

## **Chapter-4 Basics of Market Risk**

**Certificate in Risk Management**



### **Confidentiality statement**

This document should not be carried outside the physical and virtual boundaries of TCS and its client work locations. The sharing of this document with any person other than TCSer would tantamount to violation of confidentiality agreement signed by you while joining TCS.

#### **Notice**

The information given in this course material is merely for reference. Certain third party terminologies or matter that may be appearing in the course are used only for contextual identification and explanation, without an intention to infringe.

## Contents

Chapter – 4 Basics of Market Risk.....	4
4.1 Market Risk.....	5
4.2 Market Risk Management .....	9
4.3 Market Risk Measurement.....	13
4.4 Risk limits .....	22
Summary.....	25



## Chapter – 4 Basics of Market Risk

---

### Introduction

This chapter helps in understanding the basics of market risk. This chapter provides framework for market risk management with examples. It also discusses the measurement methodologies of market risk.

### Learning Objective

After reading this chapter you will:

- To understand the basics of major financial risks i.e. market risk and credit risk
- To explain the various management process for risk management
- To understand the risk management framework



#### 4.1 Market Risk

Market risk refers to the day-to-day fluctuations in stock's price. Market risk is the risk that the value of an investment will decrease due to moves in market factors. Market risk can be defined as the risk of losses in on and off-balance sheet positions arising from adverse movements in market prices. A Risk is the amount of deviation from estimated or expected outcome. Risk is intrinsic to a business activity and arises from exposure and uncertainty from potential future events. Risk is a mix of danger and opportunity. The risk in case of single asset is the risk it adds to the market portfolio.

#### Types of Market Risk

Market risk usually have an impact on stocks and options .This volatility in stock's price is caused because of change in various factors like interest rates, foreign exchange rates, equity prices, commodity prices etc. The market risk also includes liquidity risk which may arise when a bank is not able to meet its liabilities as and when they are due and may need to borrow funds at higher rates to fund these liabilities. Also known as Systematic Risk, it is the risk that the value of the portfolio of the firm will change with the movements in the market. It is also referred to as price risk. It cannot be distinctly separated from other risks as it results from the interplay of all other risks.

*Market risk is caused due to the variations in the market variables having undesirable and unfavorable impact on earnings of a Bank or on its capital.*

These changes may be consisting of undesired changes in interest rates, foreign exchange rates, equity prices and commodity prices etc. The market risk also includes liquidity risk, which may arise when a Bank is not able to meet its liabilities as, and when they are due and may need to borrow funds at higher rates to fund these liabilities.

Market risk is measured using VaR (Value at Risk) models. Market Risk can broadly be divided into:

- i. Equity risk
- ii. Currency risk
- iii. Interest rate risk
- iv. Equity index risk
- v. Commodity price risk

The various risks associated with market risk are as discussed:

### i. Interest Rate Risk

Interest rate risk is the risk that an investment's value will change due to change in interest rate or the risk that nominal spread will vary. Changes in Interest rates lead an inverse impact on securities. Interest rate can be reduced or managed through diversification or hedging. A fundamental principle of bond investing is that market interest rates and bond prices generally move in opposite directions. When market interest rates rise, prices of fixed-rate bonds fall. This phenomenon is known as interest rate risk.

*Investopedia* defines it as "the risk that an investment's value will change in the absolute level of interest rates, in the spread between two rates, in the shape of a yield curve or in any other interest rate relationship. Such changes usually affect securities inversely and can be reduced by diversifying or hedging".

Banks try to maximize their Net Interest Income (NII); the long-term objective of a commercial bank is maximization of the market value of its net worth (which is the difference between its assets and liabilities, both priced at the market value). The immediate impact of interest rate changes is on the NII and the long-term impact is on the Market Value of Equity (MVE) of the bank.

**TATA CONSULTANCY SERVICES**

Asian Crisis of 1997-98 saw short-term Thai Baht interest rates exponentially increase, as the authorities tried to prevent speculators who wanted to sell the Baht (which was pegged at a fixed exchange rate to the US Dollar). Companies with huge loan liabilities were adversely affected because of this sudden increase in interest rates.

- a) **Mismatch risk or Repricing risk:** In a situation when short term deposit of say one year maturity have been utilized for investment in long term Government securities of say 5 years would result in a mismatch. In case interest rates on deposits increase while the interest income on term loans and government securities remain same, the interest spread would get reduced having adverse impact on bank's interest income.
- b) **Basis Risk:** Basis risk or spread risk is the result which arises due to the change in the relationship between the yields or yield curves of long and short positions with the same maturity in different financial instruments.

- c) **Yield-curve risk or Price risk:** Banks' value of investments at a specific interest rate may suffer a set back or may depreciate if there is increase in market interest rates. However, any decline in interest rate may result in banks' portfolio. The change in value of investments is on account of present value of the cash flows when discounted by the new interest rates.
- d) **Option Risk:** Option risk arises due to the change in assets and liabilities durations when change occurs in interest rates. It also arises from the prepayment, cap, floor and other options embedded in underlying mortgages, term deposits & other products.

## ii. Foreign exchange (FOREX) Risk

This risk is caused as a result of fluctuating exchange rates. These risk impacts businesses indulged in exports and imports. An investment denominated in different currencies attracts currency risk. Fluctuations in exchange rates affect investments. Emerging market currencies exhibit more volatility in comparison to developed markets, thus exposing it to higher currency risks.

### TATA CONSULTANCY SERVICES

During the Asian financial crisis, firms in the affected countries had taken loans from western banks. Repayment of loans were agreed to be in foreign currency. As a result these firms were exposed to foreign exchange risk, as there was no proper risk hedging in place. As the domestic currency started to fall against the foreign currency, the amount of domestic currency required making payments increased thus leading to bankruptcy of such firms.

FOREX risk may include three types of commonly understood risks such as Transaction Exposure, Translation Exposure and Economic Exposure which are briefly explained as under:

- a) **Transaction Exposure:** The risk arises due to adverse movement of the exchange rate from the time the transaction is budgeted till the exposure is extinguished by sale or purchase of foreign currency against the home currency.
- b) **Translation Exposure:** it arises from the need to translate foreign currency assets and liabilities into the home currency for the purpose of finalizing the accounts for any given period. It can thus be defined as the risk which will alter the domestic

currency value of assets and liabilities in the balance sheet, which arises when translated at a foreign exchange rates, resulting in a reported gain or loss.

- c) **Economic Exposure:** It can be defined as change in future earning power and cash flow as a result of adjustment of the currencies. It is the sensitivity of the real domestic currency value of Assets and Liabilities, or future operating incomes to unanticipated changes in exchange rates.

The three important issues that need to be addressed in this regard are:

- Nature and magnitude of exchange risk
- The strategy to be adopted for hedging or managing exchange risk
- The tools of managing exchange risk

iii. **Equity Price Risk**

Equity Price Risk is the standard deviation of a security's price over a number of periods. This risk arises due to potential of the banks to suffer losses on its exposure to capital markets from adverse movements in prices of equity. Banks use VaR models for management of equity position risk.

**TATA CONSULTANCY SERVICES**

iv. **Commodity Price Risk**

A commodity is defined as a physical product which is or can be traded on a secondary market e.g. agriculture products, minerals, oils, and precious metals etc. the commodity price risk is often quite complex and more volatile than risks associated with currencies or interest rates.

v. **Liquidity Risk**

Liquidity risk is caused due to mismatch in maturity of bank's assets and liabilities. Commercial bank deposits generally have a much shorter contractual maturity than loans and liquidity management needs to provide cushion to cover anticipated deposit withdrawals. This risk may arise when a bank is unable to fund liabilities as these become due for payment or may be able to fund the same at cost much higher than market cost.

The key ratios which need to be analyzed may include the following:

- Total Liquid Assets to Total Assets ratio (the higher the ratio, more liquid is the bank)

- Total Liquid Assets to Total Deposits Ratio (Ratio helps in measuring the banks' ability to meet withdrawals)
- Loans to Deposits Ratio and
- Inter-bank deposits to Total Deposits Ratio.

The liquidity risk in banks manifest in different dimensions:

- a) **Funding Risk** – need to replace net outflows due to unanticipated withdrawal/non-renewal of deposits :
- b) **Time Risk** - need to compensate for non-receipt of expected inflows of funds, i.e. performing assets turning into non-performing assets; and
- c) **Call Risk** - due to crystallisation of contingent liabilities and unable to undertake profitable business opportunities when desirable.
- d) **Off Balance Sheet Risk:** liability not shown in balance sheet though has to be considered.



#### 4.2 Market Risk Management

Market risk management involves finding answers to four key questions.

- i. What are the risks?
- ii. What is the quantum how much could the price change? What would be the effect on profit and loss?
- iii. How can we monitor and control price risk?
- iv. Can we reduce the risk? And, if so then how?

Management processes for market risk management are designed essentially to answer these questions. Accordingly, management processes are sub-divided into following four parts:

#### Risk Identification

All products and transactions should be analyzed for risks associated with them. The various risks associated with standard products stand analyzed while that associated with new or non-standardized products need to be analyzed. Therefore, the approach for both differs. Products approved at corporate levels shall provide for screening procedures,

appropriate safeguards, product wise limit on exposure, and necessary guidelines in taking risks. Any new product or any deviation from the directed procedures and safeguards add to the risk content of exposure and need a clearance at the corporate level where risk return characteristics and risk quantification forms the basis of decision-making.

### **Risk measurement**

Market risk management framework is heavily dependent upon quantitative measures of risk. The market risk measures seek to capture variations in market value arising out of uncertainties associated with various market variables. These provide an objective measure of market risk in a transaction or of a portfolio. Market risk measures are based on:

- **Sensitivity:** It captures deviations of market price due to unit movement of a single market parameter. Supply –demand position, interest rate, market liquidity, inflation, exchange rate, stock prices etc., are the market parameters, which drive market values. For example, if the liquidity in the market increases that would result in increased demand that in turn may increase market price.

For example, if the market value of a portfolio of bonds changes by Rs 100,000 for 1% change in rate of interest, the interest rate sensitivity of the portfolio is Rs 100,000. This gives the measure of risk associated with the portfolio vis-à-vis change in interest rate.

- **Basis Point Value (BPV):** This is the change in value due to 1 basis point (0.01%) change in market yield. This is used as a measure of risk. The higher the BPV of a bond, higher is the risk associated with it. The computation of BPV is very simple. For example, a 5 year 65 semi-annual bond @ market yield of 8% has a price of Rs 92, which rises to Rs 92.10 at a yield of 7.95 %. So, for one BP fall in yield, market price changes by Rs 0.02 or gains by Rs 2000 per Rs 1 crore face values. BPV of the bond is, therefore, Rs 2000 per crore face values.
- **Duration:** McCauley's Duration was first proposed by Fredrick McCauley in 1938 as a means of describing a bond's price sensitivity to yield change with a single

number. This is equivalent to time, on average, that the holder of the bond must wait to receive the present value of the cash flows. It implies that if a 5 year 6% bond face value of Rs 100 with semi-annual interest has McCauley's duration say 3.7 years, then total cash flow to be received over the five year period of Rs 130 from the bond would be equivalent to receiving Rs 130 at the end of 3.7 years as a bullet payment.

Duration or Modified duration is McCauley's duration discounted by 1 period yield to maturity. The longer the duration of a security, the greater will be the price sensitivity to yield changes and higher would be the risk associated with the bond. Bond price changes can be estimated using modified duration using the following relationship:

Approx % change in price = - Modified duration \* Yield change

- **Downside Potential:** Downside potential only captures possible losses ignoring profit potential. Downside risk is the most comprehensive measure of risk as it integrates sensitivity and volatility with the adverse effect of uncertainty. This is the measure that is most relied upon by banking and financial service industry as also the regulators.

### Risk monitoring and control

Risk monitoring and control calls for implementation of risk and business policies simultaneously. It consists of setting market risk limits or controlling market risk, based on economic measures of risk while ensuring best risk adjusted return. Controlling market risk means keeping the variations of the value of a given portfolio within given boundary values through actions on limits, which are upper bounds imposed on risks.

### Risk mitigation

Risk mitigation arises due to volatility of financial instruments. The volatility of financial instruments is instrumental for both profits and risk. Risk mitigation in market risk i.e. reduction in market risk is achieved by adopting strategies that eliminate or reduce the

volatility of the portfolio. However, there are a couple of issues that are associated with risk mitigation measures.

### Risk Mitigation Strategies

Volatility of an individual instrument is market determined. But, volatility of two or more different financial instruments would have a different volatility. As a result, a portfolio of financial instruments can be created with desirable volatility characteristics. Strategies to achieve it are as discussed:

- **Strategies using Sensitivity Measures:** Say a portfolio has two bonds A and B of Rs 675 and Rs 205 respectively. The BPV of the portfolio would be the weighted average of the BPVs of all the bonds in the portfolio. The portfolio BPV will be  $(675+205)/2 = 440$ . Now, if we intend to reduce the risk of this portfolio, we may add another bond in the portfolio such that its BPV is less than 440. Say we add one more bond B in the portfolio. BPV of the portfolio will get reduced to 361.7.

Similar strategies are possible using other sensitivity measure- duration. Portfolio duration may be increased by adding higher duration instruments or by reducing lower duration instruments. Similarly, portfolio duration can be reduced by selling higher duration instruments or by adding low duration instruments.

- **Strategies using Correlation Measures:** Prices of two financial instruments that have perfect negative correlation would move exactly in opposite direction. If, the financial instruments have negative correlation and it is not perfect, then also prices would move in opposite direction but it will not be exact. In such a case price volatility of the portfolio would be there but it will be considerably low.

For example, a portfolio is long on a stock A and short in stock future of stock A. If the price of stock moves up say by Rs 10, the stock future would also go up but may not be exactly by Rs 10, say by Rs 9. The portfolio will gain Rs 10 on account of long position on stock A but will lose Rs 9 on account of short position in stock future. Reverse would also be true. The portfolio volatility however stands reduced or portfolio market risk remains mitigated. The same strategies are also possible with Interest rate swaps.

- **Strategies using Market Instruments:** Financial instruments such as options provide us with a method to hedge market risks. An option provides a right and not obligation but it comes at a cost called option premium. A position that is long on call option confers a right to buy the underlying instrument at a predetermined price called strike rate. A long position on put option confers a right to sell the underlying instrument at strike price. Both provide means to arrest downside movement and may be used from hedging a portfolio. Essentially, risk mitigation measures involve risk return trade-off as strategies to reduce the risks also reduce the upward potential.

An effective framework in a bank comprises risk identification, setting up of limits and triggers, risk monitoring, models of analysis that value positions or measure market risk, risk reporting etc.

Financial instruments take their price from the market and that depends upon interaction of market variables. Hence, market risk management processes do not have a risk pricing process. But, management of market risk needs an organization structure in place that can carry out the functions required for the purpose.

Usually, the Market Risk Management organization would consist of:

- The Board of Directors
- The Risk Management Committee
- The Asset-Liability Management Committee (ALCO)
- The ALM Support Group/ Market Risk Group
- The Middle Office

#### 4.3 Market Risk Measurement

In measuring their market risks, a choice between two broad methodologies will be permitted, subject to the approval of the national authorities. One alternative will be to measure the risks in a standardized manner, using the measurement frameworks.

The alternative methodology, which is subject to the fulfillment of certain conditions and the use of which is therefore conditional upon the explicit approval of the bank's supervisory authority,

This method allows banks to use risk measures derived from their own internal risk management models, subject to sets of conditions, namely:

- certain general criteria concerning the adequacy of the risk management system;
- qualitative standards for internal oversight of the use of models, notably by management;
- guidelines for specifying an appropriate set of market risk factors (i.e. the market rates and prices that affect the value of banks' positions);
- quantitative standards setting out the use of common minimum statistical parameters for measuring risk;
- guidelines for stress testing;
- validation procedures for external oversight of the use of models;
- rules for banks which use a mixture of models and the standardized approach

The standardized methodology uses a “building-block” approach in which specific risk and the general market risk arising from debt and equity positions are calculated separately. The focus of most internal models is a bank’s general market risk exposure, typically leaving specific risk (i.e. exposures to specific issuers of debt securities or equities) to be measured largely through separate credit risk measurement systems. Banks using these models should be subject to capital charges for the specific risk not captured by their models.

- i. **Scenario Analysis**
  - ii. **Value at risk**
- 
- i. **Scenario Analysis** - Scenario analysis refers to varying a wider range of parameters (interest rate, currency, equity price, commodity price, liquidity price) at the same time. It is the process of analyzing portfolio corresponding to a given period of time. After analyzing a portfolio for a given scenario (like in boom or normal or bearish market) portfolio risk can be easily estimated. Scenario analysis evaluates the expected value of a proposed investment or business activity Scenario analysis often examines the impact of catastrophic event on bank’s financial position for example simultaneous movements in a number of risk categories affecting all of a firm’s business operations. The scenario can be derived in a variety of ways including stochastic models or a repetition of an

historical event. It considers symmetric way of measure (up and down). A typical procedure, often called stress testing, is to use a scenario based on a historically adverse market move.

- ii. **Value at Risk-** Value at Risk (VAR) is generally accepted and widely used tool for measuring market risk inherent in trading portfolios. Var is a tool for measuring an entity's exposure to market risk. It is a quantitative measure of market risk at the portfolio level. The use of Var as a risk indicator has become more proliferated since the late 1980s, with the increased use of derivative instruments and tremendous volatility in exchange rates; many firms had started to have portfolios that include large amounts of cash and derivative instruments.

It follows the concept that reasonable expectation of loss can be deduced by evaluating market rates, prices observed volatility and the correlation. VAR summarizes the predicted maximum loss (or worst loss) over a target horizon within a given confidence level.



The well-known proprietary models that use VAR approaches are JP Morgan's Risk metrics, Banker's trust Risk Adjusted Return on Capital, and Chase's Value at risk.

Generally there are three ways of computing VAR

- a) **Parametric method or Variance covariance approach**
  - b) **Historical Simulation**
  - c) **Monte Carlo method**
- a) **Variance Covariance approach** –This method is also called the 'Delta-Normal Approach'. It assumes that the underlying market factors have a multivariate normal distribution. Therefore the market portfolio profits (or losses) are also expected to be normally distributed.
- Once the distribution of profits (or losses) is obtained, the properties of normal distribution are used to determine the loss that will be equaled or exceeded x% of the times. The formula for finding the standard deviation for portfolio consisting two asset (A and B) portfolio is:

$$\sigma_P = \sqrt{ (wA_2 \times \sigma_{A2} + wB_2 \times \sigma_{B2} + 2wA \times wB \times \rho_{AB} \times \sigma_A \times \sigma_B)}$$

Where  $\sigma_P$  is the standard deviation which represents the volatility of the portfolio

$wA$  and  $wB$  the proportions/weights of the assets A and B in the portfolio

$\sigma_{A2}$  and  $\sigma_{B2}$  are the volatilities of A and B

$\rho_{AB}$  is the correlation between the assets A and B

This value can be used to find the Var of a portfolio by constructing a matrix.

The Var is calculated as: (let at  $x=5\%$ )

$$\text{Var} = \frac{\text{Expected change in the portfolio value}}{-1.65} \quad \frac{\text{SD of change in portfolio value } (\sigma_P)}{}$$

Where 1.65 is 5% the critical value for standard normal

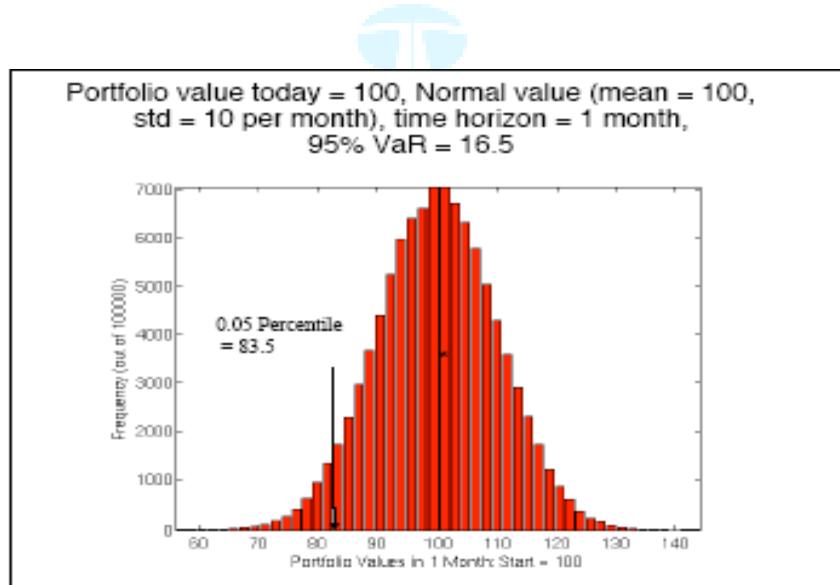


Figure 11.1 Portfolio values (Source: [www.people.brandeis.edu](http://www.people.brandeis.edu))

In the graph given above the standard deviation of the portfolio is given and confidence level = 95%. At this confidence level of 95% the critical value is 1.65 as mentioned above so we calculate Var as  $\text{std} \times 1.65 = 16.5$ .

The outcomes less than or equal to 1.65 below the mean, i.e. -1.65 occurs only 5% of the times.

### Problems in using the Variance-Covariance method

The variance/covariance method assumes that the portfolio asset's price changes are normally distributed. To verify whether this assumption is reasonable, each asset in the portfolio must be examined, which is not very feasible for portfolios having multiple assets.

This method relies on the assumption that the portfolio's value changes linearly or quadratically with the changes in the market risk, while this might not be the case always. For instruments like options and option-like instruments, this method fails, especially if the holding period is not very short (like 1 day). This is because the Delta-Normal method typically incorporates options by linearizing the option positions or replacing the non-linear functions that give their values with linear approximations.

**b) Historical simulation-** This method, forecasts for the influence of market changes can be made. The method includes the use of historical changes in risk factors and parameters observed over a particular period-extract. Usually, for that purpose the banks go one year back, yet some banks use longer periods of 4 or more years. Here are included all the interest rates, currency and exchange rates movements.

The Historical Simulation method values the portfolio using a series of historical price data (of the assets in the portfolio) that is available. Under this method, the distribution of profits (or losses) on the portfolio is constructed based on data from the past. The current portfolio is subjected to the actual changes in the market factors experienced during the last N periods.

The changes in portfolio value are sorted from the lowest value to the highest value and the series is ranked according to the percentiles. This percentile scale represents the confidence level scale, i.e., the loss at the 99th percentile will be the portfolio's potential price change calculated at a 99% confidence level. VAR is determined based on the desired confidence interval. The Var is equal to the product of the value change at the required percentile (confidence limit) and the current value of the portfolio.

Example to clear the Methodology of Historical method

Suppose that a portfolio has two assets, A and B

- Gather the 100 days of market information
- Historical experience is translated into percentage changes
- Apply the 100 percentage changes of to beginning portfolio values
- Rank the 100 resulting values
- Var is the required percentile rank
- Assume a one-day holding period and 5% probability

Date	A	% Change	B	% Change
12/10/1997	108		98	
12/9/1997	100	8.00%	100	-2.00%
12/8/1997	98	2.04%	100	0.00%
.	.	.	.	.
.	.	.	.	.
9/2/1997	108	-4.91%	95	3.08%
9/1/1997	108	0.00%	93	-2.15%

Table 11.1: % change in Portfolio

Apply all changes to the current value of assets in the portfolio

A value = 108 x % change

B value = 98 x % change

Date	A	Modeled Value	B	Modeled Value	Portfolio Value
	% Change		% Change		
12/9/1997	8.00%	116.64	-2.00%	96.04	212.68
12/8/1997	2.04%	110.20	0.00%	98	208.20
.	.	.	.	.	.
.	.	.	.	.	.
9/2/1997	-4.91%	102.70	3.08%	101.01	203.71
9/1/1997	0.00%	108.00	-2.15%	95.893	203.89

## TATA CONSULTANCY SERVICES

100 resulting portfolio values are now ranked

The 5th lowest portfolio value is the Var

Rank	Date	Portfolio Value
1	9/3/1997	200.71
2	12/4/1997	201.32
3	10/5/1997	202.31
4	3/6/1997	203.89
5	9/2/1997	203.71
.	.	.
.	.	.
.	.	.
99	4/7/1997	210.00
100	12/9/1997	212.68

Table 11.3: Resulting Portfolio

One of the advantages in the use of historical scenarios is that these scenarios have already taken place. On the other hand, it is unlikely that in future historical events will happen exactly the same way.

- c) **Monte Carlo method**- Monte Carlo simulation got its name from Monte Carlo, Monaco, the place of which the main attractions are casinos containing games of chance. The random behavior in these games of chance is similar to Monte Carlo simulation which selects variable values at random to simulate a model. Only the range for any variable is known but these variables have an uncertain value for any particular time or event. These variables can be interest rates, stock prices etc.

Monte Carlo simulation of VaR begins with a random draw on all the distributions describing price and rate movements taking into account the correlations among these variants. Mark-to-model and maturation values for all portfolio components at the VaR horizon are determined based on that price/rate path. This process is repeated enough times to achieve significance in the resulting end-of-horizon portfolio values. Then the differences between the initial portfolio value and these end-of-horizon values are ranked and the loss level at the Yth centile is reported as the VaR of the portfolio

Under it very large number of hypothetical scenarios on the basis of the measured movements in the various market variables during the last year. On the basis of a 250-day scenario used for the historical VaR, we create a countless number of possible scenarios. Each historical result for an individual variable is combined with each possible historical results combination for all the other market variables. As scenarios are randomly drawn out of that large number of scenarios created by the model, the analysis is called the Monte Carlo simulation.

To generate thousands of hypothetical changes in the market factors a pseudo-random number generator is used. These changes are used to construct thousands of hypothetical profits/losses on the current portfolio and the distribution of possible profits/losses. This distribution is used to calculate VaR.

An example of how Monte Carlo simulations are carried out: The spot price of a GBP/USD FX transaction is 1.25. Let the price of a one-year out-of-money call option be 1.25 too. The simulations are carried out by randomly changing the spot prices, to see how the price of the option changes. Let the underlying asset for the option be worth 10million USD.

Parameters of Value at Risk Var:

Once the complexity of portfolio is analyzed, the users have to decide upon the important factors for the calculation of VaR. These factors are:

- a) **The time horizon (period) to be analyzed i.e. holding period (length of the time to hold the assets in the portfolio)**- This depends upon the objectives of the portfolio and its liquidity positions. The shortest feasible holding period is one day. Although it is theoretically possible for institutions to have time horizon less than a day. The holding period in any market is, ideally, the length of time it takes to ensure orderly liquidation of positions in that market.
- b) **The confidence level for the estimate**-The confidence level/interval defines the percentage of time the firm should not lose more than the Var amount. Most commonly used confidence levels are 99% and 95%.
- c) **The Data Series**- Var is fairly data intensive. The choice of historical, implied or other types of data to determine various relationships is important, but typically there is very little choice.
- d) **Mapping>Selecting relevant risk factors**- For the calculation of Var, every instrument in the portfolio is assumed to have readily available risk and correlation data. In reality, it is very difficult to have such information. The representative approach for such instruments known as mapping selects a set of core instruments that can be correlated with risk.
- e) **The currency unit which will be used to denominate the value at risk (Var)**- With the mentioned terms it can be defined as: Value at risk is the maximum amount that

can be lost from an investment under normal market conditions for a holding period and at a particular confidence level.

#### General criteria

The supervisory authority will only give its approval if at a minimum:

- It is satisfied that the bank's risk management system is conceptually sound and is implemented with integrity;
- The bank has in the supervisory authority's view sufficient numbers of staff skilled in the use of sophisticated models not only in the trading area but also in the risk control, audit, and if necessary, back office areas;
- The bank's models have in the supervisory authority's judgment a proven track record of reasonable accuracy in measuring risk;
- The bank regularly conducts stress tests.



#### Specification of market risk factors

- For interest rates, there must be a set of risk factors corresponding to interest rates in each currency in which the bank has interest-rate-sensitive on- or off-balance Sheet positions.
- For exchange rates (which may include gold), the risk measurement system should incorporate risk factors corresponding to the individual foreign currencies in which the bank's positions are denominated. Stress testing is used for exchange rate risk.
- For equity prices, there should be risk factors corresponding to each of the equity markets in which the bank holds significant positions.
- For commodity prices, there should be risk factors corresponding to each of the commodity markets in which the bank holds significant positions.

#### 4.4 Risk limits

As stated earlier it is the board that has to determine bank's overall risk appetite and exposure limit in relation to its market risk strategy. Based on these tolerances the senior management should establish appropriate risk limits. Risk limits for business units, should be compatible with the institution's strategies, risk management systems and risk tolerance. The limits should be approved and periodically reviewed by the Board of

Directors and/or senior management, with changes in market Conditions or resources prompting a reassessment of limits. Institutions need to ensure consistency between the different types of limits.

- i. **Gap Limits:** The gap limits expressed in terms of interest sensitive ratio for a given time band aims at managing potential exposure to a bank's earnings / capital due to changes in interest rates. Setting such limits is useful way to limit the volume of a bank's repricing exposures and is an adequate and effective method of communicating the risk profile of the bank to senior management. Such gap limits can be set on a net notional basis (net of asset/ liability amounts for both on and off balance sheet items) or a duration-weighted basis, in each time band. (Duration is the weighted average term to maturity of a security's cash flow. For instance an Rs100 5 year 8% (semi Annual) coupon bond having yield of 8% will have duration of 4.217 years as already explained in the footnotes).
- ii. **Factor Sensitivity Limits:** The factor sensitivity of interest rate position is calculated by discounting the position using current market interest rate and then using the current market interest rate increase or decrease by one basis point. The difference in the two values known as factor sensitivity is the potential for loss given one basis point change in interest rate. Banks may introduce such limits for each time band as well as total exposure across all time bands. The factor sensitivity limit measures the change in portfolio present value given one basis point fluctuation in underlying interest rate.

### Market Risk Management Function

The board and senior management should set up a dedicated market risk management function to coordinate and perform daily risk management activities. An effective market risk management function should:

- o Have clearly defined responsibilities and authorities
- o Have a direct reporting line to the relevant senior management or specialized committee set up by the board
- o Be independent from the risk-taking and operational units (e.g., trading unit and settlement unit) that it reviews

- Have direct access to information from risk-taking and operational units in order for it to carry out the market risk management and control function
- Be supported by an effective risk management information system
- Be provided adequate resources and com
- Ensuring that all relevant market risks of the bank are identified, well understood, and adequately measured and assessed
- The design or selection of the bank's market risk management system.
- The testing and implementation of the bank's market risk management.



## Summary

- Market risk is caused due to the variations in the market variables having undesirable and unfavorable impact on earnings of a bank or on its capital.
- The various risks associated with market risk are Interest rate risk, Foreign exchange (FOREX) Risk, Equity Price risk, Commodity Price risk and Liquidity risk.
- Management processes for risk management are sub-divided into following four parts: Risk Identification, Risk Measurement, Risk Monitoring and Control, Risk Mitigation.
- Mean-Variance method is based on the principle of diversification and is a rather simplified model for today.
- Historical simulation method , assumes that asset returns in the future will have the same distribution as they had in the past (historical market data),
- Variance-covariance (VCV) method assumes that risk factor returns are always (jointly) normally distributed and that the change in portfolio value is linearly dependent on all risk factor returns.
- Monte Carlo simulation method, where future asset returns are more or less randomly simulated.
- The liquidity risk in banks manifest in different dimensions like funding risk, time risk and call risk.
- Rating migration is the change in the rating of a borrower over a period of time when rated on the same standard or model.



**TATA** CONSULTANCY SERVICES

[www.tcs.com](http://www.tcs.com)