A STUDY ON CONSTRUCTION OF DIVERSE PORTFOLIO USING SHARPE'S INDEX MODEL

Nikita Varma[1], Nisarg Shah[2]

[1]Student, B.V. Patel Institute of Management, Uka Tarsadia University, Mahuva, Bardoli, Gujarat, India

[2]Assistant Professorr, B.V. Patel Institute of Management, Uka Tarsadia University, Mahuva, Bardoli, Gujarat, India

Abstract

The study focus on construction of optimal portfolio using Sharpe's index model. In this research NIFTY 50 is considered as market index and all 50 companies were selected from NIFTY 50 for analytical purpose. The monthly data for all the stocks for the period of January 2017 to December 2018 have been considered. Calculating the cut-off values using all the collected data. On the basis of the cut-off values to know which securities are performing highly well and which are performing low in the market. The study findings are useful to policy makers, investors and participants of financial markets.

Keywords: Portfolio, Sharpe's index, Risk and Return.

1. Introduction

The employment of funds on assets with an aim to earn return and capital appreciation is called investment. There is risk and return involved with every investment. The security analysis and portfolio management is the most concerned aspect for rational investment and decision making. A portfolio is a set of securities such as stocks, bonds and money market instruments. The process of blending together these assets classes, so as to obtain maximum return with minimum risk is called portfolio construction. It is a very difficult task to find out good investments among various types of investments. In an optimal portfolio every investor need maximum return with a minimum return. This process is done through the construction of an optimal portfolio (Ms.S.SUBASHREE, Dr.M.BHOOPAL, 2017). In this project, it is attempt to test the Sharpe's index model in India securities market. In this research this topic has taken to study the construction of optimal portfolio using Sharpe's index model.

Sharpe's Index Model:

The Sharpe ratio or Sharpe index or Sharpe measure or reward-to-variability ratio is a measure of the excess return (or Risk Premium) per unit of risk in an investment asset or a trading strategy, named after William Forsyth Sharpe. The Sharpe Index is a measure with which you may measure the performance of your portfolio over a given period of time. The important aspect of the Sharpe Index is that this performance indicator takes into consideration the risk of the portfolio. The Markowitz Model was theoretically elegant and conceptually sounds in analyzing the risk and returns of portfolio. However, its serious limitation was that it related each security to every other security in the portfolio. Another problem is that a number of co-variances have to be estimated. $(N2-N)/2$ correlation coefficients are needed to be calculated every time. So, the need for sophistication arises, which reduces the volume of work. Then, William F. Sharpe published a simplified model to analyses the portfolio. This model needs $(3N+2)$ bits of information in compilation to $(N [N+3]/2)$ bits of information in Markowitz analysis.

Assumptions:

Sharpe has assumed that the return of security is linearly related to a single index like the market index. Theoretically, the market index should consist of all the securities trading on exchange. However, a popular average can be treated as a surrogate for the market index. In the study it is "Nifty50". Means any movement in security can be judge by the movement in index.

Formula of Sharpe model:

○ Step:-1

      Expected Return = $R_i - R_f / \beta_i$

○ Step:-2

      Arrange the securities in Descending Order.

○ Step:-3

$$C_i = \frac{\sigma^2 m i \sum_{i=1}^{i} \frac{(R_i - R_f) * \beta_i}{\sigma^2 ei}}{1 + \sigma m^2 \sum_{i=1}^{i} \frac{\beta_i^2}{\sigma^2 ei}}$$

- Step:- 4

Construction of optimal portfolio.

$$X_i = \frac{Z_i}{\sum Z_i}$$

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

2. Literature review

The article was written by **Dr. J. Murthy** in the year **2018**. The title of article is Construction of optimal portfolio using shape's single index model an empirical study on Nifty metal Index. The purpose of the study is to construct optimum portfolio using shape's single index model selected from metal stocks. Secondary data is used for the study and has been collected from website of www.nseindia.com. The sample size of the study is limited to14 metal stocks and monthly opening, closing stock prices. This is descriptive in nature. It is conclude that from 14 stock in NSC only 2 stocks are selected such as Vedanta and TATA steel with the investment of 86./. in Vedanta and 14 ./. in TATA Steel.

The article was written by **Saurabh Singh, Jayant Gautam**, in the year **2014**. The single Index model and the construction of optimal portfolio a case of banks listed on NSE India. The purpose of study is to construction of optimal portfolio using single index model. Secondary data is used which is obtain through website of NSE. In the present study 10 companies are selected for sample. The study concludes that out 10 Companies 2 companies are selected for investment.

The article was written by **Varadharajan Ganesh**, in the year **2012**.The title of article is the single index model on equity portfolio of large caps companies of selected stocks in India. The purpose of the article is to construct optimal portfolio through diversification in companies. The study is based on secondary data. Out of different companies 18 companies were selected as sample for the research .From the analysis it was found that only 5 companies were included in portfolio out of 18 companies.

The article was written **Dimpal Pandey, Davinder Suri** in the year of **2017**. The title of article is identifying the factors causing changes in optimal mix using Sharpe optimistic model. The purpose of this study is to investigate the impact of macroeconomic fact or on the companies comprising the sensex. Secondary data is

used in the research. The study concludes that outof30 SENSEX only four companies were selected in 2012 to 2014 and three companies were selected in 2016 to 2016.

The article was written by **Chintan A Shah** in the year **2015**. The title of article is Construction of portfolio using Sharpe index model and camp for BSE 15 securities. The purpose of study is to construct optimal portfolio through diversification buy using Sharpe index model. The data is collected by secondary source. Secondary data will be obtained by www.besindia.com. Top 15 companies are taken as Sample for the research on the basis of market capitalization. There search conclude that out of 15 companies an investor can invest in HDFC Bank, ICICI Bank, TCS, TATA Motors.

3. Research Methodology

An investor considering investment in securities is faced with the problem of choosing from among a large number of securities and how to allocate those funds over a group of securities. The hurdle that exists is that the investor has a problem of deciding which securities to hold and how much to invest in each of them. Through an optimal portfolio using Single index model is helpful in avoiding the difficulty of data input and time cost consideration. The main objective of study is to calculate the risk and return of the securities in the portfolio and to minimize the risk of the security. The study is based on descriptive method. Descriptive research design method can be used to understand the risk and return and evaluate the performance of selected securities. The study is purely based on secondary data. Data has been collection from website of www.nseindia.com and www.yahooindia.com**.** For the current study, Nifty 50 index is considered as market index. Prices of all the 50 stocks of Nifty 50 are taken for the research. The research is conducted between the periods of 1 January 2017 to 31 December 2018.

4.Data Analysis.

Risk free return has been taken to be the T-bill rate at 7.803% p.a.. The mean return, market variance, unsystematic risk, the intercept and the beta for all the 50 stocks has been given below:

Table 4.1 : Basic Information

Sr. No.	Company Name	Mean Return	Risk Free Rate of Return	Beta	Market Variance	Unsystem atic Risk
		(Ri)	(Rf)	(Bi)	Ꝺ2m	ei2
1	Axis Bank Ltd.	0.083153 027	7.803	1.23800 063	0.6999987 6	0.94371621 7
2	ADANIPORTS.NS	0.093669	7.803	1.45402	0.6999987	0.85664914

		128		8819	6	6
3	Asian paints Ltd.	0.099207 251	7.803	0.87687 8194	0.6999987 6	0.71277798 1
4	Bajaj Finance	0.254325 938	7.803	1.44828 9666	0.6999987 6	1.07174174 5
5	Bajaj Auto LID.	0.024600 159	7.803	0.97606 3971	0.6999987 6	0.71333541 3
6	Bajaj Finserv LTD.	0.180437 938	7.803	1.39987 1058	0.6999987 6	0.87986510 2
7	Bharti Airtal LTD.	0.030032 348	7.803	1.09638 949	0.6999987 6	1.26045964 2
8	BharatPetroleumCorporationLTD.	0.013404 41	7.803	1.32929 2363	0.6999987 6	1.29347334 5
9	Britannia Industries LTD.	0.169607 215	7.803	0.82650 0032	0.6999987 6	0.70733855 7
10	Cipla LTD.	-0.00416	7.803	0.78270 2	0.6999987 6	1.035187
11	Coal India Ltd.	-0.0037 21476	7.803	0.58580 3876	0.6999987 6	1.06639504 3
12	Dr Reddys Laboratories Ltd.	-0.0436 93502	7.803	0.56831 8837	0.6999987 6	1.45616673 5
13	Eicher Moters Ltd.	0.028933 933	7.803	1.18233 7193	0.6999987 6	0.92167458 5
14	Gail India Ltd.	0.087496 498	7.803	0.83657 0998	0.6999987 6	1.21004940 4
15	Grasim Industries Ltd.	0.060653 479	7.803	1.18905 013	0.6999987 6	0.94774668 6
16	HCL Technology Ltd.	0.053742 247	7.803	0.42901 9305	0.6999987 6	1.23373523
17	HousingDevelopmentFin.Corp.Ltd .	0.103717 534	7.803	1.14976 2544	0.6999987 6	0.57296635 3
18	HDFC Bank td.	0.124252 244	7.803	0.70413 1078	0.6999987 6	0.46735113 2
19	Hero Motocorp Ltd.	0.026742 312	7.803	0.92794 8128	0.6999987 6	0.77573089 2
20	Hindalco Industries Ltd.	0.102312 317	7.803	1.61327 6692	0.6999987 6	1.05814348 6
21	Hindustan Unilever Ltd.	0.173479 629	7.803	-0.02406 7784	0.6999987 6	1.26549037 8
22	Indusind Bank.Ltd	0.086452 646	7.803	0.94231 4474	0.6999987 6	0.73941614 9
23	INFRATEL.NS	-0.0144 5813	7.803	0.50498 9268	0.6999987 6	1.53625603 8
24	Infosys Ltd.	0.085353 4	7.803	0.59190 5	0.6999987 6	1.0604751
25	Indian Oil Corporation Ltd.	0.041315 635	7.803	1.20444 7596	0.6999987 6	1.24114635 9
26	Itc Ltd.	0.048692	7.803	0.95952	0.6999987 6	0.794948

27	Jws Steel Ltd.	0.153600089	7.803	1.423085736	0.69999876	0.94487943
28	Kotak Mahindra Bank	0.122690079	7.803	0.94900507	0.69999876	0.725477358
29	LTI.NS	0.218212	7.803	0.766769	0.69999876	1.548386
30	Mahindra & Mahindra Ltd.	0.07825011	7.803	1.097412017	0.69999876	0.711361014
31	Maruti Suzuki India Ltd.	0.083455947	7.803	1.113713352	0.69999876	0.584227025
32	NTPC Ltd.	0.00192635	7.803	0.641498765	0.69999876	0.471789805
33	ONGC Ltd.	-0.02565	7.803	0.882306	0.69999876	0.992912
34	Power Grid Corporation of India	0.033182533	7.803	0.5461747	0.69999876	0.840252054
35	Reliance Industries Ltd.	1.232405182	7.803	0.164870231	0.69999876	0.761605712
36	State Bank of India Ltd.	0.057920101	7.803	1.52263629	0.69999876	1.098246369
37	SUNPHARMA.NS	-0.053461878	7.803	0.919460686	0.69999876	1.433622048
38	Tata Moters Ltd.	-0.182659588	7.803	1.394908632	0.69999876	1.043492706
39	Tata Steel Ltd.	0.092394343	7.803	1.43664174	0.69999876	0.853732456
40	TCS	0.117333	7.803	0.386996	0.69999876	1.194362
41	Tech Mahindra Ltd.	0.105115672	7.803	0.578968466	0.69999876	1.411877655
42	Titan Company Ltd.	0.236743483	7.803	1.046098291	0.69999876	1.43897317
43	UPL.NS	0.056298	7.803	1.283875	0.69999876	1.007433
44	Vedanta Ltd.	0.05314389	7.803	1.57525675	0.69999876	1.01730088
45	Wipro Ltd.	0.079006	7.803	0.391548	0.69999876	1.023007
46	Yes Bank Ltd.	-0.00070644	7.803	1.290352801	0.69999876	1.776849496
47	ZEEL.NS	0.024366	7.803	0.851892	0.69999876	0.959122
48	Ulter Tech Cement	0.053446847	7.803	1.121307214	0.69999876	0.689023771
49	ICICI Bank	-0.087026065	7.803	0.007258179	0.69999876	4.876122962
50	Nestle	0.137683	7.803	0.586908	0.69999876	0.943879

Construction for an Optimal Portfolio

Step 1: Find out the "excess return to beta" ratio for each stock under consideration.

Step-2: Securities have to be ranked from the highest return to beta to the lowest.

Step-3:

$$C_i = \frac{\sigma^2 mi \sum_{i=1}^{i} \frac{(R_i - R_f)*\beta_i}{\sigma^2 ei}}{1 + \sigma m^2 \sum_{i=1}^{i} \frac{\beta_i^2}{\sigma^2 ei}}$$

Table 4.2 : Proceed to calculations for determining cut off rate

Sr.No.	Company Name	Excess Return to Beta	$(R_i-Rf)*\beta_i/\sigma_{ei}^2$	$\sum(R_i-Rf)*\beta_i/\sigma_{ei}^2$	Beta squ	β_i^2/σ_{ei}^2	$\sum(\beta_i^2/\sigma_{ei}$	Ci
1	LTI.NS	0.190425479	0.072306086	0.072306086	0.587935	0.379708	0.379708	0.039986
2	Titan Company Ltd.	0.157292564	0.119619086	0.191925172	1.094322	0.760488	1.140196	0.087675
3	Bajaj Finance	0.125752425	0.246114435	0.365733521	2.097543	1.957135	2.717623	0.108023
4	Britannia Industries LTD.	0.117855064	0.113816877	0.359931312	0.683102	0.965736	2.922871	0.150328
5	TCS	0.116624643	0.014624055	0.128440933	0.149766	0.125394	1.091135	0.082654
6	Nestle	0.111573084	0.040717679	0.055341734	0.344461	0.364942	0.490336	0.030857
7	Bajaj Finserv LTD.	0.077319934	0.172207258	0.212924937	1.959639	2.227204	2.592146	0.058243
8	Reliance Industries Ltd.	0.075194613	0.149955903	0.322163161	1.518823	1.994237	4.221441	0.094122
9	HDFC Bank td.	0.073924082	0.078424123	0.228380026	0.495801	1.060874	3.055111	0.091739
10	Jws Steel Ltd.	0.057199708	0.122596917	0.20102104	2.025173	2.143314	3.204187	0.056279
11	Tech Mahindra Ltd.	0.056852271	0.013497725	0.136094642	0.335204	0.237418	2.380731	0.08169
12	Kotak Mahindra Bank	0.053203171	0.066046638	0.079544363	0.900611	1.241404	1.478822	0.029792

13	Asianpaints Ltd.	0.030799319	0.033225029	0.099271668	0.768915	1.078759	2.320163	0.039593
14	HousingDevelopment Fin.Corp.Ltd.	0.027412211	0.06324 5738	0.0964 70767	1.321954	2.30721	3.385969	0.025823
15	Infosys Ltd.	0.022222189	0.007341595	0.070587333	0.350352	0.330372	2.637583	0.04013
16	Hindalco Industries Ltd.	0.018665315	0.045910124	0.053251719	2.602662	2.459649	2.790021	0.013696
17	Gail India Ltd.	0.018284757	0.010575276	0.0564854	0.699851	0.578366	3.038015	0.028145
18	Wipro Ltd.	0.017382437	0.002604962	0.013180238	0.15331	0.149862	0.728227	0.008385
19	Indusind Bank.Ltd	0.015125148	0.018163621	0.020768583	0.887957	1.200889	1.350751	0.0078 98
20	ADANIPORTS.NS	0.01476 527	0.036440509	0.054640413	2.1142	2.467988	3.668877	0.014013
21	Tata Steel Ltd.	0.014056631	0.033982586	0.070423096	2.063939	2.417548	4.885536	0.018311
22	Maruti Suzuki India Ltd.	0.010106682	0.021457238	0.055439824	1.240357	2.123074	4.540623	0.015611
23	Axis Bank Ltd.	0.008847351	0.014368571	0.035825809	1.532646	1.624053	3.747128	0.011736
24	Mahindra & Mahindra Ltd.	0.005513071	0.009333466	0.023702037	1.204313	1.69297	3.317024	0.0075 93
25	State Bank of India Ltd.	-0.009378405	-0.01979801	-0.010464544	2.318421	2.111021	3.803992	-0.00296 6
26	Grasim Industries Ltd.	-0.0097 1071	-0.014486353	-0.034284363	1.41384	1.49179	3.602812	-0.011 74
27	Vedanta Ltd.	-0.012097144	-0.029507751	-0.043994104	2.481434	2.439233	3.931024	-0.01137
28	UPL.NS	-0.01238569	-0.020265127	-0.049772878	1.648334	1.636173	4.075406	-0.01624
29	Ulter Tech Cement	-0.016724367	-0.030518607	-0.050783734	1.25733	1.824799	3.460972	-0.01561
30	Itc Ltd.	-0.024499969	-0.028374636	-0.058893243	0.920679	1.158163	2.982962	-0.02277
31	Indian Oil Corporation Ltd.	-0.025641933	-0.029971162	-0.058345798	1.450694	1.168834	2.326997	-0.02246
32	Eicher Moters Ltd.	-0.036593679	-0.055502323	-0.085473485	1.397921	1.516719	2.685553	-0.02902
33	Bharti Airtal LTD.	-0.0384	-0.0366	-0.0921	1.2020	0.9536	2.4703	-

		60467	78819	81142	7	76	95	0.0386 9

34	HCL Technology Ltd.	-0.0430 23129	-0.0064 18502	-0.0430 97321	0.1840 58	0.1491 87	1.1028 63	-0.0273 2
35	BharatPetroleumCorp orationLTD.	-0.0442 30744	-0.0604 23765	-0.0668 42267	1.7670 18	1.3661 03	1.5152 91	-0.0239 2
36	Bajaj Auto LID.	-0.0487 67133	-0.0651 31339	-0.1255 55103	0.9527 01	1.3355 58	2.7016 61	-0.0454 2
37	Hero Motocorp Ltd.	-0.0489 87316	-0.0543 77591	-0.1195 08929	0.8610 88	1.1100 34	2.4455 92	-0.0470 8
38	ZEEL.NS	-0.0561 50852	-0.0424 86574	-0.0968 64164	0.7257 2	0.7566 51	1.8666 85	-0.0443 3
39	Yes Bank Ltd.	-0.0565 01166	-0.0529 44847	-0.0954 31421	1.6650 1	0.9370 58	1.693 708	-0.040 34
40	Power Grid Corporation of India	-0.0714 37706	-0.0253 61858	-0.0783 06706	0.2983 07	0.3550 21	1.2920 78	-0.0439
41	Cipla LTD.	-0.0975 64516	-0.0577 38475	-0.0831 00334	0.6126 22	0.5917 98	0.9468 19	-0.0411 3
42	NTPC Ltd.	-0.1095 46041	-0.0955 52001	-0.1532 90476	0.4115 21	0.8722 54	1.4640 52	-0.0666 2
43	ONGC Ltd.	-0.1108 98168	-0.0869 46599	-0.1824 986	0.7784 65	0.7840 22	1.6562 76	-0.0824 8
44	Coal India Ltd.	-0.1296 02208	-0.0417 06022	-0.1286 52621	0.3431 66	0.321 8	1.1058 22	-0.073 5
45	SUNPHARMA.NS	-0.1366 69114	-0.0805 93875	-0.1222 99897	0.8454 08	0.5897 01	0.9115 01	-0.060 6
46	INFRATEL.NS	-0.1716 03895	-0.0284 85762	-0.1090 79637	0.2550 14	0.1659 97	0.7556 98	-0.0684 1
47	Tata Moters Ltd.	-0.1827 07012	-0.3406 88379	-0.3691 74141	1.9457 7	1.8646 71	2.0306 68	-0.112 1
48	Dr Reddys Laboratories Ltd.	-0.2039 23387	-0.0452 314	-0.3859 1978	0.3229 86	0.2218 06	2.0864 76	-0.2338 4
49	Hindustan Unilever Ltd.	-4.2080 99497	-0.0019 26191	-0.0471 57591	0.0005 79	0.0004 58	0.2222 64	-0.03 3
50	ICICI Bank	-21.937 46757	-0.0002 3701	-0.0021 63201	5.27-0 5	1.08 -05	0.0004 69	-0.0015 1

Interpretation:- In this,50 companies is selected as sample unit but only first 3 companies whose Access Return to Beta Ratio is more than the cutoff point (C*) is indicated in yellow colour in the above table has been selected for construction of optimal portfolio.

Step 4: Construction of optimal portfolio

$C* = 0.108023$

$$(X_i) = \frac{Z_i}{\Sigma Z_i}$$

Table 4.3: Construction of optimal portfolio

Sr. No.	Company Name	Ci	Beta	бei2	(R¡-Rƒ)/β¡	Zi=β/σei2*[(Ri-Rf)/βi]-C*	Investment in %
1	LTI.NS	0.0399861	0.766769	1.548386	0.1904245 48	0.054313636	38%
2	Titan Company Ltd.	0.0876746	1.046098	1.438973	0.1572956	0.026673223	19%
3	Bajaj Finance	0.1080227	1.44829	1.071742	0.1257543	0.061911799	43%
						0.142898658	100%

Interpretation:-Out of 50 companies 3 companies i.e. LTI.NS, Titan Company Ltd., Bajaj Finance has been selected for investment purpose for rational investor according to Sharpe's single index model. Out of 100% investment an investor can invest 43% in Bajaj Finance, 38% in LTI.NS, 19% in Titan Company Limited.

6. Finding

- Hindalco Industries Limited has highest beta value 1.613277 and Hindustan Unilever Limited has lowest beta value -0.02407

- Britannia Industries Limited has highest cut-off though it is not included in the portfolio because it gives negative return.
- It is found that out of 50 stocks considered for study, only 3 stocks are chosen for inclusion in optimal portfolio. The 'excess return to beta ratio' of only 3 stocks was above the calculated cut-off rate of 0.108023
- Majority of the stocks are found to have their beta less than 1 and hence can be termed as defensive securities. Investors who are risk averse may prefer to invest in such type of securities.
- Systematic risk is less than Unsystematic risk in SIM .It can be reduced through diversification.
- It was found in the study that maximum proportion of 43% percent should be invested in Bajaj Finance and least percent is to be invested in Titan Company Limited with 19%.

6. Conclusion.

From the discussion and analysis so far it is clear that the construction of optimal portfolio investment by using Sharpe's Single Index Model is easier and more comfortable than by using Markowitz's Mean-Variance Model. In his seminal contribution Sharpe argued that there is a considerable similarity between efficient portfolios generated by Markowitz's Model and SIM. This study helps the investors to minimize their overall risk and maximize the return of their investment over any period of time. The optimal portfolio thus developed proved to be the best investment option in NSE Nifity-50, but the daily market fluctuation based on international financial queues and emotions resulted in security price fluctuations beyond the predicted risk levels. The task of construction of optimal portfolio is tough and challenging both for institutional as well as individual investors.

This paper attempts to construct an optimal portfolio taking 50 stocks of Nifty 50 Index. As evident from the above study, only 3 stocks fulfil the selection criteria of being included in optimal portfolio. This indicates that financial sector is growing rapidly and stocks of financial sector are providing consistent and assured returns.

7. Recommendation

When any individual invest money in any one company the risk is higher compare to when an investor invest his money in various companies. The result of the study indicates that the presence of estimation risk reduced the relative impact of estimated systematic risk on optimal portfolio choice. The results are encouraging with an average return significantly higher than the market return.

8. References

1. Andrade, P. J. (2012). CONSTRUCTION OF OPTIMAL PORTFOLIO OF EQUITY, USING SHARPE'S SINGLE INDEX MODEL: A CASE STUDY OF IT SECTOR . *International Journal of Applied Financial Management Perspectives* , 190.

2. ARUN KUMAR .S.S, M. (2013). A STUDY ON CONSTRUCTION OF OPTIMAL PORTFOLIO USING SHARPE'S SINGLE INDEX MODEL . *INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT & MANAGEMENT* , 100.

3. B.N. Dutta Smriti Mahavidyalaya, B. (2013). SHARPE'S SINGLE INDEX MODEL AND ITS APPLICATION TO CONSTRUCT OPTIMAL PORTFOLIO: AN EMPIRICAL STUDY. *Great Lakes Herald* , 60.

4. Chang, J.-F. (2009). A PERFORMANCE COMPARISON BETWEEN GENETIC ALGORITHMS AND PARTICLE SWARM OPTIMIZATION APPLIED IN CONSTRUCTING EQUITY PORTFOLIOS. *International Journal of Innovative Computing, Information and Control* , 5069.

5. Chitnis, A. (2010). Performance Evaluation of Two Optimal Portfolios by Sharpe's Ratio . *Global Journal of Finance and Management* , 46.

6. Dimple Pandey, D. S. (2017). Identifying the factors causing changes in optimum portfolio mix using Sharpe optimisation model . *International Journal of Applied Research* , 752.

7. Dr. B.G. Satyaprasad, P. A. (2018). A STUDY ON OPTIMAL PORTFOLIO CONSTRUCTION OF FMCG AND PHARMACEUTICAL SECTOR STOCK WITHREFERENCE TO BSE. *International Journal of Social Sciences & Economic Environment* , 23.

8. Dr. Poornima S, A. P. (2013). A study on optimal portfolio construction using sharpes single index model with special preference to selected sectors listed in NSE . *National Journal of Advanced Research* , 31.

9. Dr.K.V.Ramanathan, K. J. (2014). CONSTRUCTIONOF OPTIMAL EQUITY PORTFOLIO USING THE SHARPE INDEX MODEL WITH REFERENCE TO BANKING AND INFORMATIONTECHNOLOGYSECTORS IN INDIA. *International Journal of Business and Administration Research Review* , 131.

10. Fattawat, K. S. (2014). Sharpe's Single Index Model and its Application Portfolio Construction: An Empirical Study . *Global Journal of Finance and Management.* , 516.