FINANCIAL INSTABILITY AND MONETARY REGULATION

Is Europe well protected from systemic risk?

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SUMMARY

ABSTRACT

The present study focuses on systemic risk in the global financial markets. It is based on theoretical literature that sees systemic risk, which is generated by the interaction between credit and asset prices, as an endogenous attribute of the financial cycle. This model will be used to highlight the part that this process has played in the financial dynamic that has been in effect since 1998. More specifically, we will be studying the episodes of financial fragility and processes of contagion that are tied into the after-effects of the August 1998 Russian default and (from autumn 2000 onwards) to the bursting of the speculative bubble. The impact of the 11 September 2001 catastrophe on the interbank settlements system is also mentioned.

To analyse the microeconomic conditions of this macroeconomic model of financial crisis at a deeper level, we will be examining the way in which financial agents have managed risk, and describing in detail the channels by which contagion has spread. It will be demonstrated that the principle of value-at-risk, which has become a ubiquitous paradigm in internal risk control, under-estimates the losses caused by extreme market volatility. As for the evaluation of credit and liquidity risk, this has become more difficult because of the impossibility of incorporating the strategic interdependencies that exist between the individual financial establishments' management systems. The preponderant role played by the over-the-counter derivative markets is also highlighted.

As its conclusion, the present study will examine a number of problems whose resolution is crucial to the containment of systemic risk. Market discipline cannot be established without a change in the structures that connect over-the-counter markets to centralised markets. Supervision cannot act efficiently in the absence of rules stipulating that financial establishments must carry out stress tests that can be aggregated with one another. The lender of last resort should be

equipped with the diagnostic abilities and instruments that will enable it to act upon market liquidity where needed.

Introduction: the topical nature of systemic risk

There has been widespread concern about systemic risk in recent years. Since the Bretton Woods system came to an end in 1971, there has been a succession of currency, banking and sovereign debt crises. Of course, the capital markets did develop enormously during the 1990s, such that the markets' own shortcomings are now more significant than whatever banking crises may occur. Now, this does not mean that banks are protected from financial upheaval - after all, they are market intermediaries themselves. It is just that they have kept their specific role, which is to provide other economic agents with settlement services. The end effect is that systemic risk goes well beyond the traditional conception of banks being vulnerable to a run on their deposits. Financial product transaction settlement systems and highly volatile asset prices are both powerful channels for propagating instability throughout the financial systems.

These dynamics also affect Europe, inasmuch as the financial markets are in full expansion in this region. This has caused Europe's banks to embark upon dangerous restructuring operations, leading to the birth of conglomerates wherein the fragility of non-supervised entities could have serious repercussions for banks belonging to the same financial network. As the European financial markets have become very similar to the American ones, there is no reason to believe that Europe could be rapidly immunised against liquidity shocks, such as the one that took place in United States after the declaration of the Russian debt moratorium in September-October 1998. High-volume international settlement systems should also undergo permanent surveillance, given that they are extremely vulnerable to operational defects and to sudden changes in the demand for liquidity, as witnessed by the fallout from 11 September 2001.

Given the rapidity of these developments, questions have been raised about the segmentation of prudential control in Europe; about vagueness regarding the identity of the lender of last resort; and about the lack of relations between national supervisors and the European Central Bank. It is important to identify the processes of financial contagion so as to be able to judge how appropriate current prudential control structures are in a changing financial sphere. This is the goal of the section below.

The first section seeks to draw hypotheses from the growing theoretical literature on systemic risk in order to guide subsequent investigation into crises that are born out of the financial markets - whose instability, both in Europe and America, is documented in the second section. There will be an illustration of the European and American markets' close correlation during periods of crisis, and there will be a comparison of the systemic events that triggered major interventions by the lender of last resort in September-October 1998 and in September 2001. As contagion is an essential process of systemic crisis, the third section demonstrates that far from comprising an irrational behaviour, this phenomenon is rooted in the most highly sophisticated control systems that financial institutions have at their disposal. The fourth section describes the main channels of contagion that run through the financial markets. It focuses on the critical role played by the over-the-counter markets during situations of stress. Lastly, the fifth and final section serves as a conclusion and reviews the types of prudential action that can help stave off systemic risk. It provides reasons for scepticism about the approach that the UE in Brussels and the BIS in Basel have been recommending jointly. It affirms the need for a European lender of last resort as well as the importance of close co-operation between national supervisors so that this European lender can fulfil its role efficiently.

I. Systemic risk: recent theoretical lessons

1.1. Definition of systemic risk

To apprehend the notion of systemic risk, it is useful to begin by defining what comprises a systemic event. There are two types (De Bandt & Hartmann, 2000). The first one follows on from an intuitive understanding of the "dominoes effect". A harmful shock or bad news affecting one or several financial institution(s) or market(s) can cause a chain reaction that will affect other institutions or markets. The second type of systemic event is related to what we intuitively call a "catastrophe". A macroeconomic shock simultaneously affects the financial conditions of a large number of institutions and markets and induces a shared negative reaction. In both cases, contagion is the process by which a systemic event can provoke a financial crisis. This can involve a variety of modalities: a run on the banking system; a drying up of credit; a sharp and widespread drop in financial asset prices; non-payments or blockages in the settlement system used to settle large amounts.

Systemic risk is therefore defined as the risk that is engendered by a systemic event which is sufficiently violent to trigger repercussions that can lead to a financial crisis. As such, systemic risk is a threat whose materialisation can have macroeconomic effects. For this reason, it can be defined as the likelihood that an economy will shift from a state of "normal" equilibrium to an "abnormal" state characterised by severe social damage (Aglietta and Moutot, 1993). With respect to the financial system, systemic risk expresses the idea that customary types of disturbances, such as those that regularly crop up during the economic cycle, can create disproportionately negative after-effects if they occur in systems that are fragile (Davis, 1995). Financial fragility is the arena in which shocks become systemic events. It leads to externalities in the transmission of shocks, externalities that can provoke non-linearity (i.e. a cumulative strengthening of and discontinuity in) the ensuing shifts (Hellwig, 1998). This means that the starting point for a theory of systemic risk is to develop at least one hypothesis as to why certain financial relationships are structured in such a fragile manner. Representative models of systemic risk are therefore distinguished by their use

of the hypothesis of fragility. It may be true that their main contribution is their description of the way in which shocks are propagated. However, the very nature of the shocks that provoke systemic events (by striking fragile systems) is also important, since this helps us to distinguish two main approaches to the origins of financial crises (Gale, 2000).

A first approach views crises as random events that are unrelated to types of economic development. This entails self-fulfilling beliefs (Diamond and Dybvig, 1983). A second approach considers that financial crises are related to the economic cycle, in which case the events that initiate them are endogenous. Here crises are part of a dynamic that leads to the materialisation of economic instability (Minsky, 1982). In both approaches, the hypothesis of fragility is essential. However, diverging perceptions of the events that trigger such processes lead to formal differences in the crises' representation.

In models that revolve around the existence of self-fulfilling beliefs, expectations play a crucial role in determining whether a systemic event might occur. A co-ordination issue is raised by the existence of expectations that may develop, for example, because of a signal that from the very outset might be independent of those variables that can actually influence financial fragility. The signal's connection to the situation in which the financial institutions actually find themselves might also be an imperfect one. In any event, co-ordination around this signal brings the financial system to an equilibrium that may be rational at an individual level but which is socially harmful. The problem of co-ordination thus raises the possibility of multiple equilibria, or at least of a whole array of states that can characterise a variety of financial situations. Financial fragility is described by this possibility of multiple equilibria. Nevertheless, co-ordination around a crisis equilibrium is a fortuitous occurrence. A run on the banking system will take place if people do indeed panic, but it won't if they don't (as long as the banks are able to satisfy "normal" withdrawal needs).

In the second approach, financial fragility depends on the endogenous interaction between credit and asset values during the course of the economic cycle. This process does not revolve around the notion of multiple equilibria. It is possible to have financial dynamics that unavoidably lead to a crisis equilibrium. According to Minsky, for example, financial fragility is the interdependency of those behaviours that can engender instability (i.e., it is a dynamic that causes a crisis).

1.2. Why are financial systems so fragile?

Theoretical models believe that two main factors drive financial fragility: liquidity and the asymmetry of information.

Liquidity is closely related to models that contain multiple equilibria. This is because the liquidity of a financial intermediary or of a market stems from a problem of co-ordination. The basic model used by Diamond and Dybvig, which has served as a starting point for a number of extrapolations, defines as a crisis a run on bank deposits. At the outset there is the deposit agreement that economic agents rely upon when seeking to protect themselves from the uncertain nature of the demand for liquidity. This leads to a microeconomic conception of banking, defining as a bank any agent who accepts to convert, unconditionally and at a fixed-price, its liabilities into currency (or directly into a consumer good in those self-styled models that are based on the existence of a single good) - whilst transforming its liabilities (some of which are promises of liquidity) into illiquid assets. The unconditional nature of this promise leads the bank to apply a process of first, first served. Financial panics stem from self-referential beliefs by each depositor that other depositors will simultaneously and prematurely attempt to make a withdrawal. However, this model only explains a run on a single bank, not contagion throughout the banking system. It sees the problem of liquidity-related co-ordination exclusively in terms of the deposit agreement, neglecting the role played by the financial markets.

Contagion from one bank to the next is propagated via the interbank markets (Rochet and Tirole, 1996; Allen and Gale, 2000). It can also be manifested in the settlements systems (Freixas and Parigi, 1998). The interbank market can redistribute banks' excess liquidity towards other banks who may have urgent needs, thus nipping any incipient panic in the bud. But this is only possible if there is no overall excess in the demand for liquidity - after all, crossed bank deposits cannot increase the banking system's aggregate liquidity. Only the lender of last resort can do this, and if this lender is apathetic, those banks who would be the first to experience difficulties with their depositors will seek to withdraw the deposits they have with their correspondents, thus propagating fragility to this latter group. Panic then spreads via the interbank market, especially since this is a market that constitutes a chain of bilateral relationships where the gross outstanding positions (rather than the net ones) are exposed to liquidity risk. In interbank settlement systems that are based on net amounts, such chain reactions can spread with blinding speed if payments are not secured. This is why such systems settle net multilateral positions via the Central bank's clearing system - by so doing, they ensure that the final payments are indeed being made. In return for this collective service, those banks who are direct members of these secured systems must respect certain prudential constraints and accept to share in the losses in case one of them fails. In a continuous gross amount settlement system, systemic risk cannot result in principle from a chain reaction of failures to make payment. However, a freeze on settlements can spread throughout the network, if one bank's inability to pay at a certain juncture puts other banks into the same situation at a later time. It may be possible to freeze settlements, a state of affairs that is symptomatic of crises in systems of this ilk. Once again, to preclude a crisis equilibrium the central bank has to provide liquidity in the form of collateralised inter-day loans.

Although central banks can overcome liquidity-related co-ordination problems in the interbank debt system *stricto sensu*, the same does not apply to markets, at least not with the financial sphere's current organisation. This is because

markets have become (or have once again become) large-scale providers of liquidity (Davis, 1994). Yet market liquidity creates a co-ordination problem that is closely related to expectations of future prices (Masson, 1999). Market liquidity is crucial because banks sell their assets to cope with uncertainties about liability-side withdrawals. But if there is doubt about the market's liquidity, expected future prices will no longer be co-ordinated on the basis of the given security's fundamental value (Genotte and Leland, 1990). The fear of lower prices causes unilateral selling, which means that prices will indeed drop. No longer sure about what floors exist under the market price, financial institutions (the "natural" providers of liquidity) withdraw from the market or else abstain from buying. This can lead to a panic equilibrium preceded by extreme price volatility.

The issue of credit is not accounted for in the aforementioned configurations of financial fragility. However, it does have a major role to play in our second factor, the asymmetry of information, with its two corollaries, contrarian strategies and moral hazard (Mishkin, 1991). The Asian crisis in particular showed that the shift from an abundance of credit to an extreme rationing thereof can constitute a sort of discontinuity (Marshall, 1998). The most interesting aspect for this second approach, which sees financial fragility as a function of the economic cycle, is the interaction between credit and the financial markets. Historians have come up with a plethora of commentaries on the significance of this process during financial crises (Kindleberger, 1996). Financial deregulation and the shaping of a single capital market in Europe mean that this theoretical model has become very topical.

The inclusion of credit as a vehicle for the funding of assets is a crucial step. It is at this level that standard theories of finance fail to explain capitalist dynamics. These models presuppose that investors purchase assets with previously acquired wealth. *But investors buy assets with credit that is born out of the banking system's creation of money*. This process contains the possibility of multiple equilibria: the self-fulfilment of people's expectations of a given credit

regime influences changes in asset prices and can engender speculative bubbles.

The micro-economic foundation of this process is the asymmetry of the contract of indebtedness. Debtors' limited liability on the loans they have received leads to an asymmetrical distribution of profits and losses. The asymmetry of information is a consequence of the legal form that contracts of indebtedness assume. When investors leverage up to purchase securities, they are transmitting part of the downside risk to the lenders, whilst keeping all of the upside potential for themselves. This incentive system causes financial fragility inasmuch as it produces an equilibrium price for assets that is systematically higher than their fundamental value during the credit expansion phase (Allen and Gale, 2000). Given that the asset's future price depends on this credit expectation, and seeing as this expectation is itself something which is uncertain, the rise in the size of the bubble matches the rise in uncertainty. And given that a bubble translates the existence of unrealistic profit expectations, a slower than expected rate of credit growth may be enough to cause the bubble to burst. Here it is the systemic event that creates a financial crisis. This is because the collapse in asset prices raises doubts about the possibility that they can be liquidated in order to reimburse debts.

1.2. The hypotheses that the present study uses

The most significant transformations affecting European finance is the markets' rising power and European banks' efforts to adapt so as to become market intermediaries capable of competing with American banks. This development places the European financial system under the influence of global systemic events. Since prudential control institutions had not kept up with this development, it is legitimate to wonder whether monetary authorities will be able to manage financial market-generated crises. It is also a good opportunity to

wonder about which reforms will need to be carried out in order that financial fragility might be reduced.

We will hypothesise that the greatest source of systemic risk in today's conditions is the interaction between credit and asset prices, as discussed in the aforementioned logic. Correlatively, financial market liquidity is a crucial factor of contagion when a price reversal occurs in several markets at the same time. The way in which banks behave is essential in determining whether market liquidity will be maintained during stress situations.

The second section will therefore analyse the interdependency between the European and American financial markets; and focus on the signs of interaction between credit and financial market dynamics. The purpose is to shore up the hypothesis of financial fragility. We will be observing episodes where systemic risk has cropped up, and spotlighting the crucial role played by the lender of last resort.

In the third section, we will be trying to understand at a deeper level banks' risk management behaviour. In reality, banks play a preponderant role in the credit expansion processes that foster speculative bubbles. We will demonstrate that the endogenous nature of risk renders the banks' control systems vulnerable to systemic events and encourages contagion. This creates serious questions about the approach that was adopted after the Asian crisis, with increased importance having been attributed to internal system controls and to "market discipline".

In the fourth section, we will describe the contagion models that are currently at work in the financial markets in terms of the aforementioned theoretical models. In conclusion, we can then focus on whether the current prudential mechanisms are likely to be capable of staving off systemic risk.

II. Instability and interdependency in the financial markets

There is that nothing surprising about the fact that financial globalisation has intensified the markets' interdependency. However, observations of synchronous and violent fluctuations in a number of debt and equity markets, both at a sectorial and at a national level, undermines financial theory-making. Is it not the case that by deregulating the markets they can become more complete? Or that a greater degree of completion increases the freedom to undertake a portfolio diversification that will reduce systemic risk and allow prices to respond more efficiently to shocks? Fans of market finance have gone as far as to announce the end of the business cycle. In this view, not only are the financial markets incapable of amplifying (or indeed of engendering) business cycles, but their ability to discover equilibrium pricing has been so efficient that shocks from the real economy can be absorbed immediately. In short, the application of information technologies to a deregulated financial sphere promises a fulfilment of the Walrasian myth of a moving equilibrium.

The viewpoint ignores the portentous nature of the 1994 bond market crisis. This was an ominous event that should have received greater attention instead of being dismissed as an aberration. It should be remembered that tougher American monetary policy had a knock-on effect on all of the world's financial markets (and on all maturities), with the rise in bond market rates amplifying the rise in money-market rates rather than offsetting them. This synchronous movement took place irrespectively of the currency regime involved – or of the economic situation of the countries subjected to this knock-on effect.

Of course, the Asian crisis of late 1997 did not repeat this phenomenon. Its contagion spread throughout all of the emerging markets, but the major Western bond markets were strengthened by a reallocation of portfolios in their direction. The preference was to move into the American markets, where rates dropped more quickly than in Europe during the latter half of 1997.

After this episode, dynamic intermarket interactions (on both the equity and the debt markets) intensified considerably, ultimately leading to the development of a global financial cycle in 2000-2001 and beyond. It is paramount to note that the crucial factors in these interdependencies, with respect to Europe and the United States, are structural in nature. This involves a coupling between a corporate governance system that is based on shareholder value and the preponderance of the public's opinion of the market in the evaluation of company performance.

Driven by the development of information technologies and subjected to the threat of mergers and acquisitions, companies have organised themselves into global networks, or at the very least restructured themselves in such a way as to serve world markets. As for financial investors, this category of agents has accelerated the conversion of national financial institutions into global portfolio managers. The fallout for the equity markets has been spectacular. An in-depth statistical study by the IMF demonstrated that the relationships between the world's various stock markets have changed deeply since 1995 (Brooks and Catâo, 2000). The study's conclusions confirm many other observations and are very significant.

Since the mid-1990s, equity markets have become highly correlated during crisis periods. Such correlations are characterised by a number of underlying structural factors. The sectorial determinants in the TMT (technology-media-telecommunications) sector completely dominate any geographic factors. This technological innovation sector is a catalyst for the rest of the market, and has set the tone for market indexes in both developed countries and also in emerging markets. This has lead to the formation of speculative bubbles, and the bursting thereof has become a global phenomenon.

Since the equity markets are being funded by high levels of leverage, interest rates for high-risk securities have been experiencing a correlated type of

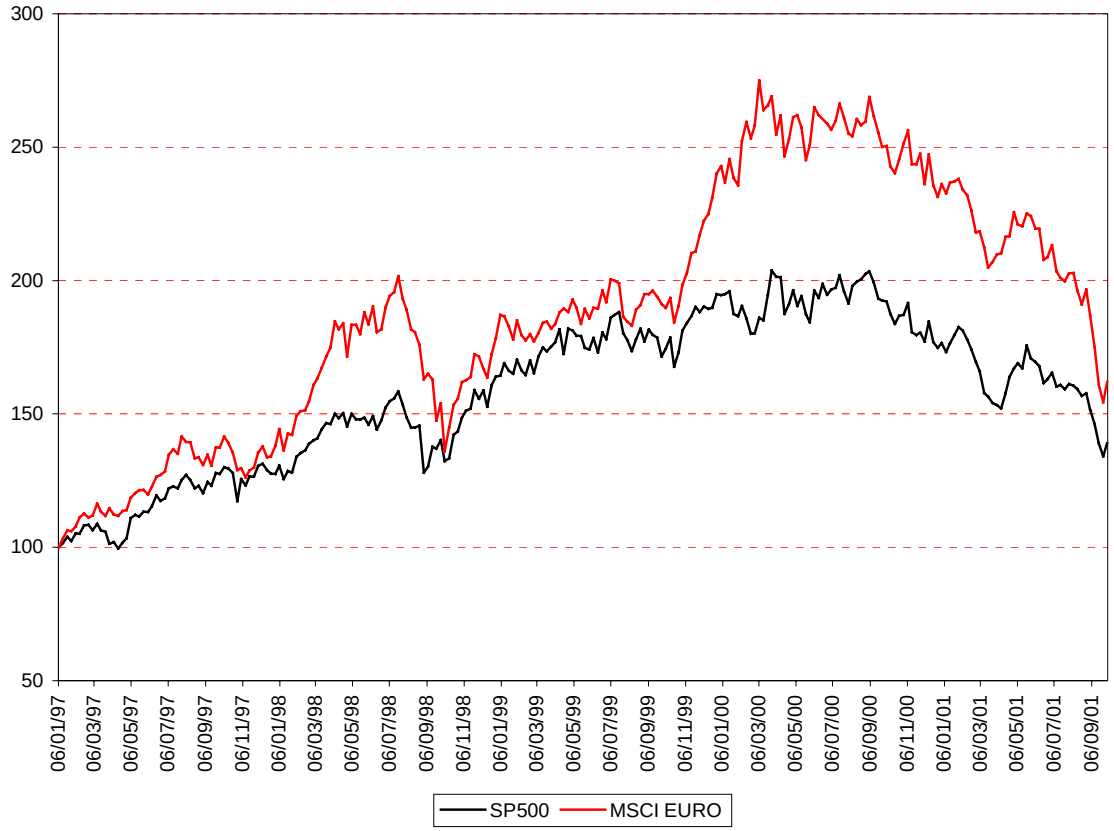
development, one that is closely related to major fluctuations in the equity markets. The outcome is that Europe is subject to the same financial cycle as United States. Thus, even though systemic risk is endogenous to a given financial cycle, Europe has become vulnerable to the same types of crises as the US. However, Continental Europe's crisis prevention and management systems have evolved according to a culture that is characterised by its experience with banking systems that are barely (if at all) market-dependent. Hence the question of whether they are really suitable for global market finance.

To answer this question, we should first highlight the reality of Europe's and the United States' shared financial cycle. We will then study the episodes of systemic risk that have taken place whenever large-scale shocks have occurred in financial systems that are subject to the influence of market dynamics.

II.1 The financial markets' instability

Equity markets in the United States and in the Euro zone have generally kept apace with one another since early 1997 (Graph 1). Severe bearish phases have been synchronised: July-October 1998, on one hand; and post-September 2000, on the other. For each of these two phases, and for the bull markets that preceded them, the European equity markets moved much more violently than the American market did.

Graph 1: Compared changes in the S&P 500 and MSCI Euro (base 100 = 1997)

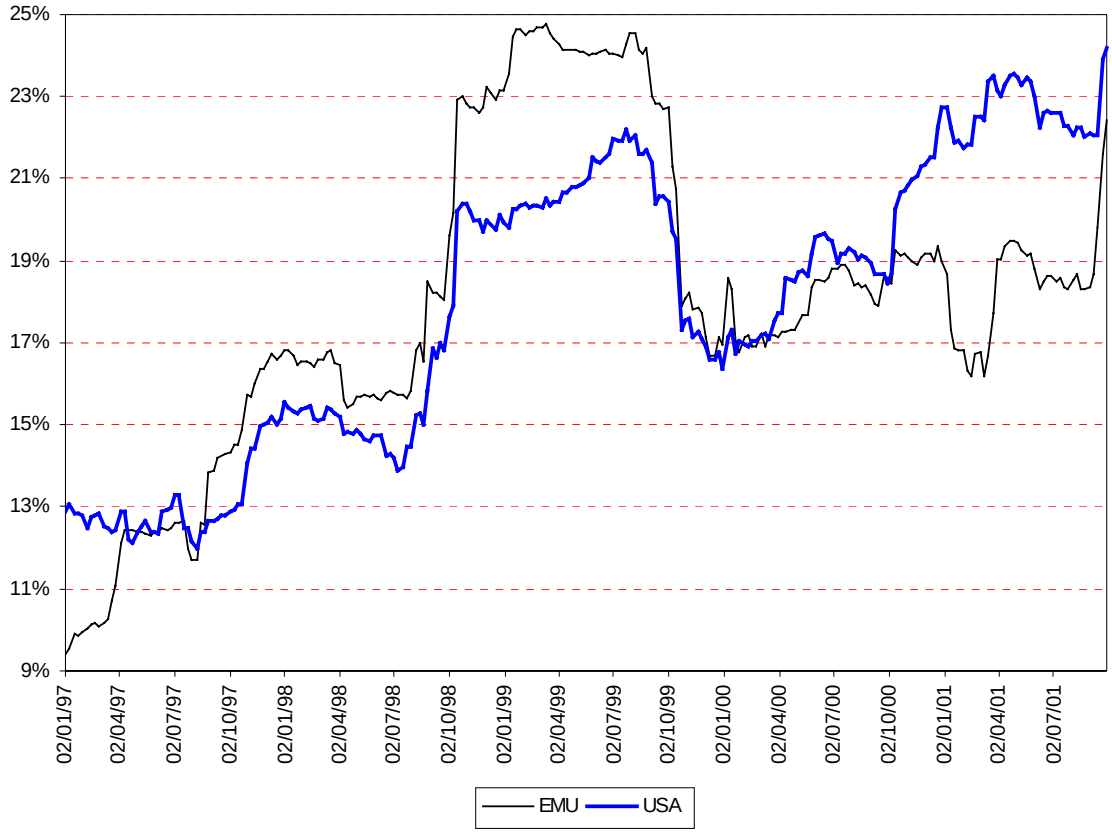


MSCI = Morgan Stanley Capital International
Source: Datastream

On the other hand, there are two measurements of instability and interdependency that do provide a somewhat different picture. The first is one-week volatility (Graph 2). We can draw several lessons from this. First of all, volatility jumped simultaneously on both markets when systemic risk appeared in September 1998 and in September 2001. It then remained high for quite some time (for one year, from September 1998 to September 1999), even during the bullish phase that took place after the systemic event has been absorbed. Lastly (and contrary to the magnitude of the overall move), the market that is the most volatile can vary. From September 2000 onwards, people began to doubt

whether American growth could continue at the same high pace. The stock market plummeted and volatility skyrocketed. The drop in the S&P 500 lead the European index downwards, even though the economic situation in Europe was still healthy. However, the fall in the European markets, albeit severe, did not cause any increase in volatility.

Graph 2 – Stock market volatilities

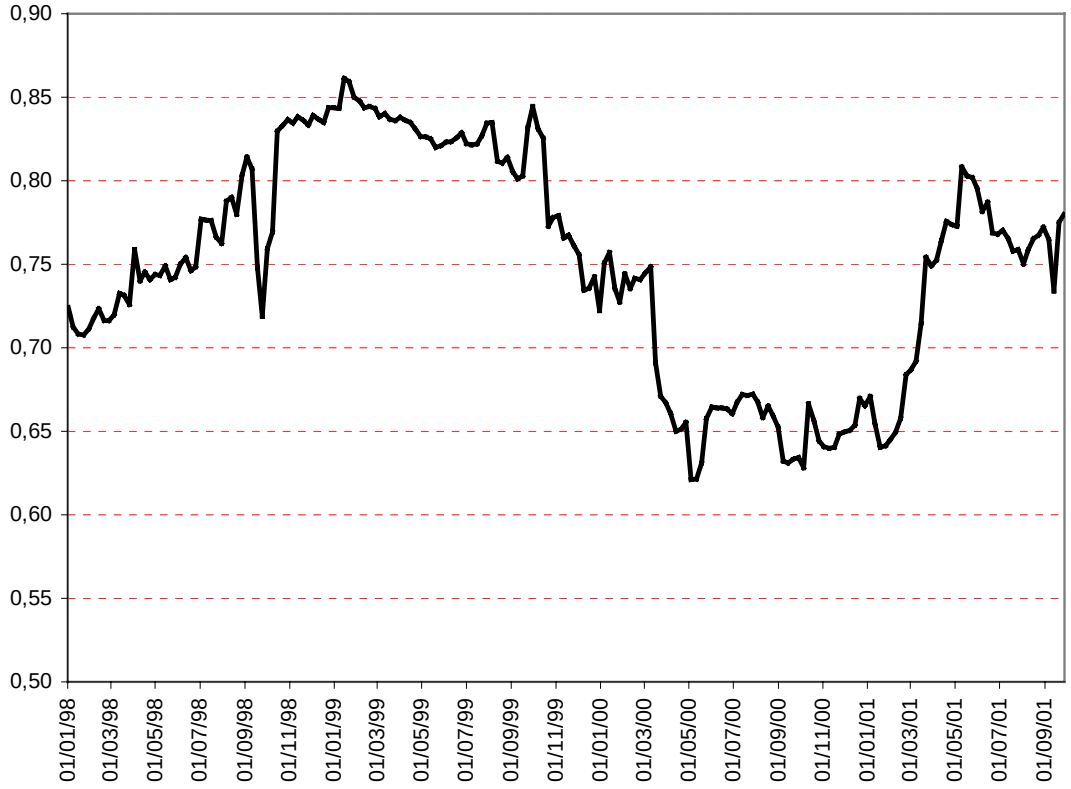


Source: Datastream. Calculations by CPR Gestion

Correlation between stock markets is an indicator that covers only part of the information we can garner from volatility measurements (Graph 3). First of all, this correlation has always been high, as Graph 1 confirms. Since April 1997 the coefficient of correlation has never sunk below 0.60. In addition, the high level of uncertainty, which reached a peak in the second half of 1998 (with the Russian crisis, the LTCM episode and the Brazilian crisis), provoked a joint rise in

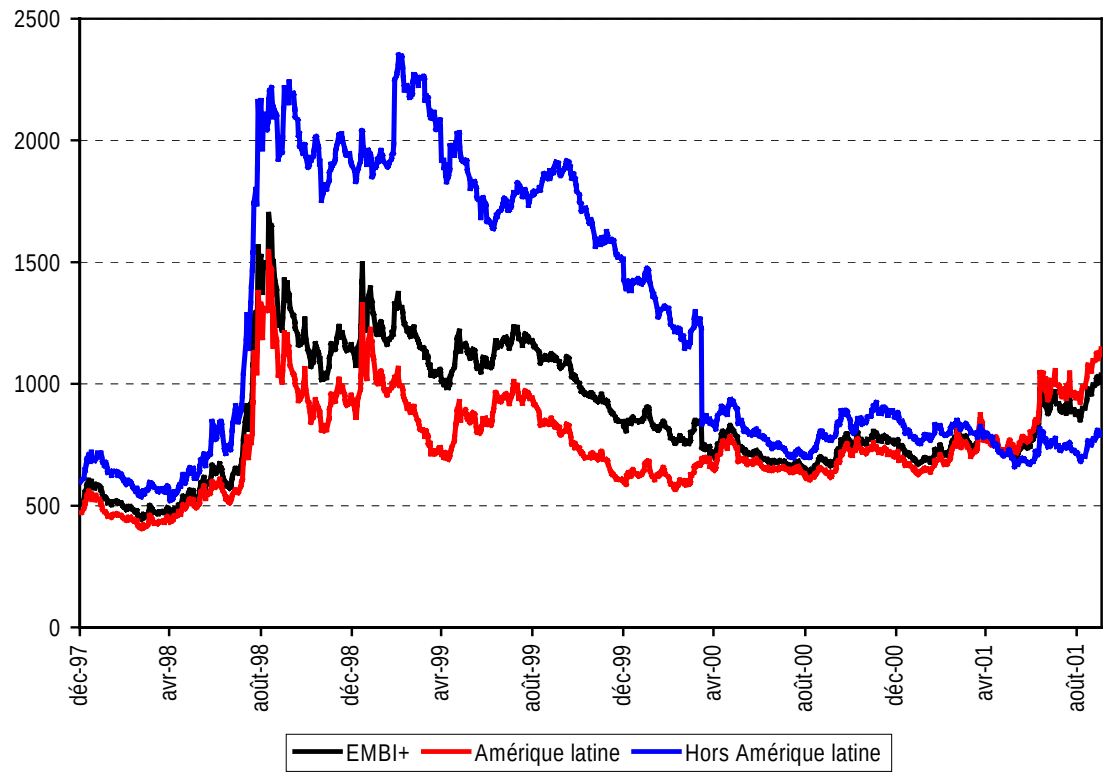
volatility and in inter-market correlation (which reached a high of 0.85 in March 1999). However, the events of 2001 were of a different nature. Correlation rose sharply between January and May 2001, yet European equity market volatility did not increase, dropping in fact for the first two months after the initial cut in American money market rates (Graph 3) and subsequently remaining below 0.75. This is coherent with the aforementioned findings by the IMF. Although equity markets move as a function of global factors, the main explanatory factor for the financial conditions that are actually driving share price evaluations is the discount rate, an integral part of US monetary policy. At the time, the Federal Reserve was fighting against a cyclical turnaround in American growth prospects, and the European equity markets reacted strongly to the more or less pessimistic indications that were being given as to the outcome of this battle.

Graph 3 – Correlation between the American and European equity markets



But global indexes provide a blurry picture of financial instability at best. This is because they do not directly indicate which of the system's weak links are giving birth to systemic events. With the theoretical model that the present article follows, we were first able to demonstrate that credit is the principal agent in the constitution of systemic risk. In other words, if we want to determine which interest rate rises are most likely to be potential harbingers of a global financial crisis, we first have to look at credit risk premiums. Two indicators are particularly useful at this level. The first is the *spread between EMBI+ rates* and the Brady bonds and US Treasury bonds of similar maturity. Of course, this spread can be indicative of a local crisis that might only spread throughout the emerging countries. However, its greatest variations translate systemic events that were born in the emerging markets, but which have had a global fallout. The second is the *high yield spread* between high-risk corporate bonds (with a rating of below Baa) and investment grade corporate bonds (Aaa). Each of these indicators incorporates both a liquidity risk and a credit risk.

Graph 4 – EMBI

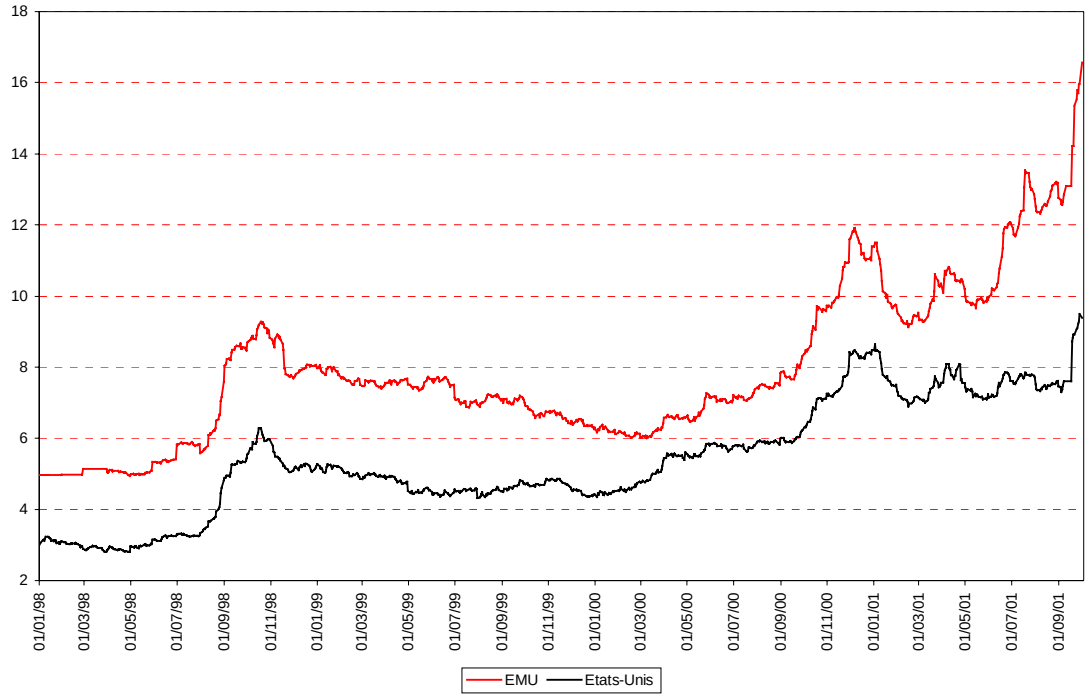


EMBI: Emerging Market Bond Index
Source: JP Morgan

The EMBI+ indicator is shown in Graph 4. The contrast is striking between 1998, on one hand, and 2000-2001, on the other. In August 1998, the Russian default, which lead to a unilateral moratorium, caused sharply higher risk premiums for all emerging markets, effectively drying up the offer of credit. In Autumn 2000 and in spring 2001, threats of default in Argentina and in Turkey did not generalise throughout all of the emerging market sector. For the moment, these latter two financial crises have remained contained in each of these countries. This is due to the immediate "last resort" intervention by the FMI, in radical contrast to its inertia when faced with the unsustainability of Russian domestic debt. In short, this spread reflected the birth of a systemic event in 1998, but not in 2000-2001 – despite the gravity of the situation in Argentina. Nevertheless, there is still a

latent threat, although the markets see it as being localised in Latin America (as witnessed by the spread's rise in this region after June 2001).

Graph 5 – Spreads between high yield instruments



Source : Moody's

Graph 5 offers an indicator comprising the spread between high yield instruments. During periods of stress, there is a striking synchronism between the United States' and the Euro zone' curves. September-October 1998 witnessed the contagion of a financial crisis through all of the capital markets. In autumn 2000, the equity markets' weakness was accelerating until the Fed's first spectacular intervention on 3 January 2001. However, spreads rose very rapidly between September 2000 and the year's end. Note also the sharply lower assessment of the quality of high-risk European companies as opposed to American firms in this category. Risk premiums also went much higher in September 2001, indicating people's assumption that a systemic event was taking place.

It is worth taking a closer look at the informational content provided by these high yield spreads. A study by the *Caisse des Dépôts et Consignations* offers some useful details (Tempéreau and Teïletche, 2001). The authors carry out an econometric risk factor analysis on the spread described in Graph 5, and also on spreads between various classes of risk (as defined by the rating agencies) within the high-risk debt sector. Their findings correspond to the theory of financial cycles. Risk premiums are indeed tied to the likelihood that borrowers might default. This rises when profits drop, in other words, when overall economic activity slows down. This is the first overall factor of risk. The second is share price volatility - after all, this is an indicator of corporate asset volatility. When this rises, so does the likelihood that the value of sellable assets is going to be lower than the value of the debts that will have to be reimbursed. Since creditors are going to have to assume the risk of bankruptcy once the assets have been sold off, risk premiums rise when share are volatile. Lastly, and as envisaged in the financial accelerator theory, the higher a firm's gearing (i.e., the relationship between its debts and equity), the more fragile it is. The authors demonstrate that these three variables (variation in GDP, share price volatility, gearing) are econometrically significant in explaining spreads between high yield instruments - especially when the company involved belongs to the lower rating brackets.

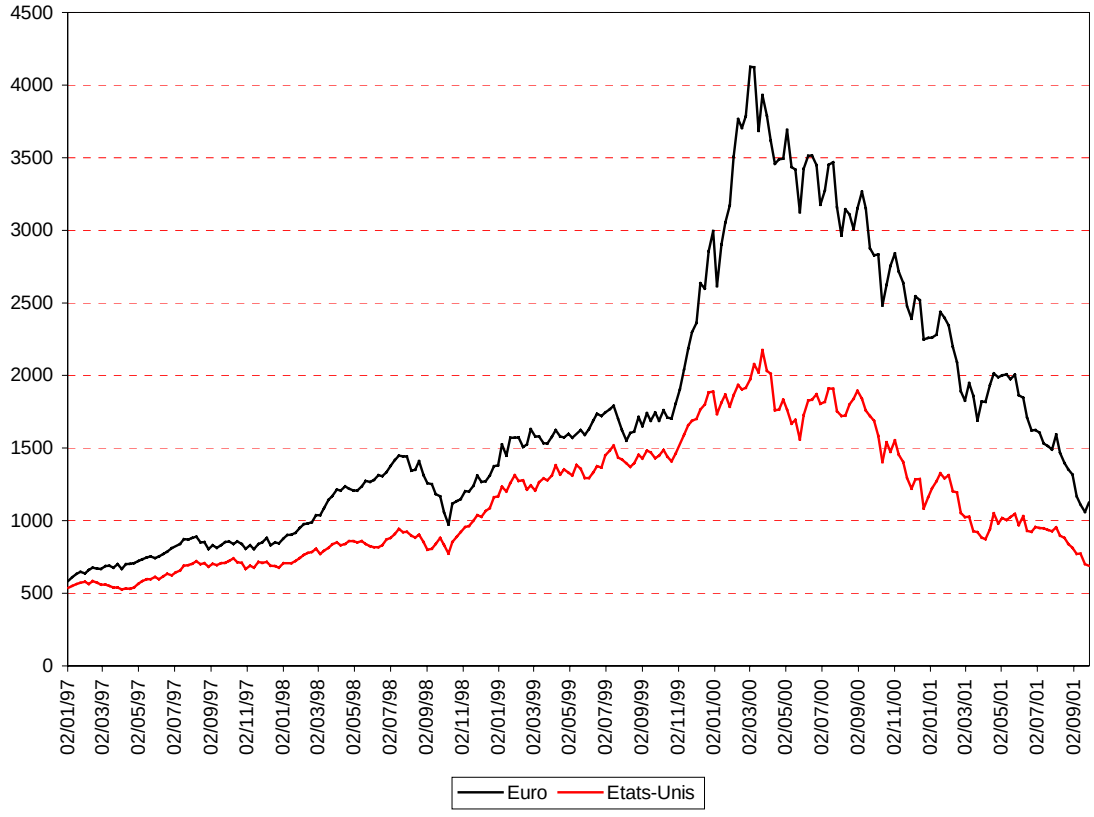
But what type of stock market volatility are we talking about here? The issue is not the volatility of global indexes. Instead, it is the volatility of those sectors where the dynamics of asset pricing and credit have lead to an over-valuation of assets and to extremely high gearing ratios, i.e., to excessive investment. This raises doubts over future profitability (due to the high level of debt that will need to be reimbursed). The TMT sector plays this role in the current cyclical reversal.

Graph 6 highlights the synchronised movements in TMT share values, notably during the speculative bubble that took place between September 1999 and March 2000. In particular, it highlights the enormous over-adjustments made by

the European equity markets. This was the peak of European large company acquisitions of American firms, takeovers that were partially funded by credit and partially by share swaps.

The correlation between the various national equity markets' extreme variations during the period of growth that followed the resolution of the September-October 1998 financial crisis, on one hand, and the initial bearish phase that lasted until April 2001 (before stabilising until the month of August), on the other, was much more noteworthy in the TMT sector than in any of the others (Table 1).

Graph 6 – Equity markets: the telecom, media and high tech sector



Source : Datastream

Table 1 – Share price variations (en %)

Country	During bullish phases in the market (1)		During bearish phases in the market (2)	
	TMT	**ex. TMT**	**TMT**	**ex. TMT**
United States	181	28	-52	5
France	350	69	-48	7
Germany	308	46	-62	-4
Great Britain	214	13	-52	19

Source : FMI – World Economic and Financial Survey, chap. 2, p. 11
(1) October 1998 – March 2000
(2) March 2000 – April 2001

Once there had been a recovery from the 1998 crisis, there were no real trends in the American equity market (outside of the TMT sector) between March 1999 and August 2001. On the other hand, during this entire period volatility was higher than it had been before the Russian crisis. As for Continental Europe, equity markets continued to rise until September 2000, even outside of the TMT sector. These gains were subsequently reversed, the effect being that there was little net movement between March 2000 and April 2001, as indicated in Table 1. All of this confirms that the TMT sector set the tone for the unstable credit and asset price dynamics which characterised the global economic cycle that was in effect from autumn 2000 onwards.

We can therefore observe two systemic events, each of which has a different origin: the Russian crisis and its impact on the financial markets in 1998; and the bursting of the TMT sector speculative bubble, which caused a reversal in the global cycle (aggravated by the 11 September 2001 attacks). We can now compare the processes that transform systemic events into global financial crises and analyse how in such circumstances the central banks' last resort interventions constitute the only possible recourse against the collapse of the financial system.

II.2. Clearly recognisable systemic crises: the after-effects of the 1998 Russian default and the 2001 terrorist attacks

What happens in a systemic crisis? In theory, contagion endogenously provokes the destruction of financial assets and liabilities. But what is the genesis of contagion? Can it strengthen without the financial systems having the endogenous wherewithal to contain it? The lender of last resort alone is able to nip contagion in the bid. This is because the fear that liquidity will disappear from the markets and/or from the settlement systems is a vector of contagion.

II.2.a. The September-October 1998 crisis

We will not be taking a second look at the whole Russian financial crisis. Instead, we will now be focusing on those aspects that were original. This is meaningful because the Russian crisis triggered a generalised disorder in the financial markets - unlike the Asian crisis (despite the fact that the latter was greater in magnitude).

Certain effects of this systemic event have already been noted (i.e., the jump in the EMBI+ spread, the strong rise in share prices). However, the originality of the financial crisis lies elsewhere. With the Asian crisis, portfolio reallocation strategies, hedging by market intermediaries and credit line withdrawals by banks had all lead to a purchasing of Western financial market assets. The crisis's propagation in the emerging markets was therefore guided by a "flight to quality". Risks in these latter markets were reassessed in terms of benchmarks comprised of highly rated Western market debt instruments. A new structure of risk premiums was established, one that favoured the Western markets. Financial institutions reacted to this shock by making fine distinctions between the different

categories of high-risk assets, something that brought about a reallocation of capital towards the technology sectors, primarily in the United States.

The fallout from the Russian crisis was completely different, in that it lead to a "flight to liquidity". The unforeseen shock of the Russian crisis provoked reactions that were disproportionate to the actual losses suffered by Western financial institutions. The Russian crisis was truly a systemic one, inasmuch as it represented a breaking of the rules of an international game that the financial community had tacitly incorporated into its evaluations, and more specifically, the certainty that it would receive official support from the G-7 and from the IMF in case it had problems with the emerging market debt it held (BIS, 1999). Doubt set in as to the financial health of participants in the global financial market. LTCM's semi-bankruptcy worsened the situation, especially since many international banks had been following similar strategies. The result was an *indiscriminate type of uncertainty*. Even the benchmarks themselves (i.e., the reference values that guide finely turned arbitrages between reward and risk and which serve as the foundation of the whole interest rate structure) were placed into doubt. *As such, it was a generalised crisis of valuation schemes that swept through the financial markets after September 1998*. This crisis translated into a generalised flight to liquidity.

This reality can be illustrated if we observe implied volatilities on those markets that are customarily the deepest, and therefore seen as benchmarks for differential evaluations of riskier assets. This volatility, which the options markets imply on a daily basis for the underlying assets (which we will be discussing below), is presented in Table 2 for a few of the crisis's watershed dates.

Table 2 – Implied volatilities in various markets during the September-October 1998 crisis (in %)

Benchmark dates	14 July	26 August	10 September	5 October
One month currency volatilities:				
Dollar/Mark	8	8	14.5	13.5
Dollar/Yen	16	15	19.0	18.2
Implied term volatility in the equity markets:				
Standard and Poor's 500	15	25	43.5	37.5
Nikkei	25	30	40	41
CAC40	21.5	35	42	58
Implied term volatility in the bond markets:				
US Long Bond 30 years	7.7	8.4	9.2	10.4
UK Gilt 30 years	5.0	5.5	6.4	9.1
Implied term volatility on short term interest rate contracts:				
Eurodollar 3 months	8.3	10.8	15.0	18.4
Euromark 3 months	9.6	12.0	14.7	17.3

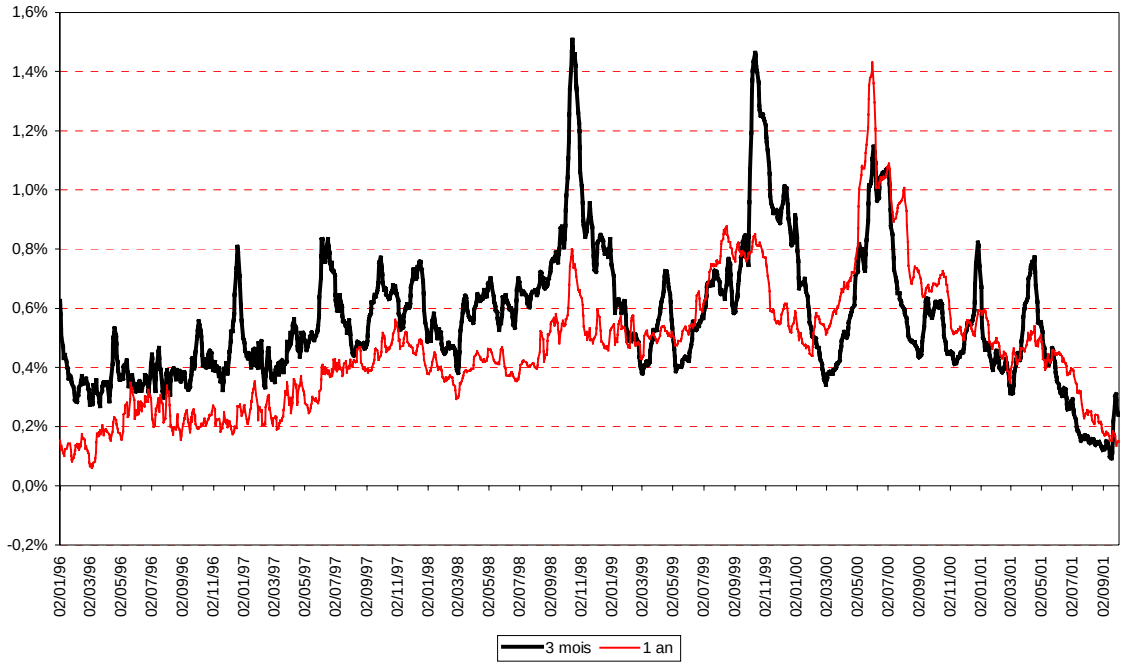
Source : Banque de France, Direction des changes (SAMI)

This general blurring of benchmarks was manifested by an unusual increase in implied volatilities, both on the listed markets for long term securities and also on more standard short term debt markets. Markets that people habitually considered to be highly liquid could no longer provide sufficient liquidity. In addition, credit risk premiums rose enormously and never returned to their pre-crisis levels. One example is the 10 year interest rate swap spread which had fluctuated between 20 and 30 basis points above the Treasury curve between early 1992 and mid-1998. This reached 110 basis points in September 1998.

Even more spectacular is the “TED” spread between the (futures contracts on the) 3-month LIBOR and 3-month U.S. T-Bill rates. LIBOR is an interbank rate that the world’s 16 top banks set for each of the standard money market maturities. A rapid rise in this spread followed by a sudden reversal cannot be seen as indicative of concern about the solvency of the world’s top banks (i.e., the fear that they would disappear from one day to the next). It is much more of an indication that there is a tension on liquidity, a tightening that emanates from the financial markets and which is concentrated in the banking sector due to mechanisms involved in contingent credit lines and the exercise of derivative contracts. As such, it is an indicator of the effects of contagion.

Graph 7 describes changes in the TED spread since early 1997. The 3-month TED spread hit a peak in October 1998, its highest level since the S&L crisis. This sudden rise was one effect of traders’ generalised disengagement from private asset markets; of their buying only the most liquid government securities; and of banks’ having been asked to fulfil different guarantees they had been making (i.e., credit lines that back up commercial paper issuance). Note that the TED spread hit another high in November 1999, when people began worrying about the Millennium bug, and before the Fed calmed market jitters by injecting enormous sums (which it withdrew from early 2000 onwards).

Graph 7 – THE TED Spread



TED : Treasury/Eurodollar
Source : Bloomberg-Calculs CPR Gestion

Securities sales that are primarily motivated by a flight to safety (and by the desire to reduce levels of debt) create collective behaviours that give no thought to analyses of fundamental value. The lowering of some prices inevitably leads to a drop in other types of prices inasmuch as the devaluing of collateral degrades the debt that it is supposed to back up. Thus the need to sell and to reduce exposure to debt spreads from one market to the next, moving deeper and deeper, until it reaches the banking system. In an atmosphere of general uncertainty, there is no spontaneous co-ordination of people's expectations as to when the market is finally going to bottom out – despite the fact that this could motivate liquidity holders to become involved again. The intervention of the last resort lender is the only efficient way to stave off a systemic crisis (Aglietta, 2000).

The Federal Reserve acted decisively in these circumstances. It faced a double problem: the collapse of LTCM; and the flight to liquidity. It was paramount to deal with the first problem because many major investment banks shared the same sort of risk exposure. This meant achieving a well-ordered reduction in debt levers to avoid the advent of panic. Dealing with the second problem involved issues that were related to monetary policy. Allowing a generalised preference for liquidity to develop would be tantamount to authorising a destabilisation of the demand for money, thus depriving monetary policy of the guidelines it needs. Re-establishing confidence thus meant restoring a co-ordination of market expectations around benchmarks so that these instruments could again fulfil their function as points of reference.

The Fed carried this double operation out with a master's touch that attests to its intimacy with the markets – a source of accumulated experience found nowhere else in the world. There is no doubt but that the Euro system would been unable to handle this type of crisis with the same level of efficiency. The ECB does not maintain close relationships with non-banking institutions that are active in the global markets. Supervisors are fragmented on a country-by-country basis, and some do not even maintain relationships with their own national central banks. They have no institutional obligation to communicate information; and they can be very calculating with one another.

Yet unified prudential and monetary decision-making turned out to be an absolutely crucial condition. It was the factor which ensured that efforts to stave off a systemic crisis would be efficient. The Federal Reserve, despite the urgency of the situation, was able to put together a banking consortium, which it then sponsored. This consortium accepted to inject $ 3.5 billion in return for taking over the management of LTCM. The purpose was to progressively reduce the fund’s risk exposure. And towards this end, the consortium wanted to be able to count on a normalisation of the interest rate structure.

To shore up deteriorating confidence, the Federal Reserve lowered the Fed Funds rates on three separate occasions, 29 September, 15 October and 17 November, reducing them from 5.5 % down to 4.75 %. The first cut, which had been widely anticipated, could not hold off the disorderly weakness that was overcoming the T-bill market. The real turning point in the crisis was the 15 October rate cut, which had not been expected and which took place outside of the FOMC. The TED spread began to ease the very next day, and T-bill rates began to swing upwards again. This reversal in confidence is one of the mysteries of collective market psychology. A loss of confidence had been generated by an interruption in generally accepted modes of evaluation, as a result of an unusual event that lay outside of the cognitive universe in which financial markets agents determine the risk exposure that they are willing to take. This disturbance confused agents, and they tried to solve this by a flight to safety. In other words, the crisis really did involve a logic of multiple equilibria. By getting people to agree to put a floor below the market, thus stopping the downward spiral of prices, the lender of last resort builds foundations that provide renewed meaning to asset valuations. Since this shift from one type of equilibrium to another constitutes a discontinuous jump (something that the crisis's destruction of beliefs had undone in a record time), the rebuilding of beliefs by the lender of last resort also took place within a similarly short period of time.

II.2.b The September 2001 crisis

This crisis was extremely different from its predecessor. Unlike 1998, the systemic event of 11 September 2001 took place, as we have seen above, against the backdrop of a major bearish phase in the financial cycle, a downwards move that was hitting the Western financial markets even more than the emerging ones. In addition, the shock that brought about the systemic crisis was not a market event, as the LTCM bankruptcy had been. Rather, it was a catastrophe that directly affected the interbank settlements systems. Now,

interrupting the payment of large amounts causes instantaneous financial paralysis. This is why such settlements systems are under the direct control of central banks. For this reason, a last resort type of intervention was organised, one that was immediate, co-ordinated and unprecedented in size. The action proves that central banks still have total control over the financial markets, despite the latter's globalised nature. *When they work together, the central banks still constitute the (international) lender of last resort.*

The central banks' first move was to inject liquidity into the banking system. The Federal Reserve intervened both in the Fed Funds market and also at the discount window. Actually, one major operational risk had to be dealt with right after the attack, due to the breakdown in computer connections. If payments had not been met (if agents had started to default on their settlements), this could have triggered a chain reaction of credit risk. In actual fact, banks who had payments to make were unable to do so because the funds they were due to receive had not arrived. In continuous gross amount settlement systems, liquidity levels are not high enough to execute all of the payment orders that back up through the system - which then begins to freeze up, affecting one agent to the next, until total paralysis sets in. In net end-of-day settlement systems, the net multilateral positions that must be settled exceed authorised credit limits and the sums that have be disbursed are much greater than the daily amounts a central bank will normally inject into the system. Banks therefore have to obtain liquidity, whatever the cost. In such conditions, the overnight interbank market rate can go through the roof. At the same time, distress sales of assets transmit the liquidity crisis to those financial markets sectors that are normally the most liquid. The situation was more brutal and sudden than it had been in 1998, and could have caused a generalised drying up of liquidity.

The central banks' response to this systemic risk was a massive last resort intervention throughout the week following the catastrophe. The Fed lent amounts of liquidity that were potentially unlimited, inasmuch as it was

impossible to determine beforehand how much was going to be needed. It worked through the discount window well as the Fed funds system, helping to shore up banks that were already supposed to be solvent. This was a non-penalty type of lending - the purpose being to ensure that final payments would always be made. All in all, the Federal Reserve injected between $36 and $81 billion dollars into the banking system each and every day between 12 and 19 September, versus an average of around $5 billion on a normal day.

Co-operation between central banks was indispensable, given the world-wide interlinkages of interbank payments. This is because of the fact that European banks, who were not receiving the sums in Dollars that they were due, lacked the currency that would allow them to make their own payments in Dollars and in Euros. The banks' need for currency convinced the ECB to make its first exceptional injection of liquidity on the morning after the attack (on 12 September). This was followed by several other injections throughout the week. In total, the ECB added 130 billion Euros to the banking system via emergency tenders. At the same time, acting via the national central banks it agreed a 30-day $50 billion swap to provide European banks with Dollars. European banks' Dollar nostro accounts were under pressure because of the interruption of their relationship with their normal American correspondents. The Bank of England and Bank Canada took the same steps as the ECB.

This was one facet of the crisis's management. Another involved monetary policy. The catastrophe of 11 September, having taken place against a backdrop of financial fragility and marked by the aforementioned weakness in a number of financial markets, could have precipitated a process analogous to the one that followed the Russian default. A market collapse could have engendered a spate of bankruptcies, or at the very least a lowering of the credit rating of those firms that had been acquiring assets during the speculative bubble. In fact, Graph 5 shows that the high yield spread rose sharply after 11 September. There was a danger that suspicion could spread to all classes of private sector debt, notably

contaminating the United States property market. If financial markets that were already heading downwards were cut off from debt financing, things would unavoidably become very difficult for the banks, and the world economy could be plunged into a deep recession.

The Fed, which had already lowered the Fed funds rate seven times between January and late August (dropping it from 6.5 % to 3.5 %), had shown that it was determined to contain stock market weakness and not allow credit quality to deteriorate throughout the economy. The decisive action took place on 17 September, the day Wall Street re-opened. Alan Greenspan announced a 0.50% cut in the Fed funds rate. Even more astute was the way in which he got the ECB to take the same decision. At 4:30 p.m., the ECB announced a money-market refinancing operation at a rate of 4.25 %. At 5:30 p.m. it cut its refinancing rate to 3.75 %. A mystery relating to the ECB's communication of a previously decided co-operation, or a surrender to American insistence? The final act of a joint last resort intervention or the first act of a monetary co-ordination intended to stave off a reversal in the global cycle?

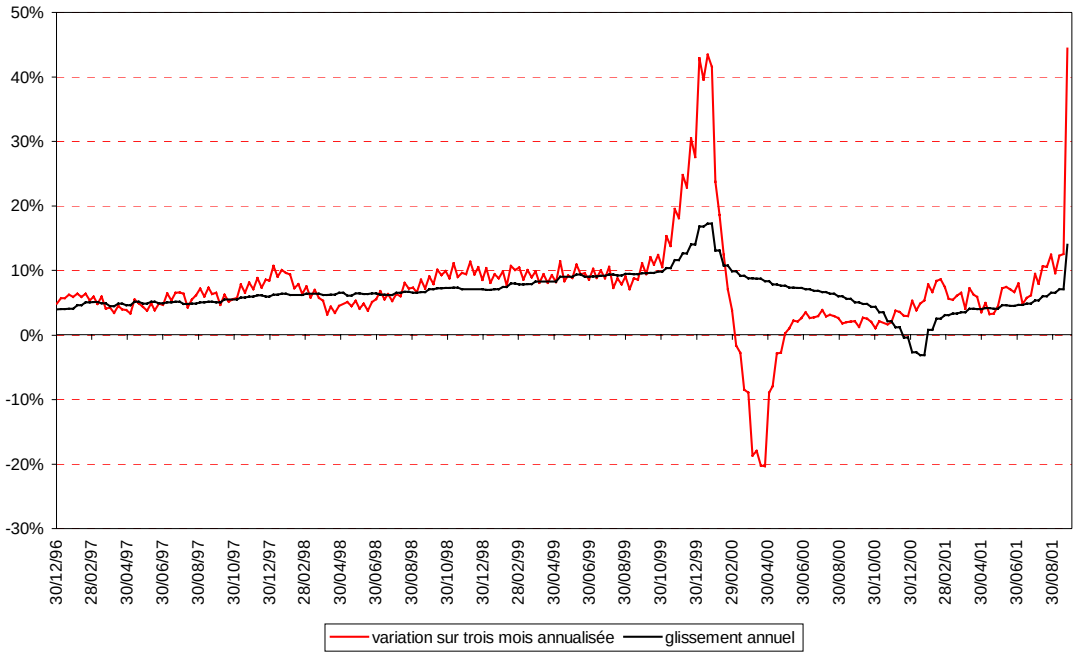
In any event, the central banks played a decisive role in holding off systemic risk. Proof of their energetic action can be read on Graph 7. Since the safeguarding of the settlements systems had been carried out immediately, the TED spread only rose 20 basis points after 11 September, instead of the 70 basis points it had risen after the LTCM incident and in the run-in to the Millennium. In fact, so much liquidity was injected that Fed funds actually dropped below their target rate for a few days.

Another sign of this can be seen on Graph 8. Although currency advances made via the settlement system are reimbursed rapidly, massive interventions are booked as variations in a central bank’s liabilities (until such time as they have been absorbed). Note the sharp rise in the money supply after 11 September. Still, and as had been the case previously during the run-in to the Millennium,

once confidence is restored the Fed is apt to withdraw any liquidity that has become surplus to requirements within a matter of weeks.

To summarise, this second section has presented the empirical benchmarks of financial fragility and systemic risk. The way in which recent financial history has unfolded supports the hypothesis that financial instability is based on an interaction between credit and asset prices. In a fragile situation, deteriorating liquidity in the financial markets and in the settlement systems is a vector of contagion that can trigger a systemic crisis. We have also been able to confirm how efficient last resort lenders can be in staving off such crises.

Graph 8 – Money Supply in the United States



Source : Datastream

To push this analysis even further, we need to understand how and why financial institutions' micro-economic behaviours can engender fragility. We also have to identify the channels by which contagion spreads. These deeper levels of analysis are essential if we are to determine not only whether it is possible to

manage crises through last resort interventions, but also whether it is possible to see such crises coming in advance.

III. THE MICROECONOMIC APPROACH TO RISK MANAGEMENT

In the first part, we saw that the acquisition of market assets on credit is the reason for the speculative slide in the price of assets, and consequently for the risk exposure of the loans associated with these assets as collateral. The use of loans as a means of taking risk positions is increased in the case of negotiated derivative markets by the conduct of financial institutions engaged in arbitrage based on anticipated relative variations in the yield between markets. The question that arises is therefore that of whether risks are systematically under-assessed, as may be evident from the collapse in asset prices.

At first sight, this question appears inept. After all, is not the surge in derivative markets proof of an improved distribution of risk, and therefore of greater robustness in the system as a whole? Have the financial intermediaries' techniques of risk control not greatly improved with the use of powerful statistical tools? Do the requirements for net worth to cover unanticipated losses not act as a guarantee against extreme movements?

Moreover, the strong capitalisation of the American banks in the present financial cycle has been mentioned as part of the argument that the banks are a line of defence to prevent deterioration in the quality of loans linked to a reduction in asset prices from degenerating into a systemic crisis. However, this argument is not as sound as it may appear. Barings Bank, to take a famous example, had a capital ratio well above the minimum of 8% a month before its bankruptcy in February 1995. What can we say at present as to the European banks? They seem to be making a respectable profit and to be strongly capitalised. However, they are heavily exposed in the telecommunications sector and, when they securitise these loans, their residual risk is opaque. Furthermore, shareholder pressure on the yield from net worth has forced the banks to eat into provisions for anticipated risks.

Finally, whether it be in the United States or in Europe, the major banks (commercial and merchant) active on the international capital markets are looking for high yield business to increase the profitability of their equity. The shifting of the weight of their assets from bilateral loans to a stable clientele towards market funding has changed the risk structure. That is why superficial comments will not be enough. If risks are being under-valued, the reason must be sought in the logic of market funding, without attempting to detect irrationality in the behaviour of the actors.

In a market that links financial weakness to the cycle, risk perception (measured by spreads) decreases during the buoyant phases and falls during a recession. The risk is therefore estimated high when losses are being made, and not when the problems that have caused the losses mature [Borio, Furfine, Lowe, 2001].

The recurrence of this phenomenon, which can be observed from one crisis to another, means that the participants in financial markets cannot distinguish between what is bearable and what is not. The hypothesis of rational anticipation is not therefore on all fours with the environment as experienced by financial operators. We know that

this hypothesis is not adapted to non-stationary environments. But it is precisely these environments that present a potential systemic risk.

The statistical methods for assessing risks based on the law of large numbers come adrift when uncertainty is endemic. One type results from strategic interaction between participants in the market. We have already seen that liquidity is a factor in these interactions if it cannot be regarded as certain. Anticipated losses on an asset portfolio can therefore be far higher than may be indicated by the standard models for assessing market risks (the *Value-at-Risk* models). A second type of endemic risk is the effect of events that do not match the operators' past experience and that influence the markets. These are new factors that fall outside the available information base. To get their bearings in this environment, operators have recourse to procedural methods which result in strategic interactions. The interdependence of credit and market risks, initiated by macro-economic disasters of some size, is of this kind. There is, in fact, no statistical method based on established theorems to allow for this interdependence. But the procedures adopted by the operators then dissociate individual rationality from collective rationality. The steps taken by each of them to protect themselves aggravate the financial situation for everyone.

As the management of credit risks and market risks cannot be combined, we shall examine the management models for these two types of risk individually and demonstrate how they can act as micro-economic supports for systemic risk. We shall then consider the methods based on the theory of extreme values that seek to exceed the natural boundaries of standard risk management.

III.1. Management of market risk and uncertainty as to liquidity

The *Value-at-Risk* (VaR) has been adopted as the pivot for market risk control amongst the financial institutions that trade in a large range of financial assets. In fact, it provides a common system of measuring the incidence of a variety of risk factors (movements in interest and exchange rates, flattening of the yield curve, variations in stock prices, property loans, raw materials and contracts derived from these assets, etc.). The VaR determines the global effect of these factors on the profits and losses of the financial establishment.

More precisely, the VaR is a measure of the probability of the ad hoc loss of a portfolio of a given composition, resulting from future variations in the risk factors. The VaR is defined as the maximum probable loss at a degree of confidence, α %. It is therefore the loss that will not be exceeded in more than (100-α)% of cases if the position of a given structure is maintained for a period [0, T].

Where V_t is the value of the position in *t*, VaR is obtained by:

$$P_r \left\{ V_o - V_T \geq VaR \right\} \leq \frac{100 - \alpha}{100}$$

Calculating the VaR therefore takes account of the systematic risk resulting from the matrix of variances and co-variances between the risk factors and the sensitivity of the portfolio components to the factors concerned. It is a measurement of the unanticipated component of the market risk as it is obtained from statistical moments of

a superior order to one in the distribution of probability associated with future variations in the risk factors.

The standard models for VaR presuppose a stochastic structure external to the risk. The distribution of multi-varied probability is taken as normal and stationary. Components of an optional type portfolio are treated separately and reintegrated into the loss on the aggregate position. But the underlying principles to the options are subject to the normal rules.

As long as the markets operate in such a way that the uncertainty can be taken as external, the temporary independence of the haphazard events is approximately satisfied. The VaR is then a powerful tool for risk control. It is an extension of the optimum diversification model for portfolios and for assessing the anticipated systematic risk component which is incorporated into the risk premiums. In fact, it provides a rational basis to determine the capital that should be put aside to absorb unexpected losses. If, therefore, the financial markets function in accordance with the hypothesis underlying the value at risk model and if the financial institutions' management systems are adapted to this method of control, there can be no systematic under-assessment of the market risk.

On the contrary, we could say that a systemic event is a configuration of markets that contradicts this hypothesis. The volatilities and correlations between yields are not stationary if market prices change abruptly. The usually weak correlation between the risk factors may become very high in volatile markets. When selling pressures spread, through fear of deterioration in liquidity, from one type of assets to another, the prices follow in a joint progress. Diversification can no longer reduce the risk. In such a stress situation, unanticipated losses may be far more substantial than predicted by the VaR [Scholes, 2000]. The prior under-assessment of the risk then results in a subsequent breakdown of the risk premiums.

Noticing too late that their losses are disproportionate in relation to the capital previously set aside, the financial establishments will seek to pick up the worthwhile pieces which they had underestimated. They will fix limits to the losses on their portfolio. In an attempt to save them, they will head for the most liquid of the assets. Furthermore, operators whose positions have been acquired with a leverage effect will be forced by their creditors to make good the fall in the value of the collateral. These calls from the wings will force them to liquidate their standby assets.

The liquid reserves must therefore grow in step with the value of the underlying positions. This immediate and general need results in an outsourcing that places such cover beyond the reach of anyone. The assets that are easiest to liquidate will be liquidated. The other assets, temporarily unsaleable, will form a residual, uncovered portfolio. Losses on this portfolio will cover the debts to be repaid. In parallel, the liquidity price will rise. Consequently, a misappreciation of market liquidity by the VaR risk management models will result in externalisation of the risk. Companies' efforts to close their positions will turn against them when the credit and market risks begin to have repercussions on each other.

The case of the hedge funds, merchant banks and major commercial banks following the Russian moratorium in August 1998 is an example of this kind. These operators actively went in for a kind of speculation known as "prior arbitrage" during and

after the Asian crisis. They sold expensive securities short and bought the securities back cheaply. They hoped for a capital gain if the yields from the securities entered into alignment. In fact, all the statistical information indicated that this happened quite often between 1992 and 1997. The loans required for this speculation to build up enormous levers were granted trusting in their past performance, the more so since the borrowers thought they were covered by the collateral [BRI, 1999]. The *current* exposure was easily covered by the collateral but the *potential future* exposure had been underestimated by the VaR models.

The shock of the Russian crisis mentioned above resulted in an enormous gap in yields, instead of the hoped for alignment. The widening of spreads impacted on the arbitrage strategies head-on. Attempts to readjust positions with a view to liquidity aggravated the rate gaps further. Other investors, observing that the drying up of liquidity was spreading to all markets, except for short-term government stocks, joined the rush to liquidity.

III.2. Credit risk management and macro-economic interdependence

The credit risk poses even more thorny problems. *Value-at-Risk* can certainly be extended to them. But the method meets up with obstacles resulting from the risk profile. In addition, the correlation between the risk factors cannot be observed directly since bank credit lumps very different categories of risk together: loans to customers, funding of market positions, credit incorporated in privately negotiated derivatives, credit within payment systems, and credit linked to exchange.

The distribution of the probability of yield from a credit is asymmetrical on the loss side and has a thick distribution tail. The lender's gain is in fact contractual. His loss comes from deterioration in the quality of the loan with a discontinuity provoked by insolvency. In addition, events that will cause the quality of loans to vary are migrations indicated by changes in listing, originally either amongst specialist agencies or amongst the banks themselves.

This question is crucial since calculating the VaR depends on transition matrixes between the classes of risk (in particular the probability of default) and the amounts of losses in each class (especially losses in the event of default). In fact, the procylic character of listings is generally evident: *the quality of credit is judged good in a period of expansion and as having deteriorated following a downturn.* The main process resulting in financial fragility through the rapid expansion of credit and an increase in stock exchange prices is not therefore picked up by the credit risk models. Under-assessment occurs during the expansion phase.

The reason for the under-assessment lies in the external factors excluded by the value-at-risk methods. When asset prices fall in a down-turn, the value of collateral falls as a whole. Losses on all defaults are therefore increased by the reduction in the value of market assets. In addition, the probabilities of individual default are increased by the simultaneous defaulting of companies in recessions. These reduce demand addressed at all undertakings, and therefore their profits. As we observed in the TMT sector in 2001, the fall in profits has been much stronger than was anticipated in debtors' listings before the downturn.

The impossibility of evaluating the probability of multiple defaults by borrowers in the externalised credit cycle rebounds on the correlations between the various components of banks' loan portfolios. The apparent diversification is reduced in a recession when correlations are increased. This is particularly the case with complex instruments comprising optional instruments whose value grows very rapidly with the cyclical turn-around: contingent credit lines, loans with premature repayment options, and counterpart risks in swaps.

The difficulties of assessing the credit risk are therefore very great. The low frequency of defaults invalidates the hypothesis of "stationarity" in the law of the probability of losses. It follows that uncertainty as to the distribution tails is very strong. The effect of underestimating losses can be very costly, since the thicker the distribution tail, the more the weak variations in the acceptable probability of default will produce major differences in the capital to be earmarked to absorb unexpected losses.

The most dangerous events are therefore those rare ones that may cause extreme losses [Herring, 1999]. Knowledge of such catastrophic events is very scant. They are in the order of Knight's radical uncertainty. It is in the light of such events occurring that financial operators have recourse to procedural logic in heuristic form. The combination of two heuristics results in a short-sighted attitude towards disaster [Guttentag and Herring, 1983]. The former is an availability heuristic of the Kahneman and Tversky type. It states that the subjective probability of a rare event gradually reduces as memories of this event fade. If it has not occurred for a long time, the probability of its occurring is regarded as virtually zero. The latter is a Simon-type threshold heuristic. A heuristic threshold exists for the subjective probability of the event where a discontinuity arises. Above this threshold, probability falls to zero. This results in blindness to disaster.

In fact, the catastrophe risk is undervalued. When the event occurs, the subjective probability is quickly reassessed. Consequently, the distribution tails for the probability of yields from credit portfolios thicken for all banks on the loss side. To preserve the same listing, the banks must enormously increase the capital to be earmarked to cover potential losses.

To illustrate the phenomenon numerically, Herring considers a distribution of probability excluding catastrophic events, the anticipated loss (covered by the risk premium and provision) is 1.25% of assets. The probability of default attaching to a BBB grading results in a VaR of 5.31% of assets. The capital to be allocated to obtain this grading is therefore 5.31 – 1.25 = 4.06% of assets, if the probability of the catastrophic event is zero. If the subjective probability of this event suddenly increases from 0 to 0.001, the capital then required to retain this BBB grading jumps to 28.75% of assets!

These orders of magnitude provide only a qualitative illustration of what may trigger a systemic crisis. However, they certainly show that ignoring catastrophic events runs down the quality of the credit without the banks being aware they are taking a greater risk. Financial systems therefore become more fragile during periods of euphoria.

III.3. Extreme values and stress tests

The inability of standard value-at-risk models to evaluate extreme losses makes it essential for them to be supplemented by other methods. A first approach, which affects only market risks, is to redefine the value at risk by recourse to the theory of extreme values. A second approach is to devise stress tests.

Let us take a period of time based on historic data on the yield from a financial asset. This period is divided into unitary intervals of time (day, week) of a given length. In each interval we see a minimum yield achieved. A series of minima is built up. These are realisations of a new haphazard variable, the extreme value inferred from the initial stochastic process.

The theorem of extreme values states that if this variable is standardised by means of two parameters (a factor of scale and a parameter of location), the extreme standardised value has an asymptotic distribution of probability (when the number of intervals of time approaches infinity), which is independent of the law of probability for the initial stochastic process. The shape of this limit distribution of probability depends only on one parameter (called the tail index) which determines the thickness of the tail [Boulier et Longin, 1999].

The importance of this theorem depends on its general application. By estimating the three parameters (scale, location, tail index) from the observed historical series of extreme values, we immediately obtain a distribution of probability which allows a VaR to be calculated without postulating anything as to the law of probability of yield from which the extreme values are measured. In relation to the occurrence of systemic events, the simulations made indicate that the under-assessment of the distribution tail of extreme values, i.e. the VaR allocated to it, is much lower than it would be for a traditional VaR [Longin, 1999]. This method would therefore allow the under-assessment of the market risk to be appreciably reduced, although it does not explicitly take strategic interdependencies into account.

When dealing with a complex portfolio, the composition of which varies in time, the procedure is more complex. The portfolio must be broken down into unitary risk factors and a multi-varied asymptotic distribution of probability must be found. In fact, the haphazard yield is a vector equal in size to the number of risk factors. A series of minimum vectoral yields is built up by the same method as above.

The theorem for extreme values shows that there is a multi-varied asymptotic distribution of probability on the standardised vector for minimal yields. This depends on the univaried distributions of each of the components and on a function of dependence between the components of the extreme yield vector. This function of dependence must therefore be postulated. But it is parametered by the coefficients of correlation between the minimal yields linked to each risk factor.

In the same way that a complex portfolio will include both long and short positions in the risk factors, multi-varied distributions must be estimated for minimum and maximum yields. However, this method is extremely unwieldy if the portfolio changes, since the multi-varied asymptotic distribution must be re-assessed on each occasion. A simplified approach would be to calculate the VaR for the univaried long and short positions for each risk factor and then assess the coefficients of the correlations between the statistics for the extreme minimum and maximum values of

these risk factors. The VaR is then determined for the position by an ad hoc formula for aggregating the VaR of the various risk factors.

This recourse to extreme values is far from being practised in internal risk control modules. But it could be so for the market risk. It will not work for credit risk. It presupposes, in fact, that to be able to determine the distribution of asymptotic probability, a sufficiently long series of extreme yields can be assembled. This requires a very substantial database of initial yields, i.e. with high frequency data. If it will not work for the credit risk, it will do so even less for the interdependencies between the market risk and the credit risk which do not respond to statistical method.

We must therefore fall back on constructing stress scenarios that throw up thorny problems. “Stress testing” can be defined as the study of the potential effects on financial conditions of introducing a specific set of changes into the risk factors resulting from exceptional but plausible events [BRI, 2000]. These tests seek to measure the losses produced by an exposure to these changes without building up statistical models for the systemic events at their source.

There are palpable limits to this method. It does not allow the probability of events from which the effects are calculated to be measured. The definition of the scenarios is arbitrary. The calculations are extremely costly. Credit and market risks cannot always be integrated.

In present banking practice, the scenarios are more often than not built up on a repetition of past crises. But we have seen that the breadth of loss depends on the contagion, i.e. the positions of others. The most meaningful test will be to presuppose that the others have the same positions as the establishment undertaking the test. If everyone tries to get out at the same time, there will be a liquidity crisis and it will therefore be impossible to do so without heavy losses. However, this test is very difficult to apply because it goes beyond the individual range of vision of the establishment over an environment that is being rocked from the outside. An individual bank cannot calculate the impact on its liquidity of the aggregated amount of the positions taken by all banks.

Here we come up against the impossibility of individual operators to take account of the external factors that lie at the heart of the systemic risk. Only the supervisors can do so by organising aggregate stress tests. But the methodology for such scenarios presupposes familiarity with the channels of contagion.

IV. THE CHANNELS OF CONTAGION

Contagion arises from the strategic interaction between the financial operators when they occur in a fragile financial situation arising within certain financial markets. We have seen that the main reason why such fragile situations occur is the self-reinforcing dynamics of credit and the price of assets, which ends in a speculative bubble. The bursting of the speculative bubble is the initial shock triggering the financial crisis. But this shock cannot be treated as external. True, there are systemic crises that come from external events. This is the case, for example, with an operational breakdown in the systems of interbank payments that underlie the capital markets for the main currencies. But historical observation supports the hypothesis that the fragility and the systemic event initiating the crisis are more often than not part of the financial cycle. It is

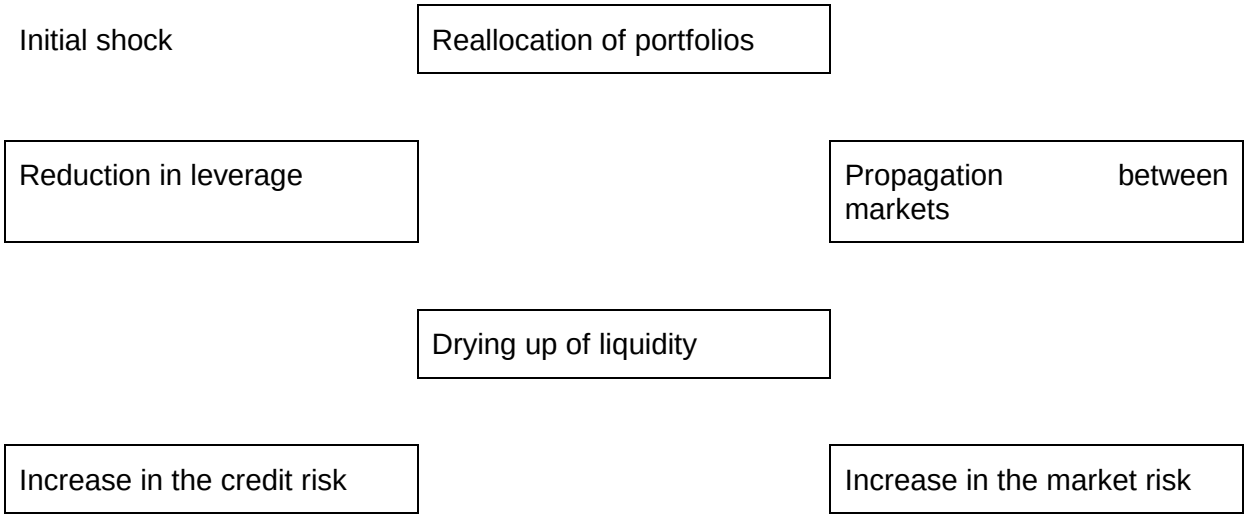
true that not every financial cycle produces fragile situations. Financial fragility arises from the credit system, the speed of its growth and the sensitivity of asset prices to increases in credit for funding the acquisition of financial and tangible assets.

Let us now suppose that there has been an initial upheaval, whatever its nature, and concentrate on the question of contagion. The micro-economic behaviour that triggers the contagion originates in methods of risk management studied in the previous section. It remains now to analyse the processes of contagion themselves. We shall first of all consider a general plan for this process. We shall then examine the role of derivative negotiated contracts.

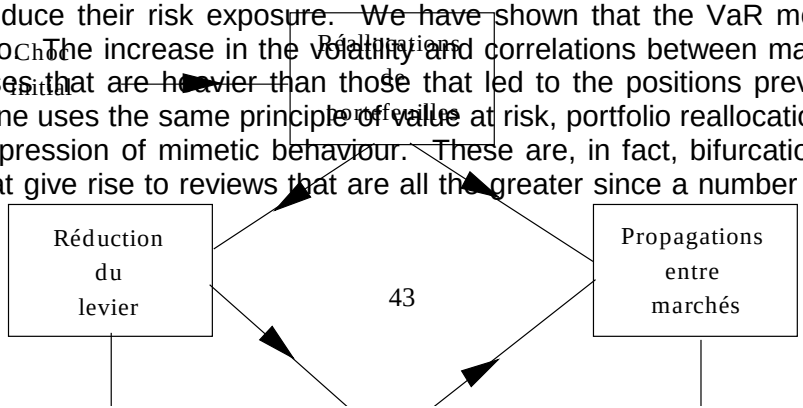
IV.1. A general plan for contagion

Let us proceed with the plan put forward by the Committee for the global financial system, which summarises its investigation of recent financial crises [BRI, 1999]. This descriptive plan will be explained by recourse to the notes on systemic risk theory explained in the first part, which links it to the financial cycle.

The initial upheaval, whatever it may be, causes an unexpected fall in the price of assets in a fragile situation. It will be remembered that in such a situation, a crisis can be avoided only by pursuing an expansion in credit at a rate at least equal to that which was anticipated during the bullish phase of the assets [Allen and Gale, 1999]. This is the credit system that Minsky called “Speculative”, i.e. viable only if the anticipated price increases take place.



When the upheaval prevents application of the strategy, the financial operators attempt to reduce their risk exposure. We have shown that the VaR models compel them to do so. The increase in the volatility and correlations between markets reveals potential losses that are heavier than those that led to the positions previously taken. Since everyone uses the same principle of value at risk, portfolio reallocations are made giving the impression of mimetic behaviour. These are, in fact, bifurcation (switching) strategies that give rise to reviews that are all the greater since a number of operatives



make them at the same time, and therefore lead to greater price falls. The more that sophisticated techniques of risk management are developed in finance, the more the principle of value at risk is spread and the greater the similarity between the strategies adopted.

Portfolio reallocation in the direction of a flight towards quality are amplified by the mechanical consequences of constraints on the balance sheets of the various categories of financial institution. Financial institutions that draw on collective savings must pay the holders of savings plans a guaranteed yield. Passive management therefore includes portfolio insurance schemes and stock-loss thresholds. These constraints trigger the sale of assets when prices fall. Similarly, calls on the margin in organised markets and failure to roll over credit lines that financed purchases on an overdraft result in distress sales. Finally, intermediaries on the derivative markets find it impossible to cover their positions on those markets and must have recourse to dynamic cover in the markets for the underlying assets. This forces them to sell short. This phenomenon is sufficiently substantial for it to be specifically considered in the following sub-section.

The result of this first wave of portfolio reallocations is selling pressure in a single direction on certain markets which form a weak link because the previous speculative bubble within them was particularly strong. These reallocations lead to a spread between markets and a reduction in leverage. The spread between markets is part of the effect of diversifying portfolios. The passive strategies of institutional investors help to reduce positions on all the more volatile markets. However, more subtly, the spread is due to attempts by speculators who have established positions to achieve gains on arbitrage by anticipating reductions in relative yields. Where these are mis-judged when these gaps are widened as a result of an increase in the volatility on share markets, they are forced to sell the mandatory securities that they can liquidate.

Generally speaking, reducing indebtedness becomes a worry which spreads when the value of collaterals falls, i.e. when the quality of the debt deteriorates. However, as we saw in the second part, the need to reduce indebtedness in a situation where it is impossible to raise new net worth means that assets must be sold. This obligation is all the more pressing if the fall in the value of assets on the balance sheet due to high leverage renders capital inadequate to cover unexpected losses. There is no other way of reconstituting capital than to sell assets. The stronger and more simultaneous the attempt to reduce leverage, the more the assets prove difficult to liquidate. The depth of the crisis is determined by the extent to which liquidity dries up in financial markets, since it can transform a process reducing the risk toward quality, i.e. increasing the defence against the risk, into panic. Panic means an indiscriminate search for liquidity resulting in the disposal of all assets with a market risk or credit risk of any kind.

Contrary to what the models that turn the crisis into an interruption caused by an entirely extraneous shock indicate, there is a gradation in financial crises. That is why the plan makes the drying up of liquidity the pivot of the process. If sufficient deep, resilient markets exist, the crisis may be a process that may be slow in absorbing the debt. But its financial fragility may be self-propagating. If the destruction of liquidity on

the markets is propagated through panic, only the lender in last resort can salvage the integrity of the financial system.

θ is a haphazard variable which describes the evolution of the yield of a financial asset under conditions of constant liquidity. Π is the proportion of participants exercising a net selling pressure as a result of the mechanism described above, which leads to an increase in action taken to avoid the risk. λ is the sensitivity of the yield to sales. This parameter is an inverse function of market liquidity. The effect of selling on yield is:

$$R = \theta - \lambda\pi$$

The effect of "normal" price volatility is added to the jump resulting from selling pressures. The stronger this pressure because of similarities in withdrawal strategies and the weaker the market liquidity (because the uncertainty discourages counterparts from being offered), the greater the distortion in the distribution of probability of yield from the asset. If the initial distribution was close to a standard log law, a value plus λ may transform it into a bimodal distribution. In that case, the selling pressure may be enough to cause the market to collapse [Morris and Shin, 1999].

When the general search for liquidity moves downward, the systemic crisis becomes self-propagating. This is shown at the bottom of the plan. The liquidity crisis aggravates all risks, both market and credit. The need to reduce debt becomes imperative. The impossibility of doing so in non-liquid markets provokes bankruptcies as a chain reaction. The latter strengthen the flight towards liquidity. The economy can develop towards a balance of depression which eliminates a greater part of the debt.

IV.2. The role of markets for negotiated derivatives

The negotiated derivative markets play an essential role in financial globalisation. Their enormous size confirms this. Negotiated derivative contracts outstanding at the end of 1998 had already reached a notional level of $80 trillion, or as much as the world total of loans, securities and equities.

These markets allow the risk factors of a complex portfolio to be separated. They are therefore indispensable risk management tools for institutional investors and speculative funds. Derivative contracts acquired by these financial institutions are issued and sold by the large international banks which act as intermediaries in the negotiated derivative markets. That is why the counterpart to the large number of users of derivative products and the distribution of risk for these operators is an extreme concentration of sellers. In 1999, the 10 largest banks conducted 90% of world transactions in negotiated derivative products.

There are two reasons for this extreme concentration. The first is the economy of scale in covering the risks of sellers of derivative contracts. The more counterparts a seller has, the greater his opportunities for offsetting the positions on his books. The second is the opaqueness of these markets, since the risk of a derivative contract lies in its potential future exposure. It is impossible for a user to obtain information on this variable which inextricably mixes the market risk and credit risk. There is not even any published price for these products, which are not negotiated on the open market. That is why users go by the reputation of the issuers. But an asymmetry of this kind in information allows the intermediaries on these markets to exploit users. They force them

to opt for structured products that users do not understand, to apply prohibitive margins to tailor-made products.

The core of the negotiated derivative markets is therefore the network of transactions between the major intermediaries. It is here that the share of the risk rejected by the end users on the purchase of their derivative products is ultimately concentrated. The risk is redistributed between the intermediaries, which gives rise to very high transaction amounts between them. However, speculative funds also participate in this counterpart role. You must therefore know how this highly typified market structure, which is effective in a calm financial environment, can accelerate contagion in times of stress [Steinherr, 2000].

An initial source of contagion lies in destabilising dynamic coverage. Let us take an intermediary on the negotiated options market (major bank or international security trader) which has issued put options purchased by investors who wished to limit their short sell risks in the light of their portfolio insurance strategies. Unless he recovers his risk, the issuer of options is faced by the threat of a potentially unlimited loss. He must therefore covers this risk. Under the conditions of a quite market, the intermediary can himself buy a put option having the same characteristics from another intermediary or from a speculator fund. However, this is not always easy in the case of tailor-made products. This is quite impossible when the price of the underlying assets falls heavily in a stress situation, i.e. when those buying put options exercise them simultaneously. The seller of a put option must therefore respond with a compensatory long position by constructing a synthetic option. This results in the sale of the asset at risk, at the low price, and to purchase non-risk securities. *The sell pressure on the options is therefore transferred to the underlying security.* The more the underlying asset falls, the greater its volatility and the more must be sold for the synthetic option to offset the increasing loss on the put, which the intermediary has sold short. This is a "delta" cover, or a "delta" "gamma" for operators who make use of a tailor second order development [Estrella, 1995]. The demand exercised by the dynamic cover is therefore a rapidly growing function of the price because the delta increases with the price for cash options. When this component of demand is strong it is sufficient to make demand total throughout the destabilising market, as a number of foreign exchange crises have shown (the role of options in the crises of the Lira and pound sterling in September 1992, the peso in December 1994, several episodes with extreme variations in the dollar-yen rate between May 1995 and October 1998). The price of the impugned asset may therefore suddenly collapse in accordance with a probability law of the Poisson type.

In fact, positions on negotiated derivatives are not transparent. It is impossible for the market operators to know the aggregate supply and demand at different price levels because the risks on derivative positions can change suddenly with fluctuations in the markets and are not divulged. That is why purchase or sell orders break down when the prices for the underlying assets cross the agreed thresholds. The impact of positions on derivatives, financed by leverage which can reach 50 or 100, was a major aspect in the September-October 1998 crisis.

A second worrying aspect of negotiated derivative markets in time of stress is liquidity. In normal times, derivatives improve the liquidity of the underlying markets. In time of stress the contrary occurs. The illiquidity of negotiated derivative markets paralyses risk circulation and therefore prevents risk management. Operators are left

with unwanted exposures to risks that they thought they could cover. The repercussions of this malfunctioning can therefore be followed right to the heart of the money market.

When the prices of the underlying assets become more volatile, the risks increase for intermediaries on the derivative markets who hold positions on a number of complex products. Even if the net positions at that instant are weak, as long as the distribution of probability over the underlying assets is normal, potential losses may increase rapidly when these distributions are distorted. Marginal deposits and collateral must then be increased. This is generally done by drawing on stand-by credit lines with the banks that are most active in the money markets at the main financial centres. These must in turn borrow marginal reserves in consideration of the increase in their lending. This causes tension in the daily rates and in future interbank interest rate contracts. Failing an immediate injection of funds by the central bank, the TED spread rises, as we saw in part 2. When no liquidity is available for the establishments whose positions in the derivative markets seem highly risky to the banks that fuel the money markets, these establishments must sell their most liquid assets in a hurry. The urgent need for liquidity creates a downward pressure on an enormous range of assets.

The tremendous effect of leverage permitted by derivative markets at low transaction costs is a third source of contagion since it facilitates speculative positions such as arbitrate of expectations. As we have seen, we have here a process that feeds speculative bubbles. That is why these operators' losses can be very heavy, even drastic. Barings, Orange County, Sumitomo Securities and LTCM are all imprinted on our memories, to mention only a few victims amongst many. The ability of senior staff to conceal losses only aggravates vulnerability. It also makes it harder for the central banks to collect information to detect the systemic risk and extends the period before any intervention.

The derivative markets are responsible for financial globalisation. They also contribute to contagion when a systemic event occurs. The problems that arise with negotiated markets are the opaqueness of the counterpart risk and the uncertainty in assessing contracts when the prices of underlying assets undergo strong and sudden fluctuation. This uncertainty initiates precipitate sales in bear markets.

CONCLUSION : BUILDING DIKES ROUND THE SYSTEMIC RISK

The developments in capital markets are radically changing financial mediation. Off-balance sheet derivatives are taking the place of the transformation of assets on the balance sheet in the allocation of risks. Negotiated derivative markets have no boundaries. Swaps and futures allow positions to be taken on assets abroad without any capital movements being recorded. While interlinking all financial assets, they act as vehicles for correlated price movements. Efficient tools in managing individual risk, they are also channels for contagion activated by systemic events. In this environment, the financial institutions are transformed. The major international intermediaries are financial conglomerates operating on global markets, with a finger in most financial functions. Europe has entered this evolution, which has accelerated with the coming of the Euro. Cautious control can therefore be adapted only with great difficulty and, what is more, possesses no unity of doctrine or unity of execution. The national separation of regulators is perpetuated and the disparity between institutional options is accentuated rather than reduced.

Questions of principle therefore arise as to what cautious regulation can achieve and questions of organisation in Europe. In this conclusion, we shall consider these questions only from the systemic risk aspect, i.e. financial stability as a whole. It will be clear that this is the more important. In fact, under normal market conditions, the means of controlling the risk produced by the markets themselves advantageously replace detailed regulations. There are three dimensions to the problem of building dikes round the systemic risk. The first is the market infrastructure. The second is the supervisory system. The third is the lender in last resort.

In the evolution of a cautious doctrine, market discipline is a catchphrase used by the regulatory authorities and an encouragement for market operators. But market discipline is illusory when it comes to separating systemic risk from existing market structures. We have demonstrated at length why value at risk was inadequate when assessing extreme events. All the more so, the counterpart risk is unknown to users of the negotiated derivative markets, as is banking risk to their depositors. Rather than a problem of information, market discipline is a question of structure. It can be created only in organised markets. The minimum of organisation is the setting up of clearing houses [Steinherr, 2000].

Clearing houses can be set up in negotiated markets without the transactions themselves being centralised in an exchange. The complete centralisation of transactions in fact implies standardised contracts, which must be homogeneous to achieve published, daily evaluated prices. This is incompatible with the tailor-made products. But clearing houses can be set up for risk management.

The decisive advantage of a clearing house is that it fixes multilateral net positions while acting as counterpart to each transaction between the intermediaries who are members of the organisation, since these transactions are verified and confirmed. It guarantees settlement of multilateral net positions, preventing the risk of a member defaulting spreading to the others. The clearing house requires cash deposits and collateral on risk positions. This security is re-assessed in relation to a risk evaluation model which is unique to all members and codified by the trade. It is therefore impossible for loss positions to accumulate, the amount of the positions being itself

appreciably reduced through multilateral clearing. That, in specific terms, is what market discipline means.

Of course, this organisation is proof to systemic risk only if the clearing house is so. It is here that the regulating authorities must intervene. Supervising system rules, members' acceptance conditions, procedures in the event of a member defaulting, and financial resources in case of stress. The clearing houses must be recognised as public property. Communication between them to detect positions effectively taken by global operators is essential, as the Barings bankruptcy illustrates in a negative way. However, clearing houses are vulnerable to the liquidity risk unless they introduce a continuous gross settlement mechanism in central bank currency.

The setting up of clearing houses in negotiated markets has been a slow process. It has been done on the initiative of the various categories of trader in derivative products. It is still limited by the straight-jacket of the national frameworks. We are so far from a global system for transactions in the underlying assets and derivatives. But, there has been an important initiative for foreign exchange transactions (the CLS Services system which is to enter into operation in London in 2002). The aim is to arrive at multilateral, multi-currency clearing with simultaneous settlement in real time on either side of an exchange transaction - "continuous-linked settlement". If it covers all the major currencies, the system will eliminate the settlement risk in the exchange markets (the Herstatt Risk).

The second aspect of building a dike round the systemic risk is supervision. A global guidance point exists in the form of the Basle Committee under the aegis of the governors of the G10 Central Banks. Under its authority it combines the study committees and the committees that work up the directives negotiated with international representatives of the main financial occupations.

Apart from the market discipline discussed above, the Basle Committee's aim is to promote value at risk and the credit listings of agencies and the banks themselves. We have shown the under-assessments of risk that result from these methods. Aware of the problem, supervisors apply an arbitrary multiplier to losses calculated by VAR models to determine capital requirements. But this guarantees nothing when faced with the contagion initiated by a systemic event. These methods take no account whatever of the strategic inter-dependence of operators.

We have seen that an initial improvement would be to supplement the standard VaR by a VaR calculated against the extreme values of a market in turmoil. However, this does not always comply with strategic interdependence and does not, therefore, permit supervisors to detect a system event as it is brewing. In the same way that market structures must be organised, stress tests must be organised. As long as these tests are undertaken in a micro-economic way, in full anarchy of techniques and hypotheses used by each bank, they will be of no use to supervisors. Tests must therefore be conducted whose macro-economic aggregation makes sense, if they are to contribute to detecting the systemic risk.

The difficulty in defining stress scenarios is to reconcile the diversity of the situations of the banks exploring them and the comparability of these valuation methods. Another difficulty is to devise a method which will take account of the interaction between the risk factors and the market operators to simulate the effect of contagion

through deterioration in market liquidity. The banks must study them regularly and notify them to the supervisors, so that the units studying the systemic risk can make use of them.

However, to estimate the liquidity risk, which is of crucial importance to the lender in last resort, from the aggregation of stress scenarios, it must be possible to model the aggregated scenarios. This aim is at present beyond reach.

Nonetheless, the collection and systemic consolidation of the leading market intermediaries is feasible if close coordination is achieved between supervisors. The problem is not the blinkered vision of the national supervisors as to the positions of the national banks that directly threaten local markets. It is the worldwide exposure of the banks which, together, threaten a market somewhere in the world from which contagion may spread. This collection should be coupled with the best stress tests that can be worked up. Supervisors could make sure that scenarios were studied where all the major intermediaries have similar positions, so that a negative impact on prices permits recovery without serious loss.

The lender in last resort (LLR) is the keystone in the dike built round the systemic risk. Since liquidity is a matter of group confidence, it is vulnerable to contagion initiated by a downturn in the price of assets or a systemic event of external origin. Amongst the world's largest financial systems, only two interventions in last resort were necessary over three years. In two of the cases they proved decisive. There can be no doubt whatever as to the need to have a LLR available.

However, the preservation or restoration of liquidity on the market presents various problems of banking liquidity under the threat of the fragility of a large sized bank (e.g. Continental Illinois in 1984) or a class of banks (e.g. the crisis amongst American “thrift” banks in 1987). In the latter case, when the central bank supports a bank in difficulties, it is the moral risk that is disputed. Action by the LLR must therefore be taken within the framework of a proper restructuring, under the aegis of a public body ensuring deposits or the public treasury. A market crisis is something different. The main handicap is the double difficulty of detecting the weak link in the interdependence of markets and in acquiring instruments for ad hoc intervention.

The former difficulty goes back to what was said above. The central bank does not have the instruments to investigate and model the contagion to determine the probability of a systemic crisis occurring and the weak link from which it may emanate. The second difficulty is one of doctrine, not of technique. The central bank does not have the resources for surgical intervention in a particular market since it is not its job to purchase securities carrying market and credit risks. It should be noted that there is at least one contrary example. During the Asian crisis, the monetary authorities in Hong Kong purchased shares to prevent the market from collapsing under the effect of the hedging funds.

The LLR therefore intervenes upstream when the contagion has become evident. It does so with the resources of monetary policy. Since the financial crisis is closely linked to the credit cycle and asset prices, the LLR acts in concert with monetary policy. Its justification lies in the need for the central bank to do something about the cycle. The fact remains, as the LTCM example shows, that a central bank with its ear to the ground

can put up a joint defence for the major intermediaries to dismantle an excessive leverage.

When we look at the ECB in the light of this analysis, we can see a number of handicaps. Firstly, supervision is not undertaken at the level of Eurozone financial markets. It remains strictly national. National supervisors do not form a cohesive system, sharing information and with permanent lines of communication. Unlike the Federal Reserve, the ECB has no means of monitoring the situation on the markets in real time. Furthermore, its monetary doctrine is impermeable to financial dynamics. It even declines responsibility for the economic cycle. That is why the action that was taken following the catastrophe on 11 September is not a precedent. The systemic upheaval occurred within the interbank payments system for which the central banks undeniably have direct responsibility. It is true that concerted action determines the contours of an international lender in last resort. But it remains limited to the stability of the currency in the strictest sense.

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