Central Bank Tools and Liquidity Shortages

Stephen G. Cecchetti and Piti Disyatat*

9 February 2009

Abstract

The current financial crisis has brought into sharper relief the fundamental role of central banks as lender of last resort and raises the question of whether the tools they have available are sufficient for confronting the challenges posed by modern liquidity crises. This paper attempts to provide a practical conceptual overview of these issues highlighting, in particular, the need to distinguish between different types of liquidity shortages before any general set of principles can be established with respect to how the lender of last resort function should be conducted.

JEL Classification: E50, E52, E58, E60

Keywords: Monetary policy, lender of last resort, liquidity operation, systemic crisis, liquidity shortage

* Cecchetti is Economic Adviser and Head of the Monetary and Economic Department, Bank for International Settlements; Research Associate, National Bureau of Economic Research; and Research Fellow, Centre for Economic Policy Research. Disyatat is Senior Economist, Monetary Policy and Exchange Rate Unit, Bank for International Settlements. This paper was prepared for the Federal Reserve Bank of New York Conference on "Central Bank Liquidity Tools," 19-20 February 2009. We are grateful to Claudio Borio, François-Louis Michaud, and Christian Upper for comments. All remaining errors are ours. Views expressed are those of the authors and not necessarily those of the BIS.

1. Introduction

The global financial crisis that began in mid-2007 has renewed concerns about financial instability and focused attention on the fundamental role of central banks in preventing and managing systemic crisis. In response to the turmoil, central banks have made extensive use of both new and existing tools for supplying central bank money to financial institutions and markets. Against this backdrop, there has been intense interest in the implications that recent financial developments may have on the fundamental nature of central banks' lender of last resort (LOLR) function and whether the traditional tools that have been at policymakers' disposal remain adequate in the face of modern liquidity crises. This paper attempts to address these issues and in doing so, provides a perspective of recent central bank liquidity operations that is tied more closely to their underlying purpose from a LOLR perspective.

We begin by defining three types of liquidity shortages that central banks may need to address. By doing this, we emphasize the fact that the conditions under which central bank liquidity – reserves or central bank money – are made available should and do differ depending on the underlying nature of the crisis officials are trying to mitigate. Importantly, this means that there may not be a single set of principles for central banks' LOLR function. Rather, actions of the central bank in its capacity as the lender of last resort will depend on the nature of the crisis it faces. Recognizing this goes some way toward reconciling the debate surrounding the appropriate role of a LOLR.[1] Following the definitions, in Section 3 we proceed with a discussion of the tools that central banks have at their disposal and how they might be tailored to address each type of liquidity shortage. Section 4 provides a brief description of how recent actions by major central banks can be interpreted from this perspective and the last section concludes. It should be noted at the outset that the focus of this paper is on central bank liquidity operations and not on their interest rate responses.

2. Liquidity Shortages and the Lender of Last Resort

Apart from the conduct of monetary policy, a vital responsibility of central banks in most countries is to perform the role of LOLR. At its core, the LOLR function is to prevent and mitigate financial instability through the provision of liquidity support either to markets or individual financial institutions. The underlying premise is that shortages of liquidity, by which we mean the inability of an institution to acquire cash or means of payment at low cost, can lead to otherwise preventable failures of institutions that then result in spillover and contagion effects that may ultimately engulf the financial system more broadly with significant implications on the real economy.[2] By signaling its willingness and ability to act decisively, the central bank's actions are intended to restore confidence in the system by avoiding fire sales of assets and supporting market functioning.

The "classical" doctrine on the LOLR as attributed to Thornton (1802) and Bagehot (1873) is commonly interpreted to imply that such lending should be extended freely without limit, but only to solvent institutions at penal rates and against good collateral (for example, see Rochet and Vives, 2004). This set of principles has been subject to substantial debate for much of the last 30 years with many issues as yet to be resolved.[3]

---

[1] We do not enter into the debate over whether the LOLR takes the place of a deposit insurance system. Recent events, especially the retail bank runs that accompanied the nationalization of Northern Rock in the UK, would appear to have settled the matter in favour of the importance of rule-based deposit insurance system.

[2] This definition of LOLR is quite broad and can, in principle, encompass any injection of central bank liquidity, including routine ones. That said, the focus will be more on extraordinary liquidity provisions that are driven by unanticipated events.

[3] See Davis (2008) and Rochet (2008) for a detailed exposition of the various views.

At the most basic level, the underlying principles of Bagehot's original dictum have been subject to various interpretations. Goodhart (1999), for example, emphasized that Bagehot's criteria for lending was not conditioned on the individual borrower, but on the availability of good collateral. As such, the distinction between illiquidity from insolvency was never an important issue. Similarly, while the imposition of a penal rate has traditionally been judged relative to the prevailing market rate, it can be argued that Bagehot only advocated that lending take place at a rate higher than the pre-crisis level (Goodhart, 1999). Following the logic that the LOLR should try to achieve the good – panic-free – equilibrium, the penalty ought to be relative to the interest rate during normal times rather than relative to the surely higher rate at which institutions would lend to each other in the market during a panic. Indeed, in practice LOLR lending has frequently taken place at prevailing market rates (Giannini, 1999).

At a more practical level, the distinction between illiquidity and insolvency has been largely dismissed on the grounds that banks generally face illiquidity when solvency is in question (Goodhart and Schoenmaker, 1995). Indeed, an individual bank will only seek assistance from the authorities when it cannot meet its liquidity needs in financial markets. Since the wholesale interbank money market is the first stop for most banks, this almost certainly means that there are significant doubts about the institution's ultimate solvency. The proposition that central banks only lend against good collateral is also undermined by the fact that a bank that is unable to raise funds in the market must, almost by definition, lack access to good security for collateralized loans. As such, emergency lending assistance from the central bank will likely be against collateral of questionable quality. In addition, the imposition of a penal rate has been criticized on grounds that such a policy could compound the problem if it imposes a substantial burden on the troubled institution.

At the same time, another facet of the debate has focused on the appropriate way in which the LOLR should be implemented. Some argue that in an advanced financial system, LOLR should be exclusively through open market operations. Insulating the real economy from financial sector disturbances means keeping interest rates near their target. Open market operations that meet system-wide changes in demand for reserves do this, after which the market can direct reserves to those most in need, thereby avoiding the mispricing that administrative mechanisms might create (Schwartz, 1992; Kaufman 1991; Goodfriend and King, 1988). Such an approach was clearly successful in the case of operations associated with the spikes in liquidity demand during the Y2K episode and in the aftermath of the stock market crash of October 1987, for example. However, others argue that LOLR may require direct lending, not open market operations, as the market may fail to deliver liquidity to banks in distress whose failure threatens the financial system (Rochet and Vives, 2004; Freixas et al., 2000a, 2000b; Goodhart, 1999).

2.1. Three Kinds of Liquidity Shortages

Rather than getting bogged down in the theoretical debate on the design and role of the LOLR, we take a more pragmatic approach and outline the broad conditions under which central banks' provision of liquidity is undertaken in practice. From this we derive some general principles that apply depending on the specific situation. Indeed, once it is recognized that the nature of the LOLR differs across circumstances, many of the issues that have been at the center of the theoretical debate fade.

It will be useful at the outset to distinguish between three types of liquidity: central bank liquidity, market liquidity, and funding liquidity. *Central bank liquidity* is deposits of financial institution at the central bank – often known as reserve or settlement balances. These reserve balances are held by financial institutions to meet reserve requirements, if any, and to achieve final settlement of all financial transactions in the payments system. Individual institutions can borrow and lend these funds in the interbank market but, for the system as a whole, the only source of these funds is the central bank.

Market liquidity refers to the ability to buy and sell assets in reasonably large quantities without significantly affecting the price. This use of the term "liquidity" is closest to the common, textbook, definition: the ease with which an asset can be converted into to means of payment (i.e. money or cash).

Finally, there is *funding liquidity*. This term describes the ability of an individual or institution to raise cash, or its equivalent, again in reasonably large quantities either via asset sales or by borrowing. As such, market and funding liquidity are closely linked (see Brunnermeier and Pedersen, 2007).

With this distinction in mind, the discussion of central banks' liquidity operations and their appropriate structure with respect to the fulfillment of the LOLR function are best premised on the clear separation of three different kinds of liquidity shortages.

Shortage of Central Bank Liquidity

The first kind of liquidity shortage is perhaps the most benign and occurs when institutions find themselves short of the reserve balances that they wish to hold, either because of inadequacies in the aggregate supply of reserves or problems related to their distribution within the system. In this situation, financial institutions risk being unable to fulfill their immediate payment obligations and the risk is that there will be "gridlock" in the payments system. Typically, the tensions manifest themselves in a spike in the overnight interest rate, but may sometimes also be transmitted to other segments of the money market. For the most part, these problems occur in the context of a well-functioning money market and in the absence of any concern over the solvency of specific institutions.

When central bank liquidity shortages occur as the result of problems related to the distribution of reserves, the underlying cause is typically technical in nature, having to do with either technological glitches or mismanagement of liquidity positions. The computer malfunction at the Bank of New York on 20 November 1985 that resulted in a large shortage of cash despite it being patently solvent and the September 2001 crisis are examples of such situations. The immediate problem confronting central banks in each case was the dislocation of liquidity, reflecting a breakdown in payments systems and the coexistence of institutions unable to lend excess funds to institutions that desperately need them.

A shortage of central bank liquidity can also arise due to an inadequate supply of reserves to the system as a whole.[4] This may reflect an error in the central bank's forecast of autonomous factors affecting liquidity conditions (for example, as a result of unexpected changes in the Treasury's balances with the central bank) or a sudden unanticipated shift in demand, or both. At the beginning of August 2007, for example, a sharp rise in uncertainty over future funding availability led to an abrupt increase in demand for reserves in the system as a whole. This put considerable upward pressure on overnight rates and many central banks initially found it harder to achieve their policy targets.

Chronic Shortage of Funding Liquidity at Specific Institutions

The second kind of liquidity shortage occurs when a particular institution experiences a chronic shortage of funding liquidity that is associated with solvency concerns as counterparties' willingness to engage in trade with it dissipates. The situation can arise as the result of a flawed business strategy (which often only becomes evident ex-post) that has left the institution exposed to persistent cash drains. Reflecting substantial perceived insolvency, the shortage of liquidity is prolonged and the form of assistance needed is essentially bridge financing that allows time for fundamental restructuring.

[4] Since it assumes that the interbank market is still functioning normally, this situation is close in nature to problem envisaged by Goodfriend and King (1988).

The primary threat posed by an institution-specific chronic liquidity shortage, and hence the main justification of any official assistance, is that failure may result in contagion and spillover effects that could put the entire financial system at risk. The key criterion in the consideration of liquidity support, as discussed further in section 3, is then whether the institution in question is systemically important or not. The distinction between illiquidity and insolvency is not really relevant. Prominent examples of situations where a chronic shortage of funding liquidity at certain institutions necessitated LOLR support include Continental Illinois in 1984 as well as the provision of liquidity support to various bank and non-bank financial institutions in the current crisis.

Systemic Shortage of Funding and Market Liquidity

The final form of liquidity shortage – a systemic shortage of both funding and market liquidity – is potentially the most destructive. It involves tensions emanating from an evaporation of confidence and coordination failures among market participants that lead to a break down of key markets. Markets, just as intermediaries, may be subject to "runs" that are driven by fundamentally similar forces. As we have seen in the aftermath of the Lehman bankruptcy, the result is a sudden and prolonged evaporation of both market and funding liquidity, with serious consequences for the stability of the financial system and the real economy.

Such crises are generally associated with a sharp rise in market participants' uncertainty about asset values as well as the financial strength of potential counterparties. Since financial markets need participants to function, a sharp rise in uncertainty that causes many players to disengage results in markets becoming illiquid (see Caballero and Krishnamurthy, 2008). As a direct consequence, assets that were thought to be easily convertible into cash are not, creating funding liquidity problems for individuals and institutions. This, in turn, heightens the credit risk of potential counterparties. The dynamics of these systemic crises are then driven by a mutually reinforcing feedback between market liquidity, funding liquidity and counterparty credit risk.[5] The 1987 stock market crash is an example of such a situation while systemic liquidity shortages have also been a prominent element of the current crisis from the very beginning.[6]

3. Central Bank Tools and Liquidity Shortages

The three types of liquidity shortages – central bank, chronic institution-specific funding, and systemic funding and market – do not always occur in isolation. Important interdependencies exist and the occurrence of one can lead to another, with dynamics that often reinforce one another. For example, acute concerns about the viability of a particular institution can rapidly spread to a loss of confidence in other institutions resulting in systemic disruptions in the interbank market that, in turn, hampers the distribution of reserves among participants leading to problems in the payments system. Indeed, the current crisis that began in mid-2007 has involved all forms of liquidity shortages.[7]

In their capacity as LOLR, central banks can influence the availability of liquidity in the financial system essentially in three different ways. Firstly, they can lend or borrow in the open market. These operations include, for instance, the repos and reverse-repos that are

[5] Brunnermeier and Pedersen (2007) provide a formal representation of this mutually reinforcing process. Freixas et al. (2000b) and Flannery (1996) develop models that illustrate how coordination failures can lead to a systemic seizing up of the interbank market. See also Borio (2004).

[6] A detailed exposition of the 1987 crisis can be found in Carlson (2007).

[7] A broad analyses of the currency crisis is provided by, Borio (2008), BIS (2008a, 2008b), Calomiris (2008), , and Gorton (2008).

the bread and butter of liquidity management during normal times. They are not targeted at specific institutions – though they may be undertaken bilaterally – but are designed to address system wide liquidity pressures. The operations are typically collateralized and conducted at the discretion of the central bank. The basic function is to regulate the level of aggregate reserves to ensure smooth functioning of the payments system and facilitate the attainment of the relevant policy interest rate target. That said, these operations can be utilized and structured to address a broader set of problems as well. For example, through these operations central banks may lend out not only reserves but also highly liquid securities such as government bonds.

Second, central banks can purchase or sell assets outright in the open market. These operations affect the aggregate supply of central bank money (reserves) on a permanent basis and are typically conducted in sovereign bonds denominated in either domestic or foreign currencies. Similar intervention in other asset markets is rare, notable exceptions being the purchases of equities by the Hong Kong Monetary Authority during the 1997 Asian financial crisis and the Bank of Japan in 2002. The application of outright transactions aimed at affecting market prices is quite controversial, and are usually justified in terms of correcting a fundamental misalignment in asset prices or the provision of two-way liquidity.

Finally, central banks can conduct transactions directed at specific institutions instead of markets as a whole. Unlike open market operations, these transactions can take place at the discretion of either the central bank or the financial institution itself, involve channeling liquidity directly to or from particular institutions, and can be either collateralized or uncollateralized. Examples of such operations include standing facilities and traditional emergency lending assistance.

Table 1: Principles of Lender of Last Resort Support

Nature of Liquidity Support	**Type of Liquidity Shortage**		
	Shortage of Central Bank Liquidity	Chronic Shortage of Funding Liquidity at Specific Institutions	Systemic Shortage of Funding and Market Liquidity
Distinction between illiquidity and solvency	Yes	No	No
Directed lending or open market	Either	Directed	Both
Lending or outright	Lending	Lending	Both
Ambiguity of access	No	Yes	No
Penalty relative to market rate	No if aggregate shortage Yes if institutional specific	No	No
Quality of collateral/Degree of central bank risk exposure	High/Negligible	Low/High	Low-High/Low-High
Term of support	Very Short (Overnight)	Long	Short to Medium
Public announcement of support	No	Depends	Yes
Separation from monetary policy	Yes	Yes	No
Coordination with fiscal authority	No	Yes	Yes

The specific institutional setup of each of these three tools vary a great deal across countries – including differences in maturity, frequency, counterparty arrangements, and eligible collateral – and can have significant implications for how financial institutions manage their own liquidity positions, as well as for the liquidity characteristics of various assets themselves.[8] Moreover, the specific setup of each of these tools crucially determines their

[8] Markets Committee (2008) contains detailed institutional specific practices for a large cross-section of countries.

function during a liquidity crisis. Depending on how they are structured, each can in principle contribute to the alleviation of all three types of liquidity shortages discussed in the previous section. The key features that characterize their application to various types of crisis will be set out below and are summarized in Table 1. Unsurprisingly, which tool should be employed will depend on the type of liquidity shortage that has arisen. Critically, this means that unlike the framework set out by Bagehot in the 19-century, there is no unique set of principles that governs how a LOLR should respond.

Before going into the details of how central banks use their tools to respond to each of the liquidity shortages we have described, it is useful to note some key implications for their balance sheets. The fulfillment of the LOLR function typically involves changing the composition of assets, the overall size of the balance sheet, or both. In doing so, central banks will normally offset any impact on reserve balances outstanding in order to maintain their interest rate targets. The main exceptions to this are: i) if there is an aggregate shortage of central bank liquidity (see below); ii) if the policy rate is zero; and iii) if reserves are remunerated at the policy rate. Whether the overall size of the balance sheet expands or not then depends on the choice of offsetting operations. If the latter are achieved through asset run-downs – that is, one asset substitutes for another – then balance sheet size is unchanged. On the other hand, if the offset is achieved through the issuance of various forms of central bank liability, such as an increase in the size of the government's deposit balance or central bank bills, balance sheet size increases. Typically, the latter becomes necessary as the scale of liquidity support rises beyond a certain point.

3.1. Shortage of Central Bank Liquidity

Faced with a shortage of reserves in the banking system as a whole, the primary aim of central bank intervention is to maintain the smooth functioning of the payments system and keep interest rates near their targets. When the problem is largely one of insufficient aggregate supply, all three forms of central bank intervention can be utilized to address the situation. Generally, however, the preferred option is to accommodate the extra demand for reserves by lending in the open market and relying on the market to distribute reserves to those most in need. The additional provision of reserves would typically not be at a penalty rate since the maintenance of the appropriate aggregate supply of reserves is a central remit of central banks. Moreover, the underlying cause can not generally be attributed to mismanagement on the part of banks. The sharp pickup in demand for liquidity buffers since August 2007, for example, reflected a general rise in uncertainty regarding future funding needs that was largely unforeseen.

If the shortage of reserves is caused by problems related to their distribution within the banking system, a situation associated with frictional payment shocks that leave some institutions suddenly and unexpectedly short of funds, the LOLR function can be implemented through directed liquidity support. Standing facilities – windows where banks can either deposit excess balances or borrow additional balances directly from the central bank at pre-specified rates at the end of the day – are designed to handle these situations. Since the nature of the problem envisaged is largely transitory, this type of liquidity support is designed to be extended for a very short-term, mostly overnight. Moreover, to maintain the incentive for financial institutions to transact in markets, access to standing facilities tend to be at penal rates of interest. Finally, standing facilities can exert a stabilizing influence on markets without any funds actually being lent out since their mere presence can act to assure banks of orderly access to overnight funds. This effect is ensured by making access unambiguous.

Regardless of whether the central bank liquidity shortage is system-wide and institution-specific, the operations conducted to address it are designed explicitly to minimize the impact on market prices of all securities other than the overnight interest rate. As such, their implementation has no bearing on, nor is it in conflict with, the official stance of policy. Furthermore, since the terms are very short and all loans are fully collateralized, the central

bank faces virtually no credit risk. The principles behind standing facility lending are in fact very much in line with conventional interpretations of Bagehot's instructions to lend freely to solvent institutions, against good collateral, at a penalty rate. As emphasized by Paul Tucker, much of the central bank lending that was discretionary in Bagehot's day has, in effect, become "hard coded" into the operating framework (Tucker, 2004).

While these operations work well most of the time, the current crisis has highlighted some potential constraints that may arise in the use of both open market operations and traditional standing facilities. For one, financial institutions may not have sufficient access to the types of assets that the central bank regards as being of acceptable quality to serve as collateral. In addition, the institutions most in need of central bank liquidity may not have direct access to the central banks itself. As recent experience has shown, capital market development has made it more likely that disturbances will originate in markets and involve counterparties who are several steps removed from the central bank's sphere of direct operation. Finally, when financial institutions lose confidence in nearly all potential counterparties bringing their soundness into question, access to standing facilities can become stigmatized and the effectiveness of these facilities as a liquidity backstop can then become severely impaired. This was particularly evident in the United States, where market rates at times rose well above the interest rates on the facilities (see CGFS, 2008). As we discuss in more detail in section 4, central banks have dealt with these problems by widening the pool of eligible assets, broadening the range of institutions that they deal with, and assuring market participants that borrowing from standing facilities should not be regarded as a sign of weakness.

3.2. Chronic Shortage of Funding Liquidity at Specific Institutions

When confronting an institution facing a chronic shortage of funding liquidity, the justification for any official-sector intervention must be that failure threatens the stability of the entire financial system. In such a circumstance whether the institution is solvent or not will be of secondary importance. Instead, central bankers are faced with a decision on whether to exercise discretionary authority and provide emergency lending assistance to a particular institution. Clearly, this situation is distinct from one described above in which an institution finds itself short of funds at the end of the day. Rather, the problem is one of large scale and potentially prolonged shortages of funding liquidity where the use of standing facilities is not adequate or appropriate. Furthermore, given the institution-specific nature of the intervention, emergency lending assistance can be clearly separated from the monetary policy stance.

Any liquidity support extended in this situation will likely expose the central bank to considerable credit risk since an institution in need of a loan of last resort would typically have exhausted much of their marketable assets and acceptable collateral. So the assets pledged to the central bank are likely to be some part of the borrowing bank's loan book, illiquid securities, or some physical asset whose value will be subject to a high degree of uncertainty. Indeed, to the extent that a loan extended under this circumstance is, in the end, simply bridging finance while a takeover or major restructuring of the recipient institution is organized, it will be accompanied by a plan for private-sector (Bear Stearns) or government (Northern Rock) support or recapitalization. This acts, at least in principle, to limit the central bank's exposure to substantial losses.

A key factor determining the scope and scale of emergency lending to an institution facing a chronic funding liquidity shortage is the central bank's ability to absorb losses. In this context, the current crisis highlights serious potential resource limitations. As financial institutions have become increasingly globalized, the scale of any potential support required has grown tremendously requiring the joint participation of fiscal authorities. Moreover, in cases such as the one in Iceland, it has even stretched beyond the limits of the entire official sector.

Because of the moral hazard implications, officials are tremendously hesitant to grant such loans. When they do, they not only charge high rates of interest to mitigate taxpayer exposure, but can wipe out shareholder equity as well as replace management. Insofar as

the institution is unable to obtain funding on its own in the market, however, the provision of liquidity support can not necessarily be deemed as being penal relative to the market rate.[9] As a further counterbalance to moral hazard, the provision of support to chronically illiquid institutions is done on discretionary basis so that the market does not take it for granted. Such "constructive ambiguity" does not necessarily mean, however, that the general set of principles that would justify emergency lending assistance are or should not be made explicit. Taylor and Williams (2009), for example, argue that uncertainty about what the government would do to aid financial institutions, and under what circumstances, was a key factor in the deterioration of the current crisis.

Once an emergency loan is granted, its communications can be critical in determining the chances of success. On the one hand, the announcement of assistance may work to assure the public that the financial system is sound, thereby boosting confidence among market participants. On the other hand, news of liquidity support may confirm public fears about potential failures and the institution receiving support may suffer a further loss of reputation. Most recently in the United Kingdom, news of LOLR support to Northern Rock precipitated a retail deposit run, which was only stopped by announcement of a government guarantee. Understandably, in the wake of this incident, for fear of the reputational consequences, banks became unwilling to access central bank lending facilities even for more benign liquidity needs. The result was a further tightening up of the money market that worsened an already bad situation.

While stigma is surely not a relevant issue for an ostensibly failing institution seeking emergency lending assistance, the central bank's decision to grant the request may worsen the stigma associated with all forms of direct lending, complicating liquidity management. While confidentiality may help to prevent knowledge of LOLR support from giving rise to panic, it will be difficult to maintain in practice since banks usually know the approximate condition of their competitors and the scale of such operations would typically necessitate public oversight.

3.3. Systemic Shortage of Funding and Market Liquidity

The limits of central banks' function of LOLR are most severely tested in a systemic liquidity crisis. This is especially so since such situations are likely to be accompanied by the other two types of liquidity shortages as well. In this circumstance, the underlying aim of official intervention is to shore up confidence in the system as a whole, restoring market functioning through the reestablishment of both funding and market liquidity. This will help forestall asset fire sales, facilitate the orderly reduction in borrowing, support the process of price discovery in markets, and restore credit flows. Succeeding will almost surely require utilization of all forms of central bank liquidity intervention listed earlier and may involve substantial modifications in standard practices and procedures. And, as is fairly clear, the central bank could well become exposed to considerable market and credit risk.

In a systemic liquidity crisis, the key challenge facing central banks is to find ways to contain flight-to-quality and re-engage the private sector in the intermediation process. Such re-engagement will only occur as agents' uncertainty over outcomes is reduced. To this end, the central bank will have to perform an intermediating role and its actions may be designed to supplement or even by-pass banks altogether.

Typically, this is will involve broadening the central bank's provision of liquidity both in terms of accessibility and structure. Tensions in the term funding market, for example, can be alleviated by the central bank both directly – through greater provision of term funding that

[9] The imposition of a penalty rate is determined largely by the degree of moral hazard that is associated with the provision of liquidity support, which is discussed further in section 3.4.

offsets some of the shortfall in market supply – and indirectly – through the assurance of access to liquidity directly from the central bank. To the extent that the latter helps to ease banks' concern about rollover risk, they may be more willing to extend term loans. At the same time, the set of institutions that the central bank transacts with may need to be expanded to ensure that the interventions reach those institutions that are most in need.

A basic thrust of liquidity operations would be to accommodate the increase in demand for assets of unquestionable liquidity while at the same time financing those institutions that find it hard to borrow in the market. This will involve shifting the asset composition of central banks' balance sheets away from highly liquid assets (primarily government securities) towards less liquid ones (typically private sector debt). In some instances, it may be necessary to side-step the banking system and provide liquidity directly to borrowers and investors in key credit markets. This may be done through outright purchases of or lending against specific classes of debt linked to particular market segments (for example, mortgages or corporate bonds). By reassuring investors that a committed buyer is in the market, such interventions may reduce the liquidity premium on various asset classes and boost the flow of credit. More generally, market prices may be influenced through the 'portfolio balance effect', whereby the change in the relative supplies of private and public securities, which are imperfect substitutes, will increase the premium that the private sector will demand for increasing their holdings of public securities at the margin. In addition, by making an asset eligible for repos or as collateral for loans from the central bank, the (liquidity) premium that might otherwise be needed to induce investors to hold that asset will be reduced.

Because the purpose of these policies is to affect market pricing of specific assets independently of the overnight rate, it will be difficult to distinguish them from the stance of monetary policy per se. They also represent a departure from the conventional view that monetary policy should refrain from directly influencing relative prices by not targeting specific asset prices. Indeed, whether yields spreads are overly wide or rationally priced for the amount of risk inherent in the prevailing economic outlook is largely a subjective assessment. Their justification, then, rests on the same logic that has been used to motivate foreign exchange interventions – the enhancement of two-way liquidity or correction of a fundamentally misaligned asset price.

Ultimately though, a systemic crisis is less amenable to central bank intervention. Central bank tools are much more limited in this context since the fundamental problem is more removed from their sphere of influence. The bulk of market and funding liquidity are generated through transactions among private entities and as such, are created endogenously in the financial system. In an environment where there is pervasive uncertainty about banks' balance sheets, both because asset valuations of various type becomes problematic and incomplete knowledge about what assets each bank holds, central bank's liquidity operations can only ease these problems indirectly, alleviating the symptoms rather than the cause. They can provide liquidity by transacting with market participants but are not able to directly ensure that private agents will transact with each other.

In the end, whether central bank actions are effective in attenuating the impact of a systemic crisis and restoring the functioning of markets or not depends on the extent to which they have a catalytic effect on mutually consenting private sector transactions. A key aim would be to generate a virtuous cycle that relies primarily on the private sector to reestablish liquidity in interconnected markets. In this respect, announcements of intended actions can be sufficient if they are credible. During the 1987 crisis, for example, the Federal Reserve (Fed) not only encouraged banks and securities firms to make credit available to brokers and dealers, but also issued highly public statements affirming its commitment to providing liquidity. Carlson (2007) argues that the latter was critical in stabilizing the situation.

By extension, ambiguity of access to central bank liquidity facilities is likely to be counterproductive in systemic crises. On the contrary, uniform access for all financial institutions, irrespective of their financial condition and systemic importance is more likely to

alleviate heightened counterparty fears. Standing facilities and loan guarantees are examples of intervention that can have this kind of catalytic effect without the liquidity actually being drawn upon. Indeed, several of the new facilities introduced, for example by the Fed, in the current crisis are available at the discretion of market participants (PDCF, AMLF, CPFF, MMIFF, as well as the reciprocal currency swap arrangements with other central banks) while others appear to have been structured to encourage market intermediation of credit.[10]

Importantly, the implementation of such measures involves an intricate balancing act. To the extent that an expanded intermediation role ends up discouraging financial institutions from dealing with one another, the central bank's response may create countervailing forces between catalyzing market activity on the one hand, and substituting for it on the other. The onus then falls on the design of an appropriate pricing structure and well-defined exit strategies, both of which can be difficult to achieve in practice.

Finally, in a situation of generalized market failure, there is less sense for liquidity support to be provided at a penal rate relative to prevailing market rates since no particular institution is benefiting relative to others. In fact, liquidity support will often be provided essentially at a subsidized rate when it involves an illiquid asset where a market price can not be found. That said, liquidity facilities may be designed in ways that are not penal when markets are dysfunctional and penal when normal activity returns.[11] Doing so would naturally lead to an automatic run-off of liquidity support as markets stabilize.

3.4. Lender of Last Resort and Moral Hazard

The creation of moral hazard is a long-standing concern associated with the provision of LOLR. Goodhart (2007), for example, argues that generous provision of liquidity by central banks, in normal times and times of crisis, has made banks careless in managing their liquidity risks. With this in mind, it is useful to assess the nature of moral hazard in light of the different types of liquidity shortages we set out here. As will become apparent, we view the moral hazard created by the LOLR as either relatively unimportant in practice or an issue that is best addressed by other facets of policy that is not directly associated with the provision of liquidity support itself.

With respect to shortages of central bank liquidity, the potential for moral hazard arises if the provision of liquidity support reduces the incentive for financial institutions to devote resources to enhancing the efficiency and effectiveness of their daily liquidity management operations. Moreover, excessive reliance on the central bank for daily liquidity management would substantially undermine private interbank market activity. Central banks have generally dealt with these issues successfully through the establishment of a pricing structure that preserves the incentive for market participants to trade with one another before going to the central bank's standing facility.

Looking at the case of chronic funding liquidity shortages at specific institutions, the underlying moral hazard concern is that the extension of liquidity assistance could establish precedents that lead to lax risk management making financial institutions generally more vulnerable to shocks. Attempts to address these concerns have centered on both the prevention of potential problems through regulatory frameworks such as prompt corrective

[10] The Term Asset-Backed Securities Loan Facility (TALF), for example, provides term credit against newly issued asset-backed securities rather than outright purchases which creates incentive for participants to establish sound collateral for the securities since they are likely to be kept on their books. Note that PDCF=Primary Dealer Credit Facility; AMLF=ABCP Money Market Fund Liquidity Facility; CPFF=Commercial Paper Funding Facility; MMIFF=Money Market Investing Funding Facility.

[11] Many of the Fed's new facilities in the current crisis are designed this way. The CPFF, for example, charges a fixed spread over the three-month market rate that should become unattractive in normal times.

action, and by imposing highly punitive financial and non-financial penalties on management and shareholders in the process of crisis resolution. The latter makes it unlikely that expectations of liquidity support will directly contribute to the taking on of excessively risky activities. Nevertheless, to the extent that creditors are protected from losses, the exercise of market discipline is weakened. This in and of itself may facilitate (rather than cause) the pursuit of excessively aggressive business strategies.

Finally, in situations of systemic crisis, the underlying coordination failures that trigger the crisis cannot be easily attributed to anticipation by private agents of government support measures in the event of a financial meltdown, so it is difficult to see how it could have been the outcome of moral hazard. Indeed if one views the evaporation of liquidity in key financial markets as a form of market failure – related to the inability of markets to cope with aggregate as opposed to idiosyncratic liquidity shocks – a case can be made that the provision of liquidity support in systemic crises serves to enhance social welfare (see, for example, Kearns and Lowe, 2008).

At the same time, expectations of generalized liquidity provision by the central bank in systemic crises may lead institutions to neglect building up buffers for such events. In this way, the inherent financial fragility that potentially contributes towards making systemic crises more likely may be partly attributable to complacencies in risk management associated with anticipation of central bank intervention. This does not, however, constitute grounds for the central bank to refrain from providing support in a systemic crisis nor for their provision to be on highly punitive terms. Insofar as such crises are associated with complacency in risk management, mistaken assumptions about asset price trajectories that only become evident ex-post, skewed compensation arrangements, limited liability and overall financial conditions that encourage risk-taking, the burden of their prevention falls more naturally on the appropriate management of macroeconomic policies and regulatory structures than the specifics of the framework for emergency liquidity provision.

Figure 1: Policy rates and reference market rates

In per cent

[1] For the United States, Fed funds target rate, for the euro area, main refinancing fixed respectively minum bid rate; for the United Kingdom, official bank rate. [2] For the United States, effective Fed funds rate; for the euro area, EONIA, for the United Kingdom, overnight Libor rate.

Sources: Bloomberg; national data.

4. Liquidity Operations in the Current Crisis: A LOLR Perspective

In the face of widespread financial market dislocations that began in August 2007, central banks have expanded liquidity operations, actively utilizing their balance sheets to address all three types of liquidity shortages. While the inherent cause may be rooted in coordination failures and informational asymmetries, so it is not new, the scale and scope of the problem has necessitated measures in some countries that are a clear departure from the past. In

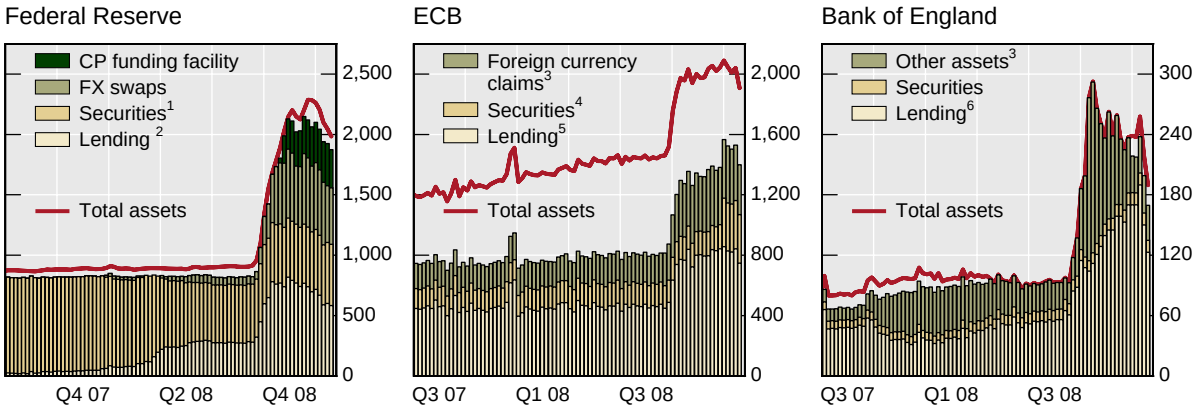
particular, because institutions have come to depend on market-based sources of liquidity, replacing lost liquidity now requires interventions on a scale that is large relative to the size of the central bank's balance sheet in normal times. This section outlines the general thrust of central banks' actions from the perspective of their LOLR function.[12]

Each of the measures central banks have undertaken since the fall of 2007 can be seen as addressing directly or indirectly at least one of the three types of liquidity shortages outlined above. With respect to addressing shortages of central bank liquidity, the focus has been on two specific areas. First, central banks acted to accommodate the greater instability in the demand for reserves through variations in the size and frequency of their operations, conducting them outside their regular schedule, and in larger than usual amounts. Second, problems related to the effective distribution of reserves have been addressed by broadening the number and type of counterparties, and enlarging the scope of eligible collateral. A key proximate goal of these interventions has been to contain deviations of market rates from the official policy stance (Figure 1).

Turning to chronic shortages of funding liquidity at specific institutions, central banks have extended emergency lending assistance to various financial institutions. This involved, for example, the extension of credit to Northern Rock in the case of the Bank of England (BOE); and the Fed's support for Bear Stearns, AIG, and Citigroup. The Swiss National Bank also stepped in to help finance the transfer of distressed assets out of UBS. These actions were undertaken jointly with the fiscal authority and generally structured to minimize the financial risk to the central bank.

Figure 2: Central bank assets

In billions of national currency



[1] Securities held outright (incl. TSLF). [2] Repurchase agreements, term auction credit and other loans. [3] Including US dollar liquidity auctions. [4] Of euro area residents and general governmnt debt in euro. [5] Including repos and other lending in euro. [6] Short and long-term reverse sterling repos.

Sources: Central banks; Datastream.

Finally, there have been four broad components to efforts aimed at alleviating systemic shortages of funding and market liquidity. First, central banks have sought to ensure the availability of backstop liquidity to key financial institutions as reflected, for example, in the creation of the PDCF by the Fed which established overnight funding for primary dealers. Second, greater assurance of the availability of term funding has been provided through the lengthening of the maturity on refinancing operations and establishing inter-central bank swap lines (to ensure the availability of (primarily) dollar funding in offshore markets). Third,

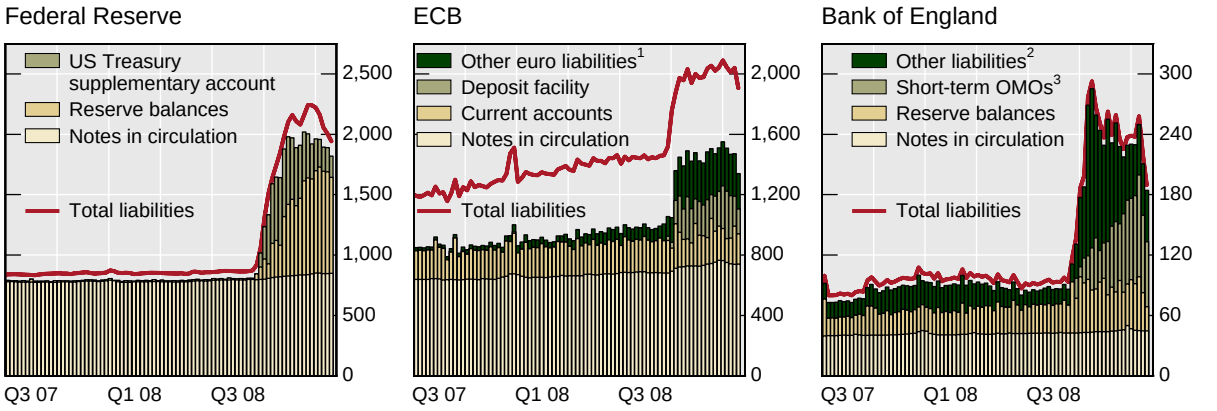
[12] For further details on central bank actions, see BIS (2008b) and CGFS (2008).

policymakers have tried to provide high-quality (sovereign) securities in exchange for lower-quality, less liquid ones in order to encourage trading in the latter. The Fed and the BOE, for example, established facilities to lend out liquid government securities against less liquid market securities. And fourth, there have been initiatives aimed at ensuring the availability credit to non-banks in cases where particular financial markets had become inoperative. The Fed's extension of credit through CPFF and TALF, direct purchases of mortgage-backed securities issued by key government agencies, as well as the Bank of Japan's outright purchases of commercial paper are examples of such an approach.[13]

Over the past 16 months, central bank actions have covered this broad spectrum, through two main phases. During the first phase (until mid-September 2008), central bank efforts were undertaken through variations in the asset composition of their balance sheets, while keeping the overall size largely unchanged. As the crisis intensified following the collapse of Lehman Brothers, central bank operations entered a second phase that involved a rapid expansion of the size of their balance sheets. In particular, as central banks increased the size and scope of their efforts to support market functioning and undertook larger emergency lending assistance, offsetting operations on the asset side of central banks' balance sheets became constrained and it was necessary to expand the capacity of reserve-draining instruments on the liability side.

Figure 3: Central bank liabilities

In billions of national currency



[1] To other euro area and non-euro area residents including central banks. [2] Including to central banks. [3] Including issuance of BoE sterling bills.

Sources: Central banks; Datastream.

The assets of the Fed and the BOE more than doubled in a matter of weeks, while those of the European Central Bank (ECB) increased by more than 30 percent (Figure 2). In the case of the Fed, the growth in assets was driven primarily by larger term operations, new lending facilities, and dollar swaps with other central banks. For the ECB and the BOE, the expansion has been driven mainly by repos and auctions of dollar liquidity. On the liability

[13] It is useful to emphasize that these somewhat unconventional liquidity operations can be applied regardless of the level of the policy rate itself. Central bank balance sheets can expand aggressively even when interest rates are positive, contrary to the widely held view that such an expansion can only take place at the cost of pushing rates to zero. The latter view is often based Japan's 'quantitative easing' experience; but the ability to expand balance sheet without compromising targets on interest rates is constrained only by the central banks' capacity to offset the impact on bank reserves. Indeed, Asian central banks that have seen their balance sheets expand in recent years with the sustained accumulation of foreign reserves have, on the whole, been able to maintain their interest rate targets.

side, the increase in balance sheet capacity of the Fed came from bank reserves and a one-off injection in the Treasury account (Figure 3). For the ECB, the primary offsetting instrument has been the deposit facility, while the BOE has increasingly relied on the issuance of central bank bills.

5. Conclusion

One hundred and thirty-five years ago, Walter Bagehot wrote that to stay a banking panic, the bank supplying reserves i) "must advance freely and vigorously to the public," ii) "that these loans should only be made at a very high rate of interest" and iii) "at this rate these advances should be made on all good banking securities, and as largely as the public ask for them." (1873, pgs. 74-75). From this central banks derived the theory of the LOLR. But Bagehot lived in a different world. Not only were there no automobiles, airplanes, or computers, there were virtually no central banks. In the late 19th century there were fewer than 20, while today there are more than 170. Since central banks are very much a 20th century creation, so it is natural to ask whether a 19th century doctrine still applies.

In this paper we have argued that Bagehot's view of the lender of last resort requires refinement. As the financial system has gained in complexity, so have all facets of the role of central banks. Following the trail blazed by Bagehot, we began by noting that central bank intervention is designed to alleviate liquidity shortages. We then went on to identify three types of such shortages that can occur in the modern financial system: i) a shortage of central bank liquidity; ii) a chronic shortage of funding liquidity at a specific institution; and iii) a systemic shortage of funding and market liquidity. This was followed up by a discussion of how it is that central banks can use their tools to address each of these.

Our analysis leads us to conclude that the appropriate principles for central banks' LOLR support must be conditioned on the particular type of liquidity shortage that is taking place. When confronted with a simple shortage of central bank liquidity, for example, Bagehot's rules apply. By contrast, a systemic event almost surely requires lending at an effectively subsidized rate compared to the market rate while taking collateral of suspect quality.

In the same way, any discussion of communication policy in the potential future application of LOLR policy, such as the desirability of constructive ambiguity, must be linked to a specific type of liquidity shortage. So, for example, while ambiguity of access to central bank liquidity may be an important countervailing force against moral hazard in situations of chronic institution-specific liquidity shortages, it is likely to be counterproductive when it comes to dealing with general shortages of central bank liquidity or in the midst of a systemic crisis.

In terms of the debate outlined earlier on the appropriate form of LOLR lending, the current crisis has made it abundantly clear that the argument that only open market operations are needed to meet the liquidity needs of manifestly sound banks is flawed since money markets can themselves fail to function properly. This is even more so in light of recent developments in the financial system. The interaction of funding liquidity with market liquidity has created 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.

Finally, when confronted with a systemic liquidity crises, the experience so far point towards some useful features that central banks are likely to require of their operational frameworks. These include: i) flexibility; ii) far reaching counterparties; iii) wide range of eligible collateral; iv) clear communication of intended actions; v) close coordination with fiscal authority; vi) close cooperation with other central banks.

References

Adrian, T and H. Shin (2008), "Financial Intermediaries, Financial Stability and Monetary Policy", paper presented at the Federal Reserve Bank of Kansas City Symposium at Jackson Hole, "*Maintaining Stability in a Changing Financial System*", Wyoming, 21-23 August.

Bagehot, W. (1873), "Lombard Street: A Description of the Money Market," London.

Bank for International Settlements (2008a), BIS 78th Annual Report, Chaper VI.

_____, (2008b), BIS Quarterly Review, December 2008.

Borio, C. (2008), "The Financial Turmoil of 2007–?: A Preliminary Assessment and Some Policy Considerations," BIS Working Papers, No 251, March.

_____, (2004), "Market Distress and Vanishing Liquidity: Anatomy and Policy Options," BIS Working Papers, No 158.

Brunnermeier, M. and L. Pedersen (2007), "Market Liquidity and Funding Liquidity," NBER Working Paper, No 12939, February.

Buiter, W. and A. Sibert (2007), "The Central Bank as the Market Maker of last Resort: From Lender of Last Resort to Market Maker of Last Resort," VOX, http://www.voxeu.org/index.php?q=node/459

Caballero R. and A. Krishnamurthy (2008), "Musical Chairs: A Comment on the Credit Crisis," in Banque de France Financial Stability Review: Special Issue on Liquidity, 11, 9–11.

Calomiris, C. (2008), "The Subprime Crisis: What's Old, What's New, and What's Next," paper presented at the Federal Reserve of Kansas City Colloquium, "Maintaining financial stability in a changing financial system", Jackson Hole, Wyoming, 21-22 August.

Carlson, M. (2007), "A Brief History of the 1987 Stock Market Crash with a Discussion of the Federal Reserve Response," Federal Reserve Board Finance and Economics Discussion Series, 2007-13.

Committee on the Global Financial System (2008), "Central Bank Operations in Response to the Financial Turmoil," CGFS Papers No. 31, July 2008.

Davis, P. (2008), "Liquidity, Financial crises and the Lender of Last Resort – How Much of a Departure is the Sub-prime Crisis?" Reserve Bank of Australia 2008 Conference, 14-15 July 2008.

Flannery, M. (1996), "Financial Crises, Payment System Problems, and Discount Window Lending," Journal of Money, Credit, and Banking, vol. 28(4), 804-824.'

Freixas X, C. Giannini, G Hoggarth and F. Soussa (2000a), "Lender of Last Resort: What Have We Learned since Bagehot?" Journal of Financial Services Research, 18(1), 63–84.

Freixas X, B. Parigi and J-C Rochet (2000b), "Systemic Risk, Interbank Relations, and Liquidity Provision by the Central Bank," Journal of Money, Credit and Banking, 32(3) Part 2, 611–638.

Giannini, C. (1998), "'Enemy of None but a Common Friend to All'? An International Perspective on the Lender-of-Last-Resort Function," Princeton Essays in International Economics, No. 214.

Goodfriend, M. and R. King (1988), "Financial Deregulation, Monetary Policy, and Central Banking," Federal Reserve Bank of Richmond *Economic Review*, May/June, 3-22.

Goodhart C. (1999), "Myths about the Lender of Last Resort," International Finance, 2(3), 339–360.

_____, (2007), "Liquidity Risk Management," Financial Markets Group Research Centre Special Paper No 175.

_____, (2008), “Liquidity and Money Market Operations,” Financial Markets Group Research Centre Special Paper No 179.

Gorton, G. (2008), “The Subprime Panic”, NBER Working Paper, No 14398, October.

Kaufman, G. (1991), “Lender of Last Resort: a Contemporary Perspective," Journal of Financial Services Research, 5, 95-110.

Kearns, J. and P. Lowe (2008), “Promoting Liquidity: Why and How?” Reserve Bank of Australia Research Discussion Paper 2008-06.

Markets Committee (2008), “Monetary Policy Frameworks and Central Bank Market Operations,” Markets Committee Compendium, June 2008.

Rochet J-C. (2008), Why Are There So Many Banking Crises? Princeton University Press, Princeton, New Jersey.

Rochet J-C and X. Vives (2004), “Coordination Failures and the Lender of Last Resort: Was Bagehot Right after All?” Journal of the European Economic Association, 2(6), 1116–1147.

Schwartz, A. (1992), “The Misuse of the Fed’s Discount Window”, Federal Reserve Bank of St. Louis Review, September/October, 58-69.

Taylor, J. and J. Williams (2009), “The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong,” NBER Working Paper 14631.

Thornton, H. (1802), An Enquiry into the Nature and Effects of the Paper Credit of Great Britain. London: Hatchard.

Tirole J. (2008), “Liquidity Shortages: Theoretical Underpinnings,” Banque de France Financial Stability Review: Special Issue on Liquidity, 11, 53–63.

Trichet J-C. (2008), “Some Lessons from the Financial Market Correction” Speech delivered at the “European Banker of the Year 2007” award ceremony, Frankfurt am Main, 30 September 2008.

Tucker, P. (2004), “Managing the Central Bank’s Balance Sheet: Where Monetary Policy Meets Financial Stability,” Speech delivered on 28 July 2004 to mark the 15th anniversary of the founding of Lombard Street Research.