Optimal Portfolio Construction in Banking and Pharmaceuticals Sectors in India : An Empirical Study

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Abstract

The main focus of this research is to construct an optimal portfolio in Indian stock market with the help of the Sharpe single index model. Portfolio construction is an important process of the investors for investment in the equity market. A good combination of portfolio will give maximum return for a particular level of risk. In this research, 13 selected stocks from the two sectors like 7 from Banking and 6 from Pharmaceuticals have been taken into consideration and these stocks are constituent of the NSE Nifty index. The proposed method formulates a unique cut off point (Cut off rate of return) and selects stocks having excess of their expected return over risk free rate of return surpassing this cut-off point. Percentage of investment in each of selected stocks is then decided on the basis of respective weights assigned to each stock depending on respective beta value, stock movement variance, unsystematic risk, return on stock and risk free return vis-a-vis the cut off rate of return. The study finds that five company stocks i.e three from pharma (Glaxo, Sunpharma, Dr.Reddy) and two from banking sectors(Axis Bank and Bank of Baroda) constitute the optimum portfolio with ideal proportion of investment of 0.60% ,50.14%,22.31%,11.28% and 15.67% respectively. This research findings and suggestions would be helpful to investors.

Keywords: Beta, Risk and return trade off, Market variance, Residual variance, Portfolio construction, Single index model, Optimal portfolio, Nifty.

1. Introduction

As the number of financial assets is ever increasing in today's market, investors are exposed to great opportunities for improving their portfolio performance. The fact that these securities have different risk return characteristics enables investors to accordingly meet their goals and risk profiles. This in turn confirms the need for a mechanism or selection technique that can select assets from different available options and their respective optimal proportions in order to create a portfolio. Portfolio is a combination of securities such as stocks, bonds and money market instruments. The process of blending together the broad asset classes so as to obtain optimum return with minimum risk is called portfolio construction. A portfolio tries to trade off the risk return preferences of an investor by not putting all eggs in a single basket and thus allows for sufficient diversification. Harry Markowitz (1952), the father of modern portfolio theory, suggests that there is a trade-off between return of an asset or a portfolio and the respective variance. His paper, Portfolio Selection, reveals that it is possible to compute the optimal weights of a portfolio of risky securities, given the corresponding historical returns and variance-covariance matrix of the securities in the portfolio through the use of a suitable model. This portfolio approach won him Nobel Prize in 1990. The work done by Markowitz was extended by William Sharpe. He simplified the amount and type of input data required to perform portfolio analysis. He made the numerous and complex computations easy which were essential to attain optimal portfolio. This simplification is achieved through single index model. This model proposed by Sharpe is the simplest and the most widely used one.

The study focuses on finding out an optimal portfolio using Sharpe's single index model. This paper is built around building up an optimal portfolio by balancing the positive and negative correlation existing between the securities and in turn getting returns closer to the anticipated results. For this study, the stocks from two sectors viz Banking and Pharmaceuticals are included since these sectors are of prime importance for real growth of an economy.

2. Objectives of the Study

The primary objective is to construct an optimal stock portfolio among selected stocks from the banking and pharmaceuticals sectors in India.

The specific objectives are:

- To present a review of past works relating to optimum portfolio construction and analysis.
- To build an optimum stock portfolio among selected stocks belonging to the banking and pharmaceuticals sectors in India, using Sharpe Single Index model.
- To calculate the proportion of investment to be made into each of the stock that is included in the optimal stock portfolio constructed by Sharpe single index model.

3. Review of Literature

In an earlier study Ward, David, Gary (1993) explained how well an investor should invest mainly focusing on investment in defaulted bonds and how appropriately they should be diversified to earn higher rate of expected returns. Such kind of a portfolio attracts investors by giving higher returns but on the contrary will also increase the level of unsystematic risk. Hence, investors have to examine the risk and return factors carefully, as they offer higher returns than equities and normal bonds.

The study of Klein & Bawa (1997) determines the effect of estimation risk on optimal portfolio choice under uncertainty. In most realistic problems, the parameters of return distributions were unknown and were estimated using available economic data. Traditional analysis neglects estimation risk by treating the estimated parameters as if they were the true parameters to determine the optimal choice under uncertainty. We show that for normally distributed returns and 'non-informative' or 'invariant' priors, the admissible set of portfolios taking the estimation uncertainty into account is identical to that given by traditional analysis. However, as a result of estimation risk, the optimal portfolio choice differs from that obtained by traditional analysis.

Stutzer (2000) explore the potential usefulness of a non-parametric approach to portfolio construction and performance measurement. The Portfolio Performance Index (PPI) is based on the notion that investors associate risk with the failure to achieve a target return. He proposed that portfolio construction and performance measurement be approached by calculating the decay rate in the probability that a given portfolio will underperform its designated benchmark. By comparing the PPI and Sharpe ratio metrics, this paper presents preliminary evidence of the economic significance of non-normalities in Australian equity returns, and documents the impact of such on portfolio construction and performance evaluation practice.

Campbell, Husiman and Kodedijk (2001) viewed that optimal stock portfolio is one which allocates financial assets by maximizing expected return subject to the constraint that the expected maximum loss should meet the Value at Risk limits set by the risk manager. Similar to the mean-variance approach a performance index like the Sharpe index is constructed. Furthermore when expected returns are assumed to be normally distributed, it is shown that the model provides almost identical results to the mean-variance approach. Liow (2001) in his research work examined the investment performance of Singapore real estate and property stocks over the past 25 years. The analysis made using coefficient of variation (CV) and Sharpe Index (SI) suggest that real estate outperformed property stocks on a risk-adjusted basis. Results also indicate that risk adjusted investment performance for residential properties remained superior to performance for other real estate types and property stocks.

Haslem and Scheraga (2003) in their study used Data Envelopment Analysis (DEA) to identify the large-cap mutual funds in the 1999 Morningstar 500 for efficient or inefficient funds. An attempt is made to identify the financial variables that differ significantly between efficient and inefficient funds and to determine the nature of these relationships. According to study findings, there are identified input/output and profile variables that are significantly different between the 1999 Morningstar 500 large-cap mutual funds that are DEA performance-efficient and inefficient. The Sharpe index represents the DEA output variable. The findings indicate the variables that are significantly different between performance efficient and inefficient funds and the nature of their relationships. The variable values associated with efficient funds are relatively conservative in nature, not aggressive. Andrea, Wilfred and Jean (2003) suggest empirical evidence on the efficiency and effectiveness of hedging U.S. based international mutual funds with an ASIA-Pacific investment objective. The case for active currency risk management is examined for a passive and a selective hedge, which is constructed with currency futures in the major currencies. Both static and dynamic hedging models are used to estimate the risk-minimizing hedge ratio. The results show that currency hedging improves the performance in internationally diversified mutual funds. Such hedging is beneficial even when based on prior optimal hedge ratios and efficiency gains from hedging, as measured by the per cent change in the Sharpe Index, are greatest under a selective portfolio strategy that is implemented with an optimal constant hedge ratio.

Moreno, Macro and Olmeda (2005) analyzed, from an investors perspective, the performance of several risk forecasting models in obtaining optimal portfolios. Specifically, it studies whether ARCH-type based models obtain portfolios whose risk-adjusted returns exceed those of the classical Markowitz model. The same analysis is performed with models based on the Lower Partial Moment (LPM) which take into account the asymmetry in the distribution of returns. The results suggest that none of the models achieve a clearly superior average performance. It is also found that models based on semi variance perform as well as those based on the variance, but not better than, even if the evaluation criterion is based on the Reward-to-Semi variance ratio. Ebner and Neumann (2008) explained the correlation instabilities in US stock returns and used three different estimation approaches to overcome the problem : (1) moving window least squares, (2) flexible least squares

and (3) the random walk model. The results suggest that a time-varying estimation of return correlations fits the data considerably better than time invariant estimation and thus, increases the efficiency of risk estimation and portfolio selection. Nateson and Rajesh (2010) constructed optimal portfolio using Sharpe's Single Index Model consisting of eight stocks from Nifty Nifty stocks six stocks selected from Nifty Junior. The respective portfolio beta's were calculated and capital allocation for each stock was also determined. Thus, the analysis of the portfolio provides the rationale for forming an optimal portfolio of the securities instead of buying only a single security.

In the Indian scenario, Varadharajan (2011) constructed an optimal equity portfolio with the help of Sharpe Index model. The study was conducted with the financial data from April 2006 to March 2011. The sample size was limited to 19. He took these companies from Banking and Information Technology. The portfolio was constructed with the top 5 stocks that meet the criteria to be included in the portfolio according to Sharpe Index Model. The portfolio predominantly consisted of stocks from the banking sector, and one stock from IT sector.

In a recent study Saravanan and Natarajan (2012) attempted to construct an optimal portfolio by using Sharpe's Single Index Model. For this purpose NSE Nifty Index has been considered. The daily data for all the stocks and index for the period of April 2006 to December 2011 have been considered. They formulated the cut-off point and selected stocks having excess of their expected return over risk free rate of return surpassing this cut-off point. Percentage of investment in each of selected stocks is then decided on the basis of respective weights assigned to each stock depending on respective beta value, stock movement variance unsystematic risk, return on stock and risk free return vis-à-vis the cut off rate of return. From the empirical analysis, it was concluded that returns on either individual securities or on portfolio comprises of securities of different companies listed in Nifty 50 stocks under various sectors are asymmetrical and heterogeneous. The optimal portfolio consists of four stocks selected out of 50 short listed scrips, giving the return of 0.116. Further it helps to elicit that return on securities of different portfolio is independent of the systematic risk prevailing in the market.

Varadharajan and Ganesh (2012) have selected companies from three sectors namely power sector, shipping sector and textile sector for construction of optimal portfolio. From each sector six companies were selected, so a total of eighteen companies. They selected these companies on the basis of market capitalization. From the analysis, they found out optimal portfolio consisting of five companies.

4. Research Methodology

This is a descriptive study of the construction of portfolio of stocks. The data taken for the study is secondary in nature. The data has been collected from the official website of National Stock Exchange (NSE), namely www.nse-india.com. The study is conducted with the financial data for the past six years from January 2008 to November 2013. The sample size of the study is limited to daily stock price series of 13 selected stocks that belong to the Banking and Pharmaceuticals sectors and these stocks are also part of the 50 stocks that constitute NSE Nifty. The sampling technique adopted is purposive sampling.

4.1 Return

The daily return on each of the selected stocks is calculated with the following formula.

$$R_{it} = \frac{P_{it}}{P_{it-1}} - 1$$

where P_t, P_{it-1} are the share price at time t and t-1 for security i.

4.2 Standard Deviation

The second phase in the context of testing of Sharpe's model for selection of appropriate securities in portfolio is used, the average returns of individual returns or portfolio are adjusted to that of risk free return (here 6.5 percent is considered as risk free rate based on the portfolio on 91-day Government of India treasury bills). Therefore to estimates the coefficients with risk free adjusted average return on individual / portfolio and on market risk, the following model is used. The selection of any stock is directly related to its excess return – beta ratio:

$$\frac{\left(R_i - R_f\right)}{\beta_i}$$

where R_i = the expected return on stock i; R_f = the return on a riskless asset and $\hat{a}_i$ = the expected change in the rate of return on stock i associated with one unit change in the market return.

The excess return is the difference between the expected return on the stock and the riskless rate of interest such as the rate offered on the government security or Treasury bill. The excess return to beta ratio measures the additional return on a security (excess of the riskless assets return) per unit of systematic risk or non-diversifiable risk. This ratio provides a relationship between potential risk and reward.

Ranking of the stocks is done on the basis of their excess return to beta. Portfolio managers would like to include stocks with higher ratios. The selection of the stocks depends on a unique cut –off rate such that all stocks with higher ratios of $(R_i - R_f)/\hat{a}_i$ are included and the stocks with lower ratios are left out. The cut- off point is denoted by C*.

$$C_i = \frac{\sigma_m{}^2 \Sigma^N{}_{i=1} \left(\frac{R_i - R_f}{\sigma_{ei}{}^2} \right) x \beta_i}{1 + \sigma_m{}^2 \Sigma^N{}_{i=1} \left(\frac{\beta_i^2}{\sigma^2{}_{ei}} \right)}$$

The highest C_i value is taken as the cut – off point C*. The stocks ranked above C* have high excess return to beta than the cut – off C_i and all the stock below C* has low excess returns to beta. If the number of stock is large, there is no need to calculate the C_i values for all the stocks after the ranking has been done. It can be calculated until the C* value is found and after calculating for one or two stocks below it the calculations can be terminated.

The C_i can be stated with mathematically equivalent way:

$$C_i = \frac{\beta_{ip}\left(R_i - R_f\right)}{\beta_i}$$

where âip = The expected changes in the rate of return on stock i associated with 1 per cent in the return on the optimal portfolio; Rp = The expected return on the optimal portfolio and âip and Rp cannot be determined until the optimal portfolio is found. To find the optimal portfolio, the formula in above should be used. Securities are added to the portfolio as long as:

$$\frac{R_i - R_f}{\beta_i} > C_i$$

Now,

$$R_i - R_f > \beta_{ip}\left(R_p - R_f\right)$$

The right hand side is the expected excess return on a particular stock based on the expected performance of the optimum portfolio. The term on the left hand side is the expected excess returns on the individual stock. Thus, the portfolio manager believes that a particular stock will perform better than the expected return base on its relationship to optimal portfolio.

4.3 Construction of the Optimal Portfolio

After determining the securities to be selected, the investors should find out how much should be invested in each security. The percentage of funds to be invested in each security can be estimated as follows:

$$X_i = \frac{Z_i}{\Sigma^N_{i=1}\left(Z_i\right)}$$

$$Z_i = \frac{\beta_i}{\sigma^2_{ei}}\left(\frac{R_i - R_f}{\beta_i} - C*\right)$$

The first expression indicates the weights on each security and they sum up to one. The second shows the relative investment in each security. The residual variance or the unsystematic risk has a role in determining the amount to be invested in each security.

5. Findings & Analysis

The results of the Sharpe Single index model for each of the 13 selected stocks are presented in table-1. It can be seen from the table that Axis Bank yielded the maximum return (0.20960) among the companies selected and Ranbaxy yielded lowest return of -0.12230. The results of the Sharpe Single index model for each of the 13 selected stocks are presented in table-1.

Table 1: Calculated values of Return, Beta & Excess return to Beta ratio for the selected stock in the Indian Banking and Pharmaceuticals sectors

Company scrip	Return (R_i)	Beta (β)	Excess Return to Beta ratio (R_i-R_f/β_i)
GLAXO	0.11549	0.32563	0.34435
AXIS BANK	0.20960	0.99979	0.06582
SUN PHARMA	0.02451	0.54808	0.02765
DR REDDY	0.07672	0.74916	0.02160
BANK OF BARODA	0.13060	0.90231	-0.06412
LUPIN	0.08632	0.42475	-0.06507
ICICI BANK	0.11735	1.15328	-0.07989
KOTAK BANK	0.08678	0.90868	-0.09905
PNB	0.07463	0.91886	-0.14233
SBI	0.09391	1.04156	-0.14650
CIPLA	0.01214	0.55327	-0.18371
HDFC BANK	0.12469	0.79893	-0.45020
RANBAXY	-0.12230	0.65829	-0.57114

The returns on stock investment are negative only for one company and positive for the remaining twelve. Further, beta is a measure of the systematic risk associated with stock returns and higher beta value signify that the volatility in stock return is high and thus not always desirable. It can be seen from table-1 that with the exception of ICICI Bank (1.15328) and SBI (1.04156) with beta of higher than1and the other beta values are less than 1.0. The lowest beta is observed for Glaxo with value of 0.32563.

According to the Sharpe model the excess return of any stock is directly related to its excess return to beta ratio. It measures the additional return on a security (excess of the risk less asset return) per unit of systematic risk. The ratio provides a relationship between potential risk and reward. For the calculation of this ratio, the risk free return (R_f) is taken as the rate of return on the 91- days Treasury bill which is found to be 6.5% for the period under study.

Ranking of the stocks are done on the basis of their excess return to beta. Based on the excess return to beta ratio the scrip's are ranked from 1 to 13, with Glaxo being in the first rank and Ranbaxy being in the last.

5.1 Cut-off point

The selection of the stocks depends on a unique cut-off rate such that all stocks with higher ratios of excess return to beta are included and stocks with lower ratio are left out. The cumulated values of C_i start declining after a particular C_i and that point is taken as the cut-off point and that stock ratio is the Cut-off ratio C. The highest value of C_i is taken as the cut-off point that is C^*. From table-2 it is seen that Bank of Baroda has the highest cut-off rate, C^*= 0.246. All the stocks having C_i greater than C^* can be included in the portfolio. With this criterion, only five stocks namely Glaxo, Axis Bank, Sun Pharma, Dr Reddy and Bank of Baroda qualify to be included in the optimal portfolio.

Table 2 : Calculated Values of Cut-off point for the selected companies

COMPANY	R_i-R_f/β_i	$(\delta m)^2$	$\beta_i^2/(\delta ei)^2$	$\{R_i$-$R_f/(\delta ei)^2\}/\beta_i$	? $\{R_i$-$R_f/(\delta ei)^2\}/\beta_i$	?$\beta^2/(\delta ei)^2$	Ci
GLAXO	0.34435	0.00050	-293.05867	-100.91338	-100.91338	-293.05867	-0.058
AXIS BANK	0.06582	0.00050	320.10924	21.06932	-79.84407	27.05057	-0.039
SUN PHARMA	0.02765	0.00050	220.59788	6.10025	-73.74382	247.64844	-0.032
DR REDDY	0.02160	0.00050	-3540.51538	-76.46029	-150.20411	-3292.86693	0.118
BANK OF BARODA	-0.06412	0.00050	530.12500	-33.99057	-184.19469	-2762.74193	0.246
LUPIN	-0.06507	0.00050	-487.64054	31.72865	-152.46604	-3250.38247	0.123
ICICI BANK	-0.07989	0.00050	176.86560	-14.12893	-166.59496	-3073.51687	0.157
KOTAK BANK	-0.09905	0.00050	-1332.16275	131.95109	-34.64387	-4405.67962	0.014
PNB	-0.14233	0.00050	285.50000	-40.63423	-75.27810	-4120.17962	0.035
SBI	-0.14650	0.00050	-19312.625	2829.23889	2753.96079	-23432.8046	-0.129
CIPLA	-0.18371	0.00050	565.52370	-103.89106	2650.06973	-22867.2809	-0.127
HDFC BANK	-0.45020	0.00050	25579.99736	-11516.1869	-8866.11724	2712.71644	-1.88
RANBAXY	-0.57114	0.00050	4749.31085	-2712.51678	-11578.6340	7462.02729	-1.22

5.2 Construction of optimal portfolio

After determining the securities to be included in the optimal portfolio, we have to determine the proportion of investment in each of these stocks. Only those stocks with Excess return to beta ratio (Column -2 to Table-2) more than C* (0.246) are to be selected in the optimal portfolio. It can be observed from table-2 that only five stocks qualify to be included in the optimal portfolio on this criterion. These are Glaxo, Axis Bank, Sun Pharma, Dr Reddy and Bank of Baroda with cut-off point (C_i) of -0.058, -0.039,-0.032,0.118 and 0.246 respectively as displayed in table-3.

Table-3: Values of cut-off point and Investment proportion for the stocks included in the Optimal portfolio

By using Sharpe index model, we are able to find out the proportion of investments to be made for each of the five stocks included in the optimal portfolio. The maximum investment should be made in Sun Pharma with a proportion of 50.14%, followed by Dr Reddy and Bank of Baroda with investment proportion of 22.31 % and 15.67% respectively and the minimum investment should be on Glaxo with 0.60%. Among five securities selected for the investment three companies belongs to pharmaceuticals sector and two companies are from banking sector. Evidently, the companies chosen for the investments are growing at a steady rate in the recent years.

6. Concluding Remarks

Risk and return play an important role in making any investment decisions. This study aims at analyzing the opportunity that are available for investors as per as returns are concerned and the investment of risk thereof. Out of 13 companies taken for the study, only 1 company is showing negative return and the other 12 companies are showing positive returns. With regard to beta values, out of 13 companies selected, only two companies stock showed beta above 1, indicating that the investments in this stocks are outperforming than the broader market. Finally out of the Banking and Pharmaceuticals sector stocks that are included in NSE Nifty, five stocks namely Axis Bank, Bank of Baroda, Glaxo, Sun Pharma and Dr Reddys are included in the Optimal Portfolio constructed in this study with maximum suggested investment in Sun Pharma (50.14%). Our study is based on the Sharpe Single index model and thus limited to the lacunas of this model.

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