

LIQUIDITY, FINANCIAL CRISES AND THE LENDER OF LAST RESORT – HOW MUCH OF A DEPARTURE IS THE SUB-PRIME CRISIS?

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Paper to be presented at the Reserve Bank of Australia conference, “Lessons from the financial turmoil of 2007 and 2008”, 14-15 July 2008.

Abstract: Liquidity risks are endemic to banks, given the maturity transformation they undertake. This gives rise to risk of bank runs, the first line of defence against which should be appropriate liquidity policy of banks. Nonetheless, solvent banks can face liquidity difficulties at times of stress, necessitating liquidity support. The traditional role of the lender of last resort (LOLR) is to avoid unnecessary failures that could threaten systemic stability, while ensuring that there are suitable safeguards for central bank balance sheets and that moral hazard is minimised. The sub-prime crisis has shown that traditional models of bank liquidity risk and of LOLR require revision, as was already apparent to a lesser extent in the Russia/LTCM episode. Funding risk now interacts with market liquidity risk, to create difficult challenges for central banks. The LOLR has had to adapt radically, for example, in terms of lending to investment banks, taking lower quality collateral and lending for longer maturities. Central banks have also been challenged by difficulties in maintaining confidentiality of support and by the interaction of these problems with low levels of deposit insurance.

Keywords: Lender of last resort, bank liquidity, market liquidity

JEL Classification: E44, E58, G18

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Introduction

This paper seeks to assess the importance of liquidity in financial crises and how the authorities may deal with it. It starts from the concept of bank runs – whereby the nature of banking means that solvent banks may at times be subject to panic runs and consequent illiquidity – and their ubiquity in most crises to date. Contagion may arise via credit risk linkages to other banks. This is a problem of “funding liquidity”. It then considers the authorities’ response to crises in terms of lender of last resort (LOLR) – illustrated by historical examples – and the evolving “doctrine” of LOLR.

The paper then goes on to assess how liquidity problems during the current crisis have differed from the past. During this crisis the authorities have had to adapt their LOLR policy to a crisis which is not merely one of “funding liquidity” but also of “market liquidity” (IMF 2008, Davis 1994), while contagion has occurred more via market prices and less via credit risk (Adrian and Shin 2008) and new “amplifiers” of financial instability have become apparent (Brunnermeier 2008). The LOLR has had to adapt radically, for example, in terms of lending to investment banks, taking lower quality collateral and lending at longer maturities. It has also been challenged by difficulties in maintaining confidentiality of support and the interaction of these problems with low levels of deposit insurance.

1 Liquidity in financial crises

Liquidity risk, in general, is the risk that an asset owner is unable to recover the full value of their asset when sale is desired. One type of liquidity risk is funding risk, which relates to the ease with which one can raise money by borrowing using an asset as collateral. Liquidity risk of this type has always played a key role in banking crises. This section provides a benchmark against which to compare previous episodes to the sub-prime crisis.

Bank assets – particularly loans – are by their nature illiquid and long term, and subject to imperfect information, while liabilities are mostly liquid and short term. These short-term liabilities are conceptually a means of disciplining bank managers via the threat of bank runs, as they help to ensure that bank managers take depositors’ interests into account by not taking excessive risks in their choice of asset holdings (Kaufman 1988). But depositors’ monitoring of projects is likely to be prone to error, making banks vulnerable to “overdiscipline” (and possibly runs on solvent banks) leading to socially wasteful liquidation of projects. Owing to the fire sale problem – that is, the inability to realise assets at full value owing to asymmetric information – illiquid banks can rapidly become insolvent.

Once one bank has experienced a run, there is the possibility of contagion, with runs on other banks. Depositors may react either to balance sheet similarities with the failed institution under uncertainty and asymmetric information (Morgan 2002), or to perceived counterparty exposures with the failed bank. Contagion could, in turn, impact on the wider economy via monetary contraction, or credit contraction owing to the difficulty individual borrowers may have in establishing new credit relations with a different financial institution when their bank fails (Freixas *et al* 2000a). Note, however, that widespread bank runs need not imply contagion. An alternative possibility, as was arguably the case with the banking crises in Scandinavia in the early 1990s, is that there is a macroeconomic shock of such magnitude that many banks become simultaneously insolvent.

There are various models of bank runs. The best known is the Diamond and Dybvig (1983) model, in which banks provide liquidity insurance to risk averse depositors. Normally the demand for repayment by depositors is predictable, and can be catered for by a low level of

liquid assets, however, if the bank is forced to sell its illiquid assets in a “fire sale”, then it may not realise sufficient cash to cover all of its deposits. Then some depositors may run, if they suspect other depositors will also do so, as they fear being last in the queue for cash (that is, there is a coordination problem). This pattern may lead to insolvency of a potentially sound institution.

The Diamond-Dybvig model assumes that bank runs are purely random events. Alternatively, Chari and Jagannathan (1988) suggest that adverse information leads to panics – that is, systematic risks are inferred from what may be idiosyncratic. Jacklin and Bhattacharya (1988) focus on the role that information of depositors may have on the quality of bank assets. Gorton (1988) saw panics occurring mainly in recessions, which confirms the adverse information hypothesis, since panics occur close to the period when business failures are most widespread.

Runs are traditionally assumed to take place among retail depositors, but large wholesale depositors are increasingly more important. Wholesale depositors are generally better informed and less likely to be covered by deposit insurance and (as discussed below) banks are increasingly dependent on wholesale funding. The interbank market is a key locus of runs in recent years, including, for example, the failures in the United States of Franklin National in 1974 and Continental Illinois in 1984.

Of course, the systemic importance of interbank markets has been increased by recent trends in financial innovation. For example, there is a growing need for liquidity owing to growth in international trading and transactions – notably over-the-counter (OTC) derivatives can give rise to unexpected liquidity demands – and also of large value interbank payments systems using real time gross settlement (RTGS). Nevertheless, although there have been individual bank failures, the domestic interbank markets of the advanced countries have historically been fairly robust.

The international interbank market has been a major focus of liquidity crises, as in the Asian Crisis of 1997. Bernard and Bisignano (2000) highlight a number of features of the international interbank market that contribute to this. They include, first, the typical lack of security (collateral) and low levels of information gathering. These may in turn be linked to moral hazard via implicit guarantees by central banks for the interbank market’s functioning. The existence of the interbank market may also lead banks to underinvest in liquidity. A range of banks with low credit quality (as in East Asia up to the crisis of 1997) may operate in it so long as lenders believe the implicit guarantees. The international interbank market is typically subject to quantity and not price rationing of credit, due to low levels of information on credit risk. The short maturity makes withdrawal easy, and more generally, the market is vulnerable to sudden increases in credit rationing during periods of stress, as a result of adverse selection and moral hazard problems. These shortcomings give rise to a potential for contagion and global transmission of shocks.

Theory has begun to catch up with this shift in importance from retail to wholesale runs.² For example, Allen and Gale (2000) highlight the possibility that systemic risks in the interbank market can vary with the structure of creditor relations. Most risky is a structure with unilateral exposure chains among banks, while there is less risk of contagion when all banks lend to each other, as the effects of shocks are less concentrated. In between these two types of structures is a tiered structure of money centre banks on which other banks rely (Freixas *et al* 2000b).

² For a survey of the theory, see De Bandt and Hartmann (2001).

2 Liquidity policy of banks

Banks can protect against liquidity risk. Most obviously this can be done by holding a significant proportion of liquid assets (a so-called net defensive position). Cash is then available to be used immediately to answer liquidity needs, while government securities can be used readily as collateral. However, banks seek to avoid holding liquid assets given the cost in terms of lower profitability, the low frequency of crises, limited liability of shareholders, and the safety net, as discussed below. There have been major declines in asset liquidity over recent decades, for example in the United Kingdom, banks' liquid assets were 30 per cent of the total in the 1950s, but today are only 1 per cent (Goodhart 2007).

Banks can dissipate withdrawal risk by diversifying funding sources. This is liability management, which aims to ensure the continuity and cost effectiveness of funding (Greenbaum and Thakor 2007). There are three key issues. The first is to ensure enough diversification to reduce liquidity risk, among, for example, certificates of deposit (CDs), eurodollars, repurchase agreements (repos), subordinated debt and contingent credit facilities from other banks as well as interbank, time and demand deposits. Securitisation is a further instrument for liability management.³ The second is to ensure the appropriate mix of traditional deposits and investment products. Deposits typically incorporate services, have payoffs that are insensitive to the fortunes of the intermediary, are for small/uninformed users and are insured, so their demand for such deposits is usually stable. Investment products are typically risk-sensitive, for large/informed users, have payoffs that vary with the intermediary's performance, involve monitoring, and hence demand may be more volatile. The third is the choice of maturity structure – duration matching affects the degree of liquidity risk, but may also reduce flexibility.

A further backup is holding adequate capital to ensure that creditworthiness is maintained in the face of adverse shocks. However, experience has shown that adequate capital according to current rules is not always sufficient to ensure liquidity problems are avoided, as solvent banks can suffer runs due to illiquidity. Regulation of bank liquidity is less developed than for capital, and not subject to international agreement.⁴ Compulsory reserve requirements are one policy for ensuring that banks hold liquidity, although their main purpose is for collateral in central bank monetary operations, overall monetary control and payments system functioning. Reserves are not readily available to meet a liquidity spike, especially if there is a mandatory minimum ratio. There is also typically qualitative oversight of liquidity policy in the context of prudential supervision (Pillar 2 of Basel II).

Goodhart (2007) argues that generous provision of liquidity by central banks, in normal times and times of crisis, has made banks careless in liquidity risk management, with low liquid assets and reckless liability management. The banks are seen as taking a liquidity “put” with the downside risk of liquidity crises covered by the central bank. It is to the LOLR, that is, liquidity policy in times of emergency, that I now turn.

3 The lender of last resort (LOLR)

I now go on to outline the doctrine of the LOLR, citing examples from history which are relevant to each point. These are the “accepted wisdom” which, I argue, is called into question by the sub-prime crisis.

³ For some discussion of contingent credit facilities see Gatev *et al* (2006).

⁴ Rochet and Vives (2004) show that a combination of liquidity requirements, capital requirements and the lender of last resort can prevent coordination failure in interbank markets.

3.1 The nature and history of LOLR

The LOLR is generally described as an institution, such as the central bank, which has the ability to produce, at its discretion, currency or “high-powered money” to support institutions facing liquidity difficulties and to create enough base money to offset public desire to switch into money during a crisis, thereby delaying legal insolvency of an institution and preventing fire sales and calling of loans.

The LOLR operation is by discretionary provision of liquidity (against collateral) to an institution or market to offset an adverse shock that creates an abnormal increase in demand for liquidity. The aim of the LOLR is to prevent illiquidity at an individual bank from leading to insolvency (owing to the fire sale problem, as defined above). Thereby it may avoid runs that spill over from bank to bank (contagion, as defined above), which may in turn lead to an impact on real wealth and GDP that would not occur in the absence of the panic. LOLR needs to act rapidly before illiquidity becomes insolvency and before such a panic begins to take hold.

I first briefly note historical developments before World War II. Although Thornton wrote first about the concept in 1802, the genesis of LOLR in practice is often thought to be the aftermath of the Overend Gurney crisis of 1866, when the Bank of England failed to prevent a crisis, which was subsequently reflected upon by Bagehot (1873). Put simply, he argued that the central bank should lend freely at a penalty rate against good collateral. Furthermore, the central bank has to act in the public interest and not solely its private interests, as the Bank may have done in 1866. The classic operation of LOLR was reflected, for example, in the rescue of Barings Bank by the Bank of England in 1890, as well as in panics during 1878 and 1914 (Bordo 1990). As noted by Goodhart (1988), these events took place during the period of the Gold Standard when the central bank was the institution maintaining convertibility of the currency with gold, which made it a natural LOLR, albeit generally also involving other banks in rescues given the limitation of its own capital base.⁵ Combined with uncertainty regarding rescues, the “club” of banks in a national market would protect against moral hazard by policing behaviour of counterparties, even in the absence of modern banking regulation.

Even after the demise of the Gold Standard, the key role of the LOLR has often been considered to offset the risk of a monetary contraction, as in 1932 in the US. However, as argued by Kaufman (1991), its more recent operation against a background of deposit insurance does not have this function, as a general flight from the banking system to currency is unlikely. Rather, crises tend to lead to a reshuffling of deposits between banks, and the LOLR seeks to limit losses of wealth and GDP that would otherwise take place when such reshuffling occurs.

Focusing now on more recent episodes and the current state of “doctrine” in a modern financial system, LOLR intervention can be by direct lending (discount window) or by open market operations, as well as by off-balance-sheet guarantees. Some argue that in an advanced financial system, LOLR should only be via open market operations, since the market will direct liquidity to where it is needed, and the risk of mispricing is avoided (Goodfriend and King 1988; Kaufman 1991). Such a policy was clearly successful in the cases of operations associated with the spikes in liquidity demand in the Y2K and September 11 episodes, as well as after the stock market crash of October 1987.

⁵ As noted by Bordo (1990), the Barings rescue included commercial banks and the Banque de France as well as the Bank of England.

However, Goodhart (1999) argues that LOLR may require direct lending, not open market operations, as market lending may fail to reach banks in distress whose failure threatens the financial system. This motivated, for example, the rescue of Continental Illinois in 1984, which was also thought to give rise to a risk of contagion due to its widespread interbank lending links (179 banks were thought to be vulnerable). In 1974 the Bundesbank let the Herstatt Bank fail, while giving liquidity assistance to the market in line with Goodfriend and King, but the consequence was a global breakdown of payments systems that almost precipitated an international financial crisis (Davis 1995).

Instruments of such direct support can be the discounting of eligible paper (such as government securities), advanced with or without collateral, and repos of the institution's assets that the central bank is willing to accept. The value of collateral should exceed that of the LOLR support. There should be provisions for repayment and the provision of funds by the LOLR must be for the short term only, allowing examination of the financial institution for long term viability. If there is default on LOLR loans, closure is needed, or if the bank is too-big-to-fail, it should be nationalised with owners and senior managers dismissed.

Generally, LOLR to date has been to banks and not for non-banks such as securities houses. Reasons are that banks are more systemically important and also so as not to weaken market discipline on less heavily regulated institutions. This was one reason for the refusal of the US to support Drexel Burnham Lambert in 1989 (although the Bank of Japan did save Yamaichi in the 1990s, see Nakaso 2001). Equally, prudent investment banks, although dependent on wholesale funding, would typically hold short-term assets, protecting them against liquidity risk. [Formatting of this para corrected.]

3.2 Costs of LOLR

There are costs to having a LOLR (He 2000). The LOLR is only supposed to aid illiquid and not insolvent institutions (Humphrey and Keleher 1984). However, as noted by Kindleberger (1986), in a crisis it is hard to distinguish illiquid and insolvent banks, and a bank that may initially be illiquid can become insolvent. Goodhart and Schoenmaker (1995) note that banks generally face illiquidity when solvency is in question. Hence, liquidity assistance may lead to support for insolvent institutions, with direct costs for the central bank and fiscal authorities. Kaufman (1991) notes that the US Federal Reserve System (Fed), for example, supported Franklin National in 1974 and Bank of New England in 1990, which both subsequently failed. Furthermore, doctrine states that LOLR is not an appropriate policy alone in cases of simultaneous macroeconomic shocks to solvency – such as in the contraction of GDP in Finland in 1990 – which may require the fiscal authorities to recapitalise banks.

As noted, beyond direct costs, the safety net reduces the incentive for banks to hold liquidity, as risk is passed to the central bank (Goodhart 2007). It may also facilitate uninsured depositors exiting a bank (Kaufman 1991). Most crucially, LOLR increases moral hazard and consequent risk taking, as well as weakening market discipline.^{6,7} Arguably this is particularly the case for direct lending as opposed to open market operations. It is widely argued that the long-term decline in bank capital adequacy up to the 1988 Basel Agreement, as well as lower liquidity buffers, result from moral hazard generated by the safety net.

⁶ As a consequence, Kane (1992) argues that LOLR is inappropriate and should be abolished given the cost of moral hazard.

⁷ This is illustrated by the existence of “support ratings” for banks alongside their standalone ratings.

Further costs are that, if offered to insolvent banks, LOLR support increases the scope for forbearance. This is because it removes the pressure on regulators to close failing banks promptly (especially if the regulator is a separate institution from the central bank). If allowed to continue operating, banks with negative net worth can cause major costs, as in the Savings and Loan crisis in the US in the 1980s. LOLR for the insolvent institution also raises the difficulty of institutions being too-big-to-fail – some banks can become “sure” of rescue owing to their systemic importance, and this is also reflected in ratings (again the rescue of Continental Illinois was arguably the genesis of this).

A further cost is conflict with other policies. There may be conflicts with the monetary policy regime, unless liquidity is fully sterilised (the LOLR action at the time of the stock market crash in 1987 was seen as generating inflation). It may also conflict with fiscal rules if there is a guarantee by the fiscal authority.

3.3 Minimising costs of LOLR

Doctrine maintains that minimising such costs requires that there be only support for institutions whose failure entails systemic risk. The central bank must ensure that banks have made efforts to gain liquidity support and all market sources of funds have been exhausted. Equally, following Bagehot (1873), the authorities should demand high quality collateral and a penalty interest rate. The former protects the central bank from credit risk and encourages the banks to lend at lower risk (Goodhart 2007). The latter, along with harsh conditionality (for example, liquidity restoration, restrictions on new business or on dividend payments), ensures that the borrower only requests LOLR support as a “last resort”. Bordo (1990) notes however that in 1974 the Fed offered Franklin National loans at below market rates.

To further reduce moral hazard, doctrine states that the central bank should seek a private solution before using the LOLR (from the creditors, other major banks, etc.). This has been the tradition in Continental Europe and indeed it is enshrined in French Law. In Germany, the private Likobank is intended to substitute for the possibility of the central bank needing to undertake LOLR. On the other hand, experience has shown that banks are increasingly less willing to play a role in such rescues, owing to deregulation and international competition (Goodhart and Schoenmaker 1995). The Bank of England experience with the rescue of Johnson Matthey in 1984 showed this. The wholly-private rescue of LTCM in 1998, however, was a recent example of creditors being willing to mount a rescue – of a hedge fund – without guarantee, showing that private rescues are still viable in extreme cases, with suitable moral suasion by central banks.

The LOLR must also ensure that there is adequate information on financial institutions and strict financial regulation; although Goodhart and Schoenmaker (1995) do not conclude that there is a benefit to overall financial stability from the central bank being the supervisor.

To avoid monetary conflict, the central bank must sterilise liquidity – otherwise there is a risk of inflation, capital outflows and a collapsing currency (as occurred in Indonesia in 1997; He 2000). This requires instruments be available such as reverse repos, foreign exchange swaps and deposit facilities. There is also a need for backup from the fiscal authorities if the rescued bank is insolvent, otherwise the central bank may itself face solvency difficulties, as in Finland in 1990 when the central bank saved an insolvent savings bank and wiped out its own capital.

The central bank, according to doctrine, should reduce moral hazard by making access to LOLR facilities uncertain – the market is not to take for granted the action to be followed by

the authorities, with decisions to be made on a case-by-case basis. The Bank of England has, for example, allowed banks such as Barings in 1995 to fail, since it was judged to be non-systemic. Ambiguity may be heightened by secrecy as to whether LOLR is taking place, as with the small UK banks that were rescued in the early 1990s, so as to avoid wider loss of confidence and ultimately underwriting the whole banking system (George 1994). Confidentiality can also help to prevent knowledge of LOLR support from giving rise to panic, a rise in borrowing costs or a loss of reputation to the bank in receipt of LOLR.

He (2000) suggests that central banks could nevertheless spell out necessary but not sufficient conditions for LOLR (for example, a precondition of solvency and exhausting available sources of funds) – thus reducing incentives for unnecessary crises and giving incentives for stabilising private sector actions. This might also reduce risks of forbearance and political interference. But *ex ante* transparency may heighten the risk of runs, and give rise to moral hazard (Economist 2008b). There remains a strong case for *ex post* transparency (that is, saying what has been done after the crisis has subsided, to ensure accountability in the use of public funds).

Generally to date, LOLR has been in domestic currency (on the argument that banks should be responsible for foreign exchange risk management). In this context, there is the unresolved problem for cross-border banks (notably in the European Union) of whether the home or host LOLR should play the largest role in a crisis.

3.4 LOLR in systemic crises

So far I have discussed LOLR for a non-systemic problem. In times of systemic crisis it may act differently (Hoelscher and Quintyn 2003). This is a situation of panic, flight-to-quality and widespread contagion. The aim is to reassure the public that financial disorder will be limited and to stop panic runs, by public announcements and visibility. The central bank may need to provide uniform support for all banks short of liquidity, even if they are suspected to be insolvent, in order to protect the payments system and the macroeconomy. Constructive ambiguity is no longer appropriate (Nakaso 2001). Collateral and solvency requirements may be relaxed, at least if there is a government guarantee. No penalty rates would be imposed as they would worsen the panic. Also the central bank would need to suspend judgement of which institutions are systemically important.

Emergency liquidity assistance in such cases is to be part of the overall crisis management strategy involving the central bank, supervisors and the fiscal authorities. It may require a general macroeconomic policy easing (for example, interest rate cuts) as a crisis by itself constitutes a tightening of financial conditions. However, care is needed to avoid inflation or an exchange rate collapse. There is an option of imposing capital controls (as in Malaysia in 1997). Costs of such emergency assistance policies can be sizeable. Hoelscher and Quintyn (2003) record that liquidity support during the Asian crisis was 16 per cent of GDP in Indonesia in the form of overdrafts from the bank, and 13 per cent of GDP in Malaysia from central bank deposits (which were, however, repaid).

In a systemic crisis, there may also be a blanket deposit guarantee by the government, as in Japan and Sweden in the 1990s, and the fiscal authorities will have to bear the costs of bank recapitalisation. The overall fiscal costs of crisis will thus often far exceed the LOLR assistance – in Indonesia the overall cost was around 50 per cent of GDP. This potential fiscal burden, in turn, helps motivate the separation of regulation from central banks (Goodhart and Schoenmaker 1995). It also underlines the point that liquidity assistance must not be a long-term policy – it should be used to stop panics and buy time for evaluation of the financial

system. The government may need to recapitalise or close insolvent banks in a long-term restructuring (as took place in Sweden and Finland in the early 1990s). The LOLR is still needed in a systemic crisis if the credibility of the deposit insurance scheme is lacking (or depositors fear delay in repayments) – in which case the fiscal authorities may also need to guarantee the central bank.

Having outlined liquidity risk, bank liquidity policy and the evolving doctrine of the LOLR, I now go on to assess whether the current sub-prime crisis requires our understanding of these concepts to be revised.

4 Recent developments in liquidity risk

4.1 The sub-prime crisis and liquidity

I suggest that the understanding of the liquidity problems in the current crisis requires theory to go beyond the Diamond-Dybvig (1983) concept of bank funding liquidity risk, to encompass market liquidity risk and its interaction with funding liquidity against a background of heightened credit risk (see also IMF 2008). It also requires consideration of the impact of banks' policies of marking to market, risk management and balance sheet management (Adrian and Shin 2008).

Market liquidity risk can be defined as the ease with which one can liquidate a position in an asset without appreciably altering its price. Institutions and markets were shown to be much closer integrated than in the past. Systemic market liquidity problems were only apparent before the sub-prime crisis during the Russia-LTCM crisis (Davis 1999, IMF 1998) – although in the case of Russia/LTCM the banks were relatively unscathed. I first describe the build up to the sub-prime crisis, as well as the crisis itself, before considering relevant liquidity risk paradigms.⁸

Key developments in the period 2000 to 2007 include the accelerating shift by banks from holding loans on balance sheet to relying on securitisation (which in turn reduced the incentive to monitor loans). Banks held increasingly low levels of on-balance-sheet liquid assets and they undertook aggressive wholesale liability management to maintain funding levels. Banks also attempted to shift risk to off-balance-sheet conduits and structured investment vehicles (SIVs) in order to save capital under Basel 1 rules.⁹ These shifts occurred in a context of low global interest rates, arising in turn from high levels of global liquidity, which prompted a hunt for yield (for example, via higher credit risk in structured products and sub-prime loans). More generally, scope for securitisation (and the impression of liquidity it gave), high credit ratings on asset backed securities (ABS) and the seeming precision of risk models based on inadequate data, may have lulled banks into taking on more credit risk than they otherwise would.

By 2007 there was a growing realisation of potential losses on sub-prime mortgages (that is, credit risk) as US house prices fell and defaults increased. These loans had been widely packaged into ABS. Investors, concerned not only about losses on the underlying assets but also lack of transparency as to how individual ABS would be affected, began to sell them. Sales led in turn not just to price falls but also market liquidity failure for the OTC markets for the ABS. As prices fell, trading became difficult or impossible, even among the lowest risk tranches of the relevant securities.

⁸ For a more detailed summary see Brunnermeier (2008).

⁹ The capital charge on credit lines to such subsidiaries were less than those of holding the assets on balance sheet.

As noted by the ECB (2008), price falls affected not only the standardised instruments such as index-based collateralised debt obligations (CDOs) but also the “bespoke” structures that are not normally traded but which are nonetheless marked to market. This link followed from the fact that implicit prices for the latter are derived from the former. Furthermore, Scheicher (2008) shows econometrically that, over and above concerns regarding credit risk, there were significant concerns about market liquidity and the lower appetite for risk in accounting for the fall in prices (the rise in spreads). Such liquidity and risk aversion effects are omitted from standard CDO pricing models.¹⁰

This liquidity failure was aggravated by rising margin requirements, which limited the freedom of speculative investors such as hedge funds, and led them to sell holdings of ABS. It was also worsened by the lack of risk capital allocated to market making in such products, due to the rise in volatility and lower revenues to investment banks, which limited their ability to take risks.

The rush to sell securitised assets may also have been worsened by effects of price falls in the context of mark-to-market accounting on the capital of leveraged institutions. Another factor was and reliance of some institutions on quantitative techniques of trading and risk management that assumed continuous liquidity (IMF 2008).

As a result, long term investors may have been constrained from taking contrarian positions that could have renewed market liquidity due to excessive leverage (for example, of hedge funds) and consequent credit restrictions in the context of mark-to-market accounting (Economist 2008a). Monoline insurers, that provide some credit guarantees to ABS and credit default swaps (CDS) themselves, also came under financial pressure (Bank of England 2008).

Banks were also rapidly affected by the loss of liquidity in the market for securitised loans. They had to mark-to-market ABS held on-balance-sheet, so price falls affected their solvency. This was unlike banking crises in the past where loans have typically been held at historic cost with no specific price. The fact that a great many ABS were held in conduits and SIVs spread the contagion, since these institutions require financing in the market for asset-backed commercial paper. Doubts by money market funds regarding the ABS held by the conduits and SIVs led to a loss of liquidity in the ABCP market also, which meant that sponsoring banks had to take the assets back on their balance sheets. The extensive holding of US ABS by European banks and related conduits and SIVs spread the impact internationally.

Meanwhile, traders’ attempts to hedge, meet margin calls or realise gains in safer or more liquid markets adversely affected liquidity in other markets in a contagious manner. Market makers in a range of markets were often unwilling to trade at posted prices (IMF 2008) due to uncertainty, volatility and concern about the risks of counterparty default.

The crisis has revealed new patterns in funding-liquidity risk which stem from market-liquidity risks. Banks were unable to securitise the mortgages and other loans they were issuing, owing to the collapse of the ABS market. They also experienced calls on backup lines of credit for conduits and SIVs that were unable to issue ABCP. Accordingly, banks hoarded liquidity in order to provide sufficient funding for their ongoing business. This hoarding was aggravated by fear of counterparty risk in the interbank market, due to other banks’ undisclosed losses on ABS from stresses affecting credit quality and the availability of liquidity. Mark-to-market becomes a highly uncertain process when liquidity collapses (ECB

¹⁰ The corollary is that the potential scale of losses is exaggerated by using a mark-to-market approach to value such illiquid securities (Bank of England 2008).

2008), giving rise to concern that the assets of counterparties are mismeasured. One consequence of these problems of funding-liquidity was the failure of the solvent UK mortgage bank Northern Rock, which had an aggressive reliance on both wholesale funding and the securitisation of assets, which was no longer feasible (UK Parliament 2008). In contrast, the US bank Countrywide was able to rely on liability insurance contracts that limited the scope for a run, a feature not present in earlier crises.¹¹

These combined features led to the emergence of historically large interest-rate premia – and quantity-rationing of funds – in the domestic interbank markets in the US, the UK and the euro area, at all but overnight maturities. Funding at three months became particularly difficult to obtain. In summary, these patterns in turn meant that funding-liquidity risk was closely related to market liquidity risk. Banks were vulnerable to this linkage due to their low holdings of liquid assets, increasing reliance on short-term wholesale funding, dependence on securitisation, backup lines to SIVs, and the rise in overall maturity mismatch on their balance sheets related to “repatriation” of SIVs and conduits.¹²

4.2 Relevant liquidity risk paradigms

In evaluating the sub-prime crisis, it clearly has elements of the standard liquidity crisis paradigm (Tirole 2008), such as an aggregate liquidity shock (fall in house prices), deterioration of underlying loan quality, fire sales (of ABS) and runs (on Northern Rock and Bear Stearns). Moreover, the run up to the crisis showed the familiar signs of the procyclicality of financial markets (Borio *et al* 2001). However, there were also a number of less familiar elements.

I suggest that one helpful paradigm for the crisis is to reinterpret the concept of liquidity insurance, central to the Diamond and Dybvig (1983) model in the context of securities markets. Securities markets offer liquidity insurance, but in a different way to banks, by increasing the ease with which assets may be transformed into cash prior to maturity (Davis 1994; and Bernardo and Welch 2004). Yields are generally lower in highly liquid securities markets, as investors are more willing to hold a claim if they are confident of its liquidity. Unlike at-call deposits at banks, there is no guarantee of a fixed rate at which securities can be liquidated immediately, but short-term high-quality debt securities provide a considerable degree of security. Meanwhile, so long as markets remain liquid, the investor benefits from a shorter effective maturity than offered by the issuer, thus there is again maturity transformation.

Like banking, however, market liquidity depends on all other holders not seeking to realise their assets at the same time. If doubt arises over the future liquidity of the securities market it is rational to sell first, before the disequilibrium between buyers and sellers becomes too great and market failure occurs. That is, prices are driven down sharply, and selling in quantity becomes extremely difficult. Such collapses may result from a fear of deteriorating funding conditions, which leads a number of investors to sell assets simultaneously before they are forced to do so under fire-sale conditions.

A loss of liquidity in debt markets may have externalities similar to bank failures. This may be particularly true if: there are leveraged investors who are forced to sell despite such illiquidity; there is contagion between markets; illiquidity makes investors unwilling to accept

¹¹ Goodhart (2007), however, notes that such liability insurance is not a resolution for a systemic crisis, as it merely relocates liquidity risk.

¹² Bradley and Shibut (2006) show that US banks' ratios of deposits to liabilities fell from 93 per cent in 1965 to 60 per cent since 2000.

new issues; and there are debtors who do not have an alternative source of rollover finance.¹³ Note that all of these channels are relevant to the description of the sub-prime crisis above, particularly with respect to the liquidity failure of the ABS and ABCP markets. Following “runs” on these markets, the interbank market was adversely affected, as banks that could not securitise – and had to finance backup lines – hoarded liquidity. Such patterns were unprecedented, given the enhanced role of banks as asset sellers and liquidity providers.

The nature of liquidity failure in securities markets is further clarified by analysis of the role of market makers, whose importance was again outlined in the description above. The response of market makers to “one way selling”, where the new equilibrium price is uncertain, is often simply to refuse to quote firm prices, for fear of accumulating stocks of depreciating securities. This contributes to a collapse of liquidity. Uncertainty is crucial; if there is a clear new market-clearing price at which buyers will re-emerge, the market makers will adjust their prices accordingly. Such uncertainty was seen as a key feature of the recent crisis, relating notably to structured products, which had no price history to help predict behaviour under stress (Caruana and Kodres 2008), and which also led to banks being unable to price their own assets.

The collapse of dealer markets, even in the absence of generalised uncertainty and one way selling, may result from perceptions of asymmetric information (Glosten and Milgrom 1985; and Kyle 1985). A rise in the share of insiders leads market makers to widen spreads to avoid losses. This discourages liquidity traders, who withdraw, increasing adverse selection. Some dealers may cease to operate. Once the insiders (with superior information) become too numerous, bid and ask prices may be too disparate to allow any trade. Here I note that banks feared that others were not disclosing their true losses on ABS, directly and via SIVs, so they refused to lend on the interbank market. Equally, ABCP investors doubted the value of assets in SIVs and so refused to finance them. In the case of either one way selling or acute asymmetric information, the asset market, in effect, ceases to function. The associated decline in liquidity is likely to increase sharply the cost of raising primary debt in such a market (that is, there will effectively be heightened price rationing of credit), or it may even be impossible to gain investor interest at any price (quantity rationing). The closure of markets for securitisation fits this description.

The IMF (2008) argue that market liquidity collapses are particularly likely when market makers lack absorptive capacity, for example, due to costs of funding inventory and internal capital limits, which will in turn relate to whether returns to market making are low. Gromb and Vanayos (2008) argue that there is a feedback loop, as price falls hit the capital of dealers, making them less willing to make markets. Indeed they may sell existing inventories, aggravating the problem. Market liquidity collapses may also occur more commonly when there is no clear order of trading, as in OTC markets, and when market makers are risk averse (Bernardo and Welch 2004). There can also be spillovers between funding instruments when firms are active in several markets, as market makers and/or arbitrageurs, as liquidity needs in one market lead to early liquidation of assets in other markets.

Adrian and Shin (2008) also suggest that contagion during the current crisis differed, in quite specific ways, from that in traditional liquidity crisis models. The traditional view, as set out

¹³ The parallels between banks and securities markets are not exact, since investors who are not constrained to sell and do not suffer defaults do not make a loss by “sitting tight” and can still make a profit on their portfolio of securities. In other words, markets, unlike banks, may become illiquid but cannot become insolvent. Equally, the difficulties for issuers arise only in the case that an existing issue of securities needs rolling over – or there is a pressing need for a further issue – when the liquidity problem arises.

in Section 1 is that credit risk leads to contagion, either via direct exposures or uncertainty over opaque balance sheets. In the current world, Adrian and Shin argue that contagion occurs via changes in market prices, according to the way that risks as measured and the mark-to-market practices of financial institutions. Financial institutions are seen to manage balance sheets actively in response to price changes and measured risk. Moreover, this appears to have led to a positive relation between changes in leverage of commercial banks and balance sheet size, as they have taken on behaviour patterns hitherto more typical of investment banks.

In an upturn, when balance sheets are strong, banks see leverage as too low and seek to expand balance sheets by increasing lending and incurring short-term liabilities. This is seen as boosting aggregate liquidity across the economy as a whole, facilitating lending to sub-prime borrowers in the run up to 2007. As things turn down, perhaps in response to an adverse shock to market prices (as occurred due to heightened perceptions of credit risk and the collapse of market liquidity in 2007), financial institutions that mark to market find their leverage too high and seek to contract their balance sheets. Cifuentes *et al* (2004) note that fire sales of assets by distressed institutions may aggravate such a pattern by further depressing market prices. Note the contrast with traditional crises, in which a deterioration of credit quality would have no immediate direct effect on the balance sheet assuming that valuations are based on book values. Mark-to-market creates a new and much closer link from illiquidity to insolvency, since a loss of liquidity causes price falls that impact solvency directly, leading in turn to further attempts to sell and further price falls.

Adrian and Shin (2008) show that a pattern of desired reduction in leverage is precisely what happened successfully in the Russia/LTCM crisis. However, the current crisis is different because banks found themselves obliged to expand credit to cover backup commitments for SIVs and conduits, due to the closure of the ABCP market. Also, the closure of the ABS market meant that banks had to hold mortgages they were issuing on balance sheet. In such a situation, it is argued that they quickly cut back on discretionary lending, most notably to the domestic interbank market.

A helpful complementary paradigm of funding liquidity that encompasses some of the events of the 2007 and 2008 crisis is provided by Freixas *et al* (2000b). According to this model, liquidity may dry up for a solvent bank in the interbank market if there is imperfect information, or if there is market tension which reduces the lending banks' excess liquidity and reduces its scope to diversify. The interbank market as a whole may face liquidity problems if each bank refuses to lend to others because it cannot be confident of its own ability to borrow, a form of liquidity crisis akin to the Diamond-Dybvig model.

Brunnermeier (2008) talks of four mechanisms by which small shocks are amplified, leading to a loss of liquidity. These are first, borrowers' balance sheet effects comprising a loss spiral (as an initial loss on a leveraged balance sheet leads to a decline in net worth, sales and price movements, further reducing net worth) and a margin spiral (as increased margins lead to deleveraging and sales, leading to lower prices, further increasing margins). Second is a lending channel effect (notably precautionary hoarding of liquidity). Third are runs on institutions and markets (including the interbank, ABCP and investment bank repo markets). Fourth are network effects, for example, when Goldman Sachs expressed concerns about exposures to Bear Stearns via swap netting arrangement, hedge funds avoided Bear Stearns as a prime broker thereby helping to bring about its demise.

5 The lender of last resort and the sub-prime crisis

Besides needing a new understanding of the nature of liquidity failure in financial crises, the recent turmoil has raised a number of issues for the traditional LOLR role of central banks (described in Section 3 above), suggesting a need to amend the traditional doctrine. These issues did not come into play in the same way in the otherwise-similar Russia/LTCM crisis (Davis 1999), where the resolution occurred largely via a private sector rescue of the hedge fund (albeit under pressure from the Fed) and interest rate cuts by the Fed. Following the same order as Section 3, I now go on to discuss issues relating to open market operations and individual lending; the nature of open market operations; the widening of the safety net from commercial banks; the issue of illiquidity and insolvency; conflicts with other macroeconomic policies; collateral policies; private sector rescues; difficulties with information; reputation of banks and LOLR confidentiality; interaction with deposit insurance; and international concerns. I conclude by pointing out the issue of how authorities may exit from current LOLR policies.

I note at the outset that although the sub-prime crisis was seen as giving rise to major risks, the operation has not (yet) involved the fiscal authorities in widespread guarantees and bailouts as is typical of a major systemic banking crisis as cited in Hoelscher and Quintyn (2003). I therefore concentrate on points raised in the non-systemic discussion of current doctrine in Sections 3.1-3.3.

5.1 The sub-prime crisis and the nature of LOLR

Earlier I discussed whether open market operations or individual lending was most appropriate for LOLR. For the most part during the current crisis, LOLR was in the form of open market operations, but under unprecedented conditions. Extreme tightness of the interbank market in all but overnight maturities had not hitherto been a feature of domestic markets in advanced countries. Accordingly, the Fed and ECB in August 2007 and thereafter intervened heavily to overcome the liquidity crisis in the interbank markets – which had negated the usual method of distributing liquidity around the banking system, including to banks lacking access to open market operations. Note that such policies do appear to be close to standard open market operations, but I contend that the emergency operations cited were “LOLR-like” in the sense of being to satisfy short term increases in the demand for reserve money, as opposed to setting interest rates *per se*.¹⁴

Owing to the interbank market difficulties, central banks such as the ECB also felt the need to lend in open market operations at longer maturities than had hitherto been the case. In the US, the Fed introduced the Term Auction Facility (TAF) making funds available at longer terms than normal. This extension of the maturity of liquidity assistance was a response to the weakness of the longer-term interbank market and the banks’ needs for such funding in the light of the collapse of ABCP issuance and the demand for backup facilities. It also meant that some players with adequate liquidity positions had even more scope to hoard liquidity. [I’d rather keep this.]

One puzzle in the current crisis is why it is so protracted given the amount of support central banks have offered to markets and institutions. A key issue is of course the underlying uncertainty about the valuation of assets on banks balance sheets. But, as Caballero and Krishnamurthy (2008) argue, there may also be underlying uncertainty as to whether central banks have the liquidity and instruments to resolve the crisis.

¹⁴ Goodhart (1999) maintains that only support for individual banks should be termed LOLR.

I noted in Section 3.1 that traditionally LOLR assistance has been provided only to commercial banks. The Fed was forced to implicitly extend safety net protection to include investment banks, incurring a balance sheet guarantee for the Bear Stearns rescue via JP Morgan. It also made emergency liquidity available to investment banks more generally.¹⁵ The Bear Stearns situation showed that some investment banks have become sufficiently systemic to warrant such rescues, not due to the size of their balance sheets but because of their central role in the markets for credit default and interest rate swaps (Economist 2008a). Equally, however, some argue that Bear Stearns had departed from the traditional model of investment banking by holding long term illiquid assets, making it particularly vulnerable to liquidity risk. Given this precedent, and wider liquidity provision, investment banks are now accorded unprecedented protection for their risk taking activities, which is widely seen as requiring tighter regulation.

5.2 The sub-prime crisis and the costs of LOLR

The role of markets in the current crisis made the issue of only lending to the illiquid and not the insolvent a more complex one. In effect, central banks were at times lending in order to reliquify markets (also via collateral as discussed below) and only indirectly to provide liquidity to institutions. A market can obviously not become insolvent but its liquidity can impact on institutions' solvency, as the sub-prime crisis showed and Section 4.2 highlighted.

Conflicts with other policies loomed large during the current crisis. Central banks injecting liquidity at times faced the challenge of not changing the overall monetary policy stance in an undesired manner. Given the need for liquidity at longer maturities than normal, sometimes this would entail central banks withdrawing liquidity at shorter maturities to keep the monetary policy stance unchanged. I note that there remained a challenge also to traditional interest rate setting given the unprecedented and persistent spreads between LIBOR and central bank rates, that made official rates a poor indicator of the true stance of monetary policy (Martin 2008).

An unanswered question in the current crisis is how much moral hazard has been generated by these "new" LOLR policies. Certainly aspects, such as the extension of the safety net to investment banks and the easing of collateral policies, as discussed below, could have the effect of worsening moral hazard.

5.3 The sub-prime crisis and minimising costs of LOLR

It was noted that requiring good collateral is a key basis of the traditional doctrine of the LOLR. Some central banks implicitly responded to the loss of market liquidity in 2007 and 2008 by reducing collateral standards (accepting residential mortgages, and even ABS). This in turn could be seen as reliquifying the ABS market indirectly, in effect setting prices for those assets, as market maker of last resort. The Fed and the Bank of England extended their lists of eligible collateral, the Fed including credit derivatives in eligible collateral. Eventually the Bank of England set up a system of long term swaps for mortgages and ABS with government bonds, thought likely to total over £50 billion, but only for assets already held on the banks' balance sheets in December 2007.

This easing of collateral requirements is an inversion of traditional LOLR rules, with central banks possibly accepting excessive credit risk (although the latter is controlled by haircuts, notably by the Bank of England) and also potentially encouraging banks to continue risky

¹⁵ This was via the new Term Securities Lending Facility (TSLF).

lending practices (if such loans can still be used as collateral), and correspondingly justifying the banks' low levels of liquid assets (Goodhart 2008b). Meanwhile banks had the incentive to hoard top quality collateral, and central banks may risk becoming lenders of first resort, facing adverse selection as banks have an incentive to offer up the worst quality assets as collateral. This was an issue for the ECB, which did not expand its already-extensive list of eligible collateral, but did find that banks were undertaking ABS securitisations solely for ECB collateral (Economist 2008b).

Doctrine states that private sector solutions need to be sought in order that LOLR policies avoid generating moral hazard. But in general these were not forthcoming in the sub-prime crisis. Northern Rock had to be rescued by the Bank of England and the UK government rather than a private sector buyer being found. Bear Stearns was only bought by JPMorgan with a Fed guarantee. These cases underline, on the one hand, the wide scale and scope of the problem, with few banks feeling strong enough to step forward as buyers. On the other hand, they also reflect the uncertainty about valuations, which may have hindered private sector buyers from stepping forward. In the case of Northern Rock, prospective buyers in advance of the run were put off by the liquidity problems of the bank, as well as the protracted process of takeover in the UK (UK Parliament 2008, pp51-52).

Adequate information was noted to be essential for efficient operation of LOLR. Northern Rock presented a challenge for the UK's nascent tripartite agreement. It was considered that the Financial Services Authority (FSA) did not warn the Bank of England of the risk to Northern Rock in a timely manner. Eichengreen (2008) attributes such problems to differences in bureaucratic incentives and questions whether separation of regulation and LOLR is appropriate. The UK is introducing an enhanced role in financial stability for the Bank of England to rebalance the relationship between the Bank of England and the FSA.¹⁶

The loss of reputation for banks obtaining support and the confidentiality of the LOLR has become an important issue (Goodhart 2008b). In the UK, LOLR support was offered to the solvent bank Northern Rock as it had suffered a loss of wholesale funding, on which it was heavily dependent, and it was considered too big to fail. This support was planned to be announced by the Bank of England, unlike its past behaviour to keep such interventions secret. (It has been reported that the Treasury Solicitor gave advice that secrecy was illegal under EU financial regulations.) However, the announcement was pre-empted by a leak to the British Broadcasting Corporation on the previous day. This is in stark contrast to earlier episodes when support was covert and successfully so.¹⁷ There followed a retail run which was only stopped by a government guarantee – the bank was ultimately nationalised.¹⁸ The internet facilitated the retail run in a manner that would not have been feasible in the past, both via direct withdrawals and panic when the bank's website crashed.

¹⁶ As set out by the UK Chancellor in June 2008, current proposals are, first, for provision of a statutory responsibility for financial stability for the Bank of England; second, changes to the governance structures of the Bank of England, to support the Bank and the Governor in the exercise of these new responsibilities, including the establishment of a new Financial Stability Committee of the Court; and third, provision of a range of tools for the Bank of England to enable it to carry out its responsibility in this area. This will include a leading role in the implementation of the new special resolution regime (SRR), should it be triggered by the FSA, including powers related to deploying and implementing the SRR tools.. These proposals will be included in the Banking Reform bill, to be introduced later in 2008.

¹⁷ The Bank of Japan faced similar challenges in 1998 when deciding not to offer LOLR to the bank LTCB, for fear of a loss of reputation. However, in that case a merger was seen as probable if not certain (Nakaso 2001).

¹⁸ Further difficulties arose thereafter for the UK authorities owing to the lack of a special insolvency scheme for banks in that country.

Particularly in the wake of this, banks were unwilling to access central bank lending facilities, for fear of similar reputation risk. Rather they increased market demands for liquidity, for example, via backup facilities, that may have worsened the tight liquidity situation (IMF 2008). The responses to such reputational issues, also present in the US, included the TAF whereby the Fed made funds available not only at longer terms but also to a wider range of counterparties and with a wider range of collateral. This was seen as not carrying a stigma in contrast to discount window borrowing (the rate for which was meanwhile reduced, contrary to traditional doctrine, to seek to avoid stigma).

The growing public awareness of limitations of the UK's deposit insurance scheme was a feature in the Northern Rock case. This featured co-insurance up to a low maximum sum, and no guarantee of a prompt payout. By its nature, it seeks to provide protection from moral hazard, incentives to monitor and a degree of consumer protection – not to protect against runs (Goodhart 2008a). The lesson is that LOLR may be called upon more often in such regimes because of runs – but a comprehensive guarantee risks generating a lot of moral hazard (and makes more urgent a bank insolvency regime for “prompt corrective action”). Some would argue that it was deposit insurance problems rather than systemic risk that motivated the Northern Rock rescue.

I noted above that the traditional LOLR was confined to the domestic banking system. The crisis revealed that the traditional LOLR is unsuited to the internationalised banking system. This was evident in the lack of liquidity in dollars for European banks, following disruption in the foreign currency swaps market, as underlying money markets dried up. This meant that banks were unable to arrange liquidity to meet payment requirements in different currencies. This was eased in December 2007 by cross currency swap arrangements between the ECB, Swiss National Bank and the Fed, linked to the TAF mentioned above.

It can be argued that the domestic focus of LOLR worsened uncertainty in the globalised banking community, where banks have exposures in many currencies. Cooperation between central banks had to be increased due to the need to avoid liquidity support operations affecting domestic monetary conditions that could have influenced the euro/dollar exchange rate. Equally, there may be a need to avoid international banks “gaming” between different collateral requirements at the major central banks (Economist 2008b), which may in turn necessitate further coordination of collateral policy (Financial Stability Forum 2008). On the other hand, there was not a major failure of a cross border institution, that will in a future crisis severely test cross-border central bank and fiscal authorities cooperation.¹⁹

Finally, the central banks face a challenge in terms of exit strategies from some of the measures that have been adopted for the crisis. They will need to prevent moral hazard, for example, by retightening collateral regimes to avoid banks having long run incentives to hold less, low quality collateral. They will also need to ensure that the interbank market is reactivated, for example, by reducing term lending facilities when they are no longer needed. The Economist (2008b) [Not italic] suggests that similar issues of generous LOLR holding back revival of publicly traded markets will arise for the European ABS market, that in mid 2008 consisted mainly of securities for collateral with the ECB.²⁰

¹⁹ As noted, the Fed accepts credit derivatives in liquidity operations while others do not, while the ECB allows for newly created ABS while the Bank of England restricts access to its long-term liquidity to securities already on banks' balance sheets in December 2007.

²⁰ The Economist [Not italic] quotes an estimate by JPMorgan that euro 320 billion in eligible mortgage backed ABS were created from August 2007 to June 2008 but only euro 5.8 billion were placed with investors.

Conclusion

It is well known that liquidity risks are endemic to banks given the maturity transformation they undertake. The first line of defence should be appropriate liquidity policy on the asset and liability side, supported by adequate capital and robust supervision. Despite these, solvent banks can face liquidity difficulties at times of stress, necessitating liquidity support.

As doctrine has developed, the role of the LOLR is to avoid unnecessary failures, with suitable safeguards for central bank balance sheets and to minimise moral hazard. The role of LOLR in crisis periods is to prevent contagious panic by all means available – the central bank in such cases requires government support. LOLR must be a temporary policy with restructuring of distressed banks and corporate borrowers in the long term.

The current crisis has shown that traditional models of banking risk and of LOLR require revision, as was already apparent to a lesser extent in the Russia/LTCM episode. Funding risk now interacts with market liquidity risk, to create difficult challenges for central banks. Runs must be envisaged in markets and not just banks, which given mark-to-market accounting, leads to threats to the liquidity and solvency of banks via changes in market prices.

As a consequence, extensive changes to the traditional LOLR have been necessary, including: longer term funding provision with a variety of lower quality collateral; bringing investment banks into the safety net; and difficult challenges related to confidentiality of bank support and the interaction with deposit insurance. It is an important issue to investigate whether the net effect of these changes has been to increase moral hazard, the Achilles Heel of the safety net. There also remains the unresolved issue of failure of cross border institutions.

Beyond the scope of this paper, there is a further challenge to develop regulation of bank liquidity so that the LOLR is not so essential in future episodes. This could involve a liquidity adjustment to value-at-risk estimates to incorporate maturity transformation, measurement of stock liquidity and appropriate market and funding liquidity stress tests (IMF 2008, Goodhart 2007).

References

- Adrian T and Shin H S (2008), "Liquidity and financial contagion", in "Banque de France Financial Stability Review: Special Issue on Liquidity", No. 11, 1-7.
- Allen and Gale (2000), "Financial contagion", *Journal of Political Economy*, 108, 1-33
- Bagehot W (1873), "Lombard Street", Kegan Paul and Co., London
- Bank of England (2008), "Financial Stability Report" Issue 23, April 2008
- Bernard H and Bisignano J (2000), "Information, liquidity and risk in the international interbank market: implicit guarantees and private credit market failure", BIS Working Paper No 86
- Bernardo A E and Welch I (2004), "Liquidity and financial market runs", *Quarterly Journal of Economics*, 119, 135-58.
- Bordo M D (1990), "The lender of last resort, alternative views and historical experience", *Federal Reserve Bank of Richmond Economic Review*, January/February, 18-29.
- Borio, Claudio, Craig Furfine and Philip Lowe ,2001, "Procyclicality of the financial system and financial stability: issues and policy options," *BIS Papers* no 1, pp 1-57.

- Bradley C M and Shibut L (2006), "The liability structure of FDIC insured institutions – changes and implications", *FDIC Banking Review*, 18/2, 1-37.
- Brunnermeier M (2008), "Deciphering the 2007/8 liquidity and credit crunch", forthcoming, *Journal of Economic Perspectives*.
- Caballero R J and Krishnamurthy A (2008), "Musical chairs, a comment on the credit crisis". in "Banque de France Financial Stability Review: Special Issue on Liquidity", No. 11, 9-12.
- Caruana J and Kodres L (2008), "Liquidity in global markets" in "Banque de France Financial Stability Review: Special Issue on Liquidity", No. 11, 65-74.
- Chari V and Jagannathan R (1988), "Banking panics, information and rational expectations equilibria", *Journal of Finance*, 43, 749-761
- Cifuentes R, Ferrucci G and Shin H (2004), "Liquidity risk and contagion", *Journal of the European Economic Association*, 3, 556-566.
- Davis E P (1994), "Market liquidity risk", in Eds. Fair D. and Raymond R., "The Competitiveness of Financial Institutions and Centres in Europe", Kluwer Academic Publishers
- Davis E P (1995), "Debt, financial fragility and systemic risk, revised and expanded version", Oxford University Press.
- Davis E P (1999), "Russia/LTCM and market liquidity risk", *The Financial Regulator*, 4/2, Summer 1999, 23-28
- De Bandt O and Hartmann P (2001), "Systemic risk, a survey", in eds C Goodhart and G Illing, "Financial crisis, contagion and the lender of last resort, a book of readings", Oxford University Press
- Diamond D and Dybvig P (1983), "Bank runs, deposit insurance and liquidity", *Journal of Political Economy*, 91, 401-419.
- ECB (2008), "How has CDO market pricing changed during the turmoil?", *European Central Bank Financial Stability Review*, June 2008, 154-162
- Eichengreen B (2008), "Ten questions about the sub-prime crisis", in "Banque de France Financial Stability Review: Special Issue on Liquidity", No. 11, 19-28.
- Economist (2008a), "Paradise lost, a special report on international banking", *The Economist*, May 17, 2008.
- Economist (2008b), "Litterbin of last resort", *The Economist*, June 14, 2008.
- Financial Stability Forum (2008), "Report of the Financial Stability Forum on enhancing market and institutional resilience", 7 April 2008, FSF, Basel.
- Freixas X, Giannini C, Hoggarth G and Soussa F (2000a), "Lender of last resort, what have we learnt since Bagehot?", *Journal of Financial Services Research*, 18, 63-84
- Freixas X, Parigi B and Rochet J-C (2000b), "Systemic risk, interbank relations and liquidity provision by the central bank", *Journal of Money Credit and Banking*, 32, 611-640.
- Gatev E, Schuermann T and Strahan P E (2006), "How do banks manage liquidity risk? Evidence from the equity and deposit markets in the fall of 1998", in ed M S Carey and R M Stulz, "The Risks of Financial Institutions" University of Chicago Press.
- George E (1994), "The pursuit of financial stability", *Bank of England Quarterly Bulletin*, February, 60-66
- Glosten L R and Milgrom P R (1985), "Bid, Ask and Transactions Prices in a Specialist Market with Heterogeneously Informed Traders", *Journal of Financial Economics*, 14, 71-100.
- Goodfriend M and King R G (1988), "Financial deregulation, monetary policy and central banking", *Federal Reserve Bank of Richmond Economic Review*, May/June, 3-22.
- Goodhart (1988), "The evolution of central banks", MIT Press, Cambridge, Mass

- Goodhart C A E (1999), "Myths about the lender of last resort", *International Finance*, 23
- Goodhart C A E (2007), "Liquidity risk management", LSE Financial Markets Group Special Paper No 175.
- Goodhart C A E (2008a), "The regulatory response to the financial crisis", LSE Financial Markets Group Special Paper No 177.
- Goodhart C A E (2008b), "Liquidity and money market operations, a proposal", LSE Financial Markets Group Special Paper No 179.
- Goodhart C A E and Schoenmaker D (1995), "Should the functions of monetary policy and banking supervision be separated?", *Oxford Economic Papers*, 47, 539-60.
- Gorton G (1988), "Banking panics and business cycles", *Oxford Economic Papers*, 40, 751-781
- Greenbaum and Thakor (2007), "Contemporary financial intermediation", Elsevier.
- Gromb D and Vanayos D (2008), "Leverage and liquidity dry ups, a framework and policy implications", mimeo, LBS and LSE.
- He D (2000), "Emergency liquidity support", Working Paper 00/79, International Monetary Fund, Washington DC
- Hoelscher D S and Quintyn M (2003), "Managing systemic banking crises", IMF Occasional Paper
- Humphrey T M and Keleher R E (1984), "The lender of last resort: a historical perspective", *Cato Journal*, 4, 275-318
- IMF (1998), "World Economic Outlook and International Capital Markets, Interim Assessment December 1998 – Financial Turbulence and the World Economy", IMF, Washington D.C.
- IMF (2008), "Containing systemic risks and restoring financial sector soundness", Global Financial Stability Report April 2008, International Monetary Fund, Washington DC
- Jacklin C and Bhattacharya S (1988), "Distinguishing panics and information based bank runs; welfare and policy implications", *Journal of Political Economy*, 96, 568-592
- Kane E J (1992), "Corporate capital and government guarantees", *Journal of Financial Services Research*, 5, 357-68.
- Kaufman G G (1988), "The truth about bank runs", in eds C England and T Huertas, "The Financial Services Revolution", Kluwer, Boston.
- Kaufman G G (1991), "Lender of last resort; a contemporary perspective", *Journal of Financial Services Research*, 5, 95-110
- Kindleberger (1986)
- Kyle A (1985), "Continuous auctions and insider trading", *Econometrica*, 53, 1315-35
- Martin C (2008), "The implications of the sub-prime crisis for monetary policy", paper presented at the conference entitled "Policy challenges from the current crisis", Brunel University, May 20, 2008.
- Morgan D (2002), "Rating banks, risk and uncertainty in an opaque industry", *American Economic Review*, 92, 874-888.
- Nakaso H (2001), "The financial crisis in Japan during the 1990s; how the Bank of Japan responded and the lessons learnt", BIS Paper No 6
- Rochet J-C and Vives X (2004), "Coordination failures and the lender of last resort: was Bagehot right after all?", *Journal of the European Economic Association*, 2, 1116-1147
- Scheicher M (2008), "How has CDO market pricing changed during the turmoil? Evidence from CDS index tranches", ECB Working Paper, forthcoming
- Thornton H (1802), "An enquiry into the nature and effects of the paper credit in Great Britain", Hatchard, London.

Tirole J (2008), "Liquidity shortages, theoretical underpinnings", in "Banque de France Financial Stability Review: Special Issue on Liquidity", No. 11, 53-64.

UK Parliament (2008), "The run on the Rock", House of Commons Select Committee Report.