Department of Applied Economics & Commerce, P.U.

MBA – IV Sem (Session : 2018-2020)

Subject : Financial Derivatives

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Unit IV - Market Risk Management

1. *Risk Identification - It has been explained in the last lecture.*

2. ***Risk Measurement –***

- *It quantifies the risk.*
- *The risk measures are essentially forward-looking.*
- *They estimate possible future losses that may arise within certain confidence level based on historical data.*

Market risk measures are based on:

i. *Sensitivity*

ii. *Volatility*

iii. *Downside potential*

i. Sensitivity

- *Sensitivity captures a deviation of market price of a target variable due to unit movement of a single market parameter.*
- *For example, change in market value of Bonds due to 1% change in interest rate would be sensitivity based measure.*

- *Supply - demand position, interest rate, market liquidity, inflation, exchange rate, stock prices, etc. are the market parameters which drive market values.*

- *Sensitivity is used as a market risk measure, particularly those that are based on changes in interest rate.*

Drawbacks

- *It is only with reference to 1 Market parameter and does not considered impact of other parameters which may also change simultaneously.*

- *Sensitivities depend on prevailing conditions and change as market environment changes.*

  Two frequently used market risk measures based on sensitivity where market parameter is change in interest rate are:

a) *Basis Point Value (BPV)*

b) *Duration*

a) Basis Point Value (BPV)

- *This is the change in value due to one basis point i.e; 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 the bond.*

- *This also helps to quickly calculate profit or loss for a given change of yield.*

- *BPV changes with the remaining maturity. Suppose a bond has five years to measure and present BPV is 2000, the BPV will decline with time and on the day of maturity it will be zero.*

b) Duration

- *McCauley's Duration was first proposed by Frederick McCauley in 1938.*
- *McCauley's Duration is the weighted average number of years that an investor must maintain a position in the bond until the present value of the bonds cash flows equals the amount paid for the bond.*
- *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 can be estimated by using the following equation:*

Approx % change in Bond price = - Modified duration x Yield change

- *Modified duration is a formula that expresses the measurable change in the value of a security in response to a change in interest rates.*
- *Modified duration concept follows that interest rate and bond prices move in opposite directions.*

ii. Volatility

- *The volatility characterizes the stability or instability of any random variable.*
- *It is a common statistical measure of dispersion around the average of any random variable such as earnings, market value, losses due to default etc.*

- *Volatility is the standard deviation of the values of these variables.*

- *Standard deviation is the square root of the variance of the random variable.*
- ***Volatility over a time Horizon T = Daily Volatility x Square root of T***

- *For Example, if daily volatility of stock is 1.5%,*
  the monthly volatility of the stock = 1.5 x 5.48 (Sq. root of 30) = 8.22

  Here T = 30 Days as the time horizon is 1 month.

- *Volatility would be more if the time horizon is more.*

- *Volatility captures both upside and downside deviations.*

iii. Downside Potential

- *Downside potential captures only possible losses ignoring profit potential. It is the adverse deviation of a target variable.*

- *Downside risk has two components:*
  a) Potential losses and
  b) Probability of occurrence.

- *Worst case scenario serves to quantify extreme losses but has low probability of occurrence.*
- *Downside risk is the most comprehensive measure of risk. 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.*

Value at risk (VaR)

- *It is a measure based on **downside potential.***
- *It is defined as the predicted worst case loss at a specific confidence level over a certain period of time assuming 'Normal Trading Conditions'.*

There are three main approaches to calculate value at risk:

a) The correlation method (or, Variance/ Covariance Matrix Method)

b) Historical simulation

c) Monte Carlo simulation

- ***All the three methods are based on three basic parameters:***

i. *Holding period*

ii. *Confidence interval and*

iii. *The historical time Horizon over which the Asset prices are observed.*

a) Correlation method:

Under this method, the change in the value of position is calculated by combining the sensitivity of each component to price changes in the underlying asset with a variance/ Covariance Matrix of the various components' volatilities and correlation.

b) Historical simulation:

This approach calculates the change in the value of a position using the actual historical movements of the underlying asset but starting from the current value of the asset.

c) Monte Carlo simulation:

This method calculate the change in the value of a Portfolio using a sample of randomly generated price scenarios. Here the user has to make certain assumptions about market structures, correlations between risk factors and volatility of these factors. Here he is imposing his views and experiences.

The closer the models fit economic reality, the more will be its accuracy.

It is not essential that all methods will give the same result.

Limitations of VAR

- *It does not major losses under any particular market conditions.*
- *Volatility also does not capture unexpected events or 'event risk'.*

Measures to get over the limitation include:

i. *Back testing*
ii. *Stress testing*

Back Testing

- *Back Testing is a process where model based VaR is compared with the actual performance of the portfolio.*
- *This is carried out for evaluating a new model or to assess the accuracy of existing models.*
- *If the models perform poorly, they should be probed further to find the cause (For Example: Check integrity of position and market data model parameters, methodology).*

Stress Testing

- *Stress testing seeks to determine possible changes in the market value of a portfolio that could arise due to non - normal movement in one or more market parameters.*
- *Non - normal movement means the movement in market parameter that is not normal day-to-day movements.*

- *The large non - normal movement in market parameters signifies abnormal market conditions.*
- *The process of stress testing involves identifying market parameters to stress, the quantum of stress and determine the time frame. Once these are determined, it is applied on the portfolio to assess the impact on it.*

Limitations of Stress Testing

- *They are based on large number of practitioner choices as to what risk factors to stress, how to combine factors stress, what range of values to consider and what time frame to analyze.*
- *There are no probabilities attached to the outcomes.*

Market value of a Portfolio varies with Stress Testing Techniques. Stress Testing covers the following techniques:

i. *Simple Sensitivity Test,*
ii. *Scenario Analysis,*
iii. *Maximum Loss,*
iv. *Extreme Value Theory*

i. Simple Sensitivity Test

- *It isolates the short-term impact on a portfolio value of a series of predefined moves in a particular market risk factor.*
- *For example, if the risk factor is an exchange rate, the shocks may be exchange rate changes of 1 to 2%, 4%, 6% and 10%.*

ii. ***Scenario Analysis***

- *A Scenario Analysis specifies the shocks that might probably affect a number of market risk factors simultaneously if an extreme, but possible event occurs.*
- *It seeks to assess the potential consequences for a firm of an extreme, but possible state of the world.*
- *A Scenario Analysis can be based on an historical event or a hypothetical event.*
- ***Historical Scenarios** employ shocks that occurred in specific historical episodes.*
- ***Hypothetical Scenario** use a structure of shocks thought to be probable in some foreseeable, but unlikely circumstances for which there is no exact parallel in recent history.*

***S**cenario Analysis is currently the leading stress testing technique.*

iii. ***Maximum Loss***

- *A Maximum Loss approach assesses the risk of a Portfolio by identifying the most of potentially damaging combination of moves of market risk factors.*
- *Risk managers use it only in an instructive way and not in any systematic manner. They do not rely on it for a setting of risk exposure limits.*

iv. ***Extreme Value Theory***

- *It is a means to better capture the risk of loss in extreme, but possible circumstances (i.e; the very high and very low potential values).*
- *It is the only stress test technique that attempts to attach a probability to stress test results.*
- *It may be difficult to be adopted in a situation where many risk factors drive the underlying return distribution.*

3. ***Risk Monitoring and Control –***

- *It calls for implementation of risk and business policies simultaneously.*
- *It consists of setting market risk limits, based on economic measures of risk while ensuring best risk adjusted return and that within the constraints of available capital.*
- *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.*

4. ***Risk Mitigation –***

- *Risk Mitigation in market reduction i.e; reduction in market risk is achieved by adopting strategies that eliminate or reduce the volatility of the portfolio.*
- *Following issues are also associated with risk mitigation measures:*

a) *Risk mitigation measures aim to reduce downside variability in net cash flow but it also reduces upside potential or profit potential simultaneously.*

b) *Risk mitigation strategies, which involve counterparty, will always be associated with counterparty risk.*