of the principal innovations of the new Accord, along with the possibility for banks to use internal approaches to calculate their regulatory capital requirements.

1|3 Vigilance by banks to ensure harmonised implementation of Pillar 2 and convergence in supervisory practices

Pillar 2 has an international dimension, to which the major banks have, justifiably, not failed to attach importance. Although the issue of convergence in supervisory practices is not peculiar to Pillar 2, it has particular relevance there, since the implementation of Pillar 2 leaves broad scope for qualitative assessment and thus for subjective judgement.

In the course of the various consultative processes, banking institutions have underlined their concern about the possibility that supervisors in different countries might adopt divergent approaches to the implementation of Pillar 2. If nothing were done to address this risk, we could end up with a situation in which multinational groups would be required to satisfy as many additional requirements as they have foreign establishments. Issues concerning the scope of application are another source of concern, at least in Europe, where the CRD stipulates that economic capital is to be calculated only on a consolidated basis for groups but that a SREP must be conducted for each individual entity.

In addition, banks fear that for some supervisors Pillar 2 will simply be an instrument for instituting an unjustified tightening of prudential requirements, and that arbitrary administrative authority will prevail over the relevance of the assessment.

These concerns have contributed to a more fundamental fear stemming from the methodological uncertainties relating to Pillar 2. Pillar 2 is indeed based primarily on general principles, in contrast to Pillar 1, whose provisions are prescriptive in nature and, for the most part, detailed and precise.

The expression of all of these fears has served as a catalyst for discussions within the Committee of European Banking Supervisors (CEBS) aimed at reducing as much as possible the risk of divergent application of the framework. Initiated in 2004, these discussions were followed by a long period of consultation designed to enable extensive exchanges with banks and different European supervisors on this subject, and culminating in the publication of guidelines on 25 January 2006.³

These guidelines define useful concepts in achieving consistent implementation of Pillar 2, both for banks (ICAAP and internal governance) and for supervisors (SREP). The guidelines help to remove any methodological uncertainty. In areas where industry has wished to obtain further clarification (for example, the treatment of interest rate risk in the non-trading book, or stress-testing), it has been decided that CEBS would conduct further analysis and refine its guidelines.

This work on the implementation of Pillar 2 was complemented by another initiative, which is not limited to Pillar 2, but essential in this area: the development of guidelines for strengthening co-operation between supervisors of multinational groups. These guidelines establish arrangements for the exchange of information between home and host supervisors, as well as a framework for co-ordinating prudential activities – particularly those relating to Pillar 2 – under the authority of the home supervisor:

- the home supervisor (on a consolidated basis) co-ordinates the preparation of the risk assessment

using the information provided by the host supervisors (subsidiaries);

- the two (or more) supervisors agree on the planning and co-ordination of supervisory activities;
- they divide up between them the tasks to be accomplished or perform them jointly;
- they agree on the outcomes of supervisory actions, data collection, etc.

Finally, at a practical level, operational networks have been set up for the prudential supervision of the major European banking groups. Each such network brings together, under the authority of the home supervisor, the different host supervisors of a given group. These networks allow the practical issues raised by the implementation of Pillar 2 to be addressed.

Following the example of what has been accomplished at the European level, the Basel Committee, through its Accord Implementation Group, is holding its own discussions on the methods for applying the provisions of Pillar 2.

2 | A POSSIBLE APPROACH TO PILLAR 2: INSTITUTING A COMPLEMENTARY CAPITAL CUSHION

The new regulatory capital ratio will make it possible to capture the intrinsic quality of risks much more precisely than the current framework. This results, however, in a degree of correlation between capital requirements and the economic environment, and, consequently, an increase in the variability of capital requirements over the course of the business cycle (see Box). Furthermore, the introduction of new accounting standards (IFRS) has resulted in the market valuation of a greater number of the assets and liabilities that figure in “risk-weighted assets” in the denominator of the ratio, or capital in the numerator. This may also increase the volatility of the capital ratio.

³ CEBS “Guidelines on the application of the supervisory review process under Pillar 2”.

Box**The influence of the business cycle on internal ratings in the Basel II framework**

By construction, the increased risk-sensitivity of capital requirements introduces a degree of correlation between the level of the regulatory capital ratio and the business cycle. Whereas under the Basel I framework, a business firm is assigned a fixed risk weight of 100%, whatever its financial condition, under the internal ratings based approach set out in Basel II, the capital charge is much more sensitive to the condition of a given counterparty, and, consequently, to the economic environment in which the counterparty operates.

The methods for determining the parameters of the risk-weighting function –the probability of default and the loss given default– have been designed to avoid excessive volatility in internal ratings. In particular, the estimation period used should be long enough for the parameters to be stable in the short term and easily predictable. For example, calculations for the probabilities of default are based on five-year averages,¹ unless a different factor that better captures the position in the business cycle is also incorporated (for the sectors or businesses for which this is justified).

Nevertheless, several empirical studies have shown that the behaviour of capital requirements calculated using the Internal ratings based approach follows relatively closely that of the business cycle. Calculations by the Basel Committee indicate that the fluctuations in the new regulatory ratio should on average represent 35%-40% of the fluctuations in economic growth. Indeed, the Basel Committee includes a “damping” factor, which is greater than 50%, linked to its methods of calculation.

The degree of pro-cyclicality is also affected by two sets of microeconomic parameters:

- *The first concerns the risk profile of each banking institution and how it evolves over time, the amplitude and speed of this process being specific to each institution. Thus, the degree of correlation between internal ratings and the business cycle may be increased or lessened depending on the business activity of each institution and its appetite for risk.*
- *The second relates to the type of model used to assign internal ratings, in particular in the advance approach, which gives institutions broad latitude to opt for specifications that reinforce or reduce the pro-cyclicality of the ratio.*

1 The transition clauses of the CRD provide, however, that a shorter historical observation period can be used if needed.

Too much volatility in the ratio is to be avoided, from the perspective both of investors and supervisors:

- For investors, the predictability of the short- to medium-term financial condition of institutions is a decisive element in their asset allocation policies. Too much variation in the ratio would be perceived as a risk factor likely to render access to markets more difficult, or to increase the cost of financing.
- From the standpoint of supervisors, the capital ratio should be relatively resilient given that the degree of exposure of banks to microeconomic or macroeconomic risks is especially pronounced by virtue of the role they play in financing various sectors. Too much instantaneous volatility would appear to indicate a lack of financial robustness.

Setting a target ratio arrived at by adding a capital cushion to the regulatory minimum, in the context

of Pillar 2, might offer a methodological and systematised solution to this problem.

2|1 Setting a target capital ratio

The determination of the target capital ratio would be based on the supervisors' analysis of all the quantitative and qualitative risks of a group: those coming under Pillar 1 as well as those covered by Pillar 2. The target ratio would have a stabilising effect on the capital coverage of financial activities, since it would fluctuate much less than the regulatory ratio. Indeed, the qualitative factors that form part of the target ratio are only partially independent of the business cycle, or change more slowly than the quantitative factors.

It is this target ratio that, after discussions with the institution, supervisors would ask the institution to

satisfy (and not to disclose). In practice, it would be above the regulatory ratio, insofar as prudential measures would be taken well before actual capital levels fall too close to the regulatory threshold. Furthermore, the assessment used to set the target ratio needs to have a certain constancy over time in order to be effective.

Moreover, given that the bank would itself need a safety margin of in relation to the target ratio, to be sure of satisfying it in all circumstances, the actual ratio held and published in the context of its operations would be greater than the target ratio and more stable than the regulatory ratio.

The target ratio would thus have a smoothing effect, as illustrated in Chart 1.

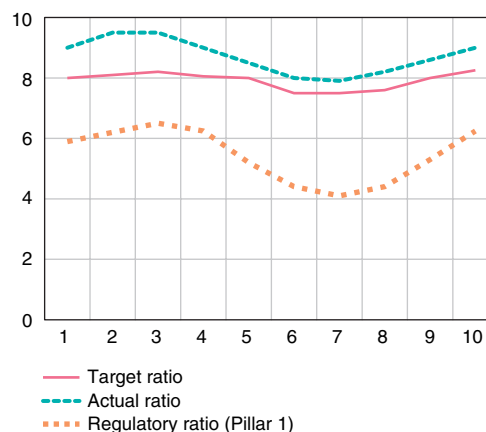
The combination of a minimum regulatory ratio (Pillar 1) and a target ratio (Pillar 2) would provide the benefits both of a risk-sensitive calculation mechanism and a capital level that is reasonably stable over time.

This approach based on a target ratio should, however, be distinguished from the calculation of economic capital. The latter serves primarily as an internal management tool for bank managers, who seek to provide an adequate return to shareholders and an optimal allocation of capital across different business lines. Economic capital appears to need to be lower than

Chart 1

The smoothing effect of the target ratio

(ratios as a % - X-axis ; time - Y-axis)



Note: The regulatory ratio moves in the opposite direction to the business cycle; the target ratio, which includes variables not correlated with the business cycle, fluctuates less; the actual ratio is managed over time in order to reduce fluctuations.

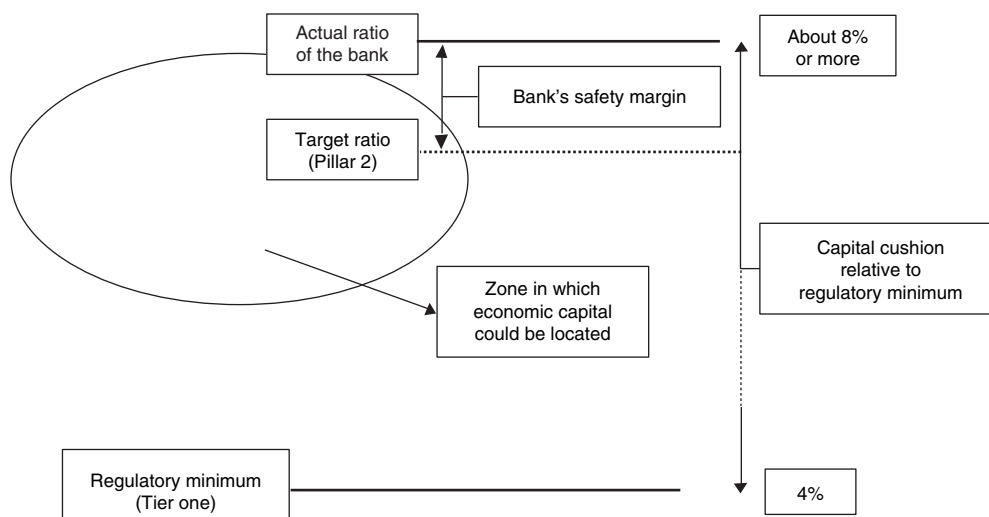
that necessary for the target ratio, which is intended to cover a longer time horizon (see Chart 2).

2|2 Implementation of the target ratio

The target ratio should be set as part of the Pillar 2 process of prudential review conducted by the supervisor in consultation with bank managers. This ratio, which should be known only to the bank and its supervisor, should be complied with, but with a temporary adjustment

Chart 2

Relationship between regulatory capital ratio, economic capital, and target and actual ratios



margin around the target when necessary, the size of which will depend upon real and approved needs.

The methods for implementing Pillar 2 will allow a dialogue between banks and supervisors, which in many cases already exists on a less formal basis. In this regard, case studies carried out at the European level (through the operational networks of the CEBS) or at the international level (in the Accord Implementation Group of the Basel Committee), should have as their objective to come up with solutions that can be applied consistently from one banking group to the next, irrespective of the country in which the parent company is established.

The target ratio would be set taking into account the various “tools” that are specific to Pillar 2, notably:

- stress tests designed to provide an assessment of the sensitivity of capital measures to changes in the economic environment or events affecting markets and liquidity;

- an examination of the factors underlying concentration risk, liquidity risk, interest rate risk, reputational and strategic risk, internal control risk, management risk and governance risk.

In France, the Commission bancaire will implement such an approach when it updates its tools for the “Organisation for the reinforcement of preventive action”, in the context of a structured dialogue with banking groups. This approach meets the long-standing expectations of rating agencies. It is already commonly agreed that a Tier 1 ratio of 6% to 6.5% represents a minimum level in terms of the expectations of the market. Furthermore, under the current regulatory framework, supervisors have for the most part been led, depending on the particular circumstances of each institution, to require a ratio well in excess of the regulatory minimum. This has been the case for several years in France and in other countries, where banks already operate at capital levels above minimum requirements.

Pillar 2 of the Basel II framework is often presented simply as an enlargement of the power of supervisors. In reality, it allows them above all to be involved in the analysis of the internal processes developed by institutions to manage their risks. The richness of the dialogue that is to take place in this framework should yield a better understanding of the expectations of both supervisors and institutions.

Since, by virtue of its greater risk-sensitivity, the regulatory capital ratio in the new prudential framework is more closely correlated with the business cycle than the current ratio, corrective measures need to be sought, in particular via the possibilities for adjustment offered by Pillar 2.

Setting a target capital ratio is one possible solution, which is close to the current practices of markets and of many supervisors, including the Commission bancaire.

Naturally, in keeping with the desire for international harmonisation which guides the implementation of Basel II, particularly at the European level, in order to be viable and acceptable to all parties, the setting of a target ratio in the context of Pillar 2, should be part of an international framework in which there is a consensus regarding this type of instrument or the achievement of a similar result. The conclusions of the discussions currently under way, in which the French authorities intend to play a leading role, will be decisive in this regard.

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