



Reserve Bank of Australia

RESEARCH
DISCUSSION
PAPER

**Promoting Liquidity:
Why and How?**

*Jonathan Kearns and
Philip Lowe*

RDP 2008-06

PROMOTING LIQUIDITY: WHY AND HOW?

Jonathan Kearns* and Philip Lowe**

Research Discussion Paper
2008-06

October 2008

*Domestic Markets Department
**Financial System Group
Reserve Bank of Australia

This paper was first presented at the Reserve Bank of Australia Conference on 'Lessons from the Financial Turmoil of 2007 and 2008' at the H.C. Coombs Centre for Financial Studies, Kirribilli, on 14–15 July 2008. Thanks to numerous colleagues who provided assistance and comments. The views expressed are those of the authors and do not necessarily reflect the views of the Reserve Bank of Australia.

Authors: kearnsj or lowep at domain rba.gov.au

Economic Publications: ecpubs@rba.gov.au

Abstract

As recent experience all too clearly demonstrates, liquid markets do not exist for all financial assets at all times. In some respects, this can be thought of as a market failure. This paper addresses how best to promote asset market liquidity given this market failure, and the appropriate balance between the private and public sectors in establishing arrangements for dealing with liquidity problems. There are three main conclusions. First, improvements in the financial infrastructure – including arrangements for disclosure and post-trade processing – have a role to play in limiting the sharp rise in information asymmetries that can occur when conditions in financial markets are strained and at turning points in the financial cycle. Second, recent events have shown up shortcomings in the way that financial institutions manage their own liquidity, and these shortcomings need addressing. Third, it may be welfare-improving for the public sector to provide liquidity services when liquidity is strained. The central bank can smooth liquidity over the cycle, and the public sector can facilitate the change of ownership of assets from a troubled institution, which *in extremis* may include the public sector buying assets outright. If the public sector does actively provide liquidity services, then arrangements need to be put in place to ensure that the potential welfare gains from doing so are not undermined by financial institutions taking on greater risk than is warranted.

JEL Classification Numbers: G21, G28

Keywords: asset market liquidity, central bank market operations, lender of last resort

Table of Contents

1.	Introduction	1
2.	The First-best and the Real World	2
3.	Reasons for Asset Market Illiquidity	6
3.1	Asymmetric Information	6
3.2	A Sudden Rise in Uncertainty	8
3.3	Market Infrastructure	9
3.4	The Need to Close Out Large Positions in a Short Period (Particularly After a Failure)	11
3.5	Summarising Reasons for Illiquidity	11
4.	Promoting Financial Infrastructure that Reduces Information Asymmetries	12
4.1	Disclosure	12
4.2	Credit Ratings	12
4.3	Market Design	13
4.4	The Way Forward	16
5.	An Increase in Holdings of Liquid Assets	17
6.	The Provision of Systemic Liquidity Services by the Public Sector	20
6.1	Open Market Operations	20
6.1.1	Accommodating an increase in the demand for liquid assets	21
6.1.2	The choice of assets eligible for a repurchase agreement	24
6.1.3	The maturity of repos	26
6.1.4	Provision of funding to an institution experiencing difficulties	28
6.2	Direct Transactions in Markets	29

6.3	Emergency Liquidity Assistance	30
6.4	Assisting Off-market Transfers	31
7.	Policy Discussion	32
	References	37

PROMOTING LIQUIDITY: WHY AND HOW?

Jonathan Kearns and Philip Lowe

1. Introduction

As recent experience all too clearly demonstrates, liquid markets do not exist for all financial assets at all times. In some respects, this can be thought of as a market failure. The broad question that this paper examines is how public policy should best address this market failure, particularly in situations in which there is a potential threat to the stability of the financial system.

This question is of more than academic interest. The events of the past year have served as a stark reminder that a lack of liquidity in asset markets, particularly in times of increased uncertainty, can have significant implications for financial institutions, and the economy as a whole. In particular, the inability to sell assets and/or to raise funding can amplify disturbances in the financial system and contribute to significant losses in output. To the extent that these effects stem from a market failure, there is a public policy case for addressing that failure or, if that is not possible, at least addressing its consequences.

The discussion in this paper centres on two broad issues. The first is how best to promote asset market liquidity, and the second is the appropriate balance between the private and public sector in establishing arrangements for dealing with liquidity problems. A particular focus is to what extent the public sector should provide ‘systemic liquidity services’ to the private sector and, if it is to provide such services, how this should be done, and what conditions should apply to address moral hazard concerns and to ensure that new distortions are not introduced.

The paper is structured as follows. It begins by summarising the ‘first-best’ world of complete markets (and complete contracts) in which institutions are able to sell assets in liquid markets and generate liquidity when it is needed, and discusses how the real world differs from this benchmark. This is followed in Section 3 by a discussion of the various reasons why liquidity problems emerge in the real world. The following three sections then discuss possible ways of dealing with liquidity problems. These include: (i) reducing information asymmetries and improving financial market infrastructure; (ii) restricting the amount of maturity transformation undertaken by the banking sector; and (iii) the public sector providing various liquidity services to the private sector. This is followed in Section 7 with a general discussion of the policy issues.

The paper’s main conclusions can be summarised as follows.

First, improvements in the financial infrastructure – including arrangements for disclosure and post-trade processing – have a role to play in limiting the sharp rise in information asymmetries that can occur when conditions in financial markets are strained and at turning points in the financial cycle. In doing so, these improvements can reduce the probability of liquidity drying up during these episodes. It is important, however, to be realistic about what can be achieved in this area, as information asymmetries are pervasive in the financial system, and are likely to remain so.

Second, recent events have shown up shortcomings in the way that financial institutions manage their own liquidity, and these shortcomings need addressing. However, the social costs of financial institutions fully self insuring against liquidity problems arising from market dislocation and/or the inability to sell assets on reasonable terms, are likely to be quite high. The public sector may be able to play a useful role here by providing a range of liquidity services to the private sector that help ameliorate the adverse effects on welfare of a lack of asset-market liquidity.

Third, if the public sector is to provide these liquidity services, then arrangements need to be put in place to ensure that the potential welfare gains from doing so are not undermined by financial institutions taking on greater risk than is warranted. Given that widespread liquidity problems are most likely to emerge at turning points in economic and financial cycles, one possibility is to strengthen the macroprudential dimension of supervision, with increased capital, and possibly liquidity, buffers being built up in the good times.

2. The First-best and the Real World

In thinking about how public policy should respond to asset illiquidity it is useful to step back and ask what the ‘first-best’ world would look like. This was done very nicely at this conference last year in a paper by Franklin Allen and Elena Carletti.¹

They note that ‘if financial markets are complete, it is possible for intermediaries to hedge all aggregate risks in financial markets’ (p 207). In such a world, institutions could use securities, derivatives or trading strategies to ensure that liquidity is available when it is needed, with the price system ensuring that the liquidity was appropriately priced in every state of the world. In this perfect world, ‘market liquidity’ would be plentiful so that assets could be readily bought and sold at their fundamental value, and ample ‘funding liquidity’ would enable solvent institutions to easily borrow against their assets.

¹ See Allen and Carletti (2007), and also Allen and Gale (2004) and Holmstrom and Tirole (1988).

The real world falls well short of this first-best benchmark in at least two important ways. The first is that not all assets can be bought and sold in liquid markets, and where liquid markets do exist in normal times, they can disappear at short notice, just when they are most needed. The second is that the availability of funding can evaporate quickly, making it difficult for institutions to continue financing their assets. The effect of this can be particularly pronounced if it coincides (as is likely) with illiquid asset markets, as the institution experiencing the funding difficulties cannot simply downsize its balance sheet by selling assets in an orderly market. The reasons why these liquidity problems can emerge are discussed in the following section.

Given the limitations of the real world, distressed fire sales of assets can occur, and solvent institutions can find themselves unable to obtain funding, or sell assets on reasonable terms. As Allen and Carletti note, the result can be more volatility in asset prices than is socially optimal, and ‘costly and inefficient crises’ (2007, p 209).

While the real world clearly falls short of the first-best, many of the developments in the financial system over recent years can be seen as moving the system closer to this benchmark. One obvious example is the securitisation of loans on banks’ balance sheets, with securitisation offering the promise that historically illiquid assets could be liquefied. Indeed, some financial institutions had included the possibility of securitisation in their contingency planning for a liquidity crisis. Another example is the widespread use of contingent credit lines, with the entity paying for such a line essentially insuring itself against the possibility of funding difficulties and/or being a forced seller of assets. There has also been very strong growth in the trading of a whole range of financial products, which has allowed various assets and risks that previously could not be traded in markets to now be traded; one example is the credit default swap (CDS) market which allows the trading of credit risk.

The paradox here, however, is that while these developments may have moved the system closer to the first-best world in normal times, they do not appear to have had the same effect under more turbulent conditions. Many of these developments assist with the management of idiosyncratic liquidity issues and aid the efficient functioning of the market under normal conditions. However, they have not proved particularly resilient under strain, and the comfort that they have provided to institutions under normal conditions may have increased aggregate liquidity risk by encouraging the belief that if things changed for the worse, the markets could be relied upon to manage both liquidity and asset positions.

As institutions have become more dependent upon financial markets for the management of their balance sheets, the importance of the smooth functioning of these markets has simultaneously increased. Not only are these markets used

for managing many more risks than was once the case, they have also supported the increased use of mark-to-market accounting. One consequence of these developments is that if liquidity dries up, amplifying movements in the prices of financial assets, the potential systemic implications are much larger than they once might have been.²

Reflecting this, in the past decade there have been a number of cases in which concerns about market liquidity have been at the forefront of policy-makers' minds. The concerns have been most acute in situations in which the failure of an institution was considered a real possibility. In particular, in the cases of both Long-Term Capital Management (LTCM) and Bear Stearns, policy-makers in the United States were extremely concerned that markets could not deal with the closing-out of positions that would inevitably follow the failure of a major counterparty. As Bill McDonough, the then Head of the Federal Reserve Bank of New York, said in the wake of LTCM's problems, the closing out of these positions '... would have caused a vicious cycle: a loss of investor confidence, leading to a rush out of private credits, leading to a further widening of credit spreads, leading to further liquidations of positions, and so on' (see McDonough 1998). Similarly, 10 years later, in explaining the Fed's actions in response to Bear Stearns' problems, the Head of the New York Fed, Tim Geithner, said that by agreeing to lend against a pool of assets, the Fed had '... reduced the risk that those assets would be liquidated quickly, exacerbating already fragile conditions in markets' (Geithner 2008).

Similar concerns arose when the US hedge fund, Amaranth Advisors, got into trouble in 2006. In particular, its counterparties were concerned that if its positions had to be closed out on-market, there would be very large movements in prices with potentially destabilising effects. In that case, the situation was resolved by one of Amaranth's bankers eventually taking over its positions off-market at a substantial discount to their apparent market value. One view on why the situation with Amaranth was more easily resolved than LTCM's is that its positions were exchange-traded rather than being over-the-counter (OTC), an issue we discuss in the next section.

Liquidity issues have also been at the forefront of concerns arising from the sub-prime problem in the United States. A sharp fall in the demand for assets with unfavourable liquidity characteristics has seen a marked fall in the price of these assets relative to those whose liquidity is more assured, with many markets having essentially closed. Many financial institutions have also become much less willing to tie up their balance sheets in assets that cannot be sold easily, including term bank loans. This, combined with concerns about the ability to tap various

² Gai *et al* (2008) present a model which explains why financial innovation may have made financial crises less likely, but more severe if they occur.

funding markets on an ongoing basis, has resulted in a substantial increase in term spreads and a significant tightening of credit conditions. In some countries, there have also been runs on financial institutions, something that in the past has been quite rare in developed financial systems.

These various liquidity problems have not just affected a small group of institutions, but have been global in nature, and have had significant effects on economic activity. Indeed, the swing from a situation in which liquidity was unusually high, to one in which it is unusually tight, has been the major driver of the current business cycle in many countries.

Given the potential for adverse impacts of liquidity problems on the financial system and the real economy, a relevant question is: how should policy-makers respond? This question has taken on additional importance over time, particularly given that many developments may have moved the financial system further away from the first-best in troubled times. The arrangements for dealing with system-wide liquidity problems and, more broadly, disruptions to markets have become particularly important.

Here there are at least three (not necessarily mutually exclusive) perspectives, which we have stylised to make the views as clear as possible.

The first is that further financial innovation is required, so that the real world looks more like the first-best, not just in normal times, but also in troubled times. According to this perspective, the main problem with current arrangements is that there are still too many missing markets and too many impediments to state-contingent contracts, and that key parts of the financial infrastructure are underdeveloped. The key to a more stable system is to develop these markets, remove these impediments, and shore up the existing markets by improving the financial infrastructure so that participants can transact on reasonable terms in both good and bad times.

A second perspective is that financial markets will never be complete, and that realistically the various forces that periodically cause liquidity problems can never be completely overcome. In response, financial institutions need to hold more liquid assets than they have become accustomed to, and to be more realistic about their true potential liquidity needs (reflecting both explicit and implicit commitments). In doing so they need to take into account the possibility that normally liquid asset markets and reliable funding sources can evaporate in times of stress. According to this perspective, liquidity insurance has been underpriced for too long and many financial institutions have undertaken too much maturity transformation. Reflecting this, institutions need to either voluntarily hold more liquidity, or be forced to do so by regulators. The case for addressing this issue through regulation is strengthened by the idea that the benefits to the system of

an institution holding more liquid assets are not fully internalised, with regulation potentially solving the distortion caused by this externality.

A third perspective is that while private financial institutions need to be responsible for ensuring that they can deal with *idiosyncratic* liquidity problems, they should not have to shoulder alone the burden of ensuring themselves against *system-wide* disruptions. According to this view, overall social welfare can be improved by the public sector providing systemic liquidity services to the private sector. In some situations it may be able to do this at little cost and with little risk to the taxpayer. In other cases, the risks may be significant, but so too may be the benefits; in particular, by playing this role, the public sector may be able to reduce the costs that society pays for financial intermediation.

We return to these various perspectives in the following sections. Before this, however, it is useful to discuss the reasons why asset markets are not always liquid.

3. Reasons for Asset Market Illiquidity

In assessing potential policy directions it is worth first considering the reasons why not all assets can be sold in liquid markets and why, on occasions, liquidity can disappear from previously liquid assets. Importantly, there can be close correlations between reductions in market liquidity and funding liquidity. If market-makers (broker-dealers) have more difficulty obtaining funding liquidity, they will be less able to fund short-term holdings and so smooth imbalances in demand/supply over time, thereby reducing market liquidity. Similarly, if market liquidity is low, then a broker-dealer will have more difficulty obtaining a collateralised loan, or that loan will have a high margin, because the lender is less certain that the market price of that asset can be realised. Consequently, funding liquidity will also be low. Reflecting these interconnections, the following discussion focuses on four explanations for a lack of liquidity in the markets for various financial assets. These are:

- the existence of asymmetric information;
- a sudden rise in uncertainty;
- a lack of adequate market infrastructure; and
- the development of one-sided markets following troubles with a market participant.

3.1 Asymmetric Information

The first, and most obvious, reason for liquidity problems is the existence of asymmetric information between the potential buyers and sellers. If buyers are concerned that sellers know more about the quality of the asset than they do

– either because they are unwilling to reveal, or unable to credibly reveal, the relevant information – they will be reluctant to purchase the asset unless this asymmetry can be overcome. This has, for example, been one reason why bank loans, particularly to small and medium-sized businesses, have typically not been traded in deep and liquid markets. Similarly, a rapid change in investors' concerns about the degree of information asymmetries can see liquidity in previously liquid markets dry up quickly.

As financial markets have matured, various ways of ameliorating the effects of asymmetric information have developed. One is for investors to rely on credit rating agencies, with many investors taking advantage of the economies of scale by delegating the monitoring of asset quality to these agencies. Another is for institutions to develop reputations for comprehensive and accurate disclosure. A third is for lenders to retain a financial interest in assets that they originate, that is, to keep some 'skin in the game'. In securitisation markets this can be achieved by the lender, or a related entity, holding the first-loss tranche, or in syndicated lending by the lead lender holding a large portion of the loan. In addition, where possible, counterparty risk could be reduced by the novation of transactions to a central counterparty.

One of the main reasons that the recent strains in credit markets have been so pervasive is that investors' confidence in some of these antidotes to information asymmetries has been severely shaken. This is particularly the case in relation to structured credit products, but also for bank balance sheets more generally.

An important element here is that the reputations of the credit rating agencies have been badly dented. Over recent years, many investors have taken comfort in the belief that these agencies were spending the necessary time and effort to understand and assess the risk associated with a wide range of assets. As a result, many felt, perhaps inappropriately, that they did not need to fully understand the details of the investment themselves. When the difficulties emerged, these same investors began questioning whether the rating agencies had really understood the assets that they were rating (or had applied appropriate ratings), and whether they had been too close to those selling the assets.

A second factor is the perception that many banks have been slow to 'come clean' about the structure of their portfolios and the extent of their losses. This perception was reinforced by some banks writing down the same assets numerous times within a relatively short period. Some investors interpreted this as banks holding back information, at least initially, particularly given the lack of transparency about the exact assets that were in the portfolio, and how those assets were being valued. Similarly, when some banks announced write-downs this led to the perception that competitor banks with assumed similar portfolios

that had made no announcement were hiding their losses. In turn, this generated increased concerns that banks knew something that outside investors did not.

3.2 A Sudden Rise in Uncertainty

A second reason that liquidity issues can emerge, including the loss of liquidity in previously liquid markets, is that uncertainty about the future increases suddenly. Here the issue is not so much that buyers think that sellers might have more information than they do, but rather that there is a general increase in uncertainty about the future economic and financial environment by both buyers and sellers of assets.

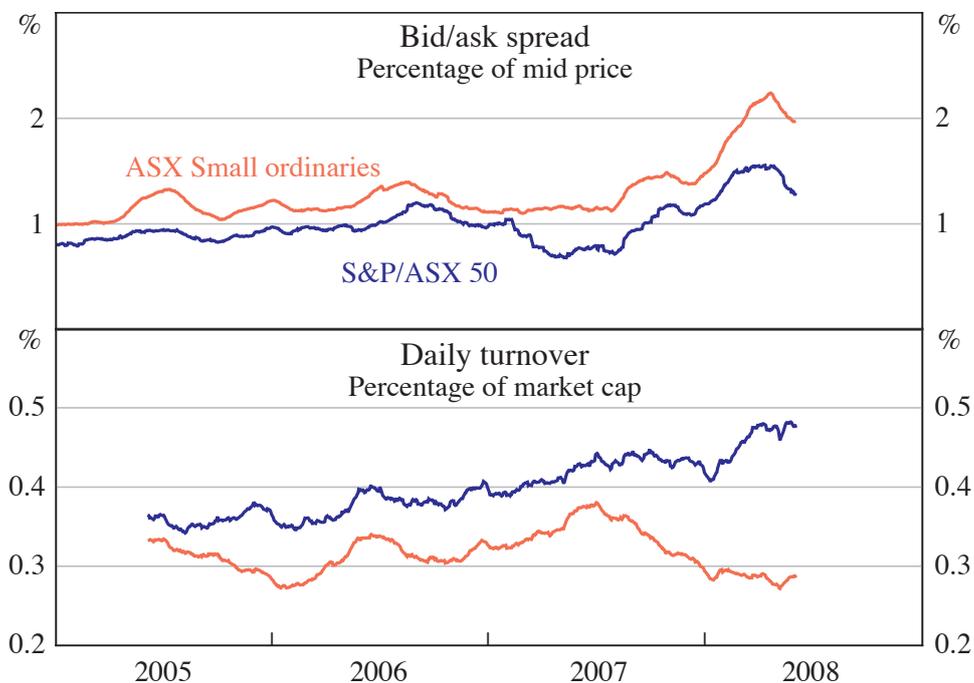
A high level of uncertainty is itself, of course, not necessarily an inhibitor to a liquid market, with many assets with highly uncertain pay-offs trading in liquid markets. Instead, the issue is more that liquidity can disappear when the degree of uncertainty suddenly increases. During such episodes, investors can come to question both existing norms of behaviour and the usefulness of the historical record in valuing assets. The result can be a significant reduction in the willingness to transact. When there are asymmetric pay-offs, an increase in uncertainty can also amplify the agency problem that an investor or lender faces.

In a sense, a rapid increase in uncertainty can itself prevent the market-clearing process, with investors choosing to stand on the sidelines until they have reassessed the risk-return characteristics of many assets. In this environment, because of the information asymmetries discussed above, sellers of assets can be seen as particularly desperate, further undermining the ability to sell assets.

Structured debt markets appear particularly prone to this problem. Credit derivatives also seem subject to evaporating liquidity; Fitch Ratings (2004), for example, found that for individual-name CDS, liquidity declined substantially when the relevant company encountered some form of stress. In contrast, in foreign exchange markets a change in the economic environment and a sharp increase in uncertainty can result in very large movements in prices, but liquidity is not normally absent for extended periods. One explanation for this is that in the foreign exchange market most of the factors that influence exchange rates are public knowledge, whereas in debt and credit derivative markets, periods of sharply increased uncertainty typically coincide with increased concerns about information asymmetries. Similarly, equity markets, as a whole, do not suffer from sharp reductions in liquidity as a result of increased uncertainty because the high levels of disclosure and considerable public analysis of stocks mean that uncertainty is less likely to result in higher perceived information asymmetries. However, even in equity markets, liquidity has recently declined more for stocks with small market capitalisation, for which there is typically less analysis and so

potentially greater information asymmetries, than for large market capitalisation stocks (Figure 1).

Figure 1: Liquidity in Large and Small Australian Listed Firms



Sources: Bloomberg; RBA

A generalised increase in uncertainty can also cause liquidity problems through banks becoming markedly less willing to make new loans. This can occur if the increase in uncertainty triggers a reassessment by banks of their ability to raise funds in the future and the extent to which existing clients will call on lines of credit. In this environment, banks may themselves seek to increase their own holdings of liquid assets, as protection against this more uncertain world. This has the potential to generate self-perpetuating liquidity problems, with banks becoming reluctant to lend and withdrawing from financial markets.

3.3 Market Infrastructure

A third factor influencing liquidity is the underlying market infrastructure. Market design – involving how buyers and sellers interact to reveal their private information and how they settle their trades – can have a significant influence on how the market responds when conditions become strained. It is notable that in the current turmoil, dislocation has tended to be greater in the markets for financial assets and derivatives that trade in OTC markets and settle bilaterally. Structured finance products and many derivatives typically trade OTC because of their inherent idiosyncratic features. Products trading in OTC markets can be tailored to the specific requirements of the counterparties and these markets

are often more suitable for new and developing products. Therefore, it is no surprise that structured financial products and many derivatives typically trade in OTC markets.

At the heart of the recent turmoil has been an increase in perceived counterparty risk, related to a large extent to asymmetric information as discussed above. Since most derivatives that trade in OTC markets settle bilaterally, confidence in one's counterparty to meet all obligations is critical to the willingness to trade. This is particularly so for many long-lived derivatives – including credit derivatives – for which the relationship with a counterparty may last many years. Not surprisingly, heightened counterparty risk has led to a significant reduction in liquidity in many bilateral markets. Indeed, it is notable that liquidity in foreign exchange swap markets declined more at longer horizons where counterparty risk is greater.

Other aspects of OTC markets can also make them more susceptible to potential buyers or sellers remaining on the sidelines. Trading in competitive markets is often concentrated, either at a point in time or a particular location, because the more traders there are, the greater the odds that a buyer or seller can find a matching order and so trade at the market price. Because OTC markets can be more fragmented than exchange-traded markets, they may be more susceptible to a loss of liquidity – in essence there is an unwillingness to transact because it can be harder to locate buyers or sellers.

Lack of transaction transparency can also reduce the willingness to trade. If market participants cannot observe recent transaction prices, then, in a period of increased uncertainty or volatility, they may be less willing to trade for fear of trading away from the true market price. In general, OTC markets have lower transaction transparency than exchange markets.

One example of a market in which low transaction transparency appears to have hampered liquidity is the market for Australian residential mortgage-backed securities (RMBS). Unlike the case in the United States, Australian RMBS have not suffered a deterioration of fundamentals, with arrears and default rates remaining low. Yet in early 2008, large selling by offshore structured investment vehicles contributed to a substantial fall in the prices of Australian RMBS. In the following months, liquidity in the market was low as buyers continued to bid at the low prices at which 'distressed' sales had reportedly taken place, while sellers asked for higher prices on the basis that the distressed selling had abated. One factor contributing to wide bid/ask spreads was a lack of timely information about actual transaction prices.

3.4 The Need to Close Out Large Positions in a Short Period (Particularly After a Failure)

A fourth factor that can lead to liquidity problems is the failure, or near failure, of a large institution or investor. The news, and rumour, surrounding such an event can result in a sharp increase in uncertainty and perceived information asymmetries, thereby decreasing liquidity through the channels described above. Ordinarily, large investors build up or sell positions gradually so as to reduce the price impact that can result from large changes in their positions. However, in a time of stress, a large investor may not have the luxury of selling gradually in order to minimise the price impact. While an asset's price falling below its fundamental value might ordinarily provide opportunities for other traders, large price falls in one market can have significant ongoing adverse consequences for that market and related markets.

The feedback mechanisms largely result from the use of debt to fund positions in those markets. The fall in asset values means that investors are less able to obtain funding, because in effect their gearing has increased. The resulting margin calls require further asset sales to repay debt, causing further price falls. Brunnermeier (forthcoming) has termed this mechanism a 'loss spiral', with Brunnermeier and Pedersen (forthcoming) presenting an additional 'margin spiral' channel that compounds the loss spiral. They argue that lending standards tighten when prices fall, so that margins increase. This reduction in funding liquidity results in additional asset sales and further price falls. Furthermore, the price fall in one market can spill over to other markets. If price falls lead to a general tightening of lending standards then the 'margin spiral' will spread to other markets. Similarly, investors may sell other assets to meet margin calls or redemptions because liquidity in the market with the initial price falls has declined and so the 'loss spiral' will spread.

Given the prevalence of borrowing to fund positions and use of margins to provide security for these loans it is difficult to avoid loss spirals and margin spirals, particularly in the case of the failure of a large investor. Hence it is important to attempt to minimise their impact by providing a market framework that reduces information asymmetries and uncertainty, thereby lessening any decline in liquidity.

3.5 Summarising Reasons for Illiquidity

The existence of asymmetric information and increases in uncertainty are central to explaining illiquidity in asset markets. As described in the paper so far, these factors alone are sufficient to hamper the development of liquid markets, or cause liquid markets to become illiquid. But their interaction with inadequate market infrastructure or one-sided markets following the failure of a large participant

can result in severe illiquidity across many asset markets. In the following sections we consider measures that have been used, or could be used, to make liquidity in financial markets more resilient to these problems. One possibility is the promotion of financial infrastructure that reduces information asymmetries. But, acknowledging that these initiatives may not always be successful or be possible, we then consider how to mitigate the impact of shocks that would reduce liquidity, either through financial institutions holding more liquid assets or the public sector providing liquidity services.

4. Promoting Financial Infrastructure that Reduces Information Asymmetries

Given the central role that information asymmetries play in market illiquidity, an obvious way in which to address liquidity issues is to reduce these asymmetries, particularly at turning points in the economic cycle.

Here, there are a number of possibilities, including: further improving disclosure by financial institutions; improving the credit rating process; and improving settlement procedures, including facilitating the increased use of central counterparties.

4.1 Disclosure

While the amount of information disclosed by banks has increased over recent years, the level of disclosure remains, in many cases, well short of what is required. Looking at recent announcements of write-downs by international banks, it is very difficult, even for sophisticated investors, to make an assessment of whether the new asset valuations are realistic. The disclosure statements typically contain only rather general statements of valuation policies, and little specific information about particular assets or portfolios of assets.

In part, the limited disclosure reflects the fundamental difficulty of valuing some assets. But it also reflects the reluctance by financial institutions to provide information about the specifics of their portfolios for fear of revealing trading strategies or portfolio positions to their competitors and counterparties.

4.2 Credit Ratings

A second possibility is to improve the credit rating process – particularly as it relates to structured credit products – in order to rebuild confidence in the rating process, and ensure that ratings convey more complete information to investors. There are many positive aspects to ratings arrangements, including avoiding the inefficiency that can arise if each investor is required to undertake his/her own analysis. But there is little doubt that ratings arrangements can be improved. One concern that has been highlighted by recent events is that the rating agencies are

paid by the issuers, rather than the investors for whom they provide information. Particularly for structured finance products, which can be designed to adhere to the rating agency's ratings criteria, the close relationship between issuers and rating agencies may distort incentives and additionally lead to structures that only just qualify for a given rating. One possible solution would be for users, rather than issuers, to pay for ratings, but the coordination or free-rider problem among investors would make such a change very difficult to achieve. A more practical modification would be to limit the degree to which rating agencies can be paid to consult on the structure of a product to be rated, acknowledging that sellers could still use their experience to attempt to structure according to ratings criteria.³

An issue that is at the heart of this debate is the extent to which ratings convey useful information to investors (and how investors use that information). While there is, understandably, a strong demand for simplicity, in many cases summarising all the relevant risk information in a single rating is too simplistic. Mechanisms need to be found to present investors with more complete information, without undermining the very useful role rating agencies can play in overcoming information asymmetries. This additional information could include the robustness of models typically used to rate structured finance products, and the sensitivity to external parameters, including changes in the economic environment.

One way in which ratings might become less simplistic is through the introduction of different ratings scales for different asset classes, such as structured finance products or corporate bonds. More useful still might be multi-dimensional ratings. For example, ratings could consist of both a letter rating (AAA, AA, etc) and an indicator that makes the distinction between the probability of default and the expected loss given default, or an indicator that summarises the transition probability matrix, thereby providing information about the likelihood of the asset suffering multiple notch downgrades. There have been several suggestions along these lines over the past year (see, for example, CGFS 2008b; IOSCO 2008; SEC 2008) and comments by the rating agencies (Fitch Ratings 2008; Moody's 2008). For structured finance products, these aspects of risk are much more critical than for standard corporate or government bonds which have generally been served well by a simple letter rating scale.

4.3 Market Design

A third possibility is for the trading in some derivatives and securitised assets to move from OTC markets to exchanges (see, for example, Cecchetti 2007; Alexander 2008). As discussed above, the nature of OTC markets may accentuate the problems of asymmetric information, especially at turning points, leading

³ See IOSCO (2008) for a proposal along these lines.

to sharp reductions in liquidity when conditions unexpectedly change. Several features of exchange-traded markets reduce or eliminate risks that exist in OTC markets, making them potentially more robust. One of these is that settlement typically occurs through a central counterparty. This means that instead of buyers and sellers having counterparty risk with other market participants, the risk is to a highly rated, and in many cases regulated, entity. As a result, concerns about counterparty risk which have contributed to reduced liquidity in many markets in the past year are largely obviated. Having assets traded on an exchange also increases price transparency, so that even in periods of increased uncertainty, market participants are more likely to know where the market price is and so this source of information asymmetry is avoided. The observability of the price can also reduce uncertainty elsewhere because marking assets to market is simpler, which, for example, would reduce information asymmetry about financial institutions' balance sheets.

There are other benefits of exchange-traded markets over OTC markets in that there are lower settlement and legal risks, lower transaction costs, and potentially greater liquidity through participation by a wider range of investors.

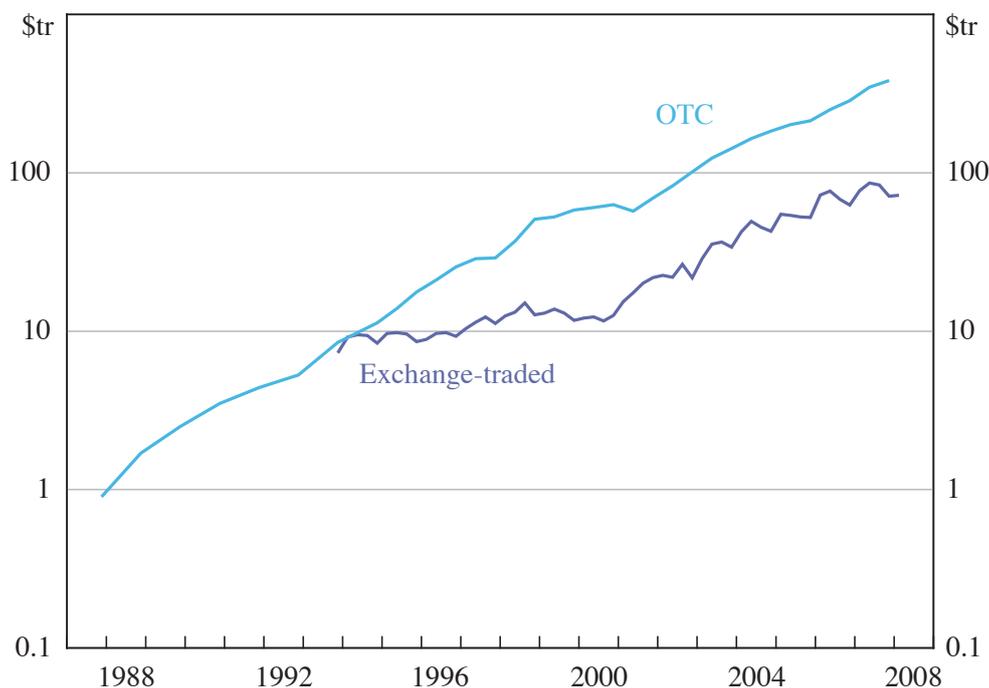
Often new financial products start out with diffuse characteristics, but over time evolve into having more standard features, making them more suited to being exchange-traded. This migration can, however, be quite difficult, requiring overcoming legal and market frictions, and the incentive that some institutions may have to retain OTC trading, where profit margins might be higher. Given these difficulties, there may be a case for regulatory policies to play a role in encouraging exchange-traded markets.

One relatively new product, which in many cases has become fairly standardised and thus suited to being exchange-traded, is the CDS. However, to date, attempts by several exchanges to list credit default derivatives have been unsuccessful.⁴ One guide for how credit derivatives could evolve is the development of interest rate derivatives, which have a longer history. As Figure 2 shows, OTC markets in these derivatives grew much more rapidly through the 1990s than the exchange-traded markets. This partly reflected the fact that interest rate derivatives were still evolving reasonably quickly and there was considerable innovation. In contrast, in more recent times – as the products have become more standardised – the two market types have seen similar growth rates.⁵

⁴ Attempts by several exchanges in the United States (CME, CBOT and CBOE) and Europe (Eurex) to list credit derivatives have been unsuccessful because of a lack of support from market participants.

⁵ The levels of outstanding derivatives in OTC and exchange-traded markets cannot be directly compared as exchanges have netting whereas the outstanding value in OTC markets is a gross figure.

Figure 2: Interest Rate Derivatives
Amounts outstanding, log scale



Sources: BIS; International Swaps and Derivatives Association, Inc

A transition from OTC to exchange-traded markets is obviously not universally possible, nor desirable, given the customised features of many financial assets. For these assets, improvements in clearing and settlement procedures can bring some of the benefits that come from exchange-based trading. In particular, it is important that the post-trade arrangements encourage the matching and clearing of trades on the trade date, or as soon as is practicably possible. The establishment of the Depository Trust Clearing Corporation's (DTCC's) Trade Information Warehouse in the United States has been a useful step forward in this regard, particularly for credit derivatives. Moreover, the use of central counterparties need not be restricted to exchange-traded markets. Indeed, there is a strong case for the use of such arrangements for a variety of OTC markets. On this front there have been some positive developments in recent months. DTCC and the Clearing Corporation (CCorp) have agreed to provide central counterparty services for some OTC credit derivatives, using DTCC's Trade Information Warehouse and the central counterparty services of CCorp.⁶ There is a good chance that a central counterparty will become a feature for some OTC credit derivatives; at a recent meeting hosted by the New York Fed, industry participants and regulators agreed

⁶ Initially CCorp will act as a central counterparty for US index trades, but it has plans to expand to cover other CDS products. The announcement is available at <<http://www.clearingcorp.com/press/pressreleases/20080528-dtcc-cds.html>>. See also Alexander (2008). For earlier discussion, see Ledrut and Upper (2007).

to support a central counterparty for CDS (see FRBNY 2008). However, there are notable challenges to overcome in developing a functional central counterparty, not the least of which is determining how to value bespoke credit derivatives in order to set margins.

One means of facilitating more products to trade on exchanges, and also directly reducing information asymmetries, is to increase the standardisation of the structure of various financial assets. Increased standardisation can concentrate liquidity, making the market more robust to shocks that would otherwise tend to cause liquidity to dry up. For RMBS, one possibility is for an exchange or another entity to set and monitor ‘qualifying’ standards, with RMBS that meet these standards being traded on an exchange. It is also possible to imagine continuous disclosure requirements being placed on the entity managing the underlying assets.⁷ In a sense, such arrangements would make the processes and infrastructure for trading of a variety of structured debt products more like those currently widely used for equities.

4.4 The Way Forward

There is little doubt that further steps along the lines discussed above could, and should, be taken to reduce existing information asymmetries and to improve market infrastructure. The main challenge is to develop arrangements that work not just in good times, but in bad times as well. Particular attention needs to be paid to ensuring that the integrity of information and the smooth functioning of infrastructure are not impaired when credit conditions or market sentiment deteriorates. Simply developing arrangements that add to the amount of information in good times, but that do not hold up in turbulent conditions may actually increase the probability of systemic liquidity problems.

It is, however, important to be realistic about what can be achieved in this dimension. The recent market strains are the end result of a long boom in the financial sector, underpinned by generally favourable economic conditions. During that boom – as has been the case in almost all preceding booms – investors and institutions simply did not pay enough attention to counterparty risks and the information that was available, applying an overly optimistic lens when looking to the future. This inherent excess optimism during the boom, followed by a period of pessimism when the risk built up during the boom materialises, is endemic and drives the procyclicality of the financial system. It means that simply providing

⁷ While not advocating a move to exchange trading, the American Securitization Forum has recently proposed standardising disclosure for RMBS to facilitate comparison of different securities and publishing monthly information on the performance of RMBS loan pools. See ASF (2008).

more information and improving market infrastructures is unlikely to be enough to address the liquidity problems that can emerge at the end of a long boom.

One consequence of this is that financial institutions and policy-makers need to consider other ways of reducing the probability of such problems emerging and dealing with them when they do emerge. These issues are addressed in the following sections.

5. An Increase in Holdings of Liquid Assets

In the various assessments of the recent credit market turmoil, a frequent conclusion has been that financial institutions and supervisors did not pay enough attention to liquidity risk. FSF (2008), for example, lists a number of shortcomings in liquidity management. These include banks: not adequately planning for system-wide stress; not adequately considering the links between market liquidity, funding and credit risk; and not anticipating the need to honour committed lines of credit or the need to provide financing to clients in order to protect their own franchise value.

Essentially, these reviews are arguing that banks have held too few liquid assets, or assets of unpredictable liquidity, and have under-priced the provision of liquidity services to their customers. It is difficult to argue with this conclusion, as it now seems clear that, over recent years, proper liquidity management slipped off the radar screen for many financial institutions. A number of recent reports have pointed to the way forward here, including the more extensive use of stress tests, the development of robust contingency funding plans, and the need to allocate appropriate liquidity to all business lines (see, for example, BCBS 2008; IIF 2008; IMF 2008). Financial regulators are likely to have a role to play in achieving progress on a number of these fronts, as private institutions are unlikely to fully internalise the benefit to the system as a whole of maintaining high levels of liquidity.

This points to important questions that do not seem to have attracted the attention that they deserve: that is, to what extent financial institutions should be required to fully 'self-insure' against system-wide liquidity problems, and to what extent the public sector should assist when such problems emerge. In raising these questions, we want to make it clear that, in most cases, institutions should be able to deal with idiosyncratic liquidity problems, without any assistance from the public sector. Furthermore, institutions need to be able to deal with significant disruptions to asset markets and to their funding sources. But full self-insurance against generalised and widespread disruptions could come at a significant cost to both financial institutions and the economy more broadly. As a very rough illustration, suppose that such insurance required institutions to hold an extra 10 per cent of their balance sheets in highly liquid, high-quality assets, and that the

expected return on these assets was 1 percentage point lower than the alternative. This type of portfolio shift would reduce the banking system's return on assets by 0.1 of a percentage point, and the return on equity by around 2 percentage points. Institutions might then be expected to increase their lending margins, which in turn might lead to a lower stock of capital in the economy and less output than might otherwise be the case.⁸ In addition, if financial institutions had to fully self-insure they might not be prepared to provide as much long-term funding as is currently the case. The issue is whether some insurance by the public sector is a better way to deal with these problems than financial institutions having to deal with them alone.

The extent to which financial institutions insure against system-wide liquidity problems is a current issue in Australia, as it is in many other countries. Over recent decades, the Australian banking system's holdings of 'liquid' assets have fallen significantly as a share of their aggregate balance sheet. In the 1960s, around 30 per cent of the banks' total assets were held in government securities, and a further 8 per cent were held on deposit at the Reserve Bank of Australia (RBA) (although the vast bulk of these assets were held to meet regulatory requirements and so were not available for short-term liquidity purposes). Today, government securities account for just 0.5 per cent of total assets, and deposits at the RBA account for a further 0.2 per cent. This decline reflects both regulatory changes and a reduction in the supply of government securities on issue.⁹

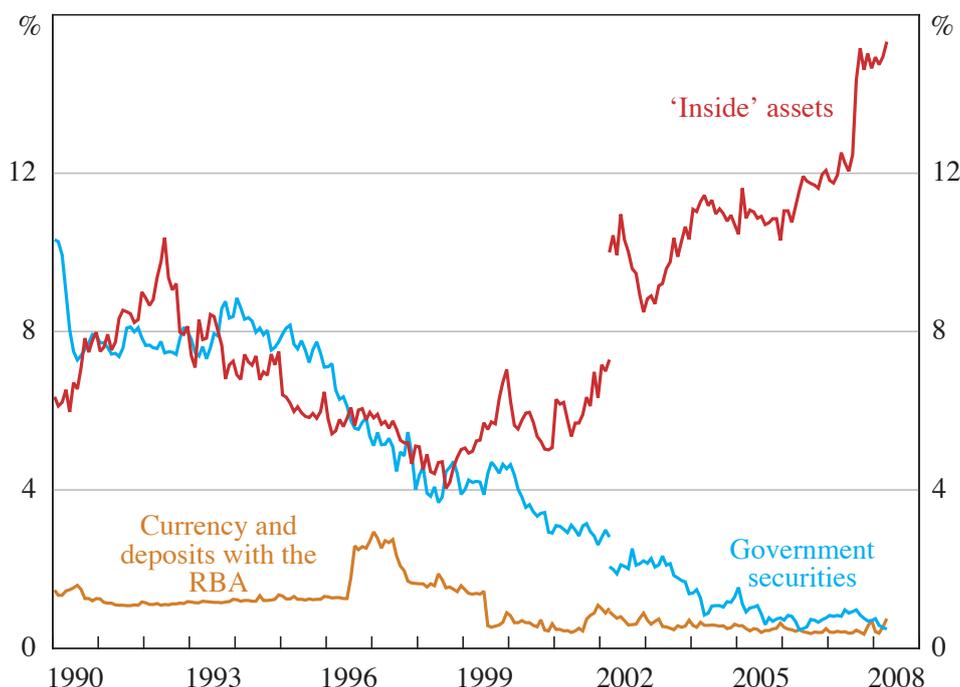
A related feature of the Australian environment is that around 90 per cent of the Australian banking system's liquid assets are 'inside assets', by which we mean the liabilities of other financial institutions (Figure 3). As at May 2008, these assets accounted for around 15 per cent of the system's domestic assets, which is up from 12 per cent a year earlier. When the strains first developed in financial markets in August/September last year, the banks' demand for liquidity increased significantly and, in response, they issued securities to one another, allowing each to record an increase in their liquid assets. Of course, at the same time, the banks' short-term liabilities also increased. This heavy reliance on inside assets is unusual by international standards. In the United States, for example, banks' holdings of such assets account for around 6 per cent of their total assets, with securities issued by the US government and federal agencies accounting for a higher 14 per cent.

This reliance on inside assets poses some challenges for dealing with system-wide liquidity problems, particularly if those problems are associated with

⁸ Of course, if the cost of funding was reduced for an institution that held more liquid assets, the effect would be less than outlined here.

⁹ See Grenville (1991) for a discussion of these changes.

Figure 3: Banks' Liquid Assets
Per cent of domestic assets



Note: Break in series due to change in reporting requirements in March 2002

Source: APRA

system-wide credit quality concerns (which has not been the case recently). There are, however, simply not enough 'outside assets' in Australia for banks to hold the bulk of their liquid assets in securities issued by entities other than banks. Currently, the total stock of outstanding Commonwealth Government bonds is around \$55 billion, with another \$70 billion of state government bonds, and \$45 billion of supra-national debt. This is in comparison to the total liquid assets of the banking system of around \$350 billion.

Reflecting these developments, the RBA has, over the past decade, broadened the range of assets it will accept in repurchase agreements ('repos') to include securities issued by financial institutions. This has substantially increased the stock of securities that the RBA will accept under repo in its market operations. In comparison to a situation in which banks hold their liquid assets in outside assets, this potentially exposes the RBA to more risk; however, this increase in risk is limited by the fact that in the normal course of operations, banks are not able to sell their own or related securities to the RBA under repo.

In the following section we discuss in further detail the various ways in which the public sector can help deal with system-wide liquidity problems, including by providing some form of liquidity insurance or other services to the private sector.

6. The Provision of Systemic Liquidity Services by the Public Sector

To some extent, liquidity can be considered a public good. As discussed above, it is possible that social welfare is improved if financial institutions do not have to fully self-insure against system-wide liquidity problems. Indeed, in some situations it may be almost impossible for them to do so, particularly if there is only a limited supply of outside liquid assets.

If the public sector is going to play a role in providing ‘systemic liquidity services’ to the private sector, there are a number of channels through which this can be done, including:

- the central bank’s open market operations;
- the outright purchase of assets where liquidity is a problem;
- the provision of liquidity assistance to an institution experiencing funding difficulties; and
- assisting with off-market transfers of assets.

Each of these is discussed in turn below. The following section then discusses some of the conditions that might apply to the provision of these services.

6.1 Open Market Operations

A basic function of a central bank is to manage the supply of settlement balances or reserves to ensure that the relevant interest rate (typically, an overnight money market rate) is close to the target level set for the purposes of monetary policy. The way in which this is done can have significant implications for how financial institutions manage their own liquidity, and for the liquidity characteristics of various assets. Through its open market operations, the central bank can create assets with unquestionable liquidity for the financial sector to hold, and by deeming assets as eligible for market operations, it can reduce illiquidity premia that apply to those assets. Market operations can also affect the maturity structure of banks’ liabilities and can be used, under some circumstances, as a channel to provide funding to institutions suffering temporary liquidity difficulties.

It has become commonplace for central banks to conduct these operations primarily in repos. Doing so makes it possible to undertake operations in a wide range of assets without taking on a high level of risk, since for a loss to occur, the central bank’s counterparty would need to fail, and the value of the underlying asset would need to fall significantly. Many central banks, however, also still use outright transactions to inject or withdraw cash from the system, although these operations are largely restricted to assets of the highest credit quality that trade in very liquid markets, typically government securities.

6.1.1 Accommodating an increase in the demand for liquid assets

As we have seen recently, during a period of strain in financial markets, the demand for assets of unquestionable liquidity increases significantly. The central bank is ideally placed to respond to this increase, as it is in the unique position of being able to create such assets easily. It can do this by buying other assets from the private sector and, in exchange, providing institutions with the most liquid asset of all – a deposit at the central bank. If this is done through a repo, the incremental risk to the central bank need only be small.

In effect, such operations – which involve an expansion of the central bank’s balance sheet – allow private institutions to improve the liquidity characteristics of their own portfolios; while the assets that are sold to the central bank may themselves normally be traded in liquid markets, there is always the possibility that some disruption to these markets will reduce their liquidity in times of stress. This possibility does not exist with central bank balances.

This type of expansion in the central bank’s balance sheet is more likely if the central bank pays a close-to-market interest rate on deposits. If interest is not paid, there can be a high opportunity cost for financial institutions of holding large balances, so that if the supply of these balances increases significantly, the overnight interest rate is likely to fall below the central bank’s target as institutions seek to lend these balances. An expansion is also more likely to occur in countries where the supply of ‘outside’ liquid assets is limited, since if system-wide credit quality concerns emerge, the demand for ‘inside’ assets is likely to decline significantly, with central banks’ balances being the main alternative very liquid investment.

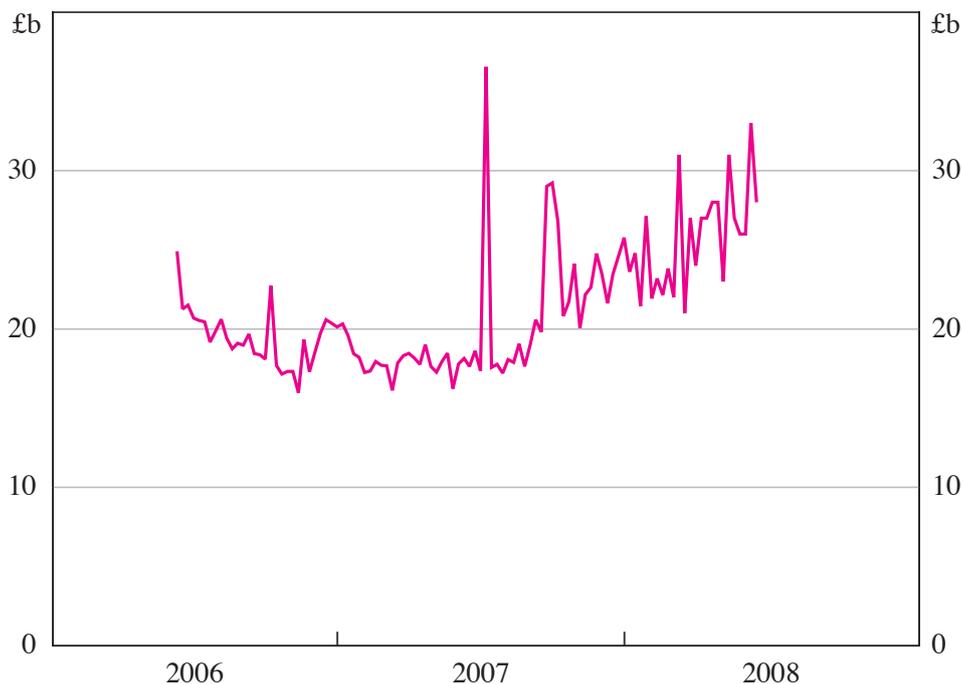
The central bank can also accommodate an increase in demand for liquid assets by altering the structure of its own balance sheet (without changing its size). In particular, it can reduce its own holdings of assets that are highly liquid (primarily government securities) and, in exchange, increase its holdings of assets that are less liquid.

Arguably, during periods in which liquid assets are very highly valued (forcing down the relative yields on these assets), it makes little sense for the central bank to hold the most liquid assets in the financial system. Provided the risk issues can be addressed, the central bank can play a type of smoothing role, by being prepared to reduce its own holdings of the most liquid assets at the very time that the private sector most values these assets. It is important to stress that, in playing this role, the central bank is in no sense bailing out banks, or funding the balance sheet expansion of the banking system. It is simply reducing its own call on the assets with the most favourable liquidity characteristics at a time when the private sector most values liquidity. In doing so, it can help reduce

the amplitude of swings in the price of liquidity, and it can do so without taking significant risks.

Over the past year or so, many central banks have responded in this way, expanding their balance sheets and/or changing the composition of their assets.¹⁰ The exact details have, to a significant extent, depended on institution-specific factors, including the composition and size of the central bank's balance sheet, the assets accepted in open market operations, and whether interest is paid on balances at the central bank. For example, reserve balances at the Bank of England rose from an average of around £20 billion in the first half of 2007, to an average of around £26 billion over the past six months (Figure 4). Similarly, in Australia, the banking system's balances at the RBA have also risen, from a daily average of around A\$0.8 billion in the first half of 2007, to a peak of almost A\$7 billion in December 2007 (Figure 5).¹¹ Early on in the current episode the RBA also reduced its limited holdings of Commonwealth Government securities held on an outright basis, as well as both its government securities held under repo and its US dollar assets held under swap arrangements (Figure 6). At the same time,

Figure 4: Reserve Balances at the Bank of England

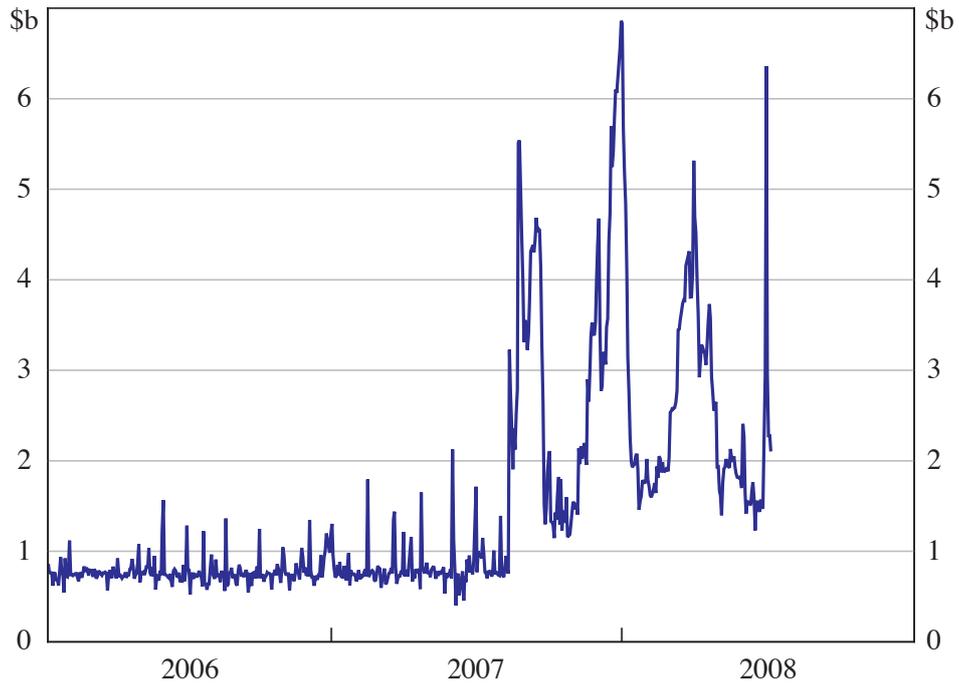


Source: Bank of England

¹⁰ See Borio and Nelson (2008) and CGFS (2008a) for a discussion of recent changes in central bank operations, DeBelle (2008) for more detail on Australia, and Hilton (2008) for more detail on the United States.

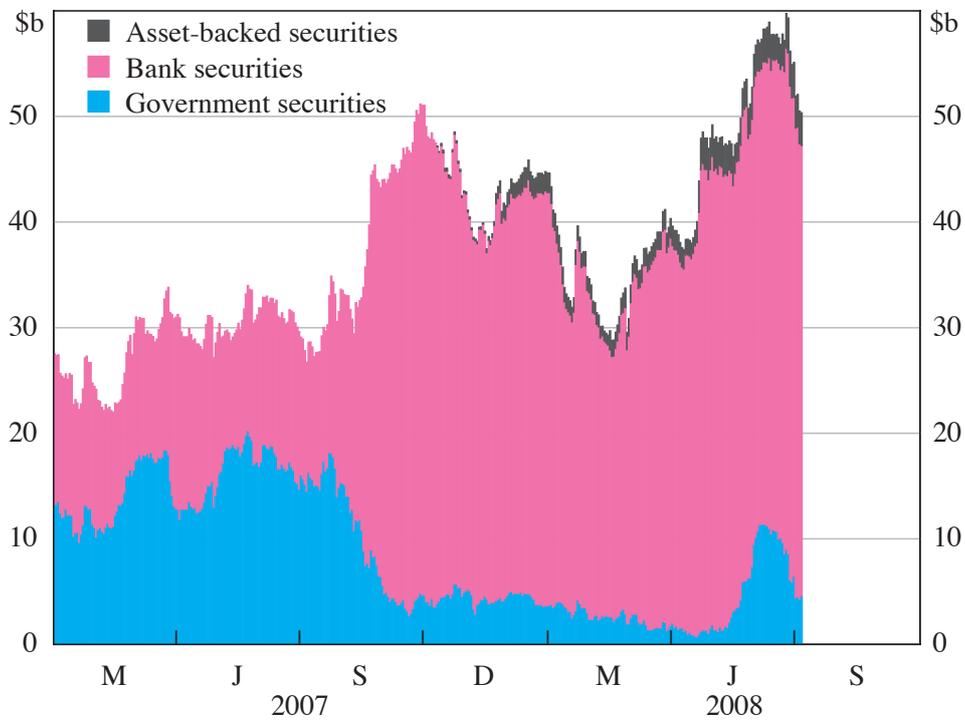
¹¹ In both the United Kingdom and Australia, interest is paid on balances at the central bank. In the United Kingdom, it is paid at the policy rate for reserves within the threshold around the reserves target. In Australia, the interest rate paid is 25 basis points below the target cash rate.

Figure 5: RBA Exchange Settlement Balances



Source: RBA

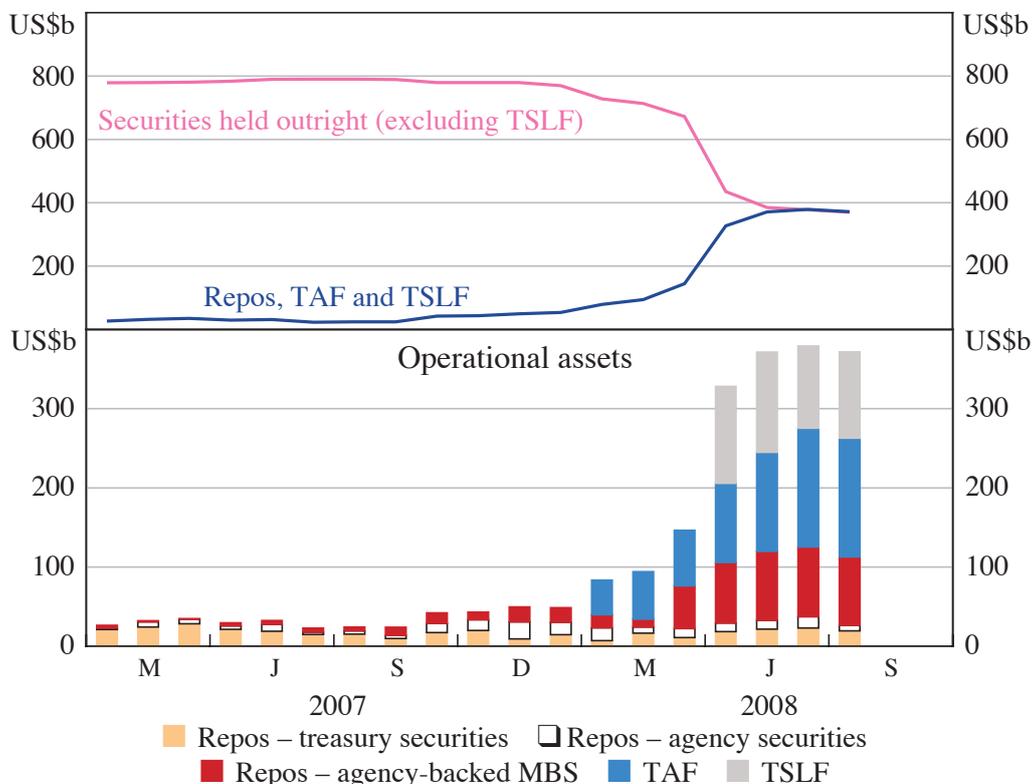
Figure 6: RBA Repo Assets



Source: RBA

the RBA increased its holdings of bank-issued paper held under repo. In the United States, there has also been a significant change in the structure of the Fed's balance sheet, with a large decline in the Fed's holdings of government securities held outright and an increase in the value of agency-backed mortgage-backed securities held under repo (Figure 7). With the introduction late last year of the term auction facility (TAF), there has also been a very large increase in the Fed's holdings of the wide range of relatively illiquid assets that banks pledge for use at the discount window. The Fed and the Bank of England also introduced facilities allowing banks to swap assets that were not particularly liquid for highly liquid government securities (the term securities lending facility, TSLF, for the Fed).

Figure 7: Federal Reserve Assets



Sources: Board of Governors of the Federal Reserve System; Federal Reserve Bank of New York; Thomson Reuters

6.1.2 *The choice of assets eligible for a repurchase agreement*

A related issue that has attracted considerable attention is the range of assets that the central bank is prepared to purchase under repo.

As recent experience illustrates, during a period in which conditions are strained, financial institutions have a strong preference to hold assets that can be used in operations with the central bank. This partly reflects a concern that other assets

may not be easily sold in the private market if the institution needs funds at short notice. By making an asset eligible for repos, the central bank can reduce the (illiquidity) premium that might otherwise be needed to induce investors to hold that asset. Increasing the range of eligible assets is also likely to give institutions greater confidence that should liquidity pressures emerge, they have appropriate assets to undertake operations with the central bank.

Historically, in many countries, including Australia, the list of eligible assets has been relatively narrow. The logic for this was that the central bank simply did not need to accept a wide range of assets to conduct its markets operations effectively, and/or that accepting assets other than of the highest credit quality exposed the central bank to an unacceptable degree of risk.

One alternative to this historical view is that, in principle, all assets on the balance sheets of financial institutions should be eligible, subject to the risks to the central bank being adequately addressed. By accepting all assets, illiquidity premia that exist because of a lack of market infrastructure or market turmoil would be reduced, and the banking system would be less susceptible to liquidity crises, with both effects potentially increasing welfare. According to this perspective, the risk issue is best addressed, not by the central bank refusing to deal in some asset classes, but by setting appropriate haircuts, advancing fewer funds against more risky assets.

Some central banks have gone a considerable way towards adopting this approach. Since the onset of the turmoil the central banks that had a relatively narrow range of eligible assets for their regular operations, including the Fed, have tended to widen the range, joining the European Central Bank and the Bank of Japan which already had very broad ranges of eligible collateral. At a practical level, one concern with accepting any assets under repo is that it can be very difficult to value illiquid assets, and to determine the true nature of the risks, especially where information asymmetries are acute. This can make setting appropriate haircuts very difficult. One possible response to this uncertainty would be to apply ultra-conservative haircuts to hard-to-evaluate assets, although this may undermine any benefit that might otherwise be gained from making these assets eligible for repos. Furthermore, within a class of illiquid and difficult-to-value assets with idiosyncratic properties – typically non-traded assets such as loans – there is the potential for a ‘lemons’ problem if a common haircut is applied. Within such an asset class, it would be possible that the central bank would only be presented with inferior assets for which a sizeable haircut was effectively less punitive.

A related issue is whether assets that have been either originated or sponsored by an institution (say its housing loans) should be accepted under repo from that institution. The main concern here is that taking such assets as part of normal

market operations can increase the risk to the central bank, as the ‘double protection’ that arises from conducting repos in third-party, or non-related, assets is significantly reduced. Doing so may also lead to financial institutions reducing their holdings of other liquid assets, while accepting assets from the institution that originated them may crowd out secondary markets because it reduces the incentive for originators to stimulate markets for those assets.

Again, an in-principle case could be made to take such ‘related’ assets, subject to appropriately calibrated haircuts. Doing so would seem less problematic if the lemons problem could be reduced, say through some combination of credit quality conditions on the loans or the loans being securitised and rated. This approach can be used to overcome, to a significant extent, the information asymmetries that might otherwise arise from taking mortgages directly from an institution, particularly where the central bank does not have the expertise, or in a crisis, time, to evaluate the quality of those mortgages. The RBA has adopted a variant of this approach for banks to have access to additional securities that they can use to obtain liquidity from the RBA in a period of turmoil. Here the RBA will accept only the AAA tranche of a securitisation of an institution’s own *prime* mortgages. The Australian Prudential Regulation Authority has indicated that these so-called ‘self-securitisations’, of which banks have constructed \$53 billion in the past six months, should not be substitutes for financial institutions’ holdings of more conventional liquid assets.

6.1.3 *The maturity of repos*

Another aspect of market operations that has drawn attention is the maturity of these operations.

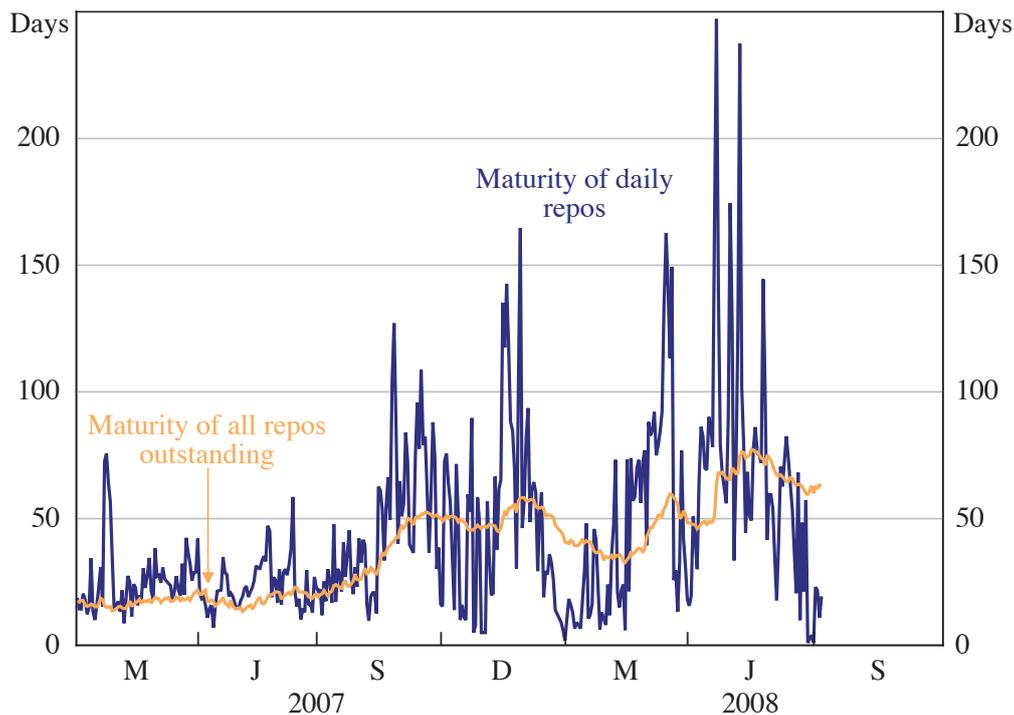
If, at one extreme, the central bank undertakes all its operations in overnight repos, the banking system is required to sell securities to the central bank each and every day, buying them back the next. In this world, an institution that sold securities would get cash only overnight, and would then need to bid again in the open market operations with other institutions the following day. In the event that this institution was unsuccessful on the second day, it might need to arrange a repo (or another transaction) with a private counterparty to obtain the funding it was seeking. If market conditions are unsettled, this may be difficult or costly. To the extent that institutions are concerned about this possibility, they are likely to be less willing than otherwise to provide term funding to their clients.

In contrast, if the central bank conducts longer-term repos, say for a maturity of six months, repo turnover is reduced, but institutions that sell securities to the central bank obtain cash for a longer period, thus reducing their rollover risk. At the margin, this may promote term funding. Similarly, conducting longer-term

repos may encourage institutions to purchase longer-term securities in order to repo to the central bank, reducing term premiums. Also, as discussed above, to the extent that repos are used by institutions to substitute less-liquid assets for more-liquid assets, the benefit of doing so is likely to be greater if the substitution is in place for a longer time.

Not surprisingly, given the benefits of undertaking longer-term repos at times when illiquidity premiums are high, most central banks have responded by increasing the maturity of their operations. In Australia, the RBA has long had a flexible approach, and has avoided having fixed maturities. Recently, it has used this flexibility to extend the average maturity of its outstanding repos from around 20 days over the first half of 2007, to around 75 days in May this year (Figure 8).¹² The average maturity of repos in other countries tends to be shorter than that in Australia, although in almost all cases it has increased over recent times (Figure 9).

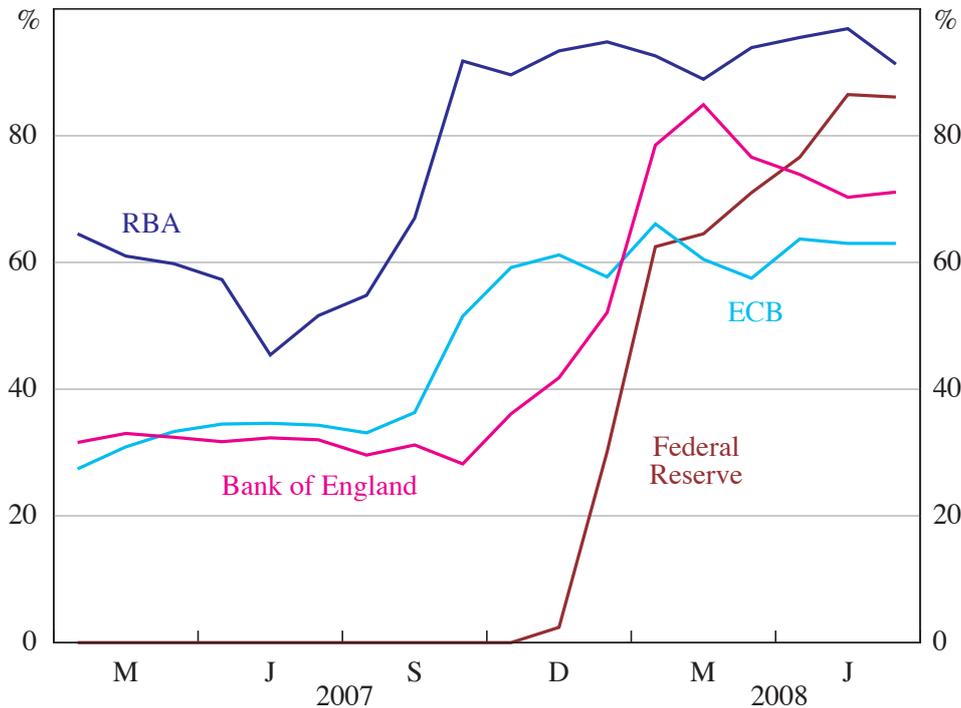
Figure 8: Average Maturity of RBA Repos



Source: RBA

¹² The longest single maturity has been 365 days.

Figure 9: Long-term Repos
Share of total repos



Notes: Long-term repos are 28 days or more; includes the TAF for the Federal Reserve

Sources: Thomson Reuters; central banks

6.1.4 Provision of funding to an institution experiencing difficulties

Finally, while a central bank's market operations are typically thought of as dealing with *system-wide* liquidity issues, they can also address liquidity strains being experienced by an individual institution. In particular, an institution having difficulty funding itself in the market is able to bid aggressively for funds in the central bank's operations, providing it has appropriate assets to repo. It might do this if the private repo or outright markets in the relevant assets have been disrupted or, for some reason, market participants do not want to take any counterparty exposure to a troubled institution, even by way of a well-secured repo. For this to be a practical option, the central bank would have to conduct open market operations frequently, preferably daily, so that a troubled institution does not have to wait to access funding.

There is, however, a limit to the extent to which market operations can be used in this way, as the size of daily operations is often relatively small compared to the funding requirements, particularly of a large bank. Furthermore, an institution that bid very aggressively for large volumes of funds over a number of days might expect to attract follow-up inquiries from the central bank and/or prudential supervisor, and to the extent that its activities become known, this has the potential to heighten market concern.

6.2 Direct Transactions in Markets

A second possible way in which the public sector can address liquidity issues is to purchase assets outright. This can be done by either the central bank or another public sector body.

This idea is sometimes seen as being quite controversial, although it has been applied to the foreign exchange market on numerous occasions. In particular, central banks (including the RBA) have been prepared to intervene in the foreign exchange market to provide two-way liquidity, and have also intervened when the value of the domestic currency was judged to be inconsistent with its fundamental value.¹³ Similar intervention in other asset markets is rare, although in Hong Kong the authorities purchased equities during the late-1990s Asian financial crisis.

In principle, the same logic that has been used to justify direct purchases or sales of domestic currency for foreign currency could be used to justify direct purchases of other assets. If an asset market lacks two-way liquidity, or prices have moved far from fundamental value, a case could be made that the public sector should step in. Indeed, in Australia, two proposals have argued recently that an entity sponsored by the Australian Government should be prepared to acquire highly-rated home loans/RMBS if funding conditions in the mortgage market are severely disrupted.¹⁴ Similar arguments have been made by Buitert and Sibert (2007) in an international context.

This type of direct intervention can, however, expose taxpayers to considerable risk, distort the operation of markets in allocating resources, and potentially delay the recovery of the secondary market. Given this, there would seem to be a strong case to consider such intervention only if:

- the lack of liquidity, or misalignment in prices, was likely to have first-order adverse effects on the macroeconomy;
- the lack of liquidity, or misalignment in prices, was the result of some clear market failure, and was not likely to be rectified in a timely way; and
- any intervention was not likely to materially distort the pricing of similar assets or affect the structure of the market in normal times.

If applied, these criteria would significantly restrict the types of assets for which intervention might be considered. They would almost certainly rule out purchases of assets with idiosyncratic features and where there were large information asymmetries. The most likely candidates are perhaps mortgage-backed securities and other high-quality bonds, although even here the likelihood of the above criteria

¹³ For a discussion of the RBA's intervention in the foreign exchange market see Becker and Sinclair (2004).

¹⁴ See Joye and Gans (2008) and Australian Securitisation Forum (2008).

being satisfied would appear to be quite low. Notwithstanding this assessment, it is possible that situations arise where the outright purchase of financial assets is in the public interest. *In extremis*, the public sector, with its long-time horizon and large balance sheet, may be able to play a role in providing necessary liquidity to key asset markets, and to limit the consequences of severe market disturbances driving asset prices a long way from their fundamental value.

6.3 Emergency Liquidity Assistance

A third possibility is to provide an explicit loan to a solvent, but troubled, institution; this is typically known as ‘emergency liquidity assistance’ or lender-of-last-resort (LOLR) loan. While no such loans have been made in Australia for many decades, emergency liquidity assistance was recently provided by the Bank of England to Northern Rock, and by the Federal Reserve Bank of New York to Bear Stearns/JPMorgan Chase.¹⁵

This type of liquidity support can expose the public sector to considerably more risk than that incurred through market operations. Not only is the value of any collateral likely to be more uncertain (as the standard assets used for repos will have been exhausted), but the ‘double protection’ offered by repos in third-party assets does not apply. Moreover, liquidity problems will almost certainly reflect market concerns about the ongoing ability of the institution to repay its liabilities. While in some cases such concerns may be unfounded, in others they may have some basis in fact. Finally, as evidenced by Northern Rock, if the liquidity support is extensive, the need to repay the loan can be a major impediment to the institution remaining in the hands of the private sector.

Despite these considerable difficulties, such support might be justified in some circumstances. This is particularly the case if the troubles reflect the breakdown of markets and an extreme increase in risk aversion. If an institution clearly has significant positive net asset value, yet cannot fund its liabilities because of severe dislocation in markets, the central bank can play a stabilising role, preventing a fire sale of assets and perhaps a loss of confidence in the system as a whole.

Under some scenarios, there is likely to be a connection between the degree of flexibility in the central bank’s market operations and the probability that a troubled institution will need to seek emergency liquidity support. In particular, the more flexible are market operations – in terms of frequency, volumes, maturities and acceptable assets – the more likely it is that an institution with assets eligible for repos will be able to exchange those assets for liquidity in the course of normal market operations when the need arises. Indeed, an argument for flexibility in

¹⁵ For a history of ‘emergency liquidity assistance’ in Australia see Fitz-Gibbon and Gizycki (2001). For a more recent discussion on the lender of last resort see Stevens (2008).

regular market operations is that it can avoid the non-linear effects – partly due to adverse effects on public confidence – that can arise when an institution is known to have sought support.

Flexibility in market operations is, however, not without risks. In particular, if the liquidity problems reflect the poor health of the institution, which is seen by the other market participants, then it is possible that flexible market operations might allow the institution to delay the action required to correct its problems, thereby increasing losses if the institution does ultimately fail. This possibility means that in times of strain, close cooperation is required between the central bank and the prudential supervisor.

Finally, given the flexibility that many central banks now have in their market operations, it is highly likely that an institution requiring an emergency loan will have very serious balance sheet problems. Hence, an emergency loan is perhaps best thought of as a bridging loan while new ownership is arranged, or the institution is fundamentally restructured. LOLR might then be thought to stand for ‘lender of last rights’. In today’s world it seems unlikely (although not impossible) that an institution would be granted emergency assistance for a short period of time, repay that loan, and then continue as normal. To the extent that emergency assistance is really bridging finance, there is a strong case for it to be accompanied by a credible plan for private-sector support or recapitalisation (Bear Stearns), or some form of government support or recapitalisation (Northern Rock). In either case, the management and shareholders would be expected to incur very significant losses.

6.4 Assisting Off-market Transfers

A fourth way in which liquidity issues could be addressed is through assisting with the off-market transfer of assets.

As noted in Section 3, the failure of a financial firm with extensive activities in financial markets raises concerns, not just because of the direct counterparty exposures, but also because of the potential cascading effects through financial markets. The fear is that many markets are simply not deep enough to deal with the rapid closing-out of positions and the flow-on effects from margin calls that would likely follow a failure. In the event that an institution with extensive operations in markets was forced into liquidation, the potential flow-on effects could undermine the stability of the financial system.

While these concerns are widely held and appear to be soundly based, it is important to note that this scenario has never played out in practice, with no major participant in financial markets having been forced into liquidation. This lack of experience makes it difficult to assess exactly what might happen in the event of

such a failure. Notwithstanding this, a reasonable question is how policy-makers should respond to this possibility (over and above providing general liquidity to the market and ensuring that the overall regulatory framework is sound).

It can be argued that these distressed situations are best dealt with by a measured selling-down of positions, rather than an immediate sale in turbulent conditions where information asymmetries are likely to be acute. In some situations such an outcome might be able to be organised by the private sector, either by a single institution, or group of institutions, purchasing the positions off market, at a substantial discount. The public sector may be able to play a useful role here, particularly if coordination issues among the troubled institution's counterparties prevent an effective solution that is in their collective interest.

A more difficult problem emerges if a private buyer cannot be found quickly. One option here would be for the public sector to purchase the assets/positions and then sell them over time when conditions are more settled; the Fed's approach to Bear Stearns can be seen in this light. The argument for such an approach is that it might avoid a fire sale of financial assets that could prejudice the stability of the overall financial system. Furthermore, provided that the assets/positions are bought at a substantial discount to current value, the purchase may deliver a favourable risk-adjusted return to the public sector.

Such actions are, however, not without considerable risks. Not only is there the obvious risk that the assets may ultimately be worth less than the price that the public sector paid, but the possibility of such actions may change the behaviour of the private sector. In addition, when decisions have to be made very quickly, a type of game can develop between the public and private sectors, particularly if the private sector believes that the public sector will go to considerable lengths to protect the stability of the financial system. This game may lead to the public sector paying more for the assets than is desirable.

These are difficult issues to resolve, but as financial markets continue to grow, ways need to be found to allow large participants in these markets to exit without causing instability in the rest of the system. As discussed earlier, improving the financial infrastructure can be helpful here, but mechanisms also need to be found to prevent the fire sale of financial assets and limit the build-up of problems in the first place.

7. Policy Discussion

It is clear that liquidity problems can have significant effects on the financial system and the real economy. It is equally clear that there is no single solution to addressing these problems. Reducing information asymmetries and improving market infrastructure have an obvious role to play. An improvement in the way

that institutions manage their own liquidity is also required. Further, at the supervisory level, attention needs to be paid to the potential for system-wide liquidity problems, and not just problems that are restricted to a single institution. Central banks (and possibly other public sector bodies) also have an important role to play. At issue is how extensive this role should be, and what conditions should apply.

Unfortunately, too often discussions of this issue are derailed by quick references to the dangers of ‘moral hazard’. It is sometimes argued that if the public sector provides *any* form of liquidity services to the private sector, the result will be more risk-taking, and ultimately either a more crisis-prone system, or higher costs to the taxpayer.

While not wishing to downplay the risks, this argument misses a key point, namely that, while the provision of liquidity services by the public sector will undoubtedly change the behaviour of the private sector, this change in behaviour need not be welfare-reducing. If some form of systemic liquidity services are not provided, private institutions need to provide their own insurance by holding more liquid assets than would otherwise be the case. The end result may be a higher cost of financial intermediation and, in turn, a lower capital stock. Institutions may also be less prepared to commit funding for longer-term projects and more likely to cut back credit lines when troubled conditions emerge (although presumably the emergence of such conditions would be less likely). Indeed, making a credible *ex ante* commitment to provide a certain degree of liquidity assistance may actually reduce moral hazard relative to a statement that the central bank will not provide liquidity assistance. If the private sector does not believe that such a statement is credible, then it is likely to condition its behaviour on the level of liquidity assistance that it *thinks* the central bank would provide.

None of this is to imply that institutions themselves should not have responsibility for managing their own liquidity. They clearly do. Moreover, they need to be prepared for significant dislocations in the key markets in which they operate and disruptions to their normal funding patterns. Over recent years, many institutions appear not to have done this adequately, undertaking too much maturity transformation, with too little capital, and on a funding base that was much less stable than widely assumed. It is important, though, that in responding to these shortcomings there is not an overreaction the other way which requires the private sector to fully self-insure against system-wide liquidity problems. Given that, to some extent, these problems arise from underlying distortions or market failures, full self-insurance is unlikely to be consistent with welfare maximisation.

In our view there is a strong case for the central bank to play the sort of liquidity smoothing role discussed in the previous section, increasing the supply of liquid assets at a time when the market places a very high value on these assets. It

can do this by increasing the size of its own balance sheet and/or changing the composition of its assets during times of strain. While playing such a smoothing role will lead to an increase in the risk carried on the central bank's balance sheet, this increase can be limited by the use of appropriate haircuts, and the central bank will be compensated for this additional risk through higher expected returns on its asset holdings.

For this role to be played effectively, the central bank needs to have a considerable degree of flexibility in its market operations, including the frequency, maturity and scale of these operations. Many central banks have moved in this direction over the past year.

We also see a strong case for the central bank being prepared to purchase a wide range of third-party assets under repo. Doing so can reduce illiquidity premia that apply to these assets and reduce the possibility that solvent financial institutions find themselves needing to seek emergency support. One useful criterion to apply in considering where the boundary should be between acceptable and non-acceptable assets is the degree of information asymmetry, with the greater the asymmetry, the weaker the case for the central bank buying the asset under repo. In some situations, this criterion might rule out accepting assets that an institution has originated itself, or at least requiring greater protection through larger haircuts.

In extremis, there may also be grounds for the public authorities to purchase outright a very limited range of assets. However, the risk-return trade-off from such purchases is, in most cases, likely to be much less attractive than the actions discussed above. This means that the 'burden of proof' that the public sector needs to meet in justifying such intervention should be set very high. One variant of this approach is for the public sector to assist with the off-market transfer of assets of a troubled financial firm, including possibly, *in extremis*, taking assets directly onto the public-sector balance sheet and disposing of those assets gradually over time. One argument for doing this is that in some extreme situations it is in the public interest for the assets owned by a troubled institution to be sold in a measured way, rather than dumped onto markets when risk and illiquidity premia are at their highest.

As discussed above, situations can also emerge where providing a loan directly to a troubled, but solvent, institution may also be in the public interest. Over time, however, with market operations becoming more flexible, the probability of such support being used to assist an institution over temporary funding difficulties has probably declined. It is more likely that such support provides bridging finance while new ownership and management are put in place.

In supporting a role for the public sector in providing a range of systemic liquidity services to the private sector, the moral hazard concerns discussed above need to be addressed. In doing so, it is important to recognise that the relative public versus private benefits of the various liquidity services differ across these services. In particular, there is a strong public good element in the central bank to play a contrarian role when liquid assets are in high demand, and in helping reduce illiquidity premiums in financial assets. While financial institutions benefit from these services, these benefits are spread widely and are not concentrated in a particular institution. In contrast, providing a direct loan to an institution can lead to significant benefits to those associated with that institution; of course there may be also benefits to the market more generally, particularly if, in the absence of the liquidity support, the troubled institution would be liquidated, causing widespread dislocation in financial markets.

How then can the moral hazard concerns be addressed? We see three not mutually exclusive possibilities.

- i. The first is a strengthening of the macro-prudential elements of supervision.

While we have argued that there are strong grounds for the central bank to take a contrarian position in the sense we discuss above, and to assist more generally when system-wide liquidity problems emerge, there is a certain asymmetry if such actions occur only when conditions are unsettled. It is not implausible that this asymmetry itself could affect private-sector behaviour. One way of addressing this is for supervisory requirements to be tightened in the good times, when liquidity is judged to be ample and credit risk low. The case for this type of cyclical supervisory response is strengthened by the observation that system-wide liquidity problems invariably have their roots in the underestimation of risk in good times.¹⁶ If the public sector is to provide some form of systemic liquidity insurance – and inevitably accept a higher level of risk in doing so – the trade-off may be a tightening of supervisory requirements in good times. In a sense, such a tightening could be thought of as part of the ‘insurance premium’ that the private sector pays for the liquidity services that the public sector provides. It would also assist in the building-up of the system’s buffers in good times and reduce the probability of liquidity problems emerging when conditions eventually deteriorate.

- ii. A second possibility is to ensure that institutions are subject to prudential regulation if there is any possibility that the public sector might need to offer some form of institution-specific support.

¹⁶ For a fuller discussion of this option see Borio (2007) and Borio, Furfine and Lowe (2001).

Significant moral hazard issues arise if an institution is able to sit outside the regulatory net but obtain support when times are troubled. Again, submitting to prudential regulation can be part of the ‘insurance premium’ that institutions are required to pay if they are to ever obtain institution-specific assistance. There is a strong case for them to be required to pay this ‘premium’ if they are large and have complicated dealings in financial markets.

A tangentially-related issue is who the central bank should be prepared to deal with in its daily market operations.¹⁷ Where these operations are conducted in high-quality, third-party assets, the counterparty risk being run by the central bank is normally low. There is, therefore, a strong case for the eligibility requirements to be largely limited to operational issues related to the effective implementation of monetary policy. If this is the case, then a very wide range of institutions – including non-banks – can participate in market operations (as is the case in Australia). The situation is somewhat different when it comes to transactions in assets that have been originated or sponsored by the central bank’s counterparty. Accepting related assets can involve significant additional risk, and the case for doing so in the course of normal market operations appears weak. This is particularly so for an institution that is not subject to prudential regulation.

- iii. A third way of addressing moral hazard relates directly to the conditions that apply to liquidity assistance outside normal market operations.

As discussed earlier, if despite the central bank having flexible operating procedures, an institution requires emergency liquidity assistance, then that institution is probably in very significant trouble. Extending support to such an institution may be in the public interest, but it also risks providing benefits to those directly associated with the institution, including its managers and shareholders. Given this, it may be better to think of emergency liquidity support as the public sector providing bridging finance, while new ownership of the institution is being arranged. This was what essentially happened in the cases of Northern Rock and Bear Stearns, with in one case the new owner being the government, and the other, a private bank. It seems likely that the days are gone (if indeed they ever existed) in which an institution could obtain emergency support, then repay that support after the funding problems resolve themselves, with the bank institution then continuing on as normal.

¹⁷ See Hilton (2008) for a discussion of recent changes in the Fed’s range of eligible counterparties.

References

- Alexander L (2008)**, ‘Central Counterparties Could Lessen Systemic Risk’, FT.com site, 5 June. Available at <<http://www.ft.com/cms/s/0/29d1f72a-329a-11dd-9b87-0000779fd2ac.html>>.
- Allen F and E Carletti (2007)**, ‘Banks, Markets and Liquidity’, in C Kent and J Lawson (eds), *The Structure and Resilience of the Financial System*, Proceedings of a Conference, Reserve Bank of Australia, Sydney, pp 201–218.
- Allen F and D Gale (2004)**, ‘Financial Intermediaries and Markets’, *Econometrica*, 72(4), pp 1023–1061.
- ASF (American Securitization Forum) (2008)**, ‘ASF Project RESTART’, 16 July. Available at <http://www.americansecuritization.com/uploadedFiles/Project_RESTART_RFC_%207_16_%2008.pdf>.
- Australian Securitisation Forum (2008)**, ‘The Australian Mortgage-Backed Securities Market: Is an Enhanced Model Needed to Lower Mortgage Rates?’, discussion paper, April.
- BCBS (Basel Committee on Banking Supervision) (2008)**, ‘Liquidity Risk: Management and Supervisory Challenges’, February.
- Becker C and M Sinclair (2004)**, ‘Profitability of Reserve Bank Foreign Exchange Operations: Twenty Years after the Float’, RBA Research Discussion Paper No 2004-06.
- Borio C (2007)**, ‘Change and Constancy in the Financial System: Implications for Financial Distress and Policy’, in C Kent and J Lawson (eds), *The Structure and Resilience of the Financial System*, Proceedings of a Conference, Reserve Bank of Australia, Sydney, pp 8–35.
- Borio C, C Furfine and P Lowe (2001)**, ‘Procyclicality of the Financial System and Financial Stability: Issues and Policy Options’, in *Marrying the Macro- and Microprudential Dimensions of Financial Stability*, BIS Papers No 1, BIS, Basel, pp 1–57.
- Borio C and W Nelson (2008)**, ‘Monetary Operations and the Financial Turmoil’, *BIS Quarterly Review*, March, pp 31–46.
- Brunnermeier MK (forthcoming)**, ‘Deciphering the 2007–08 Liquidity and Credit Crunch’, *Journal of Economic Perspectives*.
- Brunnermeier MK and LH Pedersen (forthcoming)**, ‘Market Liquidity and Funding Liquidity’, *Review of Financial Studies*.
- 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’, VoxEU.org, 13 August. Available at <<http://www.voxeu.org/index.php?q=node/459>>.

Cecchetti S (2007), ‘A Better Way to Organise Securities Markets’, FT.com site, 4 October. Available at <<http://www.ft.com/cms/s/0/fc9a4f48-72a8-11dc-b7ff-0000779fd2ac.html>>.

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

CGFS (2008b), ‘Ratings in Structured Finance: What Went Wrong and What Can Be Done to Address Shortcomings?’, CGFS Papers No 32.

Debelle G (2008), ‘Open Market Operations’, keynote address presented at the Australian Debt Markets Conference, Sydney, 27 June.

FRBNY (Federal Reserve Bank of New York) (2008), ‘Statement Regarding June 9 Meeting on Over-the-Counter Derivatives’, Press Release, 9 June. Available at <<http://www.ny.frb.org/newsevents/news/markets/2008/ma080609.html>>.

FSF (Financial Stability Forum) (2008), ‘Report of the Financial Stability Forum on Enhancing Market and Institutional Resilience’, 7 April.

Fitch Ratings (2004), ‘Liquidity in the Credit Default Swap Market: Too Little Too Late?’, Credit Market Research Report, 7 June.

Fitch Ratings (2008), ‘Fitch Proposals for Complementary Ratings and Indicators to Structured Finance Ratings’, Special Report, 1 July.

Fitz-Gibbon B and M Gizycki (2001), ‘A History of Last-Resort Lending and Other Support for Troubled Financial Institutions in Australia’, RBA Research Discussion Paper No 2001-07.

Gai PS, S Kapadia, S Millard and A Perez (2008), ‘Financial Innovation, Macroeconomic Stability and Systemic Crises’, *The Economic Journal*, 118 (527), pp 401–426.

Geithner TF (2008), ‘Actions by the New York Fed in Response to Liquidity Pressures in Financial Markets’, Testimony before the U.S. Senate Committee on Banking, Housing and Urban Affairs, Washington DC, 3 April.

Grenville S (1991), ‘The Evolution of Financial Deregulation’, in I Macfarlane (ed), *The Deregulation of Financial Intermediaries*, Proceedings of a Conference, Reserve Bank of Australia, Sydney, pp 3–35.

Hilton S (2008), ‘Recent Developments in Federal Reserve System Liquidity and Reserve Operations’, paper presented at the Reserve Bank of Australia Conference on ‘Lessons from the Financial Turmoil of 2007 and 2008’, Sydney, 14–15 July.

Holmstrom B and J Tirole (1988), ‘Private and Public Supply of Liquidity’, *Journal of Political Economy*, 106(1), pp 1–40.

IIF (Institute of International Finance) (2008), ‘Interim Report of the IIF Committee on Market Best Practices’, April.

IMF (International Monetary Fund) (2008), *Global Financial Stability Report – Containing Systemic Risks and Restoring Financial Soundness*, World Economic and Financial Surveys, IMF, Washington DC.

IOSCO (International Organization of Securities Commissions) (2008), ‘Code of Conduct Fundamentals for Credit Rating Agencies’, Report of the Technical Committee of IOSCO, May.

Joye CRE and JS Gans (2008), “‘AussieMac’: A Policy Initiative for the Australian Government to Protect Households and the Financial System against Current and Future Credit Crises”, Melbourne Business School, University of Melbourne. Available at <<http://works.bepress.com/joshuagans/17/>>.

Ledrut E and C Upper (2007), ‘Changing Post-Trading Arrangements for OTC Derivatives’, *BIS Quarterly Review*, December, pp 83–95.

McDonough WJ (1998), ‘Private-Sector Refinancing of the Large Hedge Fund, Long-Term Capital Management’, Statement before the Committee on Banking and Financial Services, U.S. House of Representatives, Washington DC, 1 October.

Moody’s (2008), ‘Introducing Assumption Volatility Scores and Loss Sensitivities for Structured Finance Securities’, Moody’s Report No SF132669.

SEC (U.S. Securities and Exchange Commission) (2008), ‘Proposed Rules for Nationally Recognized Statistical Rating Organizations’, June.

Stevens G (2008), ‘Liquidity and the Lender of Last Resort’, The Seventh Annual Sir Leslie Melville Lecture, Australian National University, Canberra, 15 April.