A REAPPRAISAL OF MARKET LIQUIDITY RISK IN THE LIGHT OF THE RUSSIA/LTCM GLOBAL SECURITIES-MARKET CRISIS[1]

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Abstract

The collapse of market liquidity in securities markets – notably in the US – that followed the Russian default and the LTCM rescue in 1998, was considered at the time to be almost unprecedented. Even Mr Greenspan remarked "we do not as yet fully understand the new system's dynamics". Clearly, the pattern was unusual in that it affected the deepest and most liquid markets in the world. However, the broad phenomenon of abrupt declines in securities market liquidity is not unusual. Amongst parallel episodes are the collapse of the FRN market in 1987, the junk bond crisis of 1990, the collapse of the Swedish commercial paper market also in 1990 and the difficulties of the ECU bond market in 1992. Admittedly, most of these comparable patterns in the past affected rather minor and segmented markets, which tended to feature a concentrated structure of market makers, investors and/or issuers. The most similar episode was perhaps that in the US CP market at the time of the Penn Central bankruptcy in 1970, which was considered of sufficiently systemic dimensions to warrant a policy response.

It is suggested that a recurrent pattern can be traced in debt securities markets, which is similar in some ways to contagious bank runs. In effect, markets cease to function, so that securities are transformed temporarily into non-marketable loans, or at least suffer major price shifts. This may entail severe difficulties for those relying on their liquidity, including investors, issuers and market makers, and can lead to systemic risk in the financial system more generally. Difficulties are more threatening now than in the past given the increasing use of securities markets for funding, trading and investment by banks and other institutions with a maturity mismatch, the incidence of "herding" behaviour as investors adopt similar portfolio strategies and the prevalence of leveraged position taking.

The issue of market liquidity risk has been neglected both in theory and practice. Emphasis in theoretical and empirical studies of financial instability is traditionally placed on bank failures, or consequences of sharp changes in asset prices. Of greater concern is that both risk management models and some aspects of regulation appear to pay rather little heed to the phenomenon. In this overall context, the paper extends earlier analysis of this topic by the author by considering the features and implications of the Russia/LTCM episode in US markets in the light of past experiences, theory and current financial market behaviour. It seeks to arrive at conclusions regarding the predictability of such events, how the risk of their occurrence can be minimised, an appropriate regulatory response to protect financial institutions, the need for central bank intervention when such crises do occur and the overall implications for a securitised financial system. A range of topics for further research is proposed which are commended to the attention of central banks and regulators.

Introduction

The collapse of market liquidity and turbulence in securities markets – notably in the US – that followed the Russian default and the LTCM bankruptcy in the early Autumn of 1998, was considered at the time to be almost unprecedented. Even Fed Chairman Mr Greenspan was heard to remark "we do not as yet fully understand the new system's dynamics". Clearly, the pattern was unusual in that it affected the deepest and most liquid markets in the world – namely those of the US. However, the broad phenomenon of abrupt increases in market liquidity risk is not unusual. Amongst parallel episodes are the collapse of the FRN market in 1987, the junk bond crisis of 1990, the collapse of the Swedish commercial paper market also in 1990 and the difficulties of the ECU bond market in 1992. Admittedly, most of these comparable patterns in the past affected rather minor markets, which tended to feature a concentrated structure of market makers, investors and/or issuers. The most similar episode was that in the US CP market at the time of the Penn Central bankruptcy, which was considered of sufficiently systemic dimensions to warrant a monetary policy response.

It is suggested that a recurrent pattern can be traced in debt securities markets, which is similar in some ways to contagious bank runs. In effect, markets cease to function, so that securities are transformed temporarily into non-marketable loans, or at least suffer major price shifts. This may entail severe difficulties for those relying on their liquidity, including investors, issuers and market makers, and can lead to systemic risk in the financial system more generally. Difficulties are more threatening now than in the past given the increasing use of securities markets for funding, trading and investment by banks and other institutions with a maturity mismatch, the incidence of "herding" behaviour as investors adopt similar portfolio strategies and the prevalence of leveraged position taking.

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The paper is structured as follows; first, an outline is given of events during the 1998 turmoil, then in the second section we outline some relevant economic theory that help their interpretation; the third section expands on some of the concerns raised by market liquidity crises. A final section seeks to draw lessons for policy and suggestions for further work. In an Annex, we look at the comparable past events, comparing and contrasting them with events in 1998. Before starting, a useful preliminary is to seek to define market liquidity. Kyle (1985) notes that it encompasses "tightness" (the cost of turning around a position over a short period of time), "Depth" (the size of an order flow innovation required to change prices by a given amount), and "resiliency" (the speed with which prices recover from a random, uninformative shock)[2].

1 The recent liquidity crisis in the US securities market[3]

The US bond market as well as other dollar securities, money and derivatives markets are rightly seen as normally amongst the deepest and most liquid in the world. The issue of how they became so heavily affected by financial turbulence and one-way selling as to become largely illiquid, not only for corporate bonds but also for government securities, repos, swaps and even foreign exchange, links closely both to the preceding bull market and the nature of financial shocks occurring in the late summer of 1998. Underlying US quantity and price data are given in Tables 1 and 2.

In common with the equity market, the US bond market had seen a major bull phase over the mid-to-late 1990s. The long non-inflationary upturn and the global decline in inflation, as well as flows of funds into the US and some beliefs that "a new era of high productivity had begun" were among the underlying factors. This bull market was manifested on the one hand in a sustained rise in equity and bond prices and on the other in a contraction of yield differentials relating to credit and liquidity risk. In other words, there appeared to have been a reduction in the price of risk required by investors. Notably, bank loan spreads, bond spreads and spreads of lower quality commercial paper all fell well below long term average values. The bull phase also coincided with a growth in issuance and

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2 Kyle also cites Black (1971), who states that "the market for a stock is liquid if (1) there are always bid and asked prices for the investor who wants to buy or sell small amounts of the stock immediately; (2) the difference between the bid and asked prices (the spread) is always small; (3) an investor who is selling a large amount of stock, in the absence of special information, can expect to do so over a long period of time at a price not very different, on average, from the current market price; (4) an investor can buy or sell a large block of stock immediately, but at a premium or discount that depends on the size of the block". The larger the block, the larger the premium or discount. In other words, a liquid market is a continuous market, in the sense that almost any amount of stock can be bought or sold immediately, and an efficient market, in the sense that small amounts of stock can be bought or sold very near the current market price, and in the sense that large amounts can be bought or sold over long periods of time at prices that are, on average, very near the current market price"

3 This account draws heavily on IMF (1998).

indebtedness, much of it securitised, albeit not a rise in corporate leverage relative to profits of the type seen in the late 1980s. To some extent, bond issuance rather represented a switch away from bank lending (although as shown in Table 1, the pattern of net borrowing derived from US flow of funds data is not entirely clear).

In these circumstances, institutional investment in vehicles such as mutual funds proved attractive to retail investors. In addition to such funds, there was rapid growth of hedge funds, leveraged and unregulated institutions generally operating offshore with high minimum investments that seek to profit either from changes in economic developments at a national or global level (macro funds) or from hedging or arbitrage strategies aiming to profit from anomalies in market pricing (relative value funds). It is estimated that in mid-1998 there were between 1000 and 4000 such funds, with total assets of as much as $400 bn.

The Asian crisis, which erupted in Thailand in July 1997 and rapidly encompassed most of the so-called tiger economies (see Davis 1999a), had remarkably little effect on securities markets in the OECD countries, as the bull market in equities and bonds continued till July 1998. Then equity prices peaked as concerns grew about the potential negative effects of the Asian crisis on US output and on corporate earnings, and prospects for early recovery in Asia and in Japan were considered to have receded. Bank shares in the US, Europe and Japan were disproportionately hit as awareness grew of their exposure to emerging markets. There was a 50 bp widening of corporate bond spreads in the first half of August, linked to concern about US growth and a beginning of a move towards quality and liquidity.

The triggers for severe turbulence in the securities markets were the moratorium on sovereign debt and effective devaluation of the rouble by the Russians in August, and the near-failure and subsequent rescue of the hedge fund LTCM in September. After Russia there was a major reassessment of risks associated with emerging market investments. This led in turn to a large-scale portfolio rebalancing and deleveraging. Large investment and trading losses were incurred. According to the IMF (1998), the Russian default had effects on other emerging markets that were absent for Asia - and were well in excess of actual exposures to that country and its economic significance - because Russia repudiated sovereign traded securities, leading to unwinding of leveraged positions, whereas Asia involved loans; Russia was a single decisive event; and it occurred amid heightened concerns about the US economy.

There followed a further fall in equity prices, a *rise* in core government bond prices (in the context of a "flight to quality") and a rise in spreads on both corporate bonds and peripheral government bonds (e.g. Denmark and Sweden vis-à-vis Germany). Spreads rose most markedly on low grade corporate bonds, reaching their highest level since the junk bond crisis of 1990 (see Annex), and unlike for high-

grade corporates actual yields also rose. Issuance collapsed for the US high yield market (to $2 bn in October compared with $15 bn per month in the second quarter). It is not clear that all of the widening in spreads was linked to credit risk perceptions. Rather, the widening was also linked to an extreme liquidity preference and a general unwillingness to deal in corporate bonds, which led to a sharp rise in spreads. In the words of McDonough (1998), there was an "abrupt and simultaneous widening of credit spreads globally, for both corporate and emerging market sovereign debt, (which) was an extraordinary event beyond the expectations of investors and financial intermediaries".

According to market participants, it would appear that a wide variety of institutions, and not just hedge funds, had taken long positions in Russia and other emerging markets. The scale of the spillover to the US and other mature markets was linked to the fact that the financing for these positions had been arranged in a leveraged manner in those markets (e.g. via a series of margin investments, short sales, repos and derivative securities). High leverage in turn reflected the relatively low margin requirements in markets such as those for OTC derivatives, and low or zero margin on repos. Rapid attempted liquidation by a large number of investors in the context of high leveraging led to sharp price changes. The overall widening of spreads after Russia and the flight from emerging markets provoked by these portfolio adjustments and increased risk aversion had further consequences. Notably, it inflicted heavy losses on the significant number of large investors which had purchased other higher-risk and/or lower-liquidity assets (e.g. junk bonds or mortgage backed securities – and off-the run Treasuries) while going short in on-the-run Treasuries and other high-quality debt on the assumption that the existing widening that had occurred after the initial Asian crisis would be unwound (i.e. spreads would "mean revert"). Such losses led to further margin calls, liquidation and hedging, putting further demands on liquidity. Long term investors tended to be unwilling to buy the assets available at low prices given their existing losses and consequent risk aversion.

In this context, there came the news of heightened concern regarding the solvency of the hedge fund LTCM. LTCM had large and leveraged positions (to magnify the value of what were felt at the time to be low risk, low profit trades anticipating the above-mentioned "mean reversion") across what were thought to be a diversified range of financial markets (including derivatives contracts such as equity options and swaps). US and European banks had credit exposures to the fund to the tune of $3-5 billion. As a hedge fund, LTCM was not regulated. The simultaneous price shifts in previously uncorrelated markets in the wake of Russia wiped out its capital and threatened insolvency. A rescue was undertaken by private-sector banks to preserve orderly market conditions (McDonough 1998). Notably, there was concern if LTCM had suddenly been put into default, its (75) counterparties would have rushed to "close out" hundreds of billions of dollars of positions, causing massive illiquidity and price shifts, harming both the counterparties and other market participants. Such a move might

generate further uncertainty on equilibrium prices in a vicious circle, which would ultimately impact sharply on the cost of capital.

Despite it being rescued, LTCM heightened the initial response of markets to the Russian shock by leading to fear of the unknown regarding unwinding of positions and fear of similar hedge fund or bank failures which would entail the unloading of assets into illiquid markets at distressed prices (although in fact LTCM was unique among hedge funds in the degree of leverage it employed). There was a sharp increase in price volatility and departures from normal pricing relationships (manifested in spreads on off-the-run Treasuries widening from a norm of under 10 bp to 35 bp, despite similar duration and the same credit risk) thus again suggesting a major premium was placed on liquidity. Similar widenings were seen in the yield spreads on eurodollar bonds and on private sector instruments over US treasury bills (see Table 2), as well as on swaps of fixed for floating rates, showing also heightened concern about counterparty risk. Even in currency markets such as the dollar-yen, there was a sharp rise in bid-offer spreads.

It is emphasised by IMF (1998) that the publicity surrounding LTCM tended to obscure the fact that much larger institutions, notably international commercial and investment banks, had taken similar if not greater positions with comparable leverage (albeit in the context of more diversified overall activities and with the benefit of close financial regulation). LTCM was estimated to have $ 80 bn in US Treasury arbitrage positions while commercial banks had $ 3000 bn. But all were seeking to unwind partially or wholly their positions. Direct creditors and counterparties of LTCM were hence not the only ones likely to be hit by losses from an enforced unwinding of LTCMs positions. The wide array of institutions holding similar portfolios were also at risk. In such circumstances, market makers were naturally reluctant to trade[4]. According to the Wall Street Journal, they "cut back on the size of trades, quoted wider bid-offer spreads or did not quote at all[5]". Consequently, markets moved to levels which were at times wholly unjustified by fundamentals[6]. Markets that were traditionally uncorrelated became highly correlated, prompting paralysis among long term investors (they reportedly "lost by being long on credit and did not take into account gains from being long on duration").

Trading techniques such as dynamic hedging and portfolio insurance apparently worsened such tendencies, and exacerbated market price movements once they began. The result was intensified focus on paper that could be liquidated quickly, regardless of its quality in other respects. Market liquidity dried up repeatedly in what are normally the deepest markets (US Treasuries, US repos, and

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4 The institutions making markets had themselves been financially weakened in the crisis.

5 There is anecdotal evidence that credit departments put pressure on their dealers to be cautious.

6 According to a market participant, "There was actual liquidation by leveraged funds, and by proprietary trading desks; long term money managers sat on the sidelines; big liquidations and fear of more to come led

even the yen-dollar), as "markets became one-sided until prices declined enough to bring buyers back…"(IMF (1998, p70)). The turbulence led to heightened uncertainty, especially after LTCM, as "it was not clear how far market prices would need to fall, or how badly counterparties balance sheets had been damaged…" (ibid, p71) intensifying the desire for liquidity at almost any cost.

In currency markets, the dollar began to fall against the yen in August in light of changed perceptions about US and Japanese growth and regarding US monetary policy and Japanese bank reform. Although the depreciation began slowly, there was a sharp move in the yen in early October shortly after LTCM, which was linked to the unwinding of short term yen borrowing, notably by macro hedge funds, while long term investors sought to correct their underweighting in Japan. There had previously been a build-up over several years of the so called yen-carry trade, where investors borrowed at low rates in yen, swapped into other currencies and bought higher-yielding assets. In addition to profit taking, the unwinding reflected institutions being confronted with margin calls in other markets. Meanwhile Japanese banks repatriated funds and closed long dollar positions in light of rising funding costs (there was price rationing of interbank funding in the context of the "Japan premium") and deteriorating access to international interbank markets (which may also have included quantity rationing). Stop-loss and option trades with similar effects may have exacerbated the fall. The virtually unprecedented shift in the dollar-yen rate (of around 15% in three days) inflicted major losses on the macro hedge funds and blunted their ability to correct pricing anomalies elsewhere. It coincided with a major steepening of yield curves in mature markets.

US conditions later eased with lower interest rates as the Fed together with other central banks eased their monetary stance, as equity markets rebounded and corporate bond spreads narrowed. There remained signs of tension, such as an aversion among dealers to taking large positions in corporate bonds, marked premia in lower quality CP and particular dangers apparent over the year-end. Issuance of corporate debt and commercial paper remained low, with a rise in bank lending tending to substitute (see Table 1). On the other hand, many judged it remarkable how quickly the turbulence eased, with issuance and prices rising sharply at the beginning of 1999. One possible argument is that the crisis entailed (after an initial overshooting) a renormalisation of spreads and prices, rather than a renewed misalignment; the suggestions above relating to underpricing in the preceding bull market are consistent with this. The argument implies that the risk of a protracted credit crunch was not acute.

In the context of the crisis, the risk management models currently in use came under scrutiny. These are so called Value-at-Risk models (VaRs), which measure how much of a firms' capital could be lost within a given confidence interval owing to changes in market prices. Investors seem not to have anticipated or understood the risks that were posed in the summer of 1998, and made similar

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market makers, arbitrage desks and hedge funds to be unable to correct anomalies as they were losing money

misjudgements to each other both in assessment and management of risk and in investment strategies. They may have relied too much on their VaRs, and not enough on market judgement, even though the limitations and assumptions underlying VaRs are well known; by their nature, VaRs rely on historical data and "normal" patterns of fluctuations. Moreover, users may also have disregarded historic risks beyond the threshold of two standard deviations. VaRs prove notably misleading in periods of stress, especially if cross-market relationships change temporarily (as they assume historic correlations will continue to hold). At times, the models themselves called for rapid portfolio rebalancing, exacerbating "one-way-selling". In addition, VaRs tend to assume that market liquidity will always be enough to enable positions to be closed out without large price changes or market turbulence. In fact, the large scale rebalancing by many institutions led market liquidity to collapse, thus inflicting larger than expected losses on firms seeking to unwind positions. A complement to VaRs is "stress testing" or "disaster scenarios", which, properly employed to show, for example, simultaneous deterioration in all markets, could have helped pinpoint the risks to investors such as LTCM. The actual risks run suggest that such tests were either not undertaken, were not adequate in terms of shocks which were simulated, or their results were not taken sufficiently seriously.

The potential losses inflicted on banks by the near-collapse of LTCM (where banks were often both lending to it and were counterparties in its transactions) implied shortcomings both in banks' credit risk assessment and management and in financial analysis of trading counterparties. Control of consolidated risks at an institutional level, assessment of the impact of market risk on credit risk and the integration of liquidity risks into risk management were all seen by IMF (1998) as areas requiring improvement. In this context, the element of human judgement needed to implement models may have allowed short termist and bonus driven pressures to override considerations of overall risk exposure. A further problem is in measurement of potential future exposures arising from derivative activities. Meanwhile supervisors evidently lacked an overview of the degree of and distribution of risk taking in national and global markets, in some cases due to lack of consolidated supervision. Inadequacies of transparency, especially of hedge funds, also came to the fore.

2 Financial instability - banks and securities markets

We now go on to offer a brief summary of aspects of recent developments in the theory of financial crises, most of which describe banking crises, *and to seek to relate them to the description above*, viewed in the light of theories of securities market structure and dynamics.

(a) Liquidity insurance and runs

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so badly".

The core of financial instability analysis has traditionally been the liquidity crisis. Such liquidity crises are best described in the context of the theory of banking as **liquidity insurance**, originated by Diamond and Dybvig (1983). By pooling risk, banks are able to provide liquidity insurance to risk averse depositors facing private liquidity risks. Meanwhile, reflecting the preferences of borrowers carrying out long term investment projects, as well as the importance of private information specific to the relationship between borrower and lender, banks' assets are long-term and illiquid, except for a small liquid proportion to meet normal demand for withdrawals;[7] hence banks engage in maturity transformation. These features give an incentive for panic runs[8] on banks even if solvent, because of imperfect information regarding the bank's assets, inability of the bank to sell or cash illiquid assets (i.e. loans) at par, and the "sequential servicing" process whereby claims are distributed. The risk that others may withdraw can cause a panic regardless of the underlying financial position of the bank and may impinge externally both on other banks (via direct financial exposures and contagion) and on borrowers unable to access other sources of funds. *If LTCM had not been rescued, a process similar to a contagious bank run could have ensued, with first the institution itself and then the most exposed creditors being starved of liquidity and forced to sell assets in a "fire sale" manner. Given underlying weakness of market liquidity, this would have exacerbated effects of the simultaneous closure of positions and prompted severe market disruption.*

Securities markets offer liquidity insurance in a different way. A liquid securities market provides optimal risk sharing from a security holder's point of view, by increasing the ease with which assets may be transformed into cash prior to maturity. The counterpart to the lower yield on bank deposits than on direct investment is that yields are lower in highly liquid securities markets, and hence the cost of funds is lower for a given maturity, as investors are more willing to hold a claim if they are confident of its liquidity. *One example is the above-mentioned distinction between on the run and off the run*[9] *US Treasury securities*[10]. Unlike sight deposits at banks, there is no guarantee of a fixed rate at which securities can be liquidated immediately, but short-term high-quality debt securities approximate to this. Meanwhile, so long as markets remain liquid, the investor of the security benefits from a shorter effective maturity than the issuer has to offer, thus there is again maturity

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7 A criticism of the paradigm, rectified in Diamond (1984), is that it does not specify the nature of bank assets and the importance of monitoring of borrowers as a key function of banks. It also ignores the role of bank capital.

8 Since the advent of deposit insurance, "retail" bank runs by households have become less common, whereas "wholesale" runs in the money and interbank markets have become prominent.

9 On the run securities are the most recently issued stocks and heavily traded; off the run are earlier issues of the same maturity which lack liquidity, being largely in the hands of long term investors.

10 Another is that "letter stocks" on the New York Stock Exchange, for which trading is restricted for a specified period, can have prices 26% lower than otherwise-identical traded stocks in the same company (Pratt (1988)).

transformation.[11] Market liquidity depends on all other holders not seeking to realise their assets at the same time. As noted by Herring (1992), *liquidity is likely to be higher in markets which are broad (a diversity of investors and market makers) and deep (with sufficient two-way volume to ensure ability to sell in volume without moving the price), as is normally the case for US securities markets*.

As is the case for banks, if doubt arises over the future liquidity of the securities market for *whatever* reason (it could be heightened credit risk or market risk), it is rational to sell first before the disequilibrium between buyers and sellers becomes too great, and market failure occurs (i.e. yields are driven up sharply, and selling in quantity becomes extremely difficult). *Sellers may either seek cash or more reliably liquid instruments. This appears to have been precisely what happened in the US markets after Russia and LTCM, hitting relatively less liquid markets disproportionately. S*uch collapses of liquidity in debt markets may have externalities similar to bank failures, particularly if there are *leveraged investors who are constrained to sell despite such illiquidity* and there is contagion between markets, as well as if illiquidity makes investors unwilling to accept new issues, and if there are debtors who do not have an alternative source of rollover finance.

Note, however, that the parallels of banks and securities markets are not exact, since investors who are not constrained to sell do not make a loss by "sitting tight" – the underlying value of their assets arising from income streams does not change purely in the case of temporary liquidity failure. In other words, markets, unlike banks, may become illiquid but cannot become insolvent. Equally, the difficulties for issuers arise only in the case that an existing securities issue is maturing and needs rolling over – or there is a pressing need for a further issue - when the liquidity problem arises.

In the market microstructure literature, the nature of securities market liquidity failure is clarified by analysis of the role of **market makers,** who buy and sell on their own account, increasing or reducing their inventories in the process[12], at announced bid (buy) or ask/offer (sell) price.[13] The response of market makers to "one way selling" where the new equilibrium price is uncertain is often simply to refuse to quote firm prices, for fear of accumulating stocks of depreciating securities, which generates a collapse of liquidity. Uncertainty is crucial; if there is a clear new market-clearing price at which buyers re-emerge, the market-makers will adjust their prices accordingly, without generating liquidity

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11 Money market funds active in short term debt markets are intermediate between banks and markets, offering pooling benefits similar to banks but a greater confidence about asset values than an individual investor (undiversified and with no cash reserves) would have in a securities market. Their liabilities may hence be viewed as "near money" and may be used for transaction purposes.

12 Unless they are able to "cross" individual buy and sell orders.

13 Ho and Saunders (1981) suggest one can also see banks as market makers in money, making bids on given terms for funds from depositors and offering loans to borrowers. The difference of bid and ask prices is then the interest rate spread. However, banks have other functions in payments, maturity transformation and monitoring of loans. We suggest treating banks as market makers would omit too many of these relevant aspects, and hence prefer to treat them separately.

collapse. Bingham (1992) argues that such collapses are particularly likely when returns to market making are low, and hence institutions are unwilling to devote large amounts of capital to it. *It was noted above that pervasive uncertainty was a feature of the situation in 1998, which was exacerbated inter alia by lack of transparency and disclosure on institutions' portfolios*[14]*. Market makers adopted defensive approaches as a consequence.*

BIS (1986) suggests a number of reasons why one-way selling may occur, for example the increasing concentration of portfolios in the hands of institutional investors, that may react similarly and simultaneously to news, transmitted increasingly rapidly by global telecommunication links (these may reduce breadth as defined above); the fiduciary role of such investors; the fact they see their holdings as short-run, low-risk, high-liquidity assets; that they may have less detailed information than would a bank on which to base a credit decision, and less of a relationship reason (than banks) to support a particular borrower or keep a particular market functioning[15]. A further set of explanation may be based on work on herding by institutional investors (Davis 1995b) which may be warranted e.g. by desire to show quality in the presence of imperfect information (Scharfstein and Stein 1990), or regular performance checks relative to peers, which may lead to mimetic behaviour. The herding literature also suggests some institutions such as hedge funds may play a "leader" role with others following suit (De Long et al 1990). *We have seen in 1998 that there was indeed herding in the sense that banks and institutional investors adopted similar leveraged positions in the expectation of "mean reversion" of spreads – a form of trading that may have driven prices away from equilibrium. Meanwhile, attempted one way selling was inspired by desire to unwind leveraged positions, but was possibly exacerbated by the prompting of VaR models and by quasi-automatic portfolio insurance, dynamic hedging and stop loss programmes.*

The economic literature suggests that market collapse in dealer markets, even in the absence of generalised uncertainty, may result from perceptions of asymmetric information (Glosten and Milgrom (1985), Kyle (1985)). The dealer faces a set of customers who may be either more, less or equally well informed about markets conditions and underlying fundamentals as he. If the former, he will need to charge a higher spread than in the case of a regular flow of "liquidity" orders from uninformed customers,[16] to offset losses made on dealings with "insider" traders whose orders reflect private information.[17] Meanwhile, there are sizeable fixed costs in organising markets, and volumes of "liquidity" trading usually respond inversely to costs of transacting. The costs of trading depend in turn

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[14] Note that liquidity could also be hindered by excessive transparency.

[15] Because of concern about direct exposures and contagion, banks may be induced to display club-like supportive behaviour (Davis (1993)).

[16] Reasons why such individuals may wish to trade could include portfolio adjustment for hedging purposes (Madhaven (1992)), uninformed speculation, or to realise wealth for consumption.

[17] Obviously, if incurring such losses the dealer may also restrict quantities at which he is prepared to deal.

on the bid-ask spread, itself related to the volume of "liquidity" trades. This can lead to a virtuous circle of narrowing spreads, new entry of market participants or even market makers, and increased trading. But in the presence of asymmetric information, markets may also enter adverse spirals leading to market failure. A relative increase in insiders leads market makers to widen spreads to avoid losses. This discourages liquidity traders, who withdraw, increasing adverse selection. Some dealers may cease to operate. Once the insiders are too numerous and if their information is too good, bid and ask prices may be too far apart to allow any trade.[18] Since a wide spread in turn prevents the insider from revealing his information by trading, shutting down the market will worsen subsequent adverse selection (i.e. the proportion of insiders relative to liquidity traders) and widens the spread further. The market will stay closed until "the insiders go away, or their information is at least partly disseminated to market participants from some other information source".[19] *In the case of LTCM, there is some evidence of asymmetric information at play (albeit not "insider trading" in a legal sense), as the unwinding of its portfolio and that of similar hedge funds and other investors was a constant fear in the market. This may have been a major cause of reductions in liquidity by market makers, compounding the effects of the losses they had made on their inventories as a consequence of unexpected price changes per se.*

In both cases (of one way selling and of acute asymmetric information), the secondary market, in effect, ceases to function. The associated decline in liquidity of claims is likely to sharply increase the cost of raising primary debt in such a market (i.e. there will effectively be heightened price rationing of credit), or it may even be impossible to gain investor interest at any price (quantity rationing). *This appears to have been notably the case in 1998 for lower-quality US corporate borrowers, who fortunately were able to access backup lines of credit with banks, albeit at higher prices.*

(b) Theories of systemic risk

Theories of systemic risk seek to categorise the ways in which liquidity crises as described above may be triggered. In this section we summarise their main features and show their applicability to securities markets, *notably in the context of the events of 1998*.

Theories emphasising **debt and financial fragility**[20] consider financial crises to be a key feature of the turning point of the business cycle, a response to previous "excesses" of borrowing which can operate through a variety of financial markets. Amongst the key components of the theory is, first, the

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18 This assumes liquidity trade is endogenous; if not, there will remain a small number of trades.

19 Madhaven (1992) suggests this implies that circuit breakers such as market closure are ineffective. An auction may be needed to restart the market.

20 Key references are Minsky (1982) and Kindleberger (1978).

concept of a displacement[21] - an exogenous event leading to improved opportunities for profitable investment, which triggers a cyclical upturn. Second, they emphasise monetary financial innovations (e.g. new forms of bank liability) which boost the supply of credit and/or the velocity of circulation of money, and enable supply and demand for finance to remain in balance during the fixed investment boom that follows the displacement. However, sharp increases in demand for credit mean interest rate increases eventually occur, which leads to "fragility". Features of fragility include an increase in debt finance; a shift from long to short-term debt; a shift from borrowing which is adequately covered by cash flow to borrowing not covered at all by it; a heightening of speculative activity in asset markets; and a reduction in margins of safety for financial institutions. Further rises in interest rates, perhaps due to policy tightening, may lead on to financial crisis, with runs on banks. Such heightened credit risk as accompanies financial fragility may clearly also lead to liquidity collapses in securities markets, if it generates one-way selling of the securities concerned. *As is emphasised in Section 1, the cycle in securities markets in the 1990s had many of the features of financial fragility, with an asset price boom, high issuance and an increase in leverage on the part of financial institutions. Increased perceptions of credit risk after Russia did indeed help to trigger the collapse in market liquidity.*

Theories of crisis focusing on **uncertainty,**[22] which were developed from those of financial fragility, define it as pertaining to future developments which are so infrequent and extreme as not to be susceptible to being reduced to objective probabilities[23] (e.g. major changes in policy regime, wars). In the presence of such uncertainty, adverse surprises may trigger shifts in confidence, affecting markets and institutions more than appears warranted by their intrinsic significance: hence leading to potential for a liquidity crisis. The response to the potential for such uncertain events, for example by those deciding on liquidity cover[24] (or pricing of loans or services) in banks, underwriters or market-makers in securities, may be to apply subjective probabilities to uncertain events[25] plus a risk premium. But agents often tend to judge such probabilities by the actions of others (i.e. herding)[26] which if it leads to low liquidity cover, undercapitalisation and underpricing of risk can lead to financial instability. Meanwhile, super-normal profits can only be earned by financial innovation when there is uneven information and uncertainty. But such innovation may lead to instability for banks and markets if risk is underpriced. Mayer and Kneeshaw (1988) suggest that this is particularly likely for innovations because firms will have little experience of the instruments; it is difficult to evaluate the

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21 Such as financial liberalisation.

22 Shaffer (1986).

23 Or alternatively and more loosely, to which expectations can only be applied with extreme difficulty.

24 Note that precautionary liquidity is less remunerative than holding illiquid assets, i.e. there is an opportunity cost.

25 Such as war or an oil price shock.

26 Such herding is not irrational if there is a greater likelihood of a bailout when shocks threaten the entire system.

risks, especially in terms of a macroeconomic environment different from the present one; and because in new markets firms may be particularly likely to pursue long term profit maximisation. In other words, uncertainty itself may be raised by the innovation process, particularly because the behaviour of new instruments during periods of financial stress is initially unknown. *The 1998 crisis was closely linked to certain financial innovations, such as the hedge fund as well as various programme trading techniques. Uncertainty was a key feature of the period – the disproportionate response to Russia may be partly explicable in terms of effects in confidence; a reassessment of decision processes rather than risk per se.*

Paradigms of **disaster myopia**[27] extend the theories stressing uncertainty and financial fragility outlined above, to distinguish on the one hand, systematic, recurrent risks such as recession and on the other hand financial crises - the latter being subject to much greater uncertainty as outlined above. In the case of recession it is suggested that objective probabilities are known and subjective probabilities tend to the objective, because unfavourable outcomes are frequent enough to ensure an over-optimistic intermediary in terms of liquidity cover or pricing of risk is driven from the market.[28] But for uncertain events, which may provoke financial crises, there is no such presumption; competition may drive prudent creditors from the market as they are undercut by those disregarding the likelihood of financial crisis for reasons of ignorance or competitive advantage. As well as competition, various psychological factors underlying this pattern of "disaster myopia" may be identified, notably a tendency to calculate probabilities by the ease with which past occurrences are brought to mind, which declines with time, as well as institutional factors such as short periods over which decision-makers in banks and securities houses are assessed, and asymmetry of outcomes for managers and shareholders. These tendencies, which imply declining expectations of shocks during periods of calm, may lead in banking markets to declining capital positions, and loosening of "equilibrium" price[29] and quantity[30] rationing of credit, and hence increased objective vulnerability of creditors to shocks. In securities markets they may lead to herding as defined above, leading to narrower bid-offer spreads, increased open positions, leveraged investments and larger underwriting exposures. For both types of institution, liquidity cover may be reduced[31]. Expectations and objective probabilities of crises may thus during a period of calm drift further and further apart, until a shock leads to an abrupt increase in credit

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27 Guttentag and Herring (1984).

28 This does however assume a suitably long time horizon

29 As reflected in the size of risk premia over safe assets.

30 Following Stiglitz and Weiss (1981), as reflected in the incidence of absolute limits on borrowing resulting from information asymmetries between borrower and a (profit maximising) lender and lack of control of the borrower by the lender.

31 Herring (1990) argues that there has been a secular increase in liquidity risk as institutions have shifted from holding of government securities as liquidity to use of interbank lines, CDs and derivatives, which are more vulnerable to market liquidity risk, as well as to changes in the market's view of an individual institution. Regulators have responded by limiting use of relatively lower quality liquidity.

rationing and/or a collapse in liquidity triggering a crisis, as institutions become aware of their imprudence. The reaction to such a crisis may be a prolonged overestimate of the probability of shocks, which may be equally damaging. *It appears that investors indeed underestimated credit risk as well as market and liquidity risk during the run up to the crisis, driven by short termism and the "bonus culture" as well as by the long non-inflationary upturn. The lack of response of spreads to Asia is another indicator of disaster myopia. Such disaster myopia may even have been exacerbated by over-confidence in the risk management models which were intended to prevent the assumption of excessive risks but which disregard market liquidity risk, and assume the future will resemble the past.*

A view of crises based on **agency costs and asymmetric information** emphasises the role such asymmetries may play in aggravating credit rationing - either by banks or securities markets - during crises. As noted by Mishkin (1991)[32], this may occur via a number of channels. First, if interest rates rise due to monetary tightening or merely to balance the credit market, adverse selection may increase sharply, giving rise to a substantial decline in lending. Second, heightened uncertainty, such that lenders find it harder to screen borrowers, increases adverse-selection problems. It is suggested that in each case the impact is greatest on borrowers whose credit quality is difficult to ascertain - which are likely to be low quality. Again, collateral is a means whereby asymmetric information problems may be reduced (as the lender is then confident of recovering his loan even if the borrower proves to be of low quality). But this means that a decrease in the valuation of assets (e.g. a stock market crash provoked by a change in future profit expectations), by lowering collateral values, sharply increases adverse selection for lenders. This will impinge more on low-quality borrowers for which there is asymmetric information. A fourth mechanism operates via moral hazard. Given asymmetric information and incomplete contracts, borrowers have incentives to engage in activities that may be to their advantage, but which harm the lender by increasing risk of default. The agency problem is greater when borrowers have low net worth as they have less to lose from default. Net worth could decline due to stock-market crashes, as well as due to an unanticipated disinflation or deflation that redistributes wealth from debtors to creditors. Such effects are plausibly greater for low-quality firms that have low net worth before such crises occur. *Although elements of adverse selection may have played a role, it would appear that the widening of corporate spreads that occurred in 1998 was not linked solely to credit risk but also related to the flight to quality in terms of liquidity of instruments. Declines in value of collateral were important transmission mechanisms but acted mainly as direct triggers for selling in the context of leveraged positions.*

Last, Davis (1990, 1995) offers an **industrial analysis** which suggests that periods of financial fragility, which may culminate in financial instability, are often preceded by changes in conditions of

[32] See also the work of Bernanke, Gertler and Gilchrist (1996) on the financial accelerator and the flight to quality.

entry by intermediaries to financial markets - banks, market makers or underwriters. As well as deregulation, such changes may be provoked by technological development or shifts on the demand side. Reduction in entry barriers may lead to heightened competition in the market concerned, whether due to actual new entry (tending to perfect competition), changes in behaviour that incumbents are obliged to adopt due to the threat of new entry, in the absence of sunk costs (heightened contestability) or competitive responses that incumbents choose to make to potential or actual entry in the presence of sunk costs (strategic competition). The last implies that new entry may entail not only falling margins but also non profit-maximising behaviour, i.e. competitive behaviour aiming to gain long-term advantage at the expense of short-run profit maximisation. Strategic competition may be particularly common in the context of a bull market and buoyant long-term expectations of growth in the market (e.g. for a financial innovation). But in all three cases the importance of factors such as uncertainty, information problems (leading to inadequate screening and monitoring of risks) and moral hazard arising from the safety net may lead to overshooting of the level of competition which is sustainable in long-run competitive equilibrium.

For banks, excessive competition may be manifested in lower capitalisation, liquidity and lower prices and higher quantities in credit markets. In primary securities markets such competition is likely to lead to increased risk-taking in underwriting. In dealer markets strategic competition may lead to skimping of the hedging of inventories, heavy position-taking on own-account, narrower bid/ask spreads and larger deal sizes. Narrower spreads and larger deals can increase risk of insolvency if they go beyond a break-even level determined by the amplitude of liquidity/insider trading as outlined above. And as also noted, low returns to market making may increase the risk that market makers will withdraw in response to minor shocks to the market, thus undermining liquidity. Underpricing of risk in secondary or primary markets may be motivated by desire to gain synergies in the other market. These trends may leave the financial system vulnerable to shocks such as abrupt monetary tightening, or shifts in policy regime which increase uncertainty and (possibly) asymmetric information. These may provoke collapses in liquidity in dealer markets as described above, as well as sharp increases in credit rationing. *There is ample evidence that intense competition may have played a role in generating the risk taking and short termism as was typical of the period leading up to the 1998 crisis, and which left the system vulnerable to the shocks of Russia and LTCM. Moreover, the increase in position taking and own-account portfolio trading in the 1990s, which was part of the background to the crisis, may be linked to increased competition in banks' core deposit and loan markets, which led them to seek alternative sources of profit.*

3 Implications of market liquidity crises for systemic financial stability

There are various reasons to anticipate collapses of secondary securities market liquidity to be a cause for concern, such as effects on primary markets, access of issuers to alternative sources of finance, importance of continuing liquidity to the solvency of investors, and contagious effects on other markets. *A number of these systemic effects indeed arose in the second half of 1998.*

Funding difficulties of intermediaries are a potential source of instability. As noted by Bingham (1991), one reason why securities market liquidity is of greater concern than in the past is that banks are more actively engaged in securities business, including not only issuance but also trading, underwriting and providing backup facilities. Hence a securities market collapse could lead to a liquidity crisis for a bank, either directly (if it relies on the relevant market for funding, or is unable to meet commitments to provide backup facilities due to "contagious" illiquidity in its own wholesale markets) but also indirectly (if suspected losses from underwriting or market making lead to doubts on the part of depositors regarding its solvency). Bank failure may in turn lead to contagious runs and a systemic crisis. *Certainly, in 1998 rising bank bond spreads and disproportionate falls in share prices for banks indicate market concerns in this respect.*

Equally, failure of a major securities house could occur during a market liquidity crisis. There could be withdrawal of bank credit lines as a consequence of perceptions of exposure to the market concerned, loss of confidence in the wholesale money markets where such firms obtain much of their funding, collapse of liquidity in those markets or demands by banks for greater collateral at a time when its asset value is falling sharply. As noted by OECD (1991), investment banks may be particularly vulnerable because of their heavy and ever-changing demand for credit, sole reliance on wholesale sources, lack of access to a lender of last resort, and multiple credit and counterparty exposures, such that solvency may be difficult to judge. Sale of assets to cover funding needs may itself depress the value of other holdings, or be impossible due to the market liquidity crisis. Note also that *net liquidity requirements imposed on such institutions by regulators to ensure investment banks survive such crises assume a reasonable amount of market liquidity is maintained* (capital requirements are of course an additional line of defence). Failure could in turn lead to further defaults, given the varied and sizeable exposures of firms to each other in several markets. Such failures may extend not only to other investment banks but also to banks and the payments system. This was the fear that led the Fed to offer liquidity to the markets - in effect, to support the investment banks - in the wake of the 1987 stock market crash (Davis (1995)). *Similar concerns were present in 1998, with concerns over investment banks being particularly acute, as reflected in greater falls in share prices than for commercial banks (although in fact prices soon rebounded)*

A second reason for concern is that securities markets are increasingly relied on as repositories for liquidity, with liquid securities acting as a substitute for lower-yielding cash or demand deposits and a

complement to matching of liabilities by assets over the longer term. Such liquidity may be sold to provide funding, or instead used as collateral for loans. Sharp declines in liquidity may lead to cash-flow difficulties due to inability to sell, or increased difficulties obtaining credit due to the lower value of collateral. Bankruptcies and defaults may ensue. *Again, falling liquidity of assets and the risk of having to sell at "distress prices" was a key aspect of concerns during the 1998 episode.*

Third, the process of securitisation has entailed a much greater reliance on securities markets by a range of institutions. Banks may to some extent rely on ability to securitise assets in order to realise liquidity as well as holding larger securities portfolios themselves. Money-market mutual funds find liquidity of money markets essential in order to maintain ability to offer fixed-price liabilities - as tends to be the case. The fear is that a departure from fixed prices would lead to an immediate "run" on the fund which would itself aggravate a market liquidity crisis by forcing the fund to seek to sell its assets. There are a wide range of non-bank financial institutions such as finance houses, whose funding relies mainly on securities markets, and whose default following securities market collapse may lead to wider difficulties in the financial sector. And, there is the increasing reliance on securities markets by non-financial companies, which may have reduced the scope of their links with banks and hence find it difficult to obtain alternative forms of credit. *As noted, although there were some fears of a "credit crunch" in 1998, US non-financial firms were apparently able to switch between markets and backup lines of credit with banks, on tighter terms. Money market funds were apparently not badly affected. But banks, investment banks and hedge funds were all heavily involved.*

Fourth, the difficulties outlined in this paper may arise just as readily in derivatives markets as in underlying securities markets. Such markets have grown rapidly in recent years, generating concerns, for example, over the lack of experience of the behaviour of such markets under stress, the complexity of the instruments and hence difficulty in understanding the risks, as well as the lack of transparency regarding exposures and the possible links between firms that derivatives transactions may generate. In some cases trading has tended to concentrate in a few institutions, heightening the risk to market liquidity from problems at one of them. Meanwhile, as noted by IMF (1993), of credit, market and liquidity risk in derivatives markets "the most difficult to counter is liquidity risk". They note that demands made on derivatives for hedging can easily make liquidity disappear. For example, market makers for some types of OTC derivatives - who tend to be banks[33] - seeking to cover open positions find it difficult to do so in their own markets, because such tailor-made instruments lack liquidity almost by definition. On the one hand, they may try to take an opposite position in organised derivatives markets - which assumes that liquidity is there. Alternatively, they may synthesise an opposite position in cash and underlying securities by using dynamic hedging techniques. But these

techniques may generate liquidity problems in the exchange or the often-thin market for the underlying securities, as they mandate sales when prices fall and vice versa, leading to risk of a collapse of the price or a breakdown of trading. Second, banks are tending to use markets in derivative products, notably forward rate agreements and swaps, to manage their own interest rate risk, instead of the traditional interbank markets. Besides exposing banks to interest rate risk, the collapse of liquidity in derivatives markets may entail heightened uncertainty over banks' exposures (given that derivative exposures are in any case off-balance sheet) and thus heighten the potential for runs. Finally, to the extent derivatives have tended to benefit the price of the underlying instrument, given heightened confidence that exposures may be hedged, a collapse in derivatives market liquidity would be likely to have deleterious consequences for the market for that instrument. *Derivatives, notably swaps and repos, were heavily affected by concern over counterparty risk - and the contagion spread even more widely to include the forex market itself.*

Conclusions

The recent global crisis centred in US financial markets highlights a number of factors, related to phenomena identified by theories of financial instability that were mainly devised to describe banking crises. As is shown by the descriptions in the Annex, this was not an isolated occurrence but rather one of a series – although each had some special features. Given the increasing role of securities markets for funding, liquidity management and asset sales by banks and non-banks, such events are of considerable potential concern to the authorities. This analysis poses a number of questions for policy makers and raises certain topics for further investigation.

First, can these events be predicted? Issues raised in this context include whether there are a priori indicators that market prices, spreads and deal sizes are out of line, whether deviations from fundamentals can be readily detected, or when markets are sufficiently related to make contagion likely. A view of the "norm" for spreads is clearly central to such a judgement. In addition, supervisors and institutions will want to be aware of when there is a sizeable overhang of similar positions that will prompt one-way-selling. "Market intelligence", obtained e.g. in normal central-banking operations in the markets, will have a key role to play.

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33 Banks are reportedly attracted to dealing not just by the direct returns to such activity but also by the ability it gives to increase the menu of interest- rate and currency risk management instruments that they can offer to their clients.

Second, what is the appropriate regulatory response to market liquidity risk? How can VaRs be extended to include such risks? Can adjustments to capital adequacy rules make a contribution[34]? How much further should “stress-testing” be developed in the light of market liquidity crises? Can robust market structures be devised that would prevent such collapses, and are supervisory regimes for market makers and underwriters able to cope with this type of occurrence?[35] An obvious additional point is that both intermediaries and end-users of securities markets must diversify their sources of funds and of liquidity so as to protect themselves against problems in individual markets and that leverage will amplify effects of portfolio adjustments as prices fall. Crisis scenarios could play an important role in such calculations. The specific issue raised by highly-leveraged institutions are addressed in Basle Committee on Banking Supervision (1999). Finally, a general issue is how to deal with short termist and bonus driven pressures which may lead firms to override considerations of overall risk exposure.

In the case where crises nonetheless occur, are there any circumstances in which central banks should intervene directly in the market concerned or more generally by cutting interest rates? Clearly, moral hazard may arise for securities markets in the same way as for banks, with imprudent underwriting and market making practices being followed on the assumption that liquidity will be maintained; non financial companies would also be more willing to increase leverage via securities markets. Moreover, acting as "market makers of last resort" – even where feasible[36] - may actually prevent market prices from reaching a new equilibrium level. Hence such responses should be avoided if at all possible. In many cases the failures were better used as salutary lessons in prudence for the market. On the other hand, where failure threatens "core" markets the case for action becomes more pressing, and the recent episode showed for the first time that even the most liquid markets are not immune.

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[34] It may be noted that whereas some supervisors distinguish between liquid and illiquid equity portfolios for the purpose of capital charges, no such distinction is typically made for debt securities.

[35] Bingham (1992) makes a number of suggestions in these areas. Issuance of standardised benchmark securities by governments, and avoidance of interest rate instability as a by-product of monetary policy are strategies that can be helpful to liquidity. He suggests that robustness of intermediaries requires adequate capital and efficient clearing and settlement, encouragement of adequate management and control procedures, that firms be induced to monitor each other and that there be a spreading of the cost of safety net assistance across market participants. More controversially, robustness may also require some limits to competition between market-makers, possibly via designation, recognition and licensing rules (note that many of the crises were in unregulated markets with free entry, such as those for eurobonds). The point is that only if there are some economic rents associated with market maker status will firms be willing to devote sufficient capital to prevent frequent liquidity collapses. An alternative to limits on entry in this context are low levels of disclosure and ability to post indicative prices. There is of course a balance to be struck between adequacy of returns and oligopolistic abuses, with high fees, wide bid-offer spreads and risks of price manipulation.

[36] Attempts to act in this manner in all but the smallest markets would risk to be overwhelmed in any case, as witness various attempts to defend exchange rate parities with foreign currency reserves.

Market liquidity risk is most threatening to the real economy where securitisation is most developed. Hence, the risk has hitherto been most prevalent in the Anglo Saxon and Nordic countries – but note that securitisation is expected to increase markedly in the euro area in the wake of EMU (Davis 1999b). In this context, whereas banks have generally been willing and able to provide a backup for liquidity in the case of market liquidity difficulties, further losses of competitive position and loss of information on borrowers could threaten this in future. The issue would arise, in other words, of whether backup lines of credit will always prove as reliable as in 1998, especially if a market liquidity failure coincides with a banking crisis per se. It was noteworthy that the 1998 crisis occurred after a prolonged upturn with banks' balance sheets being well-capitalised. Their reaction to such turbulence after a prolonged recession could have been different.

Besides the issues above, the phenomenon in question implies a number of additional topics for further investigation. These include assessment of the behaviour of markets whose liquidity fails at a micro level; what market features were most crucial to the collapse? What form of disclosure would best enable both counterparty risks and overall market risks to be detected? (The issue is similar to that for a bank lending to finance property, whose value depends on the amount of other construction being financed simultaneously.) How can the authorities best judge the likely systemic consequences of closure of a given securities market? How can large portfolios such as LTCM be unwound with minimum disruption? How can one assess linkages between credit, market[37] and liquidity risks? How can one assess the contribution of liquidity risk to widening of spreads, when credit risk is also involved?

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[37] Note that most credit risk models assume that market risk is hedged; extant empirical work seems to find a negative relation between market risk and credit risk.

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Annex: Five further episodes of liquidity risk in debt securities markets

This Annex comprises accounts of five further patterns of collapse of secondary debt markets in chronological order, that have had "contagious" effects on primary markets and in some cases also on other security markets. They are of interest both as further tests of the theory and to compare and contrast with the US experience of September 1998, as is undertaken in section (f). The key features, which are picked up by the theory as outlined in Section 2, are set in bold type.

(a) The Penn Central bankruptcy (1970) - US[38]

Although commercial paper (CP) markets - markets for short-term tradable liabilities of highly-rated companies - are long-established in the US, a crucial event in their evolution was the **innovation of the certificate of deposit (CD)** in 1962, which led both to a rapid expansion in US money markets and in the freedom of banks to bid for deposits and loans. The CD facilitated development of liability management among banks. In the light of the expanded powers offered by CDs, banks proved **eager to expand their business more generally**, opening credit lines to other financial institutions and "**nurturing the epidemic growth** of the commercial paper (CP) market, even though their generosity in granting the securing credit lines on which the market depended came at the expense of their own loan business".[39] Meanwhile experiences such as the credit crunch of 1966, which threatened to lead to a cut-off of business credit (as market rates exceeded CD ceilings) prompted non-financial firms to seek both committed lines of credit with banks and alternative sources of funds such as CP. Indeed many banks formed holding companies to issue unregulated CP to circumvent CD interest rate ceilings, thus implying that CP market failure could be a source of direct risk to banks. Finally, a lowering of interest rates in 1968, to offset the fiscal tightening that year, led to an **explosion of credit** "as lenders were encouraged to be more aggressive"[40] as well as rising inflation. Interest rates began to rise as **monetary policy was tightened**, but rather than operating strongly on demand for credit, the eventual blockage came on the supply side as political pressures mounted on banks not to raise prime rate further. Lending became unprofitable and growth of loans ceased in late 1969. **Spreads on CP and bonds rose** and the stock market fell sharply.

It was in the aftermath of this "credit crunch" that Penn Central Transportation Company failed[41] in June 1970 and defaulted on its $200 mn outstanding CP. **Investors, uncertain over credit risk, turned away from CP; issuance of CP declined sharply; companies unable to rollover their CP had to turn to banks to obtain credit; while companies found borrowing in all markets more expensive**. The authorities feared a wave of corporate bankruptcies; one ground for this was that lenders would ration credit owing to shortage of funds; the other was that they would particularly

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38 References; Timlen (1977), Wojnilower (1980).

39 Wojnilower (op cit) p286.

40 Wojnilower (op cit).

41 Failure followed a series of unsuccessful rescue attempts (Mishkin (1991)).

ration borrowers driven from the CP market, due to inability to screen out good from bad borrowers, given they lacked a relationship. Given the prior monetary tightening, onset of a recession and a sharp fall in share prices, lenders' **concerns over adverse selection and moral hazard** were particularly acute. The **authorities' response** was suspension of interest rate ceilings on short-term CDs (to enable banks to obtain funds) and indications that the discount window was available for banks needing reserves to extend loans to companies. Large-scale business failures were avoided, though firms found their borrowing capacity sharply reduced, and the cost of credit increased.

(b) The crisis in the FRN market (1986)[42]

The origins of the market in floating-rate notes (defined as medium-term securities carrying a floating rate of interest that is reset at regular intervals in relation to some predetermined market rate) lie in the early 1970s when banks used them as a means for raising short or medium-term funds to support their international lending operations. However, a major spur was given by the debt crisis, which led to a sharp decline in new lending as well as in inflows of funds to international banks. As a substitute for syndicated loans (in bank's asset portfolios and as a liability of companies and sovereigns), **FRN issues grew particularly strongly** over 1981-5, while the fixed rate eurobond market was relatively subdued. The main issuers of FRNs were governments and banks (companies preferred to issue in the fixed-rate markets). The **innovation of perpetual FRNs** in 1984 was particularly popular for banks, as the authorities allowed them to count as capital under certain conditions, while the tax authorities allowed interest expenses to be deducted, unlike dividends. However, given the indefinite maturity, liquidity was clearly essential for perpetuals to be priced, as they were, as money market instruments. Banks also were attempting by use of dated FRNs to reduce the degree of maturity and duration mismatch in their international lending. Banks, notably in Japan, also emerged as the major investors in the FRN market, given higher yields than the interbank market. There was also **rapid new entry of banks lead managing new issues and making markets in secondary issues**.

The FRN crisis began with **sharp price falls** in December 1986 in the perpetual sector, which have been blamed on factors such as; investors' **re-evaluation of the equity characteristics** of these instruments; **uncertainty** arising from fears that the supervisors would deduct any holdings of bank-issued FRNs by other banks from the latter's capital (thus making investment unattractive); **excess supply of bonds** given the size of the investor base; **mispricing of issues in relation** to risk; and **false expectations of liquidity**[43] given the size of the market. At the outset of the crisis, it was expected that the problem might be resolved by an issuing hiatus, followed by adjustment of terms (Fisher (1988)). But **large underwriting exposures** undermined the market. Rumours of heavy selling became self fulfilling and prices went into free-fall as **market makers withdrew after incurring heavy losses, thus increasing potential losses for remaining traders**. Short selling worsened the situation. Note that credit risk was not involved; spreads on the same banks' other securities were unchanged.

A similar crisis hit the much larger dated sector a month later, yields soared and issuance became virtually impossible. Although the **difficulties of the perpetual sector helped to trigger this**, the problems of **fears of new supervisory rulings**, **oversupply, underwriting exposures and illusion of liquidity** were also present in the dated sector. As described by Muehring (1987) the market had been subjected to **relentless downward pressure on yields**, which fell below Libor in 1986. One reason for this is that alternative sources of finance such as interest rate swaps and short term paper were developing rapidly. This reduction in yields tended to exclude banks as investors (given that their ability to buy FRNs is premised on borrowing funds at Libor) although they held 80-90% of extant bonds. Lead managers tried to compensate for low spreads with innovations which relied largely on risky interest-rate plays, while trading also increased sharply in an attempt by investors to maintain profits - and which helped further to compress spreads. Underwriters and investors assumed that risks

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42 References: Fisher (1988), Muehring (1987), Federal Reserve Bank of New York (1987).

43 Whereas in November perpetuals were traded on 10 bp spreads in $5 mn lots, by August 1987 the spread was 50 bp and the lot size $1 mn.

in the market were limited due to the coupon reset mechanism and **built up large positions**, failing to note that profits were largely a function of the bull market conditions. There was also an **illusion of safety in liquidity** - it was always felt that bonds could easily be sold if adverse conditions arose. Last, it was **assumed that an investor base existed beyond the banking sector**. This was not the case[44], in other words the market lacked breadth, so short term speculative demand was mistaken for genuine end-buyers, and the market proved vulnerable to herding.

After the crisis more and more **market makers withdrew** and **liquidity continued to decline**. Both the perpetual and dated FRN markets were **largely moribund** for the rest of the decade, except for some development of mortgage-related issues.

(c) The failure of the high yield (junk) bond market (1989) - US[45]

US corporate finance in the 1980s was marked by a rapid **growth in leverage**, much of which was associated with issuance of high yield bonds. Whereas there had always been low rated or speculative bonds on the market - often a result of loss of credit rating by firms ("fallen angels") - in the late 70s and early 1980s the investment bank Drexel Burnham Lambert set out to **create a market** for bonds that would have low credit ratings at issue. An additional stimulus was the decline in the private placement market, as life insurers sought greater liquidity (Crabbe et al (1990)). Initially, the market was largely a source of finance for small emerging companies which could not easily find credit from other lenders, while offering equity-like risks and rewards to investors seeking high yields. But the market also attracted take-over and LBO activity, often enabling corporate raiders to take over large companies from a small asset base. **Issuance grew rapidly**. Drexel undertook to make markets in the securities, aided by certain savings and loans and insurance companies having close relationships with the firm.

Initially **other US investment banks sought to distance themselves for the market, but were eventually attracted** by the high profitability of primary issuance activity. Investors, such as Savings and Loans institutions and insurance companies were keen investors, given the market offered equity returns together with guarantees and security associated with bonds. Also they were partly forbidden by regulation from investing directly in equities. Bush and Kaletsky (1990) suggest that junk bonds enabled such companies to offer higher yields to retail investors and gain market share at the expense of more prudent competitors, thus increasing the onus on them to hold junk bonds too. It is a matter of controversy whether **risk was underpriced** in the market; while the yields seemed generous enough to compensate for realised defaults, these occurred in the context of a period of prolonged economic expansion.[46] High leverage, the high prices paid for companies, (whose security thus depended on inflated asset values) and accounts and prospectuses based on an indefinite continuation of expansion gave grounds for caution. It can be suggested, in effect, that junk bonds **dispensed with the credit analysis**[47] **usually performed by banks, leaving investors to rely on liquidity and diversification to protect themselves**. As discussed below, the former proved an illusion in changed circumstances; the latter also (given higher defaults than anticipated) to some degree.

By 1989 the market had reached a value of $200 bn and **issues were still proceeding briskly**. These included part of the financing of the $25 bn RJR/Nabisco take-over, the largest yet. But the market was weakened by a number of factors which **increased uncertainty** arising particularly from a default

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44 Nonbanks were unwilling to buy FRNs at money market yields as they perceived the instruments as equity; after the crisis it was feared that Japanese banks would sell on any rise in price. But in fact the latter were encouraged to hold the FRNs and not trade, as their supervisors allowed them to hold them on their books at cost.

45 See Bush and Kaletsky (1991).

46 The 1990-91 slowdown has exacted a heavy toll of bonds, with default rates of 8.8% in 1990 (Moody's (1991)).

47 Although in principle the lead manager should offer credit assessment, balance may have been affected by the attraction of the front end fee.

at Campeau, a Canadian conglomerate that had financed purchases of US retailers by junk bonds as well as **sharply increasing supply** and **declining liquidity**. Fundamentals worsened sharply when the government's Savings and Loans bail-out bill ordered thrifts to dispose of all junk bonds, although it is not clear this was sufficient to account for all of the subsequent decline. As a consequence, **prices fell rapidly, liquidity collapsed**[48] **and new issues dried up**. In the wake of this came the **failure of Drexel Burnham Lambert, the main**[49] **market-maker** in February 1990, as the declining value and liquidity of its holdings of junk bonds - in effect, they turned into loans - led to a downgrade of its own debt by the rating agencies and consequent inability either to rollover its commercial paper or to obtain substitute bank finance. It is notable that the market failure occurred without a tightening of monetary policy or a recession, though the later slowdown in the US weakened the market further. No intervention was felt necessary to rescue[50] Drexel - whose failure was felt to pose no systemic threat - nor the market itself. **Issuance was near zero** through 1990, though a tentative recovery was apparent by the end of 1991.

(d) The Swedish finance company and commercial paper crisis (1990)[51]

As in many other countries, the Swedish banking sector was tightly regulated for much of the post war period, with prohibitions on entry (no new banking licences were granted from 1945 to 1983), quantitative restrictions on credit and exchange controls. Banks were obliged to hold a proportion of government bonds on their balance sheets, in the interests of cheap financing of the budget deficit; and credit was provided to the housing sector on a privileged basis. The tight regulation of banking gave rise to **growth of a non-regulated sector**, the finance houses. Although these originated in the 1920s and 30s, specialising in consumer and small company loans, in the 1970s and 80s they expanded first into factoring and leasing, and then lending to small and medium size firms, circumventing controls on banks. Their number rose from 67 in 1970 to 292 in 1988, with assets of SEK 171 billion. Heavy regulation of banks also led to development of direct finance. The Swedes **introduced a commercial paper market in 1980**. Initiated by banks - the first deregulation was of CDs[52] - it was further stimulated by issuance of short term Treasury bills in 1982. Industrial companies, housing finance institutions and government agencies were heavy users of the market. **The market grew rapidly**. By 1990 there were 270 programmes valued at SEK 160 billion, making the market the third largest in Europe. Finance houses could not issue commercial paper, but required a bank to make markets in their promissory notes (company investment certificates (CIC)). However, market participants **considered CICs identical to CP, although banks were not obliged to provide backup liquidity, or make markets**. Further **deregulation** of banks (Englund (1990)) entailed, first, abolition of liquidity ratios - which were 50% in 1983 - followed by abolition of other controls, and the end of exchange controls in 1989. The deregulation of finance created a structural expansion in markets which, along with the upturn of the cycle, caused an economic boom, rapid growth of the financial sector and increasing asset prices. Banks grew particularly strongly, balance sheet size increasing from 90% of GNP in 1985 to 200% in 1989. Mergers raised banks' competitiveness. Banks regained market share of consumer credit from finance houses, whose **margins narrowed**, and whose numbers fell sharply. Many of the finance houses **turned to higher-risk lending** such as highly-leveraged commercial real estate transactions and financing of investments in shares; banks supplied the bulk of their funds via CICs.[53]

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48 Whereas trading was $400 mn a day before Campeau, it was $150 mn in December

49 It accounted for 50% of trading.

50 However, the authorities were careful to ensure an orderly rundown of its affairs.

51 References: Bisignano (1991), Moody's (1991b).

52 Note that this entailed the spread of an innovation from abroad.

53 A similar pattern was apparent in Japan, where much speculative financing of real estate and equity markets has been via lightly regulated "non-bank banks", albeit largely funded by banks. A crisis on the Swedish scale was avoided, however (Bank of Japan (1991)).

When growth in asset prices faltered as monetary policy was tightened, a crisis occurred in the finance company sector at end-1990. The initial casualties were Nyckeln Holdings - which suffered severe credit losses when customers defaulted due to falling real estate prices - and Beijer Capital, its major shareholder, which was also highly leveraged. The proximate cause of Nyckeln's default, **even before credit losses became fully known, was inability to roll over its CIC programme**. After the failure, Beijer Capital's programme was cancelled by banks, and it failed. The **sizeable and unprecedented losses to creditors of these firms caused a "shock"** that spawned rumours that several finance houses were in difficulties, and the **CIC market dried up - banks refused to allow rollover**. Many finance houses, lacking liquidity backup facilities, were forced to sell assets; others sought emergency bank loans. Three others defaulted on their programmes. One underlying factor may have been **inadequate monitoring** of the finance companies' lending by the banks, which largely financed them and in a number of cases owned them. The crisis left banks nursing heavy losses which led on to the crisis in the banking sector a year later. The Swedish Bank Inspectorate reportedly lacked resources and authority to supervise the companies.

Meanwhile, the potential volatility of CP markets became even more apparent with the **collapse of the broader commercial paper market** which followed; for several months even well-managed non-financial companies, whatever their nature, found it difficult to raise CP. Whereas **spreads had been very low** prior to the crisis (10-15 bp over risk free), with **little differentiation in terms of credit risk**, **defaults led to a flight to quality**, with **wide spreads, low liquidity** and **all but the highest quality issuers excluded**. Some recovery in the CP market, as well as differentiation by credit quality, was apparent by July 1991, with top quality credits paying 20 bp over risk free, and finance houses able to access the market 50-150 bp spreads, if at all.

(e) The collapse of the ECU bond market (1992)

Whereas traditionally the ECU bond market had been dominated by retail investors, generally content to buy and hold the paper, the use of the market by major European governments, together with the beginning of the EMU process, made the market increasingly attractive to wholesale investors, including major institutional investors, central banks and own-account traders at securities houses and banks. Indeed, **confidence in the market**, in the light of expectations of EMU became so strong that ECU yields fell below the theoretical yield on an equivalent basket of bonds. The early 1990s also saw a **rapid growth in issuance, and new entry by underwriters**. These developments were complemented by a significant **new entry of market makers** to the sector. However, the number of market makers registered with ISMA, 44, always gave a false impression of the actual amount of activity in the market. Market sources suggest that at most there have been twelve "serious" market makers who regularly offered two way prices.

According to Euromoney (1992), the ECU sector became prey to forms of over-competition typical of the euromarkets in earlier years (see Davis (1988)), as **new entry became excessive in relation to the business**, both in the primary and secondary markets. Rather than seeking profit, **banks were seeking long term strategic advantage**, keen to make their reputations and establish relationships in what was expected to develop into Europe's bond market. Accordingly, there is evidence of **underpricing of deals**, with the underwriter accepting low or zero profits in order to "buy" market share, and accepting large, long term underwriting positions. In the secondary market, new entry led to a **narrowing of bid/ask spreads** and an increase in maximum size of trades. Bid/ask spreads were further compressed by client access to inter dealer brokers. Securities houses would often seek to make their money from **own-account trading, without developing a client base**, taking on large and risky secondary-market positions. The market makers could be caricatured as "treating a euromarket like a government bond market" - perhaps unsurprisingly given many of the large, liquid issues were ECU government bonds. The market also suffered from other structural problems, namely that it was difficult to hedge, given the cash market liquidity was greater than that of the MATIF futures contract; and the lack of a post 10 year swap curve which would have permitted asset swapping.

The **uncertainty created by the Danish and French referenda** regarding prospects for EMU led to **heavy selling** in the market in mid-1992, both by institutions and by market players seeking to unload

positions following previous excesses - and engendered a collapse of activity and **progressive withdrawal of market makers** from active trading (Financial Times (1992)). The crisis occurred in stages. The Danish "no" vote led to an initial reduction in liquidity, with sizeable losses by market makers. The second crisis occurred late in July, when a one-day suspension of the obligation to make markets was followed by a resetting of spread and size guidelines, in an attempt to encourage dealers to make markets. At the end of August, as liquidity fell further, the conditions were further relaxed. But although in the wake of this, four remaining dealers made prices for a few hours, the initiative to restore liquidity collapsed and liquidity remained poor for some months. During this period of turmoil **bid/ask spreads widened sharply**, and ECU bond yields rose to well above their theoretical levels. Notably **at 10-years, primary issuance declined to near-zero from June onwards**. As for FRNs, the collapse had little relation to credit risk - it was rather a **sharp increase in market risk**, associated in turn with uncertainty on the future valuation of bonds, which led in turn to **liquidity risk** (i.e. difficulty in selling), as described. In effect, the problem in ECU was reported to have started with heavy selling of 20-year Italian bonds (perhaps the most vulnerable to market risk), and spread. With relatively little futures liquidity to enable hedging, and lack of a swap curve so far out, liquidity difficulties rapidly emerged.

As in earlier collapses, once there was a **shock to confidence** - i.e. an increase in uncertainty that leads players to adjust their decision processes rather than merely their current opinions - it **took a long time to rebuild**. The turnover data show that turnover remained as high in the third quarter as in the second but halved in the fourth. The Bank of England (1993) suggest that high turnover in the third quarter was due to heavy selling by market makers trying to unload unprofitable positions rather than genuine end-demand. Although there was a slight pickup in 1993, turnover did not recover the 1992 level. Uncertainty spread from secondary to primary markets, making issuance difficult. Other reasons for the protracted nature of the crisis can also be adduced. For example, the reputation of market makers was tarnished and their relationships with institutions devalued. Second, the market makers (and underwriters) themselves, having been left with inventories of bonds in the collapses, were cautious about future activity. Countervailing factors that made the market relatively resilient were the commitment of governments to the markets, via their own issues and their desire to shift or retain ECU business in their own financial centres. None of these applied in the other crises described above.

(f) Assessment

Some general differences with the Russia/LTCM episode may be acknowledged. In particular, the prevalence of leveraged trading in the past was rather less. Also, the collapses tended to occur in markets for instruments that were themselves financial innovations (whether in terms of instrument or currency), whose properties in periods of stress had not yet been evaluated. Although hedge funds and programme trading are also relatively novel, they do date back some years.

But there are also strong similarities. Institutional investors rather than retail clients tended to be the main investors in the markets, whether internationally (ECU, FRNs) or domestically (US CP, Swedish CP, junk bonds). The crises tended to follow a bull market in the instrument, which entailed heavy issuance in the primary market, declines in yields and yield spreads relative to other securities, rising trading volumes and narrowing secondary market bid-ask spreads (as "liquidity trading" increased). New entry of intermediaries, and intensification of competition among existing intermediaries, was a feature of most of the crises; contemporary accounts suggest that their activities accentuated the narrowing of spreads and reduction in prices, at times in furtherance of non-profit maximising objectives in the short term ("strategic competition" for market share). However, as in 1998, rapid growth in debt did not necessarily lead to higher leverage of borrowers; one may contrast junk bonds and Swedish CP, where borrowers were previously restricted in access to credit and leverage did increase, with the other cases, where creditworthy borrowers chose to substitute between markets.

In several cases, as in 1998, the bull market led to clear overconfidence, with prices overshooting fundamental values (as in the FRN and ECU crises), large underwriting exposures and position taking, disregard of differences in instruments' characteristics (such as the Swedish CIC being seen as identical to CP, despite the fact that banks were not obliged to provide backup or make markets,

perpetual FRNs being priced as money market instruments despite indefinite maturity – and Russian bonds being seen as suitable investment instruments), and liquidity being expected to remain high despite structural problems such as a narrowness of the investor base (FRNs) or reliance on one market maker (junk bonds). These patterns indicate a collective self-deluding failure on the part of market participants to attach more than a low probability to a crisis of the type that emerged.

As for Russia and LTCM, a "shock" to such confidence, whether caused by a default (Swedish CP, Penn Central, junk bonds) or other uncertain event (such as referenda (ECU), or actual or rumoured regulatory changes (FRNs, junk bonds)), led in each case to a major re-evaluation of the securities' value[54]. The consequence was heightened uncertainty (both for investors and market makers), an increase in selling, withdrawal of market makers and widening of spreads. In each case these culminated in a collapse of liquidity and of market prices that made primary issuance virtually impossible - effectively a form of quantity rationing of credit was imposed - and which persisted for some time except for the Penn Central crisis, where the authorities intervened. (Tables 3 and 4 show the evolution of prices and quantities in the markets concerned during the crises.) Where borrowers were solely reliant on the market concerned and the authorities did not intervene (as in Sweden), there were a number of bankruptcies. But in most cases the (creditworthy) borrowers could obtain funds at a higher price elsewhere. This was also the case for US corporate borrowers in 1998.

In several cases there was contagious failure of other related *markets* which were thought to be prey to similar problems (dated FRNs, Swedish CP), although unlike 1998 difficulties did not spread more widely (eg into fixed-rate eurobonds or government securities). Moreover, the capital adequacy and liquidity cover of financial *intermediaries* in relation to losses incurred generally proved sufficient to prevent their collapse in the wake of the market. Probably partly for this reason, apart from 1998, the authorities only felt it necessary to intervene decisively in the case of Penn Central.

We suggest that as is the case for Russia/LTCM, the crises offer credence to the theories of liquidity insurance, which draw a direct parallel between market liquidity collapse and bank runs. Contagion between markets as well as individual failures were features of the crises. These tended to follow increases in generalised uncertainty regarding equilibrium prices rather than, as was the case in 1998, also asymmetric information[55] between investors and market makers. The runup to the collapses follow quite closely the predictions of uncertainty and disaster myopia theories, for example the role of innovation, of deviations of prices and quantities from fundamentals, excessive optimism regarding liquidity given structural conditions and the role of shocks in sharply reversing confidence. Given features such as higher spreads, monetary tightening and lower asset values in the wake of the crises, the various mechanisms identified by the agency cost theory of financial crisis may often be seen as underlying such rationing. But note that only in the case of Penn Central – and Russia/LTCM had spreads risen *prior* to the crisis, suggesting a role for disaster myopia too. On the other hand, although debt growth preceded the events, its incidence was not always related to the cycle and credit risk in the way predicted by theories of financial fragility. The precise relation of the crises to the various features highlighted in the theories of financial instability is outlined in Table 5.

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[54] Technical malfunction in trading or dealing systems may be another cause of difficulty. Herring (1990) notes that the malfunction of the computer system at the Bank of New York in November 1985 led to the bank developing an overdraft with the Fed of $30 bn - 30 times capital - before correcting the fault. The cost of not providing such support would have been liquidity failure in the US government bond market, with enormous costs in terms of higher yields demanded by investors.

[55] Elements of this may have been present in the ECU market, where the major market-maker was seen as having better information than the others, and in the failure of Drexel.

Table 1: Features of US corporate finance in 1998

$ billion, seasonally adjusted annual rates

	1997 Q3	1997 Q4	1998 Q1	1998 Q2	1998 Q3	1998 Q4
Net funds raised in markets	160	198	182	228	66	-156
Credit market instru-ments	284	342	321	357	375	319
Commer-cial paper	15	13	51	4	86	-43
Bank loans	57	79	12	117	119	86
Corporate bonds	123	74	157	161	87	124

Source: US flow of funds data

Table 2: US capital market prices in 1998

	1997 Q3	1997 Q4	1998 Q1	1998 Q2	1998 Q3	1998 Q4
Corporate bond spread	0.93	0.97	1.08	1.05	1.29	1.67
CP spread	0.48	0.5	0.36	0.47	0.54	0.72
CD spread	0.54	0,64	0.48	0.58	0.65	0.88
Share prices	206	211	278	308	282	266
On the run/off the run Treasuries	0.08	0.08	0.08	0.08	0.12	0.27

Source: BIS database

Table 3: Interest rate relations in securities markets

	t - 12	t – 3	t - 2	t - 1	T	t + 1	t + 2	t + 3	t + 12
Penn Central (June 1970)	1.0	1.5	1.4	1.3	1.4	1.7	1.6	1.5	0.5
FRN market (December 1986)	0.03	0.06	0.07	0.07	0.07	0.12	0.12	0.24	0.38
Junk bonds (February 1990)	2.5	2.9	2.9	3.2	3.3	2.8	2.8	2.5	3.5
Swedish CP (October 1990)	0.23	0.15	0.12	0.17	0.22	0.22	0.42	0.27	0.26
ECU bonds (July 1992)	-0.49	-0.22	-0.25	-0.39	-0.02	0.11	0.19	0.28	-0.09
US CD-TB (Sept 1998)	0.63	0.60	0.63	0.64	0.67	1.13	0.8	0.72	
US Corp. bonds (Sept 1998)	1.49	1.63	1.69	1.8	2.28	2.65	2.51	2.59	
US CP-TB (Sept 1998)	0.51	0.49	0.52	0.54	0.57	0.96	0.62	0.58	
Euro mkt. US $s – TB (Sept 1998)	0.63	0.57	0.60	0.61	0.63	1.05			

1 US CP-TB spread
2 Discounted margin on FRNs over Libor
3 US BB-AAA corporate bond spread
4 Swedish CP-TB spread.
5 ECU bond yield less theoretical yield (weighted sum of yields on constituent bonds).
6 US certs. of deposit – treasury bill spread
7 US BAA corp. bonds – 2nd mkt US Treasury notes and bonds (10 yrs)
8 US commercial paper 3 month – 3 month US treasury bill spread
9 Euro mkt. 3 month US dollars – 3 month US treasury bill spread

Table 4: New issues in securities markets

	Preceding year	Quarter of crisis (annual rate)	Year after crisis
Penn Central (Q2 1970)	7.3	-1.2	-0.04
FRN market (Q4 1986)	52.9	37.2	11.9
Junk bonds (Q1 1990)	42.7	17.2	3.5
Swedish CP (Q4 1990)	24.4	27.2	-2.2
ECU bonds (Q3 1992)	30.7	0.8	9.6
US Corp bonds (Q3 1998)	128.8	88.0	123.8 (1)
US commercial paper (Q3 1998)	20.6	85.6	-43.0 (1)

(1) Quarter following crisis

Table 5: Features of market liquidity crises

	Penn Central	FRN market	Junk bonds	Swedish CP	ECU bonds	Russia/LT CM
Liquidity collapse	Temporarily	Yes	Yes	Yes	Yes	Yes
Collapse in primary issuance	Temporarily	Yes	Yes	Yes	Yes	Yes
Debt accumulation	Yes	Yes	Yes	Yes	Yes	Yes
Heightened credit risk	Yes	No	Yes	Yes	No	Yes
Monetary tightening	Yes	No	No	Yes	No	No
Uncertainty over appropriate market prices	No	Yes	No	No	Yes	Yes
Asymmetric information	No	No	No	No	No	Yes
Innovation	Yes	Yes	Yes	Yes	Yes	Yes
Underpricing of risk	No	Yes	Yes	Yes	Yes	Yes
New entry of intermediaries	Yes	Yes	Yes	Yes	Yes	Yes
Intervention by the authorities	Yes	No	No	No	No	Yes