

CONSTRUCTION OF OPTIMAL PORTFOLIO UNDER SHARPE SINGLE INDEX MODEL: A COMPARATIVE STUDY ON IT AND PHARMA SECTORS

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ABSTRACT

Indian securities market is an exceedingly unpredictable and sensitive market where portfolio construction is exceptionally critical to get great returns. Accordingly the primary concentration of this research is to build an ideal value portfolio with the assistance of Sharpe index model. In this study, IT and PHARMA sectors have been thought about for building the ideal portfolios. Twenty companies have been selected and excess return to beta ratio has been calculated and ranked the companies based on that ratio. Ideal portfolios built for IT sector and PHARMA sector independently and thought about both the portfolios as far as portfolio return and risk. The cut-off point was ascertained in view of the most astounding worth and cut-off point should be used to calculate the proportion of money to be invested in each stocks. The outcomes of the study would be useful to investors for investing funds into IT and PHARMA sector and to choose which sector could give most elevated return at low risk.

Keywords: portfolio, sharp single index model, risk premium and cut off rate.

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INTRODUCTION

Among various Investment avenues one of the most romantic Investments is equity Investment, which results most attractive returns with tolerable risks. Equity investment involves purchase of equity shares of different companies. Investment in one stock may result high risk. So the investor needs to select more stocks in order to reduce risk. In the market plenty of equity shares are available for trading. Hence, investor may face a problem of selection of stocks for his portfolio form of investment. A portfolio is a combination of securities. Any portfolio constructed, either by an individual investor or a fund manager is expected to meet the investor's goals. A rational investor aims at attaining maximum return with minimum risk. It is, therefore, important to construct a portfolio using either of the two popular approaches, namely, traditional and modern.

In the traditional approach, investor's needs in terms of income and capital appreciation are evaluated and appropriate securities are selected to meet the needs of the investor. In the modern approach, Markowitz model is used in selection of securities based on to the risk and return analysis. Markowitz laid foundation for quantifying risk and his contribution is popularly known as 'Modern Portfolio Theory'. He has provided analytical tools for analysis and selection of optimal portfolio. He won Nobel Prize for this contribution to portfolio management in 1990. But, William Sharpe extended the work done by Markowitz. He considered market index while analyzing the portfolio. He simplified the amount and type of input data required to perform portfolio analysis. He made the numerous and complex computations easy which were essential to attain the optimal portfolio. He developed the Single Index Model to make these computations easy and construct an optimal portfolio. Till today, fund managers use this model in portfolio analysis and construction.

LITERATURE REVIEW

Saravanan and Natarajan(2012) was concluded that returns on either individual securities or on portfolio comprises of securities of different companies listed in Nifty 50 stocks under various sectors are asymmetrical and heterogeneous. The optimal portfolio consists of four stocks selected out of 50 short listed scrips, giving the return of 0.116. Further it helps to elicit that return on securities of different portfolio is independent of the systematic risk prevailing in the market.

Mandal, Niranjana (2013) found that there is a significant difference between the total risk of the optimal portfolio calculated under two different mechanisms found in SIM and Markowitz's model. The total risk of the optimal portfolio is 2.87% (in terms of SD) under SIM and the total risk of the portfolio is found to be 1.79% (in terms of SD) in Markowitz's model taking the necessary input from SIM.

Sarker, Mokta Rani (2013) conducted a study to construct an optimal portfolio using Sharpe's Single Index Model considering no short sales. The study has been conducted on individual securities listed in Dhaka Stock Exchange, where short sales are not allowed. The monthly closing prices of one hundred and sixty four companies listed in Dhaka Stock Exchange and share price index for the period of July 2007 to June 2012 have been considered in this study. This method formulates a unique cut-off point, selects stocks having excess return to beta ratio surpassing this cut-off point and determines the percentage of investment to be made in each of selected stocks. The optimum portfolio consists of thirty three stocks selected out of one hundred and sixty four stocks giving the return of 6.17%. From this empirical analysis to some extent, an investor can forecast individual securities return through the market movement and can make use of it.

Ms Apurva and A Chauhan (2014) said that Portfolio management is the crucial decision for any investor. It is important to decide where to invest and how much to invest. The present study focuses on constructing the optimal portfolio with the help of Sharpe Single Index model. Sharpe Single index model uses various inputs such as excess return to beta ratio, unsystematic risk, market return and variance etc to construct the optimal portfolio. In his study, portfolio is constructed from stocks of CNX nifty. Data is collected from top ten companies of CNX nifty based on their weights for the time period of August 2014. Out of 10 stocks, 4 stocks are selected for investing namely State Bank of India, Tata Motors Ltd, Housing Development Finance Corporation Ltd, Reliance Industries Ltd. Sharpe model suggest investors to invest major portion of their money (54.14%) in State Bank of India.

J. Francis Mary and G. Rathika (2015) stated that Risk and return plays an important role in making any investment decisions. Decision include Investment should be done or not and which securities should be included in portfolio. Determining efficient portfolios within an asset class

(e.g., stocks) can be achieved with the Single index (beta) model proposed by Sharpe. Sharpe's single-index model was applied by using the monthly closing prices of 10 companies listed in NSE and CNX PHARMA price index for the period from September 2010 to September 2014. From the empirical analysis it can be concluded that out of 10 companies only one company is selected for investment purpose on the basis of Cut-off point which is -0.11182.

Chintan A. Shah (2015) said that Sharpe model gives exact number of securities along with weightage for investment, while this is not possible in CAPM model. CAPM model only suggest different securities where investor can invest but it does not give a particular portfolio and weightage to investment in different securities.

Dr. S Poornima and Aruna. P. Remesh (2016) have been conducted a study to construct an optimal portfolio using Sharpe's single index model by using risk-return analysis of automobile and pharmaceutical sectors. This study includes ten stocks from automobile sector and ten stocks from pharmaceutical sector. Data for a period of five years (2010-2015) had been taken for the study. After analysing the collected data a "cut-off rate" can calculate. This cut-off rate is considered in the construction of optimal portfolio. Every investor prefers maximum return with a minimum risk. This study found out that Ashok Leyland having highest return and Hyundai having lowest return.

M Sathyapriya (2016) proposed that performance of PHARMA sector is comparatively better than INFRA sector from an analysis of four years' asset value, from 2008 to 2012, of companies picked from Infrastructure & Pharmaceutical sectors. In this regard, Sharpe Index Model is used, which is regularly employed to assess the performance of mutual funds and portfolio strategies. The stock performance of 20 companies from Infrastructure and Pharmaceuticals, 10 from each are taken and calculated. It is found that Pharmaceutical sector performs 80% better than that of Infrastructure sector. Performance of Infrastructure sector is comparatively poorer than Pharma as only one company is selected for the portfolio, i.e., GMR, which constitutes just 7% of the investment share.

Thus, the literature survey made for the present study showed that there is enough scope for studying the utility of Sharpe's Single Index Model under the Indian context, especially considering the securities of companies traded through the NSE which is one of the largest stock exchange in the world and which is considered as one of the major attractions to any investor, either individual or institutional.

NEED FOR THE STUDY

Every investor undergoes confusion while selecting securities for his portfolio. He also faces dilemma while deciding about the proportion of investment to be made in each security. 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. The present study is undertaken to prove that by applying this model an individual can construct a portfolio with maximum return for a given level of risk.

STATEMENT OF THE PROBLEM

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. Though Markowitz Model enables an investor to arrive at an optimal portfolio, the Single index model is helpful in avoiding the difficulty of data input and time cost consideration. Therefore, the present study is entitled, 'Construction of optimal equity portfolio with application of Sharpe single index model -A comparative study on IT and PHARMA sectors'.

OBJECTIVES OF THE STUDY

The following are the objectives of the study:

- 1) To understand the application of Sharpe's index model in order to take effective investment decisions
- 2) To calculate return and risks of selected stocks in the IT and PHARMA sectors
- 3) To calculate beta values for all selected stocks in both sectors to identify the nature of stocks
- 4) To construct an optimal portfolio with IT sector stocks and PHARMA sector stocks and compare two portfolios by portfolio return and portfolio risk and select best portfolio

SCOPE OF THE STUDY

The scope of the present study is relating to equity portfolio construction with IT stocks and PHARMA stocks from the NSE. In this study researcher considered stocks which are included in the NSE IT INDEX and PHARMA INDEX. Other stocks in the related sectors have not been taken for the portfolio analysis. Present study confined to stocks listed at national stock exchange (NSE) only.

RESEARCH METHODOLOGY

The study is mainly based on secondary data. The present study had been undertaken to construct optimal portfolios from the IT stocks and PHARMA stocks and compare the portfolio returns and risks of two portfolios using Sharpe single index model. For this purpose, took NSE as reference stock market. Nifty 500 index has been taken as bench mark market index for the purpose of measuring market return and market variance. A sample of 20 Stocks in NSE's IT and PHARMA Indices were taken for portfolio analysis. Purposive sampling method is followed to select stocks to compare portfolio return and risks of IT and PHARMA sectors. Monthly closing values of stocks and market index for eight years from April 2009 to March 2017 had been taken for calculation of mean return, risk and other data inputs for the portfolio construction. This period is chosen to identify the performance of stocks after the world financial crisis 2008 which affected drastically stock markets at international level. **91 days treasury bills yields** average return for same period has been used as proxy for risk-free rate sourced from "RBI". April 1, 2017 has been taken as base date for the selection of stocks in indices. Required data were collected from the sources of www.nseindia.com / www.moneycontrol.com. Collected data were analysed with the help of Microsoft Excel software for the calculation of mean return, standard deviation, variance, covariance, correlation, beta, alpha and residual variance or random error term.

DATA ANALYSIS AND INTERPRETATION

Measurements of market index return, risk, variance and risk free rate of return:

INDEX	RETURN %	RISK %	VARINCE	91 DAYS T - BILL RETURN
CNX NIFTY 500	1.4800	6.0880	37.0636	7.2044

Measurement of return, risk, alpha, beta and residual variance for individual stocks in IT sector and comparing them in the sector:

Table I

SECURITY	RETURN	RISK	BETA	ALPHA	RESIDUAL VARIANCE
MARET	1.4800	6.0880			
HCL TECHNOLOGIES	3.3751	8.8981	0.6407	2.4269	63.9642
INFOSYS	1.4881	7.8365	0.4101	0.8812	55.1766
KPIT TECHNOLOGIES	3.5261	15.6189	0.7992	2.3434	220.2799
MINDTREE	2.8233	10.8144	0.6072	1.9246	103.2862
ORACLE FINANCIAL SERVICES	2.0361	8.2807	0.7435	0.9356	48.0798
TATA CONSULTANCY SERVICES	2.5600	7.2361	0.3731	2.0078	47.2001
TATA ELXSI	3.9577	14.5311	1.2343	2.1309	154.6839
TECH MAHINDRA	2.6079	11.3136	0.8554	1.3419	100.8802
WIPRO	1.6612	8.6194	0.5583	0.8350	62.7425

INTERPRETATION

From the above table we can find that TATA ELXSI company stock offering the highest mean return (3.9577%) and followed by KPIT TECHNOLOGIES (3.5261%). INFOSYS providing the lowest return (1.48%) in IT sector. When come to risk among all IT companies KPIT TECHNOLOGIES having the highest risk (15.62%) and followed by TATA ELXSI (14.53%). TATA CONSULTANCY SERVICES bearing the lowest risk (7.23%). Among all IT stocks TATA ELXSI having the highest beta value (1.23) and followed by TECH MAHINDRA. TATA CONSULTANCY SERVICES has the lowest beta. HCL TECHNOLOGIES has the highest alpha value and WIPRO has lowest Alpha value. KPIT TECHNOLOGIES has the highest unsystematic risk and TATA CONSULTANCY SERVICES has lowest unsystematic risk.

Measurement of return, risk, alpha, beta and residual variance for individual stocks in PHARMA sector and comparing them in the sector:

Table II

SECURITY	RETURN	RISK	BETA	ALPHA	RESIDUAL VARIANCE
MARET	1.4800	6.0880			
AUROBINDO PHARMA	4.7435	14.5495	1.6390	2.3178	112.1230
CADILA HEALTHCARE	2.9407	7.9263	0.3231	2.4625	58.9575
CIPLA	1.2786	7.0285	0.2753	0.8712	46.5913
DIVIS LABORATORIES	1.4130	8.8839	0.4237	0.7858	72.2693
DR REDDY'S LABORATORIES	2.0464	7.5300	0.3734	1.4938	51.5343
GLAXO SMITHKLINE	1.1781	6.6780	0.2172	0.8566	42.8474
GLENMARK PHARMA	2.1200	8.4072	0.5172	1.3546	60.7659
LUPIN	2.7589	7.4715	0.2904	2.3291	52.6982
PIRAMAL ENTERPRISES	2.7102	8.1449	0.4078	2.1067	60.1760
SUNPHARMA	2.1853	7.4126	0.2725	1.7821	52.1957

INTERPRETATION

From the table, we can observe that AUROBINDO PHARMA offering the highest mean return (4.74%) and followed by CADILA HEALTHCARE (2.94%) and LUPIN (2.75%). At the same time we can say that GLAXO SMITHKLINE offering the lowest mean return (1.17%) than others. AUROBINDO PHARMA is bearing the highest risk (14.54%) and followed by DIVIS LABORATORIES (8.88%). GLAXO SMITHKLINE has the lowest risk (6.67%). Among all PHARMA stocks AUROBINDO PHARMA having highest beta value and followed by GLENMARK PHARMA. GLAXO SMITHKLINE has the lowest beta. CADILA HEALTHCARE has the highest alpha value and DIVIS LABORATORIES has lowest Alpha

value. AUROBINDO PHARMA has the highest unsystematic risk and GLAXO SMITHKLINE has lowest unsystematic risk.

PORTFOLIO ANALYSIS FOR AUTO SECTOR STOCKS

Ranking of IT stocks on the basis of excess return to beta value where $R_f = 7.2044\%$ p.a. = 0.6004% per month is taken.

We can assign ranks under SIM by calculating risk premium to beta ratio. Risk premium means the difference between mean return of a security and risk free rate of return. We assign first rank to a stock which is having high risk premium to beta ratio, next rank will give to next highest risk premium to beta ratio, like that we will assign ranks to all stocks. The following table shows calculations for assigning ranks:

Table III

SECURITY	RETURN %	BETA	$(R_i - R_f)$	$\left(\frac{R_i - R_f}{B_i}\right)$	RANK
TATA CONSULTANCY SERVICES	2.5600	0.3731	1.9596	5.2516	1
HCL TECHNOLOGIES	3.3751	0.6407	2.7747	4.3310	2
KPIT TECHNOLOGIES	3.5261	0.7992	2.9257	3.6610	3
MINDTREE	2.8233	0.6072	2.2229	3.6609	4
TATA ELXSI	3.9577	1.2343	3.3573	2.7200	5
TECH MAHINDRA	2.6079	0.8554	2.0075	2.3469	6
INFOSYS	1.4881	0.4101	0.8877	2.1646	7
ORACLE FINANCIAL SERVICES	2.0361	0.7435	1.4357	1.9308	8
WIPRO	1.6612	0.5583	1.0608	1.9001	9

Calculations for determining the cut off rate 'C*'

The major problem in the portfolio construction is selection of stocks those stocks would be included in the portfolio and how much proportion of funds to be invested in each stock. For this purpose we should calculate C_i values for all stocks and should determine cut-off point (C^*) in

order to decide which stocks could include into portfolio and which stocks should exclude from the list of stocks. We determine C^* by selecting highest C_i value in the list of C_i values. We select all the stocks above the C^* into portfolio and eliminate all stocks below C^* from the list of stocks for the portfolio construction.

C_i values for all the stocks according to the ranked order are computed using the following formula:

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

σ_{ei}^2 = unsystematic risk

β = beta value of individual security

σ_m = market index risk

$R_i - R_f$ = excess return

Measurement of C_i values for the stocks in IT sector:

Table IV

SECURITY	RANK	$\left(\frac{R_i - R_f}{B_i}\right)$	$\frac{((R_i - R_f)B_i)}{\sigma_{ei}^2}$	$\frac{\beta_i^2}{\sigma_{ei}^2}$	$\sum_{i=1}^n \frac{((R_i - R_f)B_i)}{\sigma_{ei}^2}$	$\sum_{i=1}^n \frac{\beta_i^2}{\sigma_{ei}^2}$	C_i values
TATA CONSULTANCY SERVICES	1	5.2516	0.0155	0.0029	0.0155	0.0029	0.5176
HCL TECHNOLOGIES	2	4.3310	0.0278	0.0064	0.0433	0.0094	1.1908
KPIT TECHNOLOGIES	3	3.6610	0.0106	0.0029	0.0539	0.0123	1.3733
MINDTREE	4	3.6609	0.0131	0.0036	0.0670	0.0158	1.5640
TATA ELXSI	5	2.7200	0.0268	0.0098	0.0938	0.0257	1.7802
TECH MAHINDRA	6	2.3469	0.0170	0.0073	0.1108	0.0329	1.8488
INFOSYS	7	2.1646	0.0066	0.0030	0.1174	0.0360	1.8641
ORACLE FINANCIAL SERVICES	8	1.9308	0.0222	0.0115	0.1396	0.0475	1.8744
WIPRO	9	1.9001	0.0094	0.0050	0.1490	0.0525	1.8760

X_i and Z_i are to be determined to know how much funds needs to be invested in each security using the following formula:

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

Where,

X_i = proportion of investment

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

σ_{ei}^2 = unsystematic risk

β = beta value of individual security

$R_i - R_f$ = excess return

C^* = cut off point

Calculation of Z_i and X_i for the selected securities in the optimal portfolio:

Table V

SECURITY	$\left(\frac{R_i - R_f}{\beta_i} \right)$	$\frac{\beta_i^2}{\sigma_{ei}^2}$	$\left(\frac{R_i - R_f}{\beta_i} \right) - C^*$	Z_i	X_i %
TATA CONSULTANCY SERVICES	5.2516	0.0029	3.3756	0.0100	0.1968
HCL TECHNOLOGIES	4.3310	0.0064	2.4550	0.0158	0.3113
KPIT TECHNOLOGIES	3.6610	0.0029	1.7850	0.0052	0.1023
MINDTREE	3.6609	0.0036	1.7849	0.0064	0.1259
TATA ELXSI	2.7200	0.0098	0.8440	0.0083	0.1643
TECH MAHINDRA	2.3469	0.0073	0.4709	0.0034	0.0675
INFOSYS	2.1646	0.0030	0.2886	0.0009	0.0174
ORACLE FINANCIAL SERVICES	1.9308	0.0115	0.0548	0.0006	0.0125
WIPRO	1.9001	0.0050	0.0241	0.0001	0.0024
				$\sum Z_i = 0.0506$	$\sum W_i = 1$

Measurement of portfolio beta, alpha and portfolio residual variance:**Table VI**

SELECTED SECURITY IN THE OPTIMAL PORTFOLIO	ALPHA	BETA VALUE	PROPORTION OF INVESTMENT	σ_{ei}^2	$X_i \cdot \alpha_i$	$X_i \cdot \beta_i$	$X_i \cdot \sigma_{ei}^2$
TATA CONSULTANCY SERVICES	2.0078	0.3731	0.1968	47.2001	0.3951	0.0734	9.2887
HCL TECHNOLOGIES	2.4269	0.6407	0.3113	63.9642	0.7556	0.1995	19.9140
KPIT TECHNOLOGIES	2.3434	0.7992	0.1023	220.2799	0.2397	0.0817	22.5293
MINDTREE	1.9246	0.6072	0.1259	103.2862	0.2423	0.0765	13.0054
TATA ELXSI	2.1309	1.2343	0.1643	154.6839	0.3501	0.2028	25.4117
TECH MAHINDRA	1.3419	0.8554	0.0675	100.8802	0.0906	0.0577	6.8093
INFOSYS	0.8812	0.4101	0.0174	55.1766	0.0153	0.0071	0.9592
ORACLE FINANCIAL SERVICES	0.9356	0.7435	0.0125	48.0798	0.0117	0.0093	0.5991
WIPRO	0.8350	0.5583	0.0024	62.7425	0.0020	0.0013	0.1486
					$\alpha_p =$ 2.1023	$B_p =$ 0.7093	$\sigma_{ep}^2 =$ 98.6652

Measuring portfolio return and risk for IT sector, according to Sharpe Single Index Model:

According to Sharpe single index model to calculate portfolio return and risk, we can apply the following equations:

For portfolio return

$$R_p = \alpha_p + B_p R_m$$

R_p = portfolio return

α_p = portfolio specific return

B_p = beta of the portfolio

R_m = market return

For portfolio variance

$$\sigma_p^2 = B_p^2 \sigma_m^2 + \sigma_{ep}^2$$

σ_p^2 = portfolio variance

σ_m^2 = market variance

σ_{ep}^2 = portfolio residual variance

Portfolio risk = σ_p

$$\sigma_p = \sqrt{\sigma_p^2}$$

By substituting the above inputs we can measure the portfolio return and risk:

Portfolio return

$$R_p = 2.1023 + (0.7093 * 1.4800)$$

$$R_p = 3.1520 \%$$

Portfolio variance

$$\sigma_p^2 = (0.7093)^2 37.0636 + 98.6652$$

$$\sigma_p^2 = 18.6471 + 98.6652$$

$$\sigma_p^2 = 117.3123$$

$$\sigma_p = 10.8311 \%$$

PORTFOLIO ANALYSIS FOR PHARMA SECTOR STOCKS

Ranking of PHARMA stocks on the basis of excess return to beta value where $R_f = 7.2044\%$ p.a. = 0.6004% per month is taken:

Table VII

SECURITY	RETURN	BETA	$(R_i - R_f)$	$\left(\frac{R_i - R_f}{B_i}\right)$	RANK
LUPIN	2.7589	0.2904	2.1585	7.4326	1
CADILA HEALTHCARE	2.9407	0.3231	2.3403	7.2433	2
SUNPHARMA	2.1853	0.2725	1.5849	5.8172	3
PIRAMAL ENTERPRISES	2.7102	0.4078	2.1098	5.1739	4

DR REDDY'S LABORATORIES	2.0464	0.3734	1.4460	3.8729	5
GLENMARK PHARMA	2.1200	0.5172	1.5196	2.9381	6
GLAXO SMITHKLINE	1.1781	0.2172	0.5777	2.6597	7
AUROBINDO PHARMA	4.7435	1.6390	4.1431	2.5278	8
CIPLA	1.2786	0.2753	0.6782	2.4636	9
DIVIS LABORATORIES	1.4130	0.4237	0.8126	1.9176	10

Calculations for determining the cut off rate 'C*':

Table VIII

SECURITY	RANK	$\left(\frac{R_i - R_f}{B_i}\right)$	$\frac{((R_i - R_f)B_i)}{\sigma_{ei}^2}$	$\frac{\beta_i^2}{\sigma_{ei}^2}$	$\sum_{i=1}^n \frac{((R_i - R_f)B_i)}{\sigma_{ei}^2}$	$\sum_{i=1}^n \frac{\beta_i^2}{\sigma_{ei}^2}$	Ci values
LUPIN	1	7.4326	0.0119	0.0016	0.0119	0.0016	0.4162
CADILA HEALTHCARE	2	7.2433	0.0128	0.0018	0.0247	0.0034	0.8144
SUNPHARMA	3	5.8172	0.0083	0.0014	0.0330	0.0048	1.0384
PIRAMAL ENTERPRISES	4	5.1739	0.0143	0.0028	0.0473	0.0076	1.3692
DR REDDY'S LABORATORIES	5	3.8729	0.0105	0.0027	0.0578	0.0103	1.5511
GLENMARK PHARMA	6	2.9381	0.0129	0.0044	0.0707	0.0147	1.6977
GLAXO SMITHKLINE	7	2.6597	0.0029	0.0011	0.0736	0.0158	1.7225
AUROBINDO PHARMA	8	2.5278	0.0606	0.0240	0.1342	0.0397	2.0117
CIPLA	9	2.4636	0.0040	0.0016	0.1382	0.0414	2.0225
DIVIS LABORATORIES	10	1.9176	0.0048	0.0025	0.1430	0.0438	2.0188

Calculation of Zi and Xi for the selected securities in the optimal portfolio:

Table IX

SECURITY	$\left(\frac{R_i - R_f}{B_i}\right)$	$\frac{\beta_i^2}{\sigma_{ei}^2}$	$\left(\frac{R_i - R_f}{B_i}\right) - C^*$	Zi	Xi %
LUPIN	7.4326	0.0016	5.4101	0.0087	0.1586
CADILA HEALTHCARE	7.2433	0.0018	5.2208	0.0092	0.1693
SUNPHARMA	5.8172	0.0014	3.7947	0.0054	0.0988
PIRAMAL ENTERPRISES	5.1739	0.0028	3.1514	0.0087	0.1595
DR REDDY'S LABORATORIES	3.8729	0.0027	1.8504	0.0050	0.0917
GLENMARK PHARMA	2.9381	0.0044	0.9156	0.0040	0.0738
GLAXO SMITHKLINE	2.6597	0.0011	0.6372	0.0007	0.0128
AUROBINDO PHARMA	2.5278	0.0240	0.5053	0.0121	0.2217
CIPLA	2.4636	0.0016	0.4411	0.0007	0.0131
				$\sum Zi =$ 0.0546	$\sum Wi =$ 1

Among PHARMA sector stocks, AUROBINDO PHARMA got highest proportion of investment (22%) and followed by CADILA HEALTHCARE (17%).

Measurement of portfolio beta, alpha and portfolio residual variance:

Table X

SELECTED SECURITY IN THE OPTIMAL PORTFOLIO	ALPHA	BETA VALUE	PROPORTION OF INVESTMENT	σ_{ei}^2	$Xi * \alpha_i$	$Xi * \beta_i$	$Xi * \sigma_{ei}^2$
LUPIN	2.3291	0.2904	0.1586	52.6982	0.3693	0.0460	8.3564
CADILA HEALTHCARE	2.4625	0.3231	0.1693	58.9575	0.4169	0.0547	9.9816
SUNPHARMA	1.7821	0.2725	0.0988	52.1957	0.1761	0.0269	5.1591
PIRAMAL ENTERPRISES	2.1067	0.4078	0.1595	60.1760	0.3360	0.0650	9.5973
DR REDDY'S LABORATORIES	1.4938	0.3734	0.0917	51.5343	0.1369	0.0342	4.7244

GLENMARK PHARMA	1.3546	0.5172	0.0738	60.7659	0.1000	0.0382	4.4859
GLAXO SMITHKLINE	0.8566	0.2172	0.0128	42.8474	0.0110	0.0028	0.5506
AUROBINDO PHARMA	2.3178	1.6390	0.2217	112.1230	0.5139	0.3634	24.8614
CIPLA	0.8712	0.2753	0.0131	46.5913	0.0114	0.0036	0.6123
					α_p =2.0717	B_p =0.635	$\sigma_{ep}^2 =$ 68.3289

Measuring portfolio return and risk for PHARMA sector, according to Sharpe Single Index Model:

By substituting the above inputs we can measure the portfolio return and risk:

Portfolio return

$$R_p = 2.0717 + (0.635 * 1.4800)$$

$$R_p = 3.0115 \%$$

Portfolio variance

$$\sigma_p^2 = (0.635)^2 * 37.0636 + 68.3289$$

$$\sigma_p^2 = 14.9448 + 68.3289$$

$$\sigma_p^2 = 83.2737$$

$$\sigma_p = 9.1254 \%$$

Comparison of portfolio return and risks for IT sector stocks and PHARMA sector stocks:

PORTFOLIOS	PORTFOLIO RETURN	PORTFOLIO RISK
IT SECTOR	3.1520 %	10.8311%
PHARMA SECTOR	3.0115 %	9.1254 %

FINDINGS

1. Sharpe single index model gives an easiest model for portfolio construction, which requires less number of inputs ($3n + 2$) when compared to Markowitz model.

2. From the study it was found that IT sector stocks offering slightly higher returns than the PHARMA sector stocks and also they were bearing high risks.
3. In the IT sector TATA ELEXI offering highest mean return and INFOSYS having lowest mean return. KPIT TECHNOLOGIES bearing highest risk and TCS bearing lowest risk.
4. In the PHARMA sector AUROBINDO PHARMA is offering the highest mean return and GLAXO SMITHKLINE having lowest mean return. AUROBINDO PHARMA bearing the highest risk and GLAXO SMITHKLINE bearing lowest risk.
5. Except TATA ELEXI all IT stocks listed as defensive stocks and Except AUROBINDO PHARMA all PHARMA stocks listed as defensive stocks.
6. In the IT sector HCL TECHNOLOGIES has the highest ALPHA value and WIPRO having lowest ALPHA value.
7. In the PHARMA sector CADILA has the highest ALPHA value and DIVIS LABORATORIES having lowest ALPHA value.
8. In the IT sector KPIT TECHNOLOGIES having the highest unsystematic risk and TCS having lowest unsystematic risk.
9. In the PHARMA sector AUROBINDO PHARMA having the highest unsystematic risk and GLAXO SMITHKLINE having lowest unsystematic risk.
10. In the list of IT stocks all 9 stocks are included in optimal portfolio due to C_i values of all stocks are met cut-off criteria.
11. In the list of PHARMA stocks except DIVIS LABORATORIES all stocks are included in optimal portfolio.
12. Portfolio with IT sector stocks providing the highest return (3.1520 %) and risk (10.8311%) when compared to portfolio with PHARMA sector stocks which consists portfolio return (3.0115 %) and portfolio risk (9.1254 %).

RECOMENDATIONS

So far it is clear that the construction of optimal portfolio by using Sharpe's Single Index Model is easier and more comfortable than any other portfolio models. Thus two optimal portfolios are constructed by selecting nineteen companies, 9 companies from IT sector which are constituents

of NIFTY IT INDEX listed in NSE and 10 companies from PHARMA sector which are constituents of NIFTY PHARMA INDEX listed in NSE. After calculating the “cut-off “Values for the IT sector sample companies out of 9 companies, nine were selected for the optimal portfolio construction, they are TATA CONSULTANCY SERVICES, HCL TECHNOLOGIES, KPIT TECHNOLOGIES, MINDTREE, TATA ELXSI TECH MAHINDRA, INFOSYS, ORACLE FINANCIAL SERVICES and WIPRO. In the sample of PHARMA sector companies, nine were selected out of 10 companies for the optimal portfolio construction. They are LUPIN, CADILA HEALTHCARE, SUNPHARMA, PIRAMAL ENTERPRISES, DR REDDY’S LABORATORIES, GLENMARK PHARMA, GLAXO SMITHKLINE, AUROBINDO PHARMA and CIPLA. In the two portfolios, portfolio with IT sector companies offering slightly higher return (3.15%) and bearing the highest risk (10.83%). Portfolio with PHARMA sector companies offering return to (3.01%) and bearing the lowest risk (9.1254%). From the above remarks it can be concluded that both sectors offering more or less same return but PHARMA sector portfolio having less risk when compared to IT sector. Here can suggest to the individual investors and portfolio managers to take investment decisions to invest in PHARMA stocks for moderate expected return and risk, than the IT sector stocks. This study helps the investors to minimize their investment risk and maximize the return to their investment. It can be suggested to risk aversors to invest in portfolio with PHARMA stocks.

Investing in individual securities is associated with high risk, where as investing in a portfolio of securities helped to spread the risk of many securities and thus reducing overall risk involved. Portfolios, which are combinations of securities, tend to spread risk over many securities and thus help to reduce the overall risk involved. This method of construction of optimal portfolio is very effective and convenient as revision of the optimal portfolio can be an ongoing exercise. The existence of a cut-off rate is also extremely useful because the newest securities that have an excess return-to beta ratio to the cut-off rate can be included in the optimal portfolio.

SCOPE FOR THE FORTHER RESEARCH

The present study has been taken on the topic of construction of optimal portfolios with the IT sector and PHARMA sector stocks. Here there is a scope for the further research that is to construct and Compare optimal port folios with other sectoral stocks like public sector banks and

private sector banks and metals and media. There is further scope to study on construction of diversified optimal portfolio with stocks of different sectors. In this paper the researcher used the Sharpe single index model for optimal portfolio construction. So here there is possibility to study on optimal portfolio construction with the capital asset pricing model.

CONCLUSION

Thus 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, but the daily market fluctuation based on international financial queues and emotions resulted in security price fluctuations beyond the predicted risk levels.

LIMITATIONS OF THE STUDY

The limitations of the present study are:

- The study uses monthly closing prices of stocks instead of daily closing prices of stocks.
- Only 20 companies had been selected for conducting this study 10 from IT sector and 10 from PHARMA sector. Among twenty companies, one company has excluded from the analysis due to insufficient data.
- The results of the study may not be universally applicable. The study was conducted in Indian context only.
- Here was taken few IT and PHARMA stocks for portfolio analysis out of all listed IT and PHARMA companies.

BIBLIOGRAPHY

BOOKS:

1. Punithavathy pandian, Security Analysis Portfolio Management, Second edition, VIKAS publishing house Pvt Ltd.
2. V.K Bhalla, Investment Management, 14th edition, S. CHAND Company Ltd.
3. Prasanna Chandra, Investment Analysis and Portfolio Management, 3rd edition, TATA Mc Graw – Hill.
4. S. Kevin, Security Analysis and Portfolio Management, Eastern economy edition, Prentice hall of India.

JOURNALS:

1. Chintan A. Shah, Construction of Optimal Portfolio Using Sharpe Index Model & Camp for BSE Top 15 Securities, IJRAR- International Journal of Research and Analytical Reviews, VOLUME 2, ISSUE 2, APRIL - JUNE 2015, pp. 168-178.
2. Dr. Niranjana Mandal, (2013), "Optimal Portfolio Construction by using Sharpe's Single Index Model ", the journal of institute of public enterprise, Volume-36, No 1&2, pp: 21-44.
3. Dr. S Poornima and Aruna. P. Remesh, Construction of Optimal Portfolio using Sharpe's Single Index Model: A Study with Reference to Automobiles and Pharmaceutical Sector, International Journal of Advance Research in Computer Science and Management Studies, Volume 4, Issue 3, March 2016, pp. 159-163.
4. J. Francis Mary and G. Rathika, the single index model and the construction of optimal portfolio with CNX PHARMA scrip, International Journal of Management (IJM), ISSN 0976 – 6502(Print), ISSN 0976 - 6510(Online), Volume 6, Issue 1, January (2015), pp. 87-96.
5. Ms Apurva and A Chauhan, A Study on Usage of Sharpe's Single Index Model In Portfolio Construction With Reference To Cnx Nifty, GJRA - GLOBAL JOURNAL FOR RESEARCH ANALYSIS, Volume-3, Issue-10, Oct-2014 • ISSN No 2277 – 8160, pp. 92-94.
6. Saravanan, A & Natarahan, P 2012, 'Optimal Portfolio Construction with Nifty Stocks', Advances In Management, Vol. 5(8) Aug., pp. 4-53.
7. Sarker, Mokta Rani (2013), " Optimal Portfolio Construction: Evidence from Dhaka Stock Exchange , Bangladesh", World Journal of Social Sciences, 3 (6), pp: 75-87.

WEBSITES:

www.nseindia.com

www.moneycontrol.com

www.rbi.com