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An empirical study on construction portfolio with reference to BSE

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Abstract

The main thrust of this study is to construct optimal portfolio using Sharpe single index model with reference to BSE Sensex. Portfolio construction is an important process for the investors/ portfolio managers in the capital markets. In this paper we made an attempt to apply Sharpe single index model to BSE Sensex 30 stocks. In order to construct the portfolio of BSE Sensex 30 stocks with 5 years data i.e from June 2016 to July 2021 have be considered. The proposed method formulates a unique cut-off rate and selects those securities to construct optimal portfolio and whose excess return to beta ratio is higher than the cut-off rate. Study found that nine stocks included in optimal portfolio and highest weightage of funds allocated in Dreddys Labs. It is concluded that the pre and post Covid-19 period Pharmaceutical and Financial services companies posted reasonable returns and highest risk in the study period.

Keywords: Optimal portfolio, BSE Sensex, cut-off rate, securities, beta

Introduction

It is difficult task of selecting appropriate stocks for portfolio construction (Poornima, S., & Remesh, A. P. 2019) ^[13]. A rational investor always seeks to maximize the returns with limited risk levels (Rout, B., & Panda, J. 2019) ^[16]. Investing the entire money with single stock is very risky and exposed to higher level of losses. Construction optimal portfolio always minimizes the risk of the investment (Naveen 2014) ^[12]. This is done through the construction optimal portfolio with wide range of assets in the capital markets. Present study 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 BSE Sensex 30 blue chip stocks (Raja M. *et al.* 2018) ^[15]. Many economist proposed various theories to create portfolio and the popular theories among them are Markowitz and Sharpe models (Nandan, T., & Srivastava, N. 2017) ^[11].

The rational of the study is to apply theoretical framework of portfolio management on practical scenario and form a well-diversified optimal portfolio with BSE Sensex 30 stocks (Subashree, M. S., & Bhoopa, D. M. (2017) ^[19]. Markowitz model is created optimal portfolio using efficient frontier by rational investors (Markowitz 1952). According to (Sharpe 1964) single index model, all stocks are affected by movements in the capital markets and the securities which give excess return to beta values are eligible to form a portfolio with lower level of risk (Hertina, D., Hidayat, M. B. H., & Saudi, M. H. 2021) ^[8]. Finally, calculate the unique cut-off rate of the stocks and which need to be including in optimal portfolio. In this paper we made an attempt to construct optimal portfolio using Sharpe single index model with BSE Sensex 30 stocks.

Review of Literature

Gulliksson, M., & Mazur, S. (2020) ^[7] studied portfolio construction with a single covariance matrix. Study explored convergence properties gives a solution as better than the solutions that are based on constrained least norm Moore–Penrose, Lasso, and naive equal-weighted approaches. It confirms that the optimal portfolio weights that are obtained by DFPM and Moore–Penrose inverse methods can be modelled by white noise process.

Basha, S. M., & Ramaratnam, M. S. (2017) ^[3] analyzed nifty midcap 150 stocks for optimal portfolio construction from 2011 to 2016. Sharpe single index model applied to find out

excess return to beta and calculation of cut-off point. Study confirms that the 150 stocks of midcap only 25 scripts covered in final portfolio. It's found that pharma stocks weightage will be more than the other sectors stocks.

Basanna, P., & Konnur, N. P. (2019) ^[2] Study undertaken to construct optimal portfolio using Sharpe single index with Nifty 50 index. For construction portfolio daily closing prices took from the period of four year i.e., 2014 to 2019. It is found that stocks selected for optimal portfolio is consumer non-durables (3 stocks), consumer durables (1 stock), and finance (3 stocks) and agree based sectors (1 stock).

Angelidis, T., & Tessaromatis, N. (2017) ^[1] studied global factor allocation strategy using capital market index and portfolio construction methods to meet the robust estimation of error. It is found that exchange-traded funds or index futures, a portfolio based on country indexes with favorable factor exposures significantly outperforms, both economically and statistically, the world market capitalization portfolio. The outperformance remains significant after taking into account transaction costs, alternative portfolio construction methods and tracking error mistakes.

Senthilkumar, A., Namboothiri, A., & Rajeev (2021) analyzed Sharpe single index model with Elton's portfolio optimization framework and Markowitz portfolio theory framework for optimal portfolio intra and inter-sectorial stocks. Studied 11 sector-specific stocks and one inter-sector optimal portfolio using the NSE sectorial indices and it includes automobiles, banking, financial services, FMCG, IT, media, metals, pharmaceuticals, private banks, PSU banks, realty, and broad-market inter-sector index Nifty50. It is found that inter-sector portfolio performs better than some of the intra-sector portfolios and also the intra-sector portfolios like realty, metals, information technology, and media generated higher returns with relatively moderate or less risk than their sectorial peers and benchmark indices. Study concluded that Sharpe's single index model is better than Markowitz model.

Need For the Study

Every investor gets confusion about selection of right stocks in stock market. Construction of portfolio investor get confusion like where to invest, how much to invest and proportion of investment. Financial literacy and lack of awareness is a gap for investing in capital markets. In order to meet the investor requirement Sharpe single index model is useful strategy to meet these requirements.

Objectives of the study

- To find the risk and returns of individual securities in BSE Sensex 30
- To find the optimal portfolio using single index model
- To determine proportion of investment in optimal portfolio

Research Methodology

The study on portfolio construction is empirical in nature and secondary data collected from BSE website. The data is collected from June 2016 to July 2021. The sample size is limited to 30 stocks of BSE and Risk free rate considered 7.1% (Treasury bill).

Theoretical Framework

Sharpe has provided a model for the selection of appropriate securities in optimal portfolio. Instead of co-relating each security with an index of all securities included in the analysis, Co-relate each security with the efficient market value weighted portfolio of all risky assets in the universe. Following steps involved in the process of construction of portfolio.

The steps for finding out the stocks to be included in the optimal portfolio are given below.

- (i) Find out the "Excess return 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 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 i.e. stocks unsystematic risk.

- (iii) Compute the cut-off point, which the highest value, of C_i and is taken C^* . The stock whose excess return to risk ratio is above the cut-off ratio are selected and all whose ratios are below are rejected. The main reason for this selection is that since securities are ranked from highest excess return to beta to lowest, and if particular security belongs to optimal portfolio all highest ranked securities belongs to optimal portfolio.
- (iv) Once we came 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 each stock and total comes to 1 to ensure that all funds are invested and second portion determines the relative investment in each security.

Data Analysis and Interpretation**Step: 1 Mean return, Beta and Standard deviation****Table 1:** Mean return, Beta and Standard deviation

S. No	Company	Ri	β_i	SD (σ)
1	Asian Paint	39	1.34	1.46
2	Axis Bank	31	1.48	1.99
3	Bajaj Auto	51	1.83	1.71
4	Bajaj Finsv	32	1.84	1.37
5	Bajaj Finance	36	1.86	1.59
6	Bharati Airtel	25	1.91	1.48
7	Drreddy	54	1.47	2.35
8	HCLTECH	35	2.78	1.47
9	HDFC	33	1.67	2.47
10	HDFC Bank	41	1.71	2.03
11	Hindunilvr	36	1.01	1.54
12	ICICI Bank	31	1.85	2.08
13	Indusind Bank	67	1.95	1.65
14	Infosys	33	1.46	1.91
15	ITC	19	1.03	1.12
16	Kotak Bank	22	1.65	2.11
17	L&T	12	2.08	2.08
18	M&M	29	1.99	1.37
19	Maruti	34	2.11	2.43
20	NestleInd	54	1.14	1.71
21	NTPC	33	1.15	1.49
22	Powergrid	19	1.11	1.47
23	Reliance	18	1.75	1.91
24	SBIN	37	1.79	2.23
25	Sunpharma	42	1.91	2.01
26	Tata Steel	12	1.52	1.13
27	TCS	34	2.36	1.41
28	Techmahendra	22	1.15	2.51
29	Titan	39	1.65	1.21
30	Ultracement	21	1.48	1.19

Source: Computed data

Table 1 shows calculation of mean, beta and standard deviation. Indusind Bank posted highest returns followed by Drreddys labs and Bajaj auto. HCL Technology posted beta with highest (2.67%) followed by TCS and Maruti auto. These stocks are more volatile than the other selected

stocks. Techmahendra posted highest standard deviation (2.51%) followed by Drreddys lab and State Bank of India.

Step 2: Calculation of Excess Return to Beta Ratio and Raking the Scripts**Table 2:** Calculation of Excess Return to Beta Ratio and Raking the Scripts

S. No	Company	Ri	β_i	σ_{ei2}	Ri-Rf	$\frac{Ri-Rf}{\beta_i}$	Rank
1	Asian Paint	39	1.34	0.00148	38.99	29.1003	7
2	Axis Bank	31	1.48	0.00229	30.99	20.9421	13
3	Bajaj Auto	53	1.83	0.00273	53.99	29.5051	6
4	Bajaj Finsv	32	1.84	0.00288	31.99	17.3882	18
5	Bajaj Finance	36	1.86	0.00306	35.99	19.3518	15
6	Bharati Airtel	25	1.91	0.00314	24.99	13.0860	26
7	Drreddy	54	1.47	0.00316	97.99	66.6628	1
8	HCLTECH	35	2.78	0.00353	34.99	12.5879	27
9	HDFC	83	1.67	0.00359	82.99	49.6972	2
10	HDFC Bank	41	1.71	0.00372	40.99	23.9733	9
11	Hindunilvr	36	1.01	0.00437	35.99	35.6380	4
12	ICICI Bank	31	1.85	0.00442	30.99	16.7537	20
13	Indusind Bank	67	1.95	0.00445	66.99	34.3561	5
14	Infosys	33	1.46	0.00461	32.99	22.5989	11
15	ITC	19	1.03	0.00462	18.99	18.4411	17
16	Kotak Bank	22	1.65	0.00471	21.99	13.3299	25
17	L&T	12	2.08	0.00482	11.99	5.7665	30
18	M&M	29	1.99	0.00489	28.99	14.5700	22
19	Maruti	34	2.11	0.00495	33.99	16.1111	21
20	NestleInd	54	1.14	0.00497	53.99	47.3635	3
21	NTPC	33	1.15	0.00506	32.99	28.6907	8

22	Powergrid	19	1.11	0.00513	18.99	17.1120	19
23	Reliance	18	1.75	0.00513	17.99	10.2825	28
24	SBIN	37	1.79	0.00521	36.99	20.6672	14
25	Sunpharma	42	1.91	0.00525	41.99	21.9866	12
26	Tata Steel	12	1.52	0.00526	11.99	7.8910	29
27	TCS	34	2.36	0.00539	33.99	14.4044	23
28	Techmahendra	22	1.15	0.00544	21.99	19.1255	16
29	Titan	39	1.65	0.00571	38.99	23.6329	10
30	Ultracement	21	1.48	0.00593	20.99	14.1854	24

Source: Computed data

Table 2 depicts, Calculation of excess return to beta ratio and rankings. Excess return is difference between risk free asset return and mean return. Drreddy laboratories (66.66) has posted highest excess return to beta ratio, followed by HDFC Ltd.(49.69) and Nestle Ltd. (47.36). Since scripts are ranked from highest to lowest excess return to beta ratio, we

know that all high ranked scripts belong to optimal portfolio. Investor can reduce the risk through diversification. Ultracement, posted highest (0.00593) as unsystematic risk.

Step 3: Calculation of Cut of rate

Table 3: Calculation of Cut of rate

S. No	Company	$(R_i - R_f) * \beta_i / \sigma_{e_i}^2$	$\Sigma(R_i - R_f) * \beta_i / \sigma_{e_i}^2$	$\Sigma \beta_i^2 / \sigma_{e_i}^2$	C_i	Status
1	Asian Paint	2.5898	2.5898	1.5453	0.0060	In
2	Axis Bank	9.5860	12.1758	7.4374	0.0276	In
3	Bajaj Auto	15.0500	27.2257	17.1426	0.0604	In
4	SBIN	21.4370	48.6627	34.1282	0.1041	In
5	Reliance	29.2110	77.8738	57.3138	0.1587	In
6	Bharati Airtel	18.0122	95.8860	71.7457	0.1899	In
7	Drreddy	1.8426	97.7286	73.2545	0.1929	In
8	Techmahendra	27.6449	125.3735	101.1715	0.2346	In
9	HDFC	8.8482	134.2216	110.3385	0.2469	In
10	HDFC Bank	5.2391	139.4607	115.7981	0.2540	Out
11	Hindunilvr	15.5913	155.0520	132.5857	0.2740	Out
12	ICICI Bank	14.6155	169.6675	148.9134	0.2914	Out
13	Indusind Bank	80.2734	249.9408	240.3995	0.3710	Out
14	Infosys	27.0982	277.0391	272.6644	0.3924	Out
15	ITC	68.8917	345.9308	361.7781	0.4351	Out
16	Kotak Bank	103.4890	449.4198	517.9125	0.4725	Out
17	L&T	43.0172	492.4370	584.7311	0.4837	Out
18	M&M	49.3725	541.8095	668.2291	0.4919	Out
19	Maruti	48.8614	590.6709	751.6091	0.4985	Out
20	NestleInd	90.3916	681.0625	907.3157	0.5080	Out
21	NTPC	40.1035	721.1660	977.7929	0.5111	Out
22	Powergrid	42.3348	763.5008	1055.7705	0.5127	Out
23	Bajaj Finsv	11.5553	775.0560	1077.2586	0.5131	Out
24	Bajaj Finsv	30.8592	805.9153	1135.1788	0.5138	Out
25	Sunpharma	79.9376	885.8529	1289.0406	0.5143	Out
26	Tata Steel	19.0399	904.8928	1326.4432	0.5142	Out
27	TCS	37.0522	941.9450	1399.5231	0.5139	Out
28	HCLTECH	26.9121	968.8571	1453.4857	0.5135	Out
29	Titan	74.4945	1043.3515	1604.4002	0.5120	Out
30	Ultracement	12.5065	1055.8581	1630.1196	0.5117	Out

Source: Computed data

Table 3 shows Calculation of Cut of rate C^* , All scripts whose excess return to beta ratio is above the cut off rate are selected and whose excess return to beta ratio are below are rejected. Cut off rate will decide which scripts are kept "In" the optimal portfolio and which scripts are "Out", illustrated in the "Status". Used Market variance (0.002308024) for calculation of C^* . Inference from table 3, highest value C_i has taken as the cut off rate C^* . Cut off rate is $C^* = 0.2469$.

HDFC Ltd. Recorded the C^* , there are 9 scripts are recorded with more excess return to beta ratio than the cut off rate. These nine stocks are eligible to construction optimal portfolio according to their excess return to beta ratio.

Step 4: Construction of Optimal Portfolio

Table 4: Construction of Optimal Portfolio

Company	β_i	$\sigma_{e_i}^2$	$R_i - R_f / \beta_i$	$\beta_i^2 / \sigma_{e_i}^2$	Z_i	$X_i = Z_i / \Sigma Z_i$
Asian Paint	1.34	0.99383	0.1104	2.8062	19.9000	13.9000
Axis Bank	1.48	0.01631	0.2949	179.2826	6.1935	11.3400
Bajaj Auto	1.83	0.02374	0.7370	42.9697	20.4786	11.5600

SBIN	1.79	0.00763	0.2456	448.5583	13.4300	9.0200
Reliance	1.75	0.00835	0.2843	455.3892	10.8779	8.1300
Bharati Airtel	1.91	0.00801	0.2906	266.1174	8.0514	11.4000
Drreddy	1.47	0.00802	0.1304	132.2818	12.3400	29.2100
Techmahendra	1.15	0.01205	0.3481	225.9336	19.8134	3.4500
HDFC	1.67	0.02209	0.2088	195.8533	23.4500	1.9900

Source: Computed Data

Table 4 shows the proportion of funds investment in each script. The maximum fund investment should be done in Drreddys Lab. (29.21%) followed by Asian Paint Ltd. (13.90%) and Bajaj Auto Ltd. (11.56%). However, HDFC Ltd. (1.99%) got least allocation funds in optimal portfolio. Considering Drreddys Lab. got highest fund allocation, which is holding beta reasonable beta value and higher mean return generated stock in this optimal portfolio. After having this results Investor, Portfolio manager and financial institution make a note on before investing.

Conclusion

Risk and return two parameters plays very important role in investment decision. This study aims at analyzing the opportunity that are available for investors as per as returns and risk are concerned while investing in selected stocks of firms listed in the BSE Sensex 30. Out of 30 stocks of BSE only nine stocks included optimal portfolio. The present results are similar to (Nandan, T., & Srivastava, N. 2017 ^[11] and Basanna, P., & Konnur, N. P. 2019) ^[2]. Construction optimal portfolio is a road map for portfolio manager, financial institutions and corporate bodies and investor for taking right investment decisions. Study believes a fundamental analysis of individual securities included in the portfolio would to a great extent to improve the higher performance of well-diversified portfolio. Investors should take appropriate advices and suggestions from experts from the capital markets to evaluate the stocks periodically. Study found that nine stocks included in optimal portfolio and highest weightage of funds allocated in Drreddys Labs and concluded that the pre and post covid-19 period Pharmaceutical and financial services companies posted reasonable returns and highest risk in the study period.

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