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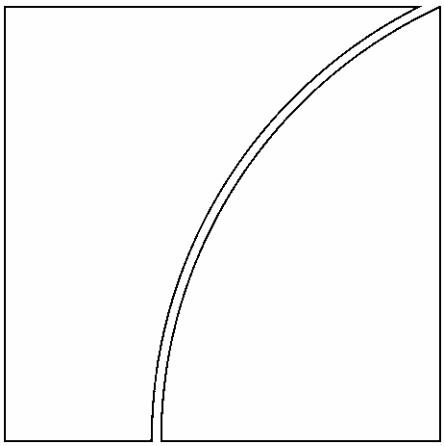

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Market distress and vanishing liquidity: anatomy and policy options

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Abstract

Since the 1980s, a number of episodes of financial market distress have underscored the importance of the smooth functioning of markets for the stability of the financial system. At the heart of these episodes was a sudden and drastic reduction in market liquidity, characterised by disorderly adjustments in asset prices, a sharp increase in the costs of executing transactions and, in the most acute cases, a "seizing up" of markets. This essay explores the anatomy of market distress as well as the policy options to address it. It argues that, despite appearances, the genesis and dynamics of market distress resemble quite closely those of banking distress and that, contrary to conventional wisdom, the growth of markets for tradable instruments, and hence the greater scope to sell assets and raise cash, need not have reduced the likelihood of funding (liquidity) crises. At times of distress, in contrast to more normal times, risk management practices, funding constraints and counterparty risk become critical determinants of market liquidity. Articulating an appropriate policy response calls for an approach that takes full account of the interdependencies between the behaviour of market participants and market dynamics. To date, much useful work has been done to address market distress by improving the *market infrastructure* and the risk management at *individual* financial institutions. The territory that remains largely unexplored is precisely the link between the *collective* actions of individual market participants and market dynamics.

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Introduction[1]

During the past two decades, in the wake of financial liberalisation and advances in information technology, financial markets have become a major force shaping economic developments. Admittedly, in the pre-World War I period markets were operating even more freely than they are today and the degree of global financial integration was in some respects greater. But never before in history have markets remotely approached their current breadth, depth and richness, as exemplified by the extraordinary spectrum of financial instruments traded and the unprecedented volume of transactions. The recent development of credit derivatives, for instance, could yet herald a qualitative change in the way financial systems intermediate funds and allocate risks, and represents just the latest addition to a bewildering variety of derivative instruments.[2] Similarly, daily turnover in markets nowadays amounts to huge multiples of GDP.[3]

More than ever before, the smooth functioning of the financial system relies on the smooth functioning of financial markets. Since the 1980s, this message has been hammered home by several episodes of "market distress", from the stock market crash of 1987 to the 1998 autumn market turbulence in fixed income markets. During these episodes, market liquidity suddenly evaporated, as signalled by disorderly adjustments in asset prices, a sharp increase in the costs of executing transactions and, in the most acute cases, a "seizing up" of markets. In turn, the market disruptions threatened to have serious implications for the financial system more generally and, possibly, the real economy. In several such instances, policymakers intervened in order to restore orderly functioning.

Awareness of the critical importance of markets has given impetus to policy and private sector initiatives aimed at ensuring their smooth operation even under testing conditions. One may refer to this process as the search for "robust market liquidity". While considerable progress has been made in this area, the road ahead is still a long one.

Proposing remedies requires a correct diagnosis. And this is a field in which policymakers and market practitioners have had relatively little guidance from the academic profession. For, while much thought has been given to the analysis of the anatomy of distress of financial institutions, such as banking crises, far less has been devoted to exploring the microeconomics of market distress. To be sure, the mythical figure of the omniscient "Walrasian auctioneer", magically setting prices to clear supply and demand, often hiding behind seemingly innocuous arbitrage conditions, has given way to a burgeoning literature that examines the mechanics of the price formation process. And yet, perhaps buttressed by the belief in "efficient markets", much of this work has addressed the functioning of markets under normal conditions as opposed to stress. Thus, the physiology of markets is by now rather well understood; their pathology much less.

This essay addresses specifically financial market distress. What is it? How does it arise? What can be done to reduce its incidence and severity? In the process, it seeks to identify a set of *analytical* questions worthy of greater attention than that received so far and to point to possible *policy* responses that merit further consideration. The objective is not to formally test specific hypotheses but,

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[1] This is a substantially revised version of the paper that appeared in Avinash Persaud (editor) *Liquidity Black Holes: Understanding, Quantifying and Managing Financial Liquidity Risk*, Risk Books, London, 2003. I would like to thank Guy Debelle, Allen Frankel, Gabriele Galati, Serge Jeanneau, Frank Packer, Eli Remolona, Hyun Shin, Nikola Tarashev, Bill White and Philip Wooldridge for very helpful comments, Anna Cobau and Angelika Donaubauer for statistical assistance and Janet Plancherel for putting the document together. All remaining errors are my sole responsibility. The views expressed are my own and do not necessarily reflect those of the Bank for International Settlements.

[2] See CGFS (2003a) and BIS (2003a).

[3] In 2001, *daily* turnover in the major financial markets was of the following order of magnitude (all the figures are in US dollars): 2.4 trillion (exchange-traded derivatives), 1.4 trillion (OTC derivatives), 1.2 trillion (all foreign exchange, of which 0.4 trillion spot transactions); 0.2 trillion (equity markets, excluding derivatives), 0.3 trillion (US Treasury securities alone). By comparison, *annual* world GDP was around 30 trillion US dollars. It may also be helpful to put this in historical perspective, using data available for Japan. Taking the ratio of the value of interbank transactions to GNP as an, admittedly rather indirect, measure of financial turnover, this ratio jumped from around 20 in 1980 to 120 in 1990, an increase mirrored, although not quite matched, in other industrial countries. Estimates suggest that this ratio in the mid-1970s was still of the same order of magnitude as it had been in the early part of the 20th century. See Borio (1995) and BIS (1994).

rather, to argue for a number of propositions that could fruitfully be investigated further, both theoretically and empirically.

A number of key points emerge from the analysis.

First, despite appearances, the genesis and dynamics of market distress bear a close resemblance to those underlying the distress of financial institutions. Likewise, all too often financial institutions and markets have been seen as alternative financial mechanisms; in fact, the degree of complementarity, or symbiotic relationship, between the two is equally, if not more, important.

Second, at the heart of market distress is vanishing liquidity. And the determinants of market liquidity in periods of stress are rather different from those typically highlighted in the analyses of the normal operation of markets. Under stress, risk management practices, funding liquidity constraints and, in the most severe cases, concerns with counterparty risk become critical. The analytical work has only begun to come to grips with some of these factors, and has left out counterparty risk altogether. It is, however, counterparty risk that can best explain situations where markets truly "seize up", adjusting through quantities rather than prices and hence, effectively, ceasing to function as markets.

Third, contrary to conventional wisdom, the growth of markets for tradable instruments, and hence the greater scope to sell assets and raise cash, need not actually reduce the likelihood of traditional funding liquidity crises. Conceivably, in fact, it could even raise that likelihood, as the smooth functioning of markets critically relies upon, and market distress can undermine, access to funding.

Fourth, ex post intervention to restore orderly market conditions can be effective, but can also have unappealing unintended consequences. This implies a useful role for prevention. And prevention calls for a two-pronged approach, dealing respectively with market infrastructure and the market players, ie the financial institutions that take positions in the markets.

Finally, just as in the case of traditional banking distress, designing correct policy responses should take full account of one critical aspect of market distress: the dynamics of distress are not so much the result of extraneous large unexpected untoward events ("shocks") that hit financial markets, as it were, from outside (ie, that are "exogenous"). Rather, they often result from the collective behaviour of market participants, which sows the seeds of, and subsequently amplifies, the market turbulence. In this sense, risk is fundamentally "endogenous". Elsewhere, this type of endogeneity of risk has been highlighted as a key ingredient of the so-called "macroprudential", as opposed to "microprudential" dimension of financial instability (Crockett (2000) and Borio (2003)). How best to take it into account in the policy response remains very much unexplored territory.

The rest of this essay is divided into three parts. Section I defines market distress, considers its relationship to the notion of market liquidity and outlines the main policy concerns, focusing on the perspective of central bankers and prudential authorities. Section II explores the dynamics of market distress, drawing some general lessons from the analysis of a series of episodes since the 1980s, and highlighting the similarities with episodes of banking distress. Section III assesses policies aimed at securing robust market liquidity, outlining the contours of the efforts already made and suggesting possible future directions. Finally, the conclusions look at the key challenges ahead.

I. Market distress and liquidity: definitions and policy concerns

Definitions

For the purposes of the present analysis, a market in distress is defined as one that experiences a sudden and substantial reduction in its liquidity.[4] A market is said to be liquid if, roughly speaking,

[4] The notion of market liquidity should be distinguished from that of funding (cash) liquidity. Cash liquidity can be defined as the ability to realise ("cash in") value, either via the sale of an asset or access to external funding. This is what underpins an institution's capacity to meet its contractual obligations. In modern financial markets, funding liquidity is best thought of as including not only command over cash and deposits, but also over other instruments that can be used to meet margin calls and hence, effectively, settle transactions, most commonly government securities. The relationship between the two notions is a multifaceted one. Some of the links are obvious. For instance, selling an asset in a market or unwinding a profitable

transactions can take place rapidly and with little impact on price (CGFS (1999a), BIS (2001a) and Harris (1990). In a liquid market, the difference between buy and sell prices is small (eg bid-ask spreads are "tight"), the size of the transactions that can be absorbed without affecting prices is large (ie there is "depth"), the speed of execution is high (ie there is "immediacy") and prices quickly return to "normal" after temporary order imbalances (ie there is "resilience").[5] Therefore, when a market is in distress any one or a combination of the following symptoms will be apparent: spreads will widen, depth will shrink, it will become harder or impossible to execute transactions and temporary order imbalances will have larger and more persistent impact on prices. Moreover, since participants attach value to market liquidity and liquidity services are costly, one would also expect to see a rise in the liquidity premia impounded in the prices of financial assets.

This definition of distress highlights the role of financial markets as *trading* mechanisms, with an emphasis on secondary market activity. This activity is seen as sustaining the two key functions of markets, namely to permit the smooth exchange of resources and transfer of risks, and, in the process, to provide price signals that "aggregate" the views of market participants and trace their evolution over time (the so-called "price discovery" process).

At a somewhat deeper level, another way of looking at this issue is to consider the distinction between fundamentals, on the one hand, and trading arrangements or the "microstructure", on the other. This is important in order to differentiate the factors behind changes in prices and to qualify more precisely the notion of market liquidity.[6] Here *fundamentals* are defined to comprise those factors independent of (exogenous to) trading arrangements that are relevant for the determination of prices. These would include participants' views about the payoffs from the assets traded, *whether well founded or not*,[7] and their attitudes towards risk. Examples might be expectations about macroeconomic developments or earnings of firms. *Trading arrangements* are defined to include those mechanisms designed to support trading. Examples include trading protocols and platforms, market making, and clearing and settlement processes.

In this highly stylised framework, one could think of market liquidity as depending exclusively on the microstructure. If so, at a point in time, the liquidity of a market would be measured by the extent to which prices reflected fundamentals. Over time, in a perfectly liquid market, changes in prices would exclusively reflect changes in fundamentals and the signals would not be "jammed" by the microstructure, such as by a rise in transactions costs, a withdrawal from market making and/or the inability to execute transactions among willing counterparties. In practice, of course, since liquidity services are highly valued and costly to produce, a perfectly liquid market is just an ideal benchmark. And, as a result, prices will normally incorporate a significant liquidity component, which will vary across market segments and over time.

Three implications follow from this analysis.

First, and most obviously, quick and even large price adjustments to new information do not imply illiquidity in the sense used here. Indeed, in a liquid market prices *should* adjust fully and immediately to reflect changes in fundamentals. Thus, the almost instantaneous adjustment of prices at times when information is released has been well documented, as in the wake of macroeconomic

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position is one way of raising cash. Others, however, are less apparent. In particular, as argued below, access to external funding can underpin market liquidity and the mechanisms that lead to the disappearance of cash liquidity under stress can be similar to those that lead to the evaporation of market liquidity.

[5] There may be a trade-off between these various dimensions. For instance, greater competition among institutions providing market-making services can improve tightness (for example, by narrowing the bid-ask spreads). However, by reducing the profitability of the activity, this can lead to a withdrawal of capital from it and to a deterioration in market depth, unless offset by other factors.

[6] See Barth et al (2002) and, more generally, BIS (2002a).

[7] Note that this is a weaker notion of "fundamentals" from that used in the literature on "capital market efficiency", in which the term is restricted only to the "true" underlying determinants of asset values (eg, true cash flows) and in which "bubbles" would be precluded by prices that reflected fundamentals. Here we are only interested in the ability of prices to aggregate or reflect the views of investors, regardless of the intrinsic validity of those views. Prices that corresponded to our "weak" variant of fundamentals might be said to be, at best, merely "semi-strong efficient" in Fama's (1970) sense, a notion that would not necessarily rule our biased expectations and bubbles. The distinction between this "weak" and the "strong" variant of the term fundamentals is important to avoid confusion in what follows.

announcements.[8] In these cases, however, the move is orderly and the trading process continues to run smoothly. The adjustment in such an "efficient" market is physiological, not pathological. One hallmark of market distress is that the original and subsequent price moves appear to be much larger than justified by the intrinsic information content of the "news", if any, triggering the price change.[9]

Second, as defined here, a liquid market should be expected to facilitate an efficient allocation of resources and risks; it would not, however, guarantee it. As long as market signals are reasonably reliable, greater liquidity will support economic efficiency. But there may be occasional instances in which the views that the market aggregates and the incentives to which market participants respond are sufficiently distorted that greater liquidity could even hamper efficiency. In other words, the definition focuses on the reliability and smoothness of the *process*, on the faithfulness of the mapping between "inputs" (views, risk preferences, etc) and "outputs" (prices). But the "inputs" may, themselves, not be conducive to efficient economic outcomes (eg, biased expectations, etc.).

Finally, as we shall see, market distress may indeed arise precisely as part of the *adjustment* of prices towards more sustainable levels, as market participants come to realise that the "inputs" in the price discovery process are out of line with underlying economic conditions (ie, are "misaligned"). If so, the adjustment towards a more sustainable level is, in and of itself, a welcome development. But the evaporation of liquidity can act as an amplifying mechanism, pushing prices further away from equilibrium and having a first order effect on perceptions of correct valuations.[10] The ill-effects are especially serious if the price adjustment endangers the soundness of counterparties. In the most serious cases, trading actually becomes impossible, and no willing counterparty can be found; the market "seizes up". As market distress intensifies and propagates, from being an *invisible facilitating* mechanism in the background, the process of exchange becomes a *conspicuous disruptive* factor in pricing, the allocation of resources and risks.

Policy concerns[11] and examples of market distress

To what extent should policymakers care about market distress? Clearly, market distress comes in many gradations. In all cases the symptoms are present, but their broader consequences on the stability of the financial system and the real economy depend on the severity of the episode, the markets affected and the impact on financial institutions. At a minimum, the disruptions can temporarily distort the information content of market prices. If short-lived and limited, however, this would not be of much concern. By contrast, if market distress is sufficiently severe or lasting, it can seriously impair economic activity. It can do so directly, such as by inducing a rise in the cost of, and restricting the access to, external funding of businesses and households. And it can do so indirectly, by contributing to financial difficulties at, or the failure of, financial institutions. The record of some of the most salient episodes of market distress since the 1980s confirms this varied picture.[12]

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[8] See, in particular, Fleming and Remolona (1999) in the case of US Treasuries and Andersen et al (2003) for a recent overview across asset classes.

[9] Indeed, in the benchmark case of "fully efficient" markets where participants hold homogeneous expectations, the adjustment would take place without any trading.

[10] The term "liquidity holes" or "liquidity black holes" has sometimes been used to refer to this phenomenon (eg Taleb (1997), Persaud (2001a) and Morris and Shin (2003)).

[11] Quite apart from concerns with financial stability, central banks are also keen to maintain well functioning, and liquid, markets as supportive of their monetary policy in normal times. One reason is central banks' shift towards market-oriented operating procedures. In particular, technical liquidity management operations, which are not intended to convey signals about the stance of policy, rely on liquid markets that allow transactions to take place without affecting the underlying price. In the case of the Federal Reserve, for instance, all market operations are of this kind, as the key policy signal is represented by announcements of the target federal funds (overnight) rate. See Borio (1997) for an elaboration of the link. In addition, central banks have made greater use of asset prices as a guide for policy, which puts a premium on market liquidity. For example, the reliability of estimates of market participants' expectations about inflation as derived from yield curves depends crucially on the liquidity of the underlying market (eg BIS (1998a)).

[12] The focus here is primarily on episodes of market distress in secondary markets, as opposed to those where primary (issuance) markets are affected first. An example of the latter could be turmoil in commercial paper market following the failure of Penn Central in 1970, when borrowers generally faced difficulties rolling over their debts (eg, Brimmer (1989)). Admittedly, however, it may be hard to draw a clear line between the two, given that the knock-on effects between primary

The global stock market crash of 1987 and the turbulence in fixed income markets in 1998 represent two archetypal cases of market distress.[13] In both cases, the initial price adjustment seemed to be out of proportion with the trigger. In the summer of 1998 the Russian default induced outsized increases in fixed income spreads in mature economies; in 1987 the specific trigger was hard to identify. In both cases, the symptoms of the evaporation of liquidity were sufficiently severe and widespread geographically to elicit a response by the monetary authorities in order to re-establish orderly markets and address the perceived threat to the financial system and the possible impact on the real economy. Especially, but not exclusively, in the United States, the authorities made it clear that they stood ready to provide liquidity freely to markets and/or actually reduced policy rates. And in both cases, to varying degrees, the soundness of financial institutions was put into question. In 1987, doubts were expressed about the solvency of the Options Clearing Corporation in Chicago; in 1998 the financial difficulties of the hedge-fund Long Term Capital Management (LTCM) in the autumn exacerbated the market turmoil and induced the monetary authorities to help co-ordinate a orderly resolution effort by market participants.

The global bond market crash in 1994, while severe, was different in several respects.[14] Alongside the previous two events, the unexpectedly sharp and internationally widespread fall in bond prices following the beginning of a tightening cycle in the United States has since become a standard stress test of market turmoil for financial institutions. The event did eventually contribute to the demise of some market participants (Granite funds and Orange County, a US local authority). But by the standards of the previous two episodes the symptoms of market distress and their threatened implications were not as pronounced. There was no specific response on the part of the monetary authorities. A similar, albeit less intense and widespread, episode took place in the spring and summer of 2003, again in part triggered by changing views about US monetary policy, disappointed by the absence of a widely expected 25 basis point cut by the Fed (eg, BIS (2003b)).

The turbulence in high-yield and related markets in 1990 provides yet another example of how dynamics and scope might differ. In this case, the epicentre of the turmoil was the failure of Drexel Burnham Lambert, the dominant market maker in high-yield ("junk") bonds, in turn triggered by a fall in the value of its portfolio. The difficulties at the firm threatened deadlocks in a number of related markets, including other fixed-income segments. In this case, the authorities intervened to help ensure and orderly wind-down of the institution and to facilitate continued trading in markets.

The East Asian crisis in 1997 is a more hybrid case still (BIS (1998b)). Here the manifestations of market distress are best seen as a result of the conjunction of underlying problems in the banking systems and the disorderly abandonment of tight exchange rate commitments ('twin" crises). Thus, market distress was mainly the consequence of system-wide crises and acted primarily as a propagating mechanism, with lingering imprints on liquidity conditions.

These examples underscore a more general point: the rapid growth and greater complexity of markets have increased the scope for market distress to have undesirable economic consequences. First, financial institutions have inevitably come to rely much more on markets to manage their risks, not least through various types of derivative instruments (Graph I.1). And the management of these risks is predicated on the assumption of continued market liquidity. Second, the growth in tradable instruments has vastly increased the volume of transactions (Graph I.2) and hence potentially added to the risks that market players incur in the process of trading, notably counterparty and settlement risk (see below). Finally, the sheer size that markets have reached means that any disruptions, were they to materialise, would likely have bigger effects on economic activity than in the past.

In other words, if we define as "systemic" financial crises that can have serious effects for real economic activity, then the rapid growth of markets has confronted policymakers with a new set of problems. Not only can systemic crises arise because of the widespread failure of financial institutions; they can also result from malfunctioning in markets. And in turn, market distress can be at the origin

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and secondary markets are a key mechanism for the propagation of turbulence. For a treatment of crises in issuance markets generally, see Mishkin (1991).

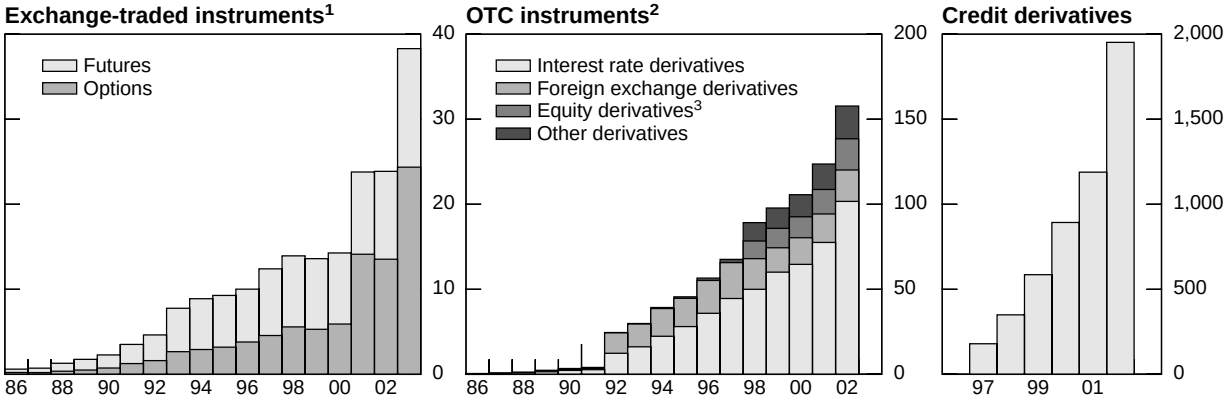
[13] For fuller descriptions of the stock market crash, see the Presidential Task Force (1988) and Hawke et al (1988); for the 1998 market turbulence, see CGFS (1999b), BIS (1999), IMF (1998) and President's Working Group on Financial Markets (1999).

[14] For a description and analysis of events, see Borio and McCauley (1996a, b), BIS (1995) and IMF (1994).

of, or amplify, systemic problems at financial institutions. That is, if markets are to act as stabilisers, rather than a source of difficulties, for the financial system as a whole, it is important that they function effectively under both normal and testing conditions. At the same time, assessing the potential consequences of market distress remains extremely hard. In some cases, the implications may be relatively benign; in others, they could be more serious. This complicates the calibration of the response, if any, once an episode of distress materialises and the assessment of the benefits and costs of alternative preventive measures.

Graph I.1 **Rapid growth of derivatives markets**

Notional amounts; in trillions of US dollars

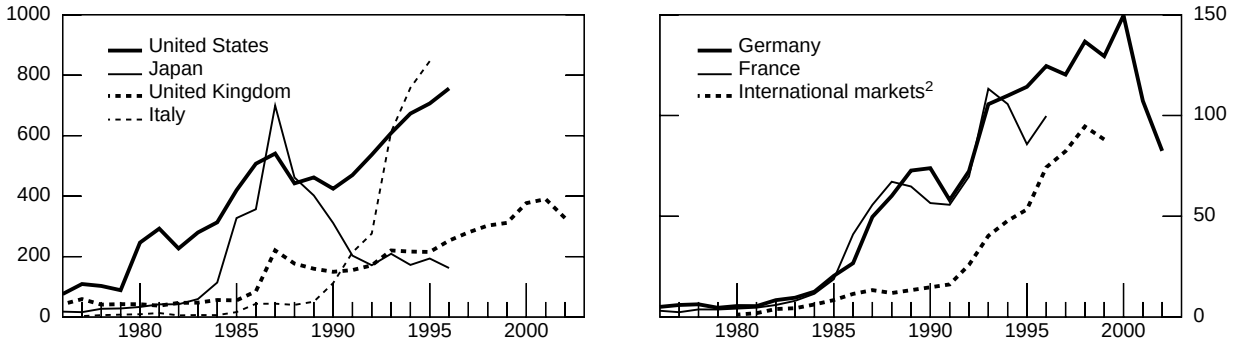


[1] Data for 2003 refer to second quarter. [2] Data prior to 1992 are not fully comparable. [3] No breakdown available prior to 1998.

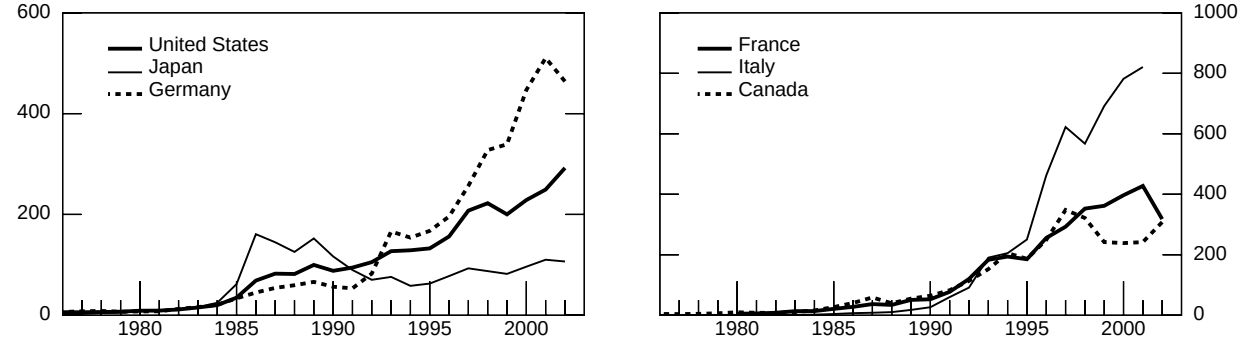
Sources: British Bankers' Association; Futures Industry Association; Swapsmonitor; BIS calculations.

Graph I.2 **Rapid growth of transactions volume**

A. Indicators of trends in turnover on securties markets[1]



B. Cross-border transactions in bonds and equities[2]



[1] Estimates of the annual value of secondary market transactions in equities and bonds, including in some cases those carried out over the counter. A purchase and corresponding sale are counted counted as a single transaction. As a percentage of GDP. [2] Gross purchases and sales of bonds and equities between residents and non-residents. As a percentage of GDP.

Sources: National data.

II. The anatomy of market distress[15]

A stylised representation

Beyond the conspicuous differences that exist between the episodes of market distress since the 1980s, a number of similarities can also be discerned. At the cost of some oversimplification, three phases of market distress can be distinguished: the build-up phase, the eruption of market distress proper and the aftermath.

The build-up phase

Episodes of market distress are often preceded by extended periods in which, at least with hindsight, balance sheets of institutions become overextended through the accumulation of risk exposure in relation to the ability to absorb that risk. In other words, they are preceded by the accumulation of "leverage" in relation to the corresponding market risk factor.[16] One needs wood to make a fire, and the intensity and life span of the fire depend on the amount of wood available. In 1997, for instance, the wood was represented in particular by carry trades in Asian currencies,[17] in 1998 by the proliferation of relative value and credit risk arbitrage strategies, and in 1994 and again in 2003 by yield curve plays.[18]

As discussed further below, measuring the build-up of pressure and leverage in real time, and sometimes even ex post, is far from straightforward. Table II.1, however, provides some evidence of the accumulation of leverage in international bond markets in the run-up to 1994. In this case, bond investments by banks and securities firms and the volume of non-residents' repo finance in selected domestic markets are taken as indirect indicators of leverage, as buttressed by anecdotal evidence at the time about the positions taken by market players.

For a while, as leverage builds up, the process is self-reinforcing. For one, the very act of taking positions often shifts prices in the profitable direction. For example, as participants take on long positions in government bonds, credit spreads or equities, the prices of the corresponding assets rise, resulting in capital gains. In addition, the success of (leveraged) trading strategies generates profits, adds to market-making capacity and hence increases the liquidity in the markets. Concomitantly, measures of market volatility may appear comparatively low.

At the same time, this process carries within itself the seeds of its own destruction. Asset prices and the corresponding yield differentials are taken to unsustainable levels. Think, for instance, of the equity price boom that preceded the stock market crash, of the major decline in bond yields in early 1994 and 2003 or of the unusual compression in bond spreads that preceded the Asian crisis (Graph II.1). Likewise, the perceived increase in market liquidity can lull participants into a false sense of security. Liquidity may be perceived as highest precisely when it is most vulnerable. In fact, the illusion of permanent market liquidity, in the strong sense of feeling always able to transact at the prevailing market price, is the most insidious threat to liquidity itself.

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[15] This section draws and expands on Borio (2000).

[16] This is a more general definition of leverage than the one normally used in corporate finance, eg the debt-to-assets or debt-to-capital ratio. It is, however, a more meaningful one, especially in the presence of off-balance sheet instruments and the complex risk exposures that market players can take on. For a very interesting discussion of different concepts of leverage, see CRMPG (1999).

[17] For an attempt to measure the size of carry trades, see McCauley and von Kleist (1998).

[18] For 1997, see BIS (1998b); for 1998, see CGFS (1999b), BIS (1999), IMF (1998) and President's Working Group on Financial Markets (1999); for 1994, see Borio and McCauley (1996a, b), BIS (1995) and IMF (1994).

Table II.1

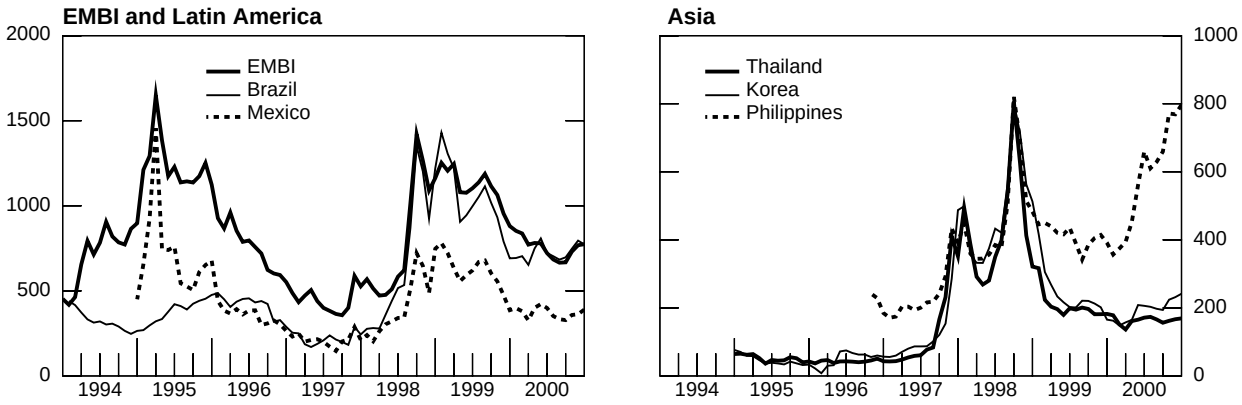
Selected indicators of leverage in international bond markets

	1991	1992	1993	1994			
				Q1	Q2	Q3	Q4
	in billions of US dollars						
United States	131	99	76	9	–26	–17	–22
Commercial banks[1]	111	105	73	17	–6	–20	–18
Securities dealers[1]	20	–6	3	–8	–20	3	–4
United Kingdom	19	53	136	–43	–18	0	..
Banks:[2] gilts	–2	6	16	2	0	–1	3
foreign bonds	15	24	52	–5	–1	7	19
GEMMs:[3] gilts	..	..	9	–9	0	–1	..
Securities dealers:							
foreign bonds	6	23	59	–31	–17	–5	3
Total	150	152	212	–34	–14	–17	..
Memorandum item							
Interbank financed[4]	7	54	182	–54	–48	–1	17
Repo financed:[5] *Spain*	..	8	24	–8	–8	–4	–2
Sweden	..	..	13	–5	–3	–6	2

[1] Treasury and agency securities for banks and also including corporate and foreign bonds for securities dealers. [2] Including building societies. [3] Gilt-edged market-makers. [4] Cross-border interbank domestic currency lending by banks in Europe as an indicator of movements in non-residents' bond purchases hedged against exchange rate risk. [5] Indicators of Treasury bond purchases by non-residents financed through repos.

Sources: Borio and McCauley (1996a,b).

Graph II.1 **Pre-crisis compression of bond spreads: Asia 1997 and autumn 1998[1]**



[1] US dollar international bonds over 10-year US Treasury bonds; since 1999, for Argentina, Brazil and Mexico, stripped spread of emerging market bond indices calculated by JP Morgan Chase.

Source: Bloomberg.

The eruption phase

The nature and timing of the trigger for the reversal are effectively unpredictable. For instance, as noted, in the case of the 1987 stock market crash it is actually hard to find a convincing piece of news that precipitated the selling; by contrast, the bond market crash of 1994 and the more recent 2003 sell-off, were triggered by monetary policy surprises. But when the reversal eventually comes, prices adjust violently, measures of actual and implied volatility rise sharply and liquidity evaporates, as evidenced by larger spreads, a larger price impact of trades and smaller depth (Graph II.2). Volume typically surges too but, in extreme situations, trading may become difficult and even grind to a halt. The experience surrounding the demise of Drexel Burnham Lambert is a good example of the latter. At the time, activity in a number of fixed income markets contracted dramatically.

During the eruption phase, when volatility rises and liquidity evaporates, the dynamics of market distress take on a life of their own. They are largely driven by the interaction of risk management systems, funding liquidity constraints, and, possibly, heightened concerns with counterparty risk. Their net effect is to undermine either the ability or the willingness to trade. Consider each of the three driving factors in turn.

Risk management systems determine the initial exposures and the response to changing market conditions. As markets adjust, losses are incurred and measures of volatility rise, a natural tendency for market participants is to reduce their exposures through various means, ranging from stop-loss and dynamic hedging strategies to value-at-risk (VaR) tools.[19] While eminently reasonable from the perspective of individual institutions, these actions can easily exacerbate price dynamics and the evaporation of liquidity.

The surge in hedging and trading activity naturally generates large and highly variable demands on cash flows ("*cash or funding liquidity*") required to complete transactions; difficulties in raising the corresponding cash liquidity can further exacerbate market distress, by precipitating distress sales and closures of positions. Even in normal times trading generates enormous settlement volumes that need to be financed; after all, for each seller there is a buyer. Funding is needed to meet margin requirements,[20] to settle trades more generally and to fund changing positions and inventories, such as through repos. But these funding needs balloon at times of market distress, as prices move violently and activity surges. In fact, at these times, even instruments designed to limit average settlement volumes can generate highly variable cash needs. For instance, to the extent that they do not require repayment of principal, futures or interest rate swap contracts reduce the settlement risks compared with the cash transactions that would replicate the same payoffs. But the daily marked-to-market margining and settlement of these contracts mean that the corresponding demands on cash flows rise, possibly non-linearly, as market prices move.

Finally, while sometimes overlooked, the process of trading can generate large, albeit in some cases short-lived, credit exposures, which make the willingness to transact a function of *counterparty risk*. Credit exposures are generated in the settlement process. In this case, they arise from the lack of synchronisation between the payment and delivery legs of transactions, for both securities and foreign exchange (eg so-called Herstatt risk), from the financing needed to meet delivery-versus-payment trades, and, to a lesser extent, from the lags between trading and settlement dates.[21] In addition, counterparty risk is inherent in derivatives transactions, where the size of the exposure can be very sensitive to the change in market prices. As risk management tools, derivatives originally targeted market risk. A neglected consequence, however, was the creation of credit exposures associated with the trades that have a positive market value vis-à-vis counterparties. The pyramiding of transactions often needed to take or hedge positions adds to these credit risks. Finally, credit risk is also incurred in the process of extending external funding.

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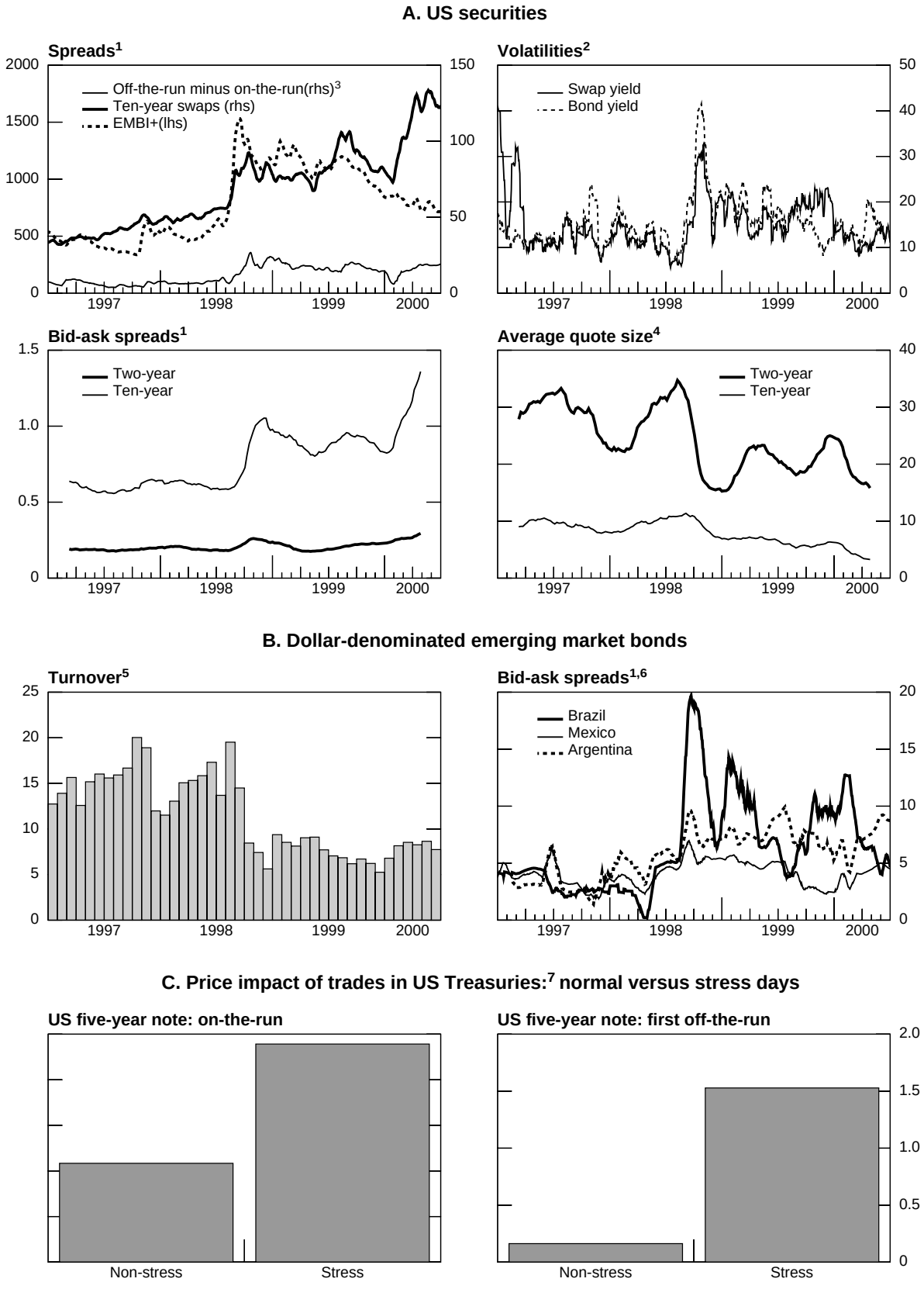
[19] Persaud (2001a,b) stresses value-at-risk methodologies in particular. The process, however, can be generated by a whole variety of mechanisms to curtail risk, some quite old-fashioned ones.

[20] In this case "cash" should be interpreted broadly to include any asset that can be used to meet margin calls.

[21] See, for instance, Borio and Van den Bergh (1993), Borio (1995) and BIS (1994).

Graph II.2 **Symptoms of market distress: the 1998 turbulence**



[1] In basis points; 10-day moving averages. [2] Annualised historical volatility; rolling 20-day window. [3] Spread between 30-year twice-off-the-run and on-the-run US Treasury bonds. [4] In billions of US dollars. [5] Daily average turnover of 25 most traded bonds in one month. [6] Of most actively traded bonds. [7] Price impact is measured as the basis point change in prices associated with a signed trade and is calculated based on a vector autoregression. Stress days are those days during the crisis period in autumn 1998.

Sources: Federal Reserve Bank of New York; Fleming (2000), based on data from GovPX; Bloomberg; Euroclear; Furfine and Remolona (2002); BIS calculations.

Such counterparty risks can have first order effects at times of market distress, both directly and indirectly. They can have them indirectly, by affecting the cash needs of market participants, since margin requirements and daily settlement of contracts are precisely mechanisms to limit counterparty exposures. This is especially important if, in order to reduce their exposure to counterparty risk, participants ask for additional margin or collateral, exacerbating funding needs.[22] They can have them directly, as hitting counterparty credit limits at times of stress can limit trading possibilities and exacerbate price dynamics. Above all, if concerns about the creditworthiness of counterparties become an issue, the withdrawal from the market can greatly exacerbate market distress. After all, the exposures and risk profiles arising from trading can be just as opaque as those of traditional loan portfolios, and possibly even more so. Opaqueness is associated with complex trading strategies and the speed with which information can become stale.

The interaction between risk management practices, liquidity constraints and, in some instances, concerns about counterparty risk has been a salient feature of the episodes of distress in recent years. It has been best documented for the market turbulence of autumn 1998, the failure of Drexel Burnham Lambert and the 1987 stock market crash.[23] Even in the milder recent bond market sell-off in 2003, risk management practices appear to have played a key role, as the breaching of risk limits induced participants to unwind their positions, exacerbating volatility in fixed income markets more generally.[24]

The aftermath phase

In the aftermath phase, the effects of severe market distress linger on. They tend to be felt well after the turbulence, even as markets return to more normal conditions. In particular, these severe dislocations leave a legacy of reduced liquidity in the market segments affected and higher liquidity premia in asset prices.[25] Scars take time to heal, especially if market-makers experience severe losses and doubts arise about the profitability of trading strategies, or the validity of hedging practices, that were directly or indirectly providing liquidity to the market during the build-up phase.

The Asian crisis in 1997 and the turbulence in mature markets in autumn 1998 illustrate this point quite clearly (Graph II.2). These events represented a watershed in market liquidity conditions in several segments of global financial markets.[26] To the surprise of many observers and market participants alike, these episodes heralded a protracted period of diminished market liquidity. In Asian and,

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[22] The role of collateral in market dynamics is examined in CGFS (2001a); Domanski and Neumann (2001) summarise the report.

[23] See CGFS (1999b) and BIS (1988, 1994, 1995, 1999). In particular, the CGFS report characterises the market turbulence in 1998 as a "global margin call". Beyond obvious similarities, the episodes exhibited a number of differences. For example, compared with the 1998 market turbulence, during 1987 deleveraging was arguably less significant and the source of order imbalances had more to do with positive feedback trading strategies such as portfolio insurance; see also CGFS (1999b) and Gennotte and Leland (1990). Likewise, the disruptive interaction of markedly different sets of trading, regulatory and institutional arrangements was more prominent in 1987, especially as between the cash and futures markets. These differences can exacerbate large and sudden intermarket trading flows, distort price and quantity signals and make it harder to distinguish liquidity from solvency problems; see, notably, Presidential Task Force (1988). For a further detailed analysis of the behaviour of market dynamics and market liquidity in fixed income markets in the autumn 1998 turbulence, documenting and explaining the drastic market reduction in liquidity, see Furfine and Remolona (2002, 2003) for US Treasuries and Upper (2001) for German government securities. Cohen and Shin (2002, 2003) document a tendency for positive feedback trading to increase at times of high market volatility in the market for US Treasury securities, based on data from 1999 to 2001.

[24] See the discussion in BIS (2003b). In 2003, compared with 1994, the role of dynamic hedging of the prepayment option in the mortgage market in the United States appears to have played much more prominent. On this, compare BIS (2003b) with Fernald et al (1994). See also Kambhu and Mosser (2001). In 1998, the turbulence in the autumn also infected exchange rate markets, resulting in the sharpest two-day move in the US dollar/yen exchange rate in the postwar floating era, showing that even the core world currency was not immune from sudden bouts of vanishing liquidity; see Morris and Shin (1999), BIS (1999), Béranger et al (1999). For a story emphasising the role of unleveraged players, see Fan and Lyons (2003).

[25] This liquidity premium has recently been modelled by Acharya and Pedersen (2002).

[26] For a more detailed discussion, see Borio (2000). As another example, the protracted reduction in market liquidity in some segments of equity markets following the crash of 1987 has been amply documented; see, for instance, BIS (1988) and International Stock Exchange (1988). The imbalance between demand for and supply of market liquidity cannot always be detected in direct measures of market depth and tightness but may be seen indirectly in the relative yield on securities. Thus, when the imbalance is especially high, the premium on liquidity increases, so that the return required on less liquid securities rises in comparison with that on their more liquid counterparts. This pattern is typical of flights to safety.

subsequently, US markets, institutions providing liquidity services came under strain as a result of the financial turbulence. Strategies that had proved consistently profitable suddenly generated huge losses, as exemplified by foreign currency carry trades and relative value arbitrage transactions. The turmoil accelerated the exit from the industry of market players who had been contributing to a perception of liquidity by taking the other side of trades in the tranquil market conditions preceding the turbulence, such as some macro and relative value arbitrage funds. The winding-down of LTCM was just the most salient example of a string of exits, of which many were voluntary (Tsatsaronis (2000a)). Hedging operations in government bond markets were thrown out of kilter as the spread between government and corporate securities defied previous historical relationships, encouraging a shift away from government securities towards swaps for hedging purposes.[27] Reportedly, the turbulence was a factor inducing several institutions to strengthen risk management and reassess the risk/reward trade-off associated with market-making, leading to a reduction in the amount of capital devoted to this activity.[28]

What does microstructure theory tell us?

It is interesting to compare the above rendering of the behaviour of markets under stress with the extant theoretical literature on market functioning and the determinants of market liquidity. That literature has predominantly focused on the behaviour of markets under normal conditions. Thus, it has paid particular attention to one specific type of asymmetric information, where some traders are assumed to know more about the value of the asset traded than others. It has also addressed questions concerning the link between the release of pre-trade and post-trade information and market liquidity. This has cast light on the trade-off that arises between the incentive to make markets by profiting on the private information gathered in the trading process, on the one hand, and the desirability of making that information more widely available, on the other. And it has generally assumed that market-makers are indifferent to risk ("risk neutral"), rather than having limited capital and being effectively risk averse.[29] While no doubt very useful, this type of analysis fails to provide helpful insights into the dynamics and determinants of liquidity under stress.

Only more recently has some attention started to be paid to the dynamics of market under stress. Some authors have focused on the net wealth and liquidity constraints that become more relevant under stress conditions.[30] Others have elaborated on the interaction between short horizons of traders, heterogeneous information among market participants and strategic interactions in the trading process.[31] Others still have highlighted the destabilising potential of dynamic hedging strategies,

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[27] For an in-depth analysis of this benchmark tipping process, see McCauley (2001); for a recent cross-country perspective, see Wooldridge (2001). For a broader overview of recent changes in fixed income cash and derivatives markets, see BIS (2001b, 2002b).

[28] See the survey by the CGFS (2001b) and, for foreign exchange markets, Galati (2000, 2001) and Chaboud et al (2003). Reinhart and Sack (2002) document the lasting increase in liquidity premia following the 1998 turbulence, presumably driven by both supply and demand factors, by decomposing the change in spreads on various US fixed income market instruments into their constituent components. Persaud (2001c), drawing on Froot et al (1999), also documents a widespread reduction in market liquidity (increase in the price impact of transactions) associated with cross-border trades more generally following the Asian crisis. In addition to the turbulence, the reduction in market liquidity may also have been reinforced by the trend towards global consolidation among market players. Apart from limiting the need to execute trades in the market, this trend has encouraged cutbacks in position and credit limits and market-making (eg Galati (2001)). Finally, the reduction of liquidity in US Treasury securities into 2000 was also related to prospects prevailing at the time that US fiscal surpluses would continue and lead to a pay-down of the existing debt (eg Fleming (2000), BIS (2001b) and Cohen and Shin (2002)). At least since the autumn of 2003, however, the pendulum has swung back again, as a broadly based search for yield has given a major boost to trading activities of institutions, not least of hedge funds, across a broad set of asset classes; see BIS (2004), especially chapters V, VI and VII.

[29] See the original article by Kyle (1985). For excellent recent reviews, see O'Hara (1995) and Lyons (2001). Only few papers have treated market-makers as explicitly risk averse (eg Grossman and Miller (1988) and references below). For evidence of effective risk aversion, see Campbell et al (1993). Of course, effective risk aversion is also what can prevent price discrepancies from being fully arbitraged away and can allow prices to diverge from their true "fundamental" value (in the strong sense of the term) even if market participants can identify it (Shleifer and Vishny (1997)).

[30] See for example Kyle and Xiong (2000) and Schinasi and Smith (1999).

[31] See Morris and Shin (2003). In a similar spirit, Brunnermeier and Pedersen (2003) model strategic predatory behaviour while Bernardo and Welch (2003) 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. In all of these models, some form of effective risk aversion is present.

insensitive to the fundamental value of assets, if participants are unable to distinguish those transactions from more information-based trades.[32] Over time, these emerging approaches hold the promise of providing a better basis for policy.

Counterparty risk, however, remains unaddressed. This is so despite the fact that it is likely to hold the clue to understanding the conditions under which markets actually "seize up", adjusting primarily through quantities rather than prices. By analogy with the literature on rationing in bank credit markets (eg Stiglitz and Weiss (1981)), it is not difficult to see how asymmetric information concerning counterparties creditworthiness could lead to reductions in market depth and, in the limit, to unwillingness to enter transactions at all. "Adverse selection" could produce such an outcome. For instance, while a market-maker might be able to defend himself by adjusting the price/bid-ask spread against a potentially better informed trader, this mechanism would not help if the concern was that the trader would not be able to settle the transaction once the market-maker had settled his side (counterparty risk). Only by transacting in smaller volumes or raising collateral margins could the market-maker mitigate such a risk. The interconnections present in the trading process, and hence the indirect exposures that characterise it, could also make it very hard for the market-marker to distinguish creditworthy from uncreditworthy counterparties. Admittedly, it is well-known that if adverse selection is sufficiently severe, even informational asymmetries about the value of the underlying asset can result in the collapse of a market through a widening of spreads (Glosten and Milgrom (1985)). However, counterparty risk has a much more immediate effect on market depth and the willingness to trade.

Market and banking distress compared: really so different?

At first sight, financial markets and banks could not look more different as mechanisms for transferring funds from savers to investors and for allocating risks in the financial system. And yet, paradoxically, below the surface the dynamics of distress are remarkably similar in the two segments. These similarities in turn point to deeper shared determinants of distress and hold clues about policy responses.

The dynamics are remarkably similar with respect to the sequence of the three phrases, namely the build-up, eruption and aftermath. In the case of banks, the phases take place at business cycle frequencies whereas in that of financial markets the rhythm is more irregular, and typically shorter. As discussed in detail elsewhere,[33] the build-up phase of banking crises, too, is characterised by self-reinforcing processes that lead institutions to become overstretched while at the same time masking the sign of rising risk. During the boom phase, rising asset prices, loosening external financing constraints and profits feed on each other and disguise the overextension in balance sheets. The specific trigger and timing of the reversal is rather unpredictable, just as in the case of market distress. But when it comes, the processes go into reverse. If the system has not built up sufficient defences during the upswing, the subsequent contraction can result in serious strains on institutions and possibly in a broader crisis. In turn, the crisis leaves behind a longer-lasting legacy of lower risk tolerance and tighter restrictions on credit extension.

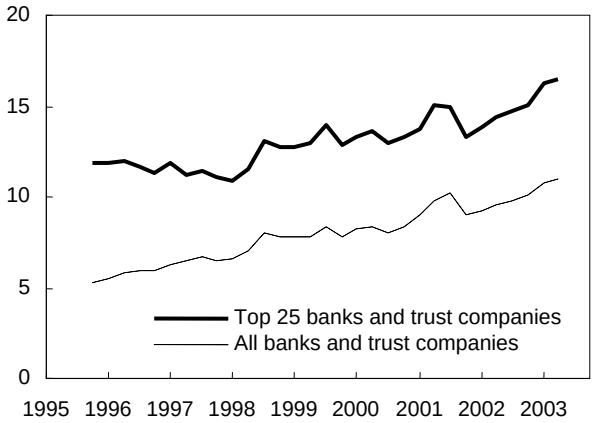
Looking closer still, similar mechanisms operate during the distress phase. In the case of banks, if safety nets fail to operate, such as in the case of foreign currency shortages, liquidity constraints can add to the strains on solvency, by precipitating distress asset sales and the need to retrench from lending. In addition, difficulties in distinguishing sound from unsound banks, not least owing to the web of contractual relationships that ties them together, can help to generalise the liquidity withdrawal. And the process has certain self-fulfilling aspects to it: concerns about delaying the withdrawal of funds precipitate their withdrawal. This is, in fact, the canonical model of the dynamics of banking crises (Diamond and Dybvig (1983)). In the case of markets, exactly the same factors are at work. A tightening of liquidity constraints and concerns with the creditworthiness of counterparties (credit risk) are precisely what underpins market distress, as they precipitate a generalised retrenchment. And

[32] This work, in fact, is of less recent vintage, having been inspired by the 1987 stock market crash; see Gennotte and Leland (1990) and, even before them, Grossman (1988).

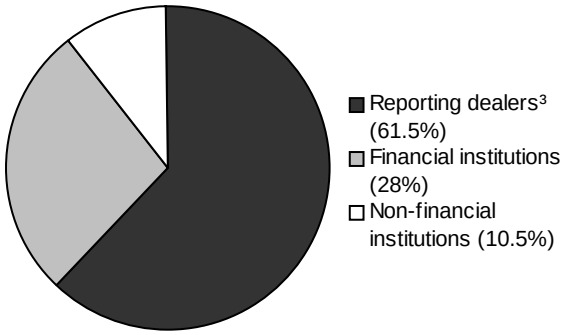
[33] See, in particular, Borio (2003) and Borio et al (2001) and the many references therein.

Graph II.3 **Banks' use of derivatives**

Notional amounts[1]



Turnover by counterparty[2]



[1] Ratio between the notional amount of off balance sheet derivatives contracts of US commercial banks and trust companies and their total assets. [2] Daily average turnover of total OTC derivatives in April 2001 broken down by counterparty. The figures are based on a survey of dealers ("reporting dealers"). [3] Largely banks.

Sources: Comptroller of the Currency; FOW TRADEdata; Futures Industry Association; BIS (2002c).

concerns about prospective lack of liquidity or large pending orders can exacerbate order imbalances just as concerns about illiquidity of banks can precipitate the withdrawal of credit lines and funds.

Thus, markets can stop functioning or seize up, as market liquidity evaporates, under essentially the same set of conditions as banks do. In this sense, markets, just as institutions, can be subject to runs.[34] The conventional wisdom that sees the growth of markets for tradable instruments as significantly reducing the risk of funding liquidity crises should be questioned.

These similarities partly reflect a very close, symbiotic relationship between financial institutions, most notably banks, and markets that is sometimes overlooked. On the one hand, as noted, banks increasingly rely on markets not just to obtain external financing[35] and to invest, but also, above all, to manage their risks, particularly through derivative instruments (Graph II.3). On the other hand, markets critically rely on banks for market-making and back stop liquidity services. Far from just being substitutable financing arrangements, the two segments are intimately and mutually dependent on each other. As a result, so, too, is their health.[36]

Several additional considerations are worth highlighting.[37]

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[34] See Borio (2000). The analogy with bank runs is also drawn by Davis (1994), for instance, who looks at a number of episodes of illiquidity. Recently, Morris and Shin (2003), building on Morris and Shin (1999), have formalised some of these aspects, focusing on the interaction between short horizons and strategic behaviour on the part of market players. Bernardo and Welch (2003) also model runs on markets, in this case triggered by anticipated liquidity shocks, closer in spirit to the Diamond and Dybvig (1983) model of bank runs. Note that the analogy with bank runs by no means implies that self-fulfilling runs are the *essence* of either bank or market distress, though. As argued in detail in Borio (2003), the main problems in the banking sector arise from an underlying deterioration in asset quality; just as in the case of markets, as described here, they generally originate in the conjunction of overstretched portfolios and asset price (spread) misalignments. The key point is simply that, in the absence of safety nets, the *dynamics* of distress can have significant run-like features.

[35] The extent to which banks finance themselves in open capital markets is often overlooked. For instance, BIS statistics indicate that as much as 70% of the outstanding stock of international securities, which was of the order of 10 trillion US dollars at mid-2001, had been issued by financial institutions, largely banks. This share has been rising over time.

[36] See also Padoa-Schioppa (2003).

[37] These aspects are examined and documented in more detail with reference to banking crises in Borio (2003) and Borio et al (2001).

First, at the heart of the origin of distress lie two types of limitation or "gaps". One type concerns agents' *perceptions* of risk, especially of how system-wide risk evolves over time (a "risk assessments gap"). Indicators of risk, such as credit spreads or measures of volatility, tend to be relatively low during the build-up phase. But there is a sense in which risk is actually rising during this phase, only to materialise as distress subsequently emerges. The tendency to use relatively short horizons and a tendency to extrapolate recent conditions, as for instance formalised in backward-looking value-at-risk models, are key here. Another type of limitation concerns the *incentives* to take on risk (an "incentives gap"). The key problem is the wedge between individual rationality and desirable aggregate outcomes. Actions that may be reasonable, if not compelling, from the perspective of individual agents can result in unwelcome outcomes when taken collectively. Familiar notions here include the "prisoner's dilemma", "coordination failures" and "herding".[38] For instance, would it be reasonable to expect a bank or investment manager to trade off a sure loss of market share in booming market conditions against the distant hope of regaining it in a future potential slump? Or to refrain from retrenching during the distress phase simply because, if everyone behaves in the same way, distress can be mitigated? This incentives gap, in turn, implies that the risk appetite or risk tolerance evolves in ways that can amplify unwelcome market dynamics, leaving clear imprints in market pricing.[39]

Second, the risk of distress is fundamentally endogenous with respect to the collective behaviour of economic agents.[40] And it is the build-up phase that ushers in the subsequent distress. It is, therefore, misleading to think of episodes of distress as a kind of meteorological storm against which insurance can be bought, the popular "perfect storm" analogy notwithstanding. For instance, the so-called "portfolio insurance strategies", so prominent in the case of the stock market crash of 1987, amounting as they did to positive feedback trading, were themselves contributing to the event they were supposed to guard against.[41]

Finally, financial institutions that structurally provide liquidity to the economy in normal times may not necessarily be the best placed to supply market liquidity under stress. The reason is that they would tend to finance their lending or market-making activity through leveraged positions and short-term funding. All else being equal, this would imply a greater sensitivity of their net wealth and funding positions to changes in market prices. In turn, this would naturally result in shorter investment horizons under stress. This puts a premium on proper risk management to overcome the possible comparative disadvantage of their funding and liability structures.[42]

III. Policy options

The objective

So much for the diagnosis; but what about the remedies?

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[38] Herding is the notion stressed by some observers, notably Persaud (2001a,b).

[39] See, eg, BIS (2004) for a discussion of the impact of changing risk tolerance on the search-for-yield phenomenon observed between the autumn of 2003 and the summer of 2004; see Tarashev et al (2003) for an attempt at measuring risk tolerance based on options prices.

[40] See Borio (2000, 2003), Crockett (2000) and Danielsson and Shin (2002).

[41] See Presidential Task Force (1988), BIS (1988) and Gennotte and Leland (1990). There is, however, not yet agreement on the importance of portfolio insurance strategies for the crash, with some observers playing down their role (eg Hawke et al (1988), Roll (1988) and Miller (1991)). Note that, quite apart from portfolio insurance strategies, all forms of dynamic hedging, such as those required to hedge option-like instruments, have a similar effect. These are ubiquitous nowadays.

[42] However, normal access to central bank funding, both intraday and for longer maturities, can be a compensating factor. From this perspective, the balance sheet structure of pension funds or insurance companies may make it easier for them to provide liquidity in periods of strain than it would be for banks and, in particular, securities firms. Conversely, risk management processes of institutional investors that do not exploit their potentially longer investment horizon can unnecessarily add to strains on market liquidity. An obvious example was the widespread use of portfolio insurance strategies in the run-up to the 1987 stock market crash. Similarly, albeit less damaging, increasingly popular trading practices, such as indexing, can also restrict the number of contrarians in markets. For a thorough discussion of this issue, see the report by the CGFS (2003b); Fender (2003) summarises the main points of that report.

One conceivable option would be to limit action to crisis management only. In this case, depending on the severity of the distress, the authorities would have to decide if and how to intervene to help restore orderly market conditions, weighing costs and benefits. On the plus side, not intervening can reinforce the disciplinary mechanisms of markets in the long run; distress acts as a wake-up call and can spur greater prudence and improvements in risk management. On the minus sign, failing to intervene and leaving market distress unchecked can result in sizable disruptions to the financial system and the real economy in the short run. This is a hard choice to make in real time.

If the authorities decide to intervene, a broad spectrum of instruments could be and has been used for this purpose, varying with the type of markets affected, the range of participants involved, and the intensity and scope of distress. But probably the time-honoured remedy par excellence has been resorting to injections of funding liquidity and possibly to an easing of the policy stance (reductions in policy rates) by the central bank. Before the establishment of prudential frameworks, and hence of ex ante forms of intervention, limiting the response to ex post funding support was precisely the classical strategy to address banking distress too.[43]

Experience suggests that this course of action can be helpful in supporting the return to normal conditions. Admittedly, in some cases the central bank could find difficulties in channelling the funds to those segments in the financial system where distress has emerged, especially if the relevant market participants do not have direct access to its liquidity facilities. Even so, this remedy has historically proved rather effective. After all, markets in distress can be starved of funding liquidity. Mechanically, more ample access to liquidity, possibly at a lower cost, should help. Psychologically, these actions can also be instrumental in restoring confidence and hence in relieving the pressure to retrench. The experiences of the 1987 stock market crash and of the market turbulence in the autumn of 1998 are telling examples of its effectiveness.

Even so, these benefits do come at a cost, analogous to that of relying exclusively on emergency liquidity assistance to address banking distress. One such cost is the possibility of undermining market discipline in the longer term (the so-called "moral hazard" problem).[44] Another is that the monetary policy stance may be unduly influenced by short-term considerations. The risk is misjudging the calibration of the monetary easing and finding it hard to reverse it sufficiently promptly, with possible untoward longer-term implications for the policy stance. The need to take decisions within a very tight timeframe and in a state of great uncertainty about the potential consequences of a hands-off approach can easily increase the risk of an overreaction.

This strongly suggests that, just as in the case of banking distress, there is a useful role for prevention too. In this case, the specific objective would be twofold. First, it would be to promote conditions that allow markets to perform effectively even under strain. This means seeking to ensure that the market permits willing buyers and sellers to transact smoothly.[45] And it implies finding ways of addressing those structural and behavioural limitations that exacerbate distress once strains emerge. Second, and more ambitiously perhaps, it would be to promote conditions that limit the development of undesirable order imbalances in the first place. This means seeking to mitigate the build-up of the overextension that sows the seeds of the subsequent market stress. Taken together, these policies can be referred to as the search for "robust market liquidity".[46]

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[43] See the famous principles elaborated by Bagehot (1873) and Thornton (1802).

[44] For an elaboration of this point, see White (2004).

[45] Even this is not self-evident, given the long-standing debate that surrounds the desirability of circuit breakers, such as temporary trading halts. For instance, in the case of the stock market crash, the Presidential Task Force (1988) concluded that organised trading halts could be helpful to allow the market to regain composure; the report commissioned by the Chicago Mercantile Exchange (Hawke et al (1988)), by contrast, concluded that they would simply make hedging harder and increase the sense of anxiety. There is a consensus, however, that trading halts are easier to rationalise when only one market is considered, otherwise they can easily divert selling pressure elsewhere. See BIS (1988) for an analysis of these issues with reference to the 1987 global stock market crash.

[46] Some of the prerequisites for liquid markets in general are well understood. For example, in its guidelines for the development of deep and liquid government bond markets, the BIS Committee on the Global Financial System lists the following factors. These include a competitive market structure, low fragmentation, low transaction costs, heterogeneity of market participants and a sound infrastructure (CGFS (1999a,c); see also APEC (1999) and, particularly on the relationship between size and liquidity, McCauley and Remolona (2000)). What follows focuses primarily on market liquidity under stress. Also, since policies would need to address the root causes of order imbalances and the propagation of disturbances,

Such policies can target two different dimensions, namely the infrastructure underpinning market functioning and the financial institutions that operate in the markets. As will become apparent, many of these policies do not necessarily target market distress per se. They may be adopted with other primary objectives in mind, such as limiting the risk of more traditional banking crises. Even so, because of the close link between a well functioning financial system generally and well functioning markets, they can also mitigate the risk of market distress emerging. Each dimension, market infrastructure and financial institutions, is considered next.

Strengthening the market infrastructure

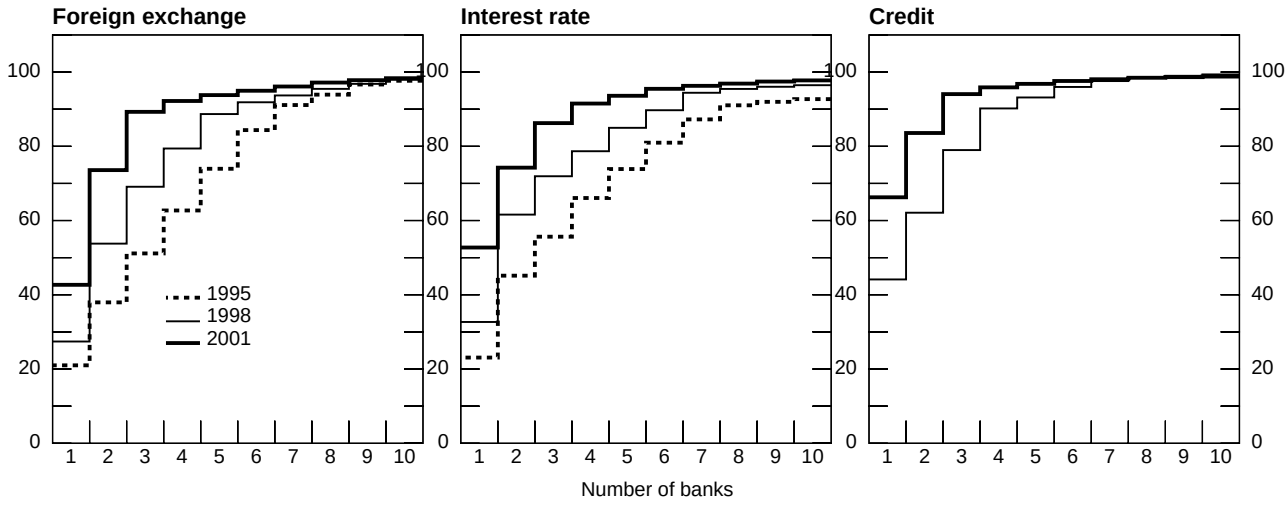
Strengthening the market infrastructure is vital to ensure that the markets continue to function effectively under stress. There are two key aspects of the infrastructure that merit attention: trading platforms and payment and settlement systems.

There is a clear consensus that, at a minimum, trading platforms should be such as to ensure that the infrastructure is capable of handling the surge in activity that characterises periods of market distress and ensure speedy execution of trades. The 1987 stock market crash, for instance, spurred a series of measures aimed at improving trading capacity and order execution (eg, Lindsey and Pecora (1998)).

Beyond this, there are still a number of largely unresolved questions about the link between the architecture of trading arrangements and market liquidity. These include questions like the relative merits of order-driven and quote-driven systems,[47] of competition and centralisation of trading arrangements and the implications of electronic trading platforms.[48] It seems fair to say, however, that despite the heat of the debate, the existence of robust market liquidity does not fundamentally hinge on the specific types of arrangement, as long as they are adequately structured.

Graph III.1: Indicators of concentration in market making of OTC derivatives

Cumulative percentage of total notional amount outstanding[1]



[1] Total OTC and exchange-traded derivatives contracts held by US commercial banks.

Sources: US Office of the Comptroller of the Currency; BIS calculations.

in principle *any* policy that addresses financial instability would be relevant. What follows, however, focuses on a limited set, more closely related to market liquidity proper.

[47] For instance, the OECD (1991) concluded that it was difficult to judge which of the two types of market had performed more effectively during the 1987 stock market crash.

[48] On electronic trading, see CGFS (2001d), Greenspan (2000) and Levitt (2000).

Of greater significance is the architecture of payment and settlement systems. More generally, upgrading clearing and settlement arrangements plays a critical role, as it allows better management of counterparty risk and settlement flows and can dampen the propagation of disturbances. Obvious examples include efforts to promote the implementation of delivery-versus-payment or payment-versus-payment mechanisms, contract netting and cross-margining, to reduce settlement lags and to improve the legal underpinning of contracts. In recent years, considerable progress has been made in this area. The Committee on Payment and Settlement and Systems has played a key role, helping to draw up standards for the sound design and operations of the systems.[49]

The importance of mechanisms to manage counterparty risk is clearly illustrated by the typical patterns of migration of liquidity during periods of market turbulence. *All else being equal*, markets with centralised counterparties can be more robust *as long as the soundness of the central counterparty is ensured*.[50] The corresponding risk mitigation and sharing mechanisms as well as greater transparency are factors that facilitate trading under stress. This is reflected in the well documented tendency for exchange-based derivatives markets - where participants tend to lay off their residual risks - to act as a kind of market liquidity provider of last resort for OTC markets.[51] Experiences during autumn 1998 or at the time of the bond market crash in 1994 are no exception. From this perspective, the very high and rising concentration of market-making in some OTC markets, such as that for credit derivatives, coupled with the fact that the market-makers have lost their once AAA rating, gives pause for thought (Graph III.1).[52] Likewise, the fact that the same players are very active across market segments adds to the potential impact on market distress should one of them ever face difficulties.[53] At the same time, major steps have also been taken in OTC markets to address counterparty risks in recent years (see below). And, by their very nature, OTC markets can handle tailored products in a way that organised exchanges cannot.

Strengthening financial institutions

Policies that target financial institutions essentially aim at promoting better risk management and better information on which to base decisions. But what does "better" precisely mean in this context? Just as in the case of banking distress, it is possible to distinguish two types of approaches, depending on the perspective that enspires them (Borio (2003) and Crockett (2000)). The microprudential approach focuses primarily on the perspective of *individual* institutions and tends to take the market risks that they face as largely *independent* of their individual behaviour *(exogenous).* Its macroprudential counterpart adopts a more *system-wide* perspective and tends to stress that those risks are to a considerable extent the result of the collective behaviour of institutions *(endogenous).* Microprudential efforts are very well advanced; macroprudential ones are just in their infancy.

The microprudential perspective

Policy responses that are inspired by a microprudential perspective tend to highlight a number of principles. Financial institutions, especially those acting as market-makers, should operate with sufficient safety cushions in terms of capital and liquidity so as to be able to absorb market strains without seeing their soundness endangered. They should not assume ex ante the existence of liquid markets in which to hedge and lay off risks. And they should have sufficient information about the market participants with whom they transact to be fully aware of the risks they incur in the process.

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[49] See BIS (1994) or Borio (1995) for an overview; CPSS (1998a) on progress in addressing foreign exchange transactions; and CPSS (2001) for recommendations for the design, operation and oversight of securities settlement systems, prepared jointly with IOSCO. More recently, the establishment of CLS, as a mechanism to address Herstatt risk in foreign exchange markets, some 30 years after the problem had been identified, has been a major development in this area; see Galati (2002).

[50] This need not be the case, as illustrated by concerns about the soundness of the Options Clearing Corporation at the time of the 1987 stock market crash. See, for example, SEC (1988) and Bernanke (1990).

[51] For an examination of clearing and settlement arrangements in OTC and exchange-based derivatives markets, see CPSS (1998b, 1997).

[52] See the discussion in BIS (2002c).

[53] Some of these issues are analysed in the Group of Ten (2001) report on financial consolidation. See also BIS (2003a).

Particularly in the wake of the 1998 autumn market turbulence, both market participants and prudential supervisors have taken steps to improve risk management practices and information flows.[54] There has been a keener recognition of the need to understand the interplay of the different types of risk (market, credit and liquidity risk), which takes centre stage at times of market distress.[55] The limitations of purely backward-looking and mechanical measures of risk, such as VaR, have become better appreciated. For instance, VaR outputs are nowadays used only as one source of information and not necessarily as bindings constraints on positions, other than when regulatory minima become binding. Correspondingly, the use of stress-testing techniques has been strongly encouraged and has become more widespread, refined and more tightly integrated within risk management processes (CGFS (2000, 2001d)). Efforts have been made to improve the management of counterparty risk. And further initiatives have sought to strengthen public disclosures concerning the risk profile of individual financial institutions.[56,57]

Among these various steps, the major efforts to improve counterparty risk deserve particular attention. These have gone well beyond due diligence. There has been increasing reliance on enforceable bilateral netting of exposures. For instance, Office of the Controller of the Currency statistics indicate that at US commercial banks the share of derivatives credit exposures reduced through such netting arrangements has risen steadily, from some 50% at the end of 1997 to close to 85% in the first quarter of 2004 (OCC (2004)).[58] And there has been much greater use, and better management, of collateral. ISDA surveys indicate that the share of all derivatives exposures offset by collateral reached around one-third in 2002[59], with the overall number of collateralised agreements having almost tripled since 2000, from 11000 to over 28000. These steps have gone hand-in-hand with closer measurement and monitoring of exposures as well as tighter management of both initial and variation margins, limiting the risk of discretionary adjustments at time of distress.[60]

The effects of the increased reliance on netting and collateral on market distress differ somewhat. From the perspective of the institutions involved, netting reduces counterparty and, in some cases, liquidity risks too. By contrast, greater use of collateral reduces counterparty risk but raises market and, above all, liquidity risks. Ex ante, it may also encourage firms to take on more leverage (CGFS (2001a) and Borio and McCauley (1996a,b)).[61] Its overall implications, therefore, will depend on how well the institutions manage the changed profile of risks.

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[54] See, in particular, the efforts made by the private sector, as described in CRMPG (1999), the Basel Committee document on highly leveraged institutions (HLIs) (BCBS 1999a) and the one evaluating the progress made since the original recommendations (BCBS 2000a). On HLIs, see also FSF (2000, 2002).

[55] For instance, for one way of integrating market liquidity and market risk, see eg Bangia et al (1999).

[56] Considerable efforts have been made in national jurisdictions and by international regulatory bodies in this area. For example, see BCBS (1999b, 2000b, 2003). See also the exploratory work by a multidisciplinary group that brings together representatives of the Committee on the Global Financial System, the Basel Committee on Banking Supervision, the International Organization of Securities Commissions and the International Association of Insurance Supervisors (CGFS 2001e).

[57] Providing timely information about risk profiles of individual institutions is a necessary condition for the proper measurement of risk and the exercise of market discipline Admittedly, it has long been recognised that, in certain circumstances, disclosure may actually be destabilising. This was the conventional wisdom regarding financial distress at banks, but the point has recently been made with respect to market crises too (eg Persaud (2001b)). Rather than an argument against disclosure per se, this can best be regarded as one in favour of *early* and *frequent* disclosure, so as to strengthen prevention and avoid discontinuities in the flow of information. The issue of potential disclosure of information about aggregate market positions raises further issues (see below).

[58] At the same time, the overall credit exposures through derivatives, after subtracting the impact of netting, while fluctuating considerably with market prices, have not shown much of a trend in relation to the firms' own capital since the mid-1990s. For instance, at the top seven US banks total credit exposure (including current and potential future exposure) has fluctuated between around 250-300% of risk-based capital (OCC (2004)). This suggests that the greater reliance on netting has allowed banks to take on more business and sustain the rapid growth of derivatives markets.

[59] The percentage was somewhat higher for fixed-income derivatives, at around 40%.

[60] See CGFS (2001a) for a discussion of the evolution of collateral practices since the 1998 market turbulence. The report also notes that a number of dealers had begun to set the tightness of margin requirements, including initial margin, in relation to the amount of information received from counterparties.

[61] In addition, from a system-wide perspective, collateral shifts the exposures to unsecured creditors; for a discussion of these issues, see CGFS (2001a).

The macroprudential perspective

Taken as a whole, these efforts represent major steps in the right direction. They make a necessary and vital contribution to the quest for robust market liquidity. But from a macroprudential perspective they leave two questions unanswered. First, is information about the risk profile of individual institutions, however detailed, sufficient to provide a reliable picture of the risk of market distress for the system as a whole? Second, are these efforts per se sufficient to take into account the wedge between individual rationality and desirable aggregate outcomes? In other words, are these efforts sufficient to address the "risk perceptions" and "incentives" gaps highlighted in the previous analysis? Lurking behind the surface of these questions hides the endogeneity of risk. Consider each in turn.

Better information

Market distress, by its very nature, will affect many institutions at the same time. And the likelihood of its emergence will likewise depend on their collective behaviour. That is, it will depend not so much on the risk profile of *individual* institutions but on the extent to which these institutions share similar exposures, ie on the *correlation* of exposures across them.[62] And because the reactions of firms to the initial price change will in turn have a first order effect on prices and market conditions, the correlation of their responses will also be important ("feed-back effects"). These factors are relevant both for the build-up of risk and for its materialisation.

This suggests that the information relevant for assessing the likelihood and intensity of market distress should somehow be based on a more system-wide view of conditions. By analogy with information about the risk profiles of *individual* institutions, one could distinguish three types of tools, namely stress tests, VaRs and leading indicators of distress.

Both "macro" stress tests and sectoral VaRs would most naturally be built from the aggregation of information drawn from firms' own risk management systems.[63] In recent years, a considerable amount of intellectual effort has gone into developing the frameworks to construct such tools, especially within the central banking community.[64] Even so, the conceptual and informational constraints remain daunting. And none of these efforts has so far been able to take into account in a meaningful way feedback effects.

Leading indicators of distress would seek to develop probabilistic statements about the likelihood of its emergence. However, except in the narrow and rather specific context of exchange rate crises, there is no extant work in this area.[65] At this stage, it is only possible to speculate about what the rough contours of these indicators might look like, reasoning by analogy with their banking distress counterparts.[66] First, they are likely to combine information about prices and leverage. Information about prices would seek to signal the potential for price "misalignments" and hence reversals; information about leverage would seek to capture the likelihood of disruptions in case prices did reverse. Second, they are likely to focus on cumulative processes, typical of the build-up phase that precedes market distress. Of the two components, measuring leverage is arguably by far the hardest. It is clearly much harder than in the case of business-cycle macro credit risk, where measures of aggregate debt can be used as proxies. One could think of using indirect indicators, such as measures of revealed effective risk tolerance, as might be deduced from price and possibly volume indicators.[67]

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[62] Of course, not all institutions are "born equal" in this respect, as a function of the nature and scale of their activities. Market makers, for instance, are especially important.

[63] These issues are discussed in more detail in Borio and Tsatsaronis (2004).

[64] See the CGFS (2000) for a first step in addressing the aggregation of stress tests with a specific focus on market risk, most closely related to market distress. For a particularly interesting analysis concerned with overall risk in the banking sector, see Elsinger et al (2002). Variants of such macro-stress tests are now routinely included in the Financial Sector Assessment Programs (FSAPs) carried out jointly be the IMF and the World Bank in co-operation with national authorities. FSAPs seek to develop a comprehensive view of the financial sector of individual countries and its interaction with overall economic performance. Their focus, however, is much broader than market distress specifically.

[65] For a review of the literature on currency crisis indicators, see IMF (2002).

[66] See Borio and Lowe (2002) for a set of indicators for banking crises in industrial and emerging market countries constructed along these lines, and Bell and Pain (2000) for a review of the literature.

[67] For some such measures, see eg Tsatsaronis (2000b), Misina (2003) and Tarashev et al (2003).

Alternatively, and much more ambitiously, one could generate estimates of leverage based on the aggregation of risk information from market participants' own risk management systems. For instance, information derived from aggregation of exposures or stress tests could be a useful input.

Whether any such tools could be developed successfully remains very much an open issue. But if they were, they could be helpful as a basis for calibration of policy responses by prudential authorities. In addition, if released to the market with a sufficient lead, this information might also contribute to restraining the build-up of risk.[68] These tools would be the market-distress analogue of the broad set of indicators now being developed for banking distress at business cycle frequencies.

Better incentives

So much for information; what about incentives? The key problem here is that actions that may appear compelling and fully rational from the perspective of individual market participants can lead to undesirable aggregate outcomes for the market as a whole. Ideally, the calibration of prudential tools should take these factors into account too.

This point can be most concretely illustrated with two real-life examples. The first relates to the behaviour of the clearing houses of exchanges at times of market stress. Routinely, clearing houses protect themselves against the default of their members through margin requirements. In turn, these margin requirements are often related to the price volatility of the contracts traded. As volatility increases, margin requirements would normally rise. During the extreme volatility that characterised the 1987 stock market crash, exchanges typically raised margin requirements. The one exception was the experience in Japan. There, the authorities actually lowered margin requirements and, in addition, relaxed lending limits on equity portfolios serving as collateral.[69] The objective was precisely to alleviate the cash shortage and distress selling in the market. The implicit judgment was that, on balance, the action would protect, rather than put at risk, the integrity of the clearing house. In effect, the clearing house was attempting to internalise the "externalities" that arise from acting as if the increase in margin requirements had no impact on the market price. The second example relates to the strategy followed by supervisory authorities in the United Kingdom in 2002. As the stock market was plummeting, the authorities relaxed regulatory constraints on insurance companies in order to relieve the pressure on them to sell shares (FSA (2002a,b)).

These examples suggest that one way of better aligning incentives with desirable market outcomes is to allow firms to draw on their cushions of capital and liquidity so as to reduce the incentive to retrench at times of stress.[70] However, if this is to be done without endangering their soundness, it is important that the cushions be high enough to start with. Discretionary relaxations of constraints at times of distress that are not embedded within such a framework would be second-best and possibly even counterproductive. In other words, a natural strategy would be to induce market participants to build up sufficient liquidity and capital cushions or excess margins in the good times so as to be able to run

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[68] There is a presumption that, as long as the public disclosure of such aggregate information is sufficiently timely and continuous, it would be stabilising. At the same time, the specific conditions under which this would indeed be so have not as yet been properly explored analytically and empirically. For example, one strand of thought argues that disclosure of the overhang of fundamental value-insensitive trades (eg for dynamic hedging or stop-loss reasons) would help the market accommodate them more easily, thereby limiting strains on market liquidity (so-called "sunshine trading" disclosures); see Gennotte and Leland (1990). This is because market participants would realise that those trades, once they come to the market, do not reflect changed views about the "fundamental" (equilibrium) price of the asset (in the strong sense), which could in turn encourage them to change their views in a similar direction. This argument is consistent with the seminal analysis by Grossman (1988), who notes that dynamic hedging strategies that (opaquely) replicate option payoffs fail to convey (or "aggregate") the information that the option prices, if they existed, would convey, as the overhang is not priced by the market. Brunnermeier and Pedersen (2003), however, show that under some conditions the release of some such information might actually destabilise the market, if other traders used it strategically to earn a higher profit at the expense of the constrained sellers. Morris and Shin (1999), too, argue that disclosure is not a panacea, as its effect depends on the nature of the strategic interactions among players. More generally, and as yet unaddressed in the literature, there is bound to be some trade-off between disclosure of public information, on the one hand, and the profit-seeking incentive of market-makers to capitalise on their private information, based on their superior knowledge of the order flow, on the other.

[69] The latter measures seem to have been taken as part of a broader support plan involving concertations between the Ministry of Finance and the big four securities houses. See BIS (1988).

[70] See Cifuentes et al (2004) for a formalisation of this point, with an emphasis on the substitutability between capital and liquidity buffers.

them down, up to a point, as market distress arises.[71] Conceptually, this would parallel suggestions to address the potentially excessive procyclicality of the banking system at business cycle frequencies.

How best to encourage the build-up of sufficient cushions, and what the correct levels should be, are issues that deserve greater attention. Stress testing carried out at the individual level and based on past scenarios of market distress can help up to a point. Implicitly, the scenarios embody price dynamics that do take into account market interactions. For example, reportedly the playing-out by financial firms of the 1994 bond market crash scenario was one reason why the violent back up in bond yields in 2003 had less of an effect on financial institutions than its counterpart in 1994.[72] Even so, these types of scenario are arguably too backward looking, being inevitably too closely shaped by the specifics of past experience. More ambitiously, the development of the system-wide information tools discussed previously could, if successful, provide a more targeted basis for adjustment. In addition, it might be worth exploring whether built-in stabilisers could be developed. For instance, one possibility might be to base additional cushions on extent to which the profitability of trading strategies over tranquil periods exceeds a long-run average. Such tools would be analogous to the use of dynamic provisioning to address the credit risk of banks over a business cycle (Borio and Lowe (2001), Fernández de Lis (2001)). Their desirability and feasibility, however, remain to be studied.

Conclusions

The continued growth and development of markets potentially increases the costs to economic activity of market malfunctioning and of episodes of severe market distress. The episodes of market distress that have occurred since the 1980s have sharpened awareness of the high stakes involved. Against this background, it is important for policymakers to develop an understanding of the anatomy and costs of market distress so as to design appropriate policy responses.

Articulating an appropriate policy response calls for a holistic approach to the problem, ie one that takes full account of the interdependencies between the behaviour of market participants and market dynamics. Much useful work has been done so far to address market distress by improving the *market infrastructure* and the risk management at *individual* financial institutions. The territory that remains largely unexplored, however, is precisely the link between the *collective* actions of individual market participants and market dynamics.

Taking steps in this direction presents a threefold challenge. The first is one of perspective. The recognition that the risk of market distress is fundamentally endogenous with respect to the behaviour of market participants rather than the result of external unforeseen events ("shocks") has not yet gained the primacy that it deserves in current thinking. The second is analytical. We simply still lack the analytical tools to address this link satisfactorily and in a way that can set a reliable basis for policy. The final one is institutional. The tools for the necessary policy response are dispersed across a variety of different authorities, including central banks, prudential supervisors, securities regulators and even the accounting profession, each with its own mandate and perspective. This complicates the elaboration and implementation of appropriate policy responses. It also puts a premium on continuous dialogue and cooperation so as to help develop a common understanding of the problem and to frame the corresponding solutions.

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[71] See eg Crockett (2000), Borio et al (2001), Borio (2000, 2003). Conversely, if institutions operate without any cushion over regulatory minima and these become tighter in periods of distress, then, all else being equal, selling pressure in the market could be exacerbated (eg Persaud (2001a,b), Goodhart and Danielsson (2001) and, for a formalisation, Danielsson et al (2002)). Jorion (2002), however, argues that the smoothing mechanisms incorporated in regulatory minima should generally be sufficient to avoid such a perverse outcome.

[72] Some comfort can be drawn here from the results of the recent report by the CGFS (2001d), as summarised in Fender and Gibson (2001). This survey of stress testing reveals that managements' responses to stress tests do not tend to be mechanical. They also point to an increasing awareness of the need to take into account market interactions, as affected by the relationship between the bank's positions, those of others and the degree of market concentration.

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