Journal of Management and Science, ISSN 2250-1819 / EISSN 2249-1260

DOI:10.26524/jms.2012.45

A study on construction of optimum portfolio with reference to the sharpe index model

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ABSTRACT: This research aims at constructing an optimal portfolio that maximizes the overall return and minimizes the risk associated with the individual stocks using the Sharpe Single Index Model. The study includes 25 stocks from five different sectors. Only the secondary data for the past five years (2007-08 to 2011-2012) are used in the study. The final portfolio thus constructed includes stocks from more than one sector. Thus even if some of the sectors do not perform well as expected, it will be compensated by the excess returns from the other sectors that exceed the expectation. This is how risk is diversified .This method of construction of optimal portfolio is very effective and convenient as revision of the optimal portfolio can be an ongoing exercise. The existence of a cut-off rate (C_i) is also extremely useful because most new stocks that have an excess return-to beta ratio above the cut-off rate (C_i) can be included in the optimal portfolio. Thus this study helps the investors to minimize risk and maximize the return on their investment.

Keywords: *beta (β), optimum portfolio, risk-less return beta ratio, maximization of return minimization of risk and cut-off point ($C_{i)}$*

INTRODUCTION

Despite many portfolio models available, Optimum portfolio only provides a complete solution for the investors who would like to spread the risk and maximize return over large number of securities. Of course each model has its own importance in the portfolio. In order to understand the optimum portfolio concept, a bit of recapitalization about the other models of portfolio and their respective merits and demerits is matter of concern. They are;

Markowitz Model**:** According to this model, holding stocks from different companies is better than investing the whole money in one company. He had given up single stock portfolio and introduced diversification. He will invest all the money in one single stock, if the expected highest return would turned-out to be real. In the uncertainty world, most of the risk-averse investors would like to invest more than one stock. This model is popular for ever because it refers the portfolio construction with the help of stock co variances. Under this model, the investors‟ decision is solely based on the expected return and variance of returns only. The investor prefers higher return to lower return and lower risk to higher risk for a given level of return and risk respectively.

Drawbacks of Markowitz Model**:** Despite the model has sound enough in analyzing the risk and return of the portfolio, but it is required to estimate n number of co variances when portfolio size has increased from more than three securities. It has limited use in the construction of portfolios. Now a days financial institutions buying large number of securities in their portfolio rather confined to two or three. In this typical situation, the financial institution has work-out thousands of co variances (11175 co-variances need to be estimate if it buys

150 securities). To simplify the cumbersome calculations, Sharpe has evolved a new model to construct the portfolio which also called Sharpe's Index Model.

Sharpe's Index Model**:** This model says that most of the stock prices move with market index (i.e. sen-sex). As such, if sen-sex increases, stock prices also increases and vice versa. With the help of this relationship, it can be estimated the return on stock.

RESEARCH METHODOLOGY: The period of study is five years i.e. from 2008 to 2012. Secondary data has been collected form www.bse.com and www.aceanalyzer.com. Nine sample companies have taken for the study based on their profitability performance and market capitalization. The sampling technique adopted is purposive sampling. Later on the collected data has been edited, processed and tabulated in the several tables and annexure. The statistical tools applied in the paper are; mean and variances etc. The financial metrics like mean return, realized return, excess return, beta (β), un-systematic risk ($\mathbf{ei2}$) and cut-off points (C_i) etc.

NEED FOR THE STUDY: In the present economic recession, an optimum portfolio is need of the hour. In a diversified portfolio some securities may not perform well as expected, but some others may exceed the expectation and making the actual return of the portfolio is closer to the anticipated one. But optimum portfolio provides maximum return with minimum risk exposure, where the risk is spread over many eligible stocks rather confined to small number of securities. As such, the financial analyst can advice his/her clients in the most profitable way.

OBJECTIVES OF THE STUDY:

- To construct a portfolio of stocks from nine selected companies using Sharpe's index model that maximizes return and minimizes risk on the portfolio.
- To analyze the risk of various securities
- To advice the individual investors rather institutional investors (whose investment basket size is very large) for their long-term investments.
- To understand the role of beta ($\boldsymbol{\beta}$) and standard deviation ($\boldsymbol{\sigma}$) in measuring the relevant risk of security and to know the proportions to invest in each security, through cut-off point (C_i) and Sharpe's Index Model.

LIMITATIONS OF THE STUDY:

- The study is limited to nine sample companies from five sectors namely; Automobiles, Banking, FMCG, IT and Pharmaceuticals. Hence, inferences cannot be generalized to the entire stocks available for trading.
- The time duration for measuring the return is one accounting year.
- The data confined to five years (2007-08 to 2010-2012)

REVIEW OF LITERATURE: Unless reviewing the studies on the construction of portfolio, the present study is not worthwhile one. Hence the following studies were reviewed in order to design the study on the optimum portfolio;

DheerajMisra and Sangeeta D.Misra, (2007) analysed the risk and returns of different sectors of the Indian economy using both the market and accounting based information. The results based on market information show that Fast Moving Consumer Goods (FMCG), healthcare and oil and gas sectors are the most defensive sectors of the indian economy where as metal and information technology (IT) sectors are the most aggressive sectors of the Indian economy.

Ayhan Kapusuzoglu and Semra Karacaer (2009), constructed portfolios with returns equal to and higher than the ISE (Istanbul Stock Exchange) National – 100 Index employing the Quadratic Programming Model in order to demonstrate the effect of the relationship between the elements of index, return and risk on the overall process of portfolio construction by the investors.

Pola and Gianni Pola (2009) propose one approach to optimal portfolio construction based on recent results on stochastic reachability, which overcome some of the limits of current approaches. Given a sequence of target sets that the investors would like their portfolio to stay within, the optimal portfolio allocation is synthesized in order to maximize the joint probability for the portfolio value to fulfill the target sets requirement.

Asmita Chitnis (2010), attempts to construct two optimal portfolios from different samples using Sharpe's Single Index Model of Capital Asset Pricing and further to compare the performance of these two portfolios by Sharpe's Ratio. For the analysis purpose, NIFTY 50 has been considered as the market index. Stocks listed on the National Stock Exchange constitute the population. Two samples of each comprising of 26 stocks (most of them being large caps) have been selected. Monthly indices as well as monthly stock prices for the period from 1st April, 2004 to 31st March, 2009 are being considered. Using Sharpe's Single Index Model a unique cut off point is defined and the optimal portfolio of stocks having excess of their expected return over risk-free rate of return greater than this cut-off point is generated for both the samples separately. Percentage of investment in the respective portfolios is further decided by the standard procedure outlined by Sharpe's Model. Finally, the performance of these two optimal portfolios is evaluated by Sharpe's Ratio.

Now the study on optimal portfolios is necessitated in the light of Euro zone recession and US down turn which impacts all the economies across the world directly or indirectly.

TOOLS FOR ANALYSIS: The following tools are playing important role in the construction of the optimum portfolio.

Beta Coefficient ($\boldsymbol{\beta}$): It is the relative measure of systematic risk. It is an index of the degree of movement of an asset's return in response to a change in the market's return.

Return: It is calculated on the basis of market price of the stocks. It is arrived by dividing the difference between opening price and closing price by the opening price. In other words, return has been computed based on the stock market information. It is computed with help of the following formula:

$$\text{Return} = \frac{(\mathbf{P1} - \mathbf{P0})}{\mathbf{P0}} \text{X}100$$

Where, P0 stands the opening price

P1 stands the closing price

Risk-free rate of return: Risk-free rate of return is the required return on a risk-free asset, typically a three month bill.

***Excess return to beta ratio*:** It is computed with the following formula

$$\text{Excess Return to beta Ratio} = \frac{(\mathbf{Ri} - \mathbf{Rf})}{\boldsymbol{\beta}}$$

Excess return to beta ratio shows the return from the investment in excess to the risk taken by the investor.

Risk free rate of return (R_f) = 9.5%

Where, R_i = the expected return on stock I, R_f = the return on a risk-free asset, $\boldsymbol{\beta}_{\mathbf{i}}$ = the expected change in the rate of return on stock associated with one unit change in the market return and C_i = the cut-off point.

DATA ANALYSIS AND RESULTS:

The collected data regarding opening and closing price of select sample companies (i.e. 25 companies from different sectors) has been used to determine the mean return, excess return and excess return to beta ratio etc. Annexure I show that only 9 sample companies were continued with profits whose mean return ranges between 3.16 per cent to 120.65 per cent. Hence, the process of construction of optimum portfolio considers 9 sample companies.

Annexure II shows that variance of return of stocks of all 25 sample companies during the study period (i.e. 2007-08 to 2011-12).

COMPARISON OF BETA (β):

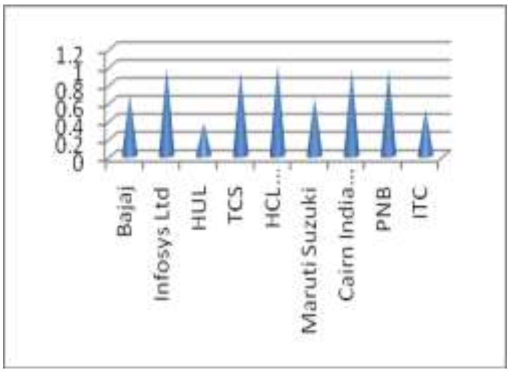

Figure 1.1 Comparison of Beta (β) of the stocks

Figure 1.1 shows the β values of the companies selected. From the chart it is clear that β value of HUL (0.37) is very less and it also implies that the risk involved in that company is very less. It is also evident that the HCL Technologies Ltd (1.02) company has highest β value which means it has the highest risk among the other companies taken.

Table 1.1: Calculation of excess return to beta ratio

Stock	Ri	$(Ri - Rf)$	β	ei2	$\frac{(Ri - Rf)}{\beta i}$	Ranks
Bajaj	104.3	94.8	0.68	739.6	129.86	1
Infosys	120.65	111.15	0.99	980.4	112.27	2
HUL	40.57	31.07	0.37	33	83.97	3
TCS	30.95	21.45	0.94	381.76	22.58	4
HCL	30.37	20.87	1.02	179.48	20.46	5
Maruti	12.55	3.05	0.65	637.25	4.77	6
Cairn	11.67	2.17	0.96	71.37	2.26	7
PNB	8.66	-0.84	0.96	331.52	-0.87	8
ITC	3.16	-6.34	0.52	60.98	-12.68	9

Source: Authors own calculations based on the collected data of nine companies

From the table 1.1, the individual mean returns are calculated using five years returns of stocks of nine (9) companies out of 25 sample companies and excess return to beta is found using the formula. The mean return of nine (9) companies ranging from 3.16 to 120.65 per cent. Then the stocks are ranked according to the excess return to beta ratio.

Table 1.2: Calculation of Cut-off point.

Stocks	$\frac{(Ri-Rf)}{\beta}$	$\frac{(Ri-Rf)\beta}{ei2}$	$\sum\frac{(R1-Rf)}{ei2}$	$\frac{\beta 2}{ei2}$	$\sum\frac{\beta 2}{ei2}$	**C_i**
Bajaj	129.86	0.09	0.09	0.0006	0.0006	**78.23**
Infosys	112.27	0.11	0.2	0.0009	0.0015	**70.63**
HUL	83.97	0.35	0.55	0.004	0.0055	**53.12**
TCS	**22.58**	0.05	0.6	0.002	0.0075	42.35
HCL	**20.46**	0.12	0.72	0.006	0.0135	28.25
Maruti Suz	**4.77**	0	0.72	0.0007	0.0142	26.94
Cairn	**2.26**	0.03	0.75	0.01	0.0242	16.46
PNB	-0.87	0	0.75	0.003	0.0272	14.64
ITC	-12.68	0.05	0.8	0.004	0.0312	13.59

Source: Authors own calculations based on the collected data of nine companies

From the table 1.2, the highest value of C_i is taken as the cut-off point i.e C^*. Here the cut-off point is C^* = 78.23. Thus the stock with C_i less than C^* can be included in the portfolio. The stocks selected must also be given preferences based on the ranking of the excess return to beta ratio. Here all other stocks above the cut-off point in the table can be selected because it has value less than the cut-off point.

CONSTRUCTION OF OPTIMUM PORTFOLIO:

For constructing the portfolio, the stocks are selected based on the ranking of the excess return to beta ratio and C_i must be less than the cut-off point.

From the C_i values of table 1.2, the investment is made in the following stocks:

Table 1.3: Stocks to be included in the portfolio

Stocks	**Cutoff point**
Bajaj	78.23
Infosys Ltd	70.63
HUL	53.12

Source: Authors judgment based on the relationship between C_i and risk-less return to beta ratio

The stocks are selected for the optimal portfolio based on excess return to beta ratio which is greater than or equal to cut-off point. The proportion the investment in each stock should be calculated.

***Proportion of investment*:** The proportions of stocks in the optimum portfolio were computed with help of the following formula.

$$Xi = \frac{Zi}{\sum Zi}$$

Where, $Zi = \frac{\beta i}{\beta ei2}$ The computed values for Xi and Zi are presented in the table 1.4.

Table 1.4: Calculation of proportion of funds to be invested in each stock

Stocks	**Z_i**	**X_i**
Bajaj	0.046	0.3194
Infosys Ltd	0.034	0.236111
HUL	0.064	0.444444
Total	0.144	0.1

Source: Authors calculation based on formulas of Z_i and X_i

Table 1.4, shows that the relative investment in each stock indicates the weights on each security and they sum up to one that is the proportion in which the money must be invested.

Table 1.5: Portfolio of stocks

Company	Proportion of investment (%)
Bajaj	31.94
Infosys Ltd	23.611
HUL	44.444

Source: Authors calculation based on X_i values

From the table 1.5, it can be inferred that maximum investment of 44.44 per cent has to be invested in the stocks of HUL Ltd. The remaining 55.56 per cent of funds have to be allocated in to Bajaj Automobiles Ltd and Info-sys Ltd with 31.94 per cent and 23.61 per cent respectively. The following chart will also represent the same break-up of investment in different stocks.

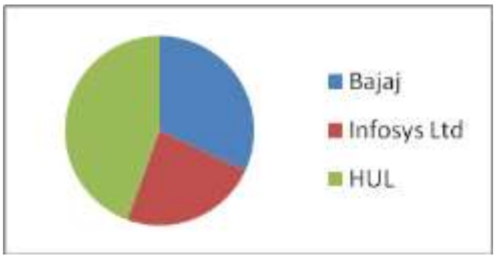

Figure 1.2 Proportion of investment (%)

FINDINGS:

- The excess return to beta ratio of selected sample companies is positive except PNB and ITC Ltd.
- The FMCG company (i.e. HUL Ltd with rank 1) has performed well when compare to other sample companies with respect to excess return.
- The stocks with moderate risk yields higher return (i.e. Bajaj Ltd 129.86)
- The returns of the stocks selected are also better than the other stocks
- The risk associated with all the individual stocks is not the same for all the years. It differs from time to time.
- The greatest proportion of investment of about 44.44 % is made in HUL Ltd. Which has the lowest beta value of 0.37 among all the stocks included in the portfolio?
- The optimum portfolio is largely diversified one as it includes the stocks of FMCG, IT and Automobiles (i.e. HUL, Infosys Ltd and Bajaj Automobiles Ltd).
- Annexure 1 shows that only 9 sample companies were continued with profits whose mean return ranges between 3.16 per cent to 120.65 per cent during the study period. This is happened because of US and European economic crisis.
- Out of nine sample companies, only three companies were included in the portfolio.

SUGGESTIONS:

- The individual investor has to invest maximum of 44.44 % in HUL Ltd as per the model prescription
- 31.94 % of the total investment has to be made in Bajaj Automobiles Ltd.
- 23.61 % of the total investment has to be made in Info-sys Ltd respectively.
- The stocks have to be continuously analyzed and portfolio has to be updated periodically.

CONCLUSIONS:

Though the recession has brought out significant decline in the trends, the rate of growth is remarkable in few stocks like HUL, Bajaj and Infosys. Individual securities, as we have risk-return characteristics of their own. Portfolios, which are combinations of securities, tend to spread risk over many securities and thus help to reduce the overall risk involved. This method of construction of optimum portfolio is very effective and convenient as revision of the optimum portfolio can be an ongoing exercise and moreover it has been proved in the Annexure II that out of 25 sample companies only nine (9) companies running with profits and the rest were huge losses. The existence of cut-off rate is also extremely useful because most new securities that have an excess return-to-beta ratio above the cut-off rate can be included in the optimum portfolio. Thus this study helps the investor to minimize their overall risk and maximize the return of their investment over any period of time.

Acknowledgements: We are highly thankful to the experts for providing the template.

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