RBI Technical Committee

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# Foreign Currency - Rupee Options

## Introduction in Indian Market

# Preface

The Reserve Bank of India has been considering the introduction of Foreign Currency – Rupee (FC/INR) options as a part of developing the derivative market in India and adding to the spectrum of hedge products available to residents for hedging currency exposures. In this context, it constituted a Technical Committee with Smt. Grace Koshie, Chief General Manager-in-charge, Exchange Control Department as Chairperson. This committee was entrusted with the task of going into the details of the product and preparing a roadmap for the introduction of currency options in India.

The members of the Committee are as follows:

| | **Institution** | **Name of the representative** |
|---|---|---|
| 1. | Bank of India | Pawan Bajaj |
| 2. | Canara Bank | K.G. Hegde |
| 3. | Citibank | Ananth Narayan |
| 4. | FEDAI | B.Y. Olkar |
| 5. | ICICI Bank Ltd. | Neeraj Gambhir |
| | ICICI Bank Ltd. | Sushil Sawant |
| 6. | Reserve Bank of India | P. Krishnamurthy |
| | Reserve Bank of India | G. Padmanabhan (Convenor) |
| 7. | State Bank of India | Partha Bhattacharyya |

The Committee had a series of meeting over the period June –02 to October-02 and this report is the outcome of the deliberations that the Committee had on the various issues regarding the introduction of foreign currency-rupee options. The overall structure of this report is as follows:

- **Part I** discusses the evolution of the option markets around the world and international experiences of the market responses after introduction of the currency options market. This part also looks at the current foreign exchange derivative products available in India and builds a rationale for the introduction of foreign currency - rupee options.

- **Part II** discusses the suggested roadmap for the introduction of FC-INR options addressing the following issues:

  (1) Inception of the FC/INR options market

    (a) Market structure and regulatory framework

    (b) Pricing and quotations

    (c) Risk Management

    (d) Documentation and Regulatory reporting

    (e) Accounting

  (2) Road map for review and further development of the market

- **Part III** comprises of Modules which discuss the theory of option pricing, give illustrations of how the market will quote and trade FC-INR options, and give details of the accounting entries to be passed for option transactions

The Committee would like to acknowledge various market participants and organisations (mentioned in Schedule VII) for providing their valuable suggestions and feedback during the discussions and preparation of the report.

## Table of Contents


**1 A brief history of option markets ..... 3**

*1.1 An introduction to options ..... 3*

*1.2 Options and market completeness ..... 4*

*1.3 Pricing and valuation: The academic approach ..... 4*

1.3.1 Model choice: Science, art or market convention ..... 5

**2 Introduction of currency options – International experiences ..... 7**

*2.1 Option markets in various countries ..... 7*

*2.2 Option markets as predictors of movements in underlying markets ..... 8*

**3 Indian derivative markets – A case for FC-INR options ..... 10**

*3.1 Derivative products available to Indian players ..... 11*

3.1.1 Products in overseas markets ..... 11

3.1.2 Rupee derivatives ..... 12

*3.2 Derivatives in India: Perspectives ..... 13*

*3.3 A case for FC-INR options ..... 14*

**4 Suggested market framework ..... 16**

*4.1 Regulatory framework and nature of the product ..... 16*

4.1.1 Nature of product ..... 17

4.1.2 Market participants ..... 18

*4.2 Pricing and quotation systems ..... 23*

*4.3 Risk management framework ..... 24*

4.3.1 Authorised dealers ..... 24

4.3.2 Risk management for clients: ..... 25

*4.4 Documentation and regulatory reporting ..... 25*

4.4.1 Documentation ..... 25

4.4.2 Regulatory reporting ..... 25

*4.5 Accounting ..... 26*

**5 Future development and evolution of the market – A roadmap ..... 29**

*5.1 Market inception ..... 29*

*5.2 Introduction of exotic options ..... 29*

*5.3 Clients as net receivers of premium ..... 30*

**6 Schedule I – Option data ..... 31**

**7 Schedule II – Option impact on underlying volatility ..... 33**

*7.1 Emerging markets: Czech Koruna and Polish Zloty ..... 33*

*7.2 European markets: Italy and Spain ..... 35*

**8 Schedule III – Theory of option pricing ..... 38**

*8.1 Discussion of the basic models for option pricing ..... 38*
8.1.1 The Black Scholes model ..... 38
8.1.2 Garman - Kohlhagen model: Currency options ..... 40

*8.2 Alternative pricing models ..... 40*
8.2.1 Tree Approaches ..... 40
8.2.2 Models for stochastic volatility ..... 41
8.2.3 The Jump Diffusion model ..... 42

*8.3 The Greeks in detail ..... 43*

*8.4 References for a further discussion of option pricing models ..... 46*
8.4.1 Books ..... 46
8.4.2 Papers ..... 47

**9 Schedule IV– Illustrations of option pricing and quotation ..... 51**

*9.1 Option pricing example ..... 51*
9.1.1 Using Black-Scholes formula ..... 51

*9.2 Delta equivalent spot position for a FC-INR option portfolio ..... 52*

*9.3 Forward positions from a FC/INR option portfolio ..... 53*
9.3.1 Suggested procedure for computation and monitoring of Forward Limits ..... 54

*9.4 Volatility fixings by British Bankers Association ..... 56*

**10 Schedule V– Detailed accounting entries ..... 57**

*10.1 Accounts ..... 57*

*10.2 Accounting entries ..... 57*
10.2.1 Recording the notional ..... 57
10.2.2 Premium payable: ..... 58
10.2.3 Premium receivable: ..... 59
10.2.4 Daily valuation entries ..... 59
10.2.5 Option expiry entries: ..... 60
10.2.6 Contract liquidation prior to maturity ..... 60

**11 Schedule VI– Acknowledgements ..... 63**

# Executive Summary

The Reserve Bank of India has been considering introduction of Foreign Currency-Rupee (FC/INR) options as a part of developing derivatives market in India and adding to the spectrum of hedge products available to residents for hedging currency exposures. In this context, it constituted a Technical Committee to lay out the road map and work out the details regarding pricing, risk management, accounting and regulatory issues. This report is outcome of the deliberations the Committee had between July 2002 and October 2002.

The Committee looked at the evolution of option markets as well as the impact of introduction of currency options in other countries. The current status of derivative markets in India was discussed in detail to make a case for speedy introduction of currency options in India. The Committee considered the inputs gained from the above exercise as well as feedback from clients to evolve a roadmap for the introduction of Foreign Currency-Rupee option markets in India. The Committee recommends a phased introduction of the product with further product enhancements in stages as follows:

1. Options may be introduced as OTC contracts with specifications like notional, strike, and maturity tailored to client needs. Initially they may be introduced as vanilla European exercise call and put options and structures thereof.

2. Authorized dealers may provide bid-offer quotes for options of varying maturities and exercise prices to their clients. The clients who would be able to use this product would be within the framework of Schedule I and II of the RBI Notification No FEMA 25/RB-2000 dated May 3, 2002 (similar to forward contracts). Further, they should also comply with the existing requirements regarding derivative products as per RBI circular A.D. (M.A. Series) circular No.1 dated January 24, 2002. In the initial phase, the clients could be allowed to enter into cost reduction strategies involving selling of options, provided there is no net flow of premium to them.

3. The committee suggests that an interbank market in FC-INR option contracts be allowed to enable ADs to initiate positions and manage risks on positions arising out of client and interbank transactions within prescribed limits.

4. Authorised dealers could quote the option premium as absolute amount or as a percentage of notional. The Committee does not recommend any particular model/formula for pricing options. However, internationally, implied volatilities on the basis of Black Scholes model (the volatility input in BS formula, which gives the option price) are quoted in the interbank market (by convention). The Committee feels that the same convention may be followed in Indian markets for standardisation and transparency. The price may be determined independently by any mechanism, but can be filtered through BS formulae for quoting. FEDAI could publish on regular basis a

matrix of polled implied volatility estimates. Various market participants could then use this matrix and BS valuations for MTM of their portfolios.

5. Regarding hedging of option portfolios the Committee suggests that:
    - Authorized dealers should be free to access spot market to delta-hedge the option portfolios
    - Authorized dealers may be allowed to hedge the other "Greeks" through interbank option transactions

6. With regard to Risk Management systems, the committee recommends the following in the nature of best practices for authorised dealers:
    - Approval from their Board/Risk Committee/ALCO for dealing in the product with appropriate risk management framework.
    - Risk management system, which allows daily computation of the MTM of the portfolio and various Greeks.
    - ADs could also be required to inform their appropriate reporting authority on regular intervals about the activities undertaken on this product.

7. The Committee suggests that ADs report separately the Delta equivalent of option positions and total open exchange positions to RBI for the purpose of monitoring the aggregate risk being carried by the system. Authorized dealers may also be required to report to RBI on periodical basis, details of the option transactions undertaken, net option portfolio delta, total open exchange position and portfolio "Greeks " for information.

8. The Committee recommends use of ISDA documentation as the basis for recording contracts between authorized dealers and counter-parties.

9. The accounting framework currently applicable for cross-currency options may be followed for FC-INR option transactions.

10. The Committee suggests periodic review of the market development by FEDAI and Reserve Bank of India. The Committee is of the view that, based on the experience gained, the following may be considered:
    - Introduction of options with exotic features
    - Clients being net receivers of premium

Part

1

# 1 A brief history of option markets

*Time is elastic ……* *Marcel Proust*

## 1.1 An introduction to options

Foreign exchange (FX) options are contracts that give the buyer the right, but not the obligation, to buy or sell one currency against the other, at a predetermined price and on or before a predetermined date. The buyer of a call (put) FX option has the right to buy (sell) a currency against another at a specified rate. If this right can only be exercised on a specific date, the option is said to be European, whereas if the option can be exercised on any date till a specific date, the option is said to be American.

Options have been used as financial instruments for centuries now. They were popular as far back as in seventeenth century Netherlands. Options on stocks were first traded on an organized exchange in 1973. While options on foreign currencies are traded on several organized exchanges, liquidity in currency options trading is centred in the over-the-counter (OTC) market. In fact, according to Malz (1998), the prices of OTC currency options provide a better expression of changing views of future exchange rates than do prices of exchange traded currency options.

> Much of the available data on the size and liquidity of the FX & derivatives markets are complied by the Bank of International Settlements (BIS). According to the BIS, the amount of outstanding FX option contracts as of March 1995 was US$ 2.5 trillion, the value of which amounted to US$ 71 billion. This is against the daily transactions in FX spot and forwards, which amounted to US$ 1.1 trillion in April 1995. Data for more recent times (half yearly volumes till June, 2001) is appended in Schedule 1.

## 1.2 Options and market completeness

With its focus on market volatility, the options market in a sense complements the spot and forwards FX market to provide the complete universe of hedging (and speculating) avenues for market participants. The standard ways in which end users utilise options are as follows:

1. Protection against downside risk (buying simple puts and calls to hedge existing FX positions)

2. Earn from covered option writing (e.g. a Japanese exporter who is long US$, selling a US$ call/ JPY put option)

3. Hedge against event driven violent moves, by buying cheap out of money calls and puts

4. Take directional views on spot and volatility

Market-makers on the other hand, typically use options not to take directional exchange rate positions, but to take positions on the volatility of the underlying. Thus trading desks would buy (sell) options if they expected the volatility of the underlying FX to increase (decrease). With this in mind, in the interbank currency option market, dealers often exchange the delta hedge when they do an options deal. The purchaser of a call, for example, will sell the forward foreign exchange to the writer. This practice of 'crossing' the delta ensures that the dealers are in agreement on the current forward rate.

It has been argued in academic literature that new financial securities can help in completing markets if their payoffs cannot be replicated by a linear combination of existing securities. Moving from an incomplete market to a complete market is welfare enhancing. It could be argued that the possibility of option contracts being replicated by dynamic underlying transactions makes them redundant. However, it has been shown that the trading of options provides information, which is otherwise unavailable (the market estimate of future volatility). Options in this sense appear to complete the market.

## 1.3 Pricing and valuation: The academic approach

> In the case of forwards and futures, some form of interest rate parity eventually determines the arbitrage free prices. Pricing of options, however, is a far greater mathematical challenge, since by definition, the probability of events had to be meaningfully estimated.

The pioneer in the area of option valuation was Louis Bachelier, who in 1900, produced a paper that derived pricing formulas for puts and calls on stocks whose underlying prices followed a normal distribution. Subsequently, Sprenkle

(1961), Boness (1964) and Samuelson (1965) proposed a description of stock price evolution by assuming that the underlying price is lognormally distributed. However, this formula was difficult to use in practice, as it contained too many unknown parameters, viz. the volatility of the stock, the growth rates of the stock and the option itself. The major breakthrough in option pricing came when Black and Scholes (1973) and Merton (1973) discovered a consistent pricing formula for stock options depending on the volatility of the underlying stock and the risk free interest rate. This breakthrough, within a few years, helped create a multi-trillion dollar market in financial derivatives. Subsequently, Black (1976) derived the formula for pricing of options on futures. Simultaneously, numerical methods to solve more complicated problems were developed as well. The earliest were the so-called binomial (Cox, Ross & Rubinstein -1979), explicit finite difference (Schwartz – 1977) and Monte Carlo (Boyle - 1977) methods. Garman and Kohlhagen (1983) extended the Black Scholes valuation formula to incorporate options on foreign exvhange (FX). Rubinstein and Reiner (1991) used the method of images to price exotic options such as barrier options.

Schedule III describes the mathematical approach for valuation of an FX option (European puts and calls) using the Garman and Kohlhagen method. It also describes the various 'Greeks' that are used to measure the risks of an option position.

### 1.3.1 Model choice: Science, art or market convention

It must be emphasized that in spite of its many successes, the Black-Scholes and therefore the Garman and Kohlhagen formula is too idealized and does not capture certain features of the market. The most important of these features are the non-lognormal distribution of the underlying prices, transaction costs, liquidity and discontinuous nature of trading. When this formula is used in practice, different volatilities are used to price options with different strikes, giving rise to the so-called volatility smile. Similarly, mismatches in demand in supply and market expectations may imply that the volatilities used for pricing puts are different from those used for pricing calls, at the same strike. This is expressed in the marketplace as a risk reversal rate.

The price conventions of the OTC option markets are typically based on the Black-Scholes pricing model. In fact, the two-way price on standard options is quoted in terms of the volatility the quoting dealer is willing to buy and sell the option at, assuming the volatilities were to be applied on the Black-Scholes formula. It is important to emphasize that dealers draw their terminology from the model, even though they do not believe that it is strictly accurate. As discussed earlier, even the feature of the actual markets that most flagrantly violates the Black-Scholes model's assumptions – the volatility smile – is most conveniently characterized using the Black-Scholes model's terminology. Because the standard currency options markets are highly active and liquid, participants do not turn to an option-pricing model to learn how much a standard option is worth, but only use it to understand the prices being quoted in the marketplace. The exceptions are exotic options, for which no liquid market exists. Even here, the

role of the model is only to provide guidance about value, since it cannot dictate prices to the market.

# 2 Introduction of currency options – International experiences

*I prefer the judgement of a 55 year old trader to that of a 25 year old mathematician …….* Alan Greenspan

## 2.1 Option markets in various countries

FX options have been growing in popularity not only in well-developed economies, but also in emerging markets. In the emerging markets, capital account liberalization has increased currency exposures of both domestic and foreign entities. The demand for instruments to manage the currency risk associated with portfolio investment, as well as foreign direct investment, is expanding quickly. Hedging products have also evolved rapidly in countries that have moved to more liberalization within managed float regimes.

The Committee looked at the evolution of currency options in countries like Hungary, Poland, South Africa, Korea, Czech Republic, Malaysia, Taiwan, and Thailand within the emerging markets category. While each market has its own nuances, there were a few discernable common threads.

1. Most markets allow domestic and foreign participants with exposures in the local currency to hedge their exposures in the onshore options market. While the actively traded options are generally simple at-the-money put/call options in the interbank market, most countries also allow offering of customized exotic options by dealers to their customers. Generally, authorized dealers are allowed to run volatility positions without any specific underlying, so as to enhance the liquidity in the markets.

2. While volumes in options markets have increased over the years in the emerging market currencies, they still remain low in relation to the volumes of options in the G7 currencies. In most emerging markets, the lack of liquidity in the long tenor FX forwards markets (as in Poland, Czech, Taiwan etc.) dramatically increases the prices of tenor options.

3. The introduction of options has been found to affect the volatility of the underlying cash market, causing a decrease in volatility in most cases. Various academic research papers also support this finding. Shastri, Sultan, and Tandon (1996) conclude that options contracts complete the market and stabilize the behaviour of the underlying instrument. Their analysis suggests that the introduction of option contracts lowers volatility of the underlying instrument, enhancing its stability, regardless of its type. Schedule II lists some data on Czech Koruna, Polish Zloty, and on the G7 side, historical Italian Lira and Spanish Peseta in support of this view.

4. Research also suggests that options have increased the speed at which the markets absorb information and adjust prices, thus making the markets more efficient. The Committee did not find any evidence of the impact of currency options on overall trading volumes in the underlying cash markets.

## 2.2 Option markets as predictors of movements in underlying markets

Campa and Chang (1998), after identifying a term structure of volatility based on implied volatilities in foreign exchange options, tested whether today's implied volatility on both the long dated and short dated options is consistent with future implied volatilities. They used daily OTC data for the US$ against the sterling, mark, yen and Swiss franc. They concluded that in sharp contrast to the literature on the term structure of interest rates, for all currencies and maturity pairs, current spreads between long run and short-run volatility do predict the right direction of future short-dated and long-dated changes.

Some of the other conclusions drawn by academic research are as follows:

1. Implied volatility is more accurate in predicting volatility increases than volatility decreases. It reflects intensive usage of options as a hedging tool when volatility increases

2. Implied volatility contains information that is useful in predicting the direction as well as magnitude of movement of volatility in underlying market

3. More flexible exchange rate regimes calls for higher volatility premiums

4. Implied volatilities derived from option pricing can be used to predict future exchange rates

The Committee would like to elaborate the last finding by looking at the volatility term structure of the Argentinean currency at year-end 2001. The enclosed graph shows the volatility surface of the ARS the last year. The surface predicted a violent devaluation in the near term, something that became a reality in January 2002.

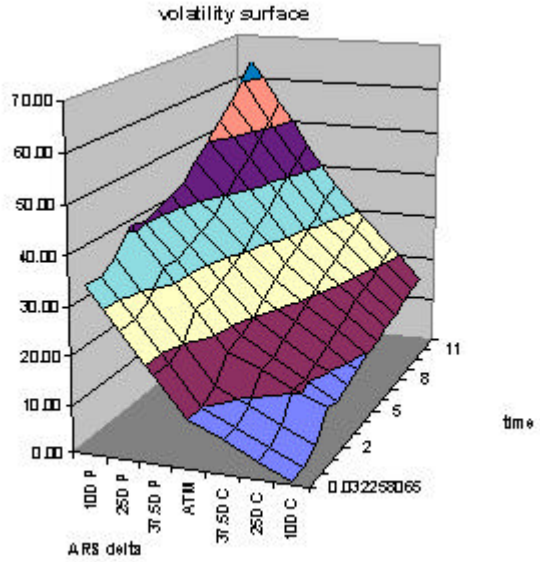



**Fig: Volatility surface of Argentinean peso**

# 3 Indian derivative markets – A case for FC-INR options

*As these events are beyond our understanding let us fake being their instigator……* Jean Cocteau

## Genesis

Business operations, by their very nature, are exposed to several risks in financial markets. The major financial decision is of course the financing mix (Debt Vs. Equity), but business operations expose the corporate to risks arising from fluctuations in foreign exchange rates, interest rates, commodity prices, equity prices etc. The risk appetite of the corporate determines the extent of hedging as well as the mechanisms for managing these risks. While market savvy corporates would like to manage their financial exposures actively, the risk-averse corporates would prefer to hedge themselves against them and focus on their core businesses. Irrespective of the risk preferences, understanding the financial risks their businesses are exposed to is critical for the survival of any non-financial corporation.

Financial Corporations provide corporates the necessary instruments and solutions to manage their exposures. Further, financial Corporations themselves need to cover the risks innate in their balance sheets. Historically, derivatives have emerged as ideal vehicles for transference of risk from one entity to another. Over the decades, financial markets created a variety of derivative products to suit the myriad needs of businesses. Apart from being ideal vehicles for transference of risk, derivatives helped markets by increasing depth and improving transparency. The easy availability, high leverage effect, low credit exposure and flexibility made derivatives popular with the users.

## Indian Scenario

In the pre-liberalization era, Indian business operated in an insular economic environment shielded from global competition. The limited number of financial products and the strict regulatory regime did not lend much scope for a derivative market to develop. Typically an Indian Corporate depended on term lending institutions for their project financing and the commercial banks for working capital finance. Commercial Banks were content to keep the asset side of their balance sheet liquid and were hardly alive to the risks arising from the mismatched interest rate re-pricing of assets and liabilities. A simple and much restricted foreign exchange forward contract was the only derivative product in the pre-liberalized era.

The liberalization process initiated in the early nineties brought in momentous change in the economic environment. The need to operate in a rapidly globalising and progressively deregulating economy forced Indian businesses to take a closer look at all aspects of their operations to remain competitive. In this process, the neglected areas like financial risks have come into sharper focus and Treasury has become a hub of action for all major corporates.

The first tentative steps towards developing a derivative Market in India started with freeing of the conventional forward contract. Allowing banks to pass on gains upon cancellation to the customers and permitting customers to cancel and re-book were the first significant changes in the long dormant derivatives market in India. Further easing of restrictions came in the form of introduction of Cross Currency Forward Contracts. Prior to this all, structures involving derivatives needed specific approval from the Ministry of Finance and RBI.

A major step in developing forex derivatives market in India was the introduction of Cross Currency Options. This was a significant step in the RBI endeavour to facilitate corporate use of derivative products in sophisticated hedging strategies.

## 3.1 Derivative products available to Indian players

The Indian derivatives market is continuously evolving; though there have been significant milestones in the development phase, the market has to still traverse a long way to become comparable with developed markets in terms of product variety, market sophistication, liquidity, depth and volumes.

The derivative products can be broadly classified as:

1. Product traded in overseas markets
2. Products involving the Rupee – Rupee derivative markets

### 3.1.1 Products in overseas markets

RBI allows Indian corporates need based access to a wide range of derivative products available in established international exchanges like LME, Simex, LIFFE, CBOT and the OTC market. Some of these products are:

1. Cross Currency options

   All Indian clients are allowed to purchase cross currency options to hedge exposures arising out of trade. They are allowed to use cost reduction strategies and structures as long as they are not net receivers of premium. Authorised dealers in India who offer these products are

required to cover these products back to back in international markets and not carry the risk in their own books.

2. Foreign currency Interest Rate Swaps/Forward Rate Agreements/Interest rate options/ Swaptions/ Caps/ Floors

   Indian banks are allowed to use the above products to hedge interest rate and currency mismatches on their balance sheets. Clients, resident as well as non-resident, are allowed to use the above products as hedges for liabilities on their balance-sheets

3. Commodity futures/ Options

   Corporates are allowed to cover non-bullion/silver commodity exposures from any of the overseas exchanges and can remit the necessary margins in foreign exchange. Large Indian players in commodities are fairly active in these markets.

### 3.1.2 Rupee derivatives

These include the following:

1. Equity Derivatives

   Exchange traded derivatives like Index Swaps, Index Options, Stock futures and Stock Options are becoming increasing popular with both retail investors and institutions. These are traded on both the major exchanges, Bombay Stock Exchange (BSE) and National Stock Exchange (NSE).

2. Commodity futures

   Several Commodity Futures Exchanges have come up in India in places like Mumbai, Kolkota, Bangalore, Cochin, etc. Each of these exchanges specialises in a single commodity. Market action in them is dominated by producers' cartels and public sector units like STC. The modus operandi is similar to major international exchanges. Liquidity is poor with market being dominated by few players.

3. Rupee Interest Rate swaps

   A market in these swaps has evolved quite rapidly over the last year. This is an OTC market wherein the major players are banks (nationalized, private and foreign) as well as corporates. Though the number of players and hence the liquidity is low, daily market turnover has increased from about Rs. 200 crores last year to current turnover of Rs. 600 crores with the entry of new players and increased corporate activity. The market has seen deals for maturity up to 10 years and the

most popular benchmarks are overnight interest rates (MIBOR rare, overnight forward implied MITOR) and other benchmarks like 6 month MIFOR (forward implied rupee rates) as well as Government security benchmark yields (in INBMK swaps).

## 3.2 Derivatives in India: Perspectives

Like in other parts of the world, commercial banks have provided the main impetus for development of derivatives market in India and are expected to do so further. The increased awareness among banks and financial institutions of the balance sheet mismatches and resulting risks has created a need for appropriate risk management products. Derivatives help Banks in broad basing their product lines and offering customized solutions tailored to specific needs of their Corporate Clients. Indian Business, shedding its pre-liberalization mindset, has also started looking for more innovative products and sophisticated solutions to optimise the financing and treasury management function. The regulatory set-up has also seen progressive liberalization with continuous addition to the spectrum of products allowed to Indian players. This backdrop provides fertile ground for the rapid growth of derivative market in India.

**Areas for facilitating derivatives markets**

A major step in the development of OTC rupee derivatives would be the amendment of SCRA to accord legal sanctity to OTC traded derivatives. SCRA requires a derivative product to be exchange traded and settled to be legally enforceable. Most non-standardized (derivatives other than futures) derivatives world over are OTC traded. Besides, commercial banks are the driving force behind Indian derivatives market and this suggests that OTC market would dominate the derivatives market in times to come. This being the case, unless SCRA accords legal sanctity to OTC traded derivatives, a good many players would perforce continue to stay away from this market. FIMMDA has proposed to RBI an amendment to SCRA. A major fillip to Indian derivative markets would be the evolution of uniform documentation and market practices to fully take care of the complexities of derivative products. The Committee feels that the issue would lose criticality as more and more players sign standard ISDA documentation agreements for derivative contracts and the market bodies, FIMMDA and FEDAI, evolve norms for the players in the respective markets.

The establishment of internationally accepted and understood accounting standards and disclosure norms and their recognition by tax authorities in the Indian scenario, is also a required step for a more rapid and orderly development of derivatives market.

**Future Developments**

The rupee derivatives market is characterized by a lower number of active corporates, fewer market makers and the resulting paucity in liquidity and market depth. Only a handful of corporate clients are actively using derivatives for their risk management. As corporate treasuries get sophisticated and new products enter the market, the potential is enormous.

Introduction of derivatives on interest rates (caplets, floorlets, swaptions, etc), credit risk (credit linked corporate notes, credit linked swaps, asset backed securities, etc), currency (rupee options) as well as structures combining these products would be expected to complete the market as well as provide the entire spectrum of investment and hedging products to banks, clients, corporates and retail players to manage their finances. Derivatives should make rapid strides in Indian markets with increasing product familiarity, increasing market participation and development of a supporting regulatory, legal and tax framework to encourage use of new and innovative products in sophisticated risk management strategies.

## 3.3 A case for FC-INR options

The current products available in FX derivative markets to hedge the risks on foreign exchange exposures are rupee forwards, rupee forex swaps, cross currency forwards and long term swaps, and cross currency options. However, for hedging forex risk, corporates are restricted to the use of forwards and long-term currency swaps.

Forwards and swaps do remove the uncertainty by hedging the exposure but they also result in the elimination of potential extraordinary gains from the currency position. Currency options provide a way of availing of the upside from any currency exposure while being protected from the downside for the payment of an upfront premium. Introduction of FC-INR options would enable Indian forex market participants manage their exposures better by hedging the foreign exchange risk.

The advantages of FC-INR currency options would be as follows:

1. Hedge for currency exposures to protect the downside while retaining the upside, by paying a premium upfront. This would be a big advantage for importers, exporters (of both goods and services) as well as businesses with exposures to international prices. Currency options would enable Indian industry and businesses to compete better in international markets by hedging currency risk.

2. Non-linear payoff of the product enables its use as hedge for various special cases and possible exposures e.g. If an Indian company is bidding for an international assignment where the bid quote would be in dollars but the costs would be in rupees, then the company runs a risk till the contract is awarded. Using forwards or currency swaps would create the reverse positions if the company is not allotted the contract, but the

use of an option contract in this case would freeze the liability only to the option premium paid upfront.

3. The nature of the instrument again makes its use possible as a hedge against uncertainty of the cash flows. Option structures can be used to hedge the volatility along with the non-linear nature of payoffs.

4. Attract further forex investment due to the availability of another mechanism for hedging forex risk.

The Committee feels a rupee options market would complement the spot and forwards FX market to provide the complete universe of hedging instruments for corporate customers. FC-INR options would be an instrument that also depends on a unique parameter, the volatility of the underlying, and thus help to complete the market.

The Committee finds the above compelling reasons for the introduction of a FC - INR options market in India to complete the spectrum of available rupee derivative products to hedge forex exposures.

Part

# 2

*Understanding a theory means understanding it as an attempt to solve a certain problem ……..* Sir Karl Popper

## 4 Suggested market framework

The Committee has considered the experience gained from international examples well as feedback from corporate clients to suggest the following roadmap for the introduction of option markets in India. The Committee suggests a phased introduction of the products with further enhancements in stages. This section of the report deals with the following issues:

(1) Inception of the FC-INR options market

   (a) Market structure and regulatory framework

   (b) Pricing and quotations

   (c) Risk Management

   (d) Documentation and Regulatory reporting

   (e) Accounting

(2) Review and further development of the market

### 4.1 Regulatory framework and nature of the product

The Committee makes the following suggestions regarding the regulatory framework at inception:

### 4.1.1 Nature of product

The committee had an extensive deliberation regarding the product nature at the inception of the market. There were essentially two views:

(1) A stream of thought was that options being a new product, a conservative approach be followed towards the introduction of the product in Indian markets. It was felt that one should introduce the product in its simplest form, and then gradually move to successive levels of complexity. Options being non-linear products require a sophisticated hedging and risk management framework. The opinion was that introduction of vanilla European options and combinations thereof would give all the concerned players familiarity with the product as well as the opportunity to validate their systems and risk management frameworks.

(2) Another point of view was that the introduction of options could be done in a more comprehensive manner by allowing all exotic options to be dealt at the inception of the market itself. This, it was felt, would reduce the cost to the clients as well as create more interest and liquidity in the market. This step, it was opined, would result in increased sophistication and a more rapid development of the market. Players who have extensive experience in overseas markets would have the risk management framework and systems in place, and could start dealing in these at the very inception of the market.

After extensive deliberations on the pros and cons of both approaches, the Committee came to the opinion that though development of market in terms of volumes and sophistication is the ultimate aim, the approach to it may be in phases. At inception, the FC-INR options market could start with plain vanilla European call and put options and structures thereof. Variants of the product could then be introduced after a review when players had developed confidence and comfort with their systems and risk management framework to handle products with exotic features (e.g. American exercise, barriers, digital payoffs, asian payoffs, etc). Hence, the Committee recommends the following product structure at inception:

1. Options can be introduced as over-the-counter contracts. Initially they may be introduced as plain vanilla European exercise call and put options and structures thereof

2. Contract Specifications:

    a. Over the Counter contracts which can be tailored to suit the counterparty needs

    b. Currency pairs: FC-INR where the foreign currency may be the currency desired by the client

    c. Exercise style: European

d. Notional amount: No minimum notional amount is suggested. It can be suited to meet counterparties' requirements

e. Premium: Payable, usually on Spot basis

f. Settlement: As specified in the contract, either delivery on Spot basis or net cash settlement in Rupees on Spot basis, depending on the FC-INR Spot rate on maturity date. (Reference rate could be the RBI reference rate at 12.00 noon or as specified in the contract itself)

g. Strike price: Tailored to counterparties' needs

h. Maturity: The maturity of the options could be tailored to the requirements of the transacting parties. The typical maturities observed in international markets in currency options are 1 week, 2weeks, 1 month, 2 months, 3 months, 6 months, 9 months, and 1 year.

### 4.1.2 Market participants

Authorised dealers may be allowed by the RBI to enter into FC-INR option contracts with their clients. ADs could provide bid-offer quotes for options of varying maturities and exercise prices to their clients.

#### 4.1.2.1 Market participants - Clients for option contracts

A person resident in India could be allowed to use foreign currency – rupee (FC-INR) options to hedge his exposure arising out of trade, foreign currency liabilities, etc within the framework of Schedule I to the RBI Notification No FEMA 25/RB-2000 dated May 3, 2002.

Currency options would hedge currency risks similar to forward contracts, and hence the committee suggests that these option contracts may be allowed to all market participants for all exposures on which forward contracts are currently allowed. These would include:

1. Indian residents

    a. To hedge genuine exchange rate exposures arising out of trade/business (authorized dealer may book transactions on estimated exposure for uncertain amounts or for clients with regular annual transactions)

    b. FC loans/ bonds after approval by the RBI

c. In case of Global Depository Receipts (GDRs), after the issue price has been finalized

d. Balance in EEFC accounts

1. Foreign Institutional Investors

    a. To hedge their exposures in India provided that the value of the hedge does not exceed 15% of the market value of the equity at initiation of the hedge

1. Non Resident Indian or Overseas Corporate Body

    a. Amount of dividend due on share held in an Indian company

    b. Balances held in FCNR and NRE accounts

    c. Amount of investment under portfolio scheme in accordance with FERA or FEMA.

In addition, FC-INR option contracts may be permitted to hedge the following

1. Special cases and contingent exposures. e.g. If an Indian company is bidding for an international assignment where the bid quote would be in dollars but the costs would be in rupees, then the company runs a risk till the contract is awarded. Using forwards or currency swaps would create the reverse positions if the company is not alloted the contract, but the use of an option contract in this case would freeze the liability only to the option premium paid upfront.

2. Derived Foreign exchange exposure viz. exposures generated because of swaps and other permitted transactions (An example of a derived exposure is as follows: A corporate XYZ has done a FC/INR swap to move from a rupee liability and take FX exposure, in which it has to pay USD 6 month LIBOR semi-annually. In this case, the corporate may be allowed to book rupee options on the next US interest payment due.)

4.1.2.2 Principle of one hedge structure transaction for one exposure at any time

Only one hedge transaction may be booked against a particular exposure for a given time period. At the maturity of the period, the client may decide whether he wants to change the hedge instrument.

Example:

An exporter has some USD receivables after 6 months. He might choose to hedge himself in this manner:

- Sell a forward for 3 month

- At maturity, net settle the contract and buy a put option for 3 months (or he may do the reverse)

Since options and forwards essentially hedge the same risk, the clients may be allowed to switch between instruments at maturity of the original contract. Participating forwards with embedded optionality may be allowed as long as these are booked/cancelled as a single transaction.

4.1.2.3 Market participants –Authorised dealers

The current regulatory framework allows all authorized dealers to offer all FX derivative products (approval required from RBI Exchange Control Department for offering cross currency options on covered basis).

However, making markets in option products requires a certain set of competencies, skills and risk management systems along with strong financials.

To avoid systemic risk that can arise because of failure of authorized dealers to manage their option portfolios, the committee suggests that RBI permission be obtained by the ADs to make markets in options. Authorised dealers who have the required resources and risk management systems to manage option portfolios may apply to Exchange Control department after getting the necessary internal Board approvals.

Other banks may use this product for the purpose of hedging trading books and balance sheet exposures or offering to their clients on covered basis.

4.1.2.4 Interbank market

The committee suggests that an interbank market be allowed in option contracts due to following reasons:

- Allowing interbank market in options will help ADs to effectively manage their options positions within the limits prescribed
- Options being non-linear products, the risks of open positions can be completely hedged only by entering into other option contracts
- It will help in providing liquidity and narrow bid-offer quotes

The Committee suggests that ADs may be allowed to hedge risks on options positions arising out of contracts with clients as well as initiate positions by entering into contracts with other ADs.

4.1.2.5 Clients as net receivers of premium

The current regulatory framework for cross currency options, as mentioned in RBI circular AP/DIR 19, allows residents to use various cost reduction strategies subject to the provision that there is no net inflow of premium to the client.

The Committee, in the course of its deliberation, received feedback from various clients who had expressed the opinion that clients should be allowed to write naked options as well as be net receivers of premium in case of structures. The Committee feels that the risks arising from a naked option are almost similar to that from a zero cost structure, and in the long run, there is a need for allowing clients to write naked options and be net receivers of premium in case of structures.

However given that rupee options will be a new product in the Indian scenario, the Committee felt that it was prudent to take a conservative approach. The rationale proposed was that as long as a client is not a net receiver of premium, he would exercise restraint and caution in using the product. The Committee suggests that at the inception of the product, the clients may be allowed to use structures as long as they are not net receivers of premium. However it recommends that this clause may be reviewed in future based on the developments in the market.

4.1.2.6 Cancelling and rebooking of contracts

The committee suggests that the current rationale regarding cancellations and rebooking for forward contracts may be continued with for the FC/INR options market in India.

This may be done with certain modifications intended to increase flexibility to market participants to manage their exposures, as well as generating liquidity and encouraging the development of the market. The modifications are as follows:

1. For exposures having maturity less than a year, as in forwards, clients may cancel and rebook option contracts without any restrictions. The same rationale may be extended for exposures with maturity more than a year keeping in mind the currency reserves and the market scenario at that period of time.

2. In particular market conditions, there could be concerns of volatility arising out of frequent cancellations and rebooking. Under such circumstances, a number of alternatives could be considered. One such alternative is to restrict the minimum maturity of the option contracts to one month in case the underlying exposure has a residual maturity of more than a year. In such cases, the contract once cancelled may not be rebooked till the maturity date of the cancelled contract. Another alternative could be to impose certain limits on the notional amounts for which cancellations and rebooking is permitted.

   Example: An importer has a USD payable after 1.5 years.

   - He books a call options for 3 months
   - He decides to cancel the option contract after 1 month. In case he does so, he may not be allowed to reinstate another hedge

transaction for the same exposure till the maturity of the original option contract

- o The above measure should remove the possibility of increased volatility because of frequent cancellation/rebooking of contracts.

The same mechanism could be used as regards to use of option contracts, in cases where forward contracts cannot be cancelled and rebooked at will; viz balances in EEFC accounts, hedge transactions of Foreign Institutional Investors, etc.

To sum up, cancellation and rebooking may be allowed for option contracts as follows:

| Cancellation/Rebooking Allowed | Cancellation/Rebooking permitted conditionally | Cancellation/Rebooking Not permitted |
|---|---|---|
| Residents<br>• Genuine exposures out of trade/ business upto 1 year – Cancellation/ rebooking of options booked as hedges allowed for all exporters and importers<br>• For Exposures more than 1 year – cancellation/ rebooking of option hedges allowed for only exporters<br><br>GDR receipts-- Cancellation/rebooking allowed for all option deals as hedges to above exposures | Exposures of duration greater than 1 year --- Option contracts of minimum maturity of one month; No rebooking until the residual maturity of cancelled contract. Alternatively limits on the amount for which cancellations and rebooking is permitted. The above conditions to be applicable to Residents<br>• Exposures more than 1 year – importers<br>• Balances in EEFC accounts<br>• Option contracts on derived exposures<br><br>FII exposures in India | Cancellation/rebooking of option hedges will not be permitted for the following:<br><br>1. Non resident Indians/Overseas Corporate Bodies<br><br>• Dividend<br>• FCNR and NRE deposits<br><br>2. Investment under portfolio scheme<br><br>Option contracts in these cases, once cancelled cannot be rebooked for the remaining maturity of the exposure |

4.1.2.7 Hedging

Since options involve non-linear payoffs, hedging schemes for options positions tend to be dynamic in nature and hedges are required to be rebalanced frequently. Static-one time hedging of an option position is possible only by entering into an offsetting option transaction. The hedging of an option portfolio entails calculation of various “Greeks” (Details provided in Schedule IV).

The most common form of hedging involves buying/selling of currencies in spot market to hedge the Delta of option portfolio. As the spot rate changes, the moneyness of the option portfolio also changes hence the Delta needs to be rebalanced frequently. Market makers are required to make their own judgements about the frequency of rebalancing the Delta-hedged portfolio. However, if a model is being used to decide about the frequency of rebalancing, such model should be sufficiently back-tested to ensure validity of assumptions. Hedging schemes also involve hedging of Gamma and Vega of their portfolios by entering into various option contracts.

The committee suggests that:

- Authorised dealers – Market makers should be allowed to hedge the option portfolios by accessing the spot market
- The extent and frequency of the hedging could be decided by the dealers
- Authorized dealers could also be allowed to hedge the other "Greeks" of their portfolios by entering into option transactions in the interbank market

## 4.2 Pricing and quotation systems

The premium of FC-INR options is dependent upon the spot rate, interest rates in both currencies and the estimate of future volatility in spot rate. While other parameters are fixed at any point in time, the estimate of future volatility can differ. Internationally, premium is quoted as percentage of the notional amount and can be settled in any of the currencies involved. It is the market practice internationally to use standardised Black-Scholes model (BS Model) for quoting. The volatility that results in required premium is called implied volatility (implied by the required premium based on standard BS model) and is also quoted in the market.

Implied volatility is, therefore, an estimate of future volatility in BS context. This estimate can differ significantly from historical observed volatility depending upon the market expectations about future.

The Committee suggests that:

- Authorised dealers could quote the option premium in Rupees or as a percentage of the Rupee notional amount. The premium could be paid in Rupee terms.
- Authorised dealers could also quote (especially in interbank market) on the basis of the implied volatility as mentioned above. (Examples in Schedule IV)

- Market players will also require pricing estimates for Marking to Market of their portfolios at regular intervals. Hence, it is recommended that, FEDAI could publish on regular basis a matrix of Black Scholes implied volatilities for various maturities and strikes based on market poll. For MTM of a given contract, the price could then be estimated based on the interpolated implied volatility using BS Model. Since there could be a number of contracts outstanding with different strikes and maturities, the use of BS implied volatilities is suggested here to ensure standardisation of MTM values across various players. An example of such fixings provided by British Bankers Association (Reuters Page BBAVOLFIX1) is provided in Schedule IV.

The use of Black Scholes/ Garman-Kohlhagen model suggested here does not imply that committee recommends this model as pricing model. The premium of the option could be arrived at using any model as market players deem fit. Some of the other models for option pricing are discussed in Schedule III.

## 4.3 Risk management framework

### 4.3.1 Authorised dealers

The committee has the following recommendations in the nature of best practices:

- ADs could be required to put in place a risk management system, which allows them to compute daily MTM of the portfolio and various other Greeks.
- ADs could also be required to obtain product approval from their Board/Risk Committee/ALCO. Specifically this approval could include:
    - Product structure proposed
    - Pricing and hedging
    - Segregation of responsibilities between front, middle and back offices with relation to dealing, confirmation and settlement
    - Limits for Delta and other Greeks
    - Stop losses etc for open positions
- ADs could also be required to report to their Board/Risk Committees/ ALCO on regular intervals about the activities undertaken on this product.

### 4.3.2 Risk management for clients:

With regard to risk management systems for clients, the committee recommends that clients interested in dealing in options would need to comply with the existing requirements regarding derivative products as per RBI circular A.D. (M.A. Series) circular No.1 dated January 24, 2002:

The Board of Directors of the corporate has to

- Draw up a risk management policy for the corporate
- Lay down clear guidelines for concluding the transactions
- Institutionalise arrangements for a quarterly review of operations and annual audit of transactions to verify compliance with the regulations
- Have in place a board resolution authorising the corporate to enter into derivative transactions
- Name the authorised signatories who would be allowed to transact on behalf of the corporate

## 4.4 Documentation and regulatory reporting

### 4.4.1 Documentation

The Committee considered both the use of ICOM documentation and ISDA documentation for recording contracts between authorised dealers and counter-parties. The Committee felt that the ISDA documentation was more comprehensive and that market players had familiarity with ISDA documentation, which they had used for other FX derivative transactions.

The Committee therefore recommends the use of ISDA documentation for recording FC-INR contracts.

### 4.4.2 Regulatory reporting

The committee suggests that Authorised Dealers be required to report to RBI on a weekly basis the following information regarding option transactions undertaken and the option portfolio.

- Option Transaction Report for the week

| Sr. | Trade | Client/ | Notiona | Option | Strike | Maturity | Premiu |
|---|---|---|---|---|---|---|---|

| No. | Date | C-party Name* | l | Call/Put | | | m |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

*Mention B/S as the client name along with counterparty, if the transaction has been done for the balance sheet

- Option positions Report

| USD Notional Outstanding | | Net Portfolio Delta | Net Portfolio Gamma | Net Portfolio Vega | Total Net Open spot position |
|---|---|---|---|---|---|
| Calls | Puts | (USD) | (USD) | (USD) | (USD) |
| | | | | | |
| | | | | | |

Authorized dealers could also be required to report the change in delta expected for the portfolio if spot changes by a certain value (0.5%, 1%, etc).

## 4.5 Accounting

The committee recommends the following accounting practices to be followed for recording the FC-INR option transactions. The detailed accounting framework is provided in the Annexure 6.

**Accounting at inception**

- An FX option transaction gives rise to a put on one currency and a call on the other. When the Bank enters into an FX option transaction, an offsetting debit and credit is recorded for each currency for Notional Value in the appropriate contingent accounts of the General Ledger.

- When the Bank sells an option, thus becoming subject to unlimited risk, it will be obligated to perform if the buyer exercises the right under the option. This liability to perform (as opposed to the potential short or long currency position) is recorded, for example, in the case of a call option by crediting " FX Options - Call Sold" with the principal amount of the call currency and debiting a per contra account, and crediting " FX Options - Put sold" with the principal amount of put currency and debiting a per contra account.

- When the Bank buys a put or a call option, it has the right to exercise and as such has an asset as the contract will only be exercised by the

Bank if it will generate a profit; thus the Bank has unlimited upside potential from buying an option. This will be recorded, for example in the case of a call option purchase by debiting "FX Options – Call Bought" with the principal amount of the call currency and crediting the relevant per contra account and in the case of a put option purchase, by debiting "FX Options – Put Bought" with the principal amount and crediting the relevant per contra account.

- The Bank should also maintain outstanding exposure on Options liability in respect of customers/counterparty Banks.

**Option premiums**

If the Bank is an option buyer, the amount paid for the premium is debited to "Premiums on Foreign Currency Options" at inception. If the Bank is the option seller, this account is credited for the amount of the premium received.

**Market valuation and revaluation of options**

- Option contracts may be marked-to-market at the same time as the foreign currency position revaluation. The market price will be the current market premium applicable to the option being valued. This price will be quoted for exchange traded currency options or calculated by the pricing model approved for OTC options.

- The gains as a result of these valuations will be debited to the "Unrealised gains/losses – foreign exchange options" account with the offset to the "Foreign exchange income – Foreign currency options" Account.

- The losses as a result of these valuations will be credited to the "Unrealised gains/losses – foreign exchange options" account with the offset to the "Foreign exchange income – Foreign currency options" account.

- The revaluation would be reversed on the subsequent day and a fresh entry would be passed depending on the MTM value on the day.

**Contract expiration**

An option contract can mature due to exercise by the option holder or by reaching the option's exercise date without having been exercised. When an option matures on expiry date, the entries originally posted to the contingent accounts should be reversed in both the cases whether the contract is expired without having been exercised or option has been exercised. The option Premium account should be closed to the foreign exchange income. Options

once exercised should be settled with the customer through the foreign exchange traders.

**Contract liquidation**

Liquidation occurs when an open exchange traded option is liquidated prior to the expiration date with an offsetting option of the same series (i.e., maturity, strike price and amount). When a contract is liquidated, the original option premium and the offsetting option premium are to be recorded to “Exchange Income – Foreign Currency Options”. In addition, the entries originally posted to the contingent account should be reversed.

**Disclosure**

The Notional Value of the outstanding options will be disclosed in the Balance Sheet of the Bank under Schedule 12 - Contingent Liabilities.

# 5 Future development and evolution of the market – A roadmap

*Anybody can buy and sell……..* James Powers

## 5.1 Market inception

The committee suggests that FC-INR options market in India could be initiated with the introduction of simple options and structures. At this stage vanilla European calls and puts, and structures comprised of them, could be allowed.

Clients could deal in combinations of vanilla European options as packaged structures provided they are not net receivers of premium. Such structures could include range-forwards, bull and bear spreads, strips, straps, straddles, strangles, butterflies, risk reversals etc.

## *5.2* Introduction of exotic options

The Committee feels that the options market would become more comprehensive and account for more sophisticated hedging strategies after the introduction of options with exotic features. This, it was felt, would reduce the cost to the clients, create specific payoffs tailored to client needs as well as create more interest and liquidity in the market. Feedback from clients was also in favour of introducing exotic options at the earliest.

The Committee suggests a review of the development in options market with vanilla options after a period of three-six months. Based on the review, more complex variants could then be introduced. This, the Committee feels, will give the market players time and experience to develop confidence and comfort with their systems and risk management frameworks.

The Committee suggests that RBI may mitigate the systemic risks associated with banks offering exotic options by giving case-by-case approvals only to banks having the required competencies to offer these products. Banks wishing to offer exotic options could evidence to RBI, the receipt of internal approvals to deal in these products as well as existence of appropriate Risk Management systems, before undertaking any transactions.

These products may be allowed in phases, depending on the speed of development of the market envisaged by the Regulator, as well as comfort with competencies and Risk Management Systems of market participants. The following non-vanilla products could be made available to market participants in phases:

- Participating forwards, range-ratio forwards, etc
- Barrier options, (Single barrier and Double barrier)
- Digital or binary options (Range digitals, Barrier digitals)
- Forward start options
- Leveraged options (with payoff as the square of [Spot-Strike])
- Compound options (call on call options, As you like it options, etc)
- Structures involving combinations of the above

The above list is however only illustrative and not exhaustive.

### *5.3* Clients as net receivers of premium

The Committee feels that in the long run, there is a need for allowing clients to write naked options and be net receivers of premium in case of structures.

As discussed before, the Committee suggests that at the inception of the product, the clients may be restricted to be net payers of the premiums in case of structures, however it recommends that this clause may be reviewed based on the developments in the market.

Part

# 3

## 6 Schedule I – Option data

**Gross market values of OTC forex derivatives – 6 months June 2001**

(Figures in millions of dollars)

| Category | Total | US dollar | Euro | Japanese yen | Pound sterling | Swiss franc |
|---|---|---|---|---|---|---|
| **OUTRIGHT FORWARDS & FOREX SWAPS** | **395,397** | **369,300** | **142,414** | **119,554** | **39,003** | **17,868** |
| With reporting dealers | 156,389 | 152,158 | 48,402 | 58,610 | 11,899 | 6,063 |
| With other financial institutions | 165,588 | 155,864 | 60,297 | 43,966 | 16,652 | 8,735 |
| With non-financial customers | 73,417 | 61,277 | 33,714 | 16,979 | 10,451 | 3,070 |
| **CURRENCY SWAPS** | **314,166** | **255,811** | **152,924** | **74,805** | **34,363** | **19,080** |
| With reporting dealers | 53,695 | 48,062 | 23,793 | 15,406 | 4,153 | 2,253 |
| With other financial institutions | 146,504 | 119,124 | 74,177 | 34,067 | 16,164 | 7,391 |
| With non-financial customers | 113,963 | 88,622 | 54,955 | 25,331 | 14,048 | 9,437 |
| **OPTIONS SOLD** | **39,452** | **31,925** | **15,525** | **16,764** | **3,837** | **974** |
| With reporting dealers | 18,253 | 14,006 | 7,532 | 8,921 | 1,900 | 331 |
| With other financial institutions | 10,975 | 9,376 | 4,030 | 4,367 | 881 | 272 |
| With non-financial customers | 10,226 | 8,543 | 3,961 | 3,477 | 1,057 | 372 |
| **OPTIONS BOUGHT** | **42,141** | **35,752** | **18,723** | **15,035** | **2,597** | **973** |
| With reporting dealers | 18,674 | 15,543 | 8,542 | 8,567 | 1,185 | 244 |
| With other financial institutions | 11,238 | 9,997 | 4,604 | 3,926 | 618 | 436 |
| With non-financial customers | 12,225 | 10,212 | 5,575 | 2,542 | 794 | 293 |
| **TOTAL OPTIONS** | **63,340** | **53,671** | **26,716** | **22,878** | **4,534** | **1,616** |
| **TOTAL CONTRACTS** | **772,896** | **678,782** | **322,053** | **217,238** | **77,902** | **38,564** |
| **TOTAL CONTRACTS INCLUDING GOLD** | **793,454** | | | | | |

(contd)

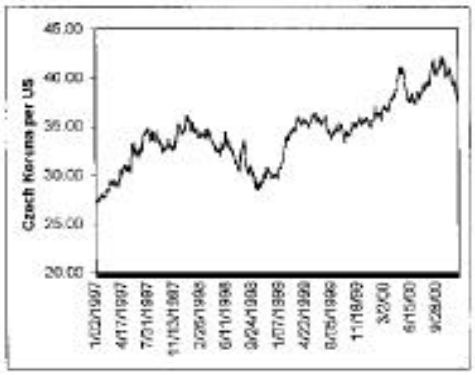
| Category | Canadian dollar | Swedish krone | Australian dollar | Danish krone | Hong Kong dollar | Thai baht |
|---|---|---|---|---|---|---|
| **OUTRIGHT FORWARDS & FOREIGN EXCHANGE SWAPS** | **13,007** | **20,486** | **7,916** | **1,299** | **1,032** | **273** |
| With reporting dealers | 2,867 | 7,055 | 1,754 | 294 | 425 | 129 |
| With other financial institutions | 6,599 | 7,602 | 4,217 | 835 | 453 | 130 |
| With non-financial customers | 3,539 | 5,829 | 1,945 | 170 | 154 | 14 |
| **CURRENCY SWAPS** | **11,383** | **10,163** | **9,753** | **625** | **710** | **770** |
| With reporting dealers | 1,291 | 1,088 | 1,007 | 89 | 70 | 310 |
| With other financial institutions | 4,107 | 3,870 | 5,335 | 372 | 525 | 420 |
| With non-financial customers | 5,986 | 5,201 | 3,411 | 164 | 115 | 40 |
| **OPTIONS SOLD** | **532** | **257** | **1,455** | **6** | **16** | **1** |
| With reporting dealers | 205 | 154 | 392 | 0 | 6 | 1 |
| With other financial institutions | 151 | 34 | 754 | 1 | 5 | 0 |
| With non-financial customers | 176 | 69 | 309 | 5 | 5 | 0 |
| **OPTIONS BOUGHT** | **561** | **300** | **2,406** | **4** | **5** | **0** |
| With reporting dealers | 211 | 141 | 454 | 1 | 3 | 0 |
| With other financial institutions | 154 | 45 | 927 | 1 | 2 | 0 |
| With non-financial customers | 196 | 115 | 1,026 | 2 | 0 | 0 |
| **TOTAL OPTIONS** | **888** | **403** | **3,469** | **10** | **15** | **0** |
| **TOTAL CONTRACTS** | **25,275** | **31,052** | **21,137** | **1,934** | **1,757** | **1,043** |

Source : BIS data

# 7 Schedule II – Option impact on underlying volatility

## 7.1 Emerging markets: Czech Koruna and Polish Zloty

Czech Koruna/USD




Polish Zloty/USD


**Statistics of Poland and Czech Republic Currency**

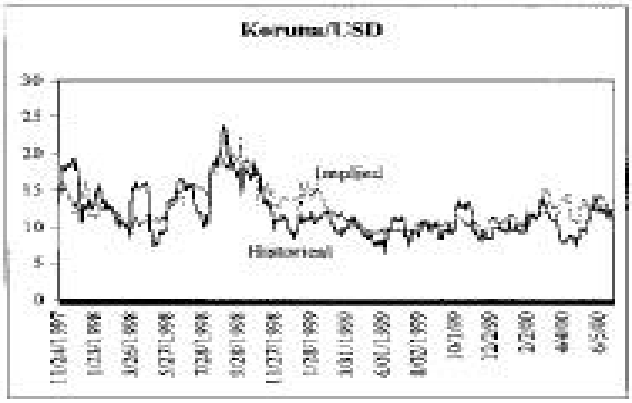
7.1.1.1 Czech Republic and Poland Currencies

| Statistic | Czech Republic (Koruna/USD) | Poland (Zloty/USD) |
|---|---|---|
| *Mean* | 0.031% | 0.035% |
| *Volatility* | 13.077% | 10.400% |
| *Skewness* | 0.962 | 0.222 |

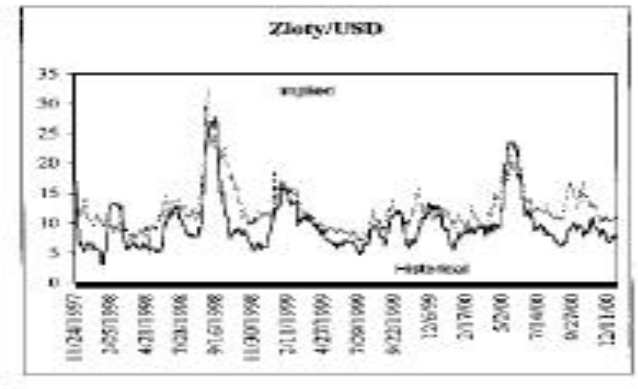
| | | |
|---|---|---|
| *Kurtosis* | 12.658 | 8.288 |

The graph shows the variation of one-month historical volatility with implied volatility in Czech Republic. Also, the historical volatility tends to follow implied volatility. The introduction of options has reduced volatility in underlying market from 18% in koruna/USD to 12% and from 15% in Zloty/USD to 12% during the period 1997 to 2000.

KORUNA/USD (Implied Volatility V/s Historical Volatility)

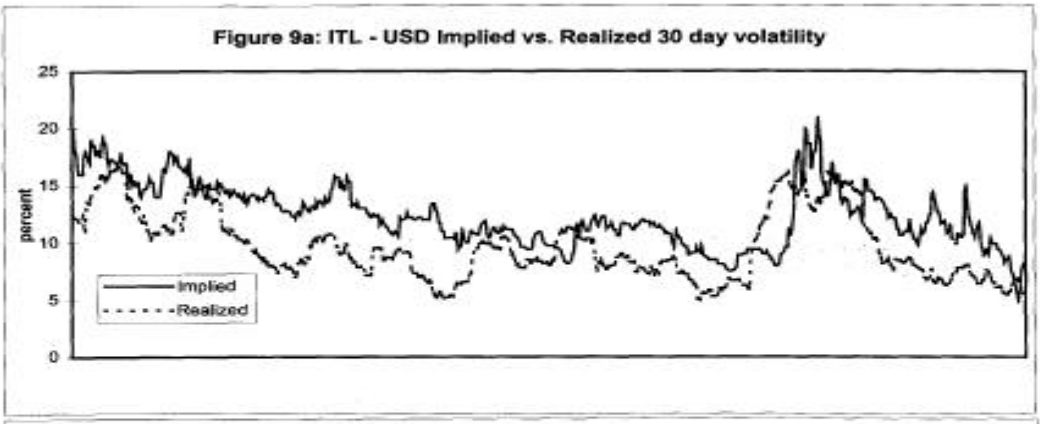


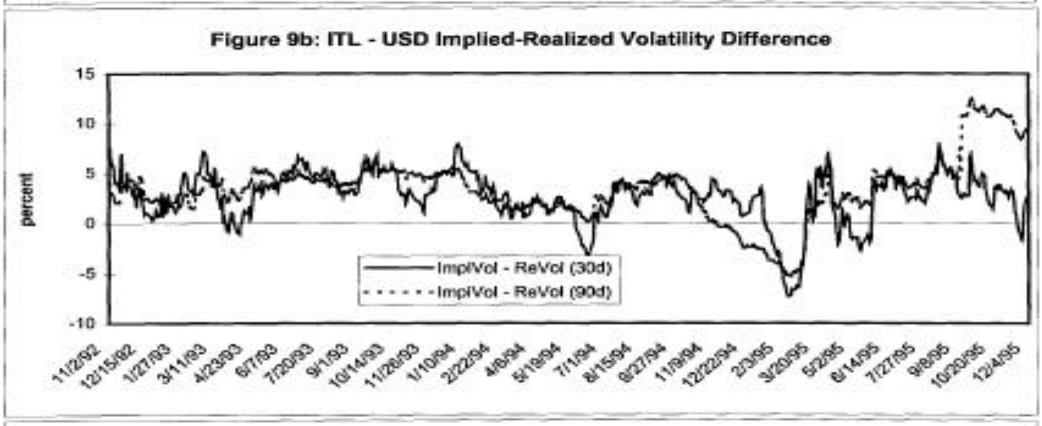

ZLOTY/USD (Implied Volatility V/s Historical Volatility)

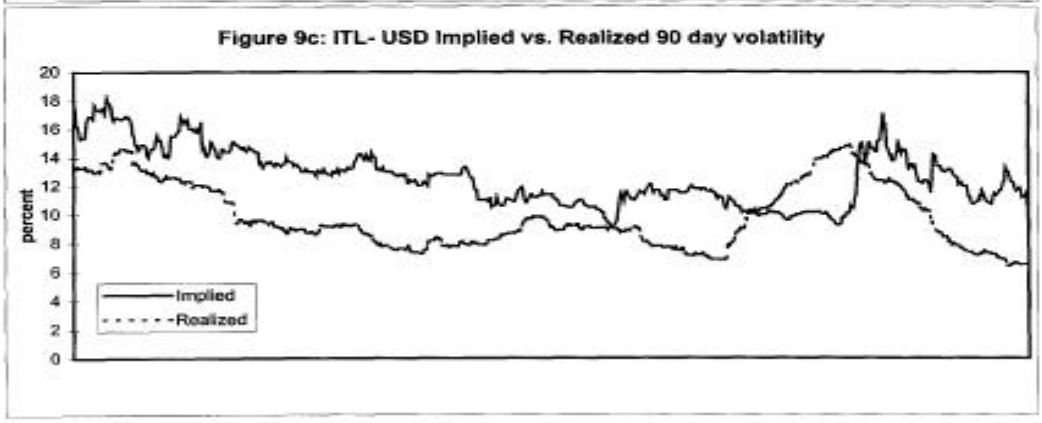



## 7.2 European markets: Italy and Spain

*Currency options in Italy*

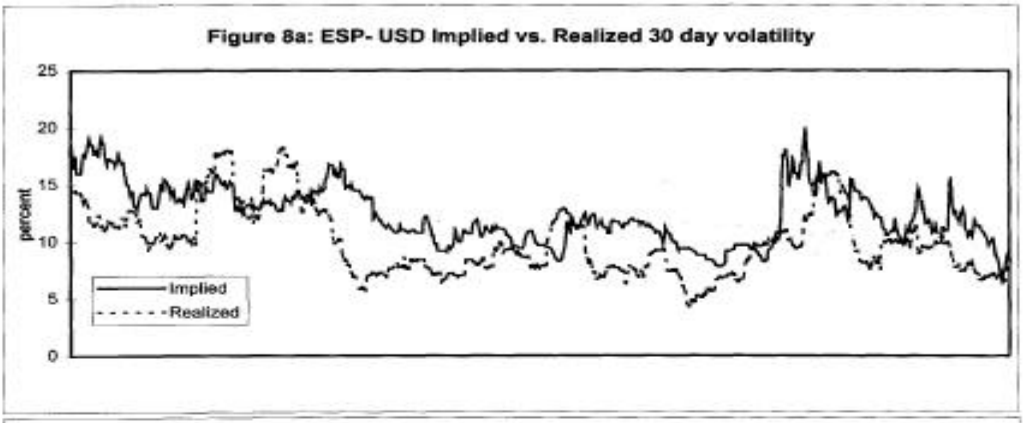


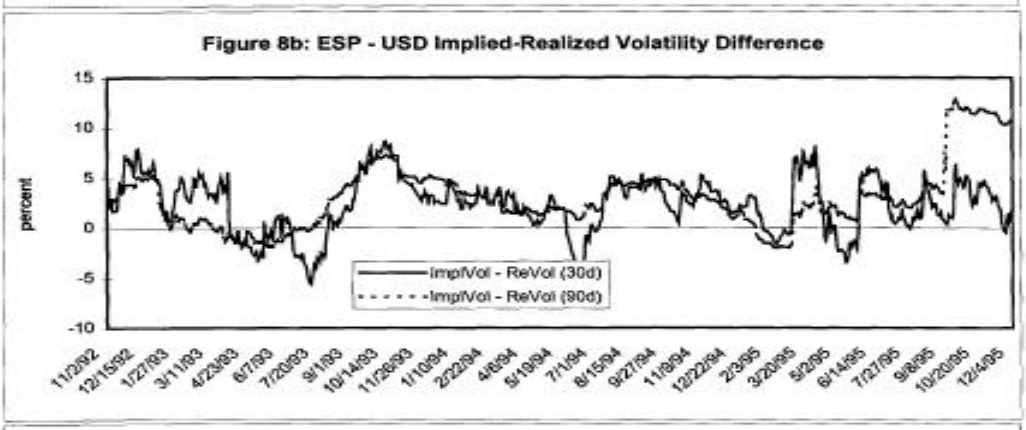



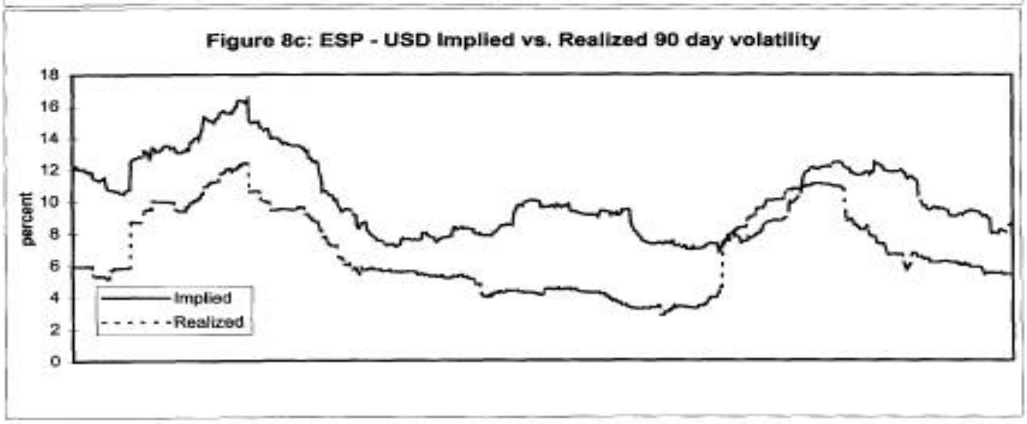




After the introduction of the options the volatility in underlying market reduced from 13% to around 6% for 30 days and from 13% to 8% for 90 days during the period 1992 and 1995.

***Currency options in Spain***




Volatility in the underlying reduced from 15% to 7% during the period 1992 to 1995.

# 8 Schedule III – Theory of option pricing

*It is always preferable to be roughly hedged against a broad set of eventualities than exactly hedged against a narrow parameter….*
Marty O' Connell

## 8.1 Discussion of the basic models for option pricing

### 8.1.1 The Black Scholes model

8.1.1.1 Underlying concepts

The Black-Scholes (B-S) differential equation, also known as the Kolmogrov equation, is an equation that must be satisfied by the price "C", of any derivative dependent on a non-dividend paying stock. The analysis is analogous to the no-arbitrage analysis used to value options when stock price changes are binomial. A risk-less portfolio consisting of a position in the option and a position in the underlying stock is set up. In the absence of arbitrage opportunities, the return from the stock must be the risk free interest rate, "r".

The Kolmogrov Equation is derived from the use of Ito's Lemma (a mathematical result) on the equations obtained from Generalised Weiner process applied to stock prices.

$$[\partial/\partial t + (r-f)S\,\partial/\partial S + \tfrac{1}{2}s_{S,t}^{2}S^{2}\partial^{2}/\partial S^{2} - r]\,C_{K,T}(t,S) = 0 \qquad \text{Eq. 1}$$

where $\delta/\delta t$ = Theta

r = risk free interest rate

f = Continuous dividend rate or Foreign currency interest rate

$\delta/\delta S$ = Delta of the option

$\delta/\delta^2 S$ = Gamma of the option

$\sigma$ = Volatility

C(K,t) = Option price

In any short period of time, the price of a call/put option is perfectly positively/negatively correlated with the price of the underlying stock. In both cases, when an appropriate portfolio of the stock and the option is set up, the gain or loss from the stock position always offsets the gain or loss from the option position so that the overall value of the portfolio at the end of the short period of time is known with certainty. The relationship between a small change in the stock price ($\Delta S$) and the resultant change in the option price ($\Delta c$)

represents the slope of the line representing the relationship between c and S. If $\Delta c = 0.4\ \Delta S$, then the riskless portfolio could be set up by a long position in 0.4 shares and a short position in one call. However, this portfolio would remain riskless only for a very short period of time and to remain riskless it must be adjusted or rebalanced frequently. Nevertheless, the return from the portfolio over a short period of time must be the risk-free rate. This is the key element in the B-S arguments and underlies the pricing formulae.

#### 8.1.1.2 Assumptions

The assumptions used to derive the B-S equation are as follows:

1. The stock price is determined by the following stochastic equation
   $dS = (\mu dt + \sigma dBt)$, where $\mu$ and $\sigma$ are constant and Bt is the standard Brownian motion.

2. The short selling of securities with full use of proceeds is permitted.

3. There are no transaction costs or taxes and securities are perfectly divisible.

4. There are no dividends during the life of the derivative.

5. There are no riskless arbitrage opportunities.

6. Security trading is continuous.

7. The risk free rate r is constant and same for all maturities.

8. Log returns are independent, stationary and normally distributed.

#### 8.1.1.3 The Black-Scholes pricing formulae

The detailed derivation of the B-S model is not discussed here, but can be obtained from any standard book on Option pricing ("Options, futures and other Derivative", 4th edition by John Hull has a good discussion on pricing). Using the risk neutral evaluation argument, the European call price, c is the value of the expected value of the European call option at maturity $E[\max(S_T - X, 0]$ discounted at the risk free rate of interest, i.e.

$$C = e^{-r(T-t)}\ E\left[\max\left(S_t - X, 0\right)\right] \qquad \text{Eq. 2}$$

Evaluating the above equation using integral calculus, the result is

$$C = S\ N(d1) - X\ e^{-r(T-t)}\ N(d2) \qquad \text{Eq. 3}$$

Where

$$d1 = \frac{\ln(S/X) + (r + s^2/2)(T-t)}{s\sqrt{(T-t)}}, \qquad d2 = \frac{\ln(S/X) + (r - s^2/2)(T-t)}{s\sqrt{(T-t)}}$$

and N (x) is the cumulative probability distribution function for a variable that is normally distributed with a mean of zero and standard deviation of 1.

### 8.1.2 Garman - Kohlhagen model: Currency options

To value currency options, S is defined as the spot exchange rate, i.e. the value of one unit of FC in terms of the local currency. The assumption is that the exchange rates follow the same type of stochastic process as a stock – geometric Brownian Motion. σ is defined as the volatility of the exchange rate and $r_f$ as the rate of interest in the foreign country. Foreign currency is analogous to a stock providing a know dividend yield equal to the risk free interest rate in the foreign currency.

The European call price is therefore given by

$$C = Se^{-r_f(T-t)} N(d1) - X e^{-r(T-t)} N(d2) \qquad \text{Eq. 4}$$

Where ,

$$d1 = \frac{\ln(S/X) + (r - r_f + s^2/2)(T-t)}{s\sqrt{(T-t)}}, \qquad d2 = \frac{\ln(S/X) + (r - r_f - s^2/2)(T-t)}{s\sqrt{(T-t)}}$$

## 8.2 Alternative pricing models

### 8.2.1 Tree Approaches

The binomial approach assumes that the spot price of the underlying follows a multiplicative binomial process over the life of the option. Specifically, the price movements assumed by the standard binomial converge to the lognormal distribution, the conventional distribution used in Black Scholes model.

The tree approach assumes that the life of the option may be divided into a discrete number of periods and during each period there are only two possible movements for the price; one step up or one step down from its level at the beginning of the period. This approach thus generates a tree of future spot prices. The present spot price implies two potential prices at the end of first

period; each of these in turn implies two more , and so on until the option reaches maturity.[1] As the number of periods assumed during the options life is increased, the distribution of the path approaches the lognormal distribution.

The current value of the option is determined by the future option values implied by this spot behaviour. At the exercise date, the option value is easily determinable, given the spot and the exercise price. The remaining option values are derived by working backward from exercise dates. At each step, the future option values derived in the previous step are weighted by the appropriate risk neutral probabilities that arise as a direct application of the Arbitrage Pricing Theorem.

The tree approach accounts for early exercise by explicitly considering the potential results of early exercise at each possible node. At each node the value of the option is the larger of value of the unexercised option and the gain from early exercise. This explicit consideration of the early exercise decision is what makes this model appropriate for American option valuation.

### 8.2.2 Models for stochastic volatility

8.2.2.1 The random variance option pricing model

Stock prices are assumed to follow the following stochastic process

$$dS = \alpha S\, dt + \sigma S\, d z_1$$

$$d\sigma = \beta(\sigma^* - \sigma)dt + \gamma dz_2 \qquad \text{Eq. 5}$$

where dz1 and dz2 are Weiner processes.

The assumption is that the instantaneous volatility parameter for stock prices follows a mean reverting process. If $\beta$ equals zero, $\sigma$ is a random walk and the unconditional variance for stock returns is infinite. The $\sigma$ parameter is normally distributed and the variance will be non-negative (One needs to ensure that $\sigma$ does not assume negative values). A call option on this stock will be a function of three variables – the price of the stock, the volatility and the time to expiration. The introduction of a random variance produces several complications:

- One would need the underlying stock and two options with different expiration dates to create a riskless hedge.

- Arbitrage is not sufficient for the determination of a unique option pricing function in this model. An alternative view is that the duplicating portfolio for an option in this model contains the stock, the riskless bond and another option. We cannot determine the price of a call option without knowing the price of another call option on the same stock but that is precisely the function that is to be determined. Hence it is not possible to derive a closed form pricing solution under these conditions.

[1] The actual number of prices at the end of second period is only three due to recombination of nodes.

- The model permits variance parameters to change randomly although an analytical formula has not been developed. The model can however, derive option prices via Monte Carlo simulations. Further research with transaction data on option prices and stock prices for a large sample would be needed before the performance of the model can be assessed.

#### 8.2.2.2 The Hull and White model

One assumption in the B-S model that is clearly not true is the assumption that volatility is constant. Hull and White considered the following stochastic volatility model for the risk neutral behaviour of a stock price:

$$dS/S = rdt + v^{0.5}\, dz(S)$$

$$d\,v = a(b - v)\,dt + v^{\alpha}\, S\, dz(v) \qquad \text{Eq. 6}$$

Where a, b, l, and $\alpha$ are constant and dz (S) and dz (v) are Weiner processes. The variable *v* in this model is the stock's variance rate (square of volatility). The Variance rate is assumed to revert to level b at a rate 'a'.

Hull and White show that when volatility is stochastic but uncorrelated with the stock price, the price of a European option is the B-S model price integrated over the probability distribution function of the average variance rate during the life of the option. Thus the European call price is

? c(V')g(V')d(v'),

where V' is the average value of the Variance rate σ2 , c is the B-S price expressed as a function of V' and g is the probability density function of V' in a risk neutral world.

In situations where the stock price and volatility are correlated, there is no simple result and option prices can only be obtained using simulation techniques. For options less than one year, the absolute impact of stochastic volatility is fairly small.

### 8.2.3 The Jump Diffusion model

Merton has suggested a model in which the stock price has jumps superimposed upon a geometric Brownian motion. Define

m expected return from stock

l rate at which jumps happen

**k** expected jump size measured as a proportional increase in the stock price

The proportional jump-size is assumed to be drawn from a probability distribution in the model. The average growth rate from the jumps is λk. This means that the expected growth rate provided by the geometric Brownian motion is μ - λk. The model is

$$dS / S = (m - lk)dt + s\ dz + dq \qquad \text{Eq. 15}$$

where dz is a Wiener process, dq is the Poisson process generating the jumps, and σ is the volatility of the geometric Brownian motion. The processes dz and dq are assumed to be independent.

The key assumption made be Merton is that the jump component of the stock's return represents non-systematic risk (i.e. risk not priced in the economy). This means that a Black-Scholes type of portfolio, which eliminates the uncertainty arising from the geometric Brownian motion, must earn the riskless rate.

As expected, jump processes give rise to fatter tails than do continuous processes. Black-Scholes formulas underprice calls and puts when they are either significantly in the money or significantly out of the money.

The simplest form of Merton's jump diffusion model is when the logarithm of the size of the proportional jump has a normal distribution. Assume that the standard deviation of the normal distribution is δ. The European call option price can then be written

$$c = \sum_{n=0}^{a} \frac{e^{-l't}(l't)^n}{n!} f_n$$

where τ = T - t and λ' = λ(1 + k). The variable $f_n$ is the Black-Scholes option price when the instantaneous variance rate is

$$s^2 + \frac{nd^2}{t}$$

and the risk free rate is

$$r - lk + \frac{ng}{t}$$

where γ = ln(1 + k).

The modelling of jumps is a particularly tricky problem as they are rare events, and also because of the difficulty in parameterisation of these models.

## 8.3 The Greeks in detail

***Delta***

The delta of an FX option is the rate of change of the option price with respect to the change in the underlying exchange rate. Mathematically, delta is the partial derivative of the option price with respect to the exchange rate.

$$\Delta = \frac{\partial C}{\partial S}$$

where C is the value of the option and S is the underlying spot exchange rate.

Under Black & Scholes model, the delta of European call options on a currency is given by

$\Delta = e^{-rfT} N(d_1)$

and for European put option on a currency,

$\Delta = e^{-rfT} [N(d_1) - 1]$

**Delta Hedging**

As per the Black Scholes model it is possible to set up a riskless portfolio i.e. hedge one's risk by taking a position in the underlying for a position in the derivative. Expressed in terms of delta, the riskless portfolio is:

-1: Option

$+\Delta$: USD/INR

As evident from Fig 1, the delta of an option changes with exchange rate. So to remain hedged, delta has to be rebalanced periodically.

***Gamma***

The gamma, $\Gamma$, of a foreign exchange option is the rate of change of the delta of the option with respect to change in the exchange rate. It is the second partial derivative of the portfolio with respect to the exchange rate:

$$\Gamma = \frac{\partial^2 C}{\partial S^2}$$

For European call or put option on a currency,

$\Gamma = e^{-rfT} N'(d_1) \ / \ S_o \sigma T^{1/2}$

**Gamma hedging**

A small gamma indicates that the delta changes slowly and hence the adjustments to keep a portfolio delta neutral are relatively infrequent. However for large gamma the frequency of adjustments is relatively higher. The Gamma

of a portfolio can be changed only using derivatives. A position in either the underlying itself or a forward contract on the underlying has zero gamma and cannot be used to change the gamma of a portfolio.

***Vega***

The vega of an option, V, is the rate of change of the value of the option with respect to the volatility of the exchange rate:

$$V = \frac{\partial C}{\partial s}$$

Here, σ is the volatility of the underlying exchange rate. Under Black Scholes model, this would be estimated as the standard deviation of the lognormal returns of the underlying FX price time series.

Under the Black Scholes model, for European call or put option on a currency,

$V = S_o T^{1/2} N'(d_1)\, e^{-r_f T}$

**Vega hedging**
If vega is high in absolute terms, the portfolio's value is very sensitive to small changes in volatility. A position in the underlying asset or in a forward contract has zero vega. However, the vega of a portfolio can be changed by adding a position in a traded option. If V is the vega of the portfolio and VT is the vega of a traded option, a position of –V/VT in the traded option makes the portfolio vega neutral.

***Theta***

The theta of an option, Θ, is the rate of change of the option with respect to the passage of time. Theta is also referred to as the time decay of the option. Theta is usually negative for an option (An exception to this could be an in-the-money European call option on a currency with very high interest rates). This is because as time passes, the option tends to become less valuable.

**Theta Hedging**
Theta is not the same type of hedge parameter as delta. There is uncertainty about the future stock price, but there is no uncertainty about the passage of time.

***RHO***

Rho is the rate of change of the option value with respect to the interest rate.

$$r = \frac{\partial C}{\partial r}$$

In case of currency options, there are two rhos corresponding to the two interest rates. The rho corresponding to the domestic interest rate is given by

Call: $r = X T e^{-rT} N(d2)$

Put: $r = -X T e^{-rT} N(-d2)$

The rho corresponding to the foreign interest rate is given by

Call: $r = -T e^{-rfT}$ So N(d1)

Put: $r = T e^{-rfT}$ So N(-d1)

**Rho hedging**
Interest rate have comparatively lower volatility. For longer tenure options rho can be hedged using interest rate swaps (MIFOR curve to hedge INR Rho and US$ LIBOR swaps to hedge USD Rho).

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# 9 Schedule IV– Illustrations of option pricing and quotation

## 9.1 Option pricing example

We explain an option transaction, wherein the premium has been computed by plugging in the implied volatility in the Black-Scholes (viz. Garman Kohlhagen formula) for currency options.

### 9.1.1 Using Black-Scholes formula

The purpose of this note is to illustrate the very simple procedure for obtaining an option value from the Black-Scholes / Garman-Kohlhagen formula. We are given the following terms that go into the formula

| | | |
|---|---|---|
| S | = | current price of the underlying asset (spot rate of FC-INR) |
| X | = | exercise price of the option |
| r | = | risk-free rate (MIFOR rate for INR) |
| T | = | time to expiration |
| $\sigma$ | = | Standard deviation of the underlying asset (FC-INR rate) |
| $r_f$ | = | yield of the underlying asset (LIBOR rate for USD) |

Let us examine each of those values in turn.

The time to expiration is determined by dividing the number of days to expiration by 365. We simply take the number of days between two dates. If today is October 20 and the option expires on November 22, there are 11 more days in October and 22 in November for a total of 33 days. Then the time to expiration is 33/365 = 0.0904.

The volatility is the one completely unobserved value that goes into the model. It is defined as the standard deviation of the continuously compounded return on the stock over the upcoming life of the option. There is considerable disagreement about the best way to estimate the volatility.

Finally we have the yield on the asset. When the underlying is a foreign currency, the yield is the foreign risk-free interest rate.

The price c of a European call and the price p of a European put on a currency paying an interest rate rf are given by:

$$c = Se^{-r_f T} N(d_1) - Xe^{-rT} N(d_2)$$
$$p = Xe^{-rT} N(-d_2) - Se^{-r_f T} N(-d_1)$$

$$where \quad d_1 = \frac{\ln(S/X) + \left(r - r_f + s^2/2\right) * T}{s\sqrt{T}}$$

$$d_2 = \frac{\ln(S/X) + \left(r - r_f - s^2/2\right) * T}{s\sqrt{T}}$$

N(d1) and N(d2) stand for cumulative normal probabilities. N(d1) is also called "Black Scholes Delta" and measures the sensitivity of the option value to the changes in the spot rate.

Let us illustrate the pricing in terms of Black Scholes implied volatility:

Consider a 1 month call option on USD/INR in which the spot USD/INR is 48.735 (S), the exercise price is 48.90 (X), MIFOR rate is 6.04% (r) for the period of 30 days (T= 0.083), and the risk-free interest rate on the foreign currency LIBOR is 1.84% (rf).

Now suppose an Authorised dealer quotes an implied volatility (offer) of 1.5% (σ). The price for the option in INR terms will be computed as follows:

- Calculation of $d_1$ using the above expression gives a value of 0.01892
- Calculation of $d_2$ using the above expression gives a value of 0.01462
- $N(d_1)$ turns out to be 0.507548, $N(d_2)$ turns out to be 0.0.505832

The price of the call option is thus calculated to be Rs. 0.081738 for a notional of USD 1 (Rs. 81,738 for a notional of USD 1 million or approx. 0.17% of the notional)

## 9.2 Delta equivalent spot position for a FC-INR option portfolio

The spot position arising out of the options transactions shall be calculated as the sum of the delta equivalent spot position of all outstanding option contracts. For the sake of simplicity, let us assume that an authorised dealer has only two options in his portfolio: a call option sold to an importer and a put option sold to an exporter.

Both options are of 1-month maturity, European and at a strike corresponding to the forward USD/INR rate. Let the notional amount for the two options be USD 1 million.

Spot= 48.735, Strike=At the money forward rate[2] = 48.90; Mid Volatility for ATMF = 1.5% (as displayed in a common forum where all market makers quote their bid and offer vols); Bid Volatility = 1.25%; Offer Volatility = 1.75%

The bid volatility is the 'Black-Scholes implied volatility' at which the market maker is prepared to buy option contracts whereas offer volatility refers to the 'Black-Scholes implied volatility' at which the market maker is ready to sell option contracts.

We have seen the formulae for computation of Black Scholes delta [as N(d1)] in Annexure 1. The delta equivalent spot positions can be calculated at the mid volatility for the various parties involved as follows:

| | Importer | Exporter | Authorised Dealer |
|---|---|---|---|
| Call delta | USD 0.5006 mn | 0 | - USD 0.5070 mn |
| Put delta | 0 | - USD 0.4978 mn | + USD 0.4978 mn |
| Net Delta Equivalent spot position | USD 0.5006 mn | - USD 0.4978 mn | - USD 0.0092 mn |

Thus the delta position of the entire portfolio for the authorised dealer is nothing but the arithmetic sum of the delta spot positions of the individual option contracts in the portfolio. The expected change in delta for a given change in spot rate is given by:

Change in delta = Gamma * Change in spot (locally)

Thus for the given portfolio, the change in delta for a 0.01% change in spot (say a 0.5 paise move) the change in delta will be ….1900276.30 * 0.01% = USD 190.02 approximately. For larger moves in spot rates, the same could be re computed under various scenarios (Scenario analysis).

## 9.3 Forward positions from a FC/INR option portfolio

The Option portfolio offered by the Market maker creates not only spot position but a position in forward also. This is the delta equivalent of the option position for the maturity bucket corresponding to the maturity of the option. Let us illustrate it with an example of a market maker who has offered following option position as on 28.3.2002:

- Sold a put at strike price of 49.52 for maturity 30.06.2002 for notional USD 1 million
- Purchased a call at strike price of 49.52 for maturity 30.06.2002 for notional USD 1 million

[2] The '*At the money forward strike*' refers to the option sold with strike price equivalent to the prevailing forward price for the maturity of the option

If we look at this sold put position and purchased call position together, we would realise that the payoffs created from this position is similar to that of payoffs created from a forward long position in USD at 49.52 for the same maturity.

| Spot rate at maturity | Payoff at maturity | |
|---|---|---|
| | Sell put + Buy Call | Forward position |
| 49.60 | 0.08 | 0.08 |
| 49.52 | 0.00 | 0.00 |
| 49.45 | -0.07 | -0.07 |

Thus we see that the payoffs of the two positions are equivalent in all scenarios, thereby implying that options not only create spot equivalent positions but also forward positions. This is equivalent to a buy position for 1 million dollar in the spot market and a sell buy position for 1 million dollar in the swap market.

The above relationship is known as the call put parity i.e.

$$c - p = Se^{-r_f T} - Xe^{-rT}$$

where,

S = current price of the underlying asset

X = exercise price of the option

r = risk-free rate

T = time to expiration

σ = Standard deviation of the underlying asset

$r_f$ = yield of the underlying asset

Thus options might actually create forward positions and hence both the spot equivalent and the swap equivalent positions of the option portfolio need to be monitored as a part of Exchange limits and the Gap limits.

### 9.3.1 Suggested procedure for computation and monitoring of Forward Limits

The Forward delta limit of an option can be computed from the spot delta position by applying the following formula

Forward delta = spot delta * $\exp((r-r_f)*t)$

Where

r = Risk free rate of INR

$r_f$= Risk free rate of the underlying currency, say USD

T=Time to maturity

In the example above the computation of the forward delta's is as under

Spot delta for put = 0.5 million (since the option strike is equal to the forward rate)

Forward delta for put = 0.5024 million (with T= 0.25 yr and $r_f$ = 1.90%)

Spot delta for call = 0.5 million

Forward delta for call = 0.5024 million (with T= 0.25 yr and $r_f$ = 1.90%)

Total forward delta position for the month of june

= forward delta for call + forward delta for put

=1.048 (equal to the delta of a plain forward contract)

Total forward position = Sum of Spot deltas

= 1 million

This ties up with the fact that delta of the underlying is 1.

## 9.4 Volatility fixings by British Bankers Association

BBA CURRENCY OPTION FX BBAVOLFIX1
BBA CURRENCY OPTION VOLATILITY FIXINGS Info<BBAVOLFIX8>
Disclaimer<BBAVOLFIX5>
Today's Date 22-07-02 Rates fixed 16:00 Ldn Time Logical Displays<BBAVOLFIX7>

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GBP/USD Spot 1.5741 USD/JPY Spot 116.30

| | 25 Delta Vols | 25 Delta Strangles | Risk Revs | 25 Delta Vols | 25 Delta Strangles | Risk Revs |
|---|---|---|---|---|---|---|
| 1W | 9.28 | | | 10.45 | | |
| 1M | 9.06 | 0.21 | 0.97 | 10.17 | 0.34 | -1.63 |
| 3M | 8.83 | 0.23 | 0.76 | 9.81 | 0.36 | -1.51 |
| 6M | 8.75 | | | 9.64 | | |
| 1Y | 8.72 | 0.25 | 0.43 | 9.55 | 0.40 | -1.20 |
| 2Y | 8.95 | | | 9.56 | | |

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EUR/USD Spot 1.0063 USD/CHF Spot 1.4437

| | 25 Delta Vols | 25 Delta Strangles | Risk Revs | 25 Delta Vols | 25 Delta Strangles | Risk Revs |
|---|---|---|---|---|---|---|
| 1W | 11.52 | | | 11.96 | | |
| 1M | 11.70 | 0.24 | 1.19 | 12.11 | 0.24 | -1.34 |
| 3M | 11.54 | 0.27 | 1.11 | 11.87 | 0.27 | -1.24 |
| 6M | 11.43 | | | 11.70 | | |
| 1Y | 11.39 | 0.27 | 0.88 | 11.63 | 0.28 | -1.02 |
| 2Y | 11.45 | | | 11.71 | | |

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# 10 Schedule V– Detailed accounting entries

## 10.1 Accounts

For recording options transactions, the following accounts should be maintained:-

1. Contingent Accounts : (off Balance Sheet)
   - FX Options – Call Bought Accounts
   - FX Options – Put Bought Accounts
   - FX Options – Call Sold Accounts
   - FX Options – Put Sold Accounts.
2. Other Accounts
   - Premium on Foreign Currency Options Accounts
   - Options Premium Receivable Accounts
   - Options Premium Payable Accounts
   - Unrealised gain/loss- Foreign Currency Options Accounts

## 10.2 Accounting entries

### 10.2.1 Recording the notional

The accounting entries to record the commitment of the options and to record notional and face value of currencies at the strike rate are as follows: (The accounting entries are given for USD/INR option transactions; the same can be replicated for any other currency FC/INR option by substituting FC for the USD components in the transactions and accounting entries)

On Trade Date :

i) **<u>When the Bank buys USD Call/INR Put</u> :**

| | | |
|---|---|---|
| Dr. FX Options – Call Bought<br>Cr. FX Options per contra | USD | <br>USD |

| | | |
|---|---|---|
| Dr. FX Options – Put bought<br>Cr. FX Options per contra | INR | <br>INR |

**i) When the Bank buys USD Put/ INR Call:**

| | | |
|---|---|---|
| Dr. FX Options - Put Bought<br>Cr. FX Options per contra | USD | <br>USD |

| | | |
|---|---|---|
| Dr. FX Options - Call Bought<br>Cr. FX Options per contra | INR | <br>INR |

**i) When the Bank sells USD Call/INR Put:**

| | | |
|---|---|---|
| Dr. FX Options per contra<br>Cr. FX Options – Call Sold | USD | <br>USD |

| | | |
|---|---|---|
| Dr. FX Options per contra<br>Cr. FX Options – Put Sold | INR | <br>INR |

**i) When the Bank sells USD Put/ INR Call**

| | | |
|---|---|---|
| Dr. FX Options per contra<br>Cr. FX Options – Put Sold | USD | <br>USD |

| | | |
|---|---|---|
| Dr. FX Options per contra<br>Cr. FX Options – Call Sold | INR | <br>INR |

### 10.2.2 Premium payable:

**i) On Trade Date :**

| | | |
|---|---|---|
| Dr. Premiums on Foreign Curr. Options<br>Cr. Options Premium Payable Account | INR | <br>INR |

(To record the premium payable - to be calculated in Indian Rs.)

**i) On premium settlement date:**

| | | |
|---|---|---|
| Dr. Options Premium Payable Account<br>Cr. INR Cash settlement account | INR | <br>INR |

(To record the cash settlement of options premium payable)

**i) On the Options expiry date/ exercise date:**

| | | |
|---|---|---|
| Dr. Exchange Income – For. Curr. Options<br>Cr. Premiums on Foreign Curr. Options | INR | <br>INR |

(Recognition of option premium paid on expiry date/exercise date)

### 10.2.3 Premium receivable:

**i) On Trade Date:**

| | | |
|---|---|---|
| Dr. Option Premium Receivable Account<br>Cr. Premiums on Foreign Curr. Options A/c | INR | <br>INR |

(To record the premium receivable on the option sold – to be calculated in Indian Rupees)

**i) On the Premium Settlement date:**

| | | |
|---|---|---|
| Dr. INR Cash settlement acct<br>Cr. Options Premium Receivable Acct. | INR | INR |

(To record the cash settlement of option premium receivable)

**i) On Options expiry date / exercise date:**

| | | |
|---|---|---|
| Dr. Premium on For. Cur. Options<br>Cr. Exchange Income – For. Cur. Options | INR | <br>INR |

(Recognition of option premium received on expiry date/exercise date)

### 10.2.4 Daily valuation entries

**i) Gain on revaluation:**

| | | |
|---|---|---|
| Dr. Unrealised gain/loss – For. Cur. Options<br>Cr. Exchange Income - For. Cur. Options | INR | <br>INR |

(To record the gain on mark-to-market valuation of the outstanding options)

**i) Loss on revaluation:**

| | | |
|---|---|---|
| Dr. Exchange Income – For. Cur. Options | INR | |
| Cr. Unrealized gain/loss – For. Cur. Options | | INR |

(To record the loss on mark-to-market valuation of the outstanding options)

Note:

- The above entries are reversed on the next business day and the new MTM recorded accordingly
- The MTM balance posted should be net of the premium received/paid amount (as the premium received/paid has been recorded)
- Net one entry will be passed daily to record the results of the mark-to-market valuation of all the outstanding options.

### 10.2.5 Option expiry entries:

1. Option contract can mature due to exercise by the option holder or by reaching the option's expiration date without having been exercised. When an option matures, the entries originally posted to the contingent accounts should be reversed.
2. Accordingly, on the date of maturity of the options, whether the contract has been exercised or the same is expired unutilized, the accounting entries as given in (A) above at the time of entering into contract, should be reversed in any of the case (i) to (iv) – CONTINGENT ACCOUNTS. Reversal of Memorandum entries is as per (A) above.
3. Options once exercised should be settled with the customer/ counterparty through foreign exchange trades.
4. Entries for recording the premiums received/paid to "Exchange Income - Foreign Currency Options" are explained under (B) and (C) above.

### 10.2.6 Contract liquidation prior to maturity

**i) When the Bank buys an Option and the contract is liquidated:**

1. Reverse the Contingent Account entries as per (A) (i) or (A) (ii) as above whether a call option or put option as the case may be.
2. Entries to be passed for accounting original option premium and offsetting option premium recording to "Exchange Income - Foreign Currency Options" are as follows:

(NOTE: Entries to be passed are either of the following two sets according to the net gain or loss on liquidation)

| | | |
|---|---|---|
| Dr. Exchange Income – For. Cur. Options<br>Dr. Options Premium Receivable Account<br>Cr. Premiums on Foreign Curr. Options | INR<br>INR | <br><br>INR |
| Dr. INR Cash settlement Account<br>Cr. Option Premium Receivable Account | INR | <br>INR |

(If the offsetting option premium received is less than the original option premium paid. NOTE: As the buyer of the option liquidates the contract prior to expiration, he is eligible to receive the premium on Mark to Market basis)

**OR**

| | | |
|---|---|---|
| Dr. Options Premium Receivable Account<br>Cr. Premiums on For. Curr. Options<br>Cr. Exchange Income - For. Curr. Options | INR | <br>INR<br>INR |
| Dr. INR Cash settlement Account<br>Cr. Options Premium Receivable Account | INR | <br>INR |

(If offsetting option premium received is more than the original option premium paid. NOTE: As the buyer of the option liquidates the contract prior to expiration, he is eligible to receive the premium MTM basis.)

**ii) When the Bank sells an option and the contract is liquidated:**

1. Reverse the Contingent Account entries as per (A) (iii) or (A) (iv) as above whether a call option or a put option as the case may be

2. Entries to be passed for accounting original option premium and offsetting option premium recording to "Exchange Income – Foreign Currency Options" are as follows:

(NOTE: Entries to be passed are either the following two sets according to the net gain or loss on liquidation.)

| | | |
|---|---|---|
| Dr. Premiums on For Curr. Options<br>Cr. Options Premium Payable Account<br>Cr. Exchange Income – For. Cur. Options | INR | <br>INR<br>INR |

| | | |
|---|---|---|
| Dr. Options Premium Payable Account<br>Cr. INR Cash settlement Account | INR | <br>INR |

(If the offsetting option premium paid is less than the original option premium received. NOTE: Though the Bank sells option, it has to pay premium on liquidation on mark- to-market basis.)

**OR**

| | | |
|---|---|---|
| Dr. Premiums on For Curr. Options<br>Dr. Exchange Income- F.C. Options<br>Cr. Option Premium Payable Account | INR<br>INR | <br><br>INR |
| Dr. Option Premium Payable Account<br>Cr. INR Cash settlement Account | INR | <br>INR |

(If offsetting option premium paid is more than the original option premium received. NOTE: Though the Bank sells option, it has to pay premium on liquidation on mark- to-market basis.)

# 11 Schedule VI– Acknowledgements

## 11.1

The Committee would like to acknowledge the following market participants and organisations for their valuable suggestions and feedback.

| | Institution | |
|---|---|---|
| 1. | Citibank | Ravi Saur |
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| 5. | Larsen and Toubro | L. Govindan |
| 6. | Reserve Bank of India | A. Rajalakshmi |
| | | Leela Pillai |
| 7. | Reliance Industries Ltd. | Ramana Gupta |
| | | Satish Nayak |
| 8. | State Bank of India | Rakesh Joshi |
| | | K. K. Rao |
| 9. | Standard Chartered Bank | Madhav Shankar |
| 10. | Western Coal Fields | Partha Bhattacharya |