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A STUDY ON INDIAN CAPITAL MARKET OF BUILDING AN OPTIMAL EQUITY PORTFOLIO USING SHARPE SINGLE INDEX MODEL

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ABSTRACT

This study was made with the intension of constructing an efficient optimal equity portfolio. The present study has used the Sharpe Single Index model to construct an optimal portfolio in the Indian Capital Market listed with NSE. For the present study 14 stocks were selected, daily closing price data were collected for the period January 2020 to January 2022. Where risk and return are determined and based on the cutoff point the selected companies' portfolio construction is determined. The selection of securities is made based on the return and excess return to beta ratio. Standard deviation is the process wherein it is used to measure the variability of the securities and the relationship of the mean variable of the securities for the chosen stock. Cut-off rate helped to identify the securities and the investment proportion to be made on those securities.

Keywords: Portfolio, Mean return, Beta, Standard deviation and Sharpe Index Model

1. INTRODUCTION

The ideal investment objective is to build an optimal investment portfolio. An investment portfolio that is able to provide maximum return at a certain level of risk. Every investor has basic instincts either he's a risk-taker or risk-averse. Sharpe's model is just an extension of Markowitz's method of Portfolio Diversification. This optimal portfolio of Sharpe is called the Single Index Model(SIM). Sharpe simplified the process of the Markowitz Model by reducing many complexities in a substantial manner.

The model has been developed by William Sharpe in 1963 and is commonly used in the finance industry. Sharpe, therefore, gave investors to select the best portfolio to get adequate returns and additionally gave the theory to determine their investment ratios in every scrip. This model requires only (3n+2) data inputs i.e., estimates of alpha (α) and beta (β) for each security, estimate of unsystematic risk ($\sigma2ei$) for each security, estimate for expected return on market index and estimates of variance of return on the market index ($\sigma2m$). Due to this simplicity, Sharpe's single index model has gained its popularity to a great extent in the arena of investment finance as compared to Markowitz's model.

Sharpe (1964) assumed that investors are homogeneous in nature and are expected to agree on the expected returns, standard deviations and correlations of the securities or stocks in chosen portfolio. However, Sharpe single index model create optimal portfolio using "Beta". Beta is simply a measure of sensitivity of stock to market movement.Sharpe finds the beta relationship to be the most significant in the portfolios, it shows the volatility or movement of stock.

2. LITERATURE REVIEW

Mokta Rani Sarker (2013) examined the 164 companies by considering monthly closing prices to construct a portfolio by using Sharpe index model during July 2007 to June 2012 from Dhaka stock exchange. The objective of the paper was to construct a portfolio and proportion of investments by calculating cut off rate and also to suggest investors and market makers to make better decisions in portfolio. Portfolio was constructed by selecting 33 stocks, out of 164 stocks based on SIM model. Further, the researcher has analyzed by calculating Portfolio Alpha, Beta, Risk and return.

Optimal Portfolio Selection Using Sharpe's Single Index Model by **M. Muthu Gopalakrishnan (2014)** the objective of this study was to test whether single index model offers an appropriate explanation of stock returns on stocks. The sample in the study consists of 13 actively traded scripts listed in the National Stock Exchange Limited, Bombay (NSE).The script in the sample are selected from NSE index. It was found that there is a significant relationship and a good explanation of index over S&P CNX Nifty.

Dr. Sathya Swaroop Debasish and Jakki Samir Khan (2012) conducted a study on the optimal portfolio construction in the Indian stock market using the Sharpe single index model. They selected 14 stocks from various manufacturing sectors of India they decided the various manufacturing sectors like Automobiles, Cement, Paints, Textiles, and Oil & Refineries. They found that the simplest 3 companies' stocks constitute the optimum

portfolio and these were Asian Paints, Tata Motors, and Hero Motor Corp. with an ideal share of investment of 1.9 %, 38.88%, and 58.22% respectively.

Dr. R. Rajkumar and S. Vinoth (2014) recognition of this study is to construct the optimal portfolio in the Indian stock market with the help of the Sharpe single index model. In this study, five selected shares from Automobiles companies were considered and these stocks are constituents of the BSE Sensex index. Daily data for all of the stocks for the duration from April first, 2008 to March thirty-first, 2013 were considered. The study observed that the simplest organization stocks represent the optimum portfolio and these were Bajaj Auto Limited and Tata vehicles with a perfect share of investment of 71% and 29% respectively.

Gupta, R. and Parikshit K. Basu (2012) wants Portfolio optimization in the Indian stock market -industry sector analysis. Study has estimated the dynamics of correlations using daily market data for the period April 1997 to April 2007 on a sample of 10 industry sectors selected randomly indicates that investors can substantially improve their reward to risk as compared with the market returns. Sharpe ratio of the optimized portfolio improves to 0.994 (for optimized portfolio) from 0.527 (for S&P Nifty index).

3. RESEARCH OBJECTIVES

- To calculate Risk and Return of Stocks listed in Nifty 50.

- To calculate proportion for each stock to be invested in portfolio.

- To construct an Optimal Portfolio for Stocks listed in Nifty 50.

4. RESEARCH METHODOLOGY

The data used for the study is mainly secondary in nature. It is collected from various sources such as published journals and websites of NSE. Closing prices of NSE 15 stocks are collected from the website of National Stock Exchange.

Return:

The risk return model suggested by Sharpe is:

$R_i = \alpha_i + \beta_i I + e_i$ (1)

Where;

R_i = expected return on security i

α_i = alpha coefficient

β_i = beta coefficient

I = expected return on index (market)

e_i = error term with the mean of zero

Framework for Mean Return on various stocks: Mean return stock is calculated on the selected stocks in financial industry by analyzing the current price divided by the preceding previous price to estimate the percentage of the return for the current financial year.

$$R_{it} = P_{it}/P_{it-1} - 1$$

Where

P_t, $P_i^{(t-1)}$ are the share price at time t and

t-1 for security i.

R_{it}= Return on security 'i' at time 't'.

t= price of security at time "t"

t-1= price of security a year earlier or whenportfolio was constructed if it's only a year old.

Calculation of Excess Return to Beta: The selection of any stock is directly related to its excess return - beta ratio

Excess return = $R_i - R_f / \beta_i$

Where

R_i = the expected return on stock i;

R_f = the return on a riskless asset and

β_i = the expected change in the rate of return on stock i associated with one unit change in the market return. This ratio provides a relationship between potential risk and reward.

Calculation of Cut-Off point : Ranking of the stocks is done on the basis of their excess return to beta. Portfolio managers would like to include stocks with higher ratios. The selection of the stocks depends on a unique cut –off rate such that all stocks with higher ratios of $(R_i – R_f) / \beta_i$ are included and the stocks with lower ratios are left out. The cutoff point is denoted by C*.

$$\text{Cut-off Rate } C_i = \frac{\sigma m^2 \sum_{t=1}^{J} \frac{(Ri - Rf)\,\beta_i}{\sigma ei}}{1 + \sigma m^2 \sum_{t=1}^{J} \frac{\beta i^2}{\sigma ei^2}}$$

Where;

σ_m^2 = variance in the market index.

σ_{ei}^2 = variance in unsystematic risk.

5. DATA ANALYSIS AND INTERPRETATION

Table 1showing descriptive statistics of nifty company

Company Name	Mean Return	SD	Beta	σ_{ei}^2
HCL Technologies LTD	0.0019	2.12%	0.055	-0.05292
Housing Development Finance Corporation	0.0005	2.47%	0.045	-0.04499
Oil & Natural Gas Corporation LTD	0.0009	2.96%	0.058	-0.05662
Divis Laboratories	0.0020	2.01%	0.013	-0.01136
Tata Consultancy Services	0.0013	1.83%	0.052	-0.05018
Tata Consumer Products	0.0017	2.24%	0.029	-0.02710
Tech Mahindra	0.0019	2.27%	0.026	-0.02423
Sun Pharmaceuticals Industries	0.0015	2.06%	0.007	-0.00510
Reliance	0.0012	2.38%	0.035	-0.03381
NTPC LTD	0.0004	2.11%	0.023	-0.02257

Grasim Industries	0.0021	2.44%	0.072	-0.06951
Shree Cements	0.0005	2.10%	0.034	-0.03319
Larsen & Toubro LTD	0.0010	2.14%	0.009	-0.00826
SBI Life Insurance Company	0.0007	2.10%	0.038	-0.03722

From the above table 1, Beta value of an industry indicates the relationship of company with that of market. Securities whose beta values are greater than 1 are highly sensitive. Securities whose beta value is equal to 1 are strongly correlated to the market and Securities whose beta value is lesser than 1 are less volatile than market. Residual variance shows the difference between return companies and market.Oil and Natural Gas Corporation has higher risk 2.96% and Tata Consultancy Services has lower risk of 1.83%.

Table 2 showing excess return and ranking:

Company Name	$(\beta i2)$	σ_{ei}^2	$(Ri - Rf)*\beta i/ \sigma ei2$	$\Sigma(Ri - Rf)*\beta i/ \sigma ei2$	$\beta i2/ \sigma ei2$	$\Sigma\beta i2/ \sigma ei2$	C	Rank
HCLTECH	0.003	-0.12892	0.0315060	0.0598927	-0.0232985	-0.040402	0.0000287	6
HDFC	0.0021	-0.12099	0.0283867	0.0609643	-0.0171035	-0.042086	0.0000278	7
ONGC	0.0033	-0.13262	0.0325776	0.0438715	-0.0249822	-0.027015	0.0000248	11
DIVISLAB	0.0002	-0.08736	0.0112939	0.0417764	-0.0020330	-0.023064	0.0000275	8
TCS	0.0027	-0.12618	0.0304825	0.0512548	-0.0210307	-0.029097	0.0000326	3
TATACONSUM	0.0008	-0.10310	0.0207723	0.0400713	-0.0080661	-0.014857	0.0000371	1
TECHM	0.0007	-0.10023	0.0192990	0.0253399	-0.0067911	-0.007324	0.0000265	10
SUNPHARMA	4E-05	-0.08110	0.0060409	0.0298928	-0.0005328	-0.011703	0.0000268	9
RELIANCE	0.0012	-0.10981	0.0238519	0.0414609	-0.0111698	-0.016516	0.0000367	2
NTPC	0.0005	-0.09857	0.0176090	0.0539773	-0.0053460	-0.040573	0.0000197	13
GRASIM	0.0051	-0.14551	0.0363683	0.0596534	-0.0352271	-0.045606	0.0000207	12
SHREECEM	0.0011	-0.10919	0.0232851	0.0315283	-0.0103790	-0.011397	0.0000296	4
LT	9E-05	-0.08426	0.0082432	0.0334497	-0.0010179	-0.013693	0.0000291	5
SBILIFE	0.0014	-0.11322	0.0252065	0.0252065	-0.0126751	-0.012675	0.0000184	14

From the above calculation, Treasury bill for the above calculation is 3.97 p.a. that is 0.076 per week. It remains same for all the companies. Based on excess return to Beta Grasim ltd. is ranked first, Sun Pharmaceuticals is ranked the lowest. Sun pharmaceutical has -11.34 excess return, Larsen and toubro with -8.10, Divislab with -5.56.

Company Name	Mean Return (Ri)	Rf	Beta (βi)	Ri-Rf	Excess Return (Ri – Rf / βi)
HCLTECH	0.0019	0.076	0.055	-0.0741	-1.35
HDFC	0.0005	0.076	0.045	-0.0755	-1.66
ONGC	0.0009	0.076	0.058	-0.0751	-1.30
DIVISLAB	0.0020	0.076	0.013	-0.0740	-5.56
TCS	0.0013	0.076	0.052	-0.0747	-1.45
TATACONSUM	0.0017	0.076	0.029	-0.0743	-2.58
TECHM	0.0019	0.076	0.026	-0.0741	-2.84
SUNPHARMA	0.0015	0.076	0.007	-0.0745	-11.34
RELIANCE	0.0012	0.076	0.035	-0.0748	-2.14
NTPC	0.0004	0.076	0.023	-0.0756	-3.29
GRASIM	0.0021	0.076	0.072	-0.0739	-1.03
SHREECEM	0.0005	0.076	0.034	-0.0755	-2.24
LT	0.0010	0.076	0.009	-0.0750	-8.10
SBILIFE	0.0007	0.076	0.038	-0.0753	-1.99

Table 3 showing the determination of cut-off point:

Finding excess return beta with residual variance of individual companies and then after summation of it. Similarly, βi2 with residual variance and summation of it. Tata Consumer Products is ranked first, Reliance is ranked on second, Tata Consultancy Service ranks third, the fourth rank is of Shree Cements and the fifth rank is of Larsen & Toubro ltd. The cut-off rate is 0.0000371 of the portfolio.

6. FINDINGS AND CONCLUSION

It is estimated that the Grasim has got the highest return of 0.0021 compared to all other companies which are selected from NSE Nifty for Construction of Portfolio. Grasim has the highest volatile of stock due to systematic risk β = 7.16% and Sun pharmaceutical has low volatile of stock due to systematic risk β = 0.66%Grasim has the highest risk of 0.0026% and Sun pharmaceutical has the lowest risk of 0.00002%.Standard deviation measures the investors volatility of annual stock of returns.

The 365 days T-BILLS are selected from RESERVE BANK OF INDIA i.e. 3.97%per annum (0.076% per week) for calculating excess return of stock. For construction of Optimal Portfolio 14 companies was taken from NSE websiteand Tata Consumer Products is ranked as the first to invest.For Optimal portfolio construction 14 companies are selected from NSE website and 5 companies are preferable for construction of the portfolio.It is observed that Sharpe's single index model gives an easy mechanism of constructing an optimal portfolio of stocks for a rational investor by analysing thereason behind the inclusion of securities in the portfolio with their respective weights.

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