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Liquidity in a time of financial turbulences

Liquidity is an elusive notion. *“It is easier to recognize than to define”*.¹

Three basic definitions are commonly used: (1) the liquidity of financial instruments reflects the ease with which they can be exchanged for money without loss of value; (2) a related concept is market liquidity defined as the market's ability to trade a given volume of assets or securities without significantly affecting their prices; (3) finally, monetary liquidity pertains to the quantity of fully liquid assets circulating in the economy. It is usually measured by a narrow or broad monetary aggregate or its ratio to nominal GDP.

Several other concepts exist, including funding liquidity, *i.e.* the ease with which economic agents can obtain external finance; balance sheet liquidity, *i.e.* the amount of liquid assets on the balance sheets of non financial institutions; and, for financial institutions, bank liquidity, *i.e.* the ability of a bank to meet its immediate commitments. All of these concepts are distinct from one another. They are also closely interrelated but in a rather complex way.

Liquidity shocks appear at the heart of the current financial turmoil. Market liquidity has been severely impaired in many occasions, most notably on some segments of the commercial paper market (asset-backed commercial paper –ABCP) as well as on inter-bank markets. But events are still unfolding. Capital losses and shortages have also appeared in a number of major financial institutions.

It is not clear today whether liquidity tensions are the main cause and source of the difficulties or simply a symptom of deeper structural changes and pressures in the financial system. To try and answer that question, it is worth stepping back and taking a look at the transformation of financial markets over the last decade and their impact on liquidity.

For the purpose of analysis, it may be useful to contrast schematically two visions of the world: the “old” and the “new”. The “old” world features a fully bank-intermediated system in which banks are the

only entities to undertake financial intermediation and assets are valued at historical cost, with depreciation taking place according to pre-set rules and judgments. By contrast, in the “new” world of securitised finance, most financial intermediation takes place in the markets, through the trading of securities. And positions and securities are marked to market (or according to fair value) in the books of financial intermediaries.

Thus, the old and new worlds differ both in their intermediation channels and valuation methods. Note that those two features are closely related. Marking to market –at least in its purest form– depends on the availability of reliable prices in deep and liquid markets. Conversely, if such markets exist, there is no justification for valuing traded securities at a level different from prices which can be observed when transactions occur.

The “two worlds” share common features: in both bank and market-based intermediation, shocks can occur due, for instance, to an abrupt change in the demand for liquidity. “Bank runs” happen when depositors start having doubts on the solvency of the institution and rush to withdraw their deposits, thereby creating or aggravating the bank's liquidity shortage. Similarly, doubts on the value of underlying assets can lead to a collapse of demand on short term securities issued by a financial intermediary, triggering a liquidity crisis. Both phenomena have been observed since the beginning of the current turmoil.

Those shocks, whether they take place in a bank or market-based systems, appear as a result of co-ordination failures between depositors or investors, whereas individual actions, by themselves fully rational, create unsustainable situations. Fundamentally sound institutions can suddenly become insolvent if they have to liquidate assets at fire-sale prices in order to meet their liquidity requirements. This illustrates the fundamental endogeneity of liquidity, which depends on confidence, *i.e.* the ability of depositors, institutions, and market participants to take risks on each other. Hence the possibility of multiple

Overview prepared by the Financial Stability Directorate under the supervision of Laurent Clerc.

¹ Andrew Crockett in this issue of the Financial Stability Review.

equilibriums, with very different possible levels of liquidity demand for the same economic situation. The “jump” from one equilibrium to another is what defines a liquidity crisis.

LIQUIDITY IN THE “NEW” WORLD OF SECURITISED FINANCE

The far-reaching transformations taking place in financial markets over the past decade have changed the contour of liquidity. Nowadays, a significant part of market liquidity creation lies outside the banking system. Alongside the traditional bank-mediated liquidity, there is a second and growing component which depends on the amount of credit that financial intermediaries are willing to extend to each other. As a consequence, market participants are more dependent on market liquidity; there is a close interaction between liquidity and valuation; new contagion channels have appeared; and, finally, uncertainty has a bigger impact than before on market and funding liquidity.

A greater dependence on market liquidity

Securitisation both enhances and relies on liquidity. On the one hand, it enhances the liquidity of underlying receivables by transforming them into tradable securities. On the other hand, the funding of a large number of market participants involved in the securitisation process depends crucially on market liquidity being permanently sustained.

This has shown to be particularly the case for conduits and structured finance vehicles (SIVs) which have been built on the premises of continuous liquidity (reaping the benefits in terms of maturity spreads).

Banks themselves have ceased to be simple providers but also become users of market liquidity. Obviously, many market participants, including market brokers and hedge funds, are dependant on liquidity facilities provided by banks. But banks themselves, especially investment banks, rely permanently on the issuance of securities for funding their financing needs. Market liquidity also impacts the asset side of their balance sheets to the extent they want to actively manage their portfolios.

For all market participants, the dynamic hedging of risks typically involves the continuous buying and selling of short and long term securities. Illiquidity of markets can thus have enormous consequences on solvency if it prevents a normal management of risky positions.

Interaction between liquidity, valuation and solvency

A major break between the “old” and “new” world is the dynamic interaction between liquidity and solvency through the valuation process of securitised assets.

At any moment in time, asset prices depend both on the expected cash flow they generate and the underlying liquidity of the market on which they are traded. In normal times, when liquidity is abundant, fundamentals prevail. However, in times of stress, the price of an asset is more a reflection of the degree of liquidity shortage than of the asset's intrinsic expected pay-offs. Overall market liquidity determines the price level for each individual security.

With mark to market accounting, changes in asset prices quickly show up on balance sheets and have an immediate impact on the net worth of all the components of the financial system. It follows that, in times of stress, liquidity movements immediately translate into changes in the equity base of banks and financial intermediaries. This may transform liquidity shocks into solvency shocks, independently of any “run”, as the current market value of an institution falls in response to a tightening of market liquidity. In turn, those changes in the equity base of banks, if perceived as threatening their ultimate solvency, will reduce and cut off their access to funding.

New contagion channels

Market liquidity affects all participants. It may act as a powerful contagion channel when its fluctuations trigger discrete moves in asset prices, followed by an abrupt expansion or contraction in the capital base of financial institutions; and finally, in a feedback loop, an increase or decrease in their ability to provide liquidity to the market.

Adrian and Shin² show that this contagion effect is amplified when financial institutions manage actively their balance sheets. Leverage tends to be pro-cyclical, increasing the amplitude of the shocks to the financial system. Also, as opposed to the “domino” model, where contagion occurs slowly through depreciation of assets, marking to market elicits immediate response to price changes by market participants, and speedy transmission between financial intermediaries.

A bigger impact of uncertainty

Following the classical distinction introduced by Knight, uncertainty –as opposed to risk– may be defined as a situation where no probability distribution can be attached to the underlying set of outcomes and risks.

Uncertainty can affect liquidity through two channels: its impact on information; its influence on market dynamics.

Liquidity depends on information. On “perfect” and complete markets, with comprehensive information available to all market participants, and a full set of state-contingent securities, there is no liquidity problem. Assets can be traded at their “fundamental” value; any solvent institution will always be properly funded and risks can always be priced and distributed to those agents most equipped to carry them.

However, markets are not perfect. There are information asymmetries whereby borrowers (issuers of securities) know more about the risks than lenders (or buyers of securities). So market participants may be reluctant to trade in those assets whose characteristics and behaviour under changing economic conditions are not well known. In times of stress, when uncertainty increases, all trades could become impossible and market liquidity dries up. *“Market liquidity is inversely related to the degree of information asymmetry prevailing among economic agents; as shown by Akerlof in his celebrated analysis of the ‘market for lemons’, a market may altogether disappear (the most extreme form of illiquidity) if information is sufficiently asymmetric.”*³

Banks are well equipped to eliminate and reduce information asymmetry through the continuous relationship they keep with their clients and borrowers. By contrast, information asymmetry is especially pervasive in modern securitised markets and structured finance.

First, innovation creates by itself uncertainty on asset valuation. The bulk of structured finance instruments are not really traded in secondary markets. They are built so as to precisely suit the characteristics and the risk profile required by investors. Therefore, their valuation tends to rely on a combination of credit pricing models and thinly traded derivatives. Very often, “mark to market” boils down, in fact, to “mark to model”. Model complexity makes it more difficult for investors to understand the intrinsic properties of assets and measure how their value will change in response to shocks. In addition, the more recent the product, the shorter the time series used to measure historical correlations and quantify risks, the more uncertain the valuation.

Second, with “mark to market”, any uncertainty on asset values immediately transforms into an uncertainty on the solvency of those financial institutions.

This amplifies liquidity problems. Ultimately, liquidity depends on the ability and the willingness of market participants to take risks *vis-à-vis* one another: the soundness of agents’ balance sheets will determine their credibility as counterparties and therefore their ability to trade and provide liquidity. But it is strikingly difficult to assess the creditworthiness of an agent in a context of increased uncertainty regarding the valuation of its balance sheet.

To some extent, problems of uncertainty and information asymmetries were “masked” by the rating process. There was a perception that identifiable default probabilities and “loss given default” existed for structured products, with the same distribution and sensitivity to shocks as “plain vanilla” securities. In other words, rating transformed uncertainty into “risk”. Rating agencies were fully transparent about their methodology. Nevertheless, there has been a deep misunderstanding as to the scope and true meaning of ratings for structured products, which may have been encouraged by the use of only one set of metrics for both structured and “plain vanilla” products.

² See Adrian and Shin in this issue of the Financial Stability Review.

³ Lorenzo Bini Smaghi, “Remarks at the Euro50-Natixis breakfast seminar”, Washington DC, 21 October 2007.

Beyond information, uncertainty also affects market dynamics. A key mechanism insuring market liquidity is the existence of informed investors willing to take risks to buy (or sell) assets which they find under (or over) valued; and, by doing so, to prevent “one sided” markets to develop into a spiral of excess volatility and low liquidity. This mechanism, however, relies upon the ability of investors to value assets with sufficient confidence and certainty. If uncertainty on valuation is too high, investors will stand by and wait, allowing liquidity to vanish in a cumulative process of market contraction and capital. Uncertainty may thus prevent the emergence of market clearing prices for complex securities. The bigger the uncertainty, the more protracted the adjustment process and the higher the risk of overshooting with significant damage to the financial system.

THE INTER-BANK MARKETS

One major surprise of the last period of turbulences has been the amplitude and rapidity of their transmission to the very “core” of the financial system, *i.e.* the inter-bank market. It is certainly too early to provide a full and comprehensive explanation. Nevertheless, the complex interactions between uncertainty and liquidity provide some insights on why the inter-bank markets were hit so hard and so fast.

Uncertainty comes in two forms:⁴ fundamental uncertainty, which affects the quality and value of assets; and strategic uncertainty, stemming from ignorance of what other market participants will do in specific situations. Those two uncertainties help to formulate two tentative explanations, which are not mutually exclusive and, indeed, may interact with each other to create a dynamic.

The apparition of “fundamental” uncertainty –*i.e.* the sudden impossibility to attach probabilities

to the different states of the world– can trigger a “regime shift”.⁵ Market participants will no longer optimise their behaviour according to pre-set strategies. Instead, they may resort to “maximin” criteria, whereby they make decisions based on worst-case scenarios. Banks will therefore tend to hoard maximum liquidity, whatever its costs, to be able to meet any contingency, however improbable, regarding their own future liquidity needs and risk exposure.

It could be argued that such precautions are unnecessary and costly since, if worst case scenarios materialise, banks can always access to exceptional central banks facilities: discount windows, marginal lending facility or emergency liquidity assistance. Recent events have shown, however, that there is great reluctance on the part of banks to use some of those facilities by fear of “signalling” their difficulties to other market participants. This stigma attached to the use of central banks’ facilities can be best explained in terms of “strategic” uncertainty (see box below).

One conjecture, developed in the attached box, would run as follows. Under the pressure of intense competition, banks would try and gain advantage in ordinary times through tight and sophisticated risk management and hedging strategies, in particular with respect to liquidity risk. When a crisis erupts, some of those strategies become more vulnerable than others. Market participants are aware of this, but cannot exactly pinpoint which institutions are most negatively affected, because individual hedging strategies are unobservable.⁶ This information asymmetry creates the risk of adverse selection and a general loss of confidence. Banks with excess liquidity will keep it, in order to reap the benefits of their superior hedging strategies. Banks with liquidity needs would do everything to avoid signalling their weaknesses. As a result, the functioning of the inter-bank market may be severely impaired.

⁴ See Rochet in this issue of the Financial Stability Review.

⁵ See for instance Adrian and Shin in this issue of the Financial Stability Review.

⁶ See for instance Adam, Dasgupta and Titman (2008): “Financial Constraints, Competition and Hedging”, forthcoming, Journal of Finance.

Competition and liquidity crises

Strategic behaviours in relation to imperfect competition have been highlighted by some market participants as a possible explanation for tensions in the inter-bank market: some banks may have been reluctant to lend short-term liquidity in order to restore their own market power by weakening their competitors.

The link between competition and liquidity crises can be formalised through various approaches: the degree of competition in the banking sector can affect hedging decisions (with respect to liquidity risk), both in terms of the overall level of liquidity provisioning, and in terms of dispersion in hedging strategies.

- *Banks may compete more aggressively ex ante so as to lock in a larger number of customers whose future liquidity needs constitute future income. Higher competition tends to increase the volume of capital dedicated to illiquid loans. This mechanically reduces the optimal share of liquid assets. Through this negative effect, competition tends to worsen the risk profile of the pool of liquidity applicants: banks that are short of liquidity make fewer monitoring efforts as they reinvest less of their own liquidity in risky projects. The risk profile of the pool of liquidity applicants may deteriorate to the point that banks with excess liquidity prefer to hoard it (at the central bank) rather than lend it on the inter-bank market: the market for liquidity then collapses.*

- *There is an alternative mechanism by which competition may amplify adverse selection. Recent literature shows that more competitive industries exhibit higher heterogeneity in hedging. Since hedging decisions are imperfectly observable, competition may therefore contribute to amplify an adverse selection problem on the inter-bank market.*

These two examples show that competition may, in some circumstances, participate in creating the preconditions for a liquidity crisis. However, competition is known to have powerful benefits in terms of reducing the cost of capital. The extent to which the former effect may significantly mitigate the later in welfare terms remains an open question.

SHOULD LIQUIDITY REGULATION BE STRENGTHENED?

In times of intense liquidity stress, it is only natural that questions be raised about the adequacy of existing liquidity rules and regulations for banks and other financial intermediaries. Most of those rules date back to more than a decade ago, a fact which, by itself, would warrant a full review. The precise policy response, however, crucially depends on the diagnosis on the origins and roots of the current turmoil.

The case for stronger regulation on liquidity rests on three arguments.

First, pure market failures.⁷ There are no incentives for banks to hold adequate amounts of liquid assets

because: (1) liquidity is costly, especially when competition drives the search for higher returns on equity; (2) liquidity shortages are very low probability events; (3) there is a perception that central banks will step in and provide liquidity support if and when it is needed (the moral hazard argument).

Second, liquidity requirements can be seen as a way of sharing the cost of the “public good” of liquidity and financial stability between the private and the public sectors. This would help and mitigate moral hazard; it would also compensate for other implicit subsidies, such as deposit insurance, granted to the banking sector.

Finally, stronger liquidity requirements would reduce the strategic uncertainty affecting banks actions, since they would be able to withstand larger shocks.⁸

⁷ See Financial Services Authority (2007): “Review of the liquidity requirements for banks and building societies”, Discussion paper 07/7, December.

⁸ See Rochet in this issue of the Financial Stability Review.

On the other hand, one could observe that the same arguments –especially relating to market failures– could be made in favour of stronger capital, rather than liquidity, requirements. Also, it is not clear that bigger liquidity cushions would help in times of crisis since, as already mentioned, the potential demand for liquidity is almost infinite in those circumstances. In addition, as Charles Goodhart neatly points out,⁹ there may be occasions where required liquidity would not necessarily correspond to usable liquidity.

It may be that increasing the resilience of the financial system would necessitate a broader approach. Apart from strengthening liquidity cushions, it may appear appropriate to limit the probability of liquidity shortages incurring in the future. This would mean first, reducing uncertainty and second, improving the robustness of financial institutions.

A reduction of uncertainty could be brought about through standardisation of securitized products and

improvements in the rating system, in order to eliminate information asymmetries.

Increasing the robustness of financial institutions obviously raises the question of capital adequacy. In the “new” world with mark-to-market, the distinction between liquidity and solvency is increasingly blurred. In addition, the ability of investors to carry risk –one important determinant of their exposure to liquidity shortages– is determined by their capital base. The turmoil has revealed the importance taken by off-balance sheet exposures of large institutions in relation to their capital.

It remains difficult, however, to find the appropriate balance between several conflicting objectives. Product standardisation may come at the expense of financial innovation. By the same token, too stringent capital requirements would reduce the return on financial activities and may be circumvented. It may therefore take sometime before all the lessons of the current episode can appropriately be drawn.

⁹ In his article entitled “Liquidity risk management” in this issue of the Financial Stability Review, Goodhart uses the metaphor of “the weary traveler who arrives at the railway station late at night, and, to his delight, sees a taxi there who could take him to his distant destination. He hails the taxi, but the taxi driver replies that he cannot take him, since local bylaws require that there must always be one taxi standing ready at the station”.

Liquidity and financial contagion

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There is an apparent puzzle at the heart of the 2007 credit crisis. The subprime mortgage sector is small relative to the financial system as a whole and the exposure was widely dispersed through securitization. Yet the crisis in the credit market has been potent. Traditionally, financial contagion has been viewed through the lens of defaults, where if A has borrowed from B and B has borrowed from C, then the default of A impacts B, which then impacts C, etc. However, in a modern market-based financial system, the channel of contagion is through price changes and the measured risks and marked-to-market capital of financial institutions. When balance sheets are marked to market, asset price changes show up immediately on balance sheets and elicit response from financial market participants. Even if exposures are dispersed widely throughout the financial system, the potential impact of a shock can be amplified many-fold through market price changes.

NB: The views expressed in this paper are those of the authors and not necessarily those of the Federal Reserve Bank of New York, or the Federal Reserve System.

The credit crisis of 2007 began with the deterioration in the credit quality of subprime mortgages in the United States. However, by most measures the total size of credit exposures could be argued to be small. The ferocity with which the crisis has unfolded raises important questions on the nature of financial contagion. The question is well posed in a recent speech by William Dudley, Executive Vice President of the Federal Reserve Bank of New York.¹

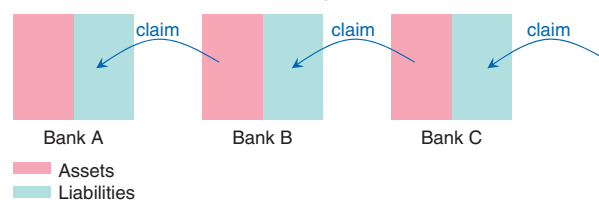
Total outstanding adjustable-rate subprime mortgages are less than USD 1 trillion. Moreover, those mortgages originated during 2006 and early 2007 represent only a fraction of that total. Thus, even if subprime delinquency rates keep climbing to unprecedented levels, it seems likely that total losses will be roughly in a range of USD 100-200 billion. Although this is a lot of money, it pales next to the USD 58 trillion of net worth of US households or the USD 16 trillion market capitalization of the US equity market.

To put these losses in perspective, a 1 percent gain or loss in the US stock market –which often occurs on a daily basis– is about the same order of magnitude of the likely subprime mortgage losses that will be gradually realized over the next few years.

So why have these losses –which are the root cause of recent market problems– led to so much market turbulence?

This is a good question. On the surface, the capital of financial institutions appeared large enough to absorb such losses without difficulty. Moreover, securitization had spread the exposures across diverse claimholders, minimizing the concentration of credit risk in the hands of financial intermediaries. A widespread opinion before the summer of 2007 was that securitization had increased the resilience of the financial system to shocks, by spreading the impact of defaults across a large number of diverse parties. So for both reasons (the small size of exposure and its wide dispersion) the conventional wisdom in policy circles up to the summer of 2007 was that the subprime exposure was too small to lead to widespread problems in the financial system.

Chart 1
The domino model of contagion



Yet, the credit crisis developed with a ferocity that appeared to sweep aside these considerations. There are important lessons here on the mechanisms of financial contagion.

It is worth drawing out the implicit assumptions that may lie behind the presumption that subprime exposures did *not* pose a serious threat to the financial system. The credit crisis of 2007 would, indeed, have been a surprise if financial contagion works primarily through defaults. A naive version of such a view could be depicted in Chart 1.

Here, bank A has borrowed from bank B, and bank B has borrowed from bank C, etc. Then, if A takes a hit and defaults, then bank B will suffer a loss. If the loss is large enough to wipe out B's capital, then B defaults. Bank C then takes a hit. In turn, if the loss is big enough, bank C defaults, etc. We could dub this the "domino" model of financial contagion.

If the domino model of financial contagion is the relevant one for our world, then defaults on subprime mortgages would have had limited impact. This is because the exposure to the subprime sector is small relative to the total size of the balance sheet, and to the capital held by the financial institutions themselves. Any defaults by subprime borrowers could easily be absorbed by the total capital of the financial sector. What is more, the widespread use of securitization will have further spread the exposures, so that any default risk is spread thinly throughout the financial system. There are no weak links in the chain, and therefore any shocks would be absorbed through small losses spread evenly across many institutions.

The domino model of contagion has been examined in many simulation studies conducted at several central banks, but the universal conclusion has been that

1 Remarks at the Federal Reserve Bank of Philadelphia, October 17th 2007. The link to the text of the speech and charts is at <http://www.ny.frb.org/newsevents/speeches/2007/dud071017.html>. Subprime exposures are small relative to other measures, too. Total US chartered commercial bank assets are 7.74 trillion dollars as of June 2007, while total outstanding mortgages are almost 14 trillion dollars according to the Federal Reserve Board's flow of funds. Asset-backed security (ABS) issuers held 2.8 trillion dollars, commercial banks and savings and credit unions held 4.9 trillion dollars, and Agency and Government Sponsored Enterprise (GSE) backed mortgage pools held 4.1 trillion dollars.

the impact of the domino model of contagion is very small. It is only with implausibly large shocks that the simulations generate any meaningful contagion.

However, the domino model is flawed. For a start, the domino model paints a picture of passive financial institutions who stand by and do nothing as the sequence of defaults unfold. In practice, however, they will take actions in reaction to unfolding events, and in anticipation of impending defaults. Second, the domino model does not take sufficient account of how prices and measured risks change. In the simplest scenario of the domino model, asset prices are fixed at their book values, and balance sheets take a hit only with default. Such a view is obsolete in the market-based financial system that we have today. Instead, the impact of price changes on balance sheets is likely to be much more potent in generating distress than outright defaults.

Indeed, defaults need not even be *necessary* to generate contagion. Price changes themselves may be enough. Take the episode of the distress suffered by European life insurance companies in the summer of 2002. By the nature of insurers' balance sheets, they have not borrowed from each other as banks do. However, when stock prices plummeted new lows in the summer of 2002, the European life insurers found that their regulatory constraints were beginning to bind. In the United Kingdom, for instance, the usual 'resilience test' applied to life insurance companies in which the firm has to demonstrate solvency in the face of a further 25% stock market decline was beginning to bind. German and Swiss insurers were even more constrained. The remedy for these insurers was to sell stocks, so as to reduce their exposures to them. However, large scale sales merely served to depress prices further, making the constraints bind harder. This generated a further round of selling, and so on. The regulators in the affected countries suspended the solvency tests for several weeks until the crisis abated. For instance, the UK Financial Services Authority diluted the resilience test so as to preempt the destabilizing forced sales of stocks by the major market players.²

The domino model of contagion is flawed, and is not useful for understanding financial contagion in a modern, market-based financial system. Instead, the key to understanding the events of 2007 is to follow the reactions of the financial institutions themselves to price changes, and to shifts in the measured risks.

Financial institutions manage their balance sheets actively in response to price changes and to changes in measured risk. Since market-wide events are felt simultaneously by all market participants, the reactions to such events are synchronized. If such synchronized reactions lead to declines in asset prices and higher levels of measured risk, there is the potential for a further round of synchronized reactions. The key players are the financial intermediaries –the broker dealers and commercial banks– whose balance sheets are highly leveraged and hence whose net worth is most sensitive to price changes and shifts in measured risk.

Elsewhere,³ we have shown that financial intermediaries react in a very different way as compared to households to shifts in prices and risk. Households tend not to adjust their balance sheets drastically to changes in asset prices. In aggregate flow of funds data for the household sector in the United States, leverage falls when total assets rise (see the paper by Adrian and Shin referred below). In other words, for households, the change in leverage and change in balance sheet size are negatively related. However, for security dealers and brokers (including the major investment banks), there is a *positive* relationship between changes in leverage and changes in balance sheet size. Far from being passive, financial intermediaries adjust their balance sheets actively and do so in such a way that leverage is high during booms and low during busts. Leverage is procyclical in this sense.

For financial intermediaries, their models of risk and economic capital dictate active management of their overall value at risk (VaR) through adjustments of their balance sheets. Denote by V the value at risk

² FSA Guidance Note 4 (2002): "Resilience test for insurers". See also FSA Press Release, June 28th 2002, No. FSA/PN/071/2002: "FSA introduces new element to life insurers' resilience tests".

³ Adrian and Shin (2007): "Liquidity and leverage" working paper, FRB New York and Princeton University, <http://www.princeton.edu/~hsshin/working.htm>

per dollar of assets held by a bank. In other words, the total value at risk of the bank is given by $V \times A$ where A is total assets. Then, if the bank maintains capital K to meet total value at risk, then we have

$$K = V \times A$$

Hence, leverage L satisfies

$$L = A/K = 1/V$$

Procyclical leverage then translates directly to the counter-cyclical nature of value at risk. Measured risk is low during booms and high during busts. From the point of view of each financial intermediary, decision rules that result in procyclical leverage are readily understandable. However, there are aggregate consequences of such behavior for the financial system as a whole.

First, consider the behavior of a financial intermediary that manages its balance sheet actively to as to maintain a constant leverage ratio of 10. Suppose the initial balance sheet is as follows. The financial intermediary holds 100 worth of assets (securities, for simplicity) and has funded this holding with debt worth 90.

Assets		Liabilities	
Securities	100	Equity	10
		Debt	90

Assume that the price of debt is approximately constant for small changes in total assets. Suppose the price of securities increases by 1% to 101.

Assets		Liabilities	
Securities	101	Equity	11
		Debt	90

Leverage then falls to $101/11 = 9.18$. If the bank targets leverage of 10, then it must take on additional debt of D to purchase D worth of securities on the asset side so that

$$\text{assets/equity} = (101 + D)/11 = 10$$

The solution is $D = 9$. The bank takes on additional debt worth 9, and with the proceeds purchases

securities worth 9. Thus, an increase in the price of the security of 1 leads to an increased holding worth 9. The demand curve is upward-sloping. After the purchase, leverage is now back up to 10.

Assets		Liabilities	
Securities	110	Equity	11
		Debt	99

The mechanism works in reverse, on the way down. Suppose there is shock to the securities price so that the value of security holdings falls to 109. On the liabilities side, it is equity that bears the burden of adjustment, since the value of debt stays approximately constant.

Assets		Liabilities	
Securities	109	Equity	10
		Debt	99

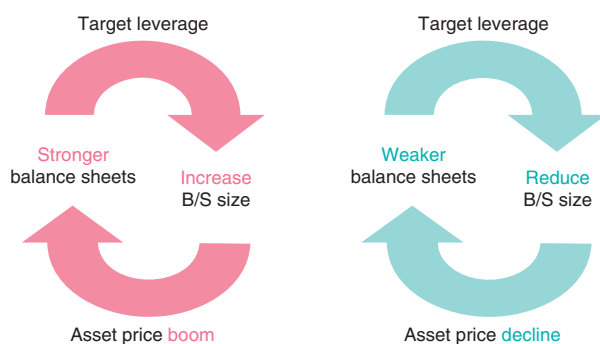
Leverage is now too high ($109/10 = 10.9$). The bank can adjust down its leverage by selling securities worth 9, and paying down 9 worth of debt. Thus, a fall in the price of securities leads to sales of securities. The supply curve is downward-sloping. The new balance sheet then looks as follows.

Assets		Liabilities	
Securities	100	Equity	10
		Debt	90

The balance sheet is now back to where it started before the price changes. Leverage is back down to the target level of 10.

Leverage targeting entails upward-sloping demands and downward-sloping supplies. The perverse nature of the demand and supply curves are even stronger when the leverage of the financial intermediary is pro-cyclical –that is, when leverage is high during booms and low during busts. When the securities price goes up, the upward adjustment of leverage entails purchases of securities that are even larger than that for the case of constant leverage. If, in addition, there is the possibility of feedback, then the adjustment of leverage and price changes will reinforce each other in an amplification of the financial cycle.

Chart 2
Price amplification of balance sheet changes



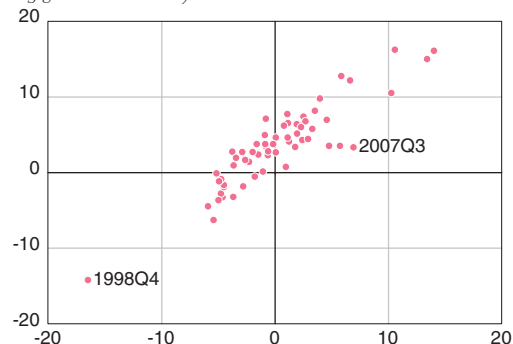
If we hypothesize that greater demand for the asset tends to put upward pressure on its price (a plausible hypothesis, it would seem), then there is the potential for a feedback effect in which stronger balance sheets feed greater demand for the asset, which in turn raises the asset's price and lead to stronger balance sheets. The mechanism works exactly in reverse in downturns. If we hypothesize that greater supply of the asset tends to put downward pressure on its price, then there is the potential for a feedback effect in which weaker balance sheets lead to greater sales of the asset, which depresses the asset's price and lead to even weaker balance sheets.

A striking portrait of procyclical leverage is given in the following figure, which plots the value-weighted change in leverage and change in assets for the five major US investment banks⁴ (Bear Stearns, Goldman Sachs, Lehman Brothers, Morgan Stanley and Merrill Lynch), plus Citigroup Global Markets which reported separately from its parent until 2004 (1998Q1 – 2004Q4).

Name	Sample
Bear Stearns	1997Q1 – 2007Q3
Goldman Sachs	1999Q2 – 2007Q3
Lehman Brothers	1993Q2 – 2007Q3
Merrill Lynch	1991Q1 – 2007Q2
Morgan Stanley	1997Q2 – 2007Q3

Chart 3
US investment banks: asset-weighted growth rates of total assets and leverage

(Quarterly growth rates in %)



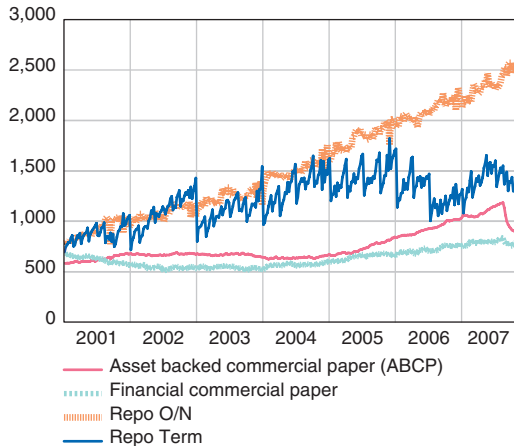
Two features stand out. First, leverage is procyclical. Leverage increases when balance sheets expand. Conversely, leverage falls when balance sheets contract. Thus, leverage tracks the waxing and waning of balance sheets in a way that amplifies the financial cycle. Although "procyclical leverage" is not a term that the banks themselves would use in describing how they behave, this is in fact what they are doing.

Second, there is a striking contrast between the distress in 1998Q4 associated with the LTCM crisis and the credit crisis of the summer of 2007. While balance sheets contracted sharply in 1998, there has not (yet) been a comparable contraction of balance sheets in the crisis of 2007. Understanding the reasons for the difference between 1998 and 2007 holds the key to unlocking some of the mysteries surrounding the drying up of the interbank credit market in the summer of 2007.

To begin with, let us see the aggregate stock of repos (both term repos and overnight repos), as well as the stock of commercial paper. The commercial paper category is itself sub-divided into the asset backed commercial paper (ABCP) and ordinary financial CP. The four series are given in the chart below, that track the stocks going back to 2001.

⁴ At the time of writing, we do not have access to the 2007 3rd quarter figures for Merrill Lynch. Otherwise, the list is complete up to 2007Q3.

Chart 4
Short-term borrowing of the financial sector
Commercial paper and repurchase agreements (Repos)
 (USD millions)



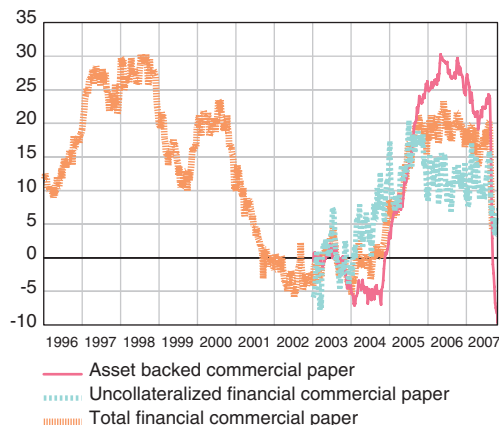
Source: Federal Reserve Bank of New York, Board of Governors of the Federal Reserve

It is noticeable how the stock of asset backed commercial paper has contracted sharply since late June of 2007, even as the overnight repos have not seen any diminution. The drop in ABCP stocks is even clearer in Chart 5 that gives the growth rates of the series.

The drop in ABCP issuance is very sharp indeed after the end of June 2007. The red line (ABCP) goes off a cliff, so to speak.

Chart 5
Commercial paper outstanding

(Annual growth rates in %)



Source: Board of Governors of the Federal Reserve

The contraction of the ABCP market suggests an explanation for why bank balance sheets have not (so far) contracted as sharply as they did in 1998. The beginnings of the credit problems of 2007 were first manifested by falling prices of securities that are associated with the subprime sector. For instance, the ABX indices started to fall in June of 2007. The ABX indices track the credit default swaps (CDS) associated with various rated tranches of collateralized debt obligations (CDOs) written on subprime mortgages, and are compiled by the London firm Markit.⁵

The falls in the prices of securities proceeded into July. By late July, measured risks increased to uncomfortable levels. In particular, the off balance sheet structured investment vehicles (SIVs) and conduits that had been set up to buy large quantities of subprime mortgage related assets began to experience difficulties in rolling over their asset-backed commercial paper liabilities. Many of the conduits and SIVs had been set up with back-up liquidity lines from banks, and such liquidity lines were beginning to be tapped by the end of July and early August.

The tapping of the credit lines were happening at precisely the moment that the risk constraints were binding harder for the banking sector. Tighter value at risk constraints translated to higher shadow value of capital and hence to the desired contraction of balance sheets. Contracting balance sheets of hedge funds and other holders of ABCPs led to a fall in the demand for the liabilities issued by SIVs and conduits. In late July and early August, SIVs and conduits began to experience difficulties in rolling over their short term liabilities.

Furthermore, as credit lines got tapped, the balance sheet constraint at the banks began to bind even harder, making them even more reluctant to lend. In effect, the banks were "lending against their will". The fact that bank balance sheets did not contract is indicative of the involuntary expansion of the banks' balance sheets. One of the consequences of such involuntary expansion was that they sought for other ways to curtail lending. Their natural response was to cut off lending that was discretionary. The seizing

up of the interbank credit market can be seen as the conjunction of:

- Desired contraction of balance sheets
- "Involuntary" lending due to the tapping of credit lines by distressed entities.

The question is how far the contraction of balance sheets have to run in the current crisis. Given the recent disclosed losses at the major banks arising from the subprime crisis, it would be reasonable to conjecture that the contraction of balance sheets still has some way to go.

The balance sheet perspective gives new insights into the nature of financial contagion in the modern, market-based financial system. Aggregate liquidity can be understood as the rate of growth of aggregate balance sheets. When financial intermediaries' balance sheets are generally strong, their leverage is too low. The financial intermediaries hold surplus capital, and they will attempt to find ways in which they can employ their surplus capital. In a loose analogy with manufacturing firms, we may see the financial system as having "surplus capacity". For such surplus capacity to be utilized, the intermediaries must expand their balance sheets. On the liabilities side, they take on more short-term debt. On the asset side, they search for potential borrowers that they can lend to. Aggregate liquidity is intimately tied to how hard the financial intermediaries search for borrowers. In the subprime mortgage market in the United States we have seen that when balance sheets are expanding fast enough, even borrowers that do not have the means to repay are granted credit –so intense is the urge to employ surplus capital. The seeds of the subsequent downturn in the credit cycle are thus sown.

Musical chairs: a comment on the credit crisis

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Uncertainty –that is, a rise in unknown and immeasurable risk rather than the measurable risk that the financial sector specializes in managing– is at the heart of the recent liquidity crisis. The financial instruments and derivative structures underpinning the recent growth in credit markets are complex. Because of the rapid proliferation of these instruments, market participants cannot refer to a historical record to measure how these financial structures will behave during a time of stress. These two factors, complexity and lack of history, are the preconditions for rampant uncertainty. We explain how a rise in uncertainty can cause a liquidity crisis and discuss central bank policies in this context.

Since the summer of 2007, world financial markets have been embroiled in a severe liquidity crisis. The current situation is particularly surprising if one considers the initial conditions. At the start of 2007, financial markets had substantial liquidity and investors were charging low prices for bearing risk. Banks were liquid and well capitalized, with a substantial buffer relative to their regulatory capital requirements. Similar statements of health could have been issued for all of the key pieces of the financial system. As late as May of 2007, it would have been hard to predict that losses on subprime mortgage investments could have precipitated a crisis of the magnitude we are witnessing. For one, the subprime losses were relatively small: even worst-case estimates put these losses at USD 250 billion, which is a drop in the bucket relative to the trillions of dollars of financial instruments traded in the world's marketplaces. Moreover, for anyone in the know, defaults on subprime mortgages were *expected*. The subprime market is the riskiest segment of the mortgage market, so it is hardly surprising that some borrowers would default on their loans. Yet the incidences of defaults have been the trigger for the current severe liquidity crisis that has ensnared markets from consumer credit to corporate credit.

Why has this happened? The heart of the recent crisis is a rise in *uncertainty* –that is, a rise in unknown and immeasurable risk rather than the measurable risk that the financial sector specializes in managing. The financial instruments and derivative structures underpinning the recent growth in credit markets are complex. Indeed, perhaps the single largest change in the financial landscape over the last 5 years has been in complex credit products: collateralised debt obligations (CDOs), collateralised loan obligations (CLOs), and the like. Because of the rapid proliferation of these instruments, market participants cannot refer to a historical record to measure how these financial structures will behave during a time of stress. These two factors, complexity and lack of history, are the preconditions for rampant uncertainty.

When defaults on subprime mortgages occurred, many market participants were taken by surprise at how their investments were reacting. The most prominent example of this is the case where AAA subprime tranches suffered losses. At this point, investors had become uncertain about their investments.

If the uncertainty was confined to subprime mortgage investments, given the relatively small size of the subprime sector, the financial system could have absorbed the losses without too much dislocation. However, investors started to question the valuation of the myriad other credit products –not just mortgage– that had been structured in much the same way as subprime investments. The result was uncertainty across the entire credit market.

To understand how uncertainty can move an economy from excess liquidity to a liquidity crunch, an analogy may be useful. In the children's game of musical chairs, when the music stops, only one child will be left without a seat. However if the children are confused about the rules and each is convinced that he will be the one left without a seat, chaos may erupt. Kids may start grabbing on to chairs, running backwards, etc.

In the same way, in today's market, uncertainty has led every player to make decisions based on imagined worst-case scenarios. Market players that have the liquidity stay out of markets or pull back dramatically. Some participants question whether their counterparties have hidden losses on their books and grow wary of trading with these counterparties. Others hoard their liquidity to cover a worst-case shock that may never occur. But the financial markets need participants and their liquidity in order to function. When many players disengage due to uncertainty, the effective supply of liquidity in the financial system contracts. Those that need liquidity are unable to get it and financial markets turn illiquid.

To make matters worse, the uncertainty over losses is concentrated in the world's largest and most reputable banks. In most previous crises, the largest banks would benefit from inflows during investors' flight to quality and could therefore act as a financial stabilizing force. This natural stabilizer is absent during the current episode. Today, banks do not lend to other banks. Less informed non-bank investors follow suit. The result is a halt in credit of all kind, which has transformed a financial markets' problem into a problem for the economy at large.

What should central banks do in this case? They must find a way to re-engage the *private sector's liquidity*. Re-engagement will only occur as agents' uncertainty over outcomes is reduced.

A central bank's mission is to stabilize the economy, as a whole, and not individual participants. When viewed as a whole, the worst-case scenarios that guide the behavior of each market participant cannot simultaneously occur. Like musical chairs, when the music stops, only one child will be left without a seat, not every child. The subprime shock at the end of the day is a small shock; it is only the actions of panicked investors that have made it large. The standard recipe in such a flight-to-quality scenario is for central banks to convincingly promise large liquidity injections in the event of a meltdown. Indeed, the response of central banks back in August 2007 to the emerging crisis was more or less textbook in terms of flight-to-quality containment, although with hindsight, we can say that it was behind the curve in terms of magnitude.

But if central banks have largely done the right thing, why is the turmoil not over? Part of the answer comes from "newness" itself. The current crisis is the result of the confusion created by complex credit products. As the initial response of the central banks failed to quell the crisis, markets have grown to fear whether central banks have the necessary

liquidity/instruments to act as a lender of last resort during the current crisis. This introduces a second layer of uncertainty aversion which in turn reduces the effectiveness of central banks to deal with the panic caused by the first layer of uncertainty.

At some level, these worries are misplaced. The central bank *can* affect the supply of liquidity; this is its core policy tool. The recent liquidity injection by the ECB of EUR 340 billion can go some way towards demonstrating that central banks exert control over liquidity supply. What's next? Possibly more dramatic steps need to be taken in order to convince the market that there is a lender of last resort.

At the end of the day, it is important to recall that the potency of a successful intervention comes from its credibility, and this requires that financial market participants be convinced that the lender of last resort is ahead of the game. The paradox is that with credibility, the likelihood of having to deliver on the promise is minimal, but the reduced anxiety fostered by a credible commitment restarts private liquidity circulation and over time helps restore normalcy.

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Market liquidity and financial stability

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Stability in financial institutions and in financial markets are closely intertwined. Banks and other financial institutions need liquid markets through which to conduct risk management. And markets need the back-up liquidity lines provided by financial institutions. Market liquidity depends not only on objective, exogenous factors, but also on endogenous market dynamics. Central banks responsible for systemic stability need to consider how far their traditional responsibility for the health of the banking system needs to be adapted to promote stability in the relevant financial markets.

NB: The views expressed in this paper are in the author's personal capacity.

The second half of 2007 has provided an object lesson of the role of liquidity in financial stability. Problems in the subprime mortgage sector of the US have led to a drying up of liquidity in a range of markets, many of which are not directly related to the mortgage sector. In turn, the loss of liquidity has caused falls in asset values which has led to distress at certain financial institutions, and caused turmoil in credit markets. Banking institutions in the United Kingdom and Germany, far from the origin of the crisis, have had to be rescued. At the time of writing (November 2007), it is unclear whether these developments will have major negative effects on real economic activity, but the potential is clearly there.

This erosion of liquidity recalls earlier episodes, most recently in 1998 and 2003, when markets "seized up" as a result of generalized unwillingness to enter into transactions. These should not be regarded as simple aberrations. They reflect characteristics of market liquidity that have been insufficiently appreciated until now. These include:

- Liquidity is not dependent simply on objective, exogenous factors, but is crucially influenced by endogenous forces, especially the dynamic reactions of market participants in the face of uncertainty and changes in asset values.
- As a result of the foregoing, liquidity can be subject to a "dual equilibrium" phenomenon. In favorable conditions, liquidity is easily available and "cheap". But under stress conditions, liquidity becomes very scarce and expensive. It may become effectively unavailable.
- Liquidity in markets and for individual intermediaries is much more interdependent than often realized. Markets are dependent on back-up liquidity lines from financial institutions, and institutions are dependent on continuous market liquidity to execute their risk management strategies.
- The actions of individual market players to conserve liquidity, while individually fully rational, can collectively have the effect of reducing liquidity in the market place as a whole.

In the remainder of this paper, I will examine the basis of these propositions, and analyse the dynamics of market stress. I will close with some reflections on policy implications and the way in which central banks manage markets.

1 | WHAT IS LIQUIDITY?

Liquidity is easier to recognize than to define. At root, liquidity is the ease with which value can be realized from assets. Value may be realized either by using creditworthiness to obtain external funding; or by the sale of owned assets in the marketplace. The former concept, "*funding liquidity*" is relevant for the ability of financial institutions to perform their intermediation functions. Typically, a financial institution is a supplier of liquidity, issuing liquid liabilities in order to hold less liquid assets, using its capital to cover liquidity risk and making a turn on the provision of liquidity services that justifies the cost of the capital involved.

The second concept, "*market liquidity*", refers to the ability to undertake transactions in such a way as to adjust portfolios and risk profiles without disturbing underlying prices. The dimensions of market liquidity include:

- market "depth", or the ability to execute large transactions without influencing prices unduly;
- "tightness", or the gap between bid and offer prices;
- "immediacy" or the speed with which transactions can be executed;
- and "resilience", or the speed with which underlying prices are restored after a disturbance.

It is worth noting that the distinction between funding liquidity and market liquidity is becoming less relevant. Financial institutions now manage their liabilities and assets in a holistic way. They do not simply approach the market to fund a given portfolio of assets. Rather, they confront changing market

conditions using risk management techniques that involve a combination of asset sales, liability issuance and derivative transactions, aimed at achieving the optimum risk profile, given their assessment of the risks and returns from alternative portfolios.

2| THE DETERMINANTS OF MARKET LIQUIDITY

It used to be believed that market liquidity could be analysed in terms of objective exogenous factors. A market was thought likely to be liquid if:

- market infrastructures were efficient, leading to low transactions costs and thus narrow bid-ask spreads;
- there were a large number of buyers and sellers, implying that order imbalances could be quickly adjusted by small movements in prices;
- and the assets transacted had transparent characteristics, so that changes in perceptions of underlying value would be quickly translated into prices.

While these factors remain important, they only help to define the relative liquidity of different markets in normal times. In times of stress, the dynamic outcome of behavioral responses by individual market players takes on considerable importance. Since market participants generally acquire assets and liabilities to trade, they will be particularly concerned about the conditions under which they can on-sell assets, or can use them as collateral for funding needs. They are, in other words, concerned not only about fundamental long-term value, but also about the value they can realize in circumstances under which they need to liquidate a position quickly.

This consideration implies a circularity in the concept of liquidity. An asset that is perceived as liquid will be demanded for its liquidity characteristics. But one that is perceived as lacking in liquidity will lose demand. What is of particular interest is how a category of assets can move from being regarded as liquid, (and therefore demanded both for intrinsic characteristics and for liquidity services)

to being regarded as illiquid. The experience of the second half of 2007 provides some clues.

Asset-backed commercial paper was regarded as among the most liquid of instruments. So liquid, in fact, that the issuing banks charged very little for the liquidity enhancement features they offered, and did not regard the contingent liability they faced as requiring much, if any set-aside capital. The liquidity originated in the fact that the borrowing entities were highly creditworthy, and the valuation of the underlying collateral was regarded as well-founded (using ratings provided by rating agencies).

When it became clear that certain types of paper were worth less than their face value, and that the discount was hard to estimate, there was a move to reduce exposures. It is important to realize that the move to reduce exposures was due *both* to the intrinsic loss in value of the underlying assets as well as to the loss of liquidity services from paper the demand for which had dried up. It was, to put it in other words, a combination of a repricing of risk and a "lemons" problem. A lemons problem arises when the potential purchaser of an asset has imperfect knowledge of its characteristics, and hence is unwilling to offer as much as the lowest price the seller is prepared to accept. In the case of asset-backed securities, the realization that collateral was (or might be) impaired, and that the degree of impairment was unknown, caused a collective unwillingness to trade. Further, the fact that such assets had become, in practice, unsaleable, meant that they lacked any liquidity characteristics, which further reduced their value.

3| THE DYNAMICS OF LIQUIDITY AND MARKET DISTRESS

Liquidity is a concept that can usefully be considered in light of the observed "procyclicality" of the financial system. Procyclicality refers not simply to the well-known psychological phenomenon which leads to an interaction of greed and fear among financial market participants, but to certain objective features of risk management practices that lead to alternating cycles of exuberance and retrenchment in the financial sector.

As an economic upswing proceeds, asset values increase, causing collateral values to rise, and inducing additional lending by financial institutions. Those that have financed positions through leverage profit most during this upswing. These gains provide borrowers with the incentive and the means to borrow more, and provide lenders with the comfort that their risks, (calculated with reference to experience over recent years) are acceptable. During this upswing phase of the cycle, therefore, leverage tends to increase, and lending institutions take on what, with the benefit of hindsight, can be seen as more risky exposures. The system at large becomes more vulnerable to a change in the cycle, although this vulnerability is obscured by apparently strong balance sheets.

In this phase, it is difficult for an institution that wishes to adopt a more conservative stance to do so. Credit costs seem to be low, liquidity is cheap and easily available, volatility is moderate, and competitor institutions are aggressively pursuing market opportunities. Those who stand aside face a loss of market share, perhaps lasting for a protracted period, before they can be proved right. In the words of Charles Prince, if the music is playing, they more or less have to dance.

But the situation is not sustainable. Eventually, a trigger signals a change in the economic cycle. The trigger may be wholly external, possibly caused by geo-political concerns, or a sudden increase in commodity prices; it may be policy-induced, for example, a preemptive rise in interest rates by the central bank, or it may be endogenous, such as overlending to a particular sector, *eg* housing.

Whatever the cause, however, it is the dynamic reactions that do the most damage. As individual institutions or market players see declines in asset prices, they see their capital cushions shrink and seek to protect their liquidity by reducing exposures. Declining prices have the further effect of raising perceived volatility and "value-at-risk". Once again, the reaction of an individual institution is to reduce exposures to limit risk. Not relevant to the actions of the individual institution is the market consequences of its actions in raising risk and reducing market values for the generality of other market players.

4 | POLICY OPTIONS

Central banks and banking regulators have traditionally seen their responsibility as covering the banking institutions that are at the core of the financial system. In this, they have developed practices to try and *prevent* problems from emerging, as well as to *manage or resolve* problems that nevertheless occur.

On the preventative side, the principal tools have been to prescribe minimum ratios of capital and liquidity that are sufficient to maintain public confidence in banking institutions even in times of stress. The problem with this approach is that the reactions of banks to an erosion of their capital or liquidity position can accentuate the market pressures that gave rise to the problem in the first place. If a bank is attempting to maintain a capital ratio of x percent, and something happens to cause the ratio to fall below the target, the natural response is to sell assets to restore the desired ratio. This in turn pushes down asset prices and exacerbates the liquidity pressures faced by other banks.

In the longer term, it would seem desirable to use supervisory tools to ensure that banks maintain sufficient capital and liquidity in normal times, such that an erosion of ratios can be allowed to occur in times of stress, without requiring a response. For example, through the use of stress tests, supervisors could require banks to build up capital even in circumstances in which conventional measures of risk showed low vulnerability. Then, when the cycle turned, and measures such as value-at-risk were rising, supervisory guidance could allow accumulated capital and liquidity to be prudently used without banks having to run down balance sheets precipitately or liquidate assets in unfavourable market conditions.

This would represent an attempt to offset the natural procyclicality of the financial system. Whether it would be fully effective is another question, however. It has to be recognized that attempts by financial institutions to reduce lending to maintain capital ratios are not simply driven by regulatory

requirements but just as powerfully by market expectations. There is a natural reluctance to reveal declining ratios in times of market stress, however good the justification.

Turning to how to manage stress at financial institutions once it has emerged, central banks have well-established practices governing how to respond to purely liquidity pressures. These include a willingness to lend, at a penalty rate and on good collateral, to banking institutions that face funding liquidity (but not solvency) problems. The *locus classicus* for this approach is Bagehot's "*Lombard Street*".

These principles have stood the test of time, and central bankers would rightly be very reluctant to challenge them. However, in modern financial systems, they leave a number of problems for which there are no very easy answers. One is the well-known issue of how to distinguish between liquidity and solvency pressure. As I have argued earlier, loss of liquidity leads to loss of value, and this can cause a liquidity problem to become a solvency problem. Moreover, not only can banks become illiquid before they become insolvent, they can also become insolvent before they become illiquid.

A second issue is how to provide liquidity support to financial institutions in circumstances where such support is fully transparent to other market participants. Nowadays, transparency has become the norm for the conduct of public policy. In practice, however, transparent provision of financial support will often be interpreted as a confirmation of vulnerability, leading to the very reactions by depositors and counterparties that the support is designed to prevent. Central banks and governments need to reflect on whether transparency, in itself a desirable feature of public policy, can in some circumstances undermine the objectives it is intended to serve.

A third issue is how to respond, if at all, to illiquidity in *markets* rather than at financial institutions. The traditional answer has been to say that markets can take care of themselves. Markets clear, at least in theory, and there should be a price at which willing buyers and willing sellers come together. There is, again in theory, no economic harm if prices move to balance supply and demand.

This view neglects certain crucial facts, however. First, markets can seize up and fail to perform their function of matching buyers and sellers. In the process, the loss of liquidity impairs the ability of financial institutions such as banks to use markets (and particularly derivative instruments) to manage their risk. Modern risk management relies on continuous liquidity in short term markets for the dynamic hedging of risk.

A further problem is presented by the fact that valuation of the assets and liabilities held by banks is increasingly based on mark-to-market accounting. When markets are illiquid, asset valuations can change rapidly, leading to volatility in the key ratios used to judge banks' strength. So central banks concerned with preserving the stability of financial institutions have, willy-nilly, a strong interest in the preservation of market liquidity.

Central banks have focused on maintaining liquidity at the short end of the money market. They have generally been willing to step in and provide the liquidity needed to keep overnight interbank rates near their policy target. In the recent market turmoil, there was some debate about how to view such assistance. Some saw it as providing support to a market (and indirectly to institutions) that had become overextended, and therefore that should be provided only at a penalty rate. An alternative view is that liquefying a market that has encountered liquidity difficulties is an extension of monetary policy actions aimed at keeping policy rates close to the target.

An issue facing central banks as they attempt to learn lessons from the recent turbulence is going to be if and how to extend liquidity assistance to markets. Should the range of collateral be broadened? And should the duration of assistance be extended? My view of the answer to these questions is in the affirmative, though I recognize this goes into controversial and uncharted territory. Markets have become larger relative to financial institutions in the intermediation process; and their role in effective risk management has grown. Central banks will, I believe, have to recognize that their overall responsibility for systemic stability makes it harder for them to take a hands-off attitude to market liquidity.

Ten questions about the subprime crisis

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The ongoing credit crunch represents the first crisis of the age of mass securitization. One conclusion sometimes drawn is that the costs of securitization, in the form of risks to financial stability, exceed the benefits. The implication is that we should return to the simpler days when commercial banks originate loans to households and firms and hold them on their balance sheets, rather than slicing them, dicing them and selling them off. But this back-to-the-future formula ignores economic realities. Securitization is bound up with the broader deregulation of financial markets and with the information-technology revolution. Policy makers cannot eliminate this process short of reimposing the kind of restrictive regulation to which banking and financial systems were subject half a century ago.

In any case, turning back the clock would not be desirable because the constellation of financial innovations referred to as securitization has real benefits for the economy. Those innovations have allowed the financial system to repackage and spread risk. They have reduced the amount of equity capital that this system requires to absorb that risk. The result has been to lower funding costs for both firms and homeowners as a class.

In the aftermath of the Great Securitization Crisis of 2007-8, would-be reformers will surely say that financial regulators need to rethink speed limits and rules of the road. In my view, policy makers should focus on the banking system. Banks still play a unique role. They are at the center of the information-impacted segments of the financial system. Their key role and their vulnerability are recognized by the protection they receive via the financial safety net. Re-thinking should start with the role of Basel II, and within Basel II of the role of internal models and bond ratings.

NB: This note draws on a longer paper prepared for a conference of the Tobin Project, "Toward a new theory of financial regulation". Financial support has been provided by the Coleman Fung Risk Management Center at the University of California, Berkeley.

The subprime crisis is widely regarded as the first financial crisis of the age of mass securitization, although the turbulence precipitated by the all-but-failure of Long-Term Capital Management (LTCM) in 1998 also has a reasonable claim to the mantle. Of the two episodes, the subprime crisis is more likely to result in far-reaching changes in the structure and regulation of securities markets. Where the LTCM crisis encouraged an ongoing assessment of the adequacy of prudential oversight of the hedge-fund industry and its counterparties, the subprime crisis has unleashed a far-reaching reassessment of the very foundations of securitized finance. Commentators now question the efficacy of the business model of originate-and-distribute. They predict a shift away from complex derivatives with difficult-to-understand performance characteristics back toward "plain-vanilla" securities that are more easily priced. They acknowledge new doubts about the adequacy of a revised Basel Accord that relies on dubious internal models and credit ratings for gauging the adequacy of bank capital.

The theme unifying these responses would appear to be wistfulness for the simpler financial era now past. But the reality is that there is no turning back the clock. Securitization and the other new technologies of financial intermediation are here to stay. As in the case of nuclear weapons, the world would be simpler if the new technology could just be forgotten. But this is not realistic. The task for regulators is not to suppress all knowledge of the new technology but to channel it in productive directions –as with nuclear power– and to prevent it from getting into the wrong hands.

Doing so is not easy, either in the case of nuclear technology or financial technology. But those seeking a nuclear nonproliferation treaty have at least one advantage over their financial counterparts: they have been at work on their problem for decades. In contrast, the subprime crisis is, in an important sense, unprecedented. Many of the challenges it poses are unfamiliar.

Understandably in this light, financial regulators are still at the stage of forming the relevant questions rather than offering conclusive answers. Likewise, what follow are necessarily less recommendations than they are questions for policy. Questions without answers do not provide closure, but they at least offer food for thought, as well as road maps for scholars

who wish to sharpen political debate about how public officials might usefully respond to the crisis in credit markets.

1 | QUESTIONS ABOUT ORIGINATE AND DISTRIBUTE

Over the past twenty years, large banks have refined strategies of securitizing credit –that is, they originate loans or purchase them from specialized brokers and transfer them to a special purpose vehicle, which then packages them into collateralized debt obligations (CDOs) for sale to other investors. Some commentators have argued that this business model has simply set the stage for financial crisis. Securitization, they argue, weakens the incentive for the originator to assess the credit quality of those loans, relative to the once-upon-a-time world in which banks held their loans on their balance sheets. As a result, the stability of the credit markets has come to hinge on the acumen of investors, who lack the specialized expertise needed to undertake such scrutiny of creditworthiness. Thus, while securitization spreads risk, it also has a tendency to raise it (creating more risk to be spread and ultimately borne by someone).

In principle, even banks that transfer loans off balance sheet will pay a price in reputational damage if they fail to adequately monitor those loans or systematically overstate their quality. Those who buy the nonperforming CDOs will blame the bank that set up the special purpose vehicle. But it is evident that this reputational mechanism is insufficient to ensure adequate monitoring, as acknowledged by Bernanke (2007a). Some would say that this situation reflects problems of incentive alignment within financial institutions: the employment relationship creates incentives for decision makers to gamble with the firm's reputation. Investment analysts and financial engineers change jobs and employers. They thus have an incentive to take risks with the firm's reputation, since a good outcome means larger bonuses while a bad outcome tarnishes the reputation of an institution with whom they will no longer have a relationship. One can make similar arguments about the incentives provided by the structure of compensation within corporate America. A CEO who encourages risky behavior will be paid handsomely

if the bet pays off and will be paid less than zero if it does not (in other words, the distribution of returns is asymmetric).

Observations like these have led some observers to recommend that originators should be required to hold a specific minimum share of the securities on their own balance sheets. Banks might be required to hold, say, 20 per cent of each CDO (or 20 per cent of each CDO tranche). This proposal would, at least in part, restore the traditional financial incentive of a bank that held the loans it originated to carefully scrutinize their credit quality.

By design, such a reform would be a step back in the direction of good-old-fashioned banking, in which institutions making loans would have less scope for diversifying their risks.¹ One should recall, therefore, that the old model had limitations. It left banks vulnerable to housing-market downturns, in turn rendering them more cautious about extending housing finance and raising the price of the latter. Reforms along these lines would thus solve problems in securities markets at the cost of heightening risk in the banking system and raising costs to consumers.

One can also question whether regulation of this form would be effective. In particular, one would expect banks to seek ways of hedging the additional exposure that regulators were attempting to force them to hold. They could take offsetting short positions in other assets whose returns were correlated with their own CDOs, use credit derivatives markets, or have their own financial engineers design and sell instruments tailored to offset the associated risks. To the extent they succeeded, incentives would not differ very much from the current situation.

2 | QUESTIONS ABOUT BASEL II

By applying minimum capital requirements to bank balance sheets and requiring more capital protection of riskier assets, the 1988 Basel Accord encouraged banks to shift risky activities off balance sheet. The growth of structured investment vehicles (SIVs) and conduits was not exactly a coincidence, in other words.

¹ The "good-old-fashioned banking" line is from Alastair Darling (see below).

² Note the tension with the previous subsection, where I discussed Chairman Bernanke's suggestion that reputational factors may not be enough to induce responsible behavior by originators. The tension dissolves in cases like that of Citigroup, which inserted put options into many of the CDOs backed by subprime mortgages that it sold to customers. Those puts allowed buyers who ran into financing problems to sell them back to the originator at original value – something that was not accounted for on the bank's balance sheet. See Wray (2007) and the references therein.

By design, the creation of these off-balance sheet entities allowed banks to reduce the capital associated with a given risk profile. In addition, it reduced the transparency of risky activities and hid them from regulatory scrutiny. Unsurprisingly, these innovations encouraged excessive risk taking, inadequate transparency, and weak regulatory scrutiny.

Basel II, which international banking authorities have designed to correct some of these deficiencies, came into operation at the beginning of this year. Under Basel II, regulators will take into account the riskiness of a bank's overall portfolio, including contingencies, when establishing capital requirements. The new approach requires banks to use portfolio models to assess the riskiness of the portfolio; where circumstances do not allow such modeling, banks must calculate their capital requirements from the credit ratings assigned to the bond portfolio. This accounting regime should reduce the incentive for shifting risky activities to a special purpose vehicle or conduit, insofar as the probability that the position will come back onto the bank's balance sheet is part of the modeling exercise.

The problem is that banks will still have an incentive to make convenient assumptions about when the loans they originate and distribute will come back onto the balance sheet, and it is not clear that supervisors will be in a position to correct them. Typically banks can assume that a loan, once sold, is gone for good. In practice, however, originators may feel compelled to repurchase securities that they previously sold for reputational reasons.² David Dodge, the now former governor of the Bank of Canada, has argued that bank capital requirements should be raised across the board to compensate for this bias (Dodge, 2007).

Prevailing accounting standards continue to allow banks to use their own internal models in making this assessment, and one can question their incentive to give proper weight to downside risks. Even state-of-the-art models have a tendency of underestimating the probability of extreme outcomes. (Of late, once-in-a-thousand-year events have a habit of happening every ten years.) They underestimate the correlation of returns on different assets in periods of high volatility. Financial engineers are

familiar with distributions with fat tails, but the tails may be even fatter than they think.

Raising questions about Basel II is easy –not so identifying effective reforms. One option would be to go back to Basel I, under which regulators put different assets into different risk buckets and assigned capital requirements accordingly. Or one could go back to Basel 1.5, a variant of Basel I in which regulators paid closer attention to contingent and off-balance-sheet assets and liabilities and provisioned accordingly. This alternative would, however, place an even greater premium on dealing with another set of problems associated with the commercial credit ratings that provided the basis for placing credits in risk buckets. At the other extreme, regulators might acknowledge the impossibility of fixing these problems and jettison capital requirements for market discipline. They could require banks to issue subordinated debt in the hope that debt holders would exercise strong oversight of banks' investment and management decisions, as recommended by Calomiris (2007).

3| QUESTIONS ABOUT STRESS TESTING

Financial institutions and their supervisors do extensive stress testing of portfolios. The question is whether the scenarios they simulate are extreme enough. These are based on estimates derived from finance-theoretic models of the distribution of returns and of how returns on different assets co-vary in more and less volatile periods. The experience of the last decade suggests that these models may systematically underestimate the likelihood of extreme returns and the increase in covariances when volatility spikes. Thus, stress tests based on these estimates produce a maximum loss in portfolio value that is only a fraction of actual losses when things go bad. A case in point is Northern Rock, the British building and loan society that has become a prominent casualty of the current crisis. Northern Rock reportedly carried out –and passed– all the stress testing exercises to which it and the UK Financial Services Authority (FSA) agreed in the first half of 2007. Evidently, the possibility that of the bank's funding sources all could dry up at the same time was not one of these scenarios.

Better models of financial market dynamics may eventually allow for more effective stress testing and systems simulation. But if the shortcomings of existing models are severe and mainly work in one direction, one can reasonably ask whether supervisory and regulatory practice should be based on such flawed frameworks.

4| QUESTIONS ABOUT LIQUIDITY

The distinguishing characteristics of many CDOs and made-to-measure mortgage-backed securities are their complexity, opacity, and specialized clientele. These characteristics meant that when significant doubts arose in the summer of 2007 about the performance of these securities, market liquidity dried up. Investors all lined up on one side of the market, as the imperfectly informed attempted to infer underlying conditions from the actions of others. Potential buyers of last resort were unable to fund their operations by borrowing from banks reluctant to lend against uncertain collateral. There was a spike in interbank rates and worries about gridlock in the interbank market as banks reluctant to lend to other banks were forced to take complex structures back onto their balance sheets.

In light of these worrisome events, some economists have argued that banks and other financial entities should be subject to liquidity requirements so that when some institutions are forced by deteriorating market conditions to sell CDOs others are in a position to buy, obviating liquidity problems. These observers similarly suggest that regulation should be used to prevent banks like Northern Rock, which possess liquid liabilities and illiquid assets, from pursuing such a risky business model; in short, regulators should require such banks to keep a proportion of their investments in liquid assets, where that portion is a function of their funding strategy. (This assumes, of course, that supervisors can reliably determine what assets are liquid. Given that some normally liquid assets can become illiquid abruptly, as the subprime crisis reminds us and as numerous past financial crises demonstrate, one would presumably want a narrow definition of the category.) Champions of the Basel Accord defend its lack of specified liquidity requirements on the grounds that the Accord is concerned with capital adequacy, not

liquidity. But this argument, critics insist, ignores the extent to which the Accord's approach encouraged regulators to neglect the importance of liquidity in their supervisory activities.

By definition, liquidity requirements raise the cost of doing business and the price of housing finance, as well as other forms of lending. Banks have always been in the liquidity transformation business, and the more that the regulatory framework requires them to hold liquid assets, the more expensive their liquidity transformation services will become. And even if banks and other institutional investors had more liquidity on hand, it by no means follows that they would wish to deploy it under the conditions anticipated by the advocates of more restrictive reserve policies. The problem in 2007 was not that the banks as a group had no liquidity to deploy but that they had no wish to deploy it, given the pervasive lack of information about the underlying economic condition of potential counterparties.

5 | QUESTIONS ABOUT RATING AGENCIES

The role of modern credit rating agencies is to provide specialized intelligence, in the form of publicly-available ratings, for use by investors seeking to price opaque securities. The subprime crisis suggests that the rating agencies' execution of this function was subpar. They failed adequately to distinguish between the riskiness of different securities. They were too generous in providing AAA ratings. They failed to downgrade mortgage-backed securities as the housing market and hence the value of the underlying mortgage obligations deteriorated. They then aggravated the crisis by reacting with wholesale downgrades once the market collapsed.

One explanation for this dismal performance lies with the imperfect models used by the rating agencies to value residential-mortgage-backed securities (RMBSs) and the associated derivatives. Their methods emanate from long experience (in two cases, more than a century's worth) of rating corporate bonds. Mason and Rosner (2007) point to a number of reasons why the application of valuation models for corporate bonds to securities backed by claims on the residential mortgage market may be misleading.

For example, the performance of a corporate bond depends on both the condition of the issuing firm and the condition of the macroeconomy. By comparison, debt securities backed by baskets of mortgage loans depend more heavily on the macroeconomic cycle and therefore are more highly correlated. Similarly, in building their estimates of default probabilities on historical evidence, the rating agencies used data from both good and bad times for corporate bonds but only data from good times for newer assets (since these novel products had never previously experienced serious market turbulence).

A second set of problems, as Calomiris (2007) notes, stems from the use of ratings by bank regulators. Basel II directs regulators to use bond ratings to determine the range of permissible bank investments and, for (smaller) banks lacking their own internal models, weighted capital requirements. Unsurprisingly, banks have responded to this delegation of public authority by applying subtle pressure on the rating agencies to elevate the entire spectrum of bonds a couple of notches, without necessarily disguising information about relative risks, in order to widen their investment choices and lower their capital costs. This dynamic works to heighten banking-sector risk and subverts the intent of regulators' use of bond ratings.

A related source of problems concerns the agencies' conflicts of interest. Rating agencies first earn fees from advising on how to structure bonds and derivatives so that these receive the desired rating. They then have a not-so-subtle incentive to rate those issues in the promised manner. All of these patterns were apparent in earlier emerging market crises. But now that the problem has hit home –now that it has hit the United States, in other words– perhaps policy-makers will take the question of how to constrain the ratings process more seriously.

The rating agencies' conflicts could be addressed by Glass-Steagall-style legislation that prevents them from both acting as advisors and issuing ratings. Since the problem of uniformly optimistic ratings has probably been exacerbated by the oligopolistic nature of the rating industry, Congress might also seek to foster more competition, since the better rating agencies will presumably out-compete the bad ones over time. The Credit Agency Reform Act of 2006 (implemented by the Securities and Exchange Commission –SEC– in 2007) has the goal of increasing

competition by making it easier for potential entrants to obtain preferred status from SEC staff, so that regulators and banks can use their ratings in setting capital requirements (and so that they can thus get business). But to date there has been little real progress in this direction. Potential entrants continue to complain about insurmountable regulatory hurdles. Until entry and real competition are possible and, as a result, rating agencies incur the standard market penalty for being wrong –namely, loss of business or even franchise– significant improvements in their performance are unlikely.

6 | QUESTIONS ABOUT SIVS AND CONDUITS

Structured investment vehicles and other mechanisms for using short-term bank funding to invest in long-term derivative securities pose some of the most striking if obscure dilemmas of the current crisis. Few market participants had even heard of SIVs and conduits before the summer of 2007. At that point they abruptly discovered that their own financial prospects and the stability of the US financial system turned on their condition.

The best way of understanding the role of these programs is by distinguishing those with and without a formal commercial bank connection. Consider self-standing SIVs. These investment funds issue asset-backed commercial paper, typically of three months maturity, to fund investments in CDOs and other long-term securities. When a CDO portfolio comprises senior or super-senior (AAA) rated securities, its managers fund as much as 90 per cent of the vehicle by issuing asset-backed commercial paper. In practice, commercial banks are among the main purchasers of that paper, but typically on an arm's-length basis –that is, they have no ongoing business relationship with the SIV issuing the paper.³

These SIVs are essentially hedge funds by another name. They invest in risky and sometimes illiquid

assets; they use significant amounts of leverage and credit in their operations; and they are not transparent. If their investment practices require significant regulatory responses, then those responses should be broadly similar to those applied to hedge funds as a class.⁴ Investors in such funds are well-capitalized, savvy individuals, firms, and mutual funds; it is not at all obvious that state intervention into their affairs is required on consumer-protection grounds. These funds remain outside the financial safety net; in the event of difficulties, their principals can choose to restructure them or close them down.

The banks extending credit to SIVs, by contrast, do not reside outside the financial safety net and frequently are too big to fail. Regulators therefore need to be sure that the banks extending back-up credit lines engage in realistic assessments of the likelihood that associated SIVs will draw on those lines; banks, in other words, must not simply assume that, because SIVs had no need to draw on credit lines in the past, they will be not do so in the future. As the events in the latter half of 2007 make clear, stress testing by banks and supervisors should include the possibility of wholesale disruption of the asset-backed commercial paper market.

Some SIVs are wholly owned and operated by a commercial or investment bank, with bank employees running the portfolio and the same bank providing the credit line.⁵ In such cases, financial engineers simply disguise and repackage traditional banking, and the distinction between the bank protected by the safety net and the SIV left to its fate becomes artificial. Among other things, banks are in the business of maturity transformation (they use short-term funding to make long-lived long-term investments). Here the maturity transformation by which banks use short-term funding to make long-lived term investments occurs through the off-balance sheet arm, outside the purview of regulators.

It follows that banks that own and operate SIVs should bring them onto their balance sheets, and those SIVs should be subject to regulatory scrutiny. To the extent that regulatory and tax arbitrage explains

³ In addition, a SIV may contract for a back-up line of credit with a bank or a syndicate as a precaution against disruptions in access to the commercial paper market.

⁴ Requiring hedge funds to periodically release more information about their investments would make little difference for market transparency, since these firms can turn their portfolios upside down in a single trading day. Requiring them to hold more capital, use less leverage or divulge more information runs the risk of simply facilitating physical and virtual relocation, whether to London or a post-office box in the Cayman Islands. Regulators generally agree that the main way of addressing the risks posed by hedge funds is by encouraging the banks providing them with credit to more carefully and regularly monitor the positions of their clients. In other words, the solution lies not in more intense regulation of hedge funds but in more intense regulation of the bank counterparties providing them with credit.

⁵ This was essentially the case of Rhineland Funding, the conduit operated by the German Bank IKB, whose difficulties ignited the crisis in August.

the creation of many of these bank-sponsored SIVs, then Congress and regulatory agencies need to tighten the relevant provisions.

7 | QUESTIONS

ABOUT TRANSPARENCY

Numerous commentators on the subprime crisis maintain that it was aggravated by the opacity of mortgage-related derivative securities. With one layer of derivatives built one on another, even specialists incompletely grasped the risks of the structured products they had bought. Because holders rarely traded these securities, their market value was elusive at best; often holders relied on their own complex economic models, with all of their limitations, to assign a value.

Thus, when the market for mortgage-backed derivatives soured and some investors headed for the exits, other investors concluded that their holdings were riskier than previously thought, leading to panicked attempts to liquidate. Financial institutions worldwide recalibrated their valuation models, which in turn generated alarming balance-sheet revisions. Liquidity problems spilled over to other markets as investors refused to accept residential-mortgage-backed securities as collateral for issuing asset-backed commercial paper. This latter day version of a cascading crisis of economic confidence suggests how a sharp shock to a limited segment of the US housing market could ultimately come to threaten the entire financial system.

Concocting ever more complex derivatives is the bread and butter of financial engineers. There is a market for their products because they allow economic agents to efficiently identify, isolate, and resell risks during periods of low volatility. (What happens in periods of high volatility is another matter.) Thus, to the extent that regulators are inclined to push for greater simplicity and transparency in the design of financial securities, they will be swimming against a powerful tide.

One way to tackle the financial rip currents would be to apply higher capital requirements to more complex derivative securities. This approach would involve going back to something resembling Basel I, in which

accountants placed different kinds of securities into different risk buckets, with banks then adjusting capital requirements accordingly. Unfortunately, such a tack would obviate a key feature of Basel II –that regulators and banks should take into account the correlation of returns on different kinds of assets when assessing risk.

Another strategy would be for central banks to announce that they were prepared to accept relatively simple, transparent instruments when providing collateral, but not complex ones. This reform would in turn reduce the attractiveness of holding relatively complex securities. The problem is that this policy might ultimately come into conflict with the authorities' responsibility for financial stability, limiting their capacity to act as liquidity provider of last resort to the markets most in need.

8 | QUESTIONS

ABOUT A SECURITIES EXCHANGE

One explanation for the severity of the current crisis stresses that brokers trade CDOs and RMBSs over the counter (traditionally by telephone but now electronically) rather than through an organized exchange. An exchange would require participants to hold margin in order to maintain positions. It would subject nonbank participants to the equivalent of capital requirements. It would encourage instrument standardization, enhancing transparency and the liquidity of the market for distress sales.

As evidence that exchange-based trading would function more smoothly, Cecchetti (2007) cites the contrasting reactions to news of the difficulties of Long-Term Capital Management in 1998 and of Amaranth Advisors in 2006. LTCM held its positions mainly in swaps traded over the counter, while Amaranth dealt in natural gas futures contracts through an organized exchange. Because the exchange required Amaranth to put up margin, it could stretch its distress sales over time rather than having to make them in bunches. And because the existence of exchange-based trading encouraged the standardization of futures contracts, the relevant economic parties had a much clearer sense of the situation than was the case with LTCM. The argument for an exchange follows directly.

What then explains the continuing domination of over the counter trading of these assets? Cecchetti has speculated that there might be tax or regulatory incentives that encourage over the counter trading, but without specifying them. Or this situation may simply be a case of path dependency, where history matters. It may be equally efficient to organize trading of a security on a centralized exchange or over the counter, but whichever venue starts first attracts the bulk of the business and thus offers superior liquidity and lower transactions costs. The initial disinclination to rely on exchanges may have partly reflected fee-seeking behavior by banks, since as originators of the relevant securities they also receive fees when they trade them over the counter, but are less likely to receive fee income from trading on an exchange. If it is the case that trading can be organized as efficiently over the counter or on an exchange, and that the latter has external social benefits, then regulations requiring exchange-based trading would have few if any costs to market participants, aside from the changeover costs –and, by the preceding arguments, significant social benefits.

9| QUESTIONS ABOUT CONSOLIDATED BANK SUPERVISION

The credit crisis of 2007, and specifically the response of the Bank of England to the liquidity squeeze at Northern Rock, raises several questions about consolidated bank supervision. Throughout the industrialized world, financial regulators are increasingly separating bank supervision from monetary policy and delegating the former to an agency independent from the central bank –preferably a single agency, to facilitate the centralization of information about different financial institutions linked together through the interbank market. This model has been adopted not only by the UK, where since 1997 prudential supervision has been the responsibility of the FSA, but also by a growing number of other countries.

The question is whether this structure actually impeded the flow of information about the condition of at least one major financial institution to the central bank, causing it not to appreciate the gravity of the unfolding problem and thus delaying its response. If so, and if such problems are commonplace, there

is an argument for either returning supervisory responsibility to the central bank or giving the financial supervisor an unlimited credit line at the central bank so that it can provide lender of last resort services when needed.

At this juncture, the severity of this problem remains unclear. Mervyn King, the governor of the Bank of England, has described how deputies from the Bank, the FSA and the Treasury met on August 14th, 2007, when the FSA relayed to the two other institutions its judgment that Northern Rock had serious problems (see Telegraph 2007). The key question is whether the FSA already had a glimmering of those problems some days earlier but did not communicate them.

In principle, nothing prevents a country's financial supervisor from picking up the phone and sharing its latest information about the condition of the banking system with central bankers. In theory, information can flow as freely between two agencies as between two departments of the same agency. But one suspects that different bureaucratic incentives would lead to different behavior in the two circumstances. When two agencies have different objectives or when they are simply jockeying for influence, they may have an incentive to strategically withhold information. But when the same individual oversees the two entities (when the central bank governor appoints and can demand the resignation of key supervisory staff as well as sitting on the monetary policy committee), the scope for strategic behavior almost surely diminishes –since the sanctions in the event that it occurs are greater.

An American recommending that countries avoid separating the lender of last resort function from the financial-supervision function will likely encounter accusations of parochialism. But advocates of such regulatory separation should encounter accusations that they are courting excessive risk.

10| QUESTIONS ABOUT THE FUTURE

The ongoing credit crunch represents the first crisis of the age of mass securitization. One conclusion sometimes drawn is that the costs of securitization, in the form of risks to financial stability, exceed the benefits. The implication is that we should return to the

simpler days of "good-old-fashioned banking" in which commercial banks originate loans to households and firms and hold them on their balance sheets, rather than slicing them, dicing them and selling them off.⁶

This back-to-the-1960s formula ignores economic realities –there is no turning back the clock on financial technology and, more fundamentally, on advances in information and communications. Securitization is bound up with the broader deregulation of financial markets and with the information-technology revolution. Policy makers cannot eliminate this process short of reimposing the kind of restrictive regulation to which banking and financial systems were subject half a century ago. Even then, regulatory institutions may well fail to suppress securitization, given the ease with which financial institutions can move their activities offshore in the age of broadband and low-cost communications.

In any case, turning back the clock would not be desirable because the constellation of financial innovations referred to as securitization has real benefits for the economy. Those innovations have allowed the financial system to repackage and spread risk. They have reduced the amount of equity capital that this system requires to absorb that risk. The result has been to lower funding costs for both firms and homeowners as a class.

Regulatory dilemmas not uncommonly arise in the course of the diffusion of a technology or financial innovation, a pattern to which financial securitization offers no exception. Some early adopters lack the training and capacity to safely operate the new machinery. Like a novice driver given the keys to a more powerful car, they manifest a troubling tendency to run off the road– or to collide with other vehicles. This problem was compounded, in the case of the automobile, by the mismatch between the design of the roads and traffic regulations and the capabilities of the new generation of engines.

In the aftermath of the Great Securitization Crisis of 2007-8, would-be reformers will surely say that financial regulators should repave and re-grade, rethinking speed limits and the rules of the road generally. But identifying specific changes to financial traffic rules is not so easy. In my view, policy makers should focus on the banking system. Banks still play a unique role. They are at the center of the information-impacted segments of the financial system. Their key role and their vulnerability are recognized by the protection they receive *via* the financial safety net. Re-thinking should start with the role of Basel II, and within Basel II of the role of internal models and bond ratings. To where it will proceed from there remains, at this early stage, anyone's guess.

6 To quote Alastair Darling in a speech from mid-September (International Business Times, 2007).

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What happened to risk dispersion?

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The turbulence in credit and funding markets in the second half of 2007 is disturbing evidence that risk dispersion in financial markets has been less effective than expected. Investors appear to have acquired risks that they did not understand. Much more worrisome, however, is the evidence that major financial firms did not succeed in shedding risks so much as in transferring them among their own business lines, resulting in an unintended concentration of risks on their own balance sheets. In order to restore confidence in the near term, and to put credit creation on a more sustainable path in the future, supervisory authorities, central banks and governments will first need to understand why the much-vaunted dispersion of risk fell so far short of expectations.

The “reluctance to lend” which underlies these strains in money markets was widely attributed to concerns about the financial condition of borrowers, as a consequence of uncertainty about the value of assets on the borrowers’ balance sheets, and also to insufficient attention to liquidity management by financial firms. But the focus on uncertainty about borrowers ignores the awkward fact that the major financial intermediaries are both lenders and borrowers themselves and their reluctance to lend significantly reflects a defensive reaction to their own uncertainties about their own balance sheets.

Better stress testing for liquidity as well as solvency would certainly be beneficial. Yet a major cause of the strains in credit and funding markets has been the apparent inability of many firms to anticipate the interaction of their various on- and off-balance sheet exposures and, particularly, to understand the velocity of their off-balance sheet activities and how these affected their overall exposures.

In considering potential remedies to the credit market’s turbulence and to the apparent failure of risk dispersion, the authorities should first reflect on their own role in the trend of pushing risks off of bank balance sheets.

The turbulence in credit and funding markets since the summer of 2007 is disturbing evidence that risk dispersion in financial markets has been less effective than expected. Investors appear to have acquired risks that they did not understand. Much more worrisome, however, is the evidence that major financial firms did not succeed in shedding risks so much as in transferring them among their own business lines, resulting in an unintended concentration of risks on their own balance sheets. In order to restore confidence in the near term, and to put credit creation on a more sustainable path in the future, supervisory authorities, central banks and governments will first need to understand why the much-vaunted dispersion of risk fell so far short of expectations.

While the general features of the credit cycle are recognizable in the events leading up to August of 2007, the sudden and persistent premium in short-term Dollar, Sterling and Euro inter-bank interest rates has been both a puzzle and a potential threat to the provision of credit to otherwise financially-healthy households and businesses. The "reluctance to lend" which underlies these strains in money markets was widely attributed to concerns about the financial condition of borrowers, as a consequence of uncertainty about the value of assets on the borrowers' balance sheets, and also to insufficient attention to liquidity management by financial firms. These are undoubtedly contributing causes of the elevated funding costs.

But the focus on uncertainty about borrowers ignores the awkward fact that the major financial intermediaries are both *lenders and borrowers themselves* and their reluctance to lend significantly reflects a defensive reaction to *their own uncertainties about their own balance sheets*. Many have focused on shortcomings in liquidity management, and it is a common critique that too much attention has been paid by regulators and others to solvency risks at the expense of liquidity risk. This may be true but too narrowly defines the problem.

Better stress testing for liquidity as well as for solvency would certainly be beneficial. Yet a major cause of the strains in credit and funding markets

has been the apparent inability of many firms to anticipate the interaction of their various on- and off-balance sheet exposures and, particularly, to understand the *velocity* of their off-balance sheet activities and how these affected their overall exposures. At the same time, the major financial intermediaries face the additional uncertainty of more complex accounting rules which might require more off-balance sheet exposures to be consolidated onto their balance sheets.

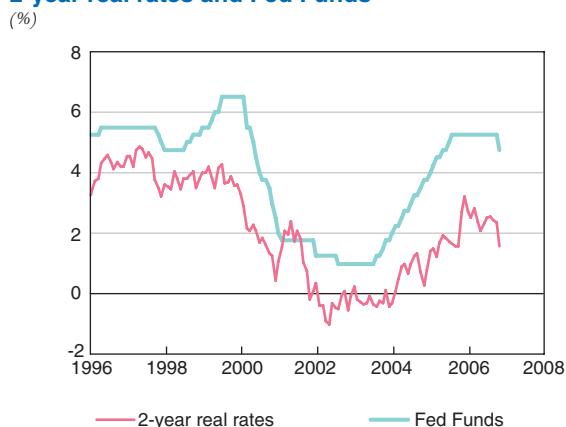
In considering potential remedies to the turbulence of 2007 and to the apparent failure of risk dispersion, the authorities should first reflect on their own role in the trend of pushing risks off of bank balance sheets. Then, before considering changes to the permissive off-balance sheet regime that has evolved, they should weigh carefully the risks of a too-rapid de-leveraging and the possibility of a further, pro-cyclical contraction of credit.

1 | THE CREDIT CYCLE

The general features of the credit cycle are easily recognized in the events leading up to and during this summer's turbulence. Accommodative monetary policy, intended to stimulate aggregate demand, has its most pronounced effects on the most interest-rate sensitive sectors of the economy. When the central bank withdraws the accommodation, raising real rates both dampens new activity and decays financial asset values. Higher rates and a flatter yield curve cause lenders' margins to narrow, increasing the risk of credit defaults and reducing demand for loans all at the same time.

In this cycle, global monetary conditions in general and United States monetary conditions in particular were extremely accommodative from 2002 to 2004. Following the events of 9/11, the recession of 2001 and the corporate scandals of 2002 and 2003, the Federal Reserve provided an extended period of monetary accommodation with negative two-year real interest rates for much of 2003 and 2004 (see Chart 1). This stimulated the most interest-rate sensitive sectors of the US economy: housing and leveraged investing.

Chart 1
2-year real rates and Fed Funds

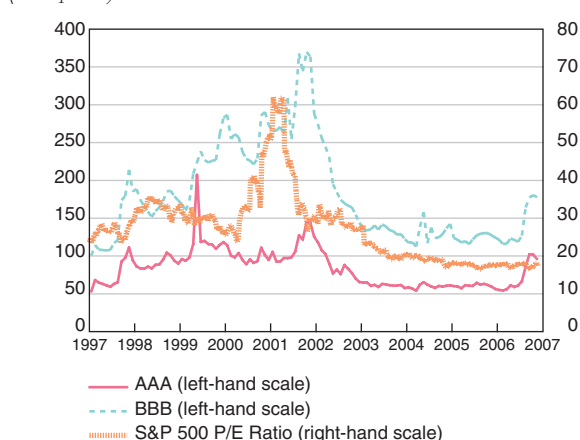


Note: Real 2-year rates: 2-year Treasury minus rate of growth of personal consumption expenditures index.

Sources: Bloomberg, Federal Reserve

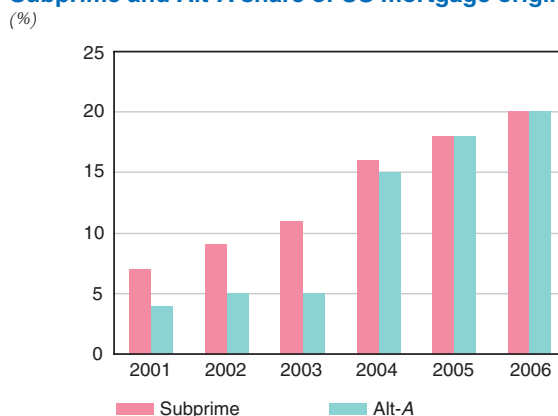
Global markets, following the stock market declines earlier in the decade, had demonstrated a marked preference for fixed-income investments –reflected in ever-tighter credit spreads and relatively low and stable equity price-earnings ratios (see Chart 2). By creating an abundance of credit, monetary policy correspondingly created a scarcity of yield in global capital markets. Subprime mortgages to less credit-worthy residential homeowners represented a “perfect” intersection of supply (given the stimulated housing investment) and demand (from investors searching for yield) (see Chart 3).

Chart 2
Corporate spreads and S&P 500 P/E ratio



Sources: Lehman Brothers, Bloomberg, JP Morgan

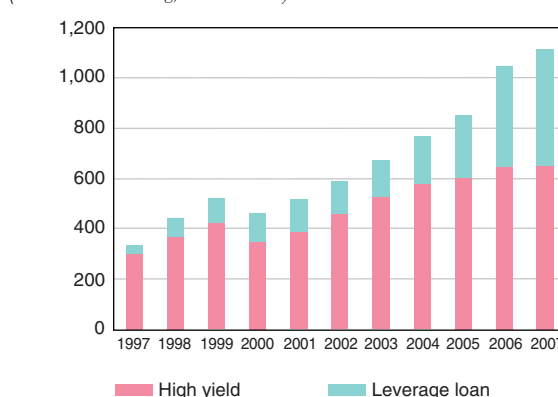
Chart 3
Subprime and Alt-A share of US mortgage origination



Source: Credit Suisse

This constellation of conditions –low real rates, rapid housing investment and demand for mortgages, and investor demand for fixed-income yield– provided an extraordinary stimulus both for leveraged corporate buyouts and the securitization and packaging of credit investment products. Nominal global issuance of credit instruments is estimated to have experienced a twelve-fold increase from USD 250 billion in 2000 to USD 3 trillion in 2006, representing the sum of mortgage-backed securities (MBS), asset-backed securities (ABS), commercial mortgage-backed securities (CMBS) and collateralized debt obligations (CDOs) –which are, themselves, levered investments in mortgages and high-yield corporate debt (see Charts 4 and 5).

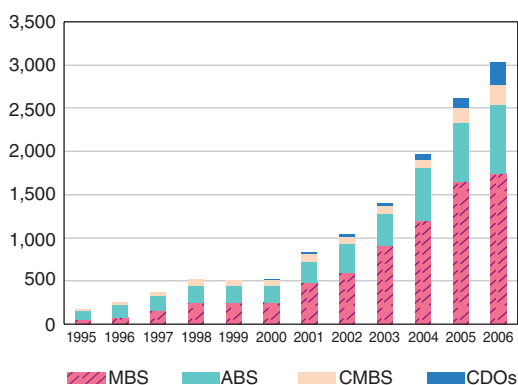
Chart 4
High yield and leveraged loan markets



Sources: Standard & Poor's, Lehman Brothers, BlackRock

Chart 5
Asset-backed securities and structured credit

(USD billions)



Sources: Lehman Brothers Fixed-Income Research, Thomson Financial, Bondware, IMF, BlackRock

The disintermediation of traditional balance sheet lending, through the securitization of credit and its transfer to investors through traded capital markets, has been going on since the 1980s. But the expansion of the securitization process in this decade has accelerated the transformation of the financial services industry from one of banks, brokers and insurance companies into one that reflects a division of labor among asset originators, asset distributors, and asset managers. This division of labor, and the growth of capital markets activity which it reflects, necessarily relies upon *funding* and *trading* positions in money and credit markets in order to move assets along the chain of agents.

2 | THE SUMMER OF 2007

The abrupt reversal of the credit market conditions in the summer of 2007 followed a sudden shift in monetary policy expectations and real rates that took place in the spring. At the start of 2007, most market participants anticipated a relatively benign path of monetary conditions from central banks. The Federal Reserve had stopped tightening policy in 2006 and was expected to begin easing policy toward the end of 2007; the Bank of England was also expected to be easing policy later in the year; and the European Central Bank was expected to be firming policy but only on a very gradual trajectory.

By May, however, the Federal Reserve showed no signs of easing in the near-term, and futures prices

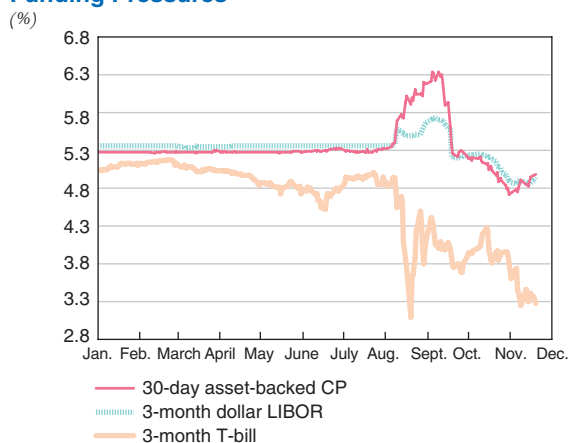
took out any expectations for rate cuts later in the year, which led to an increase in real rates as reflected in inflation-indexed Treasury securities. With poor inflation readings, the Bank of England began raising rates and the ECB was raising rates more deliberately than the market had originally anticipated. This firming in policy expectations and the associated rise in real rates led to a decline in the prices of credit instruments, particularly for securities associated with subprime mortgages.

In response to the decay in prices and the simultaneous rise in volatility, a number of major financial firms began to reduce their credit exposures to hedge funds, provided through their prime brokerage arms. While this may have been a prudent counterparty credit decision, it had the seemingly-unanticipated consequence of reducing demand for the very mortgage-backed securities and structured credit instruments that were being underwritten, packaged and sold to hedge funds and other investors by the major firms' mortgage-origination and investment banking businesses. Falling prices for these riskier, higher-yielding instruments had the predictable consequence of weakening demand which, in turn, caused a backup of inventories in asset-origination pipelines. This occurred most noticeably for subprime mortgage originators like Countrywide and for the investment banks that had commitments for private-equity financings which they had expected to repackage and sell to investors.

A wide variety of investment funds and structured vehicles set up to invest in credit instruments with short-term borrowing came under pressure. Major firms were not immune; in June, Bear Stearns confronted large losses in two hedge funds it had sponsored and, then, in early August, BNP announced that it would freeze three investment funds that it had sponsored. While these two firms garnered the most publicity during this period, there were a number of other investment vehicles, including CDOs, structured investment vehicles (SIVs) and bank conduits, which had entered the same maturity mismatch, funding with short-term asset-backed commercial paper (ABCP) and investing in credit instruments which came under pressure at the same time.

Shortly following the BNP announcement, a classic "flight to quality" began as those investors who had been financing the ABCP market sought to sell their

Chart 6
Funding Pressures

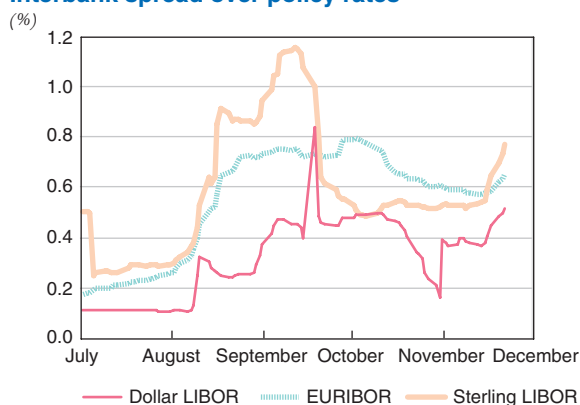


Sources: Bloomberg, BlackRock

ABCP exposures and switch to safer investments, such as short-term government bills, causing an abrupt rise in yields on ABCP and a fall in yields on government paper. As investors expressed an unwillingness to roll over the ABCP exposures, the volume of ABCP being issued began a precipitous decline. Those in need of short-term funding scrambled to find alternatives and borrowing costs began to rise sharply in the short-term Euro inter-bank market as well as in the London inter-bank market for both Sterling and US Dollars (see Charts 6 and 7).

While there were initial differences in their responses (most notably by the Bank of England), the ECB, the Bank of England and the Federal Reserve all eventually responded with the offer of larger than normal injections of reserves. The Federal Reserve has lowered both its Discount Rate and the Federal Funds Rate to reduce short-term borrowing costs.

Chart 7
Interbank spread over policy rates



Sources: European Central Bank, Bank of England, Bloomberg

Notwithstanding these efforts, spreads between both short-term government securities and central bank policy rates, on the one hand, and short-term inter-bank borrowing costs on the other, have remained at wide levels while a lack of liquidity has pervaded both traded credit markets and secured and unsecured funding markets.

3| TOO MANY, RATHER THAN TOO FEW, EXPLANATIONS

In attempting to understand the causes of the current credit and liquidity "crunch", as well as potential remedies, we have a problem of too many rather than too few explanations.

Some have focused on the easy monetary conditions that preceded this episode and insist that only time and firm monetary policy are needed to purge the system of the excesses. Others point to the myriad complex agency problems in the securitization markets ranging from the loose lending standards by asset originators who lack sufficient incentive to police credit quality to excessive instrument complexity and failures of disclosure by asset packagers and distributors, compounded by a failure of the rating agencies to be sufficiently tough on the asset originators and distributors. Another line of analysis has focused on the apparent failure of bank liquidity risk management and concluded that both banks and bank regulators have given too much attention to solvency risk, particularly in work on bank capital requirements, and too little attention to liquidity risk.

Much of the initial attention by central banks and the authorities focused on the LIBOR and EURIBOR inter-bank lending markets and was premised on the belief that the market was "broken" and needed to be "fixed." This approach is problematic on two levels.

First, the very concept of a uniform inter-bank borrowing rate is a function of good times, and tends to come under pressure when the cycle turns. In the 1970s the short-term liabilities of the clearinghouse banks in the United States traded at the same levels but this consistency fell apart in the turbulence of the 1980s. The famous "convoy" of Japanese banks

all benefited from identically-priced liabilities in the late 1980s only to see this fall apart under the pressure of the post-bubble "lost decade" of the 1990s. If credit risk was being so poorly priced in the earlier years of this decade, maybe the inter-bank lending market was actually broken when so many had the benefit of identical and low borrowing costs and maybe the market is now in the process of being fixed by a greater attention to credit risks.

Second, elevated inter-bank borrowing costs should not be thought of as the disease itself but, rather, as the symptom. The initial rise in borrowing spreads was ascribed to uncertainty about asset values causing concern about the credit quality of borrowers, leading lenders to both raise rates and cut back on the quantities they were willing to extend. Given this credit premium, adding excess central bank reserves and lowering rates, by adding to the supply of liquidity, would presumably encourage lenders to make short-term credit available to borrowers. There is much to this line of analysis but it is critically incomplete.

Potential lenders were certainly concerned about the borrowers' credit quality and this was particularly evident in the withdrawal of support from the ABCP market. But the sudden rise in inter-bank borrowing costs, and the continued scarcity of short-term secured and unsecured funding, is much more a reflection of *lenders' anxieties about their own asset quality and their own balance sheets*. The rapid and synchronized back up in borrowing costs in Dollar, Sterling, and Euro inter-bank markets strongly suggests a linkage across the balance sheets of the major *lenders*, who operate in all three markets. Thus, even initially, the strains in money markets should be understood as significantly reflecting a lenders' strike by the major financial intermediaries –who are themselves borrowers, lenders and investors in the very same credit instruments.

4 | THE FAILURE OF RISK DISPERSION

Taking a step back, it seems clear that risk dispersion did not work as expected. The continued evolution of securitization and derivative instruments should, in principle, provide for a more efficient allocation

of risks to those who both can and want to hold them, providing for a more efficient allocation of capital in the economy and for financial stability through diversification. The practice of 2007, however, has been a disappointment. Indeed, given the widespread observation that risk in general, and credit risk in particular, was being mis-priced in recent years, how could market mechanisms be expected to achieve an efficient allocation of these risks?

Why did the outcomes fall so far short of the promise? There are two possibilities: first, investors did not understand the risks that they bought and, second, the intermediaries did not know which risks they had shed, retained or reacquired. A failure by investors to understand the risks that they acquired can have two possible causes: agency problems of misaligned interests and failures of disclosure, on the one hand, and excessive exuberance (or perhaps conscious avoidance) on the part of investors, on the other. A failure by intermediaries to understand the portfolio of risks that they retained or acquired through their various business lines would reflect fundamental risk-management errors in understanding the interactions and correlations of their on- and off-balance sheet exposures.

The correct answer is: "all of the above." But we should be much more surprised and worried by the risk-management failure of the intermediaries, who are the engines of the risk-dispersion process, than by the presence of agency problems and exuberant investors. It is of course desirable for investors to understand the investment risks that they acquire but if the institutions that stand at the center of the risk dispersion process do not understand what they are doing, the trouble runs much deeper.

The role of agency problems. The increasingly-refined division of labor in securitization markets does create greater opportunities for a misalignment of interests and for agency problems to occur.

Asset originators, who are at the point of contact with borrowers, but who are expecting to pool and offload individual loans, have a diminished incentive to assure the initial credit quality of the individual borrower and to monitor the borrowers' ongoing credit standing during the life of the loan. In some asset-backed markets, the original lender retains a residual exposure and/or has ongoing liabilities in

servicing the loan and ensuring ongoing compliance with credit guidelines. But in other markets, and with respect to some structured vehicles, this is not the case.

Asset packagers and distributors have incentives to understate the risks and overstate the rewards of investment products they sell. At the same time, the current cycle and the quest for yield seem to have encouraged products of tremendous complexity. While most markets have extensive disclosure requirements for investment products, accurate and useful disclosures have to be continuously revised to keep up with instrument innovation.

The rating agencies also appear to have contributed to investors' under-estimation of the risks in many of the more complex investment structures. The long-recognized agency problem inherent in the rating agency business model of being paid by issuers (rather than investors) are even more problematic in the case of complex structured vehicles as contrasted with the securities of a traditional corporate issuer. Corporate issuers are governed by executives and boards who are accountable for the business entity's ongoing performance and cash flows that underlie the securities they issue. Structured credit vehicles, on the other hand, stand on their own, almost like financial drones which, once launched, just keep going under their initial terms and conditions. At the same time, the division of interests of structured credit vehicles is highly complex and requires extensive modeling to analyze. As a consequence, investors are likely to rely even more heavily on third-party ratings to assess the risks of structured credit instruments. During the recent rapid expansion of structured credit issuance, the rating agencies encouraged investor acceptance by assigning their highest ratings to structured pools composed of much lower quality assets, effectively diluting the quality of their service –their "brand"– to an extraordinary extent.

The efficiency of risk dispersion would undoubtedly be improved if the interests of investors were better aligned with the agents that populate our capital markets. Credit underwriters in the asset origination process need incentives to adhere to lending standards and to continue to monitor credit quality. Retention of elements of risks shared with the ultimate investors, or contractual liabilities to maintain credit standards are effective in a number

of asset-backed markets and could be adopted in others. Securities regulators can and should consider improvements in disclosure requirements that might highlight the risks associated with structured credit instruments.

Securities regulators should also consider a thorough reform of the rating agency process. Shifting the alignment of the rating agencies' incentives from those of issuers to investors would improve the efficiency of capital markets (but would likely be strongly resisted by the agencies because it is so much easier to collect rents from issuers than from investors). For example, the rating agencies could shift to a publishing model in which ratings themselves would be made public but the analytic reports behind the ratings would have to be paid for by investors. (More radical changes in the structure of the accounting and stock analyst industries were engineered earlier in this decade). A greater number of ratings per investment issue, more intellectual capital and more competition would all be desirable objectives of reform as well.

The role of investor behavior. All of these agency problems are quite real and deserve further attention. Yet, when considering an investment transaction between an institutional buyer and an institutional seller, the most effective means of ensuring that investors understand the risk they incur is to make investors responsible for those risks by adherence to the principle of *caveat emptor* –buyer beware.

Other than in cases of fraud (or material misrepresentation), how can anyone other than the institutional investor be responsible for understanding the risks they incur? Indeed, the premise that both economic efficiency and financial stability will be served by the dispersion of risks to those both willing and able to bear them rests on the assumption that risk appetites and risk tolerance will be *idiosyncratic to particular investors*.

Investors are under no compulsion to buy any particular investment. Given information asymmetries in the retail markets, an investor protection approach to regulate relations between institutional sellers and individual buyers makes a great deal of sense. But among institutional buyers and sellers, any information asymmetry between them can be resolved by the prospective buyer demanding more information, investing in their

own information and analytic capabilities or, finally, by declining to make the purchase.

Subprime mortgages are made to borrowers with lower credit ratings or who are taking on larger loans than would otherwise be deemed creditworthy. Alt-A mortgages –known as “liars’ loans”– are made to borrowers who have not completed all of the normal credit checks and lending documents. What additional disclosures or information would an investor require to be informed that securities backed by pools of these mortgages might carry greater risks and be subject to higher rates of default than those of other mortgages?

When investors are offered instruments with higher returns than those prevailing on similar instruments, it should be understood that they carry with them higher risks as well and that the higher return speaks for itself –*res ipsa locutor*– in delivering a higher level of risk. If institutional investors are not prepared to take the time and the expense to analyze and understand the risks they incur, they will have to bear the expense of losses beyond their expectations.

It is worth noting that a number of major, supposedly-sophisticated banks were victims of the same asset-valuation optimism that infected other investors, as evidenced by the significant balance-sheet mark downs of subprime and CDO exposures that many have experienced in 2007. Reversing the over-valuation of assets is how losses in financial markets can exceed the losses from defaults on the underlying cash flows: marking down an asset value whose price reflected either too low a probability of default or too optimistic an expectation for its purchase in the secondary market can cause losses to the holder of the asset even though the underlying borrower is still in good standing.

The role of the risk distributors. When we reflect on the failure of risk dispersion, we should be much more troubled by the idea that the major financial firms –the very institutions at the center of the process of risk dispersion through securitization and derivative markets– do not appear to have understood the portfolio of exposures that they had either retained or acquired.

At its most basic level this reflects a profound risk-management failure on the part of leading banks

to understand the portfolio of on- and off-balance sheet exposures they were running and, especially, how the *velocity* of their off-balance activities would affect their on-balance sheet exposures “when the music stopped.” Accounting rules intended to reduce the potential for off-balance sheet abuses, such as those that occurred at Enron, have added an additional layer of complexity to the banks’ ability to determine what is on- and off-balance sheet.

There may have been a failure of many firms to appreciate the liquidity risks that they were incurring and a trend of taking for granted both their ability to fund and their ability to adjust positions in traded markets. Greater attention to liquidity risk might have somewhat reduced the market strains but would have been an incomplete answer to the risk management failures that contributed to this episode. Their fundamental failure was in not understanding how different lines of business would interact. Put differently, a precondition for designing an effective stress test is a through understanding of the constituent exposures thrown off by each business.

Consider the following sequence of a bank in multiple lines of business. Real rates and volatility rise, leading the bank to reduce the credit it is extending to hedge funds against the collateral of subprime mortgages and CDOs (a reduction in on-balance sheet assets). The subsequent decay in asset values (as other banks also reduce exposures to hedge funds at the same time) causes on-balance sheet losses to the same assets held for the bank’s own account and off-balance sheet losses in SIVs or conduits to which the bank has extended backup credit lines supporting their ABCP programs. When demand for ABCP declines, the bank loses underwriting fees (off-balance sheet income) and finds the vehicles calling on their backup line of credit (converting an off-balance sheet claim into an on-balance sheet asset). As demand for the underlying collateral falls, mortgages and leveraged loans that the bank was originating and expecting to sell on to investors start to accumulate either on the bank’s balance sheet or the bank’s own conduits, requiring funding at precisely the same time that the bank is confronted with demands for balance sheet space from clients.

In brief, while the bank is experiencing its own on-balance sheet losses, which will eat into earnings, and possibly capital, it is confronted with the drying up

of off-balance sheet fee income and the conversion of off-balance sheet exposures into on-balance sheet ones, resulting in further demands on the bank's capital. What appears to have been lacking, underdeveloped, or receiving insufficient management attention, was the ability to simultaneously stress test on- and off-balance sheet assets and liabilities, and to understand how the stress scenario would influence the volume of off-balance sheet fee-generating activities and the velocity of off-balance sheet asset creation. A comprehensive view of a bank's liquidity and solvency risks would be the product of such a stress test.

Anticipating the interaction of banks' on- and off-balance sheet exposures has been made more complex by revisions to accounting rules. When the credit cycle turns, and losses mount, there are always difficult conversations between bankers and their accountants about the recognition of losses and the consolidation of exposures onto balance sheets. But following the collapse of Enron and the other corporate scandals, both US and international accounting rules have been extensively revised to provide greater guidance on when and how off-balance sheet vehicles may be consolidated (FIN46(R), IAS 27 & SIC 12). In an effort to reduce the potential for abuse, these rules have been made more complex and their interpretation is contingent on changing circumstances.

The role of the authorities. Before governments and regulatory authorities consider reforms to address the turbulence of 2007 they should take a step back and reflect that the quarter century of efforts to improve the safety and soundness of the banking system through the creation of risk-based capital rules has coincided with the progressive disintermediation of the banking system and a continuous movement of risks off of bank balance sheets. The evolving division of labor among asset

originators, distributors and managers, the creation of mortgage-related and asset-backed securities, and the proliferation of stand-alone, risk-bearing vehicles –from hedge funds, to conduits, to SIVs and CDOs and CLOs– have all served the purpose of removing risks from bank balance sheets and, directly or indirectly, lowering the explicit bank capital needed to support these activities.

If the dispersion of risk away from a bank-centric credit process is both *efficient* and *effective* it would, in principle, contribute to financial and macro-economic stability. An efficient process would be one that accurately prices and distributes risk to those more able and willing to hold those risks. An effective process would be one that diversified those risks in an enduring manner away from the critical functions of credit creation. On the evidence of 2007, the system appears to have failed on both counts and, under stress, rolls both credit losses and funding pressures back onto the very balance sheets that supposedly had shed the risks. It may, however, still be too early to distinguish the excesses of the cycle from flaws in the process.

Governments, central banks and regulatory authorities also face the more immediate task of balancing the risks of being too permissive with respect to off-balance exposures against the risk of causing too-rapid a de-leveraging and the consequent credit contraction that this would imply. Financial institutions are now absorbing their on- and off-balance sheet losses and exposures and many are absorbing the additional demands of their clients who need to shed assets or for funding that can no longer be secured in commercial paper markets. If market participants come to expect that accounting, solvency or liquidity rules might soon be tightened in response to the events of 2007, the liquidity and credit crunch experienced so far might be only the beginning.

Liquidity risk management

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Liquidity and solvency are the heavenly twins of banking, frequently indistinguishable. An illiquid bank can rapidly become insolvent, and an insolvent bank illiquid. As Tim Congdon noted, (FT, September 2007), in the 1950s liquid assets were typically 30 percent of British clearing banks' total assets, and these largely consisted of Treasury Bills and short dated government debt. Currently, such cash holdings are about ½ percent and traditional liquid assets about 1 percent of total liabilities.

Nor have prior standards relating to maturity transformation been maintained. Increasing proportions of long-dated assets have been financed by relatively short-dated borrowing in wholesale markets. Bank conduits financing tranches of securitised mortgages on the basis of three month asset-backed commercial paper is but an extreme example of this. Northern Rock is another.

Such time inconsistency issues are hard to resolve, especially in the middle of a (foreseen) crisis; it is worth noting that many, though not all, of the aspects of this present crisis were foreseen by financial regulators. They just did not have the instruments, or perhaps the will, to do anything about it. If, when trouble strikes, the lifeboats are manned immediately, with extra liquidity being provided on easy terms, then there is encouragement to the banks to build even more densely on the flood plain. Why should the banks bother with liquidity management when the Central Bank will do all that for them? The banks have been taking out a liquidity 'put' on the Central Bank; they are in effect putting the downside of liquidity risk to the Central Bank. What is surely needed now is a calm and comprehensive review of what the principles of bank liquidity management should be.

Liquidity and solvency are the heavenly twins of banking, frequently indistinguishable. An illiquid bank can rapidly become insolvent, and an insolvent bank illiquid. When the Basel Committee on Banking Supervision was first established in 1975, its Chairman, George Blunden, at its initial meeting vowed to try to underpin the capital and liquidity adequacy performance of the main international commercial banks. Indeed, the prior downwards trend in banks' capital ratios was halted and then reversed by Basel I. The advantages of having done so are clearly revealed by the stronger capital positions of most banks in the current context.

What is not so well known is that in the 1980s, at the same time as the Basel Committee was wrestling with capital adequacy issues, it was also attempting to reach agreement on liquidity risk management. For reasons that I have yet to discover, it failed. So while the downwards trend in capital adequacy was reversed, that in liquidity adequacy was not. As Tim Congdon noted, (FT, September 2007), in the 1950s liquid assets were typically 30 percent of British clearing banks' total assets, and these largely consisted of Treasury Bills and short dated government debt. Currently, such cash holdings are about ½ percent and traditional liquid assets about 1 percent of total liabilities.

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The standard example of a time inconsistency dilemma relates to people building homes in a flood plain. When a flood comes, do you rescue them, or not? In recent years the banks have been erecting their strategic dispositions in the middle of such a flood plain, though their problem was not too much, but too little liquidity.

Such time inconsistency issues are hard to resolve, especially in the middle of a (foreseen) crisis; it is worth noting that many, though not all, of the aspects of this present crisis *were* foreseen by financial regulators and Central Banks more widely. They just

did not have the instruments, or perhaps the will, to do anything about it. If, when trouble strikes, the lifeboats are manned immediately, with extra liquidity being provided on easy terms, then there is encouragement to the banks to build even more densely on the flood plain. Why should the banks bother with liquidity management when the Central Bank will do all that for them? The banks have been taking out a liquidity 'put' on the Central Bank; they are in effect putting the downside of liquidity risk to the Central Bank.

On the other hand, if the opportunity of a liquidity crisis is taken to penalise those misguided brethren who were insufficiently careful of their own liquidity management, and you do not man the lifeboats so enthusiastically, then there is a danger of mass drownings, in the form of bankruptcies and bank runs. These events are not politically popular, to say the least. Whether, or not, an earlier or more enthusiastic launch of a lifeboat would have prevented such fatalities, there will be many, particularly amongst those penalised, who will swear blind that it would have done so; and one cannot disprove a counter-factual. Sticking to proper principles in a crisis may be admirable, but it can be a dangerous game to play.

What is surely needed now is a calm and comprehensive review of what the principles of bank liquidity management should be. In a global financial system, this should be done multi-laterally in the Basel Committee of Banking Supervision. It is not an easy exercise; the Committee has already tried and failed once before; it must try again.

What exactly is the right distribution of responsibility for liquidity management between commercial banks and a Central Bank? There are some who believe that that responsibility should be almost entirely shouldered by the Central Bank, but yet others call for a return to more traditional banking practices. As for maturity transformation, for how long should a bank be in a position to continue to meet its commitments if the wholesale markets on which it has relied before should suddenly dry up, as we now graphically realise can happen; one day, one week, one month, one quarter, longer yet? I do not know of any good way to resolve that question, nor of any persuasive academic research on the topic.

What I do know is that the exercise ought to be done in terms of general principles, rather than by setting

required ratios or minimums. The most salient metaphor and fable in prudential regulation is of the weary traveller who arrives at the railway station late at night, and, to his delight, sees a taxi there who could take him to his distant destination. He hails the taxi, but the taxi driver replies that he cannot take him, since local bylaws require that there must always be one taxi standing ready at the station. Required liquidity is not true, usable liquidity. Nor might I add, is required minimum capital fully usable capital from the point of view of a bank.

Principles of liquidity management, (and in my view of capital adequacy also), ought to be applied in a much more discretionary manner, pillar 2 rather than pillar 1. But that sets my own position far apart from that of most American academics, who believe that a regulator simply cannot be trusted to behave well. In their view, rules and regulations are needed to constrain the regulator, as much or more so than to constrain the regulated. If that should be so, then the *essential* accompaniment to any set of rules, or of required ratios, is a ladder of ever toughening sanctions as the best practice rule is increasingly transgressed. Setting minimum levels without establishing an associated ladder of sanctions invites both forbearance and the occurrence of credit crunches. One of the, in some respects problematical, characteristics of the Basel Committee has been that it is just an ad hoc advisory committee without any international legal powers. As such, it has felt almost entirely unable to address the issue of what, if any, *sanctions* should be applied if banks or banking systems fail to maintain the Committee's proposals and principles for good banking behaviour.

Let me, however, put the question of sanctions to one side for the time being, though noting that their considered formulation is an integral and essential element in any well-designed regulation system, and return to the question of the principles of liquidity management. Unfortunately the word 'liquidity' has so many facets that it is often counter-productive to use it without further and closer definition. I want to concentrate on two amongst several of these facets; the first involves maturity transformation, the relative maturity of a bank's liabilities and assets; and the second involves the inherent liquidity of a bank's assets, that is the degree to which such assets can be sold without significant loss of value under any market conditions. These are, I hope you will agree, key elements in any bank's liquidity position.

Moreover, these two elements of a bank's liquidity management are themselves inter-twined. The more liquid, and instantly saleable at a steady price, are a bank's assets, the less the bank needs to worry about its maturity transformation, since it can pay off withdrawn liabilities with the proceeds of asset sales. One feature of the Northern Rock debacle was apparently that it had planned to securitize a sizeable proportion of its mortgage book in September. When that became impossible in the market conditions, that bank's exposure to funding problems in wholesale markets became significantly worse. *Per contra*, the less the maturity transformation, the less does a bank need to worry about the interim interest rate and market risk on its assets, since it can hold the asset until maturity, and ride out any intervening market squalls. Thus one lesson is surely that *both* sides of a bank's book have to be taken into account at the same time in order to assess its overall liquidity.

One of the underlying problems of economics is that a strategic decision by any important set of agents, *e.g.* the monetary and regulatory authorities, affects the behaviour of all the other agents, according to the Lucas critique. In this respect the willingness of Central Banks to lend against, *i.e.* to accept as collateral, certain classes of assets will in turn affect the liquidity of such assets. One of the unhappy developments in the latest crisis was an apparent disarray amongst the major Central Banks about what assets should, and should not, be used by themselves as collateral for repos. Since this issue may well depend in large part on history and the differing structures of banking systems in different currency areas, it may be that uniformity of practice amongst Central Banks is neither to be expected, nor desired. Even so it would be good to know on what grounds the Central Banks had adopted different procedures. Perhaps the relevant Central Banks could convene a (private) Conference amongst themselves to sort this out.

On matters such as this, one tends to go back to the principles laid down by Bagehot¹, to lend freely, but at a high rate, against good collateral. There were two reasons for emphasizing the quality of the collateral, first to protect the lender, *i.e.* the Central Bank, from credit default risk, and second to encourage the banks to undertake safer, less risky and speculative, lending, *i.e.* to lend on trade-related, that is 'real' bills, rather than on finance, that is speculative, bills. In Bagehot's time the first, and to some extent, the second objective were achieved by lending on the

1 Bagehot (W.) (1873): "Lombard Street"

basis of two-name commercial paper, where the bill had to be counter-signed by another bank, an accepting house, (for a small fee); the accepting house endorsement then left it at risk to pay the face value of the bill at maturity, should the original writer of the bill fail to do so.

One of the current issues relating to the market, and lender of last resort, operations of a Central Bank is how far it should widen the range of assets, which it will buy or against which it will lend, to include private sector credits, such as residential mortgages and marketable claims on high quality firms, in addition to claims against governments and public sector bodies. There is surely no question that such credits, when they are of sufficient quality, are appropriate, traditional bank assets. Moreover, since the Central Bank can rely on its outstanding currency liabilities to remain almost in perpetuity, it can absorb market and liquidity risk. What it cannot accept is credit risk, and, owing to asymmetric information, it is likely to be offered the worst such risk assets within the acceptable class held by the borrowing commercial bank, allowing that bank to access the market with its better risk paper.

Perhaps the time has come to revert to the concept of two-name paper, *i.e.* that a bank selling assets to a Central Bank has to endorse that paper, so that any credit default by the originator still has to be paid by the borrowing bank, with that liquidity taking precedence over all other creditors (except insured depositors). That would widen the acceptable range of collateral, protect the Central Bank, and throw the risks of illiquidity back on to the junior creditors of the commercial bank, the subordinated debt and equity holders where it belongs. That would also lessen, but not remove, the question of the extent of discount, or 'hair-cut', that the Central Bank should still require to protect itself against interest rate and market risk.

Most liquidity injections are, however, done by repos, rather than outright purchases. In this case the borrowing bank is already the first name and the collateral provided is the second. In such, normal, circumstances problems can still arise when the

creditworthiness (solvency) of the borrower becomes correlated with the price of the asset, which could easily be possible when the repo is collateralised on private sector assets.²

The next question for the monetary authorities is the tenor, or maturity, of their operations. The last crisis was unusual in that it was not related to an insufficiency of cash, but rather to a concern about the availability of funding to meet prospective future commitments, *e.g.* when ABCP were not rolled over, at a time when the solvency status of other banks was under some question. Accordingly three month wholesale (interbank) markets dried up, as banks sought to squirrel away funds internally and in Treasury Bills, at a time when overnight cash was, usually, in ample supply. The demand from commercial banks was for the Central Bank to loan funds for three months. But to keep overnight rates near to the policy rate, the extra loans at the longer maturity would have had to be offset by reverse repos, or open market sales at the shorter end. Would such an 'Operation Twist' have much effect? Research on this is clearly needed.

The Central Bank can establish its preferred short term policy rate with a comparatively minuscule volume of open market operations, because the effective cash reserve base, *i.e.* the buffer above the required minimum ratio, is so small. Trying to twist the yield curve *might* need to involve massive gross purchases at the longer end almost offset by almost as large reverse transactions at the shorter end. That is not to say that it would not be worth trying; what would be the cost?

My own preference would have been to have operated on the bottom side of the interest rate corridor by allowing, or encouraging commercial banks to hold longer term (*e.g.* three month) deposits at the Central Bank, at little cost relative to policy rates. If the commercial banks will not lend to each other, they will lend to the Central Bank, and the Central Bank can always ensure, by expansionary open market operations, that the commercial banks have sufficient certain access to cash, not only day by day, but also at somewhat longer maturities to defuse pure liquidity issues.³

² I am grateful to Julian Wiseman for his comments on this.

³ Operating on the lower (deposit) side of the interest rate corridor is not a hare-brained idea. No less an authority than Woodford: "Globalization and monetary Control", NBER Working Paper, No. 13329, August 2007, pp. 43 and footnote 38, describe the variation of interest rates on base money as a 'crucial element in monetary policy implementation in countries with "channel systems"'. Also see Berentsen and Monnet: "Monetary policy in a channel system", paper presented at joint Bank of England/ECB Conference on 'Payments and monetary and financial stability', Frankfurt, November 12, 2007.

But this takes us back to our starting point, how far should a Central Bank allow the commercial banks to put liquidity management onto Central Banks. Clearly if commercial banks can always rely on the Central Bank, they will undertake maximum maturity transformation, *i.e.* hold 20 year advances against overnight wholesale funds, in order to take advantage of all liquidity premia and the normally upwards sloping yield curve. One essential requirement is to ensure that the Central Bank and the taxpayer do not take the downside, and the commercial bank the upside, of such a liquidity risk play, and the 'two-name' paper proposal above goes in that direction. Even so, it is surely undesirable for Central Banks to face the prospect of holding billions of assets for quite long periods of time as the Bank of England has had to do with Northern Rock. By October 24, the total had reached GBP 20 billion and was still rising; not a satisfactory state of affairs.

But this raises the question of how one should decide on what might be an appropriate extent of maturity transformation? What are the principles involved? Moreover that question is inter-related with the issues raised earlier on the quality of the assets. If the bank holds a stock of very high quality liquid assets, then the maturity transformation can be greater, since the funding risk can be met by selling or pledging the high-quality assets. There is a trade-off between stock liquidity and maturity transformation. What, perhaps, we need is a menu of relationships between stock liquidity and maturity transformation, such as if maturity transformation is measured from 0 (no transformation) to infinite, and stock liquidity is measured as a percentage of assets, then

Actual maturity transformation	0	30	60	100	Infinite
Appropriate stock liquidity	0	5	10	30	100

An immediate problem is that this assumes that there is a single accepted scale of measurement, whether cardinal or ordinal, for both maturity transformation and stock liquidity, and this is not so. A bank will have a wide set of assets and liabilities with a variety of conditions, (*e.g.* early withdrawal penalties, interest rate roll-over dates, etc.). How can one, or should one, compare the maturity transformation positions of two banks? In the past

regulators thought about maturity ladders, so that one looked at the net position of banks over differing horizons, *e.g.*

	Up to 1 week	1-4 weeks	Up to 3 months	3-6 months	6 months >
Bank A	+20	-40	-50	+10	+60
Bank B	-30	+20	-10	--	+20

How would one compare the liquidity position of Bank A and Bank B? Moreover what does one do about retail deposits, demandable on sight but normally the most stable and reliable of all liabilities. And how about contingent liabilities? IKB and Sachsen had to be rescued when the market funding of their conduits came under pressure and they were forced to take these back on to their balance sheets in effect, and did not have enough capital to do so.

In his Belfast speech (October 9, 2007), Mervyn King compared the outcomes of the problems of Countrywide in the United States with those of Northern Rock in the United Kingdom. Countrywide had liability insurance; Northern Rock did not. The run on Countrywide was far less extensive, and politically damaging, than that on Northern Rock. Yes, indeed, but the banks writing insurance for Countrywide had by the same token a worse liquidity position. Assume two banks, A and B; A writes insurance on B; B writes insurance on A. Both appear to have insured their liabilities, but in truth there has been no reduction, just a repackaging, of aggregate liquidity risk; perhaps the repackaging relocates risk in a systemically more favourable way, perhaps not.

Before we rush to take normative action to require banks to abide by certain principles of liquidity management, there is a huge task of positive research to be done on the question of how to measure the extent of maturity transformation, with the ultimate objective of reducing it to a single scale (as the VaR measure did for banks' market risk). Can we find an equivalent VaR for maturity transformation? There is a similar problem of measuring stock liquidity. There is no firm barrier on one side of which all assets should count 100% for such stock liquidity and on the other side 0%. Again there is a major measurement exercise to be done.

By the nature of this exercise, we know that any such measurement system will be imperfect, fuzzy and open to gaming (as is VaR). What that, in turn, means that such measurement exercises should be used to set principles, and *not* required ratios or minima. The supervisory authorities should take such principles as the basis for starting dialogues with banks that fall significantly below the

appropriate levels. But they should also have the ability, once such dialogue has been undertaken, to require commercial banks to enhance their liquidity position, and to impose sanctions if they fail to do so. And that takes us back to the issue of appropriate sanctions. Since that is beyond the scope of this paper, this is, perhaps, a good point to stop.

Liquidity regulation and the lender of last resort

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The recent subprime crisis has brought back to light proposals to regulate banks' liquidity as a complement to solvency regulations. Based on recent academic research, I suggest that liquidity regulations might indeed be a way to limit the pressure on Central Banks in favour of liquidity injections during crisis periods. Another crucial question is the allocation of responsibilities between the Central Bank, the Banking Supervisors and the Treasury in the management of banking crises.

The subprime crisis of last summer has brought back to light proposals to regulate banks' liquidity as a complement to solvency regulations. In a recent article¹ *The Economist* (usually less in favour of regulatory intervention) explicitly takes this position: "recent events suggest that it may not be enough to base a regime solely on capital adequacy. The turmoil in money markets revealed that some banks put aside too few liquid assets to meet a cash squeeze... The Basel 2 agreement fine-tunes the risk-capital framework but, as regulators freely admit, it has little to say about provisioning for funding shortages".

Indeed it is interesting to contrast the formidable energy and effort that international banking supervisors have dedicated to improving and harmonizing banks' solvency regulations across countries, with the scarceness of reflections on banks' liquidity. It turns out that there is a considerable cross country variation concerning liquidity requirements. Some of the existing requirements are based on stock measures (typically a minimum level of liquid assets in relation to the stock of liquid liabilities), while others are based on mismatch analysis (*i.e.* limiting the gaps between expected inflows and outflows of cash for short term maturities). Several countries (including Australia, Germany, Singapore and the Netherlands) have recently reformed their systems by introducing new quantitative rules for banks' liquidity regulation. Other countries are considering the implementation of such reforms.

Even before the subprime crisis, banking authorities were concerned with the increasing complexity and size of financial markets, together with the emergence of a small number of "Large and Complex Banking Organizations" controlling a large number of interrelated markets. Such a system might be perfectly efficient during "normal times" but it certainly leads to serious prudential concerns during a crisis period, when liquidity is scarce.

Another reason why banking authorities might be concerned with the liquidity of banks is that these

authorities have encouraged banks to use real time gross systems (RTGSs) for large value inter-bank payments, instead of deferred net systems (DNSs) which may be prone to systemic risk.² The RTGSs are highly liquidity intensive. For example the daily turn-over on the US RTGS Fedwire is currently about 16, while that on CHIPS, the DNS that constitutes its private competitor, is currently of about 500: roughly speaking Fedwire requires 30 times more liquidity than CHIPS for a similar flow of payments.³

Finally, banking authorities are concerned by the fact that banks take huge positions on all kinds of derivative products, which are opaque and might become very liquidity demanding during a crisis period. This was particularly clear during the subprime crisis, but was also illustrated by earlier spectacular examples (Metalgellschaft, LTCM,...). Inadequate liquidity management of derivatives positions can provoke disasters, especially if large banks adopt similar strategies and rely on similar market instruments to hedge their liquidity risks.

Under the influence of the Basel Committee for Banking Supervision (BCBS), solvency regulations have received a lot of attention in the last twenty years, leading first to an harmonization across countries around a very simple solvency ratio (Basel 1) then to a revised framework implying an incredible degree of sophistication (Basel 2). But are solvency ratios (whatever their complexity) sufficient to reduce the probability and extent of bank failures, especially in front of exceptionally adverse conditions? Theoretical results and common sense suggest that liquidity requirements may be a natural complement (or partial substitute?) to solvency requirements. In any case supervisors should consider a bank's liquidity risk in conjunction with its capital adequacy: in the absence of any doubts on banks' solvency, liquidity management would essentially reduce to a pure "plumbing" problem.⁴

It is commonly accepted that Central Banks have to perform some kind of emergency liquidity assistance activity (lender of last resort) towards commercial

1 The Economist (4th October 2007) print edition. Other citations from the same article are interesting: "The private cost to banks of being light on liquid assets was clearly too low compared with the public cost that the liquidity squeeze produced in terms of instability and high interest rates... For that reason, central banks had little choice but to intervene. Trying to discipline banks after the fact by withholding liquidity risked damaging the economy. What is particularly worrying is that huge convulsions in money markets were caused by potential losses in subprime lending that are small relative to banks' capital. Unless banks are forced to protect themselves, much bigger shocks in the future might require even larger interventions by central banks. Banking regulation may need to put as much emphasis on banks' liquidity as their solvency".

2 This is criticized by Selgin (2004), who disputes the suggestion that DNSs are intrinsically subject to systemic risk, at least in the absence of government intervention.

3 However the composition of payments on the two systems is different: the average payment on Fedwire is much bigger than on CHIPS.

4 Allen and Gale (2000 and 2004) show however that when financial markets are incomplete liquidity requirements for banks may be a useful prudential tool.

banks. For several kinds of reasons (which will be developed later), inter-bank and financial markets may be insufficient providers of liquidity to banks in trouble. A liquidity requirement is a way to limit the need to use the lender of last resort (LLR) facility. A cost and benefit analysis of the LLR is thus needed to determine the appropriate extent of liquidity regulations. *A priori* the Central Bank is in a better position than commercial banks to provide liquidity assistance to banks in trouble, especially during systemic crises. However, the impossibility of governments to commit on their future actions leads to a risk of forbearance during crises periods. Thus, there is a value in limiting *a priori* the need for emergency liquidity assistance by the Central Bank. This could take the form of additional liquidity requirements, in order to cover exceptional liquidity needs under adverse circumstances.

The plan of the rest of this article is the following: section 1 examines the sources of liquidity risks for banks and the main instruments that can be used for managing them. Section 2 briefly discusses possible market failures in the provision of liquidity and explains why regulation of banks' liquidity may be justified. Section 3 concludes by discussing the way in which such a regulation could be designed.

1| THE SPECIFICITIES OF LIQUIDITY RISK FOR BANKS

Like any other firm, a bank has to manage carefully its liquidity in order to be able to cover mismatches between future cash outflows and cash inflows. However the degree of uncertainty on these mismatches is clearly much higher in the banking sector. We first examine the sources of this greater uncertainty and then review the instruments that can be used for managing liquidity risk in banks.

1|1 Source of liquidity risks for banks

On the liability side, there is obviously a large uncertainty on the amount of withdrawals of deposits (including wholesale) or the renewal of rolled-over inter-bank loans. This is especially so when the bank is under suspicion of insolvency, when there is a

temporary (aggregate) liquidity shortage or when the economy suffers from a macroeconomic shock.

On the assets side also, there is some uncertainty on the volume of new requests for loans (or renewal of old loans) that a bank will receive in the future. Of course the bank could refuse to grant these new loans but this would in general lead to the loss of profit opportunities. This would also be detrimental to the borrowing firm if it is credit rationed, and more general to the economy as a whole: we have to remember that banks are unique providers of liquidity to small and medium size enterprises, which constitute an important fraction of the private sector. This credit rationing would be especially costly if the firm is forced to close down, possibly resulting in additional losses for the bank itself.

Off-balance sheet operations are a third source of liquidity risk for banks. Examples are credit lines and other commitments. More importantly, the formidable positions taken by banks on derivative markets can generate huge liquidity needs during crisis periods.

A final source of liquidity risk are large value inter-bank payments, for which Central Banks favour the use of RTGSs over DNSs, because they are less prone to systemic risk. However RTGSs are highly liquidity intensive and can only function properly if banks hold sufficient amount of collateral to back credit lines, either from the Central Bank or from other participants. The failure of a large participant in a large value payment system (LVPS) could provoke a big disruption to the financial system. Even a liquidity shortage or a "gridlock" due to a temporary stop in the payment activity of a large bank could have dramatic consequences. This creates a "too big to fail" issue since it is likely that the Central Bank would be forced to intervene in such a situation. To avoid or simply to mitigate such problems, *ex ante* regulation of the liquidity of large participants in RTGSs seems warranted.

1|2 Instruments of liquidity management for banks

In addition to their cash reserves, banks can rely on other assets as sources of liquidity. The most important are obviously government securities,

which can be used as collateral for borrowing liquidity. However, these securities are also used as collateral for LVPSs. This raises the question of cross pledging of collateral. Such cross pledging is in general warranted, since it allows using diversification between different sources of risk for economizing on collateral. However it requires sufficient independence between payment risks and other forms of liquidity risk, as well as a constant coordination between the Central Bank (who is sometimes in charge of monitoring the LVPSs) and the Banking Supervisors. Marketable securities and inter-bank deposits can in principle be sold easily⁵ but they can lose liquidity under adverse conditions. Finally, note that liquidity needs can be strongly reduced by the use of appropriate risk management methods (Froot and Stein 1998).

2| SHOULD BANKS' LIQUIDITY BE REGULATED?

This section briefly discusses possible market failures that may justify public intervention in the regulation and provision of liquidity to banks.

2|1 Possible market failures in the provision of liquidity

Banks have two fundamental characteristics: they play a crucial role in the financing of small and medium firms that do not have a direct access to financial markets and they principally rely on external sources (deposits) for financing these loans. The fact that banks have to screen and monitor their borrowers creates an opaqueness of banks' assets: as shown by Morgan (2002), these assets are difficult to evaluate by external analysts. This opaqueness generates possibilities of moral hazard, in the form of insufficient effort by banks for screening their borrowers, or for monitoring their activities after the loan has been granted. Modern corporate finance theory (see Tirole, 2006) has shown that in such a situation, liquidity needs (due for example to costs overruns in the borrowers' projects or to deposits withdrawals in the banks themselves) are

insufficiently covered by financial markets. Following Holmström and Tirole (1998), Rochet (2004) studies possible institutional arrangements that can solve this market failure (see also Rochet 2008). For example private contractual arrangements such as pools of liquidity accompanied with inter-bank credit lines commitments can be used to mitigate this inefficiency. This can be a substitute to emergency liquidity assistance by the Central Bank, at least in the absence of aggregate shocks (see below).

Opaqueness of banks' assets also creates an externality between lenders on the inter-bank markets, payment system participants, or between uninsured depositors. The decision to renew a short term inter-bank loan, a debit cap on a large value payment system (LVPS) or a wholesale deposit depends not only on fundamental uncertainty (the quality of the bank's assets) but also on strategic uncertainty (what other lenders or depositors will do). Freixas *et al.* (2000) study the consequence of such a strategic uncertainty on the risk of contagion on an inter-bank LVPS. In such a context, liquidity requirements can be a way to limit systemic risk. Allen and Gale (2000) also show how contagion can emerge when inter-bank markets are incomplete. Using the methodology of global games popularized by Morris and Shin (1998), Rochet and Vives (2004) show that a combination of liquidity requirements, solvency requirements and LLR interventions may prevent the occurrence of coordination failures on inter-bank markets. Such coordination failures arise when some (large and uninsured) depositors decide to withdraw, not because they think the bank is likely to be insolvent, but because they anticipate others will withdraw. The rationale behind liquidity requirements is that they reduce the impact of strategic uncertainty on the final situation of the bank, since they allow the bank to withstand larger withdrawals. The same is true for solvency requirements and lender of last resort intervention. The difficulty is to determine the appropriate combination of these three instruments that minimizes the total costs of prevention of such coordination failures.

Finally, some form of government intervention may be needed in case of macroeconomic shocks such as recessions, devaluations, stock market crashes and the like. The same is true for disruptions in

⁵ Securitized loans are also a source of liquidity for banks but securitization operations are costly and have to be planned in advance. They can hardly provide liquidity in emergency situations.

the payment system. Anticipating on this kind of intervention, banks may decide opportunistically to take an excessive exposure to such risks, knowing that they are likely to be bailed out in case the risks materialize. Rochet (2004) studies this question and shows that *ex ante* regulation of banks' liquidity maybe a way to mitigate this behaviour. We now develop this analysis and discuss possible rationales for the regulation of banks' liquidity.

2|2 Possible justifications for regulating banks liquidity

After having established that banks need liquid reserves, in particular because financial and inter-bank markets may sometimes be insufficient to cover their short term financing needs, it remains to understand why a regulation is needed, *i.e.* why the managers and shareholders of these banks do not choose by themselves the appropriate level of liquid reserves for their bank.

In fact, like solvency regulations, liquidity regulations can be justified by two forms of externalities: the first is associated with the protection of small depositors, who are likely to be hurt by the failure of their bank, but are not in a position to monitor or influence the decisions of its managers. This explains why in the vast majority of countries around the world, small depositors are insured and banks are regulated and supervised by Banking Supervisors, who are in charge of protecting the interests of depositors, or minimize the liability of the Deposit Insurance Fund (DIF). The second justification for banking regulations has to do with the protection of financial stability, *i.e.* the guarantee that the payment and the financial systems are able to channel the funds appropriately between economic agents, even if the country is hit by a large shock, like a recession, a crash of asset prices, a devaluation, or a terrorist attack. Thus, there are a micro-prudential aspect and a macro-prudential aspect to solvency regulations.

Similarly, liquidity regulations can be justified by micro and macro prudential reasons: they are a complement to the LLR facility, since they limit the need for emergency liquidity assistance when an individual bank is in trouble. Also they are useful during banking crises or in case of macroeconomic shocks, since they limit the need for a generalized

bailout. This is especially so because of the commitment problem of governments who typically feel inclined to intervene *ex-post* during a banking crisis. To limit this tendency, liquidity requirements should be conditioned on the bank's exposure to macro shocks (Rochet, 2004). In practice it means that uniform liquidity requirements could be replaced by more flexible systems, where the liquidity requirement may be more or less stringent according to the bank's solvency and/or to simple measures of the bank's exposure to several types of macroeconomic shocks, deduced for example from Value At Risk calculations under different scenarios.

An important issue concerns the need for public (as opposed to private) regulation, *i.e.* whether banks could regulate themselves, like participants in a clearing house. Holmström and Tirole (1998) show that the private solution can be sufficient if there are no aggregate shocks. However a purely private solution is likely to be relatively complex to implement. It would consist in requiring banks to form pools of liquidity and to sign multilateral credit lines commitments, specifying clearly the conditions under which an illiquid bank would be allowed to draw on its credit line. By contrast, emergency liquidity assistance by the Central Bank is probably simpler to organize, but may be prone to forbearance under political pressure. In any case, due to the possibility of macro-shocks, some form of government intervention is needed. The difficulty is then to avoid excessive intervention, such as *ex-post* bailouts of insolvent banks. We discuss this question in the next section.

As already noted, liquidity regulation of large participants in the payment system is also warranted, in order to limit the risk of needing massive liquidity injections by the Central Bank in case of a disruption in the payment system. Two policy questions arise:

- Is it necessary to impose an additional liquidity requirement (on top of a simple liquidity requirement, that is aimed at covering potential liquidity problem over a short period, say a week) to cover also intraday liquidity needs?
- If the answer to the first question is yes, how to design this additional liquidity requirement, taking into account that banks have the possibility to "bypass" the RTGS by either entering into bilateral netting agreements with other banks or using

competing DNS systems, which could be more prone to systemic risk?

Finally, it should be noted that systemic risk in payment systems and inter-bank markets could be eliminated altogether if the Central Bank decided to insure inter-bank transactions and payments finality against credit risk. This system was implicitly in place in many countries during most of the last century. Thus the only logical explanation for the recent movement towards RTGSs and limitation of LLR interventions is that banking authorities want to promote peer monitoring by banks. However Rochet and Tirole (1996a) show that the effective implementation of peer monitoring among banks may be difficult, due to commitment problems by governments. Liquidity requirements may be a useful way to mitigate these commitment problems.

3 | HOW TO REGULATE BANKS LIQUIDITY?

As we have seen, there are two essential motivations for regulating banks' liquidity, one being micro-prudential (*i.e.* limiting the externality associated with individual bank failures), and the other being macro-prudential (*i.e.* limiting excessive exposures to macroeconomic shocks by banks, under the expectation of a generalized bailout by the government). A simple liquidity ratio seems to be appropriate to cover the first objective, with the possible qualification that under-capitalized banks could be subject to more stringent requirements. This would be in the spirit of the "prompt corrective action" methodology imposed by the FDIC Improvement Act to US supervisors, *i.e.* the idea of some progressiveness in the restrictions imposed to problem banks, forcing supervisors to act before it is too late.

However, the macro-prudential objective of liquidity regulation seems harder to attain, given in particular the difficulty to forecast precisely the liquidity needs of banks during a crisis. One particular component of these liquidity needs is of course related to the intraday needs of the banks for channelling their large value payments on the RTGS, but it has to be stressed that other liquidity needs, equally important to cover during a crisis, may materialize only after two to five days (for example refinancing on the inter-bank

markets). This implies that the crucial distinction is not in terms of time horizon (intraday *vs.* two to five days) but rather between individual shocks, for which there is no reason to extend emergency liquidity assistance to banks that are insolvent (and therefore simple, uniform, liquidity ratios should be enough) and macroeconomic shocks, for which a massive liquidity injection by the Central Bank (and maybe a partial recapitalization of some of the banks by the Treasury) may be warranted.

Thus there seems to be a need for a second type of liquidity requirement, based on some indices of exposure to macroeconomic shocks by individual banks, and intended to limit the need for an *ex-post* liquidity injection by the Central Bank. These indices should be designed *ex ante* (and adjusted regularly) by the Banking Supervisors, possibly after using the internal risk model of each bank and different sorts of stress tests. One difficulty would be of course to avoid regulatory arbitrage, *i.e.* "window dressing" or manipulations of accounting information by the banks, in order to minimize their liquidity requirements, without effectively decreasing their exposure to macroeconomic shocks. In the context of LVPS, it would mean for example requiring cooperation and information sharing between the RTGS and any privately run competitor, and computing collateral requirements on an aggregate basis.

However additional liquidity requirements aimed at mitigating macroeconomic shocks could constitute a "waste" of liquidity, given that they would be used only under exceptional circumstances. A superior solution may consist in this case for the Central Bank to commit to provide conditional credit lines under the strict control of an independent Banking Supervisor. The characteristics of these credit lines (maximum amount, commitment fee, conditions under which they can be used) would be specified *ex ante* by the Banking Supervisor. The associated loans could be made senior to all other liabilities, thus limiting the risk of recourse to taxpayers' money.

In summary, liquidity regulations for banks can be justified, like solvency regulations, by two different motives: one is to limit the risk and the extent of individual bank failures, the other is to limit the need for massive liquidity injections by the Central Bank in case of a macroeconomic shock. In normal times, the pool of marketable securities that can provide liquidity to the banks is substantial.

Therefore a simple, uniform liquidity ratio may be all that is needed, with the possible qualification that the Banking Supervisors could require additional liquidity for undercapitalized banks, in the spirit of the "prompt corrective action" implemented in the USA. As for macro-prudential purposes, that is anticipating what would occur in case of a large macro shock, it is probably necessary to go further, and either to require additional liquidity, or secure a credit line by the Central Bank, both based on the

exposure of each individual bank to such macro shocks and carefully monitored by the Banking Supervisors. The definition of appropriate indices of such exposures to macro shocks (possibly using stress tests and worst case scenarios) is an important empirical challenge. Similarly, some form of cost-benefit analysis of LLR interventions would be useful in order to evaluate the exact costs of liquidity provision by the Central Bank, and the social cost of excessive liquidity.

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Liquidity shortages: theoretical underpinnings

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Liquidity shortages arise when financial institutions and industrial companies scramble for, and cannot find the cash they require to meet their most urgent needs or undertake their most valuable projects. Liquidity problems are compounded when some actors do have excess liquidity, but are unwilling to lend it at the maturities desired by prospective borrowers. The paper revisits the theoretical underpinnings of such liquidity shortages: what drives corporate liquidity demand and supply? How is the latter affected by financial innovation? When does the economy produce enough liquidity for its own needs, and what is the role of public policy? The paper also offers some comments on the recent subprime episode and its implications for prudential regulation, rating agencies and public policy.

NB: Much of the material in this paper is inspired by joint work of the author with Bengt Holmström. The author is grateful to Frederic Cherbonnier and Jean-Charles Rochet for helpful comments.

Long before the early-August injections of hundreds of billions of dollars of liquidity by the Fed and the ECB, and ever since, central banks and governments have pondered over how and when to stabilize troubled credit markets. Liquidity is potentially scarce, as actors contemplate the prospect of fire sales of mortgage-backed assets, and to boot it all, actors with available liquidity refrain from lending it to those who are short of it. The USD 11 billion Citigroup write-down of mortgage-related assets and other similar developments at the time of this writing (early November) have raised questions about the effectiveness and timing of the US Treasury backed USD 75 billion "superfund" plan of three large American banks¹ to purchase assets from distressed investments in order to prevent fire sales.

But what is "liquidity"? Does liquidity matter and should governments and central banks do something about it? While trivial to a practitioner, these questions surprisingly are not so obvious to an economist trained in the general-equilibrium tradition. Intuitively, an industrial company or financial institution is short of liquidity when a) some (continuation or investment) spending decisions are worthwhile, and b) the firm somehow cannot manage to find the money to finance them. Classical (Arrow-Debreu, Modigliani-Miller) economic theory holds it that a) and b) are inconsistent: if refinancing or financing of new projects is desirable, so goes the argument, the firm can always issue claims on associated future profits, that investors will find sufficiently attractive to be willing to finance the outlay. According to this logic, firms have no reason to plan their liquidity (or for that matter to engage in risk management to avoid bad surprises in their liquidity position): they just can return to the capital market as needs arise.

This paper offers a conceptual framework in which to couch the debate about the recent subprime crisis,² and uses this framework to illustrate some of the relevant issues. This conceptual framework at the microeconomic level builds on the existence of agency costs and the concomitant difficulty for firms to access funds (section 1). Costly refinancing leads to a demand for liquidity, with a range of familiar corollaries such as risk and asset-liability

management. On the supply side, liquidity is created in several ways: inside liquidity is provided by the firms themselves by issuing securities "backed" by the firm's future income. Outside liquidity stems from the consumer sector, the State, and the international market.

Section 2 first explains why liquidity may be scarce and shows how assets such as Treasury securities command liquidity premia by serving as stores of value. It also discusses the interaction among bubbles, liquidity and investment.

Section 3 draws the implications for public policy.

1 | LIQUIDITY: DEMAND AND SUPPLY

An unfortunate habit of economists is the use of the same word, "liquidity", to cover distinct concepts. Consider the common definition: "An asset is liquid if its owner can resell it quickly at a decent price". This definition already recoups the two main and distinct interpretations of the concept:

"Market microstructure or microeconomic liquidity" understanding: an asset is liquid if the transaction costs of buying and selling the asset are small; for example:

"The degree of liquidity of a market is traditionally assessed on the basis of three essential criteria: the tightness of the bid-ask spread, which is a direct measure of transaction costs (excluding other operational costs), and two other criteria that indicate the market's ability to absorb significant volumes without adverse effects on prices : market depth, which corresponds to the volume of transactions that may be immediately executed without slippage of best limit prices, and market resilience, i.e. the speed with which prices revert to their equilibrium level following a random shock in the transaction flow." (Bervas, 2006).

In particular, assets with low bid-ask spreads (due to low transaction costs or small amounts of informational asymmetries) are liquid according to this definition. The stock market index, an on-the-run

¹ Bank of America, Citigroup, and JPMorgan Chase.

² The theoretical framework has been elaborated in collaboration with Bengt Holmström (See Holmström and Tirole 1998, 2000, 2001 and 2008).

Treasury bond, or a mortgage-backed portfolio about which actors would be symmetrically informed, are equally "liquid" according to this definition.

"Aggregate or macroeconomic liquidity" understanding: according to this alternative definition, variants of which date back to Keynes and Hicks, an asset offers liquidity to the corporate world if it can be used by the latter as a cushion to address pressing needs. To be an effective cushion, though, the asset must not lose value in those very circumstances in which the corporate sector does need money. In this respect, the on-the-run Treasury bond is rather distinct from the stock index or the hypothetical mortgage-backed portfolio in that it does not lose value in recessions,³ while the latter's value is likely to be reduced precisely in case of an industrial or financial recession.

To analyze the subprime crisis, monetary policy and other public interventions geared to adjusting the existing liquidity, the relevant definition is the macroeconomic one, and we will therefore focus on it, even though we will note incidentally that macroeconomic illiquidity makes microeconomic illiquidity more likely.

The demand for liquidity

A basic feature of corporate financial management is that revenues and outlays are not perfectly synchronized. The lack of synchronicity between cash flows and needs implies that firms and financial institutions must find ways of covering their needs in periods of shortfall. Two broad strategies are available to this purpose: "finance as you go" and "liquidity hoarding".

"Finance as you go" consists in returning to the capital market and borrowing from investors and other corporations when needs arise. Note that markets would satisfactorily bridge the temporal gaps between revenues and expenditures in a world of perfect (understand "agency-cost free") capital markets.

That strategy however has its limits as both the theory of corporate finance and the daily observation of credit rationing suggest. Due to moral hazard, adverse selection (asymmetries of information about assets

in place and projects), or mere transaction costs (we will regroup these three factors under the heading of "financial market imperfections"), cash-strapped corporations find it hard to find financing even for positive net-present-value actions. The current subprime crisis is a case in point: the lending to the ECB rather than to cash-strapped banks by banks with excess liquidity, the stalling of the collateralised debt obligation (CDO) market, the corporate credit spread, and the overall credit crunch despite the injection of liquidity by central banks all illustrate the difficulty of relying on markets for refinancing.

For this reason, corporations must complement the recourse to the financial market by some planning of their own. That is, they must hoard liquidity either directly (by holding securities on their own books) or indirectly (by securing an explicit or implicit credit line from a bank, an insurance company, or a parent company, which hold securities on their own balance sheets to back these lines of credit).

For future reference, we will call *inside liquidity* the amount that can be raised by the corporate sector simply by issuing new claims on its future income. This amount depends on the economic environment; for example, improved corporate governance assuages investors' concern about the prospect of recouping the money they invested; in economic jargon, better corporate governance increases the pledgeability of firm resources to investors. Thus, better corporate governance institutions facilitate refinancing by the corporate sector and thereby inside liquidity.

Another strategy for firms to raise money from the capital market is to securitize a portfolio of loans that it has issued. Indeed securitization, often described as an unloading of risk to other parties, is also about the certification of the quality of past activities; indeed asymmetric information about the real value of the returns streams attached to the loans makes it difficult to offer the loan portfolio as collateral against further borrowing. The securitization process, if it is accompanied by careful scrutiny by buyers, rating agencies or credit enhancers, certifies the quality of the portfolio to the market and transforms otherwise illiquid assets into tradable ones.⁴ If properly performed (*i.e.* with

³ In a first approximation. Of course, swings in the interest rate affect the value of longer-term bonds. Let's skip the corresponding discussion here, as it would bring us to a discussion of asset-liability management.

⁴ The securitization process is very similar to the exit mechanism in venture capital deals. This exit mechanism enables the venture capitalist to mobilize illiquid capital (part or all of his/her share in the venture), certify it through an initial public offering or a sale to a knowledgeable buyer, and thereby avail himself/herself of new funds to undertake new deals.

the right incentives in place), this process thereby boosts the volume of inside liquidity.

A key question that will be discussed later on is whether in the aggregate the corporate sector produces enough inside liquidity to cater for its own needs. If not, the corporate sector as a whole must hoard stores of value. But the hoarding of liquidity at the level of the corporate sector supposes the existence in the economy of "stores of value" or "reserves" or *outside liquidity*. We will return shortly to this point when we discuss the supply of liquidity.

Finally, because we will be interested in macroeconomic aspects, we will not discuss the fine points of this liquidity management by individual corporations, although this would in its own sake be worthwhile. Let it suffice to say that liquidity management must adapt to the lack of coincidence between cash flows and needs across states of nature and across time: risk management aims at partially⁵ insuring the firm's liquidity position against insurable risks. Similarly, asset-liability management (ALM) techniques try to restore some coincidence between the timing of receipts and expenditures; thus, pension funds or life-insurance companies have higher demands for securities delivering coupons 15 or 25 years ahead than banks do. Again, these standard functions of financial officers would be hard to rationalize in a classical economics world, in which firms could costlessly return to the capital market to raise funds when they need to.

The supply of liquidity

As we noted, liquidity management pre-supposes the existence of stores of value in the economy. Such outside liquidity in practice can be decomposed into five categories depending on its origin:

- *Rents created by past economic activities*: past activities have created streams of future incomes that can be mobilized as stores of value. Some are directly traded in public or private equity markets (Château d'Yquem); others are not (historical monuments and housing still owned by the State).

- *State-provided liquidity*: States supply liquidity to the corporate sector in various ways. First, they issue securities that can be used as stores of values. As usual, one must ask, what is it that the State can do that the private sector cannot do? These securities are backed by publicly owned assets, and, more interestingly, by the future tax revenue to be collected by the state. Indeed, we argue that the key to public provision of liquidity is the unique/monopoly ability of the State to access consumers' future income through taxation: while consumers can directly provide corporations with credit lines that are unbacked by real assets only in limited amounts (due to the legal or contractual inability to pledge future income—the prohibition of slavery),⁶ they can do so indirectly through the State: the future tax revenue is the collateral that backs the payment of interest and principal on Treasury securities. Second, and again using their regalian taxation power, States provide liquidity through various state-contingent injections, with varying implicit liabilities for taxpayers: repos, discount window, banking and industrial sector bailouts. But there are many less obvious ways in which States redistribute money from consumers to firms in bad times (and money the other way round in good times): non-indexed deposit insurance, whose rates don't reflect the enhanced probability of bank default during recessions; non-indexed payroll taxes financing unemployment benefits, and so forth.

- *Stores of value directly created by consumers*: consumers however may directly create stores of value when they borrow instead of financing their homes themselves. Their commitment to reimburse interest and principal on their mortgages represents a claim on their future income; this claim can be securitized and transformed into a store of value through the institution of mortgage-backed securities (MBSs).⁷ It is interesting to note in this respect that real estate mortgages of US households have grown from 15% of their net wealth in 1949 to 41% in 2001, due to various factors (financial innovation; increased risk taking through high loan-to-value ratios, teaser rates and lack of refinancing penalties; changes in legislation favoring

⁵ The reader will find in Tirole (2006, chapter 5) a review of the considerations that make full coverage of such risks suboptimal. It should be also noted that risk management does not aim at insuring investors as the latter can diversify their risks in other ways.

⁶ The main example of this is consumer credit (which incidentally is the object of securitization).

⁷ There are limits to the creation of liquidity in this manner, though. First, the consumers must consume some of the money they economize today by borrowing; otherwise they invest it into stores of value, and there is no net creation of such stores of value. Note, second, that future mortgage payments compete with taxes, especially if they are tax deductible; that may reduce the State's ability to create liquidity.

home ownership). An interesting empirical question relates to how much liquidity is really created through the dual process of mortgage borrowing and securitization. And more generally, it is to be seen how much additional liquidity can be harnessed through financial innovation; the analysis here meets that of Hernando de Soto, who argued that the transformation of "dead capital" to "live capital" is a key step in the development process.⁸

- *Foreign sources of liquidity*: corporations can buy foreign stores of value: e.g. the stock index or Treasury securities of a foreign country. They can also access lines of credit from the international financial community. The access to foreign stores of value and lines of credit is however limited as they have to be financed in foreign currency, and so, like for sovereign States themselves, the ability to borrow is bounded by the export capacity of the country.⁹

The assertion that a country's ability to borrow is limited by its capacity to export may seem strange in view of the recent American experience. However, the enormous amount of borrowing by the US is a case in point for a discussion of the role of pledgeability in facilitating financing. Corporate governance, the importance of publicly-held corporations, the role of markets and securitization in creating liquid claims, and the political economy of the country (a strong support for investor protection, due in particular to the existence of pension funds) all concur to create a substantial volume of liquidity, which is in high demand in countries producing substantial income, but few pledgeable claims.

- *Bubbles*: bubbles, by inflating the value of financial assets (stocks, real estate), inflate the volume of stores of value. To be certain, bubbles only go so far to boost corporate liquidity if they tend to burst precisely when the economy enters or is in a recession.¹⁰

2| LIQUIDITY SHORTAGES AND LIQUIDITY PREMIA

2|1 The concept of inside liquidity in the aggregate

Let us start with a basic question, that of the sufficiency of inside liquidity at the *aggregate* level. We have seen that in the presence of agency costs, the Arrow-Debreu and Modigliani-Miller feasibility of "financing as you go" by resorting to the capital market does not hold at the *individual firm* level; because investors cannot grab the entire benefits associated with their investment, they tend to ration the financing they extend to the firm. However, "financing as you go" might hold "on average" at the *macroeconomic* level, and so the corporate sector might not need outside stores of value to finance positive NPV re-investments. We therefore investigate the sufficiency of inside liquidity in an example; the conclusions are very general.

An example: consider a representative entrepreneur and three dates (and no discounting between these three dates): $t = 0, 1, 2$ (See figure below for a summary of the timing). At date 0, the entrepreneur has a project, for which she must invest 10, but she has wealth only equal to 8; she must therefore go to the capital market in order to finance this investment. The investment, if made at date 0, does not generate any revenue at date 1; actually with probability $\frac{1}{2}$, an overrun (a "liquidity shock") of 20 arises, that must be covered if the project is to go on and produce income at date 2, otherwise the project is liquidated and yields no income.¹¹ At date 2, revenue accrues (provided that the overrun, if any, has been covered at date 1). The total proceeds, 30, are shared between investors and entrepreneur; namely, the pledgeable income, that is the maximum amount that can credibly be promised to investors, is only 12.¹²

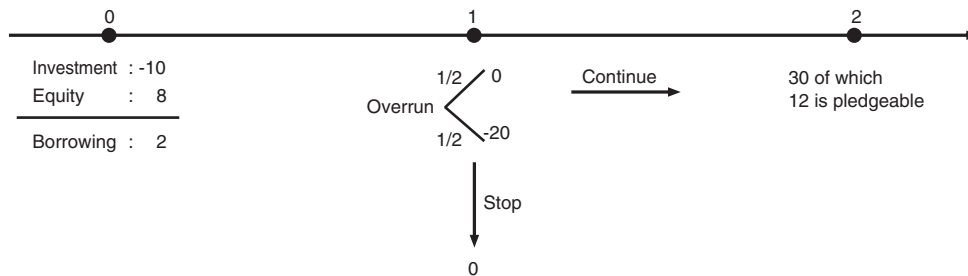
8 De Soto provides the example of giving land ownership rights to land-occupying farmers; property rights give farmers the ability to borrow against this collateral and enable them to buy equipments or new seeds.

9 On this see Caballero-Krishnamurthy (2001 and 2003) and Holmström-Tirole (2002 and 2008).

10 The popping of the bubble actually triggers a recession. On this, see Farhi and Tirole (2008).

11 With probability $\frac{1}{2}$, there is no overrun and therefore no extra expense at date 1.

12 For example, the 18 left to the entrepreneur might correspond to an incentive payment provided to the entrepreneur (or more generally the firm's insiders) to curb moral hazard. That amount may also include the entrepreneur's perks and prestige from office. Last, it could also represent money that is diverted toward other activities (affiliated companies, investment in human capital that will be operative in other, future activities).



Note first that financing the project and covering the overrun if it arises is viable for the investors, even though they cannot put their hands on the entire pie: recalling that the interest rate is by assumption equal to 0, total (date 0 plus date 1) investor outlay is equal to date-2 revenue on investors' claim on the firm: $(10-8) + (1/2)(20) = 12$.

However, the "finance as you go" strategy is not sustainable: suppose that the entrepreneur borrows 2, against claims on date-2 income, so as to just be able to cover the investment at date 0, and counts on returning to the capital market at date 1 in case of overrun. When the overrun arises, the capital market won't be willing to supply more than the maximum revenue, 12, that investors can grab at date 2 (to obtain 12, a restructuring of claims through a renegotiation with initial claimholders –who obtain 0 if the firm goes bankrupt at date 1– is needed if new investors are brought in). Therefore investors aren't willing to bring in the 20 that are necessary to withstand the liquidity shock faced by the firm.

The entrepreneur must therefore plan and hoard liquidity. In this simple example, there are various ways of doing so, but a "reasonable" one may go as follows: the firm contracts with a bank on a line of credit equal to 20. If this line is drawn, the bank becomes the senior creditor and therefore obtains 12 at date 2. The bank in exchange demands at date 0 a commitment fee equal to $4 = (1/2)(20-12)$; it makes money if the credit line is not drawn, and loses money if the firm faces an overrun. This is indeed the nature of a credit line: there would be no reason to contract in advance on a credit line if at date 1 the bank were always happy to provide the funds; it is precisely because lending is a money-losing operation at date 1 that it must be pre-arranged. The other investors must bring in 2 (the investment cost minus the entrepreneur's contribution to it) plus

the commitment fee, so 6 in total. They are willing to do so, as they get back $(1/2)(12) = 6$.

This is all well, but we haven't addressed the "macroeconomic question": where will the bank find the 20 that it has committed to bring in if the credit line is drawn? Imagine that there are lots of such entrepreneurs in this economy. Entrepreneurs are identical at date 0. As we observed, given that the firm-idiosyncratic events of liquidity shocks are independent and so there is *no macroeconomic uncertainty*, exactly half of the firms face an overrun.

The claim (which is entirely general, and so not specific to this very special example)¹³ is that the private sector produces enough inside liquidity to efficiently withstand liquidity shocks that it should withstand; another way of rephrasing the same point is that if one introduces a store of value (a Treasury bond, say) delivering 1 at date 1 (or 2, it does not matter), this store of value will trade at price 1 at date 0: it won't embody any liquidity premium for supplying liquidity services, or equivalently, its interest rate will be equal to the economy wide rate (here 0): there is no risk-free rate puzzle.

To see this, let the banks invest the 4 they receive in commitment fees in ordinary claims on other firms. If banks are diversified, the per-firm value of the resulting portfolio is $(4/6)(1/2)(12) = 4$ at date 1. To honor its credit line commitments, the bank needs $(1/2)(20-12) = 4$, so everything is in order. Note that this arrangement requires some prudential supervision: the bank in general would make more profit by selecting subsets of firms for which liquidity shocks are correlated as this strategy guarantees large profits when such shocks do not arise, and otherwise does not expose the bank, which is protected by limited liability.¹⁴

¹³ See Holmström-Tirole (1998 and 2008). The key assumption for this proposition to hold is that the corporate sector be a net borrower.

¹⁴ With perfect correlation of shocks in its portfolio, the bank makes 8 per firm in the absence of overrun and 0 in case of overrun, instead of 0.

There are other, apparently natural ways of hoarding liquidity that do not work, though. Imagine that instead of centralizing the liquidity within financial intermediaries dispatching liquidity as needed, each firm hoards liquidity in a decentralized way. That is, each firm holds the representative portfolio or index. The value of this portfolio at date 1 is $(1/2)(12) = 6$, which is insufficient to cover the liquidity shortfall (equal to 8) in the presence of an overrun. To be certain, the firms that do not face an overrun have excess liquidity: the value 6 of the security market holdings, not to mention the possibility of diluting existing claims on their pledgeable income. However, and this is the key point, they have no incentive to lend to and rescue the distressed firms; this situation is certainly reminiscent of the recent subprime crisis, in which those institutions with cash refuse to lend to those without. The efficient outcome does not arise under decentralized liquidity hoarding. There is enough aggregate liquidity in principle, but it is *wasted* by allocating liquidity in a non-contingent manner, so that firms that end up not needing liquidity have plenty of it.

Matters are quite different in the *presence of macroeconomic shocks*. To take an extreme case, suppose that with probability $1/2$ all entrepreneurs face a cost overrun simultaneously; that is, the liquidity shocks are perfectly correlated. Then there is no way investors are going to put in 20 per firm at date 1: their claims on date 2 income are only 12 per firm, and they cannot be forced to disgorge 20 even if their portfolios of claims on the firms are seized. Somehow for the efficient allocation to be sustainable there must exist stores of values in quantity at least equal to 8 per firm.

To sum up, meeting liquidity shocks in the absence of outside stores of value requires issuing new securities, *i.e.* digging into inside liquidity, along the way. There is a shortage of inside liquidity when the economy is hit by aggregate shocks. In the absence of macroeconomic shock, by contrast, the corporate sector as a whole in principle produces enough inside liquidity to meet liquidity shocks it wants to withstand, even though there is insufficient inside liquidity at the firm level. We have stressed that the adequacy of inside liquidity in the aggregate hinges on an efficient dispatching of available liquidity toward those firms in (moderate) need of cash. This is accomplished by

pooling the available liquidity at the level of financial intermediaries, who then redispach the liquidity through a mechanism akin to credit lines; by contrast, self provision of liquidity, under which each firm hoards liquidity for its own purposes, leads to a waste and therefore a potential shortage of liquidity, as firms that end up awash with cash do not lend it to those with a shortage of liquidity.

Another source of illiquidity is the asymmetry of information about stores of value. This asymmetry of information about assets increases during recessions; for example, a portfolio of mortgage-backed securities may face little risk, and therefore generate little concern about its quality, in good times, and become riskier when things get worse; in the latter circumstances, the MBS assets become illiquid as participants in asset markets are asymmetrically informed: as we announced earlier, macroeconomic illiquidity may generate microeconomic illiquidity.

2|2 Liquidity premia and LAPM

Let us return to the example, in the presence of *macroeconomic uncertainty*. Note first that holding the "stock index" (a portfolio of shares of the firms) does not bring any useful liquidity to firms or financial intermediaries: in the simple-minded example given above, the value of this stock index falls to 0 when the economy is hit by a shock: all firms are then valueless. The stock index has value in the absence of shock, but this value serves no liquidity purpose as firms don't need liquidity in this circumstances. Put differently, the stock index does not allow firms to diversify and create a store of value that can be resold in case of liquidity needs. Thus, the stock index is not a liquid security in the macroeconomic sense, even though it is perfectly liquid in the microeconomic sense.

Let us now add outside liquidity in a stylized manner to our example. Suppose that at date 0, there exist stores of value, in quantity x per firm, that the corporate world can purchase and use to meet liquidity needs at date 1. Namely, each store of value delivers 1 per firm at date 1.¹⁵ We will call these stores of value the "risk-free assets", and the return they command the "risk-free rate".

¹⁵ Or, indifferently here, at date 2: a long-term store of value delivering 1 at date 2 can be resold at date 1 to consumers at price 1 as consumers are assumed not to discount the future (the rate of interest is equal to 0).

If α is greater than δ , the shortage of liquidity, then outside liquidity makes up for this shortage. There is sufficient aggregate liquidity: firms can hoard α stores of value each; when they face a liquidity shock they can resell these α stores of value and supplement this sale through a sufficient dilution of initial claimholders: for example, if α is equal to 14, then the firms can double the number of shares in each firm. In so doing, the firms raise cash $(1/2)(12) = 6$, which together with the sale of the risk-free asset allow them to cover the cost overrun (20).¹⁶

With lower amounts of outside liquidity, outside liquidity complements inside liquidity, but there is still a shortage. Firms compete for the scarce stores of value, raising their price above 1; put differently, the risk-free assets command a return that is below that suggested by the consumers' rate of time preference (here normalized at 0). The higher α , the smaller the liquidity premium (the closer the interest rate is to 0).¹⁷ Like in the less formal accounts of Hicks and Keynes, risk-free securities are held not so much for their return, but rather because they deliver cash when firms need it: they are liquid in the macroeconomic sense.

More generally, the price of assets reflects how much liquidity they bring when it is needed. This property is very much in the spirit of the capital-asset-pricing model (CAPM), which determines security values from the covariance of their return with aggregate activity. There is a difference, though: in the CAPM paradigm, pricing is determined entirely by the consumer sector (technically, the covariance refers to that between the asset's return and the representative consumer's marginal rate of substitution). The liquidity-asset-pricing model (LAPM) adds firms to the picture and states that corporate demand for stores of value also drives the pricing of assets. In the example above, the firms pay a premium over what consumers are willing to pay and so pricing is determined on the corporate side rather than on the consumer side.

In this simple minded example, firms hold *all* risk-free assets, at least if α is less than δ , because consumers have no liquidity needs of their own. More generally and realistically, the "pricing kernel" is determined

jointly by consumers and firms with liquidity needs. The key message is therefore that one cannot ignore variations in corporate net liquidity demand when pricing assets.

The "model" described above can, at the cost of increased complexity, be used to study the dynamics of inside liquidity generation and the term structure of interest rates.¹⁸ Yesterday's investments give rise to dividends tomorrow, which if traded, create stores of value today. This creates an investment hysteresis: a higher level of liquidity supports more investment, which in turn creates future dividends that if not transformed into dead capital will create liquidity tomorrow and support new investment, and so forth. The interest rate is procyclical, and the interest rate spread (long rate minus short rate) countercyclical.

2/3 Bubbles

An asset is said to embody a bubble if its price exceeds its fundamental value, namely the value of future dividends, coupons or rentals. It is by no means easy to disentangle bubbles from fundamentals when asset prices reach high levels. For example, the high real estate prices of the first half of this decade in the US can be attributed at least partly to fundamental-boosting low interest rates resulting from Alan Greenspan's deliberate attempt to raise asset values. Shiller however argues that one can detect the existence of a real estate bubble by comparing the evolution of rental and ownership prices. Real estate prices moved in synchronicity with rental rates (the "dividends" on the real-estate assets) until 2000, and afterwards gained 70% relative to rental rates, suggesting the appearance of a bubble.

A policy debate has accordingly emerged, as to whether the central bank should try to prick, or at least lean against the bubble (assuming one succeeds in identifying one). For example, Bernanke (2002) and Bernanke-Gertler (2000 and 2001) argue that the central bank should not be concerned about a bubble unless it is a signal of incoming inflation; others, e.g. Bordo-Jeanne (2002) feel otherwise.

¹⁶ Note that the issue of liquidity waste does not arise here: with perfectly correlated shocks, as presumed in this example, a firm needs cash precisely when others also need cash; there is therefore no need to transfer cash from liquidity rich firms to firms with liquidity needs.

¹⁷ Krishnamurthy and Vissing-Jorgensen (2007) show that the yield spread between AAA rated corporate bonds and US Treasury securities is low when the stock of debt is high, and this even if one controls for default risk on corporate bonds. As they state, changes in the supply of Treasury debt trace out the demand for convenience by investors.

¹⁸ Ongoing work by Emmanuel Farhi and the author.

The classic view of asset bubbles¹⁹ has it that a) the existence of a bubble raises interest rates, b) a bubble crowds out productive investment, and c) bubbles can exist only if the economy is "dynamically inefficient", *i.e.* only if the rate of interest lies below the rate of growth of the economy (the productive sector then absorbs more resources than it delivers). While the increase in interest rates is rather uncontroversial, the validity of the other two properties has been questioned. First, while the competition (or crowding out) effect is undeniably there as bubbles inflate the volume of assets proposed to lenders, specific episodes (the Japanese or the American bubbles) suggest that asset bubbles may sometimes go hand in hand with sustained investment. Second, Abel, Mankiw, Summers and Zeckhauser (1989) have argued that there is no evidence that the economy is dynamically inefficient.

In an economy with capital market imperfections, though, bubbles also add to the volume of stores of value. Although they may burst precisely when the economy enters a recession, they still have a residual value in boosting aggregate liquidity. This implies that under certain circumstances,²⁰ bubbles and investment can be complements, rather than substitutes as predicted by the competition effect. Furthermore, it can be shown that the existence of bubbles is a) more likely in economies with little pledgeable income, and b) consistent with dynamic efficiency (the more so, the higher the agency costs in borrowing).

The burst of a bubble in this context may not be good news: it destroys a store of value and thereby creates a shortage of liquidity, resulting in lower investment.

2|4 The subprime crisis

While it is too early to provide an accurate account of the recent events, a number of factors came into play in the real estate crisis. First, the Fed for a long while kept the cost of borrowing rather low, resulting in high demand for and price of real estate. Second, credit was extended under rather risky terms: high loan-to-value ratios, backloading of reimbursements (teaser rates), low penalties, indexed mortgages.

19 See Tirole (1985).

20 See Farhi-Tirole (2008).

21 Hired by investment banks to find out modeling weaknesses.

22 Or date 2 for that matter.

Third, rating agencies underperformed, giving triple A ratings to rather risky portfolios. Commentators have pointed at several deficiencies of the rating process: weakness of models and assumptions on correlations, poor understanding of solvency of issuers and guarantors, flight of key personnel from rating agencies,²¹ conflicts of interest (repeated relationship between investment banks-whose involvement in structured finance has become substantial- and rating agencies, bundling of services by rating agencies), etc. Whatever the cause, a key step in the transformation of dead capital into liquidity failed. Ultimate buyers felt unable to assess the value of CDOs and CLOs and relied on the rating agencies' certification, but did not receive an accurate picture of those values.

A modest reduction of real estate prices (3.4% in a year) started creating threats of defaults of, or trouble for those institutions that had purchased portfolios of mortgage-backed securities, or had extended complex, and often hidden liabilities to structured investment vehicles. With it came the prospect of contagion, the stalling of markets and the worry about fire sales, making prudential regulators concerned about banks, insurance companies and pension funds with exposures to MBSs.

The recent events have many ingredients of a standard liquidity crisis. The downturn of the real estate market created the initial aggregate liquidity shock. This shock was magnified by adverse selection, as portfolios became riskier and concerns about quality more pungent. Finally, the shock was further compounded by concerns about fire sales.

3| PUBLIC SUPPLY OF LIQUIDITY

We earlier argued that the State can provide (outside) liquidity by using the future tax income to back up the reimbursements. In our stylized example for instance, the State can issue bonds at date 0 and promise to pay out at date 1.²² There are of course limits on what the State can do: first, the reimbursement through taxation introduces both substantial deadweight losses and credibility problems when national debt reaches high levels.

Second, the taxation of consumers generates social costs when consumers have liquidity needs of their own. In particular, as employees of the firms, they may face hardships precisely when firms are in need of liquidity.

The fundamental feature of public provision of liquidity is that the State should redistribute from consumers to corporations when the latter face pressing liquidity needs. We have argued that this is what it does in practice, through a variety of instruments from open market operations to the discount window, from banking bailouts to non-indexed payroll taxes and deposit insurance premia. Ideally, the State should be issuing "state-contingent liquidity", *i.e.* liquidity that delivers only during recessions. Contingent claims of this kind are usually implicit rather than explicit; an exception is the sale by the Federal Reserve of contingent access to the discount window in the context of the potential Y2K computer bug; in this case, a well-defined event of liquidity shortage (the potential problems with computers at the turn of the millennium) was identified and contingent claims accordingly issued by the central bank. But defining precisely a liquidity shortage in advance is rather hard and injections of liquidity remain for that reason by and large discretionary.

Another suggestion of economic theory is that liquidity premia attached to risk-free rate assets are signals of the scarcity of aggregate liquidity at the various maturities and therefore are a useful guide for the issuing of government securities, both in level (total public debt) and in structure (choice of maturities); for example, a very low long rate signals substantial shortages of long-term stores of value, and therefore social gains to issuing long-term Treasury securities. A case in point is the issuing by HM Treasury of long-term bonds in reaction to the low rates triggered by the 2005 reform of pension funds requirements in the United Kingdom.

Another form of public intervention consists in preventing fire sales by the corporate sector under

severe strains in their liquidity position. While economists generally abhor such cartelization activities in general (and rightly so), a case can be made that sellers of assets "over-compete" in periods of liquidity shortages. Namely, the demand curve for these assets (industrial assets or real estate) isn't perfectly elastic. Large sales may lead the price of these assets to plummet, reducing the liquidity available to the corporate sector in bad times. Orderly sales controlled or tolerated by authorities prevent too sharp a drop in the price of the assets; an alternative to avoiding fire sales prices is to offer short-term loans to potential sellers of assets, as in the case of the planned superfund in the US, meant to prevent structure investment vehicles from engaging in fire sales.

A public provision of liquidity may also buy the time needed to proceed to an orderly reallocation of liquidity. Recall that the asymmetry of information about assets increases during recessions. By injecting liquidity, the State may then be able to buy time for the owners of these assets if the latter can use this extra time to convince potential buyers of the assets of their quality.

Finally, we have taken a very normative approach. While the existence of liquidity shortages vindicates the injection of liquidity by the State, there remains a concern that the latter might inject too much liquidity, for several reasons. One, as usual, is capture by those who benefit from an injection at the expense of taxpayers; relatedly, boosting the economy temporarily at a delayed and yet invisible cost may prove tempting. Second, the State, regardless of its benevolence, may be subject to time inconsistency: it may bail out financial institutions who have not properly managed their risk, generating *ex ante* moral hazard.²³ Some of the many tools of aggregate liquidity management (*e.g.* bailouts) are more prone to generate moral hazard than others. Future research ought to provide a better picture of public policy, both in level and in structure.

23 See Rochet-Tirole (1996) for a model depicting simultaneously corporate liquidity management and the "soft budget constraint".

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Liquidity in global markets

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The latest episode of turbulence has been marked by an extended period of illiquidity in a large number of markets –ranging from traditionally highly liquid interbank money markets to the less-liquid structured credit markets. The event began with what was widely perceived as a credit deterioration in the US subprime mortgage market. However, this quickly raised uncertainty about the valuation of securities related to this market, thus affecting their liquidity. The rapidity with which this market illiquidity has been transmitted into funding illiquidity has been both striking and unprecedented.

The event has raised questions about how market liquidity in a variety of instruments is determined in both primary and secondary markets and how mechanisms act to transmit illiquidity across markets during a period of stress. The article seeks to identify how standard concepts of liquidity can be applied to various types of markets across the globe with a view to interpreting how liquidity deteriorated so quickly. Several attributes of liquidity –types of market structures (including existence of formal intermediaries and trading venues), the construction of the instruments, and the types of investors– are used to guide the analysis. One feature that appears to be important for liquidity is the degree to which information about the risks underlying the financial instrument are well understood by both buyers and sellers. Another insight is that the expectations of market participants about liquidity and their ability to monitor it also have an impact on liquidity itself. These attributes suggest that the growth in securitization and complex structured credit products –new developments in the transfer of credit risk– may carry with them a predilection to adverse liquidity events that will require further examination.

In light of the analysis, the article identifies ways of mitigating some of the problems that arose in this latest bout of illiquidity. Because liquidity is created and maintained by the market participants themselves, most of the room for improvement rests with the private sector. It is already clear that some market practices and policies will need to change and in this context some suggestions for enhancements to financial institutions' liquidity risk management are outlined. However, given that both market and funding liquidity are intimately related to financial stability, a public good, there is also a potential role for the public sector. Hence, the tools used by central banks to maintain their role in efficient monetary policy transmission together with financial stability will need to be reviewed.

The latest episode of financial turbulence has highlighted the crucial role of liquidity in global markets. While the turmoil originated in the US subprime mortgage market –initially a credit, not a liquidity event– it quickly brought into question the value of a number of asset-backed securities (ABS) and their related structured credit products that are held by financial institutions across the globe. This uncertainty gave rise to market illiquidity in these instruments and then, given the way that they were being financed, to funding illiquidity. The speed at which the disturbance in market liquidity has been transmitted to persistent dislocations in the interbank market is remarkable and hence requires more thorough analysis. It is already clear that some market practices and policies will need to change. Further, the tools used by central banks, may also require modification in order to strengthen the financial system from shocks of this nature. In light of the relation to the growth in securitization and complex structured credit products, it is an open question whether these types of liquidity events will be more likely in the future –an area that will require further study.

The event was precipitated by a recognition of the extent to which credit standards in the US subprime mortgage market had deteriorated, but quickly transformed itself into funding difficulties for financial institutions that had taken on related securities. In July, rapid declines in traded ABS indices (ABX) and credit rating agencies' downgrades of a number of the underlying ABSs, in some cases by multiple notches, contributed to uncertainty about the extent of credit deterioration and associated valuations. Following these downgrades, the inherent illiquidity of what had been assumed by some holders to be tradable securities became apparent. In particular, those investors that funded the securities held in conduits and structured investment vehicles (SIVs) with short-term asset-backed commercial paper (ABCP) began to question the validity of the underlying business model. As ABCP investors decided not to reinvest their proceeds as the paper matured, the liquidity of the ABCP market dried up, which in turn led to liquidity difficulties for the banks that had agreed to supply back-up contingent credit lines to these entities. The resulting liquidity squeeze in

interbank markets then prompted central banks to inject significant liquidity into short-term markets.

This article examines how, in the light of recent events, market illiquidity can quickly become funding illiquidity.¹ It shows how the use of alternative assumptions about the liquidity of particular assets can have important implications for bank's funding plans. The article attempts to document how, in normal times, liquidity (or the perception of it) appears to be abundant or at least sufficient for markets to function, but in stressful times, markets and products that are not designed with liquidity in mind become unstable and illiquid, precluding normal functioning. A large part of the existing literature tends to emphasize that episodes of extreme illiquidity and liquidity contagion are characterized by mechanisms largely absent during normal times. This article observes how illiquidity in one market can be transmitted to other markets in stressful conditions. Since our knowledge about drivers of liquidity during normal times is much more developed, the analysis provides a promising first start for improving our understanding and management of extreme illiquidity events.

After describing the main drivers of market liquidity, some important global markets are examined for their liquidity characteristics, both before and during the 2007 episode. It is relevant, and not surprising, that the markets for which only imprecise or little data are available on which to assess liquidity are the ones in which uncertainty has been most pronounced. Often, these assets are traded over-the-counter (OTC) rather than on an organized exchange, and the investors that hold these illiquid assets tend to have different time horizons and strategic goals than those that trade in the more liquid, exchange-traded assets.

Lastly, the article provides some guidance for how market structures for various assets may need to be considered in conjunction with their liquidity for markets that are important for financial stability. Information and disclosures are also important elements for determining and tracking market liquidity and anticipating funding liquidity difficulties. Some possible policy suggestions for both the private and public sectors are considered in this context.

¹ A number of recent contributions have studied the relevant transmission channels, both theoretically and empirically. See for example, Acharya (Viral V.) and Schaefer (S.) (2006): "Liquidity risk and correlation risk: implications for risk management," Working Paper, London Business School, and Brunnermeier (Markus K.) and Pedersen (Lasse H.) (2007): "Market liquidity and funding liquidity," NBER Working Papers 12939.

1 | TRADITIONAL CONCEPTS AND DEFINITIONS OF MARKET LIQUIDITY

A market is traditionally considered liquid if an investor has the ability to buy or sell a reasonably sized amount of an asset without appreciably affecting the price. Several characteristics about the structure of the market enhance its liquidity. First, liquidity is likely to be enhanced if information about the asset's value is distributed symmetrically between intermediaries and potential buyers and sellers.² Wide bid/ask spreads set by intermediaries can often be interpreted as reflecting asymmetric information. Second, liquidity is enhanced if the overall amount of the asset available to be purchased or sold is large relative to each investors' desired trading amount. For instance, in equity markets, a higher "free float" available for any buyer or seller to potentially acquire or put on the market increases available liquidity. Third, the price increment between quoted prices is relevant. If trades can only occur at round units, for example, one dollar, as opposed to a cent, then trades will only take place when a threshold half way between the units is achieved by the parties wanting to trade.³ Although at relatively narrow tick sizes, results are ambiguous, under most circumstances, the smaller the price increment, the higher the liquidity.⁴

Another important feature of the market's structure that influences liquidity is how the asset is traded. One element is the existence or absence of a party designated to act as an intermediary –such as a broker, specialist, local, or market-maker– which is typically also expected to provide ongoing price quotes and, sometimes, to hold an inventory of the securities. Another element is how buyers and sellers congregate, either physically or electronically. Exchange trading environments, where buyers and sellers can meet and where well-established methods of recording and publishing prices exist, tend to make it easier for transaction to occur than in OTC markets where pairs of buyers and sellers must find one another to trade.⁵ Many OTC markets have

used technology to improve the ability of buyers and sellers to find each other, but OTC markets still typically lack a formal clearing house that records trades and guarantees the performance of the opposing parties, reducing counterparty uncertainty. Another element of liquidity, immediacy –that is, the ability to find a willing buyer or seller within a short period of time– is also influenced by the existence or absence of an intermediary and the trading venue.

In addition to the characteristics of the markets in which assets trade, the characteristics of the asset itself are also relevant. The more homogeneous or standardized the asset's characteristics, the more likely multiple buyers and sellers will be found. For instance, futures contracts attempt to standardize various features of the underlying asset or commodity in order to attract heterogeneous buyers and sellers. Often the maturity date, a par or notional amount, a specified deliverable item with transparent characteristics, and an established trading unit or "tick size" are all relevant standard features of such a contract. At the other end of the spectrum, a "bespoke" OTC transaction is designed so that the contract is specifically suited for the buyer and seller in a way that personalizes the transaction, in some cases to hedge a specific risk. These transactions are often not intended to be traded in a broader market, but are meant to be held until maturity by the original buyer.

Often, the characteristics of an asset that influence the degree of liquidity are determined at the outset. Hence, the primary issuance of securities is an important determinant of likely liquidity in the future. However, it is important to distinguish between primary and secondary market liquidity because high volumes in primary markets do not necessarily imply liquidity in the secondary market. Particularly, the markets for customized credit derivatives and collateralized debt obligations are highly tailored to meet specific investor needs, which make them rather illiquid in the secondary market. The lack of secondary market liquidity may not be a major problem if the users, often long-term investors, desire the credit exposure and do not engage in active trading. However, an

2 *Glosten (L.) and Milgrom (P.) (1985): "Bid, ask and transaction prices in a specialist market with heterogeneously informed traders", Journal of Financial Economics, Vol. 14 (1), pp. 71-100, and, Glosten (L.) and Harris (L.) (1988): "Estimation of the components of the bid/ask spread," Journal of Financial Economics, Vol 21, Issue 1, pp. 123-142.*

3 *See for example Harris (L.) (1994): "Minimum price variations, discrete bid-ask spreads, and quotation sizes," Review of Financial Studies 7, pp. 149-178.*

4 *Bourghelle (D.) and Declerck (F.) (2003): "Why markets should not necessarily reduce the tick size," Journal of Banking and Finance, 28, pp. 373-398.*

5 *An prominent exception is foreign exchange markets, where OTC spot, forwards and option trades exceed their exchange-traded equivalents.*

investor wishing to unwind or modify a position may have to rely on the initial arranger of the transaction, who may not be willing or able to provide liquidity under stressed market conditions, or may do so only at a significantly depressed price.

In principle, an asset should have embedded in its price a discount that factors in the liquidity risk of holding that asset –the value of liquidity. For very liquid securities this discount is probably so small that it would be difficult to measure it precisely. For other securities, it might be difficult to measure a liquidity risk premium because the security itself is tailored to a particular group of investors making a separate calculation of the discount for liquidity hard to quantify. Most securities are between these two cases, but formal measures of a liquidity premia are still elusive. In the US Treasury market, the yield to maturity of an "on-the-run" issue, relative to bonds of similar, but slightly shorter, "off-the-run" maturity, provides a guide to the degree of liquidity in the Treasury market. In fact, this differential can sometimes be viewed as the "price of liquidity."

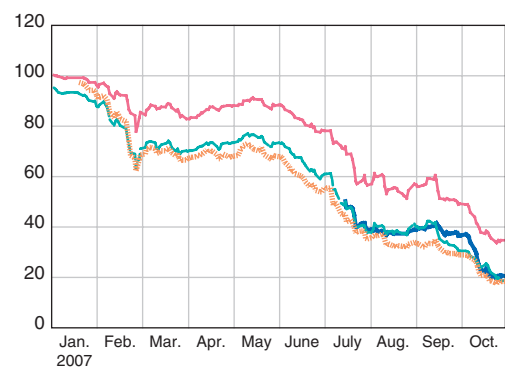
Thus, liquidity is described by a number of elements—the type of asset, the market structure, including the trading venue, and the diversity of the investor base. The value of the various components should be embedded in the price of the asset itself, but it is difficult to separate out this component, either theoretically or empirically.

2 | REVIEW OF LIQUIDITY IN GLOBAL MARKETS BEFORE AND DURING THE STRESS PERIOD IN 2007

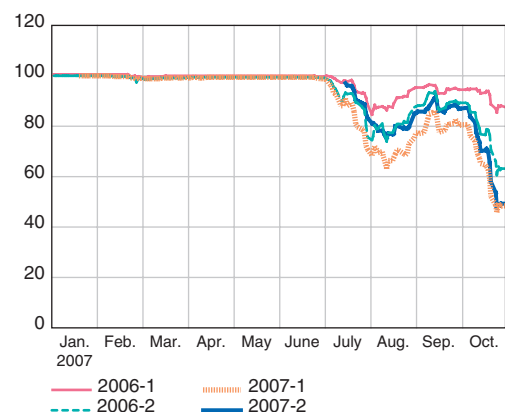
Based on the events that began in July of 2007 and the documented transmission of liquidity across markets, the liquidity characteristics of various markets are now explored. The sequence of events provides important clues regarding how and why the liquidity characteristics of markets matter for financial stability. The concepts presented above are also used to help interpret the changes in liquidity in certain markets.

As explained in the introduction, the first market to be affected by the events was the US asset-backed mortgage market, and specifically those securities backed by subprime loans. Trades in ABS occur in an OTC setting and thus volumes and prices are difficult to observe. In fact, often investors in such securities do not anticipate that they will trade them actively and neither do the arrangers of these assets. Thus, the asset is designed with low future liquidity in mind. Actual transactions in these securities are reportedly low, particularly in the more complex varieties. Such trading was undertaken primarily to make marginal adjustments to portfolios of the more active participants. A proxy market such as the tradable index market linked to credit default swaps in ABS (the "ABX") provides some clues. The volatile and declining prices in these traded indices suggest that they were used instead of the actual illiquid securities to embed the new (negative) information (Chart 1) as it arrived.

Chart 1
ABX price performance
BBB-rated



AA-rated



Source: Bloomberg

As it became evident that the same ABS securities and the structured credit products referencing those securities were likely to perform less well than anticipated, valuations became more uncertain. At first, there were declines in the ABX index and subsequently funding problems of various sorts. Following an admission by BNP Paribas that it was unable to value such securities in its money market funds and rumored difficulties in two banks in Germany, it became clear that a very geographically diverse set of institutions might themselves be holding concentrated exposures to losses on subprime ABS, including in off-balance sheet conduits and SIVs. These entities were being funded by short-term ABCP –another OTC market in which specific types of investors are targeted to purchase buy-and-hold commercial paper for the maturity of the paper.

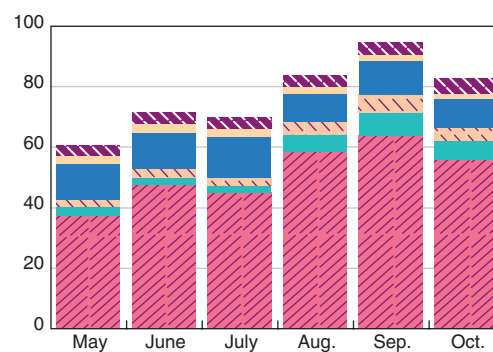
As with the ABS and structured credit market, liquidity of the ABCP market is also difficult to measure. However, one symptom of illiquidity and investor risk aversion was the degree to which the average maturity of the paper issued shortened from August onwards. Maturities of US ABCP range from 1-4 days to over 181 days, with an average maturity of 24 days in May, with some 66 percent held less than 9 days. In the month of August, the average maturity dropped to 18 days and the proportion with less than 9 days to maturity rose to 79 percent. Some normalization has occurred, but, as of October, the average maturity was still lower than prior to the disruption. The following chart shows the issuance at various maturities before, during and as of this writing (Chart 2). It is also notable that the amounts outstanding of the ABCP, where uncertainty about what backs the commercial paper is still present, have declined steadily (Chart 3) indicating funding liquidity using ABCP is still impaired.

Following the reluctance of ABCP holders to roll over their paper, or the requirement of higher yields and shorter maturities to do so, SIVs and conduits met their funding shortfalls by calling on contingent bank credit lines. Simultaneously, banks were warehousing more mortgage and leveraged loans than anticipated, due to the suspension of most transactions in the mortgage-related ABS markets and collateralized loan obligations (CLOs), while respecting liquidity commitments that had been made to other entities also under liquidity strain –hedge funds, CDOs, and other banks. This unexpected system-wide call on funds tightened the interbank market and caused a funding liquidity squeeze.

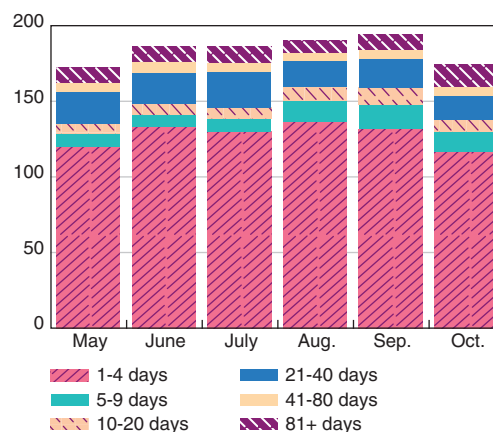
Chart 2
New issuance of asset-backed commercial paper in May-October 2007

(USD billions)

AA-rated



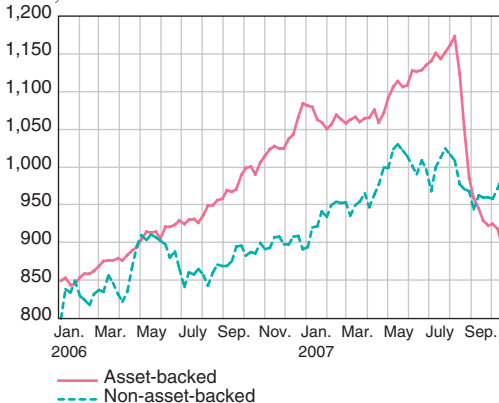
Total market



Source: Board of Governors of the Federal Reserve System

Chart 3
US commercial paper outstanding

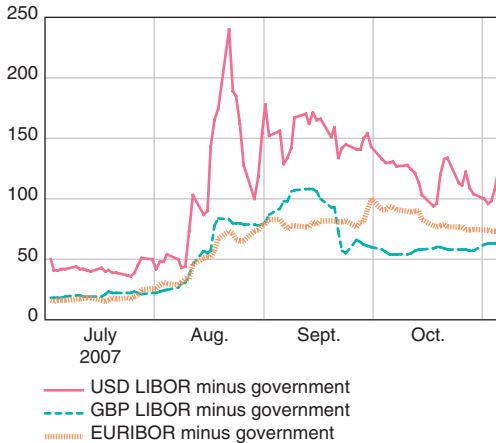
(USD billions)



Source: Board of Governors of the Federal Reserve System

Chart 4
Flight to quality

(in basis points on 3-month term)

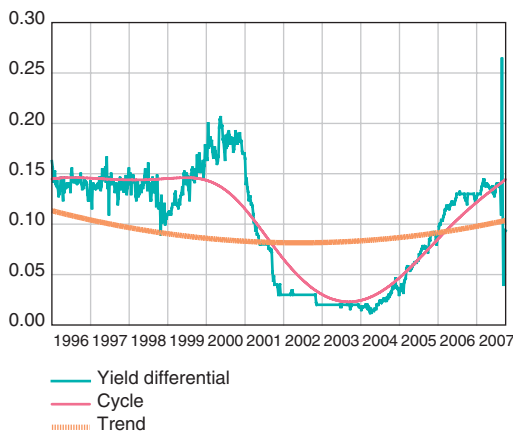


Source: Bloomberg

The illiquidity in the interbank markets can be measured in a number of ways. The most dramatic indications of difficulties were in the widening of various spreads –the spread between T-bills and Eurodollars –the TED spread– widened to extreme levels. Similar spreads in other currency markets also widened dramatically (Chart 4). While such widening can be an indicator of both credit and liquidity risk, the extreme nature of the observed moves suggests that liquidity in interbank markets was impaired. The flight to quality, and to more liquid markets, is also demonstrated by the wild gyrations in the differential

Chart 5
Yield differential of off-the-run/on-the-run US three-month Treasury bonds

(%)

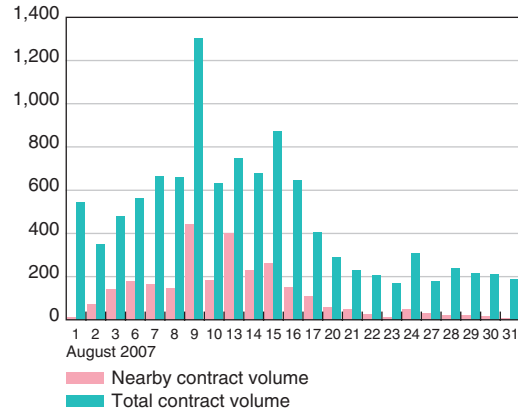


Sources: Bloomberg and IMF staff estimates

6 See Hegde (S.P.) and Paliwal (R.) (2005): "Financial contagion and market liquidity –evidence from the Asian crisis", February 23. The authors show that market liquidity dries up for both exposed and unexposed firms, but more forcefully for those entities that were more liquid and less risky during the pre-crisis period, suggesting that forced margin sales are at play.
7 See Khadani (A.E.) and Lo (A.W.) (2007): "What happened to the Quants in August 2007?", September, Working Paper, Massachusetts Institute of Technology Sloan School of Management, Cambridge, MA 02142.

Chart 6
30-day Fed Funds futures volume

(thousands of contracts)

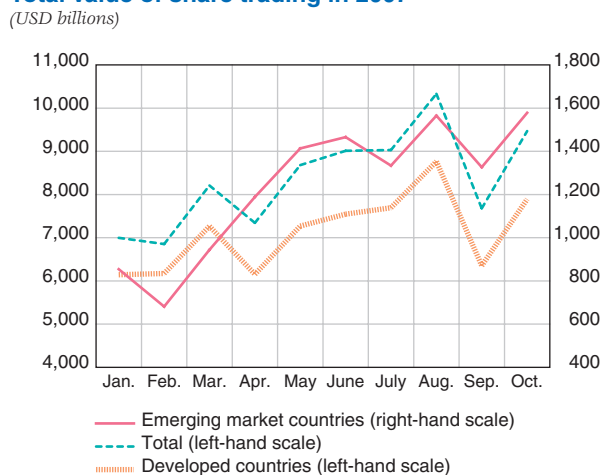


Source: Chicago Board of Trade

between less frequently traded (off-the-run) and more frequently traded (on-the-run) 3-month US Treasury bills (Chart 5). The US Fed Funds futures contract also witnessed a rise in volume as this market was easily accessible and liquid. Daily average volume doubled in the Fed Funds futures contract during mid-August when markets were most in distress (Chart 6). The OTC nature of the interbank market makes the level of activity difficult to analyze, but participants in the market expressed concern about whether quotes for term interbank lending (1- and 3-month maturities) on electronic screens could be relied upon as valid given the lack of trading activity.

The squeeze in interbank markets added to tight market liquidity conditions that had already been developing in July. Following the spike up in volatility of many markets, rising margin requirements meant that hedge funds and others subject to margining agreements –especially those that held ABS and structured credit products– attempted to offload some of these specialized securities. When they found this to be difficult, they began to sell other, more liquid, parts of their portfolios to meet margin calls and redemption requirements. In many cases, these more liquid instruments were exchange-traded equities in developed economies. In this way, liquidity spillovers were then witnessed first in the most liquid markets.⁶ Early analysis suggests there were fire sale liquidations of similar hedge fund portfolios that had been quantitatively constructed.⁷ Overall, nearly all

Chart 7
Total value of share trading in 2007
(USD billions)

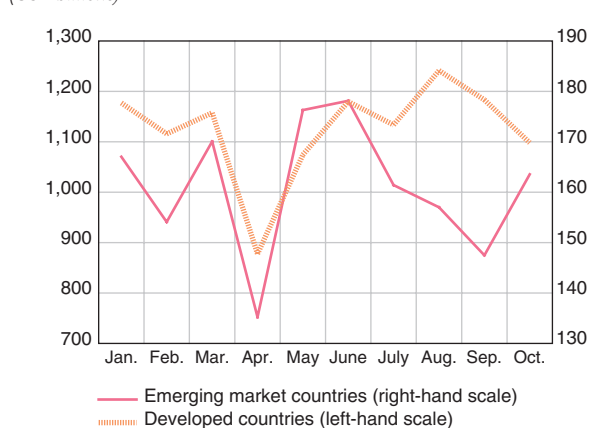


Source: World Federation of Exchanges

developed and emerging market equity markets saw their volumes reach their peaks in August (Chart 7). The United States experienced both high volumes and numbers of trades.

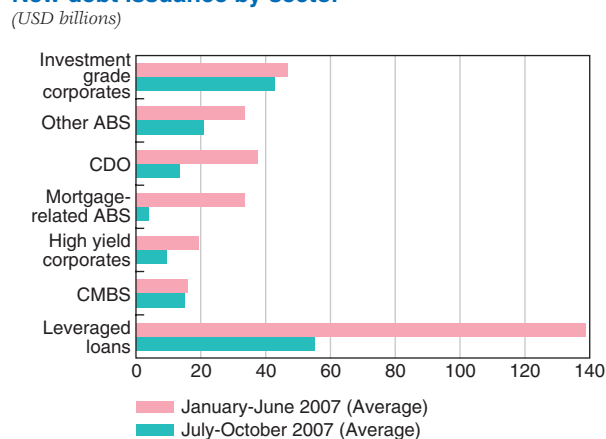
In bond markets, known for somewhat lower liquidity than equities, there was a move toward safe assets but the movements in volumes were more subdued. Volumes in the associated futures contracts, where they exist, increased, but, overall, the value of developed countries' bonds that traded increased only 9 percent from July to August. Anecdotal evidence suggests that securities viewed as risky, complex, or illiquid became more illiquid, while those with highly standardized features were traded more frequently. Measures of emerging market bonds activity show a gradual decline from June through September (Chart 8).

Chart 8
Total value of bond trading in 2007
(USD billions)



Source: World Federation of Exchanges

Chart 9
New debt issuance by sector
(USD billions)



Sources: Lehman Brothers, JPMorgan, and Bloomberg

When secondary markets experience reduced liquidity, issuance in the primary market invariably shows signs of stress, particularly, but not exclusively, those related to short-term funding markets. In the most affected markets, the decline in issues was striking (Chart 9). In the ABCP market, for instance, the decline in issuance has not yet abated. Even non-asset backed CP suffered a temporary drop in issues outstanding. Issuance of equity has also slowed in mature markets even though the price dips were relatively mild and short-lived (Table 1). Uncertainty regarding pricing and the higher cost of capital have made raising equity capital less attractive. Uncertain future prospects led investors to apply a higher discount to future cashflows, resulting in a decline in the fair value of equities. Equity issuance in emerging markets, where prices remained generally buoyant, took a hit in August and September, but appear to have recovered quickly.

In mature economy corporate bond markets, where issuance had been quite robust during the first half of 2007, issuance virtually stalled in July and August. However, since then, both US high grade and high-yield corporate issuance has recovered (Chart 9). Leveraged buyout (LBO) activity is strongly influenced by the willingness of lenders and investors to finance leveraged corporate acquisitions –willingness which is quite sensitive to the deal's characteristics and current market conditions. Hence, LBO activity also froze in July and August as investors became more conservative. Prior to July, the issuance of borrower-friendly "covenant-lite" leveraged loans had reached new highs (Chart 10). Issuance of leveraged and syndicated loans then

Table 1
Capital raised by shares (IPOs) in 2007

(USD millions)

	January	February	March	April	May	June	July	August	September	October
Developed countries										
United States	5,682.9	11,151.2	5,087.2	6,201.4	8,787.0	11,060.8	7,757.0	4,985.0	876.0	5,094.4
United Kingdom	295.9	3,311.8	7,830.5	2,809.7	11,313.4	...	8,504.6	2,339.1	205.7	1,793.2
Emerging market countries										
Brazil	1,116.6	878.3	1,456.6	2,079.3	620.8	2,833.5	6,379.3	584.1	280.8	12,322.9
Colombia	...	30.5	4,210.0	30.9	33,762.8
India	1,917.5	1,124.2	203.9	296.4	342.8	5,505.1	3,387.2	1,445.4	188.9	1,055.3
Hong Kong	31.9	1,030.2	1,497.8	7,485.9	1,882.0	615.8	4,776.7	489.1	2,539.7	5,779.6
Korea	278.4	211.6	...	468.1	97.6	765.2	543.3	256.9	328.0	85.0
China	4,200.2	2,464.9	5,332.9	2,874.1	3,433.8	2,099.9	2,387.3	1,018.2	10,968.0	8,978.7
Singapore	24.1	261.6	296.1	926.5	268.4	152.9	393.3	738.4	96.2	...
Poland	163.5	52.7	55.9	55.9	3,984.4	...	392.4	60.2	66.7	100.6

Source: World Federation of Exchanges.

fell sharply from their Q2 highs. Existing leveraged loans subsequently suffered price declines, typically trading 5-7 percent below previous highs, inhibiting further issuance.

Issuance of structured credit products associated with US mortgages suffered the most. Following robust growth from 2002 to mid-2007, the construction and distribution of complex structured credit products has all but come to a halt. Some collateralized debt obligations (CDOs) have been issued, but mortgage-related asset-backed security issuance has not recovered. Demand for more complex structures, such as CDO-squared and similar products, has disappeared. The tradability of existing structured securities was never meant to be a valued characteristic. Thus, the amount outstanding was mostly reflecting strong final demand for the

product. Now that their valuation is far from certain, the ability to trade ABS and associated products is even further impaired. The lack of liquidity has proved problematic for various financial firms to value them, or to remove them from their balance sheets following ratings downgrades.

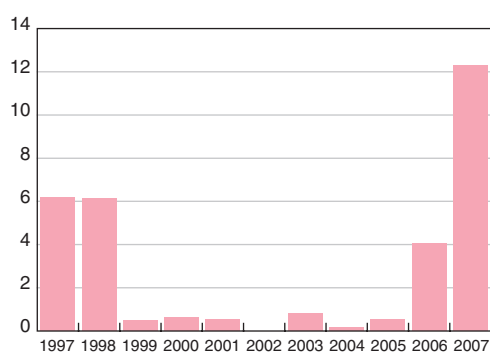
3 | INTERPRETATION AND DISCUSSION

From the data at hand, it is evident that an important feature leading to market illiquidity in this event has been asymmetric information and a lack of transparency regarding the securities that have been suspected of losing value. While much of the evidence is provided by volumes and spread data, which are indirect measures of liquidity, it is evident that markets that have the most informational uncertainty have been the most illiquid in this event. For instance, bank exposures to their SIVs and conduits, and the degree to which they may be required to take on assets from these entities, has disrupted interbank markets. For a time, banks were unwilling to lend to each other at anything but very short-term maturities, overnight to one-week, without knowing more about the risks involved and their own imminent liquidity needs. Questions about counterparty insolvency have also kept interbank markets illiquid.

While the interbank market is probably the most obvious case where a lack of information impeded market and funding liquidity, the absence of fundamental

Chart 10
Number of covenant-lite loans to total number of institutional term loans

(%)



Note: In 2007, data refers to the first half of 2007.

Source: Standard & Poor's, *Leveraged Commentary & Data*

information about how to price various structured credit products was also responsible. While traditional mortgage-backed securities, such as those issued by Freddie Mac and Fannie Mae are highly liquid, other structured credit products are very illiquid –how they are constructed shows that information and security design (matching the security to the ultimate holder) together influence market liquidity. For instance, the more bespoke the transaction, regardless of the transparency of the underlying information used to price it, the more illiquid it is likely to be. Securities based on well-established indices or reference securities are more liquid than those that are not. Similarly, the easier the structure is to understand the more likely it will be to be traded or valued without large bid-ask spreads. For most structured credit products, the high uncertainty surrounding their current value has many holders attempting to keep the securities, hoping uncertainty will be resolved, prices will stabilize at higher levels, and the ability to sell these instruments will improve, as funding liquidity returns to the system.⁸

Another factor leading to the lack of market liquidity is the trading venue. OTC markets allow buyers and sellers to satisfy very specific demands for the types of products they desire, but this positive aspect becomes disadvantageous if the investor wants to hedge or remove the asset from the balance sheet. In this event, some market participants moved to exchange-traded or more liquid index products to hedge the risks of the OTC structured products that they could not exit. Exchange-traded assets did not experience the large dip in liquidity that OTC markets appeared to have sustained and some, in fact, saw large increases in volume, though lack of OTC data makes the claim of differential liquidity difficult to verify.

The fact that historic information about trade size and frequency is so difficult to obtain for OTC markets, inhibits researchers and risk officers from developing realistic liquidity management contingencies. This need not be the case. The electronic trading systems accompanying trading in many securities, such as US Treasuries and exchange rates where brokers are present, provides the wholesale market participants with sufficient information to judge liquidity in real-time. Hence, in today's electronic trading environment, the information could be made available from OTC markets to study liquidity more rigorously.

Before examining policies that could influence market liquidity, it is important to assess the benefits and costs of developing the liquidity of a market. Many market participants and policymakers start from the position that policies should strive to make financial markets as liquid as possible. However, the needs of market participants, including their desires for product specificity, and the public "good" of liquidity need to be weighed in any policy actions.

Generally, liquidity develops in markets as more participants with differing views take part in them, demanding immediacy and finer pricing, suggesting private markets will produce the amount of liquidity demanded by the participants. That is, liquidity demands are endogenous to the development of markets themselves. For instance, when market participants decide more standardized financial products are desirable, collaborative associations are formed to move in this direction. The International Swaps Dealers Association (ISDA) is an obvious example –when the swaps market was immature, contracts were negotiated in pairs, but after a period of time, ISDA was established to standardize contracts and make swaps more tradable. If securities are used as collateral, liquidity aids assigning prices and supports the liquidation of collateral if performance of the counterparty is impaired.

However, in addition to these private sector considerations, there is also a public component to liquidity that benefits the broader objective of financial stability. Markets may be less likely to become unstable if they are liquid –price changes may be less abrupt or large and thus less likely to overshoot or display non-linear reactions. If systemic events do take place, liquid markets can allow a smoother unwinding of securities of bankrupt entities than if the securities are illiquid, thus permitting a financial system to recover more quickly.

There are several ways to increase liquidity that can be explored. Encouraging standardization by promoting working groups to provide benchmark characteristics or standardized financial instruments is one way. Making sure that regulations do not penalize exchange trading environments in relation to OTC environments would help level the playing field and make exchange trading more likely to develop. Allowing less liquid securities, or those denominated in other currencies, to be used as

⁸ The M-LEC structure promoted by Citigroup, Bank of America, and JPMorgan Chase has been designed with this notion in mind.

collateral at central bank lending facilities or in other contexts could also improve liquidity conditions.

As is clear in this episode, complexity, inadequate information and disclosure can make markets more illiquid than they would be otherwise. Thus, policies that improve transparency –reducing asymmetric information between potential buyers, sellers and intermediaries, such as brokers, market-makers, and specialists, can improve market functioning. Information can be improved at several levels: first, underlying information about the risks of the securities being traded would allow more granular pricing and lower bid-ask spreads; second, information about the market functioning itself, including recent traded prices, volumes, and trade sizes, could reduce uncertainties about the trading environment; and third, information about counterparty financial health could help in OTC environments where trading illiquidity is exacerbated by uncertainty over counterparty creditworthiness. It is notable that recently many institutions have attempted to disclose more about their exposures and businesses, knowing that uncertainty can raise their funding costs. On the other hand, too much disclosure at a time when markets are jittery can be counterproductive. Thus, if more disclosure is to be introduced, careful consideration as to its timing is warranted.

Each of these elements was in some way impaired during the latest crisis. Risks underlying complex structured credit products were difficult to grasp and price, in part due to insufficient information provided by structurers and rating agencies. For instance, the chances of multiple notch ratings downgrades were not well documented or understood. It was also clear that some markets did not function well because market participants themselves did not know whether quoted prices represented a true willingness to trade or just a place-holder designed to elicit others' agreement to a trade. Without some measure of trade size, price quotes are always difficult to interpret. Information contained in post-trade reporting requirements should allow for a reasonable delay, since real-time data on trades can sometimes alter the price dynamics through

strategic behavior to the detriment of participants initiating the trade. Financial institutions continue to be very cautious in lending funds to each other. Further information about the size of counterparty exposures, losses, and future prospects are needed to reduce concern over hidden exposures and so facilitate the resumption of trading.

Although work is still ongoing, a set of policies for better liquidity risk management within financial institutions is needed. A few obvious points can be made already. The first is that institutions should have a better understanding of the potential illiquidity of their assets in a crisis. Some did not appreciate how illiquid some of their assets were relative to their liabilities, nor did they adequately anticipate that they may need to take illiquid assets back on their balance sheets. After observing various kinds of asset liquidity, stress tests that anticipate either wider bid-ask spreads or longer potential holding periods should be considered. One solution to the liquidity squeeze is to hold more liquid assets and better match the liquidity characteristics of their assets and liabilities. In part, matching maturities of various assets would help, but this may be insufficient since maturity is not synonymous with liquidity –some short-term assets are illiquid while some long-term assets are liquid. Diversifying sources of liquidity is also advisable. As Northern Rock illustrated, relying predominantly on wholesale markets for marginal funding can be problematic at times of systemic stress. While capital is not a panacea for liquidity difficulties, having more capital can help to slow down a process whereby illiquidity leads to solvency difficulties. Counterparties may be more tolerant of providing liquidity to institutions they know to have sufficient capital.

Another line of inquiry for policymakers would focus on how central banks interact with those to whom they provide emergency liquidity support and inject liquidity. Issues of the market liquidity of the collateral, the composition of the collateral, and the types of counterparties through which central banks provide emergency liquidity support can all be usefully reexamined.

In sum, a predominant feature of this latest episode is the degree to which market illiquidity was transformed into funding illiquidity. Further analysis of the aspects of market illiquidity that were most problematic and the ways in which it links to funding illiquidity will be needed to form concrete policy recommendations. Surely, some of solutions to liquidity difficulties are in the hands of the private sector. Given the systemic nature of possible liquidity disruptions, an ongoing dialogue between the private and public sectors on how best to balance private interests with those of financial stability will be important.

The impact on financial market liquidity of the markets in financial instruments directive (MiFID)

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The Markets in Financial Instruments Directive (MiFID), which entered into force on 1 November 2007, implies the abolition of the concentration rule regarding equity transactions so far in force in France. This rule, which was applied to varying degrees across Europe, resulted in the vast majority of order flow being concentrated in regulated markets, and notably in Euronext Paris for shares listed on the French stock exchange.

Over the coming years, order flow will become fragmented de facto as a result of being able to execute client orders on regulated markets as well as on multilateral trading facilities (MTFs), and by use of systematic internalisers (SIs), which act as counterparties for transactions in the same way as market makers on price-driven markets such as the London Stock Exchange (LSE) or Nasdaq.

The competition between trading venues, which will be enhanced at the European level, has steadily been increasing since the 1970s. Since then, alternating series of regulations and technological progress have gradually weakened the monopolistic position of national regulated markets. The impact of this phenomenon has been a continuous fall in transaction costs, benefiting investors and issuers of securities through a drop in the cost of capital. However, the fragmentation of order flow stemming from a proliferation of trading venues may raise concern about a reduction in market liquidity and a slowdown in the decline in transaction costs, which would run counter to the competitive effect between systems sought by the European regulatory authorities.

Although the most conservative medium-term scenarios point to continued dominance by regulated markets, we estimate that in the case of France, a very significant share of order flow may rapidly be executed on alternative trading systems. Here, we focus on the impact on “wholesale” transactions, i.e. transactions of at least EUR 50,000, which we attribute to institutional investors. In particular, we identify the portion of these trades currently executed outside the order book. According to our estimates, these transactions constitute roughly 10% of the traded volume on CAC 40 shares and that may be lost to the regulated market each year. This volume, which would more or less equally be distributed between SIs and MTFs operating crossing systems, only constitutes a fraction of the total volume of the wholesale market.

The article is organised as follows. Section 1 presents the main drivers for competition between stock markets over the past 30 to 40 years. It describes in greater detail what constitutes the major issue over the coming years in terms of opening up to competition in Europe, i.e. MiFID, and addresses the economic implications of the new regulations. Section 2 proposes, for the most liquid shares on Euronext Paris, a preliminary estimate of wholesale order flow, i.e. block trades, which do not contribute to the price discovery process as they are currently executed outside the order book, and which could be executed on alternative trading facilities in the medium term.

NB: This document reflects the personal views of its authors and does not necessarily represent those of the Ministry of the Economy, Finance and Employment. The empirical analysis presented in this article was possible thanks to access to the Autorité des Marchés financiers (AMF – Financial Markets Authority) database. The control and the analysis of the data and the conclusions drawn from the latter remain entirely under the responsibility of the authors and the AMF is in no way responsible.

1 | DEVELOPMENT OF COMPETITION BETWEEN TRADING VENUES

1|1 Developments since the 1970s

Competition between stock markets has been increasing since the 1970s as a result of deregulation and technological progress, which have alternated in an almost cyclical fashion.

Initially, the regulatory authorities gave the necessary impetus to the opening-up and development of competition in securities trading, both in terms of the stock markets themselves, which generally were originally state-owned monopolies, and the intermediaries (brokers, banks, etc.).

In the United States, the deregulation of financial markets began in 1975 with the elimination of fixed commissions on stock market transactions, while this shift occurred later in Europe. The London Stock Exchange implemented the same type of reform in 1986 (the "Big Bang"), followed by the *Société des Bourses françaises* in 1989. In Europe as a whole, the 1993 European Investment Services Directive definitively placed trading activities in a competitive framework by putting professionals in charge of the functioning of markets.

Changes in the activities of traditional stock markets and, to a certain extent, the opening-up of foreign markets, have also fostered competition:

- Traditional stock markets have seen their role confined to providing price discovery, which is a role open to strong competition. The dematerialisation of securities (in France, the process, initiated in the late 1970s, became effective in 1984) considerably reduced the role of institutions that had controlled the whole chain of securities transactions from listing to clearing and settlement.
- The economic environment enabled investors and issuers to access foreign markets and to

develop trade-off between equity markets. With the lifting of foreign exchange and price controls in the 1970s and 1980s, investors, particularly institutional investors, were able to broaden their international portfolios, while in Europe, the introduction of the euro made easier comparisons between companies in different countries. These two factors had a positive impact on competition between stock markets that had previously mainly served a domestic market.

The opening-up to competition led to major innovations in the sector and the emergence of players making use of new technologies. Stock exchanges sought to streamline their functioning, in most cases opting for electronic systems, which are less costly, substantially reduce human intervention, increase the capacity for processing orders and decentralise transactions, thus removing the need for physical presence in a dedicated building (closure of the Paris stock market's Palais Brongniart in 1998 after the Matif's switch to electronic trading).¹

Today, the United States is virtually the only place where trading floors still exist (NYSE, CBOE, CME, etc.). The development of electronic systems on the securities trading layer was also reinforced by the arrival of new players in the form of alternative trading systems (ATSSs), including electronic communication networks (ECNs), which heightened competition among regulated markets.

In order to obtain the necessary financing from private agents to develop electronic trading systems,² stock exchanges changed their capital structure, first *via* "demutualisation", thus opening up their capital, initially held by their own members, and second, by becoming profit-making companies, a number of these exchanges were listed on their own exchanges, enabling them to further diversify their holding structures. In 2001, the leading European stock exchanges (Euronext, Deutsche Börse, LSE) were listed on their own Bourse. This trend has continued elsewhere, with the NYSE going public in March 2006 and plans to go public by the Borsa Italiana and Bolsas y Mercados Españoles (BME). According to IOSCO,³ at the end of 2005, 16 stock exchanges

1 In France, the CAC was launched in 1986 along the lines of the Canadian CATS system set up in the 1970s. Generally speaking, electronic systems were introduced in the mid-1990s (1995 in the case of Peru and India, 1996 for Mexico, South Africa, Luxembourg, Malta and Switzerland, 1997 for Germany, Brazil, Israel, 1998 for Hungary, 1999 for Austria, Tokyo, etc.).

2 The London Stock Exchange and Deutsche Börse both spent over USD 100 million to implement their respective electronic systems, Sets and Xetra (see Domowitz and Steil, 1999).

3 IOSCO Consultation Report: "Regulatory issues arising from exchange evolution", March 2006. The International Organisation of Securities Commissions (IOSCO) brings together the market regulators of 27 countries.

trading fees by 30% in response to the launch of the new competitor Dutch Trading Services.

The situation is likely to change with the application of MiFID, leading to the abolition of the concentration rule and increased competition among regulated markets and other alternative facilities.

MTFs are the alternative facilities which organise the multilateral matching of third-party buying and selling interests like most regulated markets. MiFID also recognises "systematic internalisation", meaning that investment firms act as intermediaries executing orders they receive from clients against their own book or against orders from other clients. By publishing continuous firm quotes for some equities, and the size at which it quotes, the bank sells/buys the securities when one of its clients sends a buy/sell order.

The future regulation establishes an overall operating framework ensuring the smooth functioning of the market and enhancing investor protection. In particular, it sets out a number of rules providing obligations in terms of transparency and quality of order execution:

- The "best execution" principle is defined as the obligation for intermediaries to make reasonable efforts to obtain the best possible result for their clients when executing orders. MiFID introduces a "multi-criteria" approach towards order execution conditions, defining the key aspects that the investment firm (IF) must take into account to ensure that they may obtain such a result, be it price, costs, speed and likelihood of execution and settlement, size, nature of the order or any other factor related to the execution of the order.⁵ In contrast, when the investment firm executes an order on behalf of a retail client, the best possible result is simply determined on the basis of the total costs.⁶ The latter mainly concerns SIs.

- Pre-trade transparency obligations require that regulated markets and MTFs publish quotes for listed

securities, on a continuous basis, during normal trading hours. SIs are subject to this rule only for "liquid"⁷ securities of below "standard market size".⁸ Post-trade transparency obligations require that all these market players publish transaction information (price, volume, time) after execution.

In comparison with the system in place in the United States (see Appendix 1), European regulation provides a stricter framework aimed at limiting the development of private trading systems described as opaque in the United States, or "dark pools of liquidity", which may erode liquidity on regulated markets and lead to a duality of investor classes. In particular, US pre-trade transparency obligations do not apply across the board, since the rule that requires an electronic system to publish a quote if it exceeds 5% of the traded volume in a security has been subject to exemptions (Liquidnet was granted an exemption).

Moreover, MiFID's best execution requirements are based on the rules gradually implemented on the NYSE in 1981 (the "trade-through rule") and on Nasdaq in 1997 (the order handling rule). However, the European regulation has the advantage of taking account of the transaction's various components. As it is limited to the price criterion, its counterpart in the new US regulation, Reg NMS (an extension of the trade-through rule) makes reconciling the needs of retail and institutional investors difficult. The latter will naturally seek to prevent their large orders from being executed against those of small investors (which would have an unfavourable impact on prices) by using dark pools of liquidity.

In theory, the "opacity" of these new systems affects the price discovery process, which no longer includes transaction data captured by these systems. Nevertheless, the use of algorithmic trading, which enables investors to track several trading systems around the clock, may limit the effects of fragmentation, although such strategies are not accessible to all investors.

⁵ Article 21 of Directive 2004/39/EC of 21 April 2004.

⁶ Article 44 of Directive 2006/73/EC of 10 August 2006.

⁷ A share admitted to trading on a regulated market shall be considered to have a liquid market if the share is traded daily, with a free float of not less than EUR 500 million, and if one of the following conditions is satisfied: the average daily number of transactions in the share is not less than 500; the average daily turnover for the share is not less than EUR 2 million (see Article 22 of Commission Regulation (EC) No. 1287/2006).

⁸ This threshold depends on the average value of orders executed (see Article 23 of Commission Regulation (EC) No. 1287/2006).

1|3 The economic implications of the new regulations

Financial market trends have implications beyond the financial sector alone, insofar as an improvement in price discovery or an increase in competition in this sector would lead to a reduction in the cost of capital for listed firms. The latter could be achieved directly, *via* a reduction in transaction costs, which increases the net gains expected by the investors buying the securities. Thus, all things being equal, these investors would have to do with lower gross return. A decrease in the cost of capital may also result from a reduction of barriers to cross-border investment (decrease in the "home bias" leading to an improved diversification of investments).

Economic gains stemming from a decrease in transaction costs may be substantial. Taking into account the current degree of automation of trading systems in Europe, Domowitz and Steil (2002) demonstrate that transaction costs could drop by 50% in the euro area (thanks to a reduction in explicit costs alone) which, taking account of the elasticity of the cost of capital, would make it possible to reduce the cost of capital for companies by almost 8%. For France alone, a 10% decline in the cost of capital (*i.e.* around 80 basis points) would, according to the Treasury and Economic Policy General Directorate's (DGTPE) *Mésange* model, result in a 0.3% rise in GDP at the five year horizon, meaning that the economic impact would be significant.⁹

"Explicit" transaction costs can be estimated from the investor's point of view by calculating the overall direct transaction costs buying or selling a security. These costs depend particularly on the organisation of the market, as well as on competition among IFs, which is contingent on how restrictive regulations are, and on taxation. In Paris, these costs can be obtained by referring to the advice of execution following each transaction, which lists the commission fees, VAT and stamp duty.

In addition to these expenses, *indirect costs* are related to the order execution conditions. These costs, known as "*implicit*", are less easy to estimate

and reflect market "liquidity".¹⁰ In practice, at least two components must be taken into account:¹¹ the difference between an asset's ask price and its bid price (the liquidity provider is compensated and earns income through the "*bid-ask spread*") and the transaction's impact on prices (the larger the order and the shallower the market, the greater the transaction's impact on prices).

The overall impact of the new regulations (e.g. Reg NMS and MiFID) on transaction costs introducing competition among the different trading venues remains uncertain, as numerous mechanisms may be involved and may affect the market quality:

- *By introducing competition among the different players, order flow fragmentation could lead to downward pressure on both direct and indirect transaction costs. Competition among liquidity providers leads to competition for the provision of best bid and best ask prices, while competition among the various trading venues reduces the monopoly rent which comprises, among other, access fees, and encourages the trading systems to innovate in order to reduce costs (Hamilton, 1979). An improvement in liquidity was indeed observed following the setting up of dual listing both on the London and Paris stock exchanges (traded on London's SEAQI) at the beginning of the 1990s of the most liquid shares on the French Bourse (Hamet, 1998).*

However, *order flow fragmentation between several trading systems should in theory mechanically result in reduced liquidity* in the original market. According to the age-old rule "liquidity begets liquidity", order flow consolidation should improve market quality whereas the opposite is true of order flow fragmentation. The coexistence of several competing markets is not viable; since investors are attracted to the most liquid market, the other markets should eventually close (Mendelson, 1987). Although this conclusion remains highly theoretical, and does not take into account a number of opposite effects discussed in this section, it does not detract from the fact that the internalisation of part of the order flow has a negative impact on liquidity if these orders no longer participate in the process of price discovery.

⁹ For an assessment of the impact at the European level, see the report ordered by the European Commission (2002): "Quantification of the macro-economic impact of integration of EU financial markets", London Economics.

¹⁰ For a more detailed explanation of market liquidity, see Bervus (2006).

¹¹ Ideally, the time factor should be taken into account (speed of order execution), though the most measures available at present only include the two factors mentioned above.

• The coexistence of several competing trading systems, with distinctive operational characteristics, should help to fulfil the heterogeneous needs of the various types of investors (in terms of cost, execution times, order size, etc.). The coexistence of several markets is therefore theoretically possible if the most liquid market is also the most expensive, thus attracting the largest market players, as is the case for the block trading market (see Pagano, 1989). The heterogeneity of investor preferences is confirmed by the Institutional Investor's annual survey of traders working in fund management companies.¹²

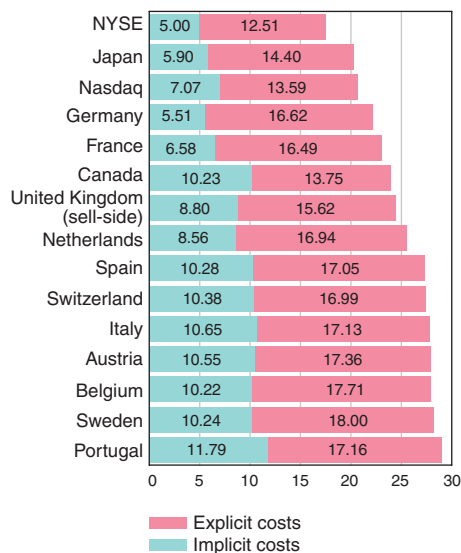
Conversely, order leakage could cause market quality to deteriorate. This would notably be the case if SIs skewed the nature of order flow by attracting "uninformed" clients on whom they make a profit ("cream skimming"). In theory, uninformed investors are indispensable to the price discovery process. To remove such investors from the main market would lead to a deterioration of market quality, with liquidity providers widening quoted bid-ask spreads when they find better-informed agents.¹³ This would have an impact on internalised orders which would in turn be more expensive as they are based on market prices.

Beyond these general arguments, it must be borne in mind that the effects of order flow fragmentation can differ greatly according to the security being dealt. An asset's initial liquidity (in terms of traded volume, bid-ask spread, etc.) is a key factor. According to Bennett and Wei (2006), the less liquid the security, the greater the impact of increased fragmentation on the volatility of a security's price and the transaction costs.

The Elkins-McSherry analysis of equity transaction costs confirms how difficult it is to anticipate the impact of regulations. During the period from June 2005 to July 2006, stocks listed on the NYSE, on the Nasdaq and the Japanese stock exchanges recorded the lowest transaction costs, with France in fifth position behind Germany. The UK ranks seventh if the sell side of transactions alone is taken into consideration.¹⁴

Figure 2
Breakdown of average transaction costs between July 2005 and June 2006

(in basis points)



Source: Elkins-McSherry

In the case of Germany, fragmentation seems to have resulted in a low market impact and high commission fees, contrary to certain theories previously highlighted in this paper. Competition is established in Germany both within the regulated Deutsche Börse's dual system (where the electronic system Xetra¹⁵ competes with the floor trading of the Frankfurt Stock Exchange), between the main regulated market and the seven small regional stock markets (Düsseldorf, Munich, Hamburg, Hanover, Stuttgart, Berlin and Bremen), and due to the option to opt out of the concentration rule (this option allows 50% of traded volume to be executed outside the regulated market).

All in all, Germany is well-positioned in terms of liquidity, which seems to indicate that fragmentation has not caused market quality to deteriorate.¹⁶ In contrast, Germany has relatively high direct costs (16.24 bp) while the vertical structure of the Deutsche Börse, which also controls clearing and settlement, should enable significant economies of scope to be achieved.

¹² Elkins-McSherry ranks securities trading systems according to the overall quality of order execution services. It appears that institutional investors prefer electronic systems to traditional stock exchanges. Traditional stock exchanges (Nasdaq and NYSE) rank last, behind electronic systems (ECNs and crossing networks).

¹³ This is referred to as the "adverse selection component of the bid/ask spread" (see Kyle, 1985).

¹⁴ Stamp duty is systematically charged on acquisitions, which brings the fees component to 49.91 bp, compared to 0.52 bp for sales. As a result, in reality, the UK stock market ranks far below the other leading stock markets.

¹⁵ Xetra has a market share of between 92% and 97% of transaction volumes on the DAX and the MDAX, see Factbook 2005, Deutsche Börse AG, p49.

¹⁶ Another explanatory factor appears to be the very small tick size (EUR 0.001 for securities of between EUR 0.001 and 0.249 and EUR 0.01 for securities of over EUR 0.25).

2| EMPIRICAL ESTIMATE OF POST-MiFID ORDER FLOW FRAGMENTATION

2|1 The post-MiFID landscape is difficult to predict

It is difficult to form a clear picture of the European stock market landscape in the medium term (three to five years). A number of major potential scenarios emerge, but no single hypothesis dominates. For instance, although the current models are fairly heterogeneous in Europe, notably due to the differences in the application of the concentration rule (see Section 1|2), regulated markets predominate in terms of market share thanks, most often, to the efficiency of fully automated systems. Contrary to what has been observed in the US since the early 1990s with the launch of Electronic computer networks (ECNs), competition based solely on new technology would therefore not be possible.

In Europe, due to the technological advantage of regulated markets, the conservative assumption whereby they will continue to predominate is the most commonly held. Investors are not willing to use other trading systems that do not appear to benefit from the same liquidity pool that characterises traditional stock exchanges, even some MTFs would offer an innovative organisation of the transactions. Moreover, in countries applying the concentration rule, intermediaries report all transactions to the regulated domestic market, which sends the information to the regulatory authorities. Following the implementation of MiFID, since IFs will be directly responsible for reporting transactions, it might be easier for them to continue executing clients' orders on the regulated market, which already proposes the infrastructures to report to the competent authorities and would be responsible for reporting obligations.

The ongoing consolidation observed over recent years within Europe, as well as between European and US stock markets, should enable regulated markets to offer an increasingly deeper liquidity pool

to investors and benefit from advantages related to economies of scale. These markets would therefore be in a position to maintain their domination.

However, the launch or the announcement in recent months of the creation of a certain number of alternative trading systems, meaning post-MiFID MTFs, heralds a more fragmented European stock market landscape.

A number of these new systems differ relatively little to those offered by the regulated markets, as they are based on an automated order book; competition will therefore depend on speed and/or cost criteria. This is the case for Chi-X, launched by Instinet, which is already active in countries that do not apply the concentration rule, and which should, in November 2007, propose a central limit order book (CLOB) for 7,500 pan-European securities. Likewise, Equiduct, primarily owned by Börse Berlin, is based on an up-to-date version of the defunct trading platform Easdaq, with a hybrid order book filled up by market makers and limit order providers. Project Turquoise, launched by seven major investment banks, including Merrill Lynch and Goldman Sachs, should be an alternative trading platform for European equities.¹⁷

Other competitors are expected to attract institutional investors, which execute transactions involving a large number of securities and for which the major criterion is to obtain a sufficiently large counterparty without revealing their position to the other market players. These systems are expected to develop along the same lines as dark pools of liquidity in the United States, *i.e.* electronic platforms that seek to match buy and sell orders anonymously, without displaying the orders publicly. Nevertheless the MiFID transparency requirements would bound their opacity. These private trading systems, organised outside the regulated markets, are mainly targeting buy-side investors,¹⁸ and less frequently sell-side players.¹⁹ Often organised as crossing systems, their originality in terms of "natural" counterparty searching methods could benefit institutional investors.

The largest project announced to date is that of ITG with its Posit Now platform, launched in February 2007. As of 1 November 2007, in the same vein as its US counterpart, it will offer fund managers

¹⁷ The system's launch, initially scheduled for end-2007, has nonetheless been postponed to the second quarter of 2008.

¹⁸ The buy-side includes all investors, *i.e.* institutional investors (pension funds, investment funds, insurance companies, etc.) and retail investors.

¹⁹ The sell-side includes intermediaries, which act on behalf of investors. These include investment companies (brokers), stock exchanges, market makers, exchanges members, etc.

continuous intraday crossing and total anonymity, on 9,000 securities in 15 countries. Posit Now will compete with Liquidnet Europe, which only focuses on the buy-side for block trades and covers 18 countries.²⁰

The emergence of SIs is more uncertain, on account of the demanding requirements associated to this status (regulatory capital, information disclosure rules, operating mode, etc). IFs must weigh up the cost of developing an SI activity against the income generated. Only the largest banks will be able to reach the critical mass allowing them to earn the bid/ask spread at a lower cost, while others could target certain listed securities or certain types of investors offering greater potential gains. For instance, a number of players are likely to specialise in wholesale clients as, according to MiFID, pre-trade transparency rules will not apply to SIs for the trading of the most liquid shares identified by the directive,²¹ while others will offer systematic internalisation for the other "illiquid" securities for the same reason.

As a result, it is difficult to assess the impact of MiFID, particularly since certain markets are likely to be less affected as they are already facing competition. Conversely, France exercised so far considerable control over its order flow, given that virtually all of its orders had to be executed on Euronext Paris, allowing a few exceptions which nonetheless respect the requirement of reporting to Euronext.

2|2 A first estimation of fragmentation in France

Concentrating the reporting of transactions in a single venue provides a means of analysing and identifying order flow that, depending on their characteristics (size, broker identity, execution facility), may make them eligible for execution on an alternative trading system as of 1 November 2007.

Estimates of the possible fragmentation from this data are based on the observation that MiFID will primarily enable professionals, *i.e.* institutional investors, to choose the venue for the execution of their buy and sell orders. These investors represent

the largest part of trading volume, with 93% of French and foreign securities traded in France in 2006 –excluding non-residents.²² In view of the fact that individual trades usually involve considerable amounts, initiatives such as Liquidnet or Posit are exclusively aimed at large institutional investors, offering them block trading networks. This clientele is also likely to be favoured by SIs, which could directly negotiate the transaction price.

This "wholesale market" is therefore a key element for assessing the potential degree of fragmentation in the French market, particularly from the point of view of IFs and their future clients' order flow management, in compliance with best execution requirements. In order to assess the share of order flow likely to permanently migrate from the French regulated market, we propose analysing the equivalent of the wholesale market currently identifiable on Euronext Paris, *via* block trades and "cross trades" (these particular trades are called "*applications*" on Euronext Paris), which, although restricted by the quoted prices from the central order book, are potentially large (see Appendix 3). These transactions represent one type of order flow already executed outside the order book and do not enter into the price discovery process.

Our analysis is carried out on Euronext Paris market data transmitted regularly to the *Autorité des Marchés financiers* (AMF –France's Financial Markets Authority). This data, which enables the identifying of brokers for each transaction, has the advantage of recording transactions executed outside the order book, on the basis of brokers' reports, which are therefore invisible to the rest of the market at the date of transaction.

The analysis is conducted for the period from July 2005 to June 2007 and for transactions of a minimum amount of EUR 50,000, referred to as "block trades" in the rest of this article, which is the threshold that corresponds to the minimum trade size (normal block amount –NBA) for an order to be eligible for block trades for the category of least liquid securities, *i.e.* those that are traded periodically by single-price call auctions. We focus on the transaction counterparties, *i.e.* whether such trades involve two clients of the same IF or if the IF executes the transaction against its own book. The

²⁰ According to Liquidnet Europe, the system has a liquidity pool of 3.5 billion securities, and the trading volume increased by over 350% in 2006, with an average cost reduction of 21.3 bp on each trade.

²¹ See Section 1|2.

²² According to the Banque de France securities survey. Institutional investors correspond to banks, insurance companies, pension funds and UCITS.

former are likely to be directly executed on an MTF like a crossing system or routed to a platform such as Project Turquoise, owned by IFs, while the latter should directly qualify as internalised trades.

Therefore, by measuring order flow lost to a certain extent by Euronext Paris, we seek to identify orders that are likely to be executed outside the regulated market after 1 November 2007. In practice, this amount could be much greater if the block trades currently executed in the order book were taken into account.

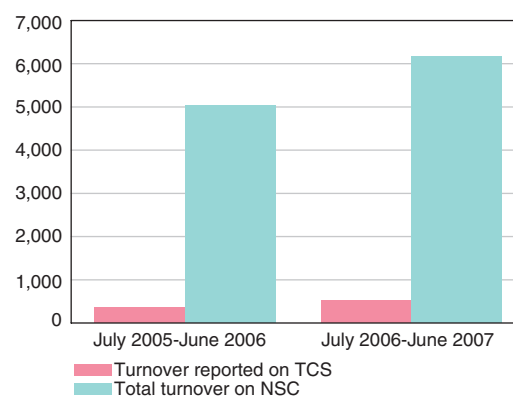
BLOCK TRADES REPORTED IN EURONEXT'S TRADE CONFIRMATION SYSTEM (TCS)

The concentration rule, which was strictly applied in France, required, until 1994, that all orders executed on the Paris stock exchange, transmitted by a broker established in France on behalf of an investor residing in France, be executed on a regulated market. However, institutional investors, discouraged by the high level of transparency that characterised the Paris Bourse, were trading executing block trades on the LSE. The Stock Exchange Automated Quotation International system (SEAQI) enabled them to trade security blocks at prices directly negotiated with the market makers in London, without revealing information to the other market players.

*The Paris stock exchange consequently took a number of steps in the mid-1990s aiming to allow block trades to be executed outside the central order book, so as to guarantee investors a certain degree of opacity.*²³ These transactions must nonetheless be reported to Euronext Paris and recorded via the TCS reporting system (see Appendix 3). Euronext's TCS is more generally used to adjust and report trades executed outside the central order book in Euronext's system.²⁴

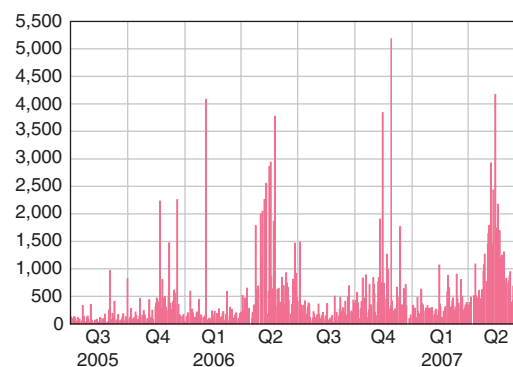
In order to assess the share of a Paris' wholesale transactions already executed outside the central order book, we analyse a limited number of transactions reported in the TCS. These transactions are classified as "block trades –out session".²⁵ To avoid taking into account small transactions executed outside trading

Figure 3
Turnover in block trades with a minimum value of EUR 50,000 reported in the TCS
Average daily turnover of Euronext Paris listed securities (EUR millions)



Turnover in block trades

(EUR millions)



Note: the average daily turnover on NSC includes turnover for trades on Euronext Paris as well as on Euronext's other stock exchanges, notably Amsterdam and Brussels. Turnover abroad is nonetheless very limited and do not significantly skew the statistics presented.

Source: SESAM database

hours in this category, only trades involving a minimum amount of EUR 50,000 are included.

The analysis for the July 2005-June 2007 period²⁶ shows that block trades represented around 8% of the total turnover (value of trades) in the central order book, with an average of 105 transactions per trading session (see Figure 3). Moreover, the block trading market is highly concentrated, both in terms of number of

²³ For a more precise definition of price and volume conditions please refer to Chapter 4 of Euronext Rule Book 1, harmonised provisions.

²⁴ See AMF Monthly Review No. 10 January 2005 (in French).

²⁵ See Euronext Cash Market – Guide to transaction reporting 2007.

²⁶ Only transactions of over EUR 50,000 are included here. This threshold corresponds to the minimum level required for transactions on securities traded by call auctions to be eligible for block trades. The thresholds are nonetheless much higher on other securities (see Appendix 3). Reported transactions that were executed below the regulatory thresholds actually occurred outside trading hours and belong to the "out of session" category. They are also reported via Euronext Trade Confirmation System (TCS), in the same category as block trades. Furthermore, only French or foreign shares listed on Euronext Paris are included here.

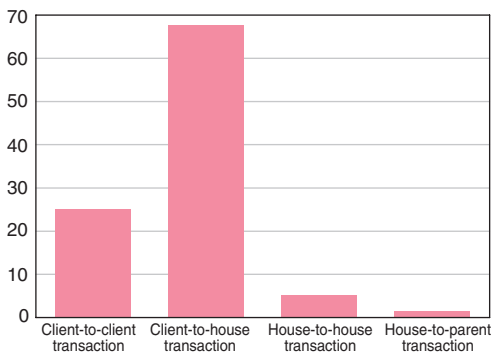
securities and the number of IFs acting as broker and maybe dealer for these block trades:

- only 30 securities listed on Euronext Paris (which listed some 730 companies at end-2006) account for 80% of transactions. More generally, the 50 most traded stocks outside the market are listed on Euronext's Blue Chip large cap index, and also, in the case of 36 of them, are components of the CAC 40 index.
- 98% of transactions of over EUR 50,000 are concentrated among 25 IFs out of a total of some 90 IFs operating acting as broker-dealers for block trades over the past two years.

Block trades are executed outside the regulated market so that investors benefit from advantageous execution conditions, such as the non-disclosure of their position to the rest of the market, an advantageous transaction price and non-fragmented execution. Most often the IF is the investor's counterparty in the transaction, or else acts as a simple broker between clients. As a result, 98% of block trades of over EUR 50,000 are

Figure 4
Breakdown of block trades exceeding EUR 50,000 carried out by the same IF according to the nature of counterparts

(%)



Note : Block trades can be carried out between two clients of the same IF (client-to-client transaction) or between the client and the IF (client-to-house transaction). Less frequently, transactions are carried out internally (house-to-house transaction) or between the IF and one of its subsidiaries (house-to-parent transaction).

Source: SESAM database

carried out by the same broker on both sides of the trade. In almost 70% of cases, the IF executes orders against its own account, which means that it acts as an SI (see Figure 4). Such trades represent an average of EUR 252 million per day.

Although there are less than half as many, transactions between clients of the same IF represent an average of EUR 164 million per day. This significant order flow might migrate from the regulated market after implementation of MiFID, gravitating towards MTFs organised as crossing systems, thus enabling investors to avoid the use of a physical broker.²⁷

BLOCK TRADES EXECUTED AT MARKET PRICE OUTSIDE THE ORDER BOOK

A "cross trade" consists of the simultaneous matching and execution by the same IF of opposing buy and sell orders (see Appendix 3). By definition, cross trades are not block trades, since they are assumed to be executed at market prices. Given that they have no maximum or minimum size limit, very small transactions can be executed in the same way as transactions corresponding to equity block trades. As regards securities listed on the Paris stock exchange's benchmark index, the CAC 40, data analysed represent around 4% of total turnover on the CAC 40 executed in the central order book (see Figure 5).

Like for block trades, only cross trades with a minimum value of EUR 50,000 are analysed. In this subset, which represents 44% of all cross trades and an average of 72 transactions per day, the average transaction size is EUR 2.7 million, i.e. less than two-thirds the amount of an average block trade.²⁸

Cross trades are characterised by a very marked concentration on a limited number of securities: in turnover terms, between July 2005 and June 2007, almost 85% were carried out on 25 securities listed on the CAC 40. IFs in this sector are more highly concentrated than in the block trading market. Almost as many IFs active on the cross-trades

²⁷ However, this does not eliminate explicit transaction costs, as each investor has to pay to access the MTF.

²⁸ The average size of transactions of over EUR 50,000 recorded in TCS under "block trades - out of session" is EUR 4.48 million. For CAC 40 securities alone, the average transaction size in this category is EUR 5.5 million.

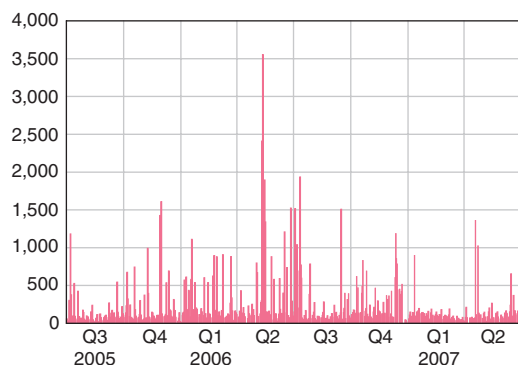
Figure 5
Cross trades on Euronext Paris on CAC40 equities
 Breakdown of average daily turnover by cross trade and in the total central order book

(EUR millions)



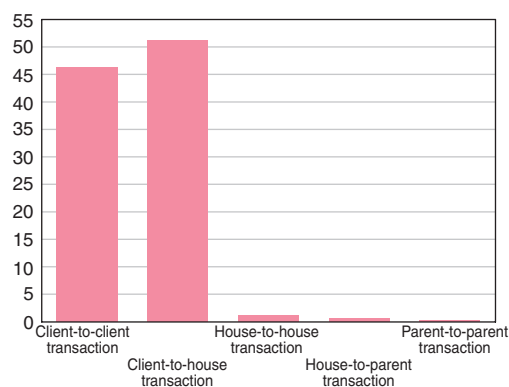
Daily turnover

(EUR millions)



Source: SESAM database

Figure 6
Breakdown of cross trades of a minimum size of EUR 50,000 according to the nature of counterpart
 (%)



Source: SESAM database

segment can be found on the block trade market. Nonetheless, over 90% of the total turnover in cross trades is handled by just 10 IFs.

Moreover, in practice, over 50% of these cross trades are executed against IFs' own accounts. As a result, like for certain block trades, these transactions are already *de facto* internalised, since the transaction price satisfies constraints of MiFID. Although the number of transactions carried out between the client and the IF for its own account is higher than that of transactions between clients, the latter has amounted to an average of EUR 97 million per day over the past two years compared to EUR 69 million for the former (see Figure 6).

A CONFIGURATION LIKELY TO RESULT IN FRAGMENTATION

Whether competitors to regulated markets emerge as of November 2007 will depend on the capacity of alternative trading systems to meet the needs of institutional investors in particular. Whether IFs decide to develop SI activities or not will depend on their achieving critical mass thanks to their retail clients and above all on volume that they will be capable of trading with institutional investors.

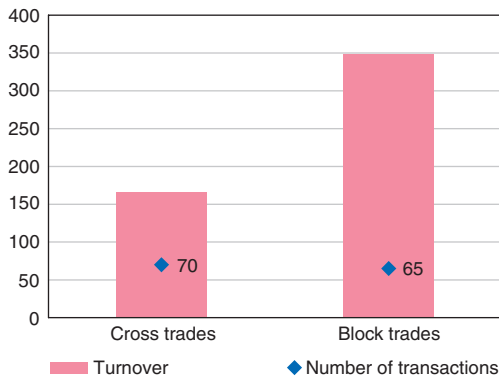
The summary of order flow observed on Euronext Paris shows that the great majority of block trades and a significant share of cross trades are on CAC 40 securities. Block trades of over EUR 50,000 executed by an IF, either as a counterparty or involving two of its clients, averaged EUR 1,285 billion per year for the July 2005-June 2007 period on CAC 40 securities alone. In comparison with Euronext's centralised system, this represents around 10% of the yearly turnover on CAC 40 securities and could be lost by the French regulated market in the medium term.

The order flow, characterised by the strong concentration of both investors and equities traded, and which currently does not participate in the price discovery process on Euronext, is therefore significant. The estimates obtained provide initial indications of the impact of the implementation of MiFID:

- The number of SIs on liquid securities listed on Euronext Paris could be between five and ten in the medium term, and represent currently 5% of per annum turnover on CAC 40 securities. Although there

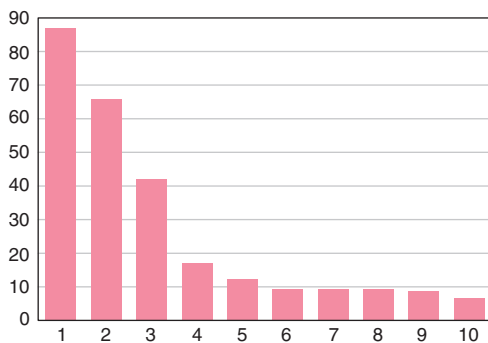
Figure 7
Summary of equity trading on the CAC 40 broken down by cross trades and block trades of over EUR 50,000

Turnover and average number of trades per day
 (EUR millions)



Average number of trades per day by the leading IFs, including proprietary trading

(EUR millions)



Source: SESAM database

are many IFs acting as broker-dealer between clients on CAC 40 securities (90 IFs during the period under review), only 40 of them execute trades on behalf of clients against their own book. Nonetheless, *only five of these IFs dominate the market, accounting for almost 80% of turnover.*

- Institutional investors could carry out around 6% of their annual turnover on MTFs organised as crossing systems if they decide to post their orders on a dedicated alternative system.²⁹

Finally, as this purely statistic analysis cannot give a dynamic estimate of order flow trends in a post-MiFID landscape, it constitutes an initial estimate of the volume of wholesale trades likely to be executed outside the French regulated market in the next few years. Since these trades do not participate in Euronext's price discovery process because of their current execution conditions, the impact on the regulated market's liquidity is likely to be limited.

Nevertheless, our analysis probably underestimates the volume likely to be lost by Euronext. Indeed, only a "hidden" share of the wholesale market is taken into account: block trades executed in the order book and those executed outside the order book by non-residents (not subject to reporting requirements) or by residents on another regulated market (such as SEAQI) are not included.

²⁹ For transactions reported in TCS, our statistics include only trades involving the same IF on both sides of the transaction. Two percent of the total volume is therefore not taken into account in our calculations, which may produce a slight downward bias to estimates of order flow transiting via a crossing system following the implementation of MiFID on 1 November 2007.

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APPENDIX 1

The development of financial markets in the United States

The emergence of competition in the United States is closely linked to the history of the deregulation of financial markets. In 1975, the US Congress passed amendments to the Securities Exchange Act of 1934 that sought to create a National Market System (NMS) which, through the Intermarket Trading System (ITS) linked the different stock exchanges and allowed investors to execute in theory their orders on the market providing the best quotes.¹

The structure of US equity market at that time consisted of a main market, the NYSE, and smaller "regional" exchanges. All these exchanges were manual auction markets, with a unique dealer on the NYSE, the "specialist" who is the only one in his specialty stocks, competing with limit order traders and dealers at other exchanges. In these conditions, the price was the most important dimension of order execution. Consequently, the members of ITS opted in 1981 for the "trade-through rule", whereby trading at a price other than the best one posted on any market in a security (a seller must sell at the highest bid price on any market, while the buyer must buy at the lowest offer price).²

The *trade-through rule*, which applied to the trading of NYSE and other exchange-listed securities but not Nasdaq-listed securities, paradoxically protected the NYSE from competition (in particular electronic communication networks (ECNs) that could never trade more than 5% of the trading volume in NYSE-listed securities). *De facto*, this best price criterion meant that orders were routed to the NYSE that indeed offered many times the best quotes (due to the fierce competition between brokers). Hence, competitors could not enter the market even if, eventually, the transaction price did not correspond to the quoted price because the best bid or offer may be gone before the order is executed. A quoted price can disappear or change long before an execution happens.

As of the end of the 1990s, the United States adopted a number of rules aiming to promote competition between traditional exchanges with a view to ensuring the best execution of customer orders, while guaranteeing investor protection. The Securities and Exchange Commission (SEC) initially focused on Nasdaq. In 1997, it established new *order handling rules* for Nasdaq market makers following an investigation revealing practices that were detrimental to investors.³

- The *limit order display rule* greatly increased the transparency of Nasdaq by requiring market makers to display customer limit orders that are priced better than the market maker's quote, or add to the size of a market maker's quote when the market maker is at the best price in the market.
- The *quote rule* has enabled ECNs to directly compete with Nasdaq market makers through the inclusion of their prices in the public quotation system. This rule, also known as *ECN Amendment*, requires market makers to publicly display (on Nasdaq) the price of any orders they place on an ECN if the price is better than their own public quotation. The ECN may also communicate the best priced orders entered by Nasdaq market makers to a traditional exchange (*ECN Display Alternative*),⁴ which must then display them.

¹ The National Market System established electronic linkages between existing exchanges (mainly for securities listed on the NYSE and AMEX) which Congress qualified as a public utility that must be adequately regulated. Henceforth, NMS securities are all listed on Nasdaq and on stock exchanges (Self-regulated organizations -SROs).

² This rule was established due to the practice of "trading through" one exchange for stock being sold/bought at a slightly higher/lower price on another.

³ See article published in 1994 by Christie (W.) and Schultz (P): "Why do Nasdaq market makers avoid odd-eighth quotes?", *Journal of Finance*, 49, 1813-1840, according to which Nasdaq market makers were implicitly colluding to keep spreads artificially wide (at least USD 0.25 whereas the tick size was USD 0.125).

⁴ See Special Studies: "Report concerning display of customer limit orders", May 2000 and "Electronic communication networks and after-hours trading", June 2000, Securities and Exchange Commission.

- Regulation ATS (*alternative trading systems*) adopted in December 1998 finally integrated ECNs and ATSS more fully into the NMS by allowing them to register as a broker-dealer or an exchange.

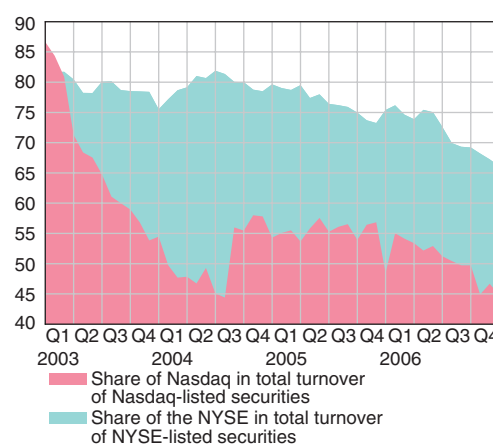
The impact on the development of ECNs was considerable and the increase in competition largely beneficial to investors. While in 1993, ECNs accounted for 13% of trading volume on Nasdaq, their share rose to 30% in 1999 and has reached 50% in recent years.⁵ Even though it is difficult to distinguish between the effects of the two main rules of 1997, it appears that, following the implementation of the new rules, the number of reported quotes increased sharply and bid-ask spreads reduced on Nasdaq.⁶ The latter effect is due to the fact that market makers posted, before the new rules, orders on ECNs that were only available to institutional investors, which represented a limited number of players.

Following *this fragmentation, exchanges lost market share in the total turnover of their own listed stocks, but also penetrated the market of their historical competitors.* Since Nasdaq started to offer, in January 2004, the dual-listing of a number of NYSE-listed stocks, competition between the two exchanges has become head-on. AMEX then adopted the same dual-listing system. There is therefore an asymmetry with the NYSE, as the latter does not authorise the trading of Nasdaq-listed securities. The NYSE regularly lost market share to Nasdaq, before regaining it through its merger with ArcaEx (Archipelago Exchange) in 2006 (see Figure A1).

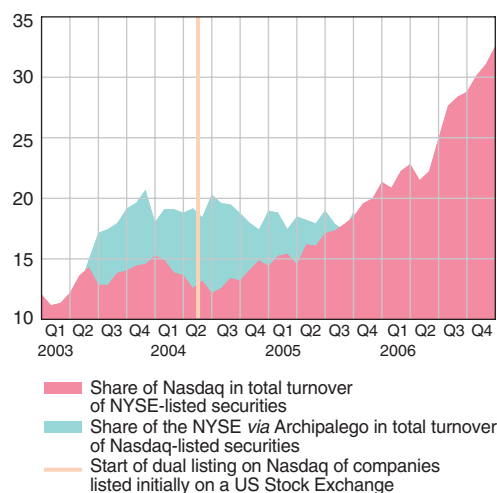
In February 2004, the SEC proposed Regulation National Market System (Reg NMS) designed to enhance and modernize the regulatory structure of the US equity markets and formally approved it in June 2005.⁷ Indeed, overlapping regulation gave rise to different possibilities for trading securities with, at one extreme, centralisation (the NYSE and the trade-through rule, with a floor structure making it geographically concentrated) and, at the other, fragmentation (Nasdaq and its electronic system).

This new regulation has notably extended the trade-through rule to Nasdaq-listed securities, but applies only to automated quotes. This measure aims to

Figure A1
Market share of US exchanges in the total turnover of stocks listed
On their own exchange
(%)



On their competitors' exchange
(%)



Sources: NYSE, Nasdaq Performance Report

⁵ In May 2004, Inet capital captured 25% of trading volumes on Nasdaq, ArcaEx 19% and Brut 9%, according to Securities Industry News.

⁶ See McInish (T), Van Ness (B) and Van Ness (R.) (1998): "The effect of the SEC's order-handling rules on Nasdaq", Journal of Financial Research 21(3), pp. 247-254.

⁷ The regulation covers four areas: the execution and processing of orders (order protection rule), access to quotes throughout the NMS (access rule), the definition of price increments (sub-penny rule) and the management and distribution of market data (market data rule). Reg NMS extends the trade-through rule to Nasdaq-listed securities.

protect customer limit orders. The main argument put forward by advocates of the trade-through rule is that it ensures that small orders at the best price are not ignored, in particular by large investors seeking a major counterparty.⁸ The scope of application of this rule has been broadened to all US listed securities, but above all, applies now only to automated quotes and no longer to manual quotes. This means that the NYSE trading floor will no longer benefit from this protection.

Having been forced to respond to competition from ECNs (by opting for a hybrid auction and electronic system in the case of the NYSE) and take account of Reg NMS that favours automated quotes, exchanges have entered into a consolidation process following a period of fragmentation. Nasdaq acquired Brut in September 2004 and Inet in December 2005. For its part, the NYSE acquired Archipelago ECN in 2006. Consolidation is already underway among ECNs, with the number of SEC-registered ECNs falling from nine in December 1999 to five in July 2004. Furthermore, in order to adapt to the new environment, a number of regional exchanges (Philadelphia and Chicago) are seeking to launch their own electronic systems.

⁸ *Opponents of this rule argue that the technological development of markets, by gradually removing human intervention, has considerably broadened best execution criteria, if only by introducing a time factor (speed of execution). Under these conditions, Nasdaq market makers have been subject, to date, to broad best execution requirements more or less corresponding to those recommended by MiFID. From this point of view, the United States has regressed: Reg NMS limits best execution to ensuring the best price for all listed securities.*

APPENDIX 2

The development of transaction costs

The annual "Global Trading Cost Analysis" survey, conducted by Elkins-McSherry and published by *Institutional Investor Magazine*, provides estimates of equity transaction costs.

These data incorporate the direct costs and part of the indirect costs, known as the *market impact*, which includes the midpoint price of the bid/ask spread and a measure of the average price shift beyond the best limit price (comparing the actual average price for a block trade with the volume-weighted average price –the mean of day's high, low, opening and closing prices– of the stock in question). The data are collected from institutional investors trading on 208 exchanges in 42 countries.

However, due to the way these data are collected, their nature and the calculation of transaction costs, a degree of caution should be exercised regarding Elkins-McSherry data. The transactions making up the database are only representative of institutional investors, which tends to overestimate market impact (which is high for these investors that generally post large orders) and underestimate explicit costs (as fees are usually lower for these investors thanks to their bargaining power).

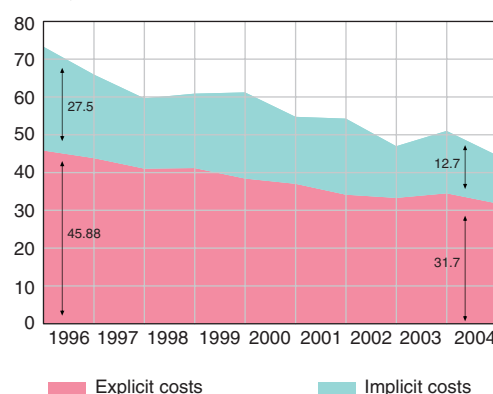
Another limitation lies in the fact that transaction costs are presented as an average per country (and not by exchange, without distinguishing between transactions carried out on a regulated market or OTC), and for all listed shares (without distinguishing between small and large caps). It is therefore difficult to attribute a transaction cost to a particular exchange, especially in countries characterised by multiple trading venues such as the United Kingdom, Germany and the United States.

Despite these limitations, Elkins-McSherry data provide very useful indications of transaction costs, showing in particular that they have declined on average by almost 40% since 1996 worldwide. This decrease was most marked for implicit costs, which fell by 55% compared with 30% for fees and commissions. Over the recent period, implicit costs have appeared to account for only a quarter of transaction costs.¹

The main driver for this cost reduction appears to be the automation-driven disintermediation of trading, which suggests that this decrease has probably been underway on and off since the end of the 1970s.² Indeed, all things being equal, electronic-based markets have significantly lower average transaction costs than their non-automated counterparts. Over the period 1996-1998, trading cost savings appear to be between 23 and 32bp on explicit costs, and between 10 and 18bp on implicit costs.

Commissions and fees have been falling steadily thanks to technological advances and the growing

Changes in global trading costs
(in basis points)



Note: Explicit costs correspond to direct costs. Implicit or indirect costs are estimated by the market impact and are negatively correlated with liquidity.

Source: Elkins-McSherry.

¹ This proportion is found at the disaggregated level for all countries, except at the end of the 1990s in North America, where the proportions were opposite (Domowitz et al., 2001).

² Elkins-McSherry data only go back to 1996.

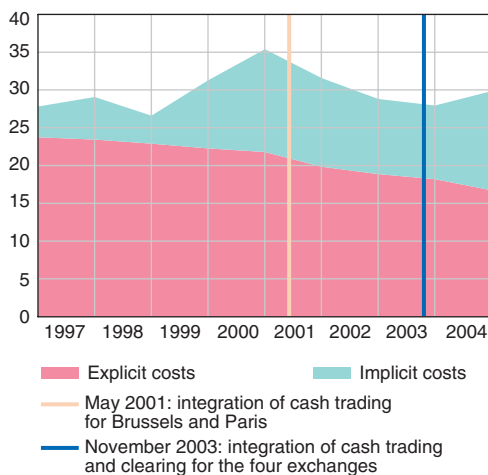
competition between intermediaries. However, *the implicit component, represented by the market impact, is subject to more erratic fluctuations and remains more difficult to "control" by exchanges as it is correlated with price volatility and trading activity.* For instance, a sharp rise in implicit costs was observed in 2000 and 2001, due to the exceptionally high volatility during this period, making it difficult to execute orders at the best price. This situation was exacerbated by the massive sell-offs observed at that time, as empirically the cost of selling is higher than that of buying.³

Unlike the situation observed on other markets, in the case of Euronext implicit costs have not returned to the level prevailing before this period of high volatility. The decline in these prices may have been less rapid because of Euronext's minimum tick size, which skews the measure of implicit costs used by Elkins-McSherry. While all US (and German) exchanges have moved to decimalisation, Euronext retains a pricing grid whereby the tick size increases with the share price. Only securities of up to EUR 50 have a minimum tick size of EUR 0.01.⁴ There are no doubt other factors behind this relatively small decline in implicit costs.

The decline in implicit costs has nevertheless been more marked in France since 2001, even though Paris was still far in 2005 from the exceptionally low levels prevailing before 2000. This result is consistent with observations by Pagano and Padilla (2005)⁵ showing that the average bid-ask spread of the securities in the CAC40 fell by around 40% since the integration of exchanges in the Euronext system. This effect appears to be due to the increase in market liquidity stemming from the larger pool of securities and the growth in cross-border trading, which has benefited the most liquid securities on the Paris stock exchange.

Transaction costs on all Euronext markets and integration process

(in basis points)

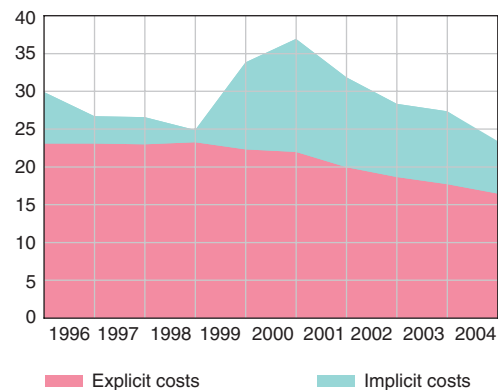


Note: Transaction costs across Euronext markets correspond to the average transaction costs of each market weighted by the year-end market capitalisation.

Source: Elkins-McSherry and own calculations.

Changes in transaction costs on the Paris stock exchange

(in basis points)



Source: Elkins-McSherry.

³ Although the reasons for this are unclear, one explanation may be that, in bear markets, when investors sell securities they are less concerned about how the transaction is executed than when they buy.

⁴ Since 2 January 1999, the tick sizes expressed in euro for shares and related securities are 0.01 up to EUR 50, 0.05 from EUR 50 to EUR 100, 0.10 from EUR 100 to EUR 500, and 0.5 above EUR 500.

⁵ Pagano and Padilla (2005): "Efficiency gains from the integration of exchanges: lessons from the Euronext "natural experiment", Report for Euronext, LECC.

APPENDIX 3

Block trading on Euronext Paris

The block trading market, sometimes also referred to as the upstairs market, exists on all stock markets. It refers to all large transactions executed outside the regulated market, *via* a broker that can act as counterparty for the transaction (broker-dealer) or that can find a counterparty through one or more dealers. Block trading is regulated to varying degrees across countries. In the United States, dealers generally offer a price at least as good as that of the listing venue. On European exchanges where the concentration rule applies, such as Euronext Paris and Borsa Italiana, execution conditions are entirely regulated in terms of the size of the transaction and the price.¹

All cash products are traded electronically on the NSC system adopted by all of the Euronext members.² NSC is a fully automated trading platform that allows members to route orders to a central order book where they are electronically matched. The orders entered into the system are directly matched according to pre-defined conditions concerning the size and possibly the price, validity date, etc.

Even though the vast majority of French residents' equity transactions are executed on Euronext Paris regulated markets³ in the NSC system, a certain number of measures were taken in 1994 to allow block trades to be executed outside the regulated market due to competition from systems that were less strict and transparent than the Paris stock exchange.⁴ These transactions eligible for block trading must reach a given size known as the normal block amount (NBA) that depends on the market capitalisation of the listed company. The price conditions then depend on the trading volume in relation to the NBA. Ordinary block trades may be carried out within the range of 5% around the last traded price, while structural block trades may be executed at a price within a range of 10% around the last traded price.⁵

These transactions are then reported to Euronext *via* the Trade confirmation system (TCS). Broker-dealers use this reporting system for their trades that are generally executed outside a regulated market.⁶

In France, according to the report published by the *Conseil des marchés financiers* (Financial Market Council) in November 2001, trades executed outside a regulated market and subject to reporting obligations are broken down as follows:

Block trades executed outside a regulated market (shares and related securities)

(amount EUR billions)

	Number of transactions	Amount
1998	76	5.9
1999	123	8.7
2000	117	8.6

Source: *Revue CMF* No. 43, November 2001, page 11

¹ Note however that there is a difference between the block trading market and the upstairs market. On the upstairs market block trades are executed outside the regulated market, with varying degrees of regulation. It only accounts for a part of all block trades, which can also be executed on regulated markets. On the NYSE, a block trade is any transaction in which 10,000 shares or more of a single stock are traded.

² These players are credit institutions and investment firms that have been authorised by the competent authorities, and place buy and sell orders on Euronext. Depending on their authorisation, they act on behalf of clients or for their own account. See "L'organisation institutionnelle et fonctionnelle des marchés d'Euronext", Euronext Paris, November.

³ It is difficult to assess for non-residents' equity transactions given that the concentration rule only applies to residents. Furthermore, the rule does not require all transactions to be executed in Paris, but on any regulated market.

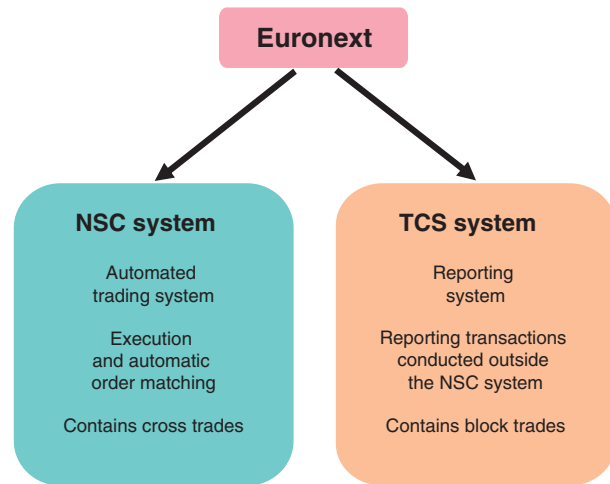
⁴ London only introduced the publication obligations of reporting regarding transaction prices in 1996.

⁵ The price conditions are defined in Euronext Rule Book, Book 1 – Harmonised Rules, Chapter 4.4.

⁶ Also registered in TCS are long and short positions eligible for deferred settlement (SRD), VWAP transactions, options exercises, etc. See Euronext Cash Market – Guide to transaction reporting 2007.

Relatively few trades are executed outside a regulated market. For instance, Bessembinder and Venkataraman (2004),⁷ who analysed block trades on Euronext Paris between April 1997 and March 1998, observed that less than 34% were facilitated in the upstairs market, with the remainder being executed in the order book. On the NYSE, this proportion is calculated at 27% for the period between December 1993 and January 1994 (Madhavan and Cheng, 1997).⁸

Other types of transactions are also executed outside the order book, but are immediately reported in the NSC system. The latter include cross trades, *i.e.* the simultaneous matching and execution by a single Euronext member of opposing buy and sell orders; they can be made only for securities traded continuously and must be executed at a price within the market's best bid/ask spread at the time of execution.⁹



Note: The NSC system is only for cash transactions. Derivatives transactions are managed on LIFFE Connect.

⁷ Bessembinder (H.) and Venkataraman (K.) (2004): "Does an electronic Stock Exchange need an upstairs market?", *Journal of Financial Economics* 73(1), 3-36.

⁸ Madhava (A.) and Cheng (M.) (1997): "In search of liquidity: block trades in the upstairs and downstairs markets", *Review of Financial Studies* 10(1), pp. 175-203.

⁹ See also Euronext Rule Book, Book 1 – Harmonised Rules, Chapter 4.4.

Market liquidity and banking liquidity: linkages, vulnerabilities and the role of disclosure

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During the course of 2007, global financial markets went through noticeable periods of turbulence. In particular, complex credit markets suffered a marked set-back. Oddly, turmoil in these fairly new markets contributed to severe liquidity shortages in short-term money and interbank markets, triggering repeated large-scale monetary interventions by central banks worldwide. Recent events have thus demonstrated that banks are considerably intertwined in financial markets; dependent on and exposed to them as regards liquidity. The aim of this article is to better understand this complex relationship and to frame relevant aspects of the latest financial market turmoil accordingly. In particular, we explore the mechanics of a market liquidity crisis and its impact on individual banks' liquidity, as well as possible spillovers to other banks. These dynamics of course raise a number of policy issues. Here, we focus on the role that greater disclosure to markets on banks' liquidity situation itself could play as a market-stabilising device.

In summary, global banks have increasingly integrated into capital markets and in terms of both funding and asset liquidity rely considerably on functioning, liquid financial markets. This is particularly visible in the shift towards secured lending transactions; growth of the securitisation market; the broadening of collateral to encompass complex products with shifting levels of market liquidity; and the rise in committed credit or liquidity lines to sponsored special purpose vehicles (SPVs) and corporates. While some of the recent developments in financial market liquidity can be attributed to technological progress, importantly, more temporary factors resulting from an environment of low interest rates have accelerated market liquidity beyond sustainable levels. While, per se, banks' ability to "liquify" assets represents a positive development which should help mitigate the fundamental liquidity risk that banks face, increased sensitivity with respect to market liquidity risk has also created new vulnerabilities with respect to sudden reversals of market liquidity. Importantly, adverse circumstances could trigger a combined increase in demands on liquid assets via margin requirements and activation of credit lines and reduced liquidity of assets and related market funding sources. The severe loss of liquidity in asset-backed securities markets and its repercussions on global interbank markets during 2007 provide a vivid illustration of the channels that link market liquidity to banks' funding and asset liquidity and of the wider externalities of idiosyncratic liquidity shocks. How can these risks be addressed? Together with active liquidity management, disclosure may represent one tool through which such vulnerability may be reduced. A large literature exists on the merits of transparency in banking. Greater transparency should alleviate refinancing frictions related to asymmetric information. When information problems are however deeper and concern aggregate uncertainty, improved disclosure on credit fundamentals may be less effective to restore confidence. Instead, better information on liquidity itself may be necessary. We explore the current availability of information on banks' liquidity and funding risks. Overall, information appears to be limited –failing to disclose in a comprehensive and comparable way the underlying dynamics of liquidity demands and funding sources. But liquidity is volatile and banks are subject to inherent liquidity mismatches. Can greater disclosure in this area ever be a useful tool to reinforce market discipline in a systemically stabilising fashion? While this question merits serious reflection, the 2007 market events have shown that current information gaps are large and need addressing.

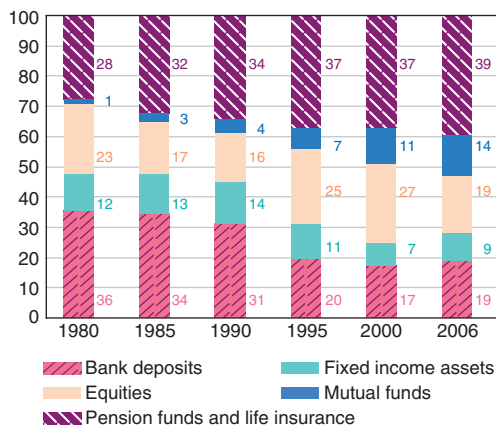
NB: The authors would like to thank Thierry Timmermans and Janet Mitchell for their comments and contributions.

1 | THE RISING INTERDEPENDENCE OF BANKS AND CAPITAL MARKETS

Banking disintermediation has been widely recognised as one of the key developments to have shaped the financial system in the recent years. This is well illustrated by the evolution in the structure of US household financial assets. While bank deposits represented 36% of those assets at the end of 1980, this share had fallen to 19% by 2006, mainly to the benefit of assets held through institutional investors (Chart 1).

But the shift of investors away from bank deposits need not be a permanent fixture. Chart 1 indicates that, from 1995 onwards, the share of bank assets in US household portfolios has more or less stabilised. More generally, banks' balance sheets have strongly increased in the recent years. The yearly growth rate in total assets of euro area monetary financial institutions (MFIs) was almost 8% between 2000 and 2006 and has recently accelerated to reach, on an annual basis, 13% during the three first quarters of 2007. Moreover, funding structures differ across banks, with some still relying extensively on customer deposits (Chart 2). At a more fundamental level, the relationship between banks and markets therefore cannot be reduced to a simple question of market share, determined by the degree of substitution between two channels of intermediation. Nor can analysts rely on a casual overview of balance sheets

Chart 1
Financial assets of US households
(in % of total¹⁾)

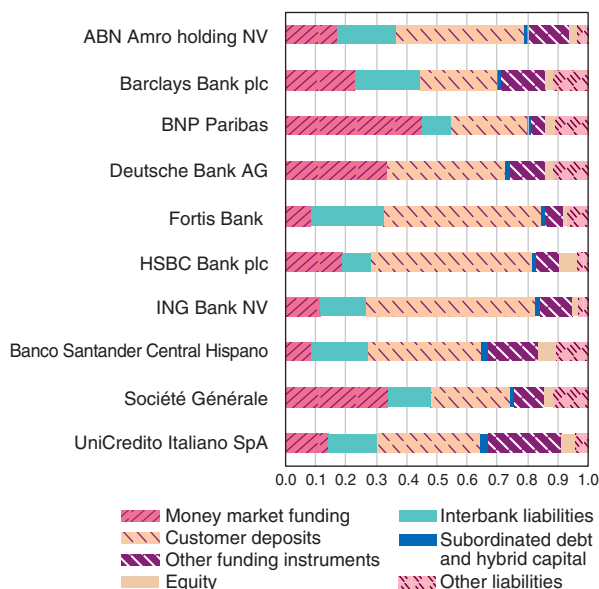


1) Excluding miscellaneous items.

Source: US Federal Reserve

1 See ECB (2007): "Euro money market survey 2006", February.

Chart 2
Liability structure of large European banks
(share in total)



Note: Money market funding consists of certificates of deposits, commercial paper and other short term money market instruments. "Other funding instruments" include funding derived from short term financial trading and derivatives.

Source: Bankscope

to fully comprehend the intricacies of the two-way bank-market relationship. In fact, banks and securities markets are increasingly intertwined and there are many indications of that.

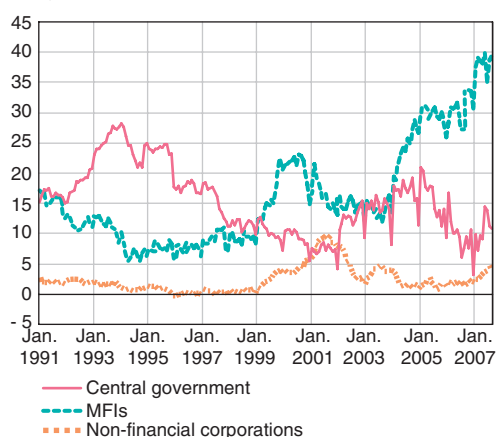
Banks are themselves major issuers of securities. In the euro area, they have even become the dominant player, the outstanding amount of debt securities issued by MFIs having recently exceeded the value of government debt securities (Chart 3).

There is also some evidence that banks are making more use of derivatives to manage funding risks.¹ Moreover, interbank funding is itself becoming increasingly dependent on market liquidity as a growing proportion of interbank transactions is carried out through repurchase agreements. An ESCB survey shows that, between 2000 and 2006, the share of secured operations in total euro money market transactions has risen from 22% to 30%. This increasing reliance on secured operations means that banks are mobilising a growing fraction of their securities portfolio as collateral. Secured funds borrowed by banks are, in turn, used to a large degree to lend secured to other market participants.

Chart 3
Euro-denominated debt securities, by issuing sector –flows and stocks

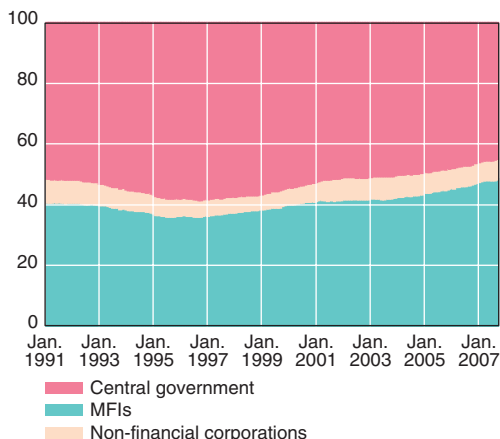
12-month moving average net monthly issue

(EUR billions)



Percent shares in outstanding amounts at end of period

(%)



Source: ECB

However, the collateral used for both legs of this secured borrowing and lending is not necessarily of the same nature nor of the same liquidity. In fact, banks are increasingly mobilising their traditional government and corporate bond portfolios to finance less liquid, but higher yielding forms of assets that again can be reused as collateral. According to a repo market survey published in June 2007, the importance of corporate bonds and asset-backed securities (ABSs) has been rising steadily.² The survey also notes a sharp rise in equity used in tri-party repos. What we observe here are in fact profound changes in liquidity management, with a view to higher efficiency and

lower operational risks.³ Aspects of this shift in behaviour include centralisation of certain functions of liquidity management and just-in-time payment approaches. These changes in collateral and liquidity management are not inconsequential, as will be discussed in Section 2.

Banks are also increasingly supplying the market with new securitised products. Many banks originate, structure and repackage in tranches illiquid assets which they redistribute to investors with corresponding risk preferences. In some cases, securitisation represents a new form of secured funding to banks. In the US, around 56% of outstanding residential mortgages are believed to have been repackaged as residential mortgage-backed securities (RMBSs) and sold on to investors, as well as 60% of subprime mortgage loans issued in 2006.⁴ Securitisation also strongly gained in importance in Europe in recent years. Issuance volume grew almost sixfold between 2000 and 2006 to reach 459 billion euro, with also complex products such as collateralised debt obligations (CDOs) being used as securitisation support.

The packaging and repackaging of assets has been assisted by the creation by banks of off-balance sheet special purpose vehicles (SPVs), the so-called "financial conduits". Asset-backed commercial paper (ABCP) conduits such as multi-seller programs or structured investment vehicles (SIVs) were designed as a cost-efficient infrastructure to the off-loading of risk and access to broad funding markets. It is worth noting that already before the summer 2007 market events, ABCP issuance was increasingly concentrated at the short end of maturity tenors, in contrast to non-collateralised commercial paper (CP), suggesting increasing rollover risk for this asset category (Chart 4).

Bank lending, too, is taking new forms. In addition to traditional corporate or retail lending, many banks are now lending directly to specialised investors such as hedge funds or other highly leveraged institutions. These exposures have been collateralised, including (until recently) by the newly created classes of assets mentioned earlier. In some cases, financing is also contingent, representing back-up credit or liquidity lines, for example to financial conduits. Liquidity

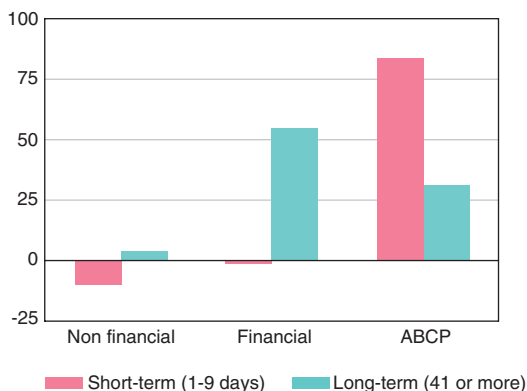
² See ICMA (June 2007).

³ See *The Institute of International Finance (2007)*.

⁴ See "Securitisation: when it goes wrong", *The Economist Magazine*, 22 septembre 2007.

Chart 4
Change in gross issues of US CP 2007-2005
by type of issuer and maturity profile

(USD millions)



Note: Change between May 2007 and average for 2005

Source: Federal Reserve Board

lines provide insurances to CP investors in case the conduit faces roll-over risks. While this protects the conduit from liquidity risk, it indicates the possibility of sudden short-term demands for bank funding – notably in periods of market turbulence.

Table 1 provides a snapshot of some of the largest European banks’ liquidity exposures *vis-à-vis* conduits recorded before the summer 2007 turmoil. Banks are also providing bridge loans to pending leveraged buy-out deals or during “ramp-up”

Table 1
European banks with some of the largest liquidity facilities to funding ratios

(liquidity facilities in USD billions; liquidity facilities/funding and Tier 1 ratio in %)

	Liquidity facilities	Liquidity facilities/funding	Tier 1 ratio
Sachsen Landesbank	24.02	31.60	7.8
IKB Deutsche Industriebank	19.47	28.82	7.2
Hypo Real Estate Bank	17.95	8.70	6.9
Lloyds Bank Group	39.09	7.19	-
Bayerische Landesbank	27.65	6.58	11.0
Calyon	19.39	6.35	9.6
Dresdner Bank	37.77	6.23	10.4

Funding = deposits + senior and subordinated debt based on end 2006 and Q1 2007 numbers; liquidity facilities show maximum commitments.

Source: Citibank

5 See BSC (2007 and 2003).

6 Securitisation has developed also thanks to: the development of statistical models and scoring techniques to standardise risk; legal changes to allow true sale and bankruptcy remoteness of SPVs; adjustments to tax systems to avoid double taxation. Some regulatory measures may have also provided incentives to shift exposures off-balance sheet. See Kendall and Fishman (2000).

7 See Bernanke, IMF (April 2007) and Bank of England (April 2007).

periods to broker-dealers and have particular links with sponsored funds –another potential source of contingent cashoutflows. ESCB data show that total off-balance sheet credit commitments of EU banks amounted to close to 17% of on-balance sheet assets in 2006, up from very low levels in 2001.⁵

As a result of all these various developments, banking activities are now more deeply embedded in markets. This trend is further reinforced by the implementation of the new IAS/IFRS accounting standards generalising the principle of fair value accounting with the consequence that a large portion of banks’ balance sheets must now be marked to market.

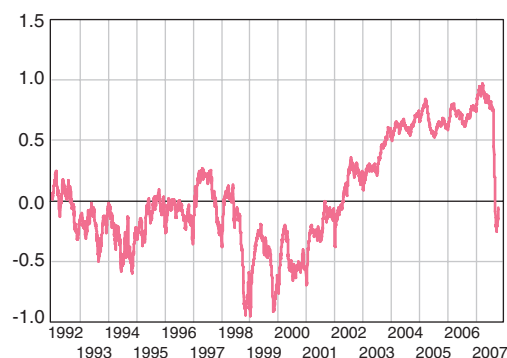
2 | THE ROLE OF MARKET LIQUIDITY: HOW IT MADE BANKS MORE VULNERABLE TO MARKET LIQUIDITY SHOCKS

2|1 Market liquidity and banking liquidity

The deepening symbiosis between banks and capital markets has probably led to a more efficient allocation of savings through the financial system and has mitigated the fundamental liquidity risk underlying the intermediation of liquid savings by banks into illiquid long-term assets. What factors have brought this about?

While a number of long-term structural factors are clearly at play, importantly, more short-term and reversible developments may have helped speed up banks’ integration into markets.⁶ Low nominal and real interest rates since 2000 probably stimulated increased leverage and risk tolerance (the so-called “search for yield”).⁷ This has led to a proliferation of different types of instruments with increasing degrees of complexity, some of which were designed to maximise returns for a given rating. Low borrowing

Chart 5
Financial market liquidity



Note: Reflects the mean of different market liquidity measures

Source: Bank of England

costs are also likely to have enhanced market liquidity in secondary markets (on-trading) (Chart 5).⁸ This is because the lower the borrowing costs, the cheaper it is for market makers, who provide assets on demand and therefore ensure secondary market liquidity, to hold certain positions.

In turn, more liquid secondary financial markets allow banks to rely to a greater extent on markets to quickly adjust exposures, and to meet unexpected funding needs. But market liquidity conditions can be subject to sudden "regime shifts" as developments in 1997/1998, during 2000 and more recently demonstrate (Chart 5), with more detrimental effects on banking liquidity than was previously the case.

Banking liquidity risk relates to the inability of a bank to meet outstanding obligations at a reasonable cost. There are a number of market frictions that can prevent a solvent bank from covering a liquidity shortage. Asymmetric information represents a major one. Investors may have imprecise information on a bank's solvency position, leaving them unwilling to lend, even though the bank may be fundamentally solvent.⁹ As will be discussed later, banks' deeper embeddedness in markets has created new information challenges for banks. Another possible source of market friction affecting banks' liquidity risk relates to imperfect competition. Banks may want to restrict liquidity to other banks in order to exploit their failure.¹⁰ Banks may also be hit by aggregate liquidity preference shocks, resulting from increased uncertainty.¹¹

The next section will explore how banking liquidity risks interact with market liquidity risks. We discuss: first, the mechanics of a single bank's market-banking liquidity relationship; second, the possible dynamics of a market liquidity crisis and its implications for overall liquidity in the banking sector; and third, illustrate such dynamics with the help of market events observed between June and September 2007.

2|2 The mechanics of a bank's market-banking liquidity relationship under stress

On the asset side of a bank, securitisation of mortgage or corporate loans provides a source of cash to banks through the sale of these assets to SPVs. A shift in market liquidity for structured assets can lead to unintended increases in on-balance sheet exposures by banks to warehoused assets and to valuation problems with these assets. The resultant pressure on earnings and the increase in capital requirements, if serious enough, may affect the bank's access to funding markets.

The value of assets held by a bank as a buffer against liquidity shocks is also contingent on market liquidity conditions. For example, ABSs may be liquid at some stage but may suffer significant haircuts and/or valuation uncertainty at other points in time. In addition, market liquidity conditions may be different across issuing and secondary markets, and this difference might be subject to shifts over time as well. For some assets, secondary markets may even not exist, despite strong issuance. Before the recent market turmoil, CDOs had been liquid in primary issuing markets, yet secondary market trading remained limited, notably for bespoke operations. Perhaps, observing robust issuance trends, market participants made incorrect inferences about market liquidity in secondary markets –notably about the effect the absence of such liquidity would have on the ability to evaluate assets and adjust portfolios under stress. Moreover, a bank's asset position in a particular instrument may be large enough to trigger disruptions if its position were partly or fully

⁸ Market liquidity risk is typically defined as the risk that market transactions cannot take place and/or only with significant impact on market clearing prices. See Kyle (1985), for a discussion of three key dimensions of market liquidity.

⁹ See Chari and Jagannathan (1988).

¹⁰ For example, Acharya, Gromb and Yorulmazer (2007).

¹¹ See, for example, Holmstrom and Tirole (1998).

unwound –again impairing the liquidity of its own asset stock.

On the liability side of banks' balance sheets, collateralised borrowing –including in the interbank market– also renders banks vulnerable to changes in the value and market liquidity of the underlying collateral. The broadening of the range of acceptable collateral in secured borrowing, especially to more complex and less liquid securities, has similarly widened the vulnerability to market liquidity shocks. Moreover, in periods of stress, margin and collateral requirements may increase if counterparties have retained the right to increase haircuts or if margins have fallen below certain thresholds. In addition, if liquidity in the market for the collateral asset suddenly dries up, valuation difficulties and disputes may result, as well as lags in transferability of collateral and uncertainty about the suitability of the collateral, thereby undermining borrowing flows.

Banks may also face unexpected cash outflows due to the activation of liquidity lines or bridge loans to the off-balance-sheet vehicles to which structured assets have previously been transferred. A shock to the liquidity of these assets can trigger the activation of bank liquidity lines if the value of the assets falls enough or if funding to the vehicle itself is disrupted by the shock. Yet, in some cases, the availability of (to-be-received) committed lines of credit (or cash inflows) may not be guaranteed if the situation is not covered by the line's terms and conditions.

Collateralised exposures to other market participants, such as banks, broker-dealers or hedge funds, are also vulnerable to shifts in market liquidity of the collateral. Besides, some of the less-regulated counterparties may themselves be highly leveraged and particularly susceptible to market shocks.

Moreover, the fragility of liquidity management in periods of stress goes beyond the quantitative effects just outlined: past models and historic relationships used to manage liquidity risk on normal days become obsolete. Consequently, as markets become illiquid, it becomes difficult to manage out of exposures or to hedge. Asset liquidity may no longer depend on

the characteristics of the asset itself, but rather on whether vulnerable counterparties have substantial positions that need liquidating.

Finally, the simultaneous pro-cyclicality of these various liquidity stresses suggests that banks' vulnerability to market liquidity risks may be greater than what the sum of individual risks suggests: deteriorating market liquidity conditions can result in reduced liquidity of collateral, increased demand for high-quality collateral; greater probability of activation of liquidity lines; and diminished scope for securitisation.

2|3 The dynamics of a market liquidity crisis and its implications for overall liquidity in the banking sector

A disturbance in the market can start off with a single, perhaps leveraged, market participant suffering an idiosyncratic liquidity shock. This might occur, for example, because of losses in a particular activity, a hedge that has gone wrong, or because of operational problems. The participant may have to adjust his portfolio as he faces stop-loss levels and margin calls.¹² In order to generate the required cash, he has to sell assets, which may start weighing on prices.

Other market participants who have followed similar trading strategies may also begin selling, but this may be widely anticipated by the rest of the market, which has little incentive in being on the asset buying side. For example, in 1998, markets expected Salomon Smith Barney to offload its inventory following an article in the press that the firm was closing its fixed-income proprietary desk. As a result, liquidity providers closed their positions, waiting for the inventory to be wound down and triggering sharp falls in prices of fixed-income instruments. This in turn negatively affected the prospects of LTCM, a hedge fund that had previously suffered losses on its Russian bond exposures and had to restore cash levels.¹³

¹² See Brunnermeier and Pedersen (2007).

¹³ See Bookstaber (1999).

The liquidity shock to a single institution thus has the potential to spread further, either through a downward spiral in the price of affected assets or by contagion to other, adjacent financial markets. Such a spiral could arise because of an insufficient number of market makers in a particular market. The smaller the number of market makers willing to match trades, the more volatile the market will be when hit by a shock.¹⁴ For example, LTCM seemed to have been a key liquidity provider to markets in the 1990s. Its exit opened up a big gap in the market for fixed-income assets, further undermining market liquidity.

Agents may also face timing mismatch problems because potential buyers require more time to analyse the potential shift in fundamentals, compared with sellers acting out of urgency to meet margin calls. Arbitrage/hedging relationships between different markets (*e.g.* derivative and underlying assets) then contribute to other asset classes also being affected. Finally, a rise in volatilities may blur the information content of price signals and increase uncertainty regarding fundamentals. These factors may prevent a gradual closing of deviations between observed prices and what is considered to be their fair value in a wide range of markets.

But because of banking liquidity externalities, market liquidity shocks have the potential to propagate even further, notably to money and/or interbank markets, with the potential to severely threaten financial stability. A liquidity shock to a bank can be transmitted to another bank *via* classical interbank links, as the former withdraws funds to meet its domestic shortage. Liquidity shocks can also spread if counterparties refuse to provide short-term liquidity because of uncertainty over whether someone will lend to them if a secondary liquidity shortage arises.¹⁵ Smaller-sized banks with activities in financial markets may also face negative spillovers to their retail funding sources. Deposit outflows towards larger, more systemic banks that are perceived as more robust, competent or benefiting from

implicit government support can further weaken small banks' liquidity positions.¹⁶

2|4 A recent illustration of the market-banking liquidity dynamics under stress: the June-September 2007 market turmoil episode

In June 2007, two highly leveraged hedge funds sponsored by Bear Stearns suffered considerable losses on their USD 20 billion portfolio of ABSs, which contained exposures, including *via* CDOs, to subprime RMBSs.¹⁷ Margin calls triggered the sale of around USD 4 billion of ABSs over a week period, driving down prices and undermining confidence in the market for these assets. AAA-rated CDO tranches were increasingly difficult to liquidate in the absence of a secondary market. In light of these developments, the funds' brokers further tightened collateral requirements, including on highly rated assets. According to the IMF, haircuts during July and August 2007 on AAA-rated ABSs and CDOs rose from 2-4% to 8-10% and, consistent with this, the cost of insuring AAA home equity loans as measured by various ABX indices soared, even though there had been virtually no defaults on AAA-rated ABSs.¹⁸ Some of the large brokers themselves held a considerable stock of ABSs, which most likely sent additional negative signals to markets as regards ultimate clearing prices, further undermining market liquidity.

Market disturbances then spread from ABS to money markets over the summer 2007, further increasing banks' liquidity risks. Short-term money markets, including interbank, CP and ABCP markets, experienced falling maturities, rollover problems and rising spreads (Charts 6 and 7). Banks relying on securitisation funding had to seek alternative funding sources, as warehousing risks materialised.¹⁹ In some cases, committed, credit or liquidity lines to

14 See Allen and Gale (1994); Huang and Wang (2007).

15 See Allen and Gale (2000); Rochet and Vives (2004).

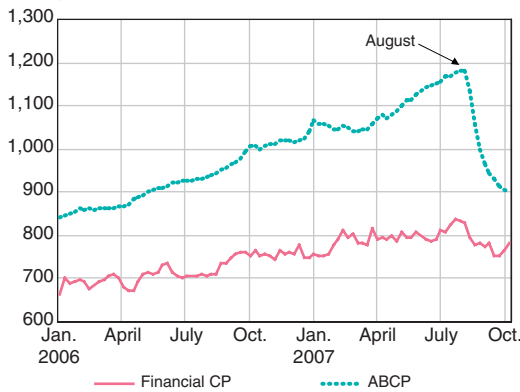
16 See Gatev, Schuerman and Strahan (2005).

17 The subprime residential mortgage market in the US suffered rising delinquencies in 2006 and 2007 as house price inflation slowed and interest rate resets kicked in, resulting in increased uncertainty about the quality of RMBS, including highly rated tranches.

18 See International Monetary Fund -IMF- (September 2007).

19 Fitch (September 2007).

Chart 6
Financial CP (AA) and ABCP outstanding (seasonally adjusted)
(USD billions)

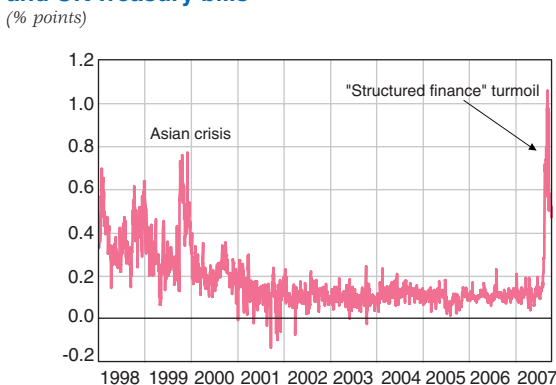


Source: Federal Reserve Board

ABCP conduits, LBOs, and other market participants were activated, further increasing demands on bank liquidity.²⁰

The effects of the initial market liquidity shock and heightened banks' liquidity risks that resulted possibly went beyond levels that can be explained by simple interbank links or by exposures to a common shock. There may have been some rationing of liquidity related to uncertainty about activation of contingent claims stemming from ABCP programs. There may also have been reputational externalities involved. Given asymmetric information, liquidity shortages

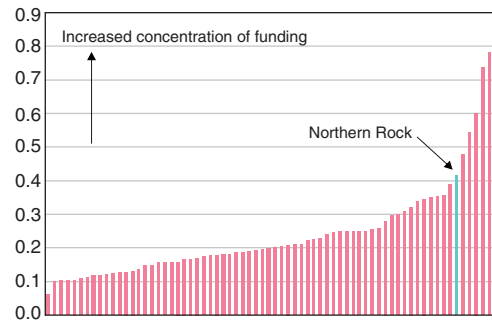
Chart 7
Spread between 3-month UK interbank and UK Treasury bills
(% points)



Source: Datastream

²⁰ The rescue of two German banks, Sachsen LB and IKB Deutsche Industriebank AG, were triggered by an inability to honour liquidity obligations to off-balance sheet vehicles (see Table 1)

Chart 8
Measure of funding concentration of European bank's in 2005
(normalised index)



Note: Based on the Herfindahl index. The higher the index the more concentrated a bank's funding. Here, it is normalised to 1 and based on the sum of squares of the relative shares of nine funding categories provided by Bankscope. The categories are interbank liabilities, retail deposits, wholesale deposits, money market funding, mortgage bonds and subordinated debt, other funding, equity and other liabilities.

Source: Bankscope, based on largest 100 European commercial banks.

revealed at one bank might have signalled something about the banking sector more generally, irrespective of the direct interbank exposures. This might explain the degree of contagion in equity markets from seemingly localised European events, such as the revelation of IKB's problems on 31 July 2007 in Germany to US banks.

Retail deposit funding of smaller-sized banks was also negatively affected in late summer of 2007: Northern Rock, an "originate and distribute" medium-sized UK mortgage lender, was exposed to a run on its retail deposits in mid September 2007 when it emerged that it had difficulties accessing securitisation markets, a major source of concentration of its overall funding. While limited and partial in its description of banks' funding vulnerabilities, a simple measure of funding concentration would indeed have suggested relatively high levels for Northern Rock (Chart 8).

Because of these spillovers between banks and with markets, idiosyncratic liquidity shocks generated considerable aggregate liquidity shortages in August and September 2007, triggering large-scale interventions by central banks worldwide.

3 | MANAGING LIQUIDITY RISKS: THE ROLE OF DISCLOSURE

Banks' vulnerability to market liquidity shocks has clearly increased. To mitigate this fragility, liquidity management is of course of crucial importance. It encapsulates within a forward-looking maturity gap framework the management of liquidity buffers, collateral, credit and liquidity lines and funding sources. Moreover, banks conduct liquidity stress tests to assess their resilience to liquidity shocks, including in changed market liquidity conditions.

Liquidity management practices do of course vary across banks, reflecting different business models and banking environments and partly explaining differences in liquidity buffers from one bank to another. These differences are illustrated in Chart 10 in Section 3|3. Individually, certain banks may also hold liquidity buffers for strategic reasons, to buy up competitors' assets cheaply when the latter experience liquidity problems. Some argue that Citibank's success in the early 20th century was based on such a strategy.²¹ But given that information imperfections are at the heart of liquidity risks, this section focuses explicitly on the role transparency may play in reducing underlying frictions.

3|1 The benefits and costs of disclosure

The 2007 market turbulence episode has led to increased calls for disclosure in the financial sector, largely motivated by a desire to reduce market uncertainty. Indeed, a large body of economic literature supports disclosure of information to investors as a means of reducing asymmetric information and hence facilitating a better allocation of resources. Greater transparency permits greater market discipline, whereby well-managed banks are rewarded, while poorly-managed banks are penalised with higher costs of capital and deposits. Thus, market forces can encourage bank management to adopt safer banking practices, lowering the risk that market disruptions will become systemic problems.

A related argument put forward is that financial institutions would be less exposed to volatile investor behaviour responding to misinformation. Of course, a prerequisite for effective use of disclosure is that there is a functioning market that can exert the necessary discipline on banks (transparency thus depends on financial development).²²

That said, even though greater disclosure may be socially desirable, market failures may prevent sufficient provision of information by market participants. There are a number of reasons why that may be the case. Informational externalities (when information about one bank is mistakenly used to infer information about another bank) could be one of these reasons. This might be because the value of banks' assets is correlated, perhaps because banks have similar business models, asset compositions, or are located in the same region.²³ In such a setting, the release of negative information by one bank can contaminate other banks perceived to be suffering from similar problems.

Empirically, the question whether disclosure always enhances financial stability is not settled either. In 1989, for example, the US Congress decided in the midst of a banking crisis to substantially increase disclosure of supervisory information. According to Jordan, Peek and Rosengren, the information released on supervisory concerns regarding the solvency of individual banks during the banking crisis did not trigger spillovers to healthy banks.²⁴ Yet, in 2007, although transparency about asset compositions appears to have been at the core of recent turbulence, there does not seem to be a clear relationship between disclosure standards in different countries' banking sectors more generally and recent banking-sector stock market declines (Chart 9).²⁵

Asymmetries in information, however, may be just part of a broader information problem prevailing in financial systems. Uncertainty and *imperfect* information that afflict both lenders and borrowers to the same extent may also be significant. A lot of work currently focuses on improving disclosure on the risks of securitisation products and losses experienced in relation to subprime mortgage defaults. In this context, investors, banks and markets are all

21 See Acharya, Gromb and Yorulmazer (2007).

22 See Ratnovski (2007).

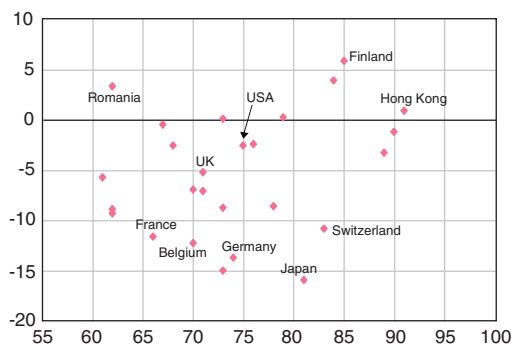
23 See Admati and Pfleiderer (2000); Chen and Hasan (2005).

24 See Jordan, Peek and Rosengren (1999).

25 Of course, share price movements in Chart 9 might also be driven by other factors.

Chart 9
Global banking sectors' initial share price correction and global bank disclosure index

(X-axis: bank disclosure index 2006; Y-axis: % change between 23/8-29/6 2007)



Note: The disclosure index (100 = highest disclosure) is a composite index that aggregates six categories of reporting, namely on loans, other earning assets, deposits, other funding, memo-lines (e.g. contingent liabilities) and income.

Sources: Datastream; World Bank

struggling simultaneously with the issue of how to value complex positions. This suggests that disclosure on uncertain credit fundamentals may be insufficient to restore market confidence. *Instead, disclosure on banks' liquidity itself might be important.* But, as will be shown in Section 3|3, current practices in this area may suffer from severe shortcomings.

3|2 Current practices in disclosure on banks' liquidity and funding risks

According to the 2001 disclosure survey conducted by the Basel Committee, liquidity was one of the areas where most progress on disclosure had been reported.²⁶ Indeed, a large number of banks report positions on liquid assets, notably cash, advances to banks or customers; market and non-market funding sources and related ratios. Data providers such as Bankscope aggregate the various components to produce comparable narrow and broad liquidity measures across banks.

Figures on loan commitments and liquidity lines are also sometimes provided. In some cases, banks disclose in their annual reports the amount

of securities pledged and received as collateral, lines of credit and degree of secured and unsecured lending. Moreover, they also publish liquidity gap analyses, showing the banks' net liquidity positions for different maturities. Qualitative information typically covers the existence of procedures and systems to deal with liquidity risks such as the setting of liquidity limits and establishment of monitoring committees, liquidity contingency plans, responsibility of local entities, policies on exposure to funding sources and limits on unsecured funding gaps. Some banks also explicitly reveal stress test scenarios and the resultant effects on banks' liquidity positions.²⁷ In some cases, central banks conduct such tests jointly with a number of banks.²⁸ Rating agencies also supply the market with information on the strength of banks' liquidity positions. Short-term ratings pick this up explicitly.

In terms of international regulation, there are few concrete mandatory disclosure requirements on liquidity. Under Pillar 3 of the Basel II regime, banks' disclosure is expected to be in line with risk management principles and proportional to the relevance and materiality of information. Specific disclosure requirements largely concern Pillar 1 and capital-related risks. Liquidity risk is specifically only mentioned in relation to securitisation and possibly related liquidity lines.²⁹ Overall, is this disclosure enough for investors to paint an accurate picture about liquidity risks in the banking sector?

3|3 Issues in liquidity disclosure

Firstly, starting off with liquidity buffers, they can only imperfectly capture the liquidity risk of a bank. The book value of assets may differ from the liquidity they can generate. Haircuts on liquid assets vary with market conditions and this is not captured by simple static balance sheet statistics. Moreover, narrow liquidity buffers shown in Chart 10 only report a fraction of "true" liquid assets –some government bonds held outside the trading portfolio (but which

²⁶ See BCBS (2003): "Public disclosure by bank: results of the 2001 disclosure survey".

²⁷ See, for example, Deutsche Bank.

²⁸ See Janssens, Lamoot and Nguyen (2007) for Belgium.

²⁹ Furthermore, when specifically considering the issue of liquidity risks in banks, the Basel Committee states in its "Sound practices for managing liquidity in banking operations" (2000) that "each bank should have in place a mechanism for ensuring that there is adequate disclosure of information about the bank in order to manage public perceptions of the organisation and its sound management (principle 13)".

are potentially very liquid) are for example excluded, but are covered by the broader liquidity measure. How banks categorise assets across the balance sheet thus affects the size of liquidity buffers and comparisons made between banks. In addition, the broad measure shown in Chart 10 excludes securities, such as equities which may be liquid, while it includes other assets –such as less liquid interbank loans with longer-term maturities.

Different buffer measures may also tell different stories over time. In Table 2, changes in classification of debt securities and changes in accounting rules may partly explain why a narrow liquid asset ratio (1) indicates a sharp fall in liquidity buffers between 2001 and 2006, while a broader measure (2) suggests the opposite.³⁰

Similarly, on the basis of the reported assets and liabilities, it may sometimes be difficult to determine whether a given security is available, *i.e.* if it could be used in a repo transaction or not. For

instance, although government bonds are generally considered to be liquid, they may have a liquidity value of zero if they already have been mobilised in a secured transaction, although they are still present on the balance sheet.³¹ Indeed, in repos, the value of securities remains on the borrowing bank's balance sheet despite the potential transfer of ownership.

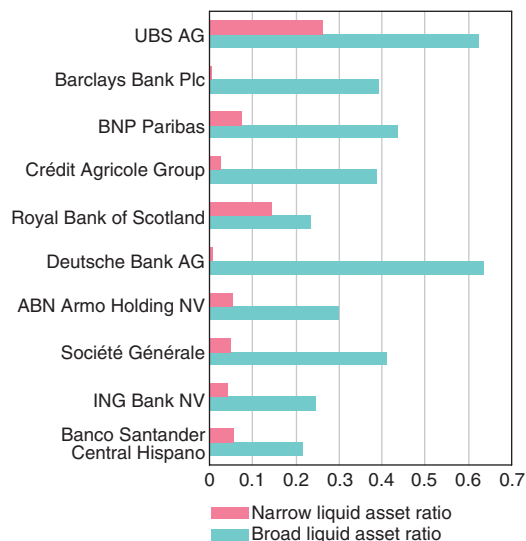
Banks can also use the cash derived from repo transactions to borrow less liquid securities in reverse repos. This again would not be recognised on the balance sheet. Liquid asset positions recorded at one point in time may thus appear more liquid than they really are.

Secondly, some banks centralise liquidity management, which of course affects liquidity ratios of the individual entities and of the consolidating group. A measure at group level is appropriate if liquidity can easily circulate among all the entities of a group, if there are no legal obstacles to its transfer across national borders and if solidarity among all the group entities is ensured.

Finally, liquidity buffers should be compared with potential liquidity needs on the liability side of the balance. A gap or cash flow analysis that matches incoming and outgoing flows of cash for several maturity buckets captures better the time dimension that lies at the heart of liquidity risk management. However, publicly-available information does not allow outsiders to construct an accurate gap analysis for individual banks. For instance, in terms of funding risk, while there may be information on the maturity of funding sources, this does not reveal much about the ease with which these sources could be renewed and how concentrated they are. In sum,

Chart 10
Liquidity buffers across large European banking groups

(share of total assets)



Note: Narrow liquid assets: Deposits and loans to banks (incl. central banks) and governmental authorities with less than three months to run to maturity; quoted/listed government bonds known by Bankscope to be realisable within three months; cash & equivalent.

Broad liquid assets: Deposits with banks (all); loans to banks (all); deposits with central banks & governmental authorities (all); all securities except equities; cash & equivalent.

Source: Bankscope

Table 2
Liquid asset ratios of EU banks

(% of total assets)

	2001	2006
Cash	1.2	1.4
Debt securities	21.7	5.6
Shares/other financial assets booked through P&L	3.7	22.2
(1) Liquid asset ratio (cash + debt)	22.9	7.0
(2) Liquid asset ratio [(1) + shares/other financial assets]	26.6	29.2

Source: BSC (2003) and (2007), 2006 data only refer to IFRS reporting countries.

³⁰ Note, however, that changes over time may also be affected by changes in the underlying sample.

³¹ The data in Chart 10 however adjust for pledgeability.

maturity gap reporting does not explicitly reveal the mechanisms of liquidity management and its underlying complexity.

Previous sections illustrated the difficulty inherent in assessing a credit institution's liquidity risk, especially on the basis of limited public information. A better assessment of liquidity risk may therefore require improved disclosure practices. The definition of best practice with regard to disclosure is no easy task, however.

As already mentioned, the lack of comparability between the data currently disclosed by banks raises questions. With the generalisation of IAS/IFRS, reporting across banks should become more systematic and comparable. But given the principles-based approach of IAS/IFRS, disclosure may still differ in many cases. Taking the example of loan commitments, banks will continue to have significant leeway as to how they report on these contingent exposures. The amount of disaggregation of liquid assets available to make industry-wide comparisons will also remain limited: "due to banks" (which typically accounts for the largest part of liquid assets) covers a broad range of exposures, including short-term collateralised loans. Disclosure of liquidity lines to conduits depends on the degree of consolidation, which itself is open to interpretation, depending on whether the bank "controls" the SPV or not. Recent events suggest that the perimeters of risk consolidation may need to be reconsidered for disclosure to be meaningful.

It might also be difficult for markets to draw relevant conclusions across banks on the basis of qualitative information currently disclosed by banks. For example, on stress tests, it is difficult for outsiders to assess whether a bank's stress test assumptions are internally consistent and how the severity of assumed shocks compares across banks. The following quote, taken from the 2006 *Annual Report* of Northern Rock, illustrates this point: *"The Group's liquidity policy is to ensure that it is able to meet retail withdrawals, repay wholesale funds as they fall due, and meet current lending requirements. [...] This is achieved by managing a diversified portfolio of high quality liquid assets, and a balanced maturity portfolio of wholesale and retail funds."*

Given that liquidity is volatile, contingent and complex, the question relating to the frequency and comprehensiveness at which information should be provided is an important one. In many countries, banks disclose relatively frequently significant details on their liquidity position to supervisors. In Belgium, for example, the scope of reporting to supervisors has recently been enhanced.³² If supervisors benefit from these data, should they not be made available more widely?

Precisely because of its volatile nature, high frequency liquidity information can easily be misinterpreted and thus create destabilising "noise" in markets. There is a risk that by "forcing firms to talk on liquidity", solvent institutions –but with a vulnerable liquidity position– could be subject to runs. Predatory trades and strategies discussed earlier could be encouraged if it is well known who is cash-rich and who is cash-poor, potentially curtailing the provision of liquidity to solvent institutions. Market liquidity could also dry up if markets anticipate the unwinding of large portfolios in particular assets by vulnerable counterparts –as was mentioned in Section 2 in relation to the LTCM crisis. Yet, perhaps if comprehensive and frequent reporting on liquidity flows (instead of stocks at a particular point in time) had already been released ex ante, institutions might have behaved more conservatively in "liquid" times, thus avoiding the erosion of liquidity under stress. Assuming such discipline is achievable, on which aspects should disclosure focus?

The multidisciplinary working group suggested in 2001 exploring the possibilities of more transparency on funding sources and on market liquidity risks.³³ Instead of static ratios, banks could be requested to publish the output of VaRs that explicitly factor in the risk of reduced market liquidity and to explain funding sources, including risks of concentrations. In addition to what was suggested at the time, regulators could request banks to publish more comprehensive information on liquidity risk management systems, comparable details of stress tests and funding contingency plans. Moreover, information on liquidity and funding flows, the components and counterparts and fluctuations over time could be helpful, as well

³² See Janssens, Lamoot and Nguyen (2007).

³³ See "Multidisciplinary working group on enhanced disclosure", BCBS, CGFS, IAIS, IOSCO (2001).

as an analysis of how these flows feed into and affect banks' balance sheets. Finally, in the spirit of recent reports, it might be useful if rating agencies monitored regularly –on a no-external-support basis– banks' robustness *vis-à-vis* liquidity risks.³⁴

But would these suggestions really help in enhancing banks' resilience to liquidity shocks and overcome problems related to imperfect information and aggregate uncertainty? To answer this question, one would first need to address some of the following deeper issues: can the market really play a disciplining role as regards banks' liquidity management or do markets only take an interest in

liquidity once it has become a problem? In other words, to what extent will markets continuously monitor potential future tail liquidity events –especially if they expect to count on central bank liquidity interventions? For example, assuming that markets knew about Northern Rock's funding concentration, why did they not put pressure on the bank earlier by raising borrowing spreads? Could mandatory disclosure as suggested above make any difference and encourage banks and markets to give more weight to liquidity issues in normal times? While these questions merit deeper reflection and further work, the 2007 market events have clearly shown that current information gaps are large and need addressing.

³⁴ See, for example, Fitch's ad-hoc report (2007): "Liquidity analysis of US securities firms", August.

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Liquid assets, liquidity constraints and global imbalances

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The world distribution of current account balances has been steadily drifting away from “normality” since 1997. This puzzling development has occurred in parallel with large scale accumulation of official foreign reserve assets in emerging Asia and commodity exporting countries, and a growing role of portfolio flows in financing the US external deficit. The theoretical toolbox that was used to understand “old puzzles” of international macroeconomics may still be relevant to address these new puzzles, to the extent that it focuses more specifically on liquidity aspects: uneven supply of liquid assets, borrowing constraints, and externalities related to financial infrastructures that foster market liquidity. The paper discusses how these various features have been introduced in the most recent literature on global imbalances. One aspect that may require further examination is the role of financial market liquidity as a “public good externality”: in the absence of appropriate provision of such a public good in emerging economies, reserve accumulation may be seen as an attempt to import the “public services” benefits of holding liquid “risk-free” assets. This may in turn possibly result in a form of “congestion” if US dollar reserve accumulation outpaces the issuance of US Treasuries or equivalent securities. Large reserve holders have thus turned to a wider range of asset classes, including asset-backed securities whose liquidity has all but vanished in the course of recent financial market turbulences. These developments could therefore affect the financing conditions of the US current account deficit, and undermine some of its structural determinants.

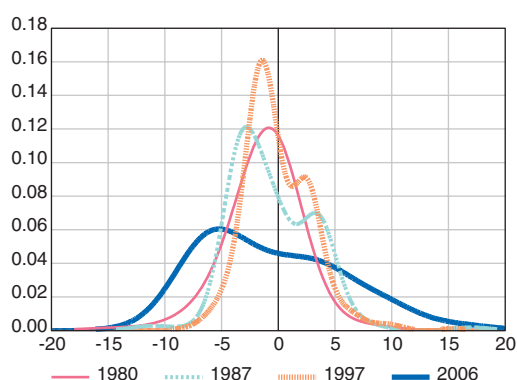
The concern expressed by policymakers and part of the academic literature over "global imbalances" has largely focused on the size and persistence of the US current account deficit, and the resulting large and growing negative external position of the US, which is often deemed to be of systemic importance. However, opposing views remain firmly entrenched on each of the following issues:

- How significant are the "stylised facts" of global imbalances?
- What are the true causes of this state of the world economy?
- Is the situation sustainable? Is a reversal desirable and how can it be achieved?

1 | SOME STYLIZED FACTS

Backus *et al.* (2006) question the claim that the US external deficit is "unprecedented" from a historical and cross-country perspective. We take a broader view of global imbalances by examining the world distribution of current account balances. In order to document the magnitude of imbalances, we look at changes in that distribution, weighting each country by its share of the world GDP. We use non-parametric estimates for the sample of countries in the IMF database (Chart 1). It appears that the 2006 situation is indeed unprecedented in the last quarter of century, not only in terms of the US deficit, but also in terms of the global distribution of imbalances.

Chart 1
World distribution of current account balances as a % of GDP
(density weighted by the share of each country in world GDP)



Source: WEO, authors calculation

¹ In principle, the surface below the distribution in a given year, of current account balances should sum to zero. In practice, it is not exactly the case in the data, because of statistical discrepancies

The world distribution of current account balances has been steadily drifting away from "normality" since 1997.¹ Namely, it has become bimodal, and it has flattened dramatically. Such a flat distribution is especially striking compared to the previous episode of large US current account deficit (that episode reached its peak in 1987 before a disorderly unwinding).

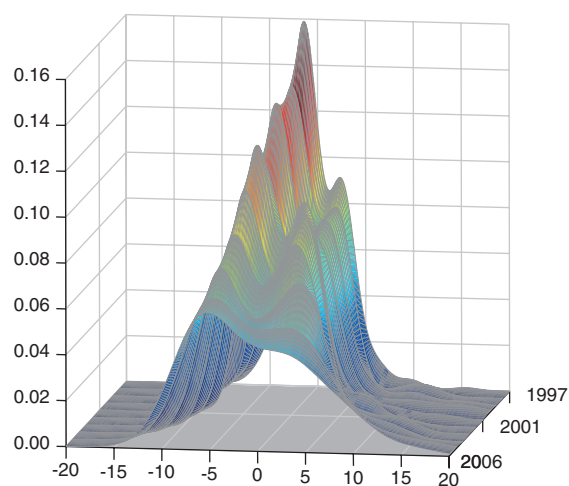
Chart 2 illustrates this spectacular flattening of the distribution with a 3-D view focusing on the period from 1997 to 2006.

While these graphs illustrate the truly global nature of growing current account imbalances, they do not by themselves provide an explanation for the phenomenon.

In addition, a key feature of this distribution is that over the last decade, on a net basis, capital flows have been consistently flowing from emerging economies towards mature economies, a paradox from the perspective of neo-classical growth theory.

The literature explaining global imbalances is abundant and meticulous observers count no less than eleven alternative explanations (Roubini, 2007). However, as highlighted by the ECB (2007), the debate largely revolves around the respective roles of cyclical vs. structural factors. More specifically: one view argues that cyclical policies may have played a role in bringing about a saving shortage in the US; another view emphasizes the role of asymmetric growth potentials

Chart 2
Change in the distribution of current account balances 1997-2006
(density weighted by country share of world GDP)



Source: WEO, authors calculation

and/or market structures in generating current account imbalances as an equilibrium outcome, which could therefore be considered efficient in some sense. A consensus view acknowledges that a combination of factors is required to understand the full picture. As summarized by Blanchard (2007) the consensus is that global imbalances result from a combination of low savings in the US, high saving in Asia and investors' preference for US financial assets.

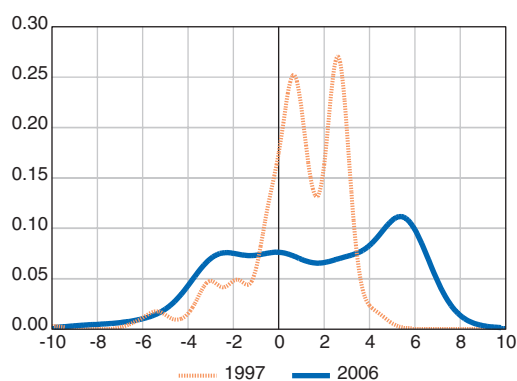
This last factor strikes us as crucial, because conventional explanations that leave it aside often also leave several macro puzzles unresolved, in particular the direction of net capital flows and the persistence of the US current account deficit.

Because current account balances by definition reflect financial flows, one cannot help noticing that the spreading out of current account imbalances has taken place over a period of fast global financial integration and innovation, even though financial market deepness has remained extremely uneven between mature economies and emerging markets.

As a matter of fact, the importance of net portfolio inflows has grown over time as a funding channel for the US current account deficit, in line with the increase of that deficit. The world distribution of net portfolio inflows as a % of GDP is depicted in Chart 3, which can be seen as one of the major counterparts to the current account balances represented in Charts 1 and 2. The increase in the size of net portfolio flows as a share of GDP is especially striking in the US, which is responsible for the rightmost bump in both the 1997 and 2006 distributions.

Chart 3
World distribution of net portfolio inflows as a % of GDP

(density weighted by the share of each country in world GDP)



Source: WEO, authors calculation

2 By contrast, the possible role of monetary policy and global "excess liquidity" in the build-up of global imbalances is not explored here.

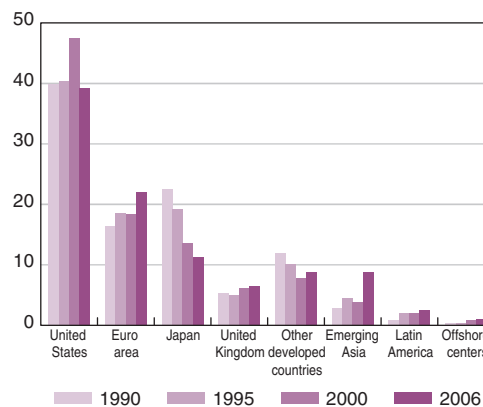
The geographic imbalance of asset market capitalizations (Chart 4) has been the inspiration for an important body of the international macroeconomics literature focusing on the financial account as the driving force of balance of payments dynamics and attempting to explain various puzzles. The main common feature of this literature is that it emphasizes the macroeconomic consequences of microeconomic market imperfections that are frequently related to liquidity issues, primarily: the ability of various economies to supply liquid assets, and the role played by liquidity/borrowing constraints. Liquidity, in a structural sense, is therefore exposed as central to the understanding of international capital flows and resulting current account trends. The purpose of this paper is to provide an overview of such liquidity related explanations of global imbalances.²

The scope for and the welfare benefits of a policy-led reversal of global imbalances (be it through structural or stabilization policies) are of course dependent on the conclusion reached with respect to its root causes. Calls for an "orderly unwinding" often focus on the role of cyclical policies, while the benign neglect view highlights the equilibrium nature of such imbalances. While structural explanations have often been interpreted as benign, an even dubbed a "new paradigm" (Xafa, 2007), we emphasize that we take them seriously as motivating policy action, in so far as the market failures that underpin these models are potentially very costly in welfare terms.

The rest of this paper is organized as follows. Section 2 discusses how the macroeconomic literature has dealt with some puzzling facts regarding current

Chart 4
World distribution of financial assets

(stock market capitalization plus total outstanding debt)



Sources: WFSE, BIS, BâF calculations

account balances and international capital flows. Section 3 reviews the specific role of liquidity issues in recent models of global imbalances, in relation with trends in asset market liquidity. Section 4 concludes by drawing some policy implications.

2 | OLD PUZZLES AND NEW PUZZLES OF INTERNATIONAL MACROECONOMICS

International macroeconomics is puzzle-rich. Obstfeld and Rogoff (2000) have famously offered a "common cause", namely international trade costs in goods markets, in order to explain six of them. Several of the puzzles they have addressed are closely related to current account imbalances, in particular the home bias in asset holdings and the Feldstein–Horioka (1980) puzzle, *i.e.* the correlation between domestic investment rates and saving rates.

It is interesting to note that growing global imbalances may have to some extent dissipated these two of puzzles, as the gap between investment and saving rates has widened in the US and in countries with large current account surpluses. More precisely, we currently witness a reduction in the Feldstein-Horioka puzzle, *i.e.* a reduction in the correlation between the saving and investment rates in the developed economies (which benefit from better financial infrastructures), whereas the correlation remains strong in emerging economies.

Regarding the home bias puzzle, anecdotal evidence indicates that international diversification has been at play in household financial portfolios. Increasing international financial integration thus appears to participate in the reduction of the home bias in asset holdings especially in the US and in Japan, economies with highly developed financial systems.

The question of why capital doesn't flow from rich to poor countries is another longstanding current account puzzle, first explored by Lucas (1990). Differences in human capital were his main focus, and empirical investigation of the Lucas puzzle (Alfaro *et al.*, 2005)

emphasizes differences in "institutional quality". We will argue later that financial infrastructure providing liquid asset markets plays a central role.

Extending the neoclassical growth framework, the inter-temporal approach to the current account (as summarized by Obstfeld and Rogoff, 1994) has recognized that in a stochastic environment, current-account balance determination largely depends on the extent to which markets exist for insuring against shocks. In the case where insurance markets exist for all future contingencies, with outcome fully verifiable and contract fully enforceable, international capital flows can perfectly insure against any country specific shock and from a formal point of view, assuming there is no "world" or aggregate shock that would remain uninsurable, each country's economy can be analysed as if perfect certainty prevailed. However, in practice, asset markets are hardly complete, in particular due to asymmetric information and moral hazard that prevent full risk sharing. In the international context, sovereign risk and distance, together with cultural and legal differences magnify the difficulties.

Heterogeneity in levels of financial development, in particular various degrees of financial markets deepness, even among developed economies, is all the more important as current account balances (as a percentage of GDP) are negatively correlated with indicators of financial development. Indeed Kharroubi (2007) shows that after the 1997 Asian crisis, countries with current account deficits have been those where financial development, as measured by private credit as a percentage of GDP, has been higher.

The puzzling direction of international capital flows has thus further been explored in models focusing on financial imperfections (*e.g.* Gertler and Rogoff, 1990).

However, until it unfolded over the last decade, the puzzling build-up of large global imbalances could not be addressed as such in the literature. More specifically, the present state of the world economy can be seen as a collection of related "new puzzles" of international macroeconomics:

- the persistence of the US current account deficit together with a persistent surplus in the US income balance, in spite of a growing negative external position (see *e.g.* Gourinchas and Rey, 2005);

- the large scale accumulation of official foreign reserve assets in emerging Asia.

Dooley, Folkerts-Landau and Garber (2003) have outlined a coherent explanation with their so-called "Bretton Woods 2" (BW2) conjecture. The idea is that Asian emerging economies are pursuing export-led growth strategies by deliberately maintaining undervalued exchange rates, while providing the funding for the US current account deficit, as the US is a key consumer of these exports. However, what strikes us is that the BW2 conjecture is in itself a puzzle. In some general game theoretic sense, it may be considered as a kind of strategic "international policy" equilibrium. But in order to ascertain its dynamic (in)stability, a more elaborate modelling of the underlying incentives is required. A deeper understanding therefore vindicates the investigation of its microeconomic foundations.

In particular, a convincing explanation of global imbalances should not only account for the "uphill" direction of net capital flows, but also for the "allocation puzzle" (Gourinchas and Jeanne, 2007): the fact that net capital flows between emerging countries and industrialized countries are directed toward economies that have lower investment rates and lower growth rates. Besides, a full understanding of the direction of *gross* capital flows (distinguishing between direct investment and portfolio investment) may require a more complex modelling of financial frictions and incentives.

To summarize, old puzzles of international macro have largely been dealt with by incorporating market imperfections such as trade frictions and capital market imperfections, as well as growth externalities such as human capital. This toolbox may still be relevant to address some new puzzles of international capital flows, by focusing more specifically on liquidity aspects:

- various degrees of risk and market completeness, that make insurance and diversification more or less available (a liquid market is one that offers a wide range of assets);
- credit market frictions such as borrowing constraints, as one particularly important aspect of market imperfection (a liquid market is one that facilitates borrowing);

- externalities resulting from accumulated capital, such as human capital, but also institutions and infrastructures, in particular financial systems (that foster market liquidity).

The next section describes how these various features have been introduced in the most recent literature on global imbalances.

3| STRUCTURAL LIQUIDITY ISSUES IN MACRO MODELS OF GLOBAL IMBALANCES

3|1 Asymmetric supply of assets, incomplete markets and global imbalances

A first approach of global imbalances where market liquidity plays a central role relies on the intuition that asymmetries in financial development translate into uneven ability to supply assets, in particular *liquid* assets. From the asset demand side, incomplete asset markets can also bear consequences for saving behaviour. Asset market completeness and liquidity can be decisive in directing capital flows, therefore determining financial account imbalances. Such financial development asymmetries are not new, so that one may wonder why they should have played a specific role in the recent build-up of global imbalances. A possible explanation relates to the recent pace of globalization: its growth benefits may have spurred demand for financial assets, while institutional changes that determine the supply of sound market instruments may proceed more slowly.

ASSET SHORTAGE

Rajan (2006) and Caballero (2006) have both popularised the "asset shortage" hypothesis as a potentially comprehensive explanation of global imbalances, as well as of some asset prices puzzles (in particular the long-term interest rates "conundrum"). Caballero is concerned with the "shortage of financial assets" in a general sense. By contrast, Rajan's concern

is with the "global shortage of hard assets", in relation with physical investment; as a consequence, he also focuses on the resulting shortage of debt instruments, which often need to be backed by hard assets.

Rajan's explanation for the asset shortage situation relies on the observation that nominal investment may have been unusually low in some areas. The consequence is that the incremental amount of assets that are produced and can serve as collateral has decreased. Rajan's approach is particularly relevant for fixed income instruments, in particular the so-called "asset-backed securities".

Caballero conjectures that the asset shortage may stem in particular from the inability of emerging economies to produce sound and high quality financial assets required by local agents, ranging from households to central banks, to store wealth. Indeed, developed countries' stock markets rely on strong property rights, while the repossession mechanisms for debt securities require appropriate infrastructure and good governance. Caballero stresses that emerging economies are characterized by "weak bankruptcy procedures, chronic macroeconomic volatility and sheer expropriation risk". As a consequence of these deficiencies, the utility of their domestic assets as a store of value or as collateral is certainly much lower than that of assets produced in developed economies. As the highest growth rates are being recorded in countries with low levels of financial development, the collateral value of investments realized in these countries is limited and therefore the world supply of financial assets is refrained.

Meanwhile, advanced economies such as the United States or the United Kingdom have managed to combine a steady growth with a great ability to produce sound and liquid financial assets, which may account for net financial flows being directed towards these economies, and the resulting build-up in their current account deficits. In particular, it is interesting to note the parallel between the growing US external deficit and the surge in residential investment in the US, accompanied by financial innovation that has favoured growing issuance of residential mortgage backed debt and other asset-backed securities.

Building on the "asset shortage" intuition, Caballero, Fahri and Gourinchas (2006) constructed a model in which asymmetric abilities of country to

produce financial assets are responsible for global imbalances. In their framework the domestic supply of financial assets is mechanically related to the level of financial development. This model fits the situation of Asian economies with high saving rates that cannot be satisfied by insufficiently liquid domestic asset markets. "Excess saving" is therefore being exported towards countries with large supply of high-quality assets. Such imbalances can moreover be exacerbated by other international asymmetries in saving behaviour (resulting from the rapid pace of growth in Asia, as well as demographic phenomena and precautionary motives).

INCOMPLETE MARKETS AND UNCERTAINTY

The role of macroeconomic volatility as a potential explanation for asset shortage was mentioned by both Rajan (2006) and Caballero (2006). Yet as Caballero *et al.* (2006) built primarily on the asset supply consequences of asymmetric levels of financial development, they did not address market completeness and risk as such. By contrast, Mendoza, Quadrini and Rios-Rull (2007) focus on the consequences of financial opening under uncertainty, when markets in different regions of the world are more or less incomplete. They are specifically interested in relating global imbalances with growing financial integration occurring among countries with heterogeneous level of financial development. Uncertainty, and the inability of agents to perfectly insure against it, have direct consequences on saving rates and on the asset demand. Besides, their modelling of heterogeneity in financial market development accounts for lasting global imbalances as well as for the composition of financial flows (direct investment from developed economies towards emerging economies and portfolio investment the other way round). A more developed economy is more likely to take risks by investing in financial assets from emerging economies whereas emerging economies will be looking for risk-free financial assets to hedge against shocks. The asymmetry in financial markets development drives the excess saving in emerging economies towards developed economies.

Beyond the market structure considerations (asset supply, relative market liquidity), a better understanding at the macroeconomic level requires to consider the liquidity services provided by foreign asset holdings.

3|2 Liquidity constraints, liquidity shocks and global imbalances

Another aspect of the role of liquidity (or lack thereof) in bringing about global imbalances is explored in the literature that addresses the role of liquidity constraints in relation with international capital flows. It is not unrelated to the issue of asymmetries in financial deepness insofar as such liquidity constraints are just a special case of market incompleteness. In a general sense, such constraints may be more or less binding depending on the state of financial development. More specifically, the issue of credit constraints is closely linked to the asset shortage/incomplete markets issue in at least two ways:

- the availability of assets that can be posted as collateral is of course a key determinant of the ability to borrow;
- the possibility that a borrowing constraint may become binding in the future is an additional motive for saving by accumulating liquid assets.

Dealing with the international dimension of liquidity constraints naturally leads to the recognition that international liquidity may differ from domestic liquidity. This was a central aspect of the approach by Barro, Mankiw and Sala-i-Martin (1995), which showed that the difficulty in using human capital as collateral for international borrowing can explain slower rates of convergence within the framework of the neo-classical growth model.

However, a different framework, based on contract theory, for dealing with liquidity constraints has now become predominant following in particular seminal work by Holmström and Tirole (1998). Caballero and Krishnamurthy (2001, 2002) provide an interesting investigation of the role of financial constraints on international capital flows, in an effort to improve models of financial crises in emerging market. In a 'dual liquidity' model, they distinguish between the financial constraints affecting borrowing and lending among agents within an emerging economy, and those affecting borrowing from foreign lenders. Financial claims on future flows (collateral) that can be sold to foreign and domestic lenders alike are labelled international liquidity, while those that can be sold solely to other domestic agents are labelled

domestic liquidity. Holmström and Tirole (2002) have further explored the issue of international liquidity by extending their model to allow for foreign investors to provide liquidity services to domestic firms. While this line of work provides valuable insight on the interactions between the tightness of the international constraint, the contraction of domestic collateral and real activity, it is not meant to deal with issues related to global imbalances.

However, two interesting implications can be drawn for the current state of the world economy if one considers that US Treasury securities can be thought of as a financial vehicle of international liquidity:

- one reason why a country such as the US has never run into a current account crisis as such may be that it has never faced a shortage of international collateral;
- the large accumulation of foreign exchange reserves in the form of US securities can be thought of as international collateral for foreign direct investment into emerging economies.

This interpretation of the role of foreign reserves has been put forward by Dooley, Folkerts-Landau and Garber (2004, 2007) and also in Gourinchas and Jeanne (2007).

More directly in relation with global imbalances, Ju and Wei (2006) build on Holmström and Tirole (1998) to propose a model that resolves two paradoxes of international capital flows: they address the issue that international capital flows from rich to poor countries can be regarded as either too small (Lucas paradox) or too large (if one believes in factor price equalization). Firms are subject to liquidity shocks, which they overcome all the more easily as financial markets are developed. Besides, Ju and Wei also allow for differences in levels of property rights protection. The combination of these ingredients allows rich patterns of gross capital flows to emerge with differences between countries: a country with little physical capital and an inefficient financial system may experience both an outflow of financial capital and a direct investment inflow, resulting in a positive net inflow. This phenomenon is described as a "bypass" of the poorly developed domestic financial system. By contrast a country with a low capital-to-labour ratio but a high risk of expropriation may experience financial outflows without the compensating direct investment inflow, thus resulting in large net capital outflow.

From the perspective of the role of liquidity issues in explaining global imbalances, Ju and Wei's approach is interesting in at least three dimensions:

- this framework explicitly outlines the role of liquidity constraints and liquidity shocks in determining the direction of capital flows;
- by making a distinction between financial flows and direct investment flows, it allows for a more accurate understanding of gross capital flows, of which "global imbalances" are a net outcome; it is consistent with the Gourinchas and Rey (2005) explanation of the US income balance;
- the ability of firms to cope with liquidity shocks is seen as an index of financial development: this can be understood as firms having access to more or less liquid financial markets, such liquidity being possibly supplied publicly in the form of government securities.

3|3 Financial market liquidity as a public good and global imbalances

The role of public goods can be analyzed both at a macro level –their contribution to growth– and at a micro level, from the perspective of economic agents that benefit from them.

Lucas (1990) showed that growth externalities can have an implication for capital flows. While his focus was on human capital, public goods clearly play a similar role. Furthermore, the role of financial infrastructure as public goods is most likely to have a defining influence on the direction of financial flows.

In a general sense, the existence and proper functioning of liquid financial markets can be interpreted as a public service that enters into the technology, and therefore the productive function of advanced market economies. It is not immediately clear however whether the service provided by deep financial market is rival³ and/or excludable,⁴ and to which of the theoretical "public goods" models it relates. Indeed, public services provided by financial markets can be characterized at various levels.

³ Rival goods are those that can be consumed by only so many persons at a time.

⁴ Excludable goods are defined by the feature that their consumption by those who have not paid for them can be prevented at low cost.

The public good may be the whole financial market infrastructure that contributes in particular to generating market liquidity: part of that infrastructure may be privately provided (*e.g.* exchanges and clearing houses), but some essential components are typically publicly provided (*e.g.* regulations, supervision, lender of last resort, contract enforcement), so that it is probably best to characterize market infrastructure as a range of various public goods.

Focusing on the components of the infrastructure that are publicly provided, regulation and supervision are clearly pure public goods. The public good factor of large-value payment systems has been explored in the context of the Eurosystem's real-time gross settlement system (Pagès and Humphrey, 2005). To the extent that they may be subject to queuing phenomena, payment systems can exhibit "network externalities". Intraday liquidity management by participants can thus potentially lead to gridlock phenomena, one aspect of systemic risk in interbank payment and settlement systems (De Bandt and Hartmann, 2000).

Congestion of public goods has been studied in the context of endogenous growth models (Barro, Sala-i-Martin, 1990), but it has not been considered as such in more recent models of financial intermediation and capital flows. Nevertheless, interesting features of several theoretical approaches can be related to that notion, in particular:

- generally speaking, constraints that prevent borrowing (*e.g.* against future labour income) by lack of the appropriate financial infrastructure can be suboptimal and costly in welfare terms;
- in Holmström and Tirole (1998), the productive sector is willing to purchase low yielding government securities as an intermediate input in the production process : the lack of publicly supplied liquidity can therefore be thought of as a form of public service congestion, namely a shortage of liquid financial assets;
- Rajan (2006) notices that a shortage of fixed assets that can be used as collateral cannot be immediately overcome by financial innovation, because financial derivatives require posting of collateral: in that spirit a form of congestion may come from the inadequacy between the rate of growth of real assets and that of financial innovation.

These approaches suggest that it is useful to focus on the actual provision (public or private) of liquid financial assets, as a key feature of an efficient market infrastructure. Ownership of such assets is rival, but excludable through price mechanisms. However, the liquidity services provided by those assets can be subject to congestion if they are used by too many asset holders at once.

From a practical standpoint, the notion of congestion evokes various undesirable states of financial markets:

- some market participants may attempt, and sometimes succeed to "corner" a large share of some liquid assets such as Government bond benchmarks;
- some segments of financial markets are sometimes subject to "seizures" (vanishing of liquidity).

How is the congestion approach useful for the understanding of global imbalances?

From the perspective of emerging economies, one can understand the accumulation of large amounts of financial assets issued by advanced economies as an attempt to import the "public service" benefits provided by holdings of US or European government securities. In other words, financial globalization can be seen as having made internationally available a public good produced in developed economies: liquid "risk-free" assets. The absence (or congestion) of such a public good in emerging economies is thus "by-passed" (using the Ju and Wei terminology). Accumulation of foreign reserves therefore serves both as an insurance against the risks of international financial integration (such as balance of payment crises or banking crises), but also as "foreign collateral" (Dooley, Garber and Folkerts-Landau, 2007; Gourinchas and Jeanne, 2007) in the international intermediation of saving: as such, it may facilitate foreign direct investment into the country. Indeed, Dooley *et al.* (2007) explicitly consider "a country's international collateral as a public good for its residents".

The two roles are clearly linked insofar as those liquid assets could be sold in order to provide emergency liquidity support to domestic banks (*e.g.* by repurchase of sterilization bills that have been issued to them).

From the perspective of the advanced economies that issue those securities however, the consequences of making them globally available are mixed.

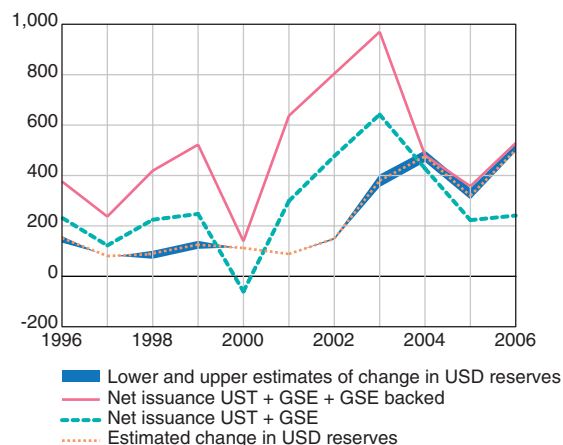
On the one hand demand for such securities by foreign reserve managers may help relax borrowing constraints for eligible issuers.

On the other hand it may induce some of the above-mentioned congestion effects in the developed financial markets: if the holdings by foreign central banks become very large, that may to some extent remove the liquidity of the instrument; in addition, large portfolio shifts may trigger market seizures in specific compartments. Chart 5 illustrates the fact that over the recent years, estimated foreign reserve accumulation in US dollars has exceeded the net issuance of US Treasuries and US Agency securities (traditional asset classes for official reserves), even when including net issuance of GSE backed mortgage pools.

As a consequence, concern over possible lack of liquidity supply in the form of traditional reserves assets may partly explain the drive of large foreign reserves holders to invest into a wider range of asset classes, in particular asset backed securities. This highlights another issue from the perspective of emerging economies investing in such assets: the fact that their liquidity has all but vanished in the course of recent financial market turbulences questions the "public good" benefits that can be expected from holding them.

Chart 5
Net issuance of US Treasury and agency securities and USD reserve accumulation

(USD billions)



Sources: COFER-IMF, Flows of Funds, BdF calculations

Recent financial market developments could structurally affect the financing conditions of the US current account deficit, with possible implications on the pace of adjustment if some categories of US issued asset classes have become less attractive to non US investors.

Yet the latest IMF projections (IMF, 2007) still forecast a small and gradual reduction in the US current account deficit as a share of GDP, together with a contraction in external surpluses of oil exporting economies. Noticeably, surpluses recorded in emerging Asia, in particular in China, are expected to be sustained at a foreseeable horizon. As a result, the world distribution of current account imbalance would evolve very slowly: the reversal in the recent flattening trend would be very limited, and the distribution would remain very asymmetric, with a fat tail on the surplus side. The puzzles of global imbalances may therefore be with us for many more years.

To the extent that global imbalances reflect various aspects of market completeness, including undesirable credit market frictions, and lack of publicly supplied liquidity in some fast growing economies, they may possibly entail large welfare losses over time. Policies favouring the removal of such structural distortions, in particular the development of insurance mechanisms and liquid financial markets in emerging economies should therefore be encouraged.

It will take time before the benefits of structural policies can be reaped. Meanwhile, as long as some bypassing of inefficient financial systems is at play, the liquidity of assets issued by advanced economies (first of all by the US) will remain central to international financial stability. In particular, whenever the liquidity of official reserve assets is at stake, the congestion hypothesis may be worth investigating. It may provide a useful framework to encompass:

- *the rationale for public supply of liquidity,*
- *the asset shortage hypothesis and,*
- *the systemic implications of "excess" foreign reserves accumulation.*

At this stage we lack a formal model to fully understand all the effects (positive and negative) arising from the international usage of liquid government securities as a public good. This however appears to us as a promising venue of research.

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Financial innovation and the liquidity frontier

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In the traditional model of financial intermediation, the sources and the process of liquidity creation through banks' balance sheets were particularly clear. The robustness of liquidity in such a regime is essentially based on the quality of the banks' assets and the credibility offered by the institutional framework within which they operate (deposit insurance, access to central bank money and more generally regulatory and prudential constraints).

In the current financial system, with the perpetual supply of new capital and risk transfer instruments, endogenous liquidity sources have undeniably diversified and grown, but they appear to be less stable and reliable. Financial innovation, to an extent, may have let market participants believe that they could, on an enduring basis, escape from the monetary constraint (the need for genuine cash) and that they could make do with the liabilities issued by other institutions to meet their liquidity needs.

However, market instruments can satisfy investors' liquidity preference only as long as the state of confidence in the marketplace supports them. Liquidity preference, which is intimately linked to asset price expectations, is indeed liable to shift swiftly at times, and to bring about runs on the most certain forms of liquidity (bank money, and worse, central bank money). Ultimately, the liquidity of financial assets depends on the trust that they can be redeemed on demand.

Such trust is probably more difficult to ascertain in the market-based, highly securitised world.

Still, crises may sometimes have educational virtues, and the turmoil of this summer has revealed some urgent needs to "robustify" the sources of liquidity in the system. It is now obvious that some additional suppliers of liquidity are needed in nearly absent secondary markets for complex structured credit products. This probably cannot be achieved without greater disclosure on the structures of investments among market participants. It is also clear that the containment of liquidity risk depends on the ability of financial institutions to properly price complex products, in their regular risk management process as well as in times of crisis.

The "liquidity frontier" cannot be pushed back indefinitely. Those who, in the end, accept illiquidity in their balance sheet must clearly understand and control the risks they are taking on. Such illiquidity is more acceptable for investors with long time horizons, and who are not subject to creditors suddenly calling in their money at short notice. For others, larger liquidity buffers acting as an automatic stabiliser to smooth the financial cycle might be necessary to hedge their risk.

Without such precautions, financial innovation could unduly extend the liquidity insurance implicitly expected of central banks. Yet, it is certainly not the role of a central bank to prompt market participants to rush into "not-so-reliable liabilities".

Over the last few years, investors have felt increasingly comfortable with risk seeking, due in part to the view that profitable, but illiquid investments, could easily be disposed of in the markets, thanks to a plentiful supply of money, low interest rates and the inflows of cash from developing and oil-exporting countries running surpluses with the US. Furthermore, the conviction that financial engineering would always allow risks to be offloaded to hundreds of other market participants has made this search for yield all the more attractive.

The current financial turmoil has at the very least shaken this common notion of "abundant liquidity" in world financial markets. It has shown that market liquidity can never be taken for granted, even in usually placid markets. This summer, not only were markets for securitized mortgages hit, but the core of interbank relationships have been endangered, prompting several central banks to provide substantial amounts of cash, at times in emergency liquidity assistance operations.

This episode of liquidity drain invites us to consider the structural changes that have affected the financial sector in recent decades and that have deeply changed the way liquidity is provided to the system. Throughout the post-Bretton Woods period, the world financial system has benefited from a continuous expansion of the availability and variety of financial instruments. New forms of intermediation and new financial products –especially those meant for the transfer of credit risk– have added flexibility to financial transactions and can be seen as a response to the demand for more liquid balance-sheets. Like in the past, this process of financial development and innovation has been a way to push back illiquidity constraints.¹ It has resulted in the creation of new sources of endogenous liquidity in markets, and simultaneously, moved banks away from their traditional monetary role, *i.e.* providing liquidity by making loans and taking deposits. Key in this process, securitization has enabled economic agents to obtain cash more readily against an array of future expected cash flows: from basic assets (loans, securities and receivables) as well as other securitized products such as subprime residential mortgage-backed securities, collateralised debt obligations (CDOs) or asset-backed commercial paper (ABCP).

This structural change towards more completeness in financial markets, raises the question of the robustness of this liquidity provision regime: are the new sources of liquidity sufficiently reliable? Is it possible to circumvent the monetary constraint on a long-term basis, *i.e.* continually produce substitutes for money through innovation without risking recurrent and distressing returns to the ultimate form of liquidity (central bank money)?

We will first attempt to clarify the way the "liquidity frontier" has been pushed back in the current financial system, which will reveal the conditions for liquidity creation. We will then examine to what extent such a regime may be moving closer to the limits of illiquidity.

1 | A NEW LIQUIDITY PROVISION REGIME: PUSHING BACK THE LIQUIDITY FRONTIER

In an ideal world of "complete markets", every commodity is perfectly liquid and therefore liquidity is always available when it is needed. Liquidity provision would not be an issue in such a world. In incomplete (real) markets, having access to liquidity implies either trading in a market or bank contracts (deposit contracts or credit lines) that offer an option to withdraw when liquidity is needed.

Bank-based systems have naturally produced liquidity in the latter form essentially, through monetary intermediation. The evolution towards more market-based financial relationships does not mean, however, that financial intermediation has become less useful in the process of liquidity creation. On the contrary, competition in the financial sector has spurred the growth of non-bank institutions offering new products adapted to the liquidity preference of investors. The increased size of the financial market has even coincided with a shift away from direct participation by individuals in financial markets towards participation through various kinds of intermediaries such as investment or pension funds.²

¹ J.R. Hicks (1969) shows, for example, how the Second Industrial Revolution has been mainly a Financial Revolution, with the growth of capital markets, which made possible the financing of large-scale and highly illiquid investments such as railroad infrastructures.

² See Allen and Santomero (1999).

The current financial system would therefore be better characterised as an "intermediated-market based system".

In fact, financial intermediaries have always produced liquidity either by means of trading in markets or by asset transformation. What has fundamentally changed is not these functions but their relative proportion and their forms.

1|1 Liquidity provision through traditional bank intermediation

In less diversified financial systems, liquidity is essentially a product of banking activity through deposit-taking and loan supply. Such traditional monetary intermediation provides insight into the necessary conditions for liquidity to be created: the ability of banks to make their debt continuously acceptable (*i.e.* their ability to roll over their deposit-taking) in order to fund their loan supply (notably in the form of loan commitments).³ The acceptability of demand deposits as money in turn rests on various characteristics of banks, notably the level of their capital, the quality of their assets and the institutional framework within which they operate (prudential supervision, deposit insurance, access to central bank money, etc.).

Confidence in the quality of the debt issued by banks is thus key to the continuity of liquidity production. This is the essential foundation for liquidity to exist.

The theory of financial intermediation suggests that the liquidity insurance offered by banks stems from their ability to transform assets. This transformation activity exists because banks are supposed to be better at pooling, selecting and monitoring investments than their depositors. In fact, any intermediary (whether bank or non bank) produces liquidity as long as it performs "qualitative asset transformation".⁴ This is a conclusion that can be drawn from the seminal work of Gurley and Shaw (1960), which remains particularly relevant in the analysis of the activity of the non-monetary financial intermediaries that have grown in the last twenty years (mutual funds, pension funds, hedge funds, etc.). According to Gurley and

Shaw, the function of financial intermediaries is to hold "primary debt securities" issued by economic agents with funding needs, and to collect resources among agents with surplus funds (investors) by issuing "indirect debt securities" that better meet their preferences than primary securities, notably in terms of liquidity. This function highlights the core business of financial intermediaries: customization of financial products, risk management and financial innovation. By absorbing some risks, reducing asymmetric information between lenders and borrowers as well as transaction costs, financial intermediaries are thus in a position to offer more liquid and acceptable assets to investors. Diamond and Rajan (2001) argue that the "fragile capital structure" of banks, subject to runs by depositors, is paradoxically a condition of their activity of liquidity creation. Without their typical balance sheet mismatch, they would simply mimic the market and would not add liquidity to the financial system. Thus, it is from their ability to absorb risks (counterparty risk, duration risk, market risk, etc.) and manage them credibly that their ability to create liquidity stems.

In recent decades, deregulation and increased competition in the financial sector have given impetus to a rapid movement of innovation. As a consequence, banks have been enticed to move to the "originate to distribute" model, by which they originate loans and then distribute the underlying risk to a myriad of outside investors by means of dedicated, innovative instruments. Banks have also purchased more willingly assets with the sole intention of reselling them. This new form of business model has deeply changed the modes of risk absorption in the financial system, and hence, has given rise to new forms of liquidity creation: less through monetary financing and more *via* capital market operations.

1|2 Capital markets as a growing source of endogenous liquidity

One of the fundamental consequences of the competition between banks and capital markets, as highlighted by Allen and Gale (1997), has been a change in the risk management function of banks. Traditionally, banks perform an "intertemporal

³ As shown by Kashyap, Rajan, Stein (2002), there is a natural synergy between these two activities, as long as deposit withdrawals and commitment takedowns are not perfectly correlated.

⁴ This expression, attributable to Bhattacharya and Thakor (1993), refers to the transformation of maturity, unit amount and other characteristics of assets performed by financial intermediaries.

smoothing" function to stabilize returns and insure investors against risks that cannot be diversified at a given point in time. This involves building up reserves of liquid and safe assets in good times, on which banks can draw to shield their customers from the liquidity shocks to which they may be subject over time.

This capacity to absorb risk on an intertemporal basis has precisely been at the base of liquidity production by banks. But with increasing competition from markets in the collection of resources, and the emergence of more attractive market products for investors, banks have found it more difficult to manage risks (and consequently produce liquidity) that way: this is precisely reflected in the change in the composition of banks' balance sheets in developed countries over the long run, with the decline in cash holdings and traditional liquid assets.

Instead, banks have increasingly used derivatives and similar techniques for managing risks. These market-based techniques are well adapted to "cross sectional risk sharing" (*i.e.* achieved through exchanges of risks among investors at a given point in time). Hence the development of credit risk transfer activities in the markets, based on credit derivatives and asset securitization. This development has led to the "commoditization" of credit risk. Financial innovation has enabled risks to be sliced and diced, and traded on their own or rebundled in the form of new products. This greater ability to trade risks and assets through market transactions in itself enhances the liquidity of the financial system. New financial structures engaged in maturity transformation, and acting more or less like banks have also emerged (money market mutual funds, securitization vehicles, etc.), which contributes to liquidity production, at least in normal times, as long as there is some maturity mismatch in their balance sheet and that this situation is sustainable.

In the process, banks have reduced their holding of non-tradable claims and increasingly behaved like non-bank financial intermediaries. Banks still provide liquidity in this way, but they are also more dependent on the market for ensuring their own liquidity, which constitutes a major change.

By putting greater demands on capital markets, banks (and other financial intermediaries) basically

rely on other investors' ability and willingness to step in to provide cash exactly when needed. Both models of liquidity provision (through traditional, relationship-based intermediation and through arm's-length, market-based finance) certainly rest on confidence. But the first regime is more institutionalized: the source of liquidity is in this case clearly identified: *i.e.* banks' balance sheets. Conversely, the new regime has diluted the sources of liquidity. They stem from multilateral, anonymous relationships in the marketplace, which makes them even more confidence-sensitive and probably more fragile.

2 | ON THE BORDERS OF ILLIQUIDITY

The marketisation of liquidity goes hand in hand with the proliferation of innovative bespoke instruments that lack deep, "battle-tested" secondary markets. By nature, their lack of transparency for investors is an impediment to the maturation of such secondary markets and even, sometimes, to the existence of an observable market price. Moreover, by feeding leverage, financial engineering increases the probability of market illiquidity and, at the same time, gives investors a misleading sense of liquidity.

2|1 Informational failures at the core of liquidity risk

LIQUIDITY AS A COGNITIVE PROBLEM

For an asset to become easily negotiable, it has to be turned into a common item for trade, *i.e.* standardized somewhat. The more an asset has a transparent economic value, whose features can be credibly communicated to a large investor base, the greater its potential liquidity. Indeed, standardisation reduces the need to make costly investment to get detailed information, and reinforces the certainty of the nominal value attached to any liquid asset. As some sociologists nicely put it, liquidity is also "a problem of public knowledge about economic assets",⁵ and relies on people's ability to formalize the income streams and events that affect the value of these assets.

⁵ See Carruthers et al. (1999) who ascribe the "liquidification" of the US secondary mortgage market to the process of homogenization organized by government agencies (Fannie Mae, Ginnie Mae and Freddie Mac) through the setting of formal standards and uniform protocols for underwriting mortgage transactions.

Many institutional arrangements can improve the understanding of assets, thus making them more acceptable: certifications, credit enhancements (such as those provided by monoline insurers), the fungibility technique⁶ or agency ratings for instance. The creation and development of organised exchanges for derivatives is clearly one of those innovations that simplified the trading process for many goods, by setting a common informational environment for traders. Obviously, it is easier to standardise the contractual terms of derivatives than the physical underlying commodity to be delivered. This accounts, for example, for the fluidification and growth of energy markets in the recent years. In the same vein, ISDA (International Swaps and Derivatives Association) master agreements have boosted the development and liquidity of credit default swaps (CDS) markets.

The basic process of securitisation also corresponds to this logic, when it is based on homogenous claims. It then allows the creation of information on the pool of underlying assets and diminishes the informational requirements for investors. Securitisation contributes to mitigate informational problems. The pooling of homogenous assets is a way to reduce adverse selection problems for investors (the probability of selecting low-performing assets), since the performance of a pool is more predictable than the performance of individual assets. This, in principle, helps investors to discriminate between sellers of good and bad products. In addition, tranching the proceeds stemming from the pool of assets according to their risk of default mitigates moral hazard problems (the probability that the seller will not monitor the risks carefully after their securitisation), when the seller commits to bear the first losses.

COGNITIVE FAILURES IN THE SECURITISED FINANCIAL SYSTEM

Nevertheless, for a large part, the creation of securities collateralised by assets has not been accompanied by the information needed by market participants to fully control their investments. The substantial information costs in structured finance is a factor that should limit the investor base. As centralised sources of information, rating agencies may in principle alleviate this cognitive burden, and indeed in recent years some less sophisticated investors have bought

structured products by relying on ratings. But rating agencies could not eliminate completely information gaps. This is particularly true for market liquidity risk, which is difficult to summarise in a simple rating.

First and foremost, the piling up of securitisation layers that largely characterises complex products markets, tends to conceal the amount of commitments and embedded leverage in the marketplace. This results in considerable valuation difficulties, especially for products that are very infrequently traded and that lack comparability with similar assets. In normal circumstances –or if these products are part of a “buy and hold” strategy– this feature is innocuous for market liquidity. But it can turn to a serious threat when urgent demands on liquidity crop up, and when they prompt forced selling.

The difficulty or inability to assess the true value of assets for some structured products is in itself a major cause of the propagation of liquidity crises. This creates all the conditions of a “market for lemons”. In general terms, a substantial flow of sell orders for an asset is likely to arouse the suspicion that initiators of transactions have privileged information on the quality of this asset, and lead potential buyers to demand an important price discount in exchange. In such a “market for lemons”, the drop in the price may even lead to the total disappearance of the market, as demonstrated by Akerlof (1970) in a founding theoretical paper, and as illustrated, notably, in the US ABCP market this summer, where people became suddenly reluctant to buy such securities. It appears that the more customised the products are, the more they are prone to such bouts of distrust on the part of investors.

This is precisely why a liquidity crisis originating from complex structured products markets manifests itself as a “flight to simplicity”, benefiting US Treasury bills for instance. This flight to the most understandable assets can have detrimental effects even for markets that in principle had no reason to be affected but were not fully transparent. For example, AAA tranches –in principle the safest– of collateralised loan obligations (CLOs) suffered from a drying-up of issuance simply because they were part of the assets of ABCP conduits and SIVs,⁷ the most critical structures in the crisis. It is likely that, from now on, those investors that have

⁶ By which new government bonds, for example French OATs, are issued with exactly the same properties as those of earlier lines.

⁷ Structured investment vehicles are special purpose structured finance operating companies, off-balance sheet, that fund a diversified portfolio of highly rated assets by issuing asset-backed commercial paper (ABCP), medium-term notes and capital. Their aim is to generate a spread between the yield of the portfolio and the vehicle's cost of funding, by managing credit and liquidity risk.

permanent liquidity needs (asset managers and bank-related funds) will decide to turn to simple or highly standardised forms of securitised instruments (securities backed by pools of homogenous assets). Other investors, able to hold assets to maturity (life insurers, pension funds, etc.) are normally in a better position to invest in illiquid structured products like CDOs or CLOs since they are more interested in the revenue flows generated by these assets than by their market value at a point in time.

All in all, the securitised financial system is particularly prone, in some non-standard and opaque segments, to crises of valuation and confidence. Hence the risk of a sudden loss of confidence and market making, and the disruption of liquidity in the underlying markets.

2|2 Risk dispersion and systemic illiquidity

Confidence and liquidity are not only threatened by the limitations of information processing capabilities of investors, but also by the deficiencies in the control of risks created by issuers and originators in a highly securitised world. In fact, it is questionable whether greater ability to spread risks necessarily leads to a more resilient financial system. Better risk dispersion does not mean that risks disappear altogether. It can even be argued that they may increase on an aggregate level.

A MINSKIAN READING OF FINANCIAL INNOVATION AND LIQUIDITY

As early as the 1950s, Hyman Minsky developed the argument that financial innovation could lead to a rise in systemic illiquidity. Contrary to the conventional wisdom that regards the growth of markets for tradable instruments as reducing the risk of liquidity crises, Minsky (1986) considers that every innovation that leads both to new ways to finance business and new substitutes for cash assets in fact implies a growing exposure to illiquidity risk on an aggregate level.

This is because the value of financial instruments relative to the quantity of means of payment cannot rise indefinitely without jeopardising the ability to redeem the debts incurred. Indeed, an increase in *leverage* in the system makes it more vulnerable to a sudden re-appraisal of risks and abrupt shifts in the liquidity demand from investors, including banks. An unexpected rise in the liquidity preference, like the one that occurred in the interbank market this summer, is always a threat to the fluid and normal circulation of liquidity in the markets.⁸

This fragility is concealed in periods of euphoria, when it seems painless to fund illiquid long-term assets with short-term, presumably liquid liabilities, *i.e.* when the distinction between near-moneys and money proper fades away. Then, the "transformation risk" is overlooked. But it comes to the forefront again when distress erupts. As distress cascades through the system, liquidity providers turn into liquidity demanders. The scope of leverage has been considerably increased with financial engineering:⁹ this appears as a threat to the robustness of liquidity.

The ability to dispose of risks may have generated bad incentives, and fuelled excess risk-taking by the banking sector through less monitoring and screening of borrowers and increased leverage. Securitisation indeed creates an agency problem between the originator and the ultimate holder. In order to maximise fees, the originator has an incentive to maximise the volume of structured products from loans and is, to some extent, less motivated to care about the quality of loans that are not meant to remain on its balance sheet. Some evidence has been found that banks using the loans sales market for risk management purposes hold less capital and make more risky loans than other banks.¹⁰ Not only do banks not necessarily take fewer risks with the use of credit risk transfer instruments, but they have also created additional (potential) risks in the system through innovation, when selling non-standard risks to the market or through the use of highly leveraged structures, with short-term financing, that increase the likelihood *and* the potential market impact of a distressed liquidation.

⁸ Hence, liquidity is not primarily a question of aggregate quantities. It is fundamentally lodged in the preferences and constraints of economic agents.

⁹ For example, constant proportion debt obligations (CPDO) vehicles –one of the newest creations in credit markets– borrow up to 15 times their capital to insure an index of bonds (such as the iTraxx) against default.

¹⁰ See Cebenoyan and Strahan (2004). Hänsel and Krahenen (2007) also document that the issue of CDOs tends to raise the systematic risk of the issuing banks.

MARKING-TO MARKET AND THE PROPAGATION OF LIQUIDITY CRISES

The illusion of "disposable risk" and the common belief that those who hold risks are better prepared to absorb and manage them properly have been challenged in the recent turbulence. This is especially true for money market funds that have invested in complex, long-term products, on the basis of their rating exclusively.

In the long chain of securitisation, some presumed risk absorbers proved in fact to be a source of distress contagion between markets. A key reason for this is that structurally, financial institutions have become more sensitive to fluctuations of market prices with the decline in traditional intermediation.

SIVs in particular, must mark their portfolio to market on a frequent basis to gauge their net asset value. The problem is that the balance sheet of SIVs is characterised by a duration and liquidity mismatch, with rather illiquid positions on the asset

side and short-term securities on the liabilities side, granting investors the right to exit their investment easily.¹¹ When SIVs found themselves unable to roll over their short-term liabilities, they were forced to liquidate their assets at a large discount and to record, on a mark-to-market basis, significant losses in their balance sheets. This was one of the vectors of contagion of the liquidity crisis this summer.

More generally, the reactions of institutions to price changes and measured risks generate procyclical adjustments in their balance sheets and hence in markets, which tends to propagate financial difficulties and lead to a liquidity squeeze.¹² Similarly, sellers of protection (for example insurers) might strain liquidity through hedging operations on security markets when they mark their exposures to market on a daily-basis.

As a result of this situation, traditional liquidity providers may have difficulty in intervening in times of stress, since they themselves need to draw liquidity from the markets when it is scarce.

The deep changes in banks' balance sheets (and off-balance positions) over the last twenty years may have affected the "qualitative asset transformation" services they offer to investors, since they are less willing to warehouse and manage the risks themselves. As mentioned previously, there cannot be liquidity creation without an agent accepting to bear and manage the risks incorporated in the initial, illiquid assets. By becoming liquidity demanders through the transfer of their risks to other financial intermediaries, banks may have obscured their own responsibilities in insuring liquidity in "second-to-last resort", which requires a close monitoring of their risks. For example some banks, in the recent financial turbulence, failed to assume their implicit responsibilities as refinancers for their conduits (IKB, SachsenLB).

In fact, part of the credit risk transferred to the market by the banking system remains liable to re-emerge suddenly and unexpectedly on bank's books via loan commitments, or loans sold with recourse for instance,¹³ even when no legal ties between banks and securitisation entities exist but reputational concerns are at stake. This forced re-intermediation is the very evidence that the production of liquidity does not depart from banks without risks. In the subprime crisis, regulated institutions have been, rather surprisingly, more affected than the others, at the periphery of the system (hedge funds, private equity funds, etc.), precisely because banks had poorly assessed their liquidity needs stemming from their sponsoring activity and their off-balance sheet vehicles.

.../...

11 That is to say that SIVs act in a similar way to banks, but without bearing the same constraints and without benefiting from the same stability of resources on the liabilities side.

12 See Adrian and Shin (2008), in this issue, on the links between mark-to-market practices and leverage.

13 In the case of loans sold with recourse, the buyer has the option to sell the loan back to the bank at a pre-arranged price if the borrower's quality deteriorates, which generates risk for the selling bank.

Still, commercial banks have a special capacity and interest in offering options to such conduits that other institutions do not have to the same extent. In the crisis, banks with a large base of stable deposits have proved more resilient than investment banks. Actually, it can be argued that banks have an advantage in hedging liquidity risk.¹⁴ This seems consistent with the notion developed in Section 1, that there is a natural complementarity in traditional monetary intermediation between loan commitments (drawn down during the crisis) and deposits (flowing into the most credible banks in the crisis). Indeed, Gatev and Strahan (2004) found that banks were at the centre of liquidity inflows during the 1998 crisis, which enabled them to provide liquidity to stressed firms.

At least for reputation reasons, it appears that banks have interest in avoiding the failure of conduits. In addition, bank sponsors are themselves direct investors in the capital notes. Therefore it may also be in their economic interest to maintain funding and avoid failures that could lead to the collapse of the capital notes market. They can do so by acting as marker makers (through the purchase of commercial paper and capital notes from the conduits, or by buying assets from them at par rather than market value) or by granting credit lines to them. It also behoves the structurers to make up for the lack of secondary markets for some tailor-made products that remain de facto very dependent on their issuers.

Admittedly, banks are unlikely to take all credits back onto their balance sheets. There is certainly no question of an indiscriminate scaling back of securitisation. But the relative illiquidity of bank assets, duly recognised and managed, may also have beneficial effects, as it creates an incentive for banks to limit their exposure to avoid forced selling (and its costs) in a liquidity crisis.¹⁵

The ability of risk absorbers to ascribe an adequate value to complex products turns out to be key in the control of liquidity risk.¹⁶ In particular, it is necessary for banks selling complex bespoke products to price them taking into account their own ability to trade and hedge such an exposure. Otherwise, they might sell products beyond their capacity to properly hedge them when markets become tight.

The "liquidity frontier" cannot be pushed back indefinitely. Those who, in the end, accept illiquidity in their balance-sheet must clearly understand and control the risks they are taking on. Such illiquidity is more acceptable for investors with long time horizons, and who are not subject to creditors suddenly calling their money at short notice.¹⁷ For the others, larger liquidity buffers acting as an automatic stabiliser to smooth the financial cycle might be necessary to hedge their risks.

Without such precautions, financial innovation could unduly extend the liquidity insurance implicitly expected of central banks. Yet, it is certainly not the role of a central bank to prompt market participants to rush into "not-so-reliable liabilities".

¹⁴ See Gatev and Strahan (2004).

¹⁵ On this point, see Wagner (2007).

¹⁶ See Bervas (2006).

¹⁷ It may be noted that such simple devices as lock-up periods in the hedge fund industry can assist in curbing the pathological rise of liquidity preference that may, at times, sweep through the financial system. This has actually been material in the recent turmoil.

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Financial market liquidity and the lender of last resort

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In the summer 2007, difficulties in the US subprime mortgage markets have led to disruptive developments in many financial market segments, in particular in interbank money markets, where central banks in the US and in Europe repeatedly intervened to restore smooth market functioning. This article investigates the circumstances in which liquidity shortages may appear in financial markets and evaluates a number of options available to the lender of last resort wishing to restore financial stability. It also suggests that the consideration of balance sheet data is not sufficient for evaluating the risks of leveraged financial entities. Instead, the analysis calls for an explicit consideration of collateral pledges, market illiquidity, and potential non-availability of market prices.

Our main messages can be summarised as follows. First, we provide a clear hierarchy across policy alternatives. Taking a risk-efficiency perspective, it turns out that targeted liquidity assistance is preferable to market-wide non-discriminatory liquidity injections. In particular, when liquidity may be alternatively used for speculative purposes during the crisis, non-discriminating open market operations may attract unfunded market participants that divert funding resources away from its best uses in the financial sector. As a consequence, targeted liquidity assistance may become strictly superior.

Second, we suggest that forced asset sales may lead to disruptive market developments in a context where financial investors are highly leveraged. Assuming away external funding or renegotiability of debt contracts, a fully leveraged investor hit by a liquidity shock would have to liquidate some assets. When markets are not perfectly liquid, asset liquidation depresses market prices. Under standard risk management constraints, lower prices induce a re-evaluation of marked-to-market balance sheets, provoke margin calls, and trigger further selling. In the worst scenario, the leveraged investor may not be able to face the sum of liquidity outflows and subsequent margin calls. In that case, the market for illiquid assets breaks down, rendering the valuation of such assets an ambiguous exercise. For investors, such potential trading disruptions imply that the loss that triggers operational default is likely to be much smaller than suggested by standard risk measures.

NB: The opinions expressed in this paper are those of the authors alone and do not necessarily reflect the views of the Banque de France.
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Episodes of financial market disruptions closely associated with liquidity shortages in equity and money markets have revived interest in the lender of last resort (LLR) debate. This article contributes to this debate by looking beyond "liquidity" *stricto sensu*. It relates LLR interventions to the issues of asset valuation, risk management, forced portfolio liquidations in potentially illiquid markets, and financial leverage.

The rest of this paper is structured as follows. Section 1 outlines the link between liquidity, money markets and the LLR. Section 2 comments and illustrates the liquidity crisis that started in August 2007 in most developed financial markets. Section 3 investigates how strategic considerations may entail liquidity disruptions. Section 4 considers three policy alternatives, emergency lending, open market operation, and outright intervention in the asset market, and investigates the impact of these policies on the trade-off between market efficiency and central bank exposure.

1 | LIQUIDITY, MONEY MARKETS AND THE LENDER OF LAST RESORT

A few years ago, Borio (2004) stated that "the genesis of market distress resembles quite closely those of banking distress". Understanding liquidity in terms of the interdependencies between individual financial institutions and market dynamics therefore seems meaningful for monetary and financial stability purposes (Davis, 1994).¹

Different definitions of liquidity have been discussed in earlier issues of the Financial Stability Review.² Over time, the basic understanding of "funding" liquidity –ability to meet cash obligations when due– has been extended in the direction of "market liquidity" to encompass the ability of financial investors to literally *liquidate* a non-cash asset

–e.g. an investment security originally bought to be held to maturity– so as to raise central bank money.³

As a preamble to the analysis of LLR positions in the context of market illiquidity, this section presents the link between illiquidity risks and contagion in the specific context of money markets (1|1), before recalling why the money market is key for LLR interventions (1|2).

1|1 Illiquidity risk, contagion and the money market

Liquidity risk, when it materialises in the case of a "systemic" institution, may entail contagion and jeopardise macroeconomic and financial stability. The literature on liquidity and banking crises has identified a number of central factors driving contagious failures of financial institutions. These factors include the following:

- peer monitoring in the money market (Rochet and Tirole, 1996);
- liquidation of interbank deposits in response to unexpected deposit withdrawals (Allen and Gale, 2000) or fears of insufficient reserves (Freixas, Parigi, and Rochet, 2000);
- adverse selection in interbank lending when information about the solvency of borrowers is imperfect (Flannery, 1996);
- limited capacity of financial markets to absorb assets sales (Allen and Gale, 2002, 2004, 2005; Gorton and Huang, 2002; Schnabel and Shin, 2004); inefficiency of asset liquidations (Diamond and Rajan, 2000);
- strength of direct balance sheet interlinkages (Cifuentes, 2002; Eichberger and Summer, 2005);⁴
- coordination problem when secondary market lenders are heterogeneously informed (Rochet and Vives, 2004);

¹ This section and Box 1 draw significantly on Hartmann and Valla (2007).

² See Bervas (2006) and Saes, Tiesset and Valla (2007).

³ 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 in the market. 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.

⁴ See Cifuentes et al. (2005) for references to specific country studies in Switzerland, Germany, the U.S., the U.K. 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.

- double moral hazard problem involving the tasks of screening loan applicants and monitoring ongoing credit relationships (Freixas, Parigi and Rochet, 2004);
- phenomena related to changes in asset prices (Cifuentes, Ferrucci and Shin, 2005).⁵

Contagion takes a particular dimension in money markets. One of their key functions is to allocate liquidity in the economy. Efficient and stable money markets enable economic agents to invest short-term revenues in a profitable way and meet payment and short-term financing needs at short notice, even under uncertainty. At the same time, money markets are also a decisive platform for implementing policies. For monetary policy purposes, the interest rates of an economy are steered through the money markets. Likewise, the operational phases of many LLR interventions are conducted via money markets. This central position of money markets and central banks was already emphasized by Bagehot (1873) in his picturesque historical account of Lombard Street.

The extent to which interbank exposure may lead to critical interlinkages is still a relatively unexplored issue (De Bandt and Hartmann, 2002). However,

some specific money market segments may turn out to be more critical than others for the (non) propagation of liquidity shortages. For instance, the market for repos (repurchase agreements secured by specific securities) is currently a key segment of the money markets. It fulfills a crucial role, in normal times for the reallocation of liquidity among banks, and in times of stress when it can be expected to act as a safety net for the smoothness of interbank cash-flows. It belongs to the inner core of the money market, the interbank market, which encompasses unsecured (deposits, other interbank liabilities) and secured (repos and other collateralized short-term loans) instruments and derivatives.

Unfortunately, scarce data and confidentiality issues are an impediment for broader empirical evidence on interbank contagion risk. Evidence ranges from limited (Furfine, 2003) to substantial (Upper and Worms, 2004, Degryse and Nguyen, 2004, Mistrulli, 2005) contagion risk.

Tables 1 and 2 depict as a background the uses of the main money market instruments (Table 1) and the key players involved (Table 2), as can be currently described in the euro context.

Table 1
Money market instruments and uses

Instrument	Use
Unsecured cash transactions (deposits) Maturities: overnight to one year.	<ul style="list-style-type: none"> • Satisfy reserve requirements (banks) • Manage fluctuations in customers' cash flows (banks)
Secured cash transactions (repos) Maturities: overnight to one year.	<ul style="list-style-type: none"> • Manage liquidity (banks) • Possibly exploit opportunities associated with expected interest rate changes (dealers) • Regular open market operations (OMOs) (central banks)
Money market derivatives (short-term forward rate agreements, interest rate swaps, foreign currency swaps, and options), in particular:	<ul style="list-style-type: none"> • Manage risks • Take speculative positions • Saving economic or even regulatory capital
– Forex swaps	<ul style="list-style-type: none"> • Transform the currency denomination of assets and liabilities so as to trade in or out of a specific currency risk
– Interest rate swaps / forwards	<ul style="list-style-type: none"> • Hedge against changes in interest rates • Take speculative positions
Short-term securities (Treasury bills and other short-term government securities, commercial paper, bank certificates of deposits, certificates issued by non-bank entities – e.g. corporations, local government, mortgage institutions, and finance companies), in particular:	
– Certificates of deposits	<ul style="list-style-type: none"> • Short-term source of financing (banks)
– Commercial paper	<ul style="list-style-type: none"> • Secured and unsecured instrument (banks, to finance loans, or firms)

⁵ The liquidity-based approach to understanding financial crises via asset price fluctuations has been developed at length by Franklin Allen and Douglas 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 little aggregate uncertainty may cause large fluctuations in asset prices (among others, Allen and Gale (2005) and references therein).

Table 2
Money market participants

Institution	Activity
Central banks	<ul style="list-style-type: none"> • Carry out OMOs • Implement the short-term interest rate reflecting its monetary policy stance • Inject / withdraw liquidity from the banking sector as necessary
Domestic and foreign banks	<ul style="list-style-type: none"> • Trade in the “secondary” money market (mostly interbank) • Act as market makers (or dealers) offering quotes and being willing to trade on a permanent basis
Other financial institutions (money market funds, insurance companies, pension funds, large non-financial corporations...)	<ul style="list-style-type: none"> • Trade (outside the interbank market)
Governments	<ul style="list-style-type: none"> • Borrow in the primary short-term securities markets
Market organisers	<ul style="list-style-type: none"> • Offer brokerage services, organise exchange, provide information

With this structure in mind, it can be seen that the decisions taken by money market investors may have an impact on adverse developments in other financial markets or on the financing of the real economy. For example, corporate borrowers in the short-term securities segment can be seriously hit if, in the context of a “flight to quality”, commercial paper is shunned and investment flows towards safer short-term government debt. This may in turn have an impact on government bond yields and may be transmitted along the yield curve. Another channel through which money market developments may have external effects is *via* the behaviour of large institutional investors such as money market funds. If for some reason the latter decide to “fly to quality”, they may indiscriminately leave the short-term corporate funding market (commercial paper and certificates of deposits) for safer havens. Given that the market for CDs is fuelled by financial institutions’ issuance, other segments of the financial system may also be affected.

1|2 Money market liquidity and the lender of last resort

All in all, theory and empirical evidence suggest that contagion *via* the money market and the propagation of instability to other segments of the financial system can potentially be strong. In this context, while banks should in principle activate risk management policies to handle money market risks, central banks are probably the only institution, if

at all, in a position to stabilize the money market through liquidity management operations.

Under normal circumstances, central banks interventions in the money market for monetary policy purposes is of an operational nature. Should such interventions become an instrument for emergency liquidity injections in times of crisis? The “historical” doctrine contends that central banks should only lend to solvent banks against good collateral. Credit should be extended to all illiquid banks at a penalty rate, and the readiness to lend without limits should be *ex ante* announced to the market (Thornton, 1802; Bagehot, 1873).⁶ Overall, it seems that these principles have not always been respected. In particular, empirical evidence suggests that insolvent banks are often bailed out, and that failing banks are more often rescued than liquidated (Goodhart and Schoenmaker, 1995; Hoffman and Santomero, 1998).

More generally, this seminal approach has been questioned at two levels. First, it might be desirable, under some circumstances, to extend LLR loans to insolvent institutions. Practice has shown that it is often difficult to distinguish *ex ante* –i.e. when a decision on an emergency intervention is needed– between liquidity and solvency issues. This “grey area” between temporary liquidity distress and more structural solvency problems in financial institutions under strain implies that it might sometimes be necessary to grant central bank funding to institutions that may turn out *ex post* to be insolvent (Goodhart, 1985).

⁶ The literature on central banks’ role as a lender of last resort has been surveyed many times, e.g. by Freixas et al. (1999). Historical evidence on the use of LLR interventions to mitigate banking crises is reviewed in Bordo (1990).

Second, if central banks bear some responsibility for the stability of the financial system, it may be desirable not to exclude the possibility to rescue insolvent banks on financial stability grounds (Solow, 1982). Central banks have to strike a balance between the risks of contagion and the moral hazard that such interventions induce.

Ways to mitigate LLR-induced moral hazard have been suggested in the literature. In theory, banks above a certain size could be systematically rescued while smaller institutions would be only randomly bailed out (Goodhart and Huang, 1999). Or, interventions could be made conditional on the amount of uninsured debt issued by the respective bank(s) (Freixas, 1999). Acharya and Yorulmazer (2006) argue that the inefficient liquidation of assets in the presence of large or contagious bank failures may justify bail-outs. Liquidity assistance to surviving banks could however reach similar results. It should be kept in mind, though, that solvency issues go much beyond the realm of money markets and central banks. When it comes to bail-outs of insolvent banks, then the role of government authorities becomes much more important.

Fundamental critiques of emergency liquidity assistance (ELA) to individual financial institutions have put forward the ability of modern interbank markets to reallocate liquidity efficiently within the banking system when needed. As a result, interventions in favour of individual banks are unnecessary in a market context where aggregate liquidity imbalances can be corrected by the central bank through liquidity injections in the open market ("lending to the market"). Concentrating on the federal funds market, Goodfriend and King (1988) consider that the market spontaneously delivers the 'desired allocation of bank reserves within the banking system at the rate decided upon by the central bank'. In the same vein, Schwartz (1992) regards the market as an informationally efficient mechanism where insolvent institutions are not funded.

However, liquidity reallocation solely through market mechanisms might fail to channel liquidity to banks that need it. For example, potential lenders or other market participants may refrain from providing liquidity for strategic reasons (Rochet and Vives, 2004; Flannery, 1996). In addition, the malfunctioning of large value payment systems in a crisis may not allow interbank lending to reach

the banks in need of liquidity (Freixas, Parigi, and Rochet, 2000). Some recent empirical literature argues, however, that US banks seem to have been successful in reallocating liquidity during periods of stress (see e.g. Strahan, Gatev, and Schuermann, 2004).

2| THE SUMMER 2007 MARKET LIQUIDITY SHORTAGE

During August 2007, the financial sector has gone through a dramatic re-appraisal of the risks contained in structured credit. As a consequence of these developments, several hedge funds and structured investment vehicles (SIVs) stumbled into severe problems, in particular because established financial channels through collateralized credit and asset-backed commercial paper turned out to be unsustainable under market stress. Financing could not be prolonged because creditors became concerned about market valuations of illiquid assets such as collateralized debt and loan obligations in a context where market (and prices) sometimes de facto disappeared. This section recalls the chronology of the August 2007 events (2|1), illustrates the implications liquidity shocks hitting fully leveraged investors may have (2|2) and reviews the steps undertaken by central banks at the outset of the crisis (2|3).

2|1 Chronology

Without benefit of hindsight, it is difficult to give a comprehensive account of the liquidity crunch that started in August 2007. This section therefore concentrates on the initial circumstances under which the crisis started.

The market disruption of August 2007 occurred in the general context of a continued drop in the market value of certain mortgage-backed securities earlier in the year – in particular, the "subprime" segment of the US market, *i.e.* loans to borrowers with poor credit value crowded-out of the standard mortgage market. Already in March 2007, market symptoms of subprime lender weakness (for example as was the case for New Century Financial) raised awareness of potential adverse developments in that sector.

In this context, two key "sparkles" triggered a substantial market reaction. On August 2nd, it became public that IKB Deutsche Industriebank AG was ailing on account of its US subprime loans exposure. One week later, on August 9th, BNP Paribas announced that the quotation of three of its funds needed to be suspended for analogous reasons.

Following those events, the interbank market came under extreme strain. European banks became unable to secure the "usual" sources of financing for investment vehicles potentially holding US subprime mortgages. This confidence crisis in money markets had the following consequences. First, amidst increased market nervousness –foremost about banks– interbank lending rates, in particular for eurodollar deposits and asset backed commercial paper, rose sharply. Second, many segments of the structured credit and mortgage market ceased to trade at all, making it difficult to price outstanding positions. Third, investors facing margin calls have sometimes even failed to raise enough cash through asset sales, thereby being forced to look for liquidity in the money market. Fourth, interbank lending became scarce in a context of liquidity hoarding. Finally, large-scale unwinding of leverage was undertaken.

2|2 Leverage, margins and forced portfolio liquidation

The summer 2007 events have shown that valuations for illiquid assets may be unavailable at the moment when the management of leveraged entities turns to the market to sell those assets. Specifically, distressed investors in search of financing by temporary disinvestment may "get stuck" because, even though the "true" valuation of assets exceeded the amount needed in cash, markets would not be willing to absorb the order flows that would create sufficient revenue to guarantee survival.

As suggested in section 2|1, highly leveraged investment entities turned out, for a reason not anticipated, to liquidate a considerable fraction of their securities holdings. For instance, a hedge fund faced with an unexpected change in market conditions, may have to unwind positions in response to calls to repay loans in lack of sufficient collateral (this situation has been studied by Stulz, 2007). Without external intervention, would survival be possible in such a situation? In case a partial liquidation through the market place can indeed save the investor from bankruptcy, the composition of the portfolio that should be sold will in turn determine the liquidity of individual assets. The numerical example developed in Box 1 shows that markets may become disrupted even when the initial liquidity imbalances are relatively small.⁷

Hedge funds are an example where risk management is outsourced to the prime broker who is also the provider of credit to the hedge fund. Depending on the strategy chosen, hedge funds tend to focus on a trading gain that can be realized if the willingness to accept risks is sufficiently high. Leverage becomes crucial in the implementation of such a strategy because the trading margin may otherwise be too small to generate sufficient investor interest. Once the market turns against the strategy, however, there may be no way out other than reversing the investment strategy.

Legal entities and structured investment vehicles used for restructuring credit are another example. For instance, such conduits may issue commercial paper backed by credit claims taken from the originator's balance sheet. The originator grants credit lines for the case that commercial paper cannot be rolled over, which helps the conduit get a better rating. However, if there are nevertheless concerns about the quality of the assets, those credit lines will have to be used.

The mechanism illustrated in Box 1 (and its formalisation in Ewerhart and Valla, 2007b) suggests that the consideration of balance sheet data may not be sufficient for managing the risks of leveraged funds and investment vehicles.⁸

7 Ewerhart and Valla (2007a) explore these questions –the conditions for successful and optimal forced liquidation of an investment portfolio in a collection of illiquid markets– from a theoretical perspective. Implications for risk management and prudential supervision of leveraged investment entities are also discussed in the paper. It is shown that higher margins make assets more liquid in a liquidation event caused by an unexpected loss or capital drain. Moreover, high correlation to other assets is detrimental to the liquidity of the individual asset. The paper also studies the impact of successful liquidations on relative asset prices, suggesting that effective risk management of leveraged financial entities should focus on the entity's potential to generate emergency cash-flows net of third-party claims for liquidity.

8 In addition, it is shown in Ewerhart and Valla (2007b) that the probabilities obtained by standard methods may be much too low for leveraged investors –in particular, marked-to-market accounting and value-at-risk figures may become meaningless for such legal entities, suggesting that the alleged "confidence crisis" might even have a legitimate motivation. As a consequence, the probability of operational default can be much higher than suggested by standard risk measures.

Box 1

Illustrative example of a forced portfolio liquidation by a leveraged institution

The problem faced by a leveraged investor forced to unwind a significant fraction of its portfolio in a collection of illiquid markets can be illustrated through a numerical example. A corresponding model of distressed portfolio liquidations is proposed in Ewerhart and Valla (2007b).

In this example, the "investor" can be thought of as any sort of leveraged fund or investment vehicle. A leveraged investor, a sizable player in the financial community, is equipped with the following balance sheet:

Assets		Liabilities	
Stocks	1,200	Equity	300
Exotics	400	Loans	1,300

The investor's creditors, who are the only providers of loans, require that funding must be secured by collateral, where haircuts of 15 and 30 percent are applied to the stock and to the exotic, respectively. With these parameters in place, it is not difficult to verify that the investor is fully leveraged, i.e., the creditors would not be willing to provide additional funding for further investments.¹ Indeed, the market value of the investor's collateral, diminished by the respective haircut, corresponds to:

$$(1) \quad (100\% - 15\%) \times 1,200 + (100\% - 30\%) \times 400 = 1,300$$

How will the investor's balance sheet be re-adjusted when an unexpected event occurs? For instance, the investor might suffer from an unexpected operational loss of EUR50. To identify the optimal liquidation strategy in this example, the investor needs to form expectations about the likely market impact of the liquidation. We assume here that initially, the market price of the stock and the exotic has been EUR10 each (so that the investor has 120 and 40 securities, respectively, of each class in her portfolio).

The expected appreciation of the stock and of the exotic investment are expected to be approximately +EUR5 and +EUR11 in the long run. The uncertainty in the returns is captured by standard deviations of EUR1 for the stock and EUR2 for the exotic investment, the correlation coefficient between the two asset returns being zero in this example.

Assuming a realistic degree of risk aversion for market investors who may be willing to buy the asset (the market's parameter of absolute risk aversion is set to 0.1 in this example), and ignoring potential indivisibilities, it turns out that it would be optimal to sell 34 stocks and 22 exotic investments, with a current market value of about EUR560, which is more than tenfold the initial loss that needed to be covered!

Why so much? First, the liquidation has a direct price impact that drives down the market value of the assets. Second and more importantly, this drop in the market value has a magnifying impact on the required liquidation size. Indeed, as a consequence of the liquidation, market prices would –conveniently rounding figures for the example and given the risk aversion above– fall to EUR9.66 for the stock and to EUR9.12 for the exotic. These variations are clearly reflected by the risk management constraint based on (1) recalculated at new market prices by the investor's creditor.

The cash flow resulting from the settlement of the market order would be:

$$(2) \quad 34 \times 9.66 + 22 \times 9.12 = 527$$

Hence, the cash-flow generated would be EUR 33 lower than the market value, as a consequence of the price impact caused by the liquidation.

.../...

¹ Scarcity of suitable collateral is illustrated by the recent regulatory concerns in the UK regarding the possibility that collateral may have been used twice by hedge funds.

However, another effect amplifies the necessary liquidation. The combined impact of lowered prices and smaller number of securities held reduces the total value of the investor's collateral basis. It can be checked that the investor's balance sheet after the liquidation is given by:

(EUR)			
Assets		Liabilities	
Stocks	833	Equity	174
Exotics	164	Loans	823

In fact, after the liquidation, the credit limit of the fully leveraged investor reduces to merely:

$$(3) \quad (100\% - 15\%) \times 833 + (100\% - 30\%) \times 164 = 823$$

Thus, the difference amount of EUR477 to the earlier EUR1,300 will be requested immediately and in cash by the creditors. The investor's net cash inflow is therefore EUR527 – EUR477 = EUR50, i.e. just enough to cover the shock that triggered liquidation in the first place. Moreover, the investor's equity position has shrunk from EUR300 to EUR174, in response to an unexpected loss of only EUR50!

An explicit consideration of collateral pledges, market illiquidity, and potential non-availability of market prices would be useful for the risk monitoring of leveraged funds and investment vehicles. This monitoring could take the form of comprehensive scenario analyses focusing in particular on internal liquidity flows that can be generated by the investor over a given horizon net of third-party claims for liquidity. Effective risk management would then make sure that this unencumbered cash-flow potential remains positive over staggered horizons with a high probability of confidence.

2|3 Central banks' reactions to the August 2007 liquidity slump

Market disruptions, forced liquidations and liquidity dry-ups, if inefficient, may be a rationale for third party initiatives to act as LLR. During the summer 2007, central banks have reacted in different ways to smooth away the liquidity disruptions following the violent market fluctuations of early August. The sequence of steps initially taken by central banks during the days following August 9th is summarised in Table 3 below.

Table 3 suggests that the reactions of central banks have been dissimilar in style, scope and timing.

Three main "approaches" can be described.

From the very start, the Federal Reserve promised to "provide whatever funding" needed to preserve interbank lending at its desired interest rate of 5.25%. *De facto*, USD 38 billion was injected on August 10th. Noticeably, the unique collateral accepted by the Fed in this entire operation was (high-quality) mortgage-backed securities.

The ECB move significantly surpassed in scale the steps taken by the Federal Reserve. In response to the sharp rise in overnight interest rates (ca. 70 basis points above its key policy rate of 4%), EUR 94.8 billion were injected in markets with the statement that the ECB stood "ready to assure orderly conditions in the euro money market".⁹

By contrast, the Bank of England first refrained to take immediate steps through market operations and made its first direct emergency loan on 21st August.

As a matter of fact, LLR interventions can take various forms, even when central banks remain within the range of consensual intervention instruments. In the sequel, the article presents microstructural and strategic factors that may accompany liquidity problems in financial markets so as to rank the alternative policy options available to the LLR.¹⁰

⁹ On August 10th, the Financial Times's headline was: "Central banks' aggressive moves stun markets", referring to the ECB liquidity auction.

¹⁰ In particular, we handle the case of large scale forced liquidations that depress asset prices, and not the case where liquidity completely vanishes following the decision by an investor to cease financing specific SIVs that are unable to sell their assets when the secondary market (even temporarily) disappears.

Table 3
Central banks' interventions and statements in the days following Thursday 9th August 2007

Central Bank	Thursday 9 th August, 2007	Friday 10 th August, 2007	Monday 13 th July 2007	Friday 17 th August, 2007	Tuesday 21 st August 2007	Initial central bank statement
European Central Bank	EUR94.84 bn (OMO, fixed rate tender with full allotment, 49 bidders)	EUR61.05 bn (OMO, variable rate tender, 62 bidders)	EUR47.67bn (OMO, o/n, 59 bidders)			"This liquidity-providing fine-tuning operation follows up on the operation conducted yesterday and aims to assure orderly conditions in the euro money market."
Federal Reserve	USD24 bn (OMO)	USD 38 bn (OMO, tranches of USD19, USD16 and USD3 bn) (repo backed with exclusively mortgage-backed securities for 30 days) ¹		Discount rate lowered (6.25% to 5.75%), Fed Funds rate unchanged (4.25%) (loan to Deutsche Bank on 20/08/2007)		"The Federal Reserve will provide reserves as necessary through open market operations to promote trading in the federal funds market at rates close to the Federal Open Market Committee's target rate of 5.25%. In current circumstances, depository institutions may experience unusual funding needs because of dislocations in money and credit markets. As always, the discount window is available as a source of funding." "Direct loans through the Fed's discount window are available as always."
Bank of England					Direct loan of GBP 314 m (standing lending facility)	
Bank of Canada	CAD1.64bn (USD1.55 bn) (o/n OMO)	CAD1.685bn (Special Purchase and Resale Agreement)	CAD670m (OMO)			"These activities are part of the Bank's normal operational duties relating to the stability and efficient function of Canada's financial system. The Bank is closely monitoring developments, and will deal with issues as they arise."
Bank of Japan		JPY1 trn (USD8.39 bn) (OMO)	JPY600bn (OMO, 1-week)			

1) The highest since September 12, 2001.

Note: The Swiss National Bank conducted a CHF 2-3 bn OMO on 10th August stating that "Nothing has changed for us, we will react flexibly to demand". The Reserve Bank of Australia injected 4.95 Australian dollars through an OMO on 10th August with the statement "The bank is proceeding with normal dealing operations". The Monetary Authority of Singapore lent 1.5 bn Singapore dollars in an OMO on the same day, saying it would "stand ready to inject liquidity". The Bank of Norway also injected money into the financial system and countries including Denmark, Indonesia and South Korea said they were ready to provide cash. Furthermore, foreign exchange interventions took place in Malaysia, the Philippines and Indonesia to support local currencies against the US dollar.

Sources: Central Bank Websites, Official Statements, Wall Street Journal.

3 | LIQUIDITY, INVESTORS' CONFIDENCE AND STRATEGIC TRADE DELAYS

In this section, we envisage a financial market in which some investors face the risk of having to liquidate their positions at prices below the fair value,

while others stand ready to exploit the temporary illiquidity of the market. This scenario can be formally captured by adapting the convenient model of financial market runs developed by Bernardo and Welch (2004).

Investor fear in the context of liquidity shortages can be schematized as follows. There is a population of risk neutral investors, each of whom owns a single unit of a financial asset. If the asset is not sold, it

renders an uncertain terminal value. However, with a positive probability, the asset if not yet liquidated must be liquidated at an interim stage. Thus, the decision problem of the investor reflects the intuitive conflict that may arise in a situation of investor fear. Selling early works like an "insurance" and guarantees a certain price level. Yet, when the crisis does not realize, selling early is clearly suboptimal from an ex-post perspective. In contrast, not selling early is equivalent to speculating on increasing prices, while accepting a positive probability of losing money. Turning to the other side of the market, consider risk neutral buyers, who stand ready to invest when markets are down. Both sides of the market are matched by a risk-averse market maker. The extended model is described in Box 2.¹¹

In the specific case of strategic buyers that are less (or not) exposed to liquidity shocks, the perspective of a localised liquidity crunch affecting other market participants may induce them to strategically delay their orders in anticipation of further price drops.

In the absence of intervention by the LLR, the strategic timing of individual market orders may cause a nontrivial social cost:

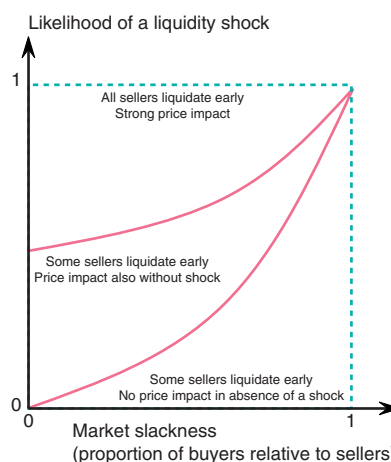
- first, under broad circumstances, the price path determined by rational trading behaviour involves inefficient precautionary liquidations;
- second, the market impact of investor fear may be amplified by the strategic delay of buy orders.

In this process, liquidity risk and market structure play a key role for market dynamics. The qualitative features of equilibrium price paths can be depicted intuitively (see Chart 1) as functions of market slackness and the likelihood of profit shocks entailing liquidity needs.

Chart 1 suggests that the higher the perceived probability of a liquidity shock, the more sellers will tend to liquidate assets early. Such early sales create an "endowment" in the market making sector which causes a further drop in prices. By contrast, asset prices are hardly affected when liquidity shocks are unlikely (as drawn in the lower part of the Chart). In "intermediate" environments where liquidity shocks are somewhat likely (middle smile of Chart 1), some but not all sellers will liquidate early. However, even if asset prices are below fundamental value, market makers will be the only agents willing to "early buy" the asset. Indeed, precautionary selling starts a downwards price trend which is anticipated and exploited by rational buyers.¹² As a result, the market may not be able to fully resolve the temporary illiquidity of an asset.

Chart 1
Precautionary sales and price impact of liquidity shortages

(Calibration of the Ewerhart and Valla (2007) model)



¹¹ Competitive market makers typically set prices such that the certainty equivalent of their material payoff is not affected through the execution of incoming order-flows. Initially, the price only depends on contemporaneous buy and sell orders. However, when uncertainty prevails as to whether liquidity shocks may shortly occur or not, market prices will depend on whether or not the liquidity shock has actually materialised. In case a shock indeed occurs, all constrained sellers who had not sold before will be forced to liquidate their positions. In case not, however, a subpopulation of investors may still sell the asset. In both cases, the equilibrium asset price reflects the limited risk-taking capacity of market makers, which implies a liquidity premium for one side of the market. For example, when there are more sellers than buyers in the short term, market prices are depressed relative to the fundamental long-term value of the asset. A similar mechanism has been described by Grossman and Miller (1980). Intuitively, prices may fall below fundamentals even before any liquidity issue has arisen because some sellers may decide to precautionary sell in anticipation of the possibility of a forced liquidation in the future. Such confidence-driven asset price drops are subject to strategic considerations on the part of buyers as well. On each trading day, market participants will trade with certainty when the transaction price anticipated for a delayed transaction is strictly less attractive. They will not trade if the opposite development for the market price is anticipated. The development of the market price is therefore bound to the decision of individual traders regarding the date at which to place their orders.

¹² The model can also accommodate short selling.

Box 2

Modelling financial market runs

Financial market runs have been formalised in different ways. This box provides a description of the dynamics of asset prices when liquidity shocks can occur at some trading point. The description synthesises a generalisation of the framework proposed by Bernardo and Welch (2004), see also Ewerhart and Valla (2007a).

Consider the market for a single risky asset ("the asset") over three dates, where trade is feasible at dates 0 and 1, and the value of the asset is revealed and paid out to the holder of the asset at date 2. Before date 2, the value of the asset is uncertain, and known to be distributed normally with mean v and variance σ^2 . Both trade and payment occur in terms of a riskless asset ("cash"), whose return is normalized to zero.

Three types of traders are in the market. First, there is a continuum of risk-neutral traders referred to as the sellers, that hold the asset but no cash, and that may be forced to liquidate the asset at date 1. The size of the population of sellers is normalized to one. Second, there is a continuum of risk-neutral traders, referred to as the buyers, who do not hold the asset. Buyers can be either funded or unfunded. Funded buyers have a cash endowment equivalent to the asset's fair value v , while unfunded buyers have no cash endowment. Finally, there are competitive risk-averse market makers that clear the market at dates 0 and 1.

At date 1, there is a probability $s < 1$ that the seller population is forced to liquidate individual positions for some exogenous reason. The state of the world is $\omega = \omega_S$ (for shock) with probability s and $\omega = \omega_N$ (for no shock) with probability $1 - s$. The realization of the state of nature becomes public information immediately before trading at date 1. Apart from the forced liquidations, sellers and funded buyers have full discretion concerning the dates at which they place orders. Sellers (buyers) may choose to sell (buy) at date 0, 1, or not to trade. If the seller sells at date 0 or 1, he receives the respective market price prevailing on that date. If he does not sell, he realizes the fundamental value of the asset at date 2. If a funded buyer invests at date 0, he may either hold the asset until maturity or sell it again at date 1 at the prevalent market price. If a buyer invests at date 1, he pays the market price at that date and holds the asset until maturity. The profit for a potential buyer of not trading at all is normalized to zero. Market orders are generally submitted without limit.

The perfectly competitive market making sector acts myopically, has an initial cash endowment of χ_0 and a utility function with constant coefficient of absolute risk aversion > 0 . Denote by α_0 and β_0 the mass of the sellers and funded buyers, respectively, that trade at date 0.

The market maker sets a price p_0 such that the certainty equivalent of the market maker's material payoff is not affected through the execution of the orders. This will determine the price at date 0 as a function of α_0 and β_0 , i.e. of sell and buy order-flows.

The market price at date 1 depends on the realization of the liquidity shock. If the shock occurs, then all those sellers who have not sold at date 0 will be forced to liquidate their positions. Thus, in this case the entire population of size $\alpha_S = 1 - \alpha_0$ of remaining sellers will sell at date 1. In the absence of a liquidity shock, however, an endogenous subpopulation of size $\alpha_N \leq 1 - \alpha_0$ of market participants sells at date 1. In addition to sellers, there may be funded buyers that sell investments at date 1. On the demand side, there is a population of funded buyers that has not bought at date 0 and may therefore decide to buy at date 1.

Given the market structure described above, zero-profit market makers will set prices according to the rules (1) and (2) below:

$$(1) \quad p_0 = v - \frac{\gamma\sigma^2}{2}(\alpha_0 - \beta_0)$$

$$(2) \quad p_1^\omega = v - \frac{\gamma\sigma^2}{2}[2(\alpha_0 - \beta_0) + (\alpha_0^\omega - \beta_0^\omega)]$$

where α_t reflects sell orders (asset supply) and β_t buy orders (asset demand) at t . The market price at date 1 depends on whether the liquidity shock has been realised ($\omega = \omega_S$) or not ($\omega = \omega_N$).

As a direct consequence of those order-mismatches, risk is inefficiently allocated. Indeed, at an individual level, the sellers do not take into account the effect of their sales on the development of the price path. Early liquidation, when chosen by a non-negligible subpopulation of the sellers, leads to a socially undesirable allocation of risks even when the shock eventually does not realize. The inefficiency could be remedied if arbitrageurs had an interest in buying early for prices below but still reasonably close to the asset's long-term valuation. However, buyers have an interest in delaying their orders, hence the persistence of the inefficiency.¹³

4| POLICY OPTIONS FOR CENTRAL BANKS

How can the LLR react to disruptive market liquidity developments? Generally speaking, a LLR can "inject cash" when liquidity grips. Cash injections are likely to deepen the market, thereby reducing the price impact of asset liquidations, which helps to mitigate the crisis.

Three main LLR options will be in turn discussed and ranked. One option consists in implementing efficient price levels through outright intervention (OI) in the asset market affected by the crisis. More customary interventions are the conduct of open market operations (OMOs) in the money market, and targeted liquidity assistance (TA), *e.g.*, through the discount window.

4|1 Outright intervention, open market operation, or targeted lending?

As a first option, the LLR could actively trade the asset directly in the market to reduce the inefficient risk allocation. The asset could be bought outright when the market price is prone to wide downwards disruptions –possibly releasing the position once prices are stabilised around the targeted fundamental asset value. Under this scenario, the LLR needs to

buy a given quantity of assets to stabilize prices in the critical state, to which a given uncertain return can be associated.

As a second option, central banks may engage in market-wide OMOs. With an OMO, the central bank offers additional credit to any counterparty eligible to take part in the operation. Note that collateral requirements do not exclude *per se* any eligible market participant from the operation. Sellers in distress, for instance, are in possession of the risky asset which can –except in some extreme cases– be used as collateral. However, one drawback of OMOs is that not only distressed institutions but also unfunded speculative buyers could obtain liquidity, as long as they possess collateral. A second drawback is that only eligible counterparties (*i.e.* essentially banks) can access OMOs.

Thus, the liquidity offered by the central bank in the open market would be available to all eligible market participants. As long as market prices remain –even slightly– below fundamentals, it can be expected that speculating buyers participate in the operations. This is because the distressed institutions' gain from averting an imminent liquidation corresponds to the difference between market prices at the time of the liquidity shock and at the time prices are back in line with fundamentals. This difference happens to be exactly equivalent to the gain for a speculative buyer that would receive central bank money at the OMO and invest it right away in the asset market in distress.

The rate at which OMOs are conducted plays an important role in channelling funds to market participants. When the OMO interest rate is "not too high", funds remain attractive both for unfunded buyers and sellers. When tender rates are raised sufficiently, speculative buyers would be deterred from borrowing and only the sellers in distress would come to the open market operation. This suggests that lending at a penalty rate would in theory allow to screen speculators away from the auction. However, in practice, it is unlikely that the respective populations of sellers and buyers could be so clearly separated that self-selection would be perfect, as required for the open market operation to match the payment structure of a targeted emergency lending operation.

¹³ In the context of the summer 2007 liquidity crisis, Joe Lewis, a Bahamas-based British billionaire, bought a nearly 7 per cent stake (*i.e.* a massive amount) in Bear Stearns more than a month after the fund collapsed and its share price initially fell. He announced on 12th September 2007 that he could "reduce his position shortly" if the shares rose significantly (Financial Times, 13th September 2007).

As a third option, the LLR could engage in the direct liquidity assistance of a targeted subpopulation of banks in distress. Any salvaged bank would keep the asset until prices have normalised, and then reimburse the LLR when feasible.

4|2 Policy ranking¹⁴

Policy objectives in the context of a liquidity crisis can be many –they might cover market efficiency, the discouragement of moral hazard, risk-return considerations, and price stability, in particular when the LLR is also the central bank. In this section, the focus lies on the trade-off between market efficiency and risk-taking. We discuss the consequences for the LLR, in terms of exposure, of securing an asset price level close to its fundamental value under the three above-mentioned policies.¹⁵

More precisely, market efficiency can be proxied by the deviation of asset prices from their fundamental value. In this respect, central banks may have in mind an asset price level that lies close enough to (but is not necessarily perfectly aligned with) the fundamental asset value. Turning to the level of risk resulting from involvement in emergency lending, the LLR may be subject, in particular, to both market and credit risks. The subsequent analysis applies to a wide class of risk metrics, including value-at-risk and expected loss measures.

For a given price level, the central bank exposure is the worst under the outright asset purchases. This is quite intuitive as in that case, the central bank bears all the market risk associated with asset price fluctuations on its balance sheet.

Second ranked is the OMO. With a market wide operation, the central bank has no way to ensure that liquidity is channelled in an optimal way to ailing institutions –unless it conducts its auction at sufficiently high penalty rates. Therefore, when asset prices are substantially below fundamentals, speculative buyers will be attracted to the liquidity auction together with the target population. While the central bank may in principle ration the auction to avoid an inflated bid volume, rationing will not be discriminatory and it will still be necessary to supply more than the "true needs" to realign asset prices.¹⁶

Finally, direct targeted liquidity assistance ensures the lowest level of risk taking while achieving the most efficient pricing in asset markets through a targeted channelling of funds.

As such, this policy ranking suggests that under certain circumstances, direct assistance to institutions in trouble can be preferred to OMOs. The reason is the strategic behavior of potential buyers who, similarly to the distressed sellers, have a motive for seeking funds when the market price falls significantly under fundamentals.

14 The ranking relies on the assumption that none of the interest rates charged to banks is too high, because otherwise neither buyers nor sellers would find it sufficiently attractive to take up the credit from the lender of last resort.

15 Formally, Ewerhart and Valla (2007a) study the problem of a lender of last resort who minimizes exposure subject to a given level of efficiency. Exposure is represented by a general-form risk metric that may include value-at-risk and expected loss measures.

16 Note that the tender procedure employed for the liquidity auction matters. For example, committing ex ante to a full allotment at a fixed preannounced rate has an adverse incentive effect on speculative buyers. In practice, central banks have some flexibility in the choice of their tender procedure, which may help somewhat (but not fully) mitigate the trade-off between efficiency and exposure.

The summer 2007 liquidity crisis illustrated how liquidity shortages in equity markets, money market (and in particular interbank) funding and lender of last resort (LLR) interventions are intertwined. Decisions taken by money market investors may amplify adverse developments in other segments of financial markets –and vice versa.

Several policy alternatives are evaluated for the lender of last resort, including open market operations and targeted liquidity assistance. While the moral hazard dimension of targeted interventions is well known and should not be ignored, they nevertheless exhibit desirable properties in terms of the trade-off between LLR risk exposure and efficiency of the risk allocation in the private sector. On those grounds, targeted operations may rank above market-wide open market operations.

Market illiquidity, disruptive asset sales and interbank liquidity dry-ups call for a reassessment of risk measures for highly leveraged investors. In particular, the consideration of balance sheet data may not be sufficient for managing the risks of leveraged funds and investment vehicles. An explicit consideration of collateral pledges, market illiquidity, and potential non-availability of market prices would be useful for the risk monitoring of leveraged funds and investment vehicles.

Looking forward, at the heart of both policy issues –last resort rescues and risk monitoring– lie transparency requirements of two kinds. First, accurate information on the ultimate size and distribution of losses related to off-balance sheet items is needed. Second, an effective risk assessment relies on the ability to properly evaluate the "true" or "fundamental" values of assets, including complex financial instruments such as structured credit products.

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Recent developments in intraday liquidity in payment and settlement systems

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Alongside consolidation and globalisation of the financial markets, the increase in values exchanged in payment and settlement systems has been remarkable. The size of intraday liquidity requested to expedite settlement of such values is accordingly very significant, especially compared to overnight or longer term liquidity.

The increasing use of risk control arrangements in payment and settlement systems (e.g. real-time gross settlement) is typically associated with higher liquidity needs, which have been balanced by the parallel development of several forms of liquidity saving features in systems.

The most remarkable developments have affected the qualitative management of intraday liquidity. A clear trend illustrated by continuous linked settlement (CLS) is the shortening of the time horizon in intraday liquidity management.

On the “supply” side, intraday liquidity can be provided by central banks or commercial banks, depending on the settlement asset used by systems. Since most central banks extend credit only against collateral, the type of assets that participants can use is an important factor in determining the opportunity costs of intra-day liquidity. In the past decade, most central banks have substantially broadened the range of collateral they accept in their provision of liquidity. Furthermore, an interbank intraday liquidity market seems to start emerging in relation with concentration of correspondent banking activities and funding costs related to critical time windows.

Developments affecting intraday liquidity management need to be adequately considered from a financial stability perspective.

Liquidity risk profile has changed alongside a variety of factors including consolidation which has led to a concentration of intraday liquidity risk and the development of interdependencies in payment and settlement systems.

One lesson to be drawn from the recent period is the usefulness for central banks, to have a list of eligible assets that is diversified enough to address an unexpected increase in collateral demand, in order to mitigate the consequences of a financial turmoil.

Over the past decade, the relevant actors, including the banking sector, central banks and the banking supervisors have taken various initiatives to better approach the diverse challenges raised by developments in intraday liquidity. Central bank policy responses encompass the provision of new settlement services which allow to optimize intraday liquidity management of banks (e.g. the new TARGET2 platform), the adaptation of their collateral policy to the new landscape of interdependent payment systems and oversight initiatives to better monitor and address changing risks.

Liquidity is usually defined as the ability for a financial institution to fund increases in assets and meet obligations as they come due. Liquidity has to be considered within different time horizons, depending on the respective maturity of obligations and assets used to fulfil these obligations. Intraday liquidity is the shortest time horizon of the overall liquidity of a said institution. It can be referred to as the funds which are available or can be borrowed during the business day in order to enable financial institutions to effect payments/settlements. Intra-day liquidity has different sources: incoming funds and intraday credit, *i.e.* the credit extended by the settlement agent of the system and reimbursed within a single business day (also called "daylight credit"). The provision of intraday credit is aimed at ensuring a smooth settlement process and avoiding gridlocks situations in the system. It allows to mitigate the effects of any hazard in sequencing payment flows in the system. Repayment of the borrowed funds should take place before the end of the business day, otherwise there is spillover to overnight credit.

Structural developments in the financial industry have led in the past years to a clear trend in shortening time horizon of liquidity risk and liquidity management. One practitioner recently summarised the situation as follows: "my short-term is intraday, my medium-term is overnight and my long-term is one week".

This evolution has notably been driven by changes in the use and in the patterns of payment and settlement systems. Actually, alongside consolidation and globalisation of the financial markets, the increase in values exchanged in payment and settlement systems has been very dynamic in the recent years. For instance, every day in France, EUR 500 billion are exchanged through large-value payment systems, which represent 30% of the country's annual GDP. Furthermore, the widespread use of real-time settlement as a way to expedite settlement in payment and securities systems has been an important change in the last decade in most countries.

Liquidity risk is usually defined as the risk of not being able to meet payment obligations when due. However, the increasing use of payment and settlement systems and the evolution of these systems towards real-time settlement practices have created a new situation, with payment obligations falling due much quicker than in the past.

Another important trend is the growing importance of collateralisation as a risk mitigation technique, especially in payment and settlement systems. Addressing intraday liquidity related issues requires considering at the same time issues related to collateral management.

The objective of this article is to address changes which have affected intraday liquidity management and the implications of these changes for financial stability, including an overview of preliminary lessons drawn from the recent period of market turbulences.

1 | CHANGES IN INTRADAY LIQUIDITY MANAGEMENT

Recent changes in intraday liquidity management have affected both the demand and the supply sides.

1|1 Evolution of intraday liquidity needs

Some developments can be categorised as constraining the amount of intraday liquidity necessary to ensure smooth functioning of settlement systems while other factors are rather influencing the way intra-day liquidity is managed in qualitative terms by participants in systems.

WIDESPREAD USE OF RISK CONTROL MEASURES HAS INCREASED THE QUANTITATIVE INTRADAY LIQUIDITY NEEDS

Over the past decade, the features of payment and settlement systems have significantly evolved.

The first crucial evolution which has influenced intraday liquidity needs is the progress in the implementation of some standard practices of risk control measures in payment and settlement systems. The stronger emphasis on risk management in the design of market infrastructure has been reflected in the shift towards real-time gross settlement (RTGS) in large-value payments and delivery versus payment (DVP) in securities settlement, which are typically associated with higher liquidity pressures.

The first example is the implementation in most countries of RTGS systems, which have become the standard model of large value payment system (LVPS), progressively replacing deferred net settlement (DNS) systems (see paragraph 2|1, *Changing forms of liquidity risk*).

DNS systems were the predominant form of payment systems in the 1980s. They are usually defined as providing settlement on a net basis at the end of a predefined settlement cycle, typically at the end of the business day.

By reducing the number and overall value of payments between financial institutions, netting minimises the usage of settlement asset. However, a drawback of DNS systems is the higher settlement risks involved, in particular since the finality is not reached immediately but late in the day.

In contrast with DNS systems, RTGS systems settle each payment individually (*i.e.* on a gross basis). Provided the payer has sufficient balances (or credit availability), each payment order is settled as soon as it enters the system (*i.e.* on a real-time basis). When the payer's funds are insufficient, the order is typically queued. RTGS systems provide the advantage that payments become final in the course of the day. The adoption of such safer systems was strongly supported and often initiated by central banks. A common side effect of settlement in RTGS mode is that the associated intraday liquidity needs required to settle an equivalent of underlying payment obligations are higher than in a DNS environment. The number of RTGS systems has increased dramatically in the 1990s.¹

Comparable evolution has taken place in the securities settlement environment where DVP model 1 has also expanded significantly in the past ten years. In contrast with model 2 and model 3 DVP, model 1 DVP implies that the delivery of the securities leg of a transaction is processed on a gross basis as well as the settlement of the related cash obligation.² This evolution has taken place as a way to improve final settlement and to accelerate both re-delivery of securities and re-use of the cash settlement proceeds.

One significant illustration of this trend in expanding the use of DVP model 1 is the implementation under

course of the Euroclear group's business model aimed at further integrating securities settlement. The so-called Euroclear settlement of Euronext-zone securities (ESES) project will lead to the creation of a single platform allowing for multi-central bank settlement in real time of securities deposited in Euroclear Belgium, Euroclear France and Euroclear Nederland. The ESES project has been implemented at Euroclear France in November 2007 and is due to be rolled out at Euroclear Belgium and Euroclear Nederland in 2008. It will entail in the three central securities depositories (CSDs) the decommissioning of the model 2 DVP systems currently used to expedite a large part of the volume of settlement of securities transactions. All transactions will accordingly be processed under a DVP model 1 basis. This change reflects the market demand for intraday finality.

Key implications of all these developments are the more complex liquidity management requirements faced by banks accessing the infrastructure, and the growing importance of collateralisation to support liquidity demand.

DEVELOPMENT OF INNOVATIVE LIQUIDITY SAVING FEATURES IN PAYMENT AND SETTLEMENT SYSTEMS

Opposite offsetting factors have recently developed in order to save liquidity and collateral associated with the widespread design of risk control measures in payment and settlement systems.

In order to respond to concerns expressed regarding the costs associated with RTGS and DVP model 1 in securities settlement, mechanisms have been introduced to allow participants to economise on liquidity needs. Concerns relate primarily to the added opportunity costs for payment system participants due to the higher amount of intraday liquidity needed to expedite settlement on a gross basis compared to net settlement. In extreme circumstances, the possibility for shortages of liquidity may emerge with the potential to generate significant disruption in payment systems.

These concerns have led the market to push LVPSs to introduce liquidity-saving features, including offsetting algorithms and the combination of

¹ See BIS (1997): "Real-time gross settlement systems", March.

² See the three different models of DVP identified in the report entitled *Delivery versus payment in securities settlement systems*, published by the Bank for International Settlements in 1992 (<http://www.bis.org>).

bilateral or multilateral netting with real-time settlement functionality (for instance, CHIPS in the United States, TARGET2 in the EU). Technological advance and legal changes have facilitated the introduction of these liquidity-saving features without reintroducing the kind of uncertainties and risks which characterised the DNS systems.

Associated to these developments, most LVPSS now provide their users with a broader range of real-time information and more flexibility to manage liquidity. Such controls include, for instance, the possibility to change the order of a payment in the queue, the intended settlement time or bilateral and multilateral credit limits to control the outflow of funds.

Actually, progress in the design of LVPSS now allows the banks to obtain earlier finality with a fewer amount of settlement asset needed at a lower cost. With a lower consumption of settlement asset, banks can make the same amount of payments with fewer settlement balances. Thus, the costs of making payments are lower. Where applied, liquidity saving features have significantly alleviated the liquidity burden on system participants, thereby relaxing potential collateral constraints.

Another example is the automated self-collateralisation procedures in securities settlement systems. Several CSDs of the Euroclear group (Euroclear France and Euroclear UK and Ireland) have liquidity-saving mechanisms that facilitate real-time DVP. Securities in the course of being purchased can be used as collateral for intra-day credit in order to fund the purchase. Monte Titoli in Italy and Iberclear in Spain use comparable arrangements.

In designing payment and settlement systems, a certain trade-off exists between on the one hand achieving early finality and thus lower risks and on the other hand economising on settlement asset and thus lower costs. While this trade-off remains, a better risk-cost equilibrium has been made possible by the development of these advanced liquidity saving features. In quantitative terms, the parallel development of liquidity saving features in systems has allowed to limit to a large extent the higher liquidity needs due to the implementation of risk control measures relying on gross settlement.

FACTORS INFLUENCING THE QUALITATIVE MANAGEMENT OF INTRADAY LIQUIDITY

One of the main remarkable developments of the recent years has been the increasing time criticality of the functioning profile of payment and settlement systems.

The liquidity demand is becoming concentrated at critical times during the day, such as when a key system requires payments to settle, in particular in the RTGS system which is the backbone of the payment organisation. Peak liquidity demands can come from the need to fund payments at specific times on different systems.

The first example can be drawn from the funding needs relating to the continuous linked settlement (CLS) system for foreign exchange transactions. At the end of 2007, CLS Bank is connected to 15 RTGS systems to allow its members to fund their positions, which has to be done within stringent schedules, in order to address the time zone differences between the different currency areas involved.

A second example is the growing implementation by central counterparties (CCPs) for securities and/or derivatives of the internationally recognised best practices, recommending to have the authority and the operational capacity to make intraday margin calls. The objective is to better capture price volatility or exceptional increases of exposures of trading positions during the day. One example of such recent development is the Intraday margin call project, implemented by LCH.Clearnet SA in Spring 2007. The arrangement focuses on intraday margin solution in derivatives markets as these are considered the most volatile in risk profile intraday. The recourse to intraday margin calls by CCPs requires participants to be able to transfer enough liquidity or collateral to the CCP within a very short notice intraday.

A third example is the increasing recourse to arrangements aimed at preventing consequences of settlement risk in DNS. Pursuant to internationally agreed standards applicable to both payment systems and securities settlement systems (SSSs), DNS systems should implement a mechanism that ensures timely settlement, even in the event of a participant's default.³

³ See Core Principle V for Systemically important payment systems (BIS, February 2001) and recommendation No 9 of the CPSS/IOSCO report on securities settlement systems (BIS, November 2001).

Among the different practices to implement such an arrangement to protect DNS systems against settlement risks, a possibility is to combine a permanent mutual fund, which amount is based upon average debit balances in the system, with complementary individual and temporary collateral for participants whose transactions would exceed the total amount of the permanent common fund. Combination of a mutual fund and individual additional collateral minimises opportunity costs in the level of the mutual fund, since exceptional peaks are covered by individual collateral. At the same time, it requires a more dynamic intraday liquidity management of participants and a close real time monitoring of the intraday evolution of their position in the related DNS system, in order to avoid that individual transactions are queued because of insufficient collateral.

One relevant example of such financial protection arrangement combining a mutual fund supplemented by individual collateral could be found in the previous revocable channel of the Euroclear France RGV2 SSS, which was decommissioned in November 2007, to be replaced by the ESES France SSS operating on a DVP model 1 basis for all types of transactions. This SSS used to process non-urgent transactions and operated on the basis of a multilateral netting of the cash leg of transactions. In order to bring the revocable channel of RGV2 into compliance with CPSS/IOSCO Recommendation 9, an arrangement was set in February 2005, consisting of caps on participants' buying positions, secured by a permanent mutual fund of over EUR 400 million, supplemented when necessary by individual collateral (*i.e.* collateral allocated strictly to cover the short cash position of the participant concerned). The arrangement was aimed at ensuring timely settlement of transactions, including in the event of an inability to settle by the participant with the largest single settlement obligation.⁴

Beyond the evolutions that have increased liquidity peaks at specific parts of the day, another trend is the extension of the operating times of systems, in order to take into account the interdependencies between them. For instance to achieve DVP settlement of securities transactions, market participants need to access both the securities and payments infrastructure. Accordingly, synchronisation of the

opening hours and cut-off times for settlement has often been achieved in order to ensure the smooth functioning of the market. One relevant example is for SSSs processing Eurosystem eligible collateral to have operating hours in compliance with NCBs requirements for TARGET.⁵

However, synchronisation of operational processes across systems in different countries and currency areas is a more recent phenomenon. At the time of implementation of CLS, the synchronisation of payment system processes was addressed, and some payment systems adapted their operating hours to meet the requirements of the CLS pay-in schedule. One of the major challenges in this context is overcoming the time-zone frictions that exist between, the Asian, the European and the American time-zones.

Extension of operating hours and synchronisation with other domestic or cross-border systems has strongly constrained intraday liquidity and collateral management, since it requires an efficient management so that timely transfer of liquidity resulting from settlement proceeds in one system is able to meet liquidity needs in another system.

1|2 Evolution of financing sources

Financing sources available to feed intraday liquidity needs have also evolved during the past years. An important distinction can be made depending on the settlement asset used, *i.e.* central bank money and commercial bank money. Developments in collateral policies have also significantly affected intraday liquidity management.

RELATION BETWEEN CENTRAL BANK MONEY AND COMMERCIAL BANK MONEY

Payment and settlement systems can settle either in central bank money or in commercial bank money.

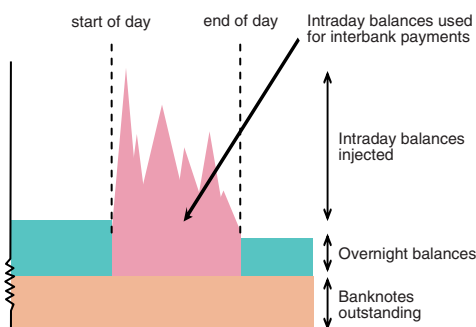
When central bank money is used as the settlement asset, the first component of intraday liquidity takes the form of deposits with the central bank that can be used to make payments during the day.

⁴ See Sampic (C.) and Hervo (F) (2003): "Protection of deferred net payment and securities settlement systems: the examples of SIT and Relit", *Banque de France, Financial Stability Review, No 3, November*.

⁵ See "Standards for the use of EU Securities Settlement Systems" in *ESCB Credit Operations -EMI, January 1998*.

Figure 1
Stylized diagram of central bank money

(y-axis: value; x-axis: time)



Source: BIS (2003): *The role of central bank money in payment systems, August.*

The intraday balance is also impacted by proceeds of settlement of payments with other participants all along the operating day.

If the intraday balance available for payments is too small relative to the value of payments to be made in a given time, it could result in gridlock, preventing payments from being executed. Thus in many cases central banks provide intraday credit to banks and other eligible account holders. Indeed, particularly with the decline in importance of reserve requirements in many economies, balances held by banks during the day are often substantially larger than those held overnight.

The smooth and safe functioning of a payment system is dependent not just on the quantity of the settlement asset. It also depends crucially on the quality of the asset and thus on the identity of the settlement agent. Therefore, international best practices recommend payment and settlement systems to use the central bank of issue as the settlement agent, providing the safest settlement asset.

However, in an era of financial globalisation, global players, active in multiple currencies, are confronted with the fact that each central bank provides as settlement asset only the currency it issues. This is one reason why systems providing multi-currency settlement services usually use commercial bank money as settlement asset. For example, the International Central Securities Depositories, Euroclear Bank and Clearstream Banking Luxembourg which service international markets and participants, provide settlement in multiple currencies in commercial bank money.

The use of commercial bank money raises specific liquidity risks in relation with the transferability of the private settlement asset in claims denominated in central bank money.

Central banks can address some of the consequences of globalisation through mutual co-operation. For example, in the mid-nineties, central banks expressed their preference for a market solution to address the need to reduce principal risk in foreign exchange settlement. CLS was launched in 2002, with support of the international central banking community. In 2007, the system provides payment versus payment (PVP) settlement in 15 major currencies which are eligible in the system. CLS Bank is the settlement institution for CLS, *i.e.* settlement is not in central bank money. However, all payments to and from CLS are made through the issuing central bank, so central bank money retains a pivotal role in the settlement of foreign exchange transactions in CLS.

CLS illustrates the clear trend towards the development of commercial money settlement backed by funding in central bank money (CHIPS in the US is another relevant example, with initial and final funding done in central bank money) or other innovative arrangements aimed at limiting the use of central bank money to a net funding (*e.g.* Clearstream settlement model or Euroclear future alternative payment model). The consequences of this type of settlement models in terms of intraday liquidity management are complex. On the one hand, the level of funding in central bank money appears very limited in quantitative terms, compared to the underlying value of payment obligations settled in commercial bank money. On the other hand, a strong settlement interdependency is introduced between the settlement system in commercial bank money and the payment system(s) used to fund the net obligations in central bank money. This requires from the banks a very close monitoring of the completion of their funding obligations, typically within tight intraday deadlines.

CENTRAL BANK INTRADAY CREDIT AND COLLATERAL POLICIES

Intraday credit policies

There is some variation in central bank policies as regards which institutions are eligible to be provided

with intraday credit in RTGS systems.⁶ Besides resident banks, which are commonly eligible to intra-day and overnight credit, there is less uniformity about providing credit to non-bank financial institutions (e.g. clearing houses or other settlement systems operators, investment firms and brokers...). Intra-day credit is generally provided only to a limited set of account holders, where necessary to ensure the orderly flow of payments. This automatically introduces a level of tiering in systems since for many institutions, direct access to a payment system may be of little or no use without access to credit. This has in turn consequences on liquidity management with direct participants having a broad access to intraday credit facility with the central bank providing clearing settlement services to other parties willing to use the system to expedite payments.

Where central banks provide credit they are potentially exposed to credit risk and consequently they require collateral, set limits and/or charge fees. Most central banks extend credit only against collateral.⁷ This is the case with the Eurosystem which grants unlimited, interest rate free but fully collateralised intraday credit to eligible counterparties participating in TARGET.

Actually, monetary policy considerations are also important when designing a central bank policy with regards to intraday credit. The failure to repay intraday credit by close of business may lead to "spillover" into overnight credit. This might threaten the implementation of monetary policy, either in case intraday credit has been granted to institutions that are not monetary policy counterparties⁸ or in a crisis situation. Actually, the amount of intraday credit may average several times the whole amount of liquidity provided overnight or longer through regular monetary policy. A massive spillover of intra-day credit into overnight credit may accordingly create short term disturbances in the conduct of monetary policy operations. However, central banks which provide fully collateralised intraday credit would become the owner of the collateral, in case one or some participants ultimately failed to reimburse credit or became insolvent. The possibility to liquidate the collateral would not only protect central banks against credit risk but also limit the impact of the spillover to the time needed to sell/realize the assets.

⁶ See BIS (2003): "The role of central bank money in payment systems", August.

⁷ The intraday credit policy of the US Federal Reserve Bank System is based upon a different framework, allowing eligible institutions to obtain a maximum amount of uncollateralised daylight overdraft ("single day net debit cap") charged with a daily fee and above this limit an additional amount of collateralised credit ("Collateralised capacity").

⁸ Which is not a widespread practice of central banks.

Diversification of eligible collateral

The collateral policy of the central banks influences the costs of the liquidity. Since most central banks extend credit only against collateral, the type of collateral that the participants of the payment systems can use is an important factor in determining the opportunity costs of holding collateral. In general, in the past decade most central banks have broadened the range of collateral they accept in their provision of intraday liquidity.

The collateral framework of the Eurosystem is one relevant example of a responsive policy to market innovations and developments. ESCB statutes state that any provision of liquidity (monetary policy or intraday) should be fully collateralised by adequate assets. At the beginning of Stage III of the Economic and Monetary Union in 1999, a two tier approach was followed. Tier 1 assets were based upon criteria common to the whole euro area whereas Tier 2 assets complied with national eligibility criteria. Irrespective of the difference in eligibility criteria, both Tier 1 and Tier 2 assets were eligible to collateralise any provision of liquidity (monetary policy or intraday) and were usable both on a domestic or cross-border basis within the euro area.

The financial industry expressed, in a public consultation made in 2003 a request to improve the collateral framework, including a desire to expand further the range of eligible assets. The Eurosystem took these views into account when it was decided to implement a phased approach towards a single list of eligible assets (implemented between Mid 2005 and 1st January 2007). The single list of Eurosystem eligible assets comprises a wide range of collateral, including marketable assets (e.g. public bonds) as well as non marketable assets, especially credit claims complying with an eligibility credit assessment framework.

TRENDS IN COMMERCIAL BANK MONEY FINANCING

Recent developments in commercial bank money intraday financing comprise the design of diverse intra-group organisations in order to better address liquidity and collateral management in a more global financial environment as well as the starting emergence of some intraday interbank market.

Internationally active institutions with a significant presence in a large number of countries manage their intraday liquidity and the related collateral in a variety of ways.⁹ It seems that a large number of internationally active banks operate primarily through correspondent banking relationships, accessing only a select group of markets directly and often managing their network of nostro agents on a partially centralised basis.

Of the small group of banks with a high level of direct participation in international payment systems, few operate with a fully centralised liquidity and collateral management function. Several others are partially centralised, managing liquidity on a regional basis.

The degree of centralisation of the liquidity and collateral management function tends to be driven by one or more of several factors: cost-efficiency, local regulatory and access factors, technological capacity and the degree of integration of IT systems across the banking group as well as the bank's particular contingency arrangements. In particular, banks with sizeable operations in multiple markets perceive the greatest scale economies from centralisation, with technological capacity and group-level contingency planning providing an additional level of comfort.

Other banks seem to consider that a decentralised liquidity and collateral management approach also supports business continuity planning, ensuring diversification of collateral and liquidity sources in the event of an emergency.

There is also some evidence of banks' implementation of in-house liquidity –and collateral– saving payment management techniques to mitigate intraday liquidity risk pressures. Examples involve queue release algorithms or internal schedulers to manage the flow of payments and prioritise obligations.

Surveys conducted at regional or international levels regarding provision of credit in the context of correspondent banking services seem to indicate that intraday overdraft limits are generally uncollateralised and can be quite large, while overnight overdrafts are comparatively small. In case of default of participants in correspondent banking arrangements, such overdrafts could accordingly become a vector for domino effects. However, to the extent that credit lines offered also tend to be uncommitted, correspondent banks would

quickly cut or suspend credit lines, in case of need. This would allow the correspondent banks to keep control of their credit risk but might also precipitate or amplify the consequences of a crisis (e.g. suspension of credit lines due to a misperception of an operational incident affecting a major bank using correspondent agents to expedite its settlement activities in away systems).

Traditionally, intraday credit provided in correspondent bank services has been free of interest. However, there is some anecdotal evidence that an interbank intraday liquidity market seems to start emerging in relation with concentration of correspondent banking activities and funding costs related to critical time windows. The introduction of CLS in particular has triggered a move towards greater concentration of correspondent activity into those banks that are direct participants in, or act as nostro agents for CLS. In relation with the time criticality of funding obligations related to CLS, those banks have started to charge intraday liquidity.

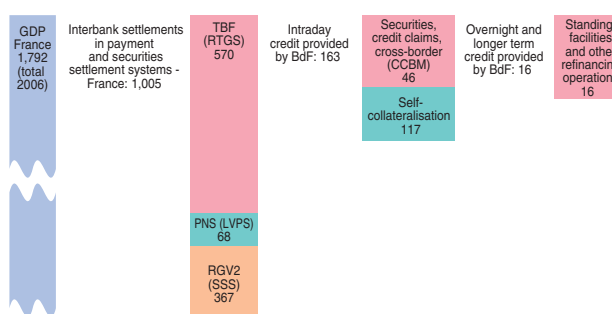
OVERVIEW OF INTRADAY CREDIT IN PARIS MARKET PLACE SETTLEMENT SYSTEMS

The following diagram provides an illustration of the respective importance of payment flows compared to the real economy (the ratio between the daily turnover in payment and settlement systems averages 56% of the annual GDP; in other words, two days turnover in payment and settlement systems is equivalent to the annual GDP in value).

The amount of intraday credit required to settle the payment and settlement obligations averages 16% of the daily turnover in value.

Figure 2
Intraday credit and settlement flows – Paris financial centre

(January – September 2007, daily average, EUR billions)



⁹ See Cross-border collateral arrangements report – CPSS BIS, January 2006.

Intraday credit granted by Banque de France is ten times higher than the overnight and longer term credit provided to the banks.

In this context, the smooth functioning of payment and settlement systems appears all the more important that a major problem preventing reimbursement of intraday credit at the end of the day would lead to a spillover to overnight credit.

2| FINANCIAL STABILITY IMPLICATIONS

The developments affecting intraday liquidity management with shortening of the time horizon in a more complex settlement landscape need to be adequately considered from a financial stability perspective. It is necessary to understand the evolution of risks, which differ depending on the settlement model used but also on the evolution of the global financial environment, characterized by a concentration of actors and growth of settlement interdependencies. Over the past decade, the relevant actors, including the banking sector, the banking supervisors and central banks have taken various initiatives to better approach changes in intraday liquidity risk.

2|1 Risks associated to intraday liquidity management

CHANGING FORMS OF LIQUIDITY RISK

Liquidity risk in payment systems differs depending on the settlement model used.

In DNS systems, finality of settlement is only achieved at the end of the day (or end of settlement cycle) and thus there is no certainty that the payments will be settled timely. If one participant fails to meet its payment obligation when due, the whole processed payment orders could be unwound and new balances excluding the defaulter would have to be presented for a new attempt for settlement. Liquidity risk would therefore arise from an unforeseen change in the liquidity position of the different participants, particularly those that expect to be creditors in the system. This situation would force them to seek other

funding resources, which could give rise to strains on the interbank market, with potential repercussions on the conduct of the monetary policy.

This situation generates the consequent risk of other participants defaulting in turn because of unexpected debit position to be covered late in the day. The liquidity risk would become systemic if, by a spillover effect, the inability of an institution to settle its net balance in one system generates a failure in other systems. Thus, in DNS systems, the liquidity risk rather materialises end-of-day than intraday, when it appears implicit.

The earlier finality occurs (*i.e.* a payment becomes unconditional and irrevocable) the lower is the risk of unexpected credit exposures arising in the settlement process. This has been a main driver to develop real-time gross settlement (RTGS payment systems and DVP model 1 for securities transactions). However, in systems operating on the basis of gross settlement, there is a risk that insufficient liquidity creates queued payments. Should they accumulate, this may generate gridlocks and eventually failed payments (and/or deliveries) at the end of the day. To a certain extent, risk mitigation measures aimed at preventing credit risk through the development of gross settlement has translated in higher liquidity risk (which can be in turn mitigated through innovative liquidity saving features described in section 1|1 *Development of innovative liquidity saving features in payment and settlement systems*).

CONCENTRATION OF INTRADAY LIQUIDITY RISKS

The continuing consolidation of the financial sector has led to a significant concentration of payments activities and associated exposures within individual banks. There is anecdotal evidence that a few banks process on their own books very high payment values –in some cases similar to those of LVPSSs. Such concentrations may arise for various reasons such as consolidation between banks, specialisation by certain banks in correspondent banking, or changes in cost structures that encourage indirect rather than direct participation in payment systems. In Europe, payment flows passing through the leading correspondent banks attain values comparable to those observed in certain national payment systems.

The process of adapting correspondent banking and custody services to the context of financial

globalisation has sometimes resulted in similarities between these arrangements and payment and settlement systems, giving birth to quasi-systems. Some banks provide services for a substantial number of other banks and financial intermediaries for which the use of a correspondent or custodian bank is an alternative to direct access to a system.

Lastly, corresponding and custodian banks which have a critical mass of customers and flows can settle transactions internally; in other words, they can make payments and deliver securities from account to account between their customers without going through payment and settlement systems. Recent regulatory developments, *e.g.* the implementation of the EU Directive 2004/39/EC on market in financial instruments ("MiFID") in the European Union is probably putting new emphasis on this trend with large banks that develop internal systems competing with infrastructures.

These developments influence the form of intra-day liquidity risk, leading to a concentration and internalisation of flows in commercial bank money outside the payment and settlement systems.

IMPACT OF SETTLEMENT INTERDEPENDENCIES ON LIQUIDITY RISK

During the past decade, the forms of interdependencies between payment and settlement systems have significantly increased and changed, primarily within the settlement infrastructure of a said country or currency area but also on a cross-border basis.

The consolidation and globalisation of the financial sector has resulted in the emergence of a few global financial institutions acting as common and significant participants in multiple systems operating in several countries. They may also play different roles, as settlement banks, liquidity providers, and collateral custodians to the same systems in which they are typically among largest participants. This creates institution-based interdependencies between payment and settlement systems.

Other forms of interdependencies that may influence liquidity management are related to the direct settlement relations between systems (*e.g.* between SSSs and payment systems to achieve DVP in securities settlements and to collateralise extensions of intra-day

credit in payment systems). Interdependencies can facilitate significant improvements in the safety and efficiency of payment and settlement processes. DVP and PVP processes, for example, have led to a significant reduction in the principal risk otherwise associated with the settlement of securities and foreign exchange transactions.

Interdependencies, however, have also substantial consequences regarding the form of liquidity risk and accordingly on the liquidity and collateral management of participants in payment and settlement systems.

In particular, as systems and system participants become more dependent on the smooth functioning of one system to meet liquidity or collateral demands in another system, the risk that a financial or operational disruption in one system may have an impact on another system and its participants also increases.

The increasing interdependence of liquidity flows among systems has led to a more complex liquidity management for systems' participants, in order to avoid the creation of unbalance between liquidity traps in some systems and liquidity shortages in other systems.

2|2 Lessons drawn from recent turmoil on financial markets

In the context of the recent turmoil that affected financial markets in the summer 2007, many payment and settlement systems and their participants faced a variety of challenges in the conduct of their settlement operations. These challenges comprised increased trading volumes and asset price volatility, as well as the consequences on systems of institutions' precautions against liquidity and credit risk. These challenges were generally well met and consequently payment and settlement systems functioned smoothly.

Regarding more specifically intraday liquidity and collateral management, several lessons can be drawn from this period of strains.

Counterparty credit concerns that became manifest in money markets did not significantly affect institutions' willingness to meet their payment and settlement obligations on a timely basis. In particular timely settlement was preserved for systems operating in the Paris financial centre.

Neither spillover from intraday to overnight credit, nor any increase in end-of-day failed/unsettled payments were ascertained. Figures do not even show any intraday gridlock or delay in the interval between the submission of payment orders and their actual settlement, compared to the normal time lags observed.

However, one important behaviour that was observed in most systems, including in the ones operating in the Paris financial centre were related to the precautionary demands for central bank liquidity.

Actually, financial institutions' increased aversion to credit and liquidity risk also affected payment and settlement systems. The difficulties in money markets led financial institutions to increase significantly the amount of collateral pledged to central banks for potential intraday and overnight credit.

The level of intraday credit provided by central banks also increased somewhat. This primarily reflects the precautionary actions of financial institutions, rather than an increase in actual intraday liquidity needs. At the same time, central banks' provision of overnight and longer term funds alleviated some of this increased demand for intraday credit.

As with the other challenges, the precautionary steps taken by institutions, ascertained by the additional central bank liquidity required did not result in visible negative implications for the functioning of systems. Central banks were able to process these additional collateral deliveries, and institutions apparently found sufficient collateral to pledge to the central bank.

Chart 3
Average and maximum settlement delay
in the French RTGS during August 2007

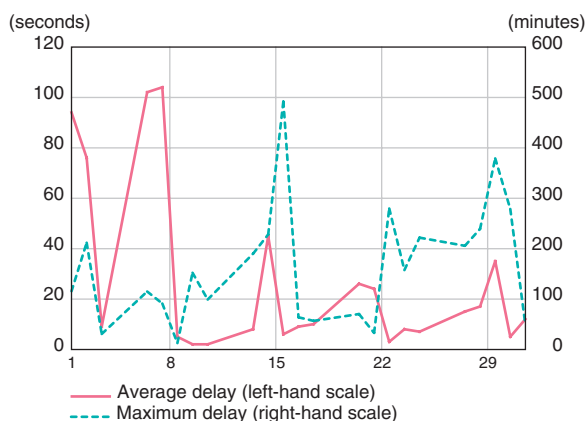
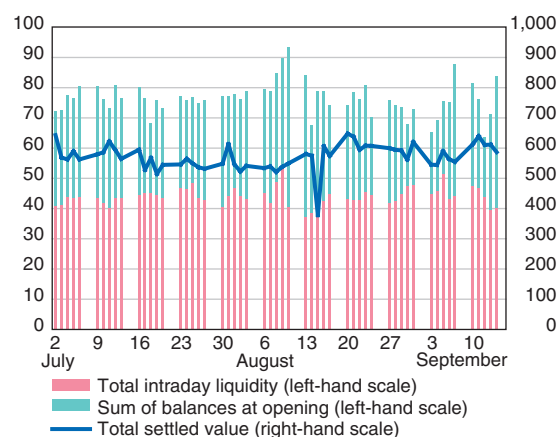


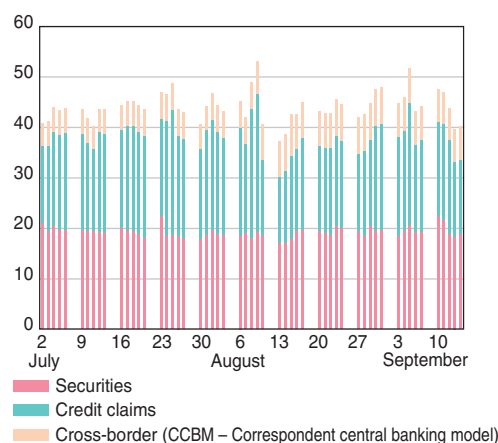
Chart 4
Total settled value and total liquidity usage
(balances at the opening and intraday liquidity borrowed)
in the French RTGS, from 1 July to 15 September 2007
(EUR billions)



As far as central bank policies are concerned, an important lesson relates to the need of having a list of eligible assets that is diversified enough to address an unexpected increase in collateral demand.

This requirement was achieved in several ways. In the euro area, the existing collateral policy of the Eurosystem results in many institutions having high levels of diverse types of collateral already posted, or ready to be posted to one or more central banks to face increased demand for liquidity. In that context, the provision of extra collateral was processed without much difficulty. Several other central banks met this demand allowing some flexibility in expanding their collateral lists in light of the turmoil.

Chart 5
Total intraday liquidity borrowed in the French RTGS
and breakdown by type of collateral
1 July to 15 September 2007
(EUR billions)



Another lesson is related to the strong relation between operational risk and liquidity risk. The question raised is whether the system design allows the mitigation of liquidity strains in preventing for instance the development of liquidity sinks in case of an operational problem at one of a major participant.

2/3 Initiatives to better mitigate intraday liquidity risks

In order to better address the intraday liquidity risks in a moving environment characterized by increased constraints in terms of systems interdependencies and shortening of the time horizon, policies and practices have been developed both by the banking sector and by the central banks and other public authorities.

INITIATIVES DEVELOPED BY THE BANKING SECTOR

In the past decade, the banking sector has taken several initiatives to address effectively liquidity risk while minimising the costs of managing payment liquidity in a global environment.

One example is the Guidelines on liquidity management released by the European Banking Federation in 1999, to take into account the new environment resulting from the implementation of TARGET in the EU.

Other relevant examples are the reports released in 2003 and 2005 by the Payments Risk Committee (PRC),¹⁰ a private sector group sponsored by the Federal Reserve Bank of New York on which many of the largest global banks are represented.

The PRC recommended central banks to further harmonise their collateral policy. It also recommended individual institutions to develop well-constructed intraday liquidity collateralised services, (such as intraday real-time repos, cross-border collateral pool facilities and intraday currency and collateral swaps). The PRC advocated that obstacles to moving collateral across borders in support of such liquidity services should be eliminated. In a second report, the PRC detailed the different market solutions, as well as the role that some market infrastructures (e.g. CLS and ICSDs – International central securities depository) could play for their implementation.

THE ROLE OF CENTRAL BANKS AND SUPERVISORS

Central banks influence payment and settlement systems by providing a variety of services to commercial banks. In doing so, central banks provide a safe settlement asset: the central bank money. In most cases, they also operate systems which allow for the transfer of that settlement asset. Central banks have also developed oversight responsibility over payment and settlement systems.

Therefore, central bank responses to the new challenges regarding intraday liquidity comprise the provision of systems offering liquidity saving features, the adaptation of their policy in the area of access to central bank money and collateral eligibility, as well as oversight initiatives to better capture the moving liquidity risk.

Most RTGS systems recently developed by the central banks encompass liquidity saving features. The new TARGET2 platform which has been launched on 19 November 2007 is one relevant example of the new RTGS generation offering state-of-the-art liquidity saving features.

Improvements in the collateral policy and in the tools to mobilise more easily eligible assets also facilitate banks to better manage their collateral and to get more easily the central bank money they need. Recent turmoil demonstrated a preference for central bank money. Actors that do not have access to central bank's refinancing are in a more difficult situation as they are dependant on banks for refinancing.

Cross-border use of collateral either on a routine or on an emergency-only basis may be an effective policy response to alleviate collateral pressure. In the Eurosystem, there is extensive use of cross-border collateral among the euro area countries, although this is limited to euro-denominated collateral assets issued in the European economic area (EEA) and settled/held in the euro area.

A few central banks accept collateral denominated in foreign currency. Several central banks (in Sweden, Switzerland, the United Kingdom, and the United States) have already introduced such facilities and have adopted a range of approaches to accepting these assets. The existing arrangements vary from emergency-only facilities through infrequently used routine cross-border collateral arrangements to arrangements used extensively on a routine basis.

¹⁰ Managing payment liquidity in global markets: risk issues and solutions, *Payments Risk Committee, March 2003 and Global payment liquidity – private sector solutions – October 2005*

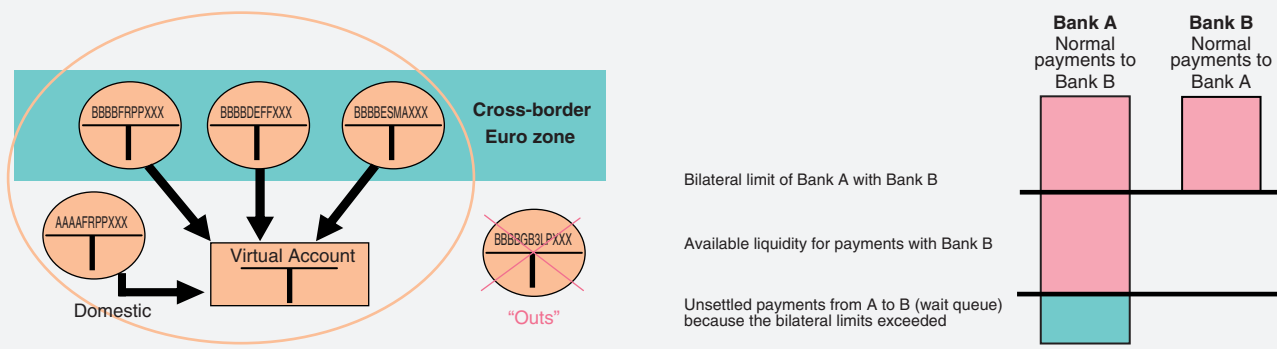
Box 1

Liquidity saving features in advanced payment systems: TARGET2's example

TARGET2 is a relevant example of a system providing its users with the most up-to-date liquidity management tools currently offered in RTGS systems. TARGET2 combines the following liquidity-saving patterns:

- **consolidated monitoring of the liquidity position in all RTGS accounts** of a credit institution across Europe, thanks to TARGET2's architecture, consisting of a single shared platform. Multi-country banks are able to manage the activity of their branches from a single point and to centralise their cash management, which will include the liquidity involved in the settlement of ancillary systems – as settlement of these systems will be performed over RTGS accounts after a transition period (maximum 4 years after TARGET2 go-live);
- **liquidity pooling functionality** based on the concept of the virtual account, which purpose is the intraday aggregation of the liquidity available on all the single accounts belonging to a group of accounts of a said banking group. Its liquidity can be managed in a consolidated way. Each transaction involving an account belonging to a group of account will be immediately booked on the relevant single account using the global liquidity available at the group of accounts level; this global liquidity available is defined as the sum of balances of all the
- RTGS accounts belonging to the group of accounts (plus the sum of all the credits lines, if any, of all the RTGS accounts belonging to the group of accounts);
- **different priority levels** that can be assigned to each payment depending on its criticality;
- **possibility to use a liquidity reservation feature** in order to facilitate the settlement of participants' operations, including the ability to set aside liquidity on specific sub-accounts especially in order to dedicate it to the settlement of transactions stemming from ancillary systems;
- **bilateral and multilateral sending limit features** offered in order to avoid that some participants are inclined to wait for receiving payments from their counterparties before issuing their own payments. Setting a bilateral limit vis-à-vis a participant prevents the settlement of payments that would cause the bilateral balance with this participant to breach this limit. Setting a multilateral limit prevents the settlement of payments that would cause the balance vis-à-vis all the participants towards whom no bilateral limit was set to breach this multilateral limit. Thanks to the multilateral limit feature, there is no need for participants to manage bilateral limits towards each other (TARGET2 should have around 1,000 direct participants);
- **optimisation mechanisms** which aim at reducing participants' liquidity needs while improving the fluidity of settlements.
 - **Offsetting processes** that are triggered by the arrival of a transaction in the system. They attempt to immediately settle this transaction, in combination with already queued transactions;
 - **five optimisation processes.** The first three of them are applied to payments placed in the queue (normal priority) and are sequentially triggered throughout the day. The other two correspond to specific settlement methods for ancillary systems.

Effect of bilateral limits on normal priority payments



Given the different needs and arrangements among the central banks, a full harmonization of the policies regarding collateral eligibility and mobilization practices does not seem feasible. However, further cooperation between central banks may be desirable to address possible common needs (e.g. responding to emergency liquidity situations), ensure readiness to respond to future challenges and facilitate individual projects of some central banks to further develop cross-border collateral facilities that may be used for routine or emergency credit, or both.¹¹

From an oversight perspective, it seems important that central banks in cooperation with other relevant public authorities are in a position to adequately address the changing nature of the liquidity risk.

A first area relates to the ability to monitor developments and risks affecting liquidity in payment and settlement systems. Several tools are used to analyse and forecast developments, including simulation models.

A second area is to develop oversight analysis and eventually specific requirements with respect to intra-day liquidity risk.

Intraday liquidity risk issues are of a common interest between banking supervisors, who are in charge of the prudential safety of the financial institutions, participating in payment and settlement systems and central banks, entitled to ensure the smooth functioning of these systems. In this respect, coordinated actions between central banks and

banking supervisors have helped strengthening the resilience of both banks and payment systems.

Supervisory requirements and recommendations have increasingly recognised that developments affecting payment and settlement systems have lead to a situation where the relevant time-frame for active liquidity management is generally quite short, including intraday liquidity.¹²

For instance, the Principle 9 set by the Basel Committee regarding Contingency Planning states that a bank should have contingency plans in place that address the strategy for handling liquidity crises and include procedures for making up cash flow shortfalls in emergency situations. It could be interesting to investigate further whether banks' contingency funding plans and stress tests adequately reflect intraday liquidity risks, including the potential for sudden and unexpected changes in liquidity or collateral needs.

Another issue is related to the regulatory approach with respect to developments in correspondent banking and custody business. A number of central banks have been working to better understand the risks issues, in relation with internalisation and concentration of flows. But large correspondents and custodians are also commercial banks that are subject to banking supervision. Thus, it is useful that central bank overseers and banking supervisors monitor and assess in cooperation the management of potential risks related to the evolution of correspondent and custody activities for the smooth functioning of the payment and settlement process.

¹¹ See BIS (2006): "Report on cross-border collateral arrangements".

¹² See Basel Committee on Banking Supervision (BCBS) (2000): "Report of the Sound Practices for managing liquidity in banking organisations", February

Box 2**Attempt to simulate and modelizing intraday liquidity risks**

Recently, several central banks have developed simulation tools able to reproduce the operation of payment systems using real payment data.

These new tools allow the different central banks to conduct several stress-testing exercises, as a part of their oversight mission. In particular, payment system simulators are especially helpful to investigate the issue of liquidity risk in RTGS systems. In such systems, an operational problem affecting the IT infrastructure of a large participant could prevent the considered participant from emitting any payment, while it would still receive payments from its counterparties. The affected participant would thus turn into a «liquidity sink» for the system, depriving the RTGS of its liquidity and consequently, threatening the smooth functioning of the system. Possible consequences include the rejection of payments at the end of the day, or a substantial increase in the average settlement delay.

Simulation tools allow central banks to quantify those consequences, and help them to define the most appropriate oversight policies to face this issue.¹ In particular, which participants should be requested to have a secondary processing site and how many contingency payments per hour should the system operator be able to make on behalf of an affected participant, are important questions, to which a payment system simulator can help provide an answer.

¹ Mazars (E.) and Woelfel (G.) (2005): "Analysis, by simulation, of the impact of a technical default of a payment system participant", Banque de France, Financial Stability Review, No 6, June.

Liquidité et contagion financière

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Le déclenchement de la crise du crédit de 2007 constitue une énigme manifeste. Le secteur des prêts hypothécaires à risque occupe en effet une place relativement peu importante au regard de la taille du système financier et les expositions étaient largement disséminées en raison de la titrisation. Or, les effets de cette crise sur le marché du crédit se sont révélés significatifs. Traditionnellement, la contagion financière a été analysée au travers du prisme des défaillances en chaîne : lorsque A emprunte auprès de B, qui lui-même a emprunté auprès de C, alors la défaillance de A se répercute sur B, puis sur C,

et ainsi de suite. Toutefois, dans un système financier moderne régi par les lois du marché, la contagion se propage par le canal des variations de prix, des risques mesurés et du capital, valorisé en valeur de marché, des institutions financières. Lorsque les bilans sont valorisés quotidiennement en valeur de marché, les variations des prix d'actifs y apparaissent immédiatement et provoquent une réaction des intervenants. Même si les expositions sont largement disséminées sur l'ensemble du système financier, l'incidence potentielle d'un choc peut être largement amplifiée par la variation des cours des actifs.

Les chaises musicales : un commentaire sur la crise du crédit

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L'incertitude — c'est-à-dire une hausse du risque inconnu et non mesurable par opposition au risque mesurable, que le secteur financier sait parfaitement gérer — est au cœur de la récente crise de liquidité. Les instruments financiers et les structures de produits dérivés qui ont soutenu la croissance récente des marchés du crédit sont complexes. En raison de la prolifération rapide de ces instruments, les intervenants de marché ne disposent pas de données

sur longue période pour évaluer le comportement futur de ces structures financières en période de tensions. Ces deux facteurs, complexité et absence de données historiques, sont les conditions préalables à une incertitude de grande ampleur. Nous expliquons comment une montée de l'incertitude peut provoquer une crise de liquidité et analysons les stratégies des banques centrales dans ce contexte.

Liquidité de marché et stabilité financière

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Il existe des interactions étroites entre la stabilité des institutions financières et celle des marchés de capitaux. Les banques et les autres institutions financières ont besoin de marchés liquides pour conduire leur stratégie de gestion du risque. De leur côté, les marchés sont tributaires des lignes de crédit fournies par les institutions financières pour couvrir leurs besoins de liquidité.

La liquidité de marché ne dépend pas seulement de facteurs objectifs exogènes, mais aussi de la dynamique endogène du marché. Les banques centrales en charge de la stabilité systémique doivent évaluer dans quelle mesure leurs missions traditionnelles de garantes de la santé du système bancaire doivent être adaptées pour favoriser la stabilité sur les marchés de capitaux concernés.

Dix questions sur la crise des *subprime*

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Le rationnement actuel du crédit représente la première crise de l'ère de la titrisation de masse. Certains en tirent la conclusion que les coûts de la titrisation, c'est-à-dire les risques pesant sur la stabilité financière, sont supérieurs aux bénéfices. D'où l'idée que l'on devrait revenir à l'âge d'or où les banques commerciales accordaient des prêts aux ménages et aux entreprises et les gardaient inscrits à leurs bilans, au lieu de les fractionner et de les découper avant de s'en défaire. Mais cette formule de retour vers le futur ignore les réalités économiques. La titrisation est étroitement imbriquée avec le mouvement plus vaste de déréglementation des marchés de capitaux et avec la révolution des technologies de l'information. Les autorités de régulation ne peuvent pas éliminer ce processus sans imposer à nouveau le genre de réglementation restrictive à laquelle les systèmes bancaire et financier étaient soumis il y a un demi-siècle.

Ce retour en arrière n'est, de toute façon, pas souhaitable car la multitude d'innovations financières, que l'on désigne sous le terme de titrisation, comporte de réels

avantages pour l'économie. Ces innovations ont permis au système financier de restructurer et de répartir les risques et elles ont réduit le montant des fonds propres dont le système a besoin pour absorber ces risques, permettant ainsi de réduire les coûts de financement à la fois pour les entreprises et pour l'ensemble des propriétaires de logements.

À la suite de la grande crise de la titrisation de 2007/2008, les partisans des réformes affirmeront certainement que les régulateurs du système financier doivent réexaminer les règles en vigueur. Selon moi, les autorités devraient se concentrer sur le système bancaire. En effet, la fonction des banques au sein du système financier demeure unique car elles sont au cœur des compartiments du système financier qui sont les plus dépendants de l'information. La protection que leur accorde le filet de sécurité financière atteste de leur rôle fondamental et de leur vulnérabilité. Toute réévaluation devrait commencer par le rôle de Bâle II et, au sein de Bâle II, par le rôle des modèles internes et de la notation des obligations.

Qu'est-il advenu de la dispersion des risques ?

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Les turbulences ayant affecté les marchés du crédit et des financements au second semestre 2007 montrent de façon préoccupante que la dispersion du risque sur les marchés de capitaux s'est avérée moins efficace que prévu. Il semble que les investisseurs aient acquis des risques qu'ils ne maîtrisaient pas. Qui plus est, les grandes institutions financières n'ont pas tant réussi à se défaire des risques qu'à les transférer à d'autres lignes de métier dans le cadre de leurs propres activités, ce qui a entraîné une concentration non souhaitée de risques dans leurs propres bilans. En vue de restaurer la confiance à court terme et de ramener le processus de création de crédit sur une voie plus soutenable à l'avenir, les autorités prudentielles, les banques centrales et les gouvernements devront d'abord comprendre pourquoi la dispersion du risque, qui ralliait tous les suffrages, n'a pu jusqu'ici tenir ses promesses.

La « réticence à prêter » à l'origine de ces tensions sur les marchés monétaires a été largement attribuée à des inquiétudes suscitées par la situation financière des emprunteurs, en raison d'incertitudes relatives à la valeur des actifs détenus au bilan de ces derniers, ainsi qu'à l'attention insuffisante portée à la gestion de la liquidité par les sociétés financières. Toutefois,

se focaliser sur l'incertitude entourant la situation des emprunteurs masque une réalité difficile à affronter : les grands intermédiaires financiers sont eux-mêmes à la fois prêteurs et emprunteurs et leur réticence à octroyer des prêts reflète dans une large mesure une réaction défensive face aux incertitudes qu'ils nourrissent concernant leur propre bilan.

L'amélioration des dispositifs de simulation de crise de liquidité et de solvabilité serait certainement bénéfique. Or, une source majeure de tensions sur les marchés du crédit et des financements réside dans l'incapacité manifeste de nombreuses entreprises d'anticiper l'interaction de leurs divers engagements inscrits au bilan et hors bilan, et, en particulier, de prendre conscience de la rapidité avec laquelle le développement de leurs activités hors bilan peut influencer sur l'ensemble de leurs expositions.

La réflexion que les autorités de supervision ont à mener sur les remèdes possibles aux turbulences affectant les marchés du crédit et sur l'échec manifeste de la dispersion du risque doit d'abord intégrer une analyse de leur propre rôle dans le développement de la tendance à sortir les risques des bilans bancaires.

La gestion du risque de liquidité

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Liquidité et solvabilité sont les deux piliers indissociables de l'activité bancaire, souvent impossibles à distinguer l'un de l'autre. Une banque illiquide peut rapidement devenir insolvable et inversement. Comme l'a souligné Tim Congdon (*Financial Times*, septembre 2007), dans les années cinquante, les actifs liquides représentaient en général 30 % de l'actif total des banques de dépôts britanniques et se composaient dans une large mesure de bons du Trésor et de titres publics à court terme. Actuellement, ces avoirs correspondent à 0,5 % environ et les actifs liquides traditionnels à quelque 1 % du passif.

Les normes antérieures relatives à la transformation des échéances n'ont pas non plus été conservées. Des proportions croissantes d'actifs à long terme ont été financées par des emprunts à relativement court terme sur les marchés interbancaires. Les conduits de financement de tranches de crédits hypothécaires titrisés adossés à du papier commercial à trois mois en constituent un exemple extrême. Northern Rock en est un autre.

Ces problèmes d'incohérence temporelle sont difficiles à résoudre, notamment dans un contexte de crise (prévue) ; il convient de souligner que de nombreux aspects de la crise actuelle, mais pas tous, avaient été anticipés par les autorités de régulation du système financier et, plus largement, par les banques centrales. Or, ces dernières ne disposaient tout simplement pas des instruments, ni sans doute de la volonté nécessaire pour remédier à la situation. Si les canots de sauvetage sont immédiatement mis à l'eau dès l'apparition des problèmes, et que des liquidités supplémentaires sont fournies à des conditions favorables, les banques sont incitées à accroître la densité de leurs constructions en zone inondable. Pourquoi devraient-elles s'inquiéter de la gestion de la liquidité lorsque c'est la banque centrale qui s'en charge ? Les banques achètent en quelque sorte une « option de vente » sur la banque centrale en matière de liquidité ; en effet, elles se défaussent du risque de liquidité sur la banque centrale. L'article entend pointer le besoin incontestable d'un examen calme et approfondi de ce que devraient être les principes de gestion de la liquidité bancaire.

La réglementation de la liquidité et le prêteur en dernier ressort

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La récente crise des *subprime* a rendu de nouveau d'actualité des propositions visant à réglementer la liquidité des banques qui viendraient compléter la réglementation en matière de solvabilité. Sur la base de travaux de recherche récents, cet article démontre qu'une réglementation de la liquidité pourrait en fait constituer

un moyen de réduire les pressions exercées sur les banques centrales en faveur d'injections de liquidités en période de crise. Une autre question cruciale concerne la répartition des responsabilités entre les banques centrales, les contrôleurs bancaires et le Trésor dans la gestion des crises bancaires.

Déficits de liquidité : fondements théoriques

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Des déficits de liquidité se forment lorsque des institutions financières et des entreprises s'efforcent, sans y parvenir, de trouver la liquidité nécessaire pour répondre à leurs besoins les plus urgents ou entreprendre des investissements rentables. Les problèmes sont amplifiés lorsque d'autres acteurs accumulent des excès de liquidité qu'ils ne sont pas disposés à prêter sur les échéances souhaitées par les emprunteurs potentiels. Le présent article réexamine les fondements théoriques de ces déficits : Quels sont les

facteurs qui déterminent la demande et l'offre de liquidité des entreprises ? Comment l'offre est-elle affectée par l'innovation financière ? Quand l'économie fournit-elle suffisamment de liquidité pour répondre à ses propres besoins et quel est le rôle des politiques publiques en la matière ? La seconde partie de l'article comporte quelques commentaires sur la crise des crédits hypothécaires à risque et ses implications pour la réglementation prudentielle, les agences de notation et les politiques publiques.

La liquidité sur les marchés mondiaux

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Le dernier épisode de turbulences a été marqué par une période prolongée d'illiquidité sur un grand nombre de marchés, allant de l'interbancaire traditionnellement très liquide aux produits structurés nettement moins liquides. Il a débuté par ce qui a été généralement considéré comme une dégradation de la qualité du crédit sur le marché américain des prêts hypothécaires à risque. Toutefois, cette situation a rapidement accentué l'incertitude quant à la valorisation des titres liés à ce marché, ce qui a affecté leur liquidité. La vitesse à laquelle l'illiquidité de ce marché s'est répercutée sur les autres marchés en affectant la liquidité des financements a été à la fois surprenante et sans précédent.

Cet événement a suscité des interrogations sur la manière dont est déterminée, sur les marchés primaire et secondaire, la liquidité de marché d'une panoplie d'instruments et sur les modalités d'action des mécanismes de transmission de l'illiquidité d'un marché à l'autre en période de crise. Cet article s'attache à identifier comment les concepts standard de la liquidité peuvent être appliqués aux différents types de marchés à travers le monde afin de comprendre la rapidité de la détérioration de la liquidité. Plusieurs caractéristiques de la liquidité, à savoir les types de structures de marchés (et l'existence d'intermédiaires et de supports de négociation officiels), la construction des instruments et les catégories d'investisseurs, sont utilisées pour guider l'analyse. Une des particularités, qui semble importante pour la liquidité,

est le niveau de compréhension, tant par les acheteurs que par les vendeurs, des informations relatives aux risques. Il s'avère par ailleurs que les anticipations des opérateurs de marché relatives à la liquidité et leur capacité à en assurer le suivi ont également une influence sur la liquidité. Ces caractéristiques tendent à indiquer que le recours croissant à la titrisation et aux produits de crédit structurés complexes, qui représentent de nouveaux mécanismes de transfert du risque de crédit, peut s'accompagner d'une propension aux chocs affectant la liquidité qui nécessitera un examen plus approfondi.

À la lumière de cette analyse, l'article identifie les moyens d'atténuer certains des problèmes apparus au cours de la récente crise de liquidité. La liquidité étant créée et entretenue par les opérateurs de marché eux-mêmes, les améliorations possibles sont pour l'essentiel du ressort du secteur privé. Il apparaît déjà clairement que certaines pratiques et stratégies de marché devront être modifiées et, dans ce contexte, plusieurs propositions d'amélioration de la gestion du risque de liquidité par les institutions financières sont exposées. Toutefois, la liquidité du marché et des financements étant intimement liée à la stabilité financière, qui constitue un bien public, le secteur public pourrait également jouer un rôle à cet égard. Par conséquent, les outils utilisés par les banques centrales pour assurer la transmission efficace de la politique monétaire et la stabilité financière devront être réexaminés.

L'impact de la directive MIF sur la liquidité des marchés financiers

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La directive sur les Marchés d'instruments financiers (MIF) qui est entrée en vigueur au 1^{er} novembre 2007 supprime la règle de concentration des ordres sur actions jusque là imposée en France. Cette règle, appliquée plus ou moins strictement dans les pays européens, avait pour conséquence la centralisation de la grande majorité des flux vers les marchés réglementés, en particulier Euronext Paris pour les actions listées sur la bourse française.

Dans les années à venir, le flux d'ordres sera *de facto* fragmenté, en raison de la possibilité d'exécuter les ordres des investisseurs sur les marchés réglementés, mais également sur les plateformes multilatérales de négociation (*Multilateral trading facilities* - MTFs) et par le recours à un internalisateur systématique (IS) qui se portera contrepartie de la transaction, à l'image des teneurs

de marché (*market-makers*) sur les marchés dirigés par le prix comme le London Stock Exchange ou le Nasdaq.

La concurrence entre places de négociation, généralisée au niveau européen, s'inscrit dans un mouvement qui remonte aux années soixante-dix. Depuis cette période, réglementations et progrès technologiques se sont succédés, fragilisant de plus en plus la position monopolistique des marchés réglementés nationaux. Ce phénomène a eu pour conséquence majeure une diminution constante des coûts de transaction profitant aux investisseurs et aux émetteurs de titres par une réduction du coût du capital. Cependant, la fragmentation du flux des ordres par une multiplication des places de négociation des actions peut faire craindre une réduction de la liquidité des marchés et un ralentissement dans le processus de baisse des coûts de transaction,

contrairement à l'effet concurrence entre systèmes voulu par les autorités de régulation européennes.

Si les scénarios les plus conservateurs à moyen terme font état d'une suprématie pérenne des marchés réglementés, nous estimons que, pour la France, une part très significative du flux d'ordres pourrait rapidement être dirigée vers les systèmes de négociation alternatifs. Nous nous intéressons à cet effet aux transactions qui relèvent du « marché de gros », à savoir les transactions d'un montant minimum de 50 000 euros, que nous attribuons aux investisseurs institutionnels. Plus précisément, nous identifions une partie de ces transactions, celles exécutées aujourd'hui en dehors du carnet d'ordres. Selon nos estimations, elles représentent environ 10 % du volume échangé sur les titres du CAC40 et pourraient chaque année échapper au marché réglementé. Ce volume, qui se répartirait à peu près équitablement entre internalisateurs systématiques

et MTFs du type *crossing systems*, ne constitue qu'une fraction du volume total du « marché de gros ».

L'article est structuré comme suit. La section 1 présente les principaux moteurs de la concurrence entre places boursières constatée ces trente à quarante dernières années. Elle détaille plus largement ce qui constitue l'enjeu majeur de ces prochaines années en termes d'ouverture à la concurrence en Europe, à savoir la directive MIF et traite des enjeux économiques des nouvelles réglementations. La section 2 propose pour les titres les plus actifs cotés à Paris une première estimation des flux d'ordres de grande taille, les blocs, qui ne participent pas au processus de formation des prix car actuellement exécutés en dehors du carnet d'ordres, et pourraient être exécutés par modes de négociation alternatifs au marché réglementé à moyen terme.

Liquidité de marché et liquidité bancaire : interdépendances, vulnérabilités et communication financière

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Pendant l'année 2007, les marchés financiers mondiaux ont traversé des périodes de turbulence intense. Les compartiments complexes des marchés du crédit, en particulier, ont connu de sérieux revers. Curieusement, l'agitation sur ces marchés plutôt récents s'est traduite par de graves pénuries de liquidité sur les marchés interbancaire et monétaire à court terme, entraînant plusieurs interventions de grande ampleur de la part des banques centrales dans le monde entier. Les événements récents ont ainsi confirmé l'interdépendance croissante des banques et des marchés financiers, les banques étant exposées à ces derniers, tout en étant tributaires pour la liquidité. Le présent article a pour objectif d'explicitier cette relation complexe et de bien cerner les principaux aspects de ces perturbations financières. Nous explorons en particulier les mécanismes d'une crise de liquidité, ainsi que ses effets sur la liquidité de chaque banque et sa propagation possible à d'autres établissements. Cette dynamique soulève bien entendu plusieurs questions du point de vue des politiques publiques. Nous nous intéressons donc au rôle que le renforcement de la communication financière sur la liquidité des banques pourrait jouer dans les efforts de stabilisation des marchés.

En résumé, les banques de taille mondiale sont de plus en plus intégrées aux marchés de capitaux, et sont tributaires de marchés financiers liquides et opérationnels, pour satisfaire leurs besoins tant de liquidité que de financement. Cette dépendance transparait tout particulièrement dans plusieurs éléments : le développement des transactions portant sur les prêts garantis, la croissance du marché de

la titrisation, l'élargissement de l'éventail des sûretés, qui englobe aujourd'hui des produits complexes à la liquidité de marché fluctuante, et la multiplication des facilités de crédit garanties ou lignes de liquidité accordées aux véhicules *ad hoc* proposés par les banques et aux entités juridiques. Certaines évolutions récentes de la liquidité des marchés financiers sont imputables au progrès technologique, mais il importe de noter que des facteurs temporaires, résultant de la faiblesse des taux d'intérêt, accélèrent la liquidité au-delà de niveaux soutenables. Si, en soi, la capacité des banques à « liquéfier » les actifs constitue une évolution positive qui devrait contribuer à atténuer le risque de liquidité fondamental auquel elles sont exposées, la sensibilité accrue au risque de liquidité de marché engendre aussi de nouvelles vulnérabilités en cas de brusques retournements. Des circonstances défavorables pourraient induire une augmentation combinée de la demande d'actifs liquides *via* les appels de marge et l'activation des lignes de crédit, et en même temps une diminution de la liquidité des actifs et des sources de financement des marchés. Le grave repli de la liquidité des marchés des titres adossés à des actifs, ainsi que ses répercussions sur les marchés interbancaires mondiaux en 2007, illustre parfaitement les voies qui relient la liquidité de marché au financement des banques et à la liquidité des actifs, ainsi que les externalités plus vastes des chocs idiosyncrasiques sur la liquidité. Comment faire face à ces risques ? Conjuguée à une gestion active de la liquidité, la communication financière devrait permettre d'amoinrir cette vulnérabilité. Une abondante littérature vante les mérites de la transparence dans l'activité bancaire.

Un renforcement de cette transparence pourrait atténuer les difficultés de refinancement résultant de l'asymétrie de l'information. Cependant, lorsque les problèmes d'information sont plus profonds et portent sur une incertitude globale, l'amélioration de la communication sur les fondamentaux du crédit sera moins efficace pour la restauration de la confiance. Une meilleure information sur la liquidité elle-même peut en revanche se révéler nécessaire. Nous étudions l'ampleur des informations actuellement disponibles sur la liquidité et les risques de financement des banques. D'une manière générale,

ces informations semblent limitées, et ne révèlent pas de manière complète et permettant des comparaisons la dynamique qui sous-tend la demande de liquidité et les sources de financement. Cependant, la liquidité est volatile et les banques sont intrinsèquement soumises à des besoins de liquidité. Un effort d'information dans ce domaine peut-il contribuer à renforcer la discipline des marchés de manière à stabiliser le système ? Cette question appelle une réflexion sérieuse, mais les événements de 2007 ont montré que les déficits d'information actuels sont importants et doivent être comblés.

Actifs liquides, contraintes de liquidité et déséquilibres mondiaux

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La distribution mondiale des soldes courants s'écarte progressivement de la « normalité » depuis 1997. Cette évolution surprenante s'est produite parallèlement à une accumulation massive d'avoirs de réserve de change dans les pays émergents d'Asie et dans les pays exportateurs de pétrole, et à l'accroissement du rôle des investissements de portefeuille dans le financement du déficit courant des États-Unis. Les outils théoriques traditionnels qui ont permis d'appréhender les « anciennes énigmes » de la macroéconomie internationale contribuent à expliquer ces évolutions, dans la mesure où ces outils prennent en compte plusieurs aspects spécifiques de la liquidité : offre asymétrique d'actifs liquides, contraintes de financement, et externalités liées aux infrastructures financières qui favorisent la liquidité du marché. L'article examine l'intégration de ces éléments dans la littérature récente relative aux déséquilibres mondiaux. Une caractéristique nécessitant un examen plus

approfondi est le rôle d'« externalité de bien public » de la liquidité des marchés de capitaux : en l'absence de ce bien public dans les économies émergentes, l'accumulation de réserves peut être considérée comme un moyen d'importer les externalités positives résultant de la détention d'actifs « sans risque » liquides. Ce phénomène est toutefois soumis au risque de « congestion » si le rythme de l'accumulation de réserves en dollars dépasse celui de l'émission de bons du Trésor américain ou de titres équivalents. Les détenteurs d'importants volants de réserves se sont par conséquent orientés vers une gamme plus étendue de catégories de titres, incluant les obligations adossées à des actifs, dont la liquidité s'est brutalement asséchée au cours des récentes perturbations sur les marchés de capitaux. Ces évolutions pourraient dès lors peser sur les conditions de financement du déficit courant des États-Unis, et remettre en cause certains de ses déterminants structurels.

L'innovation financière et la frontière de la liquidité

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Dans le modèle financier traditionnel reposant sur l'intermédiation bancaire, les sources et le processus de création de la liquidité par l'intermédiaire des bilans des banques étaient particulièrement faciles à identifier. La robustesse de la liquidité dans un tel système se fonde essentiellement sur la qualité des actifs bancaires et sur la crédibilité offerte par le cadre institutionnel dans lequel les banques opèrent (système de garantie des dépôts, accès à la monnaie de banque centrale et, plus généralement, contraintes réglementaires et prudentielles).

Dans le système financier actuel, avec le flot constant de nouveaux instruments de transfert de capital et de risques, les sources de liquidité endogènes se sont certainement diversifiées et multipliées, mais elles se révèlent moins

stables et moins fiables. Dans une certaine mesure, l'innovation financière a pu laisser croire aux intervenants de marché qu'ils pouvaient échapper de manière durable à la contrainte monétaire (*i.e.* le besoin d'instruments de paiement incontestables) et qu'ils pouvaient se contenter des engagements émis par d'autres institutions pour répondre à leurs besoins de liquidité.

Toutefois, les instruments de marché ne peuvent satisfaire la préférence pour la liquidité des investisseurs que dans la mesure où ces instruments bénéficient de la confiance du marché. La préférence pour la liquidité, qui est intimement liée aux anticipations de prix des actifs, peut en réalité se modifier brutalement et entraîner des ruées vers les formes les plus sûres de la liquidité (monnaie de banque et, pire

encore, monnaie de banque centrale). Fondamentalement, la liquidité des actifs financiers dépend de la certitude qu'ils pourront être remboursés à la demande.

Cette confiance est probablement plus difficile à établir dans un monde reposant sur la finance de marché, caractérisé par un niveau élevé de titrisation.

Les crises sont parfois riches d'enseignement : les turbulences de cet été ont révélé certains besoins urgents de consolidation des sources de liquidité du système. Il est maintenant évident que de nouveaux fournisseurs de liquidité sont nécessaires sur des marchés secondaires quasi-inexistants pour les produits de crédits structurés complexes. Il ne saurait en être ainsi sans une meilleure transparence des intervenants de marché concernant les structures d'investissement. Il est également clair que la maîtrise du risque de liquidité dépend de la capacité des institutions financières à évaluer correctement le prix des produits complexes, dans le cadre de leur processus

habituel de gestion du risque aussi bien qu'en temps de crise.

La « frontière de la liquidité » ne peut être repoussée indéfiniment. Les établissements qui acceptent, au final, l'illiquidité dans leur bilan doivent clairement comprendre et contrôler les risques qu'ils prennent. Cette illiquidité est davantage acceptable pour les investisseurs à long terme, qui ne sont pas à la merci de créanciers souhaitant récupérer leurs avoirs à bref délai. Pour les autres investisseurs, des volants de liquidité plus importants agissant comme stabilisateurs automatiques pour lisser le cycle financier pourraient s'avérer nécessaires afin de leur permettre de couvrir leurs risques.

Sans ces précautions, l'innovation financière pourrait indûment étendre la garantie de fourniture de liquidité qui est implicitement attendue des banques centrales. Or le rôle de ces dernières n'est certainement pas d'inciter les intervenants de marché à se précipiter sur des titres de qualité douteuse.

Liquidité des marchés financiers et prêteur en dernier ressort

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À l'été 2007, les problèmes liés à la dette *subprime* aux États-Unis ont entraîné des perturbations sur de nombreux segments du système financier, en particulier sur les marchés monétaires interbancaires, obligeant les banques centrales américaine et européenne à intervenir à maintes reprises afin de rétablir un bon fonctionnement. Cet article examine les circonstances dans lesquelles une pénurie de liquidité peut apparaître et évalue différentes possibilités qui s'offrent au prêteur en dernier ressort pour restaurer la stabilité financière. Il montre également que l'évaluation des risques des entités financières à levier financier ne doit pas reposer uniquement sur les données de bilan, mais prendre aussi en compte, de manière explicite, les sûretés, l'illiquidité et l'indisponibilité potentielle des prix du marché.

Nous en tirons principalement deux conclusions. Premièrement, nous établissons une hiérarchie claire entre les instruments de politique. D'après la relation entre risque et efficacité, les injections de liquidité ciblées (facilités d'urgence) sont à privilégier. En effet, lorsque la liquidité est utilisée dans un but spéculatif en période de crise, les opérations d'*open market* non discriminatoires risquent d'attirer des participants manquant de fonds, qui peuvent détourner la monnaie centrale et en priver

ceux qui en ont le plus besoin. Les injections de liquidité ciblées deviennent alors strictement préférables.

Deuxièmement, à notre avis, les cessions forcées d'actifs peuvent perturber les marchés dans le cas où les investisseurs ont un levier financier élevé. Compte tenu du financement externe et de la renégociabilité des contrats de prêt, si un investisseur au levier total est touché par un choc sur la liquidité, il sera contraint de se défaire d'une partie de ses actifs. Sur des marchés qui ne sont pas parfaitement liquides, ces liquidations induisent des baisses de prix, qui, en présence d'entraves à la gestion standard du risque, entraînent un réexamen des bilans évalués à la valeur de marché, des appels de marge et des cessions supplémentaires. Dans le pire des scénarios, l'investisseur à fort levier ne pourra peut-être pas faire face à toutes ces contractions de la liquidité et aux appels de marge dont elles s'accompagnent. Il en résulte alors un effondrement du marché des actifs illiquides, ce qui rend la valorisation de ces actifs relativement ambiguë. Pour l'investisseur, en raison de la rupture potentielle des échanges, le niveau des pertes déclenchant le défaut opérationnel est probablement beaucoup plus bas que celui donné par les mesures standard du risque.

Évolutions récentes de la liquidité intrajournalière dans les systèmes de paiement et de règlement

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Parallèlement à la consolidation et à la mondialisation des marchés de capitaux, les valeurs échangées dans les systèmes de paiement et de règlement ont considérablement augmenté. La quantité de liquidité intrajournalière nécessaire au règlement de ces valeurs est par conséquent très importante, notamment si on la compare avec la liquidité au jour le jour ou à plus long terme.

Le recours croissant aux mesures de contrôle des risques dans les systèmes de paiement et de règlement (comme par exemple, le règlement brut en temps réel) est généralement associé à des besoins de refinancement accrus. Cette tendance a été contrebalancée par le développement, en parallèle, de plusieurs mécanismes permettant d'économiser de la liquidité dans les systèmes.

Les évolutions les plus importantes ont concerné la gestion qualitative de la liquidité intrajournalière. Le système CLS (*continuous linked settlement*) illustre une tendance claire marquée par le raccourcissement de l'horizon temporel de la gestion de la liquidité intrajournalière.

Du côté de l'« offre », la liquidité intrajournalière peut être fournie par les banques centrales ou les banques commerciales, en fonction de l'actif de règlement utilisé par les systèmes. Dans la mesure où la plupart des banques centrales accordent des crédits uniquement contre remise de garanties, le type d'actifs que les participants peuvent utiliser est un facteur important pour déterminer les coûts d'opportunité de la liquidité intrajournalière. Au cours des dix dernières années, la plupart des banques centrales ont considérablement élargi la gamme des garanties qu'elles acceptent dans le cadre de leur fourniture de liquidité. En outre, un marché interbancaire de la liquidité intrajournalière semble commencer à se constituer en

liaison avec la concentration des activités de banque correspondante et les coûts de financement liés à des fenêtres temporelles critiques.

Il convient de prendre en compte de manière appropriée les évolutions affectant la gestion de la liquidité intrajournalière du point de vue de la stabilité financière.

Le profil du risque de liquidité a évolué parallèlement à divers facteurs, notamment la consolidation, ce qui a eu pour conséquence une concentration du risque de liquidité intrajournalière et le développement d'interdépendances entre les systèmes de paiement et de règlement de titres.

La période récente permet de tirer une leçon : l'utilité pour les banques centrales de disposer d'une liste d'actifs éligibles suffisamment diversifiés pour faire face à une augmentation imprévue de la demande de garanties permettant d'atténuer les conséquences d'un épisode de turbulences financières.

Au cours des dix dernières années, les acteurs concernés, notamment le secteur bancaire, les banques centrales et les contrôleurs bancaires ont pris différentes initiatives pour mieux aborder les différents défis soulevés par les évolutions de la liquidité intrajournalière. Les réponses apportées par les banques centrales recouvrent la fourniture de nouveaux services de règlement permettant d'optimiser la gestion de la liquidité intrajournalière des banques (par exemple, la nouvelle plate-forme TARGET2), l'adaptation de leur politique en matière de garanties au nouveau paysage constitué par des systèmes de paiement interdépendants ainsi que des initiatives en matière de surveillance afin de mieux suivre et de mieux traiter des risques par nature évolutifs.

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