Pacific Business Review International
Volume 8, Issue 9, March 2016

Selecting an Optimal Portfolio for Investment in Stocks in India: A Sectoral Approach

Dr Kavitha Lal
Asst. Professor
Dept. of Management Studies
Bhavan's Vivekananda College
of Science, Humanities & Commerce
Secunderabad

Dr S.R. Subba Rao
Professor
Dept. of Management Studies
Bhavan's Vivekananda College
of Science, Humanities & Commerce
Secunderabad

Abstract

Investment in stocks may be made individually or through portfolio managers. This study attempts at selecting an optimal portfolio for investment in Indian equity stocks belonging to specific economic sectors. After reviewing the relevant literature, the objectives and research methodology of the study have been spelt out. This is followed by a coverage of the concepts and definitions which are relevant for this study. A comparison of the different approaches to select an optimum portfolio has been made to get an overview of the relative measures.

In this paper, an optimum portfolio of economic sectors in India, in which the investments could be made, has been constructed, using Sharpe's index model and Treynor's index as appropriate. The choice of individual stocks within each the selected sectors could be done by the individuals or portfolio managers based on any subsequent analysis which generally aims at accrual of higher returns, given a risk level.

For the study, the CNX Nifty and the indices for the individual sectors numbering eleven, of the National Stock Exchange of India, have been considered. The data comprise daily indices for the period 1st April 2014 to 31st March 2015, as short run phenomenon in stock movements are equally important as the long run trends for investment in stocks. The CNX Nifty has been taken as the market performance index. The optimal portfolio has been constructed comprising the economic sectors, identified on the basis of a unique cut-off value in terms of returns. Valid statistical and analytical techniques have been used in arriving at the conclusions. The study being empirical in nature with the latest data on the subject selected is considered to add to the existing literature on the theme of the paper. It has practical value as the methodology used and calculations made are replicable for constructing an optimum portfolio of sectors for investment in the related equity stocks.

Keywords: CNX Nifty, Economic sectors, Optimal portfolio, Portfolio management, Sectoral indices.

Introduction

Investment in equity stocks has been done by individuals or portfolio managers for capital appreciation and/or dividend income. The investors aim at maximizing the return, with differing attitudes towards risk. Overall, the general objective is to invest in an optimal portfolio, adopting differing approaches. The present study attempts at selecting an optimal portfolio for investment in Indian stocks belonging to specific economic sectors. The relevant literature has been reviewed, and the methodology of the study has been framed accordingly.

In this study, the optimum portfolio of economic sectors in India has been constructed so that the investors could take decisions for investments in stocks belonging to the chosen sectors. For this, the Sharpe's index model and Treynor's index have been used. The selection of specific stocks depends upon the risk-return perceptions of the investors.

The study is based on the CNX Nifty and the indices for the individual sectors numbering eleven, of the National Stock Exchange of India. Daily indices, for the period 1st April 2014 to 31st March 2015, formed the data. It is felt that one-year period gives scope for adequately capturing the movements in the stock indices. Thus, no attempt has been made to distinguish between the short run and long run factors for investment in stocks. The CNX Nifty covers 50 stocks accounting for a significant part of the market, and hence it is taken as the market performance index. The optimal portfolio has been constructed from out of 11 economic sectors representing the economy of the country. The sectors for inclusion in the optimum set have been identified on the basis of a unique cut-off value in terms of returns. For the analysis of data, valid statistical and analytical techniques have been used. Based on the results, the conclusions have been arrived at.

Literature Review

The literature has various studies for studies of an optimal portfolio, applying models such as that of Markowitz, Sharpe and others. Using the Mean Variance (MV) efficient portfolio, the optimal holding period was investigated taking Istanbul stocks for the period January 2000 to November 2004. The results showed that MV efficient investment portfolio performed better for long term period (Ulucan, 2007).

The association between return and risk has been used in constructing optimal portfolios of stocks in multiple studies. Many studies have selected Sharpe Single Index Model to construct an optimal portfolio, for its simplicity and practical value. For instance, four studies are referred here in which this model has been used. One is by Varadarajan (2011) who constructed an optimal equity portfolio consisting of five stocks. Five years' data was considered i.e., from April 2006 to March 2011 covering 19 companies from banking and information technology sectors. Using the same model there are two more studies. The second is by Saravanan and Natarajan (2012) in which an optimal portfolio has been constructed comprising four stocks out of Nifty 50 stocks. Daily data of stock and index were considered for the period April 2006 to December 2011. Based on the cut-off rate of return, proportions of investments for each stock were decided. The third is by Debasish et al (2012) who have arrived at an optimal portfolio with three stocks, from out of 14 stocks in manufacturing sector which included automobiles, cement, textiles, paints, oils and refineries. Proportions of investment were decided based on the factors like beta value, return, risk free rate of return and unsystematic risk. Niranjan Mandal et al (2013) constructed an optimal portfolio using the Sharpe's model. BSE Sensex was considered as market performance index. The data covered the period April 2001 to March 2011. Securities above a cut-off rate were considered and proportions of investments in selected securities were computed.

Gopalakrishna Muthu (2014) has made a comparison of the traditional and modern portfolio theory for selection a portfolio. Secondary data was considered for the period 2004-08 from NSE Index. Using regression on market and security return, the study found that IT Index has greater sensitiveness over the stock market. The study covered undervalued stocks which help to revise the existing portfolio. The study of Nalini (2014) aimed at creating awareness among investors regarding the utility of Sharpe's model in constructing a portfolio. From BSE Sensex Index, 15 companies were considered, with yearly prices. Based on Ci values, four securities were selected to construct a portfolio.

Nageswari et al (2013) determined future risk and return of securities to form an optimal portfolio which significantly reduces variability of returns. BSE Sensex was considered with daily closing prices, for the period April 2007 to March 2012. A cut-off rate of return was evaluated which helps in selection of stocks to form a portfolio.

The portfolio optimization problem was formulated (Anangnostopoulos & Mamanis, 2010) by optimizing the objectives involving tradeoffs between risk, return and the number of securities for inclusion in an optimum portfolio. Limits are set regarding the proportion of the investments in assets, so that the chances of having smaller proportions of holdings or investments in assets having similar characteristics is avoided.

The impact of the number of securities on diversification of a portfolio was analysed by Mangram (2013) and he found that while systematic risk cannot be eliminated, unsystematic risk can be reduced much by diversification.

The literature survey broadly indicates that the optimum portfolio has been constructed using different types of models, but the generally used one is the Sharpe's single index model for its practical value.

Objectives of the Study

The objectives of the study are as follows:

1. To give a comparative analysis of the methods to select an optimal portfolio.
2. To construct an optimal portfolio for investment of funds, based on the CNX Nifty and the indices of the relative sub-groups.
3. To find out the proportion of investments to be made in each of the identified sub-groups.
4. To discuss the pros and cons of the investment in the selected optimal portfolio.

Research Methodology

For the study, data have been collected on daily indices of CNX Nifty and of the relative sub-groups numbering 11, for the period 1st April 2014 to 31st March 2015 (www.nseindia.com). The CNX Nifty has been taken as the market performance index. From the 11 sub-groups, the optimal portfolio of sub-groups has been identified, based on the values of return, variance of market index, variance of each sub-group, beta (β), systematic risk and unsystematic risk related to each sub-group. The sub-groups are ranked according to their "Excess return to Beta ratio" starting from the highest to the lowest. For each sub-group, the cut off value (Ci) is found. Then, the sub-groups for which the 'Excess return to β ratio' exceeds Ci are selected to be included in the optimal portfolio. Finally, the proportion of investments in each of the selected sub-groups in the optimal portfolio is computed. Valid statistical and financial techniques have been used to analyse and interpret the data, and arrive at the results.

Concepts and Definitions

A portfolio refers to a diversified mix of financial assets such as stocks and bonds (domestic or international) and cash. It may be held by an individual or managed by professionals, funds, banks or financial institutions. It is constructed based on investment amount, investment goals (such as growth, safety and liquidity), time period (long term or short term), and the levels of tolerance of risk (risk-prone, risk-averse or risk-neutral). The allocation of investment among the assets within the portfolio depends upon the expected risk-return ratio applicable for each asset.

Portfolio Management involves making investment decisions about the asset mix, taking into account the above factors.

An optimal portfolio is constructed with the aim of maximising the return at a given level of risk or minimising the risk at a given level of return. The return on a security i is given by:

$R_{it} = (P_{it} - P_{it-1})/P_{it-1}$ where, P_{it} and P_{it-1} are the share prices at time t and t-1 respectively.

The risk in an investment is measured by the variation in its returns. Beta of a stock denotes the risk of investing in it with respect to the market risk. It is measured by:

$\beta_i = \dfrac{\text{Covariance}(R_i, R_m)}{\sigma_m^2}$ = Correlation between security and market x $\left(\dfrac{\text{SD of security}}{\text{SD of market}}\right)$

where Ri is the return on the stock i, Rm is the return on the market or a benchmark index, is the variance of the market return and SD is standard deviation. A stock with a beta of greater than one indicates that it is more volatile than its benchmark, and should provide returns greater than the benchmark index. If beta is less than one, the stock is less volatile than its benchmark. A stock with beta of one shows that it has the same volatility as of the market. Zero beta means that the stock is uncorrelated with the benchmark (e.g. cash or treasury bills). Negative value of beta reveals counter cyclical volatility of the stock in relation to the benchmark. For example, if the benchmark returns 3%, then a stock with a beta of 1.4 should return 1.4 times 3% i.e. 4.2% or more. If not, other investments should be considered.

Beta has certain limitations. It is based on historical data, and thus ignores the future changes in the market. It depends on the time period selected. It does not discriminate between upward and downward volatility, which get averaged out. It assumes normal distribution of volatility while the pattern of data may be asymmetrical.

Instead of considering only the average portfolio return to evaluate the performance of a portfolio, risk-adjusted performance measures have come into vogue such as Sharpe's ratio, Treynor's index, Jensen's index, Modigliani measure, information ratio, etc.

When the total risk of a portfolio instead of only systematic risk is taken, we have:

$$\text{Sharpe ratio} = \frac{(R_i - R_f)}{\sigma_i}$$

where R_i is the average rate of return on portfolio, R_f is the risk-free rate of return, and σ_i is the standard deviation of portfolio. It shows the excess return earned on a portfolio per unit of its total risk (standard deviation).

Another measure of the performance of a portfolio was given by Treynor (1965) as the ratio of the excess returns to the systematic risk of the portfolio, for the evaluation period, instead of taking into account the total market risk. The Treynor's Index uses the beta of the portfolio rather than the standard deviation as in the Sharpe ratio. It is given by $(R_i - R_f)/\beta_i$, where R_f is the risk-free rate of interest such as that for government securities or Treasury bill, and σ_{ei}^2 and σ_{ej}^2 are the variations in the security i and security j's return unrelated to the market index i.e. stock's unsystematic risk, and β_i and β_j are the percentage changes in the rates of return on stock i and j respectively, associated with one unit change in the market return.

$\sigma p = \bar{R}p - (Rf + \beta p\,(\bar{R}m - Rf)$ where

$\bar{R}p$ = Expected portfolio return

βp = Beta of the portfolio

$\bar{R}m$ = Expected market return

Modigliani measure indicates the performance of the risk-matched portfolio. It is given by

$Mp = (\bar{R}p - \bar{R}m)$ / (Standard deviation of the fund's excess return X Standard deviation of market return)

Information ratio compares a fund to its benchmark. It differs from the Sharpe ratio, by comparing the excess return over the benchmark index.

Besides the above, the performance of the stocks is analysed using Technical analysis or Fundamental analysis or both. Technical analysis deals with an analysis of the data on the historical prices and volume of a stock, to determine the existence of patterns for decision making. Fundamental analysis takes into account the past and expectations relating to future regarding macro-economic factors of the economy of the country (such as gross domestic product of the country, sectoral composition, etc.) and global phenomena, a profile of the industries to which the specific stocks of interest belong, and the working of the company to which stock belongs (e.g. supply-demand factors, sales, profitability, growth prospects, risk elements determining the intrinsic value of a stock etc).

Selecting an Optimum Portfolio

The portfolio optimization model of Markowitz (1952), under assumptions of rational investor behaviour, finds out the weightings of the assets that minimize the variance of a portfolio and provides the portfolio to have a return equal or bigger than the expected return. The model requires calculation of expected return rates and variance or standard deviation (risk) for each stock of the portfolio, and the covariance or correlation coefficients for all stocks, treating them as pairs. It finds out the optimum weights or the proportion of investment in each asset in a portfolio, enabling the investor to maximise returns at a minimum risk. Changes in weights change the returns and risks for the portfolios and alter the investments as per the risk- aversion level of the investor. Thus, a multiple number of portfolios can be constructed for two or more assets, and for different proportions of assets. All the possible portfolios comprise the opportunity set. From this set, the feasible portfolios are filtered which constitute the efficient portfolios which includes the optimal portfolio providing the maximum return for a given level of risk. But, the procedure involved is tedious and practically difficult to apply.

A modification of the mean-variance portfolio model is the market model or the single index model which does not require the covariances between returns of the securities taken in pairs (Sharpe, 1964; Lintner, 1965). As per the single index model, called Shape's model, the returns of securities depend only on a market index, to arrive at an optimal portfolio. It is an improvisation over the Markowitz model. It estimates the return on stock by relating the stock prices to the market index. It is used to select securities in an optimal portfolio, based on the excess return to beta ratio $(R_i\text{-}R_f)/\beta_i$, where R_i is the expected return on the stock i. Thus, it measures the additional return on a security over the risk-free rate, per unit of systematic risk, i.e. the relationship between potential risk and reward.

As per Sharpe model, total risk comprises of unsystematic (or unique) risk plus systematic (or non-diversified) risk i.e.

$$\sigma_i^2 = \sigma_{ei}^2 + (\beta_i^2\,\sigma_m^2)$$

From this, the portfolio variance σp2 can be derived as follows:

$$\sigma_p^2 = [\sum_{i=1}^{N} X_i^2\,\sigma_{ei}^2 + \sum_{i=1}^{N} (X_i\,\beta_i)^2 \times \sigma_m^2]$$ where X_i is the proportion of stock 'i' in the portfolio.

The stocks are ranked based on their excess return to beta ratio, and the optimal portfolio includes securities above a cut-off level of excess return to beta ratio, say C*, which is found as follows:

The values of C_i are calculated as

$$C_i = [\sigma_m^2\,(\sum_{i=1}^{N} \{(R_i - R_f)\beta_i\}/\sigma_{ei}^2)] / [1 + \sigma_m^2 \sum_{i=1}^{N} (\beta_i^2/\sigma_{ei}^2)]$$

The value from which the cumulative values of C_i start declining is taken as the cut-off point and that stock ratio is considered as the cut-off ratio C*. The stocks are ranked according to the ERB values, in descending order. All the stocks for which the ratio is more than C* are selected and those for which the ratio is less than C* are omitted.

After deriving the optimum portfolio, the proportions of investments in each sub-group are arrived at as:

$$Xi = Z_i / \sum_{i=1}^{N} Zi \qquad \text{where, } Z_i = (\beta_i/\sigma_{ei}^2)\,[\{(R_i - R_f)\beta_i\} - C^*]$$

The Capital Asset Pricing Model was formulated and developed by Jack Treynor, William Sharpe, John Lintner, and Jan Mossin independently during the early 1960s, as an improvisation over the contribution of Harry Markowitz on diversification and portfolio theory. Using this model, Manish Kumar (2015), has constructed an optimal portfolio of nine stocks, from out of CNX Nifty's 50 stocks traded in the National Stock Exchange of India. The data covered the daily prices of these stocks in the period July 2012 to July 2014.

A naïve method is to select the securities for the portfolio at random assuming that the market is efficient and securities are properly priced.

Data Analysis and Results

For the present study, the Sharpe model is used. The daily indices for CNX Nifty and each of the sectors, numbering 11, have been considered for the period 1st April 2014 to 31st March 2015. Based on these indices the return is calculated. From the data on returns, the average, variance, standard deviation, beta, systematic and unsystematic risk and other measures have been found. Finally, the optimal portfolio has been constructed which comprises of the sectors that have been selected based on the cut-off value of C*.

Table 1 gives the data on the average return, standard deviation, the correlation coefficients between CNX Nifty and the indices for each of the sectors, beta, values of systematic and unsystematic risk and the values of the ratio of 'excess of the rate of return for the sectoral index over the risk-free rate of return, to the beta of the sectoral index'. The sectors are ranked for the purpose of constructing the optimal portfolio based on the ratio mentioned above. The sector with the highest ratio is ranked one.

The data show that the average return for the CNX Nifty (i.e. market) was 0.10, while for the sectoral indices it varied between (-) 0.02 and 0.22. The rates of return were above that for the market for six sectors viz., pharma (0.22), auto (0.17), bank and finance (0.16 each), IT and PSU banks (0.11 each). Pharma and auto are the growing sectors while the other four sectors are service-oriented. The Indian banking sector is generally considered as sound as per global perception, financial sector is progressing with multiple products and IT sector has phenomenal growth domestically and in terms of taking part in the global business growth as well. The rates of return were below that for the market for the remaining five sectors viz., media and realty (0.09 each), FMCG (0.04), energy (0.001), and metal (-0.02). Media and FMCG sectors are highly competitive in nature. The realty sector has passed through a phase of slump and is on the recovery path. The energy and metal sectors are traditional in nature and infrastructure-oriented prone to cyclical effects.

The data on standard deviation, indicating variability in the movement of indices, show stability for the CNX Nifty with a value of 0.87. For each of the sectors, the value is higher than that for the market, more so for PSU Banks and realty. Thus, the sectoral volatility is more when compared to that for the market, which could be because of the narrowness in the range while the market is very broad.

The values of the correlation coefficients between CNX Nifty and each of the sectoral indices reveal that the correlation is very strong between the market and the sectors of finance (0.9), bank (0.85) and auto (0.8). It is strong for energy (0.78), metal and PSU banks (0.69 each). It is above moderate for realty (0.61), and moderate for media (0.47). It is weak for FMCG (0.39), pharma (0.36) and IT (0.35). It is seen that where the correlations are on the higher side, the beta values are above 1. This is understandable as beta is a multiple of the value of correlation coefficient. The values of the unsystematic risk are higher than those of the systematic risk for each of the sectors, indicating that the intrinsic or fundamental factors are important in the case of investments on sectoral basis.

The values of (R_i-R_f)/Beta, which is the measure of Treynor's index, the excess return over the risk-free rate, expressed in terms of the units of beta, is the highest for pharma (0.44), followed by IT (0.19), auto (0.15), bank (0.11), and finance (0.10) sectors. For other sectors it is on the lower side (less than 0.1), and even negative for two sectors i.e. energy (-0.02) and metal (-0.03).

The ranking done for the sectors of investment purposes show that the top three sectors are pharma, IT and auto in that order, and the lowest three are FMCG, energy and metal (9th to 11th respectively).

Next, the cumulative values of (Ci) are given in Table 2, calculated on the basis of the Treynor's index. The cumulative cut-off rate (C*) is found to be 0.099, upto which level, the cumulative values show increasing values. The subsequent cumulative value is the same and from then on, the cumulative values have declining values. The sectors, upto which the cumulative values of Ci go on rising, get included in the optimal portfolio. The proportion of investment in these sectors in the optimal portfolio is shown in Table 3. It is the highest in pharma sector (61%), followed by auto (19%), IT (14%), bank (4%) and finance (2%). It shows a major tilt towards pharma because of the high returns associated with it. For diversification, auto and IT sectors are included, together accounting for one-third share in the total investment in the optimal portfolio. Bank and finance sectors have a nominal inclusion, due to their relatively lower returns. Overall, the portfolio is skewed towards high growth sectors from the fundamentals point of view.

Conclusion

Investment of funds in a portfolio of stocks enables investors to spread risk by diversification. Sharpe single index model has simplified the process of constructing the optimal portfolio by relating the return in a security to a single market index. Out of the 11 sectors, five are included in the optimal portfolio, with a major proportion of investment in pharma sector stocks followed by the other four. This approach of selecting an optimal portfolio takes into account the risk and return factors for the individual sectors in comparison to the risk and return associated with the market. The empirical nature of the study, applying the latest data relating to the stock market and sectoral indices, may be considered as contributing to the existing literature on the subject. It has practical significance in terms of the methodology used and calculations made. With this approach, an optimum portfolio of sectors can be constructed for investment in the related equity stocks.

References

Anagnostopoulos, K. P., & Mamanis, G. (2010). A portfolio optimization model with three objectives and discrete variables. Computers & Operations Research, 37(7): 1285-1297.

Debasish, Sathya Swaroop, Khan, & Jakki Samir. (2012). Optimal portfolio construction in stock market: An Empirical Study on selected stocks in Manufacturing sector in India, International Journal of Business Management, 2(2): 37-44.

Gopalakrishna Muthu, M. (2014). Optimal portfolio selection using Sharpe's Single Index Model. Indian Journal of Applied Research, 4(1): 286-288.

Jensen, M. C. (1968). The performance of mutual funds in the period 1945–1964. The Journal of finance, 23(2): 389-416.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. The review of economics and statistics. 47(1): 13-37.

Mangram, M. E. (2013). A Simplified Perspective of the Markowitz Portfolio Theory.

Global Journal of Business Research, 7(1): 59-70.

Manish Kumar R.P. (2015). The Application of the Capital Asset Pricing Model: Indian Capital Market Perspective. International Journal in Management and Social Science. 3(1): 391-402

Markowitz, H. (1952). Portfolio Selection. The Journal of Finance, 7(1): 77-91.

Nageswari, P., Selvam, M., & Bhuvaneswari, P. (2013). An Empirical Analysis of Optimal Portfolio Selection Using Sharpe's Optimization. Asian Journal of Research in Business Economics and Management, 3(11): 209-221.

Nalini. (2014). Optimal Portfolio Construction using Sharpe's Single Index Model-Study of selected stocks from BSE. International Journal of Advanced Research in Management and Social Sciences, 3(12): 72-93.

Niranjan Mandal, & Dutta B.N. (2013). Sharpe's Single Index Model and its Application to Construct Optimal Portfolio: An Empirical Study. Great Lakes Herald. 7(1): 1-22.

Saravanan, A. & Natarajan, P. (2012). Optimal Portfolio Construction with Nifty Stocks (an analytical prescription for investors. Advances in Management. Pondicherry University, India.

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. The Journal of Finance, 19:3: 425-442.

Treynor, J. L. (1965). How to rate management of investment funds. Harvard business review, 43(1): 63-75.

Ulucan, A. (2007). An analysis of mean-variance portfolio selection with varying holding

Periods. Applied Economics, 39: 1399-1407.

Varadarajan, P. (2011). Portfolio construction using the Sharpe Index Model with reference to banking and information technology sectors. Prime Journal of Business Administration and Management, 1(12): 392-398.

Table 1: Basic Data to construct Optimal Portfolio from Sharpe's Index Model

	Average Return	Std. Dev.	Correlation; CNX Nifty vs Sector	Beta	Sys. Risk	Unsys. Risk	(R_i-R_f) /Beta)	Rank
CNX Nifty	0.10	0.87						
Auto	0.17	1.10	0.80	1.01	0.78	1.21	0.15	3
Bank	0.16	1.34	0.85	1.31	1.30	1.80	0.11	4
Energy	0.001	1.34	0.78	1.20	1.09	1.80	-0.02	10
Finance	0.16	1.28	0.90	1.33	1.33	1.64	0.104	5
FMCG	0.04	1.07	0.39	0.48	0.18	1.14	0.0376	9
IT	0.11	1.18	0.35	0.47	0.17	1.39	0.19	2
Media	0.09	1.29	0.47	0.70	0.37	1.66	0.098	6
Metal	-0.02	1.66	0.69	1.32	1.32	2.76	-0.03	11
Pharma	0.22	1.08	0.36	0.45	0.15	1.17	0.44	1
PSU Banks	0.11	2.02	0.69	1.61	1.95	4.08	0.05	7
Realty	0.09	2.35	0.61	1.65	2.07	5.52	0.041	8

Variance of Market Index = $\sigma_m^2 = 0.75$ (from the returns data for CNX Nifty)

R_f = 8% p.a. = 0.02192% per day (i.e. approximate return on government securities).

Source: Compiled by the authors from www.nseindia.com

Table 2: Determining the Cut-off Rate (Ci)

Sector	$(R_i - R_f)/B_i$	Var_i	$[(R_i - R_f)B_i]/Var_i$	Cum. value of col. 4	B_i^2 / Var_i	Cum. value of col. 6	Market variance* col. 5	1−(Market variance* col. 7)	C_i
1	2	3	4	5	6	7	8	9	10
Pharma	0.44	1.16	0.078	0.078	0.175	0.175	0.058	1.131	0.051
IT	0.19	1.39	0.030	0.108	0.159	0.333	0.081	1.250	0.065
Auto	0.15	1.22	0.124	0.232	0.836	1.170	0.174	1.877	0.093
Bank	0.11	1.8	0.102	0.334	0.953	2.123	0.251	2.592	0.097
Finance	0.10	1.63	0.114	0.448	1.085	3.208	0.336	3.406	0.099 (C*)
Media	0.098	1.66	0.030	0.478	0.295	3.503	0.358	3.628	0.099
PSU Banks	0.05	4.09	0.035	0.513	0.634	4.137	0.385	4.103	0.094
Realty	0.041	5.5	0.021	0.534	0.495	4.632	0.401	4.474	0.090
FMCG	0.0376	1.14	0.008	0.543	0.202	4.834	0.407	4.626	0.088
Energy	-0.02	1.8	-0.013	0.529	0.800	5.634	0.397	5.226	0.076
Metal	-0.03	2.77	-0.019	0.510	0.629	6.263	0.383	5.697	0.067

Note: Some values are rounded off and may not add up to the cumulative values given in columns 5 and 7.

Source: Compiled by the authors from www.nseindia.com

Table 3: Proportion of investment in the sectors in the Optimal portfolio

	B_i/Var_i	$[(\underline{R_i - R_f}) - c^*]$ B_i	Z_i	X_i
Pharma	0.388	0.341	0.132	0.61
Auto	0.828	0.051	0.042	0.19
IT	0.338	0.091	0.031	0.14
Bank	0.728	0.011	0.008	0.04
Finance	0.816	0.005	0.004	0.02
		Total Z_i	0.217	1.00

Source: Compiled by the authors from www.nseindia.com