

Construction of an Optimal Portfolio Using Sharpe's Single Index Model : A Study on Nifty Midcap 150 Scrips

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Abstract

We made an attempt to construct an optimal portfolio using Sharpe's single index model. For this study, we collected monthly closing prices of Nifty Midcap 150 scrips from July 2011 to June 2016. In this empirical study, we considered only 25 scrips out of 150 for construction of an optimal portfolio. Nifty Midcap contains different sectors scrips. Risk can be spread among the selected scrips. Risk and return was studied for individual securities. Sharpe's single index model was formulated using the excess returns to beta ratio, cut - off rate, which finally led to the construction an optimal portfolio and determined the percentage of fund investments in various scrips. In general, investors take investment decisions based on global information and market efficiency and make portfolio choices to generate better returns. This study will fundamentally help the investors to take the right investment decisions. The present study identified an optimal portfolio from the selected 25 companies, which served to maximize the returns for the investors.

Keywords : optimal portfolio, cut off rate, investment, scrips, excess returns to beta ratio

JEL Classification : G10, G11, G14

Paper Submission Date : October 7, 2017 ; **Paper sent back for Revision :** December 19, 2017 ; **Paper Acceptance Date :** December 28, 2017

A portfolio is a combination of stocks, bonds, and financial instruments. Portfolio management deals with security analysis, portfolio selection, revision, and evaluation. Selection of a portfolio depends on investor objectives. The main objective of portfolio management is to target maximum returns from a given level of risk. A portfolio manager should maintain balance between return and risks and take appropriate decisions. Effective investment planning and constant review is required to get better returns. The main motto of investors is how to reduce the risks. Global markets are always highly volatile and sensitive. Investing entire wealth in a single scrip is also highly risky, but time bears the results. Investors have different desires and preferences and this leads to withdrawal of funds from portfolios. This may affect an optimal portfolio. Investors should have a sound knowledge of security analysis and portfolio management concepts. There are many investment avenues that are available in the market, and it is very difficult to determine the best investment options. The investors should not forget that equity markets generate better returns as compared to other asset classes. In this paper, we make an attempt using Sharpe single index model with Nifty midcap 150 scrips to construct an optimal portfolio.

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Review of Literature

Debasish and Khan (2012) explored the study on selected stocks in manufacturing sectors in India. Secondary data were collected for 10 years from 2003 to 2012. Sample size was 14 stocks from five different manufacturing sectors. Risk free rate of asset was taken as 6.5%. The study observed that opportunities are available for investors as per returns generated by selected stocks. The study determined whether the sample data could affect the optimal portfolio with selected sectors stocks. The study examined the impact of correlation between different manufacturing sectors. An optimal portfolio balances the positive and negative variance existing between the securities, which turn into higher returns. Out of the 14 stocks, only three stocks were found to be eligible for construction of an optimal portfolio. This could be helpful to investors for rebalancing the portfolio from time to time.

Naveen (2014) explained how to construct an optimal portfolio using BSE blue chip 30 scrips and using secondary data collected for the study. Negative stock returns and negative beta scrips were eliminated for the next level. The study explored how positive excess returns to beta ratio scrips were eligible for the construction of a portfolio. The study examined different parameters to find portfolio beta, portfolio alpha, and portfolio returns. Out of 24 securities, only four company stocks were selected for optimal portfolio. The study analyzed that calculation of risk helped for portfolio diversification, which gave a clear picture to investors for investment decisions. The study also suggested that investors should evaluate their portfolios from time to time and this could be helpful for investors.

Nalini (2014) explained a single index model applied on selected stocks from BSE. Data were collected from 2009 to 2014. Fifteen scrips' monthly closing prices were taken for the study. Out of 15 stocks, only four companies were included in the portfolio. It was found that high return stocks always indicated volatility on portfolio. This should be considered before taking any investment decision. The analysis revealed that when returns are high, the risk involved in a particular scrip should be considered for investment purposes. The study determined that majority of the investors might invest their funds in only one particular stock. The study examined how awareness could be created in the minds of the investors regarding the Sharpe index model. The research study found out that risks could be diversified if the portfolio created mixed high returns stocks. According to the author, micro level studies can have more impact on fund managers to make appropriate investment decisions.

Muthu (2014) made an attempt to analyze optimal portfolio construction using a single index model. The study analyzed whether a single index model offered better returns on IT companies ; 13 IT stocks were considered for the study. Monthly data were collected from IT stocks for the period from 2004 to 2008. Regression analysis was applied on market returns and excess stock returns. The study found that IT stocks were currently undervalued with the current Nifty index. There were four stocks that were found to be aggressive and contained a beta of more than one. The results revealed that IT stocks were more dominant in the market as compared to CNX Nifty blue chip stocks.

Poornima and Ramesh (2015) analyzed a single index model applied on auto and pharmaceutical sector. Secondary data were taken from the 2010 - 2015 period. Out of 20 companies, only five company scrips were selected for an optimal portfolio. This included the two different sector stocks. The study determined a positive correlation between automobile and pharmaceutical sectors. The study found that only one particular scrip showed higher beta representation from the pharmaceutical sector. The research study determined that both sector stocks would move strategically. Investors can take a call based on their objective. The study concluded that optimal portfolio generates better returns in automobile and pharmaceutical sectors.

Shah (2015) explored the construction of an optimal portfolio using Sharpe single index model and also analyzed CAPM for BSE 15 securities. The study analyzed the portfolio risk and returns evaluated in selected BSE stocks, where risk and returns were analyzed for creation of an optimal portfolio to get investment analysis.

The researcher made an attempt for the diversification of the stocks with the help of an unsystematic risk. This study compared a single index and CAPM model. Data were collected from only 15 stocks that too based on market capitalization, which posed a limited scope for the study. Determined portfolio returns and BSE index moved together and tested portfolio beta, which had more effect on optimal portfolio returns. The researcher conducted portfolio variance and portfolio returns analysis. The study concluded that variance of the portfolio posted much deviation from the market index. The study considered CAPM evaluation on selected stocks. Out of 15 stocks, only four stocks were overpriced and remaining all were underpriced. The investigation suggested that the Sharpe model was better than the CAPM model for investment purposes in BSE in selected securities.

Mary and Rathika (2015) analyzed portfolio construction using CNX pharma scrips. The study was conducted by using monthly closing prices of 10 pharma companies. Secondary data were collected from 2010 to 2014. The study found that pharma index reflected the total free float market value of all the pharmaceutical stocks in the index. The study observed that all the stocks in the pharmaceutical sector got a negative cutoff value. The study did not analyze the negative correlation between pharma companies. Beta showed a value of less than one, which means volatility was less in the market index. The study also observed that expected returns may increase if stocks rebalance on time. The study concluded that out of 10 pharma companies, only one stock was included in optimal portfolio.

Need for the Study

In construction of a portfolio, an investor gets confused like where to invest, how much to invest, and the proportion of investments. Financial literacy and lack of awareness are a gap for investing in scrips. Even if investors apply portfolio manager strategies, how much this can meet investor objectives is a question. In order to meet the investor requirements, Sharpe's single index model may be useful for the construction of an optimal portfolio. It also educates investors about investment options so that investors can do better portfolio optimization.

Objectives of the Study

- (1) To analyze the risk and returns of individual securities on Nifty Midcap.
- (2) To discover an optimal portfolio using Sharpe's single index model.
- (3) To determine proportion of investments in an optimal portfolio.
- (4) To create awareness and assist investors to take appropriate investment decisions.

Theoretical Foundation

A variance of a scrip has two risks, that is, systematic risk and unsystematic risk. As the number of scrips in the portfolio rises, unsystematic risk can be diversified, however, the market risk remains. A single index model reduces the number of inputs for better diversification.

(1) Sharpe's Single Index Model : Similar to the proverb “don't put all your eggs in one basket,” an investor cannot keep all investments into one particular or desired scrip. William Sharpe studied Markowitz's research and developed a single index model. The single index assumes that all the covariance(s) of security returns can be explained by a single factor. This factor is called as the single index. Most of the stock prices move with the index over a period. In the general context, when Nifty rises, the scrip prices also tend to rise and vice - versa. Sharpe

studied the co-movement of scrips with a market index with the help of linear regression model in a single index model.

(2) Sharpe's Optimal Portfolio : Sharpe provided a model for the selection of appropriate securities in an optimal portfolio. Instead of correlating each security with an index of all securities included in the analysis, each security can be correlated with the efficient market value weighted portfolio of all risky assets in the universe. The following steps are involved in the process of construction of a portfolio. The steps for finding out the stocks to be included in an optimal portfolio are given below :

(i) Find out the “Excess returns to beta” ratio for each stock under consideration :

$$\text{Excess Return to Beta Ratio} = \frac{R_i - R_f}{\beta_i}$$

(ii) Rank them from highest to the lowest and then proceed to calculate C_i for all stocks/portfolios according to the ranked order using the following formula :

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

where,

σ_m^2 = Variance of the return of market index,

σ_{ei}^2 = Variance of the stock's movement that is not associated with the movement of market index, that is, stocks with unsystematic risk.

(iii) Compute the cut-off point, which is the highest value of C_i and is taken as C^* . The stocks whose excess returns to risk ratio are above the cut-off ratio are selected and all those stocks whose excess returns to risk ratio are below the cut-off ratio are rejected. The main reason for this selection is that since securities are ranked from highest excess returns to beta to lowest returns, and if a particular security belongs to an optimal portfolio, all highest ranked securities belong to an optimal portfolio.

(iv) Once we come to know which securities are to be included in the optimal portfolio, we shall calculate the percent to be invested in each security by using the following formula :

$$X_i = \frac{Z_i}{\sum_{i=1}^N Z_i}$$

where,

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

The first portion determines the weight of each stock and the total comes to "1" to ensure that all funds are invested and the second portion determines the relative investment in each security.

Research Methodology

This research is a descriptive quantitative study and is based on secondary data. For this study, we collected monthly closing prices of Nifty Midcap 150 scrips from July 2011 to June 2016. Out of this data, data for 11 scrips were not available. These stocks were eliminated from the study. Nifty has been taken as the market index.

Analysis and Results

(1) Step 1 - Mean Returns, Beta, and Standard Deviation : The Table 1 shows the calculation of mean returns, beta, and standard deviation of various companies. The mean returns of scrip of Ajanta Pharmaceuticals Ltd. listed higher returns (112%) followed by returns of TVS Motor Company Ltd. (98%) and BEML Ltd. (87%). Similarly, scrips of Exide Industries Ltd. posted least returns (1%) followed by Tata Global Beverages Ltd. (1%) and Canara Bank (1%). Videocon Industries Ltd., Reliance Power Ltd., Allahabad Bank, Bank of India, IOB, UCO Bank, Jindal Steel & Power Ltd., and MMTC Ltd. scrips listed negative returns. These eight company stocks have been eliminated from further study. The analysis reveals that 62 scrips posted high beta values, which we theoretically call more volatile stocks. Suzlon Energy Ltd. listed highest beta (3.07) followed by Reliance Capital Ltd. (2.62) and Reliance Infrastructure Ltd (2.51). Similarly, Sanofi India Ltd. posted beta of 0.14, followed by Ipca Laboratories Ltd. (0.11), and eClerx Services Ltd.(0.11), and it is observed that these scrips are less volatile than the market. Symphony Ltd. and PI Industries Ltd. scrips have listed negative beta values. These two scrips are eliminated from further study.

(2) Step 2 - Calculation of Excess Returns to Beta Ratio and Ranking the Scrips : Risk free rate was assumed at 7% per annum for calculating excess returns to beta value of all scrips. The Table 2 presents detailed calculation. Scrips with positive excess returns to beta ratio are only eligible for cut off rate calculation. Negative value posted scrips are eliminated.

The Table 2 depicts the calculation of excess returns to beta ratio and ranking of the scrips. Excess returns is the difference between risk free asset returns and mean returns. eClerx Services Ltd. (1.6759) posted highest excess returns to beta ratio, followed by NATCO Pharma Ltd. (1.6269) and Vakrangee Ltd. (1.5507). Since scrips are ranked from highest to lowest excess returns to beta ratio, we know that all high ranked scrips belong to an optimal portfolio. Systematic risk is company or industry specified risk. This is also called diversified risk. Investors can reduce the volatility through diversification. L&T Finance Holdings Ltd. posted the highest (0.00148) unsystematic risk.

The Table 3 shows the calculation of the cut - off rate (C^*). All scrips whose excess returns to beta ratio is above the cut off rate are selected and whose excess returns to beta ratio are below the cut off rate are rejected. Cut off rate will decide which scrips are kept “In” the optimal portfolio and which scrips are “Out” of the optimal portfolio as illustrated in the “Status” column of Table 3. Used market variance (0.002308024) is considered for calculation of C^* . It can be inferred from the Table 3 that the highest value of C_i has been considered as the cut off rate C^* . Cut off rate is $C^* = 0.5143$, which was achieved by Havells India Ltd., and there are 24 scrips that recorded more excess returns to beta ratio than the cut off rate. These scrips are eligible for the construction of an optimal portfolio. The existence of an optimal portfolio allows a manager to determine quick decision for holding or not holding a scrip.

(3) Step 3 - Construction of an Optimal Portfolio : To calculate the proportion of funds to be invested in an optimal portfolio, the Table 4 represents the percentage of funds that were invested in each security. The Table 4 shows the proportion of funds invested in each scrip.

Table 1. Mean Returns, Beta, and Standard Deviation

S.No	Company	R_i	β_i	SD (σ)
1	Amara Raja Batteries Ltd.	56	0.44	1.46
2	Apollo Tyres Ltd.	31	0.89	1.99
3	Balkrishna Industries Ltd.	54	0.83	1.71
4	Exide Industries Ltd.	1	0.84	1.37
5	MRF Ltd.	36	0.86	1.59
6	Tube Investments of India Ltd.	25	0.91	1.48
7	TVS Motor Company Ltd.	98	1.47	2.15
8	WABCO India Ltd.	35	0.96	1.47
9	Dalmia Bharat Ltd.	83	1.67	2.47
10	Prism Cement Ltd.	41	1.71	2.03
11	The Ramco Cements Ltd.	36	1.01	1.54
12	Century Textile & Industries Ltd.	31	1.85	2.08
13	BASF India Ltd.	18	0.95	1.65
14	Gujarat Fluorochemicals Ltd.	9	1.46	1.91
15	Tata Chemicals Ltd.	7	1.03	1.12
16	Engineers India Ltd.	11	1.65	2.11
17	GMR Infrastructure Ltd.	12	2.08	2.78
18	Godrej Properties Ltd.	3	0.99	1.37
19	IRB Infrastructure Developers Ltd.	34	2.11	2.43
20	Kajaria Ceramics Ltd.	54	1.14	1.71
21	Oberoi Realty Ltd.	6	1.15	1.49
22	Phoenix Mills Ltd.	11	1.11	1.47
23	Prestige Estates Projects Ltd.	18	1.75	1.91
24	Sadbhav Engineering Ltd.	37	1.79	2.23
25	Voltas Ltd.	42	1.91	2.01
26	Akzo Nobel India Ltd.	12	0.52	1.13
27	Bajaj Corp Ltd.	34	0.36	1.41
28	Bata India Ltd.	9	1.15	2.51
29	Berger Paints India Ltd.	39	0.65	1.21
30	Gillette India Ltd.	17	0.48	1.19
31	Godrej Industries Ltd.	16	1.17	1.42
32	Havells India Ltd.	52	0.99	1.45
33	Jubilant Foodworks Ltd.	11	1.11	1.74
34	Jyothy Laboratories Ltd.	22	0.46	1.62
35	Kansai Nerolac Paints Ltd.	32	0.62	1.23
36	Rajesh Exports Ltd.	44	0.45	2.35
37	RelaxoFootwears Ltd.	56	1.14	3.62
38	Tata Global Beverages Ltd.	1	1.38	1.46
39	Trent Ltd.	7	0.75	1.39
40	TTK Prestige Ltd.	1	0.53	1.49
41	Whirlpool of India Ltd.	41	1.17	1.89
42	Adani Power Ltd.	15	2.25	1.92

43	CESC Ltd.	21	1.35	1.62
44	Gujarat State Petronet Ltd.	15	0.56	1.24
45	Indraprastha Gas Ltd.	9	0.71	1.41
46	JSW Energy Ltd.	16	2.23	2.32
47	Mangalore Refinery & Petrochemicals Ltd.	12	1.29	1.75
48	Neyveli Lignite Corporation Ltd.	6	1.26	1.45
49	Petronet LNG Ltd.	14	0.51	1.12
50	Reliance Infrastructure Ltd.	18	2.51	2.41
51	SJVN Ltd.	11	0.35	0.79
52	Torrent Power Ltd.	18	0.81	2.31
53	Coromandel International Ltd.	2	0.71	1.51
54	Bajaj Holdings & Investment Ltd.	16	0.51	0.92
55	Canara Bank	1	2.04	2.16
56	Central Bank of India	5	2.06	2.13
57	Cholamandalam Investment and Finance Company Ltd.	36	1.17	1.66
58	City Union Bank Ltd.	28	0.92	1.16
59	CRISIL Ltd.	26	0.51	1.15
60	Dewan Housing Finance Corporation Ltd.	37	1.91	2.15
61	Edelweiss Financial Services Ltd.	25	1.42	1.86
62	Federal Bank Ltd.	26	1.26	1.81
63	Gruh Finance Ltd.	57	0.73	1.33
64	IDBI Bank Ltd.	2	2.01	2.14
65	IIFL Holdings Ltd.	33	1.83	1.99
66	Indian Bank	11	1.93	2.34
67	KarurVysya Bank Ltd.	6	0.91	1.24
68	L&T Finance Holdings Ltd.	2	0.34	0.65
69	Mahindra & Mahindra Financial Services Ltd.	11	0.22	1.21
70	Muthoot Finance Ltd.	34	0.96	2.21
71	Reliance Capital Ltd.	6	2.62	2.51
72	Shriram City Union Finance Ltd.	23	0.61	1.19
73	Sundaram Finance Ltd.	41	0.69	1.29
74	Syndicate Bank	11	2.35	2.35
75	Union Bank of India	4	2.11	2.43
76	Fortis Healthcare Ltd.	2	0.87	1.57
77	AIA Engineering Ltd.	36	0.81	1.46
78	BEML Ltd.	87	2.05	2.79
79	Fag Bearings India Ltd.	29	0.87	1.26
80	Honeywell Automation India Ltd.	31	1.09	1.66
81	Mahindra CIE Automotive Ltd.	31	1.11	2.63
82	SKF India Ltd.	23	0.85	1.09
83	Supreme Industries Ltd.	33	0.57	1.14
84	Suzlon Energy Ltd.	33	3.07	3.57
85	Thermax Ltd.	12	1.15	1.29
86	Cyient Ltd.	32	0.59	1.29

87	eClerx Services Ltd.	19	0.11	1.38
88	Hexaware Technologies Ltd.	28	0.61	1.91
89	Info Edge (India) Ltd.	25	0.89	1.41
90	MindTree Ltd.	43	0.34	1.42
91	Mphasis Ltd.	3	0.76	1.44
92	Persistent Systems Ltd.	34	0.72	1.47
93	Tata Elxsi Ltd.	63	1.15	2.22
94	Vakrangee Ltd.	75	0.48	2.44
95	D.B.Corp Ltd.	12	0.55	0.97
96	Dish TV India Ltd.	8	1.54	1.83
97	JagranPrakashan Ltd.	11	0.57	0.97
98	Network18 Media & Investments Ltd.	7	1.78	2.38
99	Sun TV Network Ltd.	9	1.31	1.78
100	TV18 Broadcast Ltd.	17	2.36	2.61
101	Hindustan Copper Ltd.	6	1.71	2.42
102	National Aluminium Co. Ltd.	12	1.21	1.75
103	Ajanta Pharmaceuticals Ltd.	112	1.27	2.29
104	Alembic Pharmaceuticals Ltd.	58	0.58	1.77
105	Biocon Ltd.	21	0.38	1.31
106	Ipca Laboratories Ltd.	14	0.11	1.41
107	Jubilant Life Sciences Ltd.	27	1.22	2.58
108	NATCO Pharma Ltd.	51	0.31	2.01
109	Pfizer Ltd.	8	0.44	1.81
110	Piramal Enterprises Ltd.	35	0.41	1.17
111	Sanofi India Ltd.	14	0.14	0.94
112	Strides Shasun Ltd.	37	0.84	2.65
113	Sun Pharma Advanced Research Company Ltd.	39	0.98	2.31
114	Wockhardt Ltd.	43	1.29	3.15
115	3M India Ltd.	25	0.48	1.28
116	Adani Enterprises Ltd.	15	2.25	2.83
117	Blue Dart Express Ltd.	33	0.71	1.42
118	EIH Ltd.	9	0.76	1.29
119	Great Eastern Shipping Co. Ltd.	6	0.62	1.21
120	Gujarat Pipavav Port Ltd.	26	0.98	1.95
121	Indian Hotels Co. Ltd.	24	1.17	1.55
122	Jet Airways (India) Ltd.	9	2.23	3.13
123	Redington (India) Ltd.	13	0.72	1.51
124	Thomas Cook (India) Ltd.	41	1.27	1.71
125	Tata Communications Ltd.	31	1.12	1.55
126	Arvind Ltd.	41	1.87	2.21
127	Page Industries Ltd.	46	0.36	1.39
128	SRF Ltd.	83	1.42	2.08
129	Vardhman Textiles Ltd.	31	0.34	1.34

Table 2. Calculation of Excess Returns to Beta Ratio and Ranking the Scripts

S.No	Company	R_i	β_i	σ_{ei}^2	$R_i - R_f$	$R_i - R_f / \beta_i$	Rank
1	Amara Raja Batteries Ltd.	0.56	0.44	0.00835	0.55	1.2599	5
2	Apollo Tyres Ltd.	0.31	0.89	0.01429	0.30	0.3420	48
3	Balkrishna Industries Ltd.	0.54	0.83	0.01031	0.53	0.6438	17
4	Exide Industries Ltd.	0.01	0.84	0.00597	0.00	0.0052	127
5	MRF Ltd.	0.36	0.86	0.00752	0.35	0.4120	40
6	Tube Investments of India Ltd.	0.25	0.91	0.00708	0.24	0.2685	60
7	TVS Motor Company Ltd.	0.98	1.47	0.01384	0.97	0.6628	16
8	WABCO India Ltd.	0.35	0.96	0.00672	0.34	0.3587	43
9	Dalmia Bharat Ltd.	0.83	1.67	0.01848	0.82	0.4936	29
10	Prism Cement Ltd.	0.41	1.71	0.01014	0.40	0.2365	65
11	The Ramco Cements Ltd.	0.36	1.01	0.00738	0.35	0.3508	44
12	Century Textile & Industries Ltd.	0.31	1.85	0.00954	0.30	0.1645	82
13	BASF India Ltd.	0.18	0.95	0.00912	0.17	0.1835	76
14	Gujarat Fluorochemicals Ltd.	0.09	1.46	0.00994	0.08	0.0578	107
15	Tata Chemicals Ltd.	0.07	1.03	0.00273	0.06	0.0625	105
16	Engineers India Ltd.	0.11	1.65	0.01167	0.10	0.0632	104
17	GMR Infrastructure Ltd.	0.12	2.08	0.02145	0.11	0.0550	108
18	Godrej Properties Ltd.	0.03	0.99	0.00539	0.02	0.0246	119
19	IRB Infrastructure Developers Ltd.	0.34	2.11	0.01371	0.33	0.1585	83
20	Kajaria Ceramics Ltd.	0.54	1.14	0.00886	0.53	0.4687	32
21	Oberoi Realty Ltd.	0.06	1.15	0.00598	0.05	0.0473	111
22	Phoenix Mills Ltd.	0.11	1.11	0.00593	0.10	0.0940	92
23	Prestige Estates Projects Ltd.	0.18	1.75	0.00784	0.17	0.0996	89
24	Sadbhav Engineering Ltd.	0.37	1.79	0.01284	0.36	0.2035	72
25	Voltas Ltd.	0.42	1.91	0.00779	0.41	0.2169	67
26	Akzo Nobel India Ltd.	0.12	0.52	0.00462	0.11	0.2199	66
27	Bajaj Corp Ltd.	0.34	0.36	0.00772	0.33	0.9287	11
28	Bata India Ltd.	0.09	1.15	0.02243	0.08	0.0733	97
29	Berger Paints India Ltd.	0.39	0.65	0.00506	0.38	0.5913	18
30	Gillette India Ltd.	0.17	0.48	0.00525	0.16	0.3424	47
31	Godrej Industries Ltd.	0.16	1.17	0.00513	0.15	0.1319	85
32	Havells India Ltd.	0.52	0.99	0.00637	0.51	0.5195	25
33	Jubilant Foodworks Ltd.	0.11	1.11	0.00961	0.10	0.0940	92
34	Jyothy Laboratories Ltd.	0.22	0.46	0.01021	0.21	0.4660	33
35	Kansai Nerolac Paints Ltd.	0.32	0.62	0.00526	0.31	0.5070	27
36	Rajesh Exports Ltd.	0.44	0.45	0.02209	0.43	0.9652	9
37	RelaxoFootwears Ltd.	0.56	1.14	0.05053	0.55	0.4863	30
38	Tata Global Beverages Ltd.	0.01	1.38	0.00437	0.00	0.0031	128
39	Trent Ltd.	0.07	0.75	0.00652	0.06	0.0858	96
40	TTK Prestige Ltd.	0.01	0.53	0.00848	0.00	0.0082	125
41	Whirlpool of India Ltd.	0.41	1.17	0.00891	0.40	0.3456	46
42	Adani Power Ltd.	0.15	2.25	0.02101	0.14	0.0642	102

43	CESC Ltd.	0.21	1.35	0.00658	0.20	0.1514	84
44	Gujarat State Petronet Ltd.	0.15	0.56	0.00489	0.14	0.2578	64
45	Indraprastha Gas Ltd.	0.09	0.71	0.00694	0.08	0.1188	86
46	JSW Energy Ltd.	0.16	2.23	0.01036	0.15	0.0692	100
47	Mangalore Refinery & Petrochemicals Ltd.	0.12	1.29	0.00856	0.11	0.0886	94
48	Neyveli Lignite Corporation Ltd.	0.06	1.26	0.00495	0.05	0.0431	113
49	Petronet LNG Ltd.	0.14	0.51	0.00442	0.13	0.2634	62
50	Reliance Infrastructure Ltd.	0.18	2.51	0.00899	0.17	0.0695	99
51	SJVN Ltd.	0.11	0.35	0.00229	0.10	0.2981	55
52	Torrent Power Ltd.	0.18	0.81	0.02011	0.17	0.2152	70
53	Coromandel International Ltd.	0.02	0.71	0.00823	0.01	0.0202	122
54	Bajaj Holdings & Investment Ltd.	0.16	0.51	0.00288	0.15	0.3026	53
55	Canara Bank	0.01	2.04	0.00947	0.00	0.0021	129
56	Central Bank of India	0.05	2.06	0.00877	0.04	0.0215	120
57	Cholamandalam Investment and Finance Company Ltd.	0.36	1.17	0.00812	0.35	0.3029	52
58	City Union Bank Ltd.	0.28	0.92	0.00353	0.27	0.2982	54
59	CRISIL Ltd.	0.26	0.51	0.00482	0.25	0.4987	28
60	Dewan Housing Finance Corporation Ltd.	0.37	1.91	0.01049	0.36	0.1908	75
61	Edelweiss Financial Services Ltd.	0.25	1.42	0.00939	0.24	0.1721	80
62	Federal Bank Ltd.	0.26	1.26	0.00956	0.25	0.2019	73
63	Gruh Finance Ltd.	0.57	0.73	0.00598	0.56	0.7731	15
64	IDBI Bank Ltd.	0.02	2.01	0.00936	0.01	0.0071	126
65	IIFL Holdings Ltd.	0.33	1.83	0.00844	0.32	0.1772	78
66	Indian Bank	0.11	1.93	0.01378	0.10	0.0541	109
67	KarurVysya Bank Ltd.	0.06	0.91	0.00445	0.05	0.0597	106
68	L&T Finance Holdings Ltd.	0.02	0.34	0.00148	0.01	0.0422	114
69	Mahindra & Mahindra Financial Services Ltd.	0.11	0.22	0.00593	0.10	0.4743	31
70	Muthoot Finance Ltd.	0.34	0.96	0.01779	0.33	0.3483	45
71	Reliance Capital Ltd.	0.06	2.62	0.00981	0.05	0.0207	121
72	Shriram City Union Finance Ltd.	0.23	0.61	0.00497	0.22	0.3678	42
73	Sundaram Finance Ltd.	0.41	0.69	0.00571	0.40	0.5860	19
74	Syndicate Bank	0.11	2.35	0.00976	0.10	0.0444	112
75	Union Bank of India	0.04	2.11	0.01384	0.03	0.0163	124
76	Fortis Healthcare Ltd.	0.02	0.87	0.00837	0.01	0.0165	123
77	AIA Engineering Ltd.	0.36	0.81	0.00716	0.35	0.4375	37
78	BEML Ltd.	0.87	2.05	0.02207	0.86	0.4216	39
79	Fag Bearings India Ltd.	0.29	0.87	0.00471	0.28	0.3268	50
80	Honeywell Automation India Ltd.	0.31	1.09	0.00851	0.30	0.2792	56
81	Mahindra CIE Automotive Ltd.	0.31	1.11	0.02547	0.30	0.2742	58
82	SKF India Ltd.	0.23	0.85	0.00316	0.22	0.2639	61
83	Supreme Industries Ltd.	0.33	0.57	0.00461	0.32	0.5690	21
84	Suzlon Energy Ltd.	0.33	3.07	0.03016	0.32	0.1057	88
85	Thermax Ltd.	0.12	1.15	0.00372	0.11	0.0994	90
86	Cyient Ltd.	0.32	0.59	0.00601	0.31	0.5328	24

87	eClerx Services Ltd.	0.19	0.11	0.00783	0.18	1.6759	1
88	Hexaware Technologies Ltd.	0.28	0.61	0.01391	0.27	0.4497	36
89	Info Edge (India) Ltd.	0.25	0.89	0.00626	0.24	0.2745	57
90	MindTree Ltd.	0.43	0.34	0.00801	0.42	1.2481	6
91	Mphasis Ltd.	0.03	0.76	0.00711	0.02	0.0320	117
92	Persistent Systems Ltd.	0.34	0.72	0.00769	0.33	0.4644	34
93	Tata Elxsi Ltd.	0.63	1.15	0.01696	0.62	0.5429	22
94	Vakrangee Ltd.	0.75	0.48	0.02374	0.74	1.5507	3
95	D.B.Corp Ltd.	0.12	0.55	0.00314	0.11	0.2079	71
96	Dish TV India Ltd.	0.08	1.54	0.00823	0.07	0.0483	110
97	JagranPrakashan Ltd.	0.11	0.57	0.00306	0.10	0.1831	77
98	Network18 Media & Investments Ltd.	0.07	1.78	0.01581	0.06	0.0361	116
99	Sun TV Network Ltd.	0.09	1.31	0.00897	0.08	0.0644	101
100	TV18 Broadcast Ltd.	0.17	2.36	0.01451	0.16	0.0696	98
101	Hindustan Copper Ltd.	0.06	1.71	0.01703	0.05	0.0318	118
102	National Aluminium Co. Ltd.	0.12	1.21	0.00909	0.11	0.0945	91
103	Ajanta Pharmaceuticals Ltd.	1.12	1.27	0.01763	1.11	0.8774	13
104	Alembic Pharmaceuticals Ltd.	0.58	0.58	0.01205	0.57	0.9903	8
105	Biocon Ltd.	0.21	0.38	0.00672	0.20	0.5378	23
106	Ipca Laboratories Ltd.	0.14	0.11	0.00802	0.13	1.2213	7
107	Jubilant Life Sciences Ltd.	0.27	1.22	0.02368	0.26	0.2167	68
108	NATCO Pharma Ltd.	0.51	0.31	0.01631	0.50	1.6269	2
109	Pfizer Ltd.	0.08	0.44	0.01286	0.07	0.1690	81
110	Piramal Enterprises Ltd.	0.35	0.41	0.00521	0.34	0.8399	14
111	Sanofi India Ltd.	0.14	0.14	0.00359	0.13	0.9596	10
112	Strides Shasun Ltd.	0.37	0.84	0.02707	0.36	0.4337	38
113	Sun Pharma Advanced Research Company Ltd.	0.39	0.98	0.01956	0.38	0.3922	41
114	Wockhardt Ltd.	0.43	1.29	0.03651	0.42	0.3290	49
115	3M India Ltd.	0.25	0.48	0.00616	0.24	0.5091	26
116	Adani Enterprises Ltd.	0.15	2.25	0.02107	0.14	0.0642	102
117	Blue Dart Express Ltd.	0.33	0.71	0.00705	0.32	0.4568	35
118	EIH Ltd.	0.09	0.76	0.00544	0.08	0.1110	87
119	Great Eastern Shipping Co. Ltd.	0.06	0.62	0.00513	0.05	0.0877	95
120	Gujarat Pipavav Port Ltd.	0.26	0.98	0.01335	0.25	0.2595	63
121	Indian Hotels Co. Ltd.	0.24	1.17	0.00661	0.23	0.2003	74
122	Jet Airways (India) Ltd.	0.09	2.23	0.02851	0.08	0.0378	115
123	Redington (India) Ltd.	0.13	0.72	0.00801	0.12	0.1727	79
124	Thomas Cook (India) Ltd.	0.41	1.27	0.00811	0.40	0.3184	51
125	Tata Communications Ltd.	0.31	1.12	0.00692	0.30	0.2717	59
126	Arvind Ltd.	0.41	1.87	0.01175	0.40	0.2162	69
127	Page Industries Ltd.	0.46	0.36	0.00763	0.45	1.2621	4
128	SRF Ltd.	0.83	1.42	0.01295	0.82	0.5805	20
129	Vardhman Textiles Ltd.	0.31	0.34	0.00708	0.30	0.8951	12

Step 3. Calculation of Cut - off Rate

S.No	Company	$R_i - R_f / \beta_i$	$(R_i - R_f) * \beta_i / \sigma_{ei}^2$	$\Sigma(R_i - R_f) * \beta_i / \sigma_{ei}^2$	$\beta_i^2 / \sigma_{ei}^2$	$\Sigma \beta_i^2 / \sigma_{ei}^2$	C_i	Status
1	eClerx Services Ltd.	1.6759	2.5898	2.5898	1.5453	1.5453	0.0060	In
2	NATCO Pharma Ltd.	1.6269	9.5860	12.1758	5.8921	7.4374	0.0276	In
3	Vakrangee Ltd.	1.5507	15.0500	27.2257	9.7051	17.1426	0.0604	In
4	Page Industries Ltd.	1.2621	21.4370	48.6627	16.9856	34.1282	0.1041	In
5	Amara Raja Batteries Ltd.	1.2599	29.2110	77.8738	23.1856	57.3138	0.1587	In
6	MindTree Ltd.	1.2481	18.0122	95.8860	14.4320	71.7457	0.1899	In
7	Ipca Laboratories Ltd.	1.2213	1.8426	97.7286	1.5087	73.2545	0.1929	In
8	Alembic Pharmaceuticals Ltd.	0.9903	27.6449	125.3735	27.9170	101.1715	0.2346	In
9	Rajesh Exports Ltd.	0.9652	8.8482	134.2216	9.1670	110.3385	0.2469	In
10	Sanofi India Ltd.	0.9596	5.2391	139.4607	5.4596	115.7981	0.2540	In
11	Bajaj Corp Ltd.	0.9287	15.5913	155.0520	16.7876	132.5857	0.2740	In
12	Vardhman Textiles Ltd.	0.8951	14.6155	169.6675	16.3277	148.9134	0.2914	In
13	Ajanta Pharmaceuticals Ltd.	0.8774	80.2734	249.9408	91.4861	240.3995	0.3710	In
14	Piramal Enterprises Ltd.	0.8399	27.0982	277.0391	32.2649	272.6644	0.3924	In
15	Gruh Finance Ltd.	0.7731	68.8917	345.9308	89.1137	361.7781	0.4351	In
16	TVS Motor Company Ltd.	0.6628	103.4890	449.4198	156.1344	517.9125	0.4725	In
17	Balkrishna Industries Ltd.	0.6438	43.0172	492.4370	66.8186	584.7311	0.4837	In
18	Berger Paints India Ltd.	0.5913	49.3725	541.8095	83.4980	668.2291	0.4919	In
19	Sundaram Finance Ltd.	0.5860	48.8614	590.6709	83.3800	751.6091	0.4985	In
20	SRF Ltd.	0.5805	90.3916	681.0625	155.7066	907.3157	0.5080	In
21	Supreme Industries Ltd.	0.5690	40.1035	721.1660	70.4772	977.7929	0.5111	In
22	Tata Elxsi Ltd.	0.5429	42.3348	763.5008	77.9776	1055.7705	0.5127	In
23	Biocon Ltd.	0.5378	11.5553	775.0560	21.4881	1077.2586	0.5131	In
24	Cyient Ltd.	0.5328	30.8592	805.9153	57.9201	1135.1788	0.5138	In
25	Havells India Ltd.	0.5195	79.9376	885.8529	153.8619	1289.0406	0.5143	In
26	3M India Ltd.	0.5091	19.0399	904.8928	37.4026	1326.4432	0.5142	Out
27	Kansai Nerolac Paints Ltd.	0.5070	37.0522	941.9450	73.0798	1399.5231	0.5139	Out
28	CRISIL Ltd.	0.4987	26.9121	968.8571	53.9627	1453.4857	0.5135	Out
29	Dalmia Bharat Ltd.	0.4936	74.4945	1043.3515	150.9145	1604.4002	0.5120	Out
30	RelaxoFootwears Ltd.	0.4863	12.5065	1055.8581	25.7194	1630.1196	0.5117	Out
31	Mahindra & Mahindra Financial Services Ltd.	0.4743	3.8712	1059.7292	8.1619	1638.2815	0.5116	Out
32	Kajaria Ceramics Ltd.	0.4687	68.7533	1128.4825	146.6817	1784.9632	0.5087	Out
33	Jyothy Laboratories Ltd.	0.4660	9.6571	1138.1397	20.7248	1805.6880	0.5083	Out
34	Persistent Systems Ltd.	0.4644	31.3042	1169.4438	67.4122	1873.1002	0.5070	Out
35	Blue Dart Express Ltd.	0.4568	32.6646	1202.1084	71.5035	1944.6037	0.5055	Out
36	Hexaware Technologies Ltd.	0.4497	12.0310	1214.1394	26.7505	1971.3543	0.5049	Out
37	AIA Engineering Ltd.	0.4375	40.0866	1254.2260	91.6341	2062.9884	0.5024	Out
38	Strides Shasun Ltd.	0.4337	11.3059	1265.5319	26.0658	2089.0541	0.5017	Out
39	BEML Ltd.	0.4216	80.2859	1345.8178	190.4169	2279.4710	0.4961	Out
40	MRF Ltd.	0.4120	40.5236	1386.3414	98.3511	2377.8220	0.4932	Out

41	Sun Pharma Advanced Research Company Ltd.	0.3922	19.2566	1405.5980	49.1002	2426.9222	0.4914	Out
42	Shriram City Union Finance Ltd.	0.3678	27.5354	1433.1334	74.8692	2501.7915	0.4883	Out
43	WABCO India Ltd.	0.3587	49.1923	1482.3256	137.1429	2638.9343	0.4825	Out
44	The Ramco Cements Ltd.	0.3508	48.4945	1530.8201	138.2249	2777.1592	0.4768	Out
45	Muthoot Finance Ltd.	0.3483	18.0423	1548.8624	51.8044	2828.9636	0.4748	Out
46	Whirlpool of India Ltd.	0.3456	53.0959	1601.9583	153.6364	2982.6000	0.4690	Out
47	Gillette India Ltd.	0.3424	15.0259	1616.9842	43.8857	3026.4857	0.4674	Out
48	Apollo Tyres Ltd.	0.3420	18.9551	1635.9393	55.4304	3081.9161	0.4654	Out
49	Wockhardt Ltd.	0.3290	14.9933	1650.9326	45.5793	3127.4954	0.4636	Out
50	Fag Bearings India Ltd.	0.3268	52.5225	1703.4551	160.7006	3288.1960	0.4577	Out
51	Thomas Cook (India) Ltd.	0.3184	63.3193	1766.7744	198.8779	3487.0739	0.4507	Out
52	Cholamandalam Investment and Finance Company Ltd.	0.3029	51.0572	1817.8316	168.5837	3655.6577	0.4446	Out
53	Bajaj Holdings & Investment Ltd.	0.3026	27.3321	1845.1637	90.3125	3745.9702	0.4415	Out
54	City Union Bank Ltd.	0.2982	71.5009	1916.6646	239.7734	3985.7436	0.4337	Out
55	SJVN Ltd.	0.2981	15.9481	1932.6126	53.4934	4039.2370	0.4321	Out
56	Honeywell Automation India Ltd.	0.2792	38.9820	1971.5946	139.6122	4178.8492	0.4275	Out
57	Info Edge (India) Ltd.	0.2745	34.7393	2006.3339	126.5335	4305.3828	0.4234	Out
58	Mahindra CIE Automotive Ltd.	0.2742	13.2636	2019.5975	48.3746	4353.7573	0.4219	Out
59	Tata Communications Ltd.	0.2717	49.2583	2068.8558	181.2717	4535.0290	0.4164	Out
60	Tube Investments of India Ltd.	0.2685	31.4060	2100.2618	116.9633	4651.9923	0.4130	Out
61	SKF India Ltd.	0.2639	60.3462	2160.6080	228.6392	4880.6315	0.4066	Out
62	Petronet LNG Ltd.	0.2634	15.5014	2176.1095	58.8462	4939.4777	0.4050	Out
63	Gujarat Pipavav Port Ltd.	0.2595	18.6711	2194.7806	71.9401	5011.4177	0.4031	Out
64	Gujarat State Petronet Ltd.	0.2578	16.5304	2211.3110	64.1309	5075.5486	0.4014	Out
65	Prism Cement Ltd.	0.2365	68.1885	2279.4995	288.3728	5363.9214	0.3932	Out
66	Akzo Nobel India Ltd.	0.2199	12.8701	2292.3696	58.5281	5422.4495	0.3915	Out
67	Voltas Ltd.	0.2169	101.5919	2393.9614	468.3055	5890.7551	0.3785	Out
68	Jubilant Life Sciences Ltd.	0.2167	13.6192	2407.5806	62.8547	5953.6098	0.3770	Out
69	Arvind Ltd.	0.2162	64.3512	2471.9318	297.6085	6251.2183	0.3698	Out
70	Torrent Power Ltd.	0.2152	7.0224	2478.9542	32.6256	6283.8439	0.3691	Out
71	D.B.Corp Ltd.	0.2079	20.0287	2498.9829	96.3376	6380.1814	0.3668	Out
72	Sadbhav Engineering Ltd.	0.2035	50.7928	2549.7757	249.5405	6629.7219	0.3610	Out
73	Federal Bank Ltd.	0.2019	33.5226	2583.2982	166.0669	6795.7889	0.3573	Out
74	Indian Hotels Co. Ltd.	0.2003	41.4803	2624.7785	207.0953	7002.8842	0.3530	Out
75	Dewan Housing Finance Corporation Ltd.	0.1908	66.3394	2691.1180	347.7693	7350.6535	0.3457	Out
76	BASF India Ltd.	0.1835	18.1610	2709.2790	98.9583	7449.6118	0.3437	Out
77	JagranPrakashan Ltd.	0.1831	19.4370	2728.7160	106.1765	7555.7883	0.3416	Out
78	IIFL Holdings Ltd.	0.1772	70.3262	2799.0421	396.7891	7952.5774	0.3338	Out
79	Redington (India) Ltd.	0.1727	11.1772	2810.2193	64.7191	8017.2965	0.3325	Out
80	Edelweiss Financial Services Ltd.	0.1721	36.9511	2847.1704	214.7391	8232.0356	0.3286	Out
81	Pfizer Ltd.	0.1690	2.5437	2849.7141	15.0544	8247.0900	0.3283	Out
82	Century Textile & Industries Ltd.	0.1645	59.0189	2908.7330	358.7526	8605.8426	0.3218	Out

83	IRB Infrastructure Developers Ltd.	0.1585	51.4566	2960.1896	324.7338	8930.5764	0.3161	Out
84	CESC Ltd.	0.1514	41.9251	3002.1146	276.9757	9207.5521	0.3114	Out
85	Godrej Industries Ltd.	0.1319	35.2017	3037.3163	266.8421	9474.3942	0.3066	Out
86	Indraprastha Gas Ltd.	0.1188	8.6290	3045.9454	72.6369	9547.0311	0.3052	Out
87	EIH Ltd.	0.1110	11.7836	3057.7290	106.1765	9653.2076	0.3032	Out
88	Suzlon Energy Ltd.	0.1057	33.0153	3090.7443	312.4967	9965.7042	0.2972	Out
89	Prestige Estates Projects Ltd.	0.0996	38.9165	3129.6608	390.6250	10356.3292	0.2901	Out
90	Thermax Ltd.	0.0994	35.3489	3165.0096	355.5108	10711.8400	0.2840	Out
91	National Aluminium Co. Ltd.	0.0945	15.2210	3180.2306	161.0671	10872.9071	0.2813	Out
92	Phoenix Mills Ltd.	0.0940	19.5319	3199.7624	207.7740	11080.6811	0.2779	Out
93	Jubilant Foodworks Ltd.	0.0940	12.0524	3211.8149	128.2102	11208.8913	0.2759	Out
94	Mangalore Refinery & Petrochemicals Ltd.	0.0886	17.2320	3229.0469	194.4042	11403.2955	0.2728	Out
95	Great Eastern Shipping Co. Ltd.	0.0877	6.5681	3235.6150	74.9318	11478.2273	0.2716	Out
96	Trent Ltd.	0.0858	7.4017	3243.0167	86.2730	11564.5003	0.2703	Out
97	Bata India Ltd.	0.0733	4.3245	3247.3412	58.9612	11623.4615	0.2693	Out
98	TV18 Broadcast Ltd.	0.0696	26.7303	3274.0715	383.8456	12007.3072	0.2632	Out
99	Reliance Infrastructure Ltd.	0.0695	48.6772	3322.7487	700.7898	12708.0969	0.2528	Out
100	JSW Energy Ltd.	0.0692	33.2231	3355.9718	480.0097	13188.1066	0.2464	Out
101	Sun TV Network Ltd.	0.0644	12.3181	3368.2899	191.3155	13379.4221	0.2439	Out
102	Adani Power Ltd.	0.0642	15.4583	3383.7481	240.9567	13620.3788	0.2408	Out
103	Adani Enterprises Ltd.	0.0642	15.4142	3399.1624	240.2705	13860.6493	0.2378	Out
104	Engineers India Ltd.	0.0632	14.7533	3413.9156	233.2905	14093.9398	0.2350	Out
105	Tata Chemicals Ltd.	0.0625	24.2770	3438.1926	388.6081	14482.5478	0.2305	Out
106	KarurVysya Bank Ltd.	0.0597	11.1134	3449.3061	186.0899	14668.6377	0.2284	Out
107	Gujarat Fluorochemicals Ltd.	0.0578	12.3888	3461.6949	214.4467	14883.0844	0.2260	Out
108	GMR Infrastructure Ltd.	0.0550	11.0881	3472.7830	201.6970	15084.7814	0.2238	Out
109	Indian Bank	0.0541	14.6145	3487.3975	270.3120	15355.0934	0.2209	Out
110	Dish TV India Ltd.	0.0483	13.9116	3501.3091	288.1652	15643.2587	0.2178	Out
111	Oberoi Realty Ltd.	0.0473	10.4511	3511.7602	221.1538	15864.4125	0.2155	Out
112	Syndicate Bank	0.0444	25.1243	3536.8845	565.8299	16430.2424	0.2097	Out
113	Neyveli Lignite Corporation Ltd.	0.0431	13.8335	3550.7179	320.7273	16750.9697	0.2066	Out
114	L&T Finance Holdings Ltd.	0.0422	3.2957	3554.0136	78.1081	16829.0778	0.2059	Out
115	Jet Airways (India) Ltd.	0.0378	6.5974	3560.6110	174.4265	17003.5043	0.2042	Out
116	Network18 Media & Investments Ltd.	0.0361	7.2445	3567.8555	200.4048	17203.9091	0.2023	Out
117	Mphasis Ltd.	0.0320	2.6024	3570.4579	81.2377	17285.1468	0.2015	Out
118	Hindustan Copper Ltd.	0.0318	5.4569	3575.9148	171.7029	17456.8497	0.1999	Out
119	Godrej Properties Ltd.	0.0246	4.4717	3580.3865	181.8367	17638.6864	0.1981	Out
120	Central Bank of India	0.0215	10.4165	3590.8030	483.8769	18122.5633	0.1935	Out
121	Reliance Capital Ltd.	0.0207	14.5144	3605.3173	699.7350	18822.2983	0.1872	Out
122	Coromandel International Ltd.	0.0202	1.2376	3606.5550	61.2515	18883.5498	0.1867	Out
123	Fortis Healthcare Ltd.	0.0165	1.4911	3608.0461	90.4301	18973.9799	0.1859	Out
124	Union Bank of India	0.0163	5.2363	3613.2824	321.6835	19295.6634	0.1831	Out

125	TTK Prestige Ltd.	0.0082	0.2716	3613.5540	33.1250	19328.7884	0.1829	Out
126	IDBI Bank Ltd.	0.0071	3.0807	3616.6346	431.6346	19760.4230	0.1791	Out
127	Exide Industries Ltd.	0.0052	0.6115	3617.2461	118.1910	19878.6140	0.1781	Out
128	Tata Global Beverages Ltd.	0.0031	1.3724	3618.6185	435.7895	20314.4035	0.1744	Out
129	Canara Bank	0.0021	0.9362	3619.5547	439.4509	20753.8544	0.1708	Out

Table 4. Construction of an Optimal Portfolio

Company	β_i	σ_{ei}^2	$R_i - R_f / \beta_i$	$\beta_i^2 / \sigma_{ei}^2$	Z_i	$X_i = Z_i / \sum Z_i$
eClerx Services Ltd.	0.11	0.00783	1.6759	1.5453	1.7950	0.81
NATCO Pharma Ltd.	0.31	0.01631	1.6269	5.8921	6.5554	2.94
Vakrangee Ltd.	0.48	0.02374	1.5507	9.7051	10.0582	4.51
Page Industries Ltd.	0.36	0.00763	1.2621	16.9856	12.7007	5.70
Amara Raja Batteries Ltd.	0.44	0.00835	1.2599	23.1856	17.2858	7.76
MindTree Ltd.	0.34	0.00801	1.2481	14.4320	10.5893	4.75
Ipca Laboratories Ltd.	0.11	0.00802	1.2213	1.5087	1.0667	0.48
Alembic Pharmaceuticals Ltd.	0.58	0.01205	0.9903	27.9170	13.2861	5.96
Rajesh Exports Ltd.	0.45	0.02209	0.9652	9.1670	4.1332	1.85
Sanofi India Ltd.	0.14	0.00359	0.9596	5.4596	2.4310	1.09
Bajaj Corp Ltd.	0.36	0.00772	0.9287	16.7876	6.9568	3.12
Vardhman Textiles Ltd.	0.34	0.00708	0.8951	16.3277	6.2175	2.79
Ajanta Pharmaceuticals Ltd.	1.27	0.01763	0.8774	91.4861	33.2186	14.91
Piramal Enterprises Ltd.	0.41	0.00521	0.8399	32.2649	10.5032	4.71
Gruh Finance Ltd.	0.73	0.00598	0.7731	89.1137	23.0571	10.35
TVS Motor Company Ltd.	1.47	0.01384	0.6628	156.1344	23.1832	10.40
Balkrishna Industries Ltd.	0.83	0.01031	0.6438	66.8186	8.6498	3.88
Berger Paints India Ltd.	0.65	0.00506	0.5913	83.4980	6.4263	2.88
Sundaram Finance Ltd.	0.69	0.00571	0.5860	83.3800	5.9759	2.68
SRF Ltd.	1.42	0.01295	0.5805	155.7066	10.3058	4.62
Supreme Industries Ltd.	0.57	0.00461	0.5690	70.4772	3.8544	1.73
Tata Elxsi Ltd.	1.15	0.01696	0.5429	77.9776	2.2279	1.00
Biocon Ltd.	0.38	0.00672	0.5378	21.4881	0.5031	0.23
Cyient Ltd.	0.59	0.00601	0.5328	57.9201	1.0687	0.48
Havells India Ltd.	0.99	0.00637	0.5195	153.8619	0.8006	0.36

The maximum fund investment should be done in Ajanta Pharmaceuticals Ltd. (14.91%) followed by TVS Motor Company Ltd. (10.40%) and Gruh Finance Ltd. (10.35%); while Biocon Ltd. (0.23%) gets the smallest percentage of fund allocation. Ajanta Pharmaceuticals Ltd. (14.91%) got the highest fund allocation, as it has a beta value of 1.27 and higher mean returns (112%) are posted by this scrip. Considering the beta value, Ajanta Pharmaceuticals Ltd. is more volatile than the market.

Conclusion and Implications

Volatility plays a key role in investment decisions. Our main aim for this study was the construction of an optimal portfolio using a single index model of Nifty midcap 150 scrips. Out of 150 scrips, 11 scrips' data was not available for the study ; eight scrips posted negative returns, and two scrips posted negative beta. After elimination of these scrips, we calculated excess returns to beta ratio and cut off rate by considering 129 scrips. Out of 129 stocks, we constructed an optimal portfolio with 25 stocks. Sharpe single index model for constructing an optimal portfolio is very easy and simple, though different market indices are available for investors to choose the right portfolio. Construction of an optimal portfolio is a road map for a portfolio manager, financial institutions, corporate bodies, and investors for taking the right investment decisions.

The study believes that a fundamental analysis of individual securities included in the portfolio would, to a great extent, improve the performance of a well-diversified portfolio. Global trends have a greater effect on securities. Investors should keep this in mind before choosing the effective securities, and a final decision should be made only after determining all the factors affecting the securities. To conclude, an optimal portfolio has stocks that have significant higher returns than the Midcap index.

Limitations of the Study and Scope for Future Research

The study is based on secondary data. The study is limited only to Nifty Midcap 150 scrips belonging to NSE. For the study purpose, only a limited time period is considered, that is, from July 2011 to June 2016. The analysis was conducted using monthly adjusted closing prices and an optimal portfolio was constructed using only Sharpe's single index model.

Portfolio construction can be done on different indices and by utilizing a larger sample size. Different time intervals can be taken into account while constructing a portfolio. Optimal portfolio construction can be done on the basis of daily or weekly historical returns and a comparative study of optimal portfolio can be conducted with the help of different time horizons. All these points can be considered by researchers in future studies.

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