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Central Bank Tools and Liquidity Shortages

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 crises. 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 for 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 addresses these issues, and in doing so provides a view of recent central bank liquidity operations that is tied more closely to their underlying purpose from the LOLR perspective.

We begin in Section 2 by defining three types of liquidity shortages that central banks may need to address in operations aimed at stabilizing the financial system. In taking this approach, we emphasize the fact that the conditions under which central bank liquidity—reserves or central bank money—is made available should, and do, differ depending on the underlying nature of the problem officials are trying to mitigate. This means that there may not be a single set of principles for central banks' LOLR function. Recognizing this goes some way toward reconciling the debate surrounding the appropriate role of LOLR.[1]

After providing our 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 offers a brief description of how recent actions by major central banks can be interpreted from this perspective; Section 5 concludes. We note at the outset that our focus is on central bank liquidity operations and not on policymakers' 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 objective of the LOLR is to prevent, or at least mitigate, financial instability through the provision of liquidity support either to individual financial institutions or to financial markets. 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

[1] We do not enter 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 United Kingdom, would appear to have settled the matter in favor of the importance of a rule-based deposit insurance system.

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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 demonstrates its intention to restore confidence in the system by avoiding "fire sales" of assets and supporting market functioning.

The "classical" doctrine of 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 penalty 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 past thirty years, with many issues yet to be resolved.[3]

At their most basic level, the underlying principles of Bagehot's original dictum have been subject to a variety of interpretations. Goodhart (1999), for example, emphasizes that Bagehot's criteria for lending were not conditioned on the individual borrower but on the availability of good collateral. As such, the distinction between illiquidity and insolvency would not be an important issue. Similarly, while the imposition of a penalty rate has traditionally been judged relative to the prevailing market rate, it can be argued that Bagehot advocated only that lending take place at a rate higher than the precrisis level. Given that the LOLR strives to achieve the good—panic-free—equilibrium, a case can be made that the penalty ought to be relative to the interest rate during normal times rather than the higher rate that obtains in the market during a panic (Goodhart 1999). 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 liquidity problems when solvency is in question (Goodhart and Schoenmaker 1995). Indeed, an individual bank will seek assistance from the monetary authorities only 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 penalty rate has been criticized on the 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 implementation of LOLR support. Some argue that in an advanced financial system, LOLR should be exclusively through open market operations. As long as systemwide changes in demand for reserves are met through such operations, 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, for example, 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. However, others argue that LOLR may require direct lending, not open market operations, as the market may fail to deliver liquidity to distressed banks whose failure threatens the financial system (Rochet and Vives 2004; Freixas et al. 2000; Freixas, Parigi, and Rochet 2000; Goodhart 1999).

2.1 Three Kinds of Liquidity Shortages

Rather than getting mired 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 at the center of the theoretical debate fade.

It is useful at the outset to distinguish between three types of liquidity: central bank liquidity, market liquidity, and funding liquidity. *Central bank liquidity* is the term we use to describe deposits of financial institutions at the central bank; it is synonymous with reserves, 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 itself.

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

Finally, there is *funding liquidity*. This term describes the ability of an individual or institution to raise cash, or its

[2] This definition of LOLR is quite broad and can, in principle, encompass any injection of central bank reserves, including routine ones. That said, we focus primarily on extraordinary interventions driven by unanticipated events.

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

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, our discussion of central banks' liquidity operations and their appropriate structure with respect to the fulfillment of the LOLR function is best premised on the clear separation of three kinds of liquidity shortages: a shortage of central bank liquidity, an acute shortage of funding liquidity at specific institutions, and a systemic shortage of funding and market liquidity. We now proceed to describe each of these in turn.

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 associated with their distribution within the system. In this situation, financial institutions risk being unable to fulfill their immediate payment obligations, creating the potential for "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 as well. For the most part, these problems occur in the absence of any concern over the solvency of specific institutions.

When central bank liquidity shortages occur as a result of problems associated with 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 November 20, 1985, which resulted in a large shortage of cash despite the bank's patent solvency, and the September 2001 crisis are examples of such situations. The immediate problem confronting central banks in each case was the dislocation of reserves, reflecting a breakdown in payments systems and the coexistence of institutions unable to lend excess funds to institutions that desperately needed them.

A shortage of central bank liquidity can also arise from 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. The natural policy response was an immediate increase in the supply of reserves in an effort to meet what officials hoped would be a brief shortage of central bank liquidity.

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

Acute Shortage of Funding Liquidity at Specific Institutions

The second kind of liquidity shortage occurs when a particular institution experiences an acute shortage of funding liquidity associated with solvency concerns as the willingness of counterparties to trade with the institution dissipates. This situation can arise as the result of a flawed business strategy—which becomes evident often only 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.

The primary threat posed by an institution-specific acute liquidity shortage, and hence the main justification for 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 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 in which an acute shortage of funding liquidity at certain institutions necessitated LOLR support include Continental Illinois in 1984 and the provision of liquidity support to various bank and nonbank 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 from coordination failures among market participants that lead to a breakdown of key financial markets. Markets, just as intermediaries, may be subject to "runs" that are driven by fundamentally similar forces. As we saw in the immediate aftermath of the September 2008 bankruptcy of Lehman Brothers, the result is a sudden

and prolonged evaporation of both market and funding liquidity, with serious consequences for the stability of both 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 about the financial strength of potential counterparties. Because financial markets need participants to function, a sharp rise in uncertainty that causes many players to disengage results in illiquid markets (see Caballero and Krishnamurthy [2008]). As a direct consequence, assets that were thought to be easily convertible into cash are not, which creates 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 process involving market liquidity, funding liquidity, and counterparty credit risk.[5] The 1987 stock market crash is an example of such a situation, and systemic liquidity shortages have 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, acute 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, hamper 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 essentially have three tools with which they can influence the availability of liquidity in the financial system. The first is lending or borrowing in the open market. These operations include the repos and reverse-repos that are 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 systemwide 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 not only reserves but also highly liquid securities such as government bonds.

The second tool is the outright purchase or sale of assets 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. Prior to the current episode, similar interventions in other asset markets were rare. The purchases of equities by the Hong Kong Monetary Authority during the 1997 Asian financial crisis and by the Bank of Japan in 2002 were notable exceptions. The application of outright transactions aimed at affecting market prices is quite controversial and is 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 the channeling of 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.

The specific institutional setup of each of these three tools varies a great deal across countries—including differences in maturity, frequency, counterparty arrangements, and eligible collateral. These variations 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 function during a liquidity crisis. Depending on their structure, each can in principle contribute to the alleviation of all three types of liquidity shortages discussed earlier. The key features that characterize their application to various types of crises are set out below and are summarized in the table. Unsurprisingly, the choice of tool to be employed will depend on the type of liquidity shortage that has arisen. Critically, this means that unlike the framework

[5] Brunnermeier and Pedersen (2007) provide a formal representation of this mutually reinforcing process. Freixas, Parigi, and Rochet (2000) 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 analysis of the current crisis is provided by Borio (2008), Bank for International Settlements (2008a, 2008b), Calomiris (2008), Cecchetti (2008), and Gorton (2008).

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

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 institution-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

set out by Bagehot in the nineteenth century, there is no unique set of principles that governs how the LOLR should respond.

Before describing how central banks use their tools to respond to each of the aforementioned liquidity shortages, 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 held by the central bank, the overall size of its balance sheet, or both. In doing so, central banks will normally offset any impact on reserve balances outstanding in order to maintain the policy interest rate near its target. The main exceptions to this are: 1) if there is an aggregate shortage of central bank liquidity; 2) if the policy rate is zero; or 3) 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 is achieved by allowing one asset to substitute for another, then balance-sheet size is unchanged. However, 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 the sale of 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

When central banks are faced with a shortage of reserves in the banking system as a whole, the primary aim of their intervention is to maintain the smooth functioning of the payments system and keep interest rates near their targets. If the problem is largely one of insufficient aggregate supply, all three forms of central bank intervention can be employed 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 provision of additional reserves would typically not be at a penalty rate since the maintenance of the appropriate aggregate supply of reserves is an important remit of central banks. Moreover, the underlying cause cannot generally be attributed to mismanagement on the part of banks. The sharp pickup in demand for liquidity buffers that began in 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, where banks can either deposit excess balances or borrow additional balances directly from the central bank at prespecified 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, usually overnight. Moreover, to maintain the incentive for financial institutions to transact in markets, central banks tend to make access to standing facilities at penalty rates of interest. Finally, standing facilities can exert a stabilizing influence on markets without any funds actually being lent, 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 systemwide 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 bank itself. As recent experience has shown, development of more global capital markets has made it more likely that disturbances will originate in markets and involve counterparties that 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, impairing the effectiveness of these facilities as a liquidity backstop. This was particularly evident in the United States during 2007 and 2008, when market rates at times rose well above the interest rates on the facilities (see Committee on the Global Financial System [2008]). As we discuss in more detail in Section 4, central banks have addressed these problems by widening the pool of eligible assets, broadening the range of institutions with which they are willing to transact directly, and assuring market participants that borrowing from standing facilities should not be regarded as a sign of weakness.

3.2 Acute Shortage of Funding Liquidity at Specific Institutions

When the official sector confronts an institution facing an acute shortage of funding liquidity, the justification for intervention must be that failure threatens the stability of the entire financial system. In such a circumstance, the solvency of the institution will be of secondary importance. Instead, central bankers are faced with a decision whether to exercise discretionary authority to provide emergency lending assistance to a particular institution. Clearly, this situation is distinct from the one just described, 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 against which the use of standing facilities is inadequate or inappropriate. 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 credit risk, since an institution in need of a loan of last resort will typically have exhausted its stock of both 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, or illiquid securities, or some physical asset whose value is uncertain. To the extent that a loan extended under this circumstance is, in the end, simply bridge financing while a takeover or major restructuring of the recipient institution is organized, it will generally 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 an acute shortage of funding liquidity 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 Iceland in 2008, it can even stretch 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 have the ability to write down 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 cannot necessarily be deemed punitive relative to the market rate.[9] As a further counterbalance to moral hazard, the provision of support to acutely illiquid institutions is on a discretionary basis so that the market does not take it for granted. Such "constructive ambiguity" does not necessarily mean, however, that the

[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. We discuss this further in Section 3.4.

general set of principles that would justify emergency lending assistance should not be made explicit. Taylor (2009), for example, argues that uncertainty about what the government would do to aid financial institutions, and under what circumstances, was a key factor in the deterioration that marked the current crisis.

Once an emergency loan is granted, communication 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. In the United Kingdom in 2007, news of LOLR support to Northern Rock precipitated a retail deposit run, which was stopped only by announcement of a government guarantee. In the wake of this incident, banks understandably became unwilling to access central bank lending facilities even for more benign liquidity needs, for fear of reputational consequences. The result was a further tightening up of the money market, which 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 a request may worsen the stigma associated with all forms of direct lending, complicating liquidity management. Confidentiality may help to prevent knowledge of LOLR support from giving rise to panic, but maintaining it is difficult 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 the central bank's LOLR function are most severely tested in a systemic liquidity crisis, not least because 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 financial 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 of the forms of central bank liquidity intervention described earlier and may involve substantial modifications in standard practices and procedures. In addition, 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 occur only 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 the role of banks or even bypass banks altogether. Indeed, whereas the primary function of the LOLR in traditional discussions is to liquefy the balance sheet of banks, the current crisis has highlighted that when faced with a systemic crisis in a market-based financial system, the scope of LOLR support is likely to be much broader and involve interventions more akin to liquefying the limit order book of a particular market.

Typically, this will require a broadening of 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 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 intermediaries' concerns about rollover risk, they may become more willing to extend term loans. At the same time, the set of institutions with which the central bank transacts may need to be expanded to ensure that the interventions reach those most in need.

A basic thrust of liquidity operations during a systemic crisis is to accommodate the increase in demand for assets of unquestionable quality while at the same time financing those institutions that find it hard to borrow in the market. This involves shifting the asset composition of central banks' balance sheets away from highly liquid assets (primarily government securities) toward less liquid ones (typically private sector debt). In some instances, it may be necessary to sidestep the banking system and provide funding directly to borrowers and investors in key credit markets. This may be accomplished 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 imperfectly substitutable private and public securities will lower the premium that the private sector demands for holding risky private securities at the margin. In addition, by making an asset eligible for central bank

operations, 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 yield spreads are too wide or whether specific bonds are rationally priced given the amount of risk inherent in the prevailing economic outlook is largely a subjective assessment. Justification for such policy actions, then, rests on the same logic that has been used to motivate foreign exchange interventions—the enhancement of two-way liquidity or the attempt to move a 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 greatly removed from monetary policymakers' sphere of influence. The bulk of market and funding liquidity is generated through transactions among private entities and, as such, is created endogenously in the financial system. In an environment where there is pervasive uncertainty about banks' balance sheets, both because asset valuations of various types become problematic and because of incomplete knowledge about what assets each bank holds, a central bank's liquidity operations can ease these problems only indirectly, alleviating the symptoms rather than the cause. Central banks can provide liquidity by transacting with market participants, but they 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 depends on the extent to which they have a catalytic effect on mutually voluntary private sector transactions. A key aim would be to generate a virtuous cycle that relies primarily on the private sector to re-establish 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 not only encouraged banks and securities firms to make credit available to brokers and dealers but also issued very public statements affirming its commitment to providing liquidity. Carlson (2007) argues that the latter was critical to stabilizing the situation.

By extension, ambiguity of access to central bank liquidity facilities is likely to be counterproductive during a systemic crisis. On the contrary, uniform access for all financial institutions, irrespective of their 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. For example, several of the new facilities introduced by the Federal Reserve in the current crisis are available at the discretion of market participants (the PDCF, AMLF, CPFF, MMIFF, and TALF), 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 discourages 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, it makes less sense for liquidity support to be provided at a penalty rate relative to prevailing market rates since no particular institution is benefiting relative to others. In fact, liquidity support will often, and probably should, be provided at a subsidized rate when it involves an illiquid asset in which a market price cannot be found. That said, liquidity facilities may be designed in ways so that accessing them is not punitive when markets are dysfunctional and is punitive when normal activity returns.[11] Doing so would also 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 LOLR operations. Goodhart (2007), for example, argues that generous provision of liquidity by central banks, in normal times and in 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

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

[11] Many of the Federal Reserve'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.

that is best addressed by other facets of policy 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 responded to 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 an acute shortage of funding liquidity at specific institutions, we note that the underlying moral hazard concern is that the extension of liquidity assistance could establish precedents that lead to lax risk management and make 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 action and the imposition of highly punitive financial and nonfinancial 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—associated with 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 the task of building buffers that can be run down during such events. In this way, the inherent financial fragility that potentially contributes to 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 should a systemic crisis occur, nor does it suggest that provision at that time should be on highly punitive terms. Economically and politically, authorities have little choice but to act in the midst of a crisis, and any ex ante stance precluding provision of such support cannot be made credible. Thus, even if the existence of the central bank's liquidity facilities creates moral hazard, efforts to mitigate it are more productively channeled elsewhere. Insofar as crises are associated with complacency in risk management, mistaken assumptions about asset price trajectories that become evident only 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 on the specifics of the framework for emergency liquidity provision.

4. Liquidity Operations during the Current Crisis: The LOLR Perspective

In the face of the widespread financial market dislocations that began in August 2007, central banks have expanded liquidity operations, actively deploying their balance sheets to address all three types of liquidity shortages. While the inherent cause of the current crisis may be rooted in coordination failures and informational asymmetries—and so is not new—the scale and scope of the problem have necessitated measures in some countries that are clearly unprecedented. In particular, because institutions have come to depend on market-based sources of liabilities, replacing lost funding 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. With respect to addressing shortages of central bank liquidity, the focus has been on accommodating the greater instability in the demand for reserves and alleviating distributional problems. These have been addressed by varying the size and frequency of operations—conducting them outside their regular schedule and in larger than usual amounts—broadening the number

[12] For further details on central bank actions, see Bank for International Settlements (2008b) and Committee on the Global Financial System (2008).

and type of counterparties, and enlarging the scope of eligible collateral. A key objective of these interventions has been to contain deviations of market rates from the official policy stance (Chart 1).

For acute 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 by the Bank of England; the Federal Reserve's support for Bear Stearns, AIG, and Citigroup; and the Swiss National Bank's financing of 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.

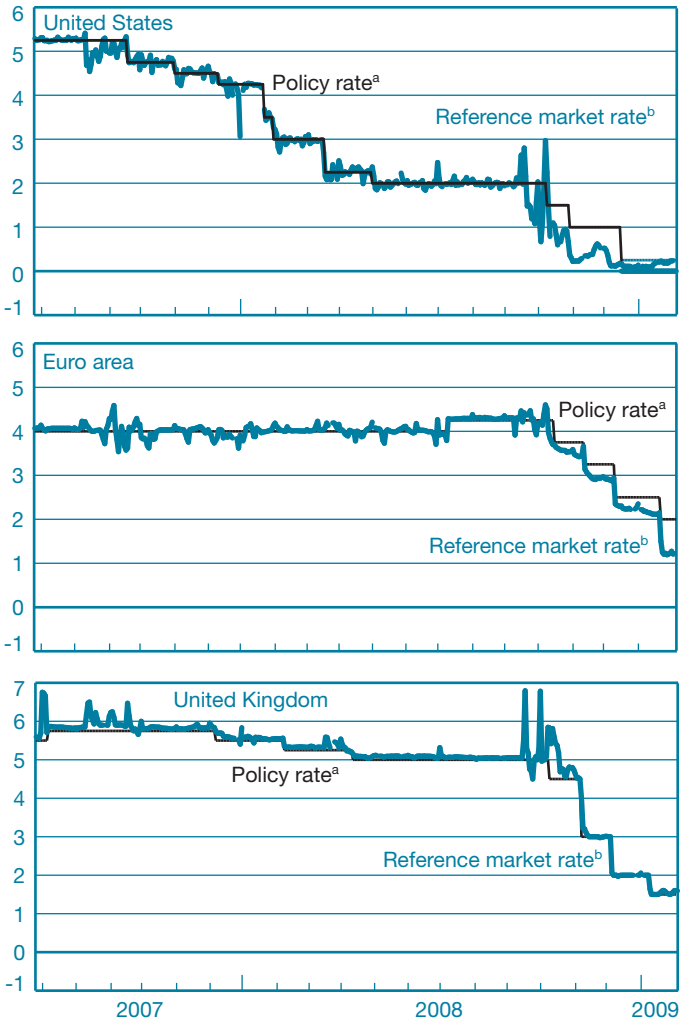
Finally, there have been four broad components to efforts aimed at alleviating systemic shortages of funding and market liquidity. First, central banks have sought to ensure the availability of backstop liquidity to key financial institutions as reflected, for example, in the creation of the Federal Reserve's PDCF, which established overnight funding for primary dealers. Second, there has been an effort to provide greater assurance of the availability of term funding through the lengthening of the maturity on refinancing operations as well as the establishment of inter–central-bank swap lines to ensure the availability of (primarily) dollar funding in offshore markets. Third, policymakers have worked to provide high-quality securities—usually sovereign ones—in exchange for lower quality, less liquid securities in order to encourage trading in the latter. The Federal Reserve and the Bank of England, for example, established facilities to lend government securities in exchange for less liquid market securities. Fourth, there have been initiatives aimed at ensuring the availability of credit to non-banks in cases where particular financial markets had become inoperative. The Federal Reserve's extension of credit through the CPFF and the TALF, direct purchases of mortgage-backed securities issued by key government agencies, and the Bank of Japan's outright purchases of commercial paper are examples of such an approach.[13]

Over the past sixteen months, central bank actions have covered this broad spectrum through two main phases. During the first phase (through mid-September 2008), central bank efforts were undertaken by varying 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 their balance sheets became

CHART 1

Policy Rates and Reference Market Rates

Percent



Sources: Bloomberg; national data.

[a] For the United States, federal funds target rate; for the euro area, minimum bid rate; for the United Kingdom, official bank rate.

[b] For the United States, effective federal funds rate; for the euro area, Eonia; for the United Kingdom, overnight Libor rate.

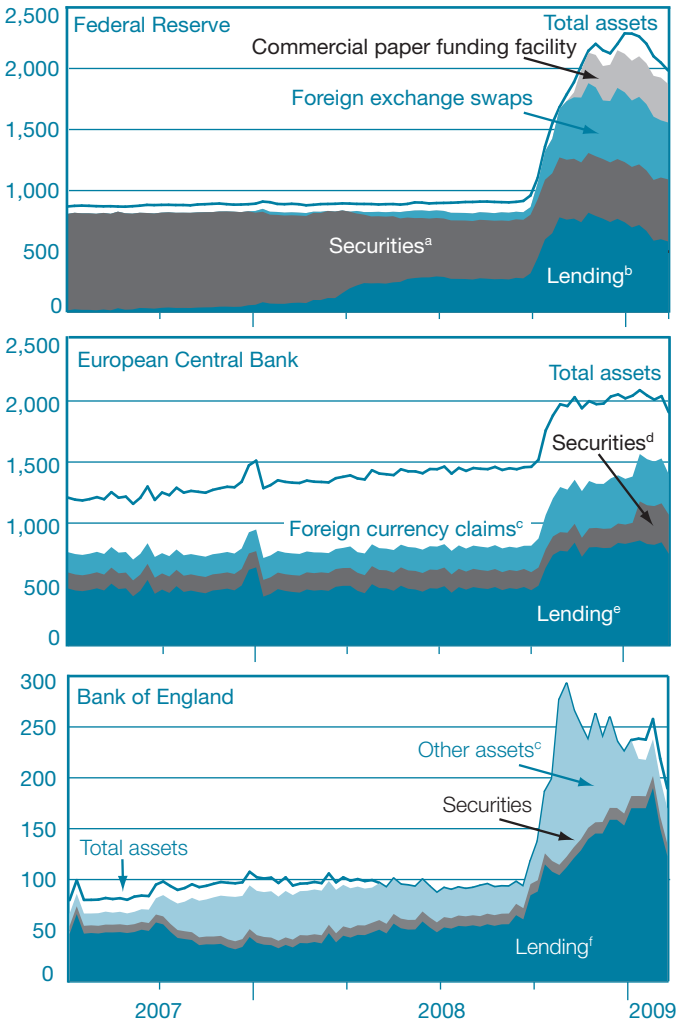
[13] It is useful to emphasize that these somewhat unconventional liquidity operations can be applied regardless of the level of the policy rate itself. Central bank balance sheets can expand aggressively even when interest rates are positive, contrary to the widely held view that such expansion can take place only at the cost of pushing rates to zero. The latter view is often based on Japan's "quantitative easing" experience; however, the ability to expand the balance sheet without compromising targets for interest rates is constrained only by 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. Disyatat (2008) provides further discussion of these issues.

constrained and it was necessary to expand the capacity of reserve-draining instruments on the liability side.

During the fall of 2008, the assets of the Federal Reserve and the Bank of England more than doubled in a matter of weeks, while those of the European Central Bank increased by more than 30 percent (Chart 2). In the case of the Federal Reserve, the growth in assets was driven by larger term operations, new lending facilities, and dollar swaps with other central banks.

For the European Central Bank and the Bank of England, the expansion was driven mainly by repos and auctions of dollar liquidity. On the liability side, the increase in balance-sheet capacity of the Federal Reserve came from bank reserves and a one-off injection in the Treasury account (Chart 3). For the European Central Bank, the primary offsetting instrument has been the deposit facility, whereas the Bank of England has increasingly relied on the issuance of central bank bills.

Chart 2
Central Bank Assets
Billions of National Currency



Sources: Central banks; Datastream.

[a] Securities held outright (including Term Securities Lending Facility).

[b] Repurchase agreements, term auction credit, and other loans.

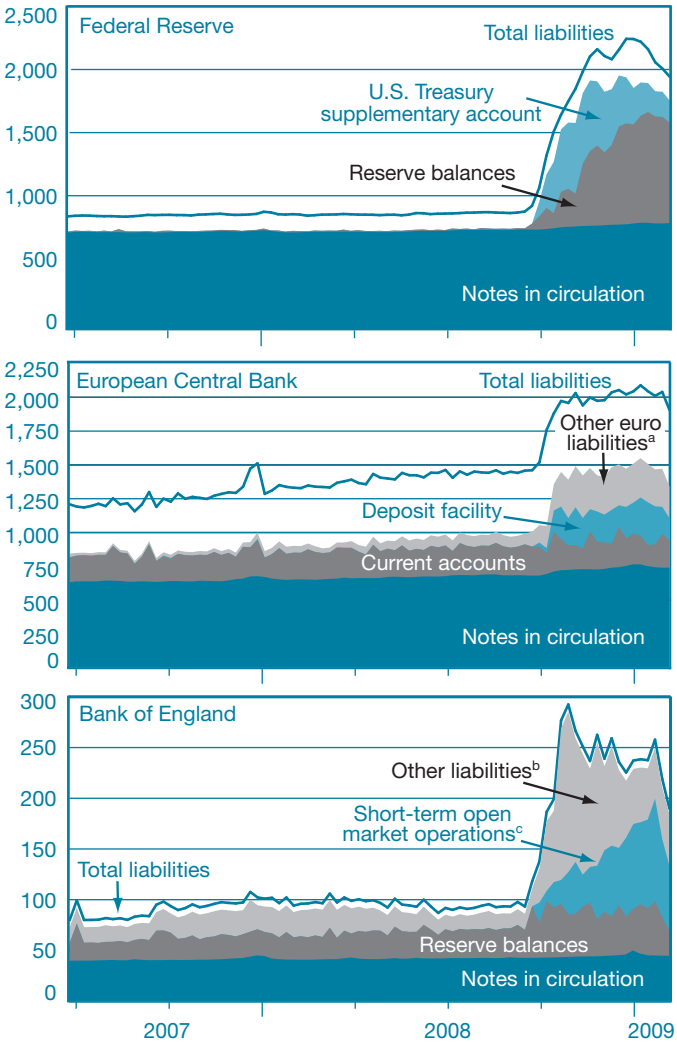
[c] Including U.S. dollar liquidity auctions.

[d] Of euro area residents and general government debt in euros.

[e] Including repos and other lending in euros.

[f] Short- and long-term reverse sterling repos.

Chart 3
Central Bank Liabilities
Billions of National Currency



Sources: Central banks; Datastream.

[a] To other euro-area and non-euro-area residents, including central banks.

[b] Including to central banks.

[c] Including issuance of Bank of England sterling bills.

5. Conclusion

One hundred and thirty-five years ago, Walter Bagehot wrote that, to stay a banking panic, 1) the bank supplying reserves "must advance freely and vigorously to the public," 2) "these loans should only be made at a very high rate of interest," and 3) "at this rate these advances should be made on all good banking securities, and as largely as the public ask for them" (1873, pp. 74-5). From these basic principles, central banks derived the theory of the lender of last resort. But Bagehot lived in a different world—not only were there no automobiles, airplanes, or computers, but there were very few central banks—fewer than 20, whereas today there are more than 170. Since central banks are essentially a twentieth-century phenomenon, it is natural to ask whether Bagehot's nineteenth-century doctrine still applies.

In this paper, we have argued that Bagehot's view of the lender of last resort requires modification. 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 refine the theory of the LOLR by identifying three types of liquidity shortages that can occur in the modern financial system: 1) a shortage of central bank liquidity, 2) an acute shortage of funding liquidity at a specific institution, and 3) a systemic shortage of funding and market liquidity.

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 dictum applies. By contrast, a systemic event almost surely requires lending at an effectively subsidized rate compared with 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 acute institution-specific liquidity shortages, it is likely to be counterproductive when it comes to dealing with general shortages of central bank liquidity or while 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 fundamentally sound banks is flawed since money markets themselves can fail to function properly. This is even more so in light of recent developments in the financial system that have increased the interdependencies between financial institutions and markets, and made it more imperative that central banks be prepared for situations in which both experience problems simultaneously.

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