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Structural Aspects of Market Liquidity from a Financial Stability Perspective

**A discussion note
prepared by the CGFS for the March 2001 meeting
of the Financial Stability Forum (FSF)**

Introduction and overview

At its September 2000 meeting, the Financial Stability Forum (FSF) invited the Committee on the Global Financial System (CGFS) to consider whether recent structural changes had adversely affected the liquidity of financial markets. To help prepare the CGFS's response to this, the Bank of England hosted a meeting of CGFS representatives and senior managers of about a dozen global financial firms in London on 14 December 2000. The meeting was chaired by Ian Plenderleith. At this meeting, senior private sector managers, many of whom with direct management responsibility for their firms' trading activities, were asked to set out their views as to whether liquidity conditions had recently changed in the core financial markets and, if so, what had been the factors behind the change. This note incorporates the results of this discussion.¹ In addition, it draws on earlier work by the CGFS, other BIS groupings and submissions by central banks. A background paper prepared for the September 2000 CGFS meeting examined some commonly used indicators of market liquidity. This is reproduced as an annex to this note.

Liquidity is difficult to define and even more difficult to measure.² Of the several dimensions of market liquidity, two of the most important are *tightness* and *depth*.³ Tightness is a market's ability to match supply and demand at low cost (measured by bid-ask spreads), while market depth relates to the ability of a market to absorb large trade flows without a significant impact on prices (approximated by volumes, quote sizes, on-the-run/off-the-run spreads and volatilities). When they raise concerns about the decline in market liquidity, market participants typically refer to a reduced ability to deal without having prices move against them, that is, about reduced market depth.

According to market commentary, liquidity in many markets never fully recovered from the sharp deterioration experienced during the 1998 financial crisis. However, market participants at the London meeting nevertheless expressed the view that liquidity conditions were, at the current juncture, not a cause of acute concern. Moreover, it was acknowledged that cycles in liquidity conditions have been a recurring feature of financial markets.

Commonly used indicators of market liquidity, although being notoriously imperfect measures of liquidity conditions, also suggest a rather benign picture. While the autumn of 1998 is indeed identified as an adverse shock to the liquidity of financial markets, liquidity indicators seem to suggest that, with the notable exception of the US government bond market, liquidity conditions have been broadly restored to pre-crisis levels. However, the usual indicators typically capture only a single dimension of

¹ This note was submitted to the March 2001 meeting of the Financial Stability Forum, after being discussed by the CGFS.

² Market liquidity, as pointed out in a note submitted by the Swiss National Bank, has been a subject of interest for more than 100 years. One of the early students of liquidity was Carl Menger, the founder of the Austrian school. Menger, in an 1892 article in the *Economic Journal*, set out a concept of market liquidity which is fully consistent with that employed by those seeking to integrate liquidity risk with contemporary techniques of risk measurement and management.

³ See the March 2000 CGFS study group report on *Market Liquidity: Research Findings and Selected Policy Implications* for a detailed discussion of market liquidity dimensions. The group was chaired by Masaaki Shirakawa of the Bank of Japan.



market liquidity and none of them is forward looking in nature, making it difficult to draw any conclusions as to what liquidity conditions might be in times of future stress.

While idiosyncratic factors might be cited as being responsible for the perception of low liquidity in specific markets, reduced liquidity is unlikely to be a purely conjunctural phenomenon. This note sets out to highlight, from a financial stability perspective, some of the structural factors at work. In doing so, it focuses on developments bearing on liquidity conditions at three different levels, namely:

- (i) **Firms:** developments at the level of the main financial firms participating in the core financial markets;
- (ii) **Markets:** developments in the structure and functioning of markets themselves; and
- (iii) **System:** developments across the global financial system as a whole.

This note illustrates how such structural developments may have served to reinforce the links between liquidity and credit risks, but also the distinction between normal times and times of stress. Discussions with market participants have revealed few concerns about liquidity problems under present market conditions. It was felt that liquidity pre-LTCM in many markets was underpriced, and that this led financial institutions to underestimate liquidity risks ("liquidity illusion"). One participant argued that such underpricing inhibited developments that would enhance the market's ability to retain liquidity in times of stress. There have indeed been several occasions since the LTCM crisis when conditions in some markets turned adverse but liquidity, which typically declined sharply in the midst of the crisis, proved to be rather resilient.

However, some elements of recent developments might influence the behaviour of market participants in a way suggesting that market dynamics in times of extreme stress may have changed significantly. Financial consolidation, the increasing use of non-government securities as hedging and valuation benchmarks, and other developments may have heightened concerns about credit risk. Such concerns can undermine market participants' willingness to enter into transactions and thus weaken market liquidity in a more uncertain environment. Other elements, such as collateralisation practices and developments in risk management policies, which should generally enhance market stability, could add pressure in times of extreme stress.

Developments at the level of the main financial firms

Two related questions dominate any consideration of how far developments at the level of the firm have affected market liquidity. The first is whether the managements of major financial firms have become more reluctant providers of risk capital to their firms' trading operations in the wake of the near-forced liquidation of LTCM's positions in the autumn of 1998. The second is how far a standardisation of management practices has contributed to heightened risk of herding behaviour in practice.

(a) The supply of risk capital

In the presentations and follow-up discussions at the December meeting, private sector participants spoke of the emphasis now being placed on interpreting and appropriately responding to equity market signals and of market discipline as influencing internal resource allocations across business lines and capital devoted to trading activity. The demonstrated willingness of equity markets to penalise earnings volatility has led firms to scale back limits assigned to proprietary trading and interdealer businesses.

Some of the market participants also emphasised that large financial firms have come to the conclusion that they can profitably sell liquidity services to customers and that such activity need not be linked to an ongoing commitment to professional trading markets. It is thus important to recognise that liquidity is also provided off-market (eg, a bank's direct provision of liquidity to its customers) and that an exclusive focus on markets alone may thus, at times, generate misleading assessments of



overall liquidity conditions. This seems to have been reinforced by financial consolidation, that is, by the declining number of dealers active in the markets. Both developments appear to be reflected in the observation that interdealer and customer-oriented businesses, at least in some markets, are now increasingly separated, with ample liquidity being provided in the customer market and a notable hesitancy to offer open two-sided quotes to other dealers.⁴ In turn, this point of view highlights the importance of the question of whether market end-users are willing to pay a fair price for guaranteed access to liquidity services.

A related development has been the increased emphasis on risk-adjusted measures of return. This may mean that less capital is devoted to market making activity and proprietary trading and may also imply that pricing anomalies may have to become larger to induce market participants to take advantage of them. A similar implication might pertain to markets with transparency-enhancing features, such as those provided by some electronic trading platforms, which may have triggered declining profit margins and thus a retreat of major traders. Finally, at the London meeting, some market participants suggested that the process of consolidation in the financial system may have reinforced the decline in capital devoted to trading and market making as merged entities usually ended up having less risk capital than the combined risk capital of the once separate institutions.

(b) The standardisation of risk measurement and management practices

At the London meeting, a number of the market participants expressed awareness of the argument that the tendency to adopt market-wide management benchmarks and tools could potentially lead to destabilising feedback effects in periods of market stress. Some sensitivity was expressed concerning reliance on common risk management tools, such as VaR measures, in the case of exposures traded in markets prone to gapping, such as the high-yield corporate debt markets. In particular, it was suggested that unconditional use of trading limits could lead to disequilibrating behaviour of market participants, implying the danger of substantial cumulative withdrawals of liquidity.⁵

However, any mechanistic view of the role of standardised management tools for the propagation of shocks is too simplistic for at least two reasons. First, different types of financial firms, with different risk profiles, will respond differently even if they use similar techniques. Secondly, actual decisions are subject to management discretion. In addition, market participants tend to differentiate between asset categories in terms of choosing risk measures to set trading limits. The use of alternative tools was given much emphasis by market participants. For example, some market participants, in the discussions in December, pointed to the importance of relying on stress tests, as opposed to VaR measures, to set limits where exposures (for example, in emerging market securities) could not be readily adjusted through market transactions.

Another market practitioner noted that the awareness of deficiencies of standard VaR measures had led firms to commonly use alternative VaR calculations⁶ and to use (as mentioned above) supplementary risk measures, such as stress tests. A recent report to the CGFS found that banks do

⁴ However, it was also noted that, in some markets, use of electronic broking systems has allowed banks to access liquidity in the market without the obligation to make two-way markets. Electronic broking, for example in the FX market, thus removes the need for reciprocal pricing agreements, meaning that fewer participants accumulate positions that they did not want in the first place.

⁵ See the note entitled *Risk management: improvement in techniques and impact on the functioning of financial markets*, prepared by the Banque de France, and the discussion on "greater homogeneity" below.

⁶ One participant mentioned the common practice of calculating VaR with more weight accorded to recent data than that given to less recent observations (exponential weighting). The objective of such a procedure is to more closely approximate historical distributions of volatility. That is, the objective involves increasing the sensitivity of measured VaR to recent historical data, a reasonable alternative from any firm's point of view but one with potential adverse systemic consequences if it were to be even more widely adopted.



not apply strict, mechanistic policies in response to stress test results.⁷ If banks exercise judgement and adopt a case-by-case approach, then the risks of herding are reduced.

Over the years, the CGFS has regularly reported on how markets have been influenced by structural developments and by advances in financial modelling. Recent years have been a particularly intensive period of development of financial risk models for both regulatory and internal risk management purposes. The use of such models has often been triggered by exceptional events such as LTCM and Y2K; but once in place, they are likely to have durable effects.⁸

Developments in the structure and functioning of markets

The three main features of changes in the structure and functioning of markets that may have affected the liquidity of markets are: the increased use of collateral; the wider use of electronic trading; and the reduced supply of government bonds in some markets.

(a) Use of collateral

The first question is whether, as trading tends to create short-lived credit exposures, there is a natural link between market liquidity and credit risk in normal as well as stress times. A precondition for deep and liquid markets is the willingness and ability to transact, which is a function of the credit risk involved. Collateral, being a risk mitigation device, can therefore support trading and foster market liquidity in general. By facilitating the continued supply of credit to borrowers who run into temporary difficulties, the effective use of collateral can limit the amplification of economic shocks.⁹ Private sector participants at the December meeting in London commented that use of collateral was viewed as essential for a smooth transfer of risks in normal times and for making the financial system more resilient to shocks.

However, the use of collateral can in certain circumstances also alter market dynamics. In particular, abrupt adjustments of collateral standards in times of stress could magnify market disturbance. In this regard, collateral management shortcomings, such as too narrow haircuts or infrequent monitoring of exposures, have been identified as a potential trigger for large margin calls and for the possibility of excessive selling pressures. This might not only further reduce liquidity in the already distressed market, but could also create contagion effects as the need to liquidate assets and to meet margin calls can affect other markets as well.

⁷ The report of the CGFS Task Force on a Census of Stress Tests, entitled *A survey of stress tests and current practice at major financial institutions*, was published in April 2001. The group was chaired by Alain Duchateau of the Commission Bancaire. It finds that there is no uniform response by the banks reporting on the census to the information gained through stress testing. In this regard, the Task Force notes a contrast between VaR, where a mechanical link between market shocks and banks' responses has been suggested in the past, and stress testing where practices are so heterogeneous that a potential for feedback trading is not evident from the census.

⁸ One practitioner at the December 2000 meeting illustrated this point by explaining how her own firm had deployed financial modelling techniques to help plan for possible Y2K-related market squeezes. She noted that the approaching Y2K problem raised overall awareness of problems relating to credit and liquidity risks, and went on to suggest that her firm would not have acquired its current modelling capability in the absence of regulatory and market interest in how the firm was managing Y2K risks. Even though Y2K proved to be a non-event for her firm, the preparations for managing it would have lasting effects. In particular, the management of the firm has come to routinely consider the firm's exposures to exceptional, but plausible, events that could trigger unusual, liquidity-related market developments. Such assessments now continue to have an impact on the firm's management decisions.

⁹ Several recent reports by Basel-based committees have dealt with issues related to collateral. The most recent is *Collateral in Wholesale Financial Markets: Recent Trends, Risk Management and Market Dynamics*. A motivation for the report, published on 6 March 2001, was the Committee's assessment that the use of collateral and related market practices had contributed to market disruptions in the summer and autumn of 1998. The CGFS Working Group on Collateral was chaired by Christine Cumming of the Federal Reserve Bank of New York.



The Report of the CGFS Working Group on Collateral assessed the possible significance for market dynamics of the growing use of collateral by market participants. The report identifies a number of channels through which increased market risk can lead to increased liquidity risk. This has implications for prudent risk management by individual firms who employ collateral to manage counterparty risk exposures in light of the market dynamics. In this regard, the potential significance for market liquidity at times of stress of the risk management policies of individual firms is of some importance.

(b) Choice of trading platforms

Market participants have exhibited considerable inertia in changing trading platforms, perhaps because of a collective awareness about the potential costs of the choice of a wrong trading system. Nevertheless, electronic trading platforms have become established and have captured, most notably in the interdealer foreign exchange market, a sizeable market share. As some of these systems, for example the Electronic Broking Services' (EBS) Spot Dealing System in the foreign exchange markets, rely on electronic order books and thus on limit orders as the ultimate source of market liquidity, concerns have been raised about the appropriateness of order books when order flows are thin or too lumpy. Another point of concern is the reliability of order-driven platforms to ensure liquid markets in times of stress.

In quote-driven markets, market makers stand ready to provide immediacy and accommodate even large orders by use of their inventories without significant impact on prices. Quote-driven systems can thus be regarded as providing greater market depth. In order-driven systems, by contrast, the activity of the market maker is taken over by a central limit order book that is used to match orders. Much of the concern about liquidity in times of stress and the increasing popularity of electronic order books has focused on the notion of "fair weather liquidity", ie liquidity that is sufficient in normal times but deteriorates appreciably as conditions become more volatile. The behaviour of limit orders, the ultimate source of liquidity in order-driven systems, is at the heart of these concerns. Limit order providers basically offer free options to the market that can be "hit" if circumstances change. This may lead to the departure of limit orders from order-driven markets in times of increasing uncertainty. However, this tendency of limit orders to be removed from the order book in more volatile times mirrors the disincentives of market makers in quote-driven markets to provide liquidity in periods of one-directional market movements. The relative reliability of either of the two extreme market structures in terms of providing liquidity in times of stress is thus not easy to determine.

A recent report by the CGFS Working Group on Electronic Trading¹⁰ concluded that many of the worries about electronic trading systems were exaggerated and that such systems had successfully coped with several specific episodes of sharp price change. It was nevertheless concluded that conditions can evolve rapidly in this area and that the CGFS should continue to periodically monitor developments.

It could be argued that the development of a network of different, yet co-existing, trading systems will be the path of evolution in the future. Such systems would operate in parallel but would be tied together through technology that creates an appearance of consolidation (possibly called virtual consolidation). At present, however, markets appear to be in a state of flux as the uncertainty as to which systems will prevail and how the others will interact.

(c) Supply of government debt

The final question is whether the reduced supply of government bonds will adversely affect the functioning of bond markets in a durable way. In theory, the answer to this question would seem "no"

¹⁰ The CGFS Working Group on Electronic Trading was chaired by Jos Heuvelman of De Nederlandsche Bank. Its report entitled *The Implications of Electronic Trading in Financial Markets* was published in January 2001.



because the key benchmark role of government bonds could in future be fulfilled by substitutes such as issues of high-credit and large-volume borrowers or by interest rate swaps.¹¹

The information available at present does not support the presumption that changes in the supply of government debt clearly dominate other factors in determining the liquidity of fixed-income markets. For example, in the case of the US market, the evidence is that adjustments have been made in market practices that have accommodated the reduced supply of US Treasury securities in a manner that has largely preserved overall liquidity in US fixed-income markets. For example, US agencies have stepped in with sizeable amounts and have sought to improve the liquidity of their debt instruments. As a result, their debt management programmes have come to mimic that of the US Treasury and the outstanding stock of agency securities has grown relative to the US Treasury market.

In practice, however, two (somewhat alternative) concerns have been raised. One is that there may be certain impediments to a smooth transition such as regulations requiring the use of government bonds in pricing as well as in asset allocation, existing legal contracts or conventions with similar effects. Other impediments may be harder to remove – for instance, doubts about the durability of high credit standing or even simply the force of customary practice over many years. Consequently, the increase in the scale of debt issuance of the US agencies has given rise to concerns about their appropriate credit treatment. One issue is what can be done to ease such impediments. The second concern is that markets may too quickly settle on a single benchmark that is not entirely satisfactory on all grounds. For instance, there might be reservations about the choice of US agency debt if this reflected the misperception that such debt is covered by a government guarantee.

Developments across the financial system as a whole

Three developments in the financial system in recent years may have exerted important influences on liquidity: (a) the intensified importance of counterparty risk in times of stress; (b) developments leading to greater homogeneity of market participants' reactions; and (c) greater transparency. These are considered in turn.

(a) Intensified importance of counterparty risk in times of stress

There are several reasons why the distinction between normal and stress periods may have grown in importance over time. One reason is that trades in wholesale financial markets can generate large credit exposures, particularly under severe stress, when counterparty and credit risks¹² are likely to increase. Heightened concerns about credit risk have an adverse impact on the willingness of market participants to enter into transactions and, thus, to provide depth to the market. Hence they become of first order importance for the determination of market liquidity in times of stress, whereas they generally play a subsidiary role otherwise.

An important example in this regard is the closure of Herstatt Bank.¹³ In this case, credit exposures were generated in the course of the clearing and settlement of interbank foreign exchange contracts.

¹¹ The following discussion draws on the material of the Study Group on Fixed-Income Markets, a group of BIS and central bank researchers, chaired by Eli Remolona (BIS). See also the note on benchmark tipping in the bond market in the February 2001 issue of the *BIS Quarterly*.

¹² Counterparty risk relates to the possibility of loss from extensions of credit that will not be settled (such as derivatives contracts) or repaid (interbank loans or placements).

¹³ Herstatt was a medium-sized commercial bank headquartered in Cologne, Germany. In the early 1970s, Herstatt became a major player in the interbank foreign exchange market. It suffered losses and, as a result, its banking licence was revoked in June 1974. At the time of its closure, Herstatt was in the middle of completing interbank foreign exchange transactions that it had entered into two days earlier. Banks that had paid DMs into Herstatt's accounts were not paid countervalues due in dollars. In testimony to a committee of the US Senate in May 1990, President Corrigan of the FRBNY commented that the



Counterparty risk, however, can also arise between the payment and delivery legs of securities trades. In addition, counterparty credit risk is also inherent in uncollateralised derivatives transactions, as the size of exposures can be very sensitive to changes in market prices. In turn, the post-1998 spread of collateralisation arrangements to manage counterparty credit exposures has been attributed to the lessons learned from the Asian crisis and the disruptive events in financial markets in the autumn of 1998.¹⁴ Growing awareness of counterparty risk might also be reflected by the increased recourse to repo transactions instead of uncollateralised money market trades.

Another reason is that the monitoring of counterparty exposures may have become more demanding. This is, in part, a reflection of the greater emphasis on market-sensitive (such as financial options involving volatile asset prices) rather than market-insensitive (such as short-term interbank loans at a fixed spread over a benchmark rate) contracting. Given the risks involved, firms now frequently update, within the course of a trading day, measures of their exposures to counterparties even in the absence of any account activity.

(b) Greater homogeneity

The importance of heterogeneity of opinion for providing market depth, that is the ability of markets to absorb large orders without significant price impact, is part of the academic literature's discussion of yet another relationship pertaining to market liquidity issues, the link between asset market crises and liquidity crises. Two features of models under which a liquidity crisis will coincide with an asset market crisis have recently been highlighted.¹⁵ The first involves homogeneity of actions among agents modelled. The second feature is the presence of strategic interaction between agents: because of feedback effects between agents' actions and prices, the actions of one market participant can come to depend on those of others via a price linkage. Furthermore, modellers have sought to differentiate normal from stressed market conditions by modelling efforts that produce rational herding behaviour, that is, liquidations of positions on the assumption that other market participants will be selling notwithstanding their own views as to fundamental value.

(c) Greater transparency

A final lesson from previous episodes of strain on market liquidity is that times of stress are typically preceded by extended periods during which the underlying problems were building up, but were often hidden because of inadequate standards of transparency. Manifestations of liquidity under stress are thus symptomatic of problems associated with why and how imbalances develop in the first place. The role of transparency in improving the functioning of financial markets has long been of interest to the CGFS, which has considered various questions related to what should be public policy regarding the dissemination of information. It has been particularly sensitive to the need to be clear as to how more information in the form of improved financial statistics could improve outcomes. At the same time, it has considered some special circumstances under which some forms of transparency could be disruptive to markets. For example, it can be argued that increased transparency can lead to strategic and potentially disruptive behaviour of market participants in highly concentrated markets. In such an environment, the provision of information is likely to induce market turbulence that would not occur in a less concentrated environment. This is because all market participants will feel compelled to react immediately to "news" about the likely future behaviour of one of only a few other market participants. The importance of this point becomes greater when one takes into account the fact that concentration

broad lesson of Herstatt was the importance for regulatory action of recognising the global nature of the marketplace. (See Statement by E Gerald Corrigan before the US Senate Committee on Banking, Housing and Urban Affairs, May 3, 1990).

¹⁴ See the above discussion on collateral practices which provides an example for the link between shifts in credit risk perception and the tightening of market liquidity conditions in times of stress.

¹⁵ See, for example, *Risk Management with Interdependent Choice*, Bank of England Financial Stability Review, November 1999.



across financial markets involves a shrinking number of firms. Information related to the positions of very large consolidated firms can thus affect market behaviour in a large number of individual asset markets.

A related point involves the disclosure of a market's trading information. Trading transparency refers to the degree that market participants are able to observe various workings of the markets themselves, for example, the degree to which market participants can observe pre- and post-trade prices as well as the volumes of completed trades. Many of the new electronic trading platforms have served to enhance this kind of transparency. Generally, transparency of trading information is seen as important for the proper functioning of markets, specifically for the promotion of reliable price discovery and efficient risk allocation. Improved trading transparency is thus assumed to add to market liquidity.

It should be noted, however, that increased trading transparency, similar to what was said above, is not always beneficial to market liquidity. There are circumstances where enhanced trade information could be detrimental to liquidity supply as it might hamper the ability of market makers to pass on excess inventories, thus limiting their willingness to make markets in the first place. The report of the CGFS study group on market liquidity offers an example. The report points to evidence from the Italian MTS market for government securities suggesting that less transparency, in the sense of hiding the identity of market makers behind quotes, has led to smaller spreads, ie improved liquidity. The content of an appropriate information set would hence differ from one market to another, depending on the characteristics of the market.

Concluding Remarks

Market commentary has it that liquidity in many financial markets never fully recovered to pre-1998 levels. There is little evidence, however, that liquidity in financial markets during normal times has been weakened to a degree that would raise systemic worries. Moreover, market liquidity has quite often proved resilient during several recent episodes when conditions of individual markets turned sharply adverse. Rather paradoxically, the reduction in market making activities and scaling-down of proprietary trading – often cited as reducing liquidity – might have ensured that liquidity is now "priced" more appropriately. This has reduced "liquidity illusion" and made financial institutions prepare better for adverse market conditions.

However, as explained in the previous sections of this note, the various structural developments in firms and markets could accentuate pressures on market liquidity in times of extreme stress. The authorities need to be vigilant even though recent experience has been rather reassuring about the resilience of liquidity in major markets. In times of stress, liquidity risk and credit risk in financial markets tend to converge. Heightened concerns about credit risks tend to limit agents' willingness to transact, reducing the depth of financial markets and the ability of market participants to adjust positions as risk assessments change.

Several structural factors can be cited to support some concern of reduced market depth and increased vulnerability of market liquidity conditions in times of stress. First, globalisation and consolidation have led to greater concentration among financial players. Reinforced by other developments, such as the introduction of electronic trading platforms, this may have brought about a reduction in the aggregate amount of risk capital devoted to market making and thus reduced market liquidity in general. With concentration implying an increasing reliance of financial markets on a limited number of key players, credit risk concerns could now turn out to be more important in times of stress if confidence in a major player were to be eroded. Finally, the reduction in government debt issuance led to a growing reliance on benchmark instruments that are (or may become) subject to credit risk.

Second, one should be aware that some risk mitigation devices, such as the use of collateral, and other risk management techniques might have changed market dynamics. Although supportive in normal times, collateral practices and the practice of marking assets to market could reinforce the impact of stress events on the financial system as a whole.

Some further reflection on risk management practices seems warranted. Financial firms should be encouraged to continuously improve their risk management practices, making due allowance for their



own particular risk profile and recognising and properly addressing the interaction of various types of risks. However, there is a potential concern that, if a wide range of market players would come to use mechanistic applications of standardised tools, this may increase, in certain circumstances, the extent and likelihood of market disruptions. Since it is not clear what would trigger such a concerted behaviour, careful monitoring at two levels is required. The first is of market and firm reactions during particular periods of stress. The CGFS has undertaken such work in the past.¹⁶ The second is of the developments in risk management by firms and collateralisation practices in markets. Care should also be taken to continue to improve the dissemination of information, at both the firm and aggregate levels. The former involves promoting the dissemination of information about risk profiles by strengthening standards of disclosure. The latter involves exploring the development of information about incipient market vulnerabilities that would allow market participants to assess possible dangers arising from the joint actions of all market participants.

The CGFS intends to continue its ongoing efforts to identify sources of risks and to examine possible avenues that would help mitigating the concerns explained in this note. Efforts in this regard include:

- Monitoring developments in market risk management and pricing practices, with particular emphasis on the possible reaction of market participants in times of stress;
- surveys of market developments such as e-finance and collateral practices to analyse their significance for altering market dynamics; and
- possible measures to enhance transparency so as to reduce uncertainty in markets.

The conclusion that there is no cause for alarm about market liquidity at present does not make continuous monitoring of possible risks any less important.

¹⁶ A CGFS report of 1999, entitled *A Review of Financial Market Events in Autumn 1998*, is the most recent post-mortem by the CGFS of the disruption of the international interbank markets associated with the financial difficulties of LTCM, a hedge fund that was an active participant in these markets. The group that prepared the report was chaired by Karen Johnson of the Federal Reserve Board.



Annex:

Liquidity of global financial markets – Selected findings

Overview

The fall of 1998 has been an unusual event for the liquidity of financial markets and the indicators assembled for this note confirm, with few exceptions, the deterioration that occurred at the time. Since then, and with the exception of the US government bond market, the evidence collected thus far suggests that liquidity conditions have broadly improved, in some cases, returning to levels pre-1998. In particular, it would seem difficult, based on commonly used indicators; to make a strong case that liquidity has deteriorated further in 2000, although volumes did decline in some markets, particularly foreign exchange. On the other hand, the fact that most indicators gyrated more widely in 1998-99 than in the previous two years suggests that any improvement in liquidity should be interpreted with caution. The main findings are summarised in Table 1.

Liquidity in the US government bond markets has deteriorated further post-LTCM, mainly at the long end, as a result of the buy-back of US government debt. In most other markets, the indicators suggest that liquidity has improved over the past year or so. This appears to be the case for interest rate swaps, various agency markets, emerging market debt, and most foreign exchange markets. The evidence is more mixed in the case of jumbo corporate bonds. In some markets (interest rate swaps, most non-government bonds), the deterioration around LTCM had not been noticeable in the first place. Local markets for Hong Kong, Australia, Korea and Brazil generally show substantial improvements in liquidity conditions from the lows reached at the time of country- or region-specific shocks.

Commonly used indicators of market liquidity have tended to be rather imperfect and have consisted broadly speaking of bid-ask spreads, a measure of tightness, and trading volumes, an indirect measure of depth. Measures of liquidity premia for recently issued government securities have also been considered. The purpose of this note is to discuss such evidence from about 80 indicators that cover key markets across countries over the past 4½ years. The markets are short-term interest rates, long-term interest rates, and foreign exchange, and exhibit diverse institutional and informational arrangements, and trading structures. Examination of the indicators may be useful in shedding light on frequently raised concerns that liquidity in financial markets has deteriorated, especially in recent months, across a broad range of markets. Given well-known imperfections of extant measures of liquidity and concerns about reliability of high-frequency market data, results should be viewed as work in progress.

Findings

The liquidity indicators assembled for the purpose of this note cover a wide range of markets for a wide range of countries over the period 1996 to the present. The indicators are mainly in the form of bid-ask spreads from commercial sources or from central bank surveys (about 50 series), trading volumes (about 30 series), volatility (about 50 series), and OR/oR spreads (about 5 series). The markets include short-term interest rates, government bonds, interest rate swaps, various agency bond markets, jumbo corporate bonds, emerging market international bonds, major currency pairs, emerging market currencies, and emerging market domestic government securities. Some derivatives markets are also included. The markets are characterised by widely different institutional arrangements (commitment to make markets, firmness of quotes) and trading structures (degree of information centralisation and dissemination, order-driven or OTC).

In discussing the evidence provided by these indicators of market liquidity, it is useful to distinguish between an assessment of developments during a period that starts before the onset of the Asian crises and extends to 1999, and developments in 2000. It is also useful to examine the periods in which each indicator registered its peak and trough deterioration. Table 2 is a detailed treatment of the indicators along those lines. The data appendix contains a compilation of the data series available thus far.



Indicators for government securities markets, including those for emerging market sovereign bonds and some US agency securities, generally suggest that the Russia/LTCM event in the fall of 1998 was unusual in the period 1996-2000. The Johnson report also described the event as unusual, but concluded from an examination of financial markets in the 1990s that it was not exceptional. It may be noted that very few of the quoted bid-ask spreads for interest rate swaps or non-government bonds actually widened in the fall of 1998.¹⁷ Most of the indicators assembled for this note that did widen during the crises period show that liquidity has since improved, sometimes significantly, across a large cross-section of markets, with the notable exception of the US government bond market. The evidence on improvement is not limited to emerging market currencies and fixed-income, although it is among the most striking in those markets. The nature and degree of the improvement may also reflect the impact of factors that are specific to some markets, eg, the development of jumbo agency, Pfandbriefe and corporate bonds. Also of note, Russia/LTCM was not necessarily the worst liquidity event of the period 1996-2000 in the local emerging markets. For those markets, "worst" tended to be associated with a country/region specific shock. For example, most indicators for Hong Kong show that the Asian crisis in the fall of 1997 was a more important event.

The deterioration of liquidity in the US government bond market seem to have intensified since the February 2000 Treasury refunding announcement, and, in the ten year sector, has significantly exceeded the one that occurred at the time of Russia/LTCM. However, not all measures necessarily point in the same direction. The spread of the US 10 year on-the-run over the US Treasury fair market curve suggest that liquidity has broadly returned to pre mid-1997 levels, although the volatility of this particular indicator has been high. At the short end of the US yield curve, the US dollar 3 month Treasury bill and the dollar libor market have also shown some signs of strain in 2000, in the latter case more so in the six months and one year segments than in the three months.

A recent study of the German Bund market during 1998 finds that, while transaction costs deteriorated during the crisis months of the fall, the market was able to handle a significantly higher level of activity and transaction costs returned to normal in a matter of weeks.¹⁸ More recent surveys conducted in 1999 have shown that the introduction of the euro has led to better liquidity in euro repo and money markets, particularly in the interest rate swap markets, but cash markets for bonds had seen no noticeable change.¹⁹ Cheapest-to-deliver Bunds are an exception, as off-the-run German 10 year Bunds that are in the basket of deliverables for the Eurex Bund futures have sometimes been more actively traded than on-the-runs in the days prior to the expiration of the nearby contract. By early 2000, the liquidity premium of the on-the-run 10 year Bund had largely returned to 1997 levels. However, the premium widened again, although moderately, in May 2000, reflecting expectations concerning the impact of UMTS licenses on future supplies of Bunds (euro swap spreads also widened at the same time as issuance of euro-denominated corporate bonds to finance the bids intensified). The liquidity premium of the on-the-run JGB has broadly returned to 1997 levels.

There is little evidence in the indicators collected thus far of a recent and broad-based deterioration in other fixed-income markets, such as interest rate swaps, jumbo agency or corporate bond markets.²⁰

Quoted bid-ask spreads in dollar interest rate swap markets have been stable since 1997, suggesting little change in the liquidity of this particular market. The same appears to true of interest rate swaps in other currencies.²¹ This is in contrast to another indicator that some observers have been using with increasing prominence in discussions of liquidity deterioration, namely the spread of swap rates over

¹⁷ Quoted bid-ask spreads have tended to be higher than survey or effective spreads in those few cases where data are available on the latter ones. One reason often cited is the fact that dealers will tend to be competitive on only one side of the market, for reasons of inventory control.

¹⁸ Upper (2000).

¹⁹ See ECB (2000). An update of the 1999 survey is currently being implemented.

²⁰ Most of the data for these markets are "Bloomberg Generic Prices" calculated by using prices contributed by financial firms and any other information that is considered relevant. The methodology used by Bloomberg is proprietary and seeks to achieve consensus pricing. If consensus is not reached, securities are marked "not priced."

²¹ Discrepancies appear to exist for particular series across data providers.



yields of benchmark government bond. The latter spreads have widened dramatically post-LTCM and again in 2000, particularly in the dollar market, because reduced supply of government benchmarks has been accompanied by declines in their yields. However, judging from direct proxies of liquidity in the swap market, it may not be justified to use such relative spreads as evidence of declining liquidity in fixed-income markets as a whole, in which the swap market plays a pivotal role.²² There is evidence that the correlation between dollar swaps and US corporate debt makes swaps a somewhat more attractive hedging instrument than Treasuries (see BIS Quarterly Review, February 2000).

In the US agencies market, bid-ask spreads increased from 4 bp in 1998 to a peak of 8 bp in the third quarter of 1999 across the four jumbo securities examined in this note; spreads have been stable at around 6 bp since March 2000. Average daily trading volumes of agency mortgage related securities doubled between 1996 and 1998 to \$71 billion. Volumes declined in 1999 and again in 2000 to stand currently at \$65 billion. Turnover in this market is on the order of 2 percent of the outstanding, compared to about 7 percent in the Treasury market.

Three jumbo 10 year Pfandbriefe have been issued between 1997 and 1998. Although bid-ask spreads did widen on average in 1999 from about 5 to 20 bp, they have since then returned to levels of between 3 and 12 bp. Trading volumes of these bonds have tripled between 1999 and 2000.

The evidence on liquidity from bid-ask spreads in the corporate bond market, both dollar-based and euro-based, varies across securities, likely reflecting factors that are specific to each issue.²³ It is worth noting that none of the 13 (12 fixed rate and one floating rate) securities assembled for this note saw a widening of bid-ask spreads in the fall of 1998. Some telecom bonds have experienced pronounced fluctuations in 2000 spreads, possibly reflecting the new uncertainties regarding credit risk. Of four US dollar jumbo Ford bonds that have been issued since 1997, bid-ask spreads for two ten years doubled since May 2000, while spreads for two five years have declined steadily since 1999. The three euro KfW 10 years that have been issued since 1997 show divergent bid-ask spreads in 1999, but a consistent narrowing into 2000.²⁴ Trading volumes for the KfWs appear to be 1/4th of the peak volumes reached in the fall of 1998.

In the foreign exchange markets, the major currencies' bid-ask spreads have broadly returned to pre-1998 levels.²⁵ However, volume has been declining appreciably since 1998, a fact often highlighted in discussions of liquidity in FX markets. Spreads on dollar/yen have been on a declining trend since 1998, while spreads on dollar/euro have remained generally stable. Bid-ask spreads in the major FX option markets show broadly similar patterns of widening in 1998-99, followed by sizeable improvements into 2000. Although there have reportedly been localised episodes of price gapping in the euro/dollar and euro/yen markets in 2000, it is difficult to assess their importance without access to long series of continuous matched intraday prices. Data on electronically brokered deals suggest that total FX market activity started to decline in the third quarter of 1998 against the background of a general reduction in financial market activity at that time, and did not pick up noticeably since then. This had been supported by an informal survey of FX turnover conducted in the autumn of 1999 among market participants in a number of important trading centres.²⁶ In the Tokyo FX market, where voice broking continues to dominate electronic broking, the decline in volumes has also been

²² Swap spreads may be viewed as an indicator of the relative liquidity of both markets, while bid-ask spreads for swaps and for US government bonds respectively are direct proxies for the liquidity of those markets. The evidence from those direct proxies seems consistent with a liquidity-based explanation of the swap spreads that emphasise deteriorating liquidity in the US Treasury bond market. Goldman Sachs Derivatives (August 11, 2000) notes the "impressive and growing liquidity of [US interest rate] swaps."

²³ Some observers have noted an improvement in the liquidity of the US corporate bond market (see Bond Market Association, June/July 2000).

²⁴ The largest KfW outstanding is the euro 5 billion 2002 floating rate note. Bid-ask spreads on this note have on average narrowed from 4 to 3 bp since April 1999.

²⁵ Data source for FX prices is Reuters; data source for volumes is EBS.

²⁶ Liquidity in the Swiss franc/euro pair has declined. The Swiss franc is now traded more against dollars than euros while, before the introduction of the euro, most of the trading in Swiss francs involved the mark.



pronounced between 1998 and 2000. The contrast between information on liquidity given by bid-ask spreads and by trading volumes appears to be particularly pronounced in the case of the FX markets, which have traditionally been viewed as being among the most liquid markets.

Finally, activity in the US repo market and the composition of the hedge fund industry provide some indirect evidence on deleveraging in traded financial instruments. Deleveraging, including the partial withdrawal of hedge funds, has often been cited as one possible factor behind the decline in liquidity that has occurred in some markets.

When a leveraged player puts on a bond position, leverage is achieved by entering a repo agreement with a counterparty, in which margins are posted against the position. Data on activity in the US repo market cover transactions involving US government, federal agencies, and federal agencies' MBS securities. Financing provided by US primary dealers to counterparties in the form of reverse repos, and financing provided by counterparties to US primary dealers in the form of repos is separately identified. To the extent that repo positions are a form of leveraged finance, changes in the outstanding amounts of financing are evidence about leverage among the primary dealers and among their counterparties. The combined US repo market for those securities declined from \$2.7 billion in mid-1998 to \$2.5 billion in 1999, with parallel declines in both the repo and reserve repo segments; it had surged by about \$1 trillion in the two years prior to 1998.²⁷ The post-LTCM decline was more pronounced and has been longer lasting than the one that occurred between 1994 and 1995, at the time of the bond market turbulence. However, the decline seems to be coming to an end. The latest data for July 2000 indicate that average daily outstandings were above \$2.6 billion. The pick-up has been driven by increased leverage of primary dealers in the form of repos, as recent levels have surpassed 1998 peaks; leverage among counterparties in the form of reverse repos has been stable at around \$1.1 billion since 1999.²⁸

Another angle on the extent of deleveraging is provided by hedge fund data. Aggregate net asset values of hedge funds have resumed their increase in 2000, after pausing briefly in 1999 following the LTCM turbulence. Much of the recent increase appears to be related to the equity gains that have been made by hedge funds. However, NAVs of hedge funds in the categories Macro/Global and Arbitrage, which have historically tended to use leveraged strategies the most, have not recovered to the same extent, reflecting a combination of withdrawals and lower returns.

²⁷ Latest data indicate that average daily outstanding for the week ended 24 July were above \$2.6 billion. Consolidation in the US financial industry has reduced the number of primary dealers by 26 percent over the past five years.

²⁸ Data on bond futures have been used to gauge leverage in the fixed-income markets, as futures require the posting of margins in much the same way as do repos (see, e.g., Fung and Hsieh (2000), Measuring the market impact of hedge funds, *Journal of Empirical Finance*). However, open interest on several such contracts has recently shrunk in parallel with declines in the supply of underlying bonds (see, e.g., CBOT T-bond futures). This latter effect has become difficult to disentangle from the effect of deleveraging per se, which should affect many more bonds than those deliverable into a bond futures.



Table 1
Summary of main findings on market liquidity

Markets	Pre mid-97 to end-99	2000
Short-term interest rates		
Libor dollar	+	-
Libor euro	+	=
Libor yen	mixed	+
US Treasury bills	-	=
Long-term interest rates		
US government bonds	-	-
German government bonds	=	=
Japanese government bonds	-	+
Canadian/Australian government bonds	=	=
US interest rate swap market	+	=
Other major interest rate swap markets	+	=
Jumbo US agency securities	-	+
Jumbo Pfandbriefe securities	-	+
Jumbo corporate bonds	mixed	mixed
Emerging market bonds	-	+
Currency markets		
Major currency pairs	=	+
Foreign exchange options	-	+
Emerging markets		
Selected markets for Hong Kong, Brazil, Korea	-	+
<i>Counter</i>	8 "-"; 3 "="; 4 "+"	2 "-"; 6 "="; 8 "+"

Note: "-" deterioration; "=" no change; "+" improvement.



Table 2
Full sample of liquidity indicators

Markets				
(I) Short-term interest rates	Pre mid-97 to end-99	2000	Peak	Trough
Libor bid-ask spread: US dollar	+	-	7-97	9-98
Libor bid-ask spread: euro	+	=	8-96	6-98
Libor bid-ask spread: Japanese yen	Mixed	+	1-00	7-99
Libor bid-ask spread: Canadian dollar	+	+	1-97	7-00
Libor bid-ask spread: Australian dollar	+	=	9-96	4-00
Libor bid-ask spread: Hong Kong dollar	=	+	3-98	4-97
Bid-ask of US 3-month Treasury bills	-	=	10-98	6-97
Trading volume of US 3-month bill	-	=	2-99	1-00
Bid-ask of Canadian 3-month Treasury bills	-	+	12-98	8-96
Trading volume of selected interest rate futures	=	+	9-98	12-97

Note: "-" deterioration; "=" no change; "+" improvement; "na" not yet available; ".." not applicable.



(II) Long-term interest rates	Pre mid-97 to end-99	2000	Peak	Trough
Bid-ask of US government 10-year note	–	–	4-00	4-97
On-the-run premia for US 10-year note	–	+	9-99	11-98
Average quote size of US 10-year note	–	–	10-98	4-00
Bid-ask of Canadian government 10-year	=	=	10-98	4-99
Bid-ask of Australian government 10-year	+	=	2-97	4-98
On-the-run premia for euro 10-year	=	–	10-98	1-00
On-the-run premia for Japan 10-year	–	+	7-99	12-98
On-the-run premia for UK 10-year	–	+	12-98	5-98
Arbitrage indicators of government yield curves	–	+	00Q1	98Q2
Implied volatilities of selected bond yields	Mixed	+	99Q1	98Q2
Trading volume of UK government securities	–	+	10-97	12-97
Trading volume of Dutch government securities	na	na	na	na
Trading volume of eurobonds	–	na	11-97	9-99
Trading volume of euro-Bund futures	+	=	2000	1996
Trading volume of yen bond futures	–	+	1997	1-00
Bid-ask spreads of US interest rate swaps	+	=	1996	2000
Bid-ask spreads of euro interest rate swaps	+	=	1996	99Q1
Bid-ask spreads of yen interest rate swaps	+	=	1996	2000
Bid-ask spreads of UK interest rate swaps	+	–	00Q1	1998-99
Bid-ask of Canada interest rate swaps	=	=	1997	1996
Bid-ask for selected US jumbo agencies	–	+	99Q3	Mixed
Bid-ask for selected jumbo Pfandbriefe	–	+	1999	Mixed
Bid-ask for selected jumbo corporate bonds	Mixed	Mixed	1999	Mixed
Bid-ask for selected emerging market bonds	–	+	10-98	1997
Trading volume of emerging market bonds	–	+	98Q3	99Q4



(III) Currency markets	Pre mid-97 to end-99	2000	Peak	Trough
Bid-ask spreads for major currency pairs	=	+	Mixed	Mixed
Trading volume of major currency markets	+	=	1998	Mixed
Trading volume of Tokyo broker market	+	-	10-98	1-00
Bid-ask for ATM options: US\$-euro	-	+	1-00	7-98
Bid-ask for ATM options: Yen-US\$	-	+	11-98	9-97
Bid-ask for ATM options: Can\$-US\$	-	+	12-98	8-98
Bid-ask for ATM options: SE krona-euro	-	+	3-99	11-97
Bid-ask spreads for FRAs, Hong Kong	-	+	1-98	7-00
Bid-ask spreads for Australian dollar	+	=	2-00	1997
Australian dollar trading volumes	+	-	98Q3	96Q1
Bid-ask spreads for Brazil Real	-	+	4-99	1998
Brazil Real spot trading volumes	-	+	98Q2	99Q3
Bid-ask spreads for Korean Won	=	=	2-98	8-00
Korean Won spot trading volumes	=	+	9-97	9-98
(IV) Local markets in emerging economies	Pre mid-97 to end-99	2000	Peak	Trough
Bid-ask for interest rate swaps: Hong Kong	-	+	1-98	97Q1
Trading volume of HK Exchange Fund bills and notes	=	+	7-98	2-00
Trading volume of Hong Kong interbank market	-	+	99Q1	00Q1
(V) Other	Pre mid-97 to end-99	2000	Peak	Trough
Trading volume on selected equity markets	+	+	4-00	Na
Historical and implied volatility of equities	=	=	11-98	98Q1
Investors' risk aversion	Mixed	-	7-97	10-97
US repo market: amounts outstanding	+	+	1998	1999