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Comparison of Sharpe's Single Index Model and CAPM in Optimum Portfolio Construction

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Abstract
A portfolio is a living and changing collection of records that reflect your accomplishments, skills, experiences, and attributes. this gives a more specified and detailed information with respect to incorporating Optimum Portfolio Construction using Sharpe's Single Index Model as well as CAPM (Capital Asset Pricing Model) approach. The results of Sharpe's SIM with CAPM are carefully evaluated and are compared in order to check the accuracy and acceptability. In order to find out the accuracy and acceptability various calculations are done in connection with Risk, Return, Standard Deviation, Beta, Unsystematic Risk, Cut-off-Rate. The main purpose of ding this research paper is to help all those investor who wants to maximize their Return and minimize their Risk with the help of Constructing Optimum Portfolio.
Keywords: Optimum Portfolio Construction, Sharpe's SIM, CAPM, Cut-off-Rate.

I. Introduction Optimum Portfolio is the method through which an investor understands the risk and returns in the Optimum Portfolio. The portfolio is a blend of stock market securities return and risk. Portfolio construction is the process of selecting the securities with the least amount of risk in order to maximize returns. There are several securities included in the portfolio they are debentures, bonds, stocks and money market instruments. The portfolio construction research project enables an investor to diversify their investment based on risk and return. This suggests investors to get hold of a well assorted portfolio in which they can put their whole wealth in a single or few assets or securities. Risk and return play a vital role in generating returns when making an investment decision. These decisions will help investors determine whether or not they should invest and what inventories should be included in a portfolio to balance investments of investors.

II. Background of the study The portfolio contains variety of securities which are traded in the security market such as Bonds, Debentures, Stocks, Gold Certificate and Money Market Instruments. The process of mixing the big asset classes to get the best return with a little risk is termed as Portfolio Construction. According to Syed Mohammad Faisal the Optimum Portfolio Construction is done with the help of excess of return top beta ration, systematic risk, standard deviation, variance, Cut-off-Rate and other mathematical tools are used to inspect different level of return and risk share market indexes. This includes the identification of the particular values to be invested and the determination of the share of the investor's money to be put in each.

III. Review of Literature Srilakshmi D & Dr Archana H N (2020)[27] the results showed that 21 stocks were bullish over the trial period and benefitted investors continuously with positive returns, whereas nine stocks had a negative trend/return. Bheemeswara Reddy V & Baskaran S (2020)[1] with the Sharpe model, the data necessary for optimum portfolios are substantially reduced In consequence, the Sharpe model sought to build an optimal portfolio. J.K.Panda & Biswajit Rout (2020)[2] In order to establish an optimum portfolio on the basis of its excess returns to beta ratio it is selected equities or securities that are higher than the cutoff rate. Nagendra Marisetty (2019)[18] one with the lowest risk and best returns is an optimum portfolio. The finest and most comprehensive approach to develop an optimum portfolio of NSE NIFTY Shares (SIM) is the Sharpe Index Model.

Imroz Mahmud (2019)[13] For this study, 178 of the 178 firms selected for the optimum portfolio building from the 54 Stock 16 Stock are selected in industry alone and are listed on the Dhaka stock exchange. Dr. B.G. Satyaprasad & Prof. Anusha P.H (2018)[7] In order to find the best mix of assets to be invested in two sectors mentioned the goal of this study was to evaluate Portfolio Performance.. Madan K.M & Dr. Manoj Kumara N. V (2018)[16] They compared the results of Sharper's SIM to CAPM in order to assess accuracy and acceptance. Prof. Guntur Anjana Raju & Ms. Mrunali Jambotkar (2018)[21] the daily closing share prices of the Stocks were used from January 1st, 2007 to October 31st, 2017. The characteristics of selected stocks were evaluated, such as returns similar to accurate and uneven hazards. Dr. Simranjeet Kaur Sandhar & Dr. Neetika Jain (2018)[10] the firms in the sample were advised to be underrated and investors should pick those stocks to adjust their portfolio, with the exception of 3 inventories (Maruti, Tata Steel and HDFC. Yudhia Mulya and Herdiyana (2018)[30] The Single Index Model was used to create the best portfolio using the daily return of stocks on the Jakarta bond during 2016. The findings showed that more equities than the portfolio that had the highest volume of active trading were held on the market. Prof. Raghavendra S Bendigeri (2018)[22] Research data are the secondary statistics on the monthly price of ETFs for the period January 2012 to June 2017 listed on BSE. It proposes that the N100 NASDAQ ETF invests nearly all money.

Sharma (2017)[25] the top 10 stocks comprising the NSE nifty were selected based on market capitalization. On the best portfolios, with the largest share of TCS investments, there were just four of these 10 stocks, the TCS, HUL, ITC and HDFC bank qualified.Tanuj Nandan & Nivedita Srivastava (2017)[28] the single index model is known as the portfolio building index, which employs only one single index. In addition, the proportion of each stock's investment in the optimum portfolio has also been calculated. Dr. Poornima S and Aruna P Ramesh (2017)[8] the ideal portfolio is built using Sharpe's model. Out of 50 selected companies listed in NSE 37 are among the top 5 companies amongst 5 Canara Banks are picked to build optimal portfolios. Laxmi Kant Giri and Dr. Gayadhar Parhi (2017)[15] constructed an optimum portfolio using the Sharpe Model Single Index by taking daily closing prices of all 50 stocks along with the NIFTY Index from the analysis of 50 stocks resulting in the selection of only 5. Soni Rashmi and Banerjee Partha Sarathi (2016)[26] the daily closing price from 3rd May 2010 to 30th April 2015 is taken for study The CNX NIFTY Index was examined by 50 participants. Dr. Poornima S and Aruna P Ramesh (2016)[6] the goal was for each stock that is included in the ideal portfolio to determine their investment proportions. This analysis showed that HDFC Bank has the greatest yields. Shah (2015)[24] the research and analysis shows that the CAPM model is superior to the Sharpe Index model because it provides accurate safeguards and weight time under each security.
Dr. S Poornima, Aruna P Remesh (2015)[9] Share prices were taken into consideration between January 2010 and December 2015. On the basis of the information received and utilised to create the best portfolio, a "cut off rate" is formed with all the data collected. Chintan A. Shah (2015)[3] In order to analyse data, research has chosen Sharpe Single Index and CAPM tools. Out of the fifteen firms, 11 have been picked for time and 5 have been chosen for the ideal portfolio investment among the five HDFC banks. J. Francis Mary and G. Rathika (2015)[14] the study was conducted between September 2010 and September 2014. Ahter analysing the 10 organisations, just one company is selected for the optimal growth of the portfolio.

Thangjam Ravichandra (2014)[29] our ideal portfolio comprises of four stocks from 50 recorded scripts with a repetition of 0.116 per cent, which is an unsystematic risk, inventory return and free return compared to the decreased return rate. Saurabh Singh & Jayant Gautam (2014)[23] the research period from January 2009 to December 2013 consisted of ten firms listed on the NSE and the CNX Bank Price Index for optimum portfolio construction. Dr. K.V. Ramanathan & K.N. Jahnavi (2014)[11] the media and entertainment industries are considered to create the optimal portfolio. This study shows that PVR has greater risk and yield than the others in the portfolio, where the yield of Dish TV is lower for other firms. Dr. R Nalini

(2014)[5] All 30 enterprises listed in the BSE were investors. The study revealed that investors may decrease their total risk by utilising this approach and maximise their income throughout any length of time. Manisha Surti & Radhika Desai (2013)[17] in this study, they have developed an optimal portfolio for Sharpe single index utilising data from 50 businesses on the CNX NSE Nifty index.

Niranjan Mandal (2013)[19] this approach produces a one-of-one cut-off rate, chooses the securities for the development of an ideal portfolio that exceeds the beta ratio. Deepak Kumar D (2013)[4] the result of each decision, risk, returns, and other considerations determined by the holders are this holding. The portfolio management involves the construction and maintenance of an investment collection. Dutta Smriti Mahavidyalaya B.N (2013)[12] in its primary contribution, Sharpe ensured that SIM and the Markowitz model created relatively equivalent efficient portfolios. This approach can illustrate how dangerous an asset is when the safety is in a diversified portfolio. Pratibha Jenifer Andrade (2012)[20] it is the risk of assets under different safeguards that restrict the entire risk of the Portfolio while increasing its returns. It is mostly concerned those risks are reduced rather than that return is expanded.

IV. Problem Statement the study

Investors do not have the expertise of investing in different securities to put their money. And an investor's principal objective is to make bigger profits. Instead of investing where there is risk. As a consequence, the Building an Efficient Portfolio Study helps an investor decrease the risk while generating an appropriate return on investment on a number of avenues.

V. Objectives of the study

- To analyse the risk and return of various selected securities listed in NIFTY 50
- To encourage investors to make a profitable investment at high return and low risk securities

VI. Research Methodology

6.1 Research Method – Descriptive Method: it describes the characteristics of the population or phenomenon studied it is called as descriptive research.

6.2 Source of Data

a) **Primary data:** The primary data is collected from the External guide and through internet about the NSE stock market's day-to-day activity.
b) **Secondary data:** The historical prices of the selected companies are gathered using official websites such as Moneycontrol.com and Yahoo Finance.com, as well as other sources such as reference Books & Journals.

6.3 Sampling Design

a) **Sampling Method – Random Sampling:** is a way of selecting a sample of observations from a population in order to make inferences about the population.
b) **Sampling Technique – Convenience Sample:** is a non-probability sampling method in which the sample is drawn from a group of people who are easy to contact or reach.

6.4 Sample Size: study considered 10 companies from 2 sectors, in each sector 5 companies are chosen.

Information Technology Sector (IT)	Banking Sector
Tata Consultancy Service (TCS)	HDFC Bank
Infosys Limited	Kotak Mahindra Bank
Wipro Limited	ICICI Bank
HCL Technologies	Axis Bank
Tech Mahindra	IDBI Bank

6.5 Tools Used for Analysis:

Financial Tool	Statistical Tool
Shape's Single Index Model Capital Asset Pricing Model	Standard Deviation Variance Beta Cut-off-Rate

a) Sharpe's Single Index Model The optimal portfolio construction is simplified if the single number measures the desirability of stock in the optimum portfolio. If such number exists we can accept the Sharpe's Single Index Model. In this situation, the attractiveness of stock is directly proportional to the excess of return to beta ratio.

$$\frac{R_i - R_f}{\beta}$$

Where:
Ri = Return on individual stock
Rf = Return on Risk-Free asset
β = Beta of individual stock

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

- $\sigma m2$ = Variance
- σei 2 = Security traffic variability associated with market movement, i.e. , irregular security risks

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

Where,

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

b) Capital Asset Pricing Model According to this theory, the required rate of return of an asset is directly related to its beta value. Un-diversifiable or systematic risk, given that the Non Market risk can be eliminated through diversification and systematic risk can be eliminated through beta. As a result, the CAPM can express the relationship between an asset's return and its1systematic risk. This is also known as the security market line.

$$R_i = R_f + \beta(R_m - R_f)$$

6.6 Hypothesis

- **H_0** – There is no significant changes in return of selected securities

VII. Analysis and Interpretation: The analysis and interpretation is by taking 10 companies 5 each from Banking Sector and IT Sector by calculating return, beta, cut-off-point, proportion.

Optimum Portfolio Construction

Table1.1 Finding out the rankings of stocks on the basis of excess of return to Beta

Company	Return	R_f	β	$\frac{R_i - R_f}{\beta}$	Rank
TCS	25.94	5.98	0.80	24.95	8
Infosys	20.34	5.98	0.05	287.2	1
Wipro	23.59	5.98	0.43	40.95	6
HCL Technologies	36.67	5.98	0.38	80.76	4
Tech Mahindra	24.63	5.98	0.52	35.86	7
HDFC Bank	18.95	5.98	0.08	162.13	2
Kotak Mahindra Bank	26.38	5.98	0.13	156.92	3
ICICI Bank	21.23	5.98	0.27	56.48	5
AXIS Bank	10.34	5.98	0.21	20.76	9
IDBI Bank	-12.37	5.98	0.97	-18.92	10

Source: Authors Calculation-money control database

In the above Table, The Infosys Limited shows the maximum return (287.2) out of 10 Companies and IDBI Bank shows the lowest return of (-18.92). The returns are positive for nine companies and negative for one company. And in the above we can see that IDBI bank is having high Beta (0.97) and Infosys is having low Beta.

Table 1.2 Calculation of Under Price and Over Price using CAPM Formula

Companies	Return	R_f	β	CAPM	
TCS	25.94	5.98	0.80	7.36	Over Price
Infosys	20.34	5.98	0.05	6.06	Over Price
Wipro	23.59	5.98	0.43	6.72	Over Price
HCL Technologies	36.67	5.98	0.38	6.63	Over Price
Tech Mahindra	24.63	5.98	0.52	6.87	Over Price
HDFC Bank	18.95	5.98	0.08	6.12	Over Price
Kotak Mahindra Bank	26.38	5.98	0.13	6.20	Over Price
ICICI Bank	21.23	5.98	0.27	6.44	Over Price
AXIS Bank	10.34	5.98	0.21	6.34	Over Price
IDBI Bank	-12.37	5.98	0.97	7.65	Under Price

Source: Authors Calculation-money control database

Table 1.3 Calculation on the basis of Rank and Unsystematic Risk

Companies	σ^2_{ei}	$\frac{(R_i - R_f)\beta}{\sigma^2_{ei}}$	$\sum \frac{(R_i - R_f)\beta}{\sigma^2_{ei}}$
Infosys	84.33	0.008	0.008
HDFC Bank	105.09	0.010	0.018
Kotak Mahindra Bank	173.00	0.015	0.033
HCL Technologies	102.95	0.113	0.146
ICICI Bank	64.03	0.064	0.21
Wipro	40.83	0.185	0.395
TECH Mahindra	84.52	0.115	0.51
TCS	294.09	0.054	0.564
AXIS Bank	135.06	0.007	0.571
IDBI Bank	8.30	-2.144	-1.573

Source: Authors Calculation-money control database

Table 1.4 Calculation of Cut-off-Point

Companies	$\frac{\beta^2}{\sigma^2_{ei}}$	$\sum \frac{\beta^2}{\sigma^2_{ei}}$	C*
Infosys	0.00003	0.00003	0.287
HDFC Bank	0.00006	0.00009	1.145
Kotak Mahindra Bank	0.00010	0.00019	2.558
HCL Technologies	0.00140	0.00159	21.59
ICICI Bank	0.00114	0.00273	16.44
Wipro	0.00453	0.00726	21.89
TECH Mahindra	0.00320	0.01046	18.84
TCS	0.00218	0.01264	19.76
Axis Bank	0.00033	0.01297	30.47
IDBI Bank	0.11336	0.12633	-11.88

Source: Authors Calculation-money control database

The choice of the correct stock depends on upon the cut-off-rate such that all those stocks with higher ratio of excess of return to beta are included and stock which arehaving low ratio are left out. The highest value of Ci is taken as cut-off point that is C*. We can also see that Axis Bank has the highest cut-off- rate of 30.47. The stocks which are having Ci grater that C* are included in the portfolio.

Table 1.5 Calculation of Proportion

Companies	σ^2_{ei}	C*	Z_i	Proportion
Infosys	84.33	0.287	0.17	0.27
HDFC Bank	105.09	1.145	0.13	0.21
Kotak Mahindra Bank	173.00	2.558	0.11	0.17
HCL Technologies	102.95	21.59	0.22	0.35
			0.63	1.00

Source: Authors Calculation-money control database

After analysing the securities which are to be included in the Optimum Portfolio, the proportion of investment to be made in each securities are calculated. It can observed from the above table only four stocks qualified which are included in the optimum portfolio on this criterion these are Infosys Ltd, HDFC Bank, Kotak Mahindra bank, HCL Technologies with cut-off-point (Ci) of 0.287, 1.145, 2.558 and 21.59 respectively as displayed in the table

VIII. Results and Discussion

- The HCL Technologies has the highest return of 57.7 and the Axis Bank ltd has the lowest return of -44.8. If the investor seeks to earn maximum return without considering the risk aspect then investment can be made on those securities which yield high return.
- The return from IDBI bank security has the highest beta value of (0.97) which means that it is volatile when compared to other companies.
- The five securities ranking from 1 to 5 based on the CI values where identified along with the proportion
- CAPM has resulted among 10 companies where 9 companies where Over-priced and 1 company was Under- Priced.
- H_o is rejected and the alternative is accepted because there are no insignificant changes in the returns of the selected company's securities.
- It is recommended for aggressive investors to invest on HCL Technologies ltd shares as it has high return of 36.67 with risk 13.91.
- Infosys limited has the low risk of 5.99 when compared with other companies, investor who wants low risk they can invest on this company
- The study advises to the investors not to prefer securities which are listed at the end of the calculation of cut-off point.
- HCL Technologies from IT Sector occupies the maximum proportion of 35% of the total investment being the most suggested stock among the 10 other IT and Banking sectors.

IX. Conclusion Construction of optimal portfolio is a challenging task for the individual as well as the institutional investors. The study attempted to create a perfect portfolio via Sharpe's Single Index Model and CAPM. The 10 example companies were selected to build the optimum portfolio. The ultimate option for Optimum Portfolio investment should only be made after assessing all elements of selected inventories. It might be a wide economic or other microeconomic aspect that governs these market securities movement and activity. There is a future scope for such study that must be carried out with various types of sampling in mind. For managers in emerging economies, like India, the current research findings and other comparable micro-level studies are important. The capital markets are still in their early phases, and many overseas institutional investors are also invested in these nations' top stock exchanges.

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