The model building approach to value at risk finance essay

The investment of any nature financial or physical assets comes with reward and risk. In order to prosper a company or an individual has to take risk. Generally, investors are risk averse. The risk can be estimated and managed in certain way such that the expected future earnings can be obtained while reducing potential future distress. The key to any investments is pursuing calculated risk path and achieving balance between risk and expected return.

The question presented in this assignment also highlights one of the important tools in the risk assessment called Value at Risk. Value at Risk (VaR) is simple but more powerful tool to understand the impact of risk on the portfolio over the period of time. The second part of the assignment explains the stress and back testing covering up some of VaR's shortcomings.

(1) Question:

Explain and critically evaluate the model building approach to Value at Risk (VaR). To what extent may the weaknesses of this approach be addressed by stress testing and back testing?

A variety of approaches to this essay may be adopted. For example, a case-study or quantitative based essay are equally appropriate.

Answer:

The investors are risk average. They want to minimise the risk and achieve expected profit out of their investment. The risk can be calculated and managed so that financial benefits can be maximised out of the investments.

Value at Risk (VaR) is one of simple and powerful tool to provide a single number summary of the total risk in a portfolios. The tools are being widely used by senior management corporate treasures and fund managers of a financial institution as well as monetary regulators. The VaR declaration is mandatory for the banks as per the Basel Accord (Hull, 2011).

VaR tells the investors, managers or regulators in a summary statement, how bad things might get. VaR enable companies or investors to consistently produce risk measures and risk management across all financial investments (Durham MBA). The VaR enable an analyst to make a statement that he/she is X percent certain that there will not be a loss of more than V dollars in the next N days (Hull, 2011).

Here the V is the VaR of the portfolio and it is function of Time (N) and confidence level (X).

The key advantage of the VaR statement is, it shows the aggregate risks faced by a financial institution or investor. This simple statement allows senior management to assess the situation and understand how bad things can get (Whitfield, n. d.).

There are two approaches in computing VaR namely a) Historical Simulation approach 2) Model-Building approach (Durham MBA)

Model-Building approach

It is a main alternative approach to historical simulation approach. It is also known as variance-covariance approach (Hull, 2011).

An important component in the calculation of VaR is the daily volatility of the asset. Usually the volatility of an asset is in volatility per year. While calculation of VaR using model-building approach, time is expressed in days and volatility of an asset is expressed in volatility per day (Hull, 2011). Therefore, volatility quoted annually can be converted in daily by

Ïƒday = Ïƒyear/ âˆš 252.

Where,

Ïƒday = Daily Volatility

Ïƒyear = Annual Volatility

252 = Assumption about 252 trading day in year. (Source Hull, 2011).

Single Asset case

The single asset case is the simple situation of calculating VaR using model-building approach, where the portfolio of asset contains a single stock. For example, we can consider portfolio of $10M in shares of ABC Inc. The other assumption are N = 10 and X= 99. We want to estimate loss level over 10 days with 99% confidence level. We can assume that the volatility of ABC Inc. is 2% per day with 32% per year (Hull, 2011).

Standard deviation of daily changes = Ïƒ = 2% of $10 million

= $200, 000

We say that value change in portfolio over a one-day period is $200, 00 with mean Zero and we can assume that the change is normally distributed.

Using cumulative normal distribution table, N(-2. 33) = 0. 01. We can say that there is 1% chances that a normally distributed variable will decrease in value by more than 2. 33 standard deviation (Hull, 2011).

It is safely assumed that the expected change in a market variable over the period can be considered to be zero for calculation VaR.

Therefore the one-day VaR is = 2. 33 x $200, 000 = $466, 000

We can calculated 10 day VaR at 99% confidence level as

= $466, 000 x âˆš 10 = $1, 473, 621

Therefore, we can say that with 99% confidence, we will not lose more than $1, 473, 621 off the value of portfolio in next 10 days (Hull, 2011).

Two Asset Case

The risk reduction can be achieved through diversification of the portfolios. There are two types of risk associated with investment namely systematic and unsystematic. Unsystematic risk is company or industry specific risk. It can be reduced using appropriate diversification.

For understanding two Asset case, we can consider price example with one more company. Let’s consider we have $5million positions in XYX Inc and the daily volatility is 1%. (Hull, 2011).

Change in value of portfolio in one day = 5, 000, 000 X 0. 01 = $50, 000

And 1-day 99% VaR is = $50, 000 x 2. 33 = $116, 500

10-day 99 % VaR is = $116, 500 x âˆš 10 = $368, 405.

Now the combine portfolio with $10 Million Shares of ABC Inc and $5 Million positions in XYZ Inc. will have standard deviation of

Ïƒ X+y = âˆš (sq(Ïƒ X) + sq(Ïƒ y) + 2 Ï Ïƒ X X Ïƒ y) (source. Hull, 2011).

Where Ï correlation coefficient on return on two asset & we assume it is 0. 3.

Ïƒ X (ABC Inc.) = 200, 000 and Ïƒ X (XYZ Inc.) = 50, 000

Therefore, the standard deviation of total portfolio over one-day period is

Ïƒ X+y = âˆš (sq(200, 000) + sq(50, 000)+ 2X0. 3X 200, 000 X 50, 000

Ïƒ X+ y = 220, 227

Hence, the 1-day VaR at 99% of total portfolio is = $ 220, 227 X 2. 33 = $ 513, 129

Hence, the 10-days VaR at 99% of total portfolio is = $ 220, 227 x âˆš 10 = $ 1, 622, 657.

We can conclude as

10-days 99% VaR of ABC Inc. only is $1, 473, 621

10-days 99% VaR of XYZ Inc. only is $ 368, 405

10-days 99% VaR of a portfolio combining ABC Inc. and XYZ Inc. is $ 1, 622, 657

The difference in addition of two individual versus combine value represents the benefit of Diversification. In this case, it is £219, 369 (Hull, 2011).

Stress Testing

There are several shortcomings in VaR calculation. The main critic is that the tool underestimates the potential losses and the actual loss could be much higher (Whitfield, n. d.).

Therefore, financial institutions also carry out other techniques called stress testing along with VaR calculation. The stress testing involves study how a portfolio would have performed in case of extreme market conditions. The extreme condition can be a scenario provided by senior management or from historical situation (Whitfield, n. d.).

For example, stress testing can be conducted by setting the percentage change in all market variables equal to those on 19th October, 1987, when S&P 500 moved by 22. 3 standard deviation. Similarly, many such historical events can be found out by analysing historical data and depending upon risk assessment levels, those scenarios can be applied to portfolio to estimate how it behaves under extreme conditions (Hull, 2011).

Depending upon type of portfolio, suitable events from the historical data can be found out and better understanding of portfolio can be derived by applying stress test. For example Dot. com bubble busts scenario, Oil price extreme scenario, change in interest, higher commodity price scenarios and natural calamities. All these scenario’s percentage changes in all market variable can be found by analysing historical events and then simulating scenario effect on portfolios (Hull, 2011).

Stress testing enables the financial institutions to consider the extreme events that can occur from time to time but the chances of such events are very less. After credit-crisis of 2007, the regulators are insisting of stressed VaR test from all financial institutions considering all market variables present during one of the stress period like year 2008(Hull, 2011).

Back testing

Back testing is an important reality check on the portfolio. Whatever method used for calculating VaR but the back testing remains important. It analyze the past performance of the portfolio and its calculated VaR. It consists of testing how good the VaR estimates were correct in past. For example, if we calculated a one-day 99 % VaR, back testing would analyze how often the loss in a day exceeded the one-day 99% calculated VaR corresponding to that day. If the exceeded loss is in the range of 1% of that day, it can be reasonably considered that the methodology is working and correctly predicting the loss. However, the loss are above 7% of the day and for many days, there is doubt about methodology and someone has to analysis the methodology & to fix it (Hull, 2011).