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Financial Derivatives II

The Risks and Their Management

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Introduction

In the previous issue of *Money & Finance*, it was argued that, at least in principle, financial derivatives are powerful instruments that can facilitate hedging against volatility in exchange rates, interest rates and securities' prices (Bhaumik, 1998). Further, some derivatives products like swaps were shown to be capable of significantly reducing the costs of borrowing of firms by allowing them to borrow in accordance with their respective comparative advantages. Moreoever, derivatives products can reduce the need on the part of firms and banks to hold idle precautionary balances to tide over unexpected adversities, thereby reducing the fraction of funds with these organisations that remain unproductive (Hentschell and Smith, 1997).

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It was also argued that while speculation is an integral part of derivatives trading, speculation as a practice facilitates creation of markets at lower (transactions) costs and thereby increases the liquidity of such markets. Since higher liquidity is associated with lower risk, it can, therefore, be argued that any additional risk arising out of speculative activities is at least partially offset by the increased liquidity of the market. Besides, the existence of derivatives markets allows the gradual reduction of informational asymmetry in the market as the private information of agents, as well as expectations about volatility, are revealed in the form of price signals, thereby reducing the risks associated with informational asymmetry among economic agents participating in the markets for both the derivatives products and the underlying securities. In general, since risks are largely a product of uncertainty, the propagation of new information through price signals can help reduce the uncertainty across both time and space and this, in turn, reduces the risks of the market participants. As such, there is little empirical evidence to suggest that the presence of speculators increases the volatilities of the derivatives and the underlying cash markets (Edwards and Ma, 1992). Indeed, at least some econometric exercises have revealed that derivatives do not affect the volatility in the cash market *per se* and that such effect, if any, was more likely to be in the form of a decrease in the volatility rather than any increase in the same (Kan, 1997). Since volatility is the stylised measure for (price) risk, there seems to be little support for the hypothesis that the presence of speculators increases the degree of riskiness in a market.

Moreover, while the presence of speculators in a derivatives market

is a foregone conclusion, a survey of firms conducted by the Treasury Management Association (TMA) has revealed that about 71% of those surveyed used derivatives for the purpose of risk management. On the other hand, only about 21% of these firms admitted to use of derivatives for investment purposes. Further, smaller firms covered by the survey, those with lesser abilities to withstand derivatives related losses than their larger counterparts, indicated their strong preferences for relatively simple derivatives, with tradtional securities with embedded options and asset-backed securities accounting for about 76% of their derivatives portfolios. Empirical evidence, therefore, suggests that the exposure of firms to derivatives related risks are perhaps not as significant as one may be inclined to think.[1] To phrase it differently, the vulnerability of the production (or real) sector that can directly be associated with exposure to (financial) derivatives related risks should perhaps not be the cause for major concerns.

While these facts and figures assuage one's apprehensions about financial derivatives to an extent, several issues continue to remain unanswered. For example, one has to address the question as to whether introduction of stock and index futures increases the volatility of the market, and whether such volatility can generate perverse expectations that can, in turn, facilitate a crash in the market for the underlying securities. More importantly, given that financial institutions are significantly large players in the derivatives market [see Table 1], one has to explore the extent to which these instruments increase the riskiness of the portfolios of these institutions. Specifically, one would have to take a closer look at the probable impact of derivatives trading on the viability of banks, the failure of which can severely disrupt the payments system and hence the economy at large. In other words, while firms which constitute a significant part of the real sector may not directly be exposed to significant derivatives related risks, derivatives related activities can adversely affect the financial system which can, in turn, disrupt activities in the real sector.

The agenda for the second part of the paper can thus be summed up succinctly: (derivatives related) risk and risk management. The paper would first highlight the risks that can be associated with derivatives trading, exploring, in turn, the risks associated with OTC and exchange traded derivatives. In this context, it would explore some of the high profile catastrophies involving derivatives trading, namely, the crash of the Dow

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[1] Why, however, do firms use derivatives? Geczy et al. (1997) argue that firms may use these financial instruments owing to a variety of reasons. For example, it might be in the interest of the management to reduce volatility in the cash flows of the firm, and thereby reduce the volatility of the profits, thereby inducing him/her to use financial derivatives if they can be used at a low cost. Such a move would also find favour with bond holders who are directly affected by the disruption of cash flows which can precipitate financial distress. The equity holders too would approve of such action if they perceive that the management possesses information to which they have no access, and that hence the use of derivatives as hedging tools is in the interest of the equity holders who would then be insulated against risks involving sudden changes in the firm's financial viability. The actual use of derivatives would be influenced by the interplay of these different pressure groups.

Jones Industrial Average (DJIA) in 1987, the losses incurred by Orange County, and the bankruptcy and subsequent sale of Barings Securities. It would become evident that regulations and development of appropriate institutions have a key role in the process of integration of derivatives into the mosaic of the financial market. Finally, it would address the regulatory issues that form the cornerstone of any market that is marked by informational asymmetry and the mismatch of the interests of individuals and the society/economy as a whole.[2] The regulation of banks, which routinely enter into forward, swap and options agreements with their clients, would be especially emphasised.

Risks Associated with Derivatives Trading

As outlined by Bhaumik (1998), financial derivatives are either in the form of specific contracts between dealers and their clients (i.e., OTC derivatives) or they are standardised and exchange traded. The general belief is that, as with the products themselves, the nature of the risks associated with the two kinds of derivatives too differ significantly. For example, it is alleged while OTC derivatives are subject to significant counterparty risk, i.e., the risk that a dealer or (more likely) a client might be unable to meet his/her commitments upon maturity of the contract, the existence of a clearing house substantially reduces the incidence of such risk for exchange traded derivatives products. At the outset, however, it would perhaps be prudent to enumerate the sources of risk, and then move on to an analysis of the extent to which any particular form of risk is relevant for a specific derivatives product.

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Broadly speaking, derivatives traders are subject to three different forms of risk.

• First, as mentioned above, they face counterparty or credit risk, i.e., there exists the possibility that one of the parties to a contract might default on the payment. There are several instances where default triggers off a payments crisis and tends to disrupt the working of the entire market. The problems faced by the Singapore International Monetary Exchange (SIMEX) in the aftermath of the default by Barings Securities amply indicated the fact that the adverse impact of such disruption on the system as a whole can be significant.

• Second, traders face marker risk, i.e., they can incur sudden and huge losses as a consequence of unfavourable market movements. Such

[2] The simplest example of the problems associated with informational asymmetry involves an entrepreneur who has borrowed money from a bank. In the absence of any regulations, (s)he would maximise his/her gains by maintaining that the firm is making a loss and that hence (s)he is not in a position to repay the bank. Since the entrepreneur enjoys an informational edge over the bank's managers, the policy makers typically authorise the latter to inspect the books of the firm, and attach collateral and/or private wealth of the entrepreneur, if necessary. These regulations provide the entrepreneur the incentive to truthfully declare his/her gains and losses. Indeed, a significant part of economic modelling has been dedicated to devising contracts under which the contracting party with some private information benefits most by revealing the same. The relevant models are known as principal-agent models. In the aforementioned example, the bank is the principal and the entrepreneur is the agent.

movements in the values of the underlying securities endanger the liquidity of the traders, and make derivatives trading unviable, as formation of expectations about the future becomes difficult. These difficulties were manifested during the 1987 crash at the New York Stock Exchange, and during the 1992 crisis at the Euro-currency market.

• Finally, trading firms face operations risk, i.e., they face the possibility that the traders might not be able to correctly anticipate changes in the values of the underlyings, and/or that the activities of the "rogue" traders might remain undetected. The problems faced by both Barings Securities and Orange County highlight the importance of operations risk in the context of derivatives trading.

Counterparty Risk

Let us now examine the extent to which the market participants are exposed to these three forms of risk. Dealers of OTC derivatives are particularly vulnerable to counterparty risk. They enter into one-on-one agreements with clients to buy and sell assets and are, therefore, exposed to the risk of defaults by one or more clients. Their problem is aggravated by the fact that the OTC contracts are usually tailor made to suit the requirements of the clients, and are thus not freely tradable, thereby reducing the ability of the dealers to sell them off, even at a discount, if they feel that a client might be unable to meet his/her obligations.

The apprehensions about the riskiness of trading in OTC derivatives, however, are perhaps largely misplaced. The banks and other dealers of such derivatives products are aware of the risks associated with the possibility of default, and hence they typically cater to the needs of only highly rated clients. For example, a study conducted by the General Accounting Office (GAO) of the United States (US) revealed that more than 97% of the firms who entered into swap agreements with US banks were rated BBB/Baa or higher. Of these, over 75% of the firms were rated A or higher (GAO, 1994, p. 59). In other words, the probability of widespread default is minimal. Further, while the outstanding notional principal of forward and swap contracts are staggering, it has been estimated that the actual exposure of dealers to default is often a very small fraction of the notional principal (Garman, 1997). For example, the GAO (1994) reported that the combined gross exposure of the 14 major US dealers of OTC derivatives, for the year 1992, was USD 114 billion, i.e., 1.8% of the USD 6.5 trillion notional principal (p. 53).[3] Finally, even though OTC contracts

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[3] Let us, for example, take into consideration a swap contract. If the notional principal is USD 1 billion, and if the client firm pays the floating rate (LIBOR), and the floating rate exceeds the (pre-determined) fixed rate by 2 percentage points, then the firm would be expected to pay the dealer/bank 2% of USD 1 billion. The exposure of the dealer/bank to counterparty risk, therefore, would be 2% of the notional principal. Similarly, suppose that a firm is committed to purchase JPY 1 billion from bank after 1 year. On maturity of the contact, if the firm fails to buy the yen, then the actual loss to the bank would be the difference between the (spot) price at which it bought the yen for the firm, and the (spot) price at which it would have to sell it. This bid-ask spread would obviously be a small fraction of the spot price(s), and hence a small fraction of the JPY 1 billion contraced for in the forwards agreement.

are usually client-specific, they can often be decomposed into two or more components, each of which can be at least partially hedged by exchange traded derivatives, thereby reducing the effective exposures of the dealers to credit/counterparty risk.

As mentioned above, counterparty risk is believed to be negligible in so far as exchange traded derivatives are concerned. Both options and futures exchanges settle trades through a clearing house. Indeed, traders with both *long* and *short* contracts enter into the respective contracts not with each other but with the clearing house. The institution of the clearing house guarantees that even if any trader fails to meet his/her obligations, the contracts of all other traders will be honoured. Hence, for example, even if a trader with a *long* stock index futures contract fails to deliver or make the appropriate payment on maturity of the contract, the trader with a *short* contract is assured of payment on the maturity date.

The institution of the clearing house, however, does not guarantee the complete absence of the possibility of widespread default. This was amply highlighted by the experience of the Hong Kong Futures Exchange (HKFE) during October 1987 (Cornford, 1995). Stock index futures trading was introduced at the HKFE in 1986, the maturity periods of the contracts being one, two and three months. On October 19, 1987, the Hang Seng declined by 11%, and trading in both the equity and futures markets was halted by the respective exchange authorities. During the next few days, it was revealed that the Hong Kong Futures Guarantee Corporation (HKFGC) had reserves of HKD 22 million, against outstanding open interests equivalent to HKD 5-6 billion in equity. In other words, if the HKFE could not meet its obligations as a clearing house, the underlying equity market could witness sell orders amounting to HKD 5-6 billion from investors who had hedged equity portfolios with futures contracts or those who were involved in index arbitrage. Hence, the government and financial institutions bailed out the HKFGC with a loan of HKD 2 billion.

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The saga was repeated after the Hang Seng crashed by 33% on October 26, 1987, and arrangements had to be made for another bailout package valued at HKD 2 billion. Investigations revealed that the crisis was precipitated by a section of the brokers who had not enforced the mark-to-market principle well, and had granted credits and extensions to their clients. Moreover, about 50% of the long contracts were held by one individual, thereby making the vulnerability of the system significantly dependent on the viability of one individual. The downturn in the market, therefore, rendered bankrupt as many as 30% of the members of the clearing house, thereby severely reducing the ability of the clearing house to make the market and meet its financial obligations. In other words, sans appropriate regulations, institutions like a clearing house might not discharge their responsibilities in the best possible manner. This is a direct consequence of the so-called agency problem which argues that the objectives of the institution might not be in harmony with the interests of its management. The importance of appropriate regulations in such contexts is fairly obvious.

Market Risk

Derivatives contracts involve either options or obligations to buy or sell assets at some pre-determined price on a pre-determined date. In the case of options, the owner of the options receives zero payment in the worst possible situation, and some positive payment if the option is in-the-money on expiration.[4] The writer of the option, on the other hand, faces some non-zero (and perhaps even non-trivial) probability that (s)he will have to face a net cash outflow equal to the differences between the market and agreed-upon values of the assets covered by the options contracts. The situation is more complicated in the case of other derivatives products which involve obligations to buy or sell the underlying assets. In such events, traders on both the long and the short sides of the contracts face the possibility of incurring losses arising out of sudden and unforeseen market movements. The risk associated with such adverse market movements involving the value/price of the underlying asset is known as market risk.

The possible impact of market risk on the portfolio of an investor was brought to fore by the experience of Orange County of the state of California, United States. In December 1994, it was revealed that the County has used borrowed funds to create a portfolio valued at USD 22 billion. Much of the investments were associated with a structured note known as *inverse floaters*. These are floating-rate contracts whose coupon rate increase when market rates decline, and vice versa. The notes/bonds lost value as the market rates rose during 1994, and hence Orange County was saddled with securities which had not matured and which had been rendered illiquid because of loss of value to the tune of USD 1.69 billion. At the same time, however, the County required funds to honour the reverse repurchase agreements which it had sold earlier, primarily to obtain funds for investment into the inverse floaters. The County filed for bankruptcy when banks and investment firms refused to renew its short-term refinancing agreement.

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Evidently, the fund managers at Orange County had expected the interest rate to decline during 1994, and the market had behaved contrary to their expectations. As such, both OTC and exchange traded derivatives are likely to be only marginally affected by such unexpected or unanticipated market movements unless they are either leveraged, as in the case of Orange County, or they mature during the period of adverse market movement. For example, suppose that an Indian firm enters into a 1-year forward contract with a bank, thereby making a commitment to purchase USD 1 million on maturity, the pre-determined exchange rate being Rs.42 per USD. Suppose that the spot exchange rate is Rs. 38 per USD. Suppose the rupee slides against the dollar during the first 10 months, falling to Rs. 46 per USD, but it hardens subsequently with support from the Reserve Bank of India (RBI), and stabilises at Rs. 42.10 at the end of the year and of the contract. The dealer bank will thus lose a maximum of Re. 0.10 per USD on maturity of the forward contract, even though the rupee fell against the

[4] Note that, for the sake of convenience, only European options are being taken into consideration.

dollar more than expected during the course of the year.[5]

Indeed, the only derivative product that can potentially lead to substantial losses on the part of the traders, even if the unanticipated market movement is short term in nature, is a *capped option*. A capped option is one that is automatically exercised when the market price of the underlying security touches the predetermined cap. For example, if "a 360 ABC capped call index option has an exercise price of 360 and a *cap interval* of 30," then "the call option has a *cap price* of 390." Similarly, if "a 310 XYZ put index option has an exercise price of 360 and a cap interval of 20," then "the put option has a cap price of 290."[6] Suppose that exchange rules are such that the options are automatically exercised if the market price at close of a day's trading breaches the cap price. Then the ABC option will be automatically exercised if the closing value of the index for a day is greater than 390, and the XYZ option will be automatically exercised if the closing value of the index for a day is less than 290. Since it is possible for stock indices and exchange rates, among others, to experience sharp intra-week volatility, the possibility for the automatic exercise of capped options on such economic variables cannot be ruled out.

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Agency Risk

The nature of agency risk, and its potential impact on the viability of an investor in the derivatives market can perhaps be best highlighted using the example of Barings Securities, the investment bank which went bankrupt in February 1995. The person deemed responsible for the demise of the firm was Nicholas Leeson. the Head Trader and General Manager of Barings' Singapore based subsidiary Barings Futures (Singapore) BF(S). One of the primary objectives of BF(S) was to identify and exploit arbitrage opportunities involving various short and long term securites that were traded both at the Osaka and the Singapore exchanges. One such security was stock index futures contracts with the Nikkei 225 as the underlying index.

As such, Leeson was considered a company asset, with his Nikkei 225 futures trades reportedly having generated revenue amounting to GBP 28.5 million during the first three quarters of 1994. However, as it was later revealed, from as early as 1992 Leeson had successfully used another account to book loss-making transactions and thereby conceal the true nature of his exposures (Cornford, 1995). Further, he overrode the Barings

[5] The difference between the spot and futures prices of a security is known as *basis*, and it is evident ftom the illustration that all invesotrs are subject to basis risk. Let us take the example of an investor who owns an asset and a short futures contract. If the initial value of the basis is greater than zero then (s)he stands to gain if the basis widens, given that it can widen only if either the spot price increases, or the futures price falls, or both price movements take place at the same time. Empirical evidence has indicated that the basis is not predictable and that hence basis risk cannot be hedged (Pennings and Muelenberg, 1997).

[6] Details regarding the nature of and risks associated with various types of options can be found in *Characteristics and Risks of Standardized Options* which was published in February 1994 by, among others, the Chicago Board Options Exchange and the American Stock Exchange.

management's January 1995 instructions not to increase the exposure of BF(S), the instructions being a reaction to the concerns expressed by SIMEX and Osaka Securities Exchange (OSE) authorities about the size of BF(S)'s positions at these exchanges. As a consequence, when the Nikkei 225 fell sharply early in 1995, BF(S) suffered huge losses on account of its unhedged long positions. The problem was aggravated when prices of 10-year Japanese Government Bond futures contracts rose, thereby generating further losses for BF(S) which had unhedged short positions in these derivatives products. The total losses for BF(S) was estimated at GBP 600 million, of which GBP 500 million was incurred during the month of February (1995) alone. The total loss of the subsidiary was higher than the total capital of the parent company, and Barings had to file for insolvency.

The Barings case clearly identifies two sources of agency problems among firms involved in derivatives trading. First, they typically tie the payoffs of dealers with the profits from the trading activity. At the same time, however, an individual dealer's liability is miniscule relative to the potential losses to the firm. At worst, (s)he might lose his/her job worth a few hundred thousand rupees or dollars. On the other hand, (s)he stands to gain substantially if the firm makes a handsome profit. In other words, there is always an incentive for a dealer to take high risk-high return gambles, thereby increasing the riskiness of the firm's portfolio (Garman, 1997). Second, while it is the responsibility of a firm's management to ensure that risk exposures attributable to the individual dealers are sustainable, they might default on this responsibility in the event that the dealers concerned generate(s) handsome profits for the firm. This again is a consequence of the fact that managers typically have limited liability. The problem is even more acute for investment and other banks whose market positions are highly leveraged.[7]

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Regulation of Derivatives Related Activities

The above analysis highlights some facts about derivatives trading. First, it is evident that it is difficult, if not impossible, to hedge against market risk, given that by their very nature these risks arise out of *unexpected* and *unanticipated* changes in market trends. In fact, it is a stylised result of finance theory that a portfolio manager cannot hedge against market or systematic risk (Bodie, Kane and Marcus, 1993). Second, the main source of risk in the derivatives market, therefore, is agency risk. Indeed, counterparty or credit risk can be attributed either to sudden changes in the market that leaves one of the parties to a contract insolvent, or to bad choice of clients on the part of the relevant OTC dealer. Third, the

[7] For example, while Leeson is justifiably blamed for his less than ethical practices, the Barings management itself had long overlooked the fact that the "top up" account of BF(S) had grown to GBP 22 million at the end of 1993, and a whopping GBP 120 million at the end of 1994. The funds from the "top up" account was supposedly used for short-term lending to clients who had to meet margin calls at the Osaka and Singapore exchanges, and hence the aforementioned sizes of the fund were unusually large. Yet Leeson continued to handle Singapore operations as the firm's blue eyed boy till February 1995.

above-mentioned agency problems are largely a consequence of limited liability of the traders, and informational asymmetry between the derivatives traders on the one hand and the depositors/investors and regulators on the other.

Clearly, there is merit to the argument that derivatives markets should be regulated. But what role can regulation play in these markets? In general, the role of regulatory authorities is to facilitate the creation of markets for goods and services when none exists. Arguably, thereafter market forces and market discipline ensure efficient allocation of resources at the lowest possible cost. In a financial market, however, the problem is not so much that a markets does not exist. The moral hazard, agency problems and adverse selection associated with such markets are consequences of the fact that there exist market imperfections as a consequence of significant informational asymmetry between the various players in these markets. Further, while the disruption of activities in financial markets can adversely affect efficient allocation of resources, the impact of any disruption on resource allocation is not the greatest cause for concern. Indeed, the vulnerability of the financial system to shocks is the cause for major concern primarily because large shocks to this system can render the payments system dysfunctional, thereby transforming a localised shock into a systemic one.[8]

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Regulation of OTC Trading

Despite the fact that banks are typically careful about the choice of counterparties to OTC contracts, the primary risk associated with OTC derivatives continues to be that of default by one or more counterparty(ies) to the contracts. The problem associated with such default(s) is of concern largely because of the fact that the market for OTC derivatives is usually made by banks, and that hence an incidence of default may lead to a severe disruption of the payments system and the market for credit. The concern is deepened by the facts that OTC derivatives outstanding are typically concentrated among a few major banks, and that these banks are closely linked to one another through their activities in several different markets.[9]

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[8] The experience of the Bank of New England highlights how a "localised" shock can get magnified into a systemic shock (Cornford, 1995). The bank had invested heavily in real estate during the 1980s, and defaults on such loans led to the declaration in January 1990 that the bank was poised to incur a loss of about USD 1 billion. The bank was able to gradually wind down its derivatives portfolio from USD 30 billion in early 1990 to about USD 6.6 billion at the time of its bankruptcy in early 1991, largely owing to the fact that counterparties were unwilling to enter into swap contracts with the ailing bank. However, the bank's experience remains a prime example of the transformation of a localised shock (in the market for real estate) into a systemic one, as the Bank of New England failed to meet its obligations to its depositors, and a section of the counterparties in the derivatives market.

[9] The GAO (1994, p. 86), for example, reported that "[a] report sponsored by the Group of Thirty indicated that eight US bank dealers accounted for 56 percent of the worldwide notional/contract amounts of interest rate and currency swaps as of December 1991. US bank regulatory data indicates that the top seven domestic bank derivatives dealers by notional/contract amounts accounted for more than 90 percent of all US bank derivatives activity as of December 1992. SEC data show a similar concentration of

Regulation of trading in OTC derivatives, in other words, overlaps considerably with the regulation of banking activities in general.

As mentioned earlier, banks are typically careful about the choice of the counterparties to OTC contracts. Hence, counterparty risk is possibly not the biggest source of risk in OTC derivatives trading activities. In other words, bulk of the risk accruing to banks—the major traders in OTC derivatives—arises out of adverse market movements and agency problems, the two sources of risk being at least partially related to each other.

Perhaps the most cliched effort to insulate banks from sudden shocks on these accounts has been in the form of prudential regulations. The Basle Committee on Banking Supervision (1994), for example, has argued the 8% capital adequacy ratio proposed by it should encompass off-balance-sheet activities of banks which includes dertivatives trading. The Committee has proposed that the risk associated with derivatives related activities of the banks be measured by the mark-to-market value of the derivatives portfolio, "and by adding a factor designed to reflect the potential exposure during the remaining life of the contract (the so-called 'add-on'). The add-ons are based on the notional principals of each contract and vary depending on two factors: first, foreign exchange contracts have higher weights than interest rate contracts, because of the higher volatility associated with certain currency pairs and also because some foreign currency swaps involve an exchange of principal at maturity; second, contracts with a residual term exceeding one year bear higher weights then those under one year."[10] However, the Committee has also recognised the fact that the quality of the counterparties to OTC contracts are generally higher than those in the other markets, and hence has capped the private sector credit risk at 50% instead of the usual 100% as in the rest of the Capital Accord. It has also allowed banks to weight net, as opposed to gross, positions with the same counterparties.

While the necessity to have capital adequacy based prudential norms is obvious, one has to take note of the fact that the effectiveness of this policy is critically dependent on the ability of a bank or OTC dealer to assess the risk exposure of its derivatives portfolio, and that hence accurate assessment of market risk is an essential pre-condition for the same. The problem is aggravated by the fact that exposures in the derivatives markets are often used to hedge against exposures in the market for the underlying securities or, alternatively, underlying securities are held as cover against exposures in the derivatives market.[11] The estimation of exposure to market

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activity among US securities derivatives dealers. The top five by notional/contract amounts accounted for about 87% of total derivatives activity for all US securities firms as of their fiscal year-end 1992." There has been a further consolidation of derivatives trading among the large OTC dealers during the nineties, and at the end of 1996 the top 8 banks in the US accounted for 94% of the total notional principal of derivatives (IMF, 1997).

[10] Basle Committee on Banking Supervision, *Prudential Supervision of Banks' Derivatives Activities*, December 1994, p. 4.

[11] A covered call option, foe example, is one for which the writer of the option holds the underlying security that is deliverable if the option is exercised. Hence, in such a case, the call writer has exposures both in the cash and options markets.

risk, therefore, has to be undertaken simultaneously for the cash and derivatives markets, and this can be a non-trivial and complicated exercise.[12] Hence, regulatory authorities as well as policy makers have emphasised the need for not only continual appraisal of the risk exposure but also investment in technology and human capital that can enable banks (and other OTC dealers) obtain reliable estimates of the exposure using the *value at risk* (VAR) technique and *stress analysis* [see Box 1] (GAO, 1994; Cornford, 1995; Jorion, undated).

The estimation of exposure to market risk, therefore, has to be undertaken simultaneously for the cash and derivatives markets, and this can be a non-trivial and complicated exercise.

However, even as sophisticated mathematical and statistical techniques are being refined for the measurement of risk exposures of banks and other derivatives dealers, one cannot but take cognisance of the fact that all models and the output thereof are only as good as the information that is fed into them. Indeed, few models, if any, are an exception to the infamous garbage-in-garbage-out (GIGO) principle. Accurate reporting of the traders' daily positions, therefore, is a key pre-requisite for the success of model based analyses of value at risk. The Barings case highlights the fact that accuracy of information can be a victim when the same person is *de facto* responsible for both trading and generating the backroom report, and when a trader is subject to "matrix" monitoring whereby (s)he is (presumably) monitored by two (or more) people. The problem associated with the former situation is but obvious, especially if the annual payoff to the dealer-reporter is contingent on the revenue generated from trading during the year. Dual monitoring, on the other hand, might be rendered ineffective by the fact that in such a situation each of the monitors might pass on the responsibility to the other, thereby leaving the trader(s) virtually free of monitoring.[13] The need for competent supervision is recognised by the regulators (GAO, 1994, p. 45), but the development of the appropriate mechanism is an internal matter of the firms, and hence an universally satisfactory solution to this issue is yet to take shape. Indeed, the only suggestion that has found some support among policy makers is that the remuneration of the derivatives traders should either be delinked from the revenue generated from such activities, or that such payoffs should also be made contingent on the riskiness of the traders' portfolios.

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Faced with the uncertainties associated with regulation of derivatives trading activities, conservative policy makers have turned their focus to the fact that, at least in the case of banks, derivatives related (and other) crises might be precipitated by the fact that the employees and management of these organisations suffer from moral hazard in the presence

[12] For example, if the exchange rate between two currencies change by 5%, it is extremely unlikely that the value of options involving these currencies will also change by 5% (GAO, 1994). It is such asymmetries between price movements in the cash and derivatives markets which make the estimation of market risk difficult, especially as the size of a bank's/dealer's portfolio grows in size.

[13] Cornford (1995, p. 199) has argued that evidence suggests that "[i]n Leeson's case the actual result [of matrix management] seems to have been a blurring of responsibility for his supervision, a situation which may have been exacerbated by frequent changes in the people at the end of his resporting lines after his arrival in Singapore."

BOX 1: Value at Risk: An Outline of the Methodology

Perhaps the most comprehensive definition of *value at risk* (VAR) has been provided by Jorion (undated): "VAR summarizes the predicted maximum loss (or worst loss) over a target horizon within a given confidence interval." The exposition hereunder is based on his paper.

In principle, the estimation of VAR is no more difficult than an understanding of its definition. Suppose that an investor has invested USD 10 million in a security. The historical data about the monthly returns to the security vary between -8.5% and 12.5%. The first stage in the estimation of the VAR would be to divide the range of returns into a number of equal blocks. For example, the range can be divided into 12 blocks: -10 to -8, -8 to -6, -6 to -4, -4 to -2, -2 to 0, 0 to 2, 2 to 4, 4 to 6, 6 to 8, 8 to 10, 10, to 12, and 12 to 14. Then the *frequency distribution* for the blocks - the number of months for which the returns fell within a particular block - can be estimated.

The frequency distribution would also tell us the historical probability of the returns being within or above or below a certain (sub) range. For example, if data is available for 4 calender years, and if 30 out of the 48 months had returns less than 6%, then the probability for a random month is (30/48 =) 0.625 that the return would be less than 6%. It is obvious that the smaller the size of the sub-ranges the easier it would be for us to accurately determine such probabilities for a large number of values.

The second stage of the estimation process would involve the determination of a confidence level. Let us suppose that we would be 95% sure about the validity of the VAR estimate. In that case, we would select a rate of return such that the number of observations (of the monthly data) falling below it would be equal to 5% of the total observations. If, as assumed above, we have monthly data for four years, then we shall have to select the rate of return such that the number of observations having value less than it is (0.05 x 48 =) 2.4. A conservative estimate, therefore, would require that the number of observations having values less than the chosen rate of return be 2. Let this rate of return be -3.1%.

The VAR for the USD 10 million portfolio would then be (10 million x -0.031 =) -0.31 million. In other words, there is only a 5% chance that the investor can lose more than USD 0.31 million during a particular month. It can be shown that (i) the VAR for T periods can be estimated from the VAR for one period using the formula

VAR(T periods) = VAR(1 period) x ÖT

and (ii) the VAR for a 99% confidence interval (used by Bankers Trust) can be converted into the VAR for a 95% confidence interval (used by JP Morgan) using the formula

VAR(95%) = VAR(99%) x (1.645/2.326)

There are pre-dominantly three ways to compute VAR: delta-normal method, historical-simulation method, and monte carlo method. The methods differ from each other primarily with repect to their assumptions about the (statistical) distribution of risk factors, and with respect to whether the usually non-linear relationships between the important variables are approximated by linear models.

The *delta-normal* method, for example, assumes that returns to all assets are normally distributed and that, therefore, the returns to the overall portfolio, a linear combination of the returns to the individual component assets, are also normally distributed. Once the weights of the different assets in a portfolio, and the volatility and the correlations between the returns to the asset are determined, the VAR for the portfolio can be estimated. The *historical-simulation* method is a variation of the delta-normal method in which the weights of the assets in the existing portfolio are used in conjunction with the time series of the returns to these assets for the previous 5 years. It can easily be verified that if the historical returns to the assets are normally distributed then the VAR estimates using the delta-normal and the historical-simulation methods would be the same.

The *monte carlo* method, on the other hand, is more complicated and proceeds in two steps. At the outset, the risk manager has to specify the stochastic processes describing the movements of the financial variables and the process parameters. The statistical distributions and values of parameters such as risk and correlation are inferred/estimated from historical data. Next, paths for all (price) variables of interest are simulated using the aforementioned process/model. For each of the horizons under consideration, the portfolio is marked-to-market, and each of these 'pseudo' payoffs are then used to generate a distribution of returns. The VAR for the portfolio is then generated out of this 'pseudo' distribution.

It has . . . been proposed that functional banking, which separates the banking and non-banking activities of a bank, should be introduced, with deposit insurance covering only the part of deposits that would be used for traditional banking activities.

of deposit insurance.[14] They have voiced the concern that given competition and hence lower margins in the traditional banking activities, bank management might be tempted to take leveraged positions in off-balance sheet products like derivatives (Darby, 1994). While, in principle, regulations mandating full disclosure should alleviate the problem (Siems, undated), experience suggests that there is little guarantee, if any, that such a regulation can *de facto* be enforced.[15] It has, therefore, been proposed that functional banking, which separates the banking and non-banking activities of a bank, should be introduced, with deposit insurance covering only the part of deposits that would be used for traditional banking activities. One other proposal that has found favour with policy makers is that of risk-weighted pricing of the deposit insurance premium (Cornford, 1995). These

[14] For a detailed review of the literature on the moral hazard problem arising as a consequence of deposit insurance and too-big-to-fail banks see Bhaumik (1996).

[15] There are, of course, some regulations that are more easily enforceable than others. For example, the Bank of England requires each dealer to report all positions and transactions related to exposure to any one counterparty, or a group of related firms, if the exposure exceeds 25% of the dealer's capital.

concerns and proposals are not new, and were first raised in the aftermath of the Savings and Loans and banking crises in the United States during the second half of the eighties (Randall, 1993). However, the proposals were subsequently not acted upon, and have been brought to the fore once again by the potential threat to the vulnerability of deposit taking (and other) financial organisations arising out of derivatives related activities.

Regulation of Exchange Based Trading

As highlighted in the previous sections, the dealers and investors buying and selling exchange traded financial derivatives too are exposed to market and agency risks.[16] Hence, the regulatory issues highlighted above are also relevant in so far as these derivatives products are concerned. The advantages with exchange traded products, however, are that these positions can be liquidated/offloaded at a very short notice, and that the principle of daily mark-to-market and margin calls significantly reduce the size of defaults, if any. In other words, despite the lower quality of traders vis-à-vis OTC derivatives, barring organisational failures as in the case of Barings Securities, traders of exchange traded products are perhaps exposed to less risk than their counterparts who deal in OTC derivatives.

However, as highlighted by the fiasco involving the HKFE, the degree of riskiness associated with exchange traded derivatives is sensitive to the financial strength of the clearing house and the members of the trading community who are financially liable for it. There is, therefore, considerable merit to the argument that clearing houses (and its members) should be subject to minimum capital requirements and that these requirements should strictly be enforced. Similarly, a case can be made in favour of creation of guarantee funds for exchanges to act as a buffer in times of unanticipated shocks, much like the GBP 100 million fund created by the London International Financial Futures Exchange (LIFFE).[17] An even more conservative approach has been espoused by the Chicago Board of Trade Clearing Corporation (CBOTCC) and the Chicago Mercantile Exchange (CME). An agreement was reached among the CBOTCC, the CME and their settlement banks "under which transfers by clearing banks to the clearing house to meet margin payments became final and irrevocable, regardless of the position vis-à-vis the clearing bank of the clearing member from which the payments were due."[18]

. . . derivates related (and other) crises might be precipitated by . . . moral hazard in the presence of deposit insurance. . . . [Conservative policy makers] have voiced the concern that given . . . lower margins in the traditional banking activities, bank management . . . might take leveraged positions in off-balance sheet products like derivatives.

[16] As mentioned above, the presence of clearing houses almost completely eliminate counterparty risk for exchange traded derivatives.

[17] Note, however, that while such a fund can help an exchange absorb the shock of an unexpected market movement and/or default, it is likely to give rise to the moral hazard problems that are associated with deposit insurance. The importance of in-house and external supervision in such an event, therefore, remains unaffected, and perhaps even augmented to some extent.

[18] Cornford (1995), p. 202. Note, however, that such action essentially *shifts* the risk from the clearing house to the banks, rather than *eliminate* the counterparty risk completely. It may be argued, however, that the potential loss to any one bank would be a small fraction of the potential loss to the clearing house as a whole, and that hence individual banks were in a better position to absorb any shock ariring out of default that the clearing house itself.

While a significant part of the subsequent research in this area has rejected the hypothesis that trading in stock index futures was (largely) responsible for the crash of 1987, there is agreement about the fact that large shifts in buying and selling pressures between cash and derivatives markets can be potentially destabilising.

Finally, as highlighted by the experience of the New York Stock Exchange (NYSE) during the crash of October 1987, technology can prove to be a major constraint, and can precipitate the formation of perverse expectations among investors, thereby bringing about (adverse) market movements of catastrophic proportions (Bodie, Kane and Marcus, 1993). The genesis of the problem lies in the fact that cash and derivatives markets are closely linked by way of interlinked market positions of the traders. Indeed, most traders either use cash positions to cover positions in the future and options markets, or positions in derivatives markets to hedge positions in the cash market. Moreover, most of them adjust their cash-derivatives portfolios continually in accordance with the principle of dynamic hedging.[19] In reality, as the *delta* for a market index changes, the traders do not buy and sell the stocks underlying the index, and take long and short positions in the market for index futures instead. Much of dynamic hedging is carried out by way of *program trading*, which can be defined as "coordinated buy orders and sell orders of entire portfolios, usually with the aid of computers, often to achieve index arbitrage objectives."[20]

On October 19, 1987, the New York market opened at 10% below the previous day's close, and the equity prices dropped further before the traders could update their portfolios based on the changed value of the *delta*. Given the rapid fall in prices, the prices quoted at the exchange lagged behind the actual market prices, and the trades too were executed behind schedule as a deluge of sell orders overwhelmed the execution system. As a consequence, traders were left without the ability to update their cash-derivatives position as rapidly as they should have if they were to hedge their portfolios perfectly. It was alleged that as the panic spread "[p]ortfolio insurers sold in the futures market, forcing prices down. The downward price pressure in the futures market was then transmitted to the stock market by index arbitrage[21] and diverted insurance portfolio sales. ..... They [i.e., index arbitrageurs] were not, however, the primary cause of the movements; rather, they were the transmission mechanism for the pressures initiated by other institutions."[22] While a significant part of the subsequent research in this area has rejected the hypothesis that trading in stock index futures was (largely) responsible for the crash of 1987 (Edwards and Ma, 1992), there is agreement about the fact that large shifts in buying and selling pressures between cash and derivatives markets can be potentially destabilising (Cornford, 1995).

The problem obviously lies with the fact that if several large buy

[19] Dynamic hedging is the process whereby a trader continually updates his/her hedging positions, in keeping with the market trends and the resultant changes in the hedge ratios. To recapitulate, the hedge ratio (or *delta*) of an option is "the number of stocks required to hedge against the price risk of holding one option" (Bodie, Kane and Marcus, 1993, p. G7).

[20] Bodie, Kane and Marcus (1993), p. G11.

[21] Index arbitrage is "[a]n investment strategy that exploits divergences between actual futures prices and their theoretically correct parity values to make a profit" (Bodie, Kane and Marcus, 1993, p. G8). A discussion about the determination of the theoretically correct futures price(s) and index arbitrage can be found in Bhaumik (1998).

[22] Brady Commission Report, as quoted in Edwards and Ma (1992), p. 260.

and sell orders are placed in the market simultaneously then even the best of technology might find it difficult to transmit the price signals and execute the orders on the second. The impact of such lags in a bear market can precipitate panic and thereby lead to catastrophie. However, it is difficult to upgrade technology beyond a point, especially given that the weakest link in the proverbial (technological) chain is human capability to assimilate and input information into the technological system. Hence, while technology at both cash and derivatives will certainly have to be upgraded to some basic minimum level, certain precautionary, if somewhat *ad hoc*, measures might have to be included within the trading systems of the exchanges, to ensure that 'informational (and therefore psychological) normalcy' returns after periods of rapid market movements.

Some market watchers and policy makers have argued in favour of regulations to curb index arbitrage. Such arbitrage, however, is an integral of the (inter-temporal) price search mechanism which connects the cash and futures markets, and hence such curbs would hardly be desirable. Similarly, higher margins might lead to greater number of bankruptcies among the market participants, thereby generating panic instead of assuaging the fears of the traders. In view of these problems, it would perhaps not be fallacious to suggest that the best regulatory instrument at the disposal of regulators is circuit breakers. Indeed, while the use of this instrument can be criticised on the ground that large changes in prices in the cash and/or derivatives market might be consequences of inflow of new information, as opposed to panic, it has to be recognised that trading halts are perhaps the only regulatory instrument that can help bring about informational and psychological normalcy on the trading floor with the least possible adverse effects on the financial system as a whole. Perhaps the best example of the use of this instrument can be seen at NYSE where "[o]nce the Dow [Jones Industrial Average] moves by 50 points during the day, thereafter all index arbitrage orders must be *stabilising*. This requires that in a falling (rising) market traders must wait for a price uptick (downtick) to sell (buy). The objective of this rule, obviously, is to prevent index arbitrage from increasing price volatility in the stock market."[23]

. . . perhaps . . . the best regulatory instrument at the disposal of regulators is circuit breakers.

. . . it has to be recognised that trading halts are perhaps the only regulatory instrument that can help bring about informational and psychological normalcy on the trading floor with the least possible adverse effects on the financial system as a whole.

Summing Up

Much of the discussion about financial derivatives in India is centred around the question as to whether or not these products should be introduced into the Indian capital market. Some opposition notwithstanding, the view that seems to have gained ground during the last few months is that these products should be introduced because otherwise the market for derivatives products, with Indian securities as underlyings, are likely to move overseas (Shah and Thomas, 1997). There is merit to this argument. It has, for example, been alleged that the foreign institutional investors (FIIs), which are not allowed to take forward cover on their equity investments,

[23] Edwards and Ma (1992), p. 270. The trading in the several future indices starts at 9:30 am, 30 minutes before trading commences on the NYSE and closes at 4:15 pm. The "upticks" and "downticks" refer to intra-day price movements.

. . . more relevant is the question as to whether interest rate based derivatives products might be introduced in India. In the recent past, attention has been focused primarily on . . . index based futures contracts, but derivatives instruments with interest rates as the underlying securities are by far the most important derivatives products in use.

have developed informal currency forward markets overseas, the short side of the contracts being taken by Indian firms with export earnings. The main issue, however, is that pertaining to the degree of convertibility of the rupee, a discussion of which lies beyond the scope of this paper.

The question of "introduction" of such derivatives in India, of course, is moot in the context of the currency market because banks and their (corporate) counterparties routinely enter into forward and swap transactions in the currency market. Much more relevant is the question as to whether interest rate based derivatives products might be introduced in India. In the recent past, attention has been focused primarily on the Gupta Committee's verdict on index based futures contracts, but derivatives instruments with interest rates as the underlying securities are by far the most important derivatives products in use [see Tables 1 and 2]. Indeed, while it remains to be seen whether stock index securities can bring life back into the bourses, there is little doubt about the fact that in the era of financial liberalisation, instruments facilitating hedging against interest rate fluctuations remain far more important and relevant than their index-based counterparts.

The nature of the derivatives notwithstanding, the regulatory institutions will have to grapple with the issue of appropriate regulations, and whether or not financial derivatives will generate undersirable headlines in India would depend largely on the ability of the policy makers to usher in the appropriate regulatory framework. Given the information available about the Gupta Committee Report, it is apparent that the policy makers have taken cognizance of the fact that the financial strengths of the derivatives exchanges will be a key factor that can help minimise the adverse impact of insolvency on the part of one or two players in the market, thereby preventing the evolution of a "local" problem into a systemic one. The norms pertaining to capital adequacy will doubtlessly be followed by those regarding disclosures, marking-to-market, and settlement of dues. Finally, the process of regulation and supervision will also benefit significantly from the institutions of screen-based trading and the increased trading in dematerialised shares, both of which increase the degree of transparency in the cash markets.

Discussions regarding two important factors, however, have been muted, and it is perhaps these factors that would eventually determine the nature of India's tryst with financial derivatives. First, derivatives are often complex products and, while the nature of these instruments might be understandable *per se*, decisions to profitably enter into such contracts demand the ability of the player(s) to understand the dynamics between the variables that are embeded in the derivatives instruments and observable macroeconomic variables in general. For example, the decision to purchase a long-term equity anticipation securities (LEAPS), hinges upon the ability of the purchaser of the call or the put option to successfully predict the trends in the underlying securities and/or indices upto a period of two years. Given that movements in securities' prices in efficient markets replicate a random walk, and hence cannot be predicted *ex ante*, it is evident that the

problems associated with such decision making is a non-trivial exercise. A key question that begs a satisfactory debate, therefore, is the extent to which market players in India are conceptually ready to be able to (more or less) accurately predict trends in financial variables, thereby avoiding fiascos *a la* Orange County.

Second, one has to recognise the fact that ensuring a reasonable flow of information about the derivatives portfolios of the market players is only one aspect of the crucial issue of supervision and regulation. The other and equally important aspect of it involves the ability of the regulators to (i) interpret this information to recognise the degree of vulnerability of the players, and (ii) ascertain that the information provided by the regulated entities reflect the true status of their potential and actual exposures to risk. It is, for example, imperative for the regulatory organisation to understand the possible differences in the magnitudes of value-at-risk when estimated using the *delta-normal* and *monte carlo* methods [see Box 1]. The problem is aggravated by the fact that the players in the market continually innovate to create new derivatives products like *credit derivatives*,[24] the implications of which for the portfolios of these players have to be understood and evaluated by regulators even as the signals pertaining to the nature of these products are being revealed by the market.

At the end of the day, it has to be understood that although derivatives are powerful financial instruments, as with any other product, their best possible use is contingent upon the ability of the users and regulators of these instruments to clearly understand the factors determining the degree of successful usage. It would perhaps be naive to believe that the players in the market would necessarily use *plain vanilla* instruments that can easily be understood and priced. Experience of the developed capital markets suggest that the complexity of the instruments inscrease significantly over time, especially in case of OTC derivatives. While, therefore, prudential norms in the form of capital adequacy and marking-to-market are integral parts of the institutional framework of derivatives markets, information and knowledge are perhaps the two factors that can make the difference between a robust derivatives market and one stymied with systemic problems. Investment in human capital, a favourite issue of economists, must once again come to the fore.

Experience of the developed capital markets suggest that the complexity of the instruments inscrease significantly over time.

. . . information and knowledge are perhaps the two factors that can make the difference between a robust derivatives market and one stymied with systemic problems.

[24] There are four types of credit derivatibves, namely, credit default swaps, credit spread swaps, total rate of return swaps, and credit spread options. Credit default swap is the simpliest of these derivatives, and such a contract allows a lending institution to transfer the risk of default for the credit disbursed by it to a counterparty, against some upfront or periodical premium. As such, it is *de facto* a put option on the principal amount of the credit which is "owned" by the bank, and "written" by the aforementioned counterparty. While, in principle, such a derivative simply allows for risk sharing that lies at the heart of contracts that are "efficient" from the perspective of economic theory, the product opens the door for significant adverse selection under circumstances where profits from traditional banking practices are shrinking and when, therefore, the lure of fee based activities become insurmountable. The problem is further exacerbated by the fact that the value of the "premium" is likely to be high if the probability of default too is high, thereby making the profit from such off-balance-sheet activities an unreliable indicator of the health of the counterparties concerned. For a brief descritption of the other credit derivatives see IMF (1997, p. 158-159].

REFERENCES

Aggarwal, R. and A. L. DeMaskey, "Cross-hedging currency risks in Asian emerging markets using derivatives in major currencies," *Journal of Portfolio Management*, 23(3): 88-95, 1997.

Bank for International Settlements, *Central Bank Survey of Foreign Exchange and Derivatives Market Activity 1995*, Basle, 1996.

_____, *International Banking and Financial Market Developments*, Basle, 1997.

Bhaumik, S. K., "Financial derivatives I: A bird's eye view of the products," *Money & Finance*, 4: 45-71, 1998.

_____, "Liberalization vs. Regulations: Some Lessons for Financial Restructuring," *Journal of Transforming Economies and Societies*, 3(2): 2-14, 1996.

Bodie, Z., E. Kane and A. Marcus, *Investments*, Irwin, 1993.

Chen, A. H., "Derivatives and bank regulation," *Pacific Basin Finance Journal*, 5: 157-165, 1997.

Cornford, A., "Risks and derivatives markets: Selected issues," *UNCTAD Review*, 189-212, 1995.

Darby, M. R., "Over-the-counter derivatives and sytemic risk to the global finance system," NBER working paper no. 4801, 1994.

Dwyer Jr., G. P., "Index arbitrage and nonlinear dynamics between the S&P 500 futures and cash," *Review of Financial Studies*, 9(1): 301-332, 1996.

Edwards, F. R. and C. W. Ma, *Futures and Options*, McGraw Hill, 1992.

Garman, M. B., "Ending the search for component VAR," Mimeo (in html format), Financial Engineering Associates Inc., 1997.

Geczy, C. *et al*., "Why firms use currency derivatives," *Journal of Finance*, LII(4): 1323-1354, 1997.

General Accounting Office, *Financial Derivatives: Actions Needed to Protect the Financial System*, Report no. GAO/GGD-94-133, 1994.

Hentschel, L. and C. W. Smith Jr., "Derivatives regulation: Implications for central banks," *Journal of Monetary Economics*, 40(2): 305-346, 1997.

International Monetary Fund, *International Capital Markets: Developments, Prospects, and Key Policy Issues*, November 1997.

Kan, A. C. N., "The effect of index futures trading on volatility of HSI constituent stocks: A note," *Pacific Basin Finance Journal*, 5: 105-114, 1997.

Kane, E. J., "Making bank risk shifting more transparent," *Pacific Basin Finance Journal*, 5: 143-156, 1997.

Jorion, P., "Orange county case," Mimeo (in html format), University of California, Irvine, undated.

Miller, M. H., "The future of futures," *Pacific Basin Finance Journal*, 5: 131-142, 1997.

Pennings, J. M. E. and M. T. G. Muelenberg, "Hedging efficiency: A futures exchange management approach," *Journal of Futures Markets*, 17(5): 599-615, 1997.

Randall, R. E. (ed.), *Safeguarding the Banking System in an Environment of Financial Cycles*, Federal Reserve Bank of Boston, 1993.

Rivett, P. And J. Davies, "Credit derivatives," Mimeo (in html format), Coopers & Lybrand, undated.

Sarkar, A. and M. Tozzi, "Electronic trading on futures exchanges," *Current Issues in Economics and Finance*, Federal Reserve Bank of New York, January 1998.

Shah, A. and S. Thomas, "Securities markets: Towards greater efficiency," *India Development Report*, Oxford University Press, 1997.

Siems, T. F., "Derivatives: In the wake of disaster," Mimeo (in html format), Federal Reserve Bank of Dallas, undated.

TABLE 1
Notional Principal of New Swaps by Location and type of End-User
(USD billion)

		1991	*1992*	*1993*	*1994*	*1995*
		INTEREST RATE SWAPS				
All end-users	**All countries**	**844.7**	**1436.7**	**2000.6**	**2982.4**	**3709.0**
	North America	315.6	493.2	646.1	971.1	1333.0
	Europe	328.8	673.4	953.0	1270.0	1712.0
	Asia	121.7	156.6	287.0	418.2	472.0
Financial Institutions	**All countries**	**492.4** (58.2%)	**853.9** (59.4%)	**1115.7** (55.7%)	**1632.5** (54.7%)	**2292.9** (61.8%)
	North America	174.8	255.5	321.7	471.1	725.4
	Europe	205.6	463.8	615.1	892.6	1247.9
	Asia	74.6	80.2	134.1	194.4	222.1
Governments	**All countries**	**79.0** (9.3%)	**148.9** (10.3%)	**198.6** (9.9%)	**178.8** (5.9%)	**232.4** (6.2%)
	North America	24.5	43.8	101.2	87.3	158.2
	Europe	40.3	75.0	72.0	73.9	62.6
	Asia	2.9	12.0	6.9	8.9	8.0
Corporations	**All countries**	**273.3** (32.3%)	**434.0** (30.2%)	**678.0** (33.8%)	**1150.0** (38.5%)	**1183.7** (31.9%)
	North America	116.4	193.9	222.3	412.7	449.4
	Europe	82.9	134.7	265.9	303.5	401.5
	Asia	44.2	73.4	146.0	215.0	241.9
		CURRENCY SWAPS				
All end-users	**All countries**	**219.1**	**234.7**	**239.0**	**296.7**	**301.3**
	North America	39.2	53.6	42.4	62.6	58.2
	Europe	106.9	122.3	130.0	149.9	169.9
	Asia	54.2	42.4	39.5	51.0	55.8
Financial Institutions	**All countries**	**98.6** (45.0%)	**78.9** (33.6%)	**77.2** (32.3%)	**107.6** (36.2%)	**143.8** (47.7%)
	North America	13.3	11.4	11.8	17.8	19.8
	Europe	59.9	55.3	47.4	63.2	91.5
	Asia	18.8	7.1	9.7	20.2	24.3
Governments	**All countries**	**30.7** (14.0%)	**42.2** (17.9%)	**52.7** (22.0%)	**54.3** (18.3%)	**49.0** (16.2%)
	North America	5.0	7.1	9.3	12.3	12.2
	Europe	17.7	29.1	29.7	24.9	26.9
	Asia	2.8	1.9	5.4	8.5	7.3
Corporations	**All countries**	**89.7** (40.9%)	**113.7** (48.4%)	**109.0** (45.6%)	**134.7** (45.3%)	**108.5** (36.0%)
	North America	20.8	35.1	21.4	32.6	26.2
	Europe	29.3	37.8	52.9	61.8	51.4
	Asia	32.7	33.3	24.4	22.3	24.3

Note: The percentages in parentheses might not add up to 100 for the respective years because of rounding off errors.
Source: Bank for International Settlements, *International Banking and Financial Market Developments*, Basle, November 1997, p. 53–52.

TABLE 2
Turnover of Exchange Traded Derivatives by Insturment and Location
(Notional Principal in USD Trillion)