CEPII

CENTRE
D'ÉTUDES PROSPECTIVES
ET D'INFORMATIONS
INTERNATIONALES

No 1996 – 01
January

Financial Market Failures and Systemic Risk

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RESUME

Dans les dernières années une succession d'accidents financiers s'est produite . Ces épisodes ont concerné une grande variété de marchés financiers incluant des marchés dérivés. Il y a un grand pas entre des perturbations locales et des crises financières étendues. Il est néanmoins utile d'étudier des évènements récents qui ont fait apparaitre des augmentations importantes de volatilité et des problèmes de liquidité. Cette revue est conduite de manière à mettre en évidence le potentiel de propagation des perturbations qui crée un risque systémique latent.

Des conclusions générales peuvent être tirées sur les sources du risque systémique dans les marchés financiers. Trois types de perturbations ont la possibilité de se propager entre les marchés : les dynamiques de prix déstabilisantes lorsqu'elles se produisent en période de tensions macroéconomiques; l'incertitude pour évaluer le risque de crédit dans des marchés de gré à gré où règne une asymétrie d'information très forte; les manques brutaux de liquidité de liquidité dans les marchés peu profonds. Ces trois sources de perturbations sont susceptibles de provoquer des discontinuités dans les engagements financiers.

C'est ainsi que l'illiquidité de marché peut forcer les banques qui en sont les teneurs à procéder à des couvertures dynamiques qui véhiculent le besoin de liquidité non satisfait d'un marché à un autre sous l'effet d'une cascade de ventes à sens unique. De nombreuses raisons, révélées par les accidents financiers étudiés, rendent compte de la possibilité d'un courant de ventes à sens unique dans les marchés actuels où la concurrence est intense et où l'influence réciproque des opérateurs est grande.

Les marchés dérivés de gré à gré sont des sources importantes de risque pour les institutions financières qui les émettent, les teneurs de marché sont peu nombreux et concentrés. Ces marchés peuvent donc manquer de profondeur en période de forte incertitude sur les conditions macroéconomiques. Si ces conditions conduisent les utilisateurs finaux de ces marchés à des ventes massives, des problèmes de liquidité peuvent se manifester. La vulnérabilité de ces dysfonctionnements locaux au risque de propagation dépend de paramètres caractéristiques des processus stochastiques gouvernant les changements de prix et d'éléments des structures de marché que la présente étude s'efforce d'identifier.

La transformation du risque de marché en risque de sytème n'est toutefois pas sans remède. Plusieurs améliorations sont envisagées par les superviseurs : l'utilisation des modèles internes de mesure des risques pour remodeler le contrôle prudentiel, l'énoncé de recommandations contraignantes pour une divulgation plus transparente des risque de marché et de crédit, l'élaboration et la mise en oeuvre de simulations des conséquences du risque systémique, l'application de provisions en capital plus exigeantes que les risques de marché.

SUMMARY

In the last few years, a host of disturbances arose in a whole range of financial and derivative markets. I review a few episodes which exhibited huge increases of volatility and liquidity problems and which had a potential for spreading over, thus entailing systemic risk.

Common lessons can be drawn from the episodes as far as sources of systemic risk are concerned. Three main factors conducive to potential spillover effects between markets stand out : destabilising price dynamics under conditions of stress, uncertainty about credit risk assessment, vulnerability to market liquidity shortfalls.

Market illiquidity can force banks acting as market makers to rely on dynamic hedging and to effectively convey the liquidity gap from one market to another under the pressure of one-way selling. Numerous reasons account for the possibility of one-way selling in present day markets where competition is intense and price expectations are affected by complex parameters.

OTC derivatives can act as weak links in periods of large unexpected changes in the volatility of financial prices. Options which are highly sensitive to the volatility of the underlying markets exacerbate price changes under stress. Potential future credit exposure on swap portfolios is very difficult to measure and can change markedly and abruptly with changes in interest rates and exchange rates.

Because OTC derivatives are major sources of risk for market-making firms, those markets often lack depth. Fixed investment and learning costs being substantial, market makers are concentrated ; which can lead to liquidity problems under the heavy selling of end-users motivated by a shift in market sentiment. The vulnerability to spillover effects depends on parameters of stochastic price dynamics and of market structure which are highlighted in the paper.

The exposure to market risk is not without remedy. Major issues include the use of internal models of risk measurement to frame prudential regulation, the guidelines for the appropriate disclosure of market and credit risks characteristics, the development of stress testing, the requirement of more demanding standards including capital charges on market risks.

Financial Market Failures and Systemic Risk

Michel Aglietta[1]

INTRODUCTION

In the last few years episodes of disturbances in financial markets have occurred frequently. The present paper is reviewing the most spectacular ones. The purpose is not to provide a detailed account of each episode but to find out what is common in the unstable dynamics of various markets.

The episodes under review are dissimilar by the magnitude of the losses encountered and by the seriousness of the spillover effects into the financial system. But they have common characters : they are international in scope even when they occur in a particular country. They show concern for disturbing price volatility and liquidity problems : they have a potential for spreading over and entailing system risk.

After drawing lessons from recent events, the concern for systemic risk is revisited. Monetarists often argue that financial market crises are pseudo-crises because they do not have the potential to induce a global contraction of liquidity in the banking system as bank runs do [Schwartz, 1992]. On the opposite side economic historians have a broad view of financial crises [Kindleberger, 1978]. But their theoretical foundations have been criticised for being too shaky or too eclectic [Mishkin, 1991]. More recently, however, it was shown that crises bursting into financial markets may exhibit liquidity problems of the sort encountered in bank runs [Davis, 1995].

The present analysis will follow suit. It will argue that liquidity is at the gist of systemic risk. A unified theory can be held based upon liquidity problems. But the way liquidity is generated in contemporaneous unregulated financial systems makes financial markets vulnerable to the externalities that feed on the dynamics of systemic risk.

In the second part of the paper, the role of derivatives is investigated in relation with their involvement in recent events and with their contribution to liquidity-generating processes in financial markets . Liquidity problems can occur as the side effect of uncertainty in valuing credit risks in OTC markets, as the outcome of destabilising price dynamics in periods of stress, as the consequence of a too concentrated marketmaking in fragile segments of derivatives markets.

A conclusion outlines the prudential issues related to the problems highlighted in the paper and the solutions framed into the recent G10-BIS proposals.

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I. RECENT TURMOILS IN FINANCIAL MARKETS

In recent years a large range of markets were hit by unexpected price volatility triggering destabilising speculation and bringing heavy losses. The foreign exchange markets experienced the EMS and the dollar crises. The worldwide slump in the bond markets in early 1994 came as a total surprise. The futures markets precipitated the *de facto* collapse of Barings and Metallgesellschaft, two venerable and respected companies. And the appealing emerging markets were badly shaken by the Mexican crisis.

In all those episodes I will emphasize the linkages which seed the vulnerability to systemic risk. In most cases, methods for hedging risk with the use of derivatives are among the self-reinforcing linkages.

I.1. Foreign Exchange Markets : EMS and dollar crises

The EMS crisis of September 1992 exhibited speculative attacks of an unprecedented magnitude. For the first time, these attacks occurred without the dollar playing a major role. For the first time also, hedging strategies made an extensive use of currency options.

The Lira was an early example of the new mood among currency traders. In the early 90's, after the Italian government had lifted capital controls and decided to join the narrow-band ERM, international investors were attracted by a high-inflation, high-yielding country, promising future convergence. Under the rationale of the so-called convergence trade, unusually large capital inflows poured unhedged into Italian financial markets, as they did in Spain too. The open positions in Lira and Peseta reflected the confidence either that the currencies would not be devaluated before investments were maturing, or that the debt markets would be liquid enough to get off with limited losses which would not cancel out the high income yield.

However, as the aftermath of the Maastricht Treaty went wrong, international investors wanted to lock in the interest yield while getting rid of the currency risk. They bought put options with a strike price a the upper limit of the band in the EMS. Lira securities-cum-put options on the Lira made compound investments which severed currency and interest rate risks. As long as the band was credible, the options were out-of-the money, thus worthless. But after the setback of the Danish referendum, pressures began to build up on intrinsically weak currencies in the EMS. When the exchange rate regime became no longer credible, the interest rate on the Lira increased with the gap between the spot exchange rate and the central parity. The closer the spot rate to the upper limit of the band, the larger the spread between Italian and German short-run interest rates. Because the spread is equal to the forward discount on the Lira, a time came when the forward Lira-DM exchange rate exceeded the limit of the band. The put options were in-the-money and duly exercised. The banks which had written the options beforehand resorted to dynamic hedging. They rushed to sell Liras heavily on the spot market against the Liras they had to buy from their counterparts in option contracts.

The role of currency options in that particular crisis and further crises is clear. The hedging strategy delayed the crisis and made it much more sudden and violent. If currency options were not available, investors in Liras would have been obliged to hedge in futures markets. Selling pressures would have been progressive, signalling to the central bank how severe the speculation was. With the use of currency options, the dynamics in the foreign exchange market was different. Heavier sales of the attacked currency were triggered by the concentration of option strike prices close to the upper margin of the band. In Italy, when the central bank raised its interest rate to defend its currency, it launched out an irresistible outflow of capital instead of the desired inflow. The market failure precipitated the exchange crisis. Under the magnitude of the speculative attack, the foreign exchange market became illiquid. The exchange rate stumbled much more than warranted on fundamental grounds.

Basically similar dynamics occurred in the early 1995 dollar crisis, but with the help of more sophisticated option contracts. Those exotic derivatives were "knock-out" call options of the dollar. The hedge funds which bought them forced the banks that sold them to set up complicated hedging positions. The hedging strategies exacerbated the market turmoil as prices fell and those hedges had to be unwound.

What is amazing is that dollar markets themselves can become illiquid under stress generated by dynamic hedging strategies which oblige dealers to sell into falling markets and buy into rallies, greatly magnifying price volatility. In early March 1995, the worsening of liquidity conditions in the New York FOREX market was signalled by widening spreads between "bid" and "offered" prices in inter-dealer trades to three times their norms, even in the dollar-DM market, the deepest in the world.

Knock-out options are particularly vicious financial innovations. They are call options on the dollar that give the right to buy dollars at a pre-set price. But instead of always expiring worthless when they are out-of--the-money, like standard options, they get knocked out when the dollar falls below a specified trigger level. Another type of threshold is embodied in the markets. The dealers who sold these options against the yen accumulated large dollar positions to hedge the risk that the yen could break below the knock-out price of 95 to the dollar. When it happened dealers engaged in heavy trading, selling dollars massively to decumulate their positions as much as the options contracts got knocked out.

The latest dollar crisis showed on a large scale other destabilising features which exacerbated the impact of the core self-reinforcing process due to the growth of options markets associated with dynamic hedging strategies. The combustible fuelling the process is borrowing. The leverage available to currency traders through bank credit lines amounts up to one hundred times their capital or more. Leverage gives them the momentum to bring on extra-volatility in their markets. And markets become thin endogeneously because of the complexity of the hedging strategies embodied into the derivatives and because currency traders are trend-followers, launching collective moves of buying as markets rise and selling as markets fall.

Liquidity problems in normally liquid markets can occur when they are hit by recurring waves of huge selling orders in quick succession in the course of a single trading day. It occurred several times in dollar markets in the hectic days of March 1995.

I.2. The 1994 worldwide bond market slump

After the tightening of US monetary policy in February 1994, the yield on long term bonds increased two to three hundred basis points within three months. The rise was unprecedented in scope, spreading all over the industrial countries. It induced huge losses. According to the 1995 BIS Report, capital losses reached $ 1500 billions (approximately 10% of OCDE GDP), the heaviest in fifty years. Furthermore, the highly synchronised increase in yields was accompanied by a much higher volatility which was also internationally correlated. The latter phenomenon was all the more surprising than it happened in the lowest interest rate countries with long-standing inflation performance, like Germany and the Netherlands.

Several features were intriguing in this period. The overall slump in bond prices occurred while inflation was low and diminishing, economic prospects were promising robust growth. The move was synchronised between markets despite opposite monetary policies : the FED was tightening whereas European central banks were loosening, after the turmoil on European currency markets had abated. Foreign bond rates did apparently respond to the Fed's action more intensely than US rates!

It is farfetched to invoke news on fundamentals to explain such a generalised behaviour of interest rates when economic conditions and prospects in the US, Europe and Japan pointed to different stages in the business cycle. Neither future inflation nor a real common shock is of any help. One has to resort to the assumption of a market failure. A speculation on a continuous decline in long-run US interest rates had gained momentum in late 1993, as a way to correct the steep slope of the yield curve at the time. Like the currency markets, the bond market was grasped by mimetic behaviour. Huge positions were taken on the bet of lower interest rates and financed by very high leverage, by means of short term borrowing and by the use of derivatives. Institutional investors, mutual funds and banks, all relied on the same financing pattern. On the BIS opinion, the systematic recourse to very high leverage is an indication of an aggressive attitude toward risk. It is motivated by excess competition in financial markets where individual performance is judged relatively to the average of the same category of financial institutions.

Competition was also the stimulus for international arbitrage. When US bond rates declined in 1993, international investors sought profitable arbitrage in Europe, Canada and Latin America. Derivatives allowed them to hedge against currency risk. Because they are well suited to separate interest and currency risks, derivatives permit direct interest arbitrage while capping against the risk of currency volatility. It ensues that international diversification of institutional portfolios becomes more sensitive to nominal interest rate differentials [Goodhart, 1994]. It amounts to an alleviation of preferred habitats and conversely a greater substitutability between bonds denominated in different currencies. But it means that investment strategies become less selective and more prone to changes in market sentiment. In the period under review the end-result was the building of portfolios which were strongly exposed to interest rate risk. Such portfolios are very sensitive to unexpected bad news, to which they overact. Indeed leverage, which was magnifying capital gains when yields were declining, was aggravating capital losses when they upturned. Investors hurried altogether to close their positions in order to repay their short term loans or honour the margin calls they suffered with their losses on derivatives.

Special factors in the markets seemed to have fed on the destabilising momentum of the precipitous debt deflation. In the US, a study by the Federal Reserve Bank of New York has highlighted the role of the mortgage debt market. With the rise of long rates households slowed down the (anticipated) repayments on their mortgage debt. The outcome was a longer duration of these securities. To restructure their portfolios, the institutional investors which hold the bulk of the mortgage debt had to sell public bonds of equivalent duration, adding up to the overall selling pressure.

International investors who arbitrage several markets apply stop-loss orders and portfolio insurance strategies on interrelated markets. They launch together automatic sales on multiple positions to limit their losses when specific thresholds are reached. Since losses in the US triggered sales of bonds in Europe and waves of sales fed on themselves with the fall in prices, the moves were highly correlated among markets.

As mentioned before, the fall in price went along with an unexpected and abrupt rise in the volatility of bond yields with a high international correlation starting in mid-February. It happened as if traders had discounted specific information on particular markets. This peculiar behaviour may be assigned to liquidity problems encountered by critical market participants which span several markets and which are highly dependent on leverage. With the downturn of the markets, capital losses became more likely and liquidity needs more pressing. They made risk aversion change abruptly. Non-resident investors withdrawing from local markets were particularly responsive. According to the BIS, the sales of securities by non-residents were positively correlated with the variation in implicit volatility on the German bond market. It is like a massive shrinking in international financial integration. The temporary retreat on national preferred habitats, confirmed by the increase in the share of domestic public bonds, was an important factor of the increase in both historic and implicit volatilities.

The other type of highly leveraged market participants are market markers. Their liquidity problems in period of stress can occur in usually liquid markets, be they currency or interest rate markets. Because of their critical role in the smooth functioning of the market, a retrenchment of key market participants can induce disorderly conditions which increase uncertainty for all market participants.

I.3. Futures markets : the demise of Barings and Metallgesellschaft

The Barings crisis was well publicised. The news burst out in late February 1995 : Barings had lost more than $ 1 billion on massive bets in exchange-traded Nikkei futures by a 28-year-old trader in its Singapore office. This event teaches a lot about the deficiencies of control systems in long-standing, well-established Houses. There was no separation of responsibilities between trading functions on one hand, margin payments and daily settlements on the other hand, there was no detection of the excess of potential losses from derivatives exposure over the entire capital of the firm by internal control at higher level of management. Neither there was any detection by host or home country regulators.

It is important to notice that the systemic implications occurred not with OTC derivatives but with exchange-traded futures which are generally considered as safe markets thanks to their legal procedures, daily clearing and margin calls. In some respect it is true. When Baring's inability to pay its margin requirements was revealed on February 24, quick action was taken according to the rules of the Exchanges. Barings' customer trading

accounts were separated from its proprietary accounts, the former being transferred to another clearing firm, without customers incurring losses. Singapore Monetary Authorities announced that they were standing behind the clearing house. However there was a lack of international co-ordination.

The Bank of England, supervisor of the failing bank was muddling through to work out a market solution, essentially concerned with London's reputation. Her top officers' attitude contrasted markedly with Mary Shapiro's decisive action. The chairman of the Commodity Futures Trading Commission (CFTC), who had already the experience of the unwinding of the Drexel case, knew enough about the chain reaction potential of a massive failure, endangering the Singapore International Monetary Exchange (SIMEX) itself.

When the investment bank failed on February 27, Singaporean regulators froze futures trades through Barings and doubled the amount of margins or collateral required to hold the dealers' positions. That self-protecting move threatened to be counterproductive, because it raised fears among global dealers about SIMEX'S fragility. They suspected that the required higher collateral might be used to bail out the Exchange's own losses instead of backing up their own positions. Therefore several US dealers were reluctant to pay the margins. But refusal to pay the extra margin would have caused dealers to forfeit their futures positions. SIMEX would have probably collapsed with the most dire consequences on the Japanese Stock Market when the banking problems were already worsening. Moreover the Exchange's collapse would have drawn some member firms along and spread a confidence crisis in all futures markets worldwide.

Aware of the potential consequences, the CFTC's chairman called urgently Singapore's top regulators to issue a joint statement assuring that the additional margins would not be used to cover Barings' losses. Ms Shapiro did also persuade Japanese authorities not to freeze permanently client money as a result of Barings' failure. So quieted, dealers paid up their margin calls and increased their collateral.

This episode shows how systemic risk can stem from the linkages between futures markets. The answer to this threat is a big improvement in the cooperation among Exchanges. The need is hampered by the competition for market share between them. However sharing data for the knowledge of large market positions taken on by dealers with multiple positions on various Exchanges is crucial. This knowledge could permit market regulators to cooperate in supervising individual dealers worldwide.

By contrast, The Metallgesellschaft case was self-contained. But it teaches another disturbing lesson. The German system of corporate governance, so efficient within the regulated and intermediated German financial system, failed to monitoring the market strategy of a US subsidiary using futures markets.

Metallgesellschaft A.G. (MG) is the fourteenth largest industrial German firm. In late 1993 and early 1994 its US subsidiary (MG Corporation) reported staggering losses on its positions in energy futures and swaps, ultimately exceeding $ 1.3. billion. Only a massive $1.9 billion rescue operation by 150 German and international banks kept MG from going into bankruptcy.

During 1993, MG's US oil trading subsidiary, MG Refining and Marketing (MGRM) established very large derivatives positions in energy futures and swaps, from which it would profit handsomely if energy prices were to rise. But energy prices fell sharply during the latter part of 1993, causing MGRM to incur unrealised losses and margin calls on these derivatives positions in excess of $ 900 millions.

MGRM's derivatives activities were part of a complex hedging strategy. Its derivatives position was used to hedge price exposure on forward-supply contracts that committed it to supplying approximately 160 million barrels of gasoline and heating oil to end-users over the next ten years at fixed prices.

MGRM hedged this price risk with energy futures and OTC swaps. However there is nothing like a perfect hedge. Hedging mainly shifts the risk parameters and, if well-conceived, diminishes its magnitude. MGRM's hedging strategy was set up to protect the profit margins in its forward delivery contracts by insulating them from increases in energy prices. MGRM hedged its forward-supply commitments of 160 million barrels with short-dated futures and swaps, barrel for barrel (a hedge ratio of one). It had to choose short-maturity contracts because the longer ones were not liquid enough to match its commitments of such a high magnitude. But it had to roll forward continuously its derivatives positions to maintain its hedge.

The in-built risk of this strategy resided in the roll over. It was profitable when the forward markets were in backwardation and loss-making when they were in contango. Thus MGRM's belief that its rollovers would be profitable amounted to a bet of a higher frequency of backwardation than of contango. According to F.R. Edwards, the short-dated hedging strategy exposed MGRM to a rollover risk o the order of 15 percent of its price risk [Edwards and Canter, 1995].

MGRM's misfortune when nearly prices fell sharply in late 1993 highlights two features that make derivatives risky even for hedging : the myopic view of market participants and the illiquidity of the longer-dated segments in the markets.

In predicting future rollover returns, the firm used historical data ten years back and made two critical assumptions : first history would repeat itself, meaning that the structure of energy futures markets would not change significantly in the future ; second a history of only ten years is long enough to uncover the long-run price relationships necessary to infer long-run equilibrium rollover returns. Both assumptions are simply not warranted. Large prediction errors result from too short time series : first from the shift in structural price relationships when fundamental economic conditions change irreversibly ; second from high variances in the distribution of rollover returns relative to mean rollover returns.

A less risky hedging strategy was not available at a reasonable cost. In principle, MGRM could have used strips of long-dated futures exactly matching the dates of its forward delivery contracts. Had MGRM contracted with OTC dealers, the latter would have had to use a similar rollover strategy to hedge their own long-term exposure to MGRM. They would have charged MGRM with a high risk premium to cover the likelihood of an adverse price change and the possibility of MGRM's default which is quite high over a ten-year period. Further more those illiquid contracts must be terminated by

direct negotiation with the dealers, a serious drawback for MGRM exposed to the early cash-out options embedded in its forward delivery contracts.

I.4. Emerging markets : the Mexican crisis

In the early 1990's, developing countries began taking bold actions of financial liberalisation. In undertaking this process, Mexico had become a highly-praised model for other so-called emerging market economies, particularly in Latin America. The response of the financial community was enthusiastic. Because of the financially-engineered recession in the industrial countries, yield were declining there. As already mentioned before, institutional and other investors were lured by the mood of governments in favour of opening their financial systems to international capital. Therefore the structure of financing was dramatically altered both on the debtor and on the creditor sides in many developing countries.

The inherited public debts were securitized by Brady bonds, which are dollar-denominated securities backed by US Treasury bonds. These instruments were welcome by hedge funds and investment banks, because they are traded in relatively thin markets where it is easy to create volatility. One strategy applied to Mexican and Venezuelan bonds was to make a collar by buying both call and put options on the same underlying bonds at predetermined strike prices. Then the hedge funds began buying the underlying asset to increase the volatility of the bonds, which in turn increased the volatility of the call options.

The banks who had sold the options would hurry buying the bonds themselves to cover their short positions. Once again the hedging strategies were magnifying price increases, attracting more conservative investors who were lured by the rising tendency of the markets. A diversification in local currency debt occurred also, thanks to the policies of pegging the local currencies which allowed the same type of gambling as the convergence trade in Europe. Governments were able to issue short-term debt, as did the Mexican government with Tesobonos, which are dollar-linked securities. The local private sector, banks and non-banks alike, was able to rest on the renewed confidence in the liberal economic policies pursued by their government in order to issue large amounts of debt owed to non-resident investors.

The fundamental reasons for the Mexican crisis are well-known and do not need to be restated in the present paper [Pisani and Sgard, 1995]. I am interested in the immediate cause of the crisis which was an acute liquidity shortage in early 1995 and, in the perspective of the present study, I am concerned with the systemic implications.

In late 1994 it appeared that the Mexican authorities would face an unmanageable liquidity problem in the first half of 1995. The amount of maturing debt owed to non-residents reached the dazzling figure of $ 60 billion, due to the careless short-term borrowing in 1994. Nonetheless the myopic view of the markets confirmed countless prior experiences. The risk premium on Tesobonos over US Treasury bills was 2 percent on the wake of the peso dizzying decline in December 1994! It jumped after the crash to reach 20 percent in February 1995 [Sachs, Tornell and Velaseo, 1995]. The same was true for premia on Brady bonds and the forward exchange rate discount which did not anticipate the crisis.

On the amount of debt held by foreigners and coming due, more than a third were Tesobonos, nearly a third were interbank lines of credit to Mexican commercial banks and a fifth was owed by the private non-bank sector. Only $ 8.5 billion constituted the external obligations of the Mexican foreign debt. On the creditor side, the overwhelming part (more than 90 percent) was held by non-official investors. Moreover a projected deficit on current account of $ 7 billion in the first half of the year should be added up to the $ 60 billion debt maturing. Against this pending obligation, the available liquid funds were utterly inadequate. Prospects for raising new money on international capital markets or rolling over part of the existing maturing debt had dried up. This is the permanent feature of a financial crisis. Seemingly limitless market liquidity sources just weeks before simply disappear when the strangled debtor needs them the most. When all official sources had been collected, the financing gap facing Mexico was about $ 55 billion in the first half of 1995, meaning a financial crisis of a huge magnitude. There was no question that systemic implications would be dramatic and that the stability of the international financial system was a stake.

To reveal the systemic linkages, a method is to guess what could have happened if the international monetary authorities had let it burn out, i.e if they had sat and looked at the so-called "market solution". The financing gap would have been closed without any new private money inflow and no rollover of existing claims. The economic slump would have been much worse than even the contractionary adjustment really experienced by Mexico in the first half of 1995. Because of the huge demand for dollars, the foreign exchange value of the peso would have collapsed without anyone knowing which value would be a floor under the dollar price of the peso. The peso value of the private sector debt would have reached extravagant amounts ; chains of bank and non-bank bankruptcies would have devastated the domestic economy because those agents were unable to finance their external debt repayments.

In the midst of the macroeconomics upheaval, the Mexican government would have had no other choice than making allowance for the market failure. It would have repaid Tesobonos in pesos and unilaterally suspended the repayment on part of Mexico's debt. It would have been forced to freeze repayments of the debt owed by banks, effectively imposing stringent capital controls.

The most dire consequences would have ensued. In Mexico the stock market would have collapsed and interest rates skyrocketed. The financing of the economy either domestic or foreign would have receded to a low ebb. With the freeze of foreign deposits into Mexican commercial banks, trade credit would have dried up. The market solution would have possibly resulted in its opposite : an end to the liberal economic policies. Considering the model role played by Mexico in the propaganda for liberal reforms in developing countries, some other emerging market economies would have surely reviewed their strategies. Indeed significant contagion effects would have been likely, at least in Latin America. More generally a global retrenchment of capital flows from emerging markets would have tightened balance of payment constraints and stifled world growth.

II. DERIVATIVES AND FINANCIAL FRAGILITY

Behind the diversity of the reviewed episodes of financial turmoil, one can detect recurrent attributes of financial fragility. Those attributes are latent in the present structure of international markets and are activated in time of stress and deterioration of market sentiment. Because the financial disturbances occurring in fragile structures have the potential to spread over markets, the dynamic linkages involved in the propagation of market risks are sources of systemic risk. Derivatives pertained to the relevant externalities in all the aforementioned crises.

In conformity with the findings, I will first draw lessons from the empirical cases to describe the sources of systemic risk stemming from financial markets. Then I will investigate some characteristics of present day derivatives markets that are conducive to externalities which can foster systemic risk : destabilising price dynamics in period of stress, uncertainty about credit risk assessment, vulnerability to liquidity risks due to the concentration of market making in OTC derivatives.

II.1. Lessons from the episodes : the sources of systemic risk in financial markets.

In the theories of systemic risk, liquidity problems are rightly singled out as the most prominent factor which is capable of propagating local financial disturbances [Davis, 1992]. For economic agents a shortfall of liquidity alters decisively the budget constraint. It entails forced sale of assets and makes it more difficult to roll over liabilities [Minsky, 1982]. It induces profitable transactions to be deferred and denies expected cash flows to others, giving rise to cumulative income contractions. In a debt market, liquidity stringency can engineer a market failure in the following sense : market participants become quite uncertain of the price level which will balance demand and supply. Being unable to anticipate a bottom under the price slump caused by the selling pressure, potential buyers of the depreciating asset which could supply the needed liquidity stay put. Therefore volatility can increase tremendously, losses get huge and participants rush to recoup their losses, thus transmitting the selling pressure to other markets.

In a narrow view of financial crises, it is asserted that there is a need for concern only if banks are affected As the bulk of liquidity comes from bank deposits, only disturbances which can launch out sequential runs on deposits throughout the banking system can also significantly affect aggregate liquidity. This viewpoint appears to seriously underrate the way liquidity is generated in present-day wholesale debt markets.

Securities markets are increasingly relied on as repositories for liquidity. Liquid securities are substitutes for lower-yielding cash or demand deposits and a complement to matching of liabilities by assets over the longer term. If banks are actively engaged in the securities business, they can undergo a liquidity crisis directly because they rely on the relevant market for funding or because they are unable to meet their commitments to provide backup facilities to other market makers. This direct linkage is adding up to the indirect one referred to by monetarists, whereby suspected losses of banks from underwriting or market making lead to doubts on the part of depositors regarding their solvency. Moreover, if derivatives are involved in the process of financing asset holdings in the underlying securities markets, their own market liquidity may supplement the more traditional interbank market liquidity as the central feature of money markets.

Be that as it may, the dealers' role of banks in OTC derivatives has hugely increased since the late 1980's. OTC derivatives are conceived to be bridges between segments of securities markets that were not perfectly arbitraged beforehand. As ways of getting liquidity, they wipe out the specificity of the interbank market. As instruments for hedging risk, they erase the separation between national and international markets.

With the multiplication of bank failures in different countries, with the rise of non-performing assets and the inadequate amounts of provisions for losses, the creditworthiness of international banks deteriorated markedly from 1990 onwards. Counterparty risks becoming more acute, banks reduced their participation to the interbank market. BIS statistics reflected the overall contraction of deposits in the international interbank market. A growing share of bank liquidity needs was covered by negotiable instruments provided by institutional investors. The latter were lured into the short-term debt market by the lack of profitable assets due to the recession. As it happened with earlier financial innovation, a change in the pattern of financing, which was the market response to peculiar circumstances, has become a permanent feature of financial practices afterward because it is less costly than financing with interbank deposits in a period of declining interest rates.

When an institutional investor is bringing forward liquidity by buying short-term debt instruments, it has to hedge against the interest rate risk (and the currency risk for international investors). OTC derivatives are particularly suitable to provide tailor-made instruments. A small cluster of large international banks stepped into the fast-developing OTC derivatives to catch the opportunity of dealers' profits in writing the customer products.

Therefore the wholesale market for liquidity has undergone a profound overhaul. In order to investigate if it is more or less prone to systemic risk than the traditional interbank market, one should know the answer to the crucial question : who are the ultimate writers of derivatives (i.e options and swaps)? If, in a low interest environment, dealers can hedge in their own markets, buying contracts sold by the investing community itself, then market risk is effectively diversified. No dynamic externality leading to systemic risk can occur. However, it is extremely unlikely that such an optimal pattern of risk diversifying can hold in volatile environments or in uncertain macroeconomic situations, when the sentiment of investors is changing abruptly and collectively in response to shocks. The episodes examined earlier in the first part of this paper give credence to this assertion. Systemic risk can take root in such circumstances.

In so far as sources of systemic risk stemming from dynamic linkages between markets for liquidity are concerned, the following lessons can be drawn from the episodes.

i. Market illiquidity can force banks acting as market makers to rely on dynamic hedging and to effectively convey the liquidity gap onto the underlying markets

Market makers are supposed to satisfy end-users (buyers and sellers of securities and derivatives) and to maintain an orderly market : i.e to limit uncertainty caused by price fluctuations, so that a market's overreaction can be countered by fundamentals-based traders acting on the basis of underlying economic considerations. In their capacity they are exposed to losses incurred if they keep standing against one-way selling. Because losses

might be too large with respect to capital or because credit might be too expensive or too risky to finance the accumulation of depreciating assets, market makers can give up sustaining market prices at any predetermined level [Bingham, 1992]. The market failure entails liquidity to dry up in the particular market and uncertainty to raise substantially the volatility of prices. Therefore dealers and a number of other market participants have to resort to dynamic hedging to hedge their positions. As observed in the episodes, markets for options are vulnerable to this self-reinforcing mechanism. If there is a concentration of option contracts at the same perceived critical price, dynamic hedging will exacerbate price movements on the underlying asset market (and feed back on the option price through the rise in volatility) and disturb cash market liquidity [Brockmeijer Report, 1995].

As seen in the bond market slump, margin and collateral calls on derivatives are higher in times of heightened volatility. To fulfil their commitments, market participants feel a pressure to liquidate their underlying assets, thus aggravating the price decline. As for the potential to create systemic risk from speculative behaviour by individual market participants, the Barings crisis is a good example. Absent decisive actions by regulators, uncertainty could have induced dealers to forfeit their positions causing SIMEX to collapse ; which would have provoked a slump in the Japanese Stock Exchange, thus worsening insolvency problems of Japanese banks.

ii. Numerous reasons account for the possibility of one-way selling in present-day markets where competition is intense and price expectations are affected by complex parameters

As mentioned above, institutional investors play a major role in the wholesale debt markets and associated derivatives markets. They are in competition for market shares and they are sensitive to short-term profits. It entails the same response to common signals, the same portfolio insurance strategies and the direct influence of each other's behaviour. Under those conditions it can be shown that the market demand for risky assets can be unstable and the resulting market price highly volatile [Artus, 1995]. The Metallgesellschaft case and the Venezuelan Brady Bonds are good examples of elusive expectations based on too short data series.

Leverage exacerbates the price instability induced by the lack of individual diversity in the market structure, constraining investment strategies to being less selective. By facilitating market arbitrage, leverage and the related use of derivatives spread the extra-volatility from one market to another.

Asymmetric information is another type of market imperfection giving rise to insiders' deliberate creation of volatility and to the occasional impediment of market making in thin markets. When dealers face a group of market participants more informed than them on the parameters that move the market price, they need to charge a higher spread or restrict transactions to offset losses made on dealing with insiders [Leland, 1992]. This externality can lead to a market failure when spreads are widened and suppliers of liquidity discouraged with the tightening grasp of insider traders. If there are sizeable fixed costs in market making, the amount of liquidity is inversely responsive to the cost of transactions. A vicious circle can thus occur when insider trading widens the bid-ask spread, which in turn reduces the volume of trade and induces liquidity suppliers to withdraw.

II.2. Destabilizing price dynamics in period of stress: the role of options

Several episodes in the foreign exchange markets highlighted the role of options and option-like instruments in disturbing the dynamics of the underlying prices at times of large changes in those asset prices. The diverging dynamics rest upon positive feed-backs when investors trade on the perceived expectations of other investors. Such effects are in-built in the dynamic hedging activities of the writers of options. It is not to say that derivatives play a leading role in sharp market price movements. But they play a larger role in the subsequent asset price changes (Hanoun Report, November 1994).

With dynamic hedging of options exposure, heavier trading occurs in the underlying assets under a period of stress. Sharp price movements entail a change in the delta of options which gives rise in turn to heavier purchases (sales) when prices rise (fall).

But there is more to say. The risk taken by option writers can be unintentionally very serious considering their management practices. This might be a transitory period, however, because the state of risk management is improving rapidly. Nonetheless, the way the non-linearities of options values are dealt with in the overwhelming majority of risk management systems is liable to very large errors for broad fluctuations in underlying asset prices.

J.P. Morgan's Risk Metrics offers the most standardized methodology for valuing market risk in whole portfolios embodying options or not. The methodology is based upon the concept of *value-at-risk.*

This concept is appealing because it measures different risks in terms of a common metric: *an amount of losses relative to a standard unit of likelihood.* It is why value-at-risk can aggregate risk across instruments, trading units and markets. More precisely, value-at-risk is an estimate of the potential changes in the value of a portfolio, based on a statistical confidence interval of changes in market prices, that are likely to occur some proportion of the time [Fisher Report, 1994]. Therefore value-at-risk incorporates two important elements of risk: the sensitivity of a portfolio to changes in underlying prices; the volatility of these underlying prices But value-at-risk is not a risk limit. It is a measure of the likely expected declines in portfolio value that will be exceeded some proportion of the time.

Operational for daily management, the concept has some drawbacks for prudential purposes. It is based on historical data of the relevant asset prices. They do not take account of extreme market conditions (i.e. abrupt changes in price of a large magnitude) especially if the observation period is short, as the Metallgesellschaft case taught us. The methodology assumes unlimited market liquidity, which is inappropriate under stress because liquidity problems are a major cause of brisk unanticipated departure of price volatility from an historical pattern. The concept relies on the tail of the probability distribution of the stochastic variations in prices, under the assumption of normality of the distribution If the assumption of normality is not warranted, large errors can be made if the actual distribution has fat tails. Finally, and it is the point with options, price variations under stress conditions can be on the order of several times the standard deviation. If the sensitivity of the instrument is assumed to be a linear function of the change of the underlying market price, the linear approximation to compute conveniently the value-at-risk of the instrument can lead to huge errors in the likely loss under a given confidence interval when the actual function is non-linear.

In dealing with option, the usual practice to compute changes in value is to use a Taylor series development of the second order (delta an gamma approximation) on the option pricing formula, around the current market price of the underlying asset. In neglecting higher order terms and the influence of the other variables (passage of time, changes in interest rate and in implied volatility), the variance of the option value can be made a function of only delta, gamma and the variance of the underlying price [J.P. Morgan's Risk Metrics, 1995].

Serious inaccuracies may result from this practice when prices change widely from the current market price [Estrella, 1995]. Even higher order Taylor series do not warrant a better approximation, because the Taylor series may not converge for large fluctuations in the underlying asset price. The alternative is very cumbersome and needs sophisticated systems and a good deal of expertise. It requires using the exact option pricing formula to compute variations in option value under a large set of movements in the underlying asset price. This is the simulation approach. If the option pricing formula is reliable, the risk can be more accurately measured on conditions that a large number of scenarios can be generated. Because options are incorporated into aggregate portfolios, pricing models should revalue each instrument under all possible scenarios.

II.3. Uncertainty about credit risk: the swap market.

Counterparty risk is a source of cash flow problems with long-term tailor-made swaps, because banks are very active in this fast-developing segment of derivatives. Systemic risk can occur when a default by one intermediary is imposing liquidity constraints on counterparties not able in turn to meet their payment obligations. A defaulting swap dealer is led to early termination of his swaps. If market making for longer maturities of OTC swaps is concentrated, the amount owed by the defaulting party can be a significant source of funds for end-users who could have difficulties to fund the unexpected shortfall of cash by borrowing. Therefore the interdealer market is the crucial segment. To hedge their positions in the swap market itself, dealers must own each other's portfolio though transactions in the interdealer market. Concentration in this market makes it more difficult to achieve full hedging with two possible consequences. First, as far as dealers are banks, they offset the unhedged leg of their net swap position in the interbank market. Second, the failure of one dealer entails the search for liquid funds by its counterparties, which ends up in borrowing from banks. Therefore, even if the liquidity-generating process has become more roundabout with the proliferation of negotiable debt-cum-derivatives instruments, it is still based upon the interbank market. The latter is exposed to sudden unexpected demand for liquid funds to close positions or satisfy margin calls triggered by shocks in derivatives or other financial markets. The interbank market is the lender-of-before-last-resort. There is no evidence, to say the least, that the securitization of liquid debt has relieved the interbank market from its central role. This linkage shall be kept in mind while analyzing the sources of risk in the swap market, which is the main type of derivatives for funding.

Credit risks are of critical importance in the swap market and are very difficult to measure. A counterparty A suffers a credit loss on a swap if his counterparty B defaults and if the swaps has a positive value for A at the time of default. The magnitude of the loss is the difference between this positive value and the amount that can be recovered from the defaulting counterparty. It depends on two stochastic processes: the probability of counterparty default on one hand, the potential credit exposure on the swap portfolio between A and B on the other. The latter is highly volatile (especially with currency swaps)

because it depends on the change in the values of the marked-to-market instruments which structure the swaps. The most insuperable difficulty to reach a correct estimate of credit losses is the fact that the correlation between the stochastic processes governing default probabilities and financial market variables is unknown. *Ignoring the joint stochastic behavior of defaults and credit exposure can lead to greatly underestimate credit risk* [Duffee, 1994]. However there is no way to integrating market and credit risk under existing valuation models and information systems. Nevertheless we know by historical experience of business cycles and financial crises that this correlation exists. Indeed, *this correlation is the gist of systemic risk*. It is not significant in normal conditions but it rises dramatically when the financial system becomes fragile in a period of heightened volatility of asset prices and high leverage. A sharp decline in asset prices tends to concur with an increase in the probability of default of non-financial and financial firms.

There are fundamental reasons for systemic risk not to be detected by sophisticated statistical analysis. To estimate potential credit exposure on a swap contract, it is necessary to approximate the probability of future changes in credit exposure (the stochastic variable) over a relevant time interval. The estimate of the probability distribution is drawn from a simulation (calibrated with historical data) of a large number of randomly-generated time paths for the underlying financial variables. The resulting numerical distribution of future credit exposure is used to calculate the expected potential credit exposure or the "maximum" potential credit exposure associated with a confidence interval.

This structured Monte Carlo approach presupposes that future data are generated by the same process that generated historical data. Therefore the only source of uncertainty appears implicitly to be the future underlying prices, not the model generating the paths. It is tantamount to say that the stochastic process which moves financial prices is stationary through time. That reference does not hold under the conditions of stress which pertain to a regime change. In regime changes, stochastic processes are decisively altered. When a financial crisis occur, volatility cannot be inferred from the time series included in the dataset. It increases widely with the sharp decline in the level of prices. A regime change can only be detected by experience. Recognizing such extreme market conditions permits to draw information not included in standard simulations, but which is the raw material of stress tests. However there is no reliable technique to discriminate between a regime change and a sequence of events in the tail of the historical distribution using only a small number of observations [Kupiec, 1995]. A large number of observations are necessary to separate acceptance or rejection of a regime change. But the financial crisis will be well under way and losses severe indeed! It is why experience cannot be replaced by statistical analysis. But for experience to be helpful, it needs a strong involvement of higher management and a control system which imposes severe limits to trading desks. Recent episodes show that financial institutions are very far from being aware of the pitfalls embodied in their most sophisticated methods.

Acknowledging that valuation models of potential credit exposure and credit losses are flawed under extreme conditions does not preclude from accepting their conclusions about the parameters of credit risk on a swap portfolio under more normal conditions.

The current credit exposure of a single contract for a counterparty is equal to zero if the value of the contract is negative (out-of-the-money contract) or to the value contract if

it is positive (in-the-money contract). The credit exposure of the portfolio is the sum of the values of all the in-the-money contracts. Potential future credit exposure on a given time interval is a multiple (depending on the confidence interval) of the standard deviation of the change in credit exposure of the portfolio. The analytic determination of this variable is possible under the assumption that all individual swaps contracts have the same standard deviation of their change in value over the time interval and that their values do not change sign in the interval. Under these assumptions, the standard deviation of the change in credit exposure of the portfolio is an increasing function of three variables: the standard deviation of the change in value of the individual contract; the number of in-the-money contracts in the portfolio; the average correlation of changes across all in-the-money contracts [Hendricks, 1993]. The interpretation of the first two variables is self-evident. The third one is the extent to which changes in the value of the in-the-money contracts move together. It will rise whenever interest rates move in the same direction. Since the average correlation is extremely volatile with interest rate changes (and exchange rate changes for currency swaps), potential credit exposure can change rapidly as well. It is why hedging in the swap market itself is difficult. It is especially the case for dealers who have positively correlated contracts with multiple counterparties. Even if the average correlation is weakly positive, the dealer's potential exposure increases with the number of contracts.

II.4. Concentration of market making in OTC derivatives.

Potential future credit exposure in swap markets and option risks are very sensitive to changes in volatility of underlying asset prices. They are major sources of risk for market making firms. When unable to hedge in their own market or when trapped by insufficient liquidity, those firms transmit the imbalances to other markets and to third parties, thus effectively being vectors of systemic risk. The reactions of critical market makers fostering positive feedbacks can occur as responses to changes in market sentiment due to shocks entailing uncertainty in credit risk assessment and (or) extreme market price fluctuations. An hedging overhang in OTC markets can spread over derivatives Exchanges or the interbank market for liquidity needs. Serving as hedging or lending of before-last-resort facilities, these markets can be strained under one-way conditions in the original OTC derivatives.

The likelihood of one-way conditions depend in turn on the breadth and depth of market making in the original markets. Many reasons explain why both characters which make for the dissemination of risk are not always present in OTC markets. Risk management is complex and loaded with fixed costs. They are not only investment costs of developing and maintaining large information and data processing systems. Even more important are learning costs to cope with ever-changing instruments which preclude the traditional routines of risk assessment. It requires building powerful statistical models for marking-to-market widely diversified portfolios and for estimating risk profiles of large vectors of correlated instruments.

The cost structure is conducive to increasing returns to scale. It is why dealers are a small number of large banks which straddle a range of interrelated OTC derivatives. Option writers face financial institutions who are likely to behave homogeneously under a common price shock, for instance in the currency markets. Swaps dealers are likely to be counterparties of end-users who want to hedge interest rate risk. As we have seen above, potential credit exposure depends on the mixture of pay-fixed and pay-floating swaps dealers have in portfolios as a result of meeting their customers' demands. Swaps of like type tend to be highly positively correlated; swap of opposite type tend to be highly negatively correlated. In situations when end-users fear the same move of interest rates, those who rush for cover are likely to hedged against the same direction of interest rate change. In that case dealers will have a positively correlated portfolio of swaps with end-users. If they are concentrated, it is not clear that they can all hedge their positions by contracting negatively correlated swaps with one another. It is why large potential credit exposure can be transmitted to other markets.

The vulnerability to spillover effects increases with the swap duration (the probability of counterparty default gets higher), the volatility of underlying prices and the sensitivity of the instrument to the magnitude of future price changes (potential credit risk exposure gets higher), the number of counterparties for each dealer (correlation between like type swaps gets higher) the vulnerability decreases with the amount of capital provision per dealer and with the number of co-dealers in the market.

CONCLUSION

The picture presented hereabove looks gloomy. But it is not the attribute of intrinsic flaws in derivatives markets, nor is it without remedy. The destabilizing processes, acknowledged in reviewing recent episodes of financial turmoil in the first part of the paper and analyzed further in the second part, occur under abnormal circumstances. More than once the extent of disorderly conditions is contained in narrow segments of financial systems. Dynamic externalities do occur. But imbalances are absorbed when they reach markets which are deep and liquid enough.

However the recurring pattern of central bank interventions and large scale restructuring of whole financial sectors with the backing of public money in a wide array of countries sounds as a warning. Systemic risk is a latent feature of present-day financial systems. There is a legitimate concern for unlikely but highly damaging market dynamics, when individual behavior worsens overall financial conditions.

It is encouraging that a debate between market participants and regulators is being held with the objective of promoting a new approach to risk prevention. An interactive process is set up whereby relevant information can be improved thanks to better methods of controlling market risk at the firm's level and to more comprehensive disclosure required from all major market participants. But risk prevention is not the end of the story. Whatever its enhancement, unanticipated shocks will still happen in particular markets causing a rush for exit. To avert contagion into interrelated markets, there is a case for more stringent capital standards against market risk and for the adoption in OTC markets of the very safety rules already introduced in Exchange markets. The G10 Committee of central banks is addressing those issues and making proposals on both information disclosure and more demanding standards.

i) Disclosure of market and credit risks

The pricing of market risk is not always accurate, especially as complex portfolios are structured with interrelated instruments. Market risk should measure the potential for losses on the global trading portfolio, encompassing both derivatives and on-balance-sheet securities. As soon as September 1994, The Fisher Report acknowledged that internal risk management practices improved within the firms but public disclosure lagged for behind. A gap has widened between the ability of financial firms to manage their own risks and their inability to assess the riskiness of other participants.

Under stress, a low market transparency is conducive to the one-way selling pressure highlighted in the present paper. If information is lacking about the risk exposure of market makers, a general suspicion about their financial situation can easily spread out. Funding difficulties encountered by one of those firms appear similar to outsiders for other market makers, if available information is too poor to permit screening. Rumors of a liquidity squeeze take over which can be self-fulfilling.

A meaningful disclosure should apply to all major market participants, be systematic and structured in a common framework to be understood by outsiders. The role of regulators is crucial to implement the procedure, because individual firms will not go ahead unilaterally. Indeed, limited information entails that a firm revealing more information than others about its risks may reasonably fear that outsiders perceive it to be worse off than market makers which abstain form disclosing. On the contrary, if regulatory authorities announce a set of quantitative and qualitative standards to be met by major market participants for the sake of market transparency, outsiders will see that the faster a firm adjusts to the required disclosure, the safer its management practices and the better its control system. A positive dynamic process can be initiated whereby relevant information disclosure is leading to enhanced disclosure practices.

The BIS has stated the principles of disclosure based upon internal models of risk assessment by financial firms. The formal framework is based upon the value-at-risk concept, which gives information to market participants on the propensity of a financial firm to take market risk. All market makers over a conventional threshold measured by the size of trading account assets should be subjected to disclosure on the same grounds.

But revealing daily value-at-risk is far from being sufficient. The holding period must be long enough to guard against the risk of being locked into unbearable positions. As depicted in the second part of the paper, this can be the case with the non-linear price behavior of options. The BIS considers that ten days is a minimal holding period for the non-linear properties of options being captured. The assessment of risk on these instruments should be made by using the full pricing formula and the effect of the change in the valuation of option contracts on the whole portfolio should be displayed.

As far as credit risks are concerned, the exposure of firms can extend well into the future in the case of swaps. At a minimum they should disclose the distribution of the replacement costs of their current outstanding positions by counterparty rating. But current exposure does not give a complete picture of credit risk. A more accurate measure is potential future credit exposure which shows how the exposure to credit risk can vary as the result of changes in market prices. A precise estimate of potential future credit exposure is rarely made by banks, let alone its disclosure. There is a large room for improvement in this respect. But more elaborate assessments require sophisticated simulation models.

These models should also be developed to provide regulators with more relevant indicators of the vulnerability of market markers to systemic risk, namely by stress tests. For the time being stress tests are still in infancy, largely ad hoc and run with widely different methods from one firm to another. According to the BIS, promoting a routine and rigorous program of stress testing would be a very valuable tool for market participants and regulators. It would enable a better understanding of the dynamics of systemic risk and would be the primary commodity for the definition of indicators of the vulnerability of whole markets to this most extreme form of failure. To carry out this particular information, stress tests should simulate market losses and changes in credit risk exposure as consequences of the following events : large and positively correlated price moves in key risk factors, worst case combination of macroeconomic shocks, major changes of correlation between risk factors, loss of market liquidity, failure of an important counterparty.

Because markets are highly interlinked and because market makers straddle a lot of markets, coordination between market regulators and bank supervisors should become an essential feature of a comprehensive prudential policy at the international level. The Barings crisis displayed blatant deficiencies in this respect. Coordination is a necessary complement of better disclosure to exploit the information revealed by stress tests for the sake of systemic risk prevention.

ii) More demanding standards

The debate between central banks of the G10 and banks acting as dealers in securities and derivatives about the proper capital charge to be held against market risk is lively to say the least. The authorities have accepted the principle of building their supervisory framework on the internal measurement of market risk by market participants. But setting up the prudential rules which make the principle operational and still preserve robust financial structures is a tricky job.

In the course of the paper, many reasons were given why the daily value-at-risk is not the appropriate measure of capital requirement. Moreover the present state of the art in individual banks differs widely, so that they can come up with a broad range of value-at-risk measures for the same portfolio under the same present market conditions. It is why a minimal normalization in the methodology, a routine disclosure with a larger array of risk measures, an involvement of higher management in tighter internal control systems, are all necessary conditions for a direct use of internal measures.

Absent these conditions, the supervisors propose to base the capital charge on the value-at-risk taken on a 10-business day holding period and apply a conventional multiplier of 5. The proposal is hotly contested by the banks who claim that it will lead to a much too high and too expensive capital requirement.

Only an improvement in risk measurement and disclosure will help reduce the gap between the conflicting views of both parties. The regulators should have enough information to detect if the value-at-risk reported by individual banks is particularly low and why it is so. In particular, because correlations between risk factors are held constant between two revision dates and change abruptly on revision dates, the daily value-at-risk may understate the change in the underlying volatility, then jumps artificially on a specific revision date.

As supervisors want traders to protect for longer risk, they demand a 10-business day holding period to report value-at-risk. To account for the volatility of the measure itself, the supervisors can make an averaging of the preceding reports over a period of several months backward or take the medium of the range defined by the x% worst figures.

The scaling-up factor is introduced to make for all the risk factors which are underestimated or completely ignored by the value-at-risk methodology. They are the factors conducive to systemic risk. As long as those factors are not well known or are not quantified even if understood, the multiplier will be conventional and vulnerable to critics. Only an accumulation of knowledge drawn from long series of stress tests could give an order of magnitude for the multiplier, which should ideally measure how much the magnitude of risk can increase when market conditions shift from normal to abnormal circumstances.

iii) Organizing OTC derivatives markets

The Barings' failure which occurred on Exchange-traded contracts plainly showed that the unwinding of the positions of an insolvent entity could be efficient and fast. There was a safety net with multiple lines of defense : customer trading accounts and proprietary accounts were separated on SIMEX, the Singapore Monetary Authorities were standing behind the SIMEX clearing house to guarantee settlements, the doubling of margin requirements on the Nikkei 225 futures contract brought on liquidity after the CFTC intervened decisively.

This safety net is completely lacking on OTC contracts. A market maker's default is much more time-consuming to unwind. Potential systemic implications are much larger when positions are not daily marked-to-market according to market prices, when variation margins are not called on a permanent basis with changes in potential losses, when no clearinghouse mechanism can take over the customer accounts of a failing firm and transfer them to another clearing firm.

To become robust to liquidity problems induced by heavy losses of important dealers, OTC markets should be made more alike Exchange-traded markets. This means introducing multilateral netting mechanisms and collaterals sensitive to changes in value-at-value risk on market exposures and to changes in potential future credit risk exposure. Therefore the requirement of collaterals is closely dependent on progress in the disclosure of potential losses. Multilateral netting meets formidable obstacles to be implemented : the wide variety of OTC contracts, the legal claims to the trading assets of the failing firm under national bankruptcy laws, the lack of transparent market prices. Therefore multilateral netting is dependent on a rule-setting process acquiring legal status and harmonizing the working of OTC markets under a coordinated supervision.

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