Abstract

Mutual fund industry as a whole has shown varied performance across years and around the globe. Each fund has shown varied growth returns depending on their style and pattern of fund. US markets had seen their worst downturn since 1929. With this respect it was difficult for fund managers to keep the wealth of their investors not only appreciates but also intact. A proper analysis of the value at risk is indeed a way through which investors can evaluate their fund performance and compare it with other benchmarks.

Considering the top 10 US stock funds with respect to their growth in AUM and the S&P 500 index a VaR analysis has been carried out to evaluate how good these funds as compared to their benchmark are. After evaluation various techniques, Monte Carlo Simulation technique was used in carrying out this analysis. Conclusions were based by keeping the worst case and best case scenarios in mind.

Introduction

The U.S. had the World’s Largest Mutual Fund Market

U.S. Mutual Fund Industry: Mutual Fund is defined as a fund established in the form of a trust to raise money through the sale of units to the public or a section of the public under one or more schemes for investing in securities, including money market instruments or gold or gold related instruments or real estate assets.

With $11.1 trillion in assets, the U.S. mutual fund industry remained the largest in the world at year-end 2009, accounting for 48 percent of the $23.0 trillion in mutual fund assets worldwide. Total net assets increased $1.5 trillion from year-end 2008’s level, largely reflecting the rebound in stock prices in 2009. Investor demand for certain types of mutual funds appeared to be driven in large part by the interest rate environment and continued uncertainty regarding the strength of the economic recovery. Money market funds, particularly those geared towards U.S. government securities, experienced substantial outflows, while inflows to bond funds reached a record high. Approximately 600 sponsors managed mutual fund assets in the United States in 2009.

Percentage of total net assets, year-end 2009

Sources: Investment Company Institute, European Fund and Asset Management Association, and other national mutual fund associations

Net Flows to Mutual Funds

Billions of dollars, 1995–2009
Equity index funds accounted for the bulk of index mutual fund assets at year-end 2009. Eighty-one percent of index mutual fund assets were invested in index funds that track either the S&P 500 index or other domestic and international stock indexes.

Almost 40 Percent of Index Mutual Fund Assets Were Invested in S&P 500 Index Funds

S&P 500 TR index: The S&P 500 is a free-float capitalization-weighted index published since 1957 of the prices of 500 large-cap common stocks actively traded in the United States. The stocks included in the S&P 500 are those of large publicly held companies that trade on either of the two largest American stock market exchanges; the NYSE, Euronext and the NASDAQ OMX.

After the Dow Jones Industrial Average, the S&P 500 is the most widely followed index of large-cap American stocks. It is considered a bellwether for the American economy, and is included in the Index of Leading Indicators. Many mutual funds, exchange-traded funds, and other funds such as pension funds, are designed to track the performance of the S&P 500 index. Hundreds of billions of US dollars have been invested in this fashion.

The index is the best known of the many indices owned and maintained by Standard & Poor's, a division of McGraw-Hill. S&P 500 refers not only to the index, but also to the 500 companies that have their common stock included in the index. The ticker symbol for the S&P 500 index varies. Some examples of the symbol are ^GSPC, .INX, and $SPX. The stocks included in the S&P 500 index are also part of the broader S&P 1500 and S&P Global 1200 stock market indices.

The "S&P 500" generally quoted is a price return index; there are also "total return" and "net total return" versions of the index. These versions differ in how dividends are accounted for. The price return version does not account for dividends; it only captures the changes in the prices of the index components. The total return version reflects the effects of dividend reinvestment. Finally, the net total return version reflects the effects of dividend reinvestment after the deduction of withholding tax.

In our study of the top 10 U.S. mutual funds, we have considered this index as the benchmark index and its total market cap was at around US $10317.21 bn as on 15th October, 2010.
**Value at Risk**

In financial mathematics and financial risk management, Value at Risk (VaR) is a widely used risk measure of the risk of loss on a specific portfolio of financial assets. For a given portfolio, probability and time horizon, VaR is defined as a threshold value such that the probability that the mark-to-market loss on the portfolio over the given time horizon exceeds this value (assuming normal markets and no trading in the portfolio) in the given probability level. Thus, we can say that Value at Risk is a percentile-based risk measure that measures the expected loss of a portfolio over a specified period of time for a set level of probability or confidence.

VaR has five main uses in finance risk management, risk measurement, financial control, financial reporting and computing regulatory capital. VaR is sometimes used in non-financial applications as well.

There are three main methods of calculating Value at Risk, they are:

1) The Historical or empirical method
2) The Parametric or analytic method
3) The Simulation or Monte-Carlo method

The Historical method involves simply taking the empirical P/L history and ordering it. Suppose we have 100 observations of the returns of our portfolio. Using a spreadsheet we would simply order the returns from largest to smallest. The Value at Risk for the 95th percentile would then be the 6th largest loss. The parametric or analytic method requires an assumption to be made about the statistical distribution (normal, log-normal etc.) from which the data is drawn. We can think of parametric approaches as fitting curves through the data and then reading off the VaR from the fitted curve. The attraction of parametric VaR is that relatively little information is needed to compute it.

The simulation or Monte-Carlo method of calculating VaR has become increasingly popular in recent years due to the dramatic increase in the availability and power of desktop PC’s. As the name implies simulation VaR generates many thousand simulated returns drawn either from a parametric assumption about the shape of the distribution or preferably by re-sampling the empirical history and generating enough data to be statistically significant and then ordering them and reading off the desired percentile as in the historic calculation method. In our research paper, we have used the Monte-Carlo method to calculate VaR.

**Literature Review**

A lot of similar research papers were reviewed in order to better understand the VaR analysis. Some of the papers were throwing light on the basic mutual fund performance measures such as Jenson’s alpha, Sortino’s ratio, Treynor’s ratio, etc. Whereas, some others were describing VaR analysis done through various ways such as Historical values model, Monte Carlo simulation model, etc.

Ramesh P. Rao and Raj Aggarwal in their paper “Performance of US-Based International Mutual Funds” have emphasized on How to achieve international diversification? 1. Invest in stocks of US multinationals with extensive interests in foreign countries. 2. Invest in firms domiciled in foreign countries. 3. Invest in an internationally diversified mutual fund. They also said that International Funds are an effective means for diversifying systematic risk w.r.t. US equities markets. Also, in general, the US equity market exerts considerably less influence on international funds than it does on domestic mutual funds.

Authors Joseph Chen, Harrison Hong, Ming Huang and Jeffrey Kubik in their research work “Does fund size erode Mutual Fund Performance?” tried to explain that the size of the fund affects the performance of fund to an extent. This is mainly because of liquidity and organisation diseconomies. Similarly, Diana P. Budiono in her paper “The analysis of Mutual Fund Performance Evidence from US equity Mutual Funds” described the history and growth of Mutual Funds in US and various models used to evaluate their performance.

The paper “Value at Risk in Mutual Funds which methodology of estimation” authored by Gallali Mohamed Imen and Guesmi Ahlem talk about Selection between 3 estimation methods, namely, parametric method, historical simulation and Monte Carlo Simulation methodology to evaluate a fund’s performance. Also, Kevin Dowd, Devald Balke and Andrew Cairns in their paper on “Long term Value at Risk” explain various principles of VaR and suggest changes in the method of calculation for short and long term horizon. They further state that as time horizon increases, VAR rises initially but then peaks, eventually falls becomes negative and then keeps falling thereafter. For low confidence level VaR peaks quickly and falls rapidly but for high confidence level, the VaR peaks slowly and stays at its nearer maximum value -which is closes to the value of investment itself -for long time.

Andrey Rogachev in his paper “Dynamic Value at Risk” comes to a conclusion that VaR models can offer a bench
mark for estimating the market risk of their portfolios. The estimation method must be carefully selected according to the portfolio of assets of various complexities and as per classes of risk factors. Further, Pilar Grau-Carles, Jorge Sainz, Javier Otamendi and Luis Miguel Doncel in their research work “Different Risk-Adjusted Fund Performance Measures: A Comparison” compare the rating of the mutual funds using different risk-adjusted performance measures. The novelty of this paper lies in the use of the VaR calculation of losses using Extreme Value Theorem (EVT) and applying it as a risk measure to construct a performance index similar to the Sharpe ratio.

**Historical Simulation**

Contrary to the parametric method, the historical simulation does not pose hypothesis taking into concern portfolio returns’ distributions. However, it relies on stationary hypothesis. Otherwise, the prices’ variation distribution of different risk factors, for the VaR estimation horizon, is estimated from observations of these prices variations during the available history. Thus, the future profits and losses distribution is established from different scenarios. Nevertheless, despite its favour to be not subject to any distribution of portfolio’s returns, this method is particularly weakened by its complete dependence to the choice of the historical data used and ignores every event not represented in the history. In addition, the corresponding period of the studied history can give a bad representation of the future.

**Monte Carlo Simulation**

Whereas the historical simulation relies on past market observations, the Monte Carlo

**Data**

Our study involved collection of values for Market Cap of Top 10 US mutual funds for a period of 5 years beginning 2006. The mutual funds included in the study are as follows:

1. Vanguard Precious Metals and Mining Inv
2. Van Eck Global Hard Assets A
3. Fidelity Select Materials
4. Birmiwal Oasis
5. Intrepid Small Cap
6. T. Rowe Price Media & Telecommunications
7. Rydex Basic Materials Inv
8. Fidelity Select Chemicals
9. Reynolds Blue Chip Growth
10. Prudential Jennison Natural Resources B
11. S&P 500 TR

**Analysis**

Taking a sample of top 10 US stock funds we tried to analyse their risk return and compared it with the benchmark S&P 500 index. Initially we gathered the data of the AUMs of these funds and calculated the returns. The following table shows all the percentage returns of last 5 years of these funds along with the S&P 500 index and their compounded annual growth rate.

We opted for a confidence level of 95%. The confidence level of a confidence interval does not indicate the probability that the given confidence interval contains the true value of the parameter. The only such claim that can be made is that the method of generating confidence intervals results in an interval that usually contains the true value; this is due to the fact that the endpoints of the confidence interval (the confidence limits) are random variables, while the true value of the parameter is fixed. Thus the annexures includes a table that shows the probability of values within different intervals at 95% confidence level. To minimise the error in the data, the random values were propagated 5000 times for each mutual funds. Accordingly a probability distribution table is generated for each of the mutual funds taken during the study.

VAR is derived in the best case and worst case scenario for each fund in comparison to the benchmark index.

In his paper, “VaR and Mutual Fund Performance Measures”, Yuxing Yan suggests that the Gram-Charlier expansion used for VaR calculation is a good method, since it takes into account the effects of the first four moments of the portfolio's return distribution, i.e., mean, variance, skewness and kurtosis. Similarly, Katerina Simons in her research work “The use of VaR by Institutional Investors” emphasises on Calculating VaR, Evaluation of risk measurement Standards and shortcomings of VaR.
Every fund in all the years has superseded the returns of S&P 500 index. However in the year 2008, due to the slump in the overall economy all the funds have shown negative returns however some have performed worse than S&P 500 also. It also needs to be noticed that the compounded annual growth rate of all the funds exceeds that of S&P 500. Using the Monte Carlo Simulation, we calculated the VaR in the best case and the VaR in the worst case scenario. The below table shows all the possible VaR of all the 10 funds and the S&P 500 index, for example for Vanguard Precious Metals and Mining Inv, considering 95% confidence interval, in a worst case scenario, there is 4.78% probability that the fund would give a return of -51.60% and in a best case scenario, the fund would give a return of around 70% with 94% probability. Similarly for other funds and S&P 500 index the VaR in the best case and worst case scenario can be analysed.

<table>
<thead>
<tr>
<th>Name of Mutual Fund</th>
<th>VAR in Best Case (%)</th>
<th>VAR in Worst case (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanguard Precious Metals and Mining Inv</td>
<td>69.88</td>
<td>-51.06</td>
</tr>
<tr>
<td>Van Eck Global Hard Assets A</td>
<td>59.76</td>
<td>-45.6</td>
</tr>
<tr>
<td>Fidelity Select Materials</td>
<td>72.37</td>
<td>-43.77</td>
</tr>
<tr>
<td>Birmiwal Oasis</td>
<td>85.72</td>
<td>-56.52</td>
</tr>
<tr>
<td>Intrepid Small Cap</td>
<td>37.54</td>
<td>-5.25</td>
</tr>
<tr>
<td>T. Rowe Price Media &amp; Telecommunications</td>
<td>62.77</td>
<td>-41.86</td>
</tr>
<tr>
<td>Rydex Basic Materials Inv</td>
<td>51.72</td>
<td>-41.51</td>
</tr>
<tr>
<td>Fidelity Select Chemicals</td>
<td>59.89</td>
<td>-38.99</td>
</tr>
<tr>
<td>Reynolds Blue Chip Growth</td>
<td>39.52</td>
<td>-3.21</td>
</tr>
<tr>
<td>Prudential Jennison Natural Resources B</td>
<td>65.75</td>
<td>-48.2</td>
</tr>
<tr>
<td>S&amp;P 500 TR</td>
<td>23.29</td>
<td>-43.46</td>
</tr>
</tbody>
</table>

All the funds in a worst case scenario have shown a negative return in the range of 35% to 55% except for 2 funds which have shown an expected return of less than 6%. The probability of the worst case scenario ranges between 3% - 5%. On comparing the worst case scenarios of each fund the S&P 500 index, there is an average probability of 4.20% to show return of -34.46% which is much lesser than the 8 funds which show a higher range. This proves that in case of a downturn, the loss suffered by investing in S&P 500 index would be lesser than the other 8 funds with similar level of probabilities.

During an up-move the maximum returns an investor would derive would be from Birmiwal Oasis of 86% with 93% probability. All other funds would give a return of a wide range from 37% to 72% in a year with around 94% probability. The below table shows the actual values of market capitalization in the best case and worst case scenario.

<table>
<thead>
<tr>
<th>Name of Mutual Fund</th>
<th>At 95% confidence level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VAR in Best Case</td>
</tr>
<tr>
<td>Vanguard Precious Metals and Mining Inv</td>
<td>82323</td>
</tr>
<tr>
<td>Van Eck Global Hard Assets A</td>
<td>46224</td>
</tr>
<tr>
<td>Fidelity Select Materials</td>
<td>29576</td>
</tr>
</tbody>
</table>

during any crisis.
The US stock funds as compared to its benchmark have shown a much better performance with respect to capital appreciation. Considering the risk involved some of these funds, S&P 500 can be a better avenue for investment during a downturn as the Value at Risk involved would be less during such instances. However over here we consider only the 8 funds which showed highest negative return and not the funds which were considered as safe investments. The expectancy of a positive return is the least for S&P 500 index. The VaR is quiet unfavourable with respect to all the other funds. With specific sector funds the returns are surely going to deviate with from the index. The S&P 500 index comprising a proportion of the sectors in it has different level of risk involved as compared to other funds.

US markets haven’t shown any convincing return across the 5 years. The latest financial crisis and the existing fragility in the system would take some time for the markets to recover. US mutual funds have also faced the brunt of these issues; however there are certain funds which we have picked which have shown exceptional performance across the 5 years. This may mainly be due to excellent fund management and allocation techniques with suitable investment in appropriate sectors. These funds however have higher standard deviations as compared to their benchmarks which signify a lot of risk complimented by great returns.

The probability of an up-move is quiet high with these funds with greater returns however one should not forget the probability of a negative return and the extent of the negativity involved.

Annexure has been attached in the following pages followed by the references. Annexure shows the charts of the VaR with the help of counts and bins using Monte Carlo Simulation. Count shows the number of entries generated through in the simulation of the bins. For every fund and the S&P 500 index the charts are prepared showing the cumulative probability and the count for every return.

References

Annexure

HISTOGRAMS OF MONTE CARLO SIMULATION

Vanguard Precious Metals and Mining Inv

Van Eck Global Hard Assets A

Fidelity Select Materials
<table>
<thead>
<tr>
<th>Mutual Fund</th>
<th>VaR (Best Case)</th>
<th></th>
<th>VaR (Worst Case)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Probability</td>
<td>Return</td>
<td>Probability</td>
<td>Return</td>
</tr>
<tr>
<td>Vanguard Precious Metals and Mining Inv</td>
<td>93.96%</td>
<td>69.88%</td>
<td>4.78%</td>
<td>-51.06%</td>
</tr>
<tr>
<td>Van Eck Global Hard Assets A</td>
<td>93.02%</td>
<td>59.76%</td>
<td>2.94%</td>
<td>-45.60%</td>
</tr>
<tr>
<td>Fidelity Select Materials</td>
<td>92.70%</td>
<td>72.37%</td>
<td>3.44%</td>
<td>-43.77%</td>
</tr>
<tr>
<td>Birmiwal Oasis</td>
<td>93.34%</td>
<td>85.72%</td>
<td>3.80%</td>
<td>-56.52%</td>
</tr>
<tr>
<td>Intrepid Small Cap</td>
<td>93.20%</td>
<td>37.54%</td>
<td>3.76%</td>
<td>-5.25%</td>
</tr>
<tr>
<td>T. Rowe Price Media &amp; Telecommunications</td>
<td>93.64%</td>
<td>62.77%</td>
<td>3.46%</td>
<td>-41.86%</td>
</tr>
<tr>
<td>Rydex Basic Materials Inv</td>
<td>93.20%</td>
<td>51.72%</td>
<td>4.10%</td>
<td>-41.51%</td>
</tr>
<tr>
<td>Fidelity Select Chemicals</td>
<td>93.48%</td>
<td>59.89%</td>
<td>4.08%</td>
<td>-38.99%</td>
</tr>
<tr>
<td>Reynolds Blue Chip Growth</td>
<td>92.88%</td>
<td>39.52%</td>
<td>3.82%</td>
<td>-3.21%</td>
</tr>
<tr>
<td>Prudential Jennison Natural Resources B</td>
<td>93.24%</td>
<td>65.75%</td>
<td>3.64%</td>
<td>-48.20%</td>
</tr>
<tr>
<td>S&amp;P 500 TR</td>
<td>92.60%</td>
<td>23.29%</td>
<td>4.20%</td>
<td>-34.46%</td>
</tr>
</tbody>
</table>

***