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Construction Of Optimum Portfolio Using Sharpe's Single Index Model: With Reference To Pharmaceutical Sector And Banking Sector Listed On Bse

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ABSTRACT

Portfolio theories attempt to derive the optimum portfolio for the investors who wish to maximize the expected utility of their investment in a single period investment horizon. Most of portfolio theories propounded by different authors makes a strong assumption by stating that only two parameters of a probability distribution affects the utility- Mean and Variance. These theories further assumes that markets are frictionless i.e. there are no taxes and transaction cost.

All individuals prefer more Return to less and are Risk averse. As far as preferring more Return to less return is concerned, the theory assumes diminishing marginal utility. Thus, if return goes up, utility increases at a decreasing rate.

In real life there are large number of stocks and the projections regarding their expected return, risk and covariance is available between them. It would be practically complicated to get the feasible region and the derivation of the efficient frontier. Given a certain number of stock and their expected return (Ri), beta (β) of stock, unsystematic risk, risk free nominal rate of return (Rf) and the standard deviation of market return (σm), this paper an attempt to construct the optimum portfolio under Sharpe approach. For the purpose of constructing Sharpe optimum portfolio, 10 pharmaceutical sector and 10 banking sector stock listed in BSE are used.

1. Introduction

Portfolio may be defined as bundle of securities. The objective of portfolio theory is to construct the optimum portfolio. An optimum portfolio is one which has the highest possible utility. Utility of the portfolio is a positive function of the expected return (Rp^{-}) and a negative function of the Standard Deviation of the portfolio (σp). Portfolio theory suffers from two drawbacks(i) It is too much data demanding (ii) It is inconsistent with the manner in which investment research is carried out in real life.

Single Index Model centers around the concept of market portfolio. A market portfolio is defined as portfolio consisting of all stock in the market with weight attached being

proportionate to their market capitalization. However, such a portfolio does not exist in real life. So, we strike a compromise and consider a well-diversified benchmark index such as the BSE Sensex, or NSE Nifty as a proxy for the market portfolio. According to this theory, the only reason why two stock are associated with each other is due to their association with the market, therefore, there is no need to study the individual relationship between two stocks. Instead, one should study the relationship between each stock and market. This is accomplished with the help of the *Characteristic line* (CL). The CL is a best fit linear relation between the return on stock (Rj) and return on market (Rm). The CL is given by

$$R_i = \alpha_i + \beta_i R_m + e_i$$

Here R_i is the expected return on security, α_i is independent component of the stock return, β_i is sensivity of stock return to market return, R_m is return on market and e_i is random residual error.

The concept of Characteristic Line is based on the understanding that risk is a measure in terms of Standard Deviation that captures the total variability of a stock return. This variability stems from two sets of factors:

i. Firm specific factors

ii. Market wide factors

Thus, there are two types of risk:

i. Firm risk or unsystematic risk or Diversifiable risk

ii. Market risk or systematic risk or non-Diversifiable risk

If a person invests his entire wealth in one stock, he would be concerned about the total risk of that stock. However, in a well-diversified portfolio, the firm's specific risk factors are randomly distributed and tend to cancel out each other, It is just the systematic risk which remains and it cannot be diversified. Remains is just the systematic risk which cannot be diversified. Assuming that all investors are rational, they must be holding diversified portfolio. So, they are not concerned about firm specific risk. Instead, they are just concerned about market risk. So, Standard Deviation of a particular stock is not a relevant measure of risk for portfolio investors. We need to define a new measure of risk, which shows the sensitivity of return on a particular stock (R_i) to return of Market (R_m). This new measure of risk is known as the Beta of the stock (β) which is the slope of Characteristic Line.

2. Objective of the study:

- To construct the optimum portfolio using Sharpe singe Index model of Pharma sector and Banking sector.
- To get weight (proportionate) of the investment of each stock in to the portfolio including both sectors stock using Sharpe model
- To construct risk and return of each stock from both sectors (pharmaceutical and banking)

3. Limitations of the study

1. The period of the study is taken only one year i.e. from 14 April 2019 to 14 April 2020.
2. Only selected stock from Banking sector and Pharmaceutical sector is taken in to the consideration.
3. Risk free rate of return is taken from interest rate provided by the bank of their fixed deposits.

4. Literature review:

Dr. R. Nalini (2014): The study of selected stocks from BSE is discussed in this research paper. .This study is an attempt to construct the optimum portfolio among the fifteen companies, but only 4 companies get outperformed and get involved in optimal portfolio. The final decision of investing should be made only after considering all the factors affecting the securities. The results of the present study and such micro level studies have more utility value to the fund managers of emerging economies like India where the capital markets are still in their developing stages and many foreign institutional investors are also interested to invest in the leading stocks traded through the stock exchanges of these countries.

Dr. Poornima S, 2 Aruna P Remesh (2016): According to this research it is Risk and return assumes a significant part in settling on any financing choices. An investor should continuously monitor the market and constantly update his portfolio by selecting right stocks for investment at that time. Sharpe Index model.

M Sathyapriya (2016): This study analyses, Dr Reddy from pharmaceutical sector satisfies the t maximum proportion of 56% of the total investment being the most suggested stock amongst the 20 companies picked. Second to it stands Cipla again from pharma with a proportion of 26% of the investment.

D**r. J.Murthy* (2018) :** The objective of this study wasto analyses the opportunity of investment as per the requirement of return and risk. 14 companies has been taken in the study out which only 7 stock are showing positive return. Rest of the stock are showing negative return. With regard to beta values, out of 14 companies selected, Tata steel, we spun crop and Vedanta, The 14 stocks that are included in NSE Nifty metal index, only two stocks namely Vedanta and Tata steel are included in the Optimal Portfolio constructed in this study with maximum suggested investment of 86 percent in Vedanta and 14 percent in Tata steel.

Tanuj Nandan1, Nivedita Srivastava (2018): The research aimed to structure the portfolio from sharpe index model f 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 24 stocks fulfill the criteria of the Sharpe model. The results of this study can be used both by individual and institutional investors in creating optimal portfolio to diversify and reduce risk and enhance their returns.

Dr.S.Poornima* Aruna.P.Remesh (2017**)**: This study recommend to invest in the following companies' share which is having the high cut-off value and excess return to beta ratio. For individual investor they can invest in banking, pharmaceutical company because of high return and low risk. Risk aggressive investor can choose metal, sector which giving high return with high risk. With respect to this, from beta point of view 37 companies showing aggressive beta that greater than one mean that their stock are out performed than market.

Imroz Mahmud (2019): The objective of this study conforms to the earlier researches conducted on portfolio optimization. This research proclaimed that the constructed portfolio the constructed outperforms every individual stock as well as the market index in terms of offering the optimal risk-return combinations.

5. Research Methodology:

This research is primarily based on descriptive analysis. The purposive sample technique is used for sampling. The data is taken from Yahoo finance and money control.com. In this research 20 stocks are considered for the analysis from two sectors i.e. pharmaceutical sector and banking sector. From each sector, 10 companies were selected which were listed on Bombay Stock Exchange. The returns were computed on monthly basis from the share price data on each of the stock and index for the period starting from 14thApril, 2019 to 14th April, 2020. Risk free nominal rate of return i.e. Rf is taken from fixed rate of interest provided on

fixed deposits by bank. Monthly rate for risk free return assumed as 0.46%. Advanced excel has been used to calculate the values of mean, standard deviation, Beta, Ri-Rf, Ci, and Zi for all stocks .

For the selected stocks, beta and unsystematic risk were also computed along with standard deviation of market. For construction of optimal portfolio for given number of stocks under Sharpe approach, we performed two following steps:

1. Choice of stock
2. Weight for the stocks

The choice of the stock is based on excess return to β ratio i.e. (Ri-Rf)/ β (higher the better). We need to find out a cutoff (C*), such that only those stocks for which:

$\frac{Ri-Rf}{\beta} \geq C^*$ are chosen.

C*is found by iterative procedure. This involve arranging all the stocks in the decreasing order based on the excess return to beta. Then the cutoff for each set of stocks is computed by:

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

Having chosen the stocks to be included in the portfolio, the weight of each stock is given by:-

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

Where, Zi $z_i = \frac{\beta_i}{\sigma_{e_i}^2}\left(\frac{R_i - R_f}{\beta_i} - C^*\right)$

Data interpretation and analysis:

In this part of the study, detailed data of all 20 companies was analyzed.

In Table 1, The stock price of banking sector stocks was recorded from April, 2019 to April, 2020.

In Table 2, the stock price of all pharmaceutical sector stocks was recorded from April, 2019 to April, 2020.

In Table 3, Beta, Standard Deviation, Expected Return, Excess Return to Beta Ratio, Rank for the Pharma Sector individually is structured.

Table 4 consist of computed values of Beta, Standard Deviation, Expected Return, Excess Return to Beta Ratio, Rank for the Banking Sector stocks individually.

Table 5 consist of Beta SD, Expected Return Excess return to beta, Rank, Unsystematic Risk all the stock is structured. Further in next step table 6. is constructed for C* and Zi value then the final output is delivered.

Table 1: Monthly closing price from April, 2019 to April 2020 of Banking sector stocks

SBI	RBL BANK	PNB BANK	KOTAK BANK	INDUSIND BANK	IDFC BANK	ICICI BANK	HDFC BANK	AXIS BANK	BOB
352	687	80	1519.	1604.5	45	423	1212	807	133
361	638	79	1476	1410	43	437	1223	807	122
332	403	69	1519	1413	41	425	1126	674	107
273	327	64	1431	1394	43	410	1114	664	93
270	328	61	1644	1381	40	433	1227	685	93
312	310	65	1573	1312	44	463	1230	736	97
341	374	65	1614	1569	46	512	1274	740	105
333	344	64	1685	1510	45	539	1272	754	102
318	318	60	1691	1258	40	526	1226	729	93
303	290	45	1619	1104	36	496	1178	697	77
196	135	33	1296	351	21	325	862	379	54
183	117	31	1251	410	22	331	895	419	50
184	119	32	1253	411	23	332	896	419	50

Source: Money control

Table 2: Monthly Closing price from April 2019 to April 2020 of Pharmaceutical sector stocks

AURO PHARMA	BIOCON	CADILA	CIPLA	DIVISLAB	DRREDDY	GLENMARK	LUPIN	PEL.BIO	SUN PHARMA
672	271	248	559	1590	1590	545	745	2170	410
608	251	242	553	1597	1597	443	755	1900	401
571	227	228	521	1634	1634	426	765	1766	427
601	236	225	472	1629	1629	384	740	1984	451
589	223	233	426	1665	1665	325	715	1593	390
470	246	252	467	1756	1756	315	746	1645	434
450	282	254	467	1787	1787	337	800	1768	450
457	294	254	478	1846	1846	347	765	1524	433
481	294	266	447	1953	1953	310	718	1545	434
506	287	260	402	2106	2106	278	640	1307	373
413	271	267	423	1988	1988	206	590	939	352
503	341	354	593	2341	2341	299	826	920	462
503	341	354	593	2341	2341	299	826	920	462

Source: Money control

Table 3: Beta, Standard Deviation, expected return, Excess return to beta ratio, Rank for the Pharma Sector stocks

Stock	Beta	SD	Expected Return	Excess return to Beta ratio	Rank
NSE		8%	2%		
LUPIN	0.62	12%	-1%	-2.35	4
PEL.BIO	0.98	13%	7%	6.6	1
BIOCON	0.63	10%	-2%	-3.90	6
CIPLA	0.20	12%	-1%	-7.3	7
DIVISLAB	0.34	5%	-3%	-10.17	8

DR.REDDY	0.11	7%	-3%	-31.45	10
GLENMARK	1.14	17%	5%	3.98	2
SUN PHARMA	0.45	11%	-1%	-3.24	5
AURO PHARMA	0.58	12%	2%	2.65	3
CADILA	0.32	9%	-3%	-10.81	9

Source: Calculated

Assuming risk free rate of 5.5% per annum and 0.46% per month, Market return of 2% pm with Standard deviation of 8%.

Table 4: Beta, Standard Deviation, expected return, Excess return to beta ratio, Rank for the Banking Sector stocks

Stock	Beta	SD	EX-Return	Excess return to Beta	Rank
HDFC	1.14	10%	2.50%	1.79	9
IDFC	1.82	17%	6%	3.04	5
INDUSBANK	3.68	34%	11%	2.86	6
RBL	2.43	25%	15%	5.98	3
PNB	1.23	12%	8%	6.13	2
SBI	1.41	15%	5%	3.22	4
KOTAK	0.76	8%	2%	2.02	8
AXIS	2.14	19%	5%	2.12	7
BOB	1.22	12%	8%	6.18	1
ICICI	1.53	14%	2%	1.006	10

Source: Calculated.

Table 5: Beta SD, Expected Return Excess return to beta, Rank, Unsystematic Risk all the stock

Stock	Beta (β)	SD (%)	Expected return (Ri)	Excess return to Beta ($\frac{Ri-Rf}{\beta}$)	Rank	$\sigma 2ei$ (UR)	$\frac{\beta^2}{\sigma 2ei}$
HDFC	1.14	10	2.5	1.79	12	80.20	0.01612
IDFC	1.82	17	6	3.04	7	2503.30	0.00132
INDUSBANK	3.68	34	11	2.86	8	39275.62	0.00035
RBL	2.43	25	15	5.98	4	33025.03	0.00018
PNB	1.23	12	8	6.13	3	1159.86	0.00130
SBI	1.41	15	5	3.22	6	7784.86	0.00026
KOTAK	0.76	8	2	2.02	11	859.49	0.00068
AXIS	2.14	19	5	2.12	10	634.44	0.00719
BOB	1.22	12	8	6.18	2	1014.18	0.00146
ICICI	1.53	14	2	1.006	13	296.69	0.00785
LUPIN	0.62	8	2	-2.35	14	106.4	0.00003414
PEL.BIO	0.98	12	-1	6.6	1	109.1	0.00008005
BIOCON	0.63	13	7	-3.90	16	65.3	0.00009393
CIPLA	0.20	10	-2	-7.3	17	148.1	0.00000190
DIVISLAB	0.34	12	-1	-10.17	18	19.4	0.00030209
DR.REDDY	0.11	5	-3	-31.45	20	41.5	0.00000718
GLENMARK	1.14	7	-3	3.98	5	191.7	0.00003559
SUN PHARMA	0.45	17	5	-3.24	15	111.3	0.00001661
AURO PHARMA	0.58	11	-1	2.65	9	109.3	0.00002828
CADILA	0.32	12	2	-10.81	19	72.0	0.00001959

Source: Calculated

Table 6 : Computation of Ci and Zi scores

Stock Col. (1)	$\frac{Ri-Rf}{\beta}$ Col(2)	$\frac{\beta^2}{\sigma^2 ei}$ Col(3)	$\frac{\sum \beta^2}{\sigma^2 ei}$ Col(4)	$\frac{(Ri-Rf)\beta}{\sigma^2 ei}$ Col(5)	$\sum_{(Ri-Rf/(\beta ei)^2)/\beta i}$ Col(6)	Ci (7)	Zi (8)
PEL.BIO	6.6	0.00008	0.0000800	0.0005283	0.00052833	0.006	0.0005
BOB	6.18	0.00146	0.0015400	0.0090228	0.00955113	0.099	0.006525
PNB	6.13	0.00130	0.0028400	0.007969	0.01752013	0.169	0.005709
RBL	5.98	0.00018	0.00302005	0.0010764	0.01859653	0.178	0.000389
GLENMARK	3.98	0.00003559	0.00305564	0.000141648	0.018738178	0.179	0.000102
SBI	3.22	0.00026	0.00331564	0.0008372	0.019575378	0.192	0.00046
IDFC	3.04	0.00132	0.00463564	0.0040128	0.023588178	0.249	0.001677
INDUSBANK	2.86	0.00035	0.00498564	0.001001	0.024589178	0.263	0.000203
AURO PHARMA	2.65	0.00002828	0.00501392	0.000074942	0.02466412	0.264	0.000094
AXIS	2.12	0.00719	0.01220392	0.0152428	0.03990692	0.466	0.004677
KOTAK	2.02	0.00068	0.01288392	0.0013736	0.04128052	0.480	0.001156
HDFC	1.79	0.01612	0.02900392	0.0288548	0.07013532	0.675	0.015
ICICI	1.006	0.00785	0.03685392	0.0078971	0.07803242	0.725	0.001426
LUPIN	-2.35	0.00003414	0.03688806	-0.000080229	0.077952191	0.725	
SUN PHARMA	-3.24	0.00001661	0.03690467	-5.38164E-05	0.077898375	0.725	
BIOCON	-3.90	0.00009393	0.0369986	-0.000366327	0.077532048	0.726	
CIPLA	-7.3	0.00000190	0.0370005	-0.00001387	0.077518178	0.726	
DIVISLAB	-10.17	0.00030209	0.03730259	0.00052833	0.074445923	0.727	
CADILA	-10.81	0.00001959	0.03732218	0.0090228	0.07465769	0.728	(C*)
DR.REDDY	-31.45	0.00000718	0.03732936	0.007969	0.074431879	0.728	

Source: Calculated

6. Interpretation

After analysis the data from all these tables, this study has been able to determine the proportion of individual stock becoming a part of the portfolio. From the table it is very clear as per methods that only those stock has been included which has higher excess return to beta than the cutoff point(c*). It is observed that 13 stock out of 20 companies qualified to be included in the optimal portfolio. It is also identified that higher weight given stock is HDFC bank and the lowest weight stock is Auro Pharma.

7. Findings

The RBL, company has the highest return that is 15, and the Glenmark pharma, company has lowest return that is -3, so if investor want to invest ignoring the risk factor they can chose RBL bank and reject Glen mark pharma. As a rational investor it is not viable to ignore the risk factor. The return from IndusInd bank has highest Beta i.e 3.68 it show the volatility of the stock or in other word it is an aggressive stock representing higher risk as compared to market risk. Pel.Bio, Bank of Baroda, PNB, RBL, Glenmark, SBI, IDFC, Indusind bank, Auro Pharma, Axis, Kotak, HDFC, ICICI, Lupin have beta greater that one means they all are having more volatility than Market. Dr. Reddy has the highest C*, while Pel Bio has a lowest C*. C* is found from the study is .728(Refer to Table 6).

8. Conclusion

Constructing an optimal portfolio is a challenging task for an individual as well as the institutional investors. This paper is an attempt to construct an optimum portfolio using the Sharpe's *Single Index Model*. Thus, the optimal portfolio is constructed by using the Sharpe's *Single Index Model.* This method is more adequate. Portfolio is constructed by taking the past one year data and after constructing the portfolio only thirteen companies were selected for the portfolio construction (Table 7). From banking sector ten companies are selected and from Pharmaceutical sector three companies are selected for *Optimal Portfolio Construction*.

The following stock were chosen for optimum portfolio **using Sharpe index model:**

Table 7: Weightages of stocks in Optimum Portfolio

Weight	STOCK
1.27	PEL.BIO
17.22	BOB
15.06	PNB
1.03	RBL
0.27	GLENMARK
1.21	SBI
4.43	IDFC
0.54	INDUSBANK
0.25	AURO PHARMA
12.34	AXIS
3.05	KOTAK
39.58	HDFC
3.76	**ICICI**

Source: Calculated

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