Construction of Optimal Portfolio on Selected Stocks of BSE Using Sharpe's Single Index Model

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Abstract: *Portfolio construction is an important process of the investors for investment in the equity market. A good combination of a portfolio will give a maximum return for a particular level of risk. This research tries to construct an optimal portfolio in Indian stock market by using the Sharpe's single index model. In this research, top 25 stocks out of 100 stocks of Sensex have been selected on the basis of their market capitalization. The data for all the stocks for the period from January 2009 to December 2019 have been considered. The proposed method formulates a unique cut-off rate and selects those stocks or securities to construct an optimal portfolio whose excess return to beta ratio is greater than the cut-off rate. Then, the proportion or weight of investment in each of the selected securities is computed on the basis of beta value, unsystematic risk, and excess return to beta ratio and cut-off rate of each of the securities is concerned.*

Keywords: *Beta, Portfolio, Cut-off rate, Optimal Portfolio, Systematic Risk and Unsystematic Risk.*

Introduction

It's a complicated task of selecting good investments by considering the trade-off between risk and return along with the combination of various types of investments for the investors. A rational investor always seeks to minimize risks and maximize returns on his investment in an optimal portfolio. For this purpose investors ought to maximize the level of return at a given level of risk and alternatively to minimize the level of risk at a given level of return. This is done through the construction of portfolio of assets which is subject to the investor's portfolio. The study's significance arises from the fact that the application of the fundamental models develops an offer to investors for making decision in the choice of optimal portfolios in the Bombay Stock Exchange (BSE).

The rational of the study is to apply theoretical framework of portfolio management on a real world scenario and to form a well-balanced optimized and diversified portfolio of stocks. Varian (1993) reviewed the history of modern portfolio theory as Markowitz's groundbreaking research on portfolio optimization was published in March 1952 in an article titled "Portfolio Selection" in the Journal of Finance. Implementation of Markowitz model is much more time-consuming and more complex by the number of estimates required. The sheer number of inputs is staggering. Recognition of this has motivated the search for the development of models. Although the majority of the studies were carried out in developed countries, only a limited number of studied were conducted in developing countries. The study attempts to find out the optimal portfolio using single index model.

William Sharpe developed the Single Index Model to make easy and compute optimal portfolio. Till date fund managers use this model in portfolio construction and analysis.

Need for the Study

Every investor undergoes confusion while selecting securities for his portfolio. He also faces dilemma while deciding about the proportion of investment to be made in each security. To help investors get out of such dilemma, the Sharpe's Single Index model may be used to construct an optimal portfolio. This paper also helps to build a portfolio by balancing the positive and negative correlation between the securities. The present study is undertaken to prove that by applying this model an individual can construct a portfolio with maximum return for a given level of risk.

Objects of the Study

The following are the objectives of the study:

- The study the relative market performance of 25 companies listed in BSE;
- To construct an optimal portfolio empirically using the Sharpe's Single Index Model;
- To identify the stocks and calculate the proportion of investment to be included in the optimal portfolio;
- To get a practical knowledge as to the idea embedded in Sharpe's index model;
- To guide investors to find out the companies that gives the maximum return with minimum risk.

Limitations of the Study

The limitations of the present study are:

- The study uses yearly prices instead of monthly data
- Only 20 companies have been selected for conducting this study.
- The portfolio is constructed based on risk and return

Research Methodology

The study on construction of portfolio is empirical in nature. The collection of data for the study is secondary in nature. The collection of data has been made from various websites like Bombay Stock Exchange (BSE) and also from data base Ebsco and Proquest . the study is conducted for the past 11 years from 2009 to 2019. The sample size if the study is limited to 20 out of 100 stocks of BSE. The technique used is Random on the basis of market capitalization.

The steps followed are

i). Estimate the return on stock. The equation to be used

$$R_i = (P_t - P_0)/P_0) \times 100$$

where P_t is current price & P_0 is previous price

ii). Next, find excess return to beta ratio for each security

Excess return to Beta Ratio = $(R_i - R_f) / \hat{a}_i$

R_i = expected return of stock i

R_f = risk free rate of return

$\hat{a}_i$ = systematic risk of stock i

$$C_i = \frac{\sigma_m^2 \sum_{i=1}^{N} \frac{(R_i - R_f)}{\sigma_{ei}^2} \times \beta_i}{1 + \sigma_m^2 \sum_{i=1}^{N} \frac{\beta_i^2}{\sigma_{ei}^2}}$$

iii). As a next step, arrange all the securities in ascending order and then calculate the 'Cut- off rate' 'C_i' by using following equation

Where,

$\sigma^2 m =$ variance of the market index

$\sigma^2 ei =$ variance of stock movement that is not associated with the movement of market index i.e. stocks' unsystematic risk

The point will be selected as cut off point after which cumulative value of C_i start declining. Those securities which have value of C_i is more or equal to cut off point will be selected in optimum portfolio.

The proportion for each selected securities will be found by using the following formula

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

While the first expression (X_i) indicates the weights on each security, the second shows the relative investment in each security.

Literature Review

Dutt (1998) used Sharpe single index model in order to optimize a portfolio of 31 companies from BSE (Bombay Stock Exchange).Singh (2007), Kumar (2011), and Elton et al. (1976) in their studies tested the efficiency of Sharpe Single Index Model to make optimum portfolio selection. Their results are similar as all concluded that Single index model is efficient in constructing optimal portfolio and portfolio return is much higher than the portfolio variance. Paudel and Koirala (2006) checked the efficiency of Sharpe portfolio optimization model using a sample of 30 stocks traded in Nepalese Stock market from 1997-2006 and identified that portfolio beta is significantly lower than the market beta. Varadharajan and Ganesh (2012) applied the SIM on equity portfolio of large caps companies of selected sectors in India. The main aim of this study is to find out the optimum companies are selected as samples. The companies with the largest market capitalization in each sector have been selected. It was found that only five companies were included in the portfolio constructed out of the eighteen companies. Tripathy, Sasikanta (2011) applied the model on selected Indian banks' Stocks. The author assumed banks comprised in BANKEX as a sample. Out of fifteen stocks by using ANOVA it was found that there is a linear relationship between security returns and the common factor that there is no difference among the there is a positive relationship between the banked and individual stocks. Dileep and Rao, Kesava (2013) studied the applicability and utility of the Single Index Model in the Indian context and also evaluated the performance of the portfolio thus constructed in terms of its rate of return. It was found from the thirty companies that only four companies were included in portfolio construction. The study concluded that William Sharpe's Single Index Model will be sustainable and applicable to the Indian market where investors can construct a portfolio for improving the expected returns on their investment. Mandal, Niranjan (2013) applied Sharpe's Single Index Model considering the daily prices of twenty one securities for the period of ten years In order to determine the daily market return, the BSE Sensex was taken as the market performance index. After formulating the cut-off rate, those securities whose C_i values greater than the cut-off point were selected. From the study it is observed that the Sharpe's Single Index Model gives an easy mechanism for constructing an optimal portfolio of stocks for a rational investor by analyzing the reason behind the inclusion of securities in the portfolio with their respective weights. Kumar, Arun and Manjunatha (2013) presented an approach to the portfolio selection based on Sharpe's Single Index Model. The main objective of the study is to analyze the performance of securities based on aggregate weighted average of EPS, Sales and net profit. Out of the fifty companies in S&P CNX Nifty only six securities were selected for the optimal portfolio construction. The percentage of investment to be made in the selected securities has been calculated using Sharpe's Single Index Model. The study reveals that stock prices and market index move in the same direction. Sarker, Mokta Rani (2013) conducted a study to construct an optimal portfolio using Sharpe's Single Index Model considering no short sales. The study has been conducted on individual securities listed in Dhaka Stock Exchange, where short sales are not allowed. This method formulates a unique cut-off point, selects stocks having excess return to beta ratio surpassing this cut-off point and determines the percentage of investment to be made in in each of selected stocks. From this empirical analysis to some extent, an investor can forecast individual securities return through the market movement and can make use of it. Gopalakrishna, Muthu (2014) explains the investment alternatives available for rational investor. A comparison of traditional portfolio theory with that of modern portfolio theory is made in this study. This study aims to test whether single index model offers an appropriate

explanation of stock returns on IT stocks. By applying regression on the market return and excess security return it is found that IT index has a phenomenal amount of sensitiveness over S&P CNX Nifty. The study investigated that there are four aggressive stocks having beta coefficient of more than one. It is recommended that among the sample companies all the stocks are undervalued except one stock and thus the investors can pick these stocks to revise their portfolio. Desai, Radhika and Surti, Manisha (2013) constructed an optimal portfolio using fifty companies which were listed on the NSE and the time duration of the study is three years. The volatility of security has been analysed. The research provides direction to investors regarding performance of securities. Once the performance is analysed and optimum portfolio of securities is constructed, it enables the investor to take appropriate decisions. Andrade, Pratibha Jenifer (2012) aimed at developing an optimal portfolio of equity of IT sector through Sharpe's Single Index Model. In this study, a sample of six top performing IT companies traded in BSE has been chosen The data related to the daily returns of the securities and the market index has been collected through secondary sources. Debasish, Satya Swaroop and Khan, Jakki Samir (2012) selected a sample fourteen stocks from the various manufacturing sectors like automobiles, cement, paints, textiles oil& refineries and these are traded in the NSE. The daily data for all the stocks for the period Jan 2003 to November 2012 has been considered. Percentage of investment in each of selected stock is decided based on respective beta value, stock movement variance unsystematic risk, return on stock risk free return. Among the fourteen selected companies an optimal portfolio using Sharpe's Single Index Model constituted only three stocks. The proportion of investment to be made was also calculated using Single Index Model. Although the principles of value investing can be traced back to the 1930s (Graham and Dodd, 1934), the first scientific evidence of the superior performance of value stocks was provided by Basu (1977), who found high E/P stocks to outperform low E/P stocks. Parallel evidence of the corresponding value premium for B/P ratios was presented by Rosenberg et al. (1985), for CF/P ratios by Chan et al. (1991) and Lakonishok et al. (1994), for D/P ratios by Blume (1980), Litzenberger and Ramaswamy (1982), and Rozeff (1984), and for S/P ratios by Barbee et al. (1996), among the first. Later on, many studies have shown not only that the value premium in stock markets is a world-wide phenomenon, but also that the relative efficiency of different valuation criteria varies both across stock markets and the sample period examined. Chan et al. (1993) document that during the 1971-1988 period, stock returns in Japan were positively related to B/P and CF/P ratios, while the results of Suzuki (1998) show the superiority of the S/P criterion in the same stock market during the 1983-1996 periods. Parallel results are also reported by Barbee et al. (1996), who find that S/P ratios explain US stock returns better than corresponding B/P ratios during the 1979-1991 period, and by Bird and Casavecchia (2007a, b), who document the superiority of S/P ratios in the European markets during the 1989-2004 period. Fama and French (1998) compare the value premiums obtained from using four different criteria for portfolio formation (i.e. B/P, CF/P, E/P, and D/P) in 13 major stock markets. According to their results, the classification criterion leading to the greatest value premium for the 1975-1995 period varies across countries; in six out of 13 regional stock markets, the B/P criterion resulted in the greatest value premium (in the USA, the UK, Belgium, Switzerland, Singapore, and Japan), while the CF/P criterion was the best in four stock markets (i.e. in Germany, Italy, Hong Kong, and Australia). In The Netherlands and Sweden, the greatest value premium was achieved by dividing stocks into portfolios based on E/P ratios, whereas in France the D/P criterion generated the largest premium. According to Kyriazis and Diacogiannis (2007), the D/P ratios provided the best and only basis for the value strategy also in the Greek stock market during the 1995-2002 periods. Dhatt et al. (2004) show that the most efficient individual

valuation multiples based on US data during the 1980-1999 period were CF/P and S/P. The authors show further that by using composite value measures, the set of efficient portfolios can be expanded, enabling investors to achieve a wider range of risk-return trade-offs. Also Pa¨ ta¨ri and Leivo (2009) report the enhancement of the risk-adjusted performance of value portfolios in the Finnish stock market when using composite value measures as portfolio formation criteria. Moreover, the results of Leong et al. (2009) are somewhat supportive of the use of composite value measures since the formation criterion that led to the best performance in their study (i.e. economic-value-added to market value) can be seen as a hybrid of the E/P and B/P ratios.

The reasons for the value premium are discussed abundantly in the financial literature. Fama and French (1993) suggest that the value premium exists to compensate investors for risk inherent in value stocks relative to growth stocks that is not captured by the traditional CAPM (henceforth CAPM, of Sharpe (1964), Lintner (1965), and Mossin (1966). Using the neoclassical framework with rational expectations and competitive equilibrium, Zhang (2005) comes to a parallel conclusion, but explains the value premium with the difference between value and growth firms in their ability to adjust the level of production to match the demand in varying economic conditions.

This, in turn, results in countercyclical price of risk and cyclical behavior of unconditional market bs of value and growth stocks. In the cornerstone study of Fama and French (1992), the authors find that size and B/P explain most of the anomalous differences in future return of stocks. However, Daniel and Titman (1997) show that, after controlling the size and B/P, returns are not strongly related to bs calculated based on the Fama and French factors (for a contrary view to this inference, see Davis et.al.,(2000). In contrast, Ang and Chen (2007) argue that when test allow for time-varying market bs, no evidence against a CAPM story for the value premium is left. Goldman (1979) and Benninga and Blume (1988) similarly examine the effect of holding period length, but without serial correlation. Merton (1971) also considers portfolio choice with auto correlated returns. Hakansson (1971) suggested that growth optimal portfolios dominate all other portfolios in the long run. While Merton and Samuelson (1974) pointed out the fallacy in this argument, it remains true that it is easier to identify the characteristics of alternative investment portfolios over a long period of time. The literature contains numerous examples of each of two different assumptions about utility. In one version (e.g., merton 1971), consumption occurs continuously or repeatedly through time, and is smoothed due to the concavity of utility. In the other version (e.g., mossin 1968; samuelson 1989a, 1991), utility depends on wealth available for consumption at some future time.

Chan and Lakonishok, 2004; Fama and French, 2006; Anderson and Brooks, 2007; Brown et al., 2008) the relative efficiency of different valuation criteria seems to vary both across stock markets and the sample period examined. Fama and French (2006) show that the inferences of Ang and Chen (2007) are valid only for the 1926-1963 period, and furthermore, that during the 1963-2004 period value stocks have lower bs than growth stocks, contrary to what the CAPM requires to explain the value premium. Moreover, in contrast to the findings of Loughran (1997) and Fama and French (2006) show that the value premium is not restricted to small cap stocks by rejecting CAPM pricing formed on size, B/P and market during 1928-2004.

Thus, the literature survey made for the present study showed that there is enough scope for studying the utility of Sharpe's Single Index Model under the Indian conditions especially considering the securities of companies traded through the BSE which is one of the oldest stock exchange in the world and which is considered as one of the major attractions to any investor either individual or institutional.

Construction of an optimal portfolio using SIM

Generally, most of the stock prices over a period of time move with the market index. Fund managers do select the securities based on the management efficiency and security analysis

which is done considering various parameters like the turnover of company, its Profit, DPS, EPS, and ROI etc.

Beta to evaluate the risk

$$\beta = \frac{(R_m - \overline{R_m})(R_m - \overline{R_m})}{(R_m - \overline{R_m})^2}$$

The excess return to Beta is computed using following formula

$$\frac{R_1 - R_f}{\beta}$$

The securities are ranked according to this ratio. The systematic and unsystematic risks are computed as under: Systematic risk $= \beta^2 \sigma^2 m$

Unsystematic risk = $\acute{o}^2_{ei}$ - Systematic risk

Data analysis and Interpretation

This part of the paper brings out data analysis and interpretation relating to the present study. The data required for this study has been collected from secondary source. Twenty five companies listed under S&P BSE Sensex have been selected for the study. The chosen companies belong to various respective sectors. They have been presented below:

Table 1: Selected Companies

SL No.	Company Name
1	RELIANCE INDUSRY LTD
2	TCS LTD
3	HDFC BANK LTD
4	HUL LTD
5	HDFC
6	ICICI BANK LTD
7	KOTAK BANK
8	INFOSYS
9	ITC LTD
10	SBI
11	BAJAJ FINANCE
12	MARUTI SUZUKI
13	AXIS BANK
14	LARSEN TOUBRO LTD
15	ASIAN PAINTS
16	ONGC
17	HCL TECH
18	BAJAJ FINCERV
19	WIPRO
20	NESTLE
21	IOCL
22	ULTRATECH
23	NTPC
24	BPCL
25	TATA STEEL

Table 1 represents the list of companies selected for the purpose of this study. The historic prices of the above companies for 11 years 2009-2019 were collected from bseindia.com. S&P BSE SENSEX is the index selected as benchmark index for the present study. A sample of fifteen companies listed under this index was selected for constructing an optimal portfolio using Sharpe's Single Index Model. As a first step, the mean returns of these companies' stocks were computed and tabulated as under:

Table – 2 : Average or Mean Return of selected companies

SL No.	Company Name	Average return (%)
1	RELIANCE INDUSRY LTD	5.65
2	TCS LTD	13.69
3	HDFC BANK LTD	10.89
4	HUL LTD	23.74
5	HDFC	6.19
6	ICICI BANK LTD	4.33
7	KOTAK BANK	14.48
8	INFOSYS	-8.94
9	ITC LTD	1.73
10	SBI	-6.87
11	BAJAJ FINANCE	55.83
12	MARUTI SUZUKI	23.20
13	AXIS BANK	4.00
14	LARSEN TOUBRO LTD	2.32
15	ASIAN PAINTS	17.93
16	ONGC	-12.70
17	HCL TECH	11.93
18	BAJAJ FINSERV	43.88
19	WIPRO	-7.72
20	NESTLE	19.92
21	IOCL	-1.96
22	ULTRATECH	18.29
23	NTPC	-6.12
24	BPCL	3.17
25	TATA STEEL	-19.14

Table 2 shows the mean returns of the twenty five companies selected for the construction of an optimal portfolio using Sharpe's Single Index Model. This table reveals that Bajaj FinServe has the highest return of 55.83 % and TATA Steel Company has the lowest mean return of -19.41 %.

To know the market risk face by each security, the beta values of sample companies' stock returns were computed below:

Table – 3 : Beta value of selected companies

Sl No.	Company Name	â
1	RELIANCE INDUSRY Ltd	0.39
2	TCS LTD	0.52
3	HDFC BANK Ltd	2.14
4	HUL Ltd	0.42
5	HDFC	0.62
6	ICICI BANK Ltd	0.87
7	KOTAK BANK	1.34
8	INFOSYS	0.26
9	ITC Ltd	0.26
10	SBI	0.62
11	BAJAJ FINANCE	2.86
12	MARUTI SUZUKI	1.86
13	AXIS BANK	0.84
14	LARSEN TURBO	1.42
15	ASIAN PAINTS	1.29
16	ONGC	1.57
17	HCL TECH	1.08
18	BAJAJ FINSERVE	1.61
19	WIPRO	-0.08
20	NESTLE	0.49
21	IOCL	1.00
22	ULTRATECH	0.96
23	NTPC	0.28
24	BPCL	0.71
25	TATA STEEL	0.85

Table -3: shows the beta values of the twenty five companies' stock returns. A beta below 1 indicates either an investment in stocks with lower volatility than the market, or a volatile investment whose price movements are not highly correlated with the market. The Bajaj Finance has the highest beta value of 2.86 which means it is highly volatile. HDFC (2.14), Kotak Bank (1.34), Larsen and Toubro (1.42) , Maruti Suzuki (1.86), Asian Paints (1.29), ONGC (1.57), HCL Tech (1.08) Bajaj Finserve (1.61), and IOCL (1.00) have the beta values greater than 1 which means they are volatile. WIPRO has negative beta i.e.-0.08 which represents lower volatility.

Table – 4 : Ranking of stocks on Excess Return to Beta ratio

SL No.	Company Name	Return(R_i)	R_i-R_f	â	R_i-R_f / â	Rank
1	RELIANCE INDUSRY LTD	5.655099	-3.35	0.389029	-8.61119	18
2	TCS LTD	13.68819	4.68	0.518683	9.022854	7
3	HDFC BANK LTD	10.8862	1.88	2.14	-0.57146	11
4	HUL LTD	23.74185	14.74	0.41565	35.46253	2
5	HDFC	6.187482	-2.81	0.624255	-4.5054	13
6	ICICI BANK LTD	4.329354	-4.67	0.866775	-5.38853	15
7	KOTAK BANK	14.48	-5.56	1.34	-2.02505	12
8	INFOSYS	-8.94202	-17.94	0.265394	-67.6053	25
9	ITC LTD	1.733994	-7.27	0.265001	-27.4188	22
10	SBI	-6.87628	-15.88	0.621761	-25.5344	21
11	BAJAJ FINANCE	55.83462	46.83	2.855934	16.39906	5
12	MARUTI SUZUKI	23.20401	14.2	1.86401	7.620136	8
13	AXIS BANK	4.008156	-4.99	0.835768	-5.97276	16
14	L & T	2.325948	-6.67	1.422683	-4.69117	14
15	ASIAN PAINTS	17.93296	8.93	1.297049	6.887138	9
16	ONGC	-12.7051	-21.71	1.56959	-13.8285	20
17	HCL TECH	11.9291	2.93	1.083796	2.702632	10
18	BAJAJ FINCERV	43.88295	34.88	1.613073	21.62516	4
19	WIPRO	-7.71516	-16.72	-0.08681	192.5525	1
20	NESTLE	19.92601	10.93	0.497306	21.97039	3
21	IOCL	-1.95935	-10.96	1.001551	-10.9424	19
22	ULTRATECH	18.28805	9.29	0.962644	9.648476	6
23	NTPC	-6.12269	-15.12	0.280489	-53.9155	24
24	BPCL	3.171495	-5.83	0.710154	-8.20738	17
25	TATA STEEL	-19.1434	-28.14	0.852669	-33.0062	23

Table 4 indicates the excess return and excess return to beta ratio. The risk free rate of interest is assumed to be 9% in this study. The excess return to beta ratio measures the additional return on a security per unit of systematic risk. Table 4 shows that the WIPRO stock has the highest excess return to beta ratio of 192.55 while that of INFOSYS stock has the lowest of -67.60. This ratio provides the relationship between risk and reward of a company's stock. The ranking of stocks done on the basis of excess return to beta ratio indicates that while the WIPRO stock ranks at the top and INFOSYS stock ranks at the bottom.

The companies are listed is based on their ranks. The excess return is divided by the unsystematic risk and multiplied by the beta in order to calculate the ' C_i' values.

Table 5 : Companies based on ranks and Unsystematic risk

Rank	Company Name	$ó^2_{ei}$	$(R_i-R_f/ó^2_{ei})â$	Cumulative of $(R_i-R_f/ó^2_{ei})â$
1	WIPRO	489.39	0.002965	0.002965
2	HUL	318.90	0.019214	0.022179
3	NESTLE	248.71	0.021847	0.044026
4	BAJAJ FINSERV	789.23	0.071296	0.115322
5	BAJAJ FINANCE	2392.93	0.055896	0.171218
6	ULTRA TECH	432.13	0.020691	0.191909
7	TCS	801.68	0.003033	0.194942
8	MARUTI SUZUKI	924.68	0.028633	0.223575
9	ASIAN PAINTS	1577.15	0.007346	0.230922
10	KOTAK	963.8	0.007668	0.23859
11	HCL	1734.453	0.00183	0.24042
12	HDFC BANK	652.13	0.006212	0.246631
13	HDFC	944.70	-0.00186	0.244773
14	L&T	517.79	-0.01834	0.226436
15	ICICI	1472.17	-0.00275	0.223686
16	AXIS BANK	1172.55	-0.00356	0.220128
17	BPCL	1373.71	-0.00301	0.217114
18	RIL	382.21	-0.0034	0.21371
19	IOCL	875.93	-0.01253	0.201179
20	ONGC	131.41	-0.25924	-0.05806
21	SBI	1339.84	-0.00737	-0.06543
22	ITC	475.76	-0.00405	-0.06948
23	TATA STEEL	2295.53	-0.01045	-0.07993
24	NTPC	159.58	-0.02658	-0.10651
25	INFOSYS	949.89	-0.00501	-0.11152

The table indicates out of the above companies BAJAJ FINANCE has the highest value of 2392.93 and NTPC has the lowest risk of 159.58.

Table -6: Cut off C_i of sample stocks

Rank	Company Name	$\hat{a}^2/\acute{o}^2_{ei}$	Cumulative of $\hat{a}^2/\acute{o}^2_{ei}$	C_i
1	WIPRO	0.0000154	0.0000154	0.830246
2	HUL	0.000542	0.000557	5.392561
3	NESTLE	0.000994	0.001552	8.620208
4	BAJAJ FISERV	0.003297	0.004848	13.72193
5	BAJAJ FINANCE	0.003409	0.008257	14.49441
6	ULTRA TECH	0.002144	0.010401	13.74985
7	TCS	0.000336	0.010737	13.63923
8	MARUTI SUZUKI	0.003758	0.014495	12.38623
9	ASIAN PAINTS	0.001067	0.015561	12.07939
10	KOTAK BANK	0.001884	0.017445	11.36088
11	HCL	0.000677	0.018122	11.0904
12	HDFC BANK	0.007072	0.025195	8.578285
13	HDFC	0.000413	0.025607	8.39322
14	L&T	0.003909	0.029516	6.846728
15	ICICI	0.00051	0.030027	6.660795
16	Axis Bank	0.000596	0.030622	6.440596
17	BPCL	0.000367	0.030989	6.284929
18	RIL	0.000396	0.031385	6.116268
19	IOCL	0.001145	0.032531	5.574922
20	ONGC	0.018747	0.051277	-1.05887
21	SBI	0.000289	0.051566	-1.18699
22	ITC	0.000148	0.051714	-1.25704
23	TATA STEEL	0.000317	0.05203	-1.43795
24	NTPC	0.000493	0.052523	-1.89928
25	INFOSYS	0.0000741	0.0526	-1.98604

Table -6 represents the C_i of sample companies. The $\hat{a}^2/\acute{o}^2_{ei}$ and its cumulative are necessary for the calculation of C_i. The C_i value goes on increasing from 0.83 to 14.49 and thereafter, starts declining. Therefore, the value of 14.49 is considered as the *"cut-off point"*. The securities which come after the cut-off point will not be considered for the optimal portfolio construction.

Table 7: Selection of stocks among 25 companies - Cut off point

Stocks	Cut off point
WIPRO	0.83
HUL	5.39
NESTLE	8.62
BAJAJ FINSERV	13.72
BAJAJ FINANCE	14.49

Table -7 deals with all the stocks with Ci greater than cut off rate can be included in the portfolio. Here the top 5 companies stock according to the excess return to beta ratio is taken for calculating the proportion of investment.

Table - 8: Proportion of Investment

RANK	COMPANY	C_i	Z_i	X_i
1	WIPRO	0.830246	-0.03158	-114.656
2	HUL	5.392561	0.027335	99.23174
3	NESTLE	8.620208	0.014948	54.26522
4	BAJAJ FINSERV	13.72193	0.014574	52.90698
5	BAJAJ FINANCE	14.49441	0.002273	8.252018
			$\sum Z_i = 0.27547$	$\sum X_i = 100$

Table – 9: Return on Portfolio

Rank	CompanyName	X_i	Return (%)	Return on portfolio (%)
1	WIPRO	-114.656	-7.71516	08.84
2	HUL	99.23174	23.74185	23.55
3	NESTLE	54.26522	19.92601	10.81
4	BAJAJ FINSERV	52.90698	43.88295	23.21
5	BAJAJ FINANCE	8.252018	55.83462	04.60
	Return on Portfolio	$\sum X_i = 100$		**71.03**

Table 9 represents that the return on portfolio are calculated based on proportion of investment in each security. The highest return on portfolio is from HUL i.e. 23.55% and the lowest is from BAJAJ FINANCE i.e. 4.6%. it may also be noticed that the individual returns of BAJAJ FINSERV and BAJAJ FINANCE companies return are higher than the portfolio return. At the same time Wipro's return is negative. Hence even the expected returns from individual stocks are less it is always beneficial to include the stocks in the portfolio. Even the investor invests in the above portfolio, the total expected portfolio return is 71.03%.

Hence, Sharpes Single Index Model (SSI) is useful to investors and helps the fund managers to derive the benefits from the securities to create a portfolio by adequate diversification.

Table 8 represents the proportion of investments to be made for an optimal portfolio. By using Sharpe's Index Model, maximum investment should be made in HUL

Conclusion

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 while investing in equity of firms listed in the Bombay stock exchange. Out of 25 companies taken for the study, 7 companies are showing negative returns and the other 18 companies are showing positive returns. Out of 25 companies, 10 companies where market beta is above 1, show that the investments in these stocks are outperforming than the market. The study shows that portfolio beta is significantly lower than the market beta and portfolio return is much higher than the portfolio variance. Sharpe's single index model for optimal portfolio construction is very simple and useful. The results are almost similar to the earlier results (e.g. Paudel and Koirala, 2006; Singh, 2007; Kumar, 2011; Elton et al.,1976; and Meenakshi and Sarita, 2012). From this empirical analysis, to some extent one can able to forecast individual security's return through the market movement and can make use of it. More micro level studies is required to conduct different types of samples. This technique will lead to portfolio has best trade –off between Risk and Return from any other portfolio under concern.

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