



## Optimal Equity Portfolio Construction by using Sharpe Single Index Model with reference to the BSE-30 (Bombay Stock Exchange) Securities

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### ABSTRACT

Portfolio construction is the process of investment of funds in different securities in which the total risk of portfolio is minimum while the return is maximum. It primarily involves reducing risk rather than increasing return. Constructing an optimal portfolio is a challenging task for the individual as well as the institutional investors. This study is aimed at creating awareness in the minds of investors regarding the utility of Sharpe's Single Index Model in portfolio construction. Twenty eight securities from the S&P BSE Sensex index were selected and ranked the companies based on excess return to beta ratio. The cut-off point was calculated based on the highest value. Among twenty eight securities only seven securities were selected for optimum portfolio by using Sharpe Single Index Model. Then after cut-off point has been used to calculate the proportion of money to be invested in selected seven securities.

**KEYWORDS :** Sharpe single index model, beta, return, systematic risk, unsystematic risk.

### INTRODUCTION

#### Concept of Portfolio:

Portfolio is the combination of securities such as stocks, bonds and money market instruments. The process of blending together the broad asset classes so as to obtain optimum return with minimum risk if called portfolio construction.

#### Concept of Sharpe Single Index Model:

Casual observation of the stock prices over a period of time reveals that most of the stock prices move with the market index. When the Sensex increases, stock prices also tend to increase and vice-versa. This indicates that some underlying factors affect the market index as well as the stock prices. Stock prices are related to the market index and this relationship could be used to estimate the return on stock. The single index model is based on the assumption that stocks vary together because of the common movement in the stock market and there are no effects beyond the market that account the stocks co-movement. The expected return, standard deviation and co-variance of the single index model represent the joint movement of securities.

#### Assumptions of Sharpe Index Model

- The expectations of all investors are homogeneous in nature.
- A uniform holding period is used in estimating risk and return for each security.
- The price movements of a security is not only dependent upon the nature of these other securities. They are also dependent on the general business and economic conditions.
- The indices, to which the returns of each security are correlated, are likely to be some securities' market proxy.
- The random disturbance terms 'e<sub>i</sub>' has an expected value zero (0) and a finite variance. It is not correlated with the return on market portfolio ( $R_m$ ) as well as with the error term ( $e_i$ ) for any other securities.

### RESEARCH METHODOLOGY

#### PROBLEM STATEMENT

"To construct an optimal equity portfolio by using Sharpe single index model with reference to BSE-30 securities"

#### RESEARCH OBJECTIVES

- To construct an optimal portfolio of BSE-30 securities by using Sharpe single index model.
- To find the proportions of investment to be made into each of the security included in optimal portfolio.
- To get the practicability of Sharpe single index model.

#### RESEARCH DESIGN

For this research, Descriptive Research Design has been used because; in this research design the researcher has got very specific objectives, clear-cut data requirements. The recommendation/findings in a descriptive research are definite.

#### DATA COLLECTION METHOD

For this research, Secondary source of data has been used; these data

are those, which have been gathered earlier for some other purpose. Secondary Data have collected from official websites of Bombay stock exchange, journals, magazines, books etc.

#### SAMPLE

Twenty eight companies included in BSE Sensex have been selected for this study.

#### SAMPLE PERIOD

MONTHLY data of twenty eight securities and Sensex have been collected during financial year April- 2005 to March-2015.

#### STATISTICAL TOOLS

Statistical tools used in this study are Standard deviation, Expected return, Beta, Residual variance, Sharpe Model using MS Excel.

#### BENEFITS OF THE STUDY

While selecting securities in portfolio, every investor has confusion about which stock to be included in his portfolio. He will also face a problem about the proportion of investment to be made in each stock. To help investors get out of such chaotic situations the Sharpe's Single Index model may be used to construct an optimal portfolio. This helps the investor to find a portfolio that best suits his needs.

#### LIMITATIONS OF THE STUDY

This study is purely based on the secondary data collection method. So any problem with this data can lead to huge change in the above said.

The data is taken on monthly basis. The findings might be different if daily data would have been used.

Only twenty eight companies' stocks have been selected in this study, hence the results of this study may not be universally applicable.

#### DATA ANALYSIS & INTERPRETATION

The historical prices of 28 securities for 10 years were collected from official website of stock market. The returns of securities as well as the market (sensex) are calculated by using following formula.

$$\text{Security/Market Return} = \frac{P_t - P_o}{P_o} * 100$$

$P_t$  = Current Month's price of security/market  
 $P_o$  = Previous Month's price of security/market

The expected return of securities is calculated by using following formula.

$$R_i = \alpha + \beta * R_m$$

$$R_m = \frac{\sum \text{Market Return}}{N}$$

$$\beta = \frac{n \sum XY - (\sum X)(\sum Y)}{n \sum X^2 - (\sum X)^2}$$

$$\alpha = Y - \beta * X$$

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Residual Variance (Unsystematic Risk) is calculated as below.

$$\sigma_{e_i}^2 = \sigma_i^2 - \beta_i^2 * \sigma_m^2$$

$\sigma_i^2$  = Standard deviation of Security  
 $\sigma_m^2$  = Market (Sensex) Variance

S&P BSE SENSEX is the index selected as benchmark index for the present study. The details of Expected Return of security, Alpha, Beta and Residual Variance (Unsystematic Risk) are depicted in Table 1.1.

**Table 1.1: Expected Return, Alpha, Beta and Residual Variance (Unsystematic Risk)**

No.	Name of Securities	Ri	ai	βi	σ <sub>ei</sub> <sup>2</sup>
1	Axis Bank Ltd	2.2314	0.12	1.38	123.24
2	Bharat Heavy Electricals Ltd	0.4088	-1.06	0.96	155.79
3	Bharti Airtel Ltd	1.111	0.04	0.7	79.215
4	Cipla Ltd/India	1.4308	0.88	0.36	88.485
5	Dr Reddy's Laboratories Ltd	1.9344	1.2	0.48	80.15
6	Gail India Ltd	1.0376	-0.37	0.92	49.155
7	HDFC Bank Ltd	1.6124	-0.04	1.08	71.235
8	Hero Moto Corp Ltd	1.718	0.8	0.6	47.4
9	Hindalco Industries Ltd	0.1432	-2.06	1.44	152.635
10	Hindustan Unilever Ltd	1.8673	1.24	0.41	52.855
11	Housing Development Finance Corp	1.5306	-0.03	1.02	79.77
12	ICICI Bank Ltd	1.3533	-1.11	1.61	91.465
13	Infosys Ltd	0.838	-0.08	0.6	99.49
14	ITC Ltd	0.5043	0.03	0.31	138.27
15	Larsen & Toubro Ltd	1.8033	-0.66	1.61	113.305
16	Lupin Ltd	2.262	1.65	0.4	136.47
17	Mahindra & Mahindra Ltd	1.6117	0.25	0.89	101.695
18	Maruti Suzuki India Ltd	2.4241	0.94	0.97	66.48
19	NTPC Ltd	0.8275	-0.32	0.75	42.8
20	Oil & Natural Gas Corp Ltd	0.26	-1.27	1	100.22
21	Reliance Industries Ltd	0.95	-0.58	1	59.47
22	State Bank of India	1.0619	-0.82	1.23	130.245
23	Sun Pharmaceutical Industries Ltd	1.6527	0.75	0.59	109.125
24	Tata Consultancy Services Ltd	1.268	0.35	0.6	86.6
25	Tata Motors Ltd	1.845	-0.45	1.5	127.975
26	Tata Steel Ltd	1.1157	-1.47	1.69	95.76
27	Vedanta Ltd	1.7873	-0.37	1.41	221.565
28	Wipro Ltd	0.7228	-0.44	0.76	100.99

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

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

them from the highest to the lowest and : Proceed to calculate Ci for all the stocks according to the ranked order using the following formula.

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

**Table 1.2: Cut off rate of sample securities**

Rank	Name of Securities	$\frac{R_i - R_f}{\beta_i}$	$\frac{\sum(R_i - R_f) \beta_i}{\sigma_{ei}^2}$	$\frac{\sum \beta_i^2}{\sigma_{ei}^2}$	Ci
1	LUPIN	1.435797	0.005897	0.001172	0.281171
2	HUL	0.165417	0.018443	0.004388	0.762403
3	DR REDDY	1.23	0.02853	0.007383	1.049497
4	CIPLA	3.28	0.033334	0.008852	1.163344
5	HERO MOTOR	3.509167	0.051917	0.016447	1.432229
6	SUNPHARMA	0.856087	0.059501	0.019654	1.508016
7	MARUTI	1.261481	0.091222	0.033794	1.702047
8	TCS	2.446667	0.098276	0.037951	1.70166
9	M&M	-0.07417	0.110193	0.045719	1.68179
10	AXIS BANK	3.944634	0.13238	0.061136	1.635566
11	HDFC BANK	1.25549	0.153035	0.077561	1.571806
12	HDFC	0.68528	0.16941	0.090598	1.534508
13	BHARTI AIRTEL	0.98	0.177018	0.096784	1.518352
14	VEDANTA	0.820323	0.186801	0.105765	1.487659
15	TATA MOTORS	0.964783	0.205497	0.123347	1.435543
16	INFOSYS	5.03	0.209043	0.126965	1.424312
17	L&T	1.53	0.231114	0.147176	1.384096
18	GAIL INDIA	2.24134	0.245855	0.164469	1.334207
19	ITC	0.77	0.246425	0.165192	1.332073
20	NTPC	0.01	0.256545	0.178276	1.295172
21	RELIANCE	0.7	0.268316	0.195091	1.2486
22	ICICI BANK	0.660081	0.287736	0.223408	1.183078
23	SBI	2.377458	0.295404	0.235002	1.159339
24	WIPRO	1.696667	0.298962	0.240745	1.14744
25	TATA STEEL	1.063333	0.31424	0.270611	1.082045
26	BHEL	0.512249	0.315218	0.276516	1.063783
27	ONGC	1.090284	0.315318	0.286494	1.029454
28	HINDALCO	0.622105	0.314311	0.300056	0.982656

Table 1.2 represents the Ci of sample companies. The Ci value goes on increasing from 0.28 to 1.70 and thereafter, starts declining. Therefore, the value of 1.70 is considered as the 'cut-off point (C\*)'. The securities which come after the cut-off point will not be considered for the optimal portfolio construction.

Step 2: After determining the securities to be selected, there is a need to find out how much should be invested in each security. The percentage of funds to be invested in each security can be estimated as follows:

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

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

**Table 1.3: Proportion of investment and Portfolio return**

Rank	Name of Securities	Zi	Xi (%)	Ri (%)	Rp (%)
1	LUPIN	0.009754	14.92889	2.262	0.337691
2	HUL	0.017396	26.62408	1.8673	0.497151
3	DR REDDY	0.010822	16.5635	1.9344	0.320404
4	CIPLA	0.00642	9.825495	1.4308	0.140583
5	HERO MOTOR	0.009426	14.42563	1.718	0.247832
6	SUNPHARMA	0.003652	5.588859	1.6527	0.092367
7	MARUTI	0.007869	12.04296	2.4241	0.291933
	<b>ΣZi</b>	<b>0.065339</b>	<b>100%</b>		<b>1.927963</b>

Table 1.3 represents the proportion of investment to be made in each security. The seven securities ranking from 1 to 7 are selected for the optimal portfolio. The table shows that 14.92% of investment may be made in Lupin stock, followed by 26.62 % in HUL Stock , 16.56 % in Dr. Reddy's stock, 9.82% in Cipla stock, 14.42% in Hero Motor Stock, 5.58% in Sunpharma Stock and 12.04% in Maruti stock.

The Table 1.3 also represents the expected return of security and the returns on portfolio. The returns on portfolio are calculated based on the proportion of investment in each security multiplied by individual security return. The total portfolio return is 1.92%.

### FINDINGS

The beta value of L&T and ICICI Bank is high that is 1.61 which states that they are highly volatile with respect to the market (sensex) as compared to other sample securities, whereas the beta value of Lupin security is low that is 0.40 which states that it is less volatile with respect to the market (sensex).

The expected return of MARUTI security is highest that is 2.42% whereas that of HINDALCO security is lowest that is 0.14% during the sample period.

The LUPIN security has the highest excess return to beta ratio of 5.03 while that of HINDALCO stock has the lowest of -0.07417. It reveals that the Lupin stock ranks first while the Hindalco stock ranks the last.

The 7 securities have been selected in the portfolio based on cut off rate  $C_i$ . They are LUPIN, HUL, DR. REDDY'S LAB, CIPLA, HERO MOTOR, SUNPHARMA and MARUTI.

The proportion of investment to be made is 14.92% in Lupin stock, followed by 26.62 % in HUL Stock, 16.56 % in Dr. Reddy's stock, 9.82% in Cipla stock, 14.42% in Hero Motor Stock, 5.58% in Sunpharma Stock and 12.04% in Maruti stock.

### CONCLUSION

It is very difficult for any individual or institutional investor to cover all listed securities in his portfolio. If investor has a list of securities to be included in his portfolio still he may face dilemma about how much to invest in such securities. With this respect a researcher has attempted to make it easy for the investors by using Sharpe Single Index Model. Out of sample of twenty eight securities only seven securities were selected for optimum portfolio. Still an investor should consider all relevant factors before including such seven securities in his portfolio. The factors can be economical, political, monetary, and other micro and macro factors.

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