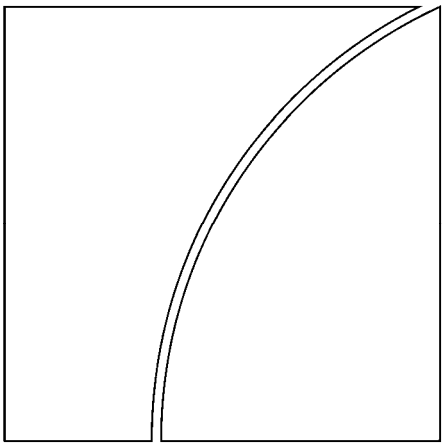
BANK FOR INTERNATIONAL SETTLEMENTS



BIS Working Papers

No 293

Ten propositions about liquidity crises

by Claudio Borio

Monetary and Economic Department

November 2009

JEL classification: E50, E51, E58, G10, G14, G18, G28.

Keywords: market and funding liquidity, liquidity crises, deposit insurance, central bank operations, monetary base.

BIS Working Papers are written by members of the Monetary and Economic Department of the Bank for International Settlements, and from time to time by other economists, and are published by the Bank. The views expressed in them are those of their authors and not necessarily the views of the BIS.

Copies of publications are available from:

Bank for International Settlements
Communications
CH-4002 Basel, Switzerland

E-mail: publications@bis.org

Fax: +41 61 280 9100 and +41 61 280 8100

This publication is available on the BIS website (www.bis.org).

© *Bank for International Settlements 2009. All rights reserved. Limited extracts may be reproduced or translated provided the source is stated.*

ISSN 1020-0959 (print)

ISSN 1682-7678 (online)

Ten propositions about liquidity crises

Claudio Borio

Abstract

What are liquidity crises? And what can be done to address them? This short paper brings together some personal reflections on this issue, largely based on previous work. In the process, it questions a number of commonly held beliefs that have become part of the conventional wisdom. The paper is organised around ten propositions that cover the following issues: the distinction between idiosyncratic and systematic elements of liquidity crises; the growing reliance on funding liquidity in a market-based financial system; the role of payment and settlement systems; the need to improve liquidity buffers; the desirability of putting in place (variable) speed limits in the financial system; the proper role of (retail) deposit insurance schemes; the double-edged sword nature of liquidity provision by central banks; the often misunderstood role of “monetary base” injections in addressing liquidity disruptions; the need to develop principles for the provision of central bank liquidity; and the need to reconsider the preventive role of monetary (interest rate) policy.

Keywords: market and funding liquidity, liquidity crises, deposit insurance, central bank operations, monetary base.

JEL classification: E50, E51, E58, G10, G14, G18, G28.

Table of contents

Introduction [1]

The financial turmoil that started in August 2007 and then grew into a full-blown global credit crisis has elicited unprecedented policy initiatives. Its long term implications for the functioning of the financial system and economic policies will be profound.

As all its predecessors, the crisis has once more hammered home the message that the evaporation of liquidity plays a key role in the dynamics of financial distress.[2] Old lessons have been re-learned; and novel policy responses have been raising questions that will be resolved only with the passage of time.

This paper lays out a number of personal reflections on liquidity crises, on their nature and on policies designed to prevent and manage them. The paper is organised around one definition and ten propositions.

One definition and ten propositions

Definition of liquidity crises

In what follows, a liquidity crisis is defined as a sudden and prolonged evaporation of both market and funding liquidity, with potentially serious consequences for the stability of the financial system and the real economy. Market liquidity is defined as the ability to trade an asset or financial instrument at short notice with little impact on its price; funding liquidity, more loosely, as the ability to raise cash (or cash equivalents) either via the sale of an asset or by borrowing.[3]

Proposition 1: on the idiosyncratic and systematic elements of liquidity crises

Proposition: Beyond obvious idiosyncratic elements, all liquidity crises share at least two key features: one concerns their dynamics once strains emerge; the other, their causes.

The ***first common feature*** is that, once they materialise, at the core of the dynamics of liquidity crises is a mutually reinforcing feedback between market liquidity, funding liquidity and counterparty risk – or credit risk more generally (Borio (2003))[4]. In all such crises,

---

[1] This paper is an expanded and updated version of the remarks prepared for the policy panel of the Deutsche Bundesbank-CESIfo conference "Liquidity: concepts and risks" held in Munich on 17-18 October 2008 and is forthcoming in *CESifo Economic Studies*. I would like to thank Piti Disyatat, Nigel Jenkinson, Robert McCauley, Frank Packer, Josef Tosovsky and two anonymous referees for helpful comments, Gert Schnabel for excellent statistical assistance, and Janet Plancherel for helping to put the whole document together. The views expressed are my own and do not necessarily reflect those of the Bank for International Settlements.

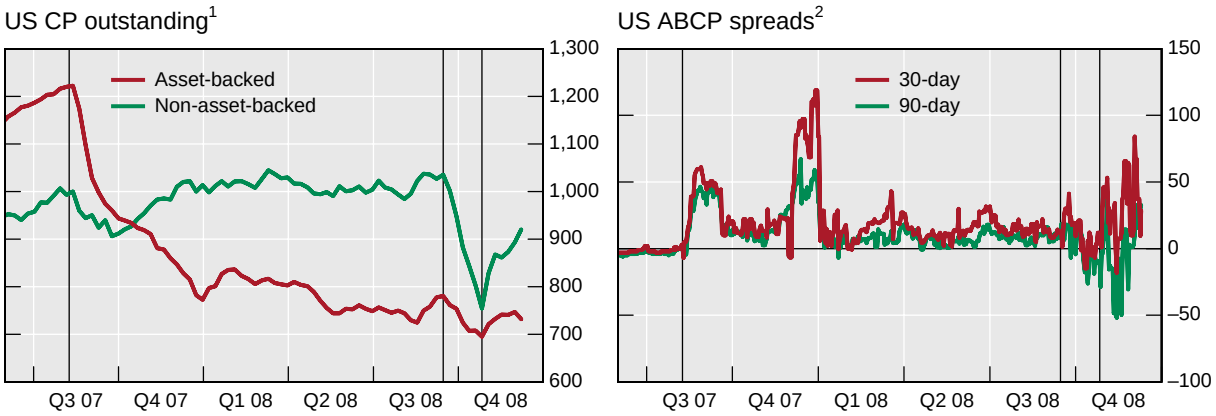
[2] For broad analyses of the current crisis, see Borio (2008), Brunnermeier (2008), Calomiris (2008), Hellwig (2008), Gorton (2008) and Kashyap et al (2008).

[3] Note that these are slightly different definitions from those used in the recent survey paper by Tirole (2009), who associates market liquidity with assets and funding liquidity *exclusively* with liabilities.

[4] For a formalisation of aspects of this mutually reinforcing process, see Brunnermeier and Pedersen (2007). For a review of the literature on distress sales, see Shim and Von Peter (2007)). Drehmann and Nikolau (2009) develop a new measure of funding liquidity risk, based on the outcome of central bank auctions, and show empirically that higher funding liquidity risk coincides with low levels of market liquidity. For a recent formalisation of the link between counterparty risk and *funding* liquidity, see Heider et al (2009).

Graph 1

Commercial paper markets seize up



The vertical lines indicate 9 August 2007, 15 September 2008 (Lehman Brothers' failure) and 27 October 2008 (launch of the Federal Reserve's Commercial Paper Funding Facility (CPFF)).

[1] Commercial paper, in trillions of US dollars. [2] Asset-backed commercial paper yield minus the corresponding Libor rate, in basis points; ABCP yields for A1+ rated issues.

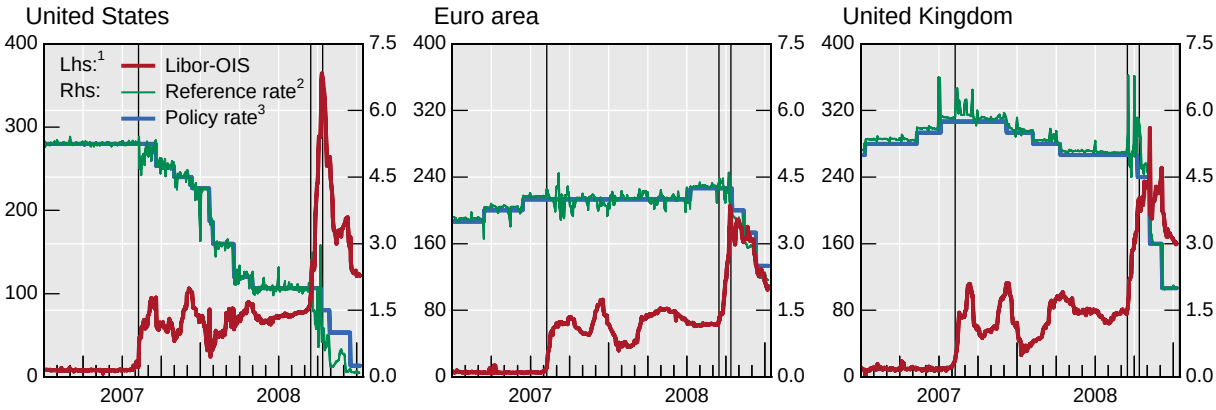
Sources: Federal Reserve Board; Bloomberg; BIS calculations.

counterparty risk either triggers or amplifies the original disturbance. It induces a withdrawal from transactions, cuts in credit lines and funding, and increases in variation margins and haircuts.[5] The tightening in funding liquidity induces fire sales, exacerbating the loss in market liquidity; in turn, the evaporation of market liquidity adds to the funding shortage.

Graph 2

Interbank markets seize up

Three-month Libor-OIS spread (lhs) and money market rates (rhs)



The vertical lines indicate 9 August 2007, 15 September 2008 (Lehman Brothers' failure) and 13 October 2008 (Fed announcement of unlimited swap lines with the ECB, Bank of England and Swiss National Bank).

[1] Libor rate minus OIS rates (for the euro area, EONIA swap; for the United Kingdom, SONIA swap) in basis points. [2] For the United States, effective federal funds rate; for the euro area, EONIA; for the United Kingdom, overnight Libor. [3] For the United States, federal funds target rate; for the euro area, minimum bid rate in the main refinancing operation; for the United Kingdom, official Bank rate.

Sources: Bloomberg; BIS calculations.

[5] Especially in the case of derivative instruments, given their highly non-linear payoffs, the increases can balloon at times of sharp changes in market prices and volatilities.

Sometimes, it is market liquidity that evaporates first. This was the case, for instance, in the current financial crisis. In the summer of 2007, it was the inability to value[6] and trade complex structured credit products that subsequently caused jittery investors to run on the off-balance sheet vehicles (conduits and Special Investment Vehicles (SIVs)) where the products were located, as investors refused to renew the asset backed commercial paper (ABCP) that financed them; in turn, the run spread the problems to the interbank market (eg Borio (2008), Brunnermeier (2008) and Graphs 1 and 2).[7] Sometimes, it is funding liquidity that evaporates first. This was the case at the time of the turmoil induced by Long Term Capital Management (LTCM) in 1998, when nervous counterparties withdrew their funding and asked for higher margins, in turn threatening fire sales that caused some secondary markets to seize up (CGFS (1999)).

A corollary is that markets, just as intermediaries, may be subject to "runs" and that the processes at work are fundamentally similar. In the familiar case of runs on banks, funding liquidity constraints can cause strains on solvency, by precipitating fire sales and a credit crunch. In addition, difficulties in distinguishing sound from unsound banks, not least owing to the web of contractual relationships that ties them together, can spread the run across the banking system. The process has certain self-fulfilling aspects: concerns about being late in withdrawing funds precipitate their early withdrawal (Diamond and Dybvig (1983)). In the case of markets and the evaporation of market liquidity, exactly the same factors are at work. A tightening of liquidity constraints and doubts about the creditworthiness of counterparties causes secondary markets to freeze and precipitates a generalised retrenchment. And, in as self-fulfilling way, anticipations of large pending orders, by precipitating sales, can trigger the evaporation of market liquidity.[8]

The ***second common feature*** is that liquidity crises are not like meteorite strikes; rather, they are the endogenous result of the build-up in risk-taking and associated overextension in balance-sheets over a prolonged period – what might be termed the build-up of financial imbalances. Unmistakable signs of such imbalances are the growth of (overt and hidden) leverage; unusually low risk premia and volatilities, and buoyant asset prices (Graph 3).

A corollary is that the build-up to the crisis is characterised by "artificial liquidity". There is a self-reinforcing process between liquidity and risk-taking. The easing of funding liquidity constraints during the expansion phase supports greater risk-taking, by facilitating position-taking and an increase in exposures. This improves market liquidity and boosts asset prices. As a result, volatility and risk premia fall, in turn inducing a further relaxation of funding liquidity constraints. When this mutually reinforcing process goes too far, it results in overextensions in balance sheets and it sows the seeds of its own destruction. Thus, both market and funding liquidity look highest precisely when they are most vulnerable.[9] The subsequent turnaround is sudden, underlying the "binary" nature of liquidity conditions and their pricing, in both the time- and cross-sectional dimension. From being unusually low,

---

[6] On the complexities involved in valuation and ratings, see eg Fender et al (2008a).

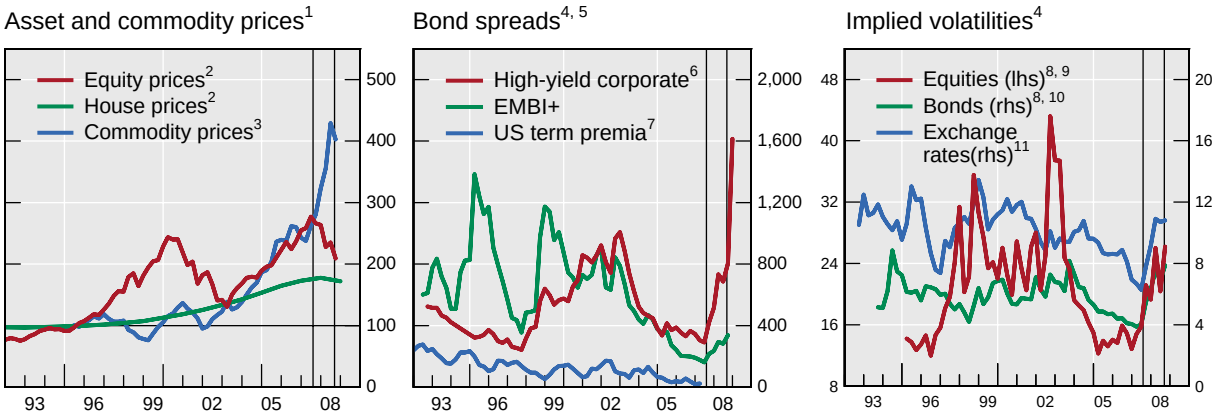
[7] A key mechanisms here was the unprecedented "involuntary reintermediation wave" that threatened banks (Borio (2008)). Banks became extremely concerned with the implications for their funding and capital positions of the forced re-absorption of the off-balance sheet vehicles, through the activation of credit lines backing them or the pressure to buy back assets because of reputational concerns.

[8] See also Bernardo and Welch (2004), who model this specific aspect of a market run: they show how perverse dynamics can occur in markets if participants, anticipating selling pressure, try to sell ahead of others in order to get a better price.

[9] This is part of the broader "paradox of financial instability": in general, the financial system looks strongest precisely when it is most vulnerable. Recall how the potential symptoms of financial imbalances could, and were, also naturally interpreted as confirmations of the Great Moderation (eg Borio (2006)). On this, see also Knight (2007) and (2008)).

Graph 3

Buoyant asset markets before the crisis



The vertical lines indicate 9 August 2007 and 15 September 2008 (Lehman Brothers' failure).

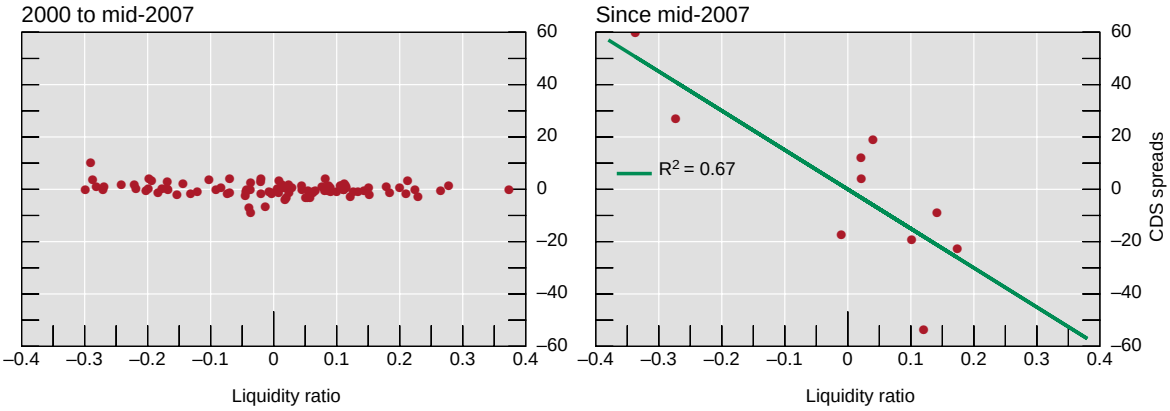
[1] 1995 = 100. [2] Sixteen OECD countries; weighted averages based on 2000 GDP and PPP exchange rates. [3] Goldman Sachs Commodity index, in US dollar terms, deflated by US CPI; quarterly averages. [4] Quarterly averages. [5] In basis points. [6] JPM Global High Yield; spread to worst. [7] Estimated for 10-year zero coupon Treasuries. [8] Simple average of the United States and Germany. [9] Derived from the price of call option contracts on stock market indices. [10] Price volatility implied by the price of call options on 10-year government bond future contracts [11] JPMorgan benchmark index for the level of G7 currencies' implied volatility.

Sources: OECD; Bloomberg; Datastream; Merrill Lynch; JPMorgan Chase; national data.

liquidity premia shoot up; from making no differentiation across firms, market participants suddenly become more discriminatory in their pricing (Graph 4))[10].

Graph 4

Liquidity ratios and CDS spreads[1]



[1] Deviation of firms' liquidity ratios and CDS spreads from peer average.

Sources: Bloomberg; JPMorgan Chase; BIS staff calculations.

[10] I am grateful to Dietrich Domanski for uncovering the relationship shown in Graph 4. On liquidity premia and their implications for risk management, see also Acharya and Schaefer (2006).

Proposition 2: on the growing reliance on funding liquidity in a market-based financial system

Proposition: Contrary to a widely-held view, the development of financial markets has increased, not reduced, the demand for funding liquidity (Borio (2003)). In other words, a market-based financial system is "funding liquidity hungry".

Many observers expected the development of markets to reduce the reliance on funding liquidity, in the sense of dependence on *external* funding. After all, if the portfolios of economic agents include more tradable securities, sales of these securities can substitute for external funding. As a result, a market-based financial system could be expected to be less vulnerable to liquidity crises.

This common reasoning, however, is based on two faulty premises. One is that the *process* of trading does not rely on funding liquidity. In fact, it is heavily dependent on it. Funding is necessary to take positions. Credit lines are an essential ingredient in the provision of market-making services and a critical backstop to the issuance of securities (eg they are needed to back-up the issuance of commercial paper). And trading puts a premium on mechanisms to address counterparty risk that can strain funding liquidity, such as collateral, margins and haircuts. A second faulty premise is that market liquidity can always remain robust under stress, thereby not amplifying the need for funding liquidity. The recent financial crisis has reminded us of just how misleading these two premises can be. It has led to un unprecedented drying up of funding liquidity, too, as highlighted by the enormous strain placed on the interbank market and the huge injections of liquidity by central banks.[11]

One corollary is that a market-based system may be more, not less, vulnerable to funding liquidity crises than a bank-based (or intermediary-based) one. When strains emerge, and market liquidity evaporates, the demand for funding liquidity can skyrocket precisely when its supply collapses.

A second corollary is that it is equally misleading to think of financial intermediaries and markets as alternative forms of finance; their complementarity is important and has grown over time (Borio (2003)). Intermediaries such as banks have become increasingly reliant on markets as a source of income and for their risk management, through their hedging operations. Markets in turn have become increasingly dependent on intermediaries for the provision of market making services and of the funding liquidity that underpin their smooth functioning. And the same capital base can ultimately support the operation of both intermediaries and markets (BIS (2005 and 2009)).

This suggests that the "spare tyre" argument (Greenspan (1999)) needs to be reconsidered, or at least qualified: the benefits of institutional diversification across intermediaries and markets may be illusory. On some occasions, resilient markets may indeed substitute for struggling intermediaries, thereby helping to maintain the flow of funds to the economy; this is what happened in the early 1990s in the United States. But probably even more often, both markets and intermediaries may face strains at the same time, as the current crisis illustrates.

[11] Even if a shift to a more market-based system reduces on-balance-sheet liquidity mismatches at banks, as we have seen in the current crisis, what matters are the mismatches *in the financial system as a whole*. For example, the tendency to underestimate the extent to which those mismatches would come back to haunt the banks, such as through the back-stop liquidity lines they had put in place, was a factor that supported the growing liquidity mismatch in the overall financial system. See also Hellwig (2008).

Proposition 3: on the role of payment and settlement systems (PSS)

Proposition: the role of PSS, a key element of the financial infrastructure, in preventing liquidity crises is important but limited.

The role of PSS is important because, if badly designed, they can exacerbate liquidity crises once they materialise. They can do so in two ways (eg Borio and van den Bergh (1993)). They can amplify concerns about counterparty risk. This occurs if the arrangements do not allow for the simultaneous exchange of instruments traded (ie no delivery versus payment (DVP) for securities or payment versus payment (PVP) for foreign exchange) or for the centralised management of counterparty risk, through a central counterparty to the transactions. And they can amplify uncertainty about cash flows, receipts and payments. This occurs, for instance, whenever there is no "finality" of payments, so that the payment transfers are revocable or can be unwound under some conditions.

The role is limited for two reasons. For one, some of the mechanisms to address counterparty risk, by design, put more pressure on liquidity, which needs to be properly managed. This is the case for DVP and PVP arrangements, for Real Time Gross Settlements (RTGS) and tri-party repos. More importantly, though, fool-proofing PSS cannot address the build-up in risk-taking and underlying asset quality problems that invariably hide behind the more disruptive liquidity crises. Indeed, in the limit, fool-proofing could achieve little if, paradoxically, confidence in strength of the infrastructure induced market participants to take on greater risks. After all, improvements in the state of the roads (eg smoothing their surface) could actually make people drive faster!

The current crisis is consistent with this view. Thanks to previous efforts, largely spear-headed by the Basel-based Committee on Payment and Settlement Systems, PSS functioned very well during the current strains. They have, on balance, been a source of strength rather than weakness. The main exceptions were dislocations to the tri-party repo settlement infrastructure and, above all, uncertainties associated with the exposures in the clearing and settlement of CDS contracts (Geithner (2008)).[12] Despite steps taken to strengthen this aspect of the infrastructure (Ledrut and Upper (2007)), the opaque and decentralised nature of the Over-the-Counter (OTC) CDS market has no doubt contributed to exacerbating strains in the financial system. As a result, the authorities and market participants have taken measures to establish a central counterparty for these contracts (CRMPG (2008), FSF (2008a) and Cecchetti et al (2009)).[13] More fundamentally, the initial liquidity strains eventually did expose the underlying asset quality and solvency problems. Several major financial institutions failed and governments engaged in broadly-based efforts to recapitalise the system (BIS (2008 and 2009), Domanski and Ramaswamy (2008) and Table 1).

The corollary is that strengthening PSS is helpful but not sufficient. Prevention of liquidity crises calls for complementary policies.

[12] While such uncertainties have generally impaired market functioning during the crisis, in the specific case of Lehman Brothers' failure in September the ex post settlement of contracts referencing the entity worked better than expected. The main disruptions that followed were associated, among other things, with the impact of bankruptcy proceedings on traditional contracts. On this, see Fender et al (2008b)).

[13] For a more cautious note on the impact of the introduction of CCPs on counterparty risk, see Duffie and Zhu (2009)).

Table 1

Elements of banking system rescue plans in developed economies[1]

Country	Expansion of retail deposit insurance	Guarantee of wholesale liabilities[2]		Capital injections[3]	Asset purchases
		New debt	Existing debt		
Australia	✓	✓	✓		✓
Austria	✓	✓		✓	
Belgium	✓	✓			
Canada		✓			✓
Denmark	✓	✓	✓		
Finland	✓				
France		✓		✓	
Germany	✓	✓		✓	✓
Greece	✓	✓		✓	
Ireland	✓	✓	✓		
Italy		✓		✓	
Netherlands	✓	✓		✓	
New Zealand	✓				
Norway					✓
Portugal	✓	✓			
Spain	✓	✓		✓	✓
Sweden	✓	✓		✓	
Switzerland				✓	✓
United Kingdom	✓	✓		✓	
United States	✓	✓		✓	✓

[1] As of mid-November 2008. [2] Includes bond issuance, interbank lending and other wholesale liabilities. Coverage of the guarantee on these items varies across countries. [3] Refers to announced programmes only (excluding standalone actions).

Source: BIS.

Proposition 4: on the need to improve buffers

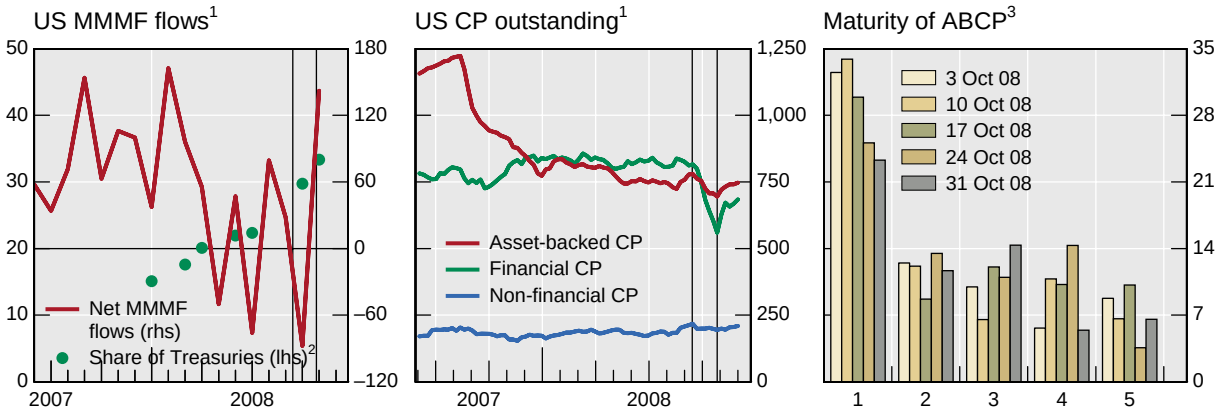
Proposition: In order better to prevent liquidity crises, there is a need to improve buffers in the system.

Continuing with the analogy with policies towards road safety, this effectively means putting in place better buffers, such as car bumpers and guard-rails. Buffers can be of two types.

One type of buffer is higher capital adequacy standards. Up to a point, higher capital buffers can limit the risk of the evaporation of liquidity, because of the critical role that counterparty risk, and credit risk more generally, plays in liquidity crises. For instance, it was concerns with potential *losses* on thinly capitalised off-balance sheet vehicles (conduits and SIVs – the so-called "shadow banking system"), that triggered a run on them in the summer of 2007.

Graph 5

US money market mutual funds (MMMF) and commercial paper (CP)



The vertical lines indicate 15 September 2008 (Lehman Brothers' failure) and 27 October 2008 (set up of the Federal Reserve's Commercial Paper Funding Facility (CPFF)).

[1] In trillions of US dollars. [2] Treasury bills, other Treasury securities and government agency issues as a percentage of total net assets outstanding. [3] Maturity of outstanding asset-backed commercial paper, weeks after date; as a percentage of total outstanding.

Sources: Federal Reserve Board; Bloomberg; BIS calculations.

Absent those concerns, the run would not have taken place, as the commercial paper backing the vehicles would have been safe. The vehicles' substantial liquidity transformation – short-term liabilities financing long-term assets that proved illiquid under stress – simply allowed this run to occur and magnified its effect.[14] Later on during the crisis similar problems occurred with money market mutual funds (BIS (2008 and 2009) and Graph 5), in effect *disguised* highly leveraged vehicles, with the leverage resulting from the promise not to "break the buck".[15] This, in turn, intensified the wholesale "run" on banks, in whose liabilities the money market funds were heavily invested (Baba et al (2009)). Had Basel II been implemented, off-balance sheet vehicles would have been less prevalent or ultimately supported by better capitalised banks, owing to the higher capital requirements against these types of exposure. This would have reduced the likelihood, or at least the intensity, of the liquidity crunch.

The second type of buffer is liquidity buffers proper. One way of strengthening them is to improve risk management in this area. The Basel Committee has recently issued a report highlighting deficiencies in market practices (BCBS (2008)). These include: inadequate treatment of individual products or business lines; underestimation of the funding requirements associated with contingent obligations, whether contractual or not; limited preparation for potentially protracted market-wide liquidity strains, including a failure to consider these scenarios in stress tests; and overly sanguine reliance on the performance of collateralised lending markets under stress, including those for FX swaps. A second way is to design regulation and supervision to ensure that buffers are high enough, as the Basel Committee is planning to do.

Two issues are worth bearing in mind when designing such liquidity buffers.

[14] See Hellwig (2008) on the more general issue of the amount and allocation of maturity risk, and the associated liquidity, interest rate and credit risks, in the financial system.

[15] Since the money market mutual funds invested heavily in short term debt of commercial and investment banks, the run on these funds and defensive adjustments in their portfolios exacerbated the tensions in the interbank market.

First, one should beware of time (state)-invariant minimum liquidity ratios: they need to be designed with care. Unless ratios equal at least 100% of the relevant base (eg, possible withdrawals*)*, only amounts *in excess of* the minima can truly act as buffers. Once the liquidity strains begin to emerge, *binding* minima could raise the imbalance between the supply of, and demand for, for liquidity, ie they could act "procyclically".[16] From shock absorbers the ratios could become shock amplifiers. In other words, time-invariant minima could fail to address the fact that risk is endogenous with respect to the collective behaviour of institutions. As a result, *once stress arises*, they could add to, rather than offset, its inherent procyclicality.[17]

Second, and more generally, stronger buffers, like improving the state of the roads, may paradoxically also lead to faster speeds (Borio (2007)). In fact, it is not uncommon to hear market participants say that the point of a better risk management system is precisely to allow them to take on more risk. If so, better risk management would act more like a speedometer than a brake: it would better measure the amount of risk taken, but not constrain it.[18] The deeper point is that distortions in incentives in the financial system may result in individual economic agents targeting levels of risk that may be inappropriate for the system as a whole.[19] Intuitively, for instance, incentive distortions may make it hard to withdraw from a lending boom for fear of loss of market share, thereby resulting in too much risk in the aggregate. As Charles Prince, then CEO of Citigroup, said just before the turmoil broke out: "as long as the music is playing, you've got to get up and dance" (reported in the Financial Times, 9 July 2007).

Proposition 5: on the desirability of putting in place (variable) speed limits

Proposition: It would be desirable to consider putting in place (variable) speed limits (Borio (2007)).

This follows from the risk that improving the financial infrastructure, such as PSS, and introducing buffers, such as in the form of minimum capital and liquidity ratios, could fail to act as a brake in the expansion phase. If so, these improvements would not effectively limit the risk of the overextension in good times that sows the seeds of the subsequent crisis. Moreover, as strains do emerge, a tight speed limit may hinder a recovery of the system.

The general principle would be to slow down the build-up in risk-taking and overextension, by increasing the resistance to it as imbalances develop (a kind of "dragging anchor"), and to allow the speed to pick up faster following any strains that do materialise (by "releasing the drag"). This would act as a stabiliser in both upward and downward phases of the credit cycle. Technically, the shadow price of the measures would increase with the build-up in risk-

[16] This, of course, assumes that the minima are hard minima, rather than soft ones backed by graduated sanctions. In that case, they can perform, to a degree, a buffer function. For example, assume that the ratio is 50% and the bank is at the minimum. Any withdrawal would induce the bank to violate the minimum, calling for remedial action (eg fire sales of less liquid assets, etc.). The reasoning is analogous to that applicable to minimum capital requirements.

[17] For a discussion of the application of this principle to liquidity, with a particular focus on market liquidity, see Borio (2003).

[18] The same limitations could apply to better risk disclosures.

[19] For example, and more formally, economic agents may fail to internalise the externalities that result from the fact that, even if they are atomistic, in the aggregate they can affect market prices: in the presence of financial frictions, this externality can result in socially undesirable outcomes, through the impact of fire sales on asset prices and the external funding constraints of other agents (eg Korineck (2008) and, for the more general theoretical result, Arnott et al (1992)). For a detailed discussion of potential incentive problems, see eg Hellwig (2008).

taking and fall as the consequences of risk-taking materialise. In other words, there is a need to think about how to induce a greater degree of *counter-cyclicality* in the prudential framework to offset the strong inherent *procyclicality* of the financial system.[20] At a minimum, it is important to limit the potential for the framework to add to that inherent procyclicality. This general objective has gained broad support in the policy community recently (FSF (2008b and 2009), Group of Twenty (2008)). One way of achieving it would be to induce countercyclical buffers, which rose during expansions and were allowed to be drawn down, in a controlled and limited fashion, as strains emerged.

Introducing effective variable speed limits, however, is no easy task. Several issues are raised, including the choice of specific instruments, the balance between rules and discretion, and the institutional set up most conducive to effective implementation (eg BIS (2009b)). A holistic approach is needed, as a whole range of policies can influence the degree of procyclicality in the financial system, including the architecture of prudential regulation and supervision, accounting[21], insurance mechanisms, closure and resolution procedures, fiscal and monetary policy (BIS (2009a, b)). Their interaction is critical. And while most of the attention in prudential regulation has so far focused on capital, other aspects are also important, not least liquidity standards.

Proposition 6: on the role of (retail) deposit insurance schemes

Proposition: (retail) deposit insurance schemes are not best-suited to prevent liquidity crises.

Deposit insurance schemes, narrowly defined as those designed to protect retail depositors in the case of bank failures, have traditionally received great attention in the context of the prevention of banking crises. Such schemes can perform a variety of roles, but the one they are most closely associated with in the academic literature is that of preventing runs on banks (eg Diamond and Dybvig (1983)).[22] Of particular concern is the possibility of runs on otherwise solvent institutions that could cause them to fail.

Seen from this narrow perspective, however, the role of *retail* deposit insurance schemes is somewhat overrated. While they can certainly help, such schemes are actually not well tailored to address the risk of bank runs. For one, they provide excessive protection. That is, they protect retail depositors in the state of *bankruptcy* in order to deal with a *liquidity* problem. As a result, while they can no doubt be effective in preventing the retail run, returning to the previous analogy, they can act too much as an accelerator ex ante. In other words, they can weaken unnecessarily market discipline. More importantly, though, they are insufficient to prevent runs. Whenever wholesale funding is present, it is this source tends to evaporate first. The more relevant and damaging runs are not by unsophisticated retail depositors, but by sophisticated creditors.[23] And from a longer historical perspective, changes in the structure and functioning of financial markets have been reducing the

---

[20] Of course, regulatory time-invariant minima (eg, for capital or liquidity), to the extent that they become binding during the expansion, can act as fixed *speed limits*. See, eg BIS (2009b). The problem with them is their performance as stress arises.

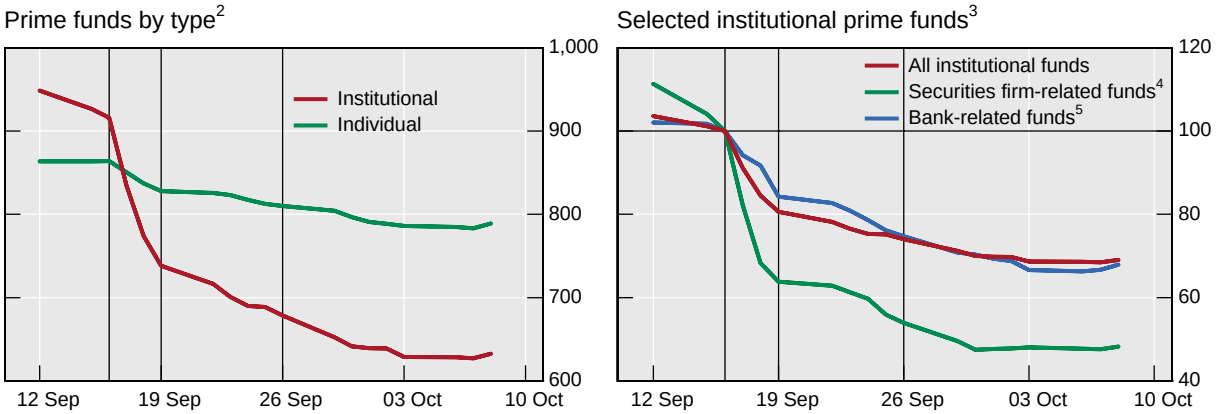
[21] On the important role of accounting in influencing procyclicality, see, for instance, Taylor and Goodhart (2006), Borio and Tsatsaronis (2006) and Plantin et al (2008).

[22] Other roles include: protecting unsophisticated depositors in the event of closure; acting as a speedy source of funds for the resolution of institutions; and helping to level the playing filed between large institutions of systemic relevance and small ones.

[23] On this, compare the disciplinary role of short-term (interpreted here as sophisticated or wholesale) funding highlighted by Calomiris and Kahn (1991), on the one hand, with the possibility of induced inefficient liquidations stressed by Huang and Ratnovsky (2008) and the sceptical note on the disciplinary role of such funding struck by Hellwig (2008), on the other.

Graph 6

Assets of prime US money market funds[1]



[1] The vertical lines indicate the Reserve Fund "breaking the buck" (16 September), the announcement of a Treasury guarantee programme and the Federal Reserve's AMLF programme (19 September) and the announcement of the first AMLF credit (26 September). [2] In billions of US dollars. [3] 16 September 2008 = 100. [4] Goldman Sachs, Merrill Lynch and Morgan Stanley. [5] Bank of America (Columbia), Bank of New York (Dreyfus), Barclays, JPMorgan Chase, State Street, Wachovia (Evergreen) and Wells Fargo.

Source: Baba et al (2009).

significance of retail schemes as devices to deal with *systemic* risks of runs. This reflects the greater importance of wholesale financial markets and funding in the system as well as the increasing systemic relevance of institutions that either do not have deposit insurance protection, such as money market mutual funds and hedge funds, or that are perceived as too large, or complex, to fail anyway (Group of Ten (2001)), so that the market perceives explicit deposit insurance as largely redundant.

On balance, the recent crisis confirms this view. To be sure, a highly publicised retail run on Northern Rock triggered a reconsideration of the effectiveness of co-insurance arrangements in the United Kingdom (Goodhart (2007)). And, following the issuance of a blanket guarantee for banks in Ireland, a number of countries extended retail deposit insurance protection (Table 1). Even so, the core manifestation of the crisis was the disruption to the *wholesale* interbank markets, and it was in this market that the survival of individual institutions was typically determined. Hence the importance of guarantees for wholesale sources of funding and, in the United States, also for money market mutual funds (same Table).[24] Indeed, there is clear evidence that it was mainly *institutional* investors in money market funds that run, *not* retail customers (Baba et al (2009) and Graph 6)).[25] And, as already noted, the institutional run on money market funds in turn intensified the wholesale US dollar liquidity squeeze on banks, especially European ones (Baba et al (2009)).

Similarly, arguably the main reasons for the extension of retail deposit insurance coverage included the need to instil confidence in consumers, so as to avoid the high *political* costs of queues outside banks and a collapse in consumption expenditure, and to defend the competitive position of national banking systems, as funds could migrate to jurisdictions with higher deposit protection. The extension may not have reflected so much a pressing concern that a *retail* run could, by itself, bring large institutions to their knees. And even when that

[24] To be sure, from this perspective, money market mutual funds are a hybrid vehicle: they are a preferred habitat for retail investors, but managed as single entities by professional asset managers.

[25] This also indicates that the reason why retail depositors are slow to run compared with wholesale depositors is not necessarily the protection provided by the deposit insurance scheme: money market mutual funds *did not* benefit from any such guarantees.

concern was present, as possibly in the case of Northern Rock, the initial trigger for the extension of emergency liquidity assistance was a *wholesale* drain of funding, ie a wholesale run.

The corollary is that, from the perspective of avoiding *liquidity* crises, retail deposit insurance schemes should best be seen as mechanisms to relieve operational constraints on liquidity support by central banks. This does not mean, however, that such schemes are unimportant. In fact, when properly structured, they remain an essential element of a properly designed safety net. But their most useful function should probably not be seen as dealing with liquidity drains. Rather, it should be *adding credibility to closure and resolution procedures*. By protecting small depositors and ensuring speedy payments, well structured deposit insurance schemes can shield the authorities from the political economy pressures to keep insolvent institutions alive. From this angle, they can actually *reduce* moral hazard relative to less structured alternatives.

Proposition 7: on the double-edged sword nature of liquidity provision by central banks

Proposition: The existence of the central bank framework to provide liquidity is a double-edged sword.

Given the potential limitations of other tools, an effective central bank framework to supply liquidity to the financial system is a necessary element of arrangements to address liquidity crises. At the same time, as is well known, the central bank provision of liquidity raises a trade off, best illustrated by analogy with the policy towards road safety. On the one hand, it acts as an ex post buffer, as it is activated once strains emerge. On the other hand, ex ante it can act as an accelerator, as anticipations of future support may induce faster speeds and greater risk-taking – the "moral hazard" problem.

While this trade-off is a long-standing and familiar issue,[26] its salience has been highlighted by the unprecedented measures taken by the central banking community during the current crisis (see below). Achieving an appropriate balance has become all the more important.

Proposition 8: on the often misunderstood role of "monetary base" injections

Proposition: in a liquidity crisis, the key to the effectiveness of central bank (funding) liquidity operations is the intermediation role played by the institution, *not* the size of the net additions to the stock of reserve balances held with the central bank (ie increases in the monetary base).

This issue remains probably one of the most commonly misunderstood aspects of the management of liquidity crises, reflecting misconceptions about monetary policy implementation more generally (Borio and Nelson (2008)).[27] The key to success in addressing the unprecedented serious dislocations in the interbank market is to ensure that central bank funds reach those that most need them, as they are unable to obtain funding at sufficiently attractive terms in the market. This explains the increase in the range of eligible counterparties and collateral as well as the lengthening in the maturity of central bank operations.[28] In other words, what is crucial is the intermediation role played by the central

---

[26] For a recent formalisation of this trade-off, in the context of pure liquidity risk, see eg Cao and Illing (2008).

[27] For an analysis of the policy responses to the crisis that is complementary to Borio and Nelson (2008) and that focuses on the United States, see Cecchetti (2008).

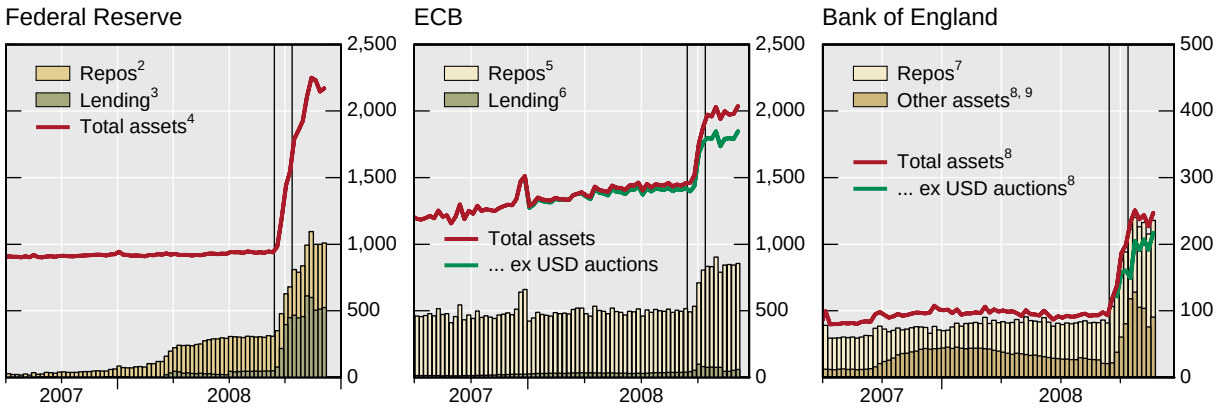
[28] This intermediation role may also require central banks providing funding in a currency other than the one they issue, as the shortage of funding may be concentrated on it. The setting up of dollar swaps between the

bank and how its financing is distributed in the system. In fact, contrary to typical press reports and broader commentary, at least until the failure of Lehman Brothers in September 2008, what central banks put in with one hand, they took away with the other. Net injections of central bank balances were effectively zero or small.

To be sure, playing an intermediation role may go hand in hand with an increase in the balance sheet of the central bank. This is indeed what happened following the failure of Lehman Brothers in mid-September 2008 (Graph 7, Michaud and Schnabel (2008) and BIS (2009a)). But even in this case, the secret to the effectiveness of the operations is *not* the increase in the monetary base per se.[29] Rather, it is the ability of the central bank to provide an attractive asset to the private sector (safe balances with it yielding a competitive risk-adjusted interest rate, ie an attractive asset in which to park liquid holdings) while at the same time financing those institutions that find it hard to borrow in the market, through an increase in, and change in the composition of, the asset side of its balance sheet (Borio and Disyatat (2009)).[30] The payment of interest on reserve balances can be very helpful in this context. In other words, in the first phase of the crisis, before Lehman's failure, central banks played an intermediation role primarily through the terms and conditions through which they provided the same amount of cumulated *net* funds to the system. In the second, they reinforced their actions by increasing the net supply of a liability highly prized by the financial system to support an even broader intermediation role driven primarily by changes in the

Graph 7

Central bank balance sheets expansion[1]



The vertical lines indicate 15 September 2008 (Lehman Brothers' failure); and 13 October 2008 (Fed announcement of unlimited swap lines with the ECB, Bank of England and Swiss National Bank).

[1] In billions of national currency units. [2] Repurchase agreements and term auction credit (TAF). [3] Primary discount credit, primary dealer credit facility, Maiden Lane (Bear Stearns), AIG, commercial paper and money market mutual fund support measures. [4] Total factors supplying reserve funds. [5] Main refinancing, long-term refinancing and fine-tuning operations in euros. [6] Marginal lending and other claims in euros on euro area credit institutions. [7] Short and long-term reverse sterling repos. [8] Adjusted by BIS for estimates of items in the course of settlement related to unlimited dollar operations. [9] Includes US dollar lending and lending to UK deposit protection.

Source: Central banks.

Federal Reserve and a number of other central banks was in response to this type of shortage, heightened by disruptions to the foreign exchange swap market (Baba et al (2008) and McGuire and Von Peter (2009)).

[29] This is so especially if interpreted in a mechanical sense, such as an automatic link between the amount supplied and the increase in the money supply (the so-called "money supply multiplier").

[30] Swapping highly prized collateral for lower quality one is another mechanisms that can, and has, been used in this context (Hördahl and King (2008)).

asset side of the balance sheet.[31] But had they supported this through the issuance of short-term central bank paper, the final outcome would arguably have been similar (Borio and Disyatat (2009))

A corollary is that the effectiveness of central bank funding operations relies on their being subsidised compared with the terms dictated by the market. This raises a host of issues about the guiding principles underlying these operations.

Proposition 9: on the need to develop principles for the provision of central bank liquidity

Proposition: there is a need to develop principles for the provision of (funding) liquidity to address protracted market-wide liquidity crises.

By now, there is a reasonably well developed set of principles for how to address the failure of individual institutions and the corresponding supporting role of emergency (funding) liquidity assistance. By contrast, the rule book for how to address persistent and severe market-wide dislocations, such as those impairing the functioning of the interbank market in the current crisis, in which problems and responsibilities are much more diffused, has yet to be written. So far, central banks have de facto been shaping those principles through their actions, under the pressure of events. While some reflection has started (CGFS (2008)), more is desirable.

The principles would need to address a number of issues. They would need to consider the relationship between central bank operations in normal times and at times of stress. This would also include how best to address the "stigma problem", so much in evidence during the current crisis, ie the unwillingness of financial institutions to be seen to borrow from the central bank for fear of providing a strong signal of weakness to the market. They would need to consider how best to deal with shortages in foreign currency, including the mechanisms for cooperation among central banks, such as through bilateral or multilateral swap agreements.[32] They would have to strike a balance between liquidity support, on the one hand, and the risk of "moral hazard", on the other. And they would need to develop "exit strategies" to deal with the "exit problem" that operations of this kind inevitably raise. Financial institutions may become excessively dependent on central bank support, which is bound to substitute itself for the operation of the private market (BIS (2009a) and Borio and Disyatat (2009)),[33]

Proposition 10: on the need to reconsider the preventive role of monetary (interest rate) policy

Proposition: there is a need to reconsider also the possible role of monetary policy (interest rate setting) in the prevention of liquidity crises.

---

[31] While in this case the increase in the asset prized by financial system participants was a liability of the central bank, it could equally have been a safe liability issued by the government.

[32] See Ho and Michaud (2008) for a description of how central banks have been providing funds in foreign currency during the current crisis.

[33] There is, in addition, the bigger issue of the relationship between these policies and those aimed to address the underlying system-wide solvency problems that most likely lie behind the liquidity crisis. One risk, for instance, is that rather than supporting a policy response to repair the financial system, prolonged liquidity support may delay the required restructuring, if it relieves the pressure to take action. On this, see BIS (2009a)).

The overarching issue here is the extent to which monetary policy may, directly or indirectly, contribute to the overextension in balance sheets and risk-taking during good times. Three questions deserve particular attention.

First, to what extent have the unusually low policy rates during the recent expansion induced greater risk-taking? This possible effect should not be underestimated and is worthy of serious investigation. The influence of interest rates on perceptions of risk and attitudes towards risk is a neglected aspect of the monetary transmission mechanism – what might be termed the "risk-taking" channel of monetary policy (Borio and Zhu (2008)).[34] This influence can operate in several ways: indirectly, through the impact that asset prices, cash flows and profits can have on the measurement of risk and risk tolerance, and hence on risk premia; directly, through the interaction between the level of policy rates and sticky rate of return norms or targets; and through the reaction function of the central bank, including its degree of transparency and anticipations of central bank support (reductions in policy rates) in case of the emergence of financial strains seen to threaten the real economy. Moreover, this risk-taking channel can draw strength from the mutually reinforcing interaction between financing constraints (funding liquidity) and risk-taking discussed under proposition 1.[35] There is now some budding empirical evidence consistent with the existence of the risk-taking channel.[36]

Second, should monetary policy lean against the build-up of risk-taking and associated financial imbalances even if near-term inflation appears under control? Arguably, the answer is "yes" (eg Borio and White (2004) and BIS (2009a)). To the extent that a strict focus on stabilising near-term inflation, over horizons of one-to-two years, can unwittingly accommodate the build-up of financial imbalances, it can raise the spectre of broader financial strains, output weakness and unwelcome disinflation, if not outright deflation, further down the road, as the imbalances unwind (Graph 8). In extreme situations, it raises the danger of crippling monetary policy, if the zero lower bound for nominal interest rates is not far away. The Japanese experience of the late 1980s–1990s and the more recent crisis are obvious examples. Put differently, returning to the road safety analogy, monetary policy could be yet another "speed limit", potentially a crucially important one. In recent years, the balance of opinion within the central banking community has become somewhat more favourably disposed towards this possibility (eg Carney (2009), Shirakawa (2009) and Trichet (2009)).

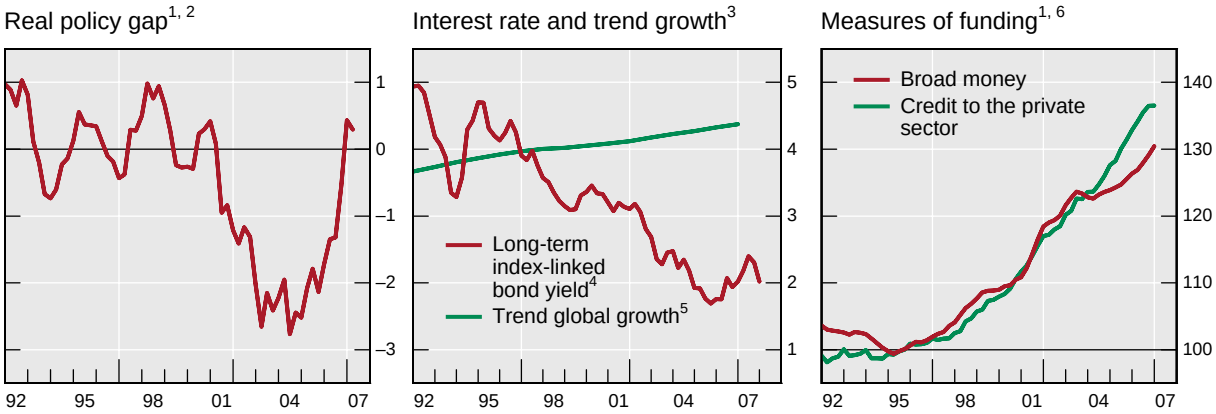
[34] On this, see also Rajan (2005). For a recent formalisation of the impact on liquidity, see Farhi and Tirole (2009).

[35] On this, see also Adrian and Shin (2007) and (2008).

[36] See, in particular, Jimenéz et al (2007) and Ionnadou et al (2008) as well as other references in Borio and Zhu (2008).

Graph 8

Low interest rates and ample global funding



[1] Sixteen OECD countries; weighted averages based on 2000 GDP and PPP exchange rates. [2] Real policy rate minus natural rate. The real rate is the nominal rate adjusted for four-quarter consumer price inflation. The natural rate is defined as the average real rate 1985–2000 (for Japan, 1985–95; for Switzerland 2000–05) plus the four-quarter growth in potential output less its long-term average. [3] In per cent. [4] From 1998; simple average of Australia, France, the United Kingdom and the United States; otherwise only Australia and the United Kingdom. [5] Trend world real GDP growth as estimated by the IMF. [6] Relative to nominal GDP; 1995 = 100.

Sources: IMF; OECD; Bloomberg; national data; BIS calculations and estimates.

Finally, is there a risk of an excessively strong and prolonged easing in response to the unwinding of financial imbalances, itself the consequence of previous risk-taking? Past experience suggests that this possibility should not be underestimated (Borio (2008)). To be sure, the risk of responding too little, too late exists. This is a more familiar risk, most commonly and spectacularly associated with the Great Depression. But, given prevailing policy paradigms, the opposite risk is arguably more serious. A concern is that the response, while possibly successful in the short run, may work only at the expense of generating further financial imbalances. Certain elements of this story can be traced in the experience of the 1980s–early 2000s boom-bust, following the easing that took place in response of the stock market crash. They can also be found in the recent cycle, following a similar response to the high-tech equity market bust. The main source of problems here is not so much the intensity and speed of the initial response, but the lack of speed with which interest rates are returned to more normal, long-run equilibrium levels (another "exit problem").[37] Paradoxically, low inflation can be a hindrance, by seemingly retarding the need for, and making it harder to justify, the "normalisation" of policy rates to levels more in line with the long-term growth potential of the economy. The experience of Japan in the current decade is especially relevant.

Clearly, in answering all of these questions, as in the case of liquidity operations, moral hazard considerations loom large.

[37] Similar issues arise in the context of the unconventional monetary policy measures taken during the crisis, which can best be termed as "balance sheet policy". For a detailed discussion of these issues, see BIS (2009a) and Borio and Disyatat (2009)).

Conclusion

The global financial crisis has hammered home the importance of the evaporation of liquidity in the dynamics of financial distress. Policies aimed at preventing and addressing such crises hare regained an urgency they had lost for some time (Goodhart (2007)). Much reflection and soul searching is under way in both policy and private circles. In designing appropriate policy responses, perhaps the most important lesson to bear in mind is an old one: as Minsky (1982) liked to stress, while liquidity strains exacerbate crises, they are typically a symptom of deeper underlying weaknesses in the quality of balance sheets that build-up slowly over the years. Addressing the build-up of those weaknesses holds the key to more effective and long-lasting remedies.

References

Acharya, V and S Schaefer (2006): "Liquidity risk and correlation risk: Implications for risk management", mimeograph.

Adrian, T and H Shin (2007): "Liquidity and financial cycles", paper presented at the 6th BIS Annual Conference, Brunnen, 18-19 June. Also available as *BIS Working Papers*, no 256, July 2008.

——— (2008): "Financial intermediaries, financial stability and monetary policy", paper presented at the Federal Reserve Bank of Kansas City Symposium at Jackson Hole, "*Maintaining Stability in a Changing Financial System*", Wyoming, 21-23 August.

Arnott, R J, B C Greenwald and J E Stiglitz (1992): "Information and economic efficiency", *Information Economics and Policy*, 6(1), pp 77-88.

Baba, RJ, R McCauley and S Ramaswamy (2009): "US dollar money market funds and non-US banks", *BIS Quarterly Review*, March, pp 65-81.

Baba, N, F Packer and T Nagano (2008): "The spillover of money market turbulence to FX swap and cross-currency swap markets", *BIS Quarterly Review*, March, pp 73-86.

Basel Committee on Banking Supervision (2008): "Liquidity Risk: Management and Supervisory Challenges", *BCBS Report*, September.

Bank for International Settlements (2005): Chapter 7, *75th Annual Report*, June.

——— (2008): "Overview", *BIS Quarterly Review*, December, pp 1-24.

——— (2009a): Chapters 6 and 8, *79th Annual Report*, June,

——— (2009b): "Addressing financial system procyclicality: a possible framework", Note for the FSF Working Group on Market and Institutional Resilience, April

Bernardo, A and I Welch (2004): "Liquidity and financial market runs", *Quarterly Journal of Economics*, Vol 119(1), February, pp 135-158.

Borio C (2003): "Market distress and vanishing liquidity: anatomy and policy options", in A Persaud (ed), *Liquidity black holes: understanding, quantifying and managing financial liquidity risk*, Risk Publications, December. Also available (revised and updated) as *BIS Working Papers*, no 158, 2004.

——— (2007): "Change and constancy in the financial system: implications for financial distress and for policy", in Reserve Bank of Australia (ed), *Financial system: structure and resilience*, Proceedings of a conference, Reserve Bank of Australia, Sydney. Also available as *BIS Working Papers*, no 237, October.

——— (2008): "The financial turmoil of 2007–?: a preliminary assessment and some policy considerations", in *Revista de Estabilidad Financiera*, Bank of Spain. Also available as *BIS Working Papers*, no 251, March.

Borio C and P Disyatat (2009): "Unconventional monetary policies: an appraisal", paper used as basis for a keynote lecture at the Money Macro and Finance Annual Conference, 7-9 September, Bradford, United Kingdom, *BIS Working Papers*, no 292, November.

Borio, C and W Nelson (2008): "Monetary operations and the financial turmoil", *BIS Quarterly Review*, March, pp 31-46.

Borio, C and K Tsatsaronis (2006): "Risk in financial reporting: status and suggested future directions", *BIS Working Papers*, no 213, August.

Borio, C and P Van den Bergh (1993): “The nature and management of payment system risks: an international perspective”, *BIS Economic Papers*, no 36, February.

Borio, C and W White (2004): “Whither monetary and financial stability? The implications of evolving policy regimes”, in Monetary policy and uncertainty: adapting to a changing economy, proceedings of symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, 28-30 August, pp 131–211. Also available as *BIS Working Papers*, no 147, February.

Borio, C and H Zhu (2008): “Capital regulation, risk-taking and monetary policy: A missing link in the transmission mechanism?”, *BIS Working Papers*, no 258, June.

Brunnermeier, M (2008): “Deciphering the Liquidity and Credit Crunch 2007-08”, *Journal of Economic Perspectives*, forthcoming.

Brunnermeier, M and L Pedersen (2007): “Market liquidity and funding liquidity”, *NBER Working Paper*, no 12939, February.

Calomiris, C (2008): “The subprime crisis: what’s old, what’s new, and what’s next”, paper presented at the Federal Reserve of Kansas City Colloquium, “*Maintaining financial stability in a changing financial system*”, Jackson Hole, Wyoming, 21-22 August.

Calomiris, C and C Kahn (1991): “The role of demandable debt in structuring optimal banking arrangements”, *The American Economic Review*, (81) June, pp 457-513.

Cao, J and G Illing (2008): “Monetary policy and liquidity shortages”, *CESifo Working Paper Series*, no 2210, February.

Carney, M (2009): "Some considerations on using monetary policy to stabilize economic activity" remarks at the symposium on Financial stability and macroeconomic policy” sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, 22 August.

Cecchetti, S G (2008): “Crisis and responses: the Federal Reserve and the financial crisis of 2007-2008”, *NBER Working Papers*, no 14134, June.

Cecchetti, S G, J Gyntelberg and M Hollanders (2009): “Central counterparties for over-the-counter derivatives”, *BIS Quarterly Review*, September, pp 45-59.

Committee on the Global Financial System (1999): *A review of financial market events in autumn 1998*, CGFS Report, no 12, October.

——— (2008): *Central bank operations in response to the financial turmoil*, CGFS Report, no 28, July.

Counterparty Risk Management Policy Group (2008): *Containing Systemic Risk: The Road to Reform*, The Report of the CRMPG III, 6 August 6.

Diamond, D and P Dybvig (1983): “Bank runs, deposit insurance and liquidity”, *Journal of Political Economy*, no 91, pp 401–19.

Domanski, D and S Ramaswamy (2008): “Government-led rescue initiatives”, *BIS Quarterly Review*, December, pp 10-11.

Drehmann, M and K Nikolaou (2009): “Funding liquidity risk: definition and measurement”, *ECB Working Papers*, no 1024, also forthcoming (revised and updated) in *BIS Working Papers*.

Duffie D and H Zhu (2009): “Do Central Clearing Counterparties Reduce Counterparty Risk?," Stanford Unviversity, Graduate School of Business, Working Paper, March 2009.

Farhi, E., and J. Tirole (2009): "Collective Moral Hazard, Maturity Mismatch, and Systemic Bailouts", mimeo.

Financial Stability Forum (2009): Report of the Financial Stability Forum on addressing procyclicality in the financial system, Basel, April.

——— (2008a): *Report of the Financial Stability Forum on enhancing market and institutional resilience*, 11 April.

——— (2008b): *Report of the Financial Stability Forum on enhancing market and institutional resilience: Follow-up on Implementation*; 10 October.

Fender, I, A Frankel and J Gyntelberg (2008b): "Three market implications of the Lehman bankruptcy", *BIS Quarterly Review*, December, pp 87–101.

Fender, I, N Tarashev and H Zhu (2008a): "Credit fundamentals, ratings and value-at-risk: CDOs versus corporate exposures", *BIS Quarterly Review*, March, pp 87–101.

Geithner, T (2008): "Reducing systemic risk in a dynamic financial system", remarks at The Economic Club of New York, New York, 9 June.

Goodhart, C (2007): Luncheon speech at the Institute of International Finance (IIF), Washington DC. 20 October.

Gorton, G (2008): "The subprime panic", *NBER Working Paper*, no 14398, October.

Greenspan, A (1999): "Lessons from the global crisis", remarks before the World Bank Group and the International Monetary Fund, *Program of Seminars*, Washington DC, 27 September.

Group of Ten (2001): *Consolidation in the financial sector*, Bank for International Settlements, Basel.

Group of Twenty (2008): *Declaration of the summit on financial markets and the world economy*, Washington DC, 15 November.

Heider, F, M Hoerova and C Holthausen (2009): "Liquidity Hoarding and Interbank Market Spreads: The Role of Counterparty Risk", *European Banking Center Discussion Paper*, no 2009-11S.

Hellwig, M (2008): "Systemic risk in the financial sector: an analysis of the subprime-mortgage financial crisis", Max Plank Institute for research on Collective Goods, November, mimeo.

Ho, C and F-L Michaud (2008): "Central bank measures to alleviate foreign currency funding shortages", *BIS Quarterly Review*, December, pp 14-15.

Hördahl, P and M King (2008): "Developments in repo markets during the financial turmoil", *BIS Quarterly Review*, December, pp 37-53.

Huang, R and L Ratnovski (2008): "The dark side of bank wholesale funding", mimeo.

Ionnadou, V P, S Ongena and J L Peydró (2008): "Monetary policy, risk-taking and pricing: evidence from a quasi-natural experiment", paper presented at the 9th Jacques Polak Annual research Conference, IMF, Washington D C, 13-14 November.

Jiménez, G, S Ongena, J L Peydró and J Saurina (2007): "Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk", *CEPR Discussion Paper*, no 6514.

Kashyap, A, R Rajan and J Stein (2008): "Rethinking capital regulation", paper prepared for the Federal Reserve Bank of Kansas City Symposium at Jackson Hole, August.

Knight, M D (2007): "Now you see it, now you don't: risk in the small and in the large", speech delivered at the Eighth Annual Risk Management Convention of the Global Association of Risk Professionals, 27–28 February. Also available as *BIS Speeches*, 2 March.

——— (2008): “Now you see it, now you don’t: the nature of risk and the current financial turmoil”, speech delivered at the Ninth Annual Risk Management Convention of the Global Association of Risk Professionals, 26 February. Also available as *BIS Speeches*, 29 February.

Korineck, A (2008): “Systemic risk-taking: amplification effects, externalities and regulatory responses”, mimeograph.

Ledrut, E and C Upper (2007): “Changing post-trading arrangements for OTC derivatives”, *BIS Quarterly Review*, December, pp 83-95.

Minsky, H P (1982): “Can “it” happen again?”, *Essays on Instability and Finance*, Armonk: M E Sharpe.

McGuire, P and G von Peter (2009): “The US dollar shortage in global banking”, *BIS Quarterly Review*, March, pp 47-63.

Michaud, F-L, and G Schnabel (2008): “Central bank balance sheets”, *BIS Quarterly Review*, December, pp 18-19.

Plantin, G, H Sapra and H S Shin (2008): “Fair value accounting and financial stability”, *Chicago GSB Research Paper*, no 08-15, July.

Rajan, R J (2005): “Financial markets, financial fragility, and central banking”, paper presented at “The Greenspan Era: Lessons for the Future” – Symposium sponsored by the Federal Reserve Bank of Kansas City; Jackson Hole, Wyoming, 25–27 August.

Shim, I and G von Peter (2007): “Distress selling and asset market feedback”, *BIS Working Papers*, no 229, January.

Shirakawa, M (2009): “Some thoughts on incentives at micro- and macro-level for crisis prevention”, remarks at the Eighth BIS Annual Conference, Financial and macroeconomic resilience – revisited, Basel, June 26.

Taylor, A and C Goodhart (2006): “Procyclicality and volatility in the financial system: the implementation of Basel II and IAS39”, in S Gerlach and P Gruenwald (eds) *Procyclicality of financial systems in Asia*, IMF and Hong Kong Institute for Monetary Research, Palgrave MacMillan, New York.

Trichet, J-C (2009): “Credible alertness revisited”, speech delivered at the symposium on Financial stability and macroeconomic policy, sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, 22 August.

Tirole, J (2009): “Illiquidity and all its friends”, paper presented at the 8th BIS Annual Conference on "Financial Systems and Macroeconomic Resilience: Revisited", 25-26 June, Basel.