

*Market Risk Analysis**

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I extend a warm welcome to the faculty from the Federal Reserve and all the participants of this programme. I am happy to inaugurate the Market Risk Analysis Programme. The periodic programmes involving the Fed Reserve experts have been welcomed wholeheartedly by the participants and we are glad to have another edition of the training programme, with focus on market risk. I hope the participants would be immensely benefited by this programme, just like the participants in the earlier programmes. The programme also comes in the context of the proposed seminal change in the RBI's banking supervision methodology and process this year. I refer to the introduction of the risk based supervision covering nearly half of the commercial banks in the first phase from the ensuing cycle onwards. Focus on risks and tailoring our supervisory stance based on the specific risks in a financial institution would be the cornerstone of the new approach towards banking supervision. In this milieu, there is a need for an enhanced understanding of the major risk categories individually as well from a collective perspective in terms of the interactions among the major risks.

2. It has now come to be accepted that the interconnected world has ensured that the uncertainties in the advanced economies find their way to developing nations through various channels like the trade, finance, commodity price and confidence channels. Critically, the uncertainties are reflected in the volatility of capital flows to emerging market which in turn reflects on the volatility of domestic financial market variables. To understand some indicators of

the linkages, we can see that the ratio of India's external trade to GDP has increased four-fold – from 8 per cent of GDP in 1972 to nearly 40 per cent now while the ratio of two-way flow of goods and finance in and out of India to its GDP which incorporates non trade related flows, has increased eight fold over last four decades, from 14 per cent in 1972 to well over 100 per cent now. Apart from linkages with the global developments, there are several domestic factors which are also important in the context of increasing trend of volatility in domestic financial markets such as widening current account deficit, growth slowdown, growing fiscal deficit and sticky inflation, to name just a few. The uncertainty and volatility associated with the financial markets are expected to continue at least for the foreseeable future, as the 'new normal'. Managing the market risks in this context is a major challenge for the corporates and the banks alike.

3. Market risk is the most dynamic among the major risks, positions and hence the risks can change much more frequently in quick time in comparison to other risks. The Financial Stability Reports of the Reserve Bank have been presented the results of coordinated stress tests of scheduled commercial banks in respect of, *inter alia*, market risk. These tests conducted on balance sheet and off balance sheet positions show that banks are indeed vulnerable to sharp movements in market prices. Market risk is a risk practitioners delight at least from the perspective of quantifying them while it is not so straightforward for credit risk and would border on the difficult in respect of operational risk. Of course, there are major issues in respect of statistical methodologies in measuring market risk and VaR based measures have been derided for underestimating risks. The issue is about the lack of having acceptable alternatives *vis-à-vis* accepting the imperfections and supplementing with other measures. I will further elaborate later in my speech.

4. With a view to adopting the Basel Committee on Banking Supervision (BCBS) framework on capital adequacy which takes into account the elements of

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credit risk in various types of assets in the balance sheet as well as off-balance sheet business and also to strengthen the capital base of banks, Reserve Bank of India decided in April 1992 to introduce a risk asset ratio system for banks (including foreign banks) in India as a capital adequacy measure. The Reserve Bank had issued guidelines to banks in June 2004 on maintenance of capital charge for market risks on the lines of 'Amendment to the Capital Accord to incorporate market risks' issued by the BCBS in 1996. The market risk positions subject to capital charge requirement are: (i) The risks pertaining to interest rate related instruments and equities in the trading book; and (ii) Foreign exchange risk (including open position in precious metals) throughout the bank (both banking and trading books). With the introduction of CDS, calculation of capital charge has been specified for banks using CDS as a protection buyer or seller.

5. A major action as part of Basel III framework is the introduction of the incremental risk charge for the trading book. In 2005, the Basel Committee became concerned that banks were reducing their capital requirements by shifting exposures from the banking book to the trading book. Structured products whose values depended on the credit worthiness of companies were increasingly put under trading book. The products were less liquid than other instruments in the trading book. Regulators had proposed an 'incremental default risk capital charge' (IDRC) that would be calculated with a 99.9 per cent confidence level and a one year time horizon for instruments in the trading book that were sensitive to default risk. These instruments would therefore be treated in much the same way as similar instruments in the banking book. In 2008, the Basel Committee recognised that most of the losses sustained in the credit market turmoil of 2007 and 2008 were from changes in credit ratings, widening of credit spreads and loss of liquidity, rather than solely as a result of defaults. It therefore amended its previous proposals so that

these risks were included. The IDRC became generalised as 'Incremental Capital Charge'(ICC). These measures are expected to reduce the incentive for regulatory arbitrage between the banking and trading books.

6. An additional response to the crisis is the introduction of a stressed value-at-risk requirement. Losses in most banks' trading books during the financial crisis have been significantly higher than the minimum capital requirements under the former Pillar 1 market risk rules. The Committee therefore requires banks to calculate a stressed value-at-risk taking into account a one-year observation period relating to significant losses, which must be calculated in addition to the value-at-risk based on the most recent one-year observation period. The additional stressed value-at-risk requirement will also help reduce the procyclicality of the minimum capital requirements for market risk. This is expected to possibly double or triple the capital that banks would have to keep for market risks, particularly for international banks. Perhaps this is the main reason for lukewarm response in applying for advanced Internal Models Approach for calculating market risk capital in India. As the recent Financial Stability Report of RBI issued last month points out, only three commercial banks have applied for the advanced approach for market risk as opposed to 15 banks who have applied for migrating to IRB approach for calculation of credit risk capital and 9 banks for migrating to AMA for calculation of operational risk capital charge. Under Basel III, even under Standardised approach banks are required to specifically consider the various valuation adjustments while valuing their derivatives portfolios like – (i) incurred CVA losses, (ii) closeout costs, (iii) operational risks, (iv) early termination, investing and funding costs, and (v) future administrative costs and where appropriate, model risk.

7. The RBI has indicated that the capital requirement under IMA would be a function of three components:

(i) Normal VaR Measure (for general market risk and specific risk) (ii) Stressed VaR Measure (for general market risk and specific risk) (iii) Incremental Risk Charge (IRC) (for positions subject to interest rate specific-risk capital charge). General market risk and specific risk can be modelled together or separately for normal VaR measure and stressed VaR measure. In other words, a bank could calculate either a combined VaR measure for the two risk categories (general market risk and specific risk) or separate VaR measures for each of them. For example, the most extensive approach to model equity risk would be having risk factors corresponding to the volatility of individual equity issues. In such a case, bank would have modelled both general market risk and specific risk together. However, in cases where a bank calculates a combined VaR measure, it should be able to isolate the VaR for each component so as to enable its backtesting and use in the day-to-day risk management. In addition, in the case of interest rate-sensitive positions, which have credit risk, the banks will also have to compute incremental risk charge for default and migration risks, which are generally not captured by the VaR model. To start with, banks in India are required to model general market risk and use the present Standardised Measurement Method for specific risk.

8. On measurement of market risks, VaR methodology has proved to be the main method of assessing the overall market risk of trading positions over a short horizon, such as a 10 day period, and under 'normal' market conditions. The mechanics of VaR has been variously described at one end of spectrum as 'a new benchmark for managing financial risk' and at the other end of the spectrum as an 'intellectual fraud' along with various shades of opinions in between the two extremes. In effect, the methodology allows us to capture in a single number the multiple components of market risk such as curve risk, basis risk and volatility risk. However, each time there is a turmoil in the worlds markets, the limitations

of it as a market risk measure are revealed.

9. VaR has proved unreliable as a measure of risk over long time periods or under abnormal market conditions. The danger posed by exceptional market shocks such as the 2007-08 financial crisis or the LTCM crisis in the world markets in 1998 – shocks that are often accompanied by a drying up of market liquidity – can be captured only by means of supplemental methodologies. The potential of VaR to exacerbate market volatility has also been acknowledged. The herd mentality that is so typical of the financial industry means that market sensitive risk management systems, such as VaR, actually make markets less stable and more prone to crisis. This is because financial institutions may have to sell assets in the affected classes when markets become volatile in order to keep within the VaR limits set by senior management; this depresses market prices even further and increases the volatility and correlation of the risk factors for these assets. This in turn might cause another set of financial institutions to exceed their VaR limits, forcing them to reduce their exposure by selling still more of the same assets – perpetuating a vicious cycle.

10. Thus the VaR measure works well as a risk measure only for markets operating under normal conditions and only over a short period, such as one trading day. Potentially, it's a very poor and misleading measure of risk in abnormal markets, over longer time periods, or for illiquid portfolios. Also, VaR, like all risk measures, depends for its integrity on a robust control environment. In many instances of rogue-trading cases, hundreds of millions of dollars of losses have been suffered by trading desks that had orders not to assume VaR exposures of more than a few million dollars. The reason for the discrepancy is reportedly due to trading desks finding some way of circumventing trading controls and suppressing risk measures. For example, a trader might falsify transaction details entered into the trade reporting systems, by using fictitious trades to balance out the

risk of real trades, or by tampering with the inputs to risk models, such as volatility estimates that determine the valuation and risk estimation for an options portfolio. As you would agree, opportunity to carry out such tasks is facilitated by inadequate management oversight arising from lack of appreciation of the importance of the internal controls in trading environment. Further, there were instances reported in recent years about management deliberately turning a blind eye to risk measures or to the apprehension of the risk managers.

11. For a good risk measure, some properties have been propounded. These include monotonicity, translation invariance, homogeneity and sub-additivity. The risk measures satisfying all the conditions are referred to as coherent. It has been observed that while VaR satisfies the first three conditions, it does not always satisfy the fourth condition of 'sub additivity' which requires that the risk measure of two portfolios after they have been merged should be no greater than the sum of their risk measure before they were merged. However, given the simplicity and want of better alternative, VaR continues to be used supplemented with many other aspects like back testing to check the accuracy of the VaR model, stress testing and scenario analysis to assess the potential impact of plausible adverse market conditions among other measures.

12. For the advanced market risk approach, a bank will need to classify its back-testing outcomes into three zones depending on the number of exceptions arising from back-testing. The extreme zone is the red zone if the back-testing results produce ten or more exceptions in which case the multiplication factors for both VaR and stressed VaR will be increased from three to four. The RBI will allow 10 or more exceptions under the most extraordinary circumstances. RBI may require banks whose model for market risk fall in Red Zone to either discontinue the model or begin work on improving the model immediately. The RBI may also consider further increase in the capital

requirements if the bank is not able to demonstrate that its models are capturing all market (general market risk and specific risk, if any) risks it is exposed to.

13. Banks that use the internal models approach for meeting market risk capital requirements must have in place a rigorous and comprehensive stress testing programme to capture such potential stresses. The stress testing programme must particularly address: (i) concentration risk; (ii) illiquidity of markets in stressed market conditions; (iii) one way markets; (iv) event and jump to default risks; (v) non linearity of products; (vi) deep out of the money positions; (vii) positions subject to the gapping of prices; and (viii) other risks that may not be captured appropriately in the VaR model (for example, recovery rate uncertainty, implied correlations and skew risk).

14. In the aftermath of the financial crisis, model risk has come under intense scrutiny, and the governance of risk model supervision, assessment and validation has taken on ever greater importance for the risk function and the financial industry as a whole. A bank is required to have a model validation process which addresses three components of the model: (a) a model inputs component, which delivers data and assumptions to the model; (b) a model processing component, which encompasses the theoretical model and the computer codes which transform the model inputs into mathematical estimates; and (c) a reporting component, which translates the mathematical estimates into useful business information.

15. An interesting perspective is the interaction between credit risks and market risks. For many reasons, both historical and practical, market and credit risk have often been treated as if they are unrelated sources of risk: the risk types have been measured separately, managed separately, and economic capital against each risk type has been assessed separately. The development of credit risk transfer markets and the moves to mark-to-market

accounting for portions of held-to-maturity banking book positions, however, have blurred distinctions between them and raise questions regarding approaches that treat the two types of risks separately. Market participants have argued that there are significant diversification benefits to be reaped from the integrated measurement and management of market and credit risks. The recent financial crisis, however, has illustrated how the two risks may reinforce each other and that in such stress situations illiquidity can worsen losses further.

16. Market risk and credit risk are often distinguished by identifying the latter with (actual or expected) default. We define default as the failure to meet a contractually pre-determined obligation. As the same economic factors tend to affect both types of risk, drawing a clear distinction between them in practical risk measurement and management is, however, very difficult. Even if distinct factors could be separately associated with the two types of risk, the factors often interact significantly in determining asset values, and therefore risk measurement and management needs to explicitly account for their joint influence. In practice, market and credit risk are often distinguished in relatively simple ways on the basis of instruments, market liquidity, accounting treatments or holding periods. It is being increasingly acknowledged that care should be exercised to ensure that such pragmatic distinctions do not lead risk managers to ignore important risks that emanate from the interactions between market and credit risk. Examples of positions in which such compounding effects may be present include foreign currency loans, floating rate loans (including sub-prime mortgage loans) or matching long and short positions in OTC derivatives.

17. As a BIS study states, non-linear interaction emerges when losses from default on an instrument depend on movements in market risk factors, or conversely, when changes in the values of instruments due to movements of market risk factors depend on whether there is a default or rating migration. In these

circumstances, the two types of risk are inextricably linked, and attempts to measure them separately and then combine them can lead to substantial biases. In fact, research shows cases in which the combined risk is actually higher than the sum of the components leading to 'compounding effects' as opposed to diversification effects. A particularly clear example is foreign currency loans, which constitute a sizable part of lending in certain countries. Consider a bank lending in foreign currency to domestic borrowers. These positions contain market risk (exchange rate risk) and credit risk (default risk of borrowers). Now assess the two risks separately. When for example the domestic economy slows, *ceteris paribus*, the probability of domestic borrowers defaulting increases. When the domestic currency depreciates, *ceteris paribus*, the value of the loan in domestic currency increases as it is denominated in foreign currency. So, on the surface one could think that the two effects offset each other. But this reasoning would neglect the strong relationship between exchange rate changes and default risk in this type of contract. The ability of a domestic borrower to repay a loan in foreign currency depends in a non-linear way on fluctuations in the exchange rate (unless the domestic borrower has other revenues in the foreign currency in which the loan is denominated). A home currency depreciation has a particularly major effect on the repayment amount and therefore repayment probability of a foreign currency loan by an unhedged domestic borrower, which tends to be stronger than the valuation effect mentioned above.

18. Similarly, floating or adjustable rate loans have coupons that change as interest rates change. Therefore, if the coupons on the loans adjust frequently (or in the limit continuously), then the interest rate risk of the loan is passed on to borrowers, and therefore, assuming the loans do not default, they have no market risk for the bank. If credit risk is computed separately from market risk, then the credit risk of the loans is computed while holding interest

rates constant. This treatment of credit risk can miss an important interaction between market and credit risk. For example, if probabilities of default are increasing in interest rates, then holding rates constant can easily lead to an understatement of the true probability of default and hence the sum of market and credit risk, when computed separately, would lead to an understatement of total risk. The same is the case with matching long and short positions in OTC derivatives. The practical challenges of moving to a fully integrated measurement and management of economic risk, however, are currently substantial. A first major obstacle to integrating market and credit risk measurement and management is that the metrics typically used for each of them are not fully comparable, with market risk models capturing a full distribution of returns and credit risk models focusing on losses from default and neglecting gains.

19. Successful management of market and credit risk often relies on liquid markets to hedge risks and unwind positions, as the ongoing financial crisis has abundantly illustrated. Liquidity conditions interact with market risk and credit risk through the horizon over which assets can be liquidated. In particular, deteriorating market liquidity often forces banks to lengthen the horizon over which they can execute their risk management strategies. As this time horizon lengthens, overall risk exposures increase, as does the contribution of credit risk relative to market risk. The liquidity of traded products can vary substantially over time and in unpredictable ways. Theoretical research indicates that such liquidity fluctuations, all else equal, should have a larger impact on prices of products with greater credit risk. Conversely, as the current financial crisis illustrates, valuation uncertainties or other shocks that enhance actual or perceived credit risks can have adverse effects on liquidity and put in motion a downward spiral between market prices and liquidity of traded credit products (see for example the case of tranches from collateralised debt obligations based on sub-prime loans).

20. As regards securitisation, the securitisation market is primarily intended to redistribute the credit risk away from the originators to a wide spectrum of investors who can bear the risk, thus aiding financial stability and provide an additional source of funding. The recent crisis in the credit markets has called into question the desirability of certain aspects of securitisation activity as well as of many elements of the 'originate to distribute' business model, because of their possible influence on originators' incentives and the potential misalignment of interests of the originators and investors. For example, if the incentives of originators are not sufficiently aligned with those of the holders of risk then banks' intermediation function, including screening and monitoring of borrowers, can be severely impaired. Once these problems become apparent to the wider market, risk sharing markets become dysfunctional or even disappear. If securitisation markets become illiquid, banks can be exposed to heightened risk from exposures to both credit risk (defaults), for example as loans can no longer be securitised, and to market risk from changes in the mark-to-market value of the securitised assets. In addition, when risk-sharing markets become illiquid, the signals from prices can become distorted or even disappear, rendering risk measurement especially challenging. A further requirement for well-functioning markets is that investors in securitisation instruments should have a firm understanding of the associated risks. Recent events exposed deficits in this understanding that were partly related to problems with the availability of information and to the complexity of certain securitisation structures that obscured the links between the performance of the underlying assets and the price of the instruments.

21. While the securitisation framework in India has been reasonably prudent, certain imprudent practices have reportedly developed like origination of loans with the sole intention of immediate securitisation and securitisation of tranches of project loans even

before the total disbursement is complete, thereby passing on the project implementation risk to investors. With a view to developing an orderly and healthy securitisation market, to ensure greater alignment of the interests of the originators and the investors as also to encourage the development of the securitisation activity in a manner consistent with the aforesaid objectives, several proposals for post-crisis reform were being considered internationally. Central to this is the idea that originators should retain a portion of each securitisation originated, as a mechanism to better align incentives and ensure more effective screening of loans. In addition, a minimum period of retention of loans prior to securitisation is also considered desirable, to give comfort to the investors regarding the due diligence exercised by the originators. Keeping in view the above objectives and the international work, the RBI had framed guidelines regarding the Minimum Holding Period and Minimum Retention Requirement among other measures and the revision in its securitisation guidelines was issued in May, 2012.

22. In the context of banks applying for moving over to advanced approaches, there is a need to clearly distinguish between different Pillar I risks. For example, we need to be clear as to under which risk category the following events would be classified – under market risk or under operational risk? – (i) Incorrect mark-to-market valuations and VaR, due to, for instance, erroneous booking of a trade into the trading system and the market moves in negative direction resulting in losses (ii) incorrect specification of deals in the term-sheet (errors related to the transaction amount, maturities and financial features) (iii) unauthorised trading in excess of risk limits (iv) failures in properly executing a stop loss. Those of you who have answered as operational risk perhaps could be proud of having some level of detailed understanding of the major risk categories. It is important to remember that with reference to the interaction between operational risk and the other

Pillar 1 risk types, for banks intending to follow AMA for operational risk, the boundaries between operational risk and credit and market risks involve different treatments. While credit-related operational risk losses are excluded from the operational risk capital requirement (as long as they continue to be treated as credit risk for the purpose of calculating minimum regulatory capital), operational risk/market risk boundary events are included in the scope of operational risk rather than under market risk for regulatory capital calculation.

23. When distinguishing between operational risk (events or losses) and market risk (events or losses) the following criteria should be applied: the events (and the related losses) which should be included in the 'scope of operational risk' are: (a) Events due to operational errors; (b) Events due to failures in internal controls; (c) Events due to wrong selection of the model, made outside a defined business process/formalised procedure and without a formalised, conscious risk-taking process; and (d) Events due to wrong implementation of the model. In all these cases, the whole amount of the loss incurred should be included in the 'scope of operational risk loss', unless the position is intentionally kept open after the operational risk event is recognised. In the latter case any portion of the loss due to adverse market conditions after the decision to keep the position open should be ascribed to market risk. The events (and the related losses) which should be excluded from the 'scope of operational risk' include those arising from wrong selection of a model, made through a formalised corporate process where the pros and cons of the model itself are carefully weighed up.

24. Participants would recall that a few days back the FED and OCC applied enforcement action against JP Morgan after they found weaknesses in internal controls in its London office which lost about \$6 billion in early 2012 on derivatives bets through synthetic credit portfolio which looked more like speculation than hedging. Some of the key

requirements forming part of the enforcement order included implementing risk management programme effectively and consistently across the firms with respect to trading activities, measures to ensure that controls for trading activities across lines of business are consistent, enhanced model risk governance, measures to ensure that material risk management issues relating to trading activities are escalated in a timely manner to senior management and the BoD or a committee thereof, as appropriate. In respect of internal audit, the requirements included enhanced escalation procedures for timely resolution if material audit exceptions and recommendations and measures to strengthen the ongoing quality assurance review of audit practices. Similarly, in respect to a \$2 billion loss at UBS, FSA while penalising the bank last year had observed that risk management of the desk was not effective in controlling the risk of unauthorised trading. The trade capture and processing system also had weakness which were exploited in order to conceal unauthorised trading. The system allowed trades to be booked to an internal counterparty without sufficient details, there were no effective methods in place to detect trades at material off-market prices and there was a lack of integration between systems. There was an understanding among personnel supporting the desk that the operation divisions main role was that of facilitation. Their main focus was on efficiency as opposed to risk control and they did not adequately challenge the front-office. All these are instances are indicative of what is missing in terms of management and control

processes that lead to such instances and are instructive to us. However, notwithstanding plethora of similar historical cases with perhaps slightly different modus operandi, new cases keep coming now and then. Perhaps, the underlying causative factors arise from the system of incentives and disincentives, which have also been factored in as part of measures to address the issues causing the financial crisis of 2007-08.

25. I am happy to note that the course coverage is comprehensive covering various areas like sound internal controls and risk management systems for a bank's trading book, tools to measure, monitor and control market risks, discussion on emerging issues in derivatives markets, discussion on securitisation and basic accounting aspects relating to derivatives. I hope the participants use the opportunity to further clarify their doubts relating to the subject area of this programme from the Fed Reserve experts. I thank the Federal Reserve System for their continuing support in training our officials on various supervisory areas. I am certain that the inputs received from this programme would assist in improving knowledge and understanding of the relevant subject areas both for the relatively new as well as experienced inspecting officials who have gathered here, which is of particular significance in the present context of moving to a risk based approach to supervision coupled with proposed migration of some of the banks to advanced approaches for computation of capital in the near future. I wish the programme a great success and wish the participants a fruitful learning experience.